

ARLINGTON HIGH SCHOOL

RAIN GARDEN DESIGN NARRATIVE

Introduction

This narrative is provided at the request of the Arlington Conservation Commission to clearly explain the design intent and value of the proposed Rain Gardens as part of the stormwater management system for the proposed Arlington High School construction project. As these rain gardens are not able to infiltrate into the underlying soils due to issues with ground contamination in the areas proposed, this narrative seeks to explain how the system will function to provide a valuable improvement to the water quality treatment of the surrounding area. This also promotes climate change resiliency per the Arlington bylaws.

Rain Garden Definition

The following language is provided from the Massachusetts Stormwater Handbook (Volume 2; Chapter 2; Page 23) which defines Rain Gardens and Bioretention Areas. The two terms bioretention area and rain garden are synonymous, and the type of system proposed has been bolded in the passage below:

“Bioretention is a technique that uses soils, plants, and microbes to treat stormwater before it is infiltrated and/or discharged. Bioretention cells are shallow depressions filled with sandy soil topped with a thick layer of mulch and planted with dense native vegetation. Stormwater runoff is directed into the cell via piped or sheet flow. The runoff percolates through the soil media that acts as a filter. There are two types of bioretention cells: **those that are designated solely as an organic filter filtering bioretention areas** and those configured to recharge groundwater in addition to acting as a filter exfiltrating bioretention areas. **A filtering bioretention area includes an impermeable liner and underdrain that intercepts the runoff before it reaches the water table so that it may be conveyed to a discharge outlet, other best management practices or the municipal storm drain system.**”

Benefits of Rain Gardens

Rain gardens are very valuable stormwater Best Management Practices (BMPs) because of the water quality treatment that they provide. The Massachusetts Stormwater Management Handbook specifies that Rain Gardens (whether exfiltrating into the ground or lined) provide 90% Total Suspended Solids Removal (TSS) with adequate pretreatment. We provide pretreatment via deep sump catch basins for all flows to the proposed Rain Garden system. This makes Rain Garden a very desirable BMP to use wherever space allows. For example, an infiltration basin only receives 80% TSS removal, 10% less than the Rain Garden equivalent.

Unlike typical infiltration systems, Rain Gardens also provide pollutant removal beyond suspended solids. Per the Massachusetts Stormwater Handbook, Rain Gardens remove 30-50% of total nitrogen load to the system, 30-90% total phosphorus, and 40-90% of other metals such as copper, lead, zinc, and cadmium. This is a great addition to an already robust design to increase the water quality of the flows from the proposed stormwater system associated with the Arlington High School project. As mentioned previously, the rain gardens also promote climate change resiliency and evapotranspiration.

Rain Garden System Design

Rain Gardens are intended to hold a small amount of stormwater for filtration, with an overflow provided for larger stormwater events where the storage of the garden is exceeded by the inflow of stormwater. The filter is provided via a series of layers of natural material, with an underdrain provided at the bottom of a lined Rain Garden system to convey the filtered stormwater to the stormwater management system. The filter consists of two (2) to three (3) inches of mulch on the ground surface with plantings, with between two (2) and four (4) feet of planting soil underneath. The bottom layer consists of eight (8) inches of gravel across the footprint of the Rain Garden which also acts as the bedding for the underdrain. For a lined system such as the one designed for this project, the liner will wrap the entire filter area on the bottom and sides to prevent exfiltration of stormwater into the ground. The mulch and soil specifications are provided within the Massachusetts Stormwater Handbook, and are contained within the project specifications to ensure that the requirements for the system per the handbook are met.

Plantings proposed within the Rain Gardens are those defined in the “Plant Species Suitable For Use in Bioretention – Herbaceous Species” list within the Massachusetts Stormwater Handbook. The plantings chosen, shown on the landscape plans for the project, are all native species. A list of the plantings used, highlighted from the list in the Massachusetts Stormwater Handbook is appended to this narrative.

Stormwater Routing

The Rain Garden system design for the Arlington High School project consists of a series of three (3) cascading Rain Gardens separated by retaining walls moving down the slope on the west side of the proposed building as shown on the Stormwater Management Plans. Per the definition provided above, these Rain Gardens are each lined with impermeable liner to prevent exfiltration of stormwater into the ground which is not suitable for infiltration. An underdrain pipe is provided for each Rain Garden to convey flows after they have filtered through the mulch and soil media. These underdrain pipes for RG-1 and RG-2 discharge to the Rain Garden downstream (RG-2 and RG-3 respectively). The top two Rain Gardens (RG-1 and RG-2) have a weir wall on their north side. This is intended to allow stormwater flows to travel over the portion of the wall adjacent to the Rain Garden in larger storm events to prevent overflow of the system. Stormwater flowing over the weir wall is intended to drop onto the rip rap pad below in the Rain Garden directly downstream of RG-1 and RG-2 (RG-2 and RG-3 respectively). RG-3 includes an outlet control structure with a series of orifices to allow for stormwater to discharge from the Rain Garden when the storage provided is exceeded without overflowing into the surrounding areas in addition to the underdrain piping for the filtered water. See the attached sketch plan for reference on the location of the various elements of the Rain Garden system graphically as described above.

Rain Garden Data from the Massachusetts Stormwater Handbook

Below is an excerpt from the Massachusetts Stormwater Handbook giving metrics for Rain Garden BMPs.

Standard	Description
2 - Peak Flow	N/A
3 - Recharge	An exfiltrating bioretention area provides groundwater recharge.
4 - TSS Removal	90% TSS removal credit with adequate pretreatment
5 - Higher Pollutant Loading	Can be used for certain land uses with higher potential pollutant loads if lined and sealed until adequate pretreatment is provided. Adequate pretreatment must include 44% TSS removal prior to infiltration. For land uses that have the potential to generate runoff with high concentrations of oil and grease such as high intensity use parking lots and gas stations, adequate pretreatment may also include an oil grit separator, sand filter or equivalent. In lieu of an oil grit separator or sand filter, a filtering bioretention area also may be used as a pretreatment device for infiltration practices exfiltrating runoff from land uses with a potential to generate runoff with high concentrations of oil and grease.
6 - Discharges near or to Critical Areas	Good option for discharges near cold-water fisheries. Should not be used near bathing beaches and shellfish growing areas.
7 - Redevelopment	Suitable with appropriate pretreatment

Pollutant Removal Efficiencies

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| • Total Suspended Solids (TSS) | 90% with vegetated filter strip or equivalent |
| • Total Nitrogen | 30% to 50% if soil media at least 30 inches |
| • Total Phosphorus | 30% to 90% |
| • Metals (copper, lead, zinc, cadmium) | 40% to 90% |
| • Pathogens (coliform, e coli) | Insufficient data |

Rain Garden Maintenance Requirements

Inspection and Maintenance of Rain Gardens shall be conducted per the Bioretention Maintenance Schedule provided below from the Massachusetts Stormwater Handbook:

Activity	Frequency
Inspect and remove trash	Monthly
Mow	2 to 12 times per year
Mulch	Annually
Fertilize	Annually
Remove dead vegetation	Annually
Prune	Annually

It should be noted that the Massachusetts Stormwater Handbook requires that rain gardens cannot have stormwater flows directed to them until the tributary area is entirely stabilized to prevent sedimentation of the rain garden. The plantings in the rain garden are species that are intended to be inundated by stormwater with each rain event, so once the plantings are in place there should be no issues with establishment, even with stormwater being directed to the rain garden.