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Filtration Fundamentals:
The basics and why filtration matters today

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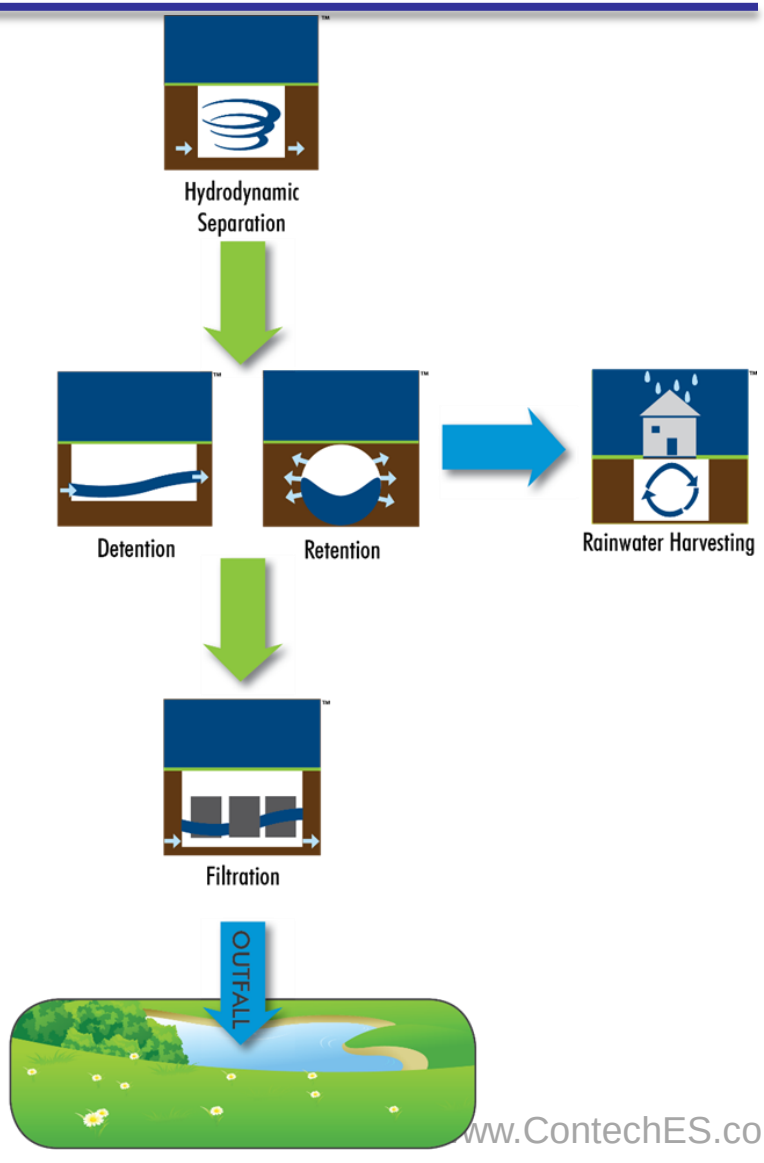
Agenda

- Filtration Overview
- Filtration in Stormwater
- Filtration Innovation
- Discussion

Advancing Treatment…

- Trending shift from HDS to Filtration
  - Great Lakes Region
  - Indianapolis suburbs
  - Ohio
  - Wisconsin
- Pollutants of Concern
  - TSS
  - Nutrients
  - Metals



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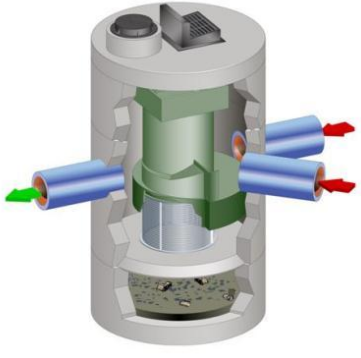
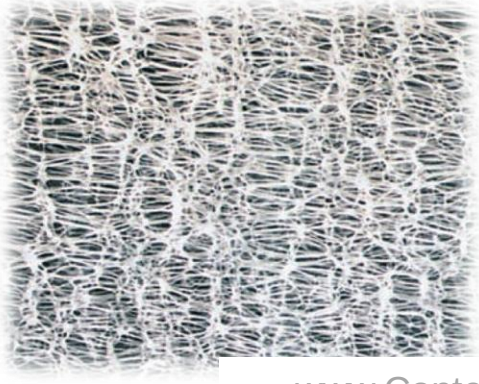
So Many Choices…

	Hydrodynamic Separation	Filtration
Pollutants of Concern	TSS	TSS, Nutrients, Metals
Targeted Particle Size	> 50 micron	< 50 micron
Recognized Testing Protocol	• Lab Testing: NJDEP • Field Testing: TARP Tier II	• Lab Testing: NJDEP • Field Testing: TAPE or TARP Tier II
Placement Relative to Detention	• Upstream for effective performance	• Upstream or downstream



Typical Applications

- Standalone Treatment
  - New Development
  - Redevelopment
- LID Pretreatment
  - Subsurface Infiltration
  - Rainwater Harvesting
- Polishing Treatment
  - Downstream of Detention



What is filtration?

- The act or process of removing something unwanted from liquid, gas, etc., by using a filter (Merriam Webster Learners Dictionary)

- **Inert Media Filtration**: A unit process in which suspended solids and associated particulate pollutants are removed by use of a media such as sand or perlite.
  - Source: Minton, Stormwater Treatment Second Edition

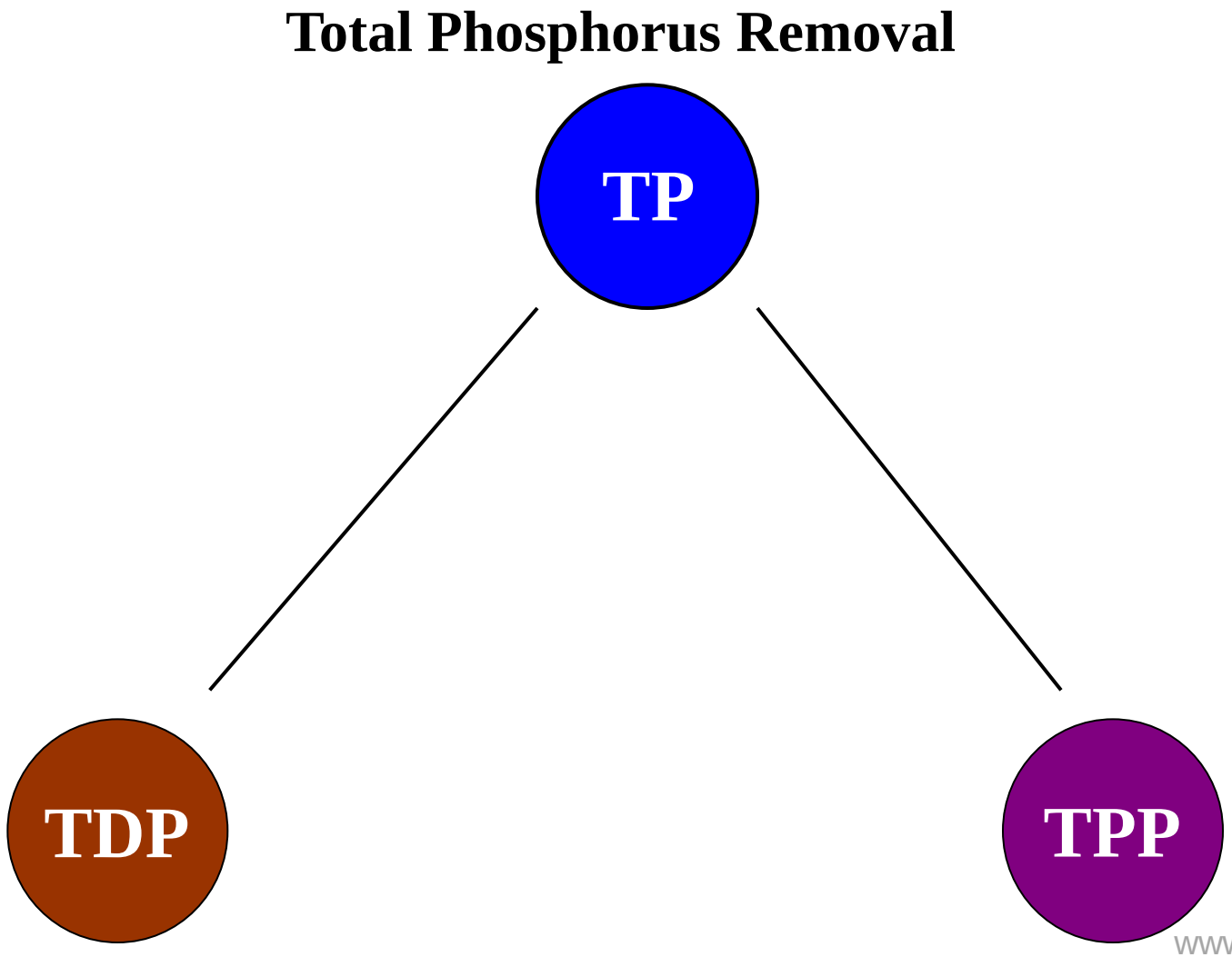
- **Sorptive Media Filtration:** A unit process in which dissolved constituents are removed by attachment to a filter media at the molecular level.
  - Source: Minton, Stormwater Treatment Second Edition

Common Filters

Factors Affecting Filter Performance

- Media Type
  - Active vs Inert
- Media Porosity/Gradation
  - Coarse vs Fine
- Media Shape
  - Irregular vs symmetrical
- Media Thickness
  - Depth vs Surface
- Hydraulic Loading Rate
  - Slow vs Fast

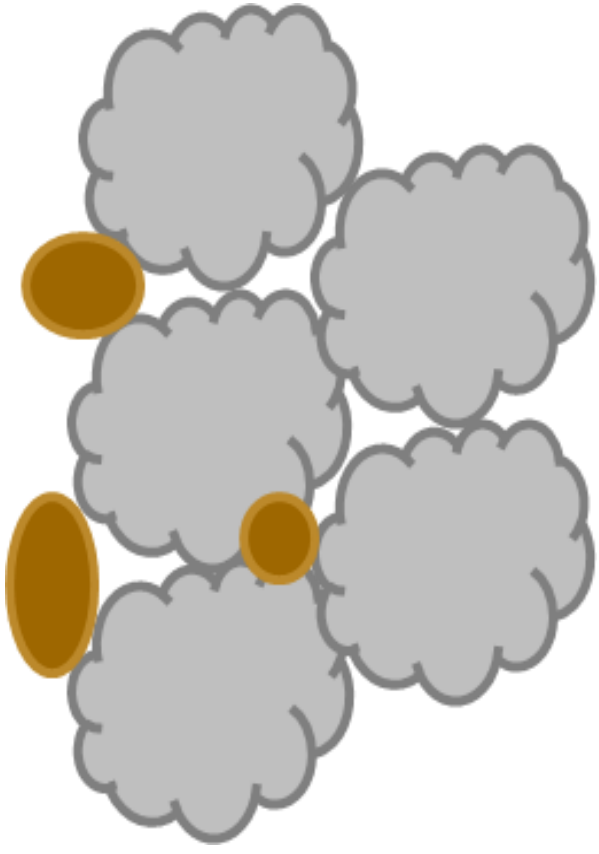
Maximizing Load Reduction



Physical/Inert Media Filtration

Examples: Screening, Media filters, Sand filters, Biofilters, Infiltration

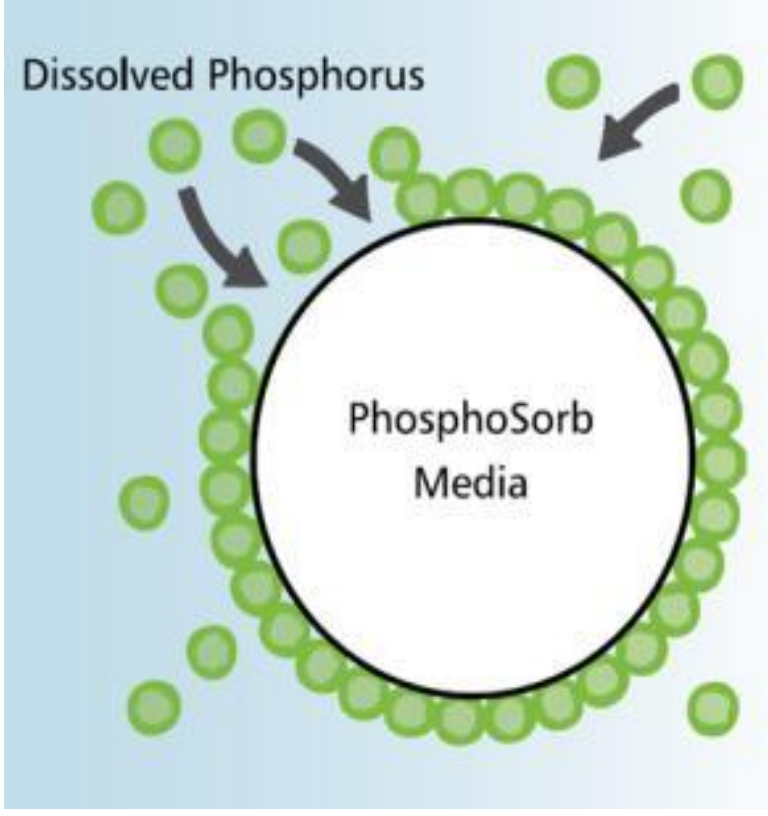
- Inert media is physical barrier to solid particles
- Sedimentation often plays major role in filter effectiveness
- Good control of solids and attached pollutants
- Removal of particulate bound pollutants (i.e. metals and phosphorus)
- No removal of dissolved/soluble pollutants
- Leaching possible
- Longevity must be considered



Reactive Filtration

Reactive filtration media with an affinity for target pollutants

- Works in parallel with physical filtration and/or sedimentation
- Target pollutant is bound to media via adsorption, ion exchange etc.
- Effective removal of soluble/dissolved pollutants
- Boosts overall pollutant load reduction
- Prevents leaching

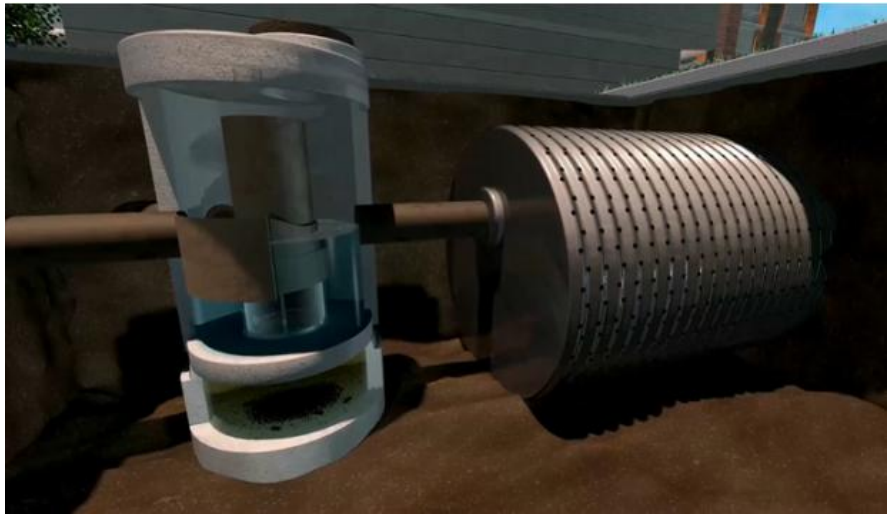


Filter Media Variables

- Range of particle sizes better than uniform size
- Finer media more effective but limits flow
- Irregular shaped particles better than symmetrical
- High surface area improves reactive capacity
- All else equal deeper is better assuming bed filtration

Critical Filter Design Considerations

- Pretreatment common to reduce load on media and extend maintenance cycle
  - Knock out the coarse stuff
- Media type and gradation
  - Often governed by pollutants of concern and performance goals



Critical Filter Design Considerations

- Hydraulic Loading Rate (gpm/ft^2 of media surface area)
  - High loading rates result in smaller filters but all else equal need more maintenance
  - Loading rates in stormwater range from 0.05 - >10 gpm/ft^2
- Longevity
  - Filters must be designed with longevity in mind especially if frequent maintenance is not realistic
- Filtration red flags
  - Media toxicity
  - Media variability
  - Media availability
  - Lack of field longevity experience

Evolution of Filter Technology

Horizontal Bed Filter

- Low infiltration rates
- Solids accumulate on surface
- Typically sand as media
- Large, land intensive

Horizontal Bed Filter

Radial Flow Filter

- Increased longevity
- Smaller structures
- Easier maintenance
- Custom filter media options

Manhole StormFilter

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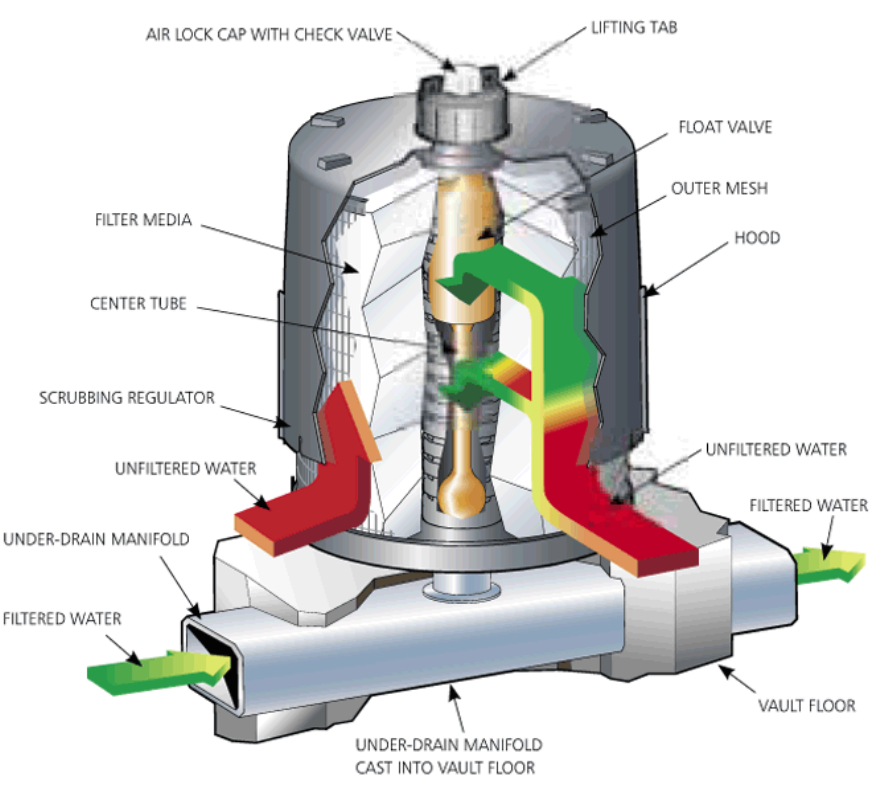
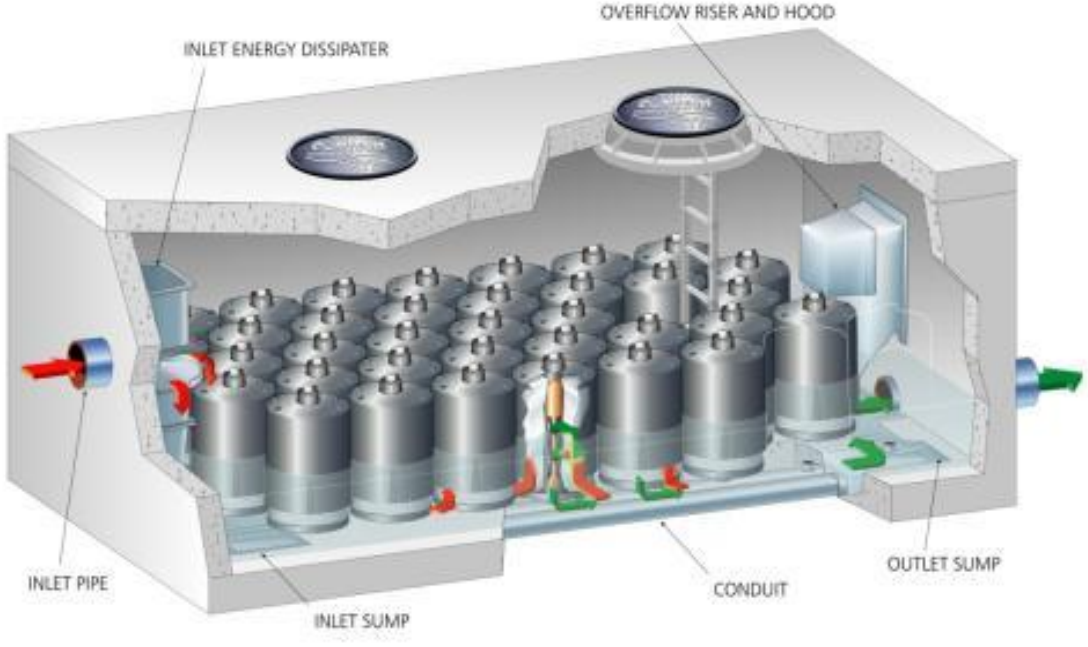
Innovative Media Filtration





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Media Filtration




	PhosphoSorb™	Perlite	CSF® Leaf Media	ZPG
Sediments	■	■	■	■
Phosphorous	■			■
Oil and Grease	■	■	■	■
Soluble Metals	■		■	■
Organics			■	■
Nutrients	■	■	■	■

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Innovative Membrane Filtration

Pleated Membrane Filter

Evolution of Filter Technology

Maximum Surface Area in
Compact System

Jellyfish Filter

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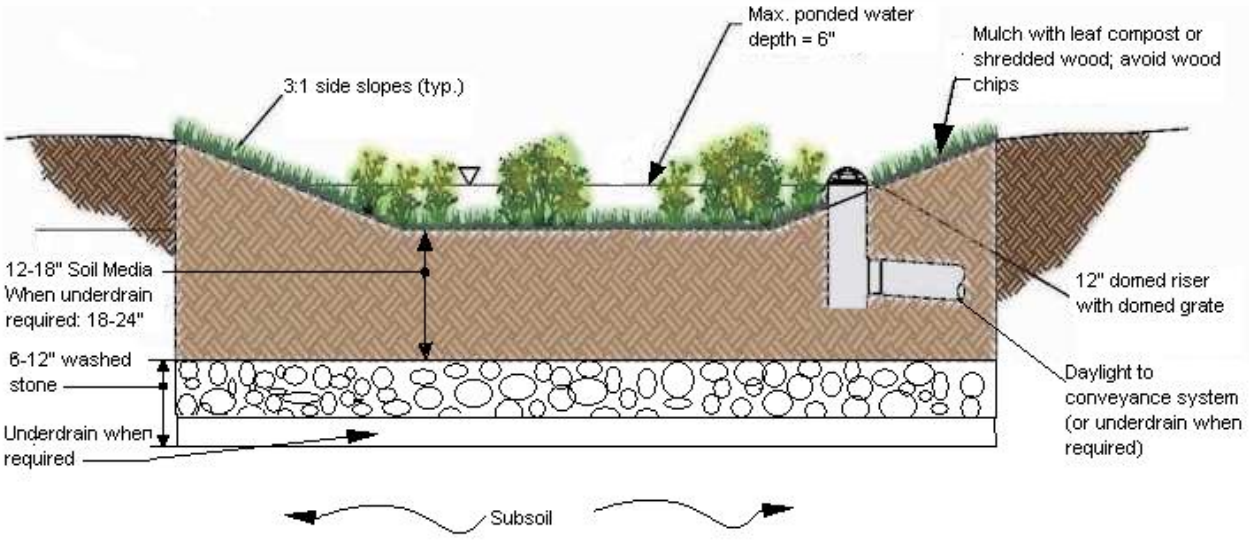
Bioretention/Biofiltration



Source: NYSDEC Chap. 5 NYS Stormwater Management Design Manual

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High Performance Biofiltration

- High Flow Media
  - Same principles as traditional biofiltration
  - 100+ inches/hr flowrate
  - Reduced footprint – typically 1% of tributary drainage area
  - Quality control of media composition

filterra® Bioretention Systems

Maintenance

- **Longevity, Longevity, Longevity…..**
- All filters clog eventually
- Must strike balance between loading rate and longevity
- Ensure maintainability

Verified Performance

- NJDEP – Lab Protocol
- TAPE – Field Protocol
- WEF STEPP

Questions?

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