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# **DRAFT VSMM Volume I**

## **DRAFT Vermont Stormwater Management Manual Public Stakeholder and Partner Presentation**

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**Pavilion Auditorium, State Street, Montpelier**

**March 15, 2016**

# Meeting Agenda

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- Introduction

- Part 1

- Background
- Next Steps
- Treatment Standards
  - New Development
  - Redevelopment
- Stormwater Hotspots
- Break – Followed by Questions on Part 1

- Part 2

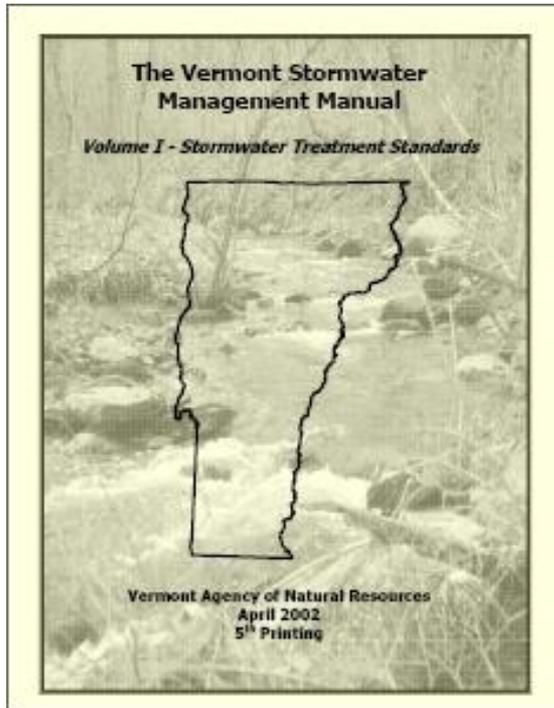
- Acceptable STPs
- Pre-Treatment
- Stormwater Treatment Practices
  - Non-Structural
  - Structural
- Alternative Treatment
- Limited Applicability Practices
- Break – Followed by Questions on Part 2

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# INTRODUCTION

# Why Update the Manual?

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- No major update since 2002
- Incorporate and expand the use of Green Stormwater Infrastructure (GSI)
- Add clarification based on experience
- Keep what works

# Developing the Draft Manual

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- Contract with Stone, Horsley Witten, and Adamant Accord
- Six (6) Stakeholder workshops held in 2013 and 2014
- Over 60 external stakeholders
- Materials from past meetings are available:  
[http://www.watershedmanagement.vt.gov/stormwater/htm/sw\\_manualrevision.htm](http://www.watershedmanagement.vt.gov/stormwater/htm/sw_manualrevision.htm)



# Draft VSMM

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- Draft manual developed by Stone and review by the Stormwater Program
- Draft is available on the website
- Internal stakeholder process
- Written comments by April 15<sup>th</sup>
  - Send comments to [Kevin.Burke@vermont.gov](mailto:Kevin.Burke@vermont.gov)
- Revision of the draft manual based on stakeholder input
  - 1-2 months

# Next Steps

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## ■ Rulemaking

- Rulemaking procedure: 3 V.S.A. § 801 - 849:  
<http://legislature.vermont.gov/statutes/chapter/03/025>
  - Prefiling with ICAR
  - File Rule with Secretary of State – public comment period
  - Revised Final Rule filed
  - Review by LCAR
  - Adoption of Final Rule
- Takes ~6 months

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# **STORMWATER TREATMENT STANDARDS**

# Stormwater Treatment Standards

## New Development - Standards



*Vegetated swale. Image credit*

[www.vtwaterquality.org/stormwater/htm/sw\\_gi\\_bmp\\_vegetatedswales.htm](http://www.vtwaterquality.org/stormwater/htm/sw_gi_bmp_vegetatedswales.htm)

### Applicable Standards

- Post-Construction Soil Depth and Quality Standard
- Groundwater Recharge Standard
- Water Quality Treatment Standard
- Channel Protection Standard
- Overbank Flood Protection Standard
- Extreme Flood Protection Standard

**Design emphasis on runoff reduction**

# Stormwater Treatment Standards

## New Development – Runoff Reduction



Practices that use disconnection and infiltration **shall first be considered** to meet Groundwater Recharge, Water Quality, and Channel Protection Standards.

Sites that do not fully meet the Channel Protection Standard by use of runoff reduction practices (see Hydrologic Condition Method Section 2.2.5.1) must justify use of other practices.

# Stormwater Treatment Standards

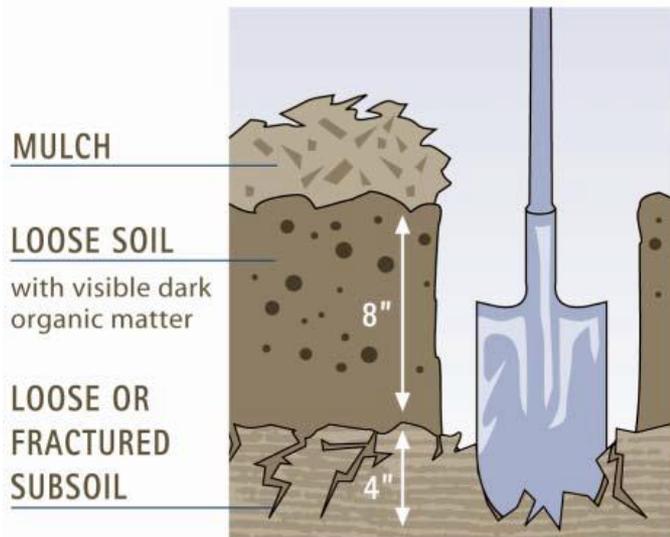
## New Development – Runoff Reduction Feasibility

### Feasibility Considerations

- Soils
- Depth to groundwater
- Retrofit/upgrade of existing system, practicality
- Hotspot land use or activity
- Proximity to drinking water supply, water source protection areas, or wastewater disposal fields
- Contaminated site/brownfield development
- Additional factors may be considered by the Department



# Post-Construction Soil Depth and Quality Standard



Illustrations of how to test for compliance with Washington State's Soil Quality and Depth BMP T5.13. Source: [http://www.soilsforsalmon.org/pdf/Field\\_Verification\\_Guide.pdf](http://www.soilsforsalmon.org/pdf/Field_Verification_Guide.pdf)

## Requirements – New Development

Retain undisturbed soils OR re-establish minimum depth of topsoil to meet organic matter, pH, soil depth standards on cleared/graded land.

- Applicable to slopes less than 3:1 (h:v), except areas covered by impervious surface, areas of a structural treatment practice, or engineered or structural fill areas.
- Stormwater design plan must depict applicable areas and compliance test locations.

# Groundwater Recharge Standard

## New Development



### Requirements – New Development

Maintain average annual recharge rate for prevailing hydrologic soil groups (HSGs) to preserve existing water table elevations.

- Changes to some treatment practice design specifications provide additional opportunities to meet standard with non-structural and structural practices

Hydrologic Soil Group (HSG)	Recharge Factor (F)	
	2002 VSMM	2016 Draft
A	0.40	0.60
B	0.25	0.35
C	0.10	0.25
D	Waived	Waived

# Water Quality Treatment Standard

## New Development



### Requirements – New Development

Capture and treatment of runoff containing majority of pollutants: 90<sup>th</sup> percentile rain event

- Draft manual changes this rain event from 0.9” to 1” (24-hour rainfall).
- Treatment practice changes provide additional opportunities to meet standard with non-structural practices

WQ Treatment Standard Minimum Pollutant Removal		
	2002 VSMM	2016 Draft
<b>TSS</b>	80%	85%
<b>TP</b>	40%	50%

Designer’s must first utilize disconnection, infiltration, and other runoff reduction practices when possible, treatment in those cases will exceed minimums.

# Channel Protection Standard

## New Development

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- Goal: Manage runoff from the 1 year storm to protect receiving waters from erosion
- Two methods for achieving Channel Protection
  - Hydrologic Condition Method
  - Extended Detention Method
- Waivers
  - Runoff after development <2 cfs
  - Direct discharges to waterbodies with drainage areas  $\geq 10$  sq. miles
  - Removed waiver for expansions less than 1 acre

# Hydrologic Condition Method (HCM)

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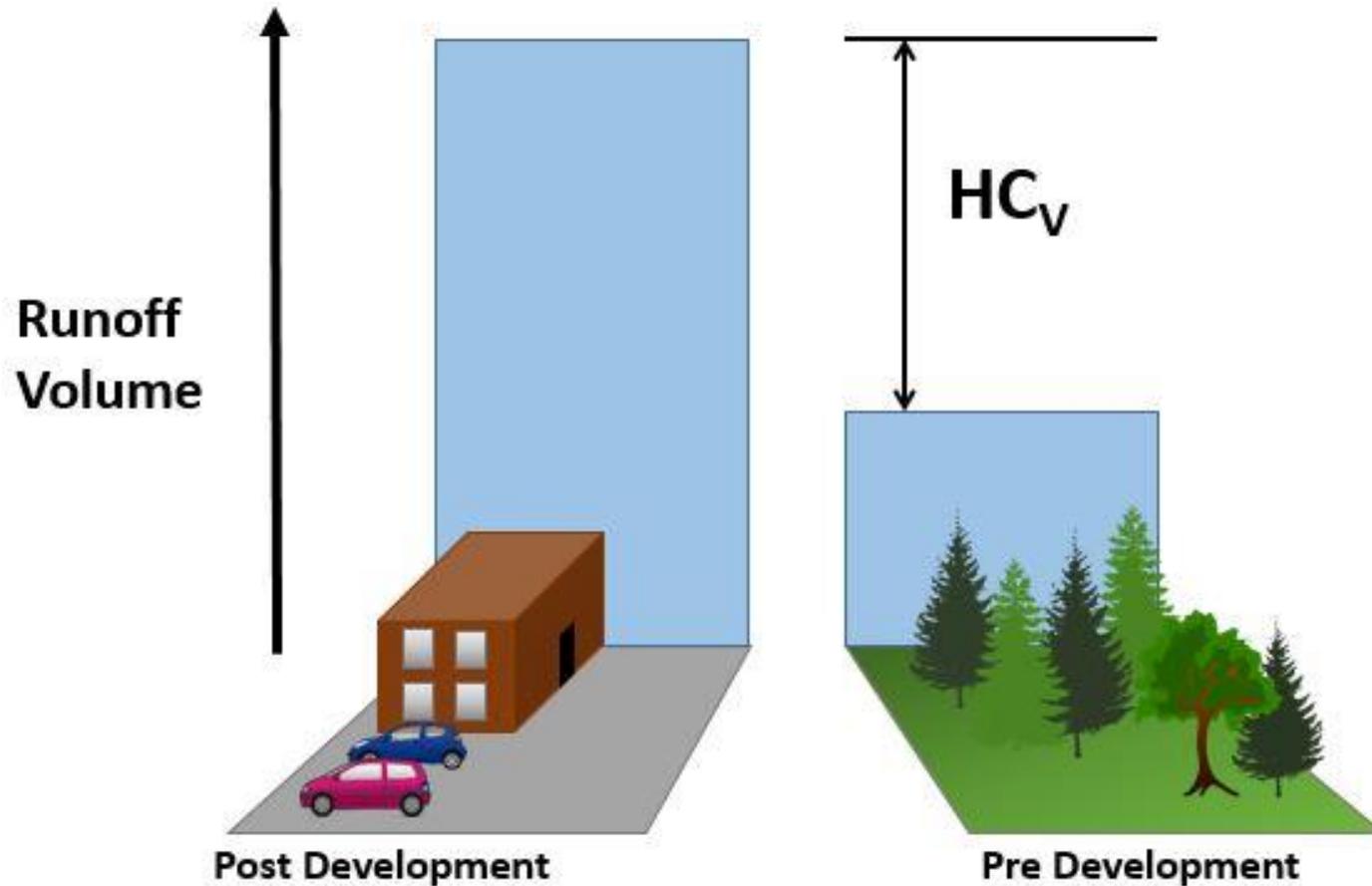
- Reduce the post-development 1 year runoff so that site runoff is equal to pre-development runoff.

$$Q_{Post} - T_v = Q_{Pre}$$

- Pre-development = woods in good condition.
- Treatment Volume ( $T_v$ ) credit is given for practices that infiltrate or otherwise reduce runoff.
- This method is designed to more easily show compliance of the  $CP_v$  standard when using small distributed practices.
- HCM spreadsheet to calculate compliance

# Hydrologic Condition Volume ( $HC_V$ )

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# Runoff Reduction STPs

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- $T_v$  credit is given for practices that reduce  $Q_{post}$ , through infiltration, evapotranspiration, etc.
- Applicable STPs:
  - Disconnections
  - Permeable Pavement
  - Bioretention
  - Filters
  - Reforestation
  - Infiltration Basins
  - Infiltration Trenches
  - Dry Swales
  - Rainwater Harvesting
  - Green Roofs

# Extended Detention Method

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- Same as the channel protection standard in the 2002 manual.
- 12 or 24 hour detention of the 1 year storm.
- Can take credit for runoff reduction short of full HCM compliance by calculating an adjusted curve number

# Calculating Adjusted Curve Numbers

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- SCS Runoff Methods define flow as:

$$Q = \frac{(P - I_a)^2}{P - I_a + S}$$

Where:

Q = Runoff in inches

P = Precipitation in inches

$I_a$  = Initial abstraction (typical losses to infiltration, interception, surface storage)

S = Potential maximum retention of the watershed as  $P \rightarrow \infty$

# Calculating Adjusted CN cont'd

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- Assuming,  $I_a = 0.2 * S$ , then the equation becomes

$$Q = \frac{(P - 0.2S)^2}{P - 0.8S}$$

- $S$  is related to  $CN$

$$S = \frac{1000}{CN} - 10$$

- Curve number ( $CN$ ) factor is dependent on land use and soil type

# Calculating Adjusted CN cont'd

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- Put those together and rearrange for CN

$$CN = \frac{200}{P + 2Q + 2 - \sqrt{5PQ + 4Q^2}}$$

- Can substitute an adjusted flow ( $Q_{Adj}$ ) for a storm based on  $T_V$ , the volume reduced for from runoff reduction.

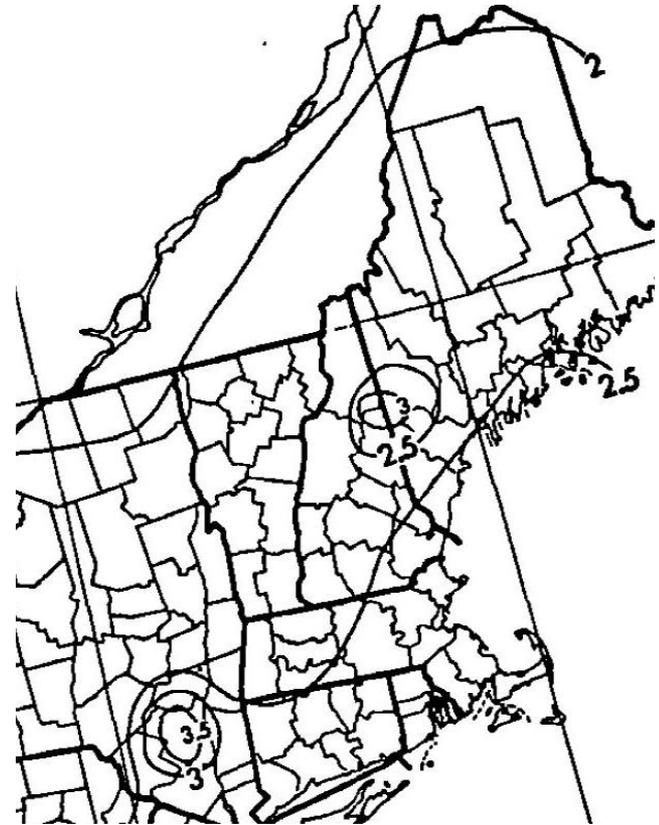
$$Q_{Adj} = Q_{Post} - T_V$$

- Time of concentration ( $T_c$ ) calculated by Watershed Lag Method.

# Old Rainfall Data – TP-40

- Released in 1961
- County rainfall averages

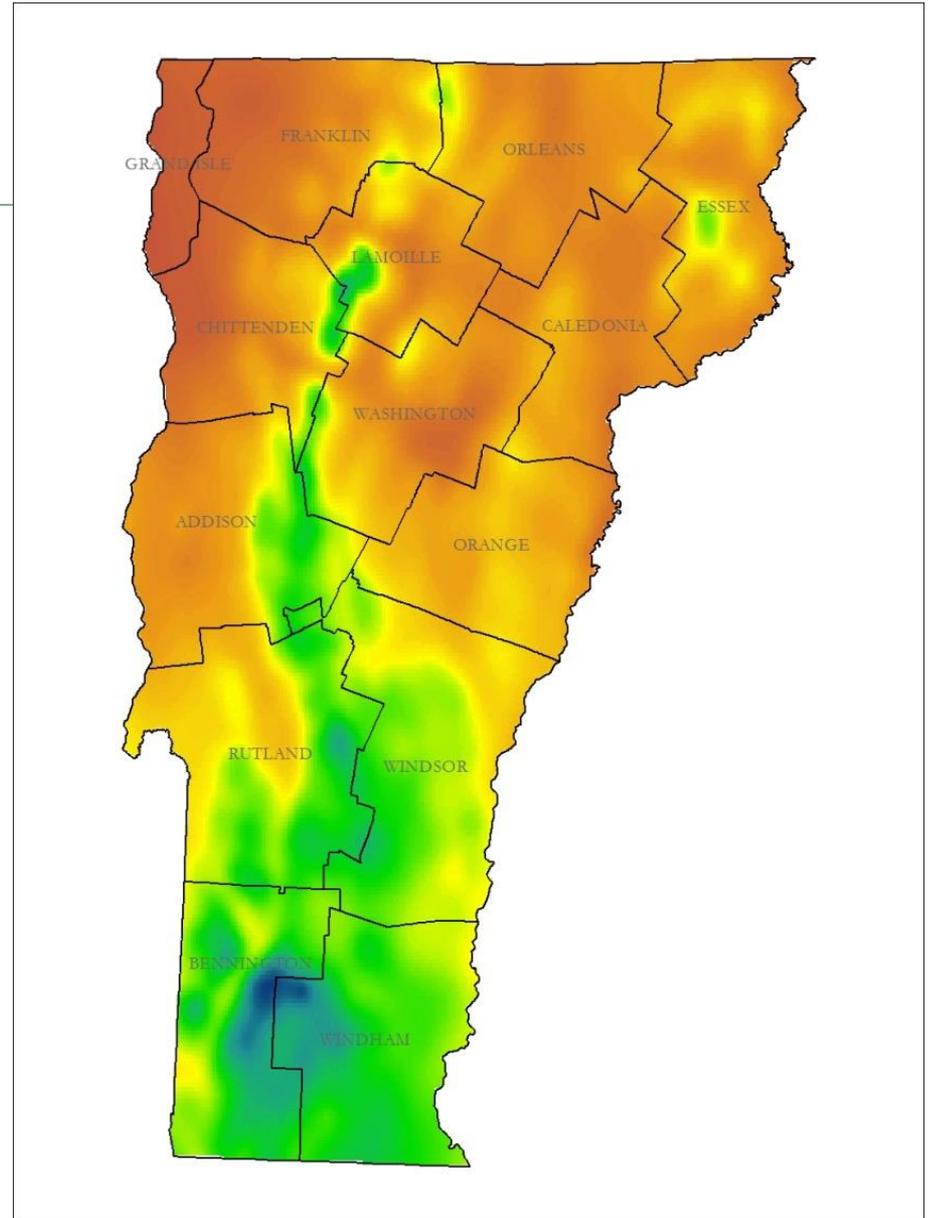
County	1yr 24 hr	2 yr 24 hr	10 yr 24 hr	100 yr 24 hr
Addison	2.2	2.4	3.4	5.4
Bennington	2.3	2.8	4.0	6.8
Caledonia	2.2	2.3	3.1	5.4
Chittenden	2.1	2.3	3.2	5.2
Essex	2.2	2.3	3.1	5.1
Franklin	2.1	2.3	3.1	5.2
Grand Isle	2.1	2.2	3.1	5.1
Lamoille	2.1	2.4	3.4	5.4
Orange	2.2	2.4	3.4	5.7
Orleans	2.1	2.2	3.1	5.0
Rutland	2.3	2.5	3.7	5.9
Washington	2.2	2.4	3.4	5.4
Windham	2.3	2.8	4.0	6.8
Windsor	2.3	2.5	3.7	5.9



# New Rainfall Data – Atlas 14

- Released December 2015
- Official update to TP-40 by NOAA
- Storm depths are more variable across the state
- Designers will look up rainfall online:

<http://hdsc.nws.noaa.gov/hdsc/pfds/>



# Overbank and Extreme Flood Protection Standards, ( $Q_{P10}$ ) & ( $Q_{P100}$ )

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- Standard unchanged from 2002 manual
  - Post development peak flow  $\leq$  Pre development peak flow for the 10 yr, 24 hour storm, 100 yr, 24 hr storm.
  - Waivers remain the same.
- Can use  $CN_{Adj}$  based on runoff reduction treatment
- Expanded section on downstream analysis
  - Allowable increase scaled to watershed size

Site Area Relative to Drainage Area of Receiving Water at Discharge Point	Allowable Flow Rate and Velocity Increase at Analysis Point
10%	5% allowable increase
5 to <10%	2.5% allowable increase
2.5% to <5%	1.25% allowable increase
1.25% to <2.5%	0.63% allowable increase
<1.25%	0.31% allowable increase

# Stormwater Treatment Standards

## Redevelopment - Standards

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*Vegetated swale. Image credit*

[www.vtwaterquality.org/stormwater/hm/sw\\_gi\\_bmp\\_vegetatedswales.htm](http://www.vtwaterquality.org/stormwater/hm/sw_gi_bmp_vegetatedswales.htm)

### Applicable Standards

- Water Quality Treatment Standard
- Post-Construction Soil Depth and Quality Standard

**Design emphasis on runoff reduction.**

# Water Quality Treatment Standard Redevelopment



## Requirements – Redevelopment

Capture and treatment of runoff containing majority of pollutants: 90<sup>th</sup> percentile rain event.

- Draft manual increases required WQv from 20% WQv to 50% WQv.
- Draft manual increases equivalent impervious surface removal from 20% to 25%
- Impervious surface removal used to meet treatment standard subject to Post-Construction Soil Depth and Quality Standard
- Greater flexibility provided to designers for water quality treatment of redeveloped surfaces, alternative practice allowance

# Section 2.3: Stormwater Hotspots

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## Hotspots May Include:

- Vehicle Fueling Stations
- Landfills
- Vehicle Salvage Yards
- Chemical, Paper, and Food Production Facilities
- Hazardous Waste Treatment, Storage, or Disposal Facilities
- Metallic and Non-Metallic Mining/Dressing Operations



Infiltration of stormwater contributing from a hotspot land use or activity by use of structural or non-structural practices to meet applicable standards is prohibited. In addition, Underground Injection Control (UIC) Rules may have additional restrictions. Stormwater not co-mingled may be allowed to infiltrate.

# Questions on Part 1

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- Stormwater Manual Update Background
- Framework – Emphasis on Runoff Reduction
- Treatment Standards
  - New Development
  - Redevelopment
- Stormwater Hotspots

Break (15 Minutes)

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# **STORMWATER TREATMENT PRACTICES**

# Chapter. 4: Acceptable Stormwater Treatment Practices (STPs)

- 4.1 Pre-treatment Practices
- 4.2 Non-Structural Practices
- 4.3 Structural Stormwater Treatment Practices
- 4.4 Alternative Stormwater Treatment Practices



Changes from 2002 Manual:

- New pre-treatment requirements and practices
- Voluntary Stormwater Management Credits incorporated as Non-Structural Treatment Practices
- Addition of Green Stormwater Infrastructure Practices
- Removal of lower performing practices as stand-alone treatment practices

# Chapter. 4: Acceptable Stormwater Treatment Practices (STPs)

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## Format:

- Design Summary Table
- Feasibility
- Conveyance
- Pre-Treatment
- Treatment
- Vegetation and Landscaping
- Construction Sequencing
- Maintenance (1<sup>st</sup> year and annual)
  
- Required Elements vs Design Guidance

## New Requirements:

- Construction Sequencing
- Expanded Maintenance Requirements

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# NON-STRUCTURAL STPS

# Section 4.1: Pre-Treatment Practices

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## Changes from 2002 Manual:

- Pre-treatment (PT) design options now provided in one centralized location
- Refined pre-treatment practice design specifications for clear, consistent, and predictable pre-treatment design requirements
- Deep sump catch basins and proprietary devices added to PT design options, which provide greater flexibility when space is limited or for redevelopment projects
- 50% TSS removal efficiency set for proprietary PT devices

## Key Considerations:

- Swales/Grass Channels only allowable for use as PT, with design requirements for permanent check-dams on slopes exceeding 2%
- STP specifications will dictate minimum volumetric sizing requirement for forebays

# Section 4.2.1: Reforestation

**Changes from 2002 Manual:** A new practice that provides  $T_v$  credit under HCM for establishment of forest canopy on site, or contiguous areas to site (under permittee ownership/control)

## Key Considerations:

- Minimum contiguous area of 10,000 ft<sup>2</sup>
- Minimum width of 50 ft.
- Reforestation areas used for disconnection treatment, maximum slope 15%
- Consider space for nearby utilities and separation to structures from fully grown trees
- Existing forest that is maintained as part of development is not credited

## Treatment Credit:

- $T_v$  applied is equivalent to 0.1 watershed inch per square foot of reforestation (363 cf/acre)
- Impervious area not required to drain to reforestation area unless used for disconnection requirements
- Soils must meet Post-Construction Soil Depth and Quality Standard
- 300 large canopy trees planted per acre



# Section 4.2.2: Simple Disconnection

## Changes from 2002 Manual:

- Allowable on slopes up to 15%
- Explicitly credited for volume reduction
- Volume reduction credit applied to 1-yr, 10-yr, and 100-yr events

## Treatment Credit:

HSG of Soil in Disconnection Area	Disconnection Area Slope	
	Less than 8%	8%-15%
A/B	35 ft	50 ft
C/D	65 ft	85 ft

## Key Considerations:

- Option for rooftops, sidewalks/paths, and residential driveways
- $T_v$  is equal to the  $WQ_v$  and is applied to all application standards
- Pre-Treatment not required for qualifying surfaces
- Slope: grade controls required on slopes > 8%

# Section 4.2.3: Disconnection to Filter Strips and Vegetated Buffers

## Changes from 2002 Manual:

- Allowable on slopes up to 15%
- Explicitly credited for volume reduction
- Volume reduction credit applied to 1-yr, 10-yr, and 100-yr events
- Incorporation of level-spreaders

## Treatment Credit:

HSG of Soil in Disconnection Area	Disconnection Area Slope	
	Less than 8%	8%-15%
A/B	35 ft	50 ft
C/D	65 ft	85 ft

## Key Considerations:

- Option for parking lots and other surfaces that don't qualify for Simple Disconnection
- Pre-Treatment Required
- Collected flow must be redistributed using a level spreader
- $T_v$  is equal to the  $WQ_v$  and is applied to all applicable standards

# Section 4.2.4: Watershed Hydrology Protection

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## Changes from 2002 Manual:

- Post-Construction Soil Depth and Quality Standard required
- 2-foot elevation contours
- Pre-treatment specifications
- Level spreader sized for max. design storm

## Key Considerations:

- Only applicable to high elevation renewable energy projects
- Impervious cover shall not exceed 5% in any watershed on site, otherwise design must satisfy CP Standard separately

## Treatment Credit:

- WQ, Re, CP standards met for all areas that fully satisfy requirements.
- Project must additionally comply with applicable Qp flood protection standards.
- Contributing watershed maintained at minimum of 90% forested land
- Design must prevent undue alteration of site's natural hydrology

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# STRUCTURAL STPS

# Section 4.3.1: Bioretention and Rain Gardens

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## Changes from 2002 Manual:

- Previously categorized as a filter system
- Relaxed groundwater separation requirements

## Key Considerations:

- Infiltrating vs Non-Infiltrating Systems
- Filter media composition
- Planting plan

## Treatment Credit:

### Infiltrating Systems:

- $T_v$  applied to  $HC_v$  is equivalent to the volume ponded, stored in the pore space, and infiltrated

### Under-drained Systems:

- $T_v$  applied to  $HC_v$  is equivalent to the volume in the sump below the under-drain

# Section 4.3.2: Dry and Wet Swales

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## Changes from 2002 Manual:

- Increase max slope to 6%
- Grade controls
- Groundwater separation requirements for dry swales

## Key Considerations:

- Dewatering

### Infiltrating:

- Infiltration rate
- Groundwater separation

### Non-Infiltrating

- Must include an under-drain

## Treatment Credit:

### Dry Swale:

- $T_v$  for infiltrating systems is equal to the volume ponded, stored in the pore space, and infiltrated.
- $T_v$  in under-drained systems is equal to volume in pore space below sump

### Wet Swales:

- Limited applicability
- Does not receive  $WQ_v$  credit
- $CP_v$  and  $Q_p$  credit is based on extended detention of volume above the permanent pool

# Section 4.3.3: Infiltration Trenches and Basins

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## Changes from 2002 Manual:

- Decreased min. infiltration rate needed
- Incorporation of dry wells with specific design requirements
- Incorporation of subsurface infiltration chambers

## Treatment Credit:

- $T_v$  is equivalent to the volume infiltrated by the system
- Infiltrated volume is credited to all applicable standards

## Key Considerations:

- Groundwater separation
- Infiltration rate
- Field infiltration testing
- Pre-treatment
- Construction sequencing
- Setbacks

# Section 4.3.4: Filtering Systems

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## Changes from 2002 Manual:

- Dry Swales and Bioretention moved to separate sections
- Filtering media limited to sand
- Contributing drainage area maximums
- Non-sand filters, including proprietary filtering devices; reviewed as Alternative STPs

## Key Considerations:

- Only provides  $WQ_v$  unless practice designed to infiltrate
- Volumetrically sized pre-treatment, min. 25% of  $WQ_v$

## Treatment Credit:

- Practice meets  $WQ_v$  only unless designed to infiltrate, then  $T_v$  is equivalent to the volume ponded, stored in the pore space, and infiltrated

# Section 4.3.5: Treatment Wetlands

## Changes from 2002 Manual:

- Treatment wetland design limited to shallow surface and gravel wetlands
- Incorporation of gravel trench outlet for shallow surface wetland to prevent thermal impacts
- More clear design specifications pertaining to depth profile, and filter bed volumetric storage.

## Key Considerations:

- Only provides  $WQ_v$
- Minimum contributing drainage area of 10 acres for shallow surface wetlands

## Treatment Credit:

- Practice meets  $WQ_v$  only, storage above permanent pool contribute to larger storm detention standards.



# Section 4.3.6: Wet Ponds

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## Changes from 2002 Manual:

- Increased minimum drainage area requirement to 10-ac
- Incorporation of gravel trench outlet to prevent thermal impacts
- Length to width ratio now 3:1

## Key Considerations:

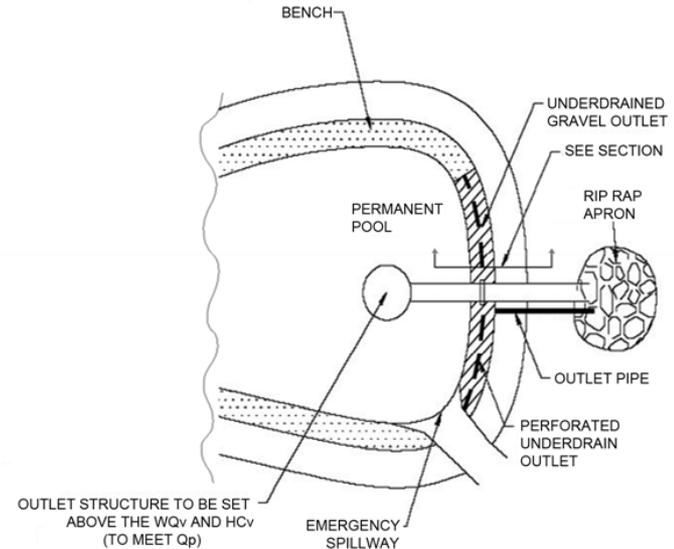
- Drainage area
- Aquatic and safety benches/space requirements
- Emergency outlet for 100-yr event must be provided

## Treatment Credit:

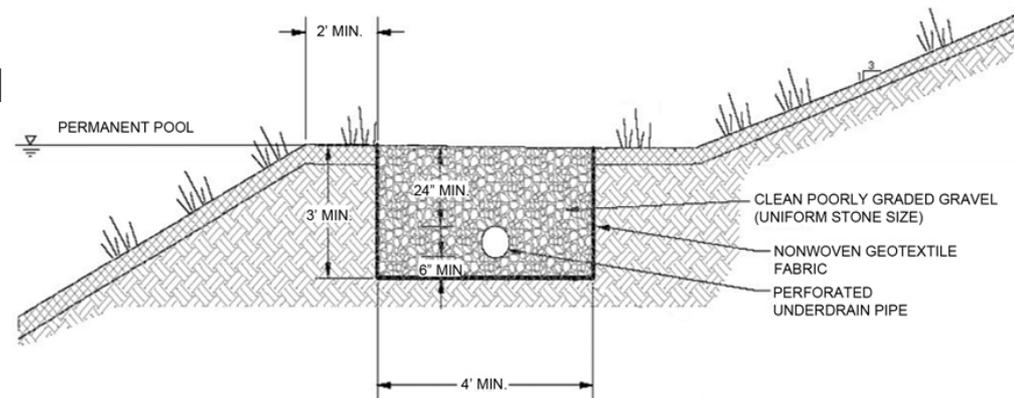
- Treatment is achieved through conformance with design requirements
- $WQ_v$ : partitioning of volume across depth zones, presence of benches
- $CP_v$ : extended detention, gravel trench outlet
- $Q_{10}/Q_{100}$ : conventional outlet control such that post development peak rate does not exceed existing condition peak rate
- $Re_v$ : no credit given

# Section 4.3.6: Wet Ponds- Gravel Trench Outlet

- Required for ponds that discharge into cold water receiving bodies
- All discharge through  $CP_v$  shall be through gravel trench outlet
- Designed to mitigate thermal impacts associated with extended detention while protecting channels from degradation consistent with the Channel Protection Standard
- Additional flow above the  $CP_v$  may be discharged through conventional outlet control structures



A



B

# Section 4.3.7: Green Roofs

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## New Practice Standard

### Key Considerations:

- Media composition
- Planting plan
- Volume 2 will contain additional construction specifications & references to building standards

### Treatment Credit:

- $T_v$  applied to  $HC_v$  is equivalent to the volume of water held in the void space of growing media.
- No credit for  $Re_v$  or  $WQ_v$



# Section 4.3.8 Permeable Pavement

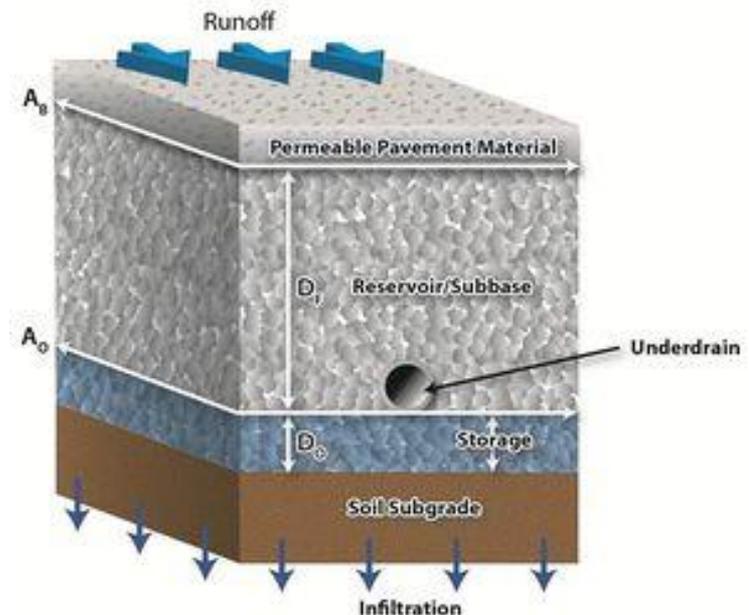
## New Practice Standard

### Key Considerations:

- Not impervious when infiltrates the 1 yr 24 hr type II storm.
- Can be used to treat rooftop runoff
- Includes Porous Asphalt, Porous Concrete, Pavers/Blocks
- Similar feasibility criteria to infiltration practices
- Care must be taken to reduce clogging

### Treatment Credit:

- $T_V$  credit based on storage capacity & infiltration rate.
- If underdrain used, credit limited to storage below underdrain.



# Section 4.3.9 Rainwater Harvesting

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## New Practice Standard

## Treatment Credit:

- $T_V$  credit based on storage capacity.

## Key Considerations:

- Must have 0.2” storage capacity
- Requires plan for use of water collected.
- Rooftop runoff doesn't require pre-treatment.



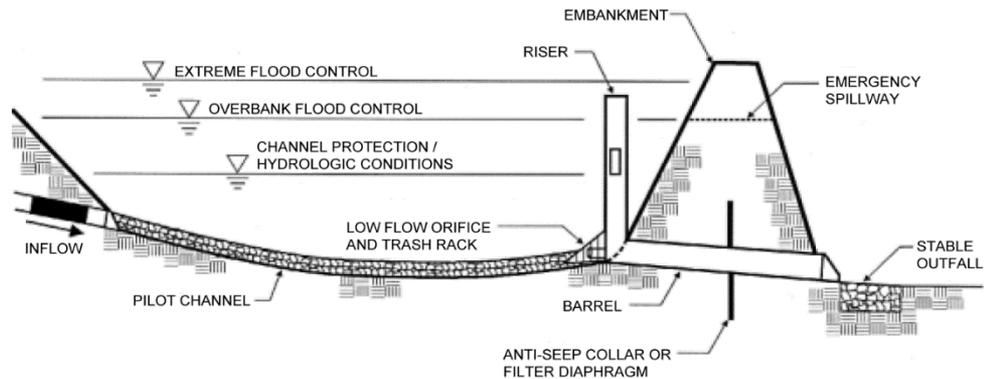
# Section 4.4 Alternative Treatment Systems

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- Process to allow use of new STPs for  $WQ_v$  credit
- Option 1: May consider acceptance by other BMP Verification programs including:
  - TAPE -Washington Department of Ecology's Technology Assessment Protocol
  - MASTEP - Massachusetts Stormwater Evaluation Project
  - ETV – USEPA Environmental Technology Verification
- Option 2: Vermont field test
  - Same procedure as used in 2002 manual
- Information is reviewed by VTDEC

# Chapter 5: Limited Applicability Practices

- Don't meet the Water Quality Standard
- Can be used to meet CPv,  $Q_{P10}$ , and  $Q_{P100}$ 
  - Dry Ponds
  - Pocket Ponds
  - Underground Storage Chambers/Vaults



# Recap - Next Steps

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- Provide written comments by Friday, April 15<sup>th</sup>
  - Send comments to [Kevin.Burke@vermont.gov](mailto:Kevin.Burke@vermont.gov)
- Stormwater Program holding similar meeting for internal stakeholders next Tuesday, March 22
- Revision of the draft manual based on stakeholder input
  - 1-2 months
  - Anticipate issuance of draft revision of Vol. 2 – Technical Guidance with revised draft

# Recap - Next Steps

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## ■ Rulemaking

- Rulemaking procedure: 3 V.S.A. § 801 - 849:  
<http://legislature.vermont.gov/statutes/chapter/03/025>
  - Prefiling with ICAR
  - File Rule with Secretary of State – public comment period
  - Revised Final Rule filed
  - Review by LCAR
  - Adoption of Final Rule
- Takes ~6 months

# Questions on Part 2

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- Acceptable Treatment Practices
- Stormwater Pre-Treatment Practices
- Stormwater Treatment Practices
- Non-structural
- Structural
- Alternative Treatment Systems
- Limited Applicability Practices