Final Report
Town of Arlington
Coastal Pollutant Remediation Grant Program FY20
June 30, 2020

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Project Title
Implementation of bioretention and multiple gravel infiltration trenches to address nutrient impairment negatively impacting anadromous fish

Project Summary
The Town of Arlington, in partnership with the Mystic River Watershed Association (MyRWA), constructed 2 bioretention basins and 20 infiltration trenches to treat stormwater runoff entering Alewife Brook, part of the Mystic River Watershed.

Background
This project builds upon a successful partnership between the Town of Arlington and the Mystic River Watershed Association, who share the common goal of reducing phosphorus pollution and improving water quality in the Mystic and its tributaries through the use of green infrastructure.

In 2015 the Town of Arlington and MyRWA secured a 604b grant award from the MA-DEP to identify potential BMP locations in Arlington. In 2018 the Town and MyRWA secured a 319 grant award from the MA-DEP to construct two bioretention basins in East Arlington. While the project was a success - both in terms of removing the first flush of pollutants during a storm and raising public awareness about green infrastructure and water quality - the project partners continued to explore more efficient, cost-effective options for phosphorus reduction in the Mystic River watershed.

In 2018, Arlington participated in the MA-DEP Stormwater Support Program for the Mystic River Watershed. This support program was a cross-jurisdictional collaboration including the Town of Arlington, Town of Winchester, MA-DEP, EPA, MyRWA, and the University of New Hampshire Stormwater Center with technical support from Horlsey Witten and Eastern Research Group, Inc. The goal of the collaboration was to coordinate municipalities to work with an expert team to discuss local water resource challenges and develop the most cost effective, appropriate approaches for improving stormwater management and other related practices, focusing on reducing nutrient pollution. The collaboration was part of the larger Mystic Watershed Alternative TMDL project.

In 2017, before this collaboration began, Arlington's Engineering Division and Conservation Commission worked together on a MA-DEP Natural Resource Damages grant to remove a broken outfall along the Mystic River in order to restore riparian habitat. As part of this grant, the Engineering Division designed up-hill pretreatment infiltration trenches to filter out pollutants before stormwater flowed out of the restored outfall. The Engineering Division was designing the infiltration trenches as the collaboration began, and was able to get technical feedback on design from the UNH Stormwater Center. Using the UNH Stormwater Center's BMP Performance Calculator, Arlington was able to evolve its infiltration trench design into more cost-effective and pollutant reducing designs. Arlington installed 11 infiltration trenches with the help of the stormwater support collaboration and as part of the NRD grant.

Using the experience from the stormwater support collaboration, Arlington and MyRWA applied for the CZM grant with the goal of installing more infiltration trenches, and exploring more designs. Through the CZM grant, Arlington designed three iterations of the infiltration trench: the street trench, the green trench, and the tree trench. Street trenches were installed in the street, green trenches were installed in sidewalks with grass strips, and tree trenches were installed in sidewalks with grass strips and designed to accommodate future tree planting. All three designs have different unit costs and varying degrees of performance efficacies. Overall, the street trench is the most cost-effective due to minimal disturbance and ease of construction. The cost of the street trenches averaged $4,200 and P removal varied from 0.75 to 2.8 lbs/year. That said, there is value to having options regarding trench type, as different areas are suitable for different types of trenches, depending on conditions on the ground.

In addition to installing 20 infiltration trenches, two bioretention basins were also built. For more information about the trenches, please refer to Table 1. BMP Summary below.

Project Overview

Under this grant, the Town of Arlington and MyRWA designed and built 2 bioretention basins and 20 infiltration trenches in East Arlington. The main goals of the project were as follows:

- Increase the number of BMPs in Arlington in order to reduce phosphorus loads into Alewife Brook thereby improving water quality.
- Explore the feasibility of infiltration trenches, which are significantly more cost effective than bioretention trenches, more efficient at removing Phosphorus, and invisible once constructed.
- Create a template or model for the infiltration trenches so that they can be replicated throughout the watershed and beyond.
- Begin to test the design of the infiltration trenches, allowing for improvement in future projects.

The Town decided to take on the task of designing the BMPs instead of hiring an engineer, allowing more grant funds to go to construction, and creating space for exploring the creation of a template or model for constructing these low-cost trenches. The process was as follows:

1. Identification of potential sites for BMPs. This work was done by interns under the supervision of the Town and an excel spreadsheet of potential locations was created. See attached form "Site Analysis Considerations for Street Infiltration Trench Installation" for guidelines that can be shared.

2. Design/ sizing of BMPs. A design template was created that can be used to calculate the necessary size of a trench based on a survey of the impervious surface and calculation of catchment area of each catch basin. The volume of stormwater that would need to be infiltrated is calculated based on the catchment area and first 0.1" of rain. See final design spreadsheets with formulas embedded.

3. Calculating phosphorus load reduction. Also included in the spreadsheet is a formula for calculating phosphorus load reduction developed by the University of New Hampshire Stormwater Center, in collaboration with EPA. This formula also calculates nitrogen (TN) and total suspended solids (TSS) reductions for these trenches. See final design spreadsheets with formulas embedded.

All of this work was done by the Town. Following finalization of the designs, bid documents were prepared and the project was put out to bid. A contractor was selected and construction commenced in May 2020. In order to keep the cost of these trenches as low as possible, the following efficiencies were incorporated:

- All products are off-the-shelf.
- The trenches are small enough that they don't require heavy machinery to construct.
- One type of gravel is called for, avoiding the need for multiple trucks or multiple trips to get different size stones for the trench.
- All paving is done at the end of the week.
- Construction is limited to one side of the street to avoid the need for a police detail.
- The designs are easily adaptable in the field depending on the site.

While the bioretention basins took approximately a week to build, approximately 2 infiltration trenches were built per day.

The cost of the bioretention basins were $30,000 each, without incorporating design costs. The average construction cost of an infiltration trench was $6,000, which includes all necessary updates (curbing, etc.). The construction of a basic street trench is estimated to cost closer to $4,200 if no other upgrades are necessary. The construction of a basic green trench is estimated to cost $2,750 if no other upgrades are necessary. The construction of a basic tree trench is estimated to cost closer to $4,000 if no other upgrades are necessary.

General Lessons Learned

- Infiltration trenches are decidedly more cost efficient than bioretention basins. However, bioretention basins are more useful for public education and building support for green infrastructure because they are more visually engaging. Bioretention basins provide habitat for birds, bees, and other pollinators. They beautify the streetscape for residents. They are recommended in situations where traffic calming is needed through interventions like a bumpout.
- These BMPs are most effective when combined with other work or projects. For example, in 2018 the Arlington Conservation Commission received a MA-DEP NRD grant to restore an outfall along the Mystic River. The Engineering Division provided in-kind pretreatment in the form of infiltration trenches uphill from the outfall, filtering out pollutants before the stormwater exited the restored riparian outfall system. The CZM BMPs were not part of a larger project like the NRD grant, but the Town is interested in pairing these small-scale BMPs with larger stormwater initiatives across Arlington.
- The Town is working on creating a form for the contractor for future projects that will allow for simpler gathering of as-built information. This information will then be captured in the town’s GIS in order to facilitate and centralize maintenance needs and calculation of annual phosphorus load removal.

Lessons learned that will be incorporated into the next phase include:

- Incorporate as-built columns and sketch locations into design.
- Simplify design with individual design sheets, spreadsheets with multiple designs, links etc as they were too cumbersome and confusing
- When new curb required be sure to have field visit to confirms required design grades
- Simplify inlet chamber by having one outlet.
- Vacuum with by-pass chamber.
- Simplify gutter inlet/wheel guard cut out procedure.
- Check grades after granite and mark elevations for proper pitch to inlets
- Incorporate mid-support on wheel guard.
- Consider grate/inlet attachment.
- Change datum to top of existing curb and mark
- Simplify design – remove redundant elevations on elevation table & as-built table

Table 1. BMP Summary*

	BMP Type	**Location**	**DA (SF)**	**P Remo**	**N Removal**	**TSS Removal**	**Volume Reduction**

				val (lb/yr)	(lb/yr)	(lb/yr)	(cf)
BMP #1	Green Trench	Across 58-60 Oxford St	7,650	.26	1.66	52.24	39
BMP #2	Street Trench	89 Oxford St	34,868	1.24	7.81	245.84	184
BMP #3	Green Trench	12 Cleveland St	26,594	.95	5.96	187.45	140
BMP #4	Green Trench	35 Cleveland St	25,877	.92	5.76	181.31	136
BMP #5	Street Trench	68 Broadway St	29,202	1.04	6.54	205.89	154
BMP #6	Green Trench	54 Marathon St	28,471	1.01	6.35	199.75	149
BMP #7	Green Trench	Across from 62 Marathon St	11,415	.4	2.54	79.9	60
BMP #8	Tree Trench	Opposite 36 Waldo St	12,324	.43	2.73	86.04	64
BMP #9	Green Trench	40 Waldo St	56,100	1.99	12.5	393.34	294
BMP #10	Tree Trench	155 Mass Ave	41,807	1.49	9.37	295.01	223
BMP #11	Tree Trench	115 Mass Ave	40,867	1.46	9.18	288.86	216
BMP #12	Tree Trench	121 Mass Ave	39,752	1.41	8.89	279.64	209

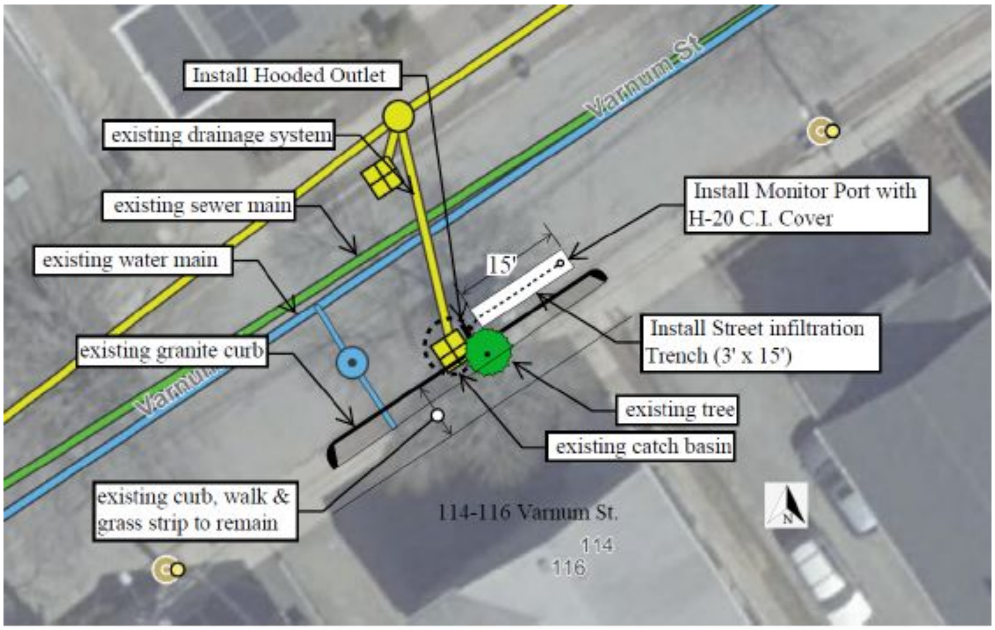
BMP #13	Street Trench	106 Sunnyside Ave	28,172	1.01	6.35	199.75	149
BMP #14	Street Trench	109 Sunnyside Ave	16,448	0.59	3.71	116.77	87
BMP #15	Street Trench	88 Sunnyside Ave	20,401	0.73	4.59	144.43	108
BMP #16	Street Trench	44-46 Fairmont St	79,206	2.83	17.77	559.29	418
BMP #17	Street Trench	45 Fairmont St	73,324	2.61	16.4	516.26	386
BMP #18	Street Trench	54 Thorndike St	76,062	2.72	17.09	537.78	402
BMP #19	Street Trench	100 Varnum St	20,973	0.75	4.69	147.5	110
BMP #20	Street Trench	114-116 Varnum St	23,416	0.84	5.27	165.94	124
BMP #21	Bioretention Basin	Herbert-Milton Intersection #1	27,000	0.99	6.25	196.67	147
BMP #22	Bioretention Basin	Herbert-Milton Intersection #2	22,000	1.04	6.54	205.89	154
TOTAL			**741,929**	**26.71**	**167.95**	**5,285.55**	**3,953**

Performance statistics calculated using the UNH Stormwater Center BMP Performance Calculator. See attached.

****Please note that the UNH spreadsheet was updated during this grant period.****

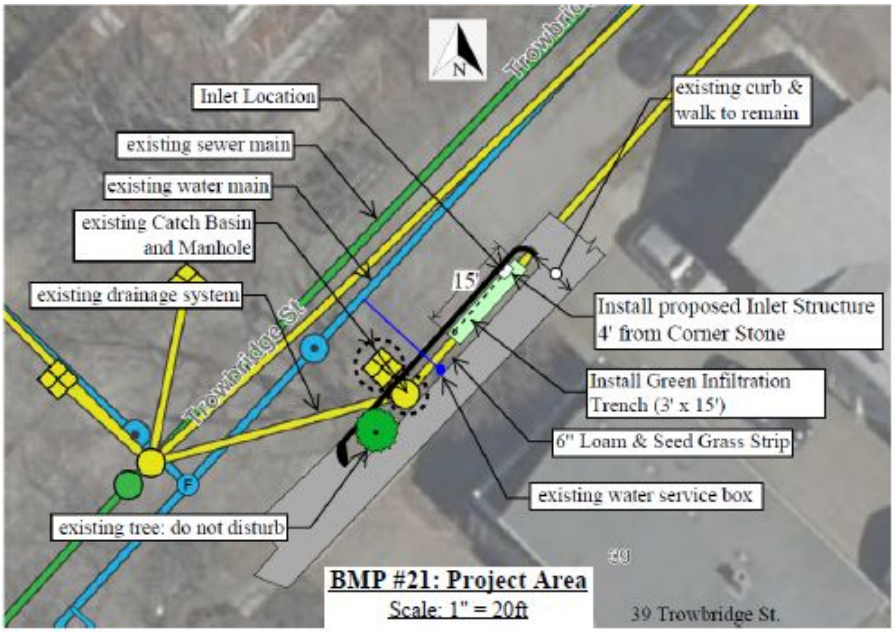
BMP Descriptions

Street Trenches were installed along an existing catch basin within the road right-of-way.

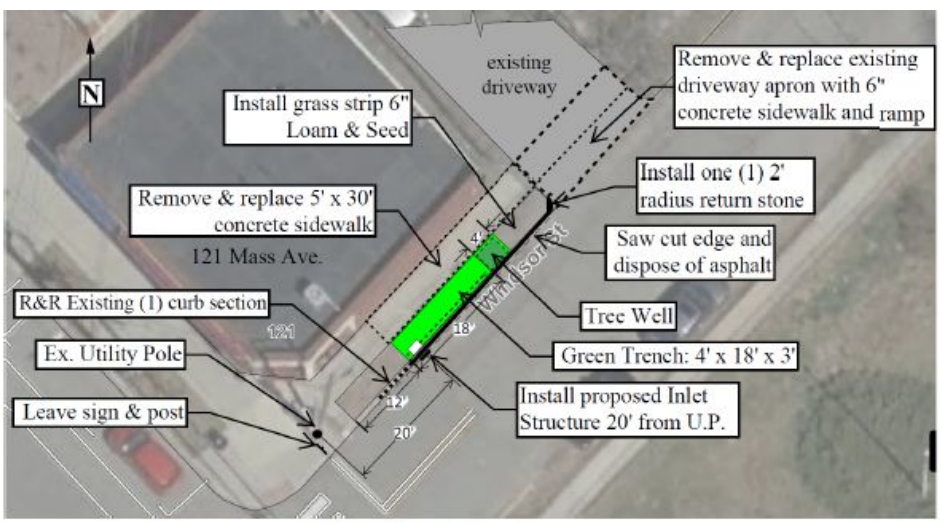


BMP #20 Project Area
Scale: 1" = 20ft

Green Trenches were installed upgradient from an existing catch basin, within the vegetated strip area of a sidewalk. Please note that all of the green/tree trenches are placed upgradient from a catch basin. They may be adjacent or around a corner but ultimately if the stormwater runoff exceeds capacity, flow will continue down the street, as it did before the project.

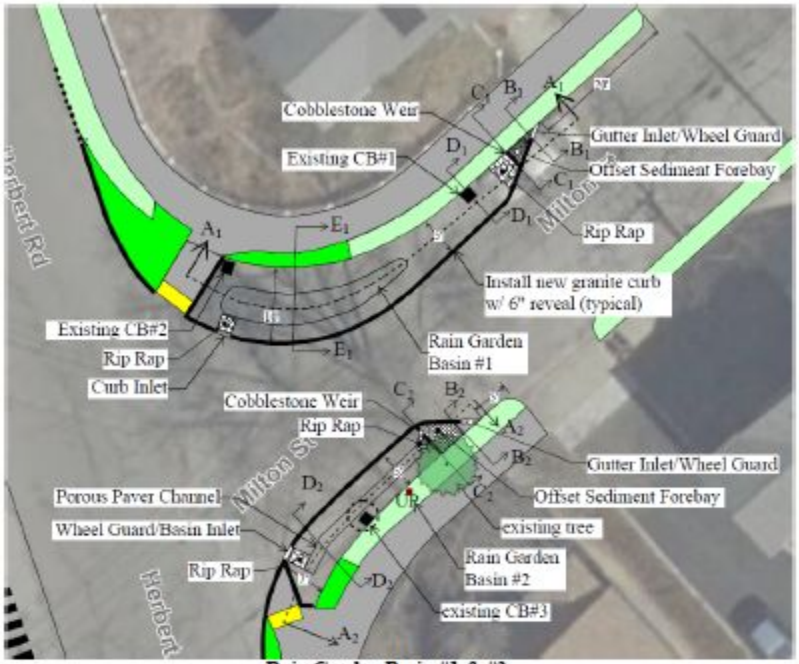


Tree Trenches were installed upgradient from an existing catch basin, within the vegetated strip area of a sidewalk and installed with a tree well so that a tree could be planted in the future.



BMP #12: Project Area
Scale: 1" = 20ft

Bioretention Basins, or rain gardens, were installed within the road right-of-way of an extra wide intersection. The bioretention basins not only improve water quality, but have the co-benefit of adding traffic calming to a wide, and somewhat dangerous intersection.



Rain Garden Basin #1 & #2
Cross Section Guide
scale: 1" = 10ft

Table 2. Summary of Completed Tasks

Task		Description	Deliverable(s)	Completion Date
1	Conduct project kickoff meeting	CZM and the Town of Arlington met to discuss the tasks, deliverables and due dates.	-Kickoff meeting -Minutes	September 2019
2	100% Design Plans and Specifications	The Town prepared draft design plans for review by CZM. Designs were finalized based on review and technical specifications were prepared for bidding.	-Electronic copy of final designs stamped by a professional engineer with supporting materials -Technical specifications	Draft January 2020 Final February 2020

3	Permitting	The Town developed and submitted documents for each of the project sites as needed to the Conservation Commission (ConCom). *Update: It was determined that none of the work fell within the jurisdiction of ConCom and therefore an RDA was not necessary.*	- Requests for Determination of Applicability (RDA) and other documents as needed - Documentation of ConCom decisions	January 2020
4	Bidding and Contract Administration	The Town prepared the construction bid documents for public notice and distribution. Advertised as appropriate, received construction bids, reviewed contractor qualifications, selected the preferred contractor, prepared and executed a construction contract with the selected vendor.	-Electronic copies of bid package -One fully executed construction contract between the Town and the selected vendor	March 2020
5	Construction	The Town oversaw the construction of 2 bioretention basins and 20 infiltration trenches.	-Notify CZM of construction start and end -Photos of construction activities and constructed BMPs	May-June 2020
6	Recorded Plans for Constructed BMPs	The Town prepared red-lined as-built plans showing any alterations, notes, elevation changes, etc.	-Electronic copy of "As-Built" plans stamped and certified by a professional engineer	June 2020
7	Operations and Maintenance Plan	The Town developed an O&M Plan based on the existing plan for previously constructed BMPs. *Update: The completion of this deliverable was pushed back, as Emily Sullivan was poised to put this together when COVID19 hit and she was reassigned to the Health Department. This instead was completed by Wayne Chouinard at the end of May. CZM reviewed the document and edits were incorporated into the final draft.*	-O&M Plan for CZM review -Post-construction site visit to review the O&M procedures	Draft May 2020 Final June 2020

8	Outreach (match)	MyRWA conducted public outreach and education for the project. Activities included neighborhood door hangers and flyers, a dedicated public meeting, stories in local papers, online materials in local facebook and yahoo groups, a pre-construction flyer, and a post-construction sign at the bioretention basins. *Update: Fortunately, the bulk of the outreach was done in Dec of 2019, including door hangers, flyers, a story in a local publication, and online communications preceding a public meeting. Outreach around construction was limited due to COVID. Pre-construction notices were sent out and flyers posted near construction sites, and post-construction signs installed. Photos and video were taken, but plans to hire a videographer to put together a short film were delayed a year due to COVID. Following construction, temporary educational signage was put up at the rain gardens, a press release was created and shared, and a social media post celebrating the install was released by MyRWA.* *https://arlington.wickedlocal.com/news/20191126/is-there-oil-stain-in-your-driveway-you-could-be-polluting-arlingtons-waterways* *https://www.yourarlington.com/arlington-archives/town-school/environment/16409-green-112719.html* *https://mysticriver.org/news/greeninfrastructure* *https://twitter.com/MysticMyRWA/status/1283862562992463878* *The final report will be posted on the Town of Arlington and MyRWA's web sites.*	-Notify CZM of any public outreach activities -Electronic copies of any materials produced	June 2020
9	Final Report	The Town and Project Partners have prepared a final report for CZM review to	-Final report to CZM and posted on Town or Project Partner's website	Draft June 2020

		summarize the work performed and the final designs for the constructed BMPs.		Final June 2020
10	Grant Administration and Reporting	The applicant provided administrative services, including review of contractor invoices, contractor payment, compilation of staff time and match contribution, submission of all deliverables, and submission of reimbursement package.	-Paperwork and records necessary to enable CZM reimbursement to the grantee	Deliverables: June 30, 2020 Reimbursement: July 31, 2020

Attachments

- Final designs and technical Specifications
- O&M plans
- As-built plan
- Photos
- Outreach materials