MEMORANDUM

TO: David Desrosiers, P.E., Highway Superintendent, Town of Granby, MA

FROM: Julianne Busa, PhD; Rachael Weiter, EIT; Sarah Hayden, MSc

DATE: August 12, 2021

RE: Stormwater Retrofit Plan

1. Introduction

The Post-Construction Stormwater Management minimum control measure of the United States Environmental Protection Agency (EPA) *General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts* (2016 MS4 Permit, including 2020 modifications) requires that permittees identify a minimum of five permittee-owned properties that could potentially be modified or retrofitted with BMPs designed to reduce the frequency, volume, and pollutant loads of stormwater discharges to and from its MS4 through the reduction of impervious area connected to the MS4. Fuss & O'Neill performed a planning-level assessment of potential stormwater retrofit sites throughout the Town of Granby where low-impact development (LID), green infrastructure (GI), and/or runoff reduction could be implemented to address these requirements and identify potential stormwater retrofit projects.

The termsLID, and green infrastructure all refer to systems and practices that reduce surface water runoff through the use of vegetation, soils, and natural processes to manage water and create healthier urban and suburban environments (EPA, 2014). Stormwater retrofits can include a variety of LID and green infrastructure practices such as bioretention, engineered wetland systems, permeable pavement, green roofs, green streets, infiltration systems, tree boxes, and rainwater harvesting. These practices capture, manage, and/or reuse rainfall close to where it falls, thereby reducing stormwater runoff and keeping it out of drainage systems and receiving waters.

In addition to reducing polluted runoff and improving water quality, LID and green infrastructure practices can improve flow conditions in streams and rivers by infiltrating water into the ground, thereby reducing peak flows during wet weather and sustaining or increasing stream base flow during dry periods, which can be important for aquatic habitat and fisheries. When applied throughout a watershed, LID and green infrastructure can recharge aquifers and groundwater supplies and help mitigate flood risk and increase flood resiliency. At a smaller scale, LID and green infrastructure can also reduce erosive velocities and streambank erosion.

Finally, LID and green infrastructure have been shown to provide other social and economic benefits relative to reduced energy consumption, improved air quality, carbon reduction and sequestration, improved property values, recreational opportunities, overall economic vitality, and adaptation to climate change.

2. Methods and Findings

Development of the stormwater retrofit plan consisted of three major tasks:

1. **Screening-level assessment** to efficiently identify areas within the community with the greatest feasibility for and potential benefits from stormwater retrofits to reduce impervious area connected to the MS4,
2. **Field inventories** of the most promising stormwater retrofit opportunities identified from the screening step,
3. **Stormwater retrofit concept designs** for selected retrofit sites, including anticipated reductions in impervious cover and pollutant loads and planning level costs.

This retrofit plan documents the methods and findings of the screening-level assessment, as well as field inventories and concept designs for selected retrofit sites.

2.1 Site Screening Evaluation

Sites were selected and analyzed using Geographic Information System (GIS) mapping and associated geospatial data and aerial imagery. GIS allows for rapid evaluation of specific land-based attributes that are important for assessing the feasibility of stormwater retrofit practices. The assessment used the following site evaluation criteria[1] and data sources.

- **Land Ownership** – Publicly-owned (e.g., municipal) sites are most favorable because they avoid the cost of land acquisition and provide direct control over stormwater retrofit construction, maintenance, and monitoring by the municipality. Both parcel-specific practices and linear BMPs in municipal right of ways or easements were considered. Other publicly-owned sites such as schools and state-owned property (road right of ways, parks, etc.) are also potential stormwater retrofit candidates. Publicly-owned properties in the Town were identified and mapped using the "Tax Parcels for Query" dataset from MassGIS from 2019.

- **Regulated Area** – Under the MS4 Permit, the Town's regulated area is defined based on those areas considered "urbanized" as defined based on 2010 Census data. (Note that 2020 Census definitions and mapping data are not yet available.) Locations within or immediately adjacent to the regulated area were given preference when identifying potential retrofit sites.

- **Water Quality** – The Town's impaired waters, as listed in the "2016 Integrated List of Waters" were also included for site screening to identify potential opportunities to provide water quality improvements, specifically focusing on nitrogen and phosphorus-impaired waterbodies. Under the MS4 Permit, Granby is subject to the Long Island Sound TMDL for Total Nitrogen. In addition, Weston Brook is impaired for Total Phosphorus, and Bachelor Brook and Stony Brook are both impaired for E. coli.

- **Subsurface Conditions** – Subsurface conditions are key considerations for infiltration-based green infrastructure retrofits. Soil infiltration capacity, depth to groundwater, depth to restrictive

[1] Other site-specific factors such as land area, impervious area, drainage area, subsurface utilities, subsurface contamination, and storm drainage system capacity are also important considerations for stormwater retrofits.

layers (bedrock, dense till), soil bulk density, and inundation of soils due to flooding are important soil-based characteristics that can affect the feasibility of infiltration-based green infrastructure retrofits. For the purposes of this screening evaluation, Natural Resources Conservation Service (NRCS) soil classifications and the Soil Survey Geographic Database (SSURGO) were used to assess the feasibility of infiltration practices at a given site.

Hydrologic Soil Groups (HSGs) mapped by the NRCS provide an initial estimate of infiltration rate and storage capacity of soils on a site. Group A soils have the lowest runoff potential (highest infiltration rates) and Group D soils have the highest runoff potential (lowest infiltration rates) when thoroughly wet. Soils with higher infiltration capacities are generally better suited for green infrastructure; therefore soil types A and B were selected from USDA Web Soil Survey data from 2019. HSG mapping provides an initial estimate of infiltration potential; field investigations are necessary to verify soil conditions for final feasibility determinations and design purposes.

- **100-Year Floodplain** – Practices installed within the 100-year floodplain are more likely to be inundated during large riverine flood events, which may make them more susceptible to damage or pollutant export. For this screening-level analysis, sites outside the 100-year floodplain were given preference wherever possible. The FEMA Flood Insurance Rate Map retrieved from MassGIS in 2019 was used to identify the extent of the floodplain.

- **Impervious Cover** – Water quality impacts are known to occur in surface waters within drainage basins that have a high degree of impervious cover due to changes in watershed hydrology and pollutant sources that result from development of the landscape with hard surfaces. Sites with higher amounts of impervious cover generate more runoff and have greater potential for runoff reduction through the use of stormwater retrofits. Further, as the purpose of this MS4 Permit requirement is to develop a list of priority projects to improve water quality, areas with a high degree of development and impervious surfaces were considered high priority for stormwater retrofits.

The site screening process described above was performed by applying each of the screening criteria in succession to identify areas where favorable conditions overlapped. Additional input from the Town was obtained relative to:

- Planned capital improvements
- Existing drainage systems
- Available space relative to existing utilities/septic systems
- Known drainage issues

2.2 *Site Screening Results*

A total of 27 sites were identified from the GIS-based screening evaluation. This list included 22 Town-owned properties, three (3) right-of-way locations, three (3) State-owned properties, and one (1) federal property. Of these, 24 were selected for further assessment (**Figure 1; Table 1**). The list of sites was provided to the Town for review and comment before proceeding with the field investigation. The comments provided information to further inform focus areas within the sites and preferred BMP types for various sites, but did not change the overall site list.

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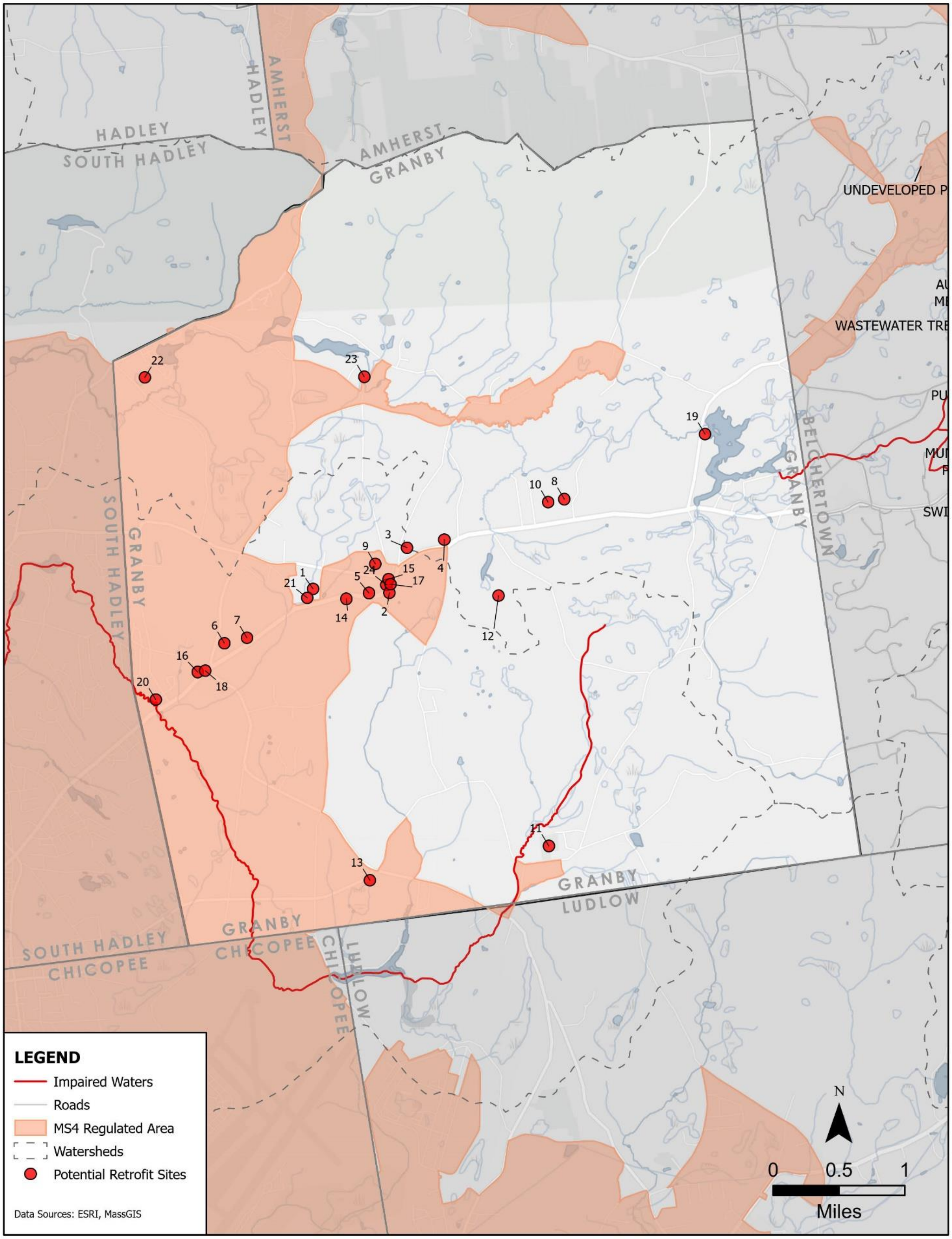

Figure 1. Map of potential retrofit sites selected for assessment in the Town of Granby. Site numbers correspond to the Site No. column in Table 1.

Table 1. Potential retrofit sites and initial recommendations.

Granby Retrofit Sites							
	Site No.	**Site Name**	**Address**	**Hydrologic Soil Group A or B?**	**Within Regulated Area**	**Within 1000 feet of Impaired Waterbody?**	**Initial Retrofit Recommendations**
Town-Owned Properties	1	Highway Department	15 Crescent St	Yes	Mix	No	N/A. Site is already treated by an underground infiltration system.
	2	Old Granby Public Library	1 Library Ln	Yes	Yes	No	Bioretention supplemented by an underground infiltration system or dry well at northeast corner of parking lot and in the adjacent right-of-way.
	3	Granby Police and Fire Departments	257-259 East State St	Yes	No	No	N/A. Site is already treated by stormwater basins.
	4	Granby Free Public Library	297 East State St	Yes	No	No	N/A. Site is already treated by one or more stormwater basins.
	5	Granby Town Hall	215 West State St	Yes	Yes	No	N/A. Site is not owned by Town and may move in the future.
	6	Hillside Heights	26 Amherst St	No	Yes	No	N/A. Housing Authority site is owned and operated by the State.
	7	Phins Hill Manor	50 Phins Hill Manor	Yes	Yes	No	N/A. Housing Authority site is owned and operated by the State.
	8	East Meadow School	393 East State St	Yes	No	No	N/A. Site is already treated by an underground infiltration system and possibly other BMPs.
	9	West Street Elementary School	14 West St	Yes	Yes	No	Bioretention basins at southwest corner of property near driveway. Pavement removal and site restoration in eastern parking lot. Rain garden near playground. Supplemental dry wells, infiltrating catch basins, or subsurface infiltration as needed. Non-stormwater practices: solar canopies over parking lots; rooftop solar or green roof; nature-inspired playground
	10	Granby Jr/Sr High School	385 East State St	Yes	No	No	Determine conditions of subsurface infiltration practice in lawn between school and State Street. Supplement the existing practice as needed with bioretention basins or swales, subsurface infiltration, and educational signage. Regrade parking lot and other surfaces as needed or add infiltrating catch basins to eliminate standing water. Non-stormwater practices: solar canopies over parking lots; native plantings
	11	Brown Ellison Park	Carver St	Yes	No	Yes	Bioretention swale in right-of-way along Carver Street. Revegetate sides of driveway where drivers have driven off the gravel surface and caused rutting and erosion. Place boulders along edge of driveway prevent driving on grass.
	12	Dufresne Recreation Park	32 Kendall St	Yes	No	Yes	Remove and restore unnecessary impervious surfaces, including those within 50-100 feet of water's edge, except for necessary access for the disabled or for maintenance. Pave the remaining sections existing parking lots to define the limits of the drivable area and to stabilize loose sediment. Retrofit the existing swale to create a bioretention swale. Install a grade control to halt the headcut erosion occurring in the swale. Where overflow parking is needed, consider the installation of grasspave or gravelpave products to limit the expansion of impervious area. Consider interactive practices and informational signs.
	13	Abandoned Residence	152 New Ludlow Rd	Yes	Mix	No	Remove and restore impervious area, including paved driveway.
	14	Abandoned Ambulance Dispatch Center	194 West State Street	Yes	Yes	No	Remove and restore impervious area, including paved driveway.
	15	Right-of-way adjacent to the Town House (Granby Historical Association)	West St	Yes	Yes	No	Infiltrating catch basins and/or bioretention swales in the right-of-way of West Street.
	16	Post Office	63 W State St	No	Yes	No	N/A. Federally-owned site is already largely disconnected.
	17	Town Common	Common St	Yes	Yes	No	Subsurface infiltration.
	18	Intersection of US 202 and Pleasant St	W State St/Pleasant St	No	Yes	Yes	N/A. Limited opportunities for retrofits based on information collected at site visit.
	19	Undeveloped Site #1	School St (72.4707545°W 42.2733044°N)	Yes	No	Yes	N/A. Limited opportunities for retrofits based on information collected at site visit.
	20	Undeveloped Site #2	Karen Dr (72.5551108°W 42.2459757°N)	Yes	Mix	No	N/A. Limited opportunities for retrofits based on information collected at site visit.
	21	Undeveloped Site #3	West St (72.5276380°W 42.2550960°N)	Yes	Yes	No	N/A. Limited opportunities for retrofits based on information collected at site visit.
	22	Undeveloped Site #4	Burnett St (72.5523948°W 42.2795366°N)	Yes	Yes	No	N/A. Limited opportunities for retrofits based on information collected at site visit.
	23	Undeveloped Site #5	Porter St (72.5201194°W 42.2800810°N)	Yes	Yes	No	N/A. Limited opportunities for retrofits based on information collected at site visit.
	24	Undeveloped Site #6	State St	Yes	Yes	No	N/A. Limited opportunities for retrofits based on information collected at site visit.

3. Field Inventories, Site Selection, and Conceptual Designs

3.1 Field Inventories

Field visits were conducted of the selected sites in April 2021. The sites and adjacent street areas were walked and visually inspected for potential stormwater retrofit opportunities (i.e., impervious surfaces connected to the on-site drainage system, available green space to accommodate new stormwater retrofits, and drainage features that could be enhanced or improved) and physical site characteristics such as site configuration, drainage patterns, current use, slope, landscaping, subsurface utilities, design complexity, and maintenance access considerations. Field notes on potential stormwater retrofit sites were recorded using the "Retrofit Reconnaissance Investigation" forms developed by the Center for Watershed Protection. Site photographs were taken to document site conditions/drainage features/etc.

The primary types of stormwater retrofits considered generally included:

- Bioretention/bioswales, including roadside bioswales or linear bioretention.
- Subsurface infiltration practices, including infiltration galleys, dry wells, and infiltrating catch basins.
- Impervious area removal and restoration

Permeable pavement (sidewalks, on-street and parking lot parking spaces, and low-traffic areas) was not considered due to concerns expressed by the Town regarding their use of sand as a winter road treatment and internal maintenance capabilities with available labor and equipment.

3.2 Sites Selected for Concept Designs

Based on the findings of the field inventories, potential stormwater retrofit opportunities were identified at 9 of the sites visited (see **Table 1** for potential retrofit suggestions). The list was further narrowed down with input from the Highway Superintendent to select five top priority sites for further development of concept designs. These sites were selected because they: (1) have the greatest feasibility for stormwater retrofits, (2) provide the best opportunities to infiltrate (i.e., reduce) or filter runoff and impervious area (IA) coverage, and (3) were considered the most likely candidates for implementation by the Town. Many of the sites are also in highly visible, public locations and therefore provide good demonstration value. The five sites are listed in **Table 2** with a summary of the proposed retrofit elements, estimated costs, and associated IA reduction.

Table 2. Sites selected for development of stormwater retrofit design concepts.

Site Name	Stormwater Retrofit BMP Type	Project Cost Estimate[1]	Impervious Area Treated	Cost Effectiveness ($1,000 per Acre Impervious Treated)
Brown Ellison Park	• Bioretention Basin	$22,000	0.36 acres	$61
Old Granby Public Library	• Bioretention Basins	$22,000	0.51 acres	$43
West Street Elementary[f2]	• Bioretention Basins and Rain Garden • Pavement Removal and Restoration	$94,900	1.16 acres	$82
Town Common Right-of-Way	• Subsurface Infiltration	$208,000	0.76 acres	$274
Dufresne Recreation Park	• Bioretention Swale • Impervious Area Removal and Restoration	$431,000	2.97 acres	$145
TOTAL		**$777,900**	**5.76 acres**	

[1] Planning level opinion of cost. Includes estimated costs for engineering design, permitting, and construction. Excludes operation and maintenance costs.

[2] Costs associated with solar canopies and rooftop solar are not included in the costs.

3.3 *Design Concepts*

Stormwater retrofit design concepts were prepared for the selected sites. The design concepts reflect opportunities for infiltration and/or water quality treatment at each site. Opportunities were also evaluated to manage additional runoff from on-site and off-site drainage areas. BMPs were sited and preliminarily sized to accommodate the Water Quality Volume—defined as the first inch of runoff from the impervious area on a site. These concepts are sized to meet or exceed the water quality and impervious area (IA) requirements outlined in the MS4 Permit, which, for redevelopment sites (including retrofits) requires on-site retention of 0.8 inches of the total runoff from the post-construction impervious area on the site.

At many of the selected sites, there is sufficient physical space to build a practice that would retain/treat larger storms. Given the increasing frequency of heavy precipitation events associated with climate change impacts, the Town may wish to consider taking advantage of available space to implement retrofit designs with additional retention/treatment capacity to manage additional flow/accommodate larger storms and thereby address other goals such as increasing flooding resilience and climate resilience. Note that this approach would increase implementation costs, although these increases are often more favorable than a 1:1 ratio of increased size to cost due to economies of scale.

The retrofit design concepts, including planning-level costs and estimated pollutant load reductions (where TMDLs or water quality impairments apply), are presented on the following concept sheets. Each concept sheet includes a general site description, the proposed retrofit concept, field images, example images of similar completed retrofit opportunities (where available) or typical details of recommended BMPs. Sizing calculations for the recommended practices are provided in **Attachment A**.

Preliminary, planning-level costs were estimated for the site-specific concepts based upon unit costs derived from published sources, engineering experience, and the proposed design concepts. A 30% allowance has been incorporated to account for the costs of design and permitting. A more detailed breakdown of estimated costs, including operation and maintenance costs and total annualized costs based on the anticipated design life of each practice, is provided in **Attachment B**. Refined cos estimates would be developed during the design phase, and must take into consideration more detailed, site-specific data gathering, especially related to soils and the location of utilities.

The stormwater retrofit concepts presented in this retrofit plan provide potential on-the-ground projects for future implementation. They also serve as examples of the types of projects that could be implemented at similar sites throughout the Town. It is important to emphasize that these design concepts are not detailed designs and that further evaluation will be necessary to determine the ultimate feasibility of these designs, as well as conduct full design and permitting for these and similar site-specific concepts.

Brown Ellison Park
Bioretention Basin and Erosion Control and Prevention
Carver Street, Granby, MA

Site Description

Brown Ellison Park is a recreational facility located on Carver Street. The facility consists of various recreational fields, including a volleyball court, baseball field and two soccer fields. The park is owned and maintained by the Town, and the facilities are used by students and the broader community. A large gravel parking lot provides parking for patrons, and runoff from this lot is captured by a grass-lined swale that is mowed regularly. The entire facility is surrounded by a fence. The driveway entrance from Carver Street has been widened by vehicle traffic and rutting and erosion is visible where the grass has been reduced. Runoff from Carver Street enters town-maintained storm sewers via catch basins located on the road shoulder west of the park.

Proposed Concept

- Improve the existing swale in the right-of-way between the fence surrounding the park and Carver Street by adding bioretention media to provide enhanced pollutant removal and infiltration of runoff from Carver Street and an adjacent residential property. Add check dams along the length of the swale to increase settling and infiltration.
- Restore the grass to either side of the driveway entrance to the park to stabilize soil and prevent further erosion. Install a line of boulders along each side of the driveway to prevent cars from leaving the driving surface and damaging the grass.

Image 2: Existing conditions showing encroachment on the grass and ponding at edges of entrance driveway.

Image 1: Example of a vegetated swale with check dams to infiltrate stormwater.

Retrofit Concept Summary

Impervious Area Treated: 0.36 acres
Design Storage Volume (DSV): 1,304 ft^3
Runoff Capture Depth: 1.0 inches
Required DSV to Retain 0.8” Runoff: 1,038 ft^3

Annual Load Reduction
Nitrogen: 99%

Estimated Cost: $22,000*
*Estimated costs do not include the cost of grass restoration or boulder placement.

Image 3: Location of the proposed bioretention swale (blue) in the right-of-way east of the entrance to Brown Ellison Park. Restoration of grass ground cover and placement of boulders is recommended (orange) along both sides of the driveway.

Brown Ellison Park Stormwater Retrofit Concept

Granby, Massachusetts

0' 50' 100'

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Old Granby Public Library
Bioretention Basins
1 Library Lane, Granby, MA

Site Description

The Old Granby Public Library is a historic structure located near the Granby Town Common in a highly visible area. A small parking lot located on Center Street provides parking for Town staff who maintain the property. Runoff from the property and the lot is captured by Town-maintained catch basins on Center Street. A well and septic system are located on the property.

Proposed Concept

- Install an L-shaped bioretention basin in the open lawn north of the parking lot to treat and infiltrate runoff from the property.
- Disconnect existing downspouts from their subsurface drains and direct them toward the proposed bioretention basin.
- Add curb cuts along Center Street to direct water from the roadway into the proposed bioretention basin.
- Install a second bioretention basin in the existing island between the driveways to infiltrate runoff from the remainder of the parking lot.
- Utilize the existing catch basin at the corner of the driveway as an overflow for both basins to return excess stormwater to the existing drainage system during large storm events.

Image 1: Existing conditions at catch basin on Center Street during field assessment. Note the erosion at edge of road caused by stormwater flowing to catch basin.

Image 2: Existing conditions with downspouts connected directly into the underground drainage system.

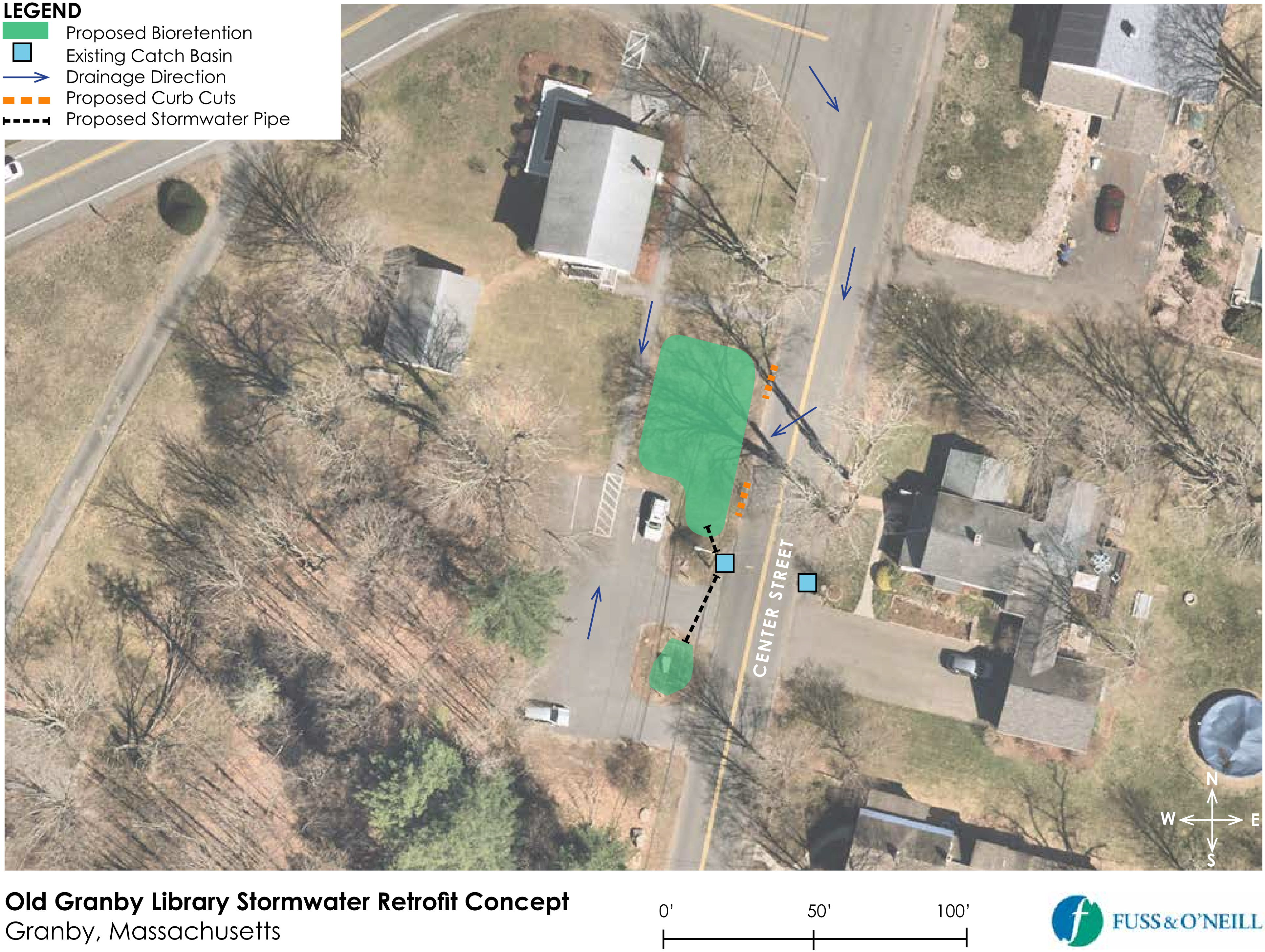
Retrofit Concept Summary

Impervious Area Treated: 0.51 acres
Design Storage Volume (DSV): 1,852 ft^3
Runoff Capture Depth: 1.01 inches
Required DSV to Retain 0.8" Runoff: 1,476 ft^3

Annual Load Reduction
Nitrogen: 99%

Estimated Cost: $22,000

Image 3: Proposed L-shaped bioretention basin.



Old Granby Library Stormwater Retrofit Concept

Granby, Massachusetts

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West Street Elementary School
Bioretention Basins, Pavement Removal, Solar Canopy, and Nature-Play Area
West Street Granby, MA

Site Description

The West Street Elementary School is a permanently closed public school building constructed in 1948 and closed in 2018. The school is known to have structural problems. A playground located behind the school is unmaintained with broken equipment. A failed septic system is located on the site behind the school. The future of the site is unknown. Abandoned schools in other Massachusetts municipalities have been converted to or considered for emergency response and coordination centers, apartments/housing, Veterans Affairs facilities, municipal offices, community centers, etc.

Proposed Concept

The site's future use and design will determine which of the following practices may be most appropriate. This list is not exhaustive, and other practices may also be considered.

- Install two bioretention basins near the western driveway to treat and infiltrate runoff from the western parking lot and West Street. Retrofit an existing catch basin to serve as an overflow structure.
- Replace the existing playground equipment with a nature-play area. Install a rain garden near the playground. In addition to treating and infiltrating stormwater, the rain garden could provide an interactive and educational amenity for visitors of all ages, particularly those visiting the playground.
- Remove unneeded pavement to restore infiltration.
- Erect solar canopies over the eastern and western parking lots to provide a renewable, on-site energy source and to shade the parking lot.
- Install a green roof or solar panels on the roof of the building. This recommendation assumes that the building will be renovated or replaced and can provide adequate structural support for the proposed practices.
- Install informational signage to explain the function of the stormwater practices. Imagery, language, and level of detail can be tailored to the intended audience, depending on the future use of the site.

Image 1: Example of an established bioretention area/ rain garden with native plantings.

Image 2: (Above) Solar canopy over parking lot at the University of Massachusetts Amherst. (Image source: https://www.umass.edu/sustainability/robsham-visitor-center-solar-canopies)

Image 3: (right) Nature-play area at Clark Reservation State Park in Jamesville, NY. featuring play structures, statues of native animals, a scavenger hunt, and native vegetation. (Image source: Parkitects)

Retrofit Concept Summary

Impervious Area Treated: 1.12 acres
Design Storage Volume (DSV): 3,800 ft^3
Runoff Capture Depth: 0.72 inches
Required DSV to Retain 0.8" Runoff: 4,206 ft^3

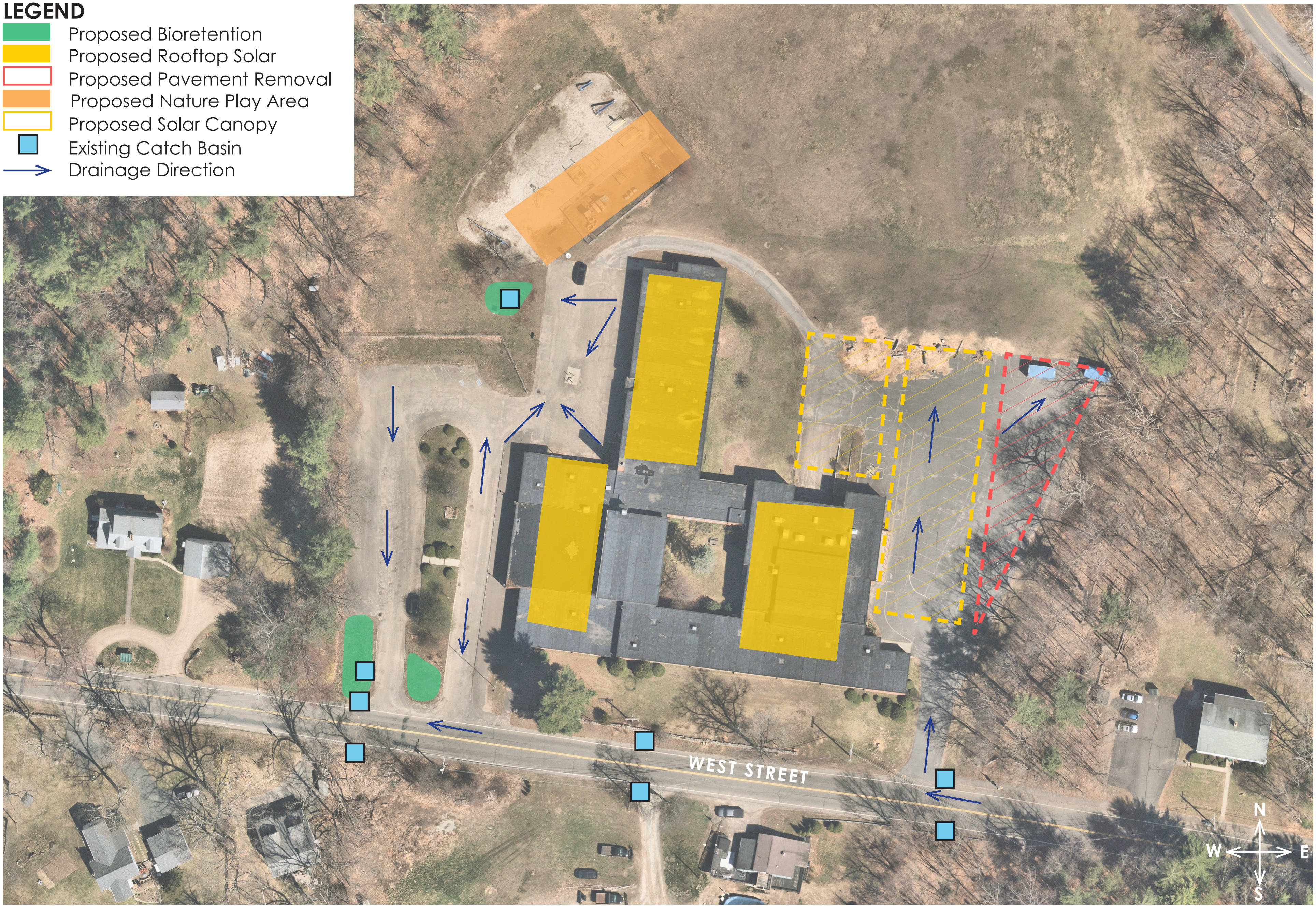
Annual Load Reduction

Nitrogen: 96%

Estimated Cost: $86,400*

Bioretention – SW Basin: $27,000
Bioretention – Driveway Median: $15,000
Rain Garden: $9,000
Pavement Removal: $43,900

*Estimated costs do not include the cost of the nature-play area, solar canopies, or rooftop solar/green roof installation.



West Street Elementary School Stormwater Retrofit Concept

Granby, Massachusetts

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Public Streets and Right-of-Way Surrounding the Town Common
Subsurface Infiltration
Common Street, Granby, MA

Site Description
Common Street is a Town-owned road parallel to and approximately 150 feet from US Route 202 /State Street. The street appears to have been damaged due to standing water. The Town of Granby reports that there are few or no utilities buried under Common Street. The Granby Town Common is a highly visible, privately-owned space located on US Route 202/State Street, West Street, Common Street, and Porter Street. This open space is used to hold public events such as fairs and festivals but has a history of flooding due to stormwater following rain events.

Proposed Concept

- Install subsurface infiltration chambers and infiltrating catch basins along Common Street to treat and infiltrate runoff.
    - Retrofit existing catch basins/install additional catch basins with a deep sump or proprietary filtration device to provide pretreatment for the subsurface infiltration practices.
- To address flooding on the Town Common and better direct water toward the proposed infiltration practices:
    - Install additional curb at locations around boundary of the Town Common to prevent runoff from leaving the surrounding streets and pooling on the Town Common.
    - Determine if the low point in the curb at the catch basin on the west side of US 202/State Street halfway between Porter Street and West Street is a source of water to the Town Common, and raise the curb at this location to match the adjoining curb if so.
    - Regularly clean the catch basin located in the lawn at the southeast corner of the Town Common which tends to accumulate debris.
- Coordinate proposed activities with the upcoming rehabilitation of US 202/State Street and any repaving of Common Street and adjoining streets, if possible, to reduce construction costs.

Image 1: Typical infiltrating catch basin installation.

Retrofit Concept Summary

Impervious Area Treated: 0.76 acres
Design Storage Volume (DSV): 2,845 ft^3
Runoff Capture Depth: 1.0 inches
Required DSV to Retain 0.8" Runoff: 2,211 ft^3

Annual Load Reduction
Nitrogen: 99%

Estimated Cost: $208,000*
*Estimated costs do not include the cost of curb extension or repairs

Image 2: Installation of a subsurface infiltration system in Narragansett, RI (image source: RIDOT Linear Stormwater Manual)

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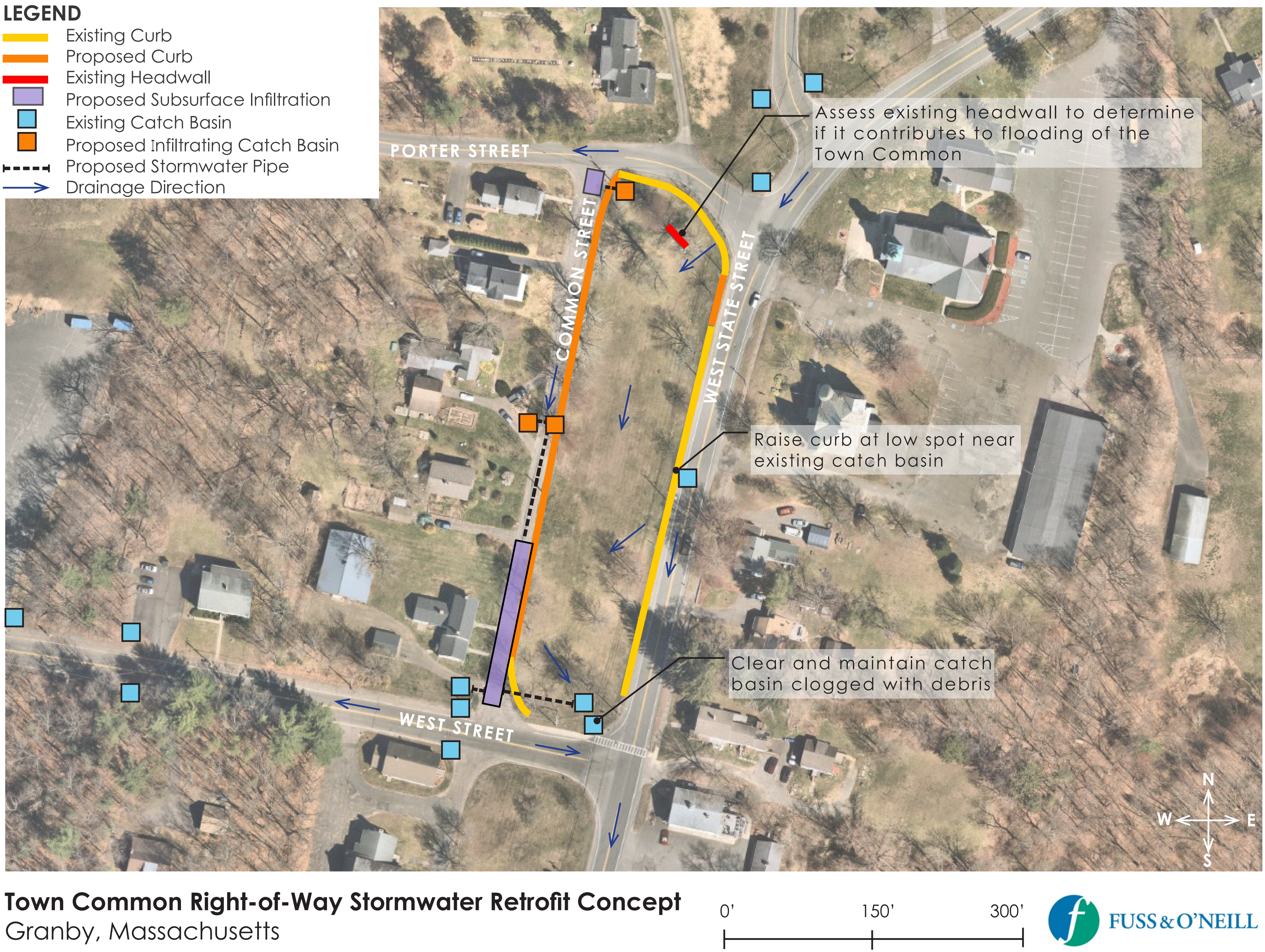

Town Common Right-of-Way Stormwater Retrofit Concept

Granby, Massachusetts

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Dufresne Recreation Park
Impervious Area Removal and Bioretention Swale
Taylor Street and Kendall Street, Granby, MA

Site Description

Dufresne Recreation Park is a recreational facility located between Taylor Street and Kendall Street, with a driveway entrance on each. The facility consists of various recreational fields, a pond, a playground, two horse rings, a dog park, and hiking trails, among other amenities. The park is owned and maintained by the Town, and the facilities are used by students and the broader community. Two large gravel and/or dirt parking lots provide parking for patrons. Runoff from the western lot is partially captured by a grass-lined swale that is severely eroded; as a result of this erosion, a large amount of sediment is transported into the pond. The eastern parking lot drains directly to the pond. The parking lots have been eroded by traffic and expanded by vehicles driving onto and/or parking on the grass. Currently patrons also have vehicular access right up to the shore on both sides of the lake.

Proposed Concept

- Remove impervious area at each parking lot and limit driving and parking to formalized and improved parking areas. Reduce erosion and bare soils by utilizing boulders and gates to prevent cars from leaving the driving surface and damaging the grass, or from driving within 100 feet of open water (except for maintenance or access for patrons with disabilities).
    - Install informational signage to explain the changes and their benefits.
    - Overflow parking may be provided in grassed areas, possibly using vegetated permeable parking technologies.
- Retrofit the existing swale to create a bioretention swale to capture and treat runoff from the proposed formal parking area and playground.
    - Install informational signage and/or interactive elements to provide public education at both a K-8 level and for adults.

Image 1: The existing swale to be retrofitted. Note the upstream extent of severe erosion in the existing swale, with exposed soils visible where erosion has already occurred.

Retrofit Concept Summary

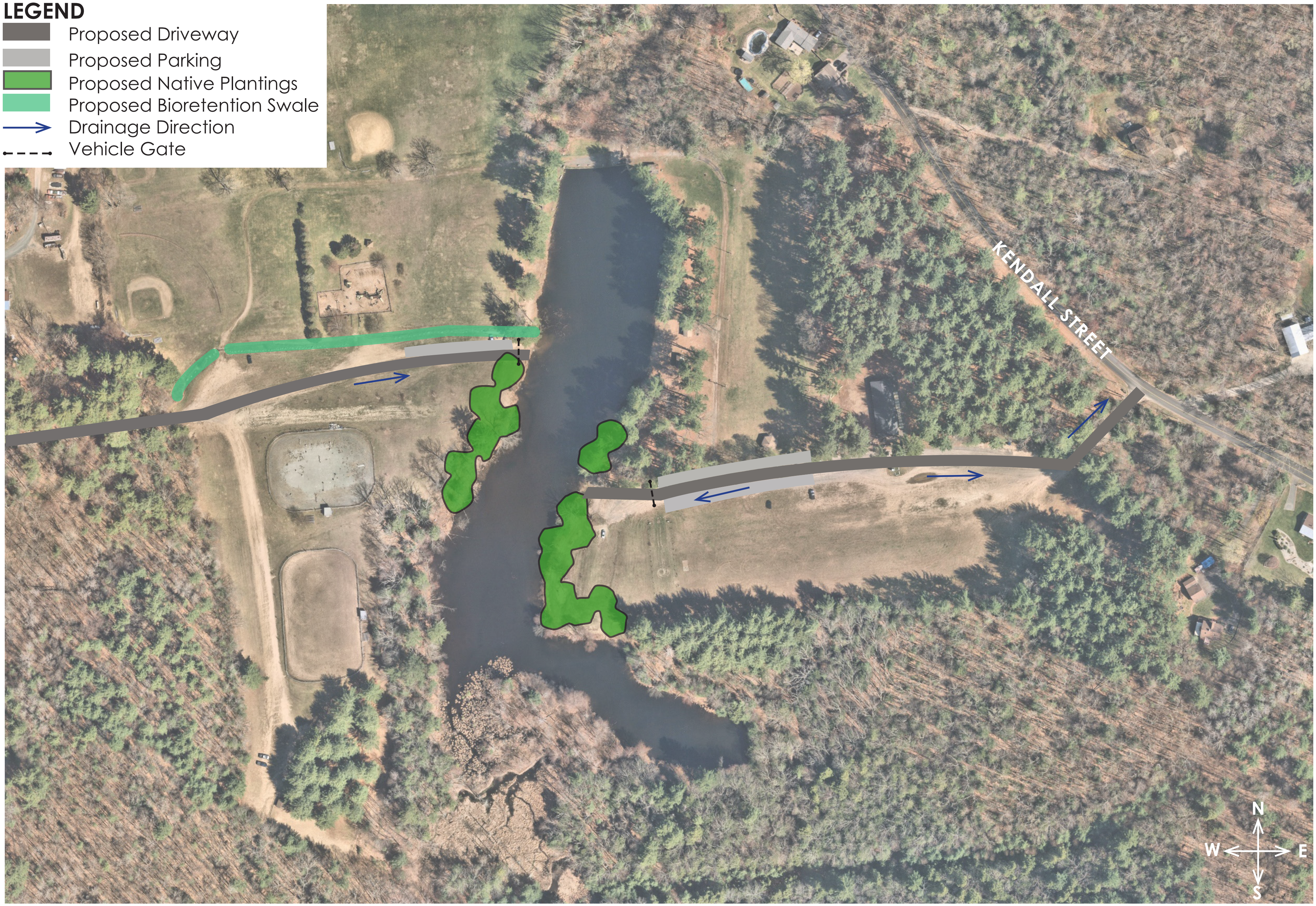
Impervious Area Treated: 3.76 acres
Design Storage Volume (DSV): 10,766 ft^3
Runoff Capture Depth: 0.79 inches
Required DSV to Retain 0.8" Runoff: 10,911 ft^3

Annual Load Reduction
Nitrogen: 92%

Estimated Cost: $431,000*
Bioretention: $51,000
West Parking Lot Upgrade, Restoration: $162,000
East Parking Lot Upgrade, Restoration: $210,000
Native Plantings: $8,000

*Estimated costs do not include the cost of permeable overflow parking.

Image 2: The western parking lot, which is rutted and has expanded due to drivers parking or driving on the grass. Sediment from the parking lot is carried by runoff into the pond.



Dufresne Recreation Park Stormwater Retrofit Concept

Granby, Massachusetts

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Attachment A

Retrofit Sizing Calculations

Retrofit Sizing Calculations

Retrofit Site	BMP Description	Contributing Drainage Area (Pervious and Impervious) (Sq Ft)	Impervious Cover within Drainage Area (Sq Ft)	DCIA (Acres)	Area of Proposed BMP (Sq Ft)	Water Quality Volume* (CF)	Design Storage Volume (CF)	% WQV treated	Runoff Capture Depth (inches)
Brown Ellison Park	Bioretetention Swale	34,141	15,569	0.36	875	1,297	1,304	100%	1.00
Granby Old Public Library	L-Shaped Bioretention Basin	36,070	20,942	0.48	1,175	1,745	1,751	100%	1.00
	Bioretention between Driveways	1,200	1,200	0.03	68	100	101	101%	1.01
West Street Elementary	Western Bioretention Basin	59,109	32,222	0.74	1,050	1,786	1,565	88%	0.88
	Median Bioretention Basin	31,271	14,783	0.34	600	1,232	894	73%	0.73
	Rain Garden	7,545	5,971	0.14	335	498	499	100%	1.00
	Impervious Area Removal and Restoration	18,139	10,109	0.23	10,109	1,512	842	56%	1.00
Town Common Right-of-Way	Subsurface Infiltration - North	3,255	3,232	0.07	64	269	269	100%	1.00
	Subsurface Infiltration - South	95,653	29,940	0.69	560	2,495	2,576	103%	1.03
Dufresne Recreation Park	Impervious Area Removal and Restoration - West Parking Lot	74,449	34,145	0.78	34,145	2,845	2,845	100%	1.00
	Impervious Area Removal and Restoration - East Parking Lot	249,430	58,646	1.35	58,646	4,887	4,887	100%	1.00
	Bioretention Swale	812,605	70,881	1.63	2,036	5,907	3,034	51%	0.51

* Water Quality Volume (WQV) refers to the runoff generated by the first one inch of rainfall on the impervious area of a site

Attachment B

Planning Level Cost Estimates

Order of Magnitude Cost Estimates

Order of Magnitude Cost Range																	
Site Number	Location and BMP Type		Construction					Planning and Design		Cost Range			Life Cycle				
			Unit Cost	Unit	Adjustment Factor	Quantity	Base Cost	Allowance	Cost	Total Cost	-30%	50%	Lifespan (yrs.)	Annual Cost Over Lifespan	O&M (% Cost)	O&M ($/yr.)	Total Capitalized Cost/Year Over Lifespan
1	Brown Ellison Park	Bioretetention Swale	$12.87	CF storage volume	1.0	1,304	$16,782	30%	$5,030	$22,000	$15,000	$33,000	20	$1,620	4%	$60	$1,680
2	Old Granby Library	L-Shaped Bioretention Basin	$12.87	CF storage volume	1.0	1,175	$15,122	30%	$4,540	$20,000	$14,000	$30,000	20	$1,470	4%	$60	$1,530
		Bioretention between Driveways	$12.87	CF storage volume	1.0	68	$875	30%	$260	$2,000	$1,000	$3,000	75	$80	4%	$0	$80
3	West Street Elementary	Western Bioretention Basin	$12.87	CF storage volume	1.0	1,565	$20,141	30%	$6,040	$27,000	$19,000	$41,000	20	$1,990	4%	$80	$2,070
		Median Bioretention Basin	$12.87	CF storage volume	1.0	894	$11,505	30%	$3,450	$15,000	$11,000	$23,000	20	$1,100	4%	$40	$1,140
		Rain Garden	$12.87	CF storage volume	1.0	499	$6,422	30%	$1,930	$9,000	$6,000	$14,000	20	$660	4%	$30	$690
		Impervious Area Removal and Restoration	$30.00	SY	1.0	1,123	$33,697	30%	$10,110	$43,900	$31,000	$66,000	N/A	N/A	0%	N/A	N/A
4	Town Commonw ROW	Subsurface Infiltration - North	$55.94	CF storage volume	1.0	269	$15,047	30%	$4,510	$20,000	$14,000	$30,000	75	$840	4%	$30	$870
		Subsurface Infiltration - South	$55.94	CF storage volume	1.0	2,576	$144,098	30%	$43,230	$188,000	$132,000	$282,000	75	$7,940	4%	$320	$8,260
5	Dufresne Recreation Park	West Parking Lot: Impervious Area Removal and Restoration; Formalization of Remaining Lot; Access Gate and Boulders	--	Project Specific Estimate	1.0	124,000	$124,000	30%	$37,200	$162,000	$113,000	$243,000	N/A	N/A	0%	N/A	N/A
		East Parking Lot: Impervious Area Removal and Restoration; Formalization of Remaining Lot; Access Gate and Boulders	--	Project Specific Estimate	1.0	161,000	$161,000	30%	$48,300	$210,000	$147,000	$315,000	N/A	N/A	0%	N/A	N/A
		Native Plantings	$40.00	EA	1.0	138	$5,506	30%	$1,650	$8,000	$6,000	$12,000	20	$590	4%	$20	$610
		Bioretention Swale	$12.87	CF storage volume	1.0	3,034	$39,046	30%	$11,710	$51,000	$36,000	$77,000	20	$3,750	4%	$150	$3,900
									Total	***$777,900***	***$545,000***	***$1,169,000***					

Notes:
Rate of Inflation used = 2%
Interest (discount) rate used = 6%
Costs are based on screening-level evaluations of site characteristics and should be used for planning purposes only. Construction costs could vary significantly.
Quantities were determined through sizing calculations according to recommended formulas. BMP size may vary slightly on the concept sheets provided, as these images are provided for illustrative purposes only.
Bioretention/Rain Gardens/Swales: Mataleska, Karen, "MS4 Resource: BMP Cost Estimates" (2016). UNH Stormwater Center. 32.https://scholars.unh.edu/cgi/viewcontent.cgi?article=1031&context=stormwater
Subsurface Infiltration: Mataleska, Karen, "MS4 Resource: BMP Cost Estimates" (2016). UNH Stormwater Center. 32.
Pavement Removal: MassHighway Weighted Bid Prices (All Districts) 5/2019-5/2020 "Old Pavement Excavation"