



DRAFT VSMM Volume I

DRAFT Vermont Stormwater Management Manual Public Stakeholder and Partner Presentation

Pavilion Auditorium, State Street, Montpelier

March 15, 2016

Meeting Agenda

- Introduction

- Part 1

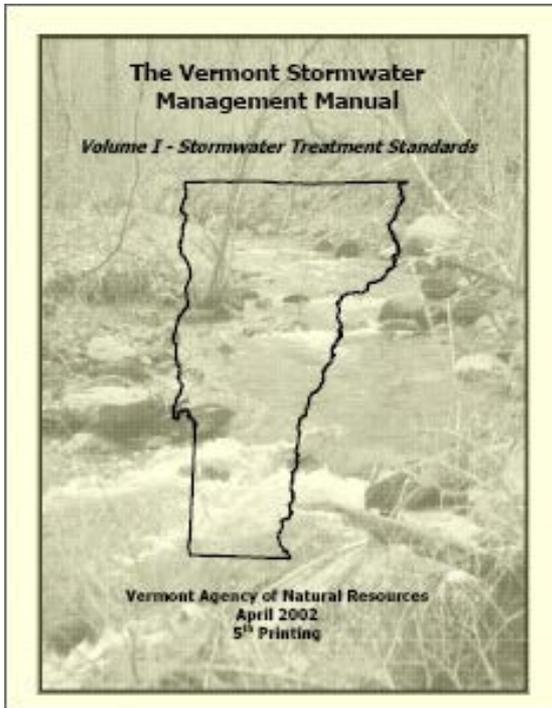
- Background
- Next Steps
- Treatment Standards
 - New Development
 - Redevelopment
- Stormwater Hotspots
- Break – Followed by Questions on Part 1

- Part 2

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

INTRODUCTION

Why Update the Manual?



- 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

- 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



Draft VSMM

- Draft manual developed by Stone and review by the Stormwater Program
- Draft is available on the website
- Internal stakeholder process
- Written comments by April 15th
 - Send comments to Kevin.Burke@vermont.gov
- Revision of the draft manual based on stakeholder input
 - 1-2 months

Next Steps

■ 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

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

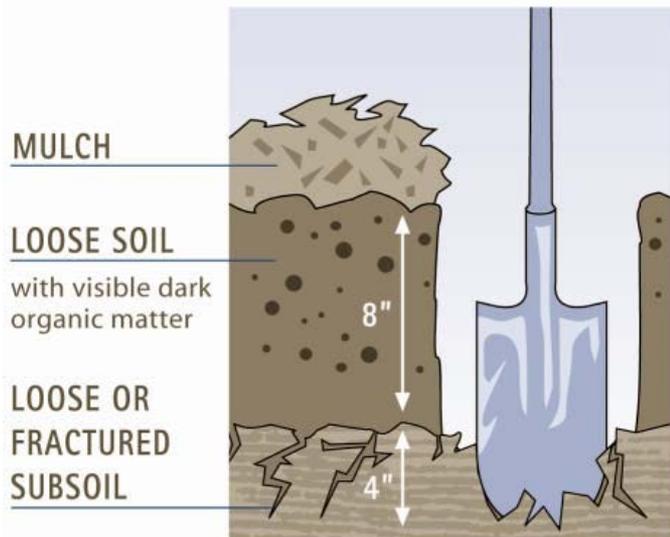
New Development – Runoff Reduction Feasibility

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

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: 90th 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
TSS	80%	85%
TP	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

- 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 ≥ 10 sq. miles
 - Removed waiver for expansions less than 1 acre

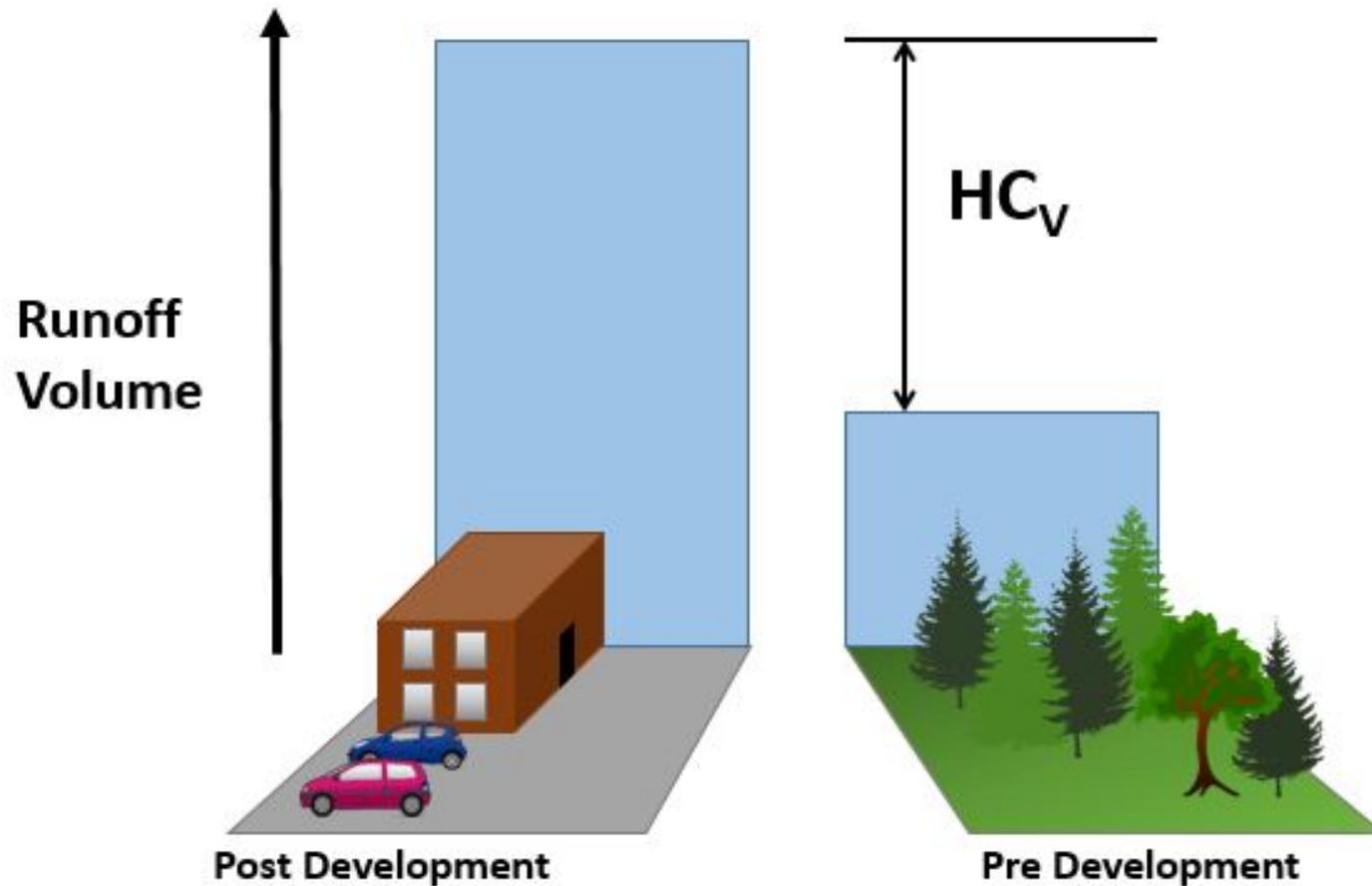
Hydrologic Condition Method (HCM)

- 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)



Runoff Reduction STPs

- 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

- 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

- 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

- 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

- 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.

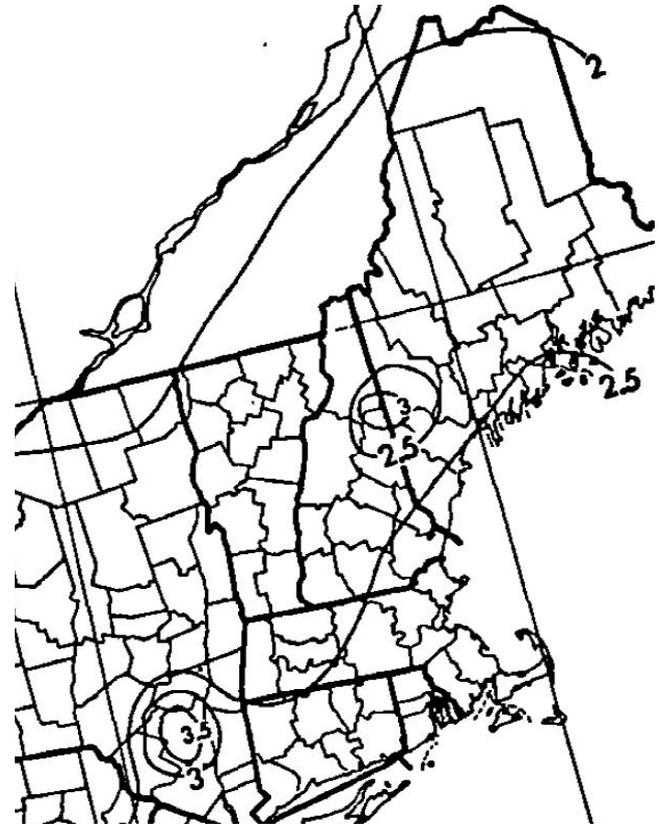
$$Q_{Adj} = Q_{Post} - T_V$$

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

Old Rainfall Data – TP-40

- Released in 1961
- County rainfall averages

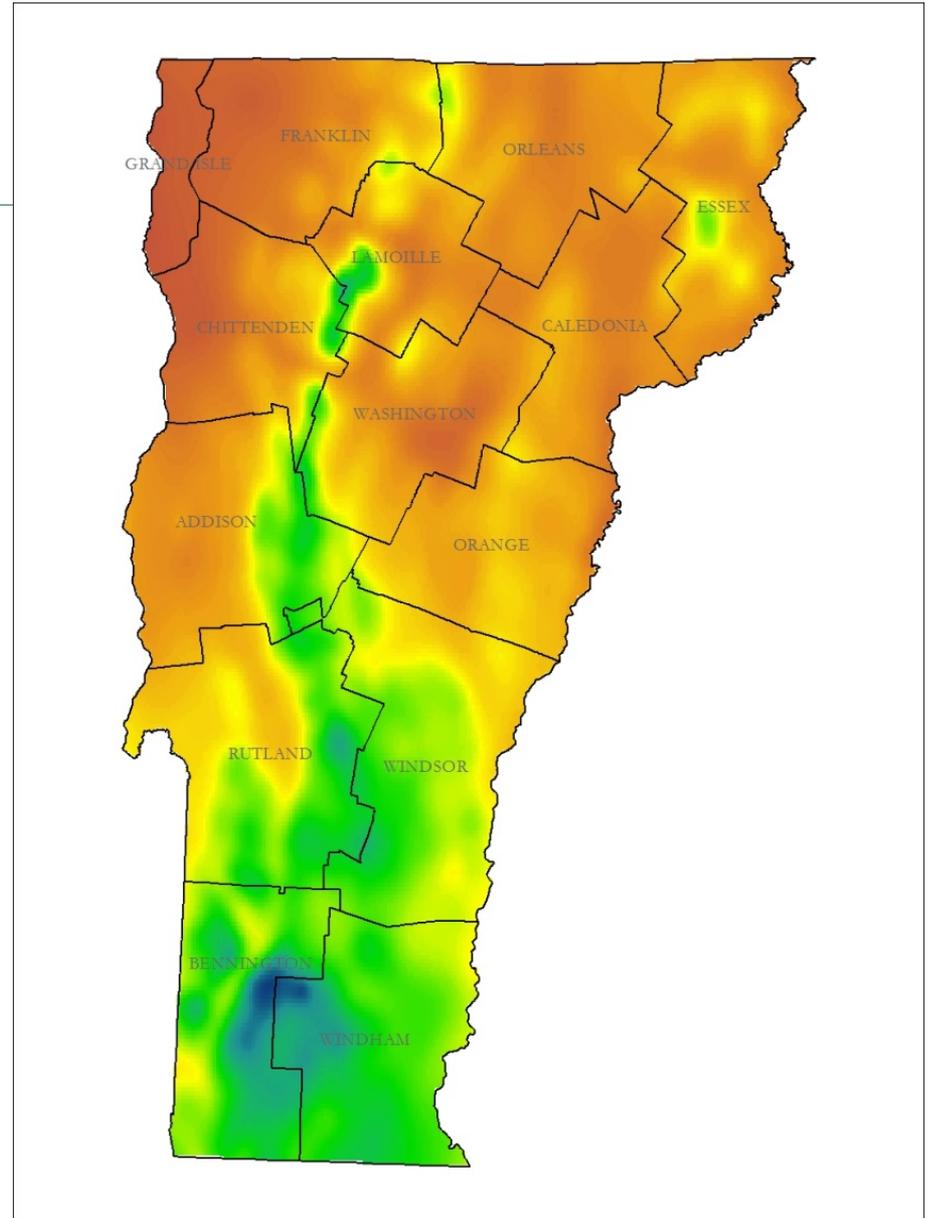
County	1yr 24 hr	2 yr 24 hr	10 yr 24 hr	100 yr 24 hr
Addison	2.2	2.4	3.4	5.4
Bennington	2.3	2.8	4.0	6.8
Caledonia	2.2	2.3	3.1	5.4
Chittenden	2.1	2.3	3.2	5.2
Essex	2.2	2.3	3.1	5.1
Franklin	2.1	2.3	3.1	5.2
Grand Isle	2.1	2.2	3.1	5.1
Lamoille	2.1	2.4	3.4	5.4
Orange	2.2	2.4	3.4	5.7
Orleans	2.1	2.2	3.1	5.0
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})

- 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



Vegetated swale. Image credit

www.vtwaterquality.org/stormwater/htm/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: 90th 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

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

- 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)

Format:

- Design Summary Table
- Feasibility
- Conveyance
- Pre-Treatment
- Treatment
- Vegetation and Landscaping
- Construction Sequencing
- Maintenance (1st year and annual)

- Required Elements vs Design Guidance

New Requirements:

- Construction Sequencing
- Expanded Maintenance Requirements

NON-STRUCTURAL STPS

Section 4.1: Pre-Treatment Practices

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 ft²
- 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

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

STRUCTURAL STPS

Section 4.3.1: Bioretention and Rain Gardens

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

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

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

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

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:

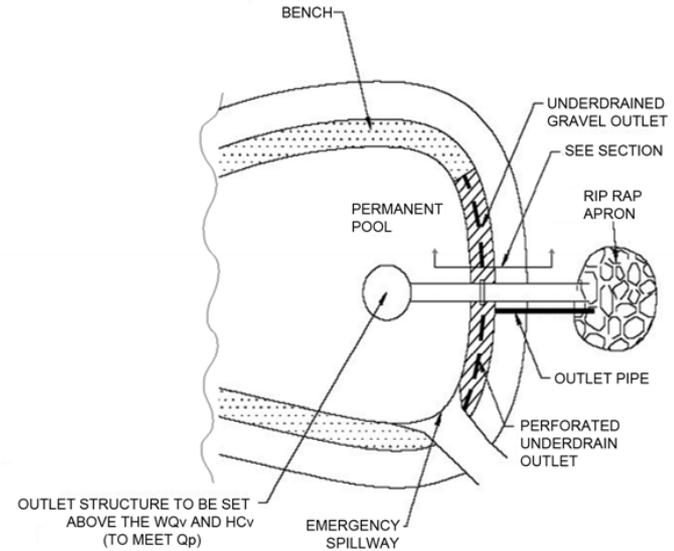
- Drainage area
- Aquatic and safety benches/space requirements
- Emergency outlet for 100-yr event must be provided

Treatment Credit:

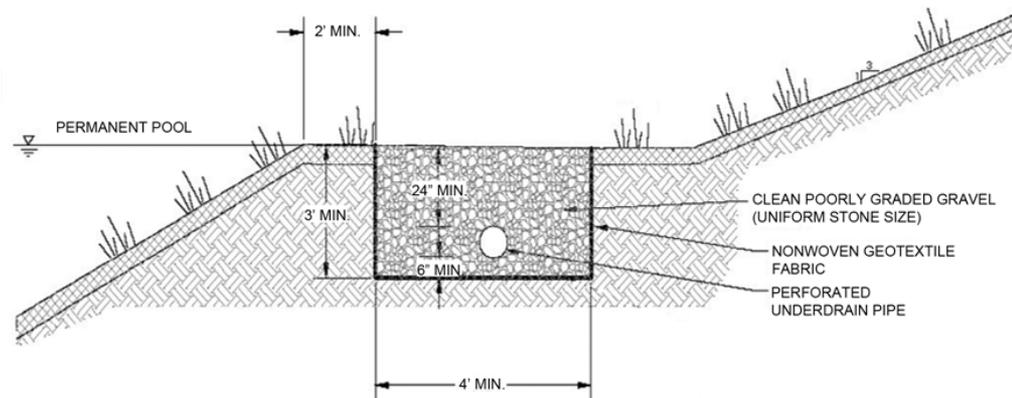
- Treatment is achieved through conformance with design requirements
- WQ_v : partitioning of volume across depth zones, presence of benches
- CP_v : extended detention, gravel trench outlet
- Q_{10}/Q_{100} : conventional outlet control such that post development peak rate does not exceed existing condition 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

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

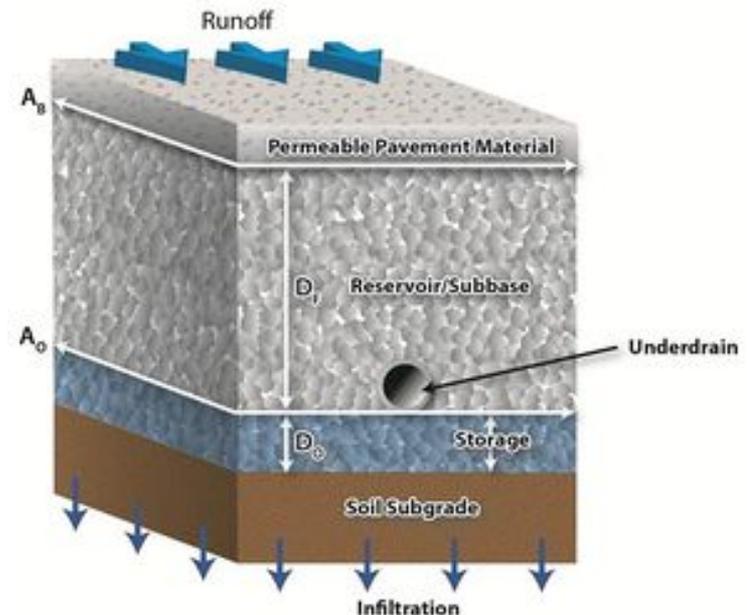
New Practice Standard

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

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.

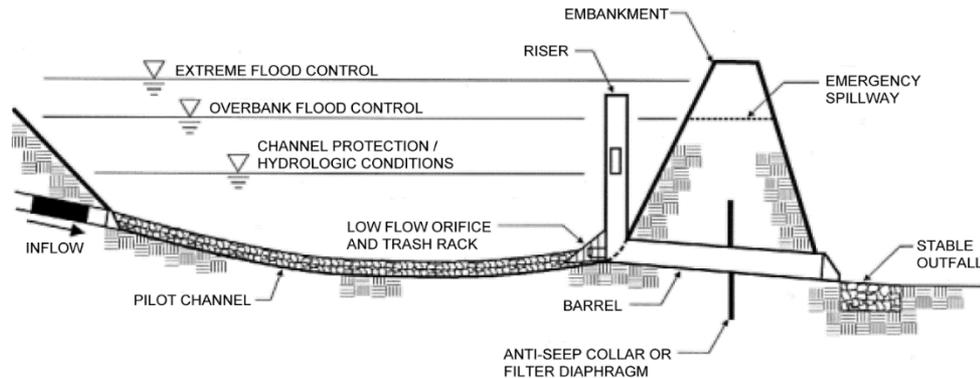


Section 4.4 Alternative Treatment Systems

- 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

- Provide written comments by Friday, April 15th
 - Send comments to 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

■ 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
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Questions on Part 2

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