Lake Phosphorus Control Plan (LPCP) Template - Appendix R.2

1 Calculation Support Worksheet for Determination of LPCP Area

Goal: Provide guidance and support to select your LPCP scope area and estimate your baseline load based on land use analysis. Communities may choose between implementing the LPCP in just the Urbanized Area (UA) of the drainage area to your impaired water body, or (if applicable) within the entirety of the drainage area to the impaired water body within your community's jurisdictional boundary.

"Item 3" of Permit Appendix F allows municipalities to select the LPCP Area (LPCP Scope) Baseline. This dictates:

(a) Where within the municipality the LPCP will be implemented, and
(b) What the associated Phosphorus reduction target (in mass/year) is for the area selected.

Here, we will walk you through the key considerations for LPCP-scope determination. Table 1-1 lists the required percent reduction targets for each waterbody. This information is pulled from Tables F-6 of Permit Appendix F. Based on your selection, you will calculate the associated baseline load in that LPCP Area and apply the Required Percent Reduction(s) in Table 1-1. Guidance to calculate your Baseline is provided later in this Calculation Support worksheet.

Note: In all cases, the selected LPCP Area must be entirely located within the sub-watershed boundary for each waterbody.

Table 1-1. (Permit Table F-6) Required Percent Reduction by Waterbody

Primary Municipality	Waterbody Name	Required Percent Reduction
Auburn	Leesville Pond	31%
	Auburn Pond	24%
	Eddy Pond	0%
	Pondville Pond	8%
	Stoneville Pond	3%
Charlton	Buffumville Lake	28%
	Dresser Hill Pond	17%
	Gore Pond	14%
	Granite Reservoir	11%
	Jones Pond	13%
	Pierpoint Meadow Pond	27%
	Pikes Pond	38%
Dudley	Gore Pond	14%
	Larner Pond	55%

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Primary Municipality	Waterbody Name	Required Percent Reduction
	New Pond	56%
	Pierpoint Meadow Pond	27%
	Shepherd Pond	25%
	Tobins Pond	62%
	Wallis Pond	54%
Gardner	Hilchey Pond	27%
	Parker Pond	47%
	Bents Pond	52%
	Ramsdall Pond	49%
Grafton	Flint Pond/Lake Quinsigamond	49%
Granby	Aldrich Lake East	0%
Hadley	Lake Warner	24%
Harvard	Bare Hill Pond	2%
Hudson	Lake Boon	28%
Leicester	Smiths Pond	30%
	Southwick Pond	64%
	Cedar Meadow Pond	17%
	Dutton Pond	23%
	Greenville Pond	14%
	Rochdale Pond	8%
Ludlow	Minechoag Pond	48%
Millbury	Brierly Pond	14%
	Dorothy Pond	1%
	Howe Reservoir	48%
Oxford	Buffumville Lake	28%
	Hudson Pond	37%
	Lowes Pond	51%
	McKinstry Pond	79%
	Robinson Pond	8%
	Texas Pond	21%
Shrewsbury	Flint Pond/Lake Quinsigamond	49%
	Jordan Pond	60%
	Mill Pond	43%
	Newton Pond	19%
	Shirley Street Pond	30%
Spencer	Quaboag Pond	29%

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Primary Municipality	Waterbody Name	Required Percent Reduction
	Quacumquasit Pond	2%
	Jones Pond	13%
	Sugden Reservoir	31%
Springfield	Loon Pond	10%
	Long Pond	56%
	Mona Lake	57%
Stow	Lake Boon	28%
Templeton	Brazell Pond	62%
	Depot Pond	50%
	Bourn-Hadley Pond	49%
	Greenwood Pond 2	56%
Wilbraham	Spectacle Pond	45%
Winchendon	Lake Denison	22%
	Stoddard Pond	24%
	Whitney Pond	16%
	Whites Mill Pond	21%

In instances where the water body drainage area is entirely encompassed by the regulated urbanized area, the LPCP area will coincide with the delineated drainage area. Where the drainage area extends beyond the regulated urbanized area boundary, but within the municipality's jurisdiction, the community may choose either the full drainage area or just that within the urbanized area. Note: drainage areas to listed water bodies may extend across municipal jurisdictional boundaries. If your community contains a portion of a drainage area, but not the water body itself, you are still responsible for meeting the pollutant reduction requirement for that portion of the drainage area. The required reduction in mass/year in the entire drainage area will be higher than that for just the Urbanized Area. There are a few reasons you may decide to implement your LPCP across the broader drainage area within your jurisdiction, including:

- Most readily developable and re-developable land is located outside the Urbanized Area;
- Key large parcels suitable for structural BMPs are located outside the Urbanized Area;
- Soil types, groundwater conditions, etc. most suitable to BMPs outside the Urbanized Area (this may be a consideration for communities with a very small difference);
- New development with modern stormwater controls is present/prevalent outside the Urbanized Area.
- Your municipality's Urbanized Area covers almost the entire sub-watershed/drainage area.
- Creating a distinction of the Urbanized Area will complicate BMP tracking. (i.e. how easy or difficult will it be to implement and track enhanced non-structural BMPs in a targeted area vs. entire drainage area within the community?)

We also recommend considering the following:

- Local regulation does not yet require the same phosphorus removal standards in UA vs outside of UA;
- The Massachusetts Coastal Resilience maps are a good resource for considering where stormwater management opportunities geographically reside in your community.

Note: A community can always elect to expand the LPCP Area from only the Urbanized Area to the entire watershed in their municipal bounds *at a later phase of LPCP planning*; however, if you select your entire jurisdiction, you cannot go backwards.

LPCP Area: For use in Template

Based on these instructions and considerations, select an LPCP Area and enter your selection below:

- ☐ Urbanized Area Only
- ☐ Entire watershed
- ☐ N/A no distinction

Based on this selection, calculate your baseline load using the guidelines below.

LPCP Baseline Determination

Note: You will need to prepare an LPCP Baseline Determination for each lake/pond subject to a TMDL to which your MS4 discharges.

The Baseline Phosphorus load must be calculated using the methodology in Attachment 1 to Appendix F also detailed in Workshop #1. To accomplish this, you will need the land use within your selected LPCP Area. Some suggestions on how to do this include:

- Use the MassDEP Watershed Based Planning Tool (http://prj.geosyntec.com/MassDEPWBP)
- Use MassGIS land use and calculate the acreage of each land use type in GIS
    - Note, recommend using 2005 land use instead of 2016, since the 2016 land use types do not currently (June 2022) align with calculations presented in Attachment 1 to Appendix F
- Use local land use data and calculate the acreage of each land use type

Note: If you have decided to implement your LPCP within the entire lake/pond watershed, one way to accomplish this would be to use the MassDEP Watershed Based Planning Tool. Element A of the tool will output your land use areas in the selected watershed, which can then be used to calculate the associated phosphorus load. The tool was based on 2005 land use data. If land use is substantially unchanged, this data will provide a good basis for determining base loads. Manual re-calculation may be required if significant development has occurred since 2005.

While the MassDEP Watershed Based Planning tool contains a built-in MS4 module, this will not provide the required output in Element A necessary for the Baseline Determination (i.e. it does not provide a table of land use by lake/pond watershed, instead it provides aggregated land use for a portion of the MS4 Regulated (Urbanized) Area that may contain multiple waterbodies). In this case, additional analysis will be required in GIS.

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Regardless of the tool used, the land use types must align with the categories in Attachment 1 to Appendix F. A simplified spreadsheet can be used as a basis for performing calculations in alignment with Attachments 1-3 to the Permit Appendix F and to support your calculations to determine the items in the following table. Once you have determined the acreages attributed to each of the land use types in your determined LPCP area, enter the values into the table below.

Note that the first column, “Item Number,” will be used throughout this Appendix and the Template to track calculated values.

Table 1-2. Selected Phosphorus Load Characteristics

Item Number	Name	lbs/yr or %	kg/yr or %
1.1	Baseline Phosphorus Load (calculated)		
1.2	Required Percent Reduction in Phosphorus Load (from Table 1-1)		
1.3	Stormwater Phosphorus Load Reduction Requirement (Item 1.1 x Item 1.2)		
1.4	Allowable Phosphorus Load (Item 1.1 – Item 1.3)		

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2 Calculation Support for Structural and Non-Structural BMP Tracking

Goal: Provide guidance to calculate phosphorus loads/credits for:

- Land use, development (for use in the Performance Evaluations); and
- Structural and non-structural BMPs.

The three sections of this worksheet will provide guidance for calculating both of these items.

Most of the calculations here will need to be performed in an accounting tool while leveraging data within your municipality. A summary of potential inputs and calculation tools is provided in Table 2-1. The BMP Accounting and Tracking Tool (BATT) is strongly recommended for any calculations that will be used to document permit compliance. A more detailed resource summary is included Appendix R.4:

Table 2-1. Accounting Resources

Potential Input Sources	Potential Methods to Perform Calculations
● Town maps/ GIS data ● Oliver online tool ● MassGIS land use (2005 vs 2016) ● MassGIS impervious cover data (2005) and more recent impervious cover that is specific to a municipality ● Local permit filings (Stormwater Authority/ Agency, Planning Board Records, Conservation Commission NOIs, Board of Health review, etc.) ● Zoning, Conservation, and Public Works/ Engineering Records	● MassDEP Watershed Based Planning Tool ● BMP Accounting and Tracking Tool (BATT) ● UNHSC Simple Municipal tracking form

Part (2a). Changes to Land Use, Development, and Conversion of Impervious Cover since your Baseline

Under the Performance Evaluation section in Appendix F, permittees are required to calculate "phosphorus export increases resulting from development and augment their baseline loads accordingly." The LPCP Area and Baseline selected in Worksheet 1 were calculated based on Phosphorus Loading Export Rates (PLERs) estimated from different land use/land cover types, and these can be used to make updates from the changes since your baseline load was developed, as detailed in Attachment 1 to Appendix F of the Permit.

You will need to estimate the following items:

(1) Acreage of net change to impervious cover since your baseline, and
(2) Acreage of changed land uses since your baseline was calculated.

If you have in-house GIS capability, calculating annual changes can be undertaken through GIS analysis using most recent fly-over data or other publicly available data.

If you do not have GIS capabilities in-house, you can estimate changes based on changes at the site scale using:

- Planning Board plans and records
- Zoning Board plans and records

Tip/Trick: Review your Assessors Database for all new development dated after the year of your Baseline to streamline changes each time you have to update development to current conditions.

Land areas, in acres, for each land use type can be calculated by following the guidance provided by Workshop #1 of the PCP training workshop series. This will use the PLERs in Attachment 1 to calculate the changes in Phosphorus loading based on the different land use types.

1. **Item 2.1: Report the net change in phosphorus loading from land use change: _____ lb/yr (note whether it's in increase (+) or a decrease (-))**

This change will be used to calculate your current phosphorus load, which will update the total amount of phosphorus that must be mitigated to meet your Allowable Phosphorus Load selected in Worksheet 1. Use the value above (Item 2.1) and the results from Worksheet 1 to fill in the following table. For simplicity of calculation, we ask you to re-report the values determined on Worksheet 1 below:

Table 2-2. Phosphorus Loads Reflecting Development Updates

Condition	Value
Baseline P-Load, lbs/yr	*[Item 1.1]*
Stormwater P-Load Reduction Requirement, lbs/yr	*[Item 1.3]*
Allowable P-Load, lbs/yr	*[Item 1.4]*
Changes in P-Load Since Baseline (P-inc), lbs/yr	*[Item 2.1]*
Current P-Load, lbs/yr	*Item 2.2 = [Item 1.1 + Item 2.1]*
Current Stormwater P-Load Reduction Requirement, lbs/yr	*Item 2.3 = [Item 2.2 – Item 1.4]*
Year 8 Milestone: 20% of Reduction, in lbs/yr	*0.2 * [Item 2.3]*
Year 10 Milestone: 40% of Reduction, in lbs/yr	*0.4 * [Item 2.3]*
Year 13 Milestone: 70% of Reduction, in lbs/yr	*0.7 * [Item 2.3]*
Year 15 Milestone: 100% of Reduction, in lbs/yr	*[Item 2.3]*

Part (2b). Non-Structural BMP Calculation for Current Practices

Appendix F also allows municipalities to take credit for any enhanced non-structural BMPs that are currently in practice. Step (2b) focuses on the three non-structural BMPs for which permittees can receive credit: street sweeping, catch basin cleaning, and yard waste/leaf litter collection. See Workshop #2 showing steps for Non-Structural BMP calculation and Permit Appendix F Attachment 2 excerpts detailing what may be credited.

First, we recommend you calculate your credits from ***existing*** BMPs to better understand what portion of your Stormwater Phosphorus Load Reduction (determined in

Worksheet 1 of this appendix) you are currently getting credit for. Then, the guidance provided here and in Workshop #2 presentation (Slides 10-15) can also be used to estimate and track credits for ***planned*** BMPs.

From the permit:

Street Sweeping: For full credit for monthly and weekly sweeping frequencies, sweeping must be conducted year-round. If not, an adjustment factor will be used[1]. The following frequencies are considered enhanced:

- *2 times / year*
- *Monthly*
- *Weekly*

Catch Basin Cleaning: To take credit, you must maintain a minimum sump storage capacity of 50% throughout the year, and clean catch basins semi-annually.

Enhanced Organic Waste and Leaf Litter Collection Program: In order to earn this credit (Credit leaf litter), the permittee must gather and remove all landscaping wastes, organic debris, and leaf litter from impervious roadways and parking lots at least once per week during the period of September 1 to December 1 of each year. Credit can only be earned for those impervious surfaces that are cleared of organic materials in accordance with the description above. The gathering and removal shall occur immediately following any landscaping activities in the Watershed and at additional times when necessary to achieve a weekly cleaning frequency. The permittee must ensure that the disposal of these materials will not contribute pollutants to any surface water discharges. The permittee may use an enhanced sweeping program (e.g., weekly frequency) as part of earning this credit provided that the sweeping is effective at removing leaf litter and organic materials.[2]

Report Results by Category:

Table 2-3. Existing Non-Structural BMPs

Non-Structural BMP	Implementation Levels	Average Annual P-Reduction (lbs/yr)
Street Sweeping		
CB Cleaning		
Leaf Litter Program		
Item 2.4: Total Existing Non-Structural Credit		

Use the information in the table above to enter into Table 1-4 of the Template.

Part (2c). Structural BMP Calculation from Constructed and Maintained BMPs

[1] Attachment 2 to Appendix F, page 5 of 10: "for example, if sweeping does not occur Dec – Feb, the adjustment factor would be 9/12 (months) = 0.75. Year-round sweeping has an adjustment factor of 1.0.
[2] Attachment 2 to Appendix F Excerpt, page 9 of 10

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Before determining enhancements that should be undertaken moving forward, this is an opportunity to take credit for any structural BMPs already in place that are receiving proper maintenance, are currently working as intended, and can be certified to that condition. Part (2c) focuses on structural BMP implementation. **EPA's BMP Accounting and Tracking Tool (BATT) is the tool that is best suited for this step.** It will also help you establish a good database for tracking structural controls going forward.

Note that if you decide to take credit for existing BMPs, we recommend you complete this ASAP to get a better idea of how much progress you've already made towards your Allowable Phosphorus Load, which will direct how you continue to plan your program. It is recommended that you undertake this effort if there has been considerable development in your community in the past two decades that has involved installation of stormwater BMPs and 1. You have documentation on these systems, 2. The systems have been maintained and are functioning as designed.

To calculate reduction credit, you will need to build an inventory of all installed structural BMPs using the "InventoryStructuralBMPs" tab in Appendix R.5 that includes the following information:

- BMP Type
- BMP Drainage Area (acres)
- BMP Location
- BMP Design Storage Volume (ft^3)
- Impervious and Pervious Area Contributions, with
    - Impervious Land Use Type and Area (acres)
    - Pervious Hydrologic Soil Group (HSG) and Area (acres)
- Phosphorus Reduction (% Removal)
    - Note, this can be calculated based on the storage capacity of a BMP using the performance curves in Attachment 3 (utilized in the BATT tool). Need BMP type and storage volume.

Some recommendations on how to compile the above information is as follows:

- BMP record plans and as-built drawings
- BMP design documents
- Local GIS information for land use

For all structural BMPs that have already been installed, use the BATT tool to calculate associated phosphorus credits that can be taken. BATT uses the equations in Attachment 3 to Appendix F to estimate phosphorus credits. Workshops #2 and #3 of the PCP workshop series detail how and what is needed to use these equations. A spreadsheet can also be used for planning purposes such as if you want to make an educated guess about how much credit you might get from BMPs that are currently installed before tracking down all the data needed for the BATT and investing in staff capacity to learn BATT. **EPA recommends using the BATT tool for compliance reporting and documentation.**

Based on BATT, or any other tool used, enter the summary of current structural BMPs and their associated phosphorus credit in the table below. This will be replicated in Table 1-6 of the Template.

Table 2-4. Structural BMPs

Name of Lake/Pond Watershed in which BMP is Located	Current Structural BMP Type	Number of BMPs	Total Acres Managed	Total Annual P-Reduction (lb/yr)
Item 2.5: Total Phosphorus Credit from Current Structural BMPs				

Note that the procedures for Parts (2b) and (2c) will be replicated for planned BMPs in subsequent sections of the LPCP. The guidance here should be followed for all planned BMPs. Take note of any data that was not easily accessible for calculation here – procedures for structural BMP implementation moving forward should work to address this deficiency, by working with developers to obtain this information during your site plan approval or other permitting processes should be standardized and efficient moving forward. Maintenance requirements that are the Town's responsibility should be detailed in your Stormwater Water Management Plan (SWMP).

Calculation Summary: With your current phosphorus load (Item 2.2) calculated above, and your reductions due to current structural and non-structural BMPs, you can now apply these credits to augment that reduction requirement, progressing you further towards your Allowable Phosphorus Load.

Table 2-5. Calculation Summary for Existing Conditions

Condition	From Permit
Current Stormwater P-Load Reduction Requirement, lbs/yr	*Item 2.3 = [Item 2.2 – Item 1.4]*
Non-Structural BMP Reduction Credit, lbs/yr	*Item 2.4*
Structural BMP Reduction Credit, lbs/yr	*Item 2.5*
Total Reductions due to Existing BMPs, lbs/yr	*Item 2.6 = [Item 2.4 + Item 2.5]*
Remaining Stormwater P-Load Reduction Requirement, lbs/yr	*Item 2.7 = [Item 2.3 – Item 2.6]*

Other Useful Benchmarking Exercises

Based on the data collected in this worksheet, we recommend a couple of benchmarking exercises, based on the work done so far, which may help lend some context to your future planning. This information will not be explicitly used in the Template, but it will be good information to inform your LPCP approach,

Non-Structural Control Benchmark: Re-Report 2.4: Total phosphorus credit associated with current non-structural BMPs: _____ lb/yr

What BMPs are in practice to achieve this reduction: _____

_____

_____

How much does this cost, annually (if available): _____

_____

_____

Describe level of effort to maintain (staff time, equipment purchasing/maintenance, tracking, etc.

_____

_____

_____

To estimate costs for structural BMP controls, use the guidance provided in Slides 18-26 of the PCP Training Workshop #3 and the Cost-Benefit Resource Toolkit for Phosphorus Control BMPs (Appendix R.7). This document compiled cost information from numerous communities to provide an estimate for the cost of phosphorus removal in the Charles River watershed. If you have sufficient data from your own community you could do the benchmarking exercise below.

Structural Control Benchmark: Re-Report 2.5: Total phosphorus credit associated with existing structural BMPs: _____ lb/yr

What types of BMPs (and how many of each) were implemented to achieve this reduction:

_____

_____

_____

How much did this cost overall to implement (if available; for municipally owned): ____

_____

_____

_____

How much does this cost, annually, to maintain (if available; for municipally maintained):

_____

_____

_____

Describe level of effort to maintain (staff time, equipment purchasing/maintenance, tracking, etc.

_____

_____

_____

Approximate Historical Unit Cost for Non-Structural BMPs = [Total implementation cost] / [lb removed] _____

Approximate Historical Unit Cost for Structural BMPs = [Total implementation cost] / [lb removed] _____

If cost information is not readily available, use this as an opportunity to more qualitatively determine the relative efficacy of structural and non-structural BMPs based on historical data. The LPCP Guidance Tools in Appendix R.1 will walk you through the process to begin selecting methods to obtain further - phosphorus reduction credits, including, but not limited to, structural and non-structural BMPs. Some considerations, based on historical data, you should consider, include:

- How effective are the existing structural and non-structural BMPs?
- Is O&M manageable? Sustainable? What is the effort required to implement and maintain?
- Do you have the capacity to enhance over existing? For example, if sweeping monthly, do you have the capacity to enhance further to weekly?
- What are your limiting factors if enhancing current operations does not seem feasible? Staff availability? Funding? O&M training?