Memorandum

To: DCR Stormwater Section
10 Park Plaza
Boston, MA 02116

Date: 5/08/26

Project #: 15722.00

From: Olivia Ting, Sara Molla, Sarah Nalven, & Kelly Siry, PE

Re: Charles River and Lake & Pond Phosphorus Control Plan Annual Performance Review – Permit Year 8

This memorandum summarizes VHB's Permit Year (PY) 8 performance evaluation of DCR's Phosphorus Control Plans (PCPs). DCR has PCPs for the Charles River Watershed (Charles River PCP) and three Lake and Pond Watersheds (Lake & Pond PCPs). A performance evaluation is required annually under the 2016 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts (MS4 Permit).

Introduction

DCR has developed a Charles River PCP and three Lake & Pond PCPs in accordance with the MS4 Permit. DCR submitted these PCPs to the Environmental Protection Agency (EPA) in June 2023 or PY5. Requirements for these reports are included in the MS4 Permit's Appendix F, Section A.I, entitled "Charles River Watershed Phosphorus TMDL Requirements" and Appendix F, Section A.II, entitled "Lake and Pond Phosphorus TMDL Requirements." Requirements include planning for and implementing stormwater best management practices (BMPs) to achieve numeric phosphorus reduction requirements. DCR's PCPs can be found at DCR's Stormwater Management webpage.

Beginning in PY6, the MS4 Permit Appendix F requires permittees to complete an annual performance evaluation of their PCPs. The performance evaluation "shall evaluate the effectiveness of the PCP by tracking the phosphorus reductions achieved through implementation of structural and non-structural BMPs and tracking increases resulting from development." The results of the performance evaluation must be reported in the permittee's annual report.

DCR recently completed requirements of the PCP performance evaluation for PY8, including tracking phosphorus load changes due to development and calculating phosphorus treatment credit from newly mapped BMPs. The following sections provide the results of these efforts and DCR's current progress toward meeting the PCP load reduction requirements.

Methods

Baseline Phosphorus Load

As required by the MS4 Permit, since PY6, VHB has annually evaluated the change in DCR's baseline phosphorus load, using 2005 as the baseline year. This evaluation is conducted by using the latest aerial imagery and other data to identify updates to impervious cover and land use since 2005. VHB then recalculates baseline phosphorus load, accounting for identified updates, and compares the updated load to DCR's 2005 baseline load. [1,2]

1 The 2005 baseline load that is used for comparison is calculated using the current-day catchment layer so that load generated by the same area can be compared between 2005 and current-day, with only impervious cover and land use data as variables.

2 The 2005 baseline load that is ultimately used for PCP compliance and reported in this document is provided by the MS4 Permit's Appendix F. However, 2005 baseline load still must be calculated to understand the difference between baseline and current day load, which is used as the "load due to development" value.

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In PY8, VHB took a focused approach to identifying changes in impervious cover and land use by reviewing properties for changes only where known projects had occurred. Every three to five years, VHB conducts a more holistic manual review of all MS4-regulated DCR area within PCP watersheds. This holistic approach was most recently performed in PY6 and is described in DCR's PY6 PCP Performance Evaluation memo.[3]

Phosphorus Load Reduction Credit

As required by the MS4 Permit, in PY8 VHB calculated phosphorus load reduction credit provided by new BMPs in the Charles River and Lake & Pond PCP Watersheds. DCR began fulfilling this requirement in PY5 as part of PCP development and will continue to do so annually to comply with MS4 requirements. The methodology used for crediting is prescribed by the MS4 Permit's Appendix F Attachment 3 and is described in Chapter 4 of the document, Methods for PCP & NSIR Development, which DCR submitted to EPA as part of the PY5 PCP submission.[4]

In PY8, VHB reviewed and credited new BMPs, i.e. BMPs that had been mapped in DCR's GIS database since the PY7 performance evaluation because they were either recently constructed or had been recently identified through field visits, design plan set review, and/or VHB desktop review. These new BMPs reviewed in PY8 were mapped between April 1, 2025 and November 14, 2025. BMPs mapped after November 14, 2025 will be reviewed in PY9. VHB estimated pollutant reduction credit provided by each new BMP and added this credit to previous totals to provide updated pollutant load reduction values for each PCP watershed. In PY8, BMPs in the Charles River Watershed were also reviewed to ensure they were discharging to the MS4 and not combined sewer and as a result, one BMP was subtracted from previous totals after VHB discovered it drained to combined sewer.[5]

Additionally, in PY8, VHB recredited five BMPs in PCP watersheds using more accurate DSV estimates. Credit for these BMPs had been previously calculated assuming runoff depth treated was 0.5 inch, but was recalculated using individual design storage volume (DSV) estimates that were based on plan sets, stormwater reports, or other available information. This recrediting effort was performed to demonstrate that the BMPs in the PCP watersheds were meeting PCP PY8 targets with individually estimated (versus assumed 0.5 inch) DSVs, per a request by Environmental Protection Agency (EPA) staff during the spring 2025 EPA audit of DCR's MS4 Permit compliance.

Over the next several years, VHB plans to ensure all BMPs are recredited using individually estimated DSVs. However, in PY8, VHB only performed recrediting in two watersheds (Table 1). Recrediting with individually estimated DSVs was not performed in the Charles River Watershed, as the combined credit from street sweeping and impervious cover (IC) disconnection allowed DCR to meet the Charles River Watershed PY8 target (Table 1). Recrediting was also not performed in the Bents/ Ramsdall Watershed, where the only facility is Dunn State Park, because DCR is planning construction at the park this summer, including modifications to several BMPs, and it is more appropriate to recredit after this construction is complete (Table 1).

3 VHB Memorandum to DCR. "Charles River and Lake & Pond Phosphorus Control Plan Annual Performance Review – Permit Year 6." June 26, 2024. (https://www.mass.gov/doc/pcp-performance-evaluation-memo/download)

4 Two changes were made to the crediting methodology beginning in PY6 (and were applied to BMPs credited in PY5 so all BMPs are credited using a consistent methodology). These changes are not included in the Methods for PCP & NSIR Development document but are described in DCR's PY6 PCP Performance Evaluation memo in detail. In summary, the changes include 1) assuming soil type of Hydrologic Soil Group (HSG) C rather than B when there are gaps in National Resource Conservation Service (NRCS) HSG data and 2) calculating BMP catchment load by summing the load from each combination of HSG and land use in the BMP's catchment area instead of taking the predominant HSG and land use.

5 VHB Memorandum to DCR. "Delineation and Evaluation of Catchments that Discharge to Combined Sewer in the Charles River Watershed." September 5, 2025.

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Table 1. BMP Recrediting Status by Watershed

Watershed	BMPs Recredited in PY8	Are there credited BMPs that still use assumed 0.5-inch DSVs?	Notes
Charles River	1	Yes	One IC disconnection BMP was recredited due to PY8 redelineation of disconnection area; Charles PY8 target was met using street sweeping and IC disconnection credit, so BMPs with assumed 0.5-inch DSVs will be recredited in future years.
Auburn Pond / Leesville Pond	3	No	N/A
Bents Pond / Ramsdall Pond	None	Yes	More appropriate to recredit after Dunn State Park construction is complete (estimated fall 2026).
Lake Quinsigamond & Flint Pond	2	No	N/A

One additional BMP was recredited as a result of VHB's PY8 focus on impervious cover (IC) disconnection field verification (Table 1). In PY8, VHB updated BMP inspection and maintenance forms in the DCR database to better accommodate IC disconnection inspections and held a training with DCR staff on how to identify IC disconnection and how to inspect and maintain it. DCR staff then visited each IC disconnection BMP in the field and either confirmed the delineation or worked with VHB if delineations needed adjustment. As a result of these inspections, one IC disconnection BMP in the Charles River Watershed (surface BMP 19627) was redelineated based on field observations and thus needed to be recredited.

Note that by crediting each BMP, DCR assumes the BMP is functioning as designed. If BMPs are not properly maintained, their effectiveness in reducing phosphorus load decreases. VHB is working to support improvement of DCR's BMP inspection and maintenance procedures to ensure that each BMP functions as designed and that calculated treatment is accurate.

Charles River PCP

Baseline Phosphorus Load

To determine change in baseline load since 2005, in PY8 VHB reviewed DCR's facilities for changes to impervious cover and land use, focusing on areas that had undergone known projects. In the Charles River Watershed, this review resulted in adjustment of impervious cover data at the Hammond Pond Parkway and Newell Boathouse facilities, which had both undergone construction in 2025, as well as land use data at the Northeastern Boathouse, which was adjusted to ensure land use classification consistency across boathouses. Based on these updates, VHB found that in total since 2005, 11.2 ac of impervious cover has been added while 9.5 ac has been removed. DCR's change in baseline load since 2005 was estimated to be 2.1 lb/yr (Table 2), a 1 lb/yr decrease from the 3.1 lb/yr reported in PY7. This decrease in "load due to development" as it is called in the MS4 Permit, can be attributed to Phase 1 of the Hammond Pond Parkway improvement project, where a roughly one-mile stretch of a four-lane parkway was converted to a two-

lane parkway with a shared-use path. As a result, total required reduction (which is 22% of baseline load) also decreased to 192.5 lb/yr.

Table 2. Charles River PCP Baseline Phosphorus Load and Required Phosphorus Reduction Summary

Watershed	2005 Baseline Load (lb/yr)	Load due to Development since 2005 (lb/yr)	Updated Load (lb/yr)	Percent Reduction Required	Total Required Reduction (lb/yr)	Total Allowable Load (lb/yr)
Charles River	873.0*	2.1	875.1	22%	192.5	682.6

*2005 Baseline Load for the Charles River Watershed was provided by the MS4 Permit's Appendix F.

Phosphorus Load Reduction Credit

In the Charles River Watershed, VHB identified 11 new BMPs to credit in PY8, for which phosphorus reduction credit totaled 1.1 lb/yr with an average of 0.1 lb/yr (Table 3). These BMPs were located in the following facilities:

- Elm Bank Reservation (2 BMPs)
- Forest Grove (2 BMPs)
- Newell Boathouse (4 BMPs)
- Northeastern Boathouse (2 BMPs)
- Parkman Drive (1 BMP)

DCR's 1.1 lb/yr of credit in the Charles River Watershed in PY8 represents a relatively small amount of credit, given that in PY6 and PY7, DCR added 7.6 lb/yr and 11.4 lb/yr of credit, respectively. This also represents a relatively small amount of credit given that 11 BMPs were credited, meaning a phosphorus reduction per BMP of about 0.1 lb/yr. This small amount of credit is in part because 6 of the 11 credited BMPs are located on leased boathouse properties, where DCR did not oversee the design and the catchment areas are small. These small catchments help explain the low phosphorus reduction per BMP of 0.1 lb/yr. More broadly, these results illustrate that much of the "low-hanging fruit" of BMP crediting, or the readily achievable credit, has likely been exhausted, such as identifying and crediting existing BMPs, and annual additional credit is likely to continue diminishing. This underscores the importance of maximizing opportunities to incorporate effective stormwater treatment into every redevelopment project, thereby reducing the need for more costly standalone stormwater retrofits in the future.

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Table 3. Phosphorus Reduction from BMPs Newly Credited in PY8 in the Charles River Watershed

BMP Type	Count	Total P Reduction (lb/yr)	Average P Reduction (lb/yr)	Average P Reduction (%)
Surface BMPs				
Bioretention Infiltration Basin/Swale	1	0.2	0.2	99
Infiltration Trench	4	0.6	0.1	91
Impervious Area Disconnection	5	0.3	0.1	75
Subsurface BMPs				
Detention Chamber	1	0.1	0.1	19
Total	**11**	**1.1***	**0.1**	**71**

*The total P reduction was calculated using the unrounded P reduction value of each BMP. The sum of the rounded values in Table 2 is slightly greater than the actual total due to the rounding discrepancy.

In addition to the 11 new BMPs credited, the IC disconnection surface BMP 19627 was recredited as a result of being re-delineated in PY8, and its credit increased by 0.1 lb/yr (Table 4).

Table 4. BMPs Recredited in PY8 in the Charles River Watershed

BMP ID	BMP Type	PY7 P Reduction (lb/yr)	PY8 P Reduction (lb/yr)	Difference (lb/yr)
19627	Impervious Area Disconnection	0.8	0.9	+0.1

Finally, one historically credited BMP in the Charles River Watershed, subsurface BMP 20119, was removed from crediting totals in PY8 after new information indicated it was not part of DCR's MS4-regulated area, but instead discharged to combined sewer (Table 5). (Note that although this BMP is no longer credited under DCR's PCP, it remains in DCR's database.)

Table 5. BMPs Removed from Crediting in PY8 in the Charles River Watershed

BMP ID	BMP Type	P Reduction (lb/yr)
20119	Leaching Basin	0.2

With PY8 BMP crediting complete, **DCR has now accounted for 79.6 lb/yr of phosphorus load reduction in the Charles River Watershed, or 41% of the final PY20 reduction target.** DCR has met interim PCP deadlines up to PY13, which requires a 35% reduction (Table 6). In the next 12 years, DCR will have to remove 112.9 lb/yr of phosphorus from its stormwater load.

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Table 6. Existing and Remaining Phosphorus Load Reduction in the Charles River Watershed

Sweeping P Reduction (lb/yr)	Structural P Reduction (lb/yr)	Structural BMP Count	Total P Reduction (lb/yr)	Required PY13 P Reduction (lb/yr)	Required PY20 (Final) P Reduction (lb/yr)	Remaining Required P Reduction (lb/yr)	Progress to PY20 P Reduction
31.0	48.6	121	79.6	67.4	192.5	112.9	41%

Note that the credit reported above may shift slightly in future permit years, as 90 BMPs totaling 31.5 lb/yr of credit were estimated using an assumed 0.5-inch DSV rather than individual DSV estimates. (The remaining 17.1 lb/yr of structural credit is from BMP types that do not use a DSV to calculate load reduction such as IC disconnection and underdrained porous pavement, or BMPs that were credited in PY8 which used individual DSV estimates.) In future permit years, VHB will work towards recrediting these BMPs so that all MS4 Permit deadlines are met using BMP credit that was calculated with individually estimated versus assumed DSVs.

Lake & Pond PCPs

Baseline Phosphorus Load

Updates due to Development

In PY8, VHB reviewed DCR's facilities in Lake & Pond PCP Watersheds for changes to impervious cover and land use in order to determine change in baseline load since 2005. Although none of the watersheds appeared to have undergone development in the last year, VHB identified and flagged changes to impervious cover in the Lake Quinsigamond & Flint Pond Watershed that had occurred between 2009 and 2010 but had not been previously identified (the reconfiguration of the Regatta Point parking area at Lake Quinsigamond State Park). As the PY8 review did not identify changes to impervious cover or land use in the Auburn Pond/ Leesville Pond or Bents Pond/ Ramsdall Pond watersheds, VHB has not identified any load due to development since 2005 in these watersheds. Table 7 presents current loads and phosphorus reduction requirements for each Lake & Pond PCP.

Updates due to Facility Boundary Changes

In PY8, the 2005 baseline loads were also updated in the Auburn Pond/ Leesville Pond and Lake Quinsigamond & Flint Pond Watersheds as a result of adjustments made to facility boundaries since the last baseline load calculations. In the Lake Quinsigamond & Flint Pond Watershed, new information revealed that DCR owned the entire parking lot at the Honorable Charles J. Buffone Skating Rink. Previously, only a portion of the parking lot had been included in the facility boundary, so the addition of the remaining parking lot increased impervious cover at the facility, therefore increasing phosphorus load (Table 8). In the Auburn Pond/ Leesville Pond Watershed, the Daniel S. Horgan Memorial Skating Rink (Horgan Rink) facility boundary was corrected and shifted to the south, which increased impervious cover at the facility and thus phosphorus load (Table 8). Despite this increase in baseline load, the Auburn Pond/ Leesville Pond Watershed still meets its final PY15 load reduction requirement with the recently installed BMPs at Horgan Rink, as explained in the "Phosphorus Load Reduction Credit" section below. The Bents Pond/ Ramsdall Pond Watershed's 2005 baseline load remained unchanged (Table 8).

Table 7. Lake & Pond PCP Baseline Phosphorus Load and Required Phosphorus Reduction Summary

Watershed	2005 Baseline Load (lb/yr)	Load due to Development since 2005 (lb/yr)	Updated Load (lb/yr)	Percent Reduction Required	Total Required Reduction (lb/yr)	Total Allowable Load (lb/yr)
Auburn Pond / Leesville Pond[6]	5.4	0	5.4	31%	1.7	3.7
Bents Pond / Ramsdall Pond[7]	1.7	0	1.7	52%	0.9	0.8
Lake Quinsigamond & Flint Pond	20.4	-0.1	20.3	49%	10.0	10.3

Table 8. Lake & Pond PCP Baseline Phosphorus Load Updates

Watershed	PY7 2005 Baseline Load (lb/yr)	PY8 2005 Baseline Load (lb/yr)
Auburn Pond / Leesville Pond	4.5	5.4
Bents Pond / Ramsdall Pond	1.7	1.7
Lake Quinsigamond & Flint Pond	18.5	20.4

Phosphorus Load Reduction Credit

In Lake & Pond PCP Watersheds, VHB identified two newly mapped, creditable BMPs during the PY8 review, both of which were in the Lake Quinsigamond & Flint Pond Watershed. Table 9 provides BMP type and phosphorus load reduction information for the two credited BMPs.

Table 9. Phosphorus Reduction from BMPs Newly Credited in PY8 BMPs in Lake & Ponds Watersheds*

BMP Type	Count	Total P Reduction (lb/yr)	Average P Reduction (lb/yr)	Average P Reduction (%)
Lake Quinsigamond & Flint Pond				
Sand & Organic Filter	1	0.1	0.1	56
Leaching Galley	1	2.8	2.8	77

*There were no new BMPs in the Auburn Pond/ Leesville Pond Watershed or the Bents Pond/ Ramsdall Pond Watershed in PY8.

[6] The Leesville Pond Watershed's phosphorus reduction requirement is included in this table and used for calculations because it is higher than Auburn Pond's and therefore used as the governing target.

[7] The Bents Pond Watershed's phosphorus reduction requirement is included in this table and used for calculations because it is higher than Ramsdall Pond's and therefore used as the governing target.

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In addition to crediting new BMPs, VHB recredited BMPs using individually estimated DSVs instead of an assumed 0.5-inch runoff depth, per EPA's request. Recrediting was performed on two BMPs in the Lake Quinsigamond & Flint Pond Watershed and three BMPs in the Auburn Pond/ Leesville Pond Watershed (Table 10), leaving no BMPs in these watersheds remaining for recrediting. In the Lake Quinsigamond & Flint Pond Watershed, using individually estimated DSVs provided an additional 1.2 lb/yr of phosphorus reduction credit. In the Auburn Pond/ Leesville Pond Watershed, where the only facility is Horgan Rink, using individually estimated DSVs reduced credit by 0.7 lb/yr. (Note that the credit in the database for the Horgan Rink BMPs previously did not match the credit estimates developed during BMP design, as VHB's standard BMP crediting protocol until this year has been to assume a 0.5 inch runoff depth for all BMPs. This recrediting analysis brought database credit into alignment with the credit estimated during design.) Once construction is complete at Dunn State Park, VHB will update the BMP credits in the Bents Pond/ Ramsdall Pond Watershed using individually estimated DSVs.

With PY8 crediting complete, **DCR is meeting the final PCP target for the Auburn Pond/ Leesville Pond Watershed and meeting interim deadlines through PY13 for the Lake Quinsigamond & Flint Pond Watershed (Table 11). Interim deadlines for the Bents Pond/ Ramsdall Pond Watershed have been met through PY10 (Table 11), although this credit is based on an assumed 0.5-inch DSV.** BMP credit in this watershed will be reevaluated in PY9 once construction is complete, at which point individually estimated DSVs will be used for crediting.

Although progress towards the PCP targets has been made, more load reduction is needed. In the next seven years (by PY15 or June 2033), DCR will be required to meet final targets for the two incomplete Lakes & Ponds Watersheds. Within five years (by PY13 or June 2031), DCR will have to reduce phosphorus load by at least 0.1 lb/yr in the Bents Pond/ Ramsdall Pond Watershed (Table 11).

Table 10. Phosphorus Reduction from BMPs Recredited in PY8 BMPs in Lake & Ponds Watersheds*

BMP ID	BMP Type	PY7 P Reduction (lb/yr)	PY8 P Reduction (lb/yr)	Difference (lb/yr)
Lake Quinsigamond & Flint Pond				
19446	Bioretention Infiltration Basin/Swale	1.0	1.9	+0.9
19444	Leaching Galley	3.4	3.7	+0.3
Auburn Pond/ Leesville Pond				
19904	Infiltration Basin/Swale	0.5	0.6	+0.1
20308	Leaching Basin	0.9	0.6	-0.3
20309	Leaching Basin	1.1	0.6	-0.5

Table 11. Existing versus Required Phosphorus Load Reduction in Lake & Pond PCPs

	Existing P Load Reduction (lb/yr)			Required P Load Reduction (lb/yr)				Remaining Required P Load Reduction (lb/yr)
	Structural BMPs[1]	Sweeping[2]	Total	PY8	PY10	PY13	PY15 (Final)	
Auburn Pond / Leesville Pond	1.8 (3)	0.01	**1.8**	0.3	0.7	1.2	1.7	**0.0**
Bents Pond / Ramsdall Pond	0.5 (1)	0.00	**0.5**	0.2	0.4	[0.6]	[0.9]	**0.4**
Lake Quinsigamond & Flint Pond	8.9 (5)	0.03	**8.9**	2.0	4.0	7.0	[10.0]	**1.1**

[1] Number of BMPs is shown in parentheses.

[2] Street sweeping phosphorus load reduction values are rounded to the nearest hundredth rather than tenth due to their small magnitude.

Green cells indicate permit milestones have been met

[Red] cells indicate permit milestones have not yet been met

Conclusions

In accordance with the MS4 Permit, DCR has completed a PY8 performance evaluation of the Charles River and Lake & Pond PCPs. This performance evaluation reflects continued progress toward DCR's phosphorus reduction requirements in both the Charles River and Lake & Pond PCPs.

The Lake & Pond PCPs show significant progress. The Auburn Pond/ Leesville Pond Watershed has met its final reduction target, the Bents Pond/ Ramsdall Pond Watershed is expected to meet its final target once Dunn State Park improvements are complete, and the Lake Quinsigamond & Flint Pond Watershed added two new BMPs in PY8 and needs only 1.1 lb/yr of additional load reduction to meet its final goal, which could potentially be achieved by just one high-quality BMP. Over the next few years, DCR should prioritize fulfilling the remaining Lake & Pond PCP requirements so that the only remaining PCP requirements are for the Charles River Watershed.

In the Charles River Watershed, in PY8, DCR added new BMP credit, while also achieving a meaningful reduction in baseline load through a project that reduced impervious cover. At the same time, the relatively small amount of BMP credit gained this year compared with PY6 and PY7 indicates that opportunities for readily achievable credit (i.e. "the low hanging fruit") are diminishing. Moving forward, it will be critical for DCR to capitalize on every redevelopment opportunity to incorporate as much MS4-creditable, stormwater treatment as possible and to reduce impervious cover wherever feasible, thereby avoiding the need for costly stand-alone retrofits to meet the ultimate phosphorus reduction requirement. As of this performance evaluation, DCR has 112.9 lb/yr of phosphorus remaining and 12 years to reach its final target in the Charles River Watershed. Meeting this requirement will likely require substantial investment, making it essential that future reductions be planned and implemented as strategically and cost-effectively as possible.

VHB will continue to support DCR in meeting PCP targets through detailed annual tracking and accounting and targeted programmatic assistance. This includes ensuring that new BMPs are consistently identified, mapped, and

credited using the most accurate available data; supporting DCR's internal systems so that activities are structured to maximize treatment credit; developing tools to help staff and designers align projects with MS4 crediting requirements; and pursuing new avenues for BMP credit where appropriate. Through this combination of strategic planning, careful accounting, and targeted program support, DCR will be equipped to make steady progress toward PCP goals and to manage MS4-compliance as effectively as possible.