INFORMATIONAL WEBINAR MANUALS UPDATES

Presented by: Kathleen Knight, CT DEEP, Timothy Hunter, CT DEEP,
Denise Savageau CT Council on Soil and Water Conservation and
Erik Mas, Fuss & O'Neill

WELCOME & HOUSE KEEPING

MANUALS UPDATE WEBINAR

Purpose: Informational Webinar for the Update to the Connecticut Soil Erosion and Sediment Control Guidelines and the Stormwater Quality Manual

With Project Support from:

Long Island Sound Study
A Partnership to Restore and Protect the Sound

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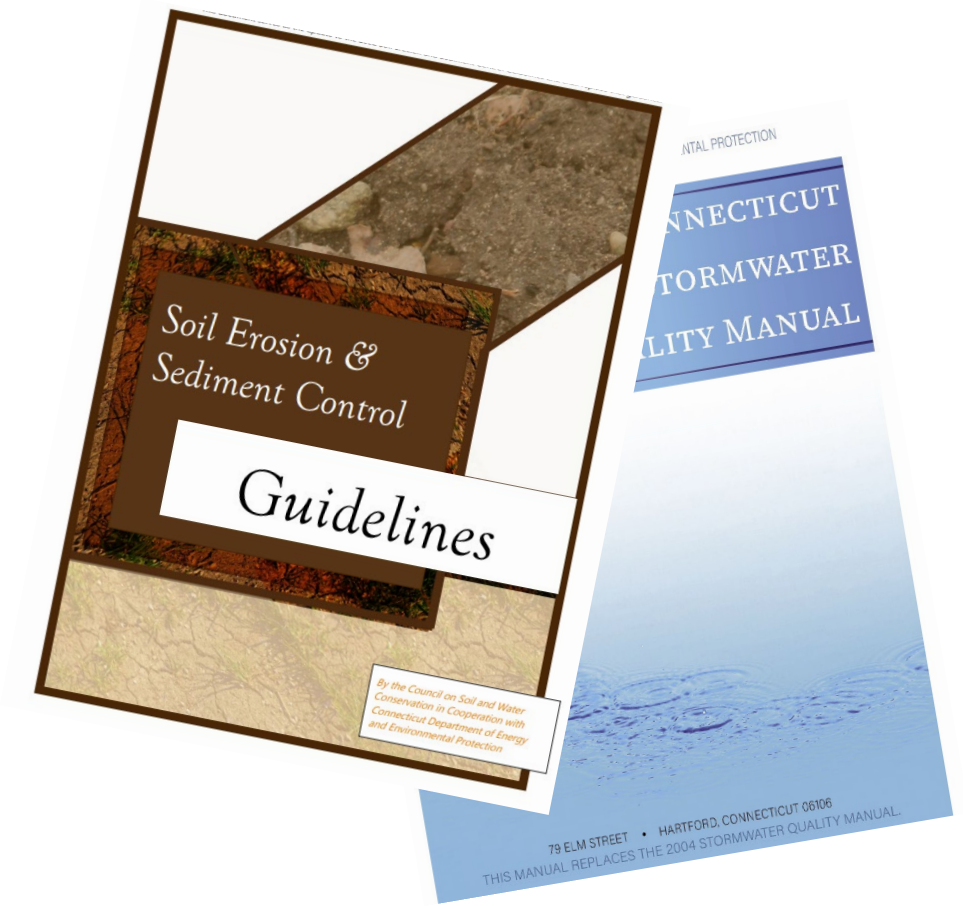
AGENDA

- Welcome, 2:00-2:05 PM, Kathleen Knight, CT DEEP
- Soil Erosion & Sediment Control Guidelines, 2:05-2:25 PM
  - Introduction, Denise Savageau, Connecticut Council on Soil & Water Conservation
  - Technical Revisions, Erik Mas, Fuss & O'Neill
- Questions, 2:25-2:35 PM
- Stormwater Quality Manual, 2:35-3:15 PM
  - Introduction, Kathleen Knight, CT DEEP
  - Technical Revisions, Erik Mas, Fuss & O'Neill
- Questions, 3:15-3:25 PM
- How to Comment, 3:25-3:30 PM, Timothy Hunter, CT DEEP

The Collaborative Process of the Revisions to the Manuals

ACKNOWLEDGEMENTS

These updates were brought to you by the following Workgroup Members:



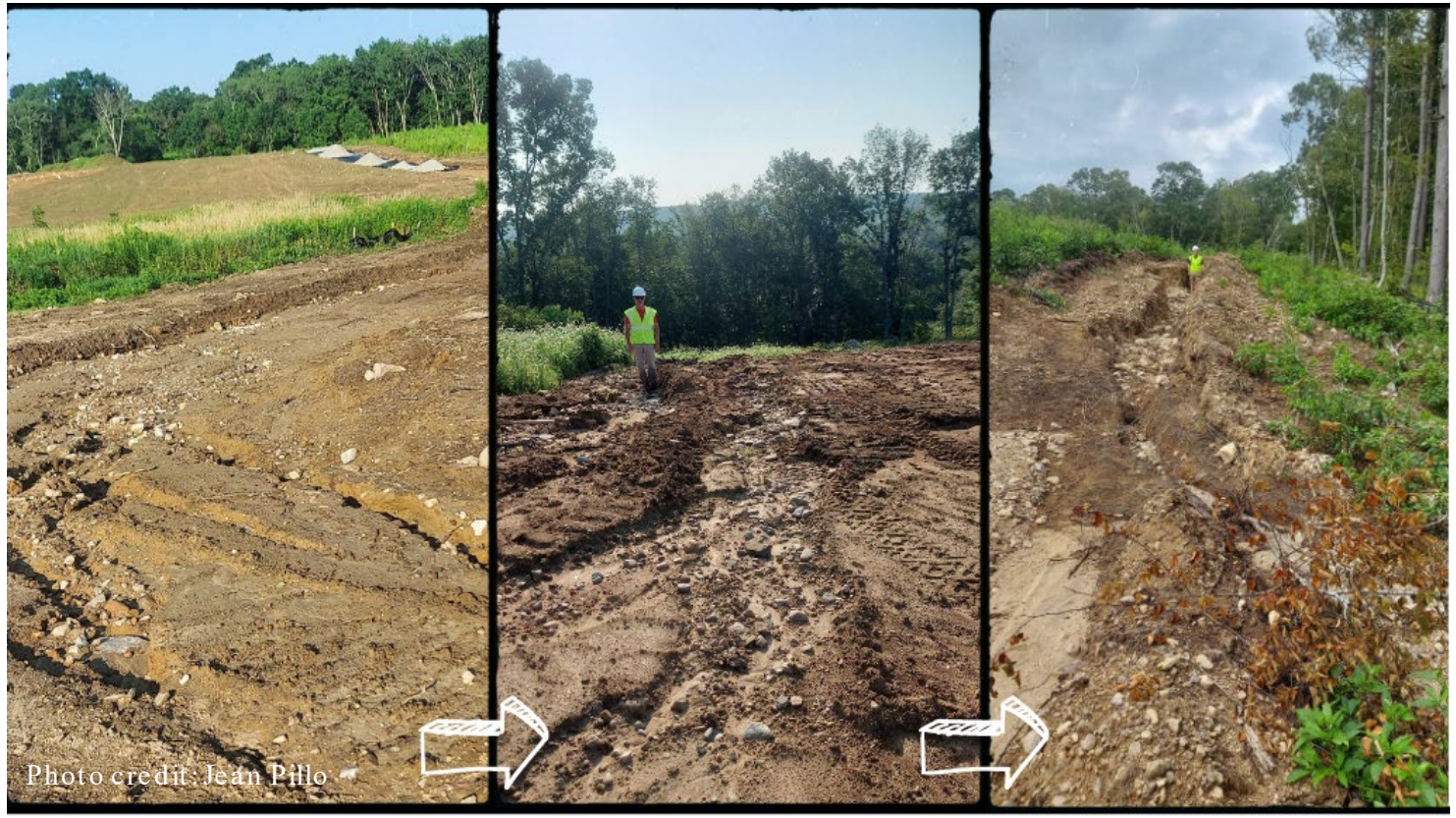
Lilian Ruiz
Denise Savageau
Barbara Kelly
Joanna Shapiro
Judy Rondeau
Dan Mullins
Chris Sullivan
Melissa Mostowy
Cynthia Rabinowitz
Jane Brawerman
Kelly Starr
Bill Lucey
Michael Dietz
Mary Looney
Derek Dilaj
Jennifer Kaufman
Greg Pidluski
Bradley Parsons
Thomas Morgart
John Longnecker

Kristin Walker
Adhir Agrawal
Daniel Imig
Erik Mas, PE
Dean Audet, PE
Celicia Boyden, EIT, MS
Keith Goodrow, PE, LEED AP
Sara Morrison, MLA
Diane Mas, PhD, REHS/RS, CC-P
Stephanie White, RLA, CNU-A, LEED AP
Elizabeth Kirmmse
Tom Galeota
Erik Bedan
John Gaucher
Karen Allen
Chris Stone
Carol Papp
Maria Leyva
Tim Hunter
Kathleen Knight

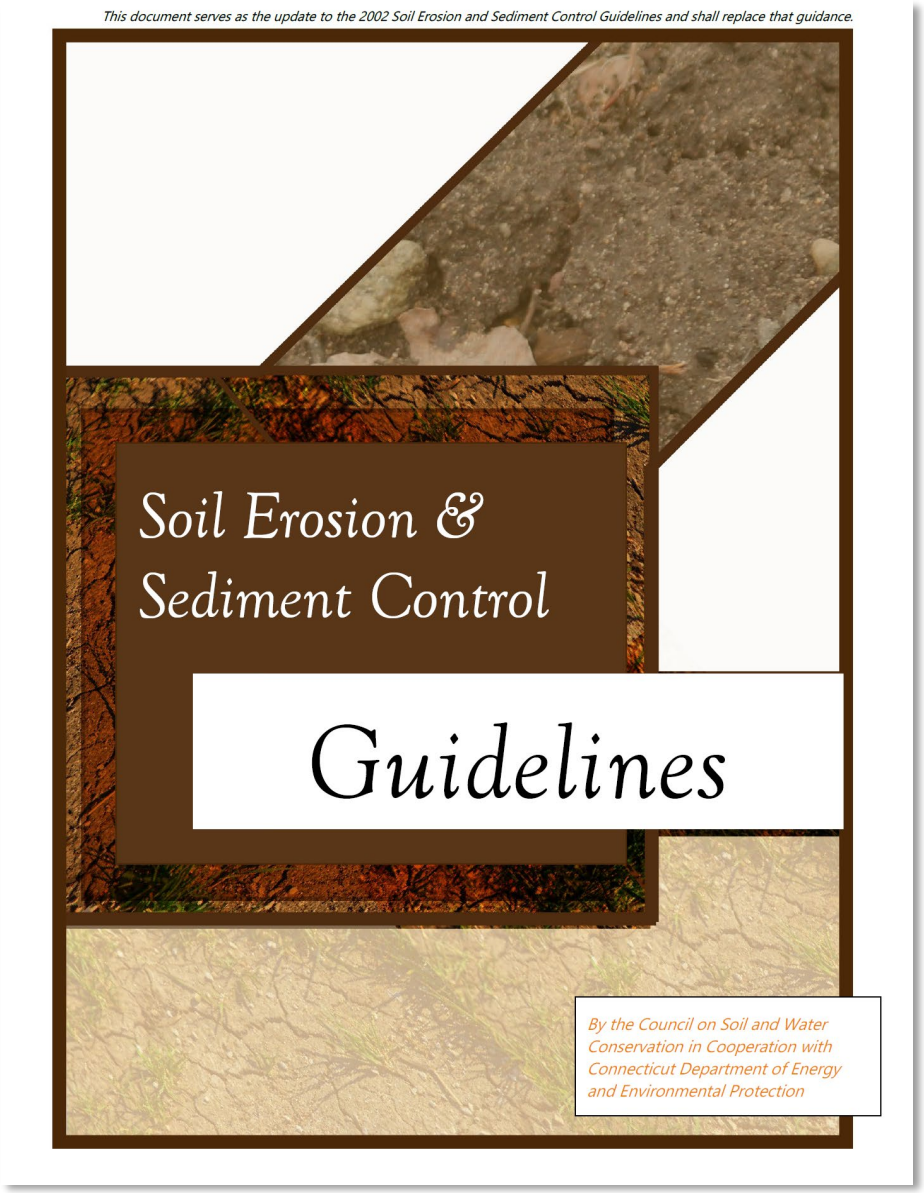
SOIL EROSION AND SEDIMENT CONTROL GUIDELINES

Introduction of Soil Erosion and Sediment Control Guidelines, Denise Savageau

CT COUNCIL ON SOIL & WATER CONSERVATION



Soil Erosion & Sediment Control Guidelines



- Replaces the 2002 Soil Erosion & Sediment Control Guidelines
  - Advances in the science and practice of soil erosion and sediment control
  - Updated regulatory environment
- Format and technical changes
- "Refresh"

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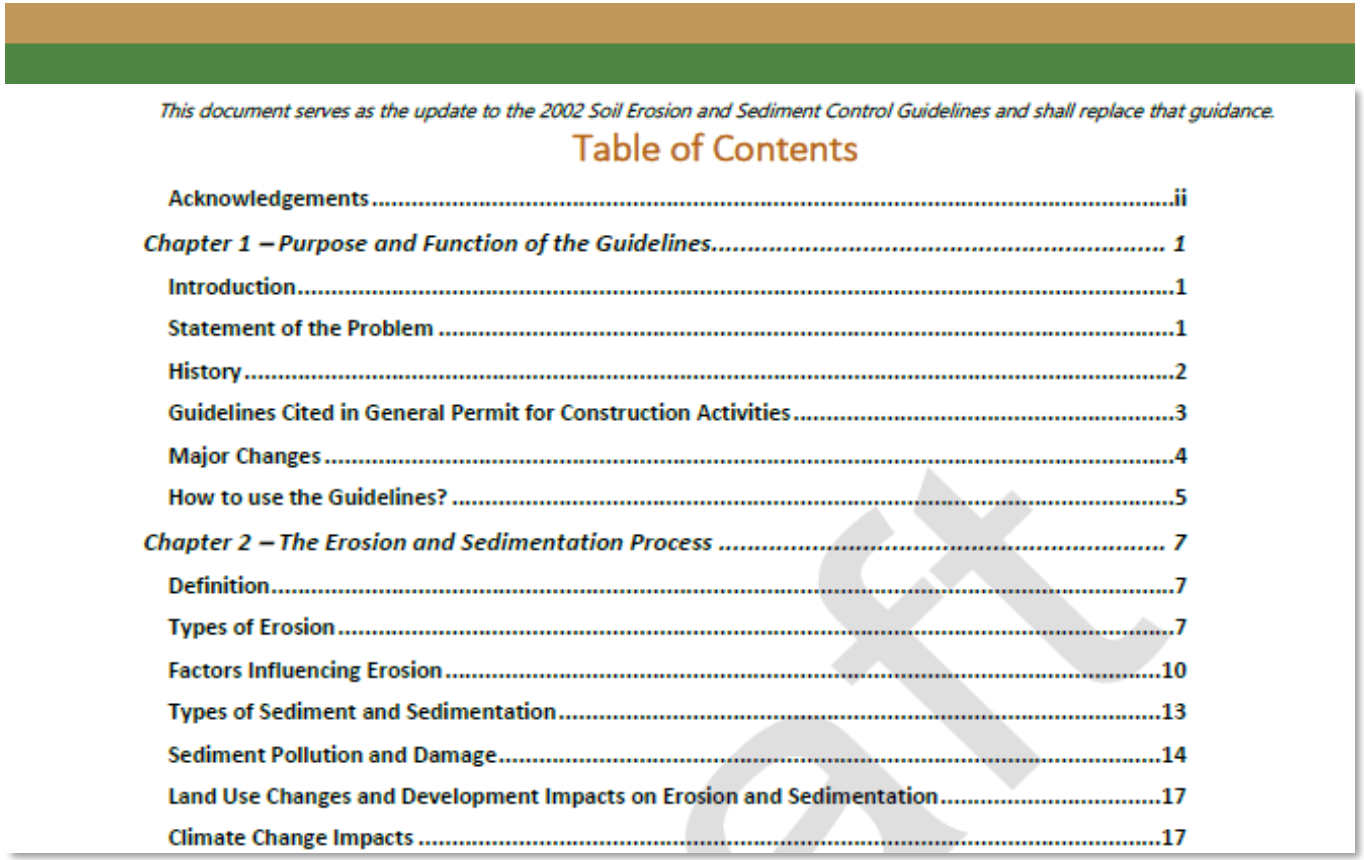
Objectives of 2023 Revisions

- Incorporate updated information on soil erosion and sediment controls
- Resolve conflicts with and improve consistency between SESCG and SWQM
- Greater consistency with CT DEEP stormwater general permits
- Incorporate climate change and resilience considerations
- Enhance usability of the guidelines for designers and reviewers

What Hasn't Changed?

- Applicability and regulatory basis
  - Guidance (no independent regulatory authority)
  - Referenced by municipal regulations and state permit programs
  - Projects that require E&S control
- Overall framework
  - Functional groups & measures
- Background information



This document serves as the update to the 2002 Soil Erosion and Sediment Control Guidelines and shall replace that guidance.

Table of Contents

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Major Revisions

Format changes

References CT SWQM for post-construction stormwater management

Integrates information from 2011 LID Appendix, where relevant

E&S controls for specialized applications

Updated section on E&S Control Plans

Updated design storm precipitation and climate change considerations

Adds new control measures

Updates some control measures

Removes some control measures

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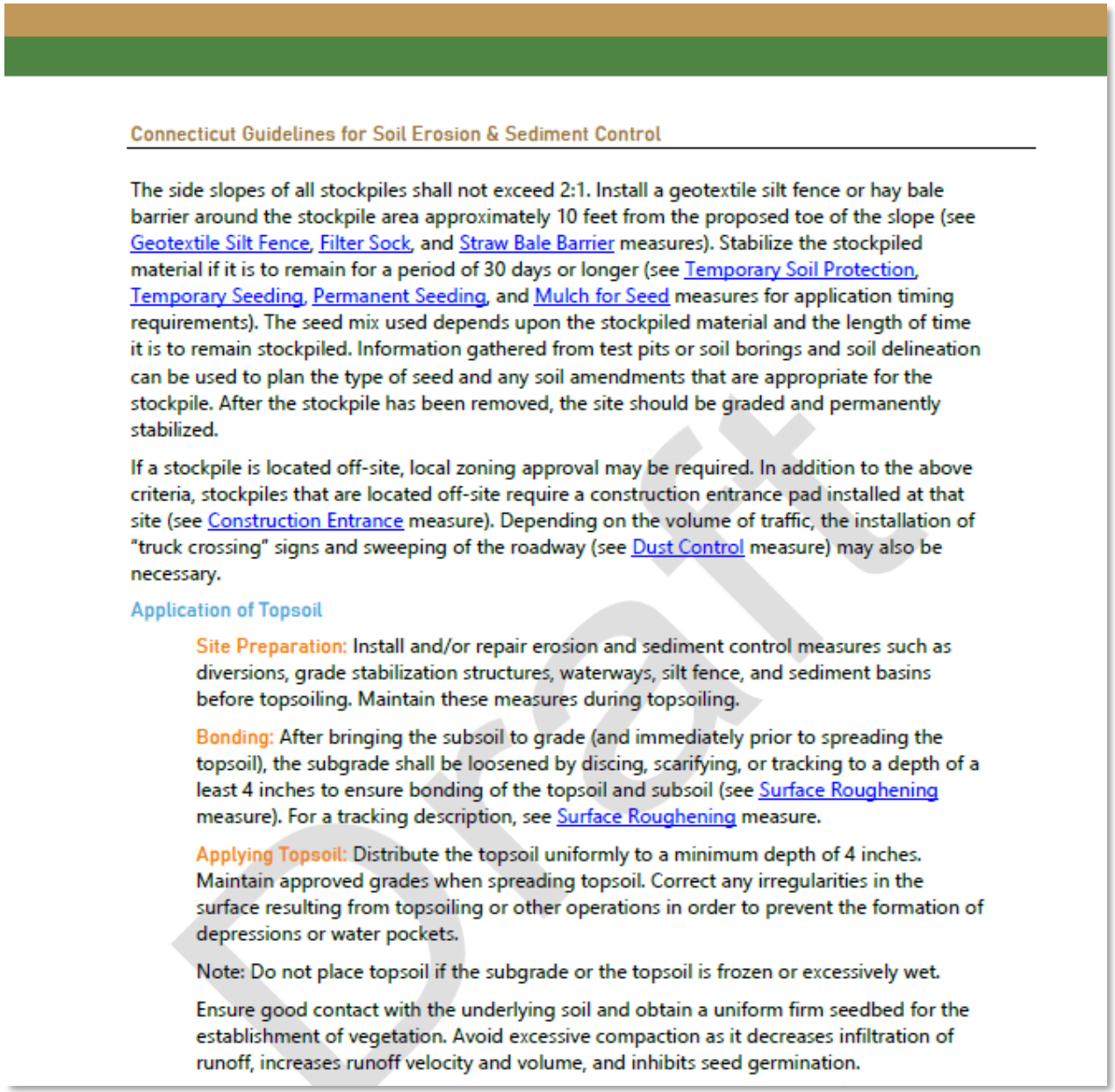
Format and Structural Changes to Guidelines

- **Removed appendices** that can be accessed online
- **Use of links and hyperlinks** to navigate document and external sources
- **References CT SWQM** for post-construction stormwater management
- **Incorporates LID** site planning and design into E&S Control Planning process and throughout Guidelines



Connecticut Guidelines for Soil Erosion & Sediment Control

The side slopes of all stockpiles shall not exceed 2:1. Install a geotextile silt fence or hay bale barrier around the stockpile area approximately 10 feet from the proposed toe of the slope (see Geotextile Silt Fence, Filter Sock, and Straw Bale Barrier measures). Stabilize the stockpiled material if it is to remain for a period of 30 days or longer (see Temporary Soil Protection, Temporary Seeding, Permanent Seeding, and Mulch for Seed measures for application timing requirements). The seed mix used depends upon the stockpiled material and the length of time it is to remain stockpiled. Information gathered from test pits or soil borings and soil delineation can be used to plan the type of seed and any soil amendments that are appropriate for the stockpile. After the stockpile has been removed, the site should be graded and permanently stabilized.

If a stockpile is located off-site, local zoning approval may be required. In addition to the above criteria, stockpiles that are located off-site require a construction entrance pad installed at that site (see Construction Entrance measure). Depending on the volume of traffic, the installation of "truck crossing" signs and sweeping of the roadway (see Dust Control measure) may also be necessary.

Application of Topsoil

Site Preparation: Install and/or repair erosion and sediment control measures such as diversions, grade stabilization structures, waterways, silt fence, and sediment basins before topsoiling. Maintain these measures during topsoiling.

Bonding: After bringing the subsoil to grade (and immediately prior to spreading the topsoil), the subgrade shall be loosened by discing, scarifying, or tracking to a depth of a least 4 inches to ensure bonding of the topsoil and subsoil (see Surface Roughening measure). For a tracking description, see Surface Roughening measure.

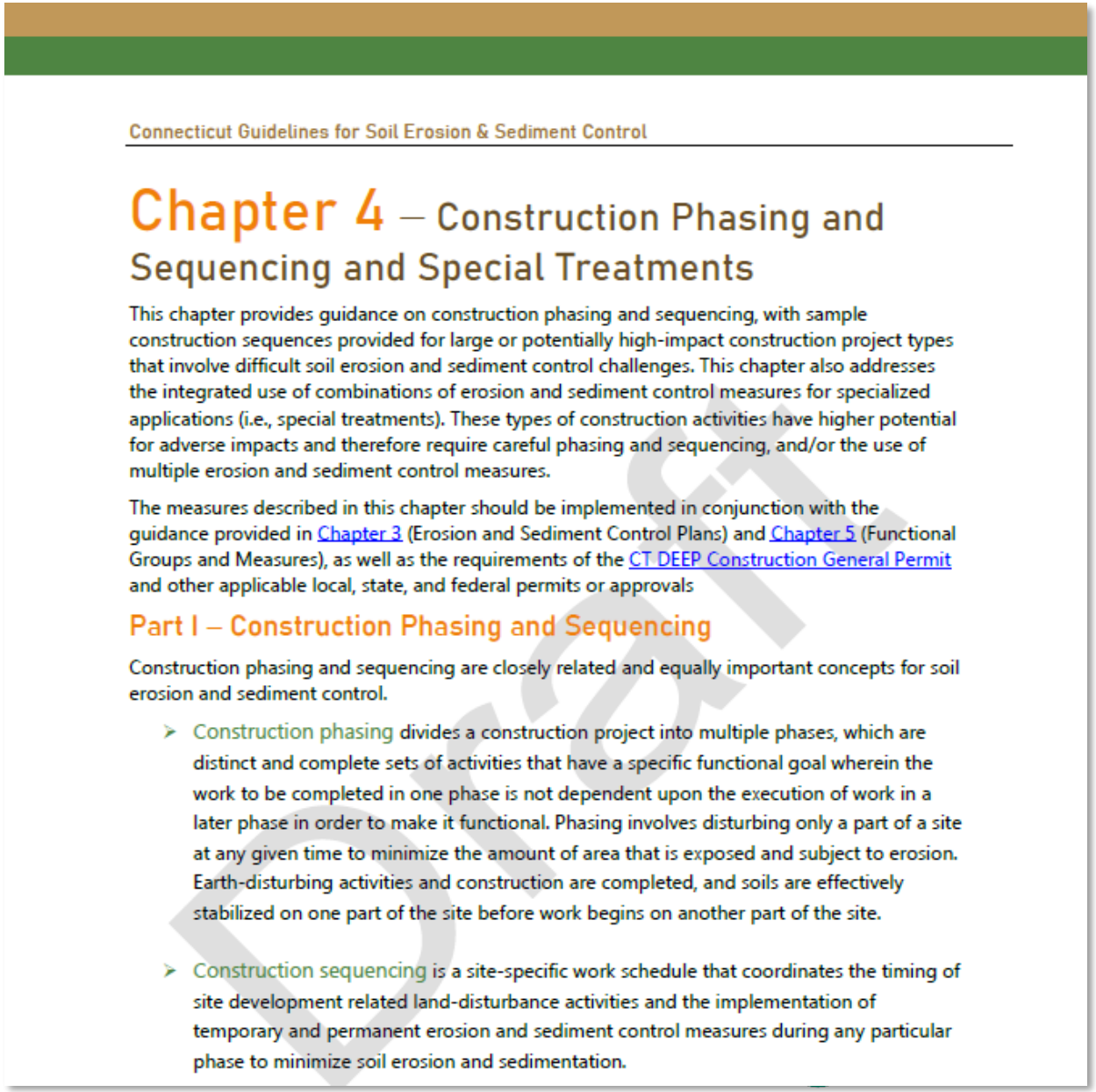
Applying Topsoil: Distribute the topsoil uniformly to a minimum depth of 4 inches. Maintain approved grades when spreading topsoil. Correct any irregularities in the surface resulting from topsoiling or other operations in order to prevent the formation of depressions or water pockets.

Note: Do not place topsoil if the subgrade or the topsoil is frozen or excessively wet.

Ensure good contact with the underlying soil and obtain a uniform firm seedbed for the establishment of vegetation. Avoid excessive compaction as it decreases infiltration of runoff, increases runoff velocity and volume, and inhibits seed germination.

E&S Controls for Specialized Applications

- Several new types of projects
  - Solar Array Construction Projects
  - Soil Bioengineering
  - Projects in Coastal Shoreline Environments



Connecticut Guidelines for Soil Erosion & Sediment Control

Chapter 4 – Construction Phasing and Sequencing and Special Treatments

This chapter provides guidance on construction phasing and sequencing, with sample construction sequences provided for large or potentially high-impact construction project types that involve difficult soil erosion and sediment control challenges. This chapter also addresses the integrated use of combinations of erosion and sediment control measures for specialized applications (i.e., special treatments). These types of construction activities have higher potential for adverse impacts and therefore require careful phasing and sequencing, and/or the use of multiple erosion and sediment control measures.

The measures described in this chapter should be implemented in conjunction with the guidance provided in Chapter 3 (Erosion and Sediment Control Plans) and Chapter 5 (Functional Groups and Measures), as well as the requirements of the CT DEEP Construction General Permit and other applicable local, state, and federal permits or approvals

Part I – Construction Phasing and Sequencing

Construction phasing and sequencing are closely related and equally important concepts for soil erosion and sediment control.

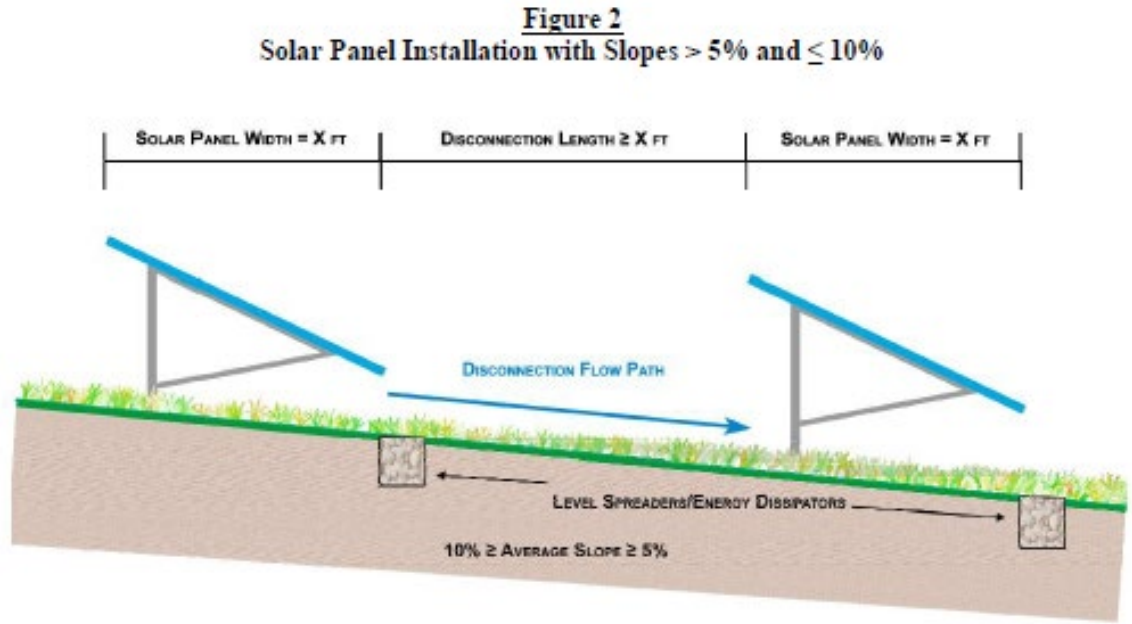
- Construction phasing divides a construction project into multiple phases, which are distinct and complete sets of activities that have a specific functional goal wherein the work to be completed in one phase is not dependent upon the execution of work in a later phase in order to make it functional. Phasing involves disturbing only a part of a site at any given time to minimize the amount of area that is exposed and subject to erosion. Earth-disturbing activities and construction are completed, and soils are effectively stabilized on one part of the site before work begins on another part of the site.

- Construction sequencing is a site-specific work schedule that coordinates the timing of site development related land-disturbance activities and the implementation of temporary and permanent erosion and sediment control measures during any particular phase to minimize soil erosion and sedimentation.

E&S Controls for Specialized Applications

Solar Array Construction Projects

- CT DEEP Construction Stormwater General Permit (Appendix I)
- Design and construction requirements



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E&S Controls for Specialized Applications

Soil Bioengineering

- Use of live and dead plant materials with natural and synthetic support materials
- Slope stabilization, erosion reduction, vegetative establishment
- More permanent controls with habitat and water quality benefits

Fascines

Bioengineering Fiber Rolls

Live Crib Walls

Live Staking

Tree Revetments

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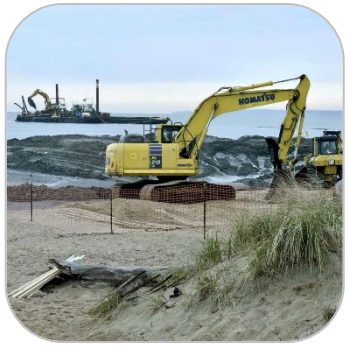
E&S Controls for Specialized Applications

Coastal Shoreline Environments

- High energy environment
- Erodible sandy soils
- Coastal storms and sea level rise
- Living shoreline techniques

Dune Creation & Restoration

Beach Nourishment



Coastal Bank Protection

Joint Planted Revetment

Marsh Creation & Enhancement

Living Breakwaters

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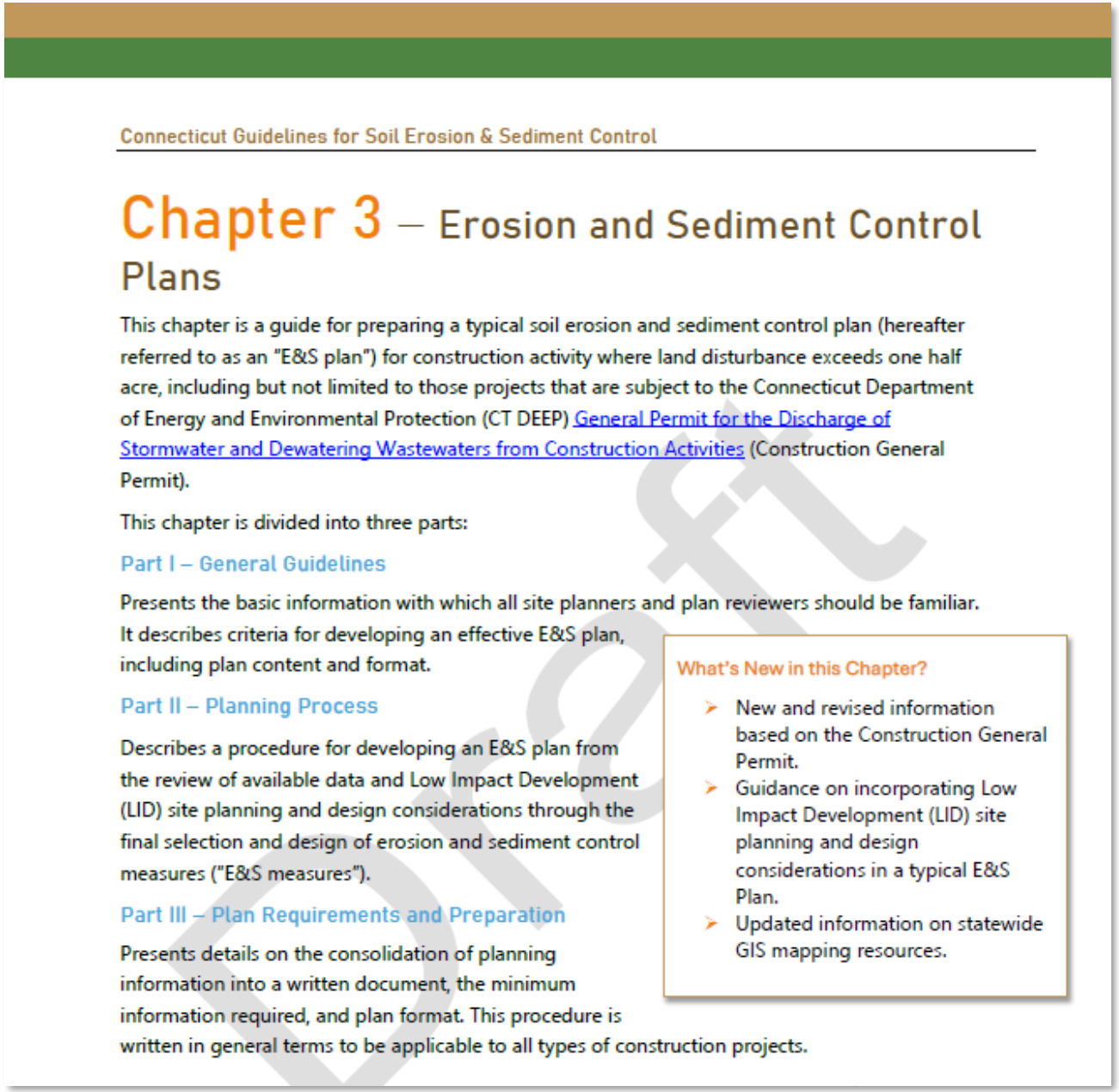
E&S Control Plans

- Greater consistency with E&S Plan requirements of Construction General Permit
- Guidance on incorporating LID site planning and design considerations
- Updated information on statewide GIS resources



Connecticut Guidelines for Soil Erosion & Sediment Control

Chapter 3 – Erosion and Sediment Control Plans

This chapter is a guide for preparing a typical soil erosion and sediment control plan (hereafter referred to as an "E&S plan") for construction activity where land disturbance exceeds one half acre, including but not limited to those projects that are subject to the Connecticut Department of Energy and Environmental Protection (CT DEEP) General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities (Construction General Permit).

This chapter is divided into three parts:

Part I – General Guidelines

Presents the basic information with which all site planners and plan reviewers should be familiar. It describes criteria for developing an effective E&S plan, including plan content and format.

Part II – Planning Process

Describes a procedure for developing an E&S plan from the review of available data and Low Impact Development (LID) site planning and design considerations through the final selection and design of erosion and sediment control measures ("E&S measures").

Part III – Plan Requirements and Preparation

Presents details on the consolidation of planning information into a written document, the minimum information required, and plan format. This procedure is written in general terms to be applicable to all types of construction projects.

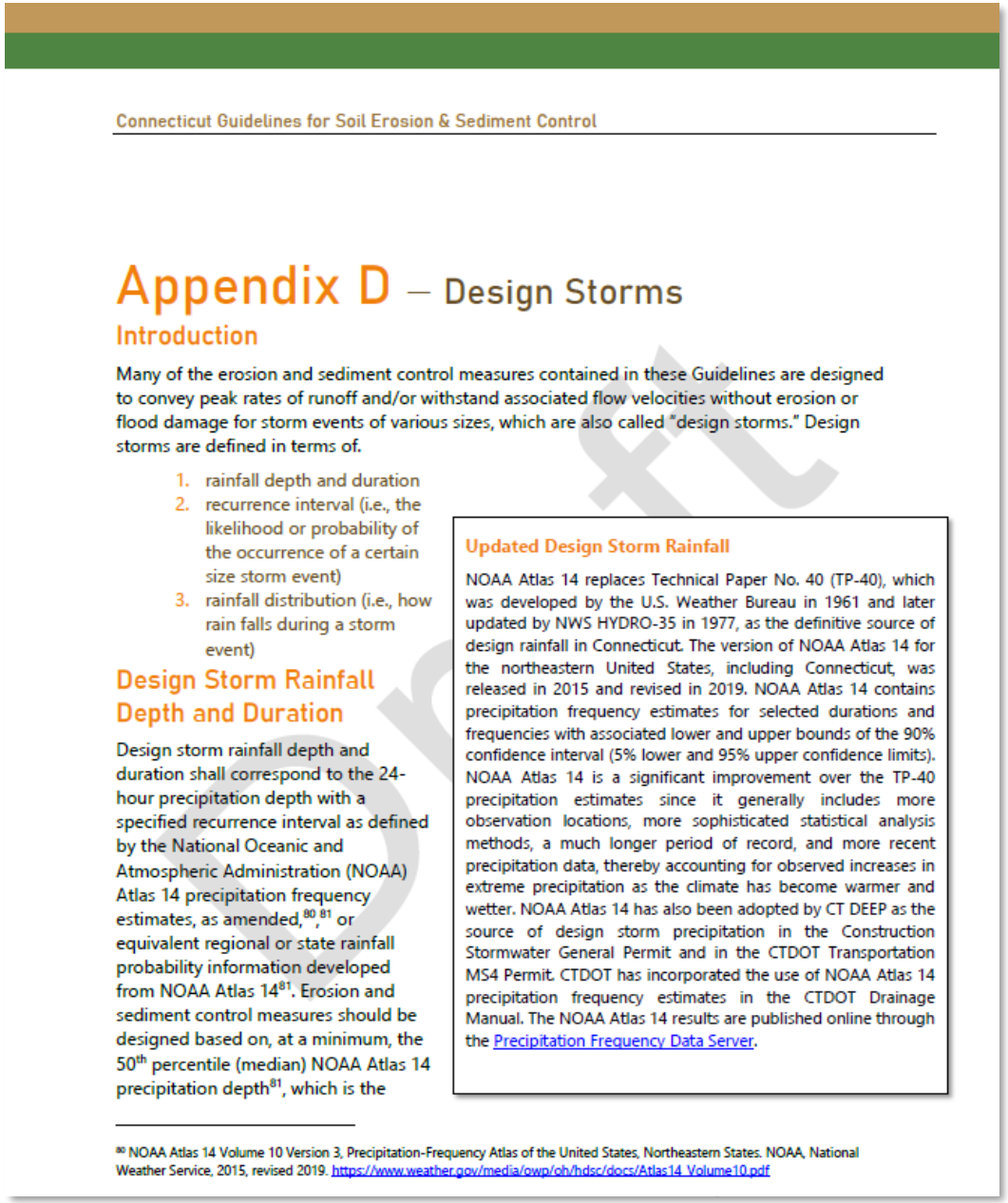
What's New in this Chapter?

- New and revised information based on the Construction General Permit.
- Guidance on incorporating Low Impact Development (LID) site planning and design considerations in a typical E&S Plan.
- Updated information on statewide GIS mapping resources.

Draft

Updated Design Storm Precipitation

- Consistency with updated SWQM
- NOAA Atlas 14
- Consider adopting future generations of NOAA Atlas 14 precipitation products (projected future rainfall – climate change)



Appendix D – Design Storms

Introduction

Many of the erosion and sediment control measures contained in these Guidelines are designed to convey peak rates of runoff and/or withstand associated flow velocities without erosion or flood damage for storm events of various sizes, which are also called "design storms." Design storms are defined in terms of.

1. rainfall depth and duration
2. recurrence interval (i.e., the likelihood or probability of the occurrence of a certain size storm event)
3. rainfall distribution (i.e., how rain falls during a storm event)

Design Storm Rainfall Depth and Duration

Design storm rainfall depth and duration shall correspond to the 24-hour precipitation depth with a specified recurrence interval as defined by the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 precipitation frequency estimates, as amended,[80],[81] or equivalent regional or state rainfall probability information developed from NOAA Atlas 14[81]. Erosion and sediment control measures should be designed based on, at a minimum, the 50th percentile (median) NOAA Atlas 14 precipitation depth[81], which is the

Updated Design Storm Rainfall

NOAA Atlas 14 replaces Technical Paper No. 40 (TP-40), which was developed by the U.S. Weather Bureau in 1961 and later updated by NWS HYDRO-35 in 1977, as the definitive source of design rainfall in Connecticut. The version of NOAA Atlas 14 for the northeastern United States, including Connecticut, was released in 2015 and revised in 2019. NOAA Atlas 14 contains precipitation frequency estimates for selected durations and frequencies with associated lower and upper bounds of the 90% confidence interval (5% lower and 95% upper confidence limits). NOAA Atlas 14 is a significant improvement over the TP-40 precipitation estimates since it generally includes more observation locations, more sophisticated statistical analysis methods, a much longer period of record, and more recent precipitation data, thereby accounting for observed increases in extreme precipitation as the climate has become warmer and wetter. NOAA Atlas 14 has also been adopted by CT DEEP as the source of design storm precipitation in the Construction Stormwater General Permit and in the CTDOT Transportation MS4 Permit. CTDOT has incorporated the use of NOAA Atlas 14 precipitation frequency estimates in the CTDOT Drainage Manual. The NOAA Atlas 14 results are published online through the Precipitation Frequency Data Server.

[80] NOAA Atlas 14 Volume 10 Version 3, Precipitation-Frequency Atlas of the United States, Northeastern States. NOAA, National Weather Service, 2015, revised 2019. https://www.weather.gov/media/owp/oh/hdsc/docs/Atlas14_Volume10.pdf

Erosion & Sediment Controls Technical Guidance

Functional Groups and Measures (Chapter 5)

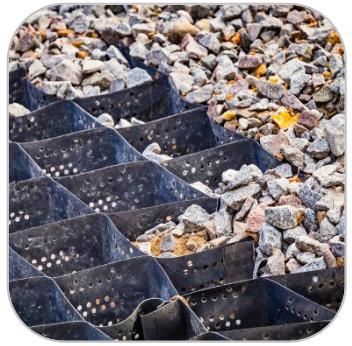
Protect Vegetation

Preserve & Conserve Soil

Vegetative Soil Cover

Non-Living Soil Protection

Stabilization Structures



Drainageways & Watercourses

Diversions

Subsurface Drains

Energy Dissipators

Sediment Impoundments, Barriers & Filters

Tire Tracked Soils

Dewatering

Erosion & Sediment Controls Technical Guidance

New Control Measures Added (Chapter 5)

Fiber Roll

Filter Sock

Inlet Protection

Pumping Settling Basin

Cellular Confinement System

Articulating Concrete Block

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Erosion & Sediment Controls Technical Guidance

Updated or Eliminated Control Measures (Chapter 5)

Hay Bale Barrier (Replaced with Straw Bales)

Dust Control (Non-Asphalt Tackifiers)

Level Spreader

Permanent Detention Basin (refer to SWQM)

Stone Check Dam

Temporary Sediment Basin

Stone Slope Protection

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Erosion & Sediment Controls Technical Guidance

Other Changes (Chapter 5)

- Greater emphasis on use of local seed sources for temporary and permanent vegetative soil cover
- Updated guidance on fertilizer usage
- Updated Landscape Planting measure (Connecticut web-based resources)
- Updated post-storm inspection criteria consistent with CT DEEP Construction General Permit

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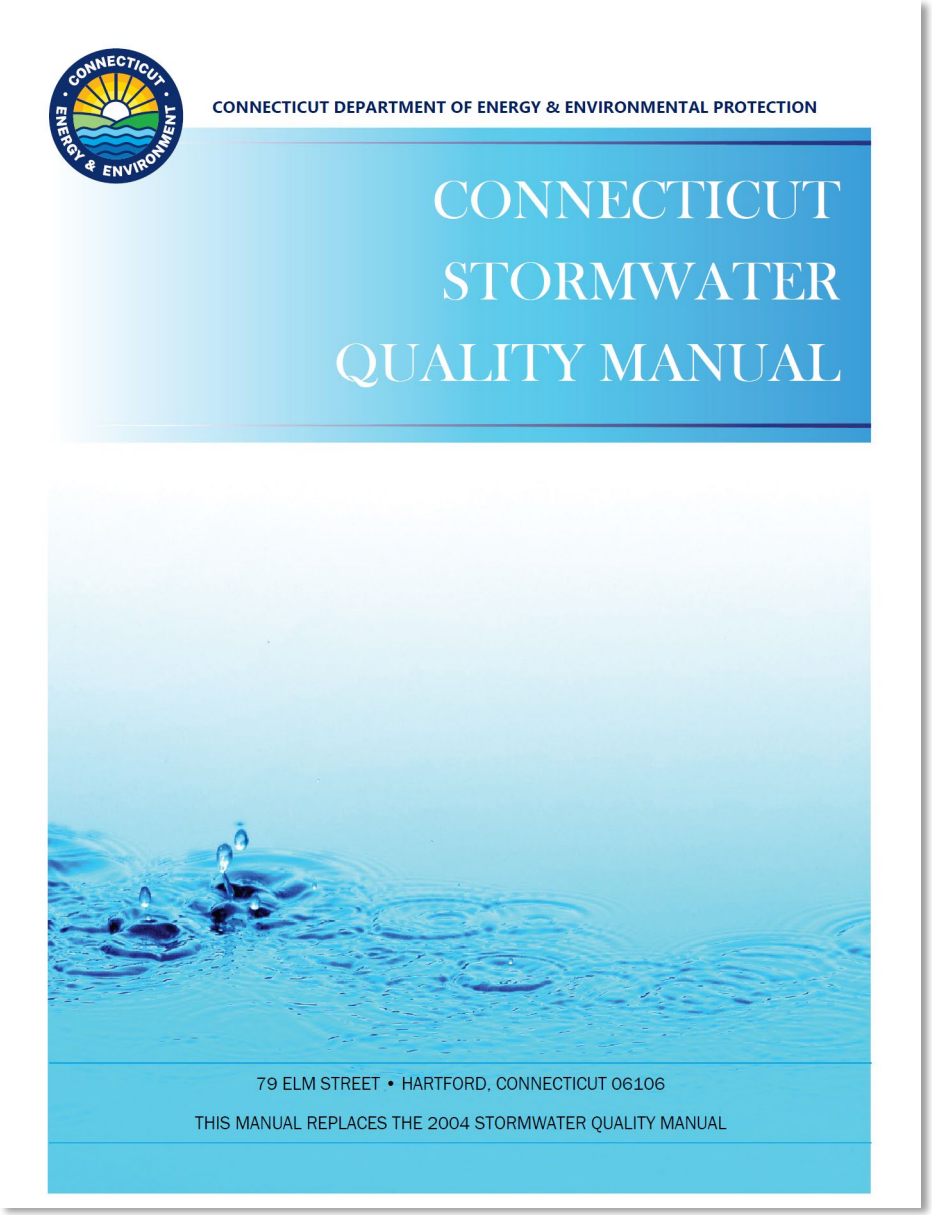
STORMWATER QUALITY MANUAL

Introduction of Stormwater Quality Manual Revisions, Kathleen Knight

- Out of date precipitation\climate considerations
- Function focused organization for site specific needs
- Flexibility & adaptability in approach
- Coordination with SESCG
- Low Impact Development (LID) is a focus moved forward in current draft.
- Updated regionally applicable resources.

Connecticut Stormwater Quality Manual



- Replaces the 2004 Connecticut Stormwater Quality Manual
  - Advances in the practice of stormwater management
  - Scientific understanding of stormwater impacts and controls
  - Updated regulatory environment
- More significant revisions than the SESCG (“Overhaul”)

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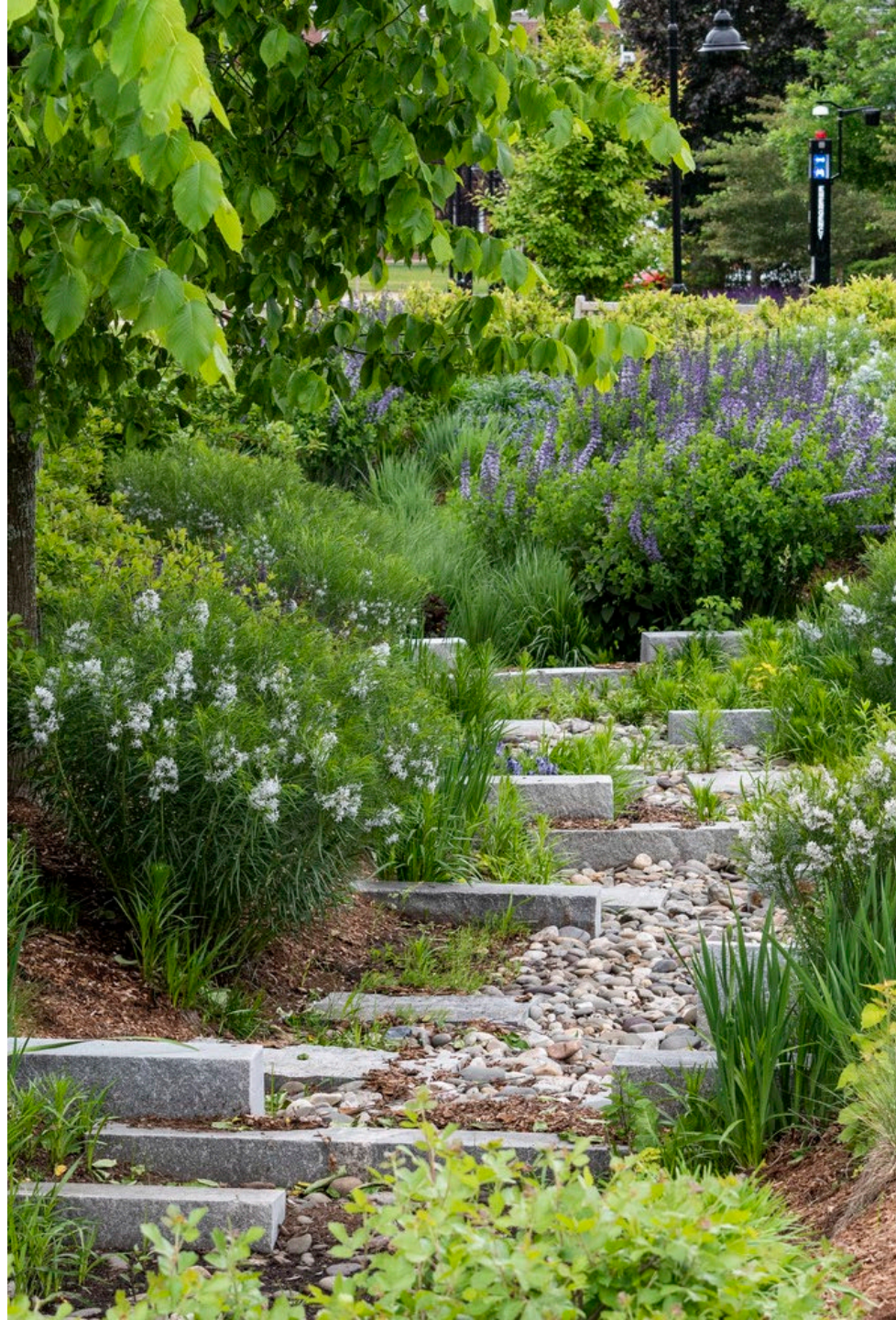
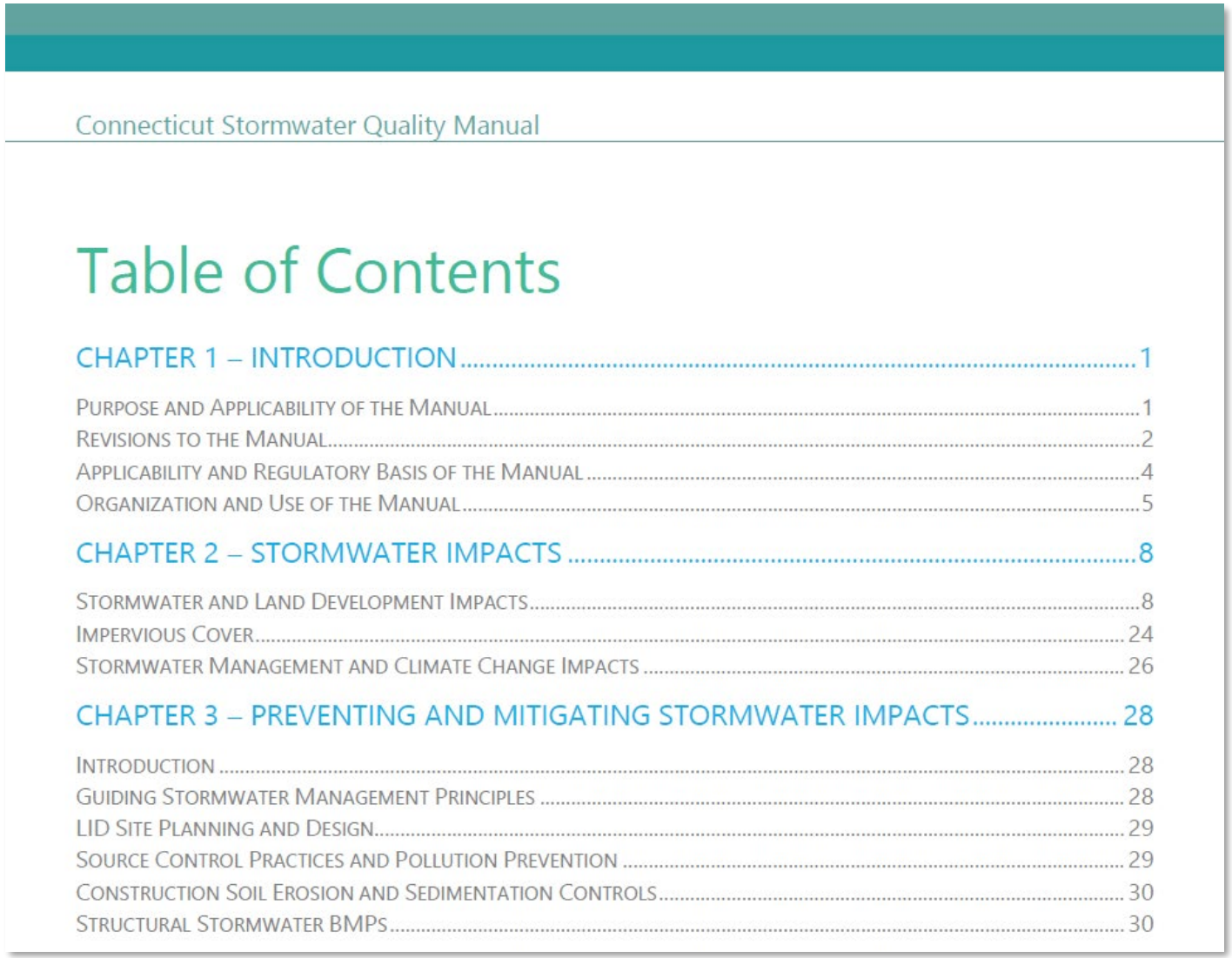
Objectives of 2023 Revisions

- Incorporate updated information on stormwater BMPs
- Resolve conflicts with and improve consistency between SWQM and SESCG
- Greater consistency with CT DEEP stormwater general permits
- Incorporate climate change and resilience considerations
- Enhance usability of the manual for designers and reviewers



What Hasn't Changed?

- Applicability and regulatory basis
  - Guidance (no independent regulatory authority)
  - Referenced by municipal regulations and state permit programs
  - New development, redevelopment, & retrofits
- Background information



Connecticut Stormwater Quality Manual

Table of Contents

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Major Revisions

- Updated stormwater management standards & performance criteria
- Updated design storm precipitation and climate change considerations
- Greater emphasis on non-structural LID & stormwater retention
- Integrates 2011 LID Appendix into the revised manual
- Functional classification of structural stormwater BMPs
- New chapter on design of stormwater infiltration systems
- Incorporates EPA stormwater BMP performance curves
- Updated information on stormwater BMP selection
- Updated section on stormwater retrofits
- Updated section on proprietary stormwater BMPs
- Updated design guidance for structural stormwater BMPs
- Stormwater BMP planting guide

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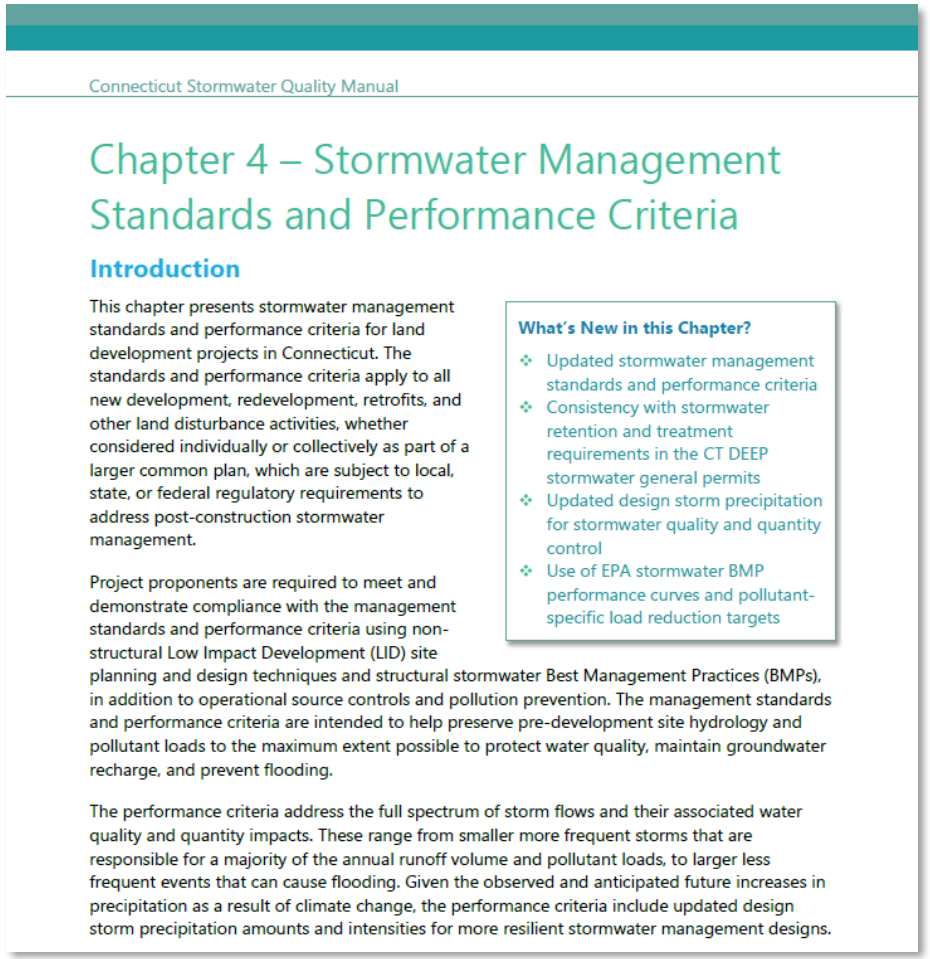
Stormwater Management Standards & Performance Criteria (Chapter 4)

- Consistency with post-construction stormwater management requirements of CT DEEP stormwater general permits and municipal stormwater regulations
- Emphasis on non-structural LID and stormwater retention
- Retention/infiltration replaces previous groundwater recharge requirement
- Updated design storm precipitation
- EPA stormwater BMP performance curves



Connecticut Stormwater Quality Manual

Chapter 4 – Stormwater Management Standards and Performance Criteria

Introduction

This chapter presents stormwater management standards and performance criteria for land development projects in Connecticut. The standards and performance criteria apply to all new development, redevelopment, retrofits, and other land disturbance activities, whether considered individually or collectively as part of a larger common plan, which are subject to local, state, or federal regulatory requirements to address post-construction stormwater management.

What's New in this Chapter?

- Updated stormwater management standards and performance criteria
- Consistency with stormwater retention and treatment requirements in the CT DEEP stormwater general permits
- Updated design storm precipitation for stormwater quality and quantity control
- Use of EPA stormwater BMP performance curves and pollutant-specific load reduction targets

Project proponents are required to meet and demonstrate compliance with the management standards and performance criteria using non-structural Low Impact Development (LID) site planning and design techniques and structural stormwater Best Management Practices (BMPs), in addition to operational source controls and pollution prevention. The management standards and performance criteria are intended to help preserve pre-development site hydrology and pollutant loads to the maximum extent possible to protect water quality, maintain groundwater recharge, and prevent flooding.

The performance criteria address the full spectrum of storm flows and their associated water quality and quantity impacts. These range from smaller more frequent storms that are responsible for a majority of the annual runoff volume and pollutant loads, to larger less frequent events that can cause flooding. Given the observed and anticipated future increases in precipitation as a result of climate change, the performance criteria include updated design storm precipitation amounts and intensities for more resilient stormwater management designs.

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Standard 1. Runoff Volume & Pollutant Reduction

1. LID Site Planning and Design

Non-structural LID

Require consideration of LID site planning and design to the furthest degree possible prior to other practices.

Reduce post-development impervious area and stormwater runoff volumes.

See Chapter 5 for impervious surface disconnection guidance.

2. Stormwater Retention

Structural BMPs

Retain on-site the Design Retention Volume (100% or 50% of the water quality volume, WQV) to the Maximum Extent Achievable.

Retaining the Design Retention Volume on-site achieves compliance with Standard 1- Runoff Volume and Pollutant Reduction.

3. Stormwater Treatment

Structural BMPs

If cannot retain on-site the Design Retention Volume, provide additional stormwater treatment to the Maximum Extent Achievable up to 100% of the WQV.

Document basis for alternative retention volume and compliance with minimum required pollutant load reductions.

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Standard 1. Runoff Volume & Pollutant Reduction

LID Site Planning and Design

- Consider non-structural LID site planning and design strategies to the **furthest degree possible** prior to the consideration of structural stormwater BMPs
- Reduce and disconnect impervious area
- Chapter 5 – LID Site Planning and Design Strategies

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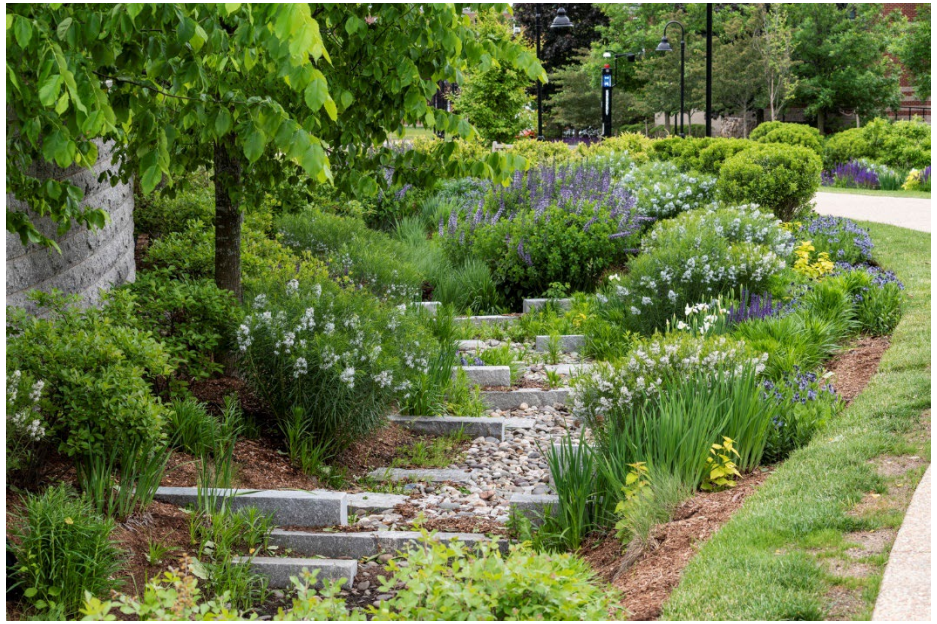
Standard 1. Runoff Volume & Pollutant Reduction

Stormwater Retention

- Retain on-site the **Design Retention Volume (DRV)** to the **Maximum Extent Achievable**
- DRV = 100% or 50% of the Water Quality Volume (WQV)
- **Hold post-development runoff on-site** using structural stormwater BMPs or non-structural LID site planning and design strategies (no discharge up to DRV)
- See **Table 8-1** for BMPs suitable for stormwater retention



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Standard 1. Runoff Volume & Pollutant Reduction

Stormwater Treatment

- If cannot retain on-site the full DRV, **provide treatment without retention** for remainder of DRV up to 100% WQV to the Maximum Extent Achievable
- Use **stormwater BMP performance curves** to demonstrate adequate pollutant reduction
- See **Table 8-1** for BMPs suitable for providing treatment without retention
- Multiple BMPs in series (treatment train) typically required

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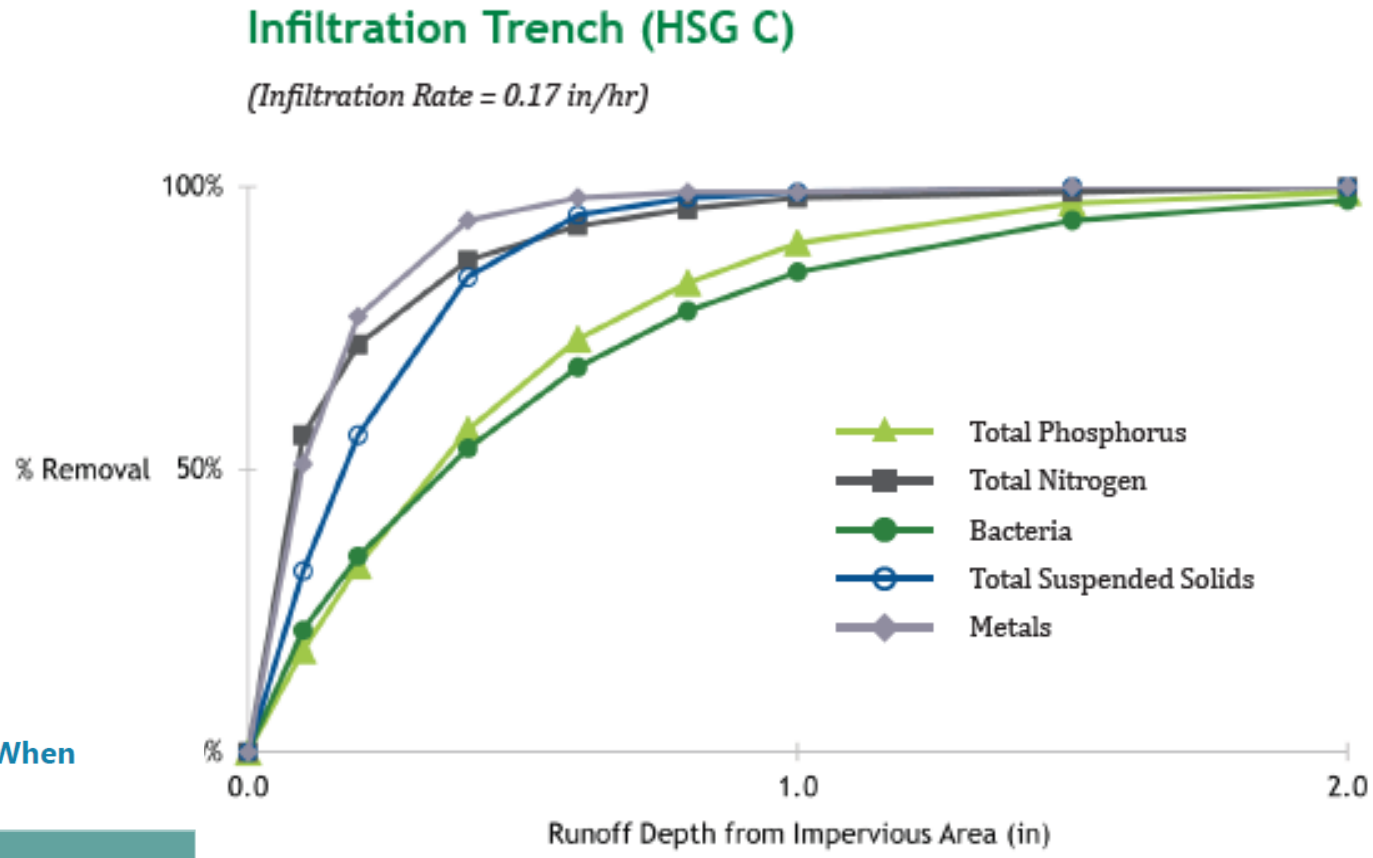
Stormwater BMP Performance Curves

- EPA Region 1
- Long-term pollutant removal
- Design storage volume (Appendix C)
- Confirm adequate pollutant removal when DRV cannot be fully retained on-site



Source: New England Stormwater Retrofit Manual, VHB, UNH Stormwater Center, and SNEP Network.

Table 4-3. Minimum Required Average Annual Pollutant Load Reductions When Additional Stormwater Treatment is Needed[1]

Water Quality Parameter	New Development	Redevelopment/Retrofits
Total Suspended Solids (TSS)	90%	80%
Total Phosphorus (TP)	60%	50%
Total Nitrogen (TN)	40%	30%

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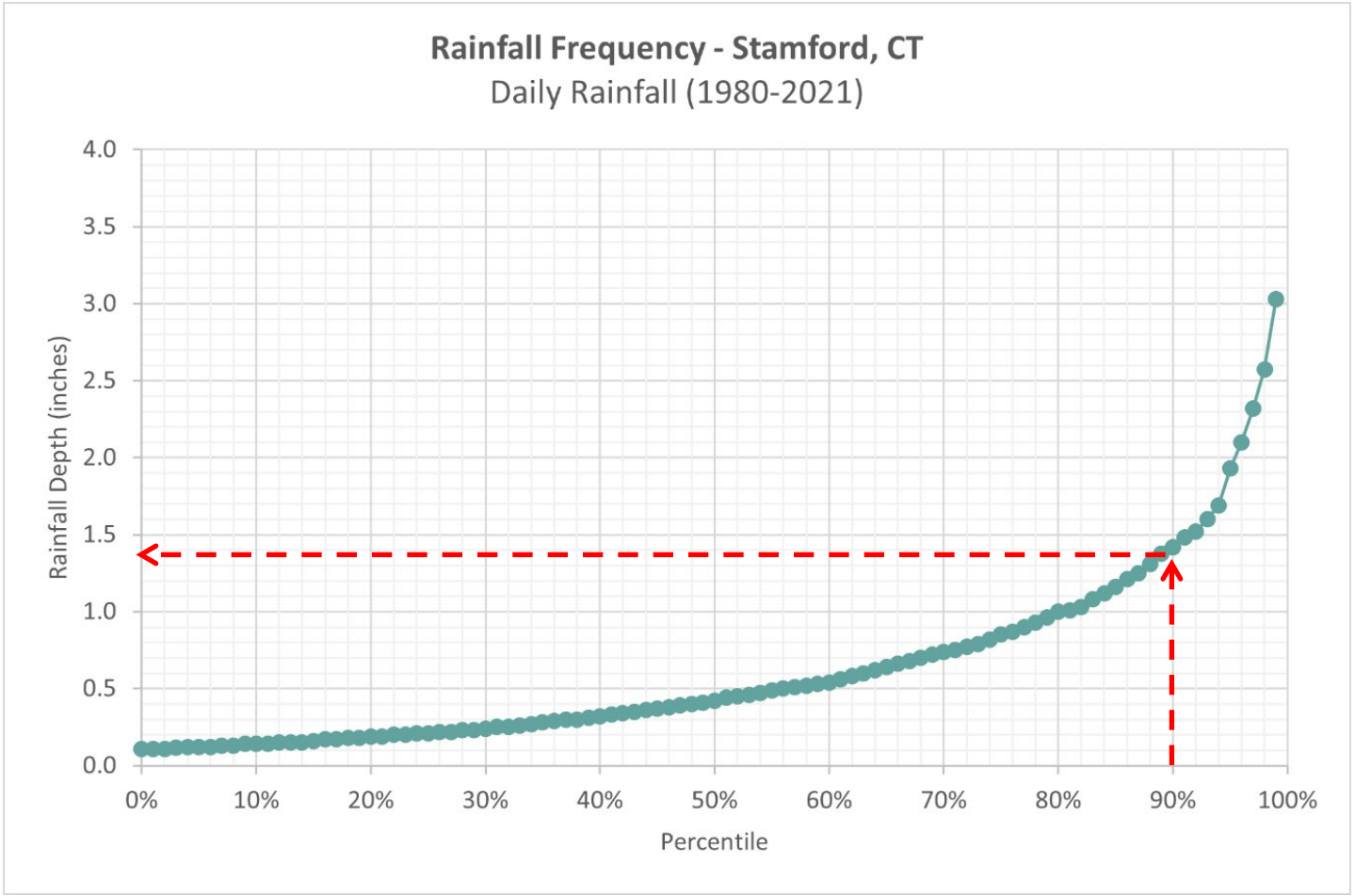
Updated Water Quality Volume (WQV)

- First flush principle, majority of pollutant load
- Also helps maintain pre-development hydrology
- Updated 90th percentile rainfall event
- Increases water quality storm from 1.0 inch to 1.3 inches
- No change to WQV equation



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Standard 2. Stormwater Runoff Quantity Control

Peak Runoff Attenuation

2, 10, 100-yr, 24-hr Storms

Control the 2-yr post development peak flow rate to 50% of predevelopment rate.

Control the 10-yr post development peak flow rate to pre-development rate.

Potentially control the 100-year post development peak flow rate to pre-development rate, as required by review authority.

Conveyance Protection

10-yr, 24-hr Storm

Design the conveyance system leading to, from, and through structural stormwater BMPs based on the 10-yr or larger magnitude design storm.

Emergency Outlet Sizing

100-yr, 24-hr Storm

Size the emergency outlet of stormwater quantity control structures to safely pass the post-development peak runoff from the 100-year or larger magnitude design storm in a controlled manner without eroding the outlet and downstream drainage systems.

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Updated Stormwater Quantity Control Design Storm Rainfall

Parameter	2004 Stormwater Quality Manual	2023 Stormwater Quality Manual
24-hour Rainfall Depth	TP-40	NOAA Atlas 14 (and subsequent generations)
Rainfall Distribution	NRCS Type III	NRCS NOAA_D

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Climate Change Considerations

Stormwater Impacts (Appendix G)

- More frequent and intense storms and drainage flooding
- Increased runoff and pollutant loads
- Rising sea levels and groundwater levels in coastal areas
- Water quality impacts (harmful algal blooms, cold-water streams, recreational waters)
- More frequent, intense, and longer lasting periods of drought, reduced streamflow

Climate Change Considerations

Resilient Design Elements (Appendix G)

- Emphasis on non-structural LID
- Updated design storm precipitation
  - Consider adopting future generations of NOAA Atlas 14 precipitation products (projected future rainfall – climate change)
- Coastal considerations (sea level rise)
- Mitigating impacts to stream temperatures and nutrient loads

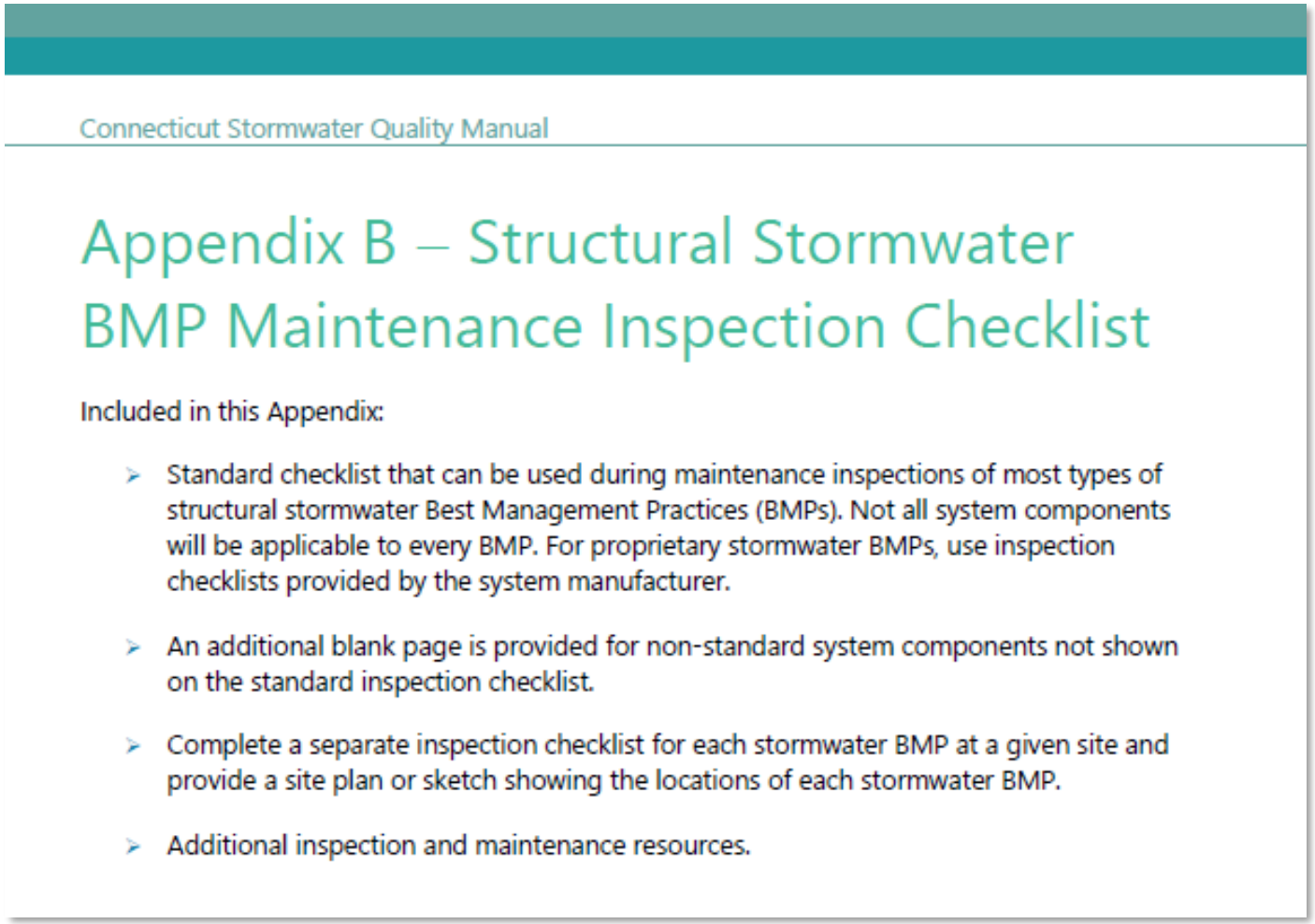
Standard 3. Construction Soil Erosion & Sediment Control

- **Soil Erosion and Sediment Control (SESC) Plan**
  - Consistency with local requirements, Guidelines, and Construction General Permit
  - Stormwater Management Plan (Chapter 12)

Standard 4. Post-Construction Operation and Maintenance

- **Operation and Maintenance (O&M) Plan**
  - Inspection and maintenance activities (Chapter 13), schedules, responsible parties
  - Stormwater Management Plan (Chapter 12)
  - Source Control Practices and Pollution Prevention (Chapter 6)

Standard 4. Post-Construction Operation and Maintenance

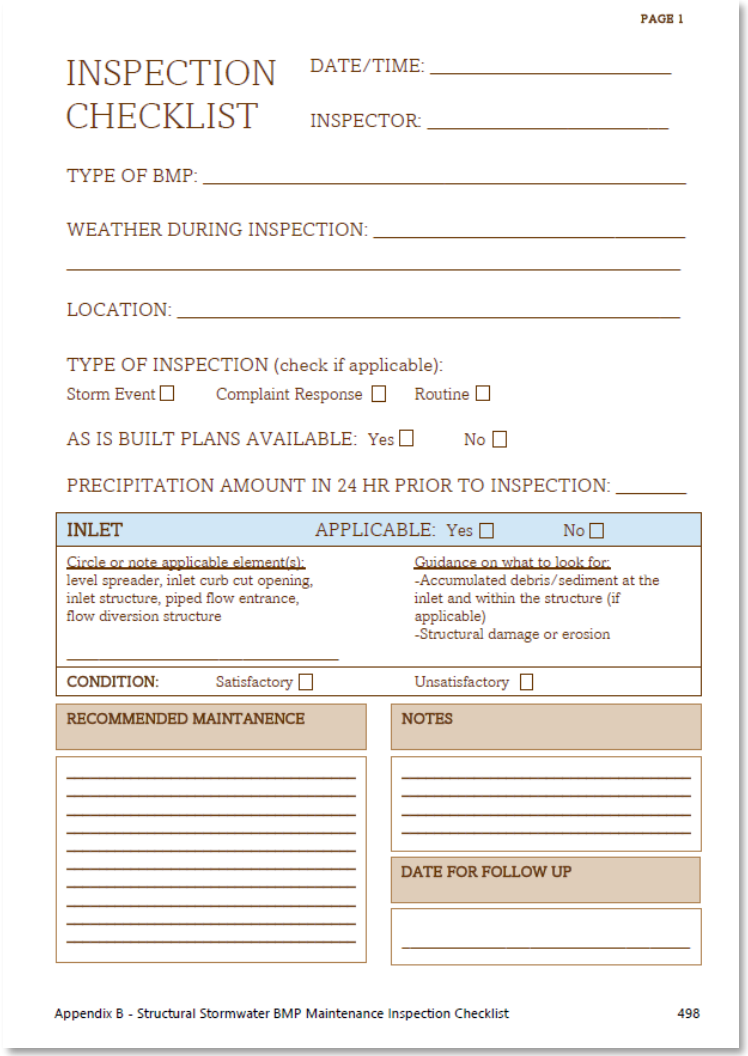


Connecticut Stormwater Quality Manual

Appendix B – Structural Stormwater BMP Maintenance Inspection Checklist

Included in this Appendix:

- Standard checklist that can be used during maintenance inspections of most types of structural stormwater Best Management Practices (BMPs). Not all system components will be applicable to every BMP. For proprietary stormwater BMPs, use inspection checklists provided by the system manufacturer.
- An additional blank page is provided for non-standard system components not shown on the standard inspection checklist.
- Complete a separate inspection checklist for each stormwater BMP at a given site and provide a site plan or sketch showing the locations of each stormwater BMP.
- Additional inspection and maintenance resources.



PAGE 1

INSPECTION CHECKLIST

DATE/TIME: _____

INSPECTOR: _____

TYPE OF BMP: _____

WEATHER DURING INSPECTION: _____

_____

LOCATION: _____

TYPE OF INSPECTION (check if applicable):

Storm Event ☐ Complaint Response ☐ Routine ☐

AS IS BUILT PLANS AVAILABLE: Yes ☐ No ☐

PRECIPITATION AMOUNT IN 24 HR PRIOR TO INSPECTION: _____

INLET	APPLICABLE: Yes ☐	No ☐
Circle or note applicable element(s): level spreader, inlet curb cut opening, inlet structure, piped flow entrance, flow diversion structure	Guidance on what to look for: -Accumulated debris/sediment at the inlet and within the structure (if applicable) -Structural damage or erosion	
CONDITION:	Satisfactory ☐	Unsatisfactory ☐
RECOMMENDED MAINTANENCE	NOTES	
_____	_____	
	DATE FOR FOLLOW UP	
	_____	

Appendix B - Structural Stormwater BMP Maintenance Inspection Checklist 498

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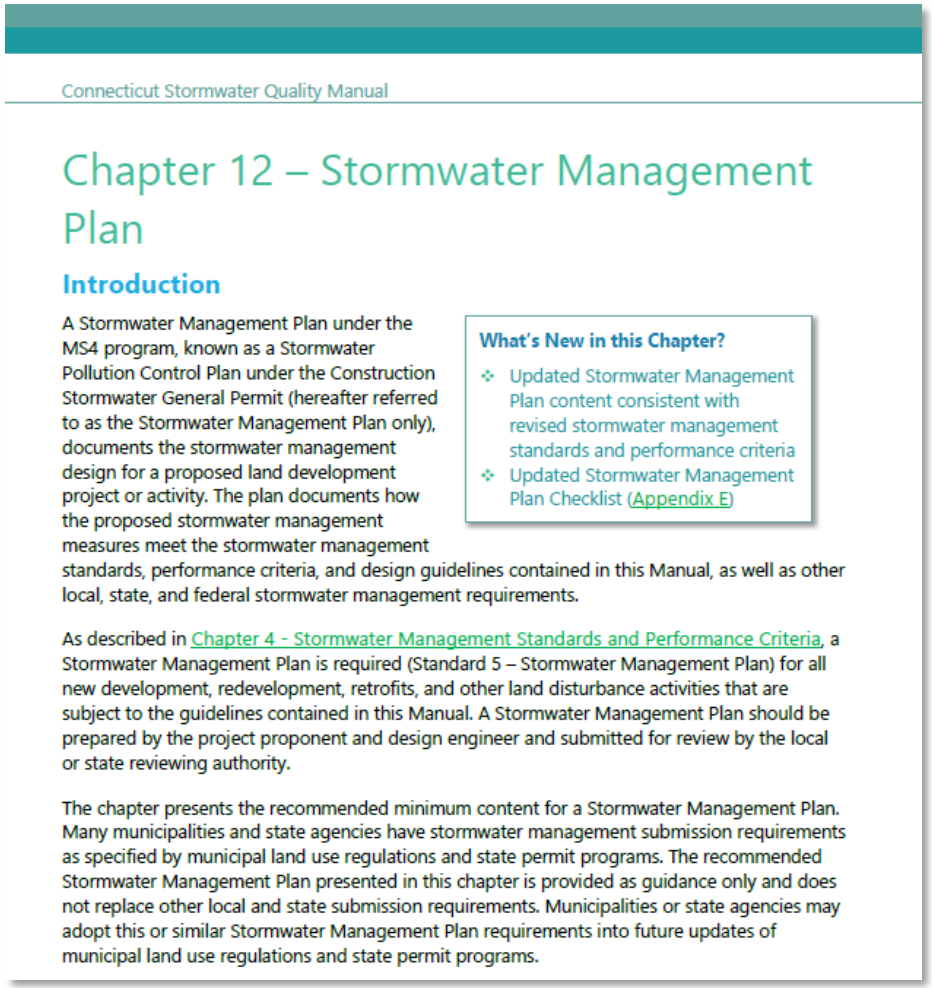
Standard 5. Stormwater Management Plan

- Document how stormwater management system meets local and state requirements and the guidelines in the Manual
- **Updated Stormwater Management Plan guidance** (Chapter 12)
  - Stormwater Management Report
  - Compliance Summary
  - Design Calculations
  - Design Drawings
  - SESC Plan, O&M Plan, Other Support Docs



Connecticut Stormwater Quality Manual

Chapter 12 – Stormwater Management Plan

Introduction

What's New in this Chapter?

- Updated Stormwater Management Plan content consistent with revised stormwater management standards and performance criteria
- Updated Stormwater Management Plan Checklist (Appendix E)

A Stormwater Management Plan under the MS4 program, known as a Stormwater Pollution Control Plan under the Construction Stormwater General Permit (hereafter referred to as the Stormwater Management Plan only), documents the stormwater management design for a proposed land development project or activity. The plan documents how the proposed stormwater management measures meet the stormwater management standards, performance criteria, and design guidelines contained in this Manual, as well as other local, state, and federal stormwater management requirements.

As described in Chapter 4 - Stormwater Management Standards and Performance Criteria, a Stormwater Management Plan is required (Standard 5 – Stormwater Management Plan) for all new development, redevelopment, retrofits, and other land disturbance activities that are subject to the guidelines contained in this Manual. A Stormwater Management Plan should be prepared by the project proponent and design engineer and submitted for review by the local or state reviewing authority.

The chapter presents the recommended minimum content for a Stormwater Management Plan. Many municipalities and state agencies have stormwater management submission requirements as specified by municipal land use regulations and state permit programs. The recommended Stormwater Management Plan presented in this chapter is provided as guidance only and does not replace other local and state submission requirements. Municipalities or state agencies may adopt this or similar Stormwater Management Plan requirements into future updates of municipal land use regulations and state permit programs.

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Structural Stormwater BMP Design Guidance

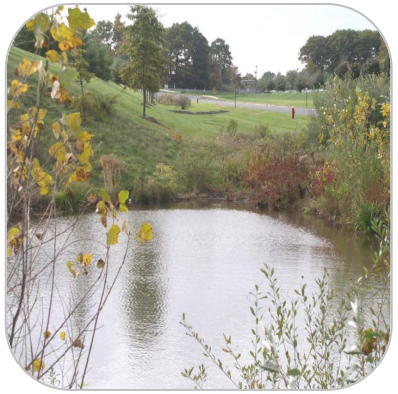
Functional Classification

Pretreatment BMPs

Infiltration BMPs

Filtering BMPs

Stormwater Pond BMPs

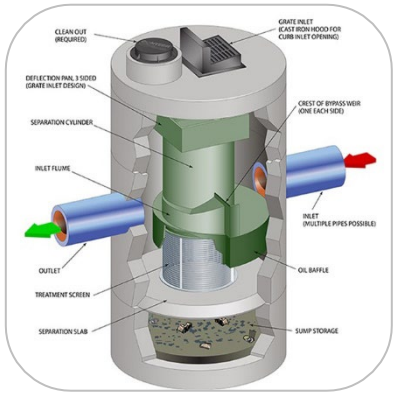


Stormwater Wetland BMPs

Water Quality Conveyance BMPs

Stormwater Reuse BMPs

Proprietary BMPs



Other BMPs and Accessories

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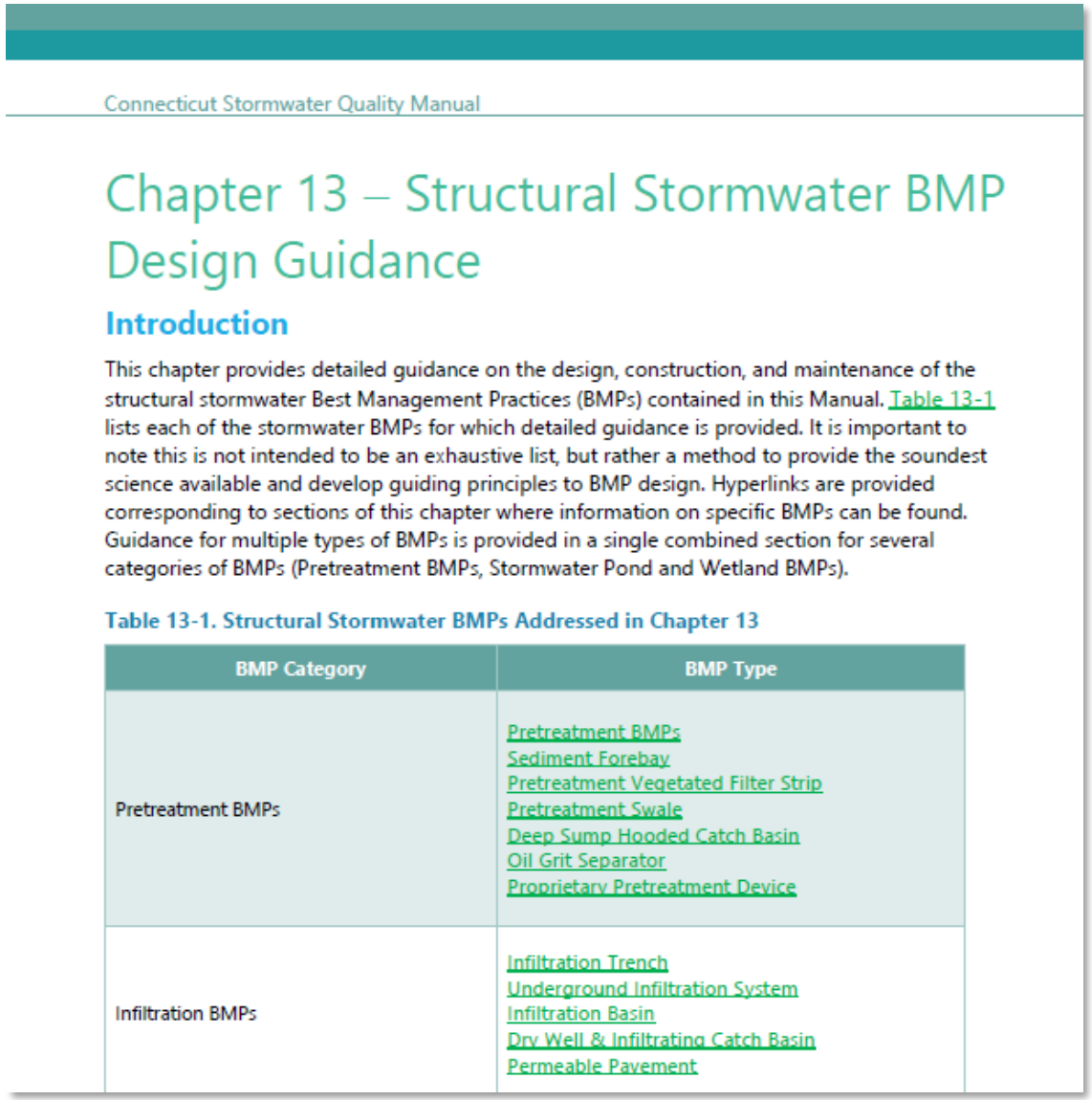
Structural Stormwater BMP Design Guidance

Updated Technical Guidance (Chapter 13)

- Description
- Advantages & Limitations
- Siting Considerations
- Soil Evaluation Requirements
- Design Recommendations
- Construction Recommendations
- Maintenance Needs



Connecticut Stormwater Quality Manual

Chapter 13 – Structural Stormwater BMP Design Guidance

Introduction

This chapter provides detailed guidance on the design, construction, and maintenance of the structural stormwater Best Management Practices (BMPs) contained in this Manual. Table 13-1 lists each of the stormwater BMPs for which detailed guidance is provided. It is important to note this is not intended to be an exhaustive list, but rather a method to provide the soundest science available and develop guiding principles to BMP design. Hyperlinks are provided corresponding to sections of this chapter where information on specific BMPs can be found. Guidance for multiple types of BMPs is provided in a single combined section for several categories of BMPs (Pretreatment BMPs, Stormwater Pond and Wetland BMPs).

Table 13-1. Structural Stormwater BMPs Addressed in Chapter 13

BMP Category	BMP Type
Pretreatment BMPs	Pretreatment BMPs Sediment Forebay Pretreatment Vegetated Filter Strip Pretreatment Swale Deep Sump Hooded Catch Basin Oil Grit Separator Proprietary Pretreatment Device
Infiltration BMPs	Infiltration Trench Underground Infiltration System Infiltration Basin Dry Well & Infiltrating Catch Basin Permeable Pavement

Infiltration Basin

Stormwater BMP Type

Pretreatment BMP	□
Infiltration BMP	■
Filtering BMP	□
Stormwater Pond BMP	□
Stormwater Wetland BMP	□
Water Quality Conveyance BMP	□
Stormwater Reuse BMP	□
Proprietary BMP	□
Other BMPs and Accessories	□

Stormwater Management Suitability

Retention	■
Treatment	■
Pretreatment	□
Peak Runoff Attenuation*	■

*On-line systems only

Pollutant Removal

Sediment*	High
Phosphorus	High
Nitrogen	Low
Bacteria	High

*Includes sediment-bound pollutants and floatables (with pretreatment)

Implementation

Capital Cost	Low
Maintenance Burden	Low
Land Requirement	Medium

Description

Infiltration basins are open stormwater impoundments designed to capture and infiltrate the stormwater over several days but do not retain a permanent pool of water. The bottom of an infiltration basin typically contains vegetation to increase the infiltration capacity of the basin, allow for vegetative uptake, and reduce soil erosion and scouring of the basin. This BMP can receive both sheet flow and piped runoff discharged directly into the basin. Runoff gradually infiltrates into the underlying soil through the bottom of the basin, removing pollutants through sorption, trapping, straining, and bacterial degradation, or transformation. Infiltration basins may also be used to provide stormwater quantity control when designed as on-line facilities.

Infiltration basins are a cost-effective approach to managing stormwater where there is adequate space. Water is stored above the bottom of the basin rather than in subsurface storage media, which is more cost-effective than other infiltration approaches.

Advantages

- Cost-effective approach to recharge stormwater as it does not require subsurface storage media and stormwater can be temporarily stored aboveground.
- Naturally can take advantage of topographic low areas.
- High solids, phosphorus, and bacteria removal efficiency.
- Can provide stormwater retention, runoff volume reduction, groundwater recharge, and some peak runoff attenuation when designed as an on-line system

Limitations

- Require adequate space to store stormwater aboveground. Difficult to site in urban and fully developed locations.
- System clogging would require replacement of basin surface.
- Lower removal of dissolved pollutants especially in coarse soils.
- Should not be used with underdrain systems.

Siting Considerations

- **Potential Locations:** Best located where there is adequate surface area to temporarily store stormwater. Infiltration basins are suitable in urban and rural settings, but require adequate space, which makes their use limited in urban areas. Locate where:
  - The topography allows the design of the infiltration basin bottom to be level
  - Snow storage will not occur atop the basin
  - There is a low likelihood that pedestrian traffic will cut across the basin.
- **Drainage Area:** The maximum contributing drainage area for infiltration basins is 10 acres.
- **General:** Meet the soils, water table, bedrock, and horizontal setback requirements specified in Chapter 10 - General Design Guidance for Stormwater Infiltration Systems. Infiltration basins can be designed as on-line or off-line practices.

Soil Evaluation

- Conduct an evaluation of the soil characteristics and subsurface conditions at the location of the proposed system including soil type, depth to the seasonal high groundwater table, depth to bedrock, and soil infiltration rate. Refer to Chapter 10 - General Design Guidance for Stormwater Infiltration Systems for soil evaluation guidance.

Design Recommendations

Pretreatment

- Incorporate pretreatment measures at locations where runoff enters the infiltration basin in accordance with the Pretreatment BMPs section of this Manual.
- Acceptable pretreatment measures include vegetative filter strips, sediment forebays, pretreatment swales, deep sump hooded catch basins,[76] oil grit separators, and proprietary pretreatment devices.
- Sediment forebays should have a minimum storage volume of 25% of the Water Quality Volume (WQV), while flow-through Pretreatment BMPs should treat at least the equivalent Water Quality Flow (WQF). A minimum sediment forebay storage volume of 10% of the

[76] Only recommended for space constrained sites where no other Pretreatment BMPs are feasible.

WQV may be used in urban settings, space constrained sites, and as retrofits, with the approval of the review authority.

Sizing and Dimensions

- Basin Surface Area
  - Basin should be designed by either the Static or Dynamic Methods as described in Chapter 10 - General Design Guidance for Stormwater Infiltration Systems.
  - Basin should completely drain in 48 hours or less after the end of the design storm as described in Chapter 10 - General Design Guidance for Stormwater Infiltration Systems.
- Ponding Depth
  - Maximum depth of water above the basin bottom: 36 inches
- Bottom Slope
  - Bottom slope of the basin should be level.
- Side Slopes
  - Side slopes should be 3(H):1(V) or flatter especially on grassed slopes where mowing is required.
  - In ultra-urban locations or space constrained areas; side slopes of 2(H):1(V) may be utilized if properly designed to account for erosion and slope stability. Stabilize the slope with turf reinforcement matting or equivalent if the slope could potentially erode.
  - If site topography does not allow for 3(H):1(V) slopes or adequately stabilized 2(H):1(V) slopes, vertical concrete walls with a maximum height of 30 inches can be used. Drop curbs or similar precast structures can also be used to create stable, vertical side walls.

Inlet

- Design the inlet in accordance with the Inlet and Outlet Controls section of this Manual.
- Runoff can be introduced through overland flow, curb cuts, inlet structures, swales/channels, and/or pipes.
- Design in an off-line configuration to the extent feasible if runoff is delivered by a storm drainpipe or is along the main storm conveyance system.

Outlet & Overflow

- Design the outlet in accordance with the Inlet and Outlet Controls section of this Manual.
- Outlets are typically a stabilized spillway, gabion berm, concrete weir, curb cut opening, precast concrete structure, or polyethylene/polyvinyl chloride riser structure.

- On-line systems should have a primary outlet sized to convey the 10-year, 24-hour storm event, at a minimum, to the storm drainage system or stabilized channel. An emergency spillway is required to convey the 100-year storm event (assuming the primary outlet is not designed to pass the 100-year storm event).
- Off-line systems should be designed with a bypass or overflow for flows in excess of the water quality storm.

Materials

- Surface Cover
  - Should use 4 to 6 inches of loam/topsoil and seed to establish stabilized permanent vegetative cover as desired for the site and application. Select vegetation with the guidance provided in Appendix F of this Manual.
  - Alternatively, the bottom of the basin can be landscaped utilizing plant materials suitable for the site and application. Select plants with the guidance provided in Appendix F of this Manual.
  - Mulch can be 2 to 4 inches of shredded hardwood bark mulch, aged for 6 month or 3 inches of 3/8" to ¾" size pea gravel conforming to AASHTO No. 8 or No. 5 stone. Pea gravel should be clean (washed and free from dirt and debris) and rounded in shape. Mulch may be used directly around the plants, but mulch should NOT be used to cover the entire bottom of the infiltration basin.
  - Do not plant any woody vegetation (e.g., shrubs and trees) on embankments that are used to retain water in the basin. Those embankments should be stabilized with a grass cover.

Winter Operations

- Infiltration basins should not be used for storage of plowed snow. To the extent feasible, locate and design the system to avoid snow storage areas and potential damage from snow plowing activities. Refer to Chapter 7 - Overview of Structural Stormwater Best Management Practices for general design considerations related to winter operations.

Construction Recommendations

- The design engineer should develop a detailed, site-specific construction sequence.
- The design engineer should inspect the installation during the following stages of construction, at a minimum:
  - After excavation of the infiltration basin and scarification of bottom and side slopes of excavation
  - After installation of bypass, outlet/overflow, and inlet controls
  - After pea gravel or loam/topsoil and grass surface cover have been installed
- The design engineer should provide an as-built plan of the completed infiltration basin along with a certification that the system was designed in accordance with the guidance

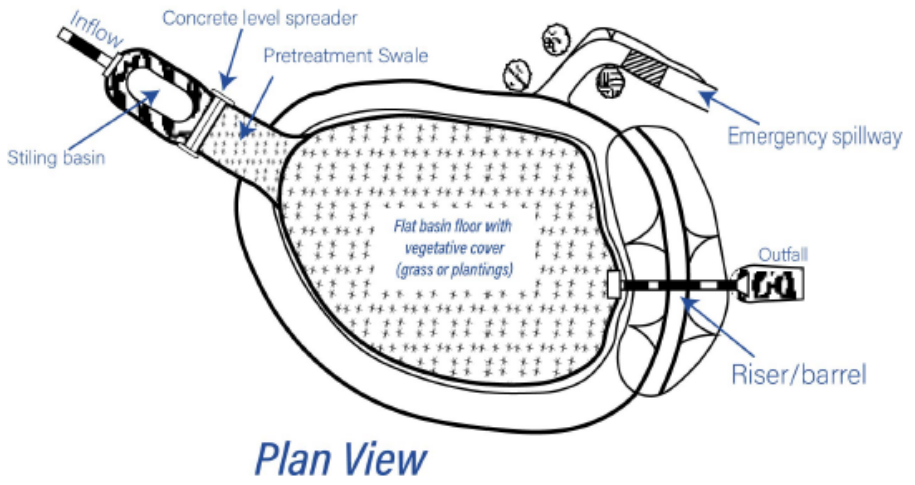
- Maintenance should be detailed in a legally binding maintenance agreement.
- Maintenance activities such as sediment removal, mowing, and repairs should be performed with rakes and light-weight equipment rather than heavy construction equipment to avoid compaction of the filter media and underlying soils. Heavy equipment may be used for sediment removal and other maintenance activities if the equipment is positioned outside the limits of the system. Heavy construction equipment should not be allowed within the limits of the system for maintenance purposes.

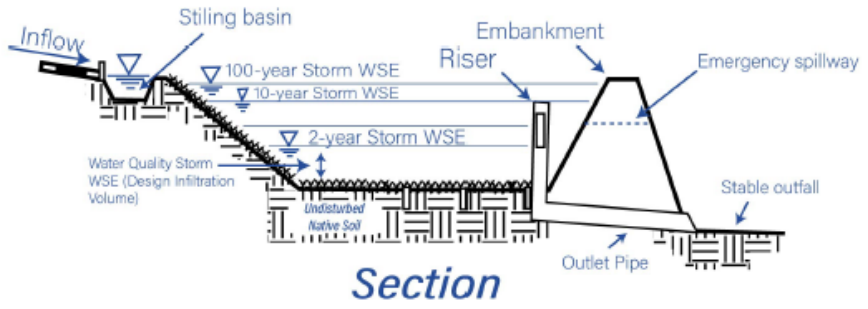
Recommended Maintenance Activities

- Inspect after major storms (1 inch or more of precipitation) in the first few months following construction.
- Inspect the sediment forebay or other pretreatment area twice a year.
- Inspect the remainder of the infiltration basin annually.
- Refer to Appendix B for maintenance inspection checklists, including items to focus on during inspections.
- Remove trash and organic debris (leaves) in the Spring and Fall.
- Remove sediment from the sediment forebay or other pretreatment area when it accumulates to a depth of more than 12 inches or 50% of the design depth. Clean outlet of sediment forebay or other pretreatment measures when drawdown time exceeds 36 hours after the end of a storm event.
- Remove sediment from the infiltration basin surface when the sediment accumulation exceeds 2 inches or when drawdown time exceeds 48 hours after the end of a storm event, indicating that the system is clogged.
- Weed as necessary. Mow grass within infiltration basin to a height of 3 to 6 inches. Maintain a healthy, vigorous stand of grass cover; re-seed as necessary.
- Maintain vegetated filter strips or grassed side slopes of infiltration basin in accordance with maintenance recommendations in the Pretreatment BMPs section of this Manual.
- Periodically remove grass clippings to prevent clogging of the surface of the infiltration basin.

Mowing should not be performed when the ground is soft to avoid the creation of ruts and compaction, which can reduce infiltration.

Figure 13-10. Infiltration Basin Schematic

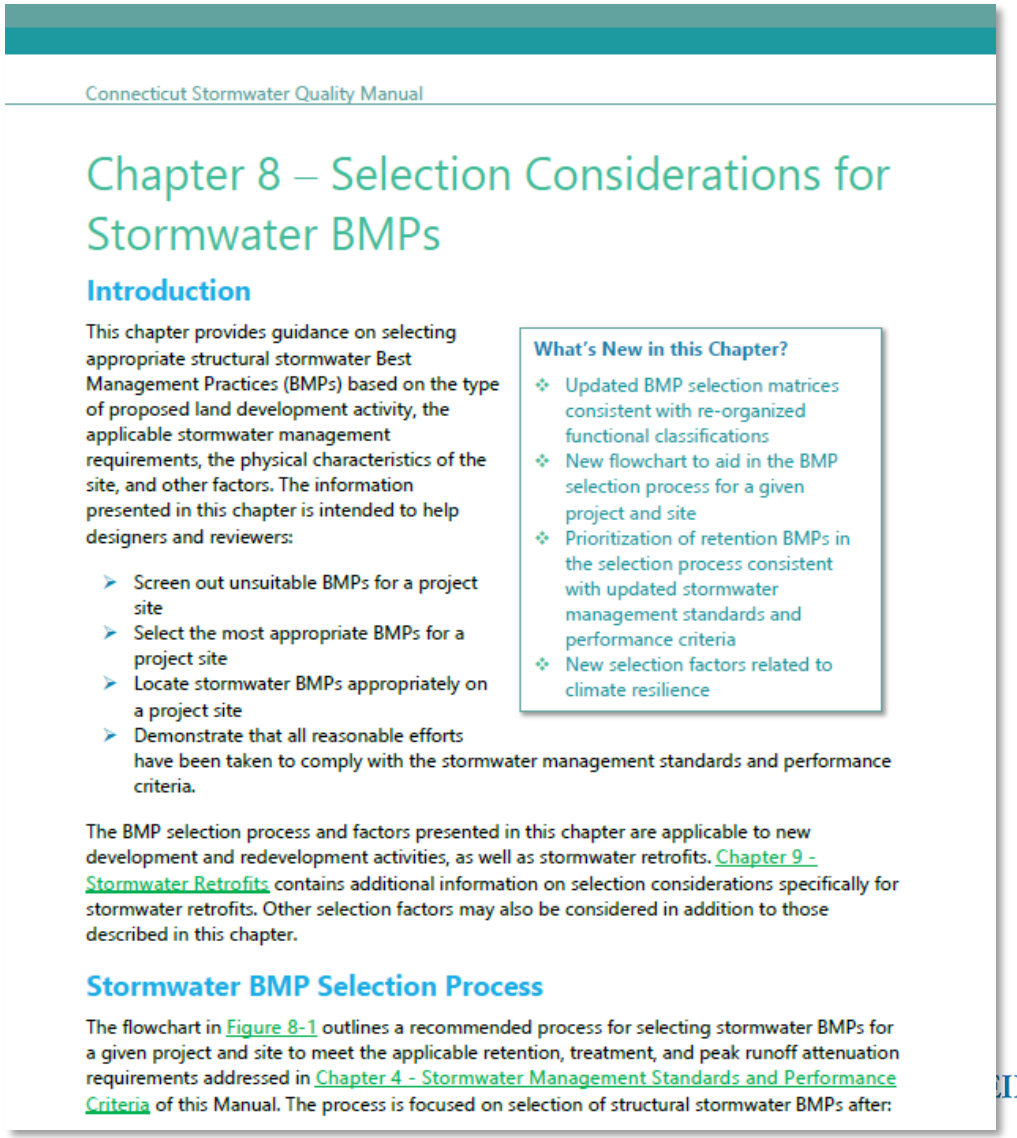




Structural Stormwater BMP Design Guidance

BMP Selection Considerations (Chapter 8)

- New BMP selection flowchart
- Prioritization of retention BMPs
- Updated BMP selection matrices



Connecticut Stormwater Quality Manual

Chapter 8 – Selection Considerations for Stormwater BMPs

Introduction

This chapter provides guidance on selecting appropriate structural stormwater Best Management Practices (BMPs) based on the type of proposed land development activity, the applicable stormwater management requirements, the physical characteristics of the site, and other factors. The information presented in this chapter is intended to help designers and reviewers:

- Screen out unsuitable BMPs for a project site
- Select the most appropriate BMPs for a project site
- Locate stormwater BMPs appropriately on a project site
- Demonstrate that all reasonable efforts have been taken to comply with the stormwater management standards and performance criteria.

What's New in this Chapter?

- Updated BMP selection matrices consistent with re-organized functional classifications
- New flowchart to aid in the BMP selection process for a given project and site
- Prioritization of retention BMPs in the selection process consistent with updated stormwater management standards and performance criteria
- New selection factors related to climate resilience

The BMP selection process and factors presented in this chapter are applicable to new development and redevelopment activities, as well as stormwater retrofits. Chapter 9 - Stormwater Retrofits contains additional information on selection considerations specifically for stormwater retrofits. Other selection factors may also be considered in addition to those described in this chapter.

Stormwater BMP Selection Process

The flowchart in Figure 8-1 outlines a recommended process for selecting stormwater BMPs for a given project and site to meet the applicable retention, treatment, and peak runoff attenuation requirements addressed in Chapter 4 - Stormwater Management Standards and Performance Criteria of this Manual. The process is focused on selection of structural stormwater BMPs after:

Structural Stormwater BMP Design Guidance

Stormwater Management Suitability

- Retention
- Treatment
- Pretreatment
- Peak Runoff Attenuation

Table 8-1. Stormwater Management Suitability

BMP Category	BMP Type	Retention		Treatment	Pretreatment	Peak Runoff Attenuation (5)	Requires Pretreatment?
		Volume Reduction	Infiltration/ Recharge				
Pretreatment BMPs	Sediment Forebay				●		No
	Pretreatment Vegetated Filter Strip				●		No
	Pretreatment Swale				●		No
	Deep Sump Hooded Catch Basin				●		No
	Oil Grit Separator				●		No
	Proprietary Pretreatment Device				(1)		No
Infiltration BMPs	Infiltration Trench	●	●	●		●	**Yes**
	Underground Infiltration System	●	●	●		●	**Yes**
	Infiltration Basin	●	●	●		●	**Yes**
	Dry Well	(2)	(2)	(2)			No
	Infiltrating Catch Basin	(3)	(3)	(3)			**Yes**
	Permeable Pavement	●	●	●		●	No
Filtering BMPs	Bioretention	(4)	(4)	●		●	**Yes**
	Sand Filter	(4)	(4)	●		●	**Yes**
	Tree Filter	(4)	(4)	●			**Yes**
Stormwater Pond BMPs	Wet Pond			●		●	**Yes**
	Micropool Extended Detention Pond			●		●	**Yes**
	Wet Extended Detention Pond					●	**Yes**
	Multiple Pond System			●		●	**Yes**
Stormwater Wetland BMPs	Subsurface Gravel Wetland			●			**Yes**
	Shallow Wetland			●			**Yes**
	Extended Detention Shallow Wetland			●		●	**Yes**
	Pond/Wetland System			●		●	**Yes**

Structural Stormwater BMP Design Guidance

Physical Feasibility Factors

- Drainage Area
- Site Slope
- Soil Infiltration Capacity
- Depth to Seasonal High Groundwater
- Depth to Bedrock

Table 8-5. Physical Feasibility – Depth to Seasonal High Groundwater Table and Bedrock

BMP Category	BMP Type	Depth to Seasonal High Groundwater Table (1)				Depth to Bedrock		
		< 1 ft	1 – 2 ft	2 – 3 ft	> 3 ft	< 2 ft	2 – 3 ft	> 3 ft
Infiltration BMPs	Infiltration Trench			(2)	💧		(2)	💧
	Underground Infiltration System			(2)	💧		(2)	💧
	Infiltration Basin			(2)	💧		(2)	💧
	Dry Well			(2)	💧		(2)	💧
	Infiltrating Catch Basin			(2)	💧		(2)	💧
	Porous Asphalt			(2)	💧		(2)	💧
	Pervious Concrete			(2)	💧		(2)	💧
	Permeable Concrete Interlocking Pavers			(2)	💧		(2)	💧
Filtering BMPs	Bioretention		(3)	(2)	💧	(3)	(2)	💧
	Sand Filter		(3)	(2)	💧	(3)	(2)	💧
	Tree Filter		(3)	(2)	💧	(3)	(2)	💧
Stormwater Pond BMPs	Wet Pond	💧	💧	(4)		💧	💧	💧
	Micropool Extended Detention Pond	💧	💧	(4)		💧	💧	💧
	Wet Extended Detention Pond	💧	💧	(4)		💧	💧	💧
	Multiple Pond System	💧	💧	(4)		💧	💧	💧
Stormwater Wetland BMPs	Subsurface Gravel Wetland	💧	💧	(4)		💧	💧	💧
	Shallow Wetland	💧	💧	(4)		💧	💧	💧
	Extended Detention Shallow Wetland	💧	💧	(4)		💧	💧	💧
	Pond/Wetland System	💧	💧	(4)		💧	💧	💧

Structural Stormwater BMP Design Guidance

Physical Feasibility Factors

- Drainage Area
- Site Slope
- Soil Infiltration Capacity
- Depth to Seasonal High Groundwater
- Depth to Bedrock

BMP Category	BMP Type	Depth to Seasonal High Groundwater Table (1)				Depth to Bedrock		
		< 1 ft	1 – 2 ft	2 – 3 ft	> 3 ft	< 2 ft	2 – 3 ft	> 3 ft
Water Quality Conveyance BMPs	Dry Water Quality Swale			(2)	💧		(2)	💧
	Wet Water Quality Swale	💧	💧	(4)		💧	💧	💧
Stormwater Reuse BMPs	Rain Barrel	Not Applicable				Not Applicable		
	Cistern	Not Applicable				Not Applicable		
Proprietary BMPs	Manufactured Treatment System	Not Applicable				Not Applicable		
Other BMPs and BMP Accessories	Green Roof	Not Applicable				Not Applicable		
	Dry Extended Detention Basin	(6)	💧	💧	💧	(5)	💧	💧
	Underground Detention (no infiltration)	💧	💧	💧	💧	💧	💧	💧

Notes:

Depth from bottom of infiltration systems or top of filtering systems to seasonal high groundwater table and bedrock or other impermeable material or subsurface layer as determined from test pits or soil borings (refer to Chapter 10 - General Design Guidance for Stormwater Infiltration Systems for soil evaluation methods).

(1) Stormwater BMPs designed with an underdrain system and impermeable liner may be used in areas where the required vertical separation to SHGT and bedrock cannot be met. Such systems are suitable for providing treatment but do not provide retention credit.

(2) Strictly residential uses or for stormwater retrofits where the minimum 3-foot separation cannot be met due to existing site constraints and there is little risk to groundwater quality, or where groundwater is already impacted (classified as GB) and there is little risk to groundwater quality from the infiltrated stormwater.

(3) For unlined filtering systems, the bottom of the filtering system should be at least 1 foot above SHGT and bedrock.

(4) Liner required in permeable soils.

(5) At least 1 foot of separation required.

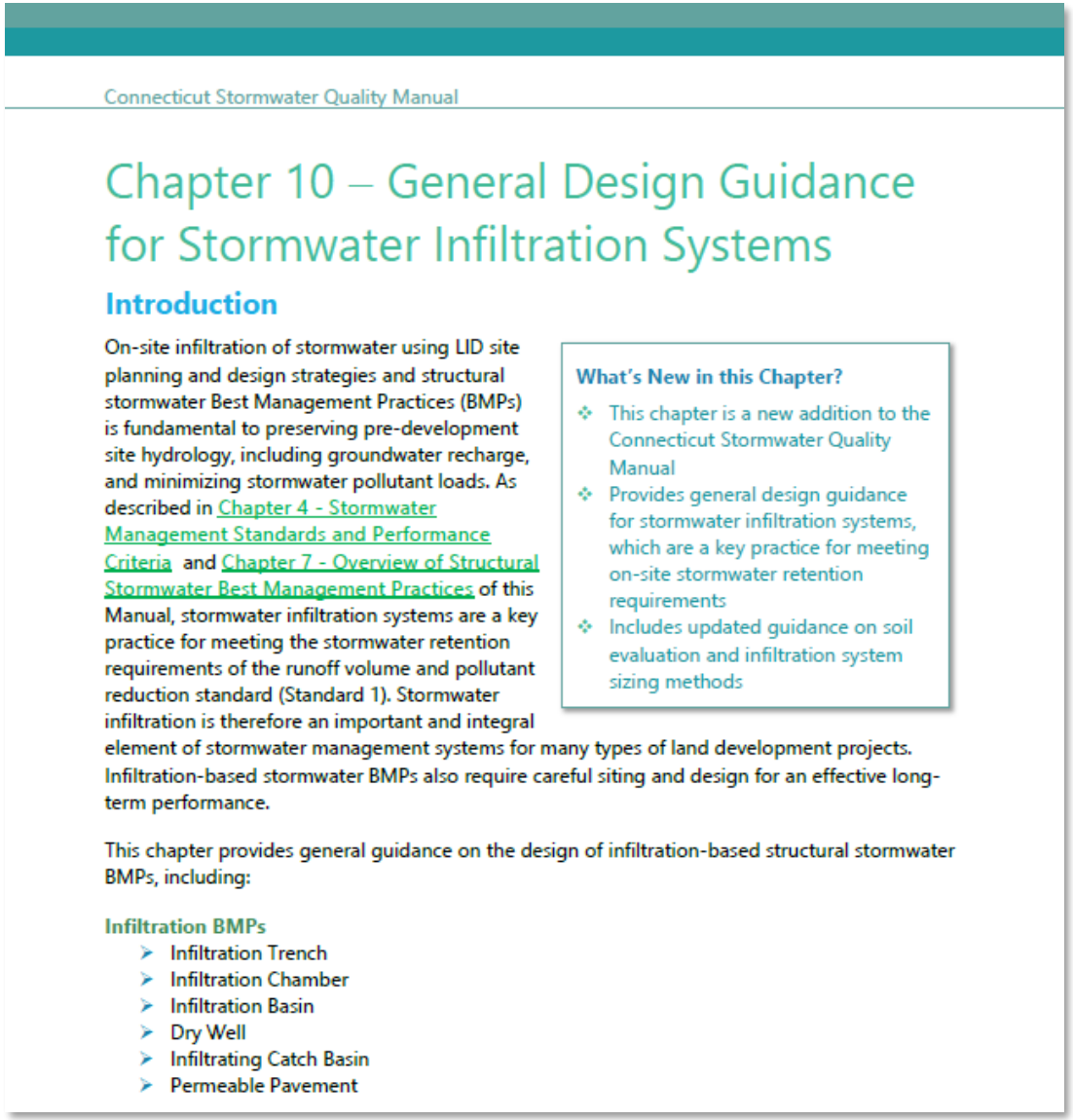
(6) Liner recommended.

Legend			
	💧	💧	Suitable
	See notes	See notes	Suitable under certain conditions or with design restrictions as noted
			Generally not suitable

Structural Stormwater BMP Design Guidance

Stormwater Infiltration System Design (Chapter 10)

- New section of the Manual
  - Infiltration BMPs
  - Filtering BMPs and Dry WQ Swale (when designed for infiltration)
- Meeting retention requirements through infiltration
- Careful siting and design for effective long-term performance



Connecticut Stormwater Quality Manual

Chapter 10 – General Design Guidance for Stormwater Infiltration Systems

Introduction

On-site infiltration of stormwater using LID site planning and design strategies and structural stormwater Best Management Practices (BMPs) is fundamental to preserving pre-development site hydrology, including groundwater recharge, and minimizing stormwater pollutant loads. As described in Chapter 4 - Stormwater Management Standards and Performance Criteria and Chapter 7 - Overview of Structural Stormwater Best Management Practices of this Manual, stormwater infiltration systems are a key practice for meeting the stormwater retention requirements of the runoff volume and pollutant reduction standard (Standard 1). Stormwater infiltration is therefore an important and integral element of stormwater management systems for many types of land development projects. Infiltration-based stormwater BMPs also require careful siting and design for an effective long-term performance.

What's New in this Chapter?

- This chapter is a new addition to the Connecticut Stormwater Quality Manual
- Provides general design guidance for stormwater infiltration systems, which are a key practice for meeting on-site stormwater retention requirements
- Includes updated guidance on soil evaluation and infiltration system sizing methods

This chapter provides general guidance on the design of infiltration-based structural stormwater BMPs, including:

Infiltration BMPs

- Infiltration Trench
- Infiltration Chamber
- Infiltration Basin
- Dry Well
- Infiltrating Catch Basin
- Permeable Pavement

Structural Stormwater BMP Design Guidance

Stormwater Infiltration System Design (Chapter 10)

Soil Evaluation Guidance

- Initial screening
- Test pits and soil borings
- Field infiltration testing
- Evaluation documentation

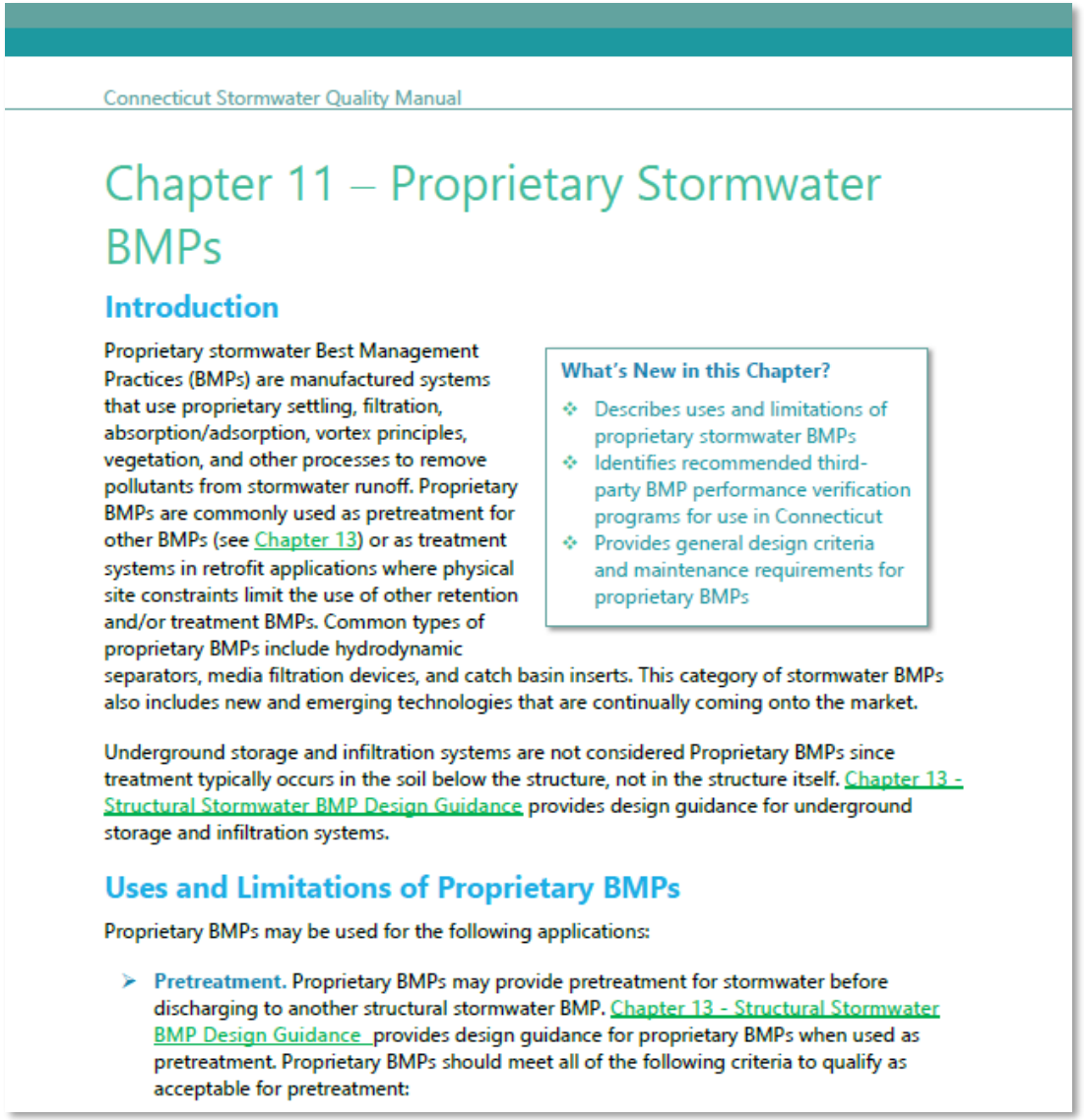
General Design Guidance

- Design infiltration rate
- Maximum drain time
- Horizontal setbacks
- Vertical separation to groundwater and bedrock
- Pretreatment
- Design infiltration volume
- Sizing methods (static vs. dynamic)
- Underdrains & impermeable liners

Structural Stormwater BMP Design Guidance

Proprietary Stormwater BMPs (Chapter 11)

- Uses and limitations
  - Pretreatment and treatment
  - Not suitable for retention
- Third-party performance verification
  - NJCAT, TAPE, or other equivalent programs
- General design criteria and maintenance considerations



Connecticut Stormwater Quality Manual

Chapter 11 – Proprietary Stormwater BMPs

Introduction

Proprietary stormwater Best Management Practices (BMPs) are manufactured systems that use proprietary settling, filtration, absorption/adsorption, vortex principles, vegetation, and other processes to remove pollutants from stormwater runoff. Proprietary BMPs are commonly used as pretreatment for other BMPs (see Chapter 13) or as treatment systems in retrofit applications where physical site constraints limit the use of other retention and/or treatment BMPs. Common types of proprietary BMPs include hydrodynamic separators, media filtration devices, and catch basin inserts. This category of stormwater BMPs also includes new and emerging technologies that are continually coming onto the market.

What's New in this Chapter?

- Describes uses and limitations of proprietary stormwater BMPs
- Identifies recommended third-party BMP performance verification programs for use in Connecticut
- Provides general design criteria and maintenance requirements for proprietary BMPs

Underground storage and infiltration systems are not considered Proprietary BMPs since treatment typically occurs in the soil below the structure, not in the structure itself. Chapter 13 - Structural Stormwater BMP Design Guidance provides design guidance for underground storage and infiltration systems.

Uses and Limitations of Proprietary BMPs

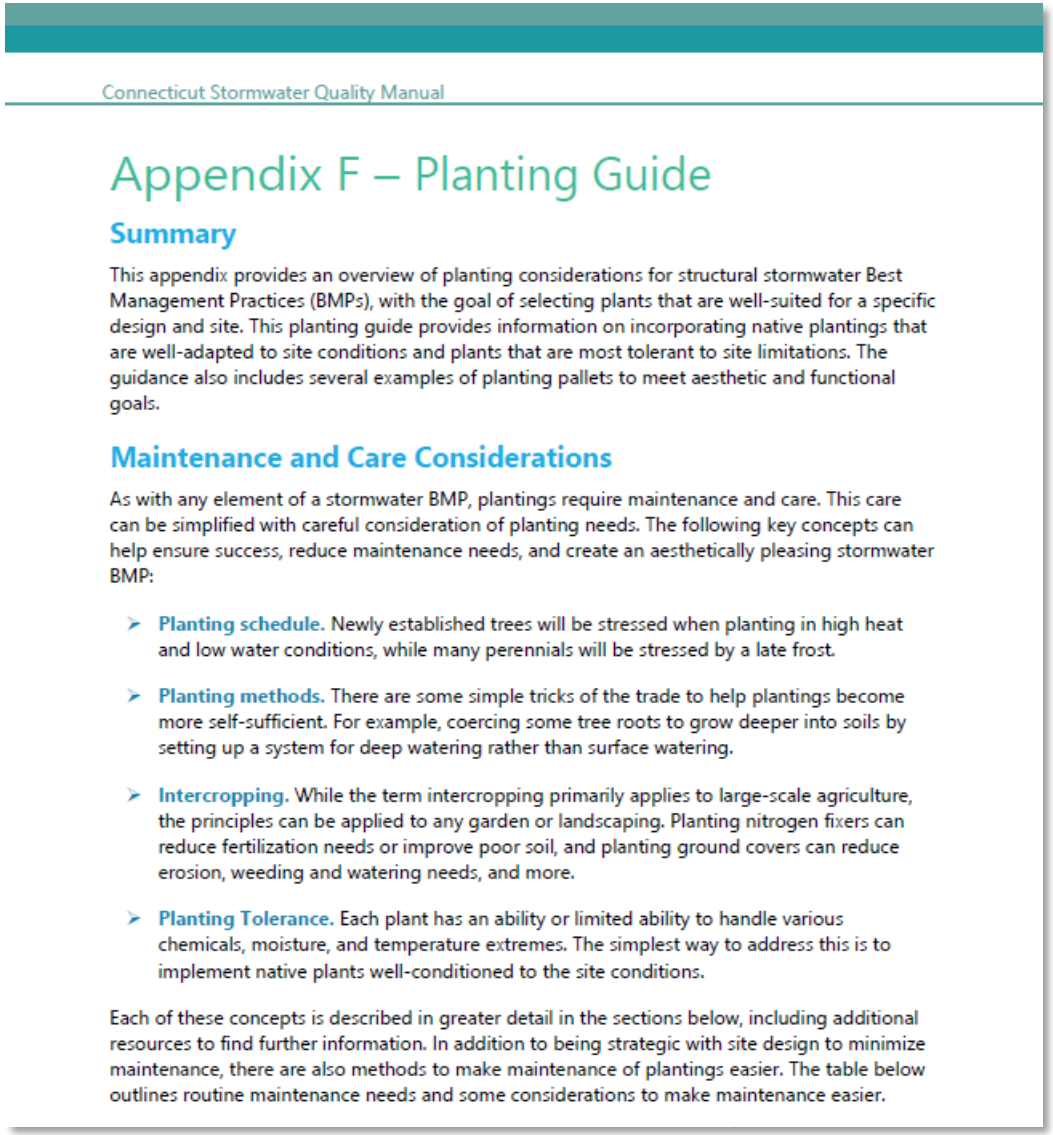
Proprietary BMPs may be used for the following applications:

- **Pretreatment.** Proprietary BMPs may provide pretreatment for stormwater before discharging to another structural stormwater BMP. Chapter 13 - Structural Stormwater BMP Design Guidance provides design guidance for proprietary BMPs when used as pretreatment. Proprietary BMPs should meet all of the following criteria to qualify as acceptable for pretreatment:

Structural Stormwater BMP Design Guidance

Stormwater Planting Guide (Appendix F)

- Native plantings that are well-adapted to site conditions
- Attract pollinators, deter pests, reduce watering and fertilizer needs
- Plant selection, maintenance, & care
- Example planting palettes



Connecticut Stormwater Quality Manual

Appendix F – Planting Guide

Summary

This appendix provides an overview of planting considerations for structural stormwater Best Management Practices (BMPs), with the goal of selecting plants that are well-suited for a specific design and site. This planting guide provides information on incorporating native plantings that are well-adapted to site conditions and plants that are most tolerant to site limitations. The guidance also includes several examples of planting pallets to meet aesthetic and functional goals.

Maintenance and Care Considerations

As with any element of a stormwater BMP, plantings require maintenance and care. This care can be simplified with careful consideration of planting needs. The following key concepts can help ensure success, reduce maintenance needs, and create an aesthetically pleasing stormwater BMP:

- **Planting schedule.** Newly established trees will be stressed when planting in high heat and low water conditions, while many perennials will be stressed by a late frost.
- **Planting methods.** There are some simple tricks of the trade to help plantings become more self-sufficient. For example, coercing some tree roots to grow deeper into soils by setting up a system for deep watering rather than surface watering.
- **Intercropping.** While the term intercropping primarily applies to large-scale agriculture, the principles can be applied to any garden or landscaping. Planting nitrogen fixers can reduce fertilization needs or improve poor soil, and planting ground covers can reduce erosion, weeding and watering needs, and more.
- **Planting Tolerance.** Each plant has an ability or limited ability to handle various chemicals, moisture, and temperature extremes. The simplest way to address this is to implement native plants well-conditioned to the site conditions.

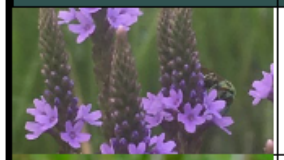
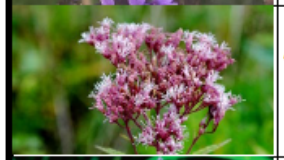
Each of these concepts is described in greater detail in the sections below, including additional resources to find further information. In addition to being strategic with site design to minimize maintenance, there are also methods to make maintenance of plantings easier. The table below outlines routine maintenance needs and some considerations to make maintenance easier.

Structural Stormwater BMP Design Guidance

Stormwater Planting Guide (Appendix F)

Figure A-2. Planting Palette Example B

Location Suitability	Legend: Sunny; Partly Shaded; Directly Adjacent to Roadways; Wet Areas				
BMP Suitability	Stormwater Pond	Bioretention	Infiltration Trench	Infiltration Basin	Filter Strip

Plant Photo	Name	Attributes		Notes
	*Verbena hastata,* Swamp Verbena	• Livestock will not eat • Beneficial for pollinators • Quick to establish • Prefers wet to moist soil	• Best for wet meadow, emergent or submergent zones • Moderate salt tolerance • Nitrogen fixing	Spacing 12-24 inches
	*Eupatorium maculatum,* Spotted Joe Pye Weed	• Prefers wet to moist soil • Best for wet meadow, emergent or submergent zones • Prefers sandy soils but will grow in non-sandy wetlands	• Beneficial for pollinators • Drought tolerant • Fibrous roots can make it ideal for erosion control	Spacing: 4-5 feet on center
	*Iris versicolor,* Harlequin Blueflag	• Preference for acidic soils • Good filter of excess nutrients • Deer resistant • In wet soils will thrive without fertilizer • Wet to moist soils	• Best for wet meadow, emergent or submergent zones • Roots can be good erosion control	Spacing 2-3 Feet
	*Carex stricta,* Tussock Sedge	• Drought tolerant for short periods • Prefers standing water or moist soils • Deer resistant	• Nitrogen Fixing • Best for wet meadow, emergent or submergent zones • Good filter for water clarity	Spacing 1-3 Feet
	*Caltha palustris,* Marsh Marigold	• Beneficial for pollinators • Flooding tolerant, prefers moist soil • Best for wet meadow and emergent zones • Deer resistant	• High salt tolerance • Alkaline tolerant • Beneficial for wood ducks • Good ground cover	Spacing 12 inches

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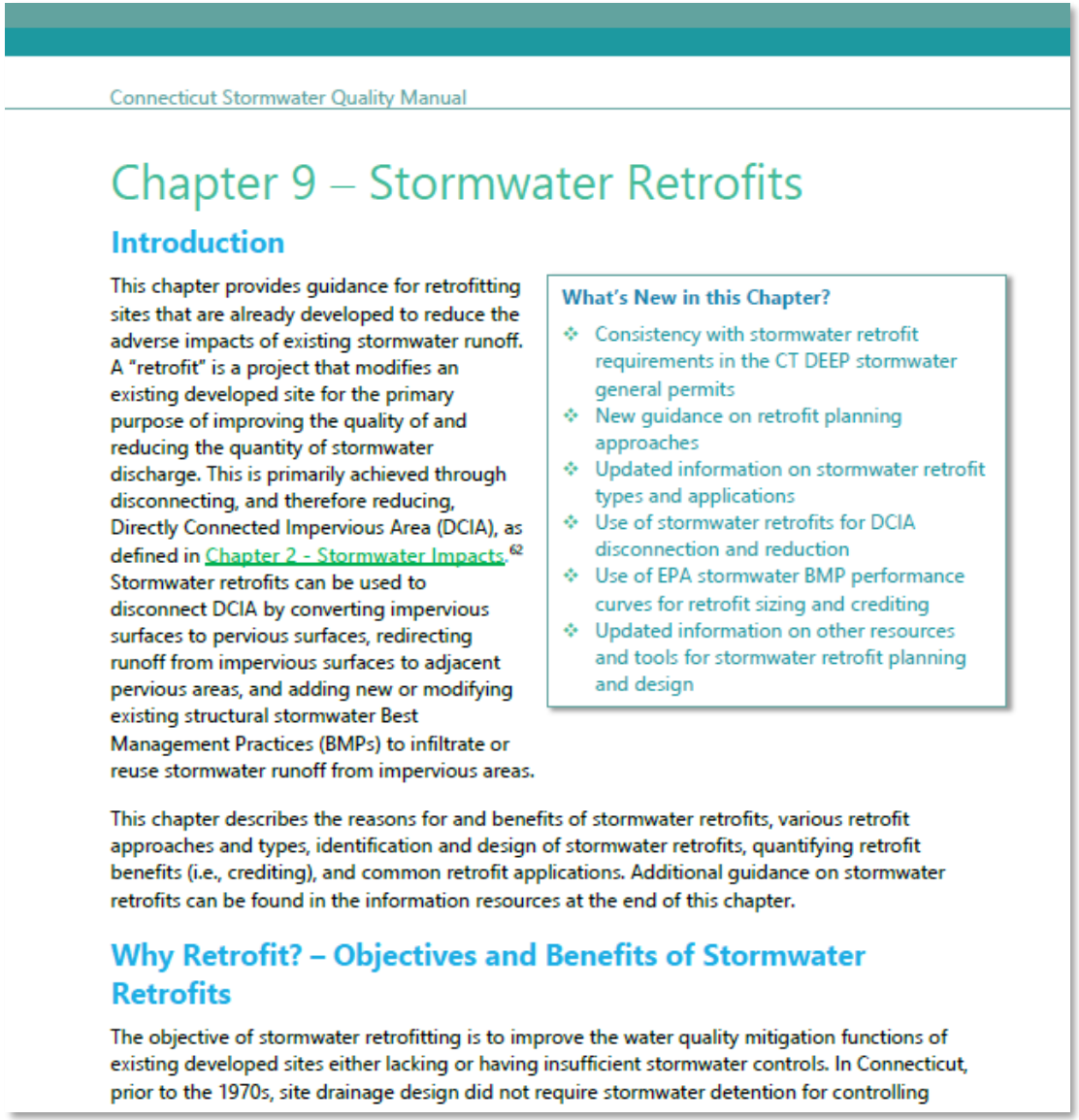
Structural Stormwater BMP Design Guidance

Stormwater Retrofits (Chapter 9)

- Guidance on retrofitting to reduce & disconnect DCIA (MS4 Permits)
- Retrofit planning
- Updated information on retrofit types & applications
- EPA BMP performance curves for sizing and crediting
- References New England Stormwater Retrofit Manual (2022)



Connecticut Stormwater Quality Manual

Chapter 9 – Stormwater Retrofits

Introduction

This chapter provides guidance for retrofitting sites that are already developed to reduce the adverse impacts of existing stormwater runoff. A "retrofit" is a project that modifies an existing developed site for the primary purpose of improving the quality of and reducing the quantity of stormwater discharge. This is primarily achieved through disconnecting, and therefore reducing, Directly Connected Impervious Area (DCIA), as defined in Chapter 2 - Stormwater Impacts.[62] Stormwater retrofits can be used to disconnect DCIA by converting impervious surfaces to pervious surfaces, redirecting runoff from impervious surfaces to adjacent pervious areas, and adding new or modifying existing structural stormwater Best Management Practices (BMPs) to infiltrate or reuse stormwater runoff from impervious areas.

What's New in this Chapter?

- Consistency with stormwater retrofit requirements in the CT DEEP stormwater general permits
- New guidance on retrofit planning approaches
- Updated information on stormwater retrofit types and applications
- Use of stormwater retrofits for DCIA disconnection and reduction
- Use of EPA stormwater BMP performance curves for retrofit sizing and crediting
- Updated information on other resources and tools for stormwater retrofit planning and design

This chapter describes the reasons for and benefits of stormwater retrofits, various retrofit approaches and types, identification and design of stormwater retrofits, quantifying retrofit benefits (i.e., crediting), and common retrofit applications. Additional guidance on stormwater retrofits can be found in the information resources at the end of this chapter.

Why Retrofit? – Objectives and Benefits of Stormwater Retrofits

The objective of stormwater retrofitting is to improve the water quality mitigation functions of existing developed sites either lacking or having insufficient stormwater controls. In Connecticut, prior to the 1970s, site drainage design did not require stormwater detention for controlling

HOW TO COMMENT

Email comments to: Kathleen.Knight@ct.gov

Deadline for Comments: **COB March 1, 2023**