



*Green Infrastructure Implementation Case Study:
Design and Construction of Stormwater Best
Management Practice Retrofits for the Control of
Nitrogen on Cape Cod*

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Background: the Clean Water Act, Cape Cod and Green Infrastructure

- **Permits** – next-generation Small MS4 General Permits for MA and NH
 - Includes structural and non-structural BMPs to achieve water quality objectives for nutrients
- **EPA Policy** – recent Jan 2016 Green Infrastructure (GI) Policy
 - Promoting SRF financing of GI Projects nationally
- **Cape Cod §208 Water Quality Plan Update**
 - Developed by Cape Cod Commission (CCC)- encourages Cape communities to develop ways to reduce N, P



Background: the Clean Water Act, Cape Cod and Green Infrastructure

- **Southern New England Program (SNEP)**
 - New EPA geographic program with line-item appropriations
 - Goal- “restore the ecological health of southeastern New England’s estuaries, watersheds, and coastal waters and ensure access now and in the future to resilient, self sustaining ecosystems of clean water, healthy diverse habitats, and associated populations of fish, shellfish, and other aquatic dependent organisms”
- **EPA’s interest in Green Infrastructure:**
 - Demonstrating innovative technologies
 - Technology Transfer
 - Building practitioner understanding and acceptance



Cape Cod N BMP Retrofits: Technical Assistance Project Solicitation & Selection

- **State, CCC and Muni's request** EPA to provide stormwater project for nitrogen → Best Management Practice **(BMP) Retrofits for N** (N BMP Retrofits)
- June 2014: EPA invites interested muni's to **submit SNEP project proposals**



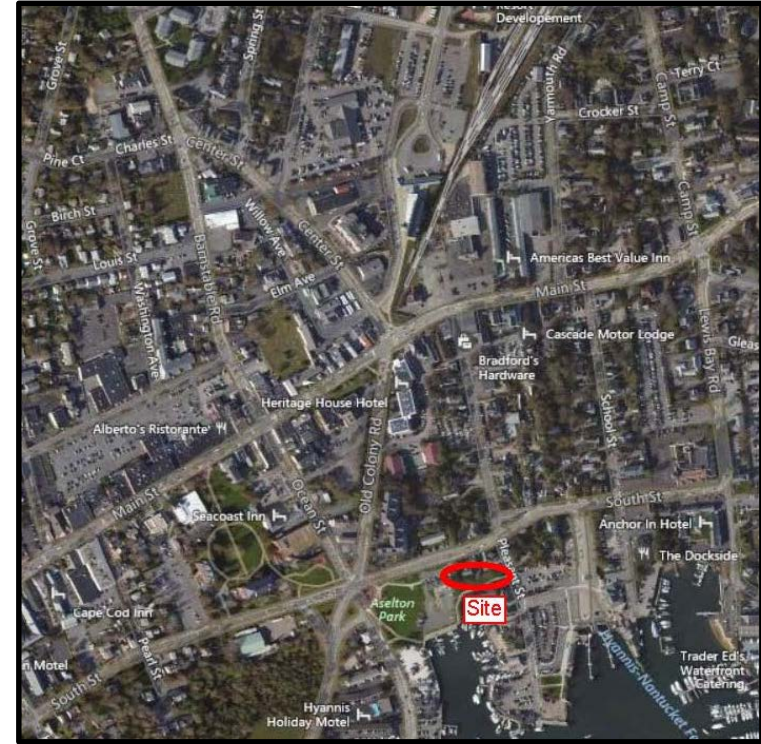
Cape Cod N BMP Retrofits: Technical Assistance Project Solicitation & Selection

■ Project selection criteria:

- Ability and interest → **partnership** (MOU, outreach, coordination, O&M)
- **Transferability** of technology
- Ease of **permitting**
- Site ideally situated to promote public **outreach/awareness** of nutrient pollution in stormwater
- Site ideally situated near an **impaired water body** with a high **nitrogen reduction target** (NRT)
- Other:
 - Potential tie-in / ease of tie-in to MS4;
 - Materials management;
 - Location of utilities;
 - Site traffic (e.g., Cape Cod summer season).



Selected Site: Barnstable



■ Hyannis Inner Harbor, Barnstable, MA

- parcel: 0.35 acres
- drainage area: 6.9 acres
- IC: 3.5 acres (~ 51% IC)
- MS4 trunk line runs through the site
- drains to Hyannis Inner Harbor
 - impaired for TN and fecal coliform
- Total attenuated watershed N load: 41.5%
- subwatershed N load reduction target (NRT): 19.6-52.8%
- percent NRT due to stormwater / IC: 21%

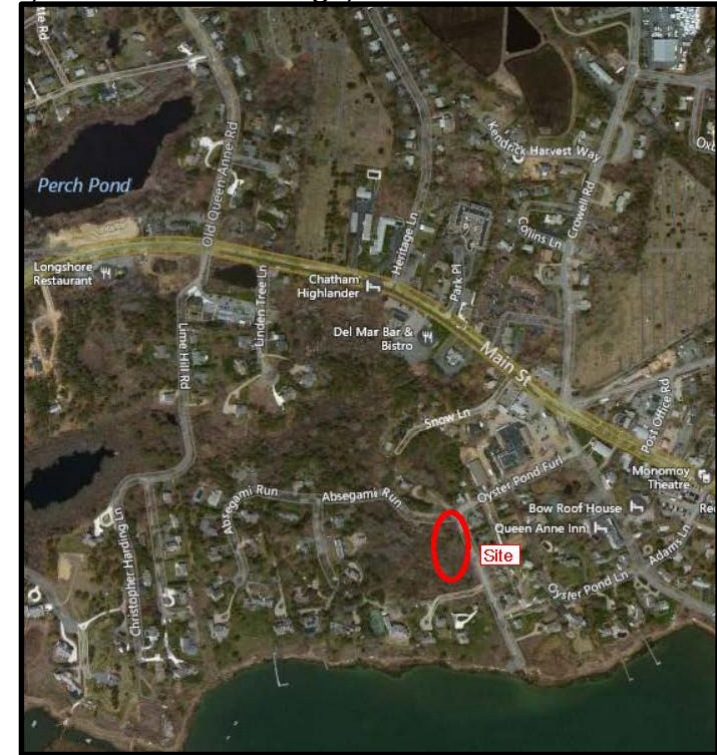




Selected Site: Chatham

■ Undeveloped Town parcel near Oyster Pond, Chatham, MA

- parcel: 3.19 acres
- drainage area: 16.9 acres
- IC: 5.7 acres (34% IC)
- MS4 trunk line runs by the site
- drains to Oyster Pond,
impaired for TN and fecal coliform
- watershed/subwatershed N load reduction target (NRT): 74-88.2%
- percent NRT due to stormwater: 15%

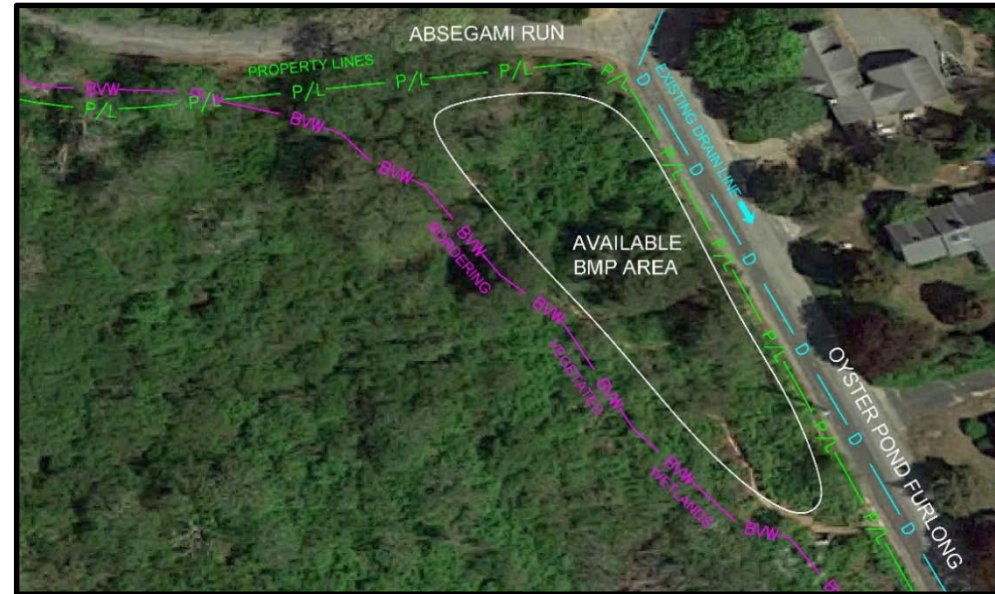
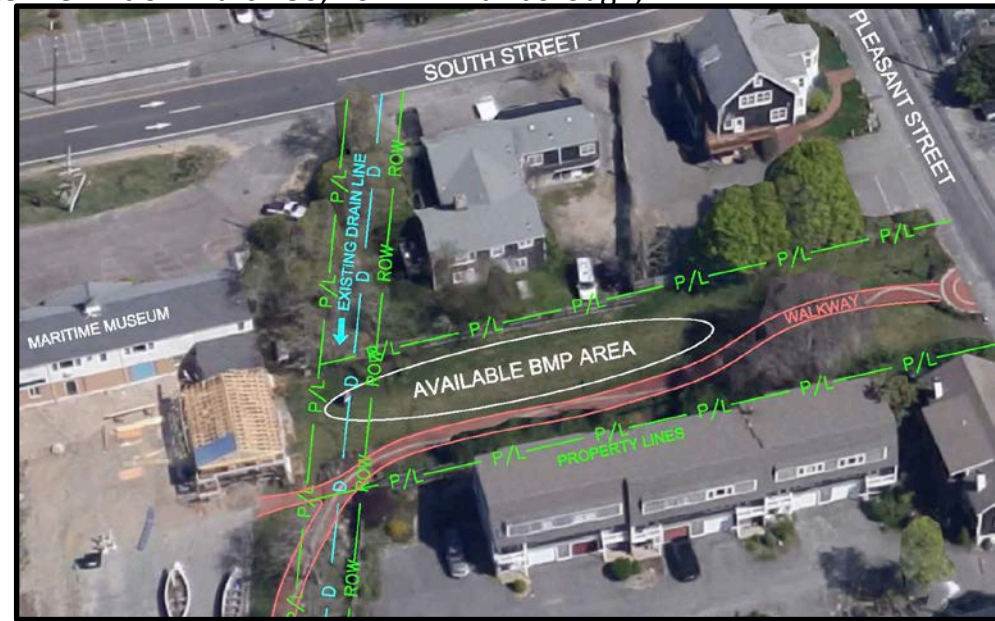




Site Constraints

- **Hyannis Inner Harbor, Barnstable, MA**
 - parcel: 0.35-ac, 0.19-ac available (54%)
 - park site, high traffic area
 - very shallow groundwater

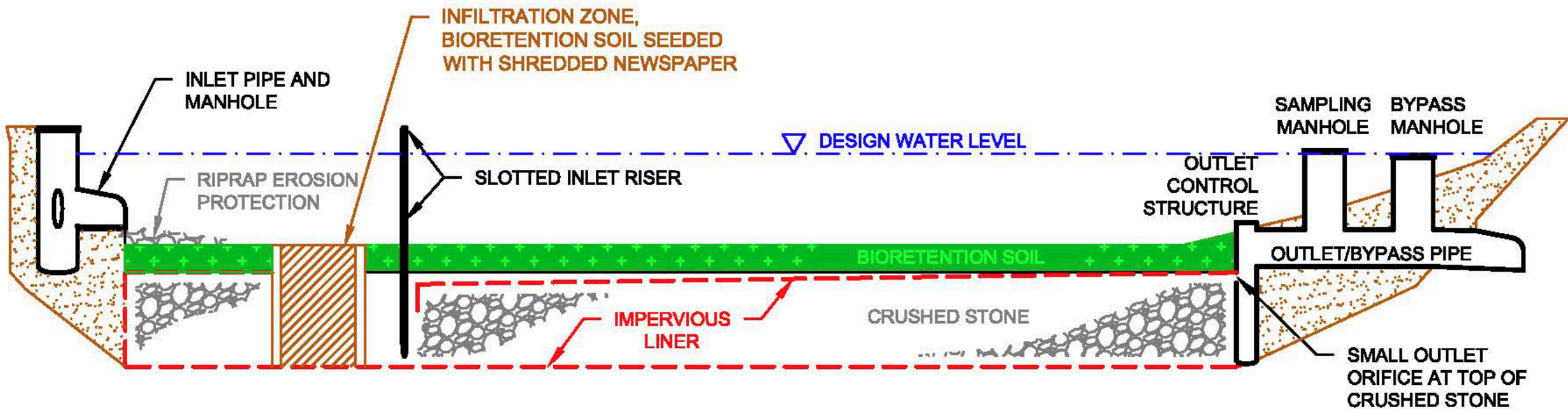
- **Oyster Pond, Chatham, MA**
 - parcel: 3.19-ac, 0.33-ac available (10%)
 - wetland complex
 - shallow groundwater
 - deep drain line





Selected BMP: Hybrid Bioretention and Gravel Wetland System

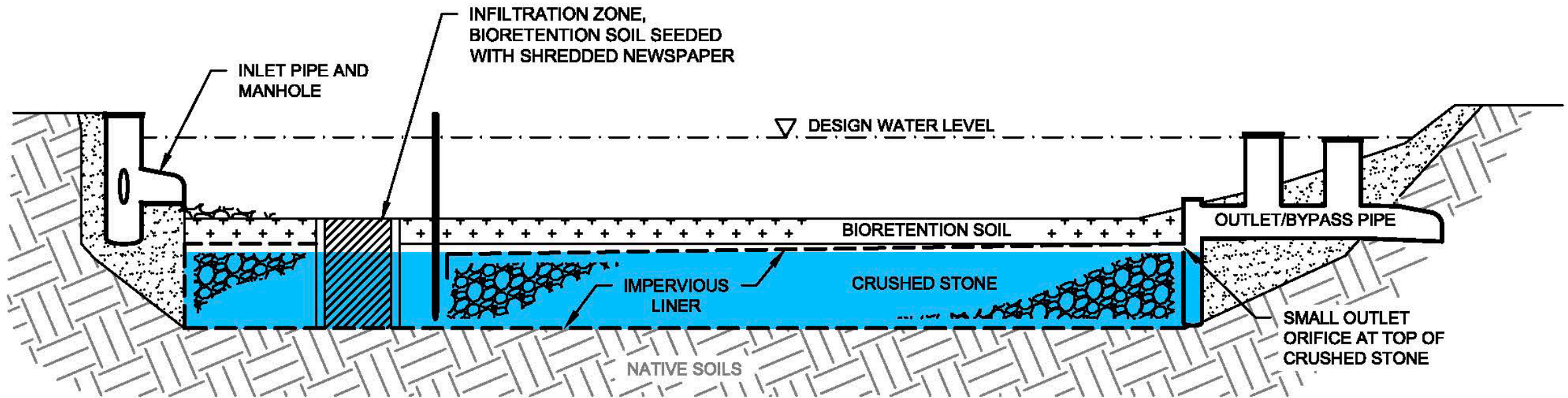
- Bioretention aesthetics - **surface aerobic** storage
- Gravel wetland functionality - **subsurface anaerobic** storage





BMP, Pre-Storm

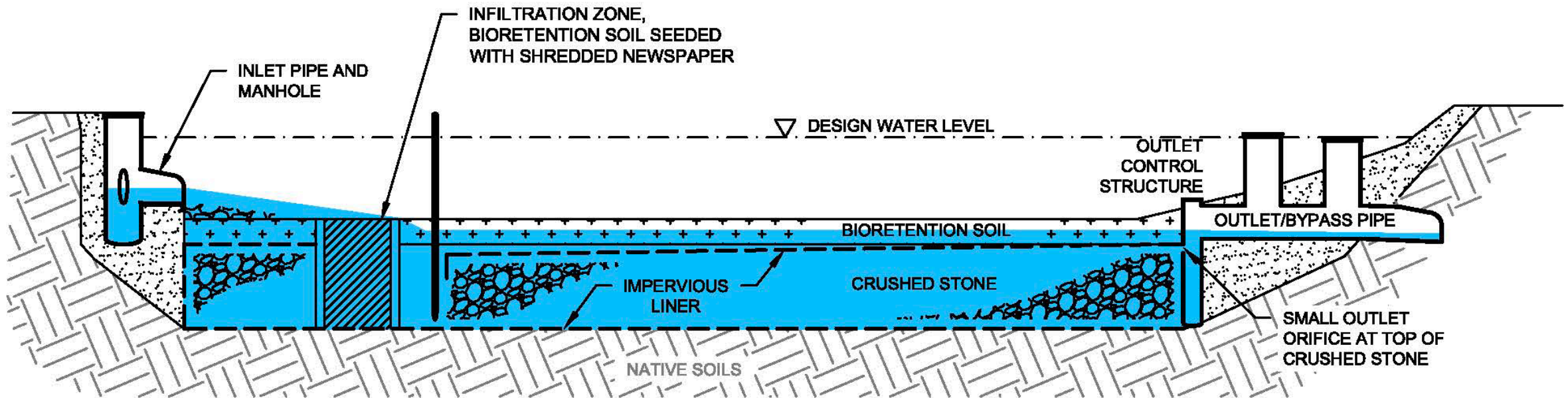
- Gravel cell full of water
- Water level regulated by low-flow orifice





BMP, Start of Storm

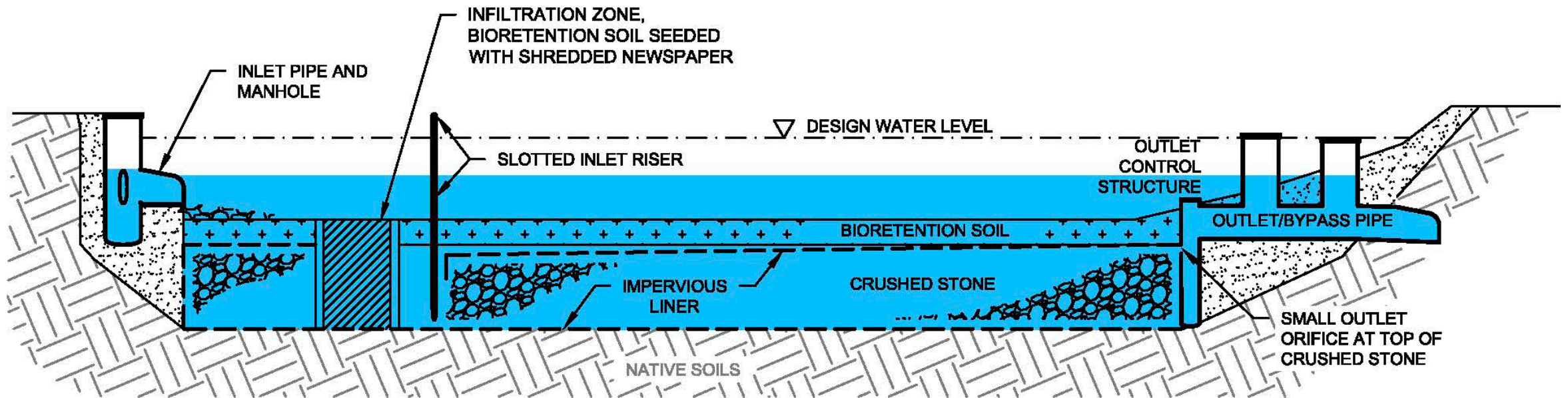
- Water flows in through inlet pipe/manhole
- Stormwater infiltrates through infiltration zone
- BMP begins to outlet through outlet control structure





BMP, Mid-Storm

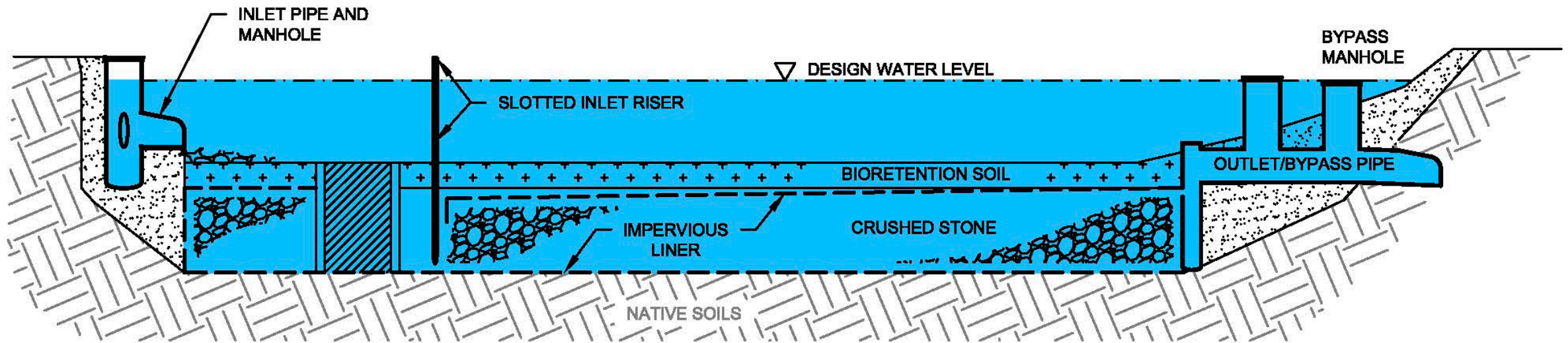
- Water continues to flow in through inlet pipe/manhole
- Stormwater infiltrates through infiltration zone and slotted inlet riser
- BMP outlets through outlet structure orifice





BMP, Large Storm

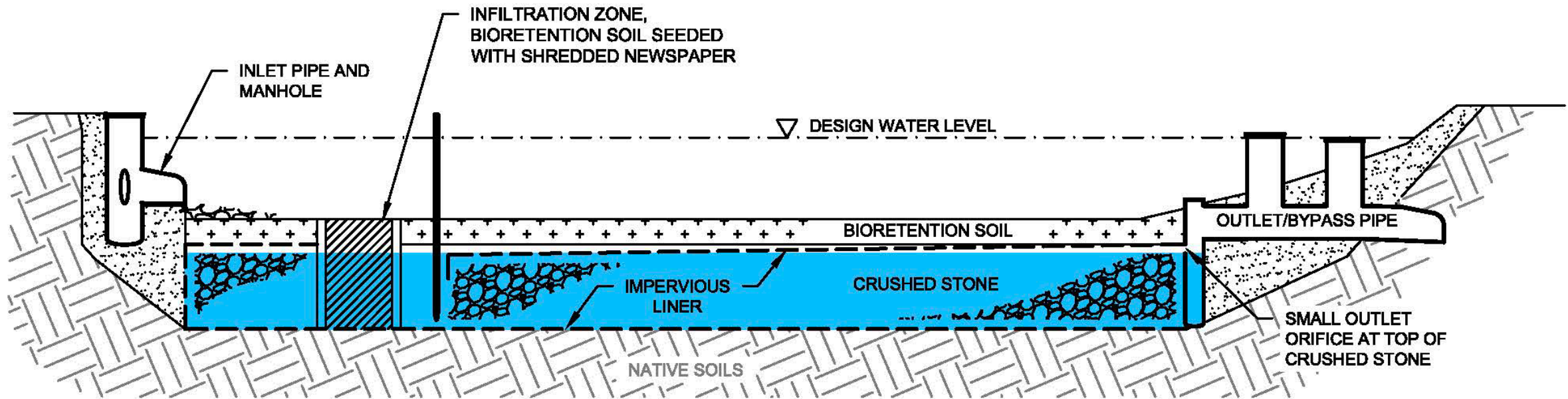
- Inlet pipe and manhole surcharge
- Stormwater infiltrates through infiltration zone and slotted inlet riser
- BMP outlets through outlet structure orifice and bypass manhole





BMP, Post-Storm

- Surface water slowly infiltrates into gravel cell
- Drains out over 24 hours, water level regulated by low-flow orifice
- Gravel cell remains full of water





Existing conditions

Construction- Barnstable



MS4 Main



Initial excavation- on-site remnants

Construction- Barnstable



Site constraints- access and material handling

Construction from access road



Construction- Barnstable



Bottom liner install

Construction - Barnstable



ISR delivery



ISR & top liner installed



Finished Barnstable Site



Barnstable Site During Storm



Construction- Chatham

Existing conditions



Site clearing





Construction- Chatham



Site clearing



Rough excavation



Construction- Chatham





Construction- Chatham



Top liner installed



Bio-soil installation



Construction- Chatham



Outlet protection and bio-soil



Access road gate



Finished Chatham Site



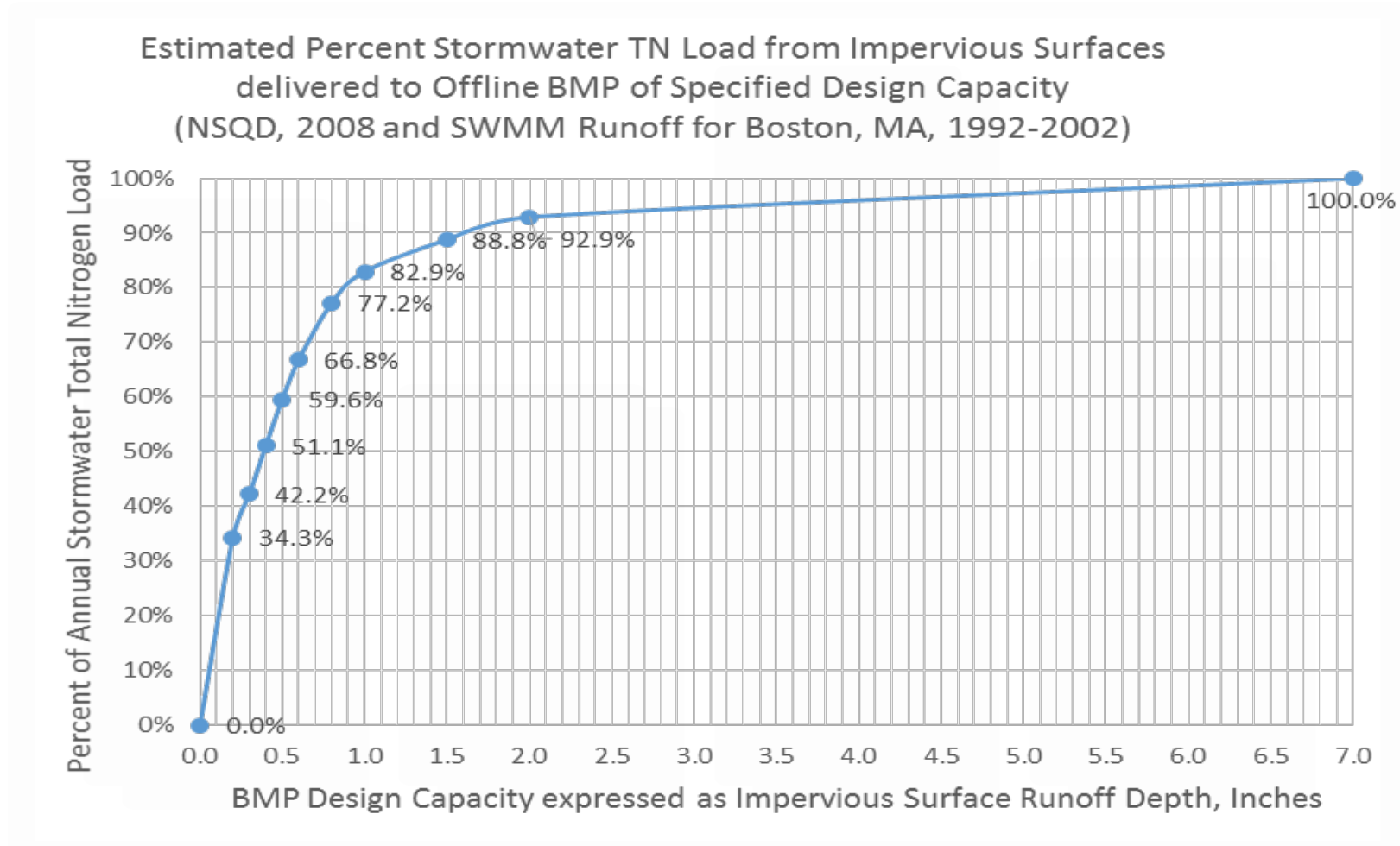
Performance Assessment

- To Be Determined . . .
- **Approach:** allow BMP anerobe populations to establish over ~1-year, then install monitoring equipment:
 - sample inlet to BMP, outlet from BMP, existing drainage system bypass.
 - sample each for **flow and nutrients** with auto-samplers and volunteers
- Monitoring Plan and Quality Assurance Project Plan (QAPP) **currently under development**
- **Schedule:**
 - start 2017
 - ~ 20 storm events per year
 - 3+ years of performance monitoring



Performance Assessment

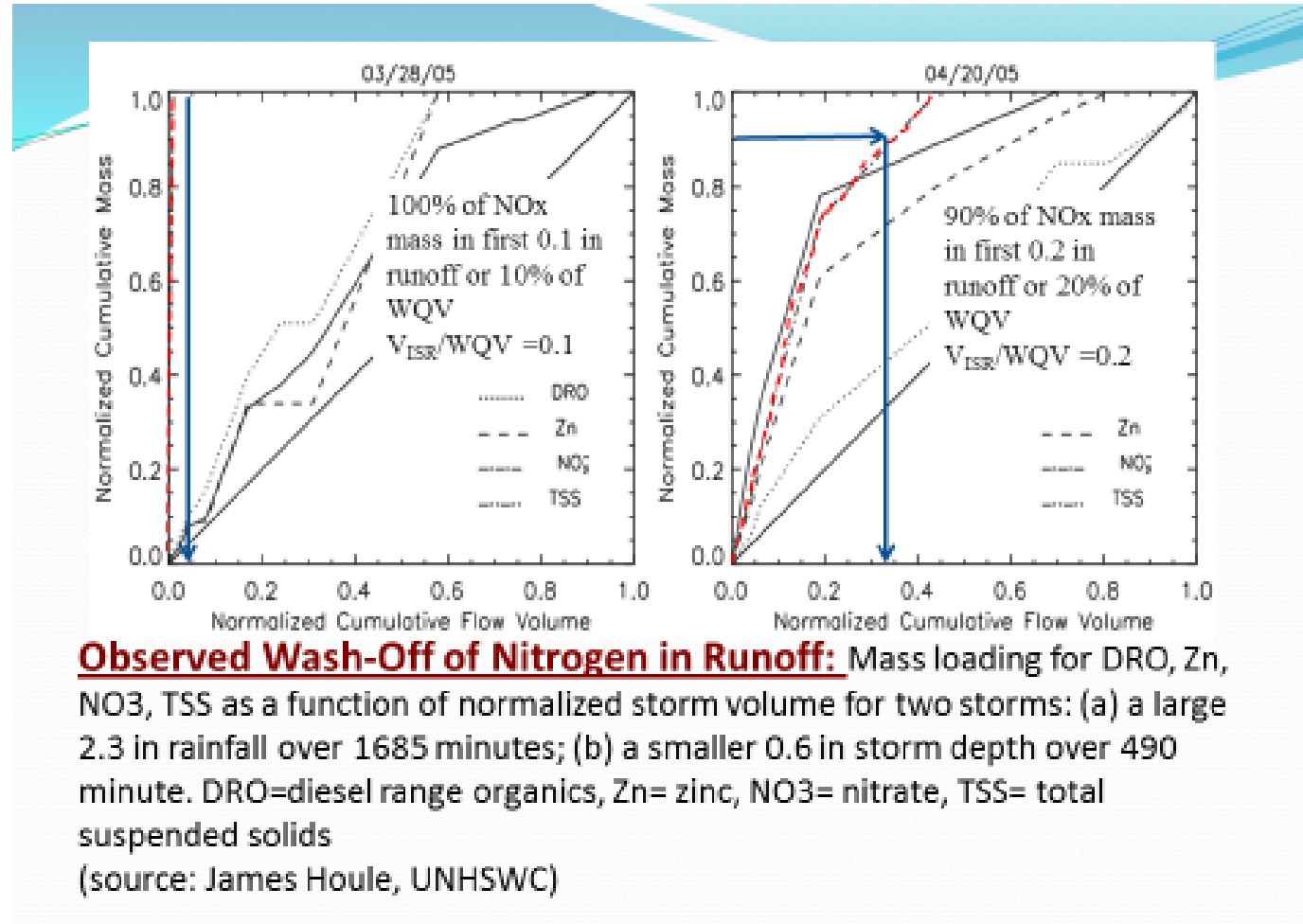
Anticipated Performance:





Performance Assessment

Anticipated Performance:





Project Website

<https://www.epa.gov/snecwrp/cape-cod-stormwater-best-management-practices-bmps>

Questions?

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