Rhode Island Stormwater Design and Installation Standards Manual



Public Workshop

Material Specifications and Measures for WVTS Construction and Maintenance

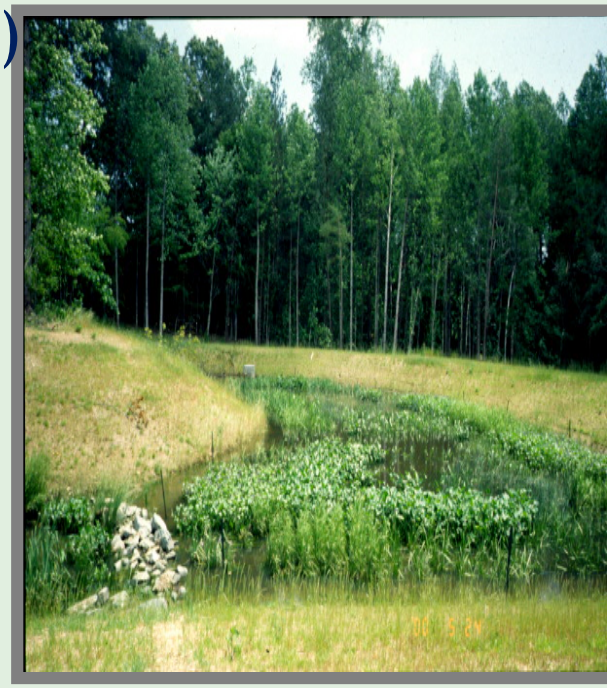
March 24, 2011

Horsley Witten Group, Inc.

Section 5.2: Wet Vegetated Treatment Systems

Shallow WVTS: Design Notes

- Min flowpath of 2:1 (length to width)
- High surface area to volume ratio
  - Pretreatment (10% of WQv)
  - Deepwater zones (25% of WQv)
  - Remaining 65% WQv combination of shallow pool and ED
- Shallow depths over most of surface area
  - 35% 6 inches or less
  - 65% 18 inches or less
- Complex internal microtopography, including aquatic benches
- Plant with emergent vegetation
- Consumes most land of any BMP
  - 1.5% of DA



Gravel WVTS: Design Notes

- Min. length-to-width ratio 1:1, min. flowpath (L) of 15 ft
- Pretreatment: 10% WQv
- Remaining 90%, a combination of one or more basins/chambers filled with gravel and open ED
- Outlet invert just below gravel surface
- Surface area must be minimum 0.35% of DA
- May use organic soil
- Plant with emergent vegetation

WVTS Materials List

1. Earthwork
   - Embankment/berm soils
2. Outlet Control Structures
   - Concrete /PVC
   - Trash racks/hoods
3. Pipe
   - HDPE/PVC/Concrete
4. Storage
   - Clean washed stone
   - PVC chambers
5. Geomembrane liner
6. Plantings
   - Organic soils
   - Trees, shrubs & herbaceous materials
7. Other
   - ESC measures
   - Level spreaders
   - Loam and seed
   - Rip rap

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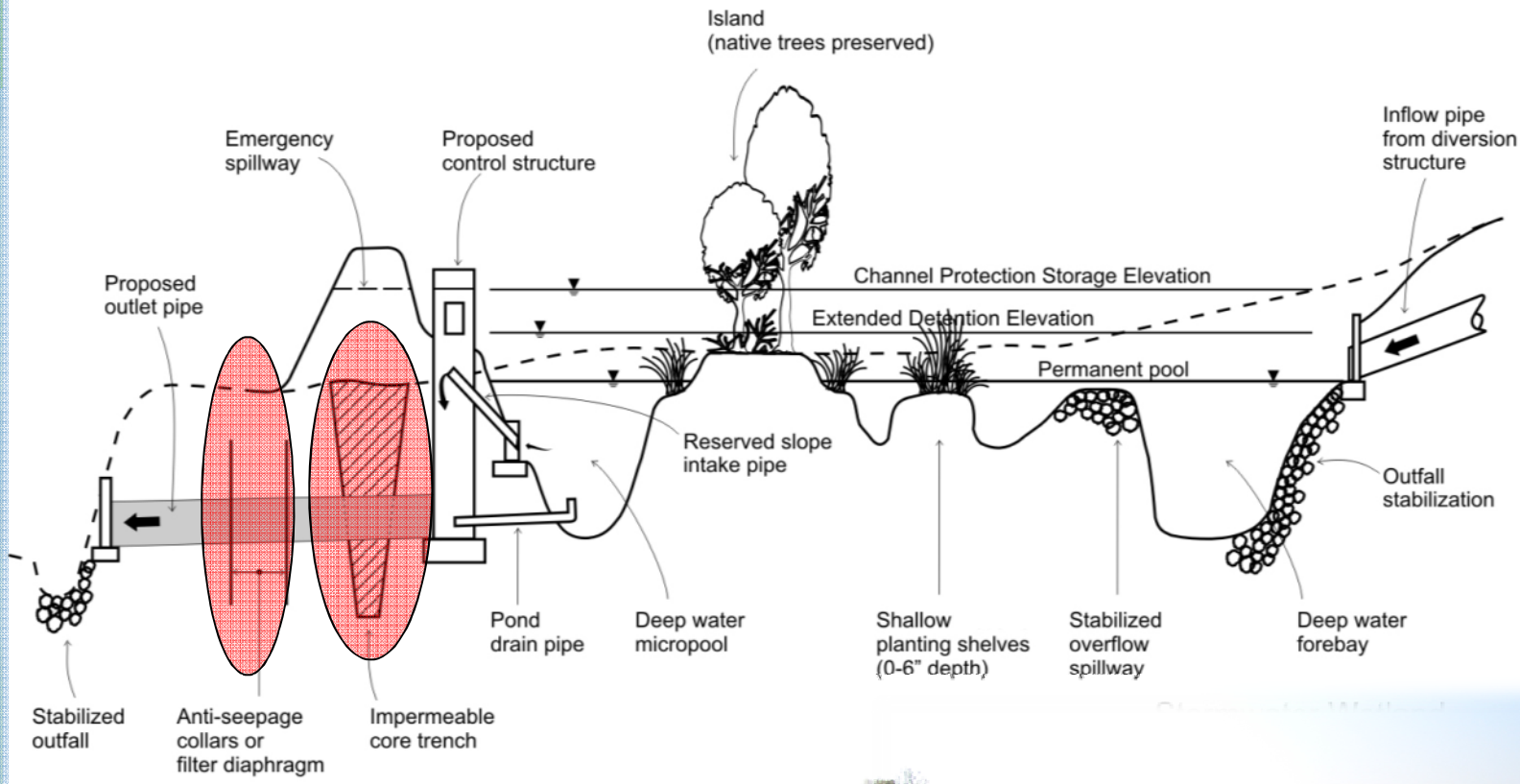
Approved WQ BMPs

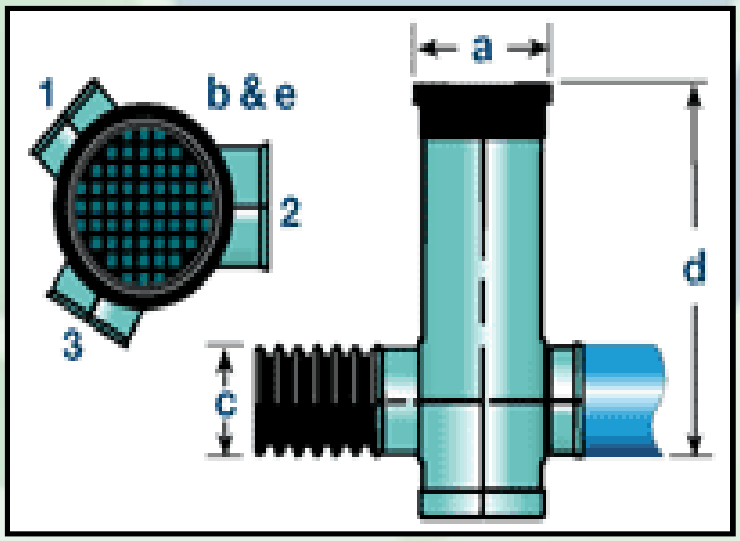


- Dams of ≥6' or capacity of ≥ 15 ac-ft should consult DEM Office of Compliance and Inspection Dam Safety regulations.

1. Embankments

- Fill material shall be free of roots, stones > 6 inches, other debris, placed in 8-inch layers.
- AASHTO Method T-99 (Standard Proctor) for compaction – 95% of maximum dry density with moisture content within 2% of the optimum.
- Embankment core and cut-off trench shall conform to USC GC, SC, CH, or CL and have at least 30% passing the #200 sieve.
- Cut-off trench min. width and depth of 4'. Side slopes 1:1 or flatter
- Embankment core shall have top width of 4' or less, height shall extend up to at least 100-yr water elevation or as shown on plans. 1:1 or flatter.

2. Outlet Control Structures



- Fiberglass Nyloplast (ADS, Inc.) catch basin structures
  - With frame and grate
- Typically 24” Diameter with main outlet and 1 to 2 underdrain inlets

Other Outlets

Concrete:

5000 psi concrete

Joint Sealant:

1) Mortar
2) Rubber Gasket
3) Butyl Joint Sealant

Air content: 6 % by volume

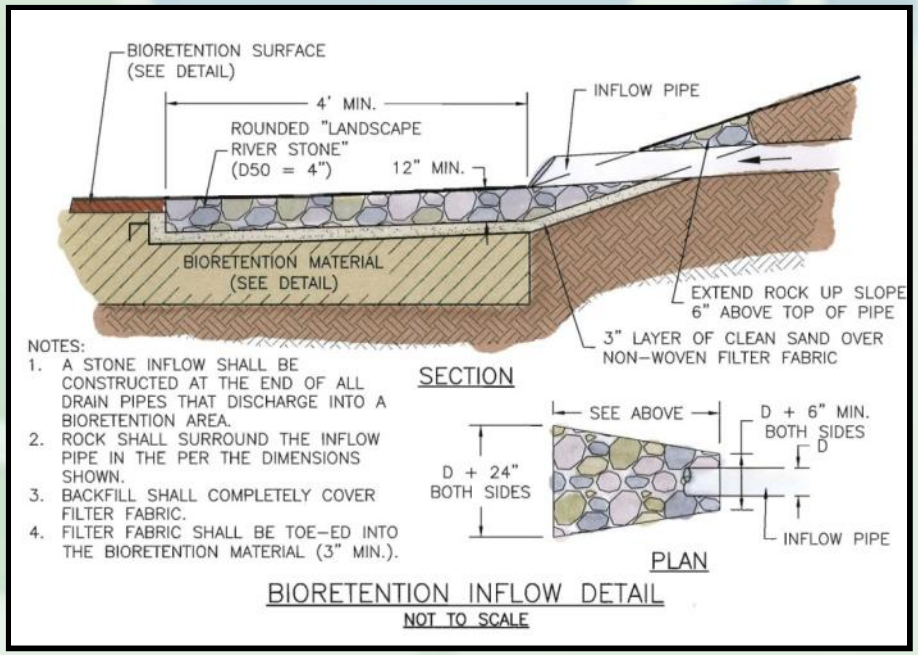
Trash Racks:

- Glass reinforced HDPE.
  - Load Rating: 2030 lbs./sq.ft.
  - Ultimate yield Strength: 1855 lbs./sq.ft.
- Maximum Deflection (@ 90 degrees F): < 2.00 inches
- UV protection must meet or exceed ASTM D2565-99.
- Grid material is 1 ½" thick with 5/8" webbing on center.

2. Outlet Control Structures

- Anti-seep collars, joints and valves shall be watertight.

3. Pipes - Inlet Structures



- HDPE Pipe with flared end section
- RCP with flared end section or wingwalls
- Riprap or landscape stone apron

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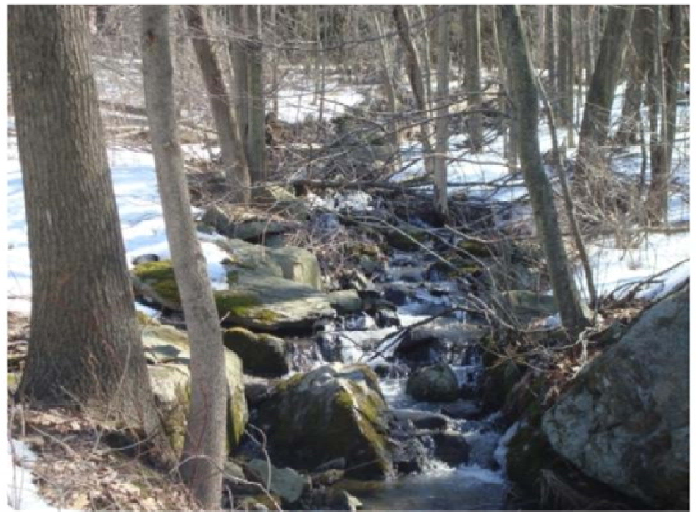
Underdrain Pipe Cleanout

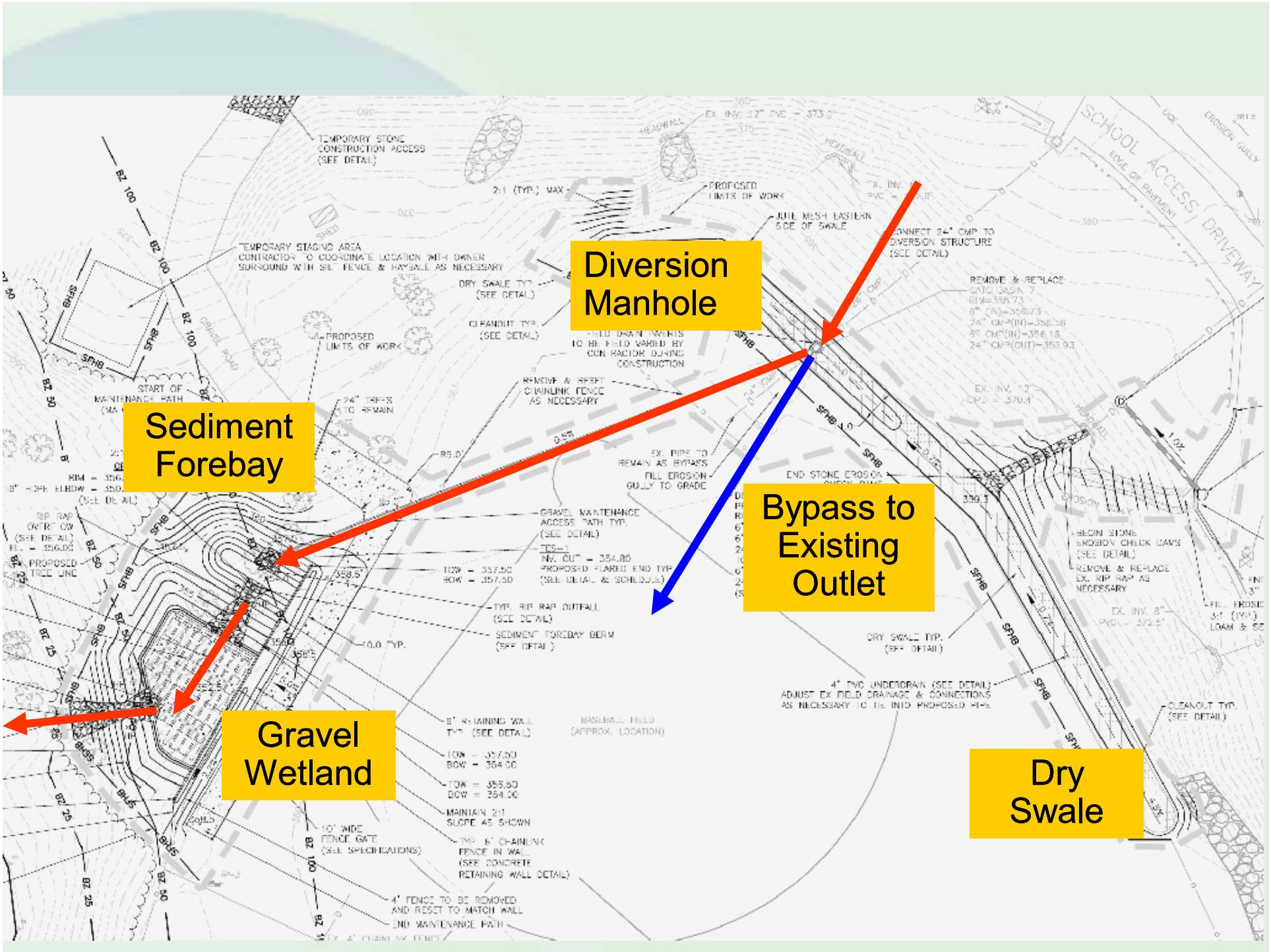
- Rigid schedule 40 PVC pipe with 5/8” perforations @ 6” O.C. meeting ASTM D 1785 (burrs removed)
- Filter Fabric or not?
- PVC elbow, cap and all associated fittings

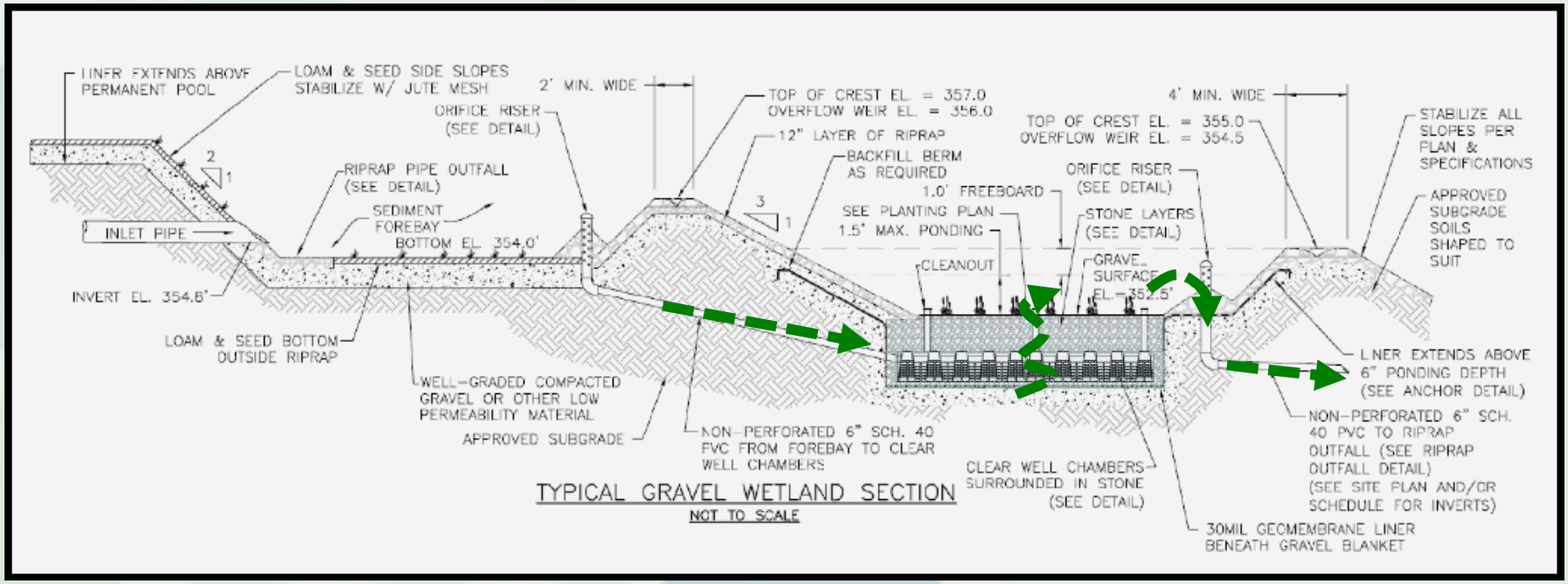
Bare Hill Pond, Harvard MA



321 acre freshwater lake
Town Swimming Beach
Eutrophication problems
Phosphorous/Noxious Plant TMDL

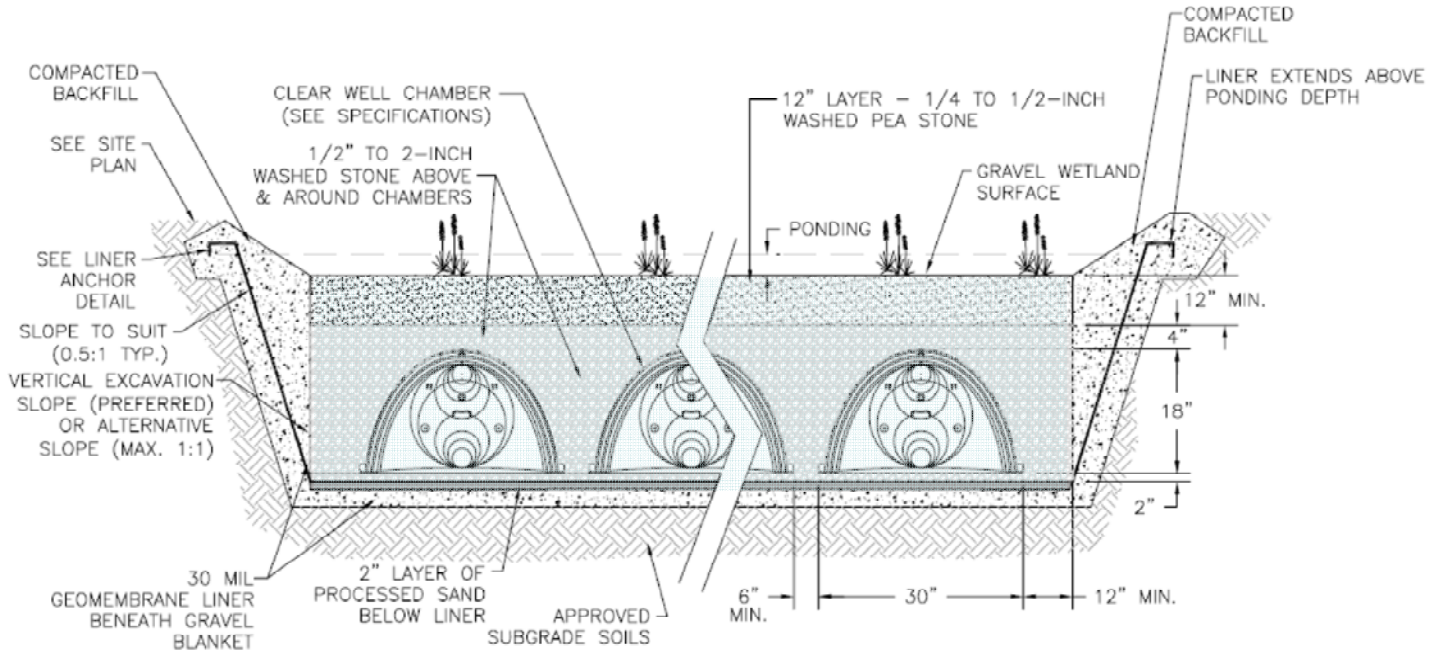
- Gravel WVTS


Diversion Manhole
Sediment Forebay
Bypass to Existing Outlet
Gravel Wetland
Dry Swale



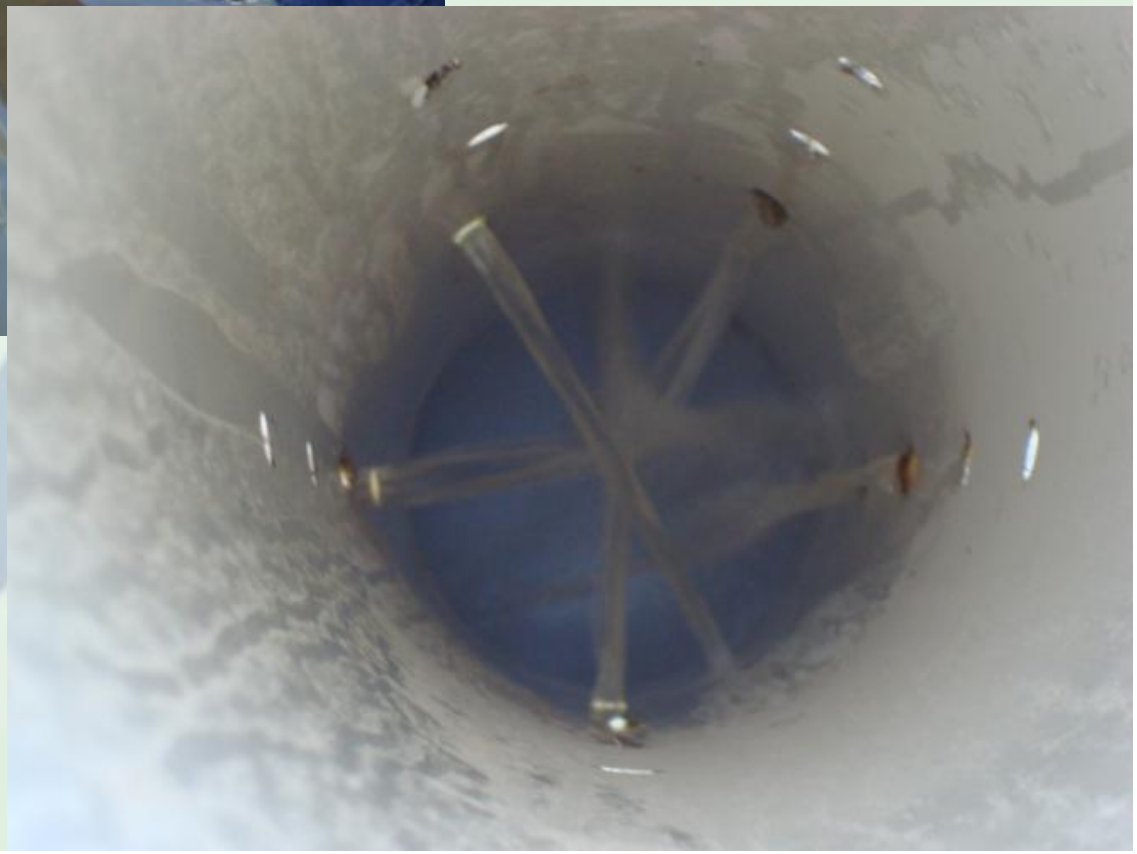
TYPICAL GRAVEL WETLAND SECTION

NOT TO SCALE



TYPICAL CLEAR WELL CHAMBER CROSS SECTION DETAIL

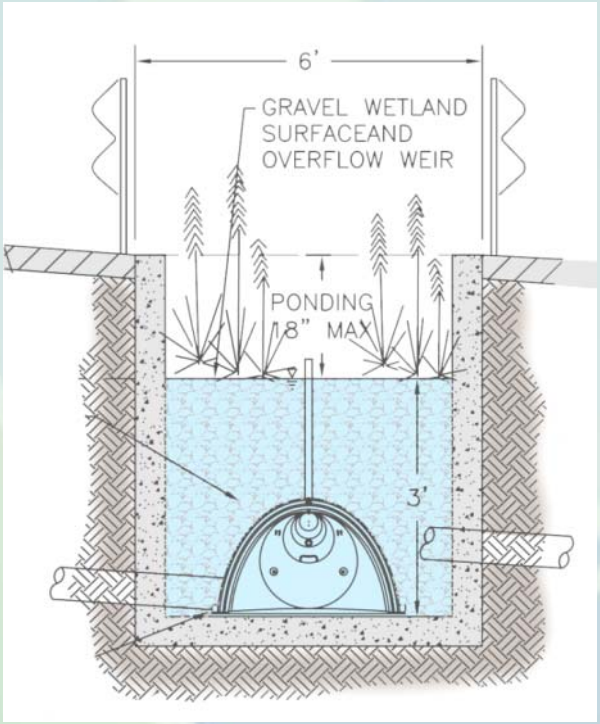
NOT TO SCALE



4. Storage - Gravel

- AASHTO M-43 standard
- Washed, clean and open graded
- Size Varies;
  - ASTM # 2 or 3 Stone (<2 to2 ½")
  - ASTM #57 Stone (<1½")
  - ASTM #8 (1-2")

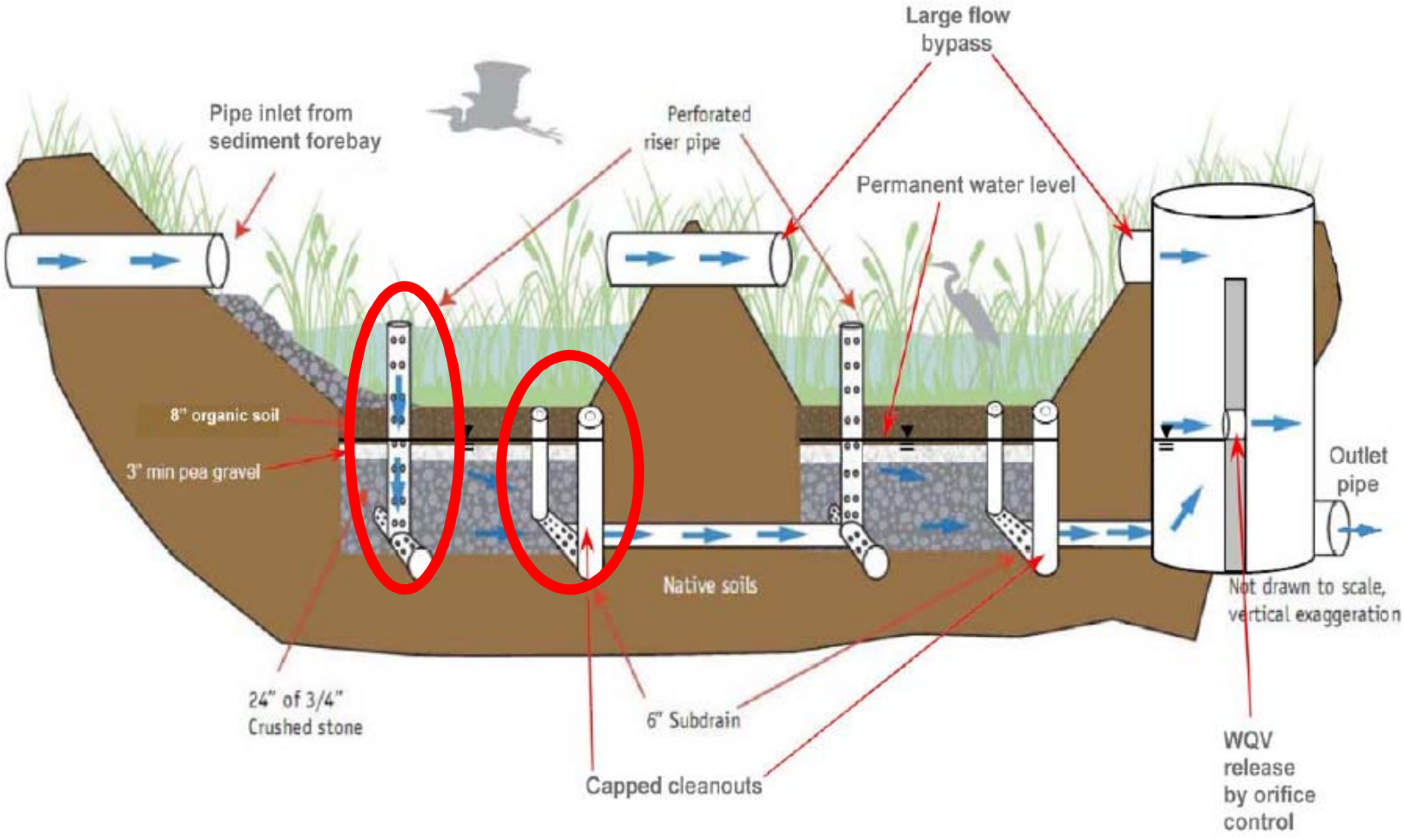
Storage Chambers



- Injection molded from virgin polypropylene resin;
- Chambers shall be open-bottomed

Minimum separation of 15’

Figure 5-3 Gravel WVTS – Alternative 2



Filter Fabric

- Non-woven geotextile fabric with a flow rate of > 110 gal./min./sf.

- For use along the side walls, elsewhere?

5. Impermeable Liners

- When a WVTS is located in medium to coarse sands and above the average groundwater table, a liner shall be used to sustain a permanent pool of water. Typically needed when infiltration rate is 0.05 in/hr or greater
- Acceptable options: a) 6-12 inches of clay (minimum 15% passing the #200 sieve and min. permeability of 1 $x10^{-5}$ cm/sec), b) a 20 mil poly-liner, c) bentonite, or d) use of chemical additives.
- Use sand under liners for good base.

Liners (cont'd)

30MIL PVC impermeable liner:

- Specific Gravity (ASTM D 792): 120 (min.)
- Tensile (ASTM D 882): 73 (lb/in-width, min)
- Elongation at Break (ASTM D 882): 380 (% min.)
- Modulus (ASTM D 882): 30 (lb/in-width, min)
- Tear Resistance (ASTM D 1004): 30 (lb/in-min.)

Bentonite Clay

- bentonite shall be a free flowing, high swelling, granular sodium bentonite.

6. Plants

- Native plants referred, non-invasive mandatory;
- Tolerant to wet/inundation
- Mix of shrubs and perennials – Shallow WVTS
- Rushes and sedges – Gravel WVTS
- Smaller plant sizes to keep costs down?

Plants

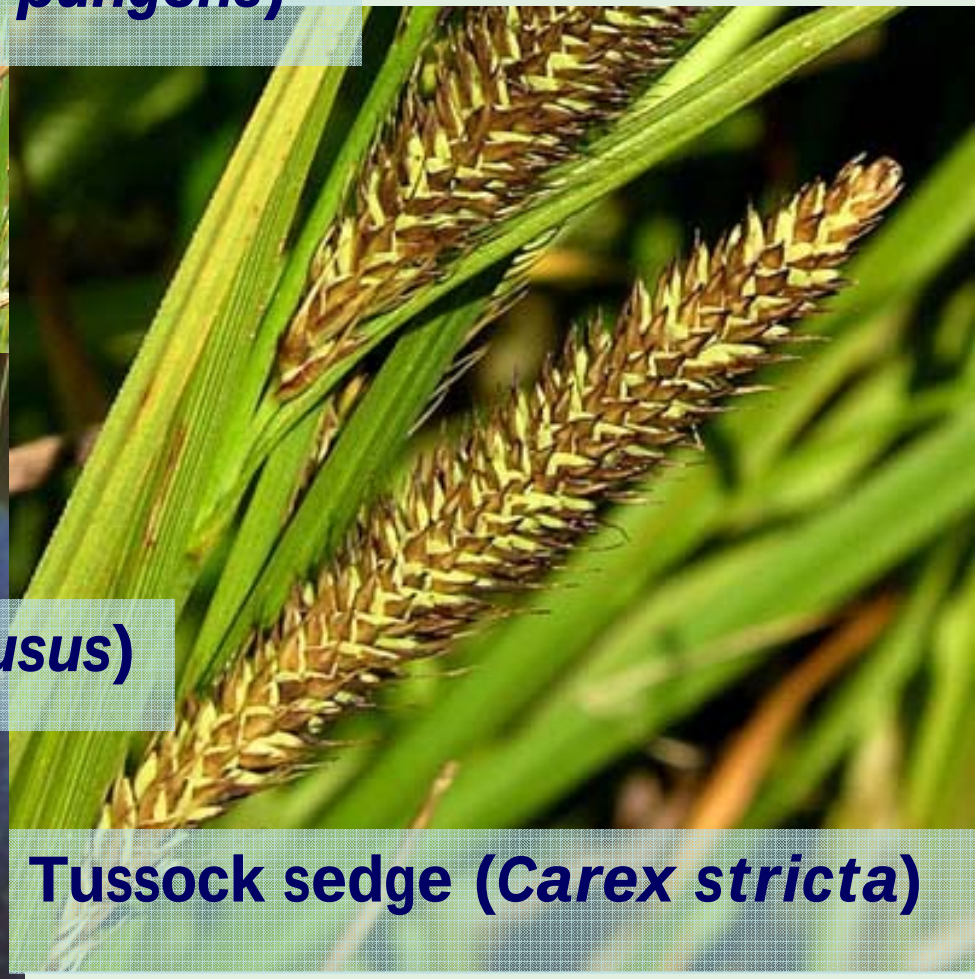
- All plant material shall conform to the guidelines of the "American Standard for Nursery Stock" latest edition

ANLA™
American Nursery & Landscape Association

Gravel WVTS Plantings

Three-square bullrush (*Scirpus pungens*)

Soft rush (*Juncus effusus*)



Tussock sedge (*Carex stricta*)

Watering

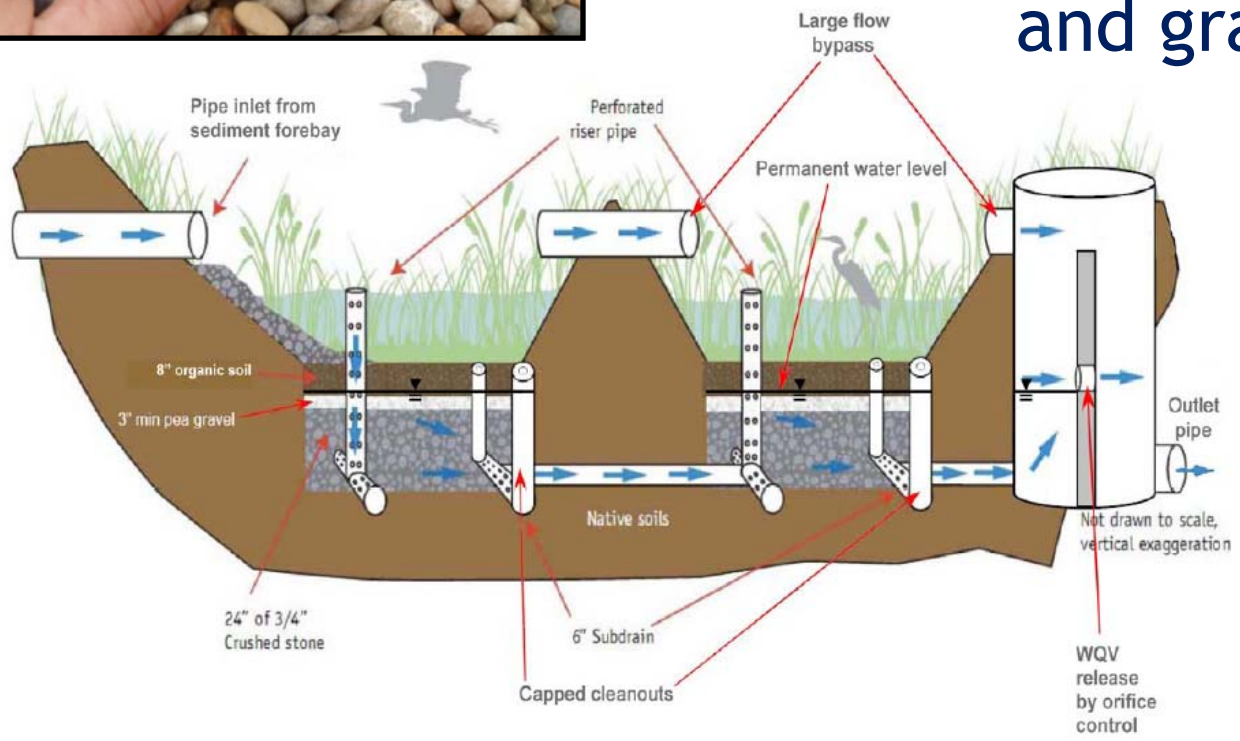
- Soaker hose to water plants
- Both plants and grass will need watering during the initial establishment period.
- A watering schedule should be determined based upon plan species and the time of year
- If the plants are chosen properly watering should not be necessary after the plants are established

Gravel WVTS Organic Soil

- Uniform mix, free of stones, stumps, roots or other similar objects larger than 2 inches, and free of noxious weeds.
- 70 - 80 Sand
- 5 - 10% Soil Fines (<5% Clay)
- 15 – 20% Organic Matter
- Organic matter shall be well aged (6-12 months), well aerated, leaf compost or approved equivalent.
- Should have min. thickness of 8”

Pea Gravel

- 3/8” Washed stone
- Should be used between the organic soil layer and gravel



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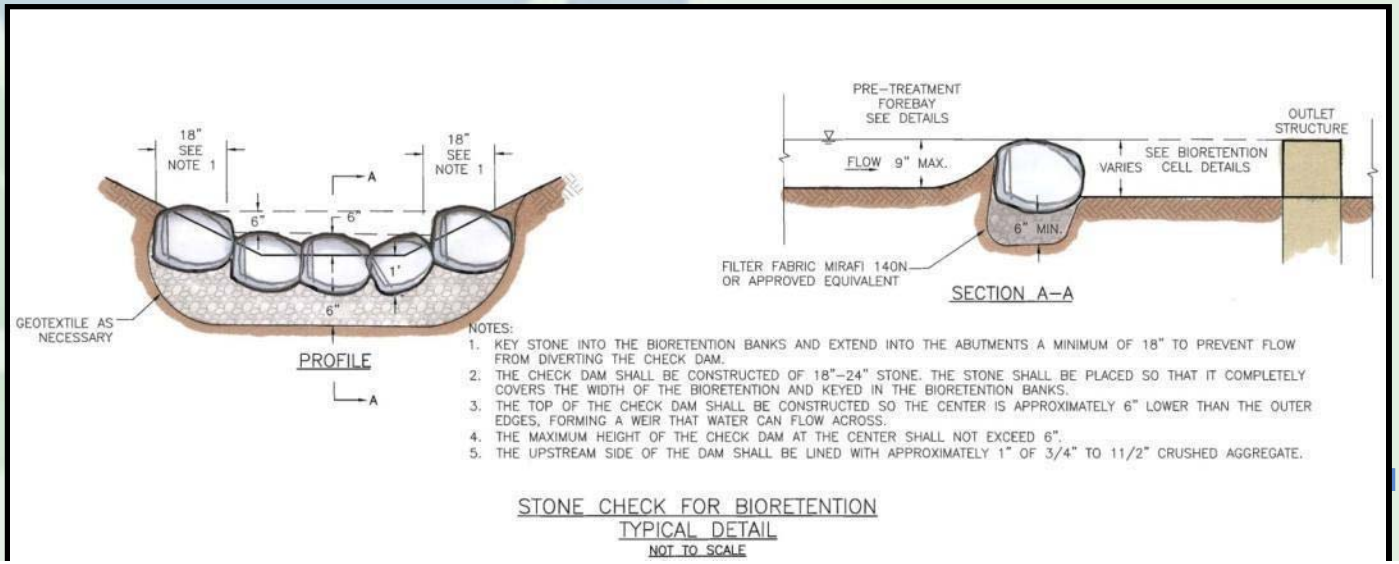
7. Other: Stone Forebay Structures

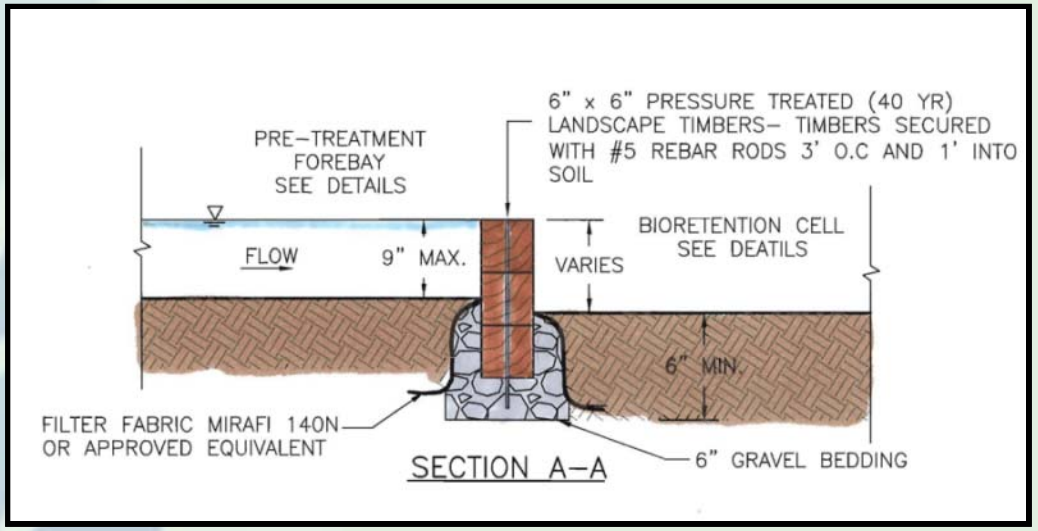
- Stone size in accordance with DA
- Concave shape
- Filter Fabric below subbase
- Height below overflow spillway



Inc.

Other Options for Forebays

- 6” x 6” Pressure treated timbers
- Sediment Forebay Weir Wall



- Pre-cast curbing
- Armor downgradient edge of weir?

Side Slopes: Loam/ESC Blanket

- pH range of 5.5 to 7
- A minimum of 6 % and a maximum of 20 % organic material content
- Free of stones 1” or larger in any dimension

- Woven 100% biodegradable jute fiber
- Bionet S150BN
- To be used on >3:1 side slopes for stabilization

Grass Seed/Sod

- New England Conservation/Wildlife mix or approved equivalent
  - http://www.newp.com
- To be used on side slopes
- Sod can be used for faster results, but will increase the cost

Landscape Stone/Rip Rap

- Rounded landscape river stone
- Min 4” diameter
- Greater aesthetic value but is more expensive

- Provide durable stone meeting RIDOT requirements
- D_{50} varies
- Less aesthetic value but is less expensive

Gravel Wetland Material Specifications		
Material	**Specification**	**Notes**
Wetland Planting Soil	70 - 80 Sand 5 - 10% Soil Fines (<5% Clay) 15 – 20% Organic Matter	Organic matter shall be well aged (6-12 months), well aerated, leaf compost or approved equivalent.
Pea Gravel	3/8" washed stone	For use between the Gravel Wetland Planting Soil and the ¾" crushed stone.
Crushed Stone	¾" washed, crushed stone, clean and free of all fines. MA Highway M2.01.0 or approved equivalent.	For used between the Pea Gravel and the impermeable liner.
Processed Sand	Clean, processed sand, free of all debris.	For use under the impermeable liner.
Subgrade Soil	Well-compacted, fine-grained, stable soil.	Native materials may be used if appropriate. USDA Soil Groups C and/or D are best.
Filter Fabric	Non-woven geotextile fabric: Grab Tensile Strength (ASTM D 4632): 120 lbf (530 N); Tear Strength (ASTM D 4533): 50 lbf (220 N); Puncture Resistance (ASTM D 4833): 65lbf (300 N);. Water Flow Rate (ASTM D 449): 135 gpm per sq. ft. (5500 L/min per sq. m); Apparent Opening Size (ASTM D 4751): No. 70 (0.212 mm);.	For use over underdrains.
Geomembrane Liner	30MIL PVC impermeable liner: Specific Gravity (ASTM D 792): 120 (min.) Tensile (ASTM D 882): 73 (lb/in-width, min) Elongation at Break (ASTM D 882): 380 (% min.) Modulus (ASTM D 882): 30 (lb/in-width, min) Tear Resistance (ASTM D 1004): 30 (lb/in-min.) Resistance to Soil Burial (ASTM G 160): 1. Breaking Factor: 5 % change, max. 2. Elongation at break: 20 % change, max. 3. Modulus at 100% Elongation: 20 % change, max. Low Temp. (ASTM D 1790): -29 F	Liner shall be installed per manufacturer recommendations with proper seam sealing and penetration sealing methods.

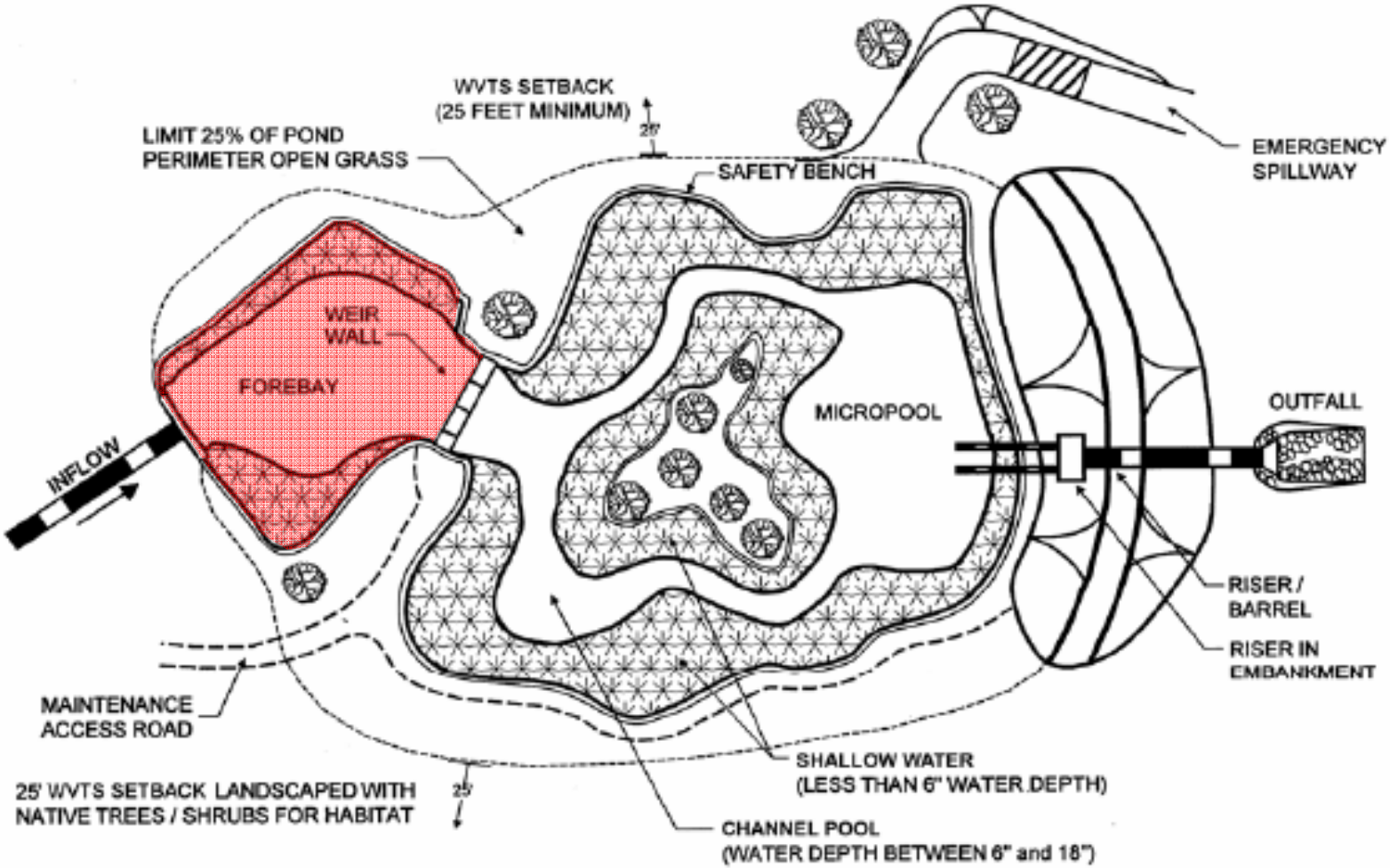
Gravel Wetland Material Specifications		
Material	**Specification**	**Notes**
	Dimensional Stability: (ASTM D 1204): 3% Water Extraction (ASTM D 3083): .15% Volatile Loss (ASTM D 1203A): .7% Hydro Static Resistance (ASTM D 751A): 100 psi	
Underdrain	3" rigid schedule 40 PVC pipe, with 3/8" perforations @ 3" o.c. meeting ASTMD 1785 or AASHTO M-278 (Or equivalent corrugated HDPE if shown in Drawings).	Perforated pipe for length of gravel wetland, and non-perforated pipe as needed to connect with storm drain system. T's and Y's as needed depending on underdrain configuration.
Underdrain Cleanouts	Non perforated schedule 40 PVC pipe, PVC elbow, cap, and all associated fittings	Extend cleanout pipes to surface with vented caps at Ts and Ys.
Clear Well Chamber	As specified in the Clear Well Specifications. See drawings and specifications.	Chambers shall be equipped with cleanout connections in the locations shown in the Drawings.
Erosion Control Blanket	Woven, 100% biodegradable jute fiber 7.70 lbs/1000 sqft. Bionet S150BN or approved equivalent.	To be used on 3:1 side slopes or greater of gravel wetland area.
Grass Seed	New England Conservation/Wildlife/Mix or approved equivalent.	Application rate 25 lbs/ acres or per seed manufacturer's requirements.
Plants	As specified in the Drawings	See Drawings for plant species names, locations and quantities.

BMP Pretreatment Requirements

BMP Group	Required %WQ_v	Notes
WVTS	10%	• Provided at each inlet, unless inlet provides <10% of inflow
Infiltration	25%	• Grass channel, filter strip, sediment forebay, proprietary device • Deep sump catch basin combined with one of the following: – Upper sand layer; or – Washed pea gravel (1/8" to 3/8") • Not required for permeable pavements (unless there is "run-on") or drywells
Filtering Practices	25%	• Deep sump catch basins may not be used as sole pretreatment.
Green Roofs	Not Applicable. No pretreatment required for direct rainfall.	
Open Channels	10%	• forebays/checkdams at pipe inlets and/or driveway crossings. • filter strip

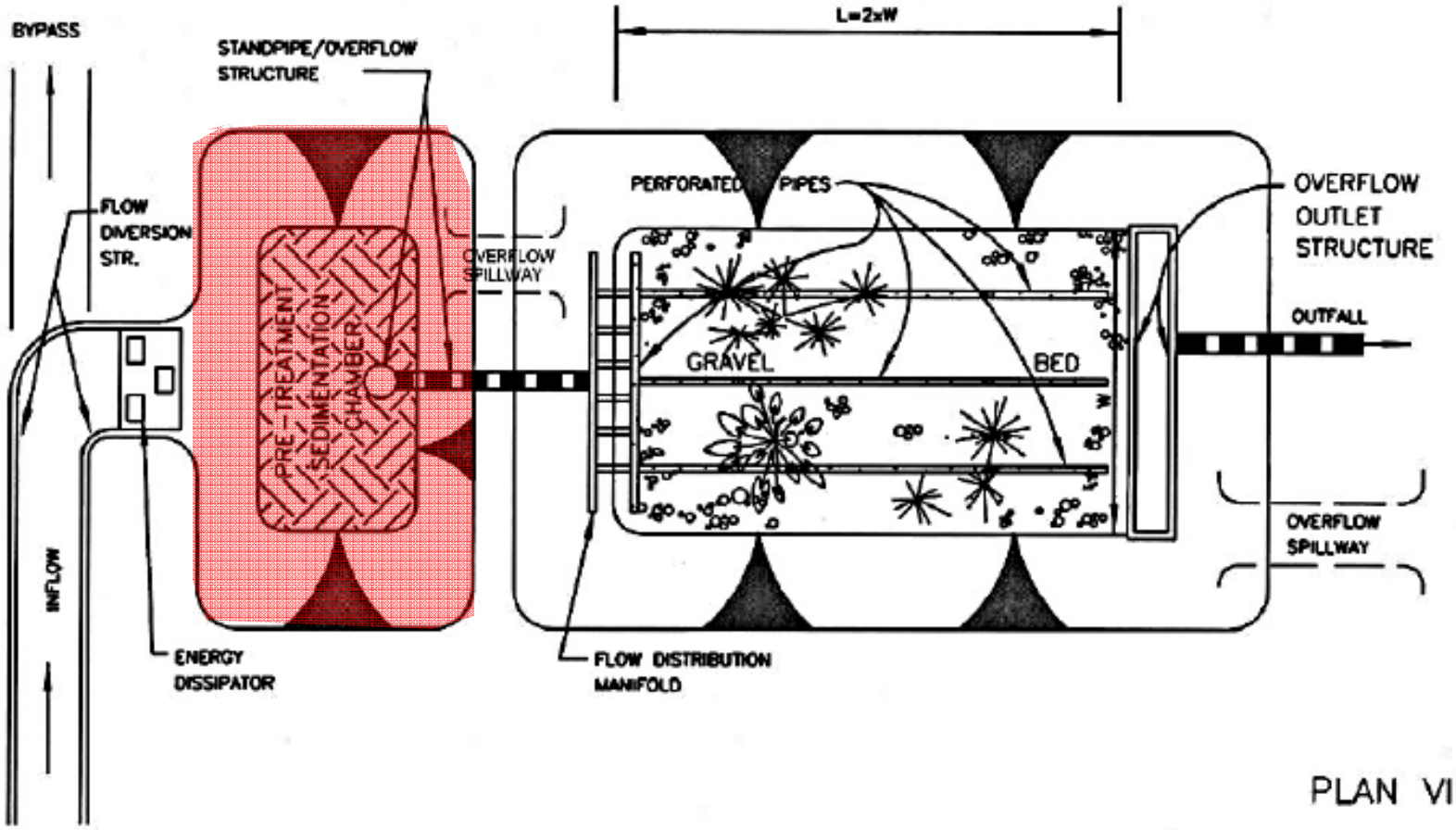
WVTS: Shallow WVTS

Figure 5-1 Shallow WVTS



WVTS: Gravel WVTS

Figure 5-2 Gravel WVTS – Alternative 1

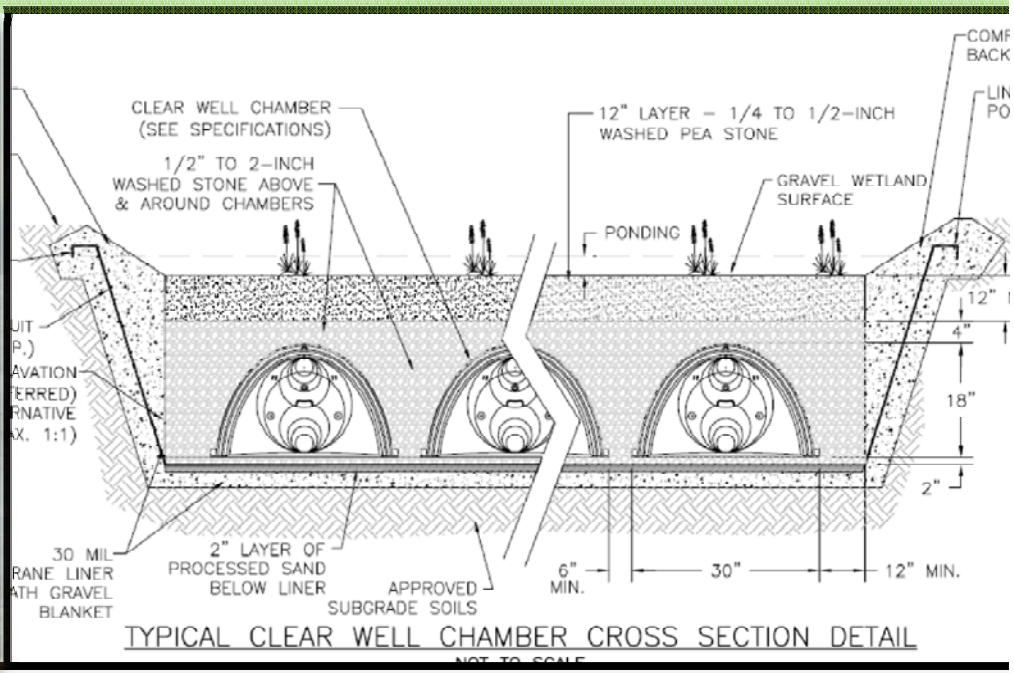


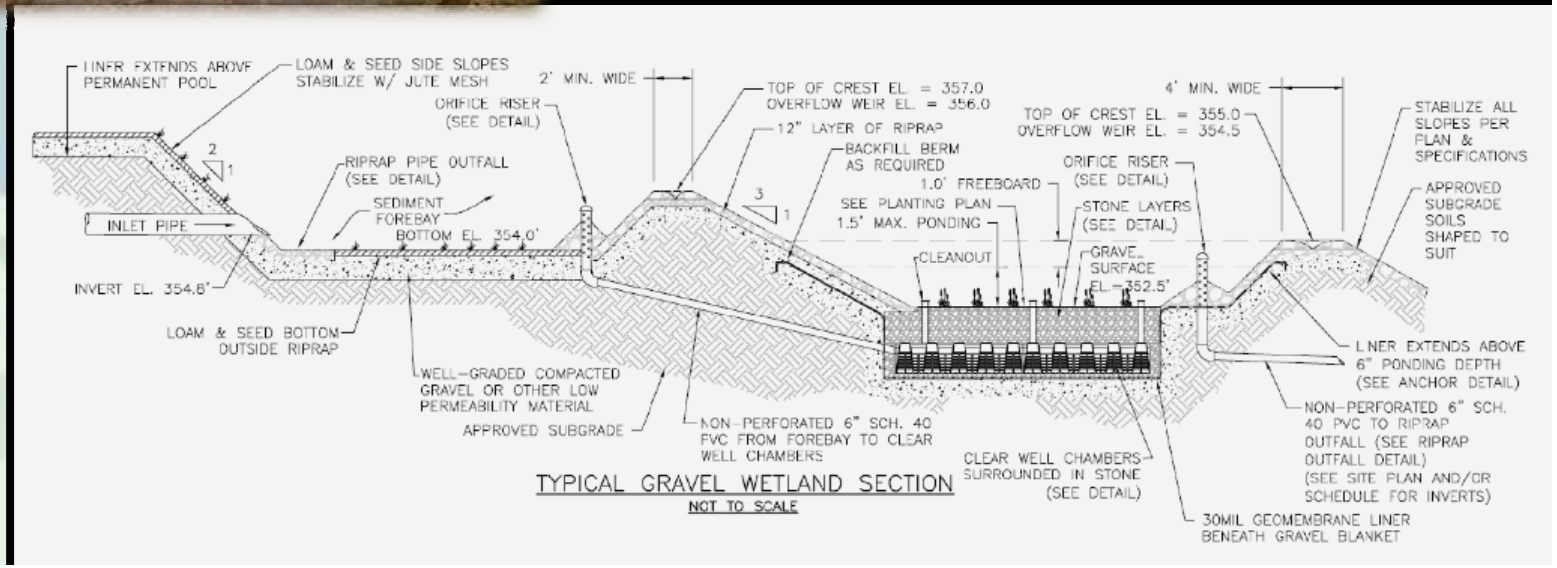
7. Other Elements: Level Spreaders

Elements of Proper Installation

- Good Design Plans;
- Construction administration by the design engineer or a qualified resident engineer;
- Contractor skills and experience;
- Time of year construction;
- Surface water diversions and dewatering;
- Temporary and permanent stability;
- Construction stake-out;
- Routine construction inspections and progress meetings;
- Construction record documents.

Gravel WVTS


CLEAR WELL CHAMBER
(SEE SPECIFICATIONS)
1/2" TO 2-INCH
WASHED STONE ABOVE
& AROUND CHAMBERS
12" LAYER - 1/4 TO 1/2-INCH
WASHED PEA STONE
GRAVEL WETLAND
SURFACE
PONDING
12"
4"
18"
2"
30 MIL
RANE LINER
TH GRAVEL
BLANKET
2" LAYER OF
PROCESSED SAND
BELOW LINER
APPROVED
SUBGRADE SOILS
6"
MIN.
30"
12" MIN.
TYPICAL CLEAR WELL CHAMBER CROSS SECTION DETAIL


LINER EXTENDS ABOVE
PERMANENT POOL
LOAM & SEED SIDE SLOPES
STABILIZE W/ JUTE MESH
2' MIN. WIDE
ORIFICE RISER
(SEE DETAIL)
TOP OF CREST EL. = 357.0
OVERFLOW WEIR EL. = 356.0
12" LAYER OF RIPRAP
RIPRAP PIPE OUTFALL
(SEE DETAIL)
SEDIMENT
FOREBAY
BOTTOM EL. 354.0'
INLET PIPE
INVERT EL. 354.8'
LOAM & SEED BOTTOM
OUTSIDE RIPRAP
WELL-GRADED COMPACTED
GRAVEL OR OTHER LOW
PERMEABILITY MATERIAL
APPROVED SUBGRADE
NON-PERFORATED 6" SCH. 40
PVC FROM FOREBAY TO CLEAR
WELL CHAMBERS
BACKFILL BERM
AS REQUIRED
1.0' FREEBOARD
SEE PLANTING PLAN
1.5' MAX. PONDING
CLEANOUT
4' MIN. WIDE
TOP OF CREST EL. = 355.0
OVERFLOW WEIR EL. = 354.5
ORIFICE RISER
(SEE DETAIL)
STONE LAYERS
(SEE DETAIL)
GRAVEL
SURFACE
EL. 352.5'
CLEAR WELL CHAMBERS
SURROUNDED IN STONE
(SEE DETAIL)
STABILIZE ALL
SLOPES PER
PLAN &
SPECIFICATIONS
APPROVED
SUBGRADE
SOILS
SHAPED TO
SUIT
LINER EXTENDS ABOVE
6" PONDING DEPTH
(SEE ANCHOR DETAIL)
NON-PERFORATED 6" SCH.
40 PVC TO RIPRAP
OUTFALL (SEE RIPRAP
OUTFALL DETAIL)
(SEE SITE PLAN AND/OR
SCHEDULE FOR INVERTS)
30MIL GEOMEMBRANE LINER
BENEATH GRAVEL BLANKET
TYPICAL GRAVEL WETLAND SECTION
NOT TO SCALE

Mandatory Inspection

- Liners in WVTS
  - Confirm sub grade dimensions
  - Prior to the installation of the underdrain
  - Watertight and coordinated with grading
- Control Devices
  - Confirm orifice/weir dimensions/elevations
  - Outlet pipe
  - Overflow spillways

Inspection No. 10

Client: City of Peabody
Inspector: KMH
Inspection Date: 3/16/11
Weather: Rain, 40F

Project Name: Perkins Street
Project No: 9050
Arrival Time: 10:00AM
Departure Time: 12:00PM

Hawley Wilson Group, Inc.
90 Route 6A, Sandwich, MA 02563
Phone: (508) 833-6600
Fax: (508) 833-3150

Personnel on site:
Mike Rygiel (JTI)
Brendan Callahan (Peabody)

Reference Plan:
Perkins Street Stormwater Retrofits
Construction Plans
Peabody, MA
Date: May 6, 2010 (rev. 6/14/10)

Contractor(s) equipment:
None

Work observed:

Erosion Control	☒
Clearing	☐
Excavation/Fill/Compaction	☒
Road Subbase	☐
Gravel Base	☐
Pavement/Binder Only	☒
Water	☒
Gas/Electric/Telephone	☐

Drainage	☒
Wastewater	☒
Sidewalk	☒
Final Grading	☒
Surface Stabilization	☐
Monuments	☒
Cleanup	☐

Photos Taken: Yes ☒ No ☐

General Notes/Comments:

- A site walk was performed to revisit the punch-list items that were identified in December, 2010. Rain during the site visit allowed HW to assess the functionality of the various stormwater facilities. Most areas appeared to be functioning as designed but there are areas that require additional site work at all three project Phases.
- The most significant items remaining include grading and stabilization around the level spreader (Phase 3), berm reconstructive work (Phase 3), asphalt paving (Phases 1 & 3), and repairs and modifications to the irrigation pad (Phase 2). Hydroseeding is needed at much of Phase 3 and at the reinforced swales between Phases 1 & 2.
- HW will create two SK drawings showing proposed repairs and/or modifications to the various facilities. JTI shall submit prices upon receipt of the various modifications.
- The final punch-list of the remaining construction activities was updated and values assigned to each remaining task.
- Photos of several of the various outstanding tasks are included in this document. Please reference Inspection Reports 8 & 9 for additional photos and information.

Inspection No. 10

Item 3.03: Extend berm grading to end of the concrete level spreader to prevent runoff from bypassing the spreader. Repair existing erosion gullies and stabilize with riprap or crushed stone.

Item 3.04: Grading at the southeast end of the project area should be adjusted to redirect field runoff into the basin.

\\hwserver\hw-server\Projects\2009\9050 Peabody-Perkins St-Allens Lane\Construction Admin\Inspection Reports\110316_Inspection10_9050.doc


Protecting BMPs

Witten Group, Inc.

WVTS - Maintenance

- Clean-out trash racks and access gates;
- Remove sediment from forebay every 5 yrs or after 50% loss in capacity – whichever occurs first;
- If 50% vegetative coverage is not achieved after 2nd growing season, reinforcement planting is required.
- Remove sediment and organic build-up from gravel WVTS ~2 yrs
- For discharges >200 ft from cold-water fisheries, inspect gravel trench outlet after every storm in first 3 months of operation. After that - once annually.

WVTS – Maintenance Guidance

- Replace dead/damaged vegetation
- Vegetation management around perimeter of WVTS
- Repair minor gullying.
- Repair embankment structural integrity (borrowing animals, seepage, slope sloughing);
- Repair structural elements (spillways, orifice, weir, etc.);
- Major erosion (inflow/exit channels)

Questions?