FUSS & O'NEILL

What Waste Site Cleanup Professionals Need to Know about Stormwater

Presentation to

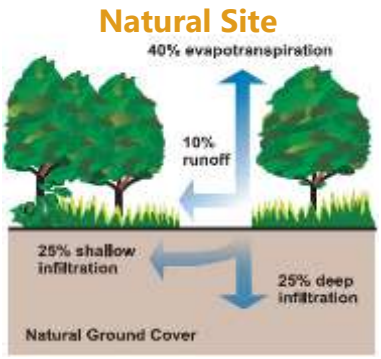
NEWMOA

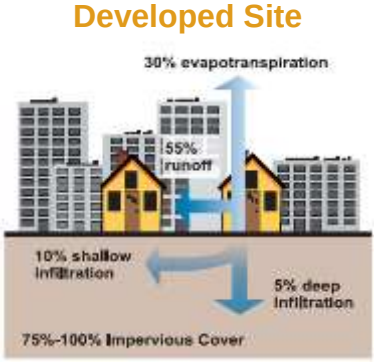
September 26, 2019

Stormwater 101 for Cleanup Professionals

- **Urban hydrology**
- **Water quality impacts & improvement**
- **Infiltration capacity, considerations, limitations**
- **Guidance document: stormwater infiltration systems in Connecticut urban fills**
- **Who to connect with in the states**

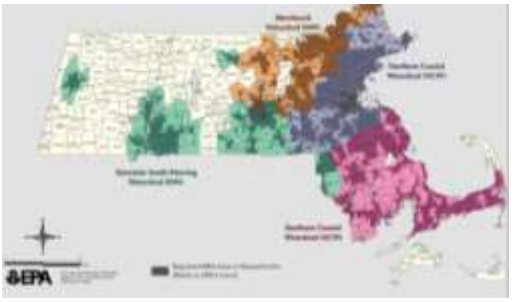
Hydrology





Water Quality Impacts

- **Historical and new development**
- **Impaired coastal waters**
  - **Shellfish**
  - **Recreation**
  - **Fish/wildlife habitat**
- **Nonpoint sources**
  - **Stormwater runoff**
  - **Waterfowl**
  - **Marinas/boating**



Water Quality Impacts

TMDLs

- About 40% of the nation's lakes, ponds, rivers, wetlands and coastal waters are listed as "impaired waters" because of point discharges (MADEP)
- Focus shift from nonpoint sources (urban and agricultural surface runoff) and subsurface sources (septic systems)
- Pollutant loads considered on a watershed scale
- Goal is to meet Water Quality Standards

Water Quality Impacts

TMDLs

Federal requirement (Clean Water Act): if a water body doesn't meet State WQS for a pollutant a TMDL must be developed for that pollutant → **Watershed scale**

Water Quality Improvements

Treatment:

- Physically adsorb onto a surface
- Biologically absorb into tissue
- Chemical alteration (to a less harmful state)
- Removal from system

Typical treatment targets:

- Bacteria
- Total suspended solids (TSS)
- Heavy metals
- Nutrients primarily nitrogen & phosphorus

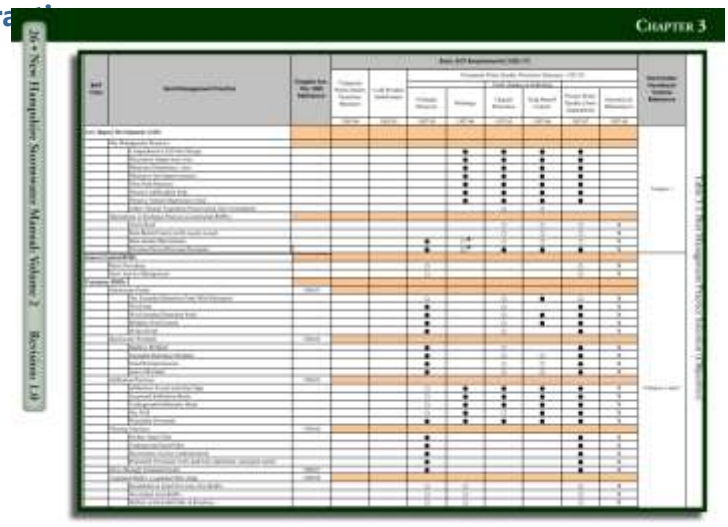
Pollutant Removal Strategies

Pollutant removal tools:

- EPA performance and optimization tools
- University of New Hampshire Stormwater Center
  https://www.unh.edu/unhsc/
- NHDES Stormwater Manual, Volume 2
  https://www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/wd-08-20b.pdf
- Vermont Department of Environmental Conservation, Stormwater Management Manual
  https://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/Permitinformation/2016_12_20%3B%202017_VSMM_Rule_Final.pdf
- Chesapeake Conservancy
- Interstate Technology Regulatory Council (ITR
  https://stormwater-1.itrcweb.org/

NHDES Stormwater Manual, Volume 2

Chapter 3 Screening and Selecting Best Management Pra



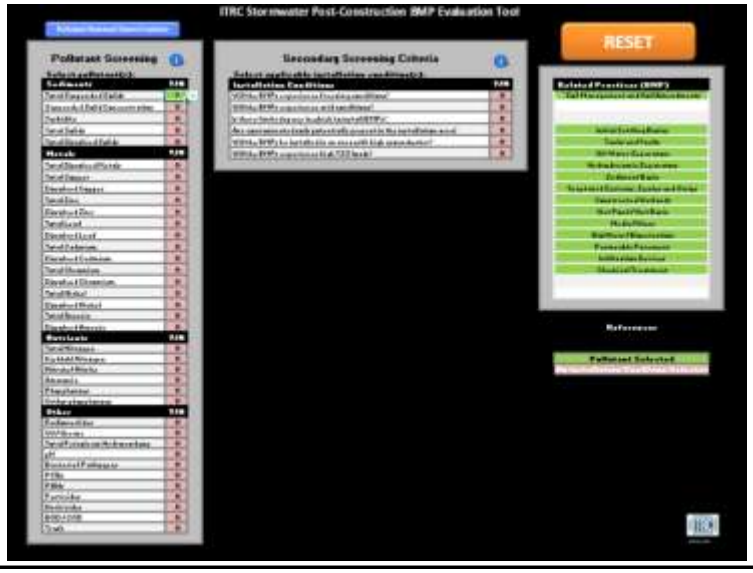
ITRC BMP Screening Tool

ITRC Best Management Practices Screening Tool

- Pollutants of concern, environmental conditions, site restrictions, other factors

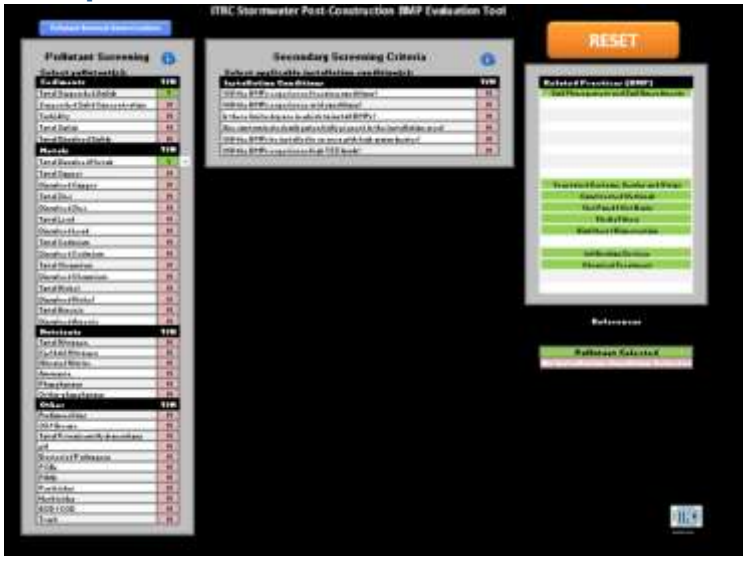
ITRC BMP Screening Tool

Pick pollutants – start with TSS



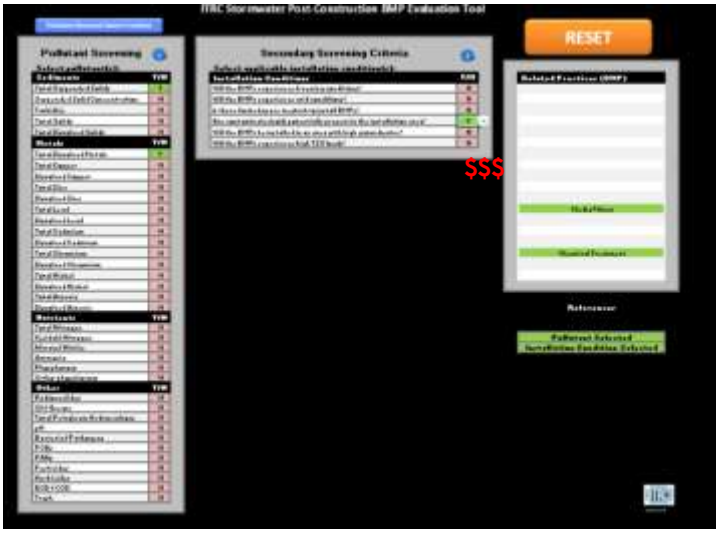
ITRC BMP Screening Tool

Pick pollutants – add total dissolved



ITRC BMP Screening Tool

Site condition – contaminated soils in installation area



Infiltration considerations

Subsurface conditions

- **Soil type and permeability**
- **Bedrock**
- **Groundwater depth**
- **Presence of Contaminated soil**

Infiltration capacity

Determine infiltration rate

- **Field Testing Requirements in "Soil Evaluation" of MA Stormwater Handbook**
- **Section 2-4 Design Infiltration Rate NH Stormwater Manual**
- **Field analysis conducted by**
  - **Degree in Soil Science, Geology, or Groundwater Hydrology or**
  - **State-registered PE or**
  - **Engineer-in-Training (EIT) with civil degree**
- **Methods**
  - **Permeameter**
  - **Infiltrometer**
- **Requires factor of safety of 2**

Infiltration capacity

Determine infiltration capacity of management area:

- **Empirical methods or numeric modeling**
- **Modeling based on Darcy's Law**
  - ✓ **Energy gradient**
  - ✓ **Hydraulic conductivity**
  - ✓ **Surface area**

USDA Soil Texture	Design Infiltration Rate (f_c) (in/hr)
Sand	8.27
Loamy Sand	2.41
Sandy Loam	1.02
Loam	0.52
Silt Loam	0.27

- **Impacts of climate change**
  - ✓ **Infiltration capacity is what it is**
  - ✓ **Infiltration systems will see more frequent exposure to runoff**
  - ✓ **Overflow to gravity system!**

Considerations at contaminated sites

Current stormwater management practice is green infrastructure and low impact development, which rely on infiltration and groundwater recharge.

- **Potential to mobilize contaminants and impact groundwater**
- **Can be overcome within regulatory framework**
- **Apply to new projects, redevelopment projects, retrofits of existing drainage systems**

Guidance document – infiltration in urban fill

Grant provided by CT Institute for Resilience and Climate Adaptation (CIRCA).

- **Policies and regulations regarding stormwater quality, Low Impact Development practices, stormwater management and work in urban soils are in separate documents and permit programs**
- **Develop a Design Guidance Checklist that summarizes and guides project planners and designers through the regulatory requirements**
- **Define tasks needed to evaluate and design stormwater management systems in urban areas that may contain urban fill**
- **Checklist is CT-centric but can be adapted for any state**

Guidance document – infiltration in urban fill

1. Introduction
2. Purpose
3. Limitations
4. Design Guidance for Stormwater Infiltration at Sites Characterized by Urban Fill
5. Design Considerations
6. Environmental Considerations

Guidance document – infiltration in urban fill

1. Introduction

- Soils affected by history of development are sometimes referred to as urban soils or urban fill
- Burning of wood and coal, industrial activity byproducts - heavy metals, PAHs
- LID and GI address stormwater quality, groundwater recharge and flood resilience objectives. They can also mobilize contaminants and impact groundwater
- Permit programs – municipal, state (MS4 and waste management)

Guidance document – infiltration in urban fill

2. Purpose

- Provide guidance for project planners and designers on the siting and design of stormwater infiltration systems in urban settings with historical urban fill. Examples include bioretention basins, rain gardens, water quality swales, subsurface infiltration chambers and trenches
- Guide project planners and designers through the appropriate requirements of applicable regulatory practices and policies
- Improve consistency in how planners and designers site and design LID, and green infrastructure, in Connecticut to meet water quality, flood resilience, and other objectives

Guidance document – infiltration in urban fill

- Raise awareness of the potential to encounter urban fill in areas of proposed stormwater management
- Highlight the critical questions that should be asked to inform the design of an acceptable stormwater management system
- Identify the regulatory requirements that could apply to the design and construction of stormwater infiltration systems in urban fill

3. Limitations of design guidance

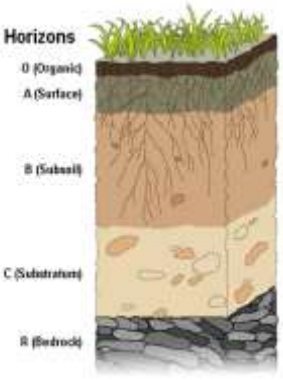
- Users of this checklist must be knowledgeable and proficient in land use and land development in Connecticut, and in particular:
  - Design and construction of stormwater management systems

Guidance document – infiltration in urban fill

- Characterization of contaminated soils and groundwater Construction cost estimating
- Management of contaminated soils and groundwater
- Be familiar with applicable local, state and federal regulations

4. Design Guidance

- Identifying urban fill areas
  - Walk through
  - Topographic maps, NRCS maps
  - Test pits or geotech borings
  - Collect & analyze soil samples, evaluat data vs. regulations



Guidance document – infiltration in urban fill

Design approach factors

- Level of contamination
- Land uses
- Classification / potential use of groundwater

Retention

Treatment

Guidance document – infiltration in urban fill

Design approaches

Retain, discharge to stream

- "Hold runoff on-site" for water quality event (1")
- Used in land use activities with potential for spills or high pollutant loads
- Structures, filter with liner
- Discharge to gravity drainage system
- Examples
  - Tank
  - Oversized drainage pipe
  - Leaching system with lined sides and bottom

Treat and infiltrate

- Removal of sediment, floatables, and nutrients that may clog the system or "mask" soils and reduce infiltration over time
- Treated runoff infiltrates into soil
- Overflow - Discharge to gravity drainage system
- Examples
  - Infiltration basin
  - Surface Bioretention
  - Permeable pavement
  - Water quality swale

Guidance document – infiltration in urban fill

Design considerations

Constructability

- Space: planimetric, disturbance footprint

Guidance document – infiltration in urban fill

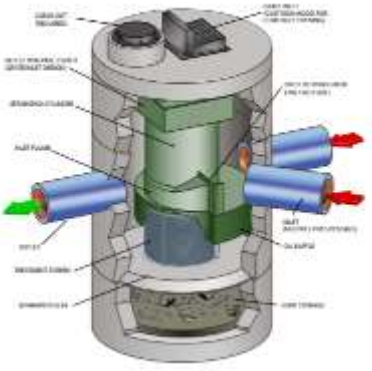
Design considerations

Constructability

- Slopes: potential instability of saturated soil
- Surface restoration
- Depth to seasonal high groundwater
- Soil type

Land use / pretreatment needs

- Stormwater quality
- Potential for spill or high pollutant lo

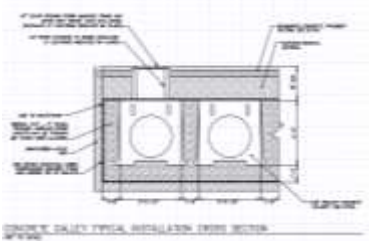


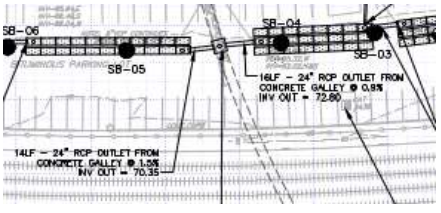
Guidance document – infiltration in urban fill

Design considerations

Capacity needs

- High or low flow rates
- Bypass high rates to gravity system or watercourse





Separation distances

- Potable wells, septic systems, public water supply

Design considerations

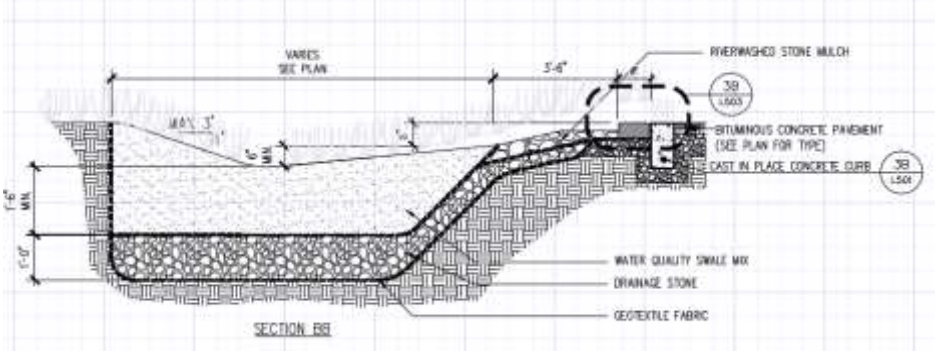
Stormwater Management Standards

- **Peak flow rate**
- **TSS removal**
- **Depth to groundwater**
- **Groundwater recharge**

Hydrologic Group Volume to Recharge (x Total Impervious Area)	
Hydrologic Group	Volume to Recharge x Total Impervious Area
A	0.40 (NH) 0.60(MA, VT) inches of runoff
B	0.25 (NH) 0.35 (MA, VT) inches of runoff
C	0.15 (NH) 0.25 (MA, VT) inches of runoff
D	0.00 (NH) 0.10 (MA) inches of runoff (Waived in VT)

Design considerations

Typical bioswale cross section



Design considerations

Design

Stormwater runoff model

- 1D (HydroCAD), 2D (PCSWMM)
- Calibration if possible

Design capacity

- On-site vs. off-site watershed contributions
- Design return frequency (high)
- Overflow to gravity outlet (low frequency storm)

Groundwater recharge

- Stormwater manual requirements
- Soil infiltration capacity (determine in-situ or in lab)

System footprint, constructability, other factors

Who to contact

Local stormwater authority

State stormwater authority and permitting

MA: https://www.mass.gov/info-details/stormwater

NH: https://www.des.nh.gov/organization/divisions/water/aot/index.htm

VT: https://dec.vermont.gov/watershed/stormwater

Groundwater program

Waste management program

Questions

My contact Information:
Rick Lundborn, PE
(603) 767-4728
rlundborn@fando.com