WROC
Massachusetts Water Resource Outreach Center

Assessing Pollution Reduction Credits: *Supplemental Materials*

Abstract

Pursuant to the MS4 permit, communities must reduce phosphorus from stormwater runoff by a prescribed amount. This process can be challenging. In collaboration with the Charles River Watershed Association, we conducted interviews, site visits and distributed a survey to understand the challenges communities face in assessing phosphorus reduction. Using this data, we developed recommendations to help communities in the Charles River Watershed streamline the process of receiving phosphorus reduction credit for existing structural BMPs. Our final recommendations took the form of a 6 page information sheet, which highlighted different approaches that can help communities be successful in phosphorus reduction.

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Appendix A: Informed Consent Preamble for Interviews

We are a group of students from Worcester Polytechnic Institute in Massachusetts, and we are conducting research to support the Charles River Watershed Association's efforts to facilitate information sharing about the MS4 General Permit. The intent of this project is not related to compliance assessments in any way.

We are conducting this interview to learn more about the obstacles your communities and other communities face to identify, implement and maintain existing structural stormwater runoff Best Management Practices. We believe this research will ultimately help communities reduce stormwater pollution, more easily meet regulation regulations and receive phosphorus reduction credit, overall improving the health of the Charles River watershed.

Your participation is voluntary and appreciated. There is no risk associated with your participation in the study. If at any time you wish to withdraw from the study, you may do so. If you have additional questions, you may reach out to our faculty advisor Professor Corey Dehner (cdehner@wpi.edu). If you would like, we are happy to share a copy of our results at the conclusion of the study, or you can find the final report at WPI's Gordon Library.

Appendix B: Interview Question Sample with Communities

1) How did you first get involved in stormwater management?

Data Collection Questions

2) Tell us about the data collection process for the BMPs?
3) How do you keep track of all the information? Software? Work order? Paper copies?
4) Are there any challenges and obstacles you've dealt with in stormwater management?
    a) What are some challenges and successes when mapping already built BMPs? What tool do you use?
    b) What are some challenges and successes in terms of their design, operation and maintenance of BMPs?
    c) How do you keep track of and ensure operation and maintenance on BMPs that are privately owned? Any challenges and successes?
    d) How about Wetlands? Any challenges and successes arise from addressing conserved lands?
    e) Staffing? If so, what type of staff would be beneficial to have to address stormwater management?
5) Have you done any field measurements of BMPs that did not have drawings or paper records? If so, how did that go?
6) Have you or a contractor assessed the need for Operation and Maintenance? If so, how did that go and how much did it cost?
7) How much progress has your community made in calculating phosphorus reduction credit?
    a) Did you ever need to rebuild/ retrofit a BMPs in order to receive credit for phosphorus? If so, how did that go?
8) Has there been any challenge and successes in terms of public involvement?
9) Do you have dedicated funding towards stormwater management? Has there been any consideration on utilizing a stormwater fee?

Conclusion Questions

10) Can we arrange a site visit on some of the work you are doing?
11) Do you have any recommendations for us as we move forward with our project?
12) Is there anyone else you recommend we interview?
13) If we have additional questions, is it ok if we reach out? If so, do you prefer we reach out via email or via phone?

If a community had a stormwater fee, we asked…

1) We noticed you have a stormwater utility fee, something a lot of towns may not have . Could you describe some successes and challenges to utilizing stormwater fees?
2) Do you think stormwater fees can be successful for other towns that don't have one? Explain
3) We noticed as well that you have a reduction credits on BMPs to help save money, how has this been successful? How can stormwater fees and the credit program be implemented in the future?

Appendix C: Interview Question Sample for Regulators

Icebreaker Question

1) Can you tell us about your history working at EPA and present position?

Communities Based Questions

2) What is the organizational structure of TMDL and MS4 permits and how are you involved? Do you engage mostly at the agency level or community level?)

Pollution Credit Questions

3) Could you describe how pollution credit is earned and some challenges that may occur in that process?
4) What specific questions do communities ask you about calculating credits for BMPs?
5) Have communities asked about how to use the epa tools to calculate credits for older BMPs with limited information, and if so, what do you suggest they take as an approach (e.g. measurements, field data collection, assumptions, etc.)
6) Communities often spend a significant amount of funding for operations and maintenance of existing BMPs and find through calculations that the amount of phosphorus removed is very small. Based on the projects you have been on, how could communities minimize expenses and maximize phosphorus reduction?
7) How can you help a community that may be struggling in meeting the requirements of the MS4 permit? + Optional question - Is there a community you can think of that has a streamlined process and is successfully mapping, logging and reporting for their MS4 permits?
8) Are there technical help/opportunities available from the US EPA (or other agencies) that communities can find/reach out to help them? If so, what kind of help have you seen communities need the most?
9) In the next MS4 Permit draft, what can be by the US EPA to make receiving pollution credits more streamlined?
    a) Nutrition credit trading?
    b) Adding Non Structural BMP
    c) Any other aspects that may be considered?

Conclusion Questions

10) Do you have any recommendations for us as we move forward with our project
11) Is there anyone else you recommend we interview?
12) If we have additional questions, is it ok if we reach out? If so, do you prefer we reach out via email or via phone?

Appendix D: Comparative Matrices of Phosphorus Reduction Challenges (or interview responses)

D-1. Matrix of Funding, Records, Protected Land and Staffing Challenges

KEY
Was a Challenge
Wasn't a Challenge
Did not mention, follow up questions needed

	Old Records	Funding	Protected Land	Staffing
Municipality A		Funding competing with other town departments		
Municipality B		Have a stormwater fee which helps but still need more money		Needs more staff for O&M
Municipality C	Old records in archive files, hard to find all BMPS	No stormwater fee, depending on town funding.	Swampy conservation wetland. Moving and maintenance a BMPs near wetlands is difficult challenge	Inspection of BMPs one by one and very time consuming and having more staff would be helpful
Municipality D	Few incidents but old records provide valuable and useful BMP data, well organized	Competing with other departments for funding such as the police, fire department, education, etc.	Might need to utilize conservation wetlands for BMPs if there's not enough space, which hurts the environment	Need more staffing in terms of O&M

	Old Records	Funding	Protected Land	Staffing
Municipality E	paper recording, info can get lost and may not be dependable	Working on getting stormwater fee approved as funding is needed for O&M as staffing	A tree may need to be cut down that might be prevented due to wetlands but overall not a problem as wetland and conservation land department understand the problem of stormwater	Need more staff to help with operations and maintenance of clean catch basin
Municipality F	No troubles with old records as of right now	Competing with other departments for funding such as the police and fire department. Education takes about 60% of the funds. Stormwater takes about 7% of revenue. Stormwater fee study was done 8 years ago but never shared to the public, currently a new study that will be made public is in the process but no known ETA.	Works well with preventing stormwater pollution into wetland and did not find it a problem working with wetlands	Talks about hiring a stormwater engineer, but are still under funded
Municipality G	Has data on BMP's since 5 years ago, located mostly everything	Funding is still a persistent issue as the engineering department is very small and is not able to fund for more staff. Funding needs to be voted on in town meetings. Talks of having stormwater fee	Has rules and regulations around wetlands, and developers themselves are responsible for setting up stormwater regulation, but issue is seeing if developers do what they say	Staffing is very small and limited. The Engineering department is very small, with only three people in staff. The highway department deals with the maintenance and operations of BMPs

D-2. Matrix of Data Collection, Mapping, Privately Owned BMP

	Data Collection	Mapping	Privately Owned BMP
Municipality A		Not everything is mapped and still a work in progress	
Municipality B	Had no trouble mapping BMPs	Use optitool, relatively easy	Have not started tracking privately owned BMPs. Working on stormwater ordinance for non residential property in redevelopment.
Municipality C	data and BMPs in different locations so not everything is scanned in	have mapped all new BMPs but keep running into old ones	have to reach out and send reminders to ensure proper maintenance. Still working on the process on tracking and maintenance
Municipality D	Data collection for existing mapped BMP's is no issue with BATT tool	No trouble with mapping new BMPs as well as identify old ones, however mapping old BMPs is still in the process of achieving	Send out checklist for BMPs for O&M, however, some homeowner do not even know that BMPs are installed in their property
Municipality E	struggle with older underground BMPs proactive	Uses Sedaru Fieldforce to keep track of all BMPs for stormwater including privately own BMPs	Have ease agreement with private BMPs that allows the DPW to do maintenance
Municipality F	Data collection for mapping outfalls and drainage systems is pretty much completed. Have not tracked BMPs yet	Mapping of GIs done and captured about 95% of the drain systems. The individuals BMPs captured in as-built plans but not individually mapped	Have found that privately owned BMPs are maintained by HOA and condo fees. They may need to step in if a BMP is not effective but overall not a challenge
Municipality G	Using GIS for MS4 Compliance as well as a GPS system to keep track of most public BMPs, hired a consultant	Using aerial photography to plot catch basins and topography.	behind on maintaining privately owned bmps, hard to keep up communications with private contractors, make sure they are keeping up with maintenance, lots of phosphorus from privately owned land

D-3. Matrix of Maintenance, Phosphorous Credits, Public Involvement

	Maintenance	Phosphorus Credits	Public Involvement
Municipality A	Lack the necessary staff to keep up with maintenance	Still is a work in progress	
Municipality B	Were able to do some maintenance but saw it being a problem in the future. Require O & M plans for stormwater fee credit applicants	Has an consultant look at excel sheet (Optitool) to ensure the accuracy of BMPs but still working on phosphorus reduction plan	Have seen positive public engagement with visually pleasing BMPs. Older demographic may be a challenge
Municipality C	going out and inspecting one by one, inspection on sheets, size and if BMP needs maintenance.Trying to maintain brand new BMPs is challenging as well. Needs new equipment for internal maintenance in the DPW	Still behind on calculating Phosphorus credit but is slowly getting there	Notices that residents don't care about stormwater unless it's there basement is flooded
Municipality D	Trouble with maintenance as many of the BMPs are spread out as well as other departments are in charge of maintenance so they have to remind them and make sure they are funded.	Installment of BMPs and retrofitting reduced very small amount of Phosphorus	Sees public involvement as not as effective as just installing new BMPs.
Municipality E	Shoots for 2.5 catch basins every hour, needs to meet at least 50% filled to receive phosprus credit. Has catch basin truck, but not enough staff or funding to continuously clean basin year round	Still a work in progress to calculating phosphorus, hired consultant to help with that	Resistance toward stormwater fee and notices lack of education in term of stormwater
Municipality F	Cleans about 1/3 of catch basins out of the 4500. Hires a consultant to clean catch basins and have a system where certain areas are clean throughout the year. All the catch basins should be cleaned in 3 years theoretically. However mention challenges with maintenance as they lack the staff and funds to continuously clean all BMPs	Still a work in progress. The newer BMPs have the calculations, but not the old ones.	Little progress on education of stormwater

	Maintenance	Phosphorus Credits	Public Involvement
Municipality G	The highway surveyor is incharge of operations and maintenance and mentions challenges in keeping BMPs maintained as there is a lot of BMPs and needs more manpower	Hired a consultant to do calculations and sampling. However, still in the process of receiving the credit	Some pushback for retrofitting bmps, some public education on radio and tv, no phosphorus fertilizer, reached out to students, some successes but overall a tough topic

Appendix E: Informed Consent for Survey

We are a group of students from Worcester Polytechnic Institute in Massachusetts, and we are working with the Charles River Watershed Association on streamlining the process for receiving MS4 credit. **This survey should take about 5-7 minutes to fill out.**

Your participation is voluntary and appreciated. This project is not related to compliance assessments in any way and your participation in this survey does not put you at any risk. **We will keep the identity of all respondents confidential and your community will remain anonymous in our final report.** If you have additional questions, you may reach out to our faculty advisor Professor Corey Dehner (cdehner@wpi.edu). We are happy to share a copy of our results at the conclusion of our project, and the final report will be available at WPI's Gordon Library.

Appendix F: Survey Questions + Results/Analysis

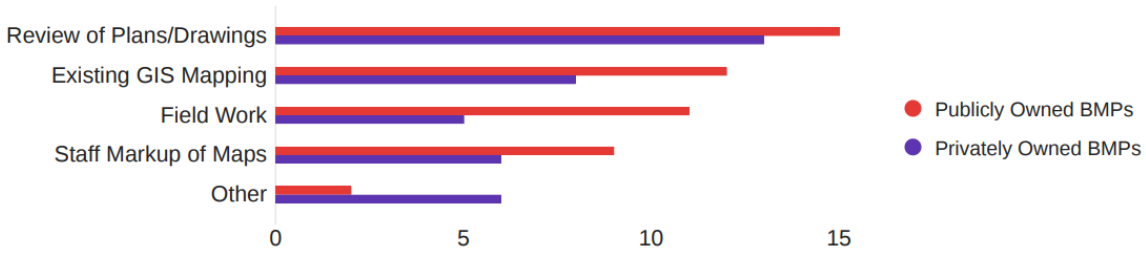
Q1 - Position/Job Title

Position/Job Title
Director of Public Works
Assistant Town Engineer
Environmental Affairs
Stormwater Manager
Town Engineer
director
Senior Civil Engineer
DPW Director
City Engineer
Senior Civil Engineer
Stormwater Program Manager
Assistant Director of Public Works
Compliance Coordinator
City Engineer
Senior Engineer

Q2 - Years in Position

Years in Position
8
10
1.5
1
4.5
17
5 months
31
23
2
1 year 5 months
4
4
8
8

Q3 - How have you located publicly owned BMPs (check all that apply)?

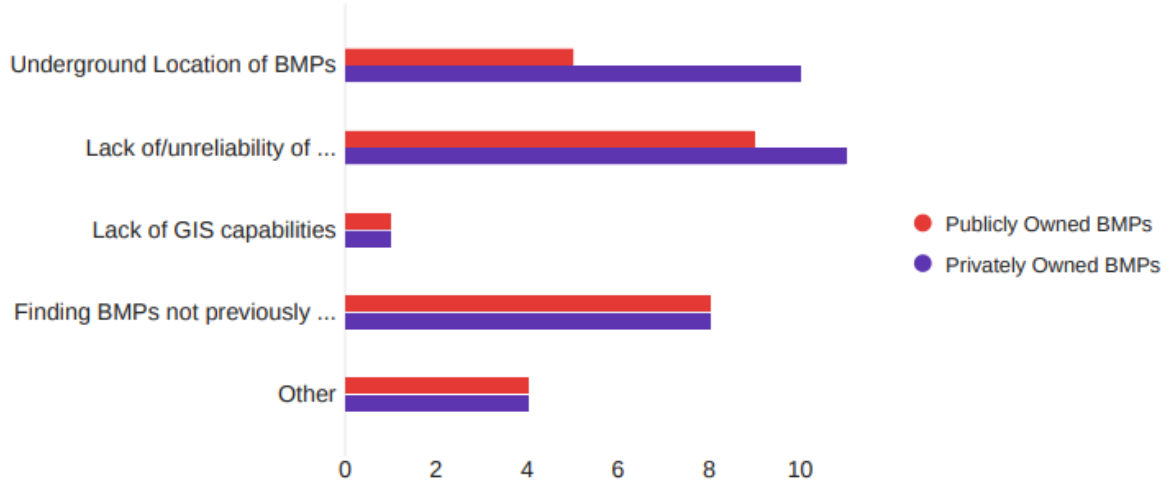


Field	Review of Plans/Drawings	Existing GIS Mapping	Field Work	Staff Markup of Maps	Other	Total
Publicly Owned BMPs	15	12	11	9	2	49
Privately Owned BMPs	13	8	5	6	6	38

Q3 - If you checked other, please explain.

If you checked other, please explain.
Community permits any land disturbance over 2500 square feet with a stormwater permit. This permit records the presence and maintenance requirements for private BMPs.
We are in the process of locating and inspecting privately owned BMPs in the Charles River Watershed.
We have worked directly with commercial/business campuses to determine the type and extent of BMP's that exist on site.
Deed research
Have not located as of this time
Reports from other departments, residents, DOT, etc.

Q4 - If you haven't identified all publicly and privately owned stormwater BMPs, what obstacles, besides staffing, funding and time, prevent you from doing so? (Check all that apply)



Field	Underground Location of BMPs	Lack of/unreliability of plans/drawings	Lack of GIS capabilities	Finding BMPs not previously mapped	Other	Total
Publicly Owned BMPs	5	9	1	8	4	27
Privately Owned BMPs	10	11	1	8	4	34

Q4 - If you checked other, please explain.

If you checked other, please explain.
We have confidence in the accuracy and scope of our BMP ID locations.
NA
We have identified all
Lack of access to privately owned BMPs. If there isn't a drainage easement, we cannot verify the BMP in the field.
Not granted access to private property, lack of access agreements/easements

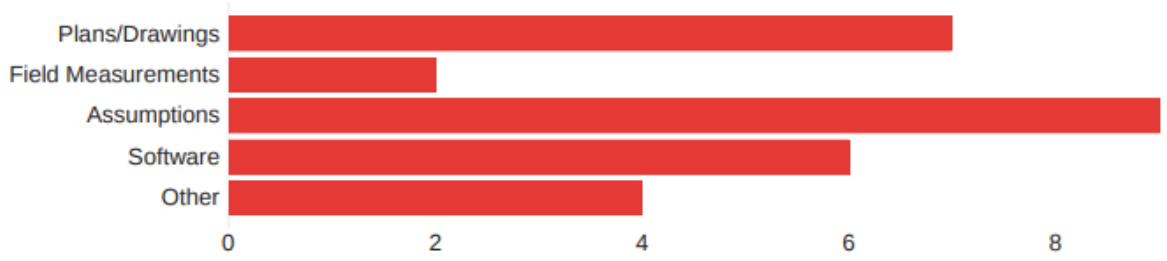
Q5- (Optional) What tip would you share with others to make finding public and private stormwater BMPs easier?

(Optional) What tip would you share with others to make finding public and private stormwater BMPs easier?
Hire passionate employees. Put boots on the ground. Locate during spring / fall when leafy vegetative growth is minimal. Complete outfall testing.
Require as-built drawings that include utilities at the time of closing out planning/conservation/stormwater permitting
Translation of paper/electronic As-built (PDFs) into GIS based record keeping.
get out of office, schedule a time, even if a couple of hours to work on it
Establish and maintain a robust GIS system
We have been very successful in using our summer college interns in finding and mapping BMP's.
If doing field work, do it during the late fall/early spring when vegetation growth is low. Unmaintained BMPs can be almost invisible due to plant growth.
For new and redevelopment projects, make sure the data needed to enter into the BATT tool is collected upfront in a simple, concise way.
Use GPS and digital tools

Q6 - (Optional) What tip would you share with others to make the mapping of stormwater BMPs process easier?

(Optional) What tip would you share with others to make the mapping of stormwater BMPs process easier?
Map Town BMPs and private BMPs on separate layer or with separate color to indicate maintenance responsibilities
If GPS capability available, GPS key structures/connections to drain system for future reference
We utilize PeopleGIS which has forms for BMPs and once located we can use these forms for inspections and maintenance.
Establish and maintain a robust GIS system with asset management software
Electronic submission of as built plans tied into certificate of occupancy.
Look at gis first - it can be surprisingly easy to pick out detention basins in aerials or with contours.
Outsource it to a consultant.
GPS locate when you're out in the field verifying the BMP locations.

Q7 - For stormwater BMPs that are already constructed, what information do you use to calculate the phosphorus reduction achieved by the stormwater BMP? (Check all that apply)

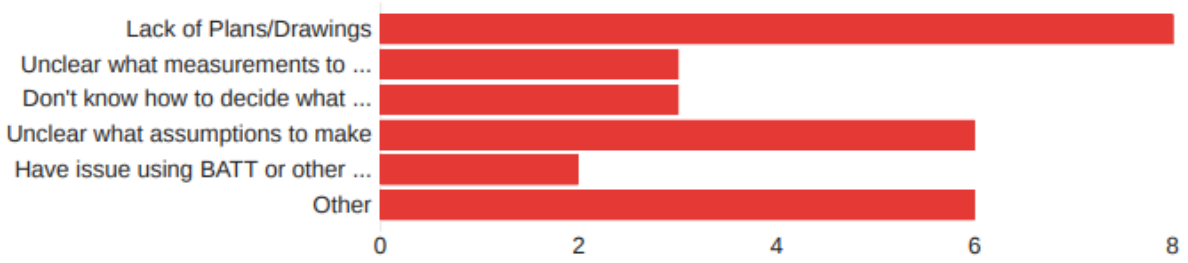


Field	Choice Count
Plans/Drawings	7
Field Measurements	2
Assumptions	9
Software	6
Other	4
Total	28

Q7 - If checked other, please explain.

If checked other, please explain.
Consultant handles this aspect of our plan.
Spreadsheet developed by the designers that show some of the required information for the BATT tool, if available.
Have not started calculations yet. Most structures have not been maintained. Maintenance will be needed before calculations.
Land use data from GIS

Q8 - What obstacles have you faced calculating reductions achieved in accordance with the permit for these already constructed stormwater BMPs? (Check all that apply)



Field	Choice Count
Lack of Plans/Drawings	8
Unclear what measurements to collect in field	3
Don't know how to decide what type of BMP it is	3
Unclear what assumptions to make	6
Have issue using BATT or other software	2
Other	6
Total	28

Q9 - (Optional) Can you provide an example for some of the obstacle you faced and how you overcame it?

(Optional) Can you provide an example for some of the obstacle you faced and how you overcame it?

Currently working through this problem. Obstacles will be encountered in the next couple weeks.

So far, phosphorous removal is solely linked to solids removal and is fundamentally an assumed, non-quantitative value.

We are just getting started with calculating reductions so have very little knowledge of the obstacles. The CRWA webinars actually have added more confusion to the process.

underlying soil conditions impact calculations

Accessing the BMPs for measurements. Many around surrounded by a padlocked fence where no one has the key. Have had to break locks and climb fences. Also find BATT to be a cumbersome program that does not tie in together nicely with our GIS. Also issues accessing privately-owned BMPs.

Most older plans don't include all the information needed for the BATT tool such as the storage volume or infiltration rates. Some don't have Stormwater Reports supporting the plan, which makes it even more challenging to get the information needed for the BATT tool. Also, there aren't clear descriptions of the types of BMPs which makes it difficult to confirm the appropriate selection in the BATT tool. For example, something labeled as a detention basin in the plan, may actually be a retention basin when you confirm it in the field.

Have plans but no as-built or stormwater report. Need to make assumption that BMP was built per plan, need to assume soil conditions if not documented based on knowledge of the area or soil survey--many soils are classified simply as "urban"

Lack of technical data for pollutant reduction efficiencies for proprietary BMPs

Q10 - (Optional) What tips or tricks do you have for the obstacles you faced in calculating reductions?

(Optional) What tips or tricks do you have for the obstacles you faced in calculating reductions?

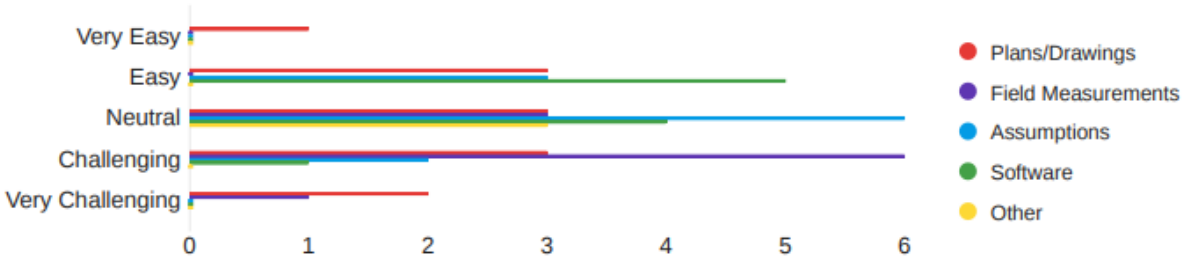
The best way to get the reduction calcs is through the BATT tool. There's no way to measure the reduction in the field with certain BMPs that infiltrate.

we use the state soils maps where information is unavailable

Stay organized.

The BATT tool has a lot of idiosyncrasies and can be difficult to use, but seems to be the best way to calculate the P reductions.

Q11 - How challenging was it to use the following information to calculate phosphorus reduction for existing stormwater BMPs?



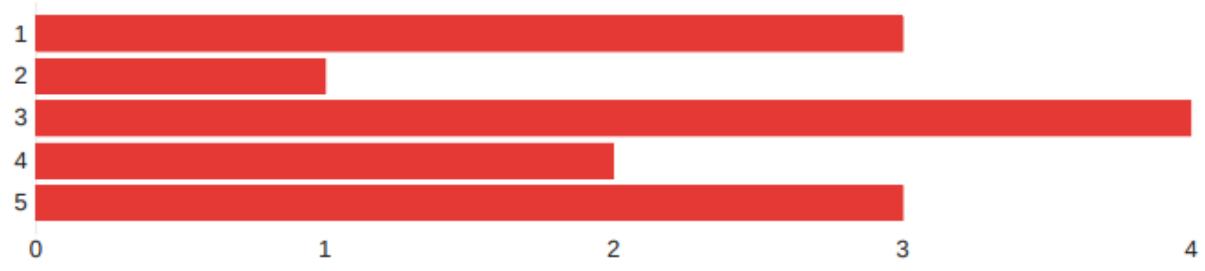
Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Plans/Drawings	1	5	3	1	1	12
Field Measurements	3	5	4	1	0	10
Assumptions	2	4	3	1	0	11
Software	2	4	3	1	0	10
Other	3	3	3	0	0	3

Field	Very Easy	Easy	Neutral	Challenging	Very Challenging	Total
Plans/Drawings	1	3	3	3	2	12
Field Measurements	0	0	3	6	1	10
Assumptions	0	3	6	2	0	11
Software	0	5	4	1	0	10
Other	0	0	3	0	0	3

Q11 - For options you selected as ‘challenging’ or ‘very challenging’, please explain more.

For options you selected as ‘challenging’ or ‘very challenging’, please explain more.
Don't have software for individual BMPs
Some plans/drawings may be different from what was built and may not have been reflected in the as-built. That is why in field measurements are better. Finding the BMPs and measuring is challenging especially on private property.
We are missing many as-built plans and only have permitting-only sets that do not necessarily match what was actually built. Access for field measurements has been an issue to to vegetation growth, private property, and locked fences.
plans and drawings for BMPs do not show any of the information required to be inputted into the BATT tool (drainage area, impervious vs pervious, infiltration rates, volume of BMP).
We do not have a Town Engineer so we don't have anyone to do field measurements. The plans/drawings are only as useful as the detailed information they provide. Software, like the BATT tool, is only useful if you have all the data for each of the fields.
See comments above. Also, older systems may be inaccessible due to not having proper inspection ports, clean-outs etc.

Q12 - From a scale from 1 to 5, 5 being most cost-effective, how cost-effective is it to find, maintain, and calculate credits for older public and private stormwater BMPs built before the Massachusetts Stormwater Handbook adopted in early 2008?



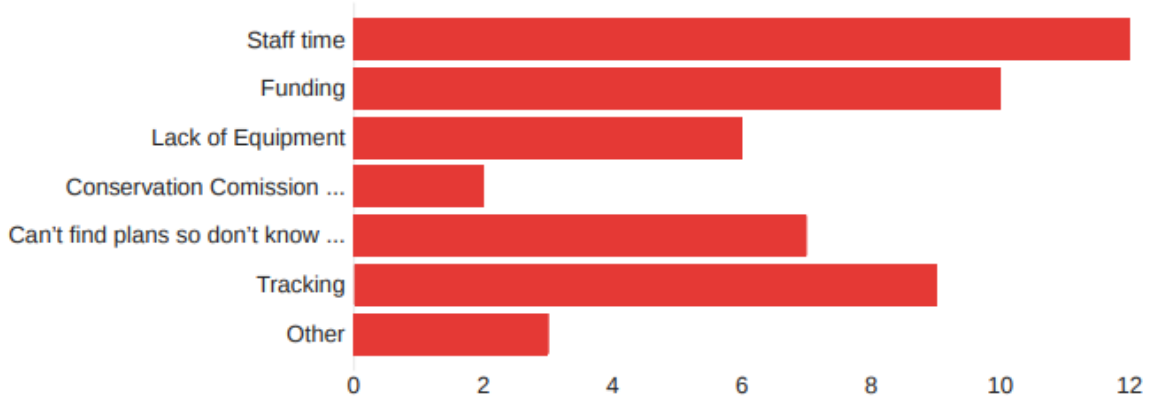
Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Finding BMPs	1.00	5.00	3.08	1.44	2.07	13
Maintaining BMPs	1.00	4.00	2.08	1.07	1.15	13
Calculating Credit for BMPs	1.00	5.00	2.46	1.08	1.17	13

Field	1	2	3	4	5
Finding BMPs	3	1	4	2	3
Maintaining BMPs	5	4	2	2	0
Calculating Credit for BMPs	3	3	6	0	1
Total	11	8	12	4	4

Q12 - Please explain your ranking.

Please explain your ranking.
Currently working on this aspect of our permit.
'Finding' older BMPs (pre MS4) permit would require many man hours. Maintenance is required by O&M Plans and is privately performed, calculating credit based on assumptions is easy but not necessarily accurate
The older the municipal BMP, the less reliable it is and more difficult to maintain or rehabilitate
Maintaining BMPs is extremely expensive, especially when they have deferred maintenance. Calculating the credits takes time and field work, but is do-able. My approach to finding BMPs has been to let it happen serendipitously while doing other field work or record drawing research for other MS4 deliverables - so not too much extra cost.
not sure how to answer this question.
If I didn't have an intern who could look through all the historic plans and identify existing BMPs - we would not be in the position we are in today. If you can't hire an intern or allow an employee to spend dozens of hours uninterrupted to read through hundreds of plans, there is no other cost effective way to find the existing BMPs. Maintaining BMPs once they are brought back to their original design should be fairly inexpensive; however, many of these BMPs haven't been maintained for 20 to 40 years and have significant overgrowth. Restoring these existing BMPs will be a multi-million dollar effort. However, once they're brought back into conformance, the town will be able to capture that phosphorus removal without having to pay for new engineered plans and construction. We estimate that restoring all existing BMPs will help the town reduce its phosphorus load by 10%.
Obtaining credits for already installed systems is the most cost-effective way to meet TMDL requirements, but for private BMPs there is no effective and efficient way to ensure they are being maintained.

Q13 - EPA requires municipalities to maintain BMPs to achieve credit for phosphorus reduction. What are specific obstacles to maintaining public stormwater BMPs?

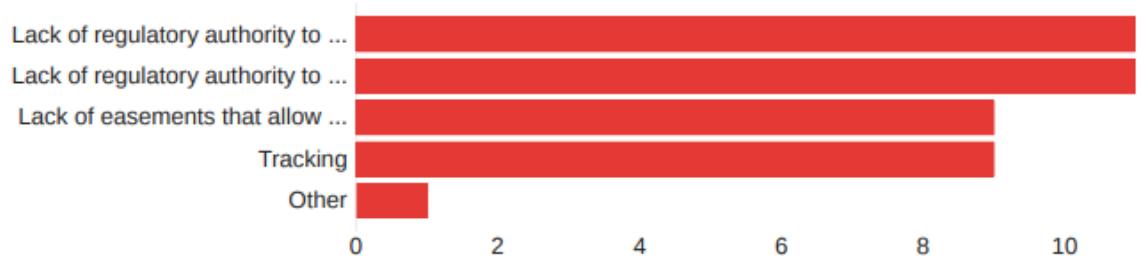


Field	Choice Count
Staff time	12
Funding	10
Lack of Equipment	6
Conservation Comission Rescriction	2
Can't find plans so don't know what original BMPs should be like	7
Tracking	9
Other	3
Total	49

Q13 - If checked other, please explain.

If checked other, please explain.
Staff knowledge of how and why BMPs need to be maintained
staff trained in green infrastructure O&M
Managing privately owned BMPs.

Q14 - What are specific obstacles to ensuring maintenance of private stormwater BMPs? (check all that apply)



Field	Choice Count
Lack of regulatory authority to require maintenance	11
Lack of regulatory authority to enforce against non-maintenance	11
Lack of easements that allow municipalities to maintain.	9
Tracking	9
Other	1
Total	41

Q14- If checked other, please explain.

If checked other, please explain.
Tracking is extremely difficult for this. Some homeowners don't even know they have the BMP on their property.
Lack of knowledge as to why BMPs are important; seen as an aesthetic issue only

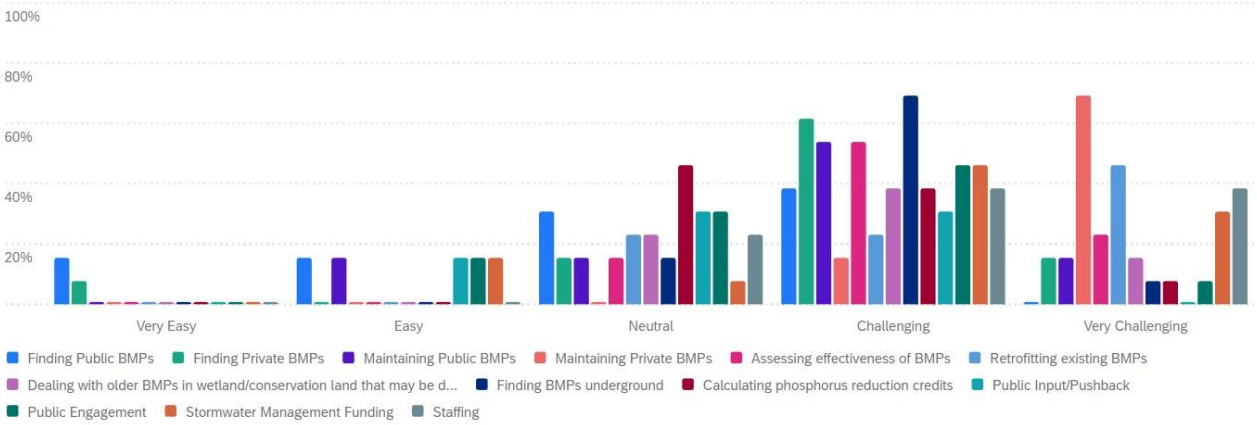
Q15 - (Optional) What tip would you share with others to make the process of maintaining stormwater BMPs easier?

(Optional) What tip would you share with others to make the process of maintaining stormwater BMPs easier?
Public Education
once maintenance is started, set up schedule that works for that BMP
maintain a data base with frequency of maintenance and actions completed
We have a phosphorus TMDL; emphasizing the cost implications of not maintaining the BMPs can be motivating.

Q16 - (Optional) Is there a built date for specific stormwater BMPs which your Conservation Commission will not allow maintenance on? If so please provide a year.

(Optional) Is there a built date for specific stormwater BMPs which your Conservation Commission will not allow maintenance on? If so please provide a year.
no
not applicable
If Definitive Plans were signed after November 18, 1996, our conservation commission allows for maintenance within the BMP and does not require permission through the Conservation Commission.
No

Please rank the following in terms of how much or little of a challenge it poses in your community?



Field	Min	Max	Mean	Standard Deviation	Variance	Responses
Finding Public BMPs	1	4	3	1	1	13
Finding Private BMPs	1	5	4	1	1	13
Maintaining Public BMPs	2	5	4	1	1	13
Maintaining Private BMPs	4	7	5	1	1	13
Assessing effectiveness of BMPs	3	7	4	1	1	13
Retrofitting existing BMPs	3	7	4	1	1	13
Dealing with older BMPs in wetland/conservation land that may be difficult to access	3	7	5	1	2	13
Finding BMPs underground	3	7	4	1	1	13
Calculating phosphorus reduction credits	3	7	4	1	1	13
Public Input/Pushback	2	7	4	2	3	13
Public Engagement	2	5	3	1	1	13
Stormwater Management Funding	2	5	4	1	1	13
Staffing	3	5	4	1	1	13

Field	very Easy	Easy	Neutral	Challenging	very Challenging	Unsure	Total
Finding Public BMPs	2	2	4	5	0	0	13
Finding Private BMPs	1	0	2	8	2	0	13
Maintaining Public BMPs	0	2	2	7	2	0	13
Maintaining Private BMPs	0	0	0	2	9	2	13
Assessing effectiveness of BMPs	0	0	2	7	3	1	13
Retrofitting existing BMPs	0	0	3	3	6	1	13
Dealing with older BMPs in wetland/conservation land that may be difficult to access	0	0	3	5	2	3	13
Finding BMPs underground	0	0	2	9	1	1	13
Calculating phosphorus reduction credits	0	0	6	5	1	1	13
Public Input/Pushback	0	2	4	4	0	3	13
Public Engagement	0	2	4	6	1	0	13
Stormwater Management Funding	0	2	1	6	4	0	13
Staffing	0	0	3	5	5	0	13

Q28 - For a few or all options you selected as ‘challenging’ or ‘very challenging’, can you provide any thoughts?

For a few or all options you selected as ‘challenging’ or ‘very challenging’, can you provide any thoughts?
Assessing effectiveness of BMP's: water storage is simple to asses - phosphorus reduction is not.
The Dept of Public Works is currently tasked with various activities including delivery of potable water, maintaining safety of roadways and collection of sewage, solid waste and recycling. These are all 365 days a year operations. Stormwater has been appended and is now ramping up to requiring testing and monitoring all with no additional funding for staff, equipment, resources or trained personnel. All of the task listed require, staff, equipment and trained personnel. Creating the time to do these tasks is not something that most Departments are able to do in the short period of the permit schedule.
I think you can figure this out.
Getting credits for maintenance on private BMPs is going to be a challenge moving forward. Some homeowners may not know they even have a BMP in their parcel and may not even participate if we require maintenance to be tracked. Some residents don't understand why we need to track these systems so public education and outreach is crucial. Staffing is low with almost every municipality.
Engaging private entities to maintain their facilities is difficult at best because it's never a budget item. Municipal DPW's are strapped for people and BMP maintenance tends to be a low priority item
There is a general lack of knowledge as to why these structures are important, willingness, staff availability, and funding. While we are making some headway, it can be hard to overcome inertia.

Finding existing BMPs is challenging and would have been very challenging if we didn't have an intern help make a huge dent in the workload. Maintaining existing BMPs is challenging for now because of the costs and time needed to bring them back to their original design. Once they are restored, it should be fairly easy to maintain them going forward with an annual mow or cleanout. We will need new equipment to maintain them internally in the DPW and staff time is already a challenge with the current workload. Working with Private BMP owners is very challenging right now because of Staff time needed to reach out to owners and begin collecting the information needed. If owners have not maintained their BMPs this will appear to be an additional unaccounted expense, which will likely cause backlash from those owners. I have NO IDEA how to truly test the effectiveness of the BMP once restored - the only metric I use is the BATT tool and what the EPA claims we remove. Retrofitting existing BMPs isn't an approach we are taking at this time, we are more focused on restoring them to their original design. Conservation restrictions are challenging in that it takes additional regulatory time - however, if you can partner with the Conservation Agent and inform them of what you're trying to accomplish, it can be done. If there are underground BMPs that are not identified on a plan, there is very little chance we are going to find them unless something fails. Calculating BMP credits using the BATT tool is only as good as the date you have to enter. Funding for stormwater management is a challenge in our community because they town is strongly against a stormwater utility at this point. Funding right now is through General Funds and some Capital Funds. Stormwater Management could easily be its own Division of the Department of Public Works with a few people working on administrative items such as reporting and tracking, someone working on outreach and education, someone in the field tracking and maintaining the system, someone maintaining the GIS database, and someone working on project planning, development, and grant writing. Currently, there are two people working on these items and stormwater management is only one aspect of their jobs.

There is no way to know the actual effectiveness of BMPs beyond the credit system in the permit. While the CIty is able to inspect and maintain it's own BMPs, we havent' found an efficient and effective way to track private BMPs. While many projects have O&M plans and we could likely enforce inspection and maintenance, we lack the staffing resources to do so.

Appendix G: Challenges, Successes and Recommendations Matrix

Appendix G-1: Old/Unreliable Plans: Challenges, Successes and Recommendations

Old/Unreliable Plans		
Challenges	**Successes**	**Recommendations**
Unreliable Location of BMPs: Communities noticed that records and plans were often inaccurate, especially if the plan was permitting-only plan ,which may not match what was actually built. Some communities are missing as-built plans, which makes the location of BMP unclear. The records had plans of stormwater controls but when people went out to go find them they noticed they were in a different spot or not built as planned. A few times, town engineers or members from the DPW would have trouble finding old underground BMPs because the plans were not built as seen in plans and no one knew where they were. Looking through older plans may not be an effective way to determine locations of BMPs**.**	**Doing Fieldwork and Surveying Land:** Towns that have identified all BMPs, including public and private, found that having a strong GIS system and doing fieldwork allowed them to locate all BMPs and map where they are rather than just depending on plans. One community specifically that has identified and tracked all public and private BMPs by setting hours outside of the office to complete the necessary field work and maintain a robust GIS system. (Note: Very strong GIS, which allows for the department to utilize an IPad to insert data and pictures while on site) A few communities suggested locating during late fall or early spring when vegetation is minimum.	**Stay Organize and Digitize Plans** If older plans are accurate and have necessary information such as retention area and impervious vs pervious area. digitalizing these plans into the GIS system, or other organization strategies, will help keep everything organized and easy to access.
Missing Necessary Information for Phosphorus Calculations: Communities that utilizes older plans to calculate phosphorus have a challenge utilizing plans because some plans may not be reliable and may not have the necessary information to calculate the phosphorus (drainage area, impervious vs pervious, infiltration rates, volume of BMP), or was not built as the plan is laid out. Although developers are required to have this information in as-builts, you need to make the assumptions drawings are accurate. This is especially true for plans that do not have a stormwater report that supports the plan, which makes it difficult for confirming appropriate selection in the BATT tool.		**Hire a Consultant** that can do a Gap Analysis for any missing information For plans that have any missing information, hiring a consultant to do gap analysis to find that information will make entering information into the BATT tool easier and older plans more accurate.

Old/Unreliable Plans		
Challenges	**Successes**	**Recommendations**
Finding Older Plans: Many communities found old plans to be more unreliable and some communities experienced difficulties finding older records. Some plans were more than thirty years old, and the BMPs had not been checked on or maintained since they were built. Fixing these records, digitizing and digging up old BMPs records proved to be tedious and frustrating for the communities who attempted it. Some communities digitize these plans and have them stored in online files, however some communities that are still catching up with stormwater management have older paper records, stored away in boxes, which in some cases, may be missing. Some communities depend solely on plants as they don't have the necessary personnel to do field measurements.		**Require Electronic As-Built Drawings for Future BMP**s To avoid any future plans with missing information and the possibility of losing drawings, requiring as-built electrical drawings for future implication and redevelopment will make organizing plans and calculating phosphorus easier.

Appendix G-2: Communication: Challenges, Successes and Recommendations

Communication		
Challenges	**Successes**	**Recommendations**
Communication Between Departments: Some communities saw a lack of communication between the communities departments (DPW, engineers, public health and conservation) For example, one community found that the DPW could install BMPs without notifying the town engineers, which did not allow engineers to probably track and insert BMP into GIS system. Some communities depend on the DPW to do the maintenance and have to remind the DPW for maintenance. Those communities found there was no process on checking if maintenance was done and solely based on trust that it was done.	**Stormwater Coalition:** Communities in a stormwater coalition were able to communicate their challenges and successes. Specifically, most communities within one of the coalitions in Massachusetts do not have a TMDL for a large body of water such as a river, however few of the communities do. The communities without the TMDL are looking forward to what the communities in the Charles River Watershed are planning to address the TMDL and their actions will help other communities in the future with stormwater management.	**Join a stormwater coalition:**Join and actively participate in a stormwater coalition. This will help communities communicate their successes and challenges. Communities can learn from each other. Stormwater coalitions can also help give communities additional resources. In addition the Statewide Coalition meetings provide good information.
Communication Between Town and Private Owners: Many communities found that there was a lack of communication between the town engineers and owners of private BMPs. The lack of communication comes from ensuring that private property owners are meeting all the stormwater requirements, keeping up with maintenance of their BMPs and ensuring the BMPs are still effective. Communities that have ordinances and checklists in place to ensure operation and maintenance find that the level of in-person communication and inspection is very limited mainly due to staff time.		**Persuade MassDEP to Provide More Communication to Communities.** This is a way for the community to gain access to information about how to register for state stormwater email lists, how to attend stormwater coalition meetings, and other stormwater management tips. Would be a great way for regulators to work closer with communities and inform communities about what is being done to address stormwater. The need for conversation will help move this problem forward.

Communication		
Challenges	**Successes**	**Recommendations**
Communication between communities: Communities in general do not communicate their challenges and successes to each other. Many communities are struggling with problems that other communities have found a solution for. Communities are not always aware of these solutions and are not able to help each other due to limited time.		
Communication between communities: Communities in general do not communicate their challenges and successes to each other. Many communities are struggling with problems that other communities have found a solution for. Communities are not always aware of these solutions and are not able to help each other due to limited time.		

Appendix G-3: Mapping: Challenges, Successes and Recommendations

Mapping		
Challenges	**Successes**	**Recommendations**
Underground BMPs: Mapping underground BMPs is a challenge for many communities because they are harder to find within plans and are not always reliable for underground BMPs. If drawings are missing, finding the underground BMP could be very difficult.	**Software Solutions:** Communities using advanced software that can map all BMP locations as well as GI Infrastructure allows communities to find mapping to be a non-issue. Most communities have GIS software, however some only had the outfalls information and did not have individual BUMPs tracked. Programs such as sedaru fieldforce are strong for its user friendly capabilities and portable, as you can bring an ipad to insert any data or notes while surveying BMPs	**Utilizing Consultant or Intern** Stormwater management can be overwhelming, but utilizing a consultant or intern will save time and money as well as minimize tedious work.
Finding BMPs that were not Previously Mapped Communities sometimes run into the issue of finding a BMP because it was not previously mapped in the GIS system. One community found that another department built a new catch basin and did not mention it to the department in charge of mapping into the GIS system. Some communities might have not considered if the structure was a BMP or not. Some communities stated that some BMPs were overgrown to the point where it did not seem like BMP, however it was.	**Utilizing Interns** Some communities who utilized summer interns were able to get a lot of the tedious work done with mapping done within one summer.	**Differentiate Town BMPs and Private BMPs** Map private and public BMPs in separate layers or with separate color in the GIS system, which could indicate maintenance responsibilities.
		GPS locate BMPs and Key Structure to Drain Systems GPS locate when out doing fieldwork to verify BMPs locations, as well as establish key structures and connections to drain systems for future reference.

Appendix G-4: Privately Owned BMPs: Challenges, Successes and Recommendations

Privately Owned BMPs		
Challenges	**Successes**	**Recommendations**
Challenges with Mapping and Maintenance: Most communities find mapping and maintaining privately owned BMPs to be a challenge due to communication with property owners ensuring maintenance, lack of easement/agreements, and unreliable plans/records.	**Development of Stormwater Ordinance:** Towns that have, or in process of developing stormwater ordinance, will require certain private property owners with a certain amount of impervious surface to send in their O & M, which can be helpful in the phosphorus calculations. In the survey, a lot of communities stated the difficulty to maintain and track BMPs. Communities with college campuses, who are larger stormwater pollutants, can benefit from having stormwater ordinances. Having an audience that has a process for maintenance of BMPs will allow the community to receive the necessary credits for phosphorus.	**Develop a Stormwater Ordinance** Require private property owners with a certain amount of impervious surface to send in their O & M and do yearly inspections to ensure maintenance is being kept up with**.**
Granting Access/Easements: Many communities have trouble granting access to private BMPs because there isn't any easement/agreement in place to allow for maintenance and inspection. Going through the process of having an agreement can be difficult, especially if the homeowner does not allow access to BMP or is unaware that they own the BMP.	**Easement/Agreements:** Communities that have easements allowed maintenance from the DPW in privately owned BMPs, which made identifying BMPs easier and allowed for maintenance to occur, which will allow for phosphorus to be calculated. For example, as mentioned above, one town had an easement in a HOA, which allowed the DWP to perform maintenance in a retention area that is technically the HOA responsibility to maintain. This allowed for the correct maintenance to be done, which prevented flooding from occurring.	**Establish Easement** Although there are a lot of obstacles to establishing easements such as legal restrictions and resistance, this can be crucial for communities that need to depend on private property to meet their TMDLs.

Privately Owned BMPs		
Challenges	**Successes**	**Recommendations**
Communication Between Department and Community: Communities found communication to be an obstacle present when dealing with private contractors and private property owners keeping up with their maintenance. Some communities that have ordinance and checklists in place to ensure operation and maintenance find that the level of in-person communication and inspection is very limited mainly due to staff time.		

Appendix G-5: Phosphorus Calculations: Challenges, Successes and Recommendations

Phosphorus Calculations		
Challenges	**Successes**	**Recommendations**
Various Challenges: Most towns that we interviewed are in various stages in the process of calculating the amount of phosphorus reduction that the MS4 Permit requires.	**Keeping Record and Track of Maintenance** One of the requirements to receive credit is to show efforts in O&M. Communities who kept track of maintenance allowed them to start the credit calculations. Developing schedules, staying organized and keeping track of all O & M completed and how frequently it is done are some of the tips the community shared with us during surveys and interviews.	**BATT Training** There are resources provided by the CRWA on how to calculate phosphorus and utilize the BATT tool. The US EPA should host some training to help these communities utilize the BATT to**ol.**
Disconnect Between Communities and Regulators Phosphorus calculations are only done through calculating the amount and type of BMP, not actual field measurements of phosphorus reduction. Some communities question if their phosphorus reduction calculations are actually representative of what their communities BMPs are actually reducing. Seems like there is some sort of disconnect between regulators and communities.		**Keep Record and Track of Maintenance** Develop schedules, stay organized and keep track of all O & M completed and how frequently it is done are some of the tips the community shared with us during surveys and interviews.
Overwhelmed by the Amount of Phosphorus Required to Reduced: One community that used the BATT tool to calculate phosphorus found that the amount of phosphorus removed for the installment of 25 BMPs was very small, which made the phosphorus reduction requirement seem impossible for the community. Another community has very limited land space as well as a large TMDL and will need to depend on private BMPs to reduce the phosphorus, which is a challenge in itself.		**What Data to Collect in Field Measurements:** Drainage area, impervious vs pervious, infiltration rates, volume of BMP and verifying type of BMPs are some of the data that could be collected with fieldwork.

Phosphorus Calculations		
Challenges	**Successes**	**Recommendations**
Still are in the Process of Identifying, Mapping, or Maintenance of BMPs Some communities are still in the process of identifying and maintaining existing structural BMPs. This restricts them from receiving phosphorus reduction credits as their needs to be proof of O & M and mapping and without it, communities can meet the TMDLs requirements.		**Hire a Consultant:** Having a consultant in charge of phosphorus credit can help jumpstart the community with calculations and save valuable time.
Trouble with the BATT tool Some communities found the BATT tool to be confusing and very complex. One community had to make lots of assumptions because the town does not have a town engineer to be able to get some field measurements necessary for the calculations. Some assumptions that had to be made included underlying soil conditions, land use data and that the plans are accurate. Plans should include drainage area, impervious vs pervious, infiltration rates, volume of BMP, which are all necessities for the BATT tool. This information are likely to be missing in older plans.		
Field Measurements Field measurements are difficult for communities for a variety of reasons. Some communities do not have a town engineer in order to do the fieldwork and gap analysis to see what is missing on plans. A Lot of communities find that lack of access to private BMPs restricted communities from doing field measurements, as one community state found that some BMPs are surrounded by a fence and padlock. Some communities hire consultants to do fieldwork and calculation for the community, but the same challenges can occur with the consultants.		

Appendix G-6: Operations and Maintenance: Challenges, Successes and Recommendations

Operations and Maintenance		
Challenges	**Successes**	**Recommendations**
Overground BMPs Bumps that are overgrown and full of vegetation are a lot more difficult to maintain than newer BMPs. In Order to maintain the overgrown BMP, this will take a lot of staff, time and funding in order to clear tree debris, dead plants and trash. At the end of the maintenance, the cost to maintain may not be worth the amount of phosphorus that can be reduced. One community had a retention pond that was not maintained for over 30 years and lacked the staff and time to clear the BMPs and make it effective once more. However, they stated that smaller BMPs such as the catch basin, could clean out revelation quicker than this larger project.	**Consultant/Contractors:** Having Consultants and Contractors for Operation and Maintenance helps communities by offloading tedious fieldwork such as BMP cleaning to specialized workers. This assisted towns with lesser amounts of stormwater employees, and with a relatively lower cost than hiring new personnel. Some communities were able to clean the catch basin effectively by rotating which catch basins are cleaned during the year. Having the contractor doing it also saved the DPW from the need for investing in equipment.	**Utilize Contractors/Consultants:** For towns with smaller size Stormwater sections and lesser staff, contractors and consultants can greatly assist the town's stormwater infrastructure and phosphorus control plans as a greater alternative to offload field work to specialists.
The Need for More Staff and Equipment for O&M: Most communities stated the need for having more staff. labor and equipment to keep up with maintenance as many communities notice the large amount of BMPs in the communities and not enough staff, time and equipment to keep up with maintenance for every single one. A few communities hired contractors, for example, to clean catch basins, which can be used to distribute the work, but hiring contractors can be expensive.	**Agreement Between Departments and Conservation Commission** Some communities stated that understanding the importance of stormwater runoff will allow two departments to work out a plan. One community has a specific built date that will allow maintenance of BMP in wetlands if built after a certain date. Other communities also stated that working with the conservation commission is often not a problem and more of a collaborative effort as the conservation commission understands the issue of stormwater runoff. There was one community that we talked to wanted the town engineers to design stormwater measures to prevent pollution into wetlands.	**Staff Training and Education:** Educating the staff about stormwater runoff, such as a one hour presentation, will help staff understand why they are doing the work they are doing. Our team found that many people do not understand why it is important to mitigate stormwater, and educating the staff about the importance of maintaining BMPs can help move this problem forward.

Operations and Maintenance		
Challenges	**Successes**	**Recommendations**
Wetlands/Conservation: Some communities had trouble maintaining older BMPs in locations near or within wetlands because that land is protected under most conservation commissions. One community specifically is allowed to do maintenance on a BMP in wetlands built after a certain date.		**Conduct a Cost-Benefit Analysis for Older BMPs** BMPs that are overgrown or old could not be effective anymore. Analyzing whether maintaining the BMPs is worth the amount of phosphorus credit can save time and money.
HOA / Privately Owned Companies: Understanding who has the responsibility of maintaining the BMP's, whether it is an HOA maintaining them, or an easement for the DPW to maintain the BMP. One community needed to have an easement in place with the HOA to allow maintenance of a retention pond, as technically, it was the responsibility of the HOA to do maintenance. However, it was not being maintained the way it should have been due to the lack of expertise from HOA volunteers.		
Lack of Staff Education and Awareness In our survey, some communities stated the need for more stormwater education internally. Educating the staff on why it is important to keep up with maintenance and how to do it correctly is a challenge as communities find that there's a lack of expertise within the staff on green infrastructure and the importance of mitigating stormwater runoff.		

Appendix G-7: Public Involvement: Challenges, Successes and Recommendations

Public Involvement		
Challenges	**Successes**	**Recommendations**
Lack of Public Education: There is a lack of public education in all of the communities, which is preventing support for stormwater projects and obstacles towards stormwater funding (stormwater fees and general town funds competing) .	**Involving Neighborhood Residents**: One community found that members of the community were more enthusiastic about stormwater with the proper education and allowing them to get involved. This community involved members of a neighborhood to choose the plants going in the rain garden on their street. These community members were excited and promised to keep up with maintenance.	**Keep Community Members Informed**: Schedule community plantings. This could be an educational tool for students or a community service opportunity. Involve residents when creating BMPs in their neighborhood.
Lack of Support for Stormwater Fee: Each community that currently has a stormwater fee or is in the process of implementing one, saw resistance from the public due to the disapproval of the added expense and lack of understanding the importance of stormwater management.	**New BMPs in Public Areas:** A Few towns have built new BMPs in public areas like near schools or in parks, providing a great opportunity to educate the public on stormwater management. Some communities that implemented BMPs on school grounds allowed for stormwater education to be brought into light in lower/middle school levels. It is important that the next generation that is solving the stormwater problem is exposed to it early to understand the importance of mitigating stormwater.	**Put up signs**: BMPs in public areas are a good way to educate community members about stormwater management so put signs up to explain what the BMPs do and how to keep them clean. Develop understanding that BMPs are for stormwater rather than just aesthetics

Appendix H: Infographic for Municipalities on Pollution Reduction Credits (or final deliverable: Assessing Pollution Reduction Credits).

Assessing Pollution Reduction Credits

Aaron Searth, Maeve Sousa, Evan Wu

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Charles River Watershed Association

Abstract

Pursuant to the MS4 permit, communities must reduce phosphorus from stormwater runoff by a prescribed amount. This process can be challenging. In collaboration with the Charles River Watershed Association, we conducted interviews, site visits and distributed a survey to understand the challenges communities face in assessing phosphorus reduction. Using this data, we developed recommendations to help communities in the Charles River Watershed streamline the process of receiving phosphorus reduction credit for existing structural BMPs. Our final recommendations took the form of a 6 page information sheet , which highlighted different approaches that can help communities be successful in phosphorus reduction.

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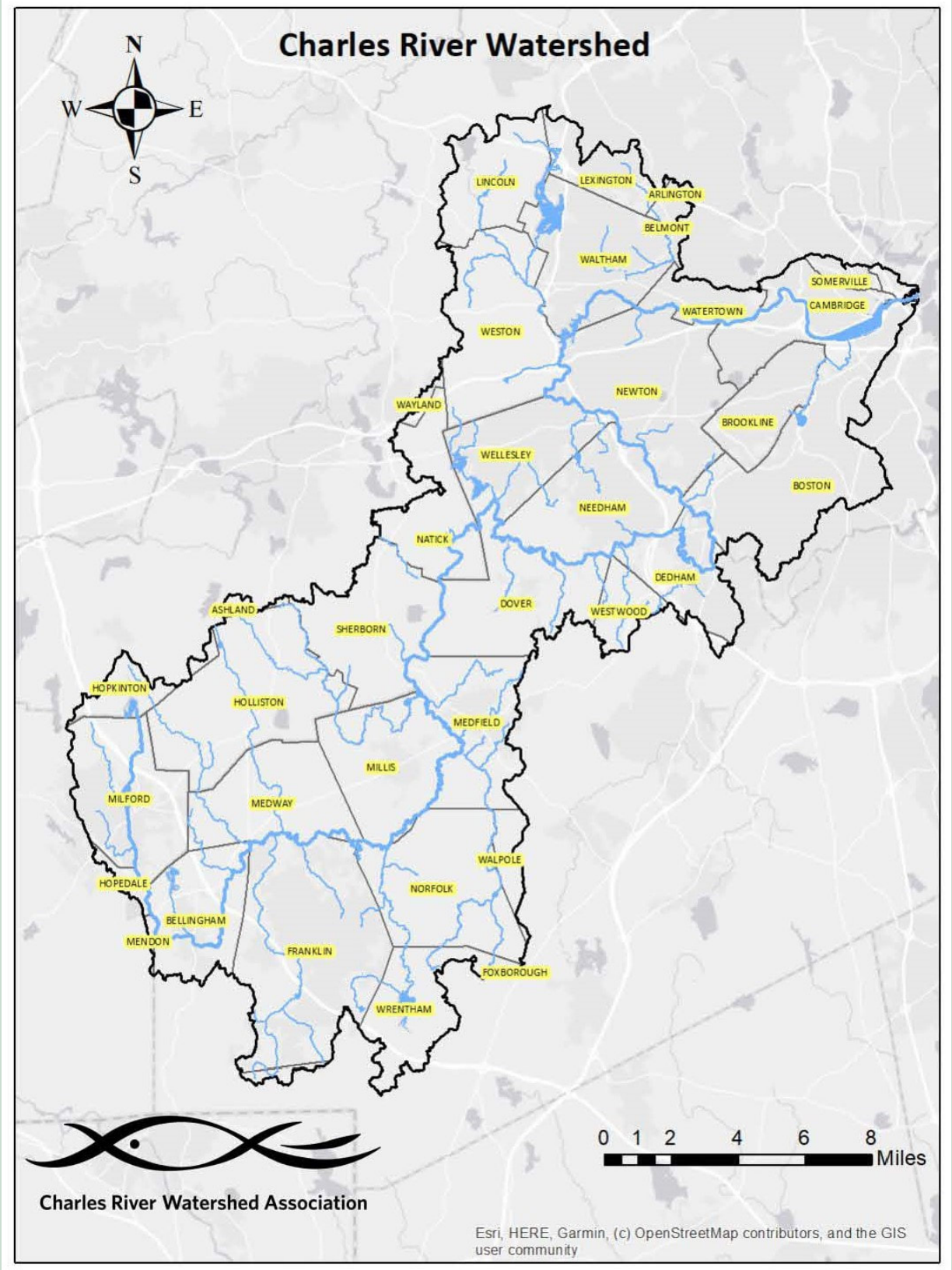
Assessing Pollution Reduction Credits



To see the full report, please use the link below to be redirected to our teams website.

(link)

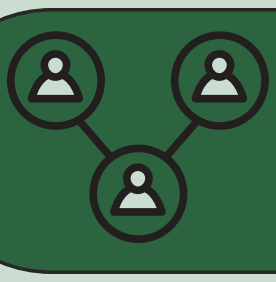
PHOSPHOROUS CALCUATIONS 1

Most communities interviewed are in various stages of calculating their phosphorus reduction.

Communites ranked these phosphorus calculations tools from the most challenging to the least challenging,

1. ***Plans/Drawing***
2. ***Field Measurements***
3. ***Assumptions***
4. ***Software***

Challenge 1: Still in the Process of Identifying, Mapping, or Maintenance of BMPs: *Some communities are still in the process of identifying and maintaining existing structural BMPs, preventing them from credit calculations for those locations.*



Challenge 2: Disconnect Between Communities and Regulators: *Some communities question if their phosphorus reduction calculations are actually representative of what their communities' BMPs are actually reducing.*

Challenge 3: Trouble with the BATT Tool : *Some communities found the BATT tool to be confusing. Challenges include unclear assumptions such as soil conditions and the assumption that plans are accurate.*

Challenge 4: Field Measurements are Difficult for Communities for a Variety of Reasons: *Challenges include lack of staff to perform fieldwork, and access to private BMPs for maintenance and inspection.*

What has been Successful?

Keeping Record of Maintenance: *One of the requirements to receive credit is to show annual O&M. Communities who kept track of maintenance by utilizing spreadsheets allowed them to start the credit calculations. One community uses PeopleGIS, which integrates inspection and maintenance data in GIS system*

Future Plans Requirements *Require projects that undergo local permitting to submit phosphorus reduction calculations, pre and post new and redevelopment or at the very least, require clear and concise information for the BATT tool.*

Stormwater Utility Fee *Communities that have stormwater fees require O&M plans in order to receive a reduction credit of the fee.*

Hiring a Consultant: *Some communities utilize consultants to handle the phosphorus credit calculations, which allow for communities to focus on other aspects of stormwater management.*

Recommendations:

Keep Record and Track of Maintenance *Develop schedules to stay organized and keep track of all O&M completed and how frequently it is done. Some communities track maintenance and inspection into their GIS system, and other communities use spreadsheets and one drive folders to keep track of maintenance.*

Utilize the BATT Tool *Although communities have some challenges, the BATT tool is approved by EPA to calculate phosphorus credit. CRWA provides training and the US EPA has guidelines regarding the BATT tools.*

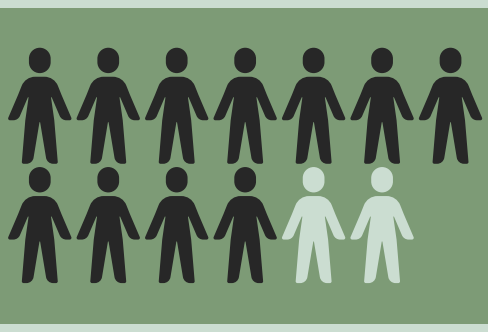
Data to Collect in Field Measurements: *Drainage area, impervious vs pervious, infiltration rates, volume of BMP and verifying type of BMPs are some of the data that could be collected with fieldwork.*

Hire a Consultant: *Having a consultant in charge of phosphorus credit can help jumpstart the community with calculations and save valuable time.*

PRIVATELY OWNED BMPS 2

Most communities find mapping and maintaining privately owned BMP's to be a challenge. ***Establishing regulations and easements is necessary for maintaining private BMPs.***

11 out of 13 survey respondents lack regulation for maintenance of private BMPs. 9 out of 13 lacked easements for maintenance.



Challenge 1: Obtaining Access/Easements: *Many communities have trouble receiving access to private BMPs for inspection and/or maintenance and the process of having an agreement can be difficult.*

Challenge 2: Communication Between Department and Community: *Communities found communication to be an obstacle when dealing with private contractors and property owners keeping up with their maintenance. Lack of staff time limits in-person communication and inspection.*

Challenges 3: Mapping Privately Owned BMPs: *This is challenge to communities due to lack of communication and proper connection between the town and private contractors and owners specifically with plans.*

What has been Succesful?

Stormwater Ordinance/Bylaw and Regulations: *Some communities that have, or are in the process of updating, a stormwater ordinance, require private property owners that have undergone the permit process to submit their O&M annually or more often. This be helpful in locating final BMPs, confirming maintenance, and completing the phosphorus calculations.*

Easement/Agreement to Maintenance: *Communities that have easements in privately owned BMPs found that this allows for maintenance and credit calculations. Some communities found that a selling point for some private owners was having the town maintain BMPs on their property, which overall could improve the aesthetic of the property without the owner having to do any work.*

Recommendations

Include specific requirements in local Stormwater Ordinance/Bylaw and/or Regulations: *Require projects that undergo local permitting to submit their O&M plan and complete yearly inspections to ensure proper and timely maintenance.*

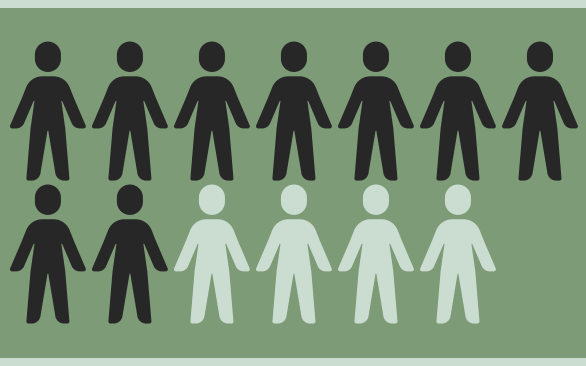
Establish Easements: *Although there are a lot of obstacles to establishing easements, such as legal restrictions and resistance, this can be crucial for communities that need to depend on private property to meet their TMDLs.*

Watch MS4 Permit sessions regarding private BMPs: *The Charles River Watershed Association held a workshop, which had lots of tips and tricks that describes calculations of privately-owned stormwater BMPs and how communities can ensure maintenance.*

OPERATION AND MAINTENENCE 3

Operation and Maintenance of BMPs has been a challenge for every community, however the challenges varied.

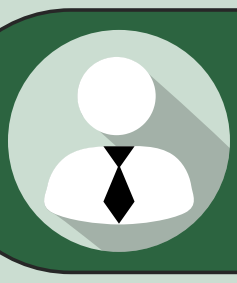
10 out of the 13 survey respondents stated that staff time and funding was the biggest obstacles when maintaining public BMPs.



Challenge 1: Need for More Staff and Equipment for O&M *: Most communities report needing more staff and equipment to keep up with maintenance of all BMPs in their communities.*

Challenge 2: Privately Owned BMPs/HOA: *Understanding who has the responsibility of maintaining the BMP's (HOA, easement for community maintenance, or private owner can be difficult*

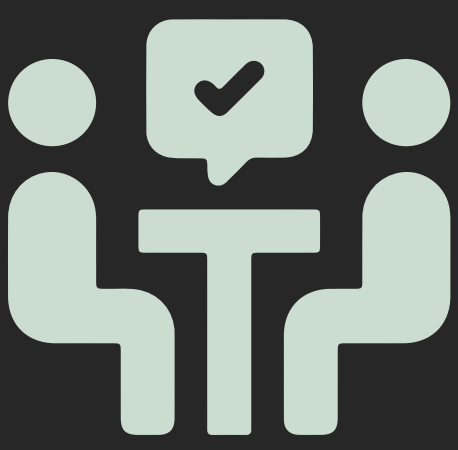
Challenge 3: Overgrown BMPs: *BMPs that are overgrown and full of vegetation are a lot more difficult to maintain than newer BMPs, requiring more staff, time and funding.*



Challenge 4: Lack of Expertise: *Some communities report insignificant training within staff on stormwater management, which creates challenges in proper and timely O&M*

What has been Successful?

Consultant/Contractors: *Having consultants and contractors for operation and maintenance helped communities by offloading tedious fieldwork such as catch basin cleaning, which communities utilize bidding annually for funding. This assisted towns with lesser amounts of stormwater employees, and with a relatively lower cost than hiring new personnel and equipment.*



Agreement Between Departments and Conservation Commission: *Some communities stated that understanding the importance of stormwater runoff will allow two departments to work out a plan for operations and maintenance.*

Recommendations

Outsource to Consultant/Contractors: *Good option if the community is lacking the necessary equipment or staff to keep up with maintenance.*

Staff Training and Education : *Requiring staff training to attend training/discussion on stormwater runoff, its challenges and benefits of stormwater management could increase appreciation and teamwork on proper O&M. The CRWA and MassDEP have training/workshop sessions that can be helpful for staff to attend.*

Conduct a Cost-Benefit Analysis for Older BMPs: *BMPs that are overgrown or old may not be effective anymore. Analyzing whether maintaining the BMPs is worth the amount of phosphorus credit can save time and money. Some communities were able to determine how much it would cost to reduce a certain amount of phosphorus, which allowed them to prioritize which BMPs need maintenance.*

PUBLIC INVOLVMENT 4

There is a lack of public education in communities. ***Increasing public involvement and awareness could help with your stormwater management.***

7 out of 13 survey respondents found public engagement to be challenging

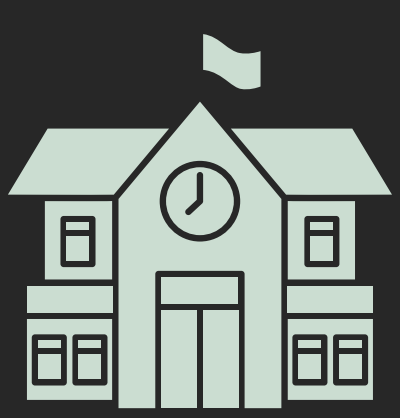
Challenge 1: Overall Lack of Stormwater Awareness and Education: *Many community members are unaware of the importance of mitigating stormwater runoff.*

Challenge 2: Resistance Towards Funding: *Many community members are resistant to having to pay a stormwater utility fee Other communities use a small percentage of their general budget towards stormwater mitigation*

What has been Succesful?

Involving Residents: *One community found higher engagement and enthusiasm,residents get to choose what plants go in the rain garden on their street.*

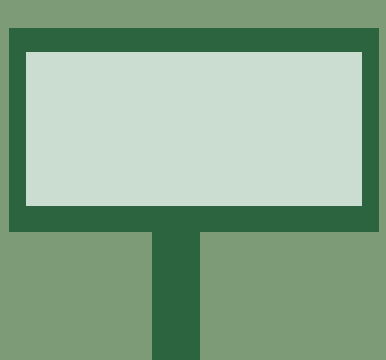
Adding Educational Value to Public BMPs: *Some communities have built new BMPs in public areas (schools, parks, libraries), providing a great opportunity to educate the public on stormwater management.*



Recommendations

Involve community members: *Schedule community plantings and involve residents, garden clubs, and students to increase engagement and support. This could be an educational tool for students or a community service opportunity.*

Utilize Educational Signs: *BMPs in public areas is a good way to educate community members about stormwater. Put up signage to explain what BMPs are, their benefit to the community and how to keep them clean.*

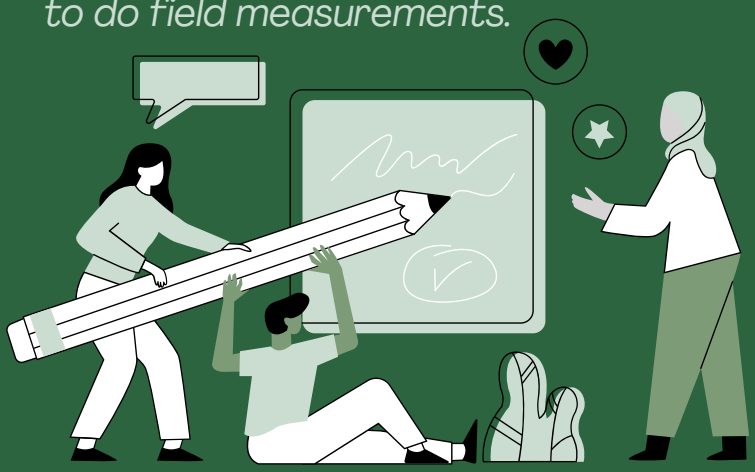


OLD/UNRELIABLE PLANS AND MAPPING 5

Challenges may occur when utilizing older plans/drawing to calculate phosphorus, as well as mapping BMPs.

Challenges

1. ***Unreliable Location of BMPs***: *Many plans were inaccurate (e.g., permitting-only plans did not reflect actual built BMPs).*
2. ***Missing Plans:*** *All communities have some missing plans (especially older plans that were not digitized) or paper plans lost in files.*
3. ***Dependence on Plans***: *Some communities depend solely on plans, as they dont have the necessary personnel to do field measurements.*



4. Missing Necessary Information on Plans: *Communities utilizing plans to calculate phosphorus find some plans unreliable and missing necessary information to calculate the phosphorus (drainage area, impervious vs pervious, infiltration rates, volume of BMP).*

5. Underground BMPs: *Mapping underground BMPs is a challenge for many communities because they are harder to find in the field and plans are not always reliable for underground BMPs. If drawings are missing, finding the underground BMP could be very difficult.*

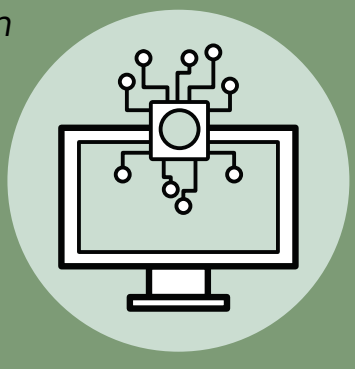
6. ***Unmapped BMPs:*** *Communities sometimes find BMPs that were not previously mapped in their GIS system. Some unmapped BMPs were overgrown and became unrecognizable as a BMP.*

What has been Successful?

Fieldwork/Surveying Land: *Communities that have identified all BMPs, including public and private, found that having a strong GIS system and doing fieldwork allowed them to locate all BMPs and map where they are rather than just depending on plans.*

Establishing and Maintaining Robust GIS System: *Communities with a strong GIS system with asset management software, such as PeopleGIS, allowed for future stormwater management to be more streamlined, by integrating maintenance and inspection in GIS system. Sedaru Fieldforce is a good program for on-site data collection as it has strong IPad capabilities.*

Digitize Plans: *If older plans are accurate and have necessary information for calculating phosphorus, digitalizing these plans into a GIS system, or other organization strategies, will help keep everything organized and easy to access. Some communities had successes with utilizing interns to do bulk scans and organization*



Do a Gap Analysis: *For plans that have any missing information, hiring a consultant to do gap analysis to find that information will make entering information into the BATT tool easier such as inflation rate and soil conditions.*

Recommendations

Require Electronic As-Builts Drawings for Future BMPs: *To avoid missing information with future plans and the possibility of losing drawings, communities should require as-built electronic drawings for future implication of BMPs. This will make filing and organizing plans easier.*

Utilize Interns: *Some communities who utilized summer interns were able to get a lot of the tedious work done with mapping, scanning plans and other work that was completed within even one summer.*

For unreliable locations based on plans: *complete physical field work to find BMPs. Develop a strategy for data collection in advance. Communities recommended tracking during early spring or late fall when vegetation is at a minimum*

For BMPs identified to have missing plans, but location is known: *we would recommend that the department first assess if BMP needs maintenance. Once you've assessed if maintenance is needed, take field measurements by utilizing a survey crew or consultant that can help receive the necessary data.*

For BMPs missing necessary information, but location is known and plans are representative: *Utilize data such as state soil maps if soil conditions are unknown and collect data such as drainage area, impervious vs pervious, infiltration rates, volume of BMP, outfalls testing and type of BMPs.*

COMMUNICATION 6

Small- and large-scale communication is difficult for many communities.

Communities without the TMDLs are looking forward to what the communities in the Charles River Watershed are planning to address the TMDL and ***their actions will help other communities in the future with stormwater management.***

Challenge 1: Communication Between Departments*: Some communities experience a lack of communication between the local departments, specifically with maintenance.*

Challenge 2: Communication Between Town and Private Owners: *Many communities report a lack of communication between town staff and private BMP owners resulting in lack of information on maintenance, efficiency, and total reduction of pollutants from private BMPs*

Challenge 3: Communication between communities*: Communities generally do not widely share their challenges and successes with one another. Some communities are unaware that other communities already have solutions for shared problems.*

What has been Succesful?

Stormwater Coalition*: Communities in a stormwater coalition were able to communicate their challenges and successes. Communities without the TMDL are looking forward to what the communities in the Charles River Watershed are planning to address with their TMDLs. Their actions will help other communities in the future with stormwater management.*

Recommendations:

Join a stormwater coalition: *Join and actively participate in a regional stormwater coalition. Communities in coalitions share their successes and challenges as well as learn from each other. Stormwater coalitions can also help give communities additional resources and information related to stormwater management.*

Persuade MassDEP to Provide More Communication to Communities: *We suggest communities request the MassDEP to do a quarterly newsletter to help communities receive any additional information and updates. MassDEP could provide communication resources to communities, such as registration for the email list, ways to join a stormwater coalition, and coalition meeting schedules.*