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Reducing Directly Connected Impervious Area (DCIA) through Municipal Retrofits




Connecticut Council of Small Towns (COST) Stormwater Management Workshop

October 22, 2019

Presentation Outline

- What is DCIA and why does it matter?
- DCIA reduction – how much is enough?
- How can I achieve DCIA reduction goals?
- What is a retrofit plan and why do I need one?
- How do I develop a retrofit plan?
- Examples
- Questions

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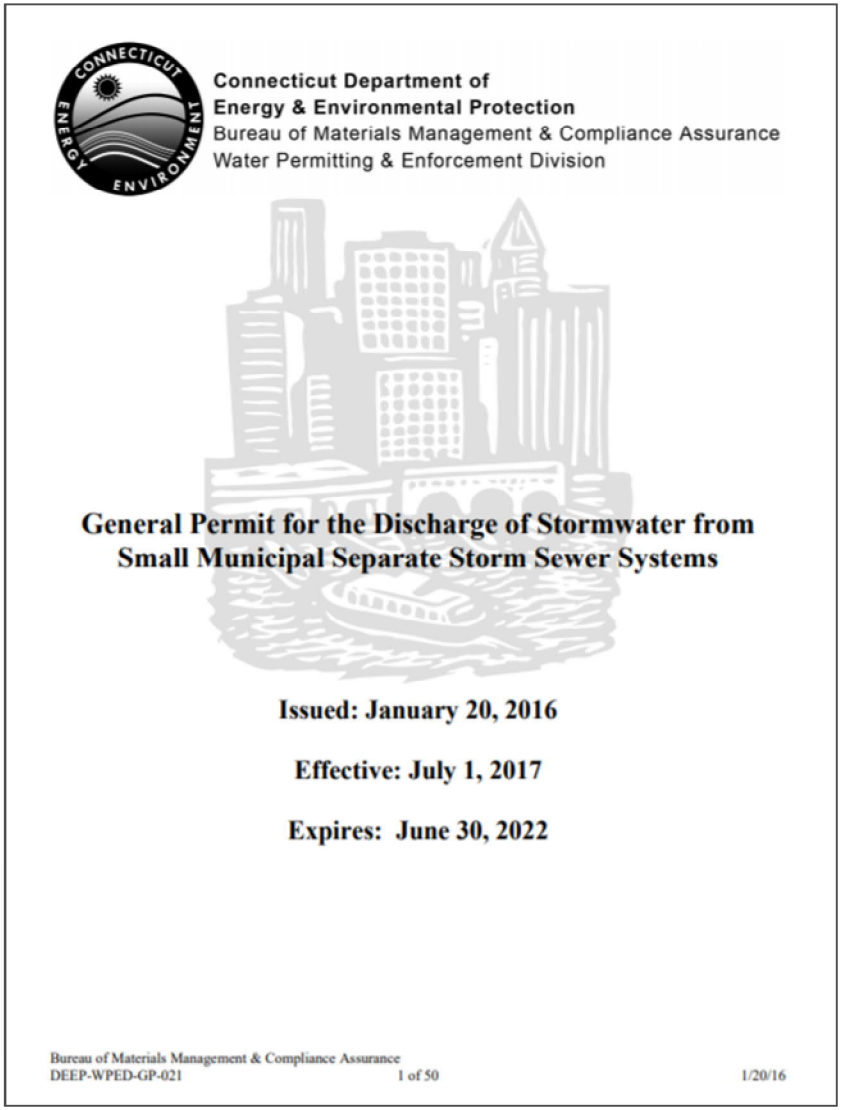
MS4 Permit Requirements

- MCM 6 – Pollution Prevention/Good Housekeeping "Retrofit Program"
- Goal: "disconnect" existing Directly Connected Impervious Areas (DCIA)
- Develop Retrofit Plan by end of Year 3
- Implement retrofit projects by end of Years 4 and 5



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Energy & Environmental Protection
Bureau of Materials Management & Compliance Assurance
Water Permitting & Enforcement Division

General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems

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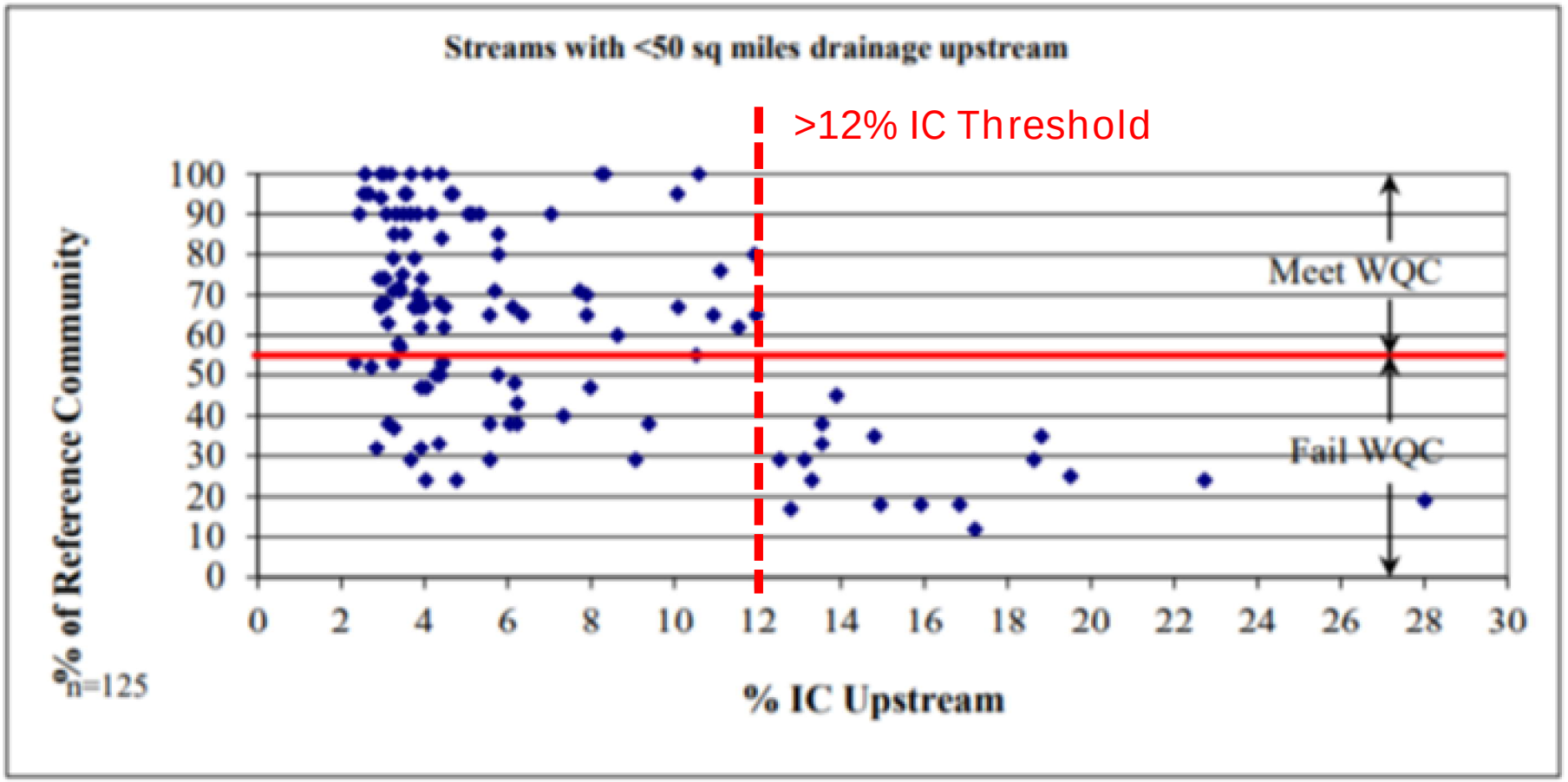
Why Impervious Cover?

- Reliable indicator of water quality in a watershed



Source: CT Watershed Response Plan for Impervious Cover, CTDEEP

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What is DCIA?

Directly Connected Impervious Area (DCIA)

- Impervious area from which stormwater runoff discharges DIRECTLY to the MS4 or directly to waters of the state
- NOT impervious areas discharging through a system designed to retain the appropriate Water Quality Volume

All impervious cover is not created equal!

IC ≠ DCIA

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Examples of DCIA

- Runoff from a parking lots, roads, driveways, roofs, etc. entering the drainage system directly

Examples of DCIA

- Runoff discharging directly to waters of the state – rivers, ponds, wetlands, coastal waters

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Examples – Not DCIA

- Driveways, roofs, etc. that discharge to pervious areas and infiltrate into the ground


Pavement Disconnection


Disconnected Downspouts


Disconnected Driveway

Examples – Not DCIA

- Impervious areas discharging through stormwater controls (structural BMPs)

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When is DCIA Considered “Disconnected”?

- Retain appropriate portion of the Water Quality Volume on-site (infiltration BMPs)
  - ½ WQV ≥ 40% DCIA
  - Full WQV < 40% DCIA
- Where not feasible, retain runoff volume to maximum extent achievable and treat rest of the volume up to the WQV (treatment BMPs)

Water Quality Volume (WQV)
Volume of runoff generated by first 1” of rainfall

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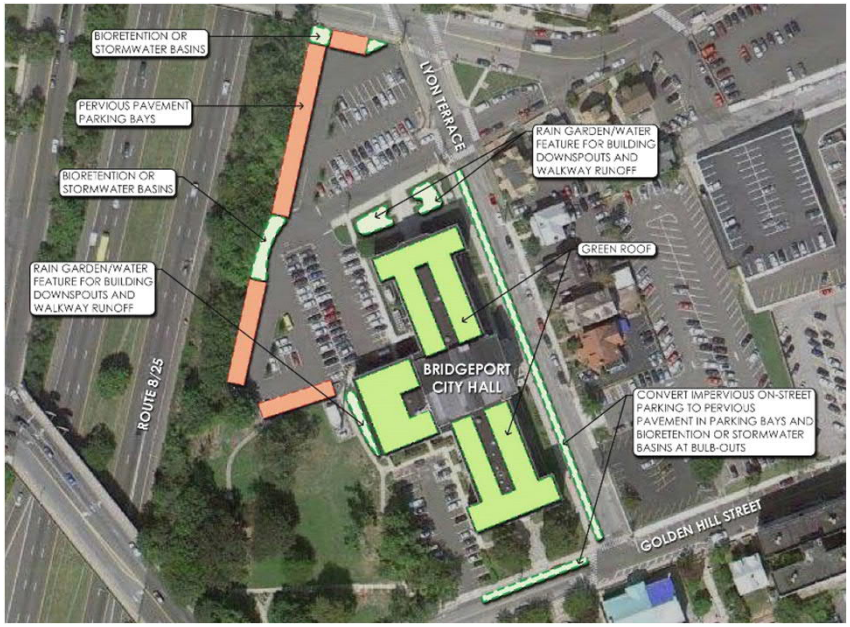
Municipal Retrofit Types

- Municipal Sites
  - Municipal parking lots
  - Schools, libraries, police, fire stations
  - Parking at parks and recreation areas
  - Public works facilities
- Municipal Right-of-Way
  - Roads and sidewalks
  - Local roads can account for 20% or more of town-wide IC



Retrofit existing municipal sites and right-of-way using LID and GI stormwater controls

Infiltration BMPs – Sites

Surface and Subsurface Infiltration Systems

Infiltration BMPs – Sites

Permeable/Porous Pavement

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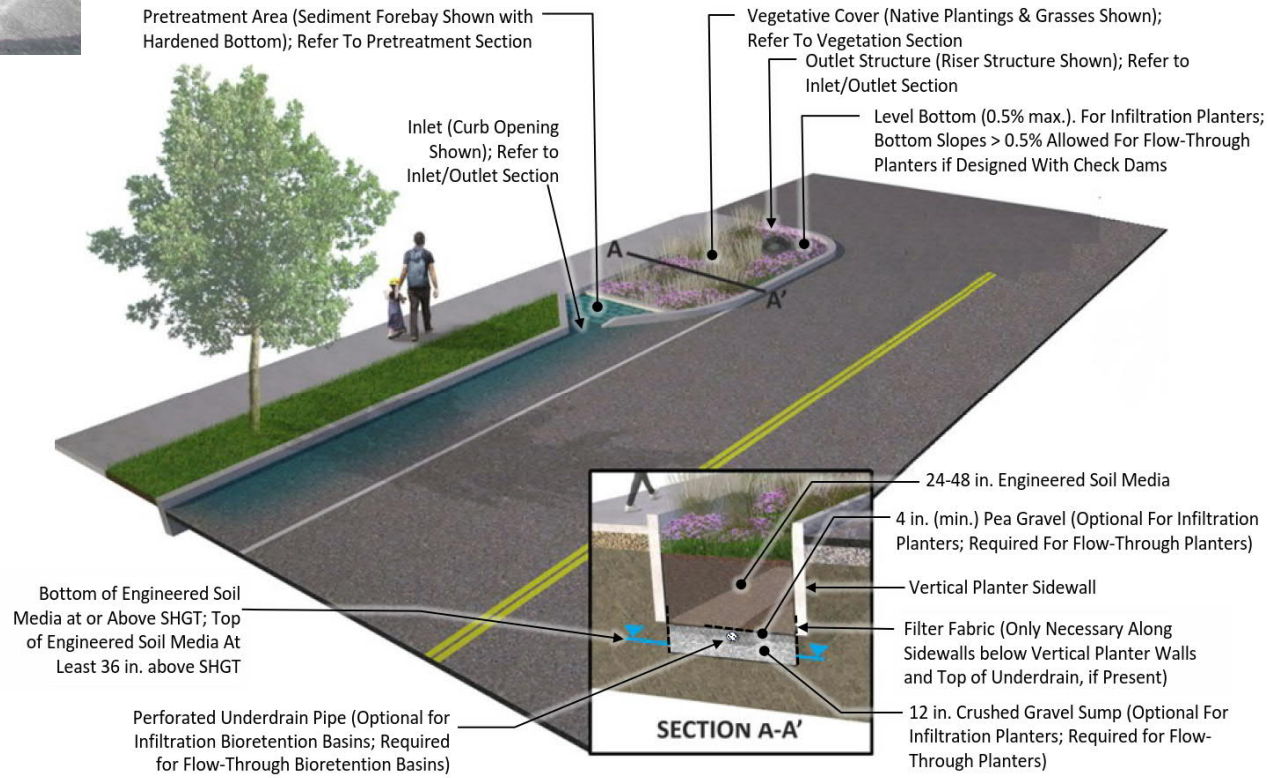
Infiltration BMPs – ROW

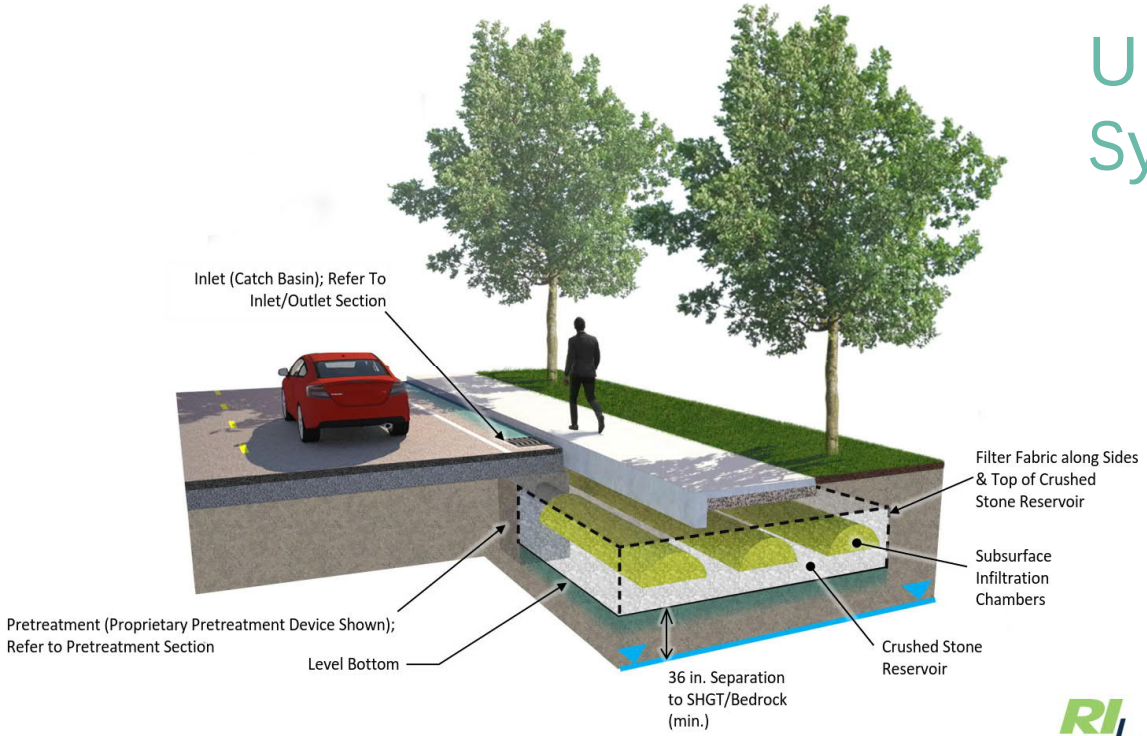
Roadside Bioswales

Bioretention Curb Extensions

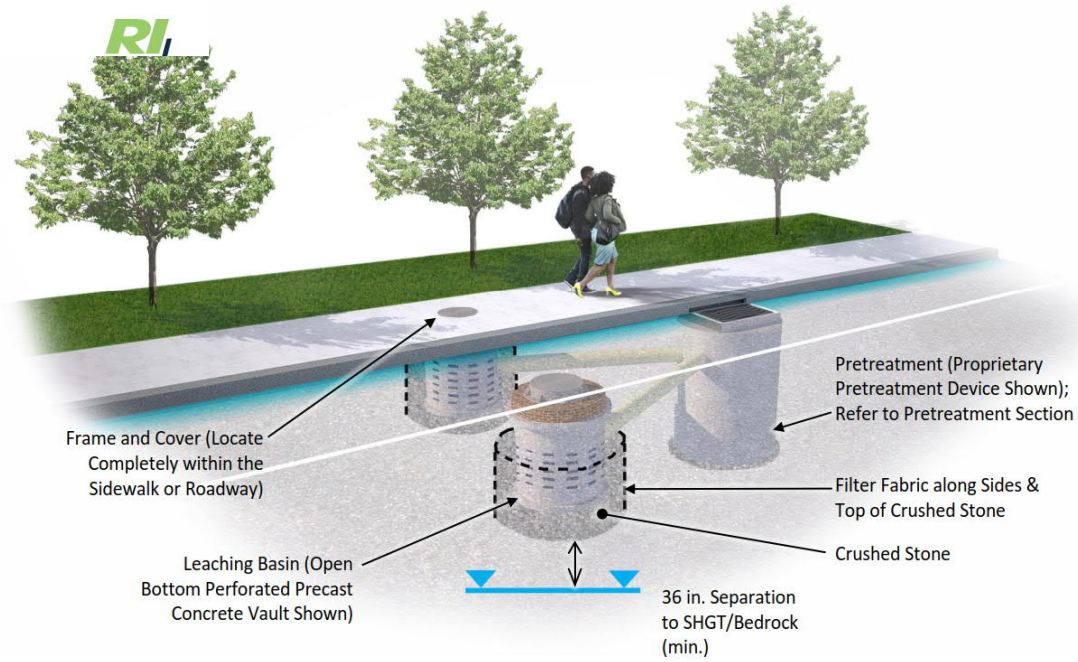


Infiltration BMPs – ROW

Underground Infiltration Systems

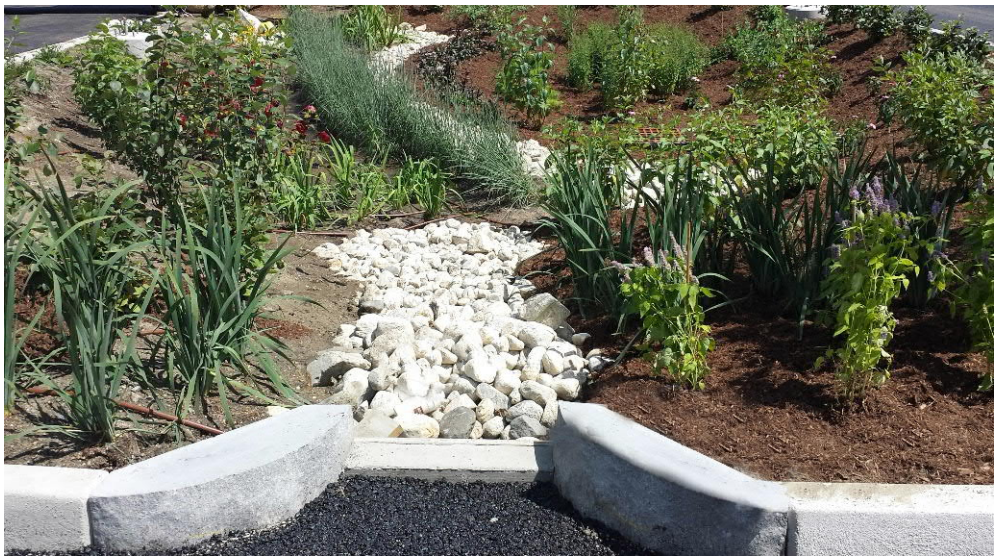


Leaching Catch Basins



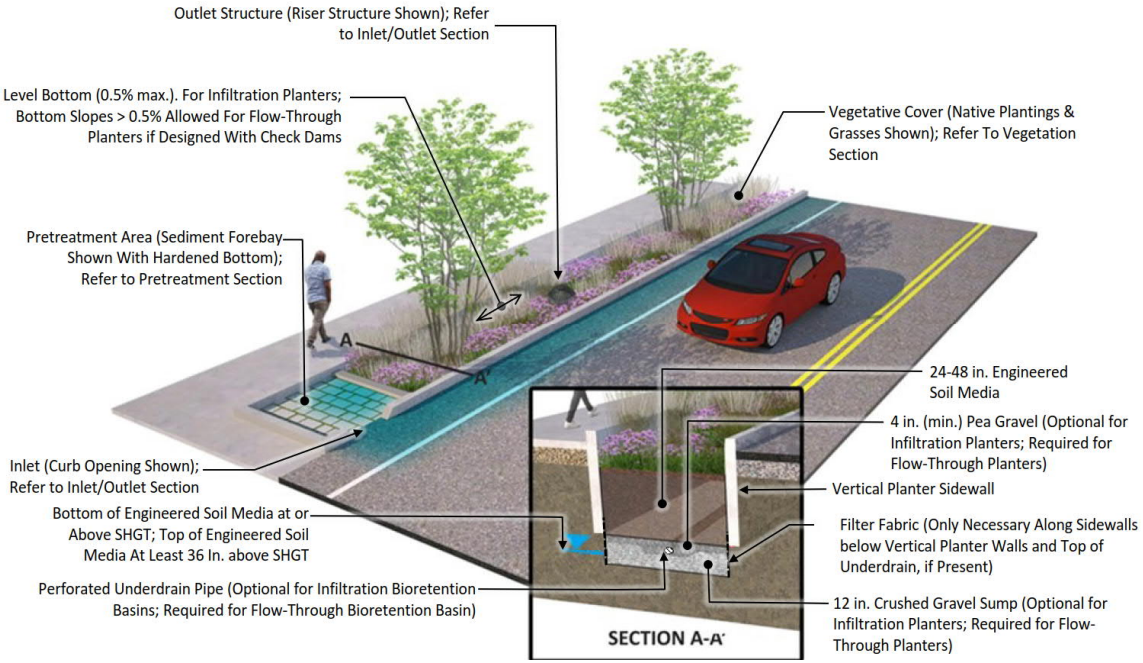
Treatment BMPs – Sites

Bioretention/Rain Gardens

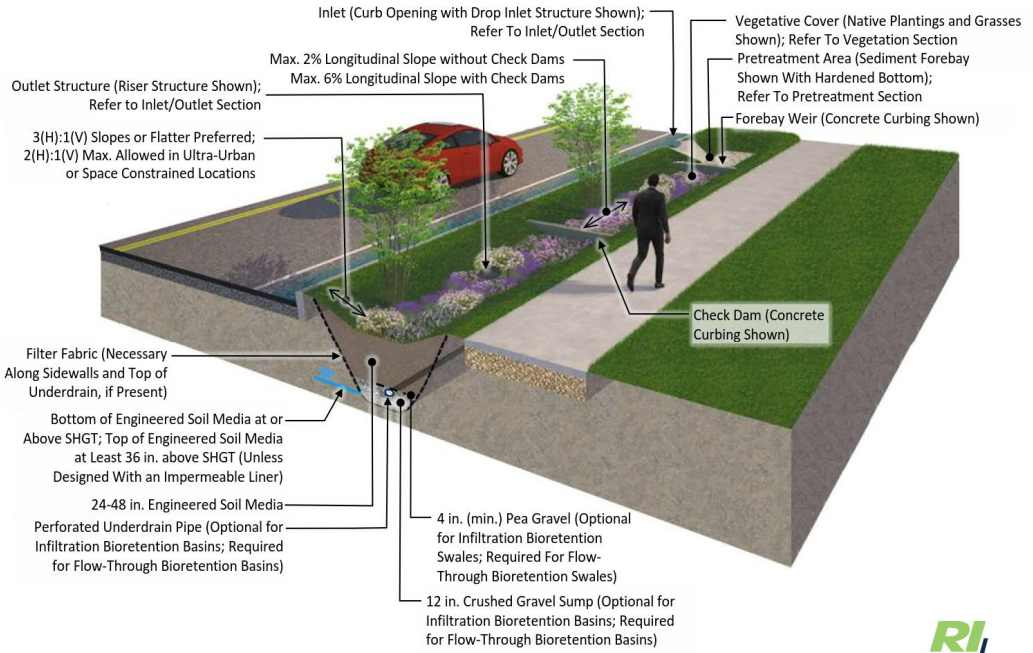


Treatment BMPs – ROW

Bioretention Curb Inlet Planter

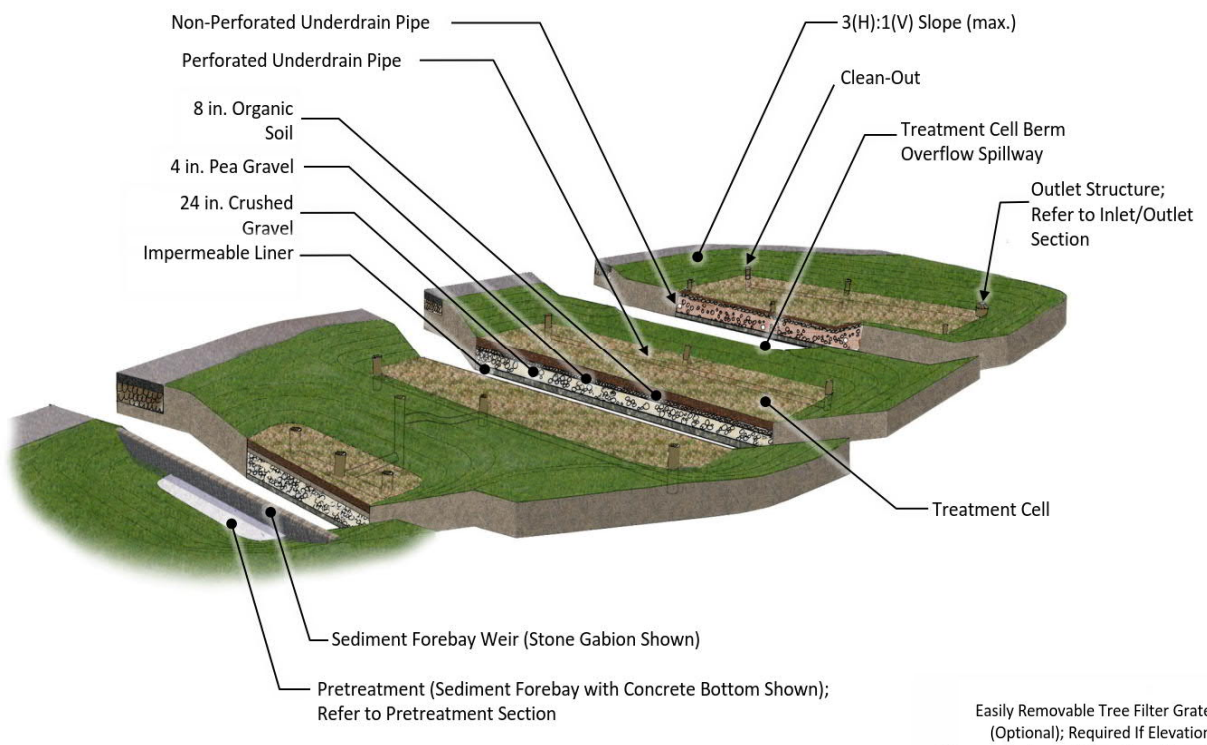


Bioretention Swale

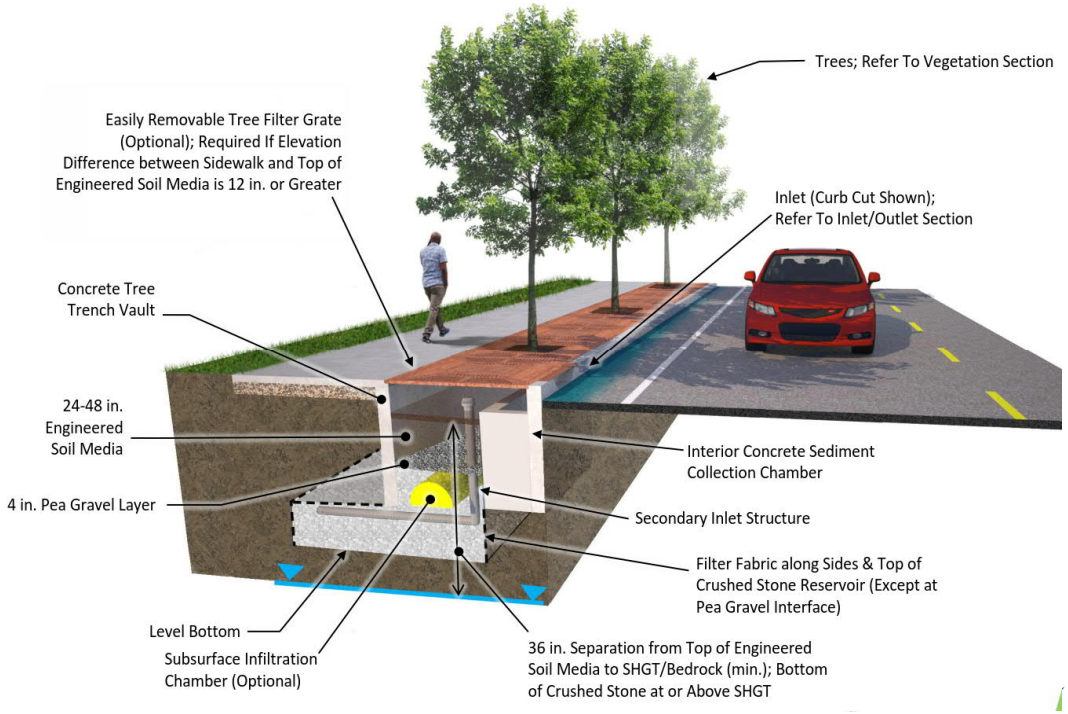


Treatment BMPs – ROW

Wet Vegetated Treatment System

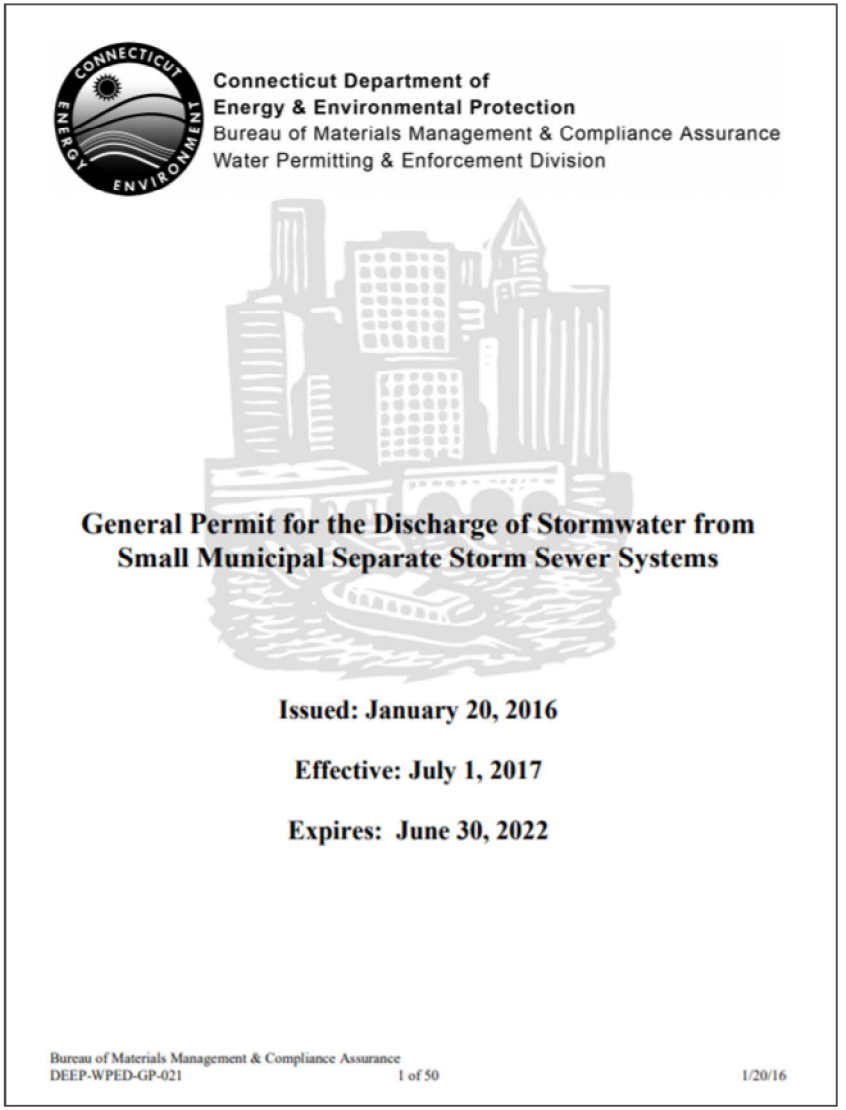


Tree Filter with Storage



DCIA Reduction Goals in MS4 Permit

- 2% reduction by end of 5-year permit
  - 1% in Year 4 (2021)
  - 1% in Year 5 (2022)
- Can count disconnections implemented since 2012
- 1% reduction per year after Year 5
- Maximum Extent Practicable (MEP)
- Track disconnections/DCIA annually



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Estimating Baseline DCIA

- Reductions measured against 2012 baseline
- Estimate DCIA town-wide (excluding state roads and other MS4s)
- 1-foot resolution statewide IC data (2012 imagery)

Source: UConn CLEAR

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DCIA Estimation Method

- Range of Approaches (UConn CLEAR/NEMO)

UCONN | COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

CLEAR

Getting from IC to DCIA

- Three Approaches
  - Just use IC
  - Estimate DCIA based on existing land use
  - Aerial imagery and field checks

Fiesta

Tesla

Prius

NEMO

Sutherland Equations

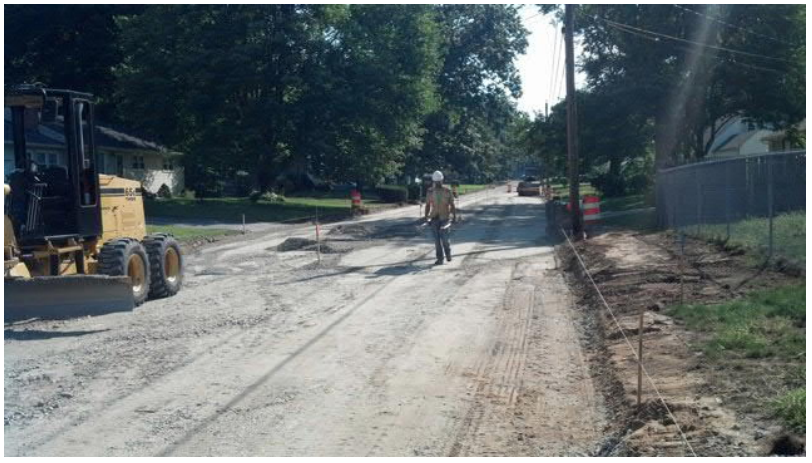
Connectivity Level	Description of Contributing Area	Land use type	Equation	Example for a Watershed with 20% Impervious Cover (IC)
1. Fully Connected (default)	100% storm sewered with all IC	High density mixed use, commercial	None. DCIA% = IC%	**20% DCIA**
2. Wicked Connected	Mostly storm sewered with curb and gutter, residential rooftops connected to MS4	High density residential, commercial, industrial, institutional	DCIA%=0.4(%IC)^1.2	**14.6% DCIA**
3. Moderately Connection	Mostly storm sewered with curb and gutter, residential rooftops NOT connected to MS4	Medium density residential, commercial, industrial, institutional, open land	DCIA%=0.1(%IC)^1.5	**8.9% DCIA**
4. Sorta Connected	50% storm sewered with some infiltration and residential rooftops not connected to MS4	Low density residential, open land	DCIA%=0.04(%IC)^1.7	**6.5% DCIA**
5. Slightly Connected	Small % of urban area storm sewered or mostly infiltration	Agricultural, forested, natural areas	DCIA%=0.01(%IC)^2	**4% DCIA**

Baseline DCIA and DCIA Reduction Goals

Municipality	DCIA (%)	DCIA (acres)	2% DCIA Reduction Goal (acres)
Danbury	9.2	2,599	52.0
Stonington	3.5	871	17.4
New Fairfield	1.2	185	3.7
Somers	1.5	268	5.4
Woodbury	0.8	192	3.8

Development of a Municipal Retrofit Plan

- Identify prioritized list of sites and ROW projects to meet 2% DCIA reduction goal and provide water quality and quantity benefits
- Retrofits are more cost-effective when implemented in conjunction with planned projects
- Integration with municipal capital planning process



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Retrofit Planning Process

1. Objectives and criteria
2. Background data/information gathering
3. Desktop screening
4. Site assessment
5. Prioritization
6. Conceptual designs

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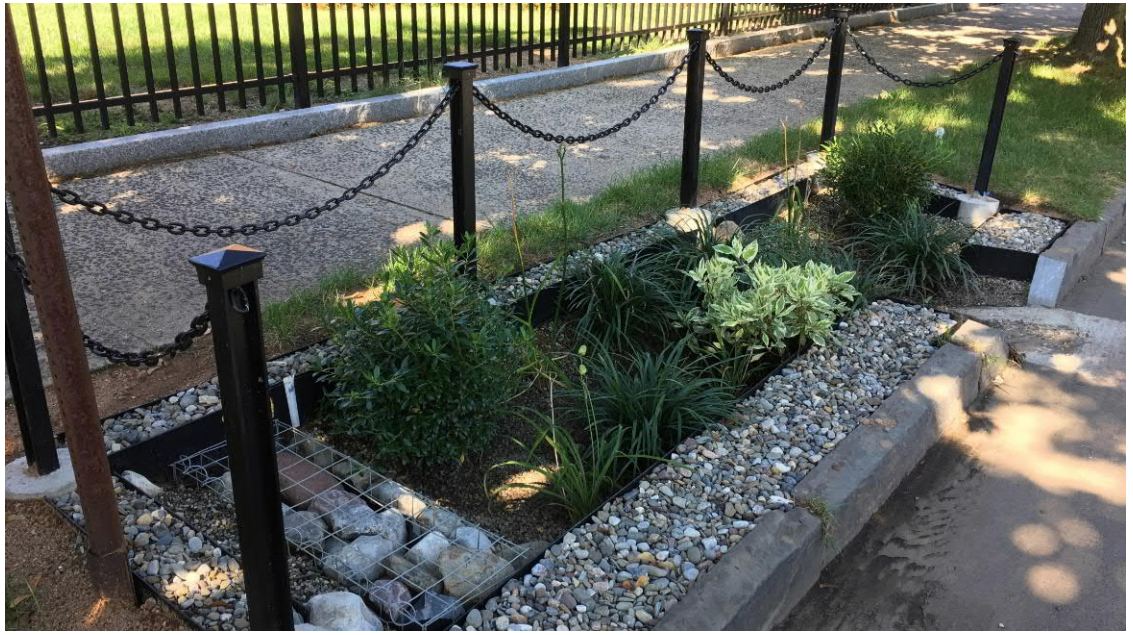
Retrofit Objectives and Criteria

- Permit compliance and other local objectives
  - Planned municipal stormwater/drainage infrastructure upgrades, road projects, site projects (CIP)
  - Water Quality
  - Flooding
  - Preferred BMPs
  - O&M issues



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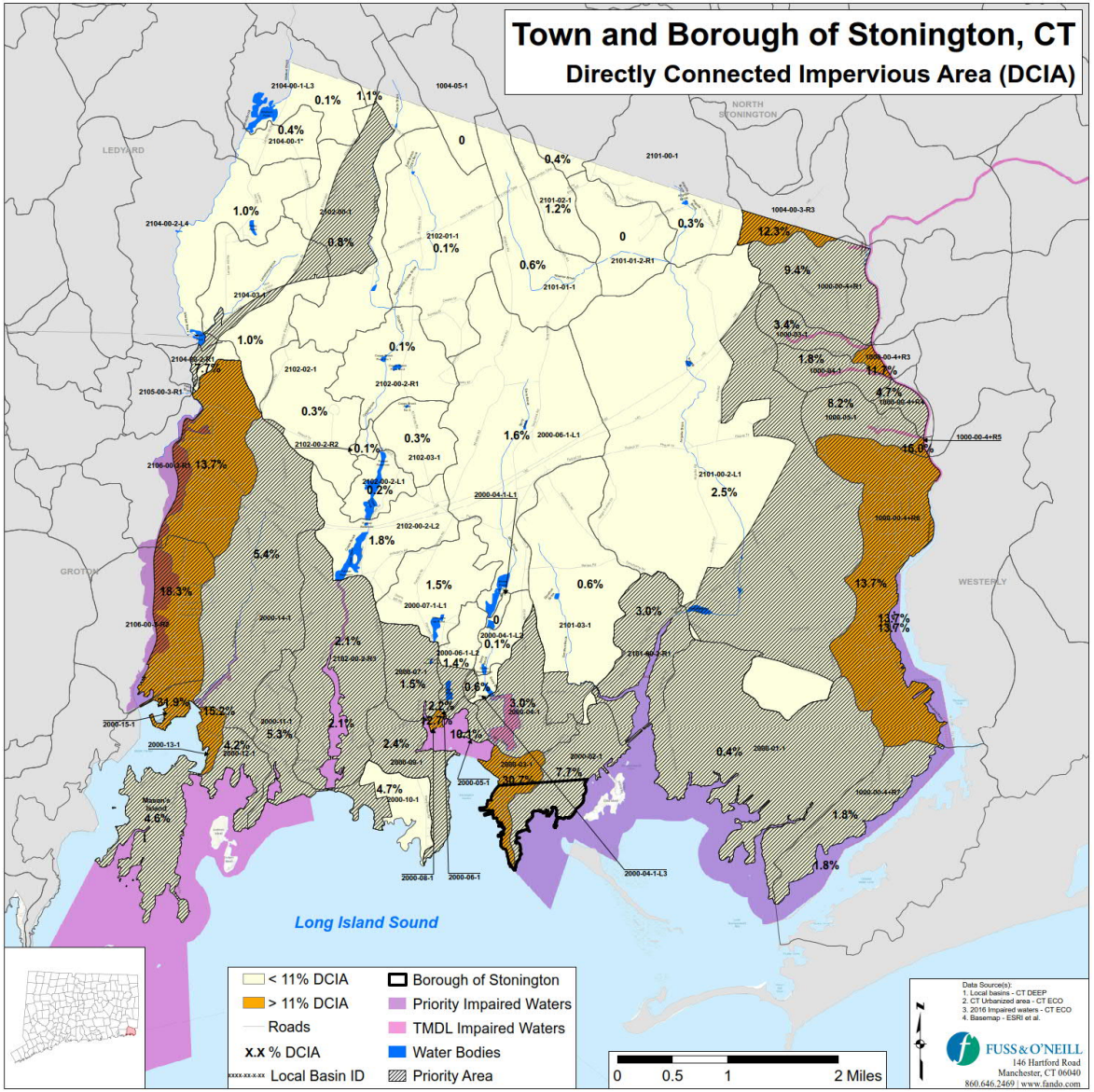
Background Data and Information Needs

- Priority Area
- Drainage system mapping
- Impaired Waters/TMDL
- Hydrologic Soil Group
- Depth to Groundwater
- Parcel Data (Ownership)



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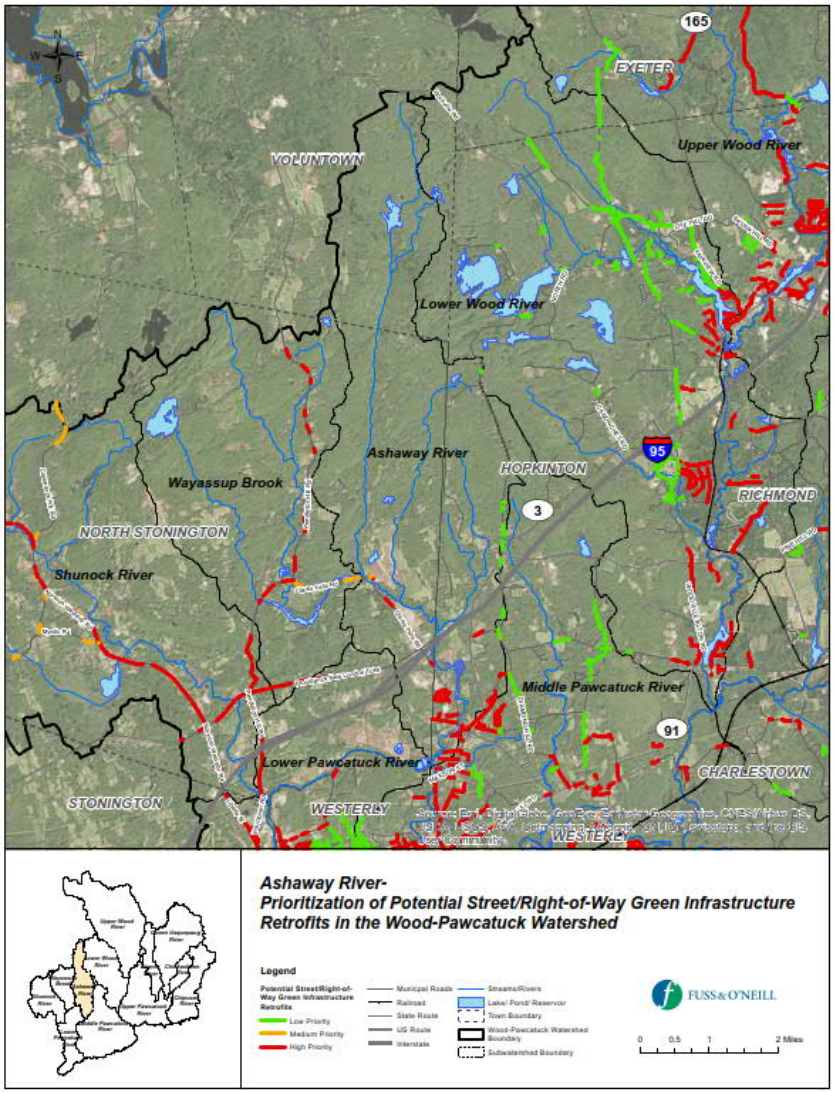
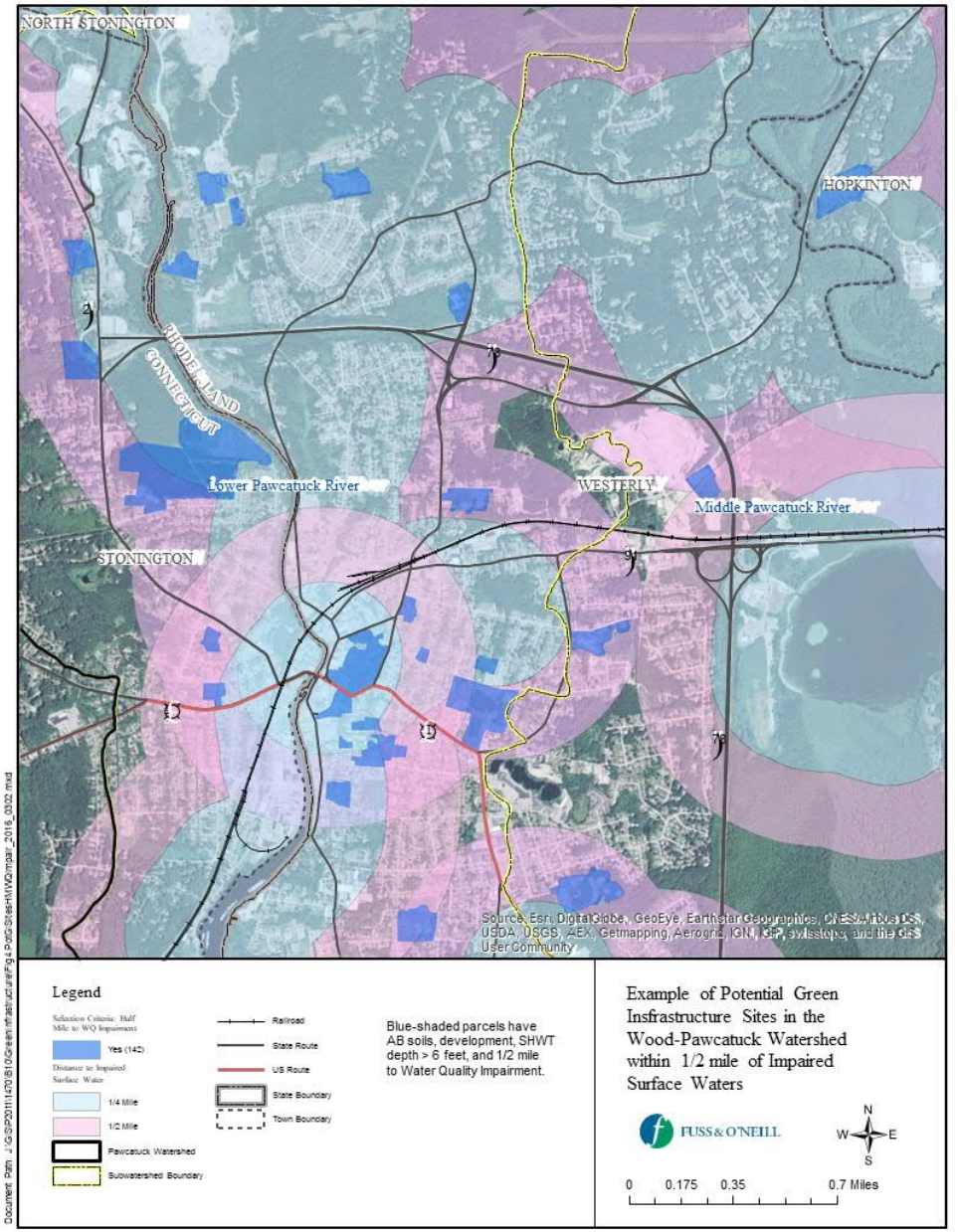
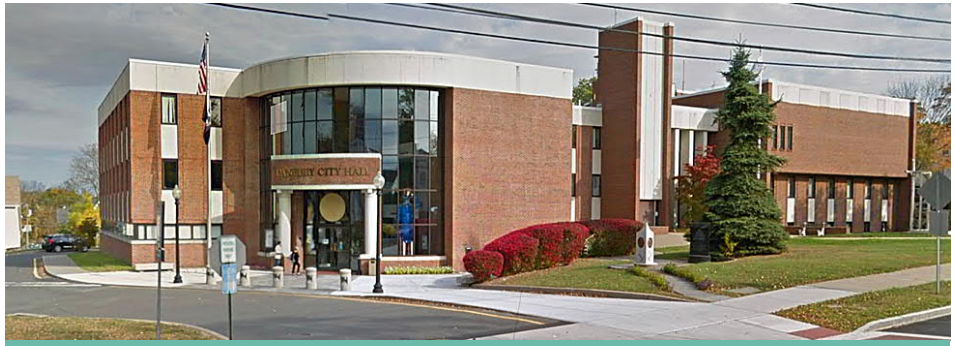
Desktop Screening

- Parcel-based opportunities
- Right-of-way opportunities





Screening Factors



Municipal Facilities & Sites

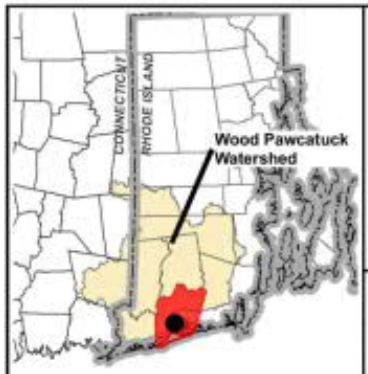
- Priority Area
- Water Quality Impairments/TMDLs
- Impervious area
- Slope
- Soils
- Depth to groundwater

Municipal Right-of-Way

- Priority Area
- Water Quality Impairments/TMDLs
- Impervious area
- Slope
- Soils
- Depth to groundwater
- Road classification
- Road Width

Site Assessment – Pawcatuck River

- Field reconnaissance/site visits
- Site constraints
  - Site drainage patterns
  - Storm drainage system configuration
  - Available space
  - Utility conflicts
  - Site operations



Legend

- Existing Catch Basin
- Proposed Catch Basin
- Proposed Overflow Structure
- Proposed Level Spreader
- Proposed Storm Drain
- BMP Drainage Area Boundary
- Bioretention
- Raingarden
- Underground Infiltration
- Green Roof
- Pervious Pavers
- Forested Buffer
- Articulating Concrete Matting

0 50 100 200 Feet

N W E S

Disclaimer: This map is not the product of a Professional Land Survey. It was created by Fuss & O'Neill, Inc. for general reference, informational, planning and guidance use, and is not a legally authoratative source as to location of natural or manmade features. Proper interpretation of this map may require the assistance of appropriate professional services. Fuss & O'Neill, Inc. makes no warrantee, express or implied, related to the spatial accuracy, reliability, completeness, or currentness of this map.

Data Source(s): Drainage Areas by Fuss & O'Neill, 2016; Aerial Photography: April 2014 USGS 0.3 m multispectral ortho imagery, downloaded from ArcGIS Online; Contour Lines from Northeast LIDAR Project 2011, RIGIS

Stormwater Retrofit Concept

Vin Gormley Trailhead Parking

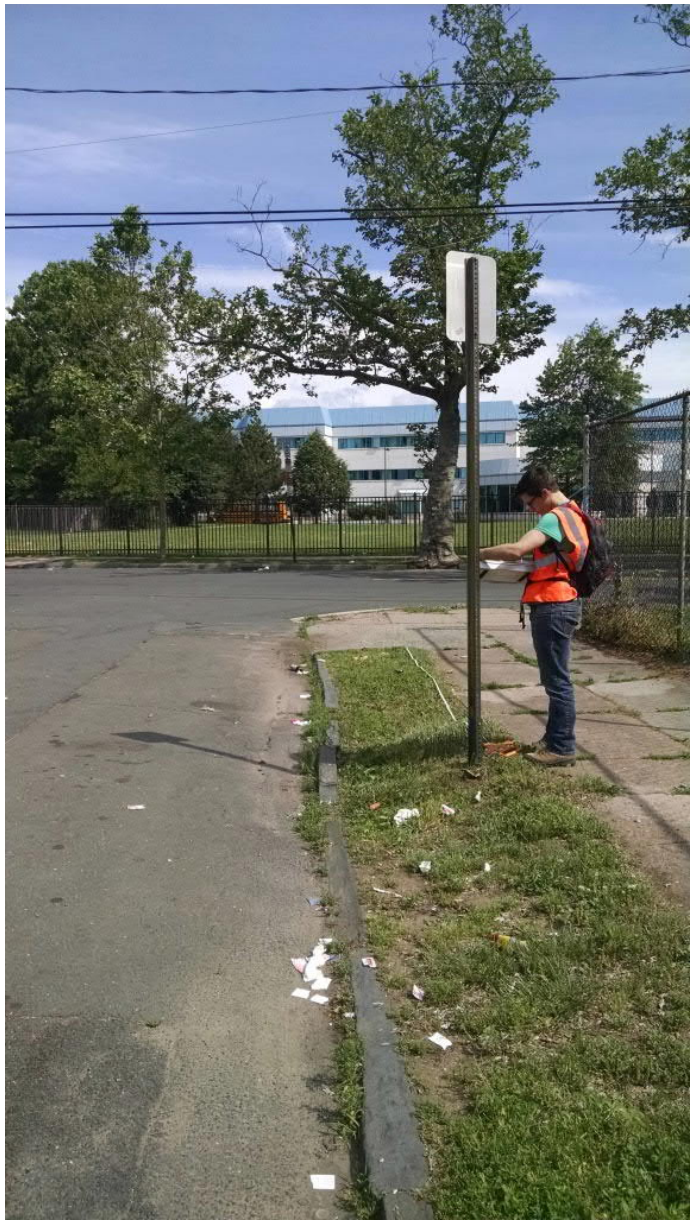
Retrofit Site No. 21

Charlestown Rhode Island

FUSS & O'NEILL
317 Iron Horse Way, Suite 204
Providence, RI 02908
401.861.3070 | www.fando.com

Site Assessment – New Haven Bioswales

- Visually inspected all streets in project area (West River)
- Sufficient space
- Streets with sidewalk & tree belt
- Minimum separation distances
- Avoid infrastructure conflicts
  - Trees
  - Parking meters
  - Sign posts
  - Telephone/light poles
  - Fire hydrants
  - Edge of driveway/curb cut



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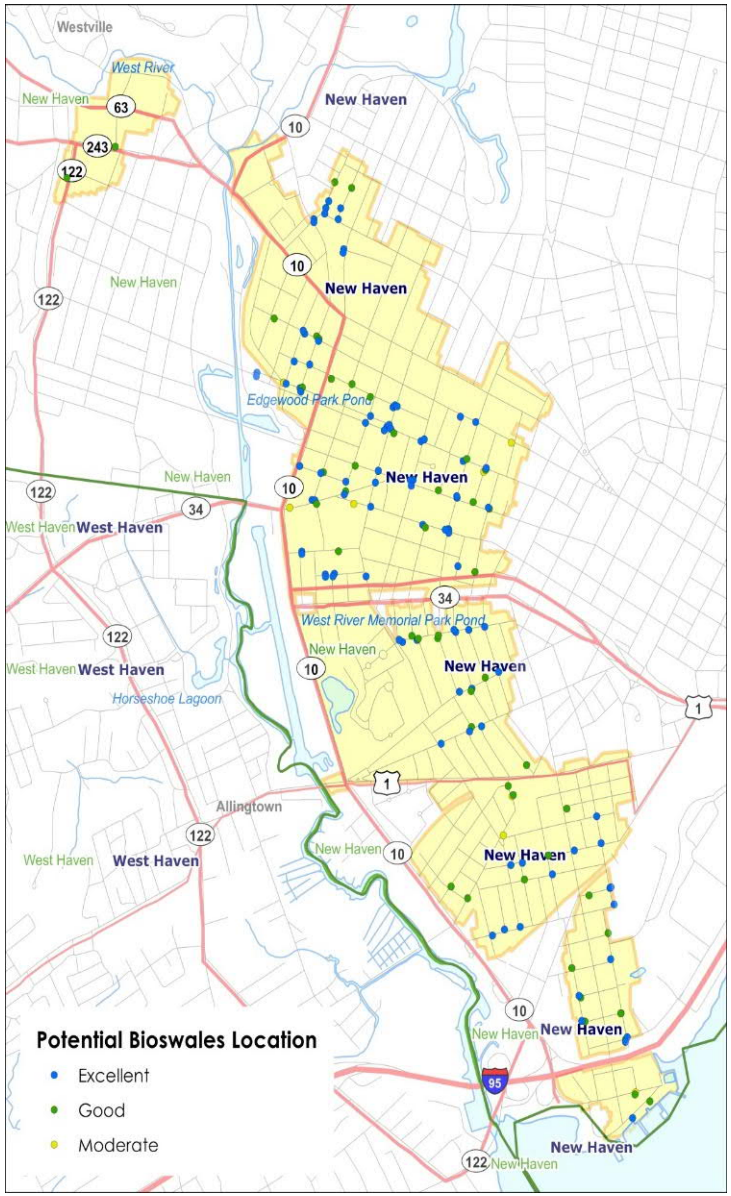
Potential Bioswale Locations

- 154 potential bioswale locations identified



Bioswale Site Rating Factors and Criteria

Rating Factors	Rating Criteria		
	Excellent	Good	Moderate
Tree belt and Sidewalk Widths	5-foot or greater tree belt width OR 10-foot or greater sidewalk width with no tree belt	Less than 5-foot tree belt width BUT greater than 9-foot combined sidewalk and tree belt width	Not applicable
Utility Laterals	Utility laterals are not present or believed not to be present within proposed bioswale footprint	One utility lateral is present or believed to be present within proposed bioswale footprint	More than one utility lateral is present or believed to be present within proposed bioswale footprint
Other Factors	There are no other factors making the site unfavorable	There are no other factors making the site unfavorable	Other factors make the location less favorable due to high trash generation area, a potential conflict with adjacent land uses, or other concern or issue

- 70 bioswales constructed (2019)

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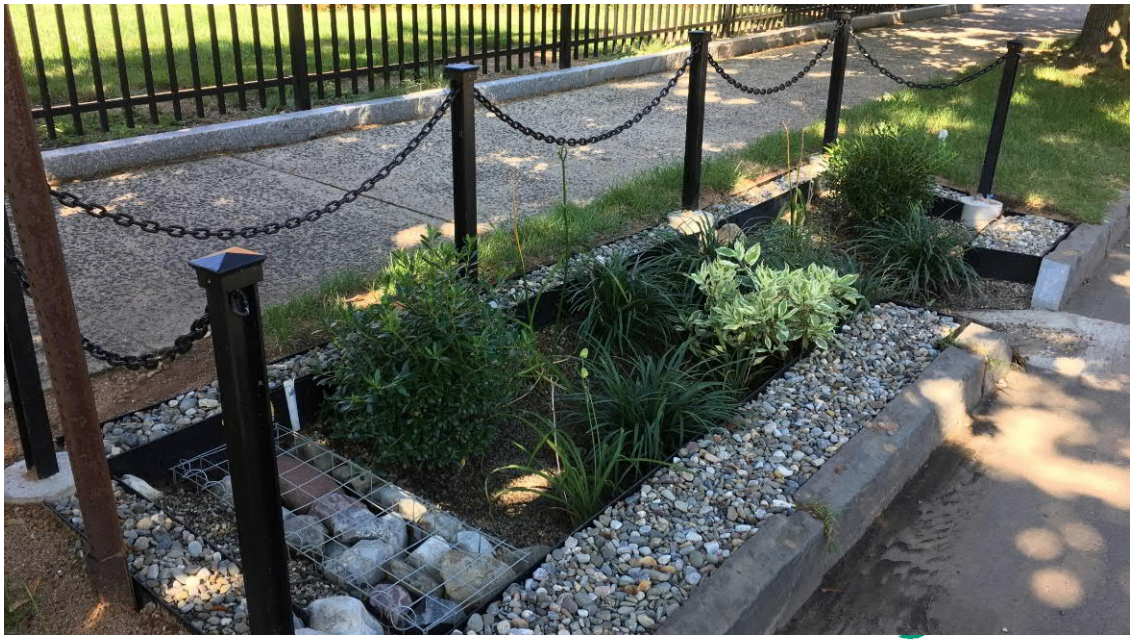
Site Assessment – New Haven Bioswales



Retrofit Project Prioritization

- Built-in to site screening
  - Priority Area (required by MS4 Permit)
  - Other site and BMP factors
- Other Considerations
  - O&M issues
  - Public acceptance
  - Public visibility
  - Educational/demonstration value

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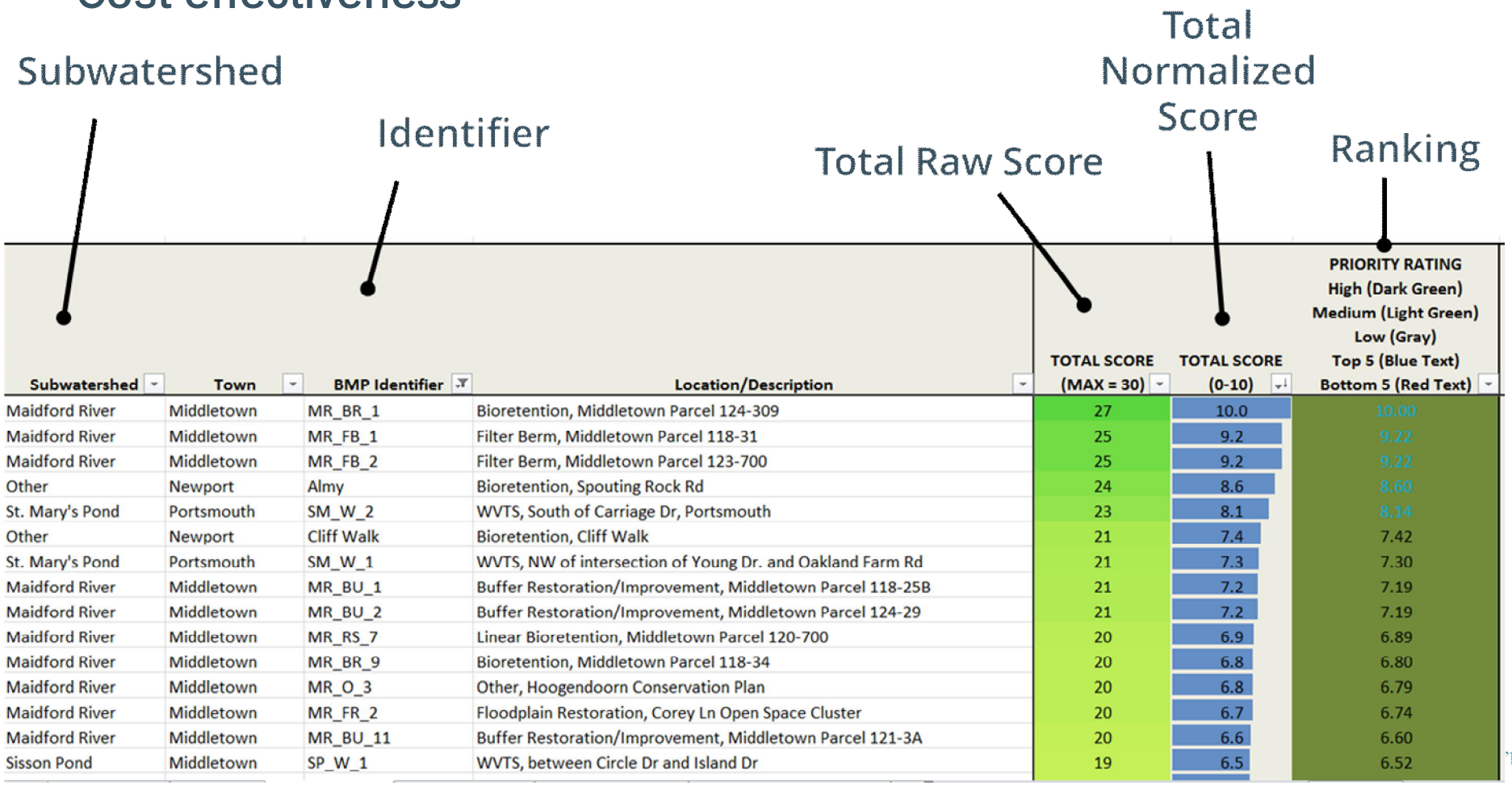
Retrofit Project Prioritization

- Quantitative Approach (scoring and ranking)
  - Watershed and BMP characteristics
  - Community considerations
  - Cost effectiveness



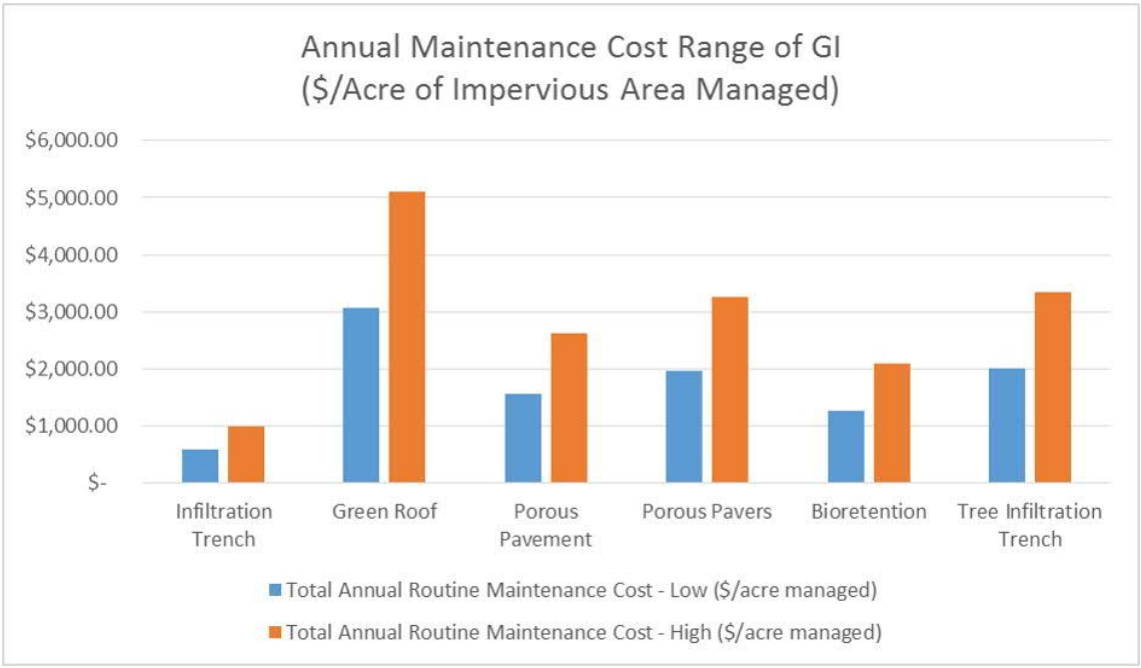
Subwatershed	Town	BMP Identifier	Location/Description	TOTAL SCORE (MAX = 30)	TOTAL SCORE (0-10)	PRIORITY RATING High (Dark Green) Medium (Light Green) Low (Gray) Top 5 (Blue Text) Bottom 5 (Red Text)
Maidford River	Middletown	MR_BR_1	Bioretention, Middletown Parcel 124-309	27	10.0	10.00
Maidford River	Middletown	MR_FB_1	Filter Berm, Middletown Parcel 118-31	25	9.2	9.22
Maidford River	Middletown	MR_FB_2	Filter Berm, Middletown Parcel 123-700	25	9.2	9.22
Other	Newport	Almy	Bioretention, Spouting Rock Rd	24	8.6	8.60
St. Mary's Pond	Portsmouth	SM_W_2	WVTS, South of Carriage Dr, Portsmouth	23	8.1	8.14
Other	Newport	Cliff Walk	Bioretention, Cliff Walk	21	7.4	7.42
St. Mary's Pond	Portsmouth	SM_W_1	WVTS, NW of intersection of Young Dr. and Oakland Farm Rd	21	7.3	7.30
Maidford River	Middletown	MR_BU_1	Buffer Restoration/Improvement, Middletown Parcel 118-25B	21	7.2	7.19
Maidford River	Middletown	MR_BU_2	Buffer Restoration/Improvement, Middletown Parcel 124-29	21	7.2	7.19
Maidford River	Middletown	MR_RS_7	Linear Bioretention, Middletown Parcel 120-700	20	6.9	6.89
Maidford River	Middletown	MR_BR_9	Bioretention, Middletown Parcel 118-34	20	6.8	6.80
Maidford River	Middletown	MR_O_3	Other, Hoogendoorn Conservation Plan	20	6.8	6.79
Maidford River	Middletown	MR_FR_2	Floodplain Restoration, Corey Ln Open Space Cluster	20	6.7	6.74
Maidford River	Middletown	MR_BU_11	Buffer Restoration/Improvement, Middletown Parcel 121-3A	20	6.6	6.60
Sisson Pond	Middletown	SP_W_1	WVTS, between Circle Dr and Island Dr	19	6.5	6.52

Retrofit Costs

- Costs
  - Upfront and ongoing maintenance costs
- Cost-Effectiveness
  - $ per acre DCIA removed
  - $ per pound of pollutant removed

BMP	Design and Installation Unit Cost ($/ft^3) (2018)
Infiltration Trench	$12.60 – $37.80
Infiltration Basin	$6.30 – $18.90
Bioretention	$15.60 – $46.80
Gravel Wetlands/WVTS	$8.86 – $26.58
Porous Pavement	$18.24 – $54.72
Sand Filter	$18.10 – $54.30
Wet Pond	$6.86 – $20.58

Source: Stormwater Control Measure Nomographs with pollutant removal and design cost estimates, UNH Stormwater Center, May 2019



Source: Water Environment Federation, 2015

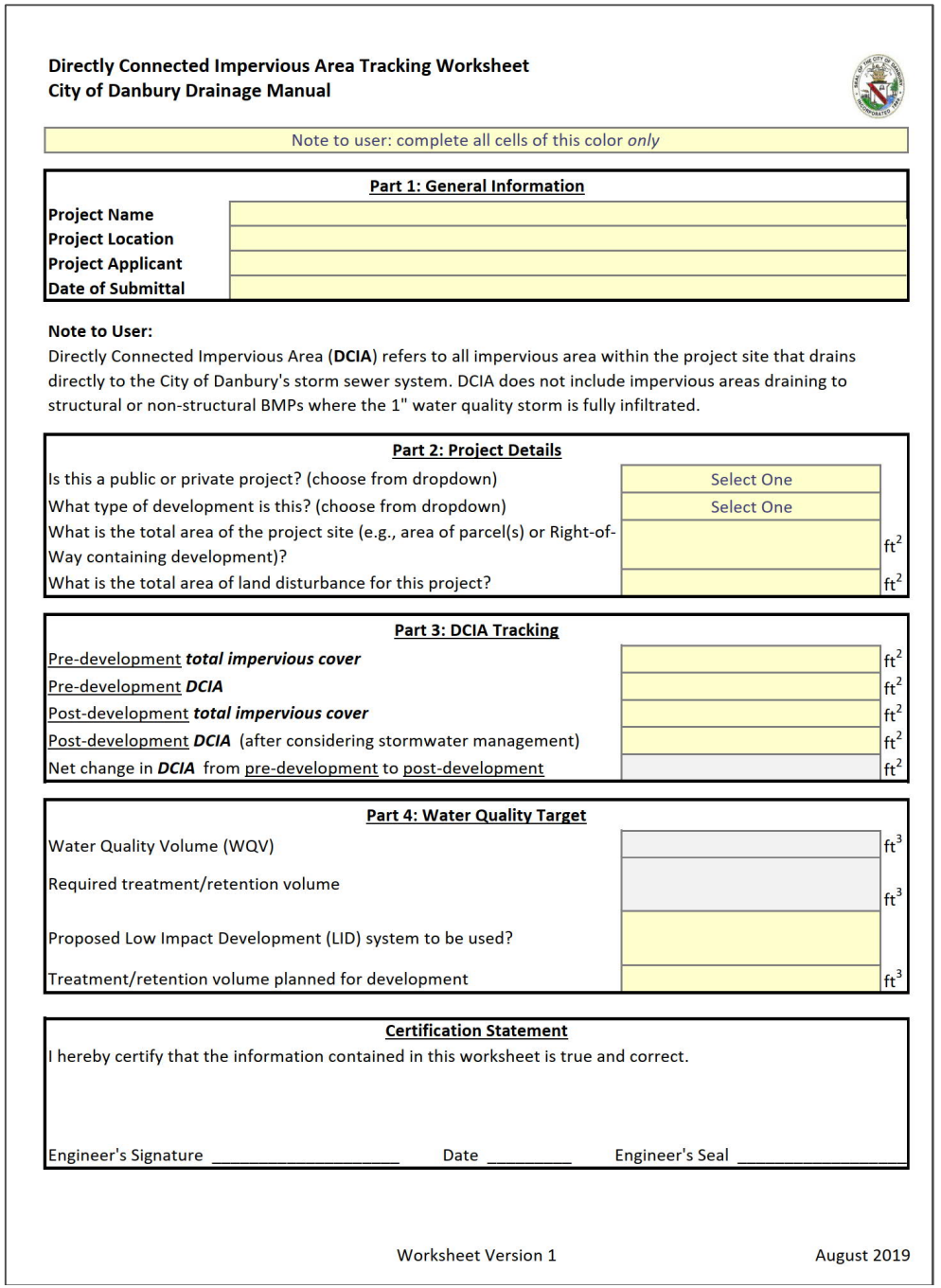
DCIA Reduction Costs

- WQV x Design and Installation Unit Cost

Municipality	2% DCIA Reduction Goal (acres)	Potential Design and Installation Cost ($)
Danbury	52.0	$5.3M
Stonington	17.4	$1.8M
New Fairfield	3.7	$200K
Somers	5.4	$300K
Woodbury	3.8	$200K

DCIA Reduction Tracking

- Document DCIA reduction for each retrofit and redevelopment project



Directly Connected Impervious Area Tracking Worksheet
City of Danbury Drainage Manual

Note to user: complete all cells of this color *only*

Part 1: General Information

Project Name	
Project Location	
Project Applicant	
Date of Submittal	

Note to User:
Directly Connected Impervious Area (**DCIA**) refers to all impervious area within the project site that drains directly to the City of Danbury's storm sewer system. DCIA does not include impervious areas draining to structural or non-structural BMPs where the 1" water quality storm is fully infiltrated.

Part 2: Project Details

Is this a public or private project? (choose from dropdown)	Select One	
What type of development is this? (choose from dropdown)	Select One	
What is the total area of the project site (e.g., area of parcel(s) or Right-of-Way containing development)?		ft^2
What is the total area of land disturbance for this project?		ft^2

Part 3: DCIA Tracking

Pre-development ***total impervious cover***		ft^2
Pre-development ***DCIA***		ft^2
Post-development ***total impervious cover***		ft^2
Post-development ***DCIA*** (after considering stormwater management)		ft^2
Net change in ***DCIA*** from pre-development to post-development		ft^2

Part 4: Water Quality Target

Water Quality Volume (WQV)		ft^3
Required treatment/retention volume		ft^3
Proposed Low Impact Development (LID) system to be used?		
Treatment/retention volume planned for development		ft^3

Certification Statement

I hereby certify that the information contained in this worksheet is true and correct.

Engineer's Signature _____ Date _____ Engineer's Seal _____

Worksheet Version 1 August 2019

DCIA Reduction Tracking

- Document town-wide DCIA reduction annually

Directly Connected Impervious Area Tracking Spreadsheet
City of Danbury

10/21/2019

Date Completed	Project Name	Owner Type (Dropdown)	Project Type (Dropdown)	Notes (e.g. LID Practice Used)	Change In IC[1]		Change In DCIA[2]		Cummulative Total IC[1]		Cummulative Total DCIA[2]	
					Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
2012 Watershed Baseline									4,879.42	17.354%	2,598.70	9.242%
		Select One	Select One									
		Select One	Select One									
		Select One	Select One									
		Select One	Select One									
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Total City Land Area (Acres)	28,117.56

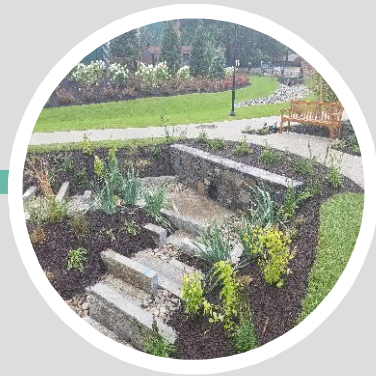
Change in Directly Connecticut Impervious Area (Percent)			
	Public	Private	Total
New Development	0.000%	0.000%	0.000%
Redevelopment	0.000%	0.000%	0.000%
Retrofit	0.000%	0.000%	0.000%

Notes:
1. IC (Impervious Cover): Surfaces that prohibit the movement of water from the land surface into the underlying soil or dirt (ex. buildings and pavement). *(Impervious Surface Methodology* , New Jersey Water Supply Authority, May 2000)
2. DCIA (Directly Connected Impervious Area): Impervious area from which stormwater runoff discharge directly to waters of the state or directly to a storm sewer system that discharges to waters of the state. (2017 MS4 General Permit)
3. Impervious area removed should be displayed as negative.
4. Impervious cover added should be displayed as a postivie value.

MS4 Permit Schedule

- Determine Baseline DCIA – June 2020
- Develop Retrofit Plan – June 2020
- Implement Projects from Retrofit Plan
  - June 2021 (1% DCIA Reduction)
  - June 2022 (1% DCIA Reduction)
  - Annually thereafter (1% DCIA Reduction)



Questions?

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