# Nitrogen and Phosphorus Source Identification Report for Proctor Brook (MA93-39) and Tributary

October 2025

This document contains the original report, created in June 2023, accompanied by Addendum A, created in October 2025. While the original report remains unchanged, Addendum A provides modifications to its content.

# Nitrogen & Phosphorus Source Identification Report for Proctor Brook (MA93-39) and Tributary

For compliance with the National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts

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JUNE 2023

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# 1

# Introduction

This Nitrogen and Phosphorus Source Identification Report (NSIR/PSIR) was developed in accordance with the 2016 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (MS4 Permit), Appendix H, Parts I.1.b and II.1.b. This NSIR/PSIR addresses regulated property owned and/or operated by the Massachusetts Department of Conservation and Recreation (DCR) that discharges to the Proctor Brook segment MA93-39 and its tributaries. DCR owns and operates property across Massachusetts, some of which generates MS4 regulated stormwater discharges. The purpose of this report is to identify discharges that are contributing to the Proctor Brook watershed's nitrogen and phosphorus impaired waterbodies and to devise an effective approach for reducing this contribution.

The methods used to develop this NSIR/PSIR are explained in depth in a document entitled "Methods for Phosphorus Control Plan & Nutrient Source Identification Report Development," referred to here as the DCR PCP & NSIR Methods. This document, which will be submitted separately to the Environmental Protection Agency (EPA), includes methods for determining which portions of DCR facilities are regulated, delineating drainage catchments within facilities, calculating pollutant loading, prioritizing catchments for treatment, crediting stormwater control measures, and determining appropriate organization of impaired waterbody segments for inclusion in this report.

Results of this NSIR/PSIR are presented in the DCR NSIR & PSIR Web Application, which can be found at the following link:
https://vhb.maps.arcgis.com/apps/dashboards/4cfdc963fe0442aba6e91c69c05064ac#mode=view

For reference, Appendix A includes metadata for each layer presented in the web application.

# 2

# Waterbodies Subject to NSIR/PSIR Requirements

Segment MA93-39 of the Proctor Brook, as defined by Massachusetts Department of Environmental Protection (MassDEP), is water quality limited for nitrogen and phosphorus based on the MassDEP's Final 2016 Integrated List of Waters and does not have an approved Total Maximum Daily Load (TMDL).[1] Therefore, under Appendix H of the MS4 Permit, DCR is required to develop an NSIR/PSIR to address nitrogen and phosphorus load in stormwater discharges from DCR's MS4 to this waterbody segment and the segment's tributaries. DCR discharges stormwater to several nutrient limited waterbodies without TMDLs that are also subject to NSIR/PSIRs and which are located upstream of segment MA93-39, i.e., within the watershed of and tributaries to MA93-39 (Table 1). Therefore, these additional waterbodies are also included in this report. The DCR NSIR & PSIR Web Application displays each of these nutrient impaired waterbodies, their watersheds, and the MS4-regulated DCR facilities within the watersheds.

**Table 1 Waterbodies Included in this NSIR/PSIR**

| Waterbody Name | Waterbody ID |
|---|---|
| Proctor Brook | MA93-39 |
| Goldthwait Brook | MA93-05 |

1 MassDEP. Massachusetts Year 2016 Integrated List of Waters: Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. December 2019. https://www.mass.gov/doc/final-massachusetts-year-2016-integrated-list-of-waters/download

# 3

# Regulated MS4 Area

*(Meets Appendix H. Parts I.1.b.i.1, I.1.b.i.3, II.1.b.i.1 & Part II.1.b.i.3)*

Table 2 presents the total MS4-regulated area within the watershed, including the estimated impervious area, directly connected impervious area (DCIA), and pervious area. The DCR PCP & NSIR Methods contains methodology for determining DCR's MS4-regulated area and for calculating total impervious area and DCIA.

**Table 2 Regulated MS4 Area**

| Type of Regulated Area | Area (acres) |
|---|---|
| Impervious Area | 2.8 |
| Directly Connected Impervious Area | 2.0 |
| Pervious Area | 0.7 |
| **Total Regulated Area** | **3.5** |

*Note: Areas above do not sum to equal total regulated area as DCIA is a subset of IA

Catchments were delineated within MS4-regulated DCR property for the purposes of pollutant load and treatment calculations. The DCR PCP & NSIR Methods discusses catchment delineation, but briefly, catchments were delineated using 3-meter resolution contour data, DCR stormwater drainage infrastructure and the latest available aerial imagery. These catchments do not necessarily align with catchments delineated for illicit discharge detection and elimination (IDDE) purposes, which are catchments of individual outfalls. The DCR NSIR & PSIR Web Application displays each catchment's total impervious area and DCIA in the catchment layer pop-up.

# 4

# Monitoring Results

*(Meets Appendix H. Part I.1.b.i.2 & Part II.1.b.i.2)*

Results from dry and wet weather screening and sampling of DCR's outfalls and interconnections in this watershed are publicly available at the following URL as provided in the DCR MS4 Annual Report: https://vhb.maps.arcgis.com/apps/webappviewer/index.html?id=87a35a2683aa4478a07ade7ffb7c1b2a

Nitrogen and phosphorus concentrations measured during IDDE monitoring are from one-time grab samples and are not indicative of annual loads. Therefore, these results were not used when prioritizing catchments for load reduction. Outfalls that were found to have dry or wet weather flow with sewer input indicators will be addressed as part of DCR's MS4 IDDE program, adding to the nitrogen and phosphorus load reduction planned in this NSIR/PSIR.

# 5

# Load Reduction Planning

DCR takes many approaches to pollutant load reduction, including street sweeping, catch basin cleaning, leaf litter pick-up, good housekeeping at labor yards, proper fertilizer management, sediment and erosion control and other source control. The focus of the planning in this NSIR/PSIR, however, is pollutant reduction through structural stormwater control measures.

## 5.1 Catchment Prioritization

*(Meets Appendix H. Part I.1.b.i.4 and Part II.1.b.i.4)*

To prioritize DCR catchments with high nitrogen and phosphorus loading, a GIS analysis was first performed to estimate annual average nitrogen and phosphorus loading of each MS4-regulated catchment. This analysis accounted for land use, land cover, and soil type, and is described in more detail in the DCR PCP & NSIR Methods. Next, catchments of different sizes were compared using each catchment's nitrogen and phosphorus load per area. DCR developed a ranking system based on this metric, presented in Table 3, to ensure consistent identification of priority catchments across this watershed and all other PSIR watersheds. The development of this ranking system is discussed further in the DCR PCP & NSIR Methods.

Results of catchment prioritization are displayed in Table 3 and in the DCR NSIR & PSIR Web Application. Table 3 presents the count of catchments that fall within each priority level. The DCR NSIR & PSIR Web Application indicates each catchment's priority with a stop-light color scheme defined in Table 3, and displays each catchment's annual average nitrogen and phosphorus load per area in the catchment layer pop-up. DCR property not subject to the requirements of this NSIR/PSIR is also displayed with gray hatch-marks. Appendix A contains metadata for the DCR NSIR & PSIR Web Application.

**Table 3 Catchment Prioritization**

| Catchment Priority | Phosphorus Loading Rate (lb/ ac/yr) | Nitrogen Loading Rate (lb/ ac/yr) | NSIR & PSIR Web Application Color | Count of Catchments |
|---|---|---|---|---|
| High Priority | >1.0 | >8.1 | Red | 1 |
| Medium Priority | 0.3 to 1.0 | 2.6 to 8.1 | Orange | 0 |
| Low Priority | <0.3 | <2.6 | Green | 0 |

## 5.2 Potential Structural BMPs

*(Meets Appendix H. Part I items 1.b.i.5, 1.c.i & 1.c.ii, and Part II items 1.b.i.5, 1.c.i & 1.c.ii)*

### 5.2.1 General Approach to BMP Planning

In Permit Year 5, the catchments prioritized above were further evaluated for stormwater treatment opportunities. DCR's general approach to planning structural control measures, or best management practices (BMPs), falls into two main categories: stand-alone stormwater retrofit projects and opportunistic incorporation of BMPs into planned site development or redevelopment projects. For stand-alone retrofits, DCR targets catchments that are determined to have high load, as these are areas where implementing stormwater treatment could result in the largest impact. Within these catchments, DCR prioritizes opportunities for impervious cover disconnection or removal, retrofits of existing BMPs, and construction of surface infiltration or filtration practices (infiltration being preferable). DCR also takes an opportunistic approach to stormwater retrofits and has developed the DCR Stormwater Handbook, which encourages designers to incorporate BMPs into all projects, even those that do not trigger the MS4 Permit's post-construction requirement threshold of one acre disturbed. DCR's approach for planning structural BMPs is further described in the DCR PCP & NSIR Methods.

### 5.2.2 Planned Structural BMPs

DCR's process for identifying potential standalone stormwater retrofits in this NSIR/PSIR watershed began in Permit Year 4, when DCR evaluated catchments and assigned each a "treatment status." If catchments were MS4-regulated and not already treated by a BMP, they were given a treatment status based on their potential for treatment. This determination was based on a high-level evaluation of site characteristics, such as ability to collect drainage and available space for treatment, which primarily involved reviewing DCR's drainage geodatabase and aerial photographs of the site.

In Permit Year 5, DCR took all catchments that had been identified as having high potential for treatment and assessed those that had also been designated as High Priority (see Section 5.1) based on their nitrogen and/or phosphorus load per area. These high load, high potential catchments were then subjected to a systematic and detailed evaluation to determine 1) if there were any infrastructure, resurfacing, or redevelopment activities planned for the catchment and 2) the engineering and regulatory feasibility of retrofitting the catchment with BMPs. The DCR NSIR & PSIR Web Application

shows the results of this evaluation. If a catchment was evaluated, its pop-up contains a "catchment considerations" form with nine attribute fields that guided the evaluation. The PCP & NSIR Methods discusses these nine attribute fields and the process for populating them.

In this NSIR/PSIR watershed, one catchment was evaluated with a catchment considerations form. After evaluation, this catchment was included in this watershed's list of sites for planned structural BMPs. The BMP type and load reduction for this site will be selected during design, but Section 5.2.1 provides more detail on DCR's general approach for BMP selection.

### 5.2.3 Implementation Schedule & Cost

DCR plans to construct at least one BMP in this NSIR/PSIR watershed in the next permit term, and will select which planned BMPs get constructed based on which appear to be the most feasible according to the catchment considerations form and further design evaluations. DCR will also implement BMPs opportunistically as redevelopment projects take place in the watershed.

The estimated cost of building one BMP in this watershed is estimated to be $50,000 to $100,000 per permit term if the BMP must be a stand-alone retrofit project. However, costs will be lower if the BMP can be incorporated into already planned development or redevelopment.

The MS4 Permit requires that the permittee plan and install a minimum of one structural BMP as a demonstration project within six years of the permit effective date. In this NSIR/PSIR watershed, DCR has not installed any BMPs within the permit term. In spring 2023, DCR evaluated the watershed in order to select a location for a demonstration project. The Proctor Brook watershed only contains one DCR facility, the McVann-O'Keefe Skating Rink in Peabody, so site selection was limited to this facility. Next DCR created a conceptual design for a stormwater retrofit project. The current concept includes two BMPs: a linear infiltration practice that would receive sheet flow from a portion of an existing parking lot at the site, and impervious cover disconnection, which would be achieved by removal of existing curbing. DCR plans to complete design and install at least one of the BMPs as a demonstration project during Permit Year 6.

## 5.3 Nitrogen and/or Phosphorus Removal by Existing Structural BMPs

*(Meets Appendix H. Part I.1.c.iii and Part II.1.c.iii)*

DCR tracks BMPs in its drainage infrastructure geodatabase and currently has no DCR owned and/or maintained BMPs identified in this NSIR/PSIR watershed. The MS4 Permit requires DCR to estimate the nitrogen and phosphorus reduction of BMPs in NSIR/PSIR watersheds. As new BMPs are constructed within this watershed, DCR will calculate these estimates and associate them with BMP information in the drainage infrastructure geodatabase.

# A

# DCR NSIR & PSIR Web Application Metadata

Table A1 below provides reference metadata for the DCR NSIR & PSIR Web Application accessible at the URL below.

https://vhb.maps.arcgis.com/apps/dashboards/4cfdc963fe0442aba6e91c69c05064ac#mode=view

**Table A1 DCR NSIR & PSIR Web Application Metadata**

| Layer Name | Description | Source | Feature Class |
|---|---|---|---|
| Outlet | Outlets mapped in DCR's drainage geodatabase | DCR | Point |
| Inlet | Inlets (e.g., catch basins) mapped in DCR's drainage geodatabase | DCR | Point |
| Manhole | Manholes mapped in DCR's drainage geodatabase | DCR | Point |
| Miscellaneous Structure - Point | Miscellaneous structures mapped as a point in DCR's drainage geodatabase | DCR | Point |
| Miscellaneous Structure - Polygon | Miscellaneous structures mapped as a polygon in DCR's drainage geodatabase | DCR | Polygon |
| Linear Feature | Linear features, such as pipes and other conveyances, mapped in DCR's drainage geodatabase | DCR | Line |
| Surface BMP | Aboveground structural stormwater control measures (BMPs) mapped in DCR's drainage geodatabase. Surface BMPs are colored light purple. They have a star if they were assigned load reduction credit. Pop-ups show load reduction credit and several other parameters used to calculate credit. | DCR | Polygon |
| Subsurface BMP | Belowground structural stormwater control measures (BMPs) mapped in DCR's drainage geodatabase. Subsurface BMPs are colored dark purple. They have a star if they were assigned load reduction credit. Pop-ups show load reduction credit and several other parameters used to calculate credit. | DCR | Polygon |

| | | | |
|---|---|---|---|
| Catchment | Subdivides DCR property based on the catchments' "discharge priority," which is an attribute that provides information such as whether the property is subject to PSIR/NSIR requirements. Catchments with a discharge priority of high, medium, or low (colored in red, orange, and green, respectively) are subject to PSIR/NSIR requirements. These catchments are delineated based on gross drainage patterns and given a discharge priority designation based on their pollutant load per area (high being the highest load and thus highest priority for treatment, etc.). Catchments with a discharge priority of non-discharge, unregulated, or outside NSIR watershed (symbolized with diagonal, horizontal, and vertical gray hatched lines, respectively) are not subject to PSIR/NSIR requirements; the reason for which is indicated by the discharge priority. These areas are either outside the NSIR-requiring watershed (outside NSIR watershed), within an unregulated DCR facility (unregulated), or within a regulated DCR facility but do not discharge stormwater (non-discharge). Catchment layer pop-ups include several catchment characteristics, including catchment treatment status. Catchments can have a treatment status of "existing" if the catchment is treated by an existing, creditable BMP, "high potential" or "low potential" if the catchment is not treated by a BMP, or "non-discharge" if the catchment does not include any channelized discharge and is therefore not considered regulated under the MS4 Permit. Catchment pop-ups also show BMP structure ID if the catchment is treated by a creditable BMP. | DCR | Polygon |
| DCR NSIR Required Watersheds: Parent | Displays the watersheds of the most downstream waterbody segment of each NSIR report | DCR | Polygon |
| DCR NSIR Required Watersheds: Child | Displays the watersheds of each NSIR-requiring waterbody segment within the parent watersheds | DCR | Polygon |
| Nitrogen and/or Phosphorus Impaired Waterbodies: Rivers | "MassDEP 2016 Impaired Waters – Waterbody AUs – Rivers (arcs)" data layer filtered for only Total Phosphorus and Total Nitrogen impairments | MassDEP | Line |
| Nitrogen and/or Phosphorus Impaired Waterbodies: Lakes & Estuaries | "MassDEP 2016 Impaired Waters – Waterbody AUs – Lakes, Estuaries (polygons)" data layer filtered for only Total Phosphorus and Total Nitrogen impairments | MassDEP | Polygon |

# Addendum A

## Nitrogen & Phosphorus Source Identification Report for Proctor Brook (MA93-39) and Tributary

This addendum modifies and supplements the previously distributed NSIR-PSIR for Proctor Brook (MA93-39) and Tributary (June 2023)

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The Nitrogen and Phosphorus Source Identification Report (NSIR-PSIR) for Proctor Brook was developed and submitted to the U.S. Environmental Protection Agency in 2023, in accordance with the 2016 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (MS4 Permit), Appendix H, Part II.1.b. This addendum makes the following modification to this report.

**Updates to Catchment Prioritization**

Per the MS4 Permit's Appendix H Sections I.1.b.i.4 and II.1.b.i.4, permittees are required to prioritize catchments with high nitrogen and phosphorus loading, respectively. Prioritization in the original report was based on nitrogen and phosphorus estimates that used the Sutherland equations, which assume different levels of impervious cover disconnection based on land use. However, DCR has recently altered its load estimation approach to no longer use the Sutherland equations and assume all impervious cover is directly connected. This adjustment more precisely reflects individual catchments' impacts. While this methodology change resulted in shifts in priority levels for individual catchments, relative prioritization remained largely unchanged. Additionally, a new "highest" priority category was introduced to better prioritize catchments with the highest nutrient loading. More information on this prioritization can be found in the Methods for Phosphorus Control Plan & Nutrient Source Identification Report Development document. An updated version of the original report's **Table 3** is included below to show the updated prioritizations. (Note that this table no longer includes reference to the NSIR & PSIR Web App, as the Web App was not updated as part of this addendum creation.)

**Table 3 Catchment Prioritization**

| Catchment Priority | P Loading Rate (lb/ac/yr) | N Loading Rate (lb/ac/yr) | Count of Catchments[1] |
|---|---|---|---|
| Highest Priority | ≥1.8 | ≥13.8 | 1 |
| High Priority | 1.0 ≤ P Load < 1.8 | 8.1 ≤ N Load < 13.8 | 1 |
| Medium Priority | 0.3 ≤ P Load < 1.0 | 2.6 ≤ N Load < 8.1 | - |
| Low Priority | <0.3 | <2.6 | - |

[1] Note that total count of catchments may differ from count in the original report, as catchment delineations have been updated over the last several years through BMP crediting work, property ownership updates, etc.