Stormwater BMP Details

From the 2019 Stormwater Management Manual For Western Washington

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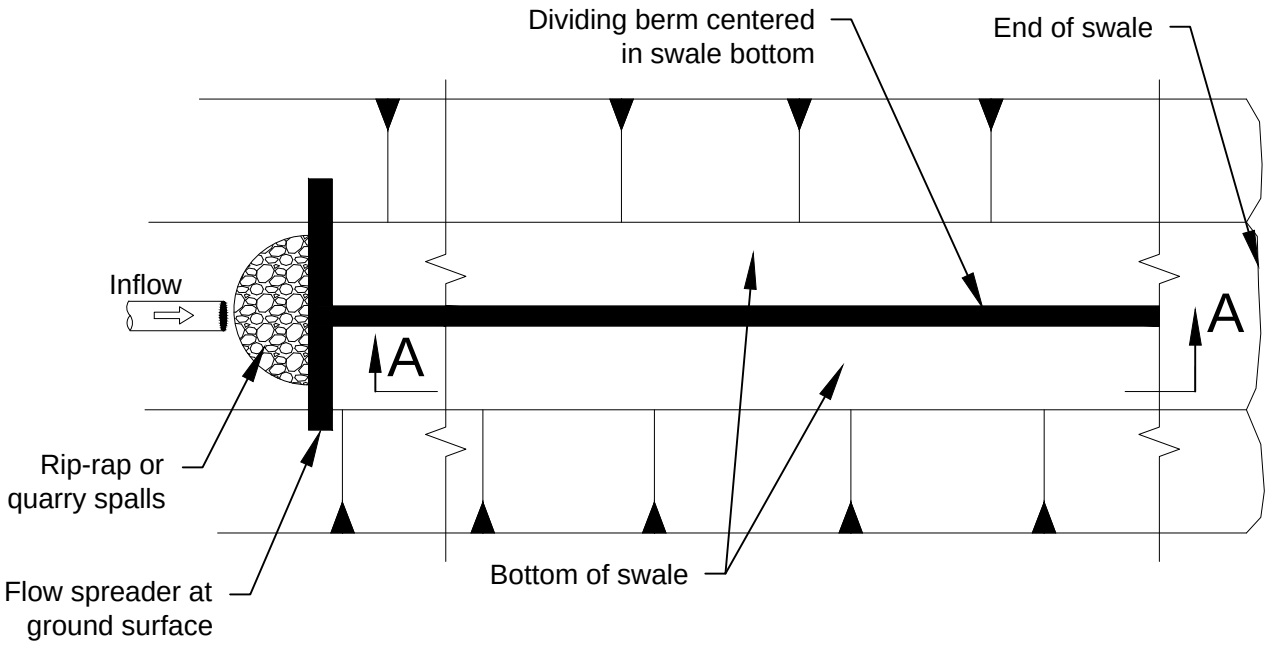
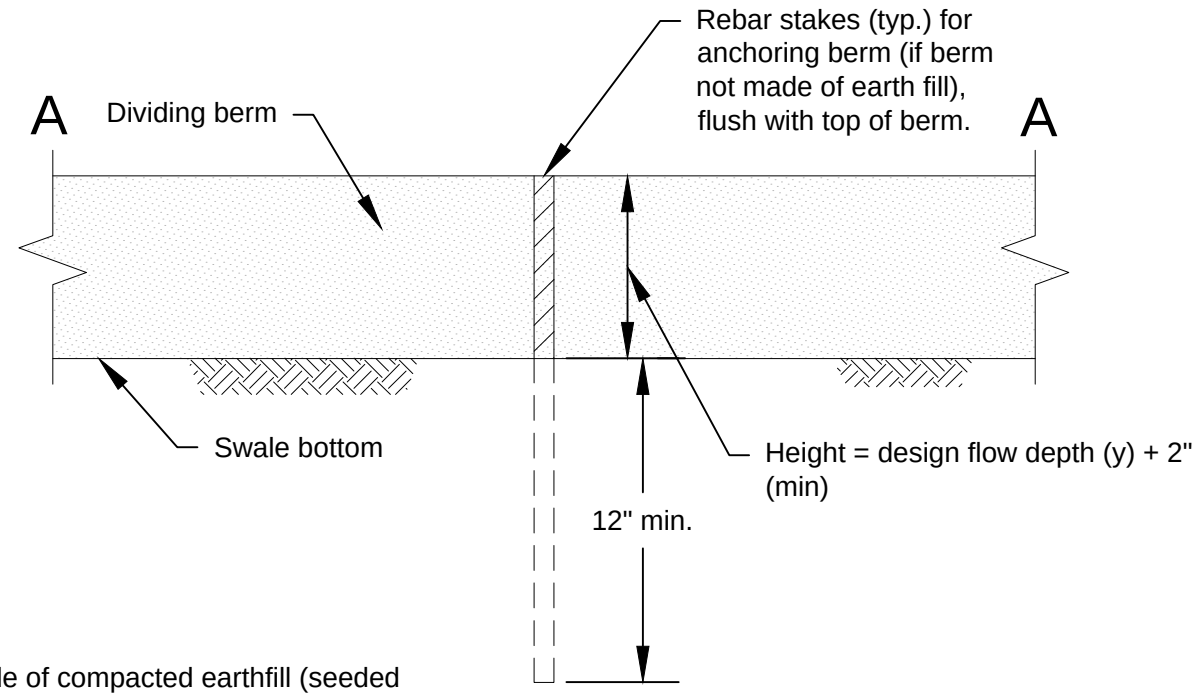


Plan View



Section A-A

Notes:

1. Berm may be made of compacted earthfill (seeded with grass), timber, concrete plastic, or similar weather-resistant non-erodible material.

2. Rebar stakes or similar berm anchoring materials needed if berm made of timber, plastic, or concrete curbing - stake placement required at both ends of each individual member (at a minimum).

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Swale Dividing Berm

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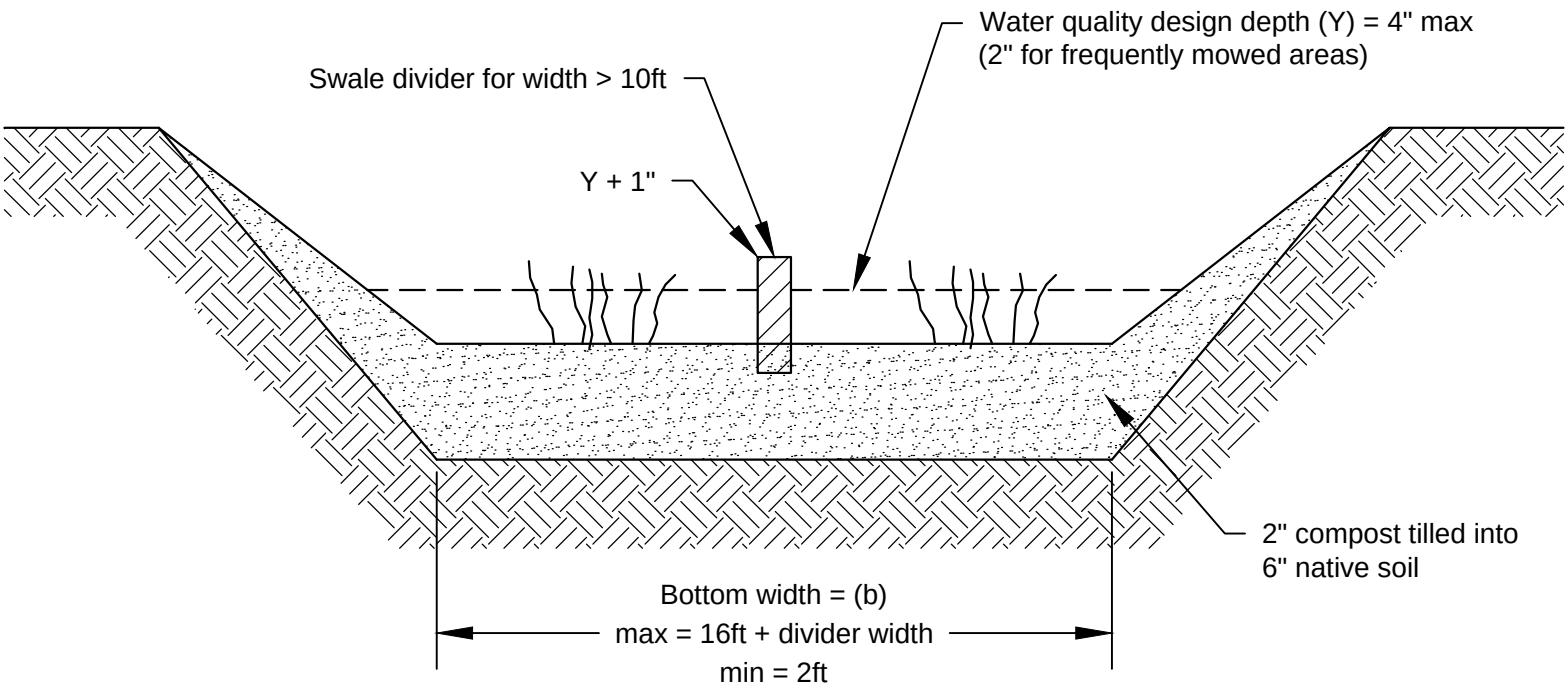

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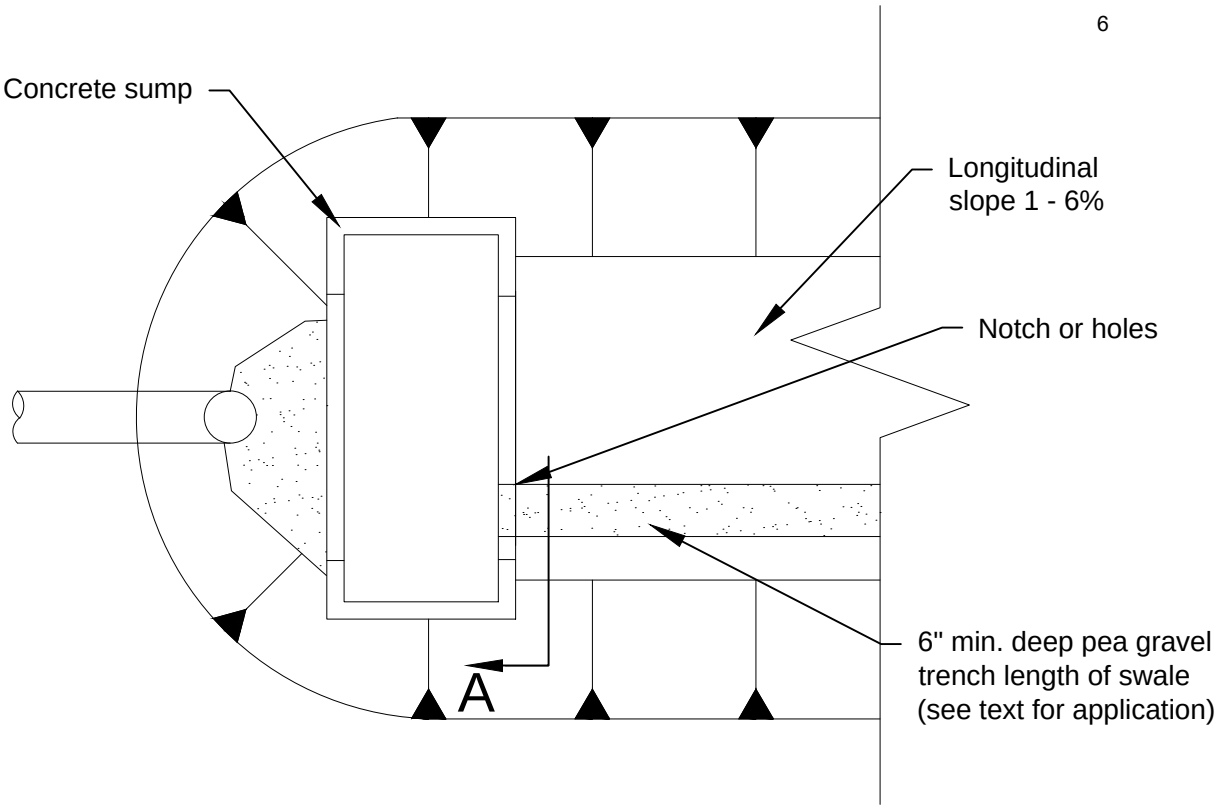
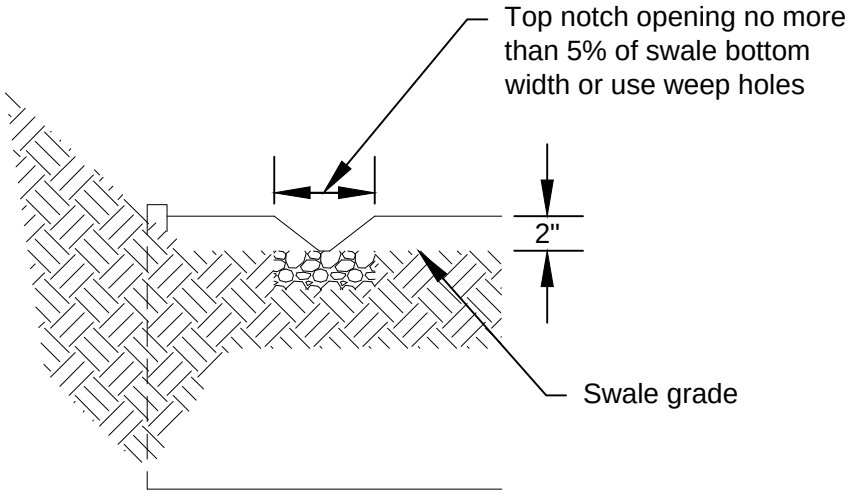
Typical Swale Section

Revised June 2016



Plan View



Section A

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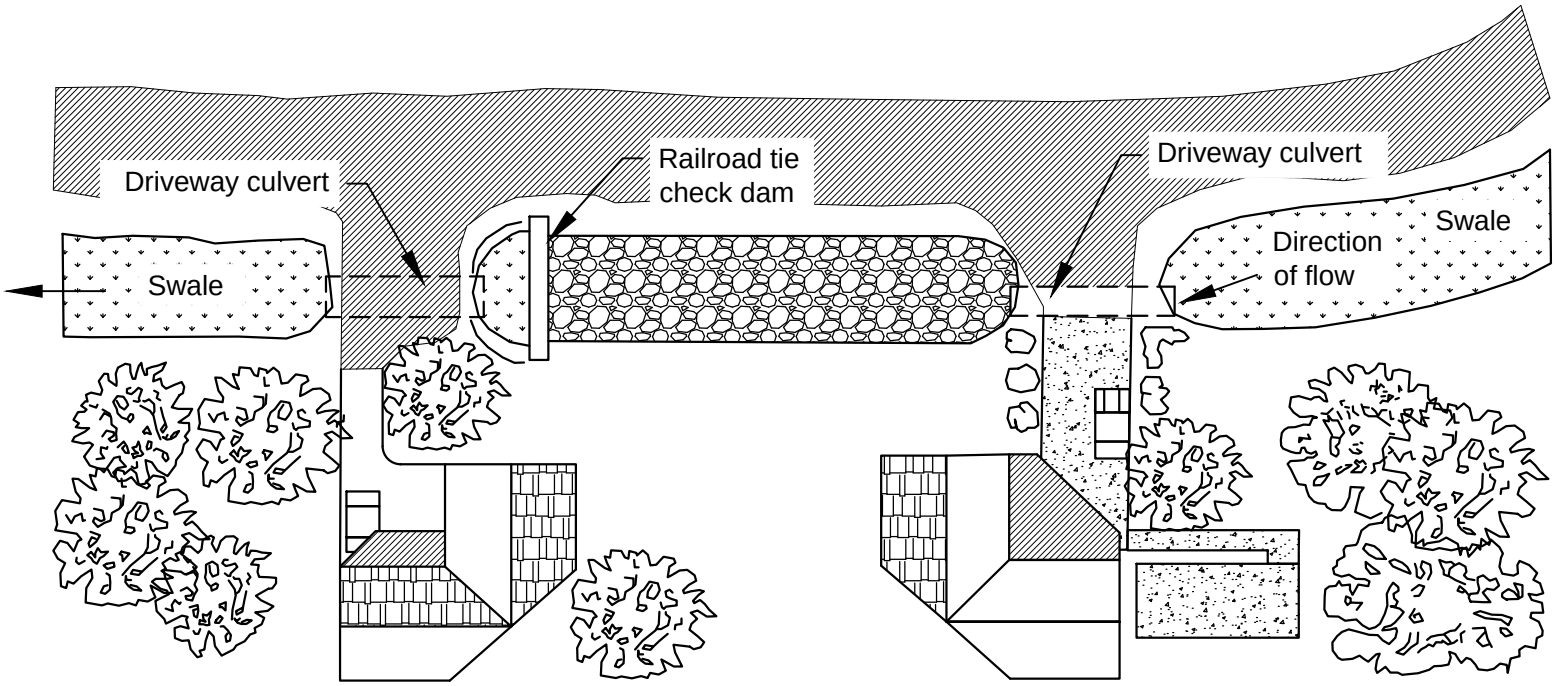
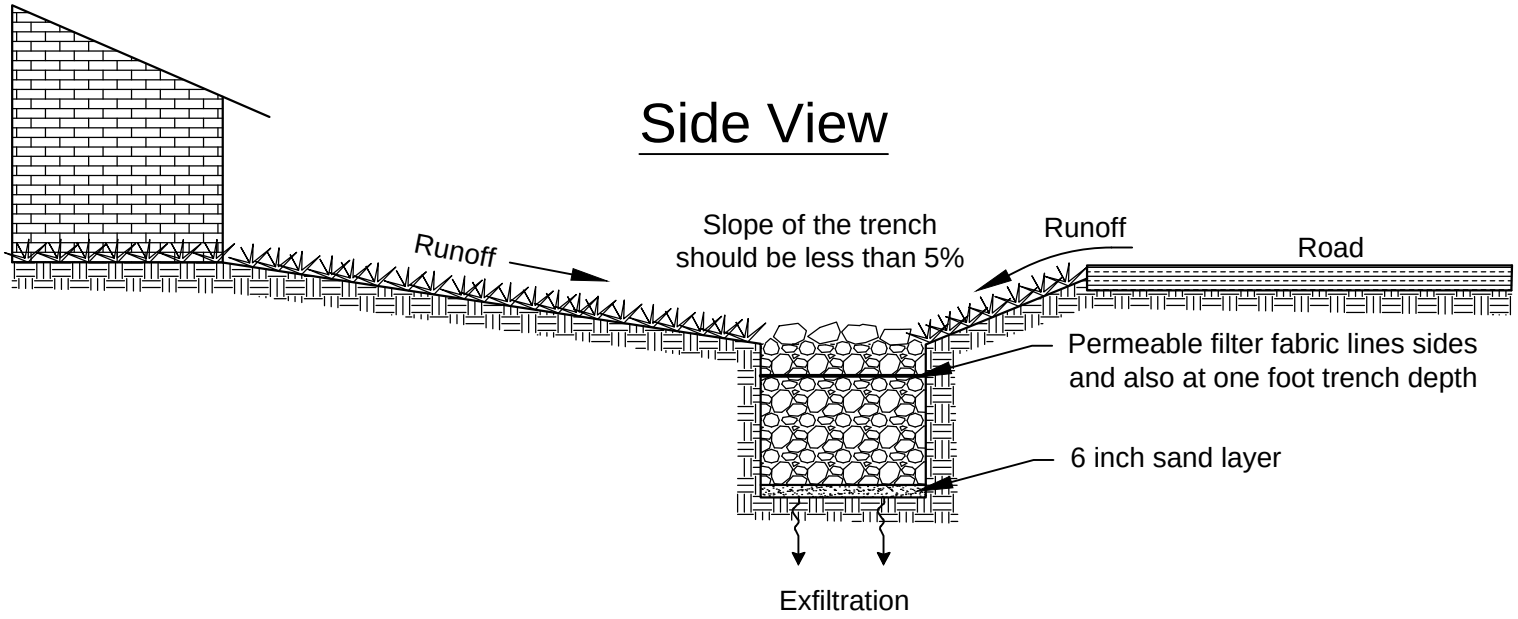
Biofiltration Swale Low-Flow Drain Detail

Revised March 2016

Top View



Side View



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Swale/Trench Design

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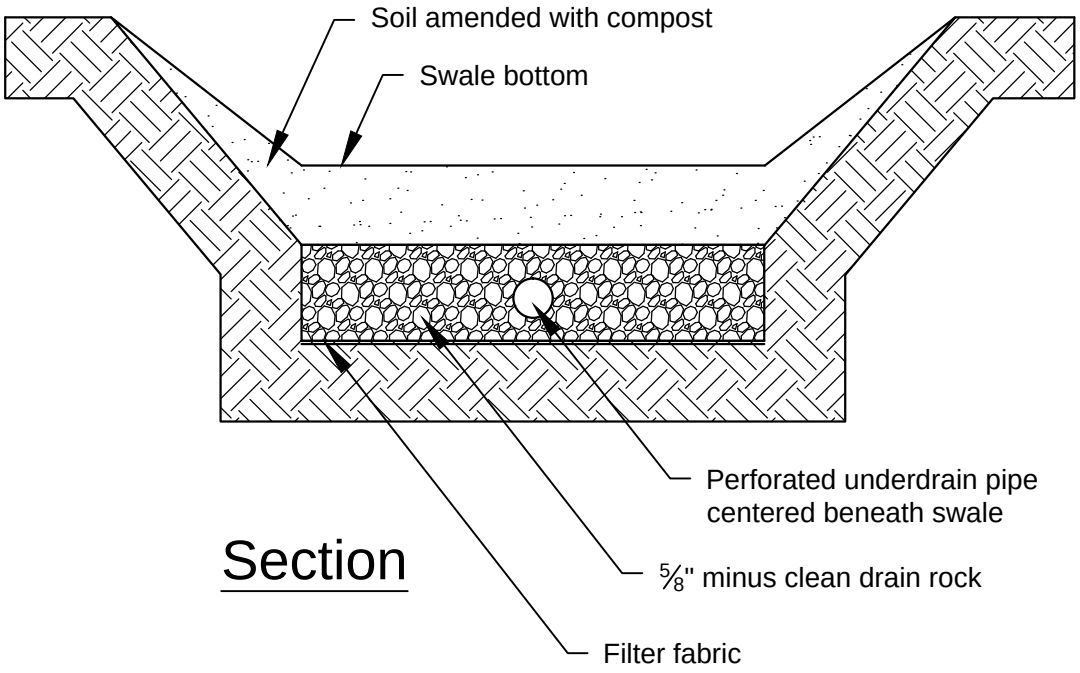
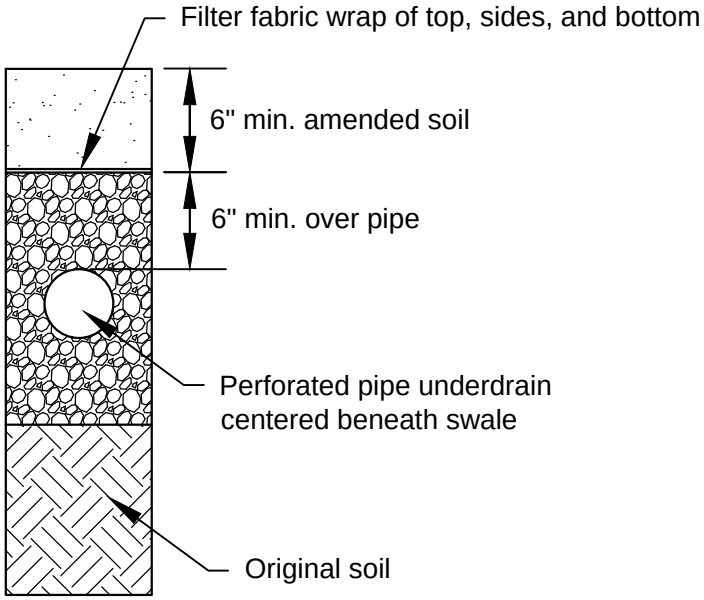


Section



Detail A

Note: Underdrain must infiltrate or drain freely to an acceptable discharge point.

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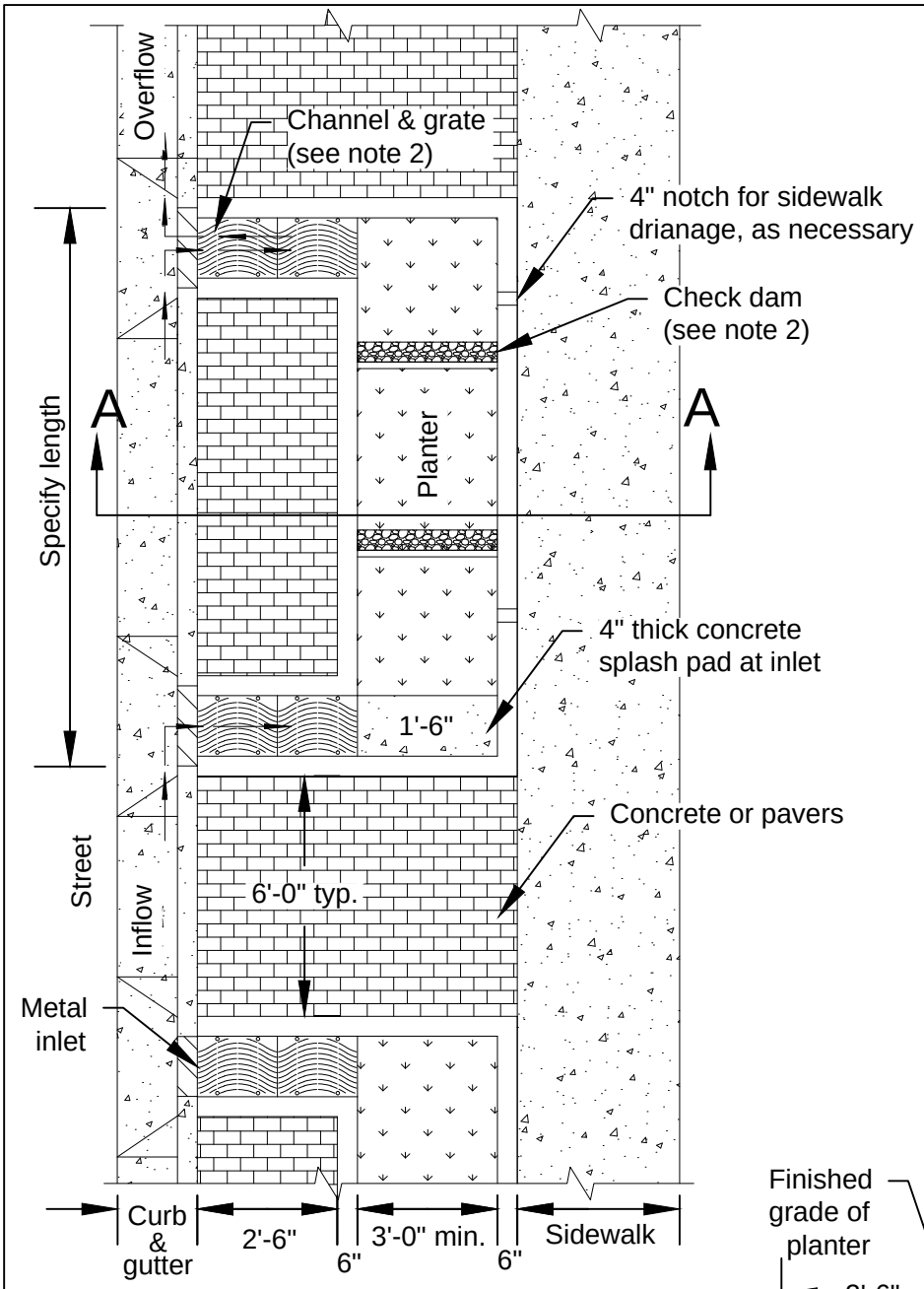
Biofiltration Swale Underdrain Detail

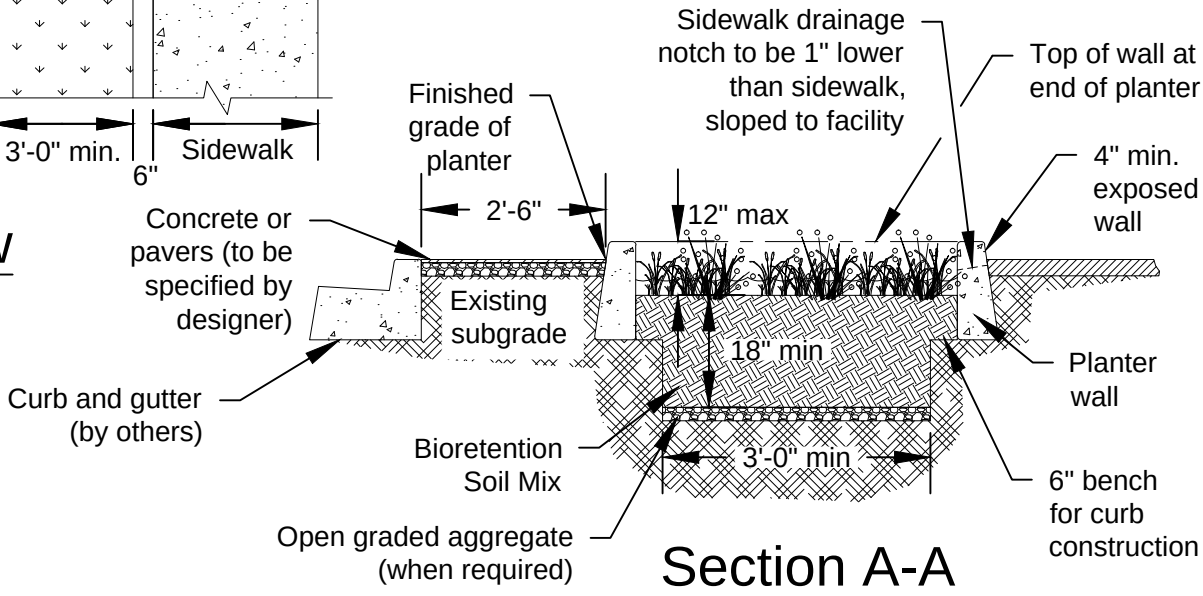
Revised June 2016



Plan View

DESIGNER INFORMATION:

1. Adapt plan view example to your engineered design.
2. Include beginning and ending stations for each facility. Provide stations and/or dimensions and elevations at every inlet, outlet, check dam, planter corner and sidewalk notch.
3. Longitudinal slope of planter matches road.
4. Sidewalk elevation must be set above inlet and outlet elevations to allow overflow to drain to street before sidewalk.
5. Minimum interior planter width is 3 feet. A minimum of 4 feet interior planter width is required for street trees in planter.
6. Existing utility lines must be sleeved or relocated. Proposed utility lines to be located out of the facility.
7. Area and depth of facility are based upon engineering calculations and right-of-way constraints.
8. May use concrete or pavers.



Section A-A

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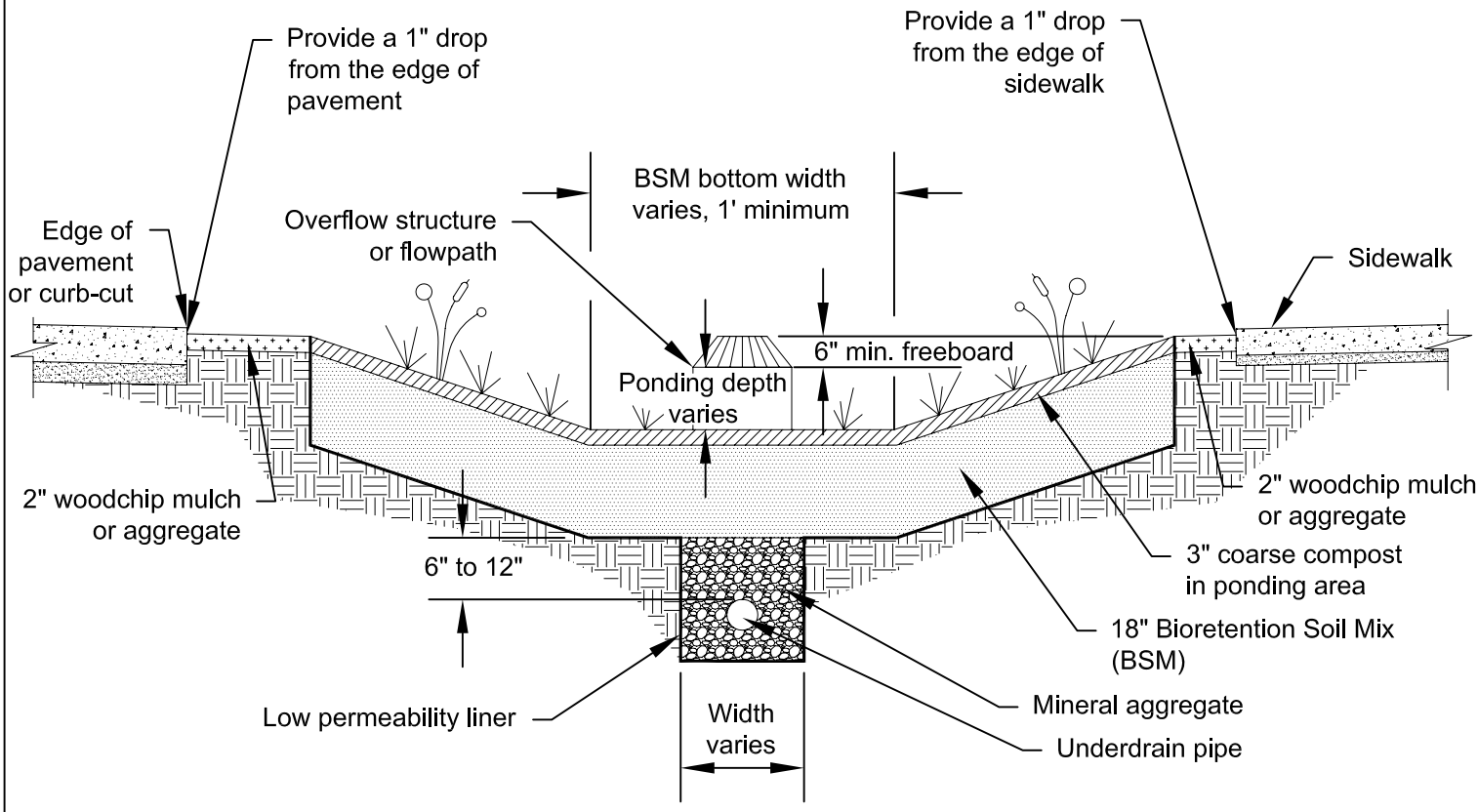
Example of a Bioretention Planter

Revised October 2016



Note: See **BMP T7.30: Bioretention** for further details regarding design, installation, and maintenance of bioretention.

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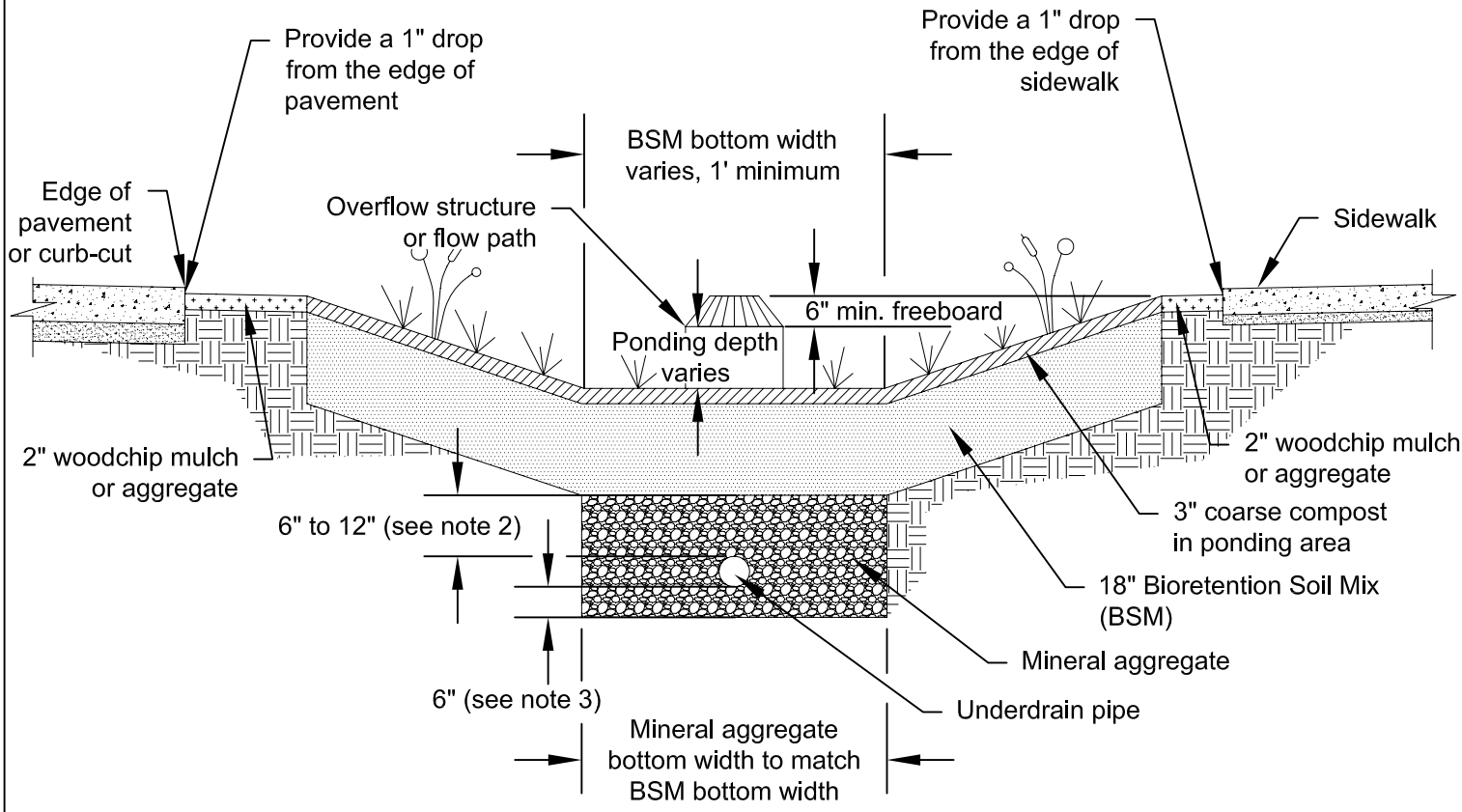
Typical Bioretention w/Liner (Not LID)

Revised January 2022



Notes:

1. See **BMP T7.30: Bioretention** for further details regarding design, installation, and maintenance of bioretention.
2. Minimum 6" to discourage fines from entering the underdrain from the BSM. Maximum 12" to prevent unnecessary BMP depth from encroaching into the seasonal high ground water.
3. If depth to the seasonal high ground water allows, this distance may be larger.
4. When an underdrain is used, the design must ensure that the seasonal high ground water does not encroach into the BMP (including the mineral aggregate layer surrounding the underdrain pipe).

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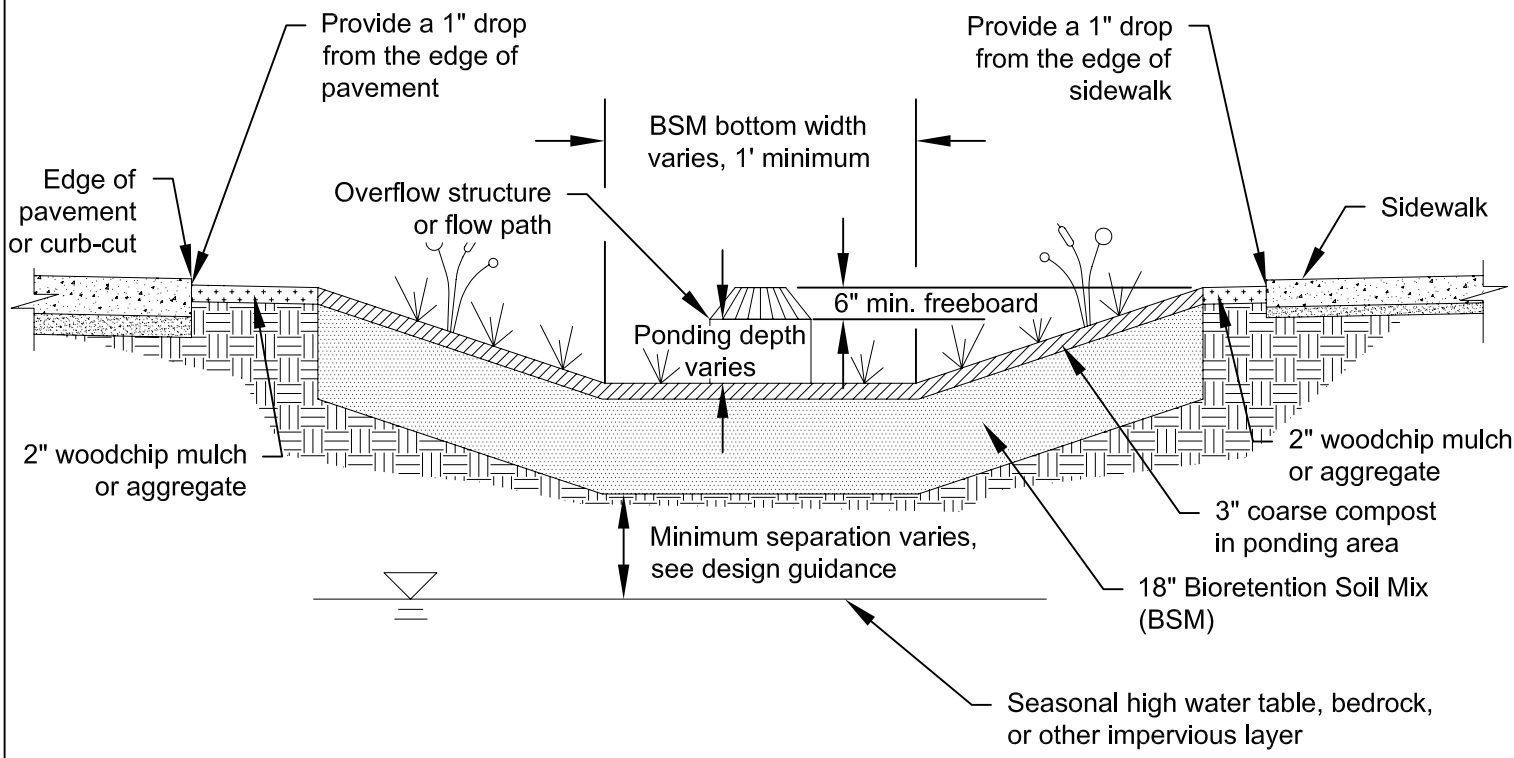
Typical Bioretention w/Underdrain

Revised January 2022



Note: See **BMP T7.30: Bioretention** for further details regarding design, installation, and maintenance of bioretention.

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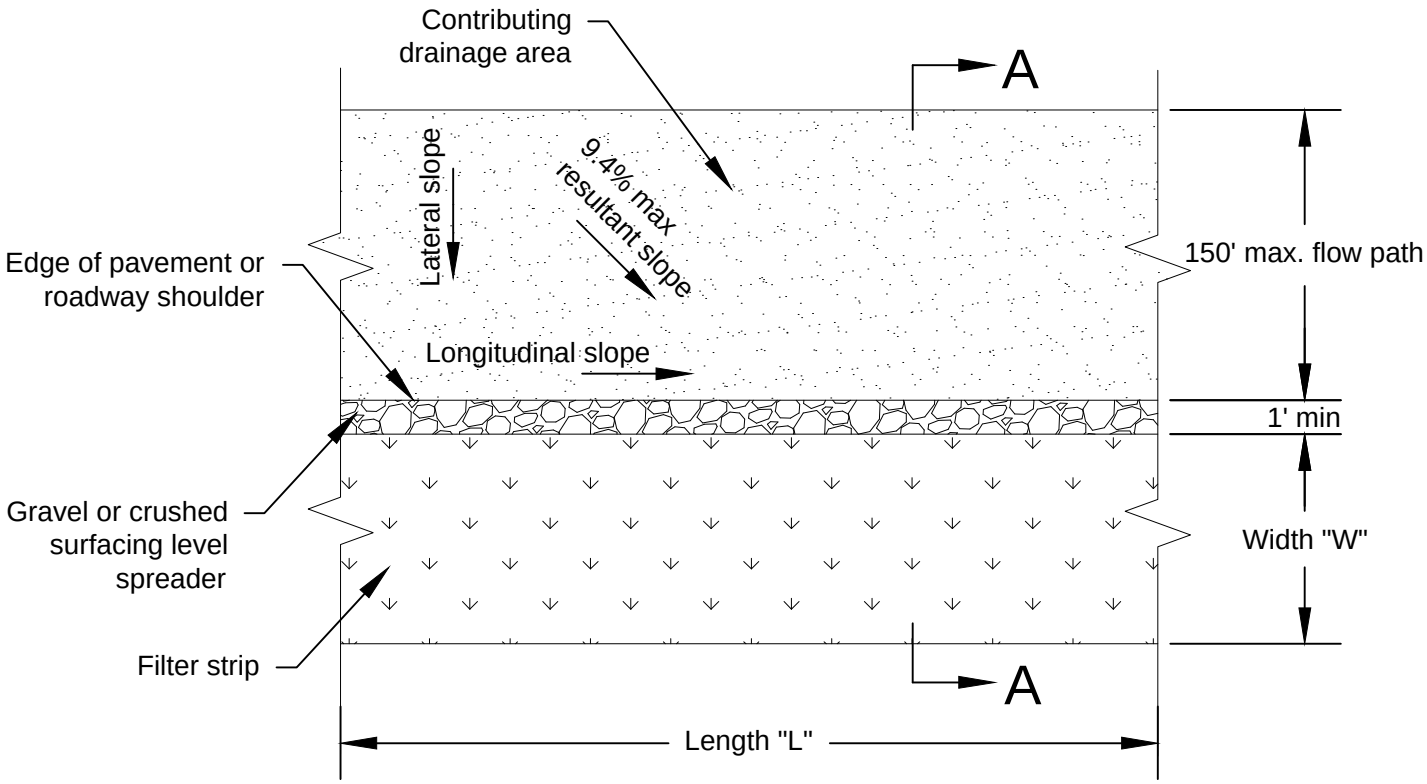
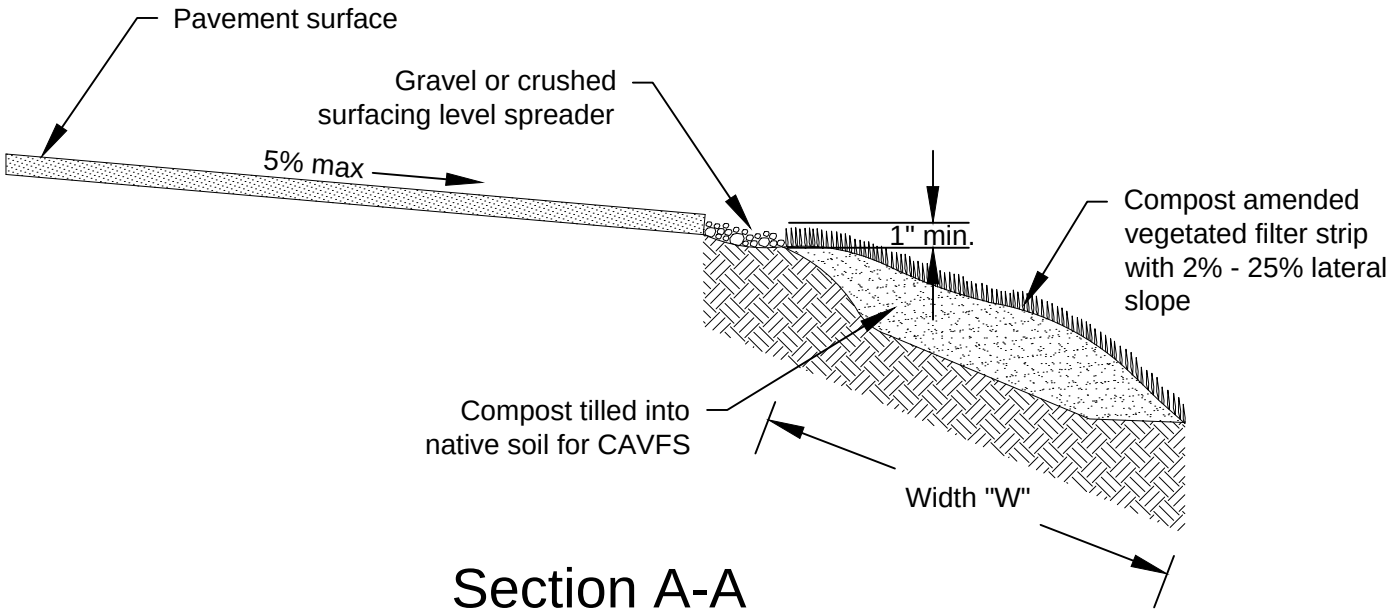
Typical Bioretention

Revised January 2022



Plan View



Section A-A

This drawing is only an example that needs to be adjusted and revised for each project.

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Example of a Compost Amended Vegetated Filter Strip (CAVFS)

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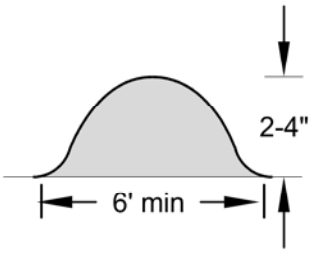
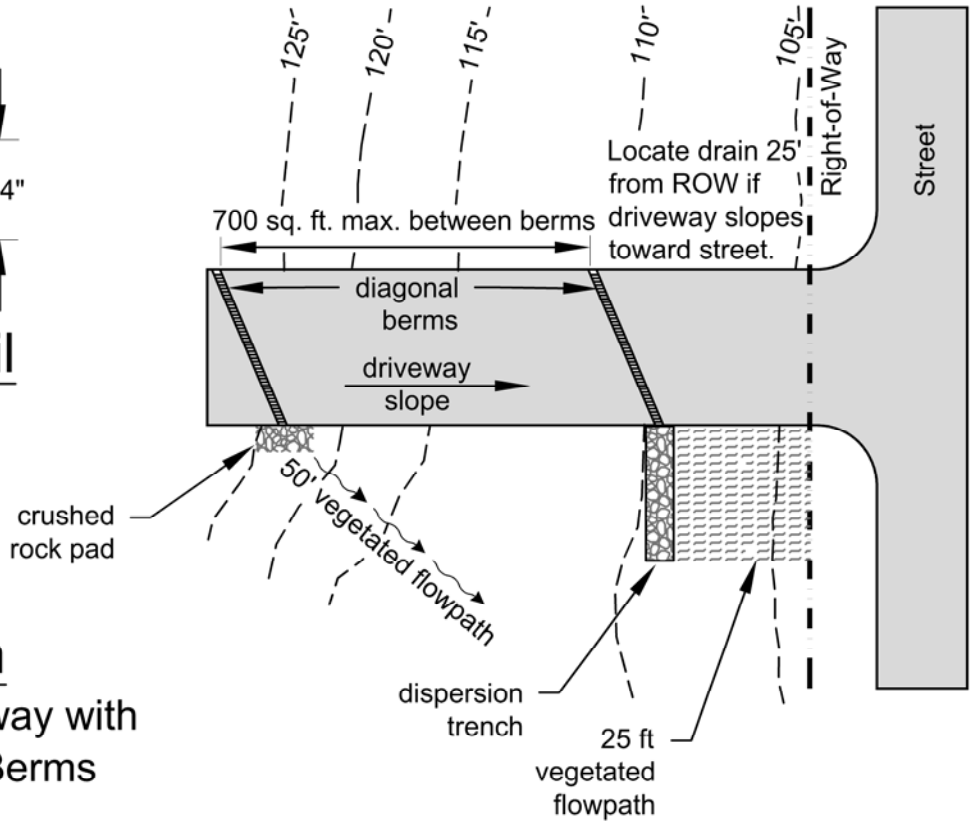
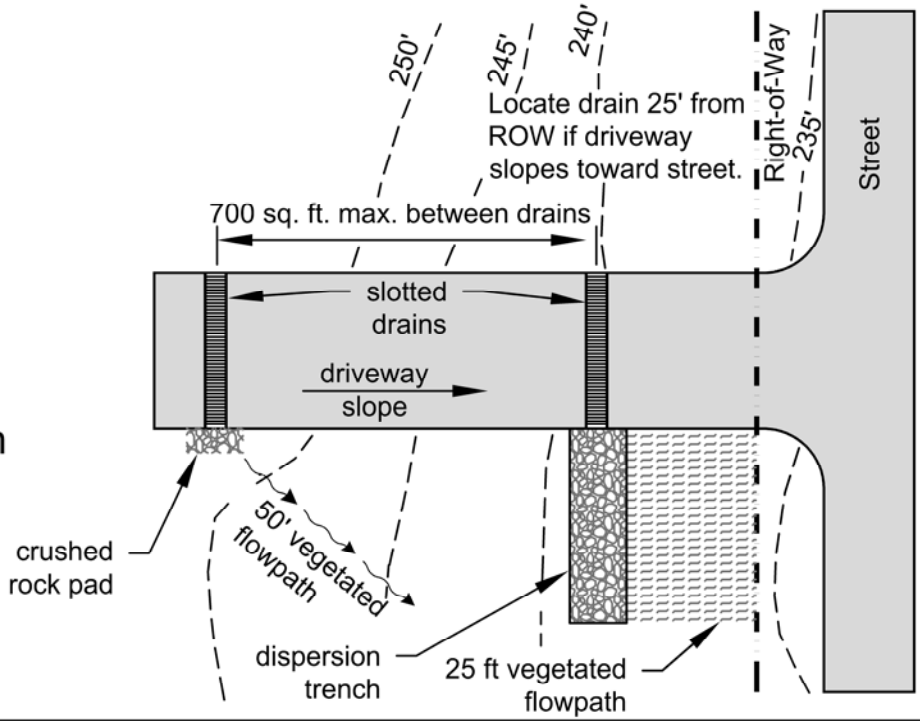


Berm Detail



Plan
Steep Driveway with Diagonal Berms



Plan
Steep Driveway with Slotted Drains

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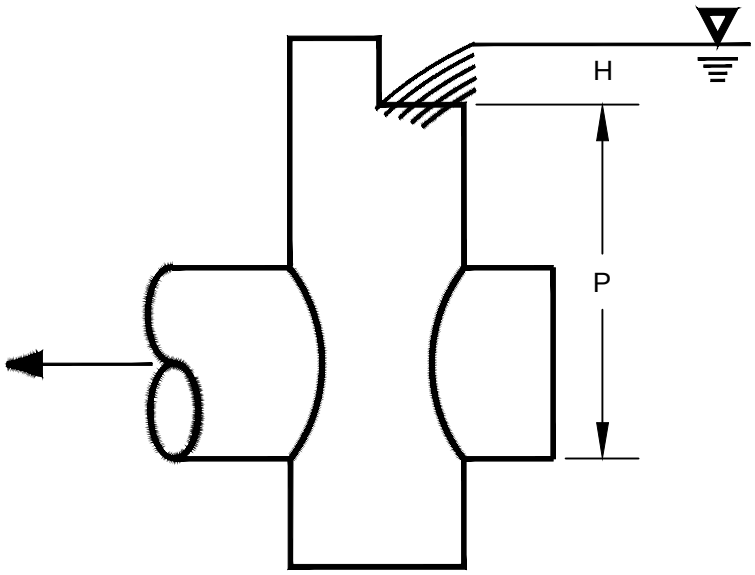
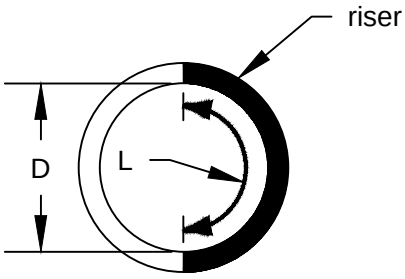
Typical Concentrated Flow Dispersion for Steep Driveways

Revised May 2019



Section



Plan

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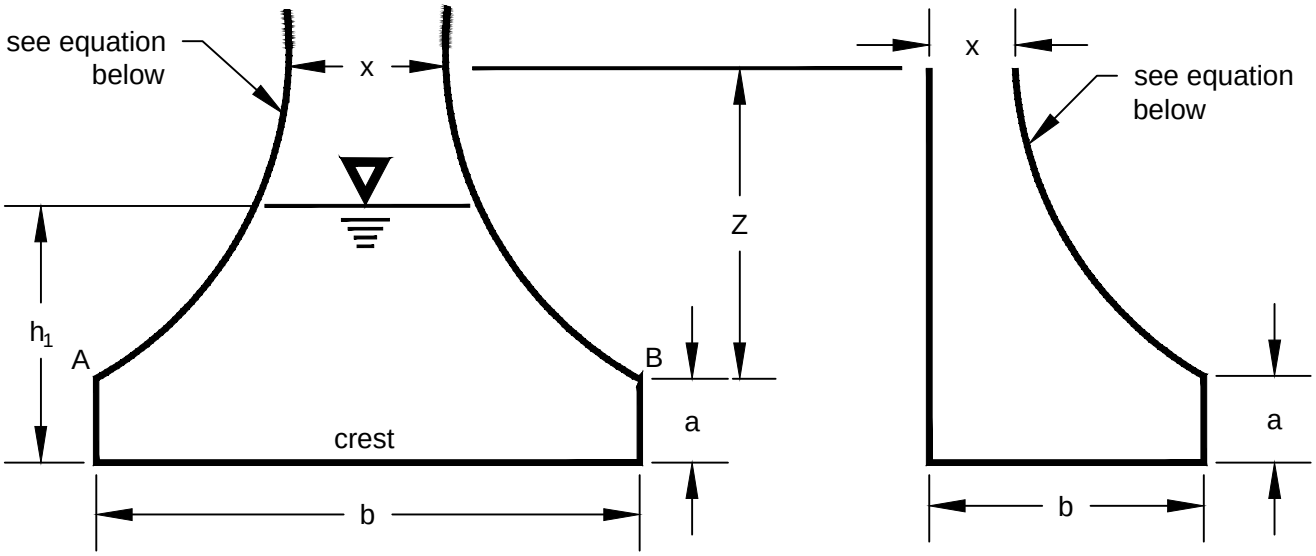
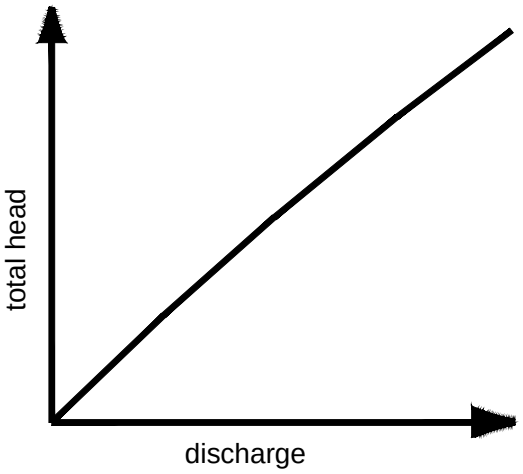
Rectangular, Sharp-Crested Weir

Revised June 2016



Symmetrical

Non-symmetrical



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Sutro Weir

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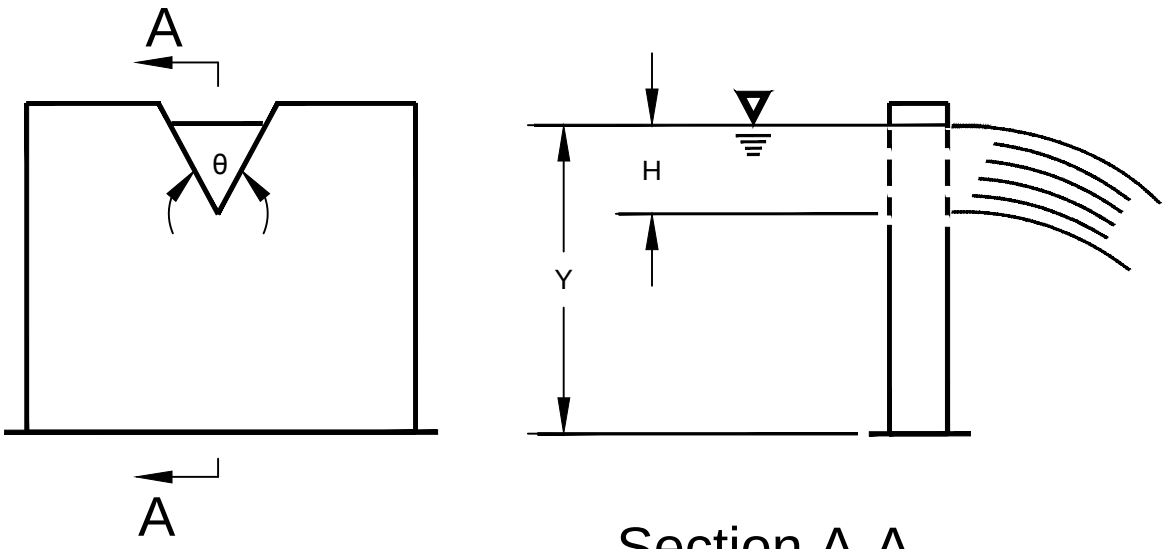
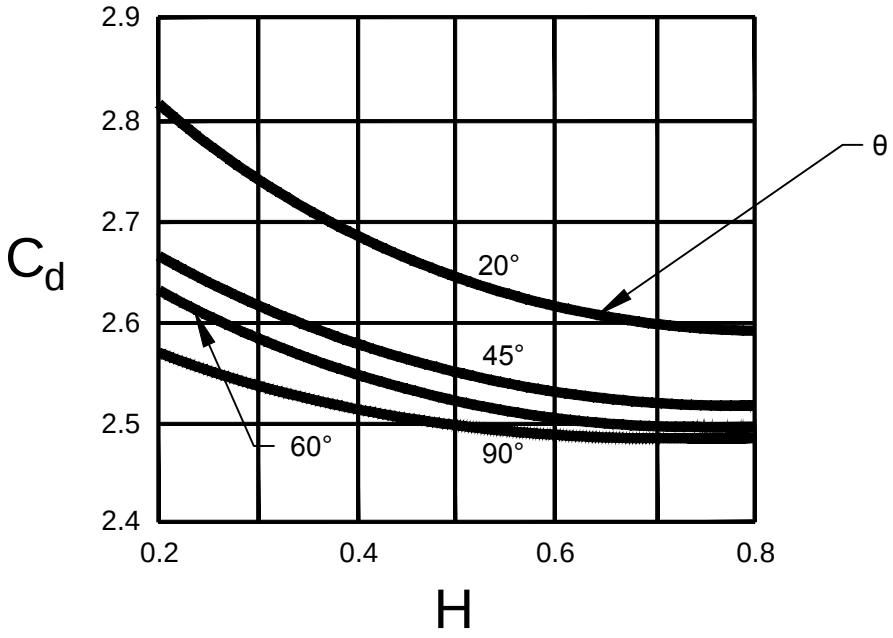


Section A-A

$$Q = C_d(\text{Tan}\frac{\theta}{2})H^{\frac{5}{2}} \text{ in cfs}$$

Where values of C_d may be taken from the following chart :



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V-Notch, Sharp Crested Weir

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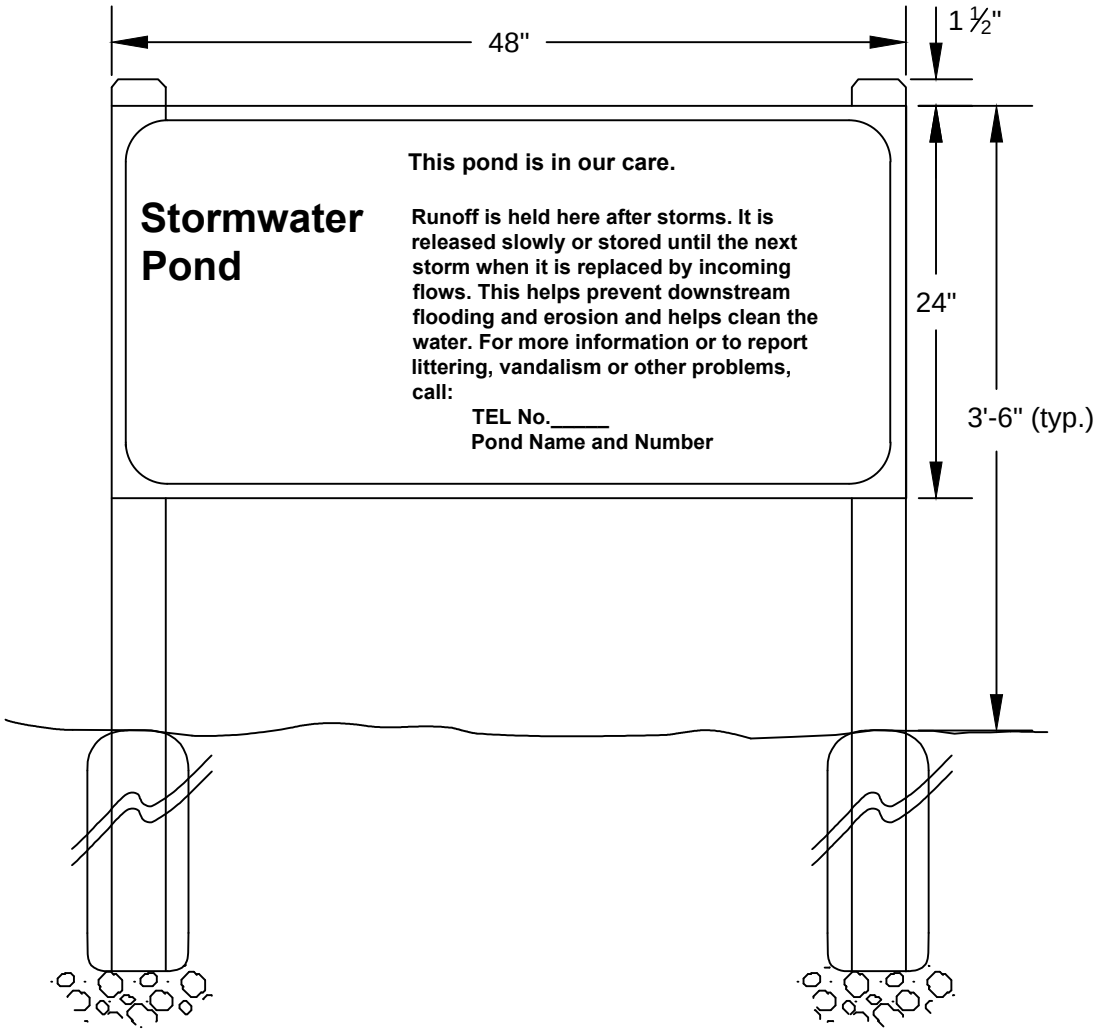

Sample Specifications:

Size:	48 inches by 24 inches
Material:	0.125-gauge aluminum
Face:	Non-reflective vinyl or 3 coats outdoor enamel (sprayed).
Lettering:	Silk screen enamel where possible, or vinyl letters.
Colors:	Beige background, teal letters.
Type face:	Helvetica condensed. Title: 3 inch; Sub-Title: 1 ½ inch; Text: 1 inch; Outer Border:; ⅛ inch; Border Distance from Edge: ¼ inch; all text 1 ¾ inch from border.
Posts:	Pressure treated, beveled tops, 1 ½ inch higher than sign.
Installation:	Secure to chain link fence if available. Otherwise install on two 4" x 4" posts, pressure treated, mounted atop gravel bed, installed in 30-inch concrete filled post holes (8-inch minimum diameter). Top of sign no higher than 42 inches from ground surface.
Placement:	Face sign in direction of primary visual or physical access. Do not block any access road. Do not place within 6 feet of structural facilities (e.g. manholes, spillways, pipe inlets).
Special Notes:	This facility is lined to protect groundwater (if a liner that restricts infiltration of stormwater exists).

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Example of Permanent Surface Water Control Pond Sign

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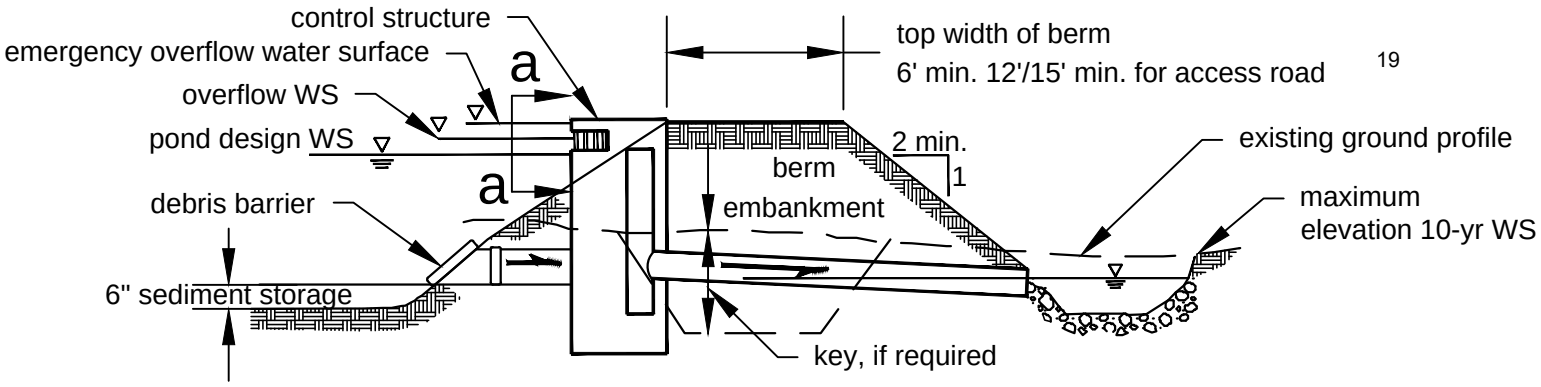
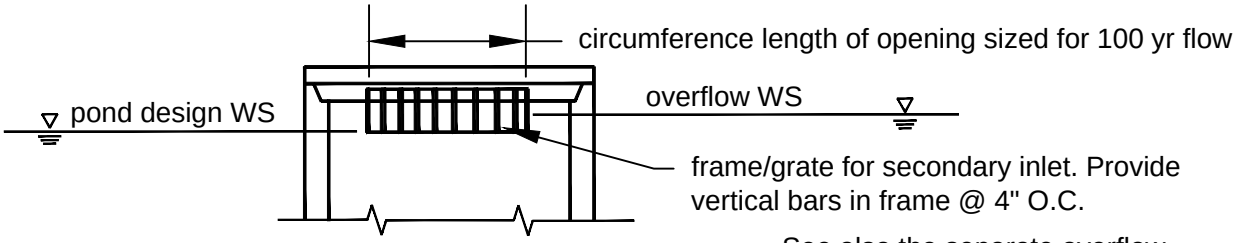


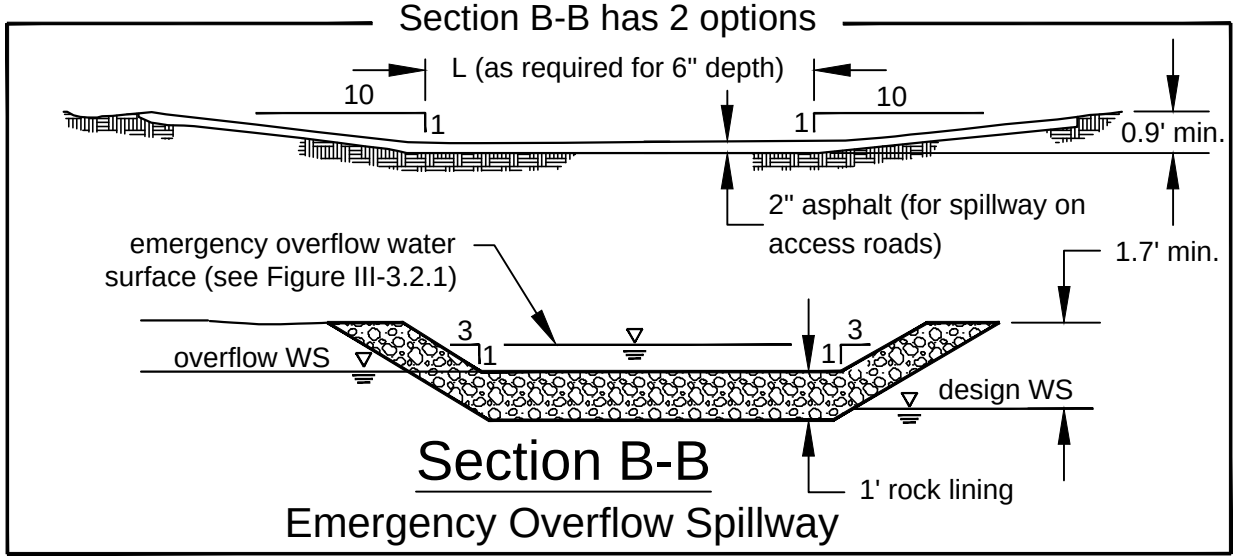
Section A-A



Section a-a

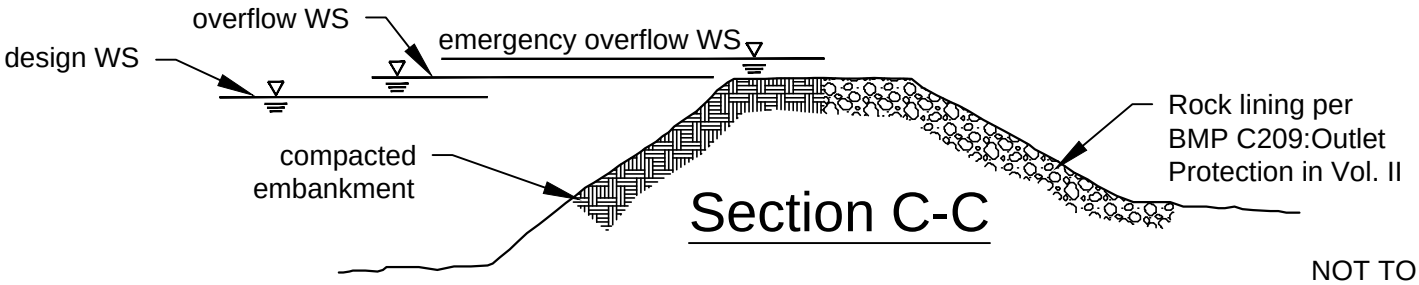
See also the separate overflow structure shown in Figure III-3.2.3

Section B-B has 2 options



Section B-B

Emergency Overflow Spillway



Section C-C

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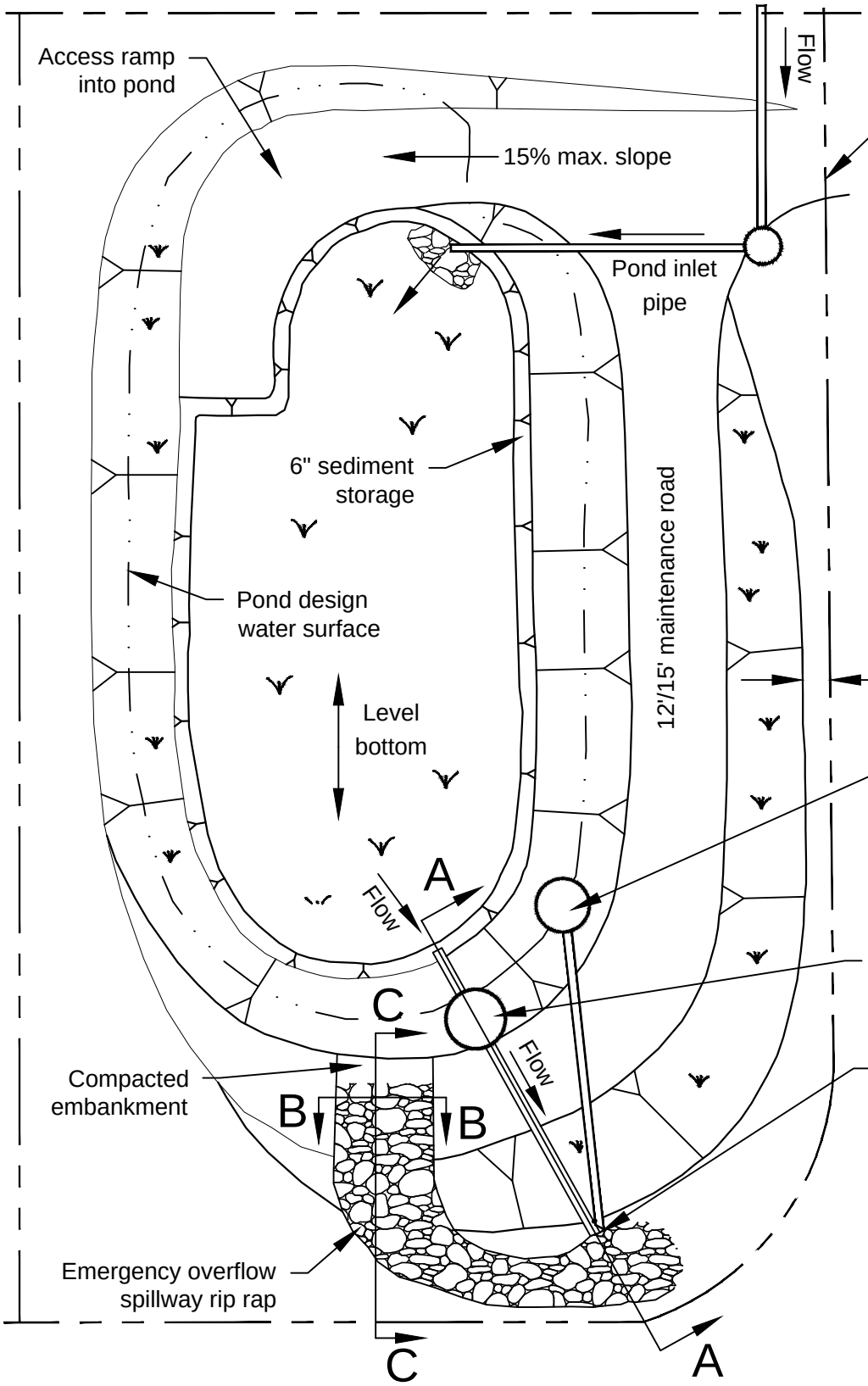
Typical Detention Pond Sections

Revised June 2016



Note: This detail is a schematic representation only. Actual configuration will vary depending on specific site constraints and applicable design criteria.

See Figure III-3.2.2 for section cut diagrams

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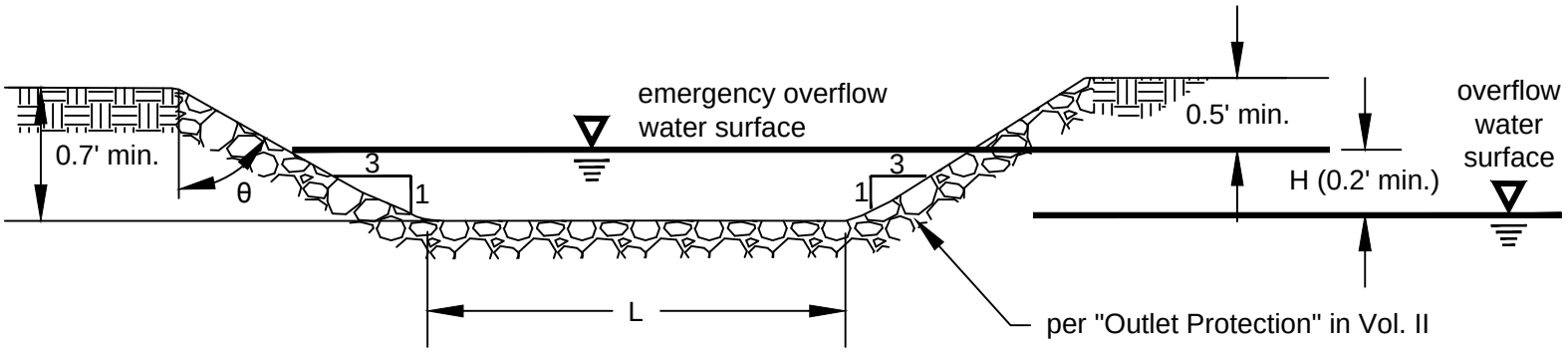
Typical Detention Pond

Revised June 2016



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Weir Section for Emergency Overflow Spillway

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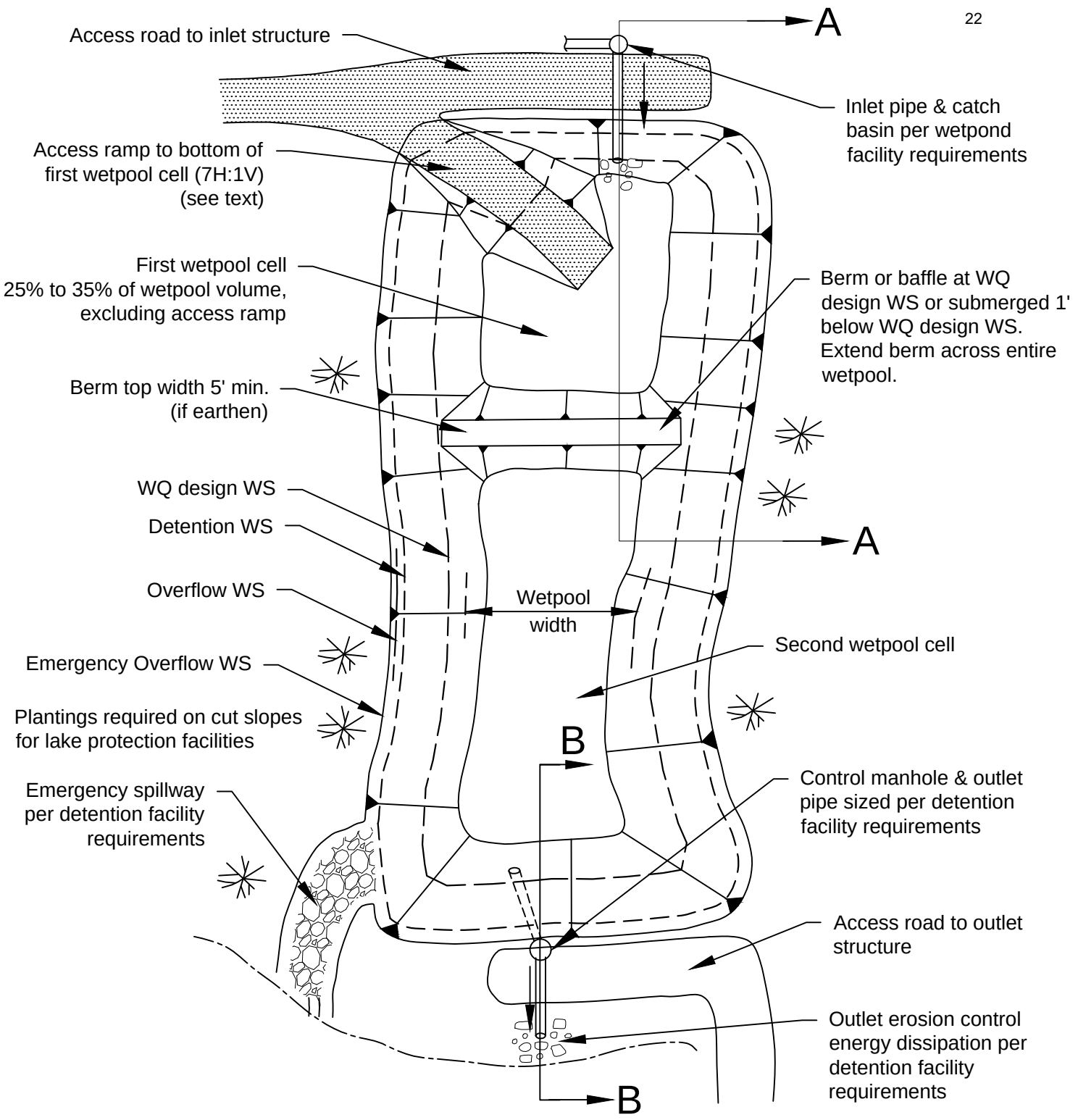

Plan View

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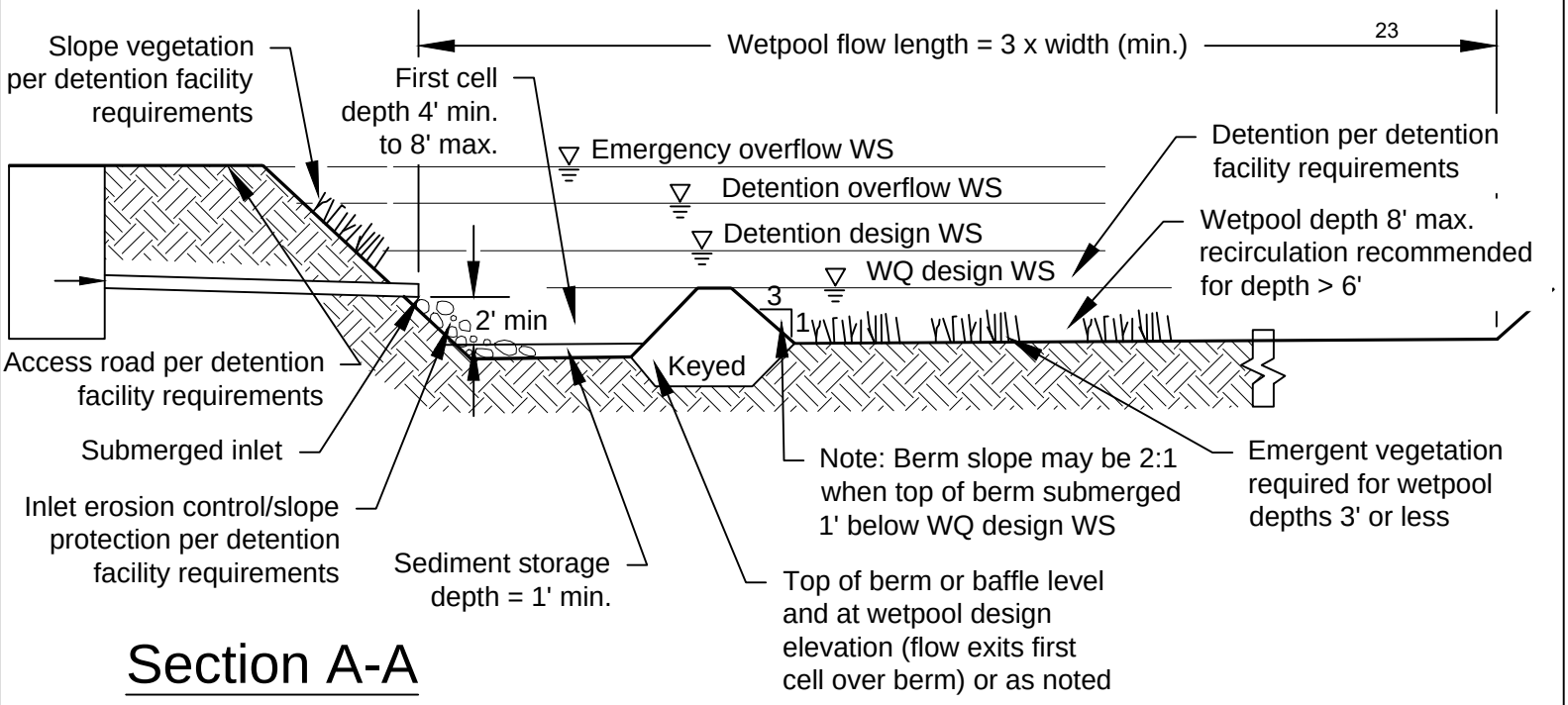
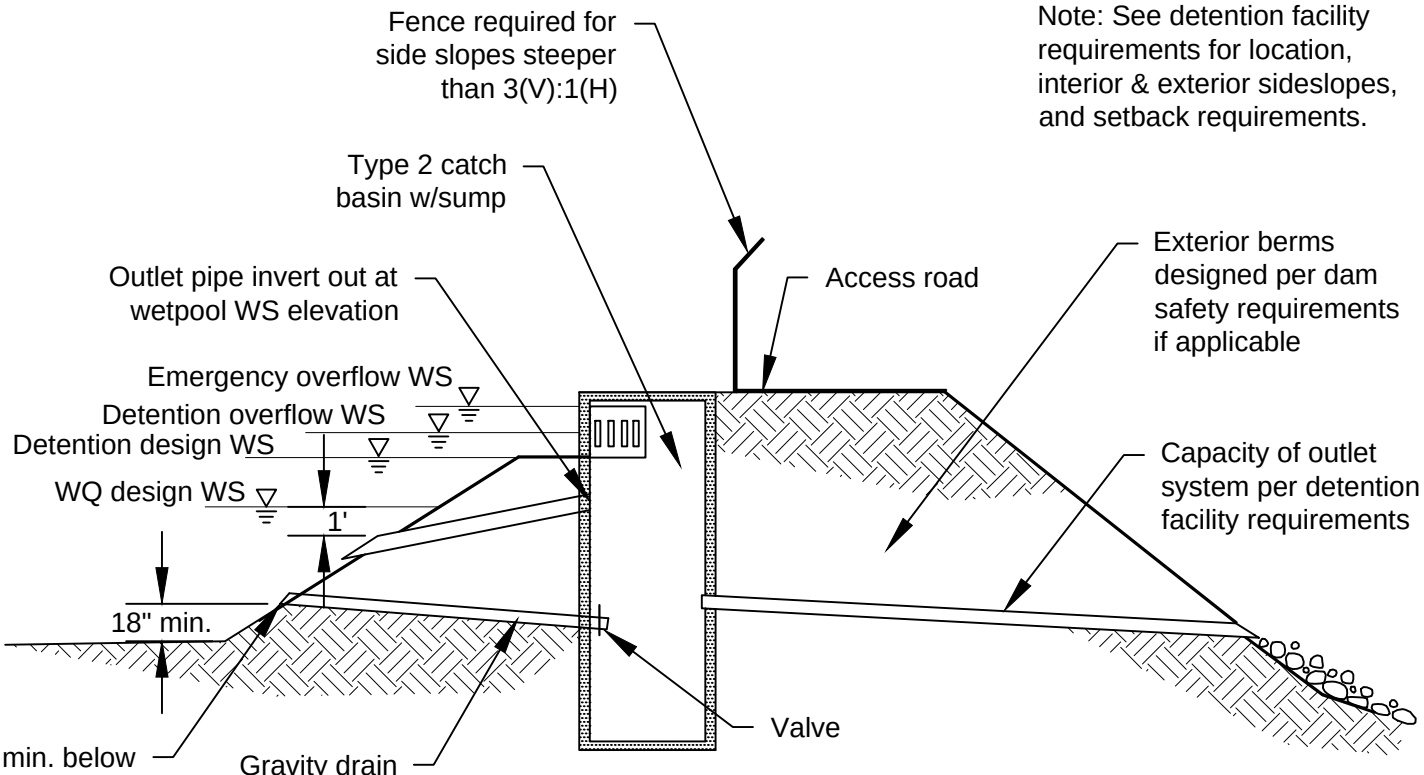
Combined Detention and Wetpond (Plan View)

Revised June 2016



Section A-A



Section B-B

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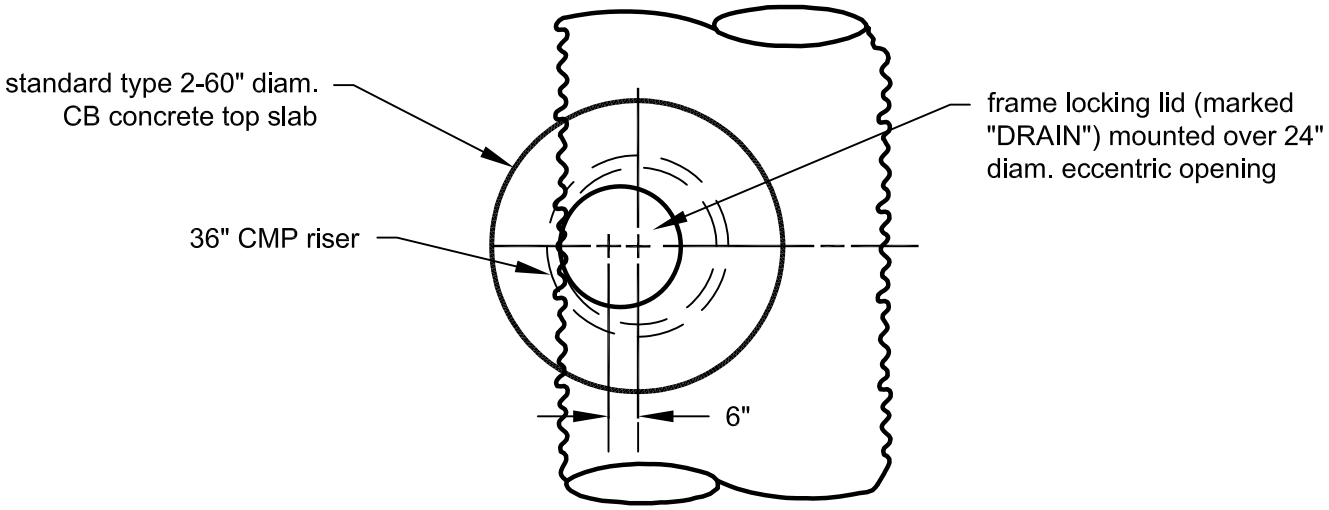
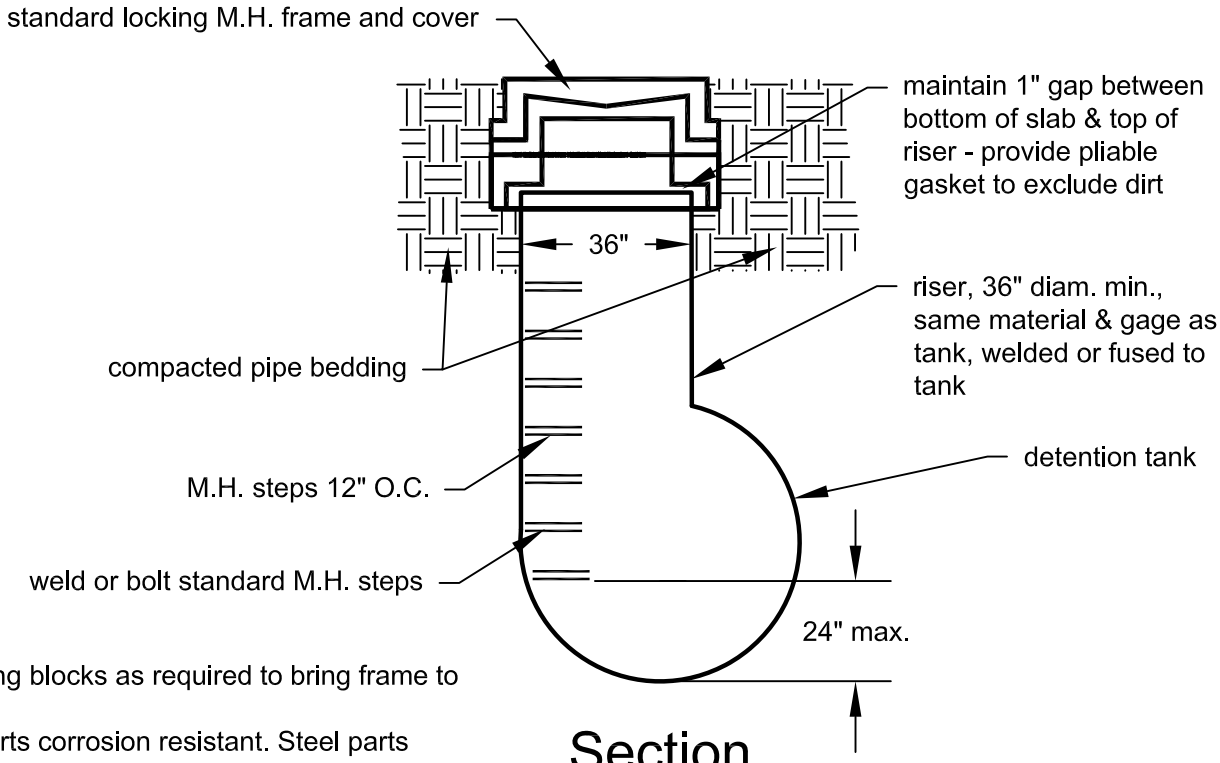
Combined Detention and Wetpond (Section View)

Revised June 2016



Plan



Section

Notes:
1. Use adjusting blocks as required to bring frame to grade.
2. All metal parts corrosion resistant. Steel parts galvanized and asphalt coated (Treatment 1 or better), or aluminized steel (Type II or better).
3. Must be located for access by maintenance vehicles.
4. May substitute WSDOT special Type IV manhole (RCP only)

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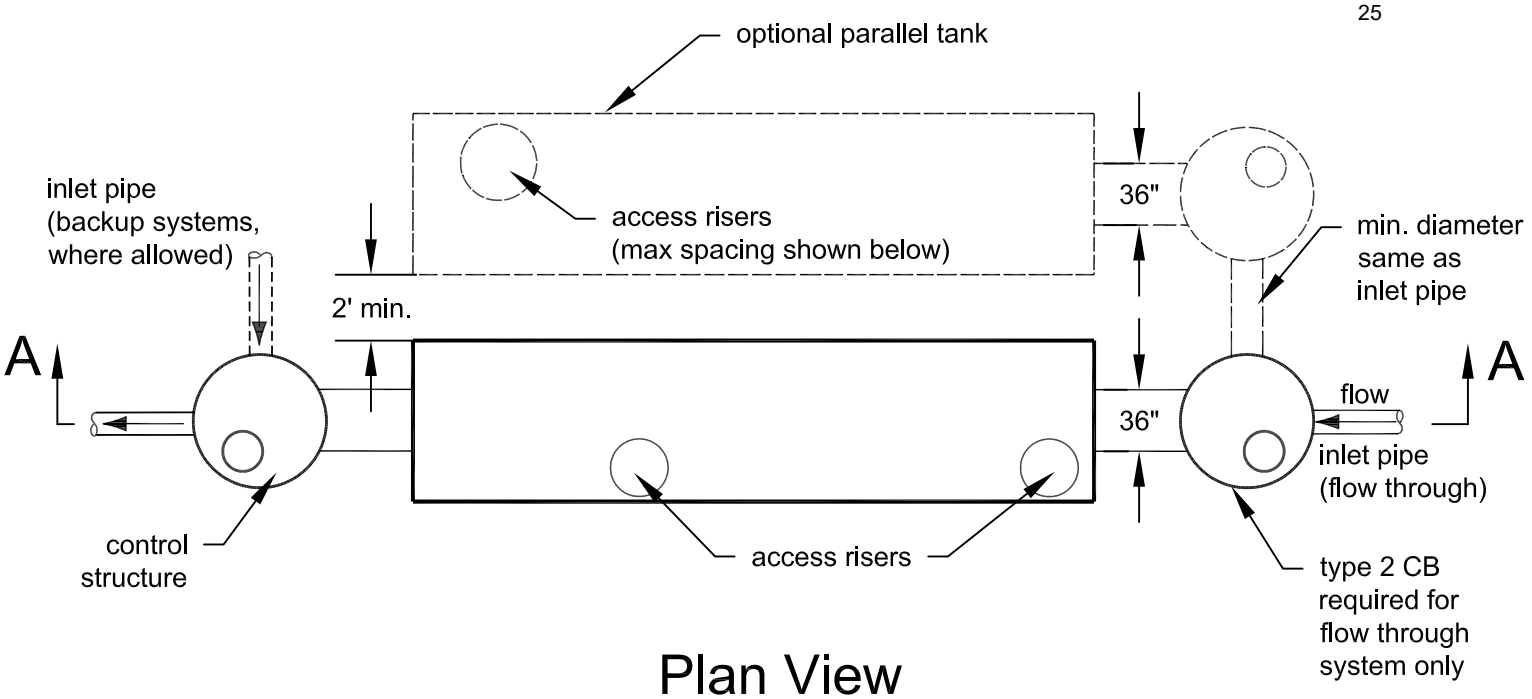
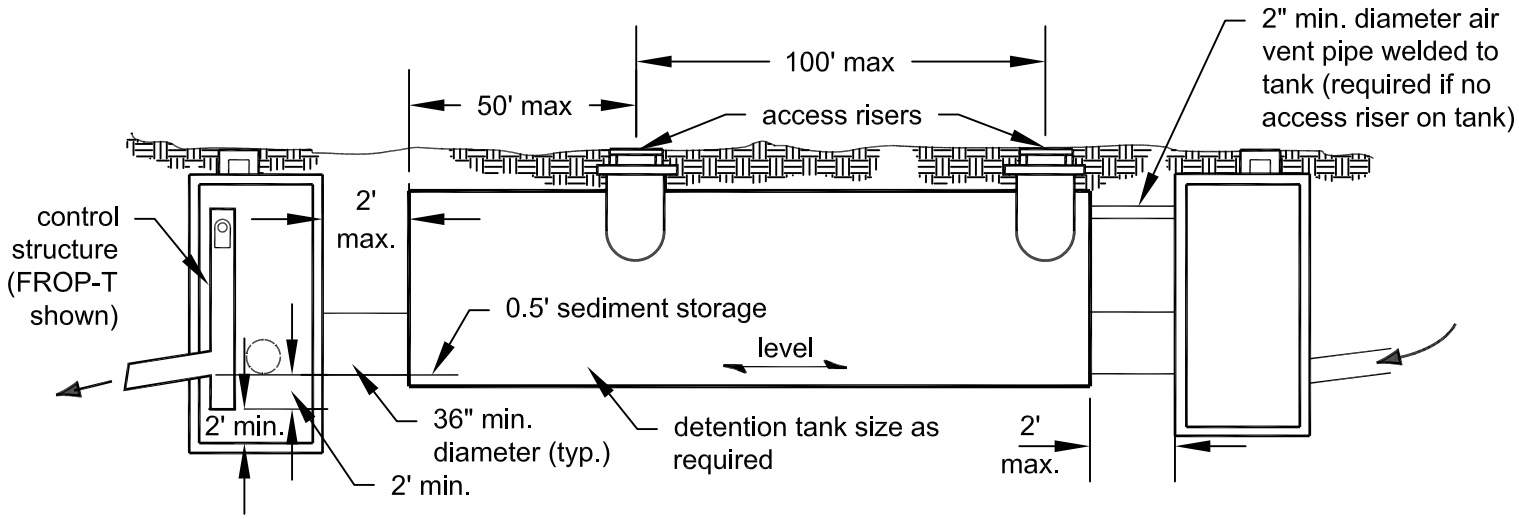
Detention Tank Access Detail

Revised May 2019



Plan View

"Flow-through" system shown solid.
Designs for "flow backup" system
and parallel tanks shown dashed.



Section A-A

"Flow-through" system shown solid.

Note:
All metal parts corrosion resistant. Steel parts galvanized and asphalt coated (Treatment 1 or better), or aluminized steel (Type II or better).

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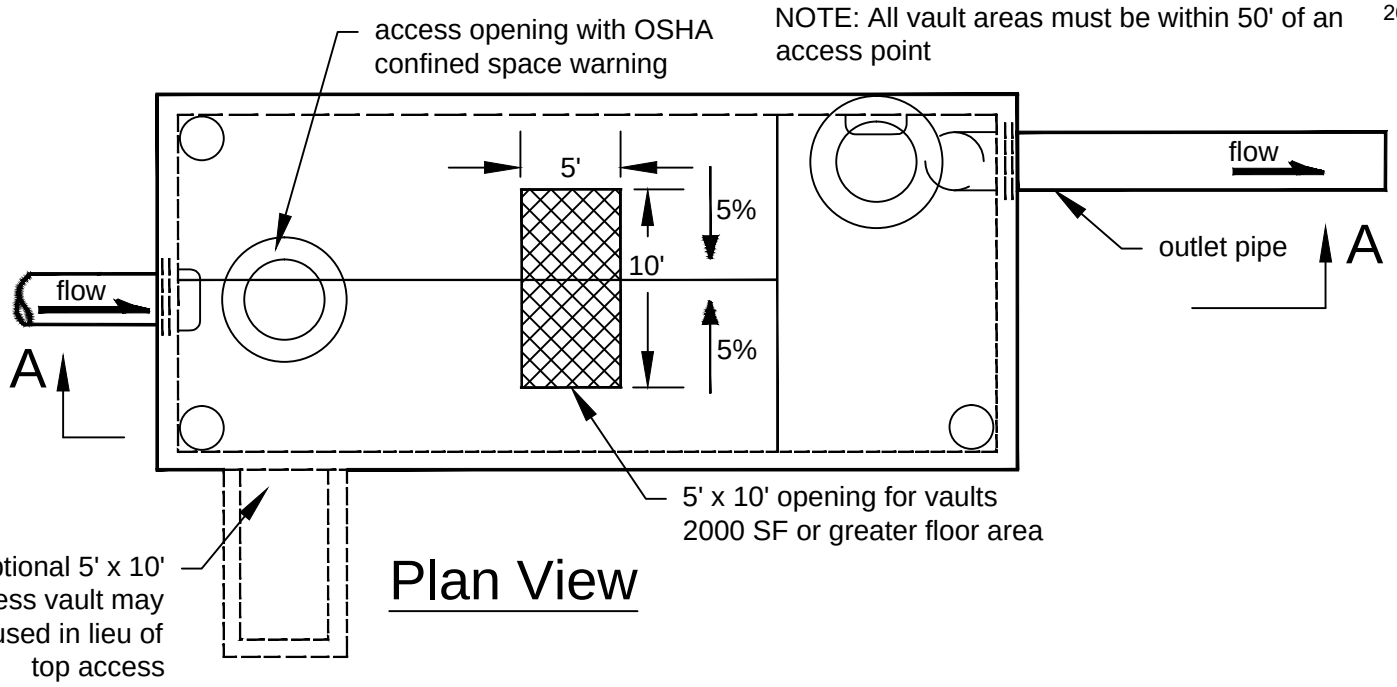
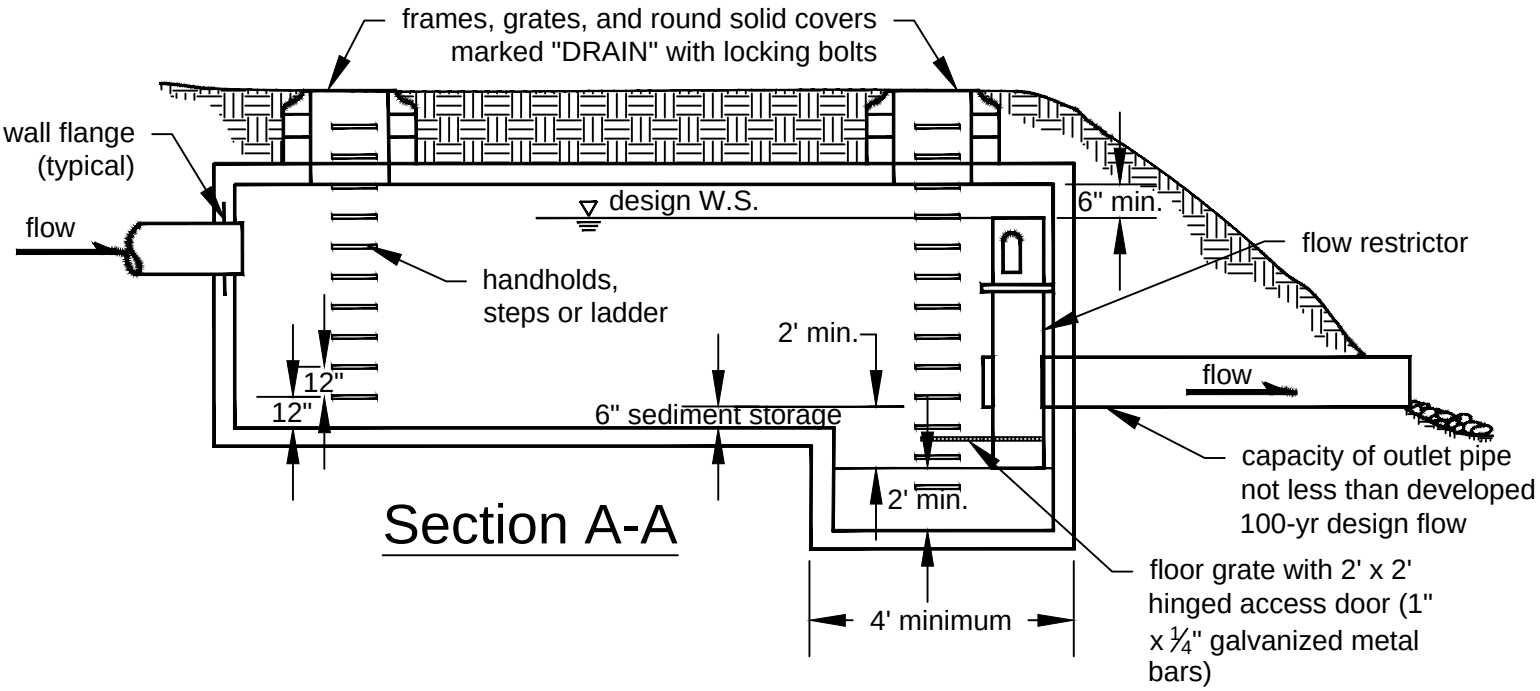
Typical Detention Tank

Revised May 2019

NOTE: All vault areas must be within 50' of an access point



Plan View



Section A-A

Notes:

1. All metal parts must be corrosion resistant. Steel parts must be galvanized and asphalt coated (Treatment 1 or better).
2. Provide water stop at all cast-in-place construction joints. Precast vaults shall have approved rubber gasket system.
3. Vaults ≤ 10' wide must use removable lids.
4. Prefabricated vault sections may require structural modifications to support 5' x 10' opening over main vault. Alternatively, access can be provided via a side vestibule as shown.

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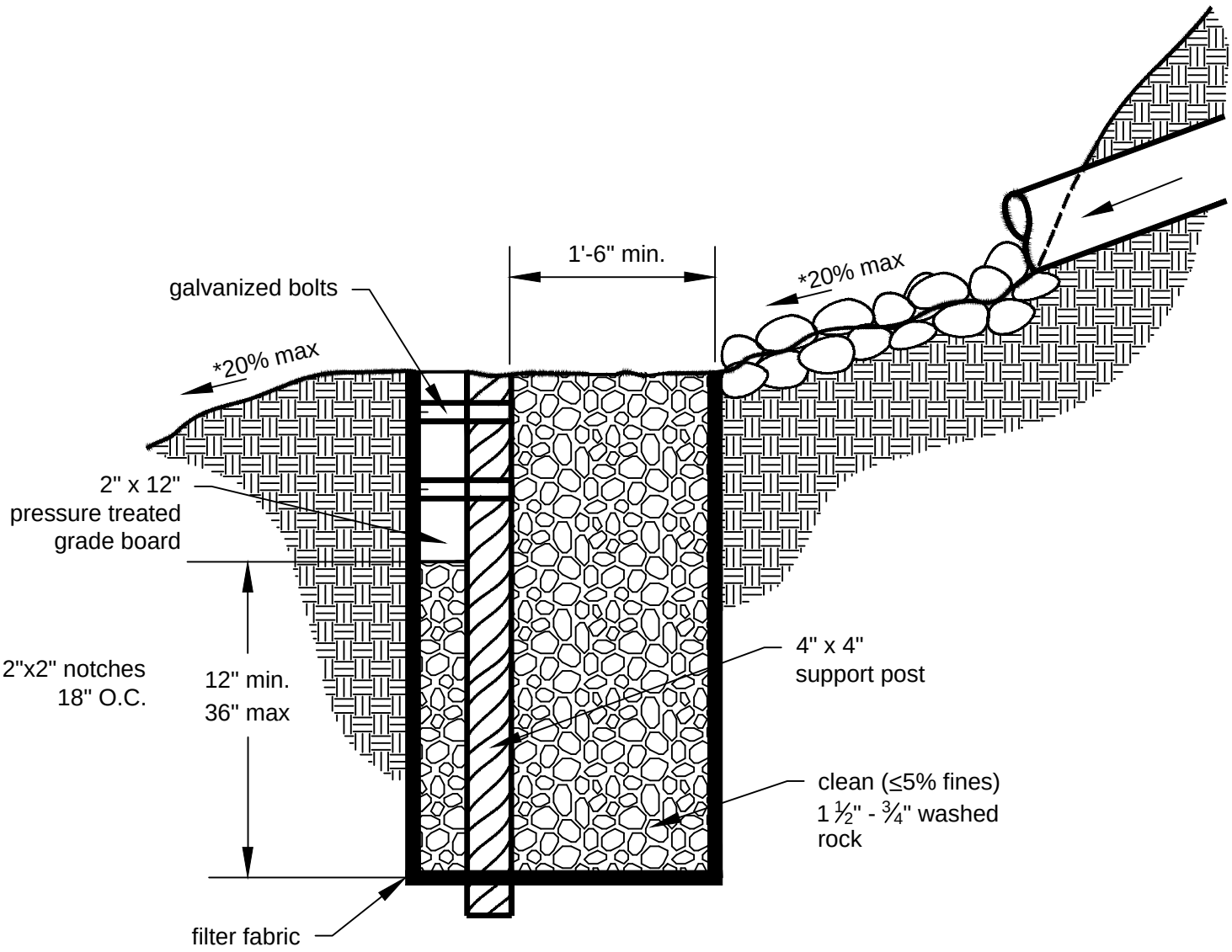
Typical Detention Vault

Revised June 2016



*15% max for flow control/runoff treatment in rural areas.

Section A-A

Notes:

1. This trench shall be constructed so as to prevent point discharge and/or erosion.
2. Trenches may be placed no closer than 50 feet to one another. (100 feet along flowline)
3. Trench and grade board must be level. Align to follow contours of site.
4. Support post spacing as required by soil conditions to ensure grade board remains level.

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Alternative Flow Dispersal Trench

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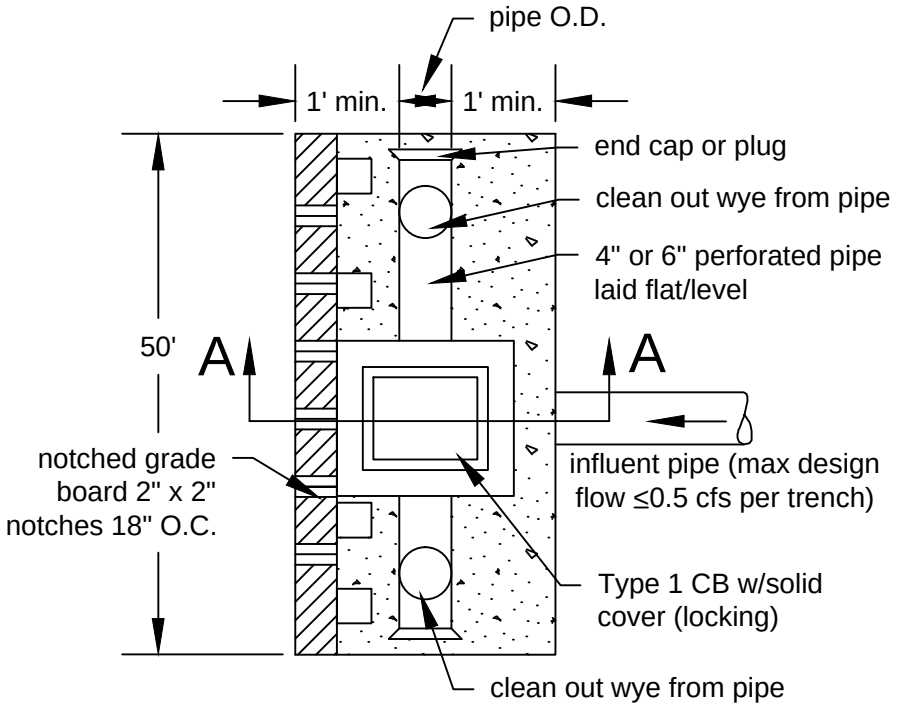
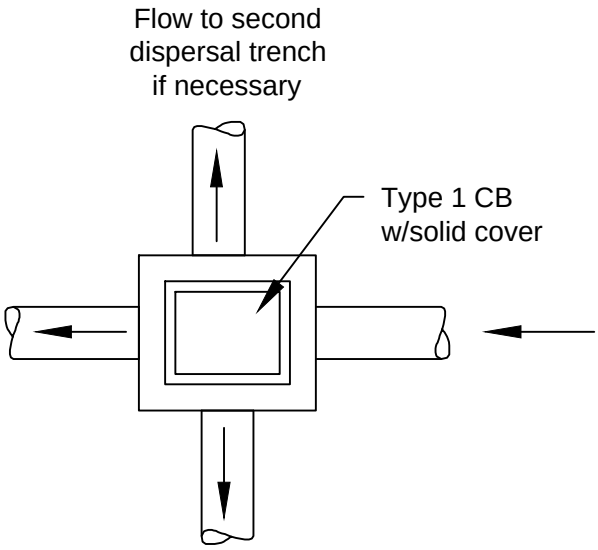
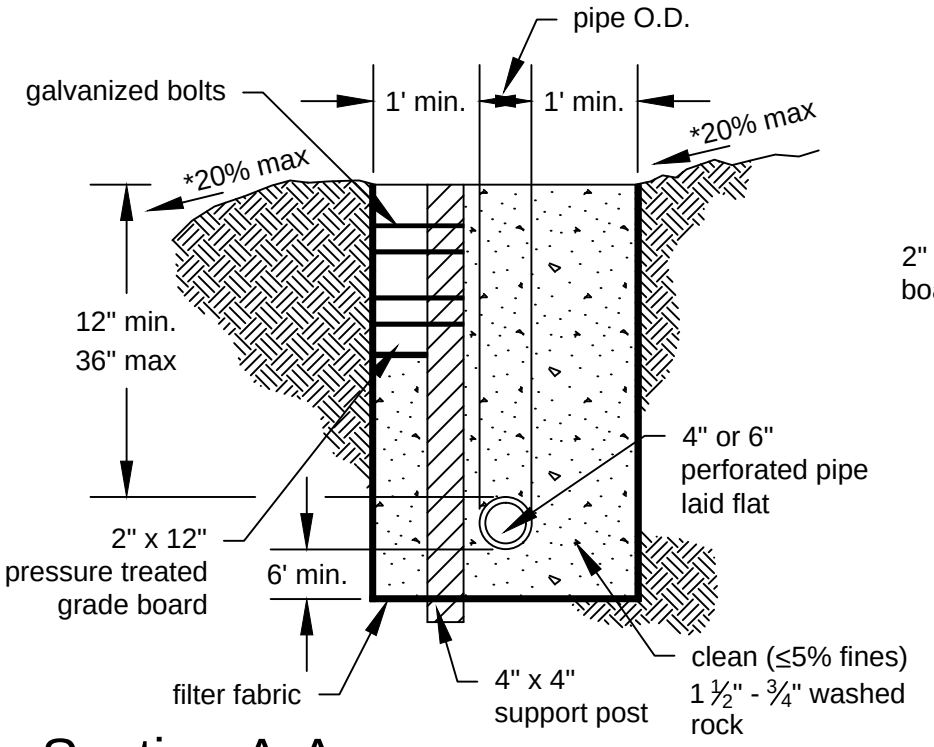
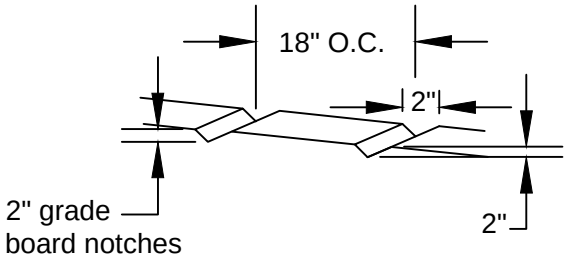




Plan



Section A-A



Notes:

1. This trench shall be constructed so as to prevent point discharge and/or erosion.
2. Trenches may be placed no closer than 50 feet to one another. (100 feet along flowline)
3. Trench and grade board must be level. Align to follow contours of site.
4. Support post spacing as required by soil conditions to ensure grade board remains level.

*15% max for flow control/runoff treatment in rural areas.

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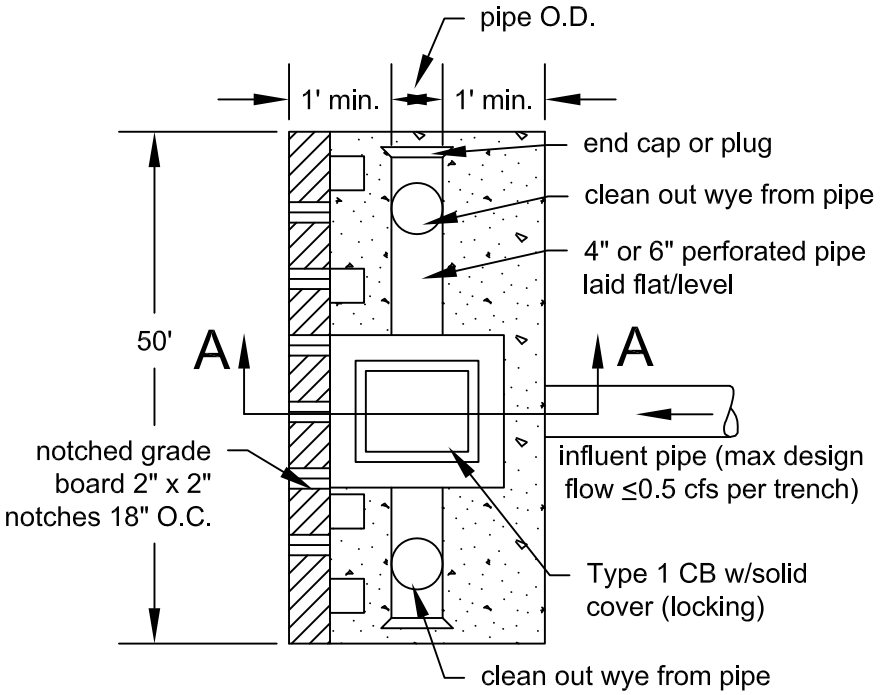
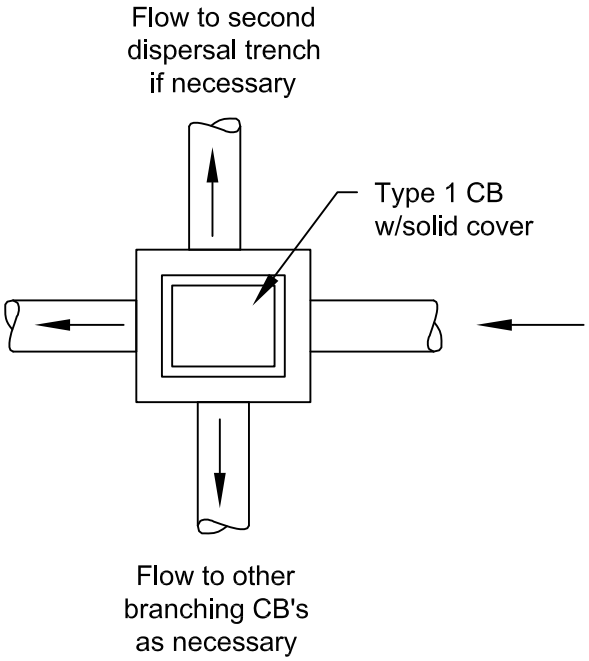
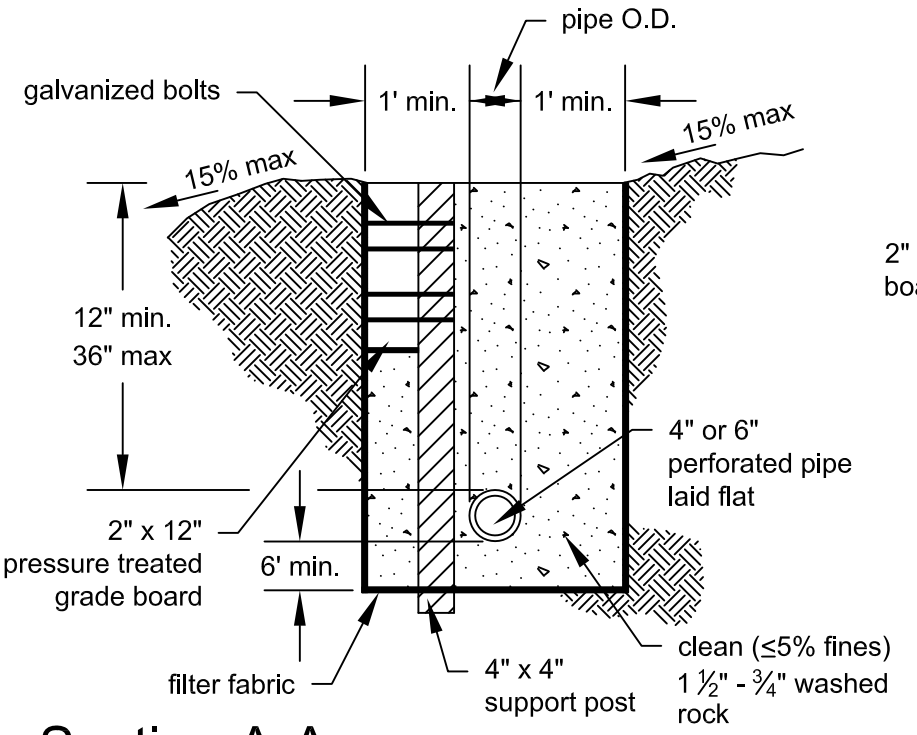
Flow Dispersal Trench

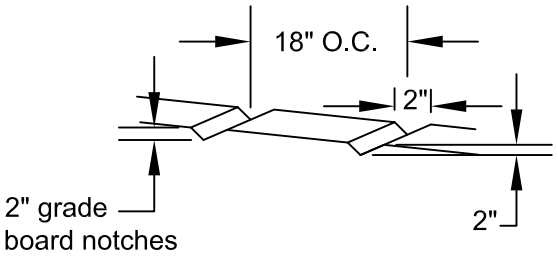
Revised June 2017





Plan





Section A-A

Notes:

1. This trench shall be constructed so as to prevent point discharge and/or erosion.
2. Trenches may be placed no closer than 50 feet to one another. (100 feet along flowline)
3. Trench and grade board must be level. Align to follow contours of site.
4. Support post spacing as required by soil conditions to ensure grade board remains level.

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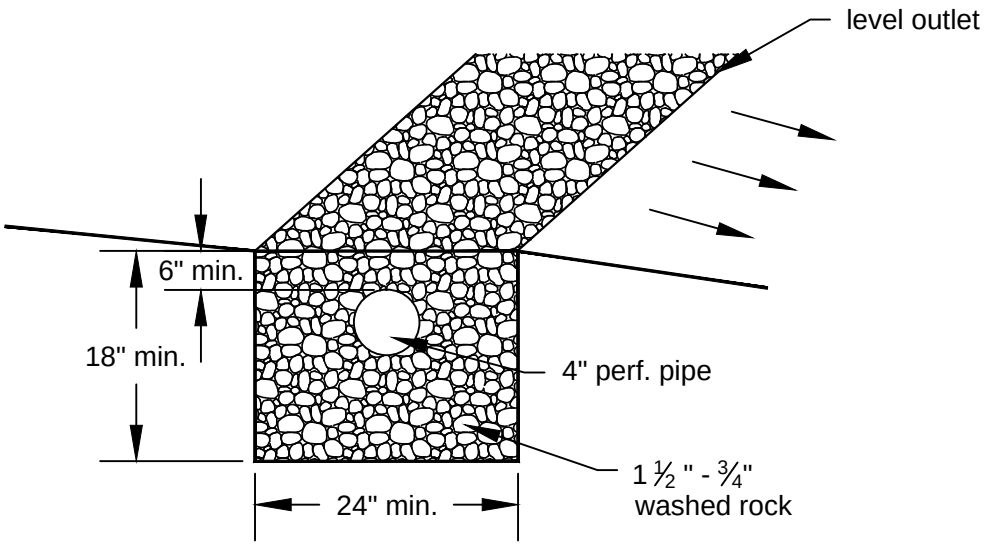
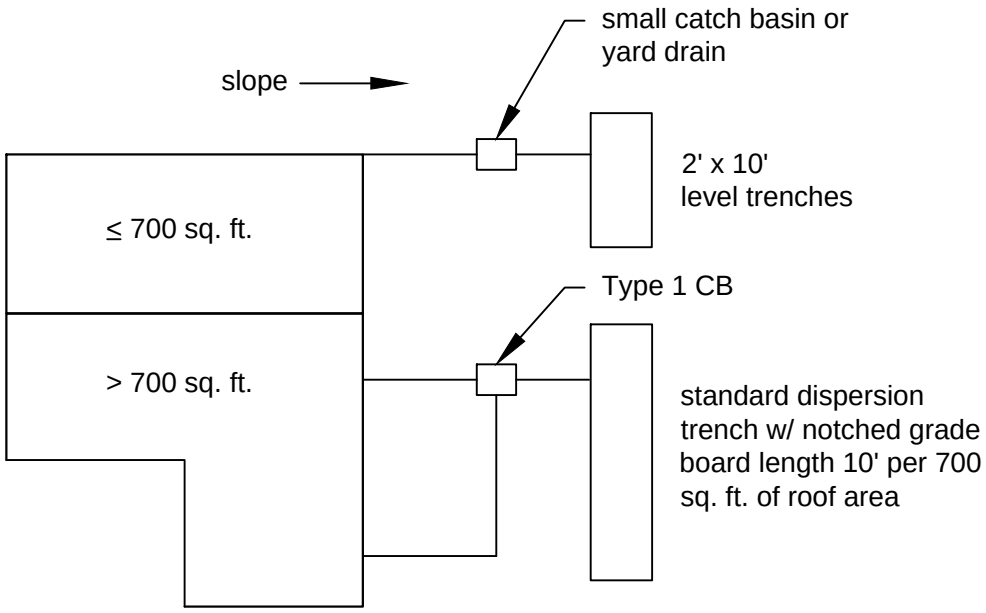
Standard Dispersion Trench with Notched Grade Board

Revised May 2019



Trench X-Section



Plan View of Roof

Source: King County Department of Natural Resources, 1998

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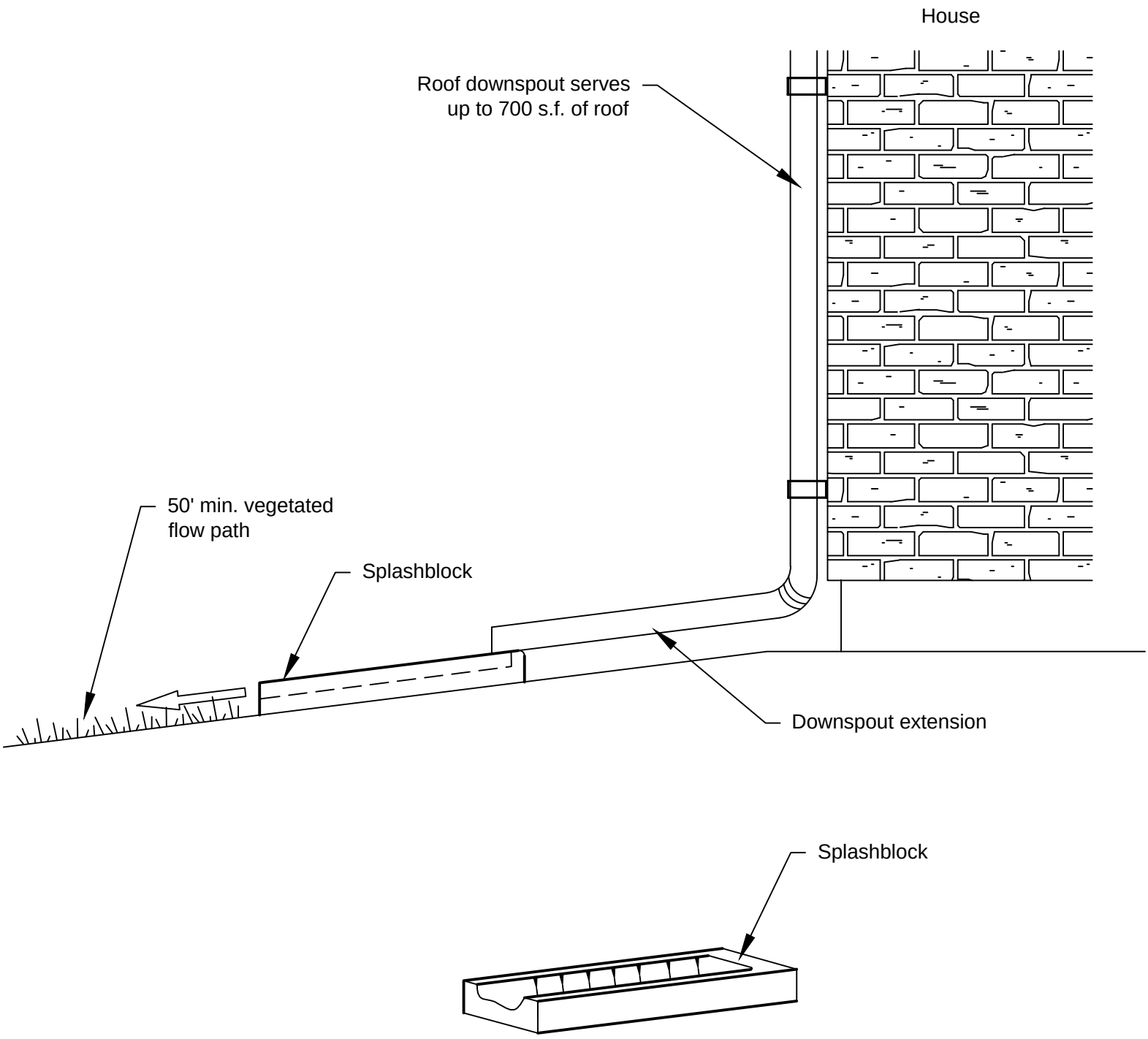
Typical Downspout Dispersion Trench

Revised December 2016



Source: King County Department of Natural Resources, 1998

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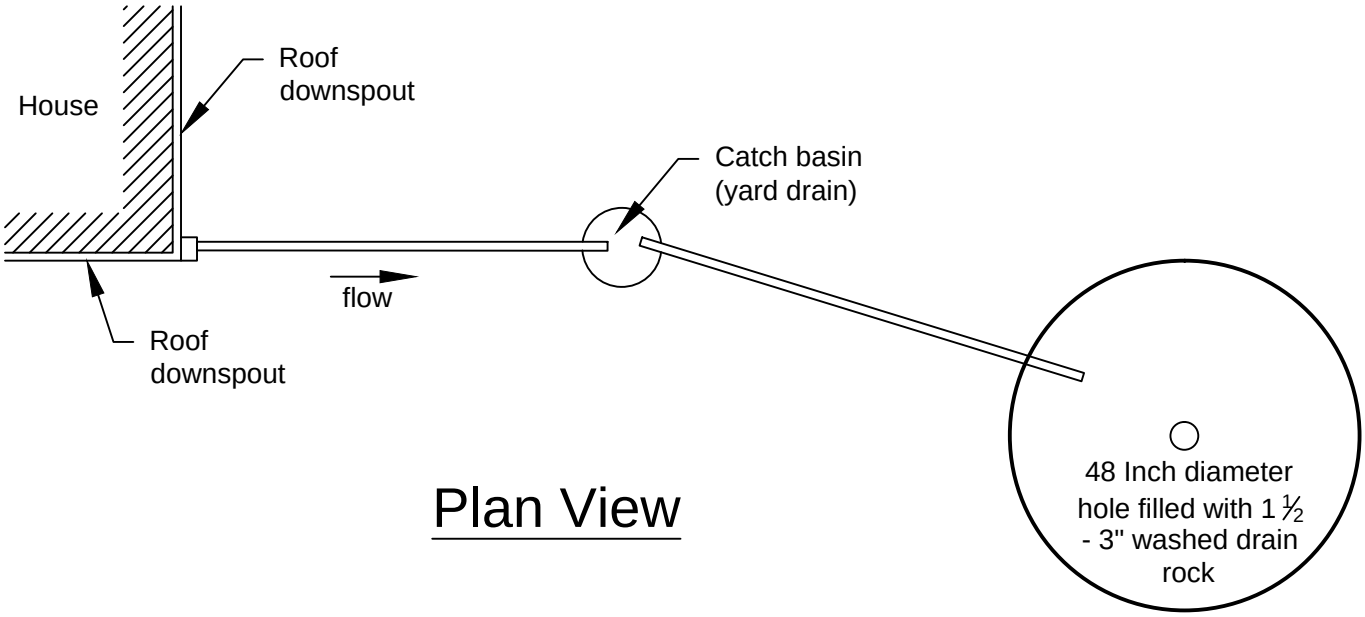
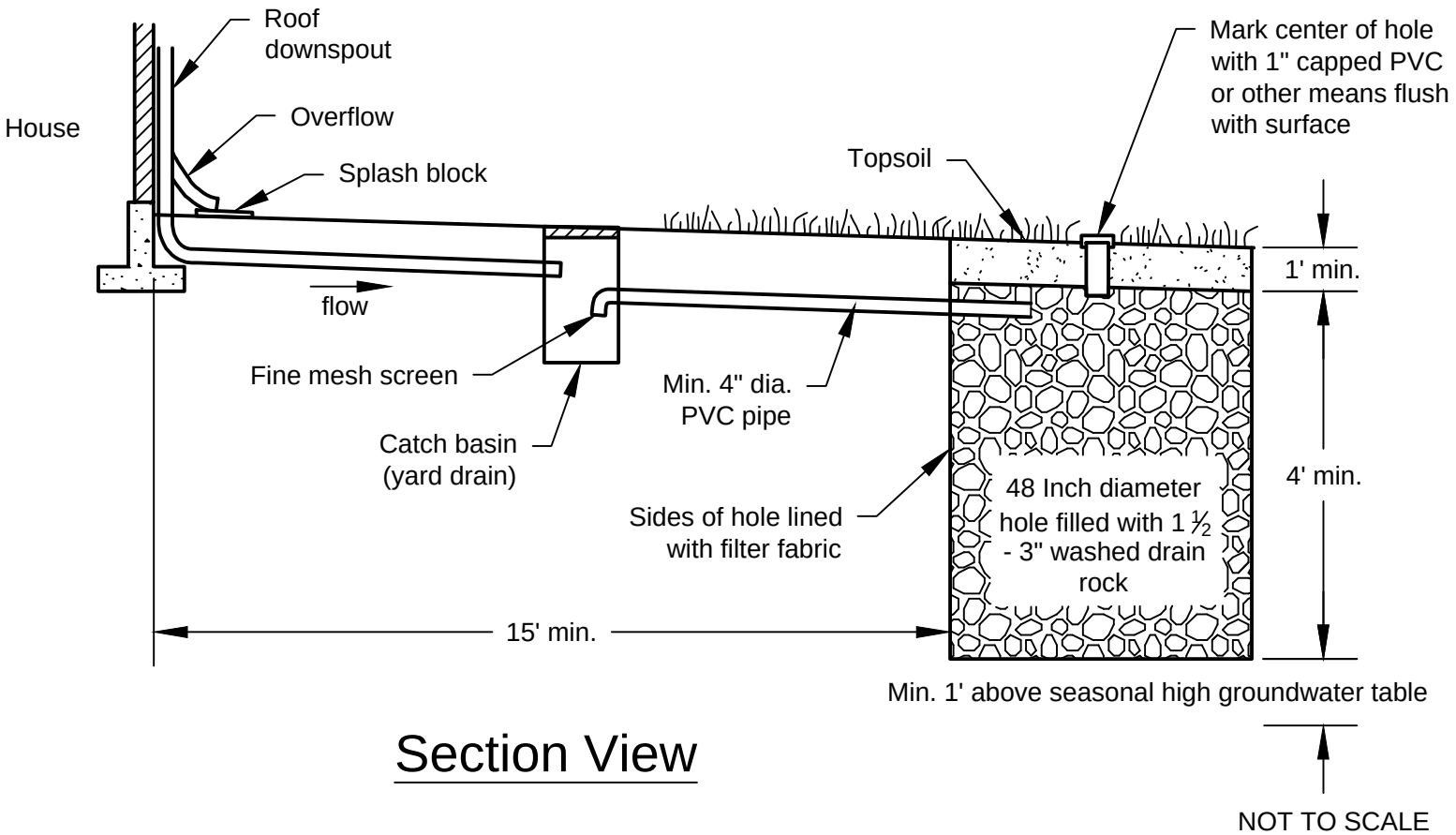
Typical Downspout Splashblock Dispersion

Revised December 2016



Plan View



Section View

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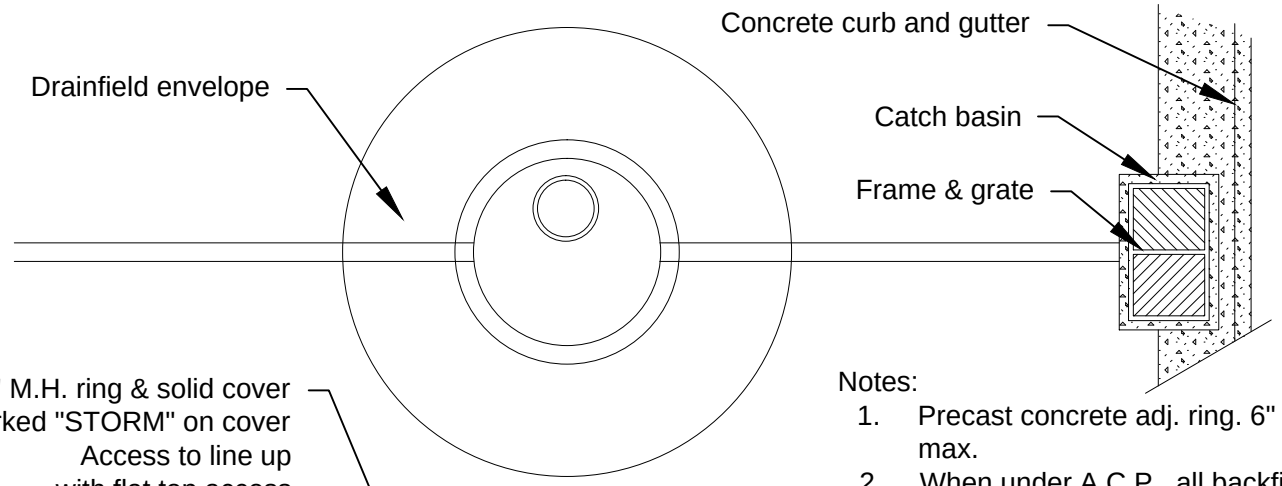
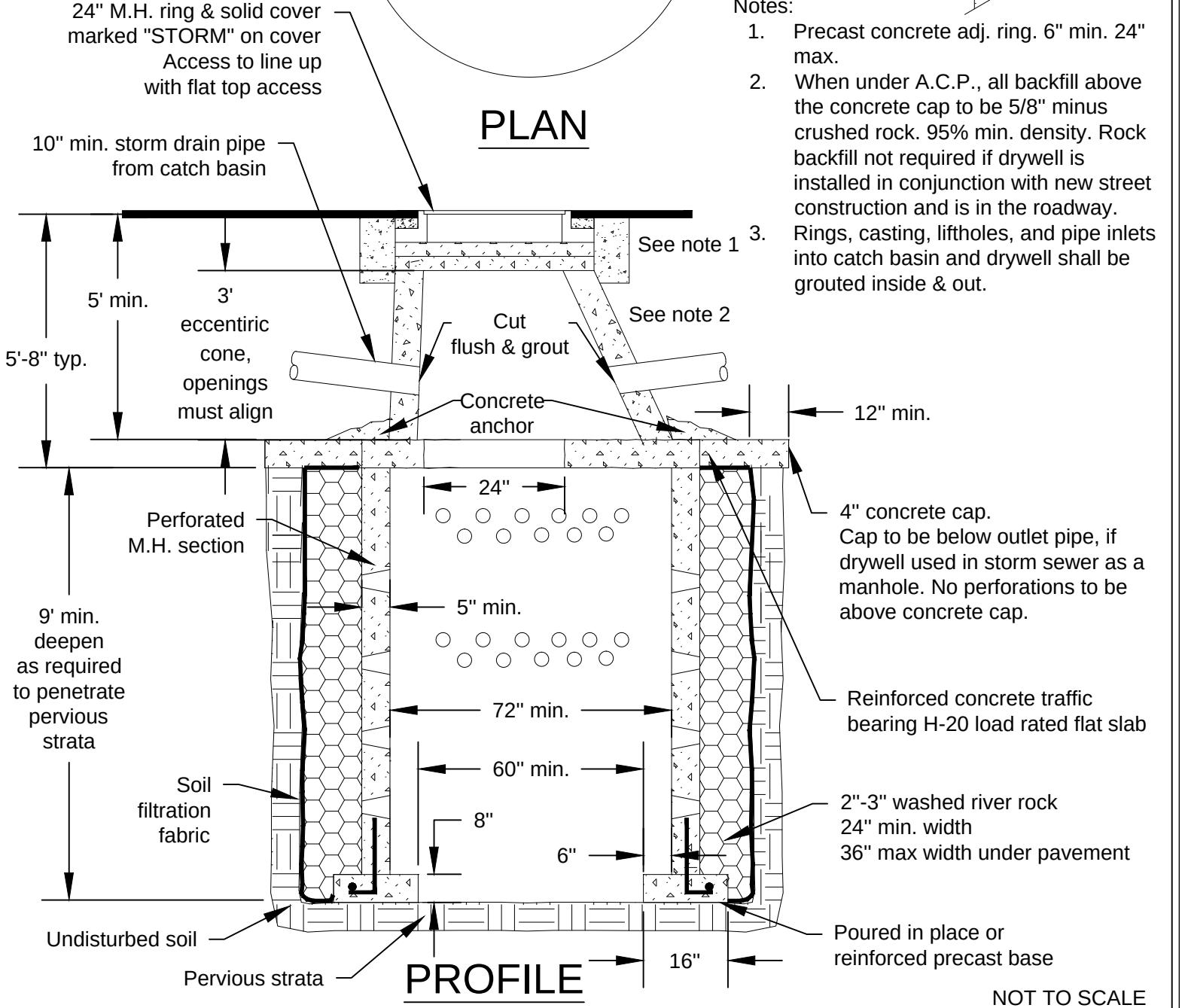
Typical Downspout Infiltration Drywell

Revised June 2016



PLAN



PROFILE

Notes:

1. Precast concrete adj. ring. 6" min. 24" max.
2. When under A.C.P., all backfill above the concrete cap to be 5/8" minus crushed rock. 95% min. density. Rock backfill not required if drywell is installed in conjunction with new street construction and is in the roadway.
3. Rings, casting, liftholes, and pipe inlets into catch basin and drywell shall be grouted inside & out.

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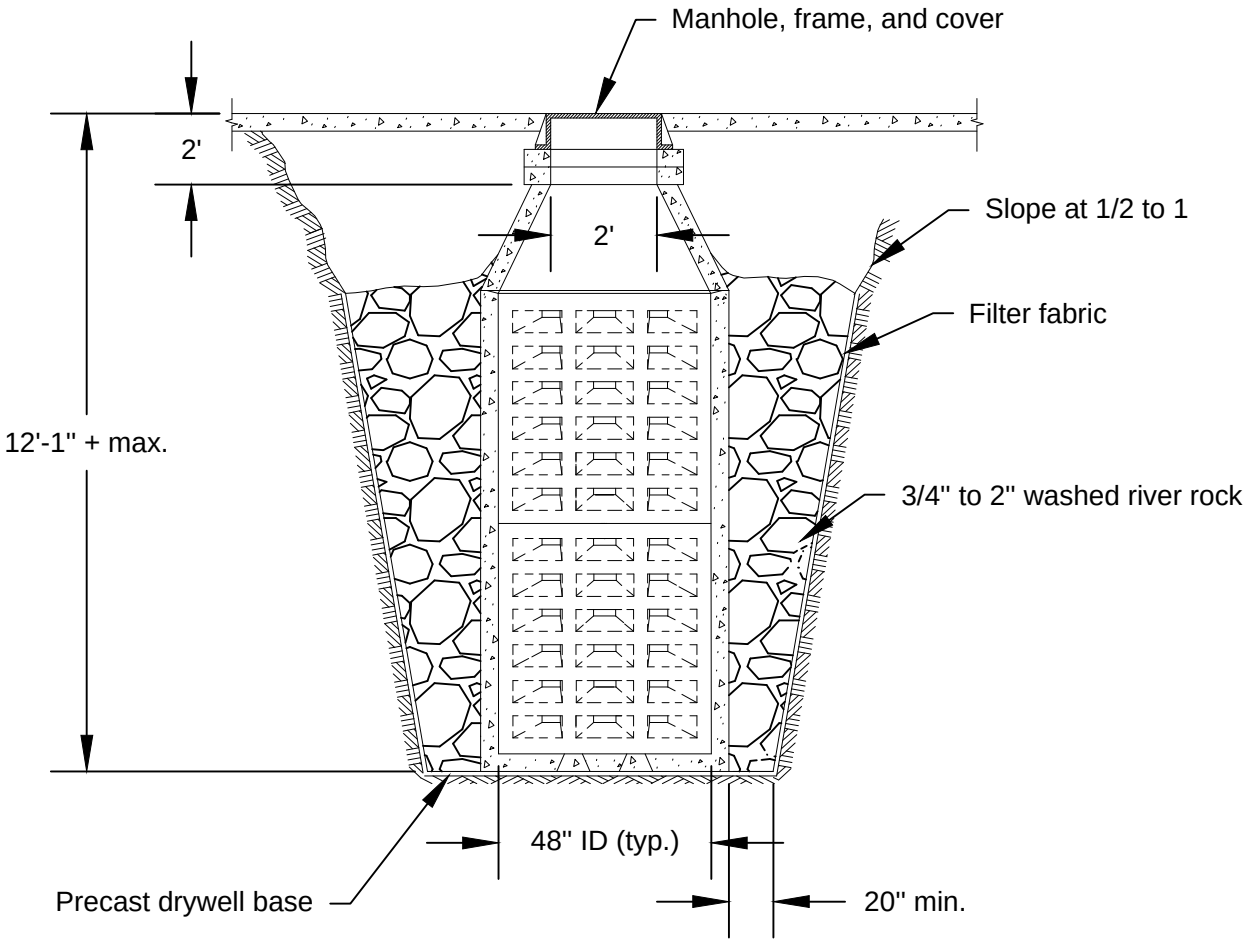
Typical Infiltration Drywell Type 1

Revised June 2018



Notes:

1. Backfill above filter fabric to base of asphalt with crushed surfacing base course.

2. Size and spacing of drywells determined by drainage analysis.

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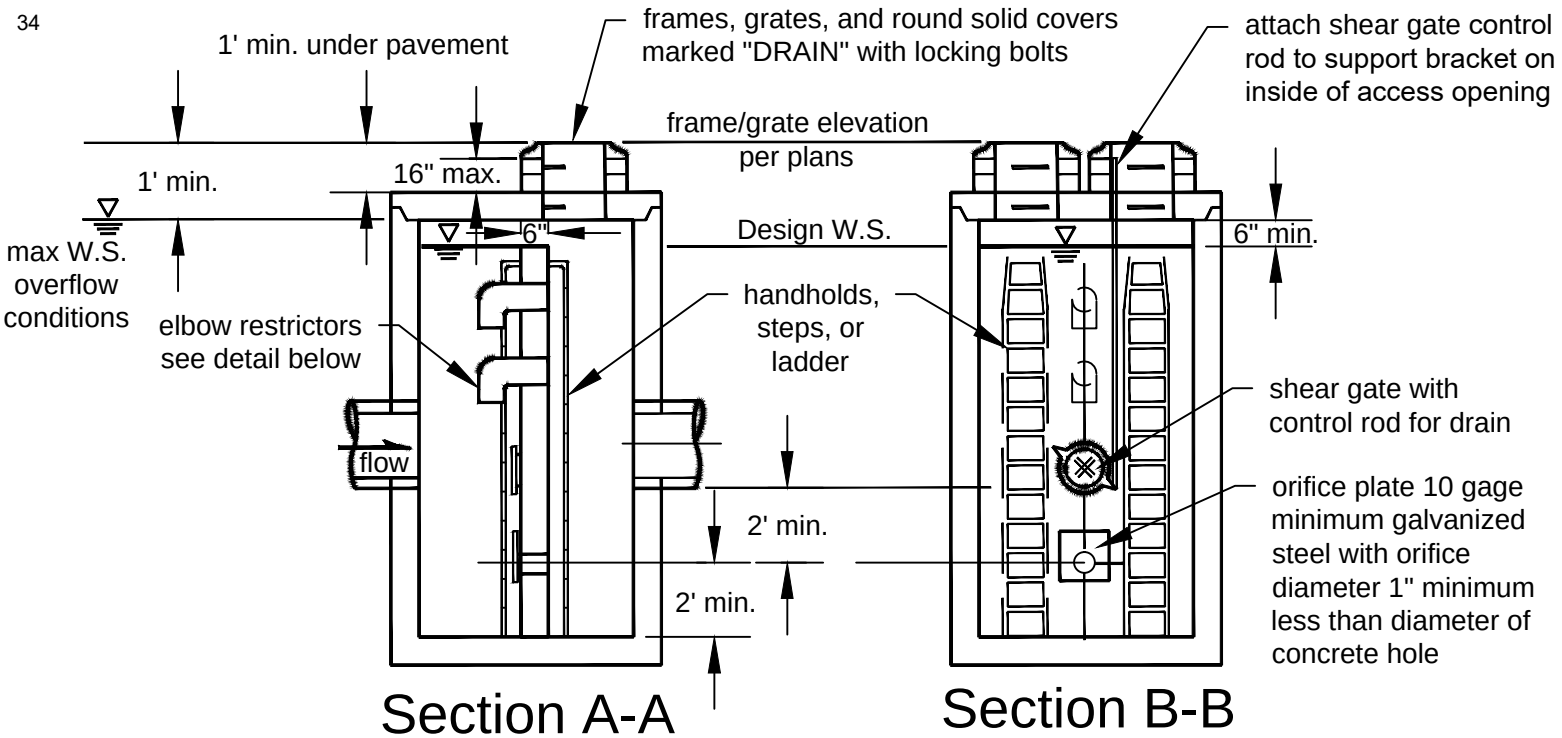
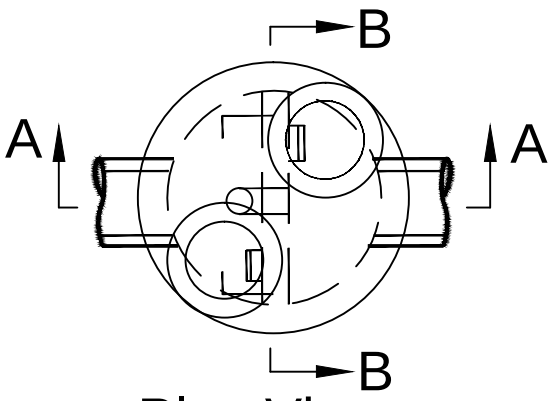
Typical Infiltration Drywell Type 2

Revised June 2018

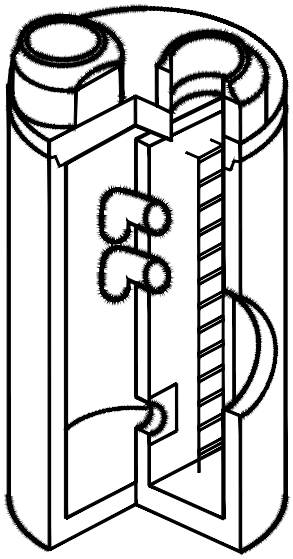


Section A-A

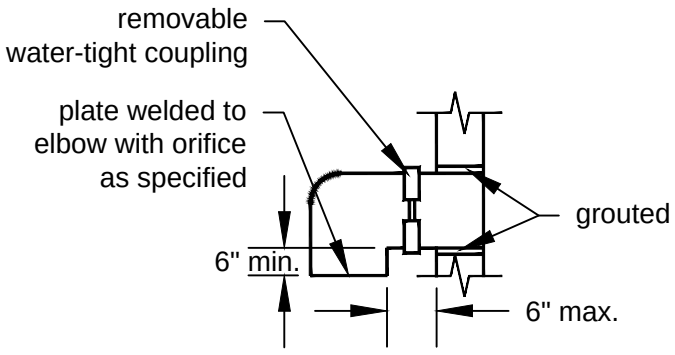
Section B-B



Plan View



Isometric



Elbow Restrictor Detail

Notes:

1. Outlet capacity: 100 year developed peak flow
2. Metal parts: corrosion resistant steel parts galvanized and asphalt coated
3. Catch basin: type 2 minimum 72" diameter
4. Orifices: sized and located as required with lowest orifice a minimum of 2' from base

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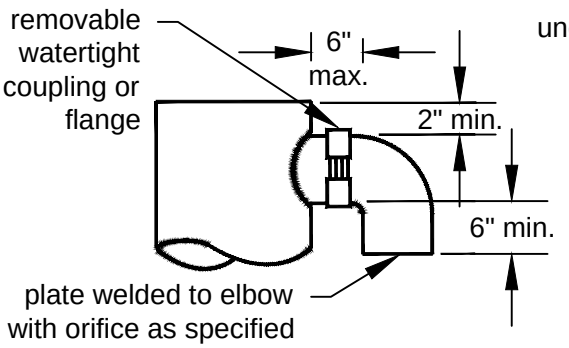
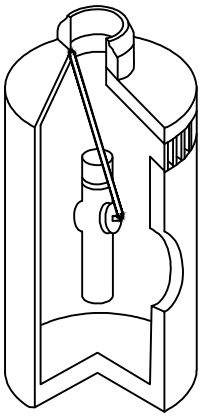
Flow Restrictor (Baffle)

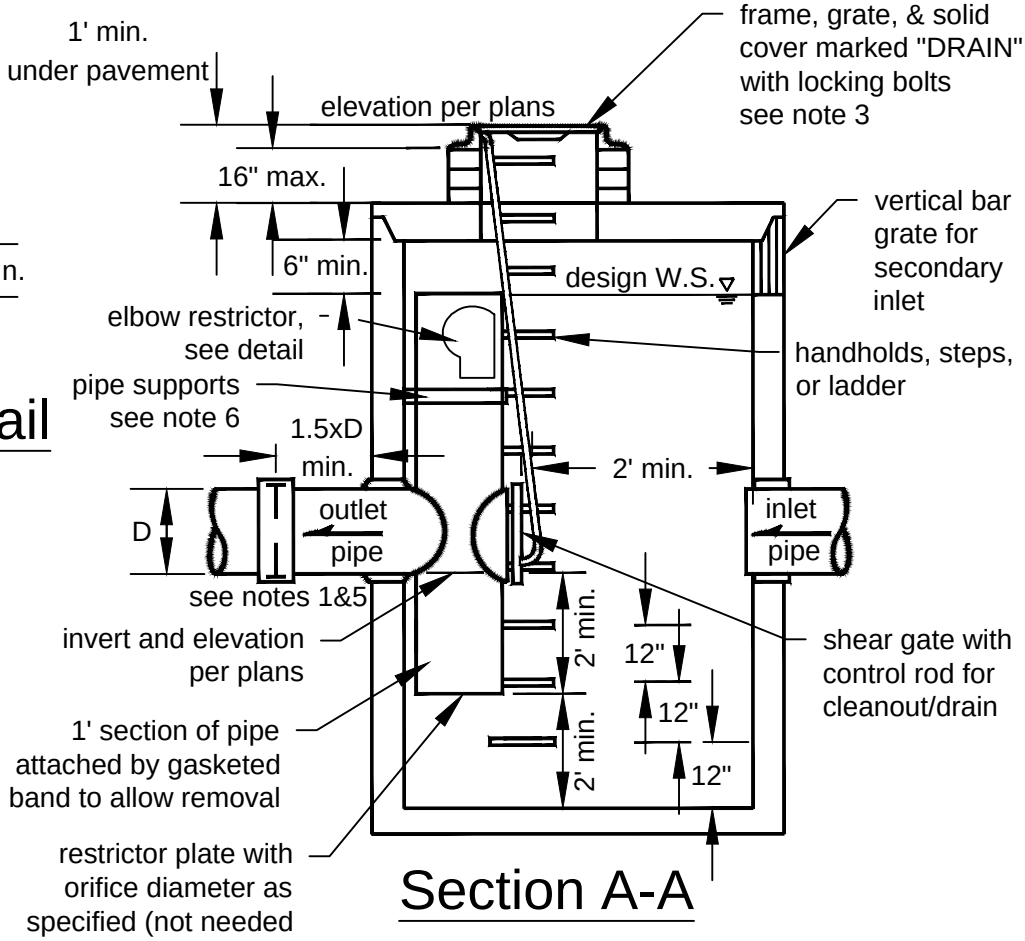
Revised June 2016



Elbow Restrictor Detail



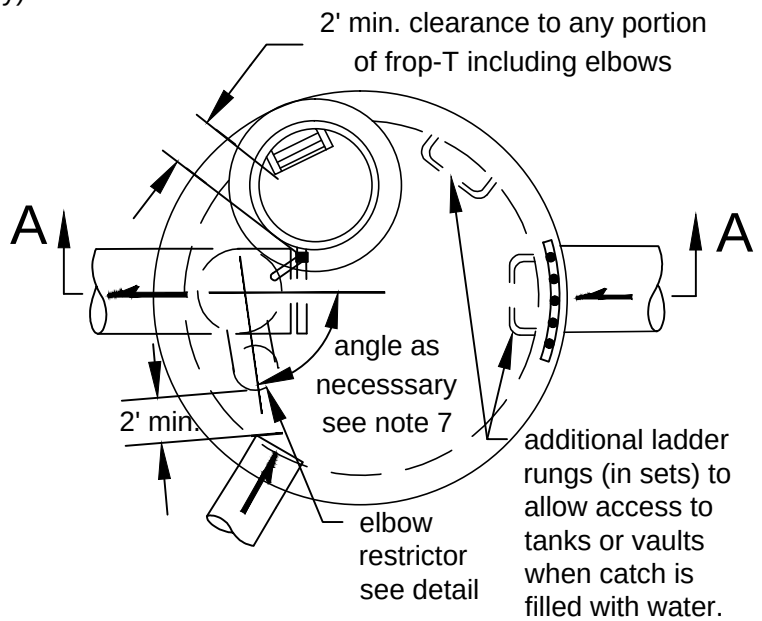
Isometric



Section A-A

Notes:

1. Use a minimum of a 54" diameter type 2 catch basin.
2. Outlet Capacity: 100-yr developed peak flow.
3. Metal Parts: Corrosion resistant. Non-Galvanized parts preferred. Galvanized pipe parts to have asphalt treatment 1.
4. Frame and ladder or steps offset so:
   A. Cleanout gate is visible from top.
   B. Climb-down space is clear of riser and cleanout gate.
   C. Frame is clear of curb.
5. If metal outlet pipe connects to cement concrete pipe: outlet pipe to have smooth O.D. equal to concrete pipe I.D. less ¼".
6. Provide at least one 3" x 0.90 inches support bracket anchored to concrete wall. (maximum 3'-0" vertical spacing)
7. Locate elbow restrictor(s) as necessary to provide minimum clearance as shown.
8. Locate additional ladder rungs in structures used as access to tanks or vaults to allow access when catch basin is filled with water.



Plan View

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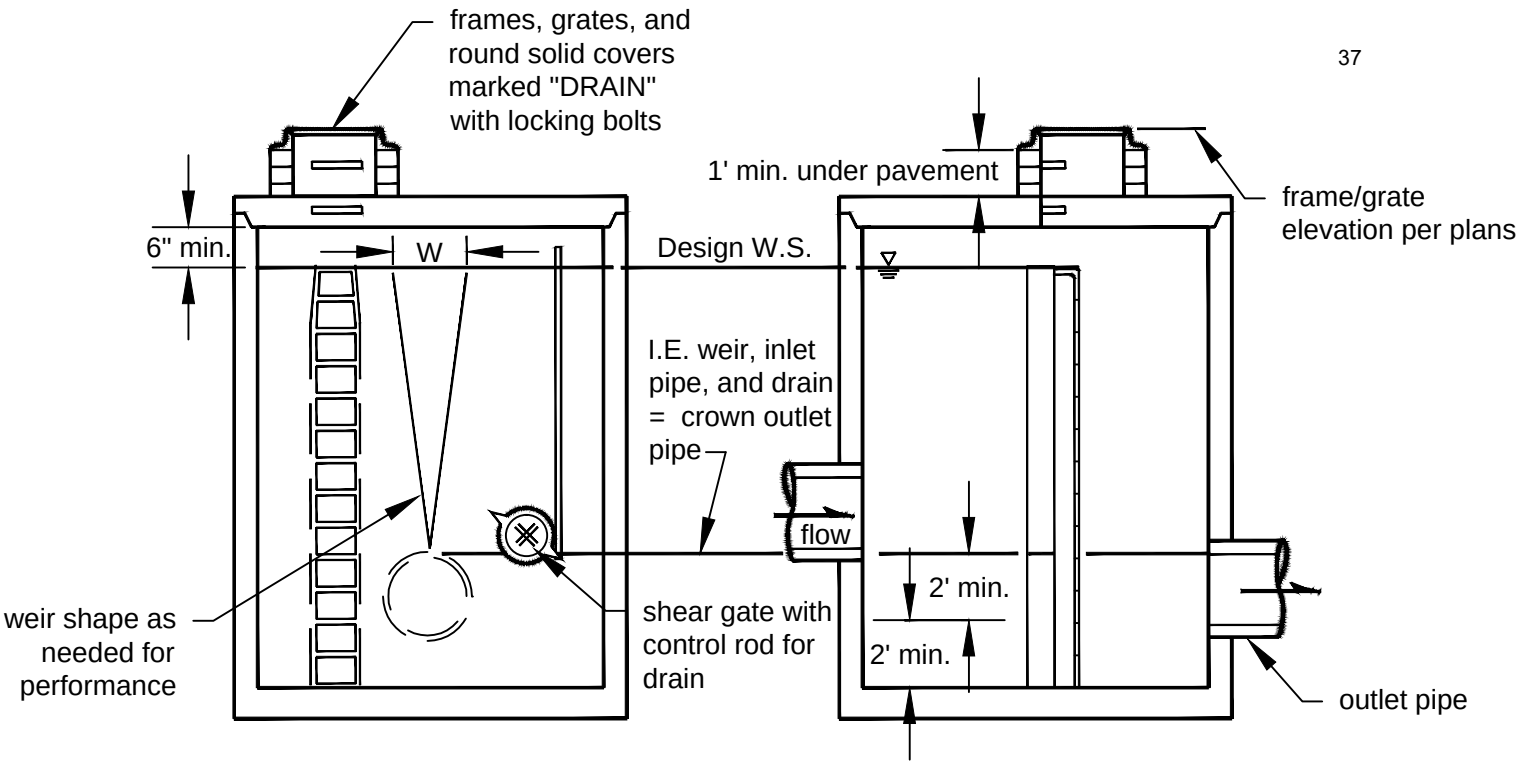
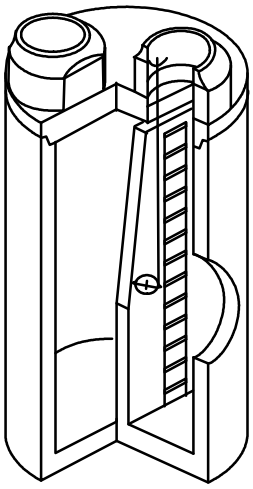
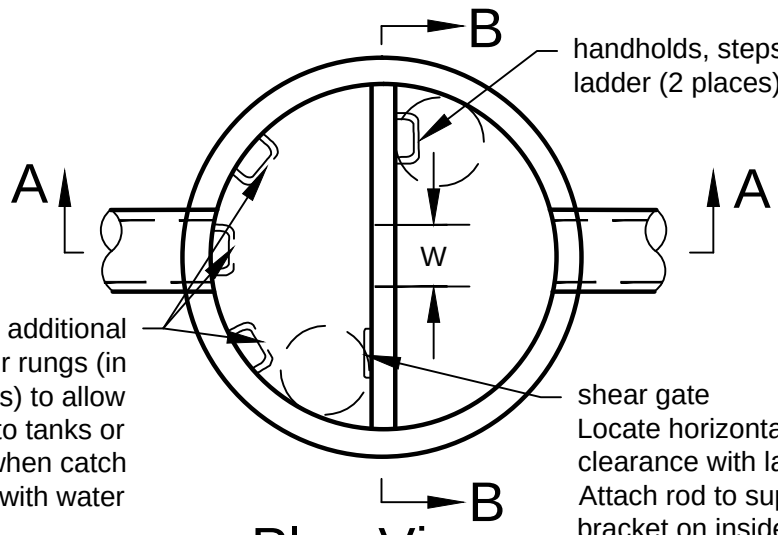
Flow Restrictor (TEE)

Revised June 2016





Isometric



Plan View

Notes:

1. Outlet Capacity: 100-year developed peak flow.
2. Metal Parts: corrosion resistant steel parts galvanized and asphalt coated.
3. Catch Basin: type 2 min. 72" diameter.
4. Baffle Wall: to be designed with concrete reinforcing as required.
5. Spill containment must be provided to temporarily detain oil or floatable pollutants in runoff due to accidental spill or illegal dumping.

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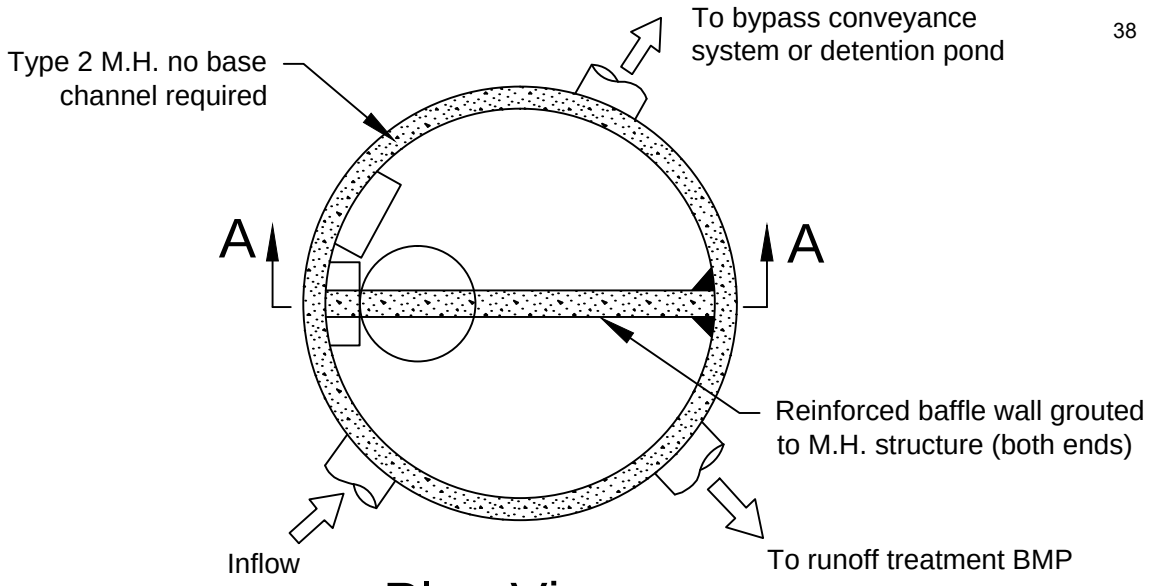
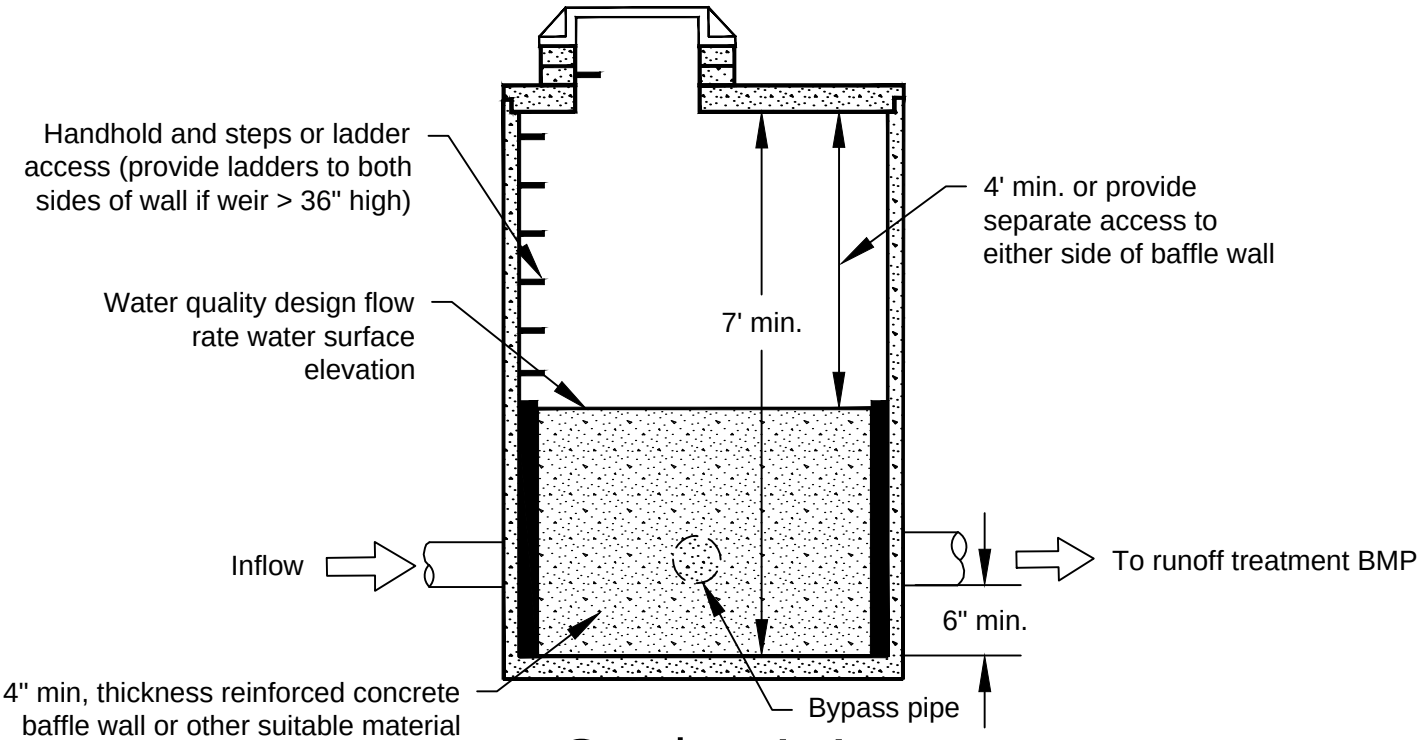
Flow Restrictor (Weir)

Revised June 2016



Plan View



Section A-A

Note: The outlet pipe to the Runoff Treatment BMP may require an orifice plate installed on the outlet to control the water quality design flow rate water surface elevation (weir height). The water quality design flow rate water surface elevation should be set to provide a minimum headwater/diameter ratio of 2.0 on the outlet pipe.

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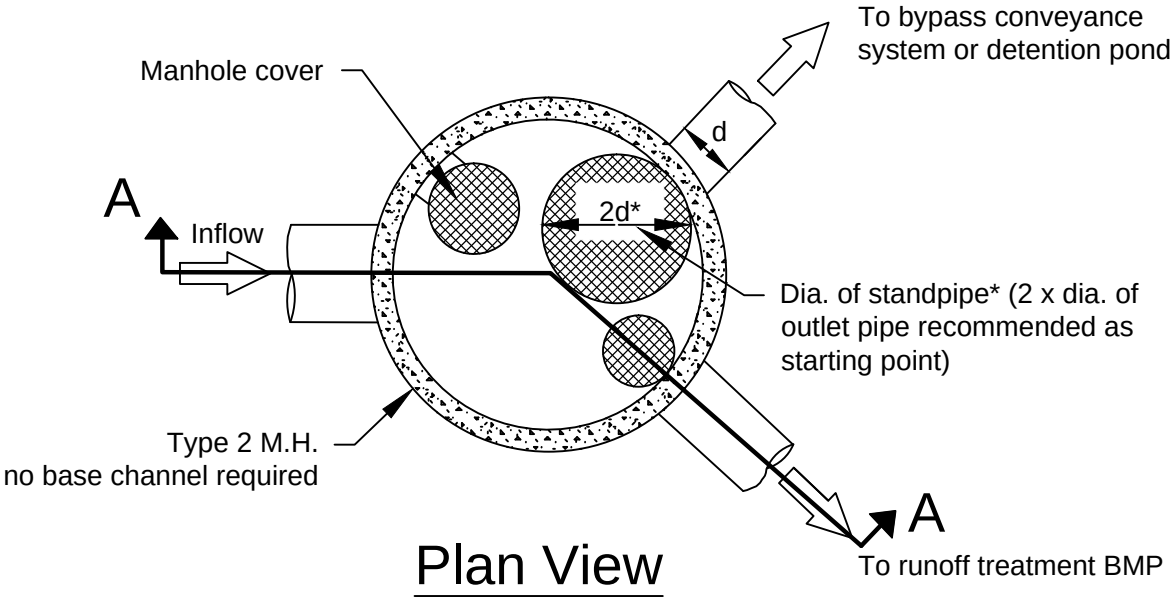
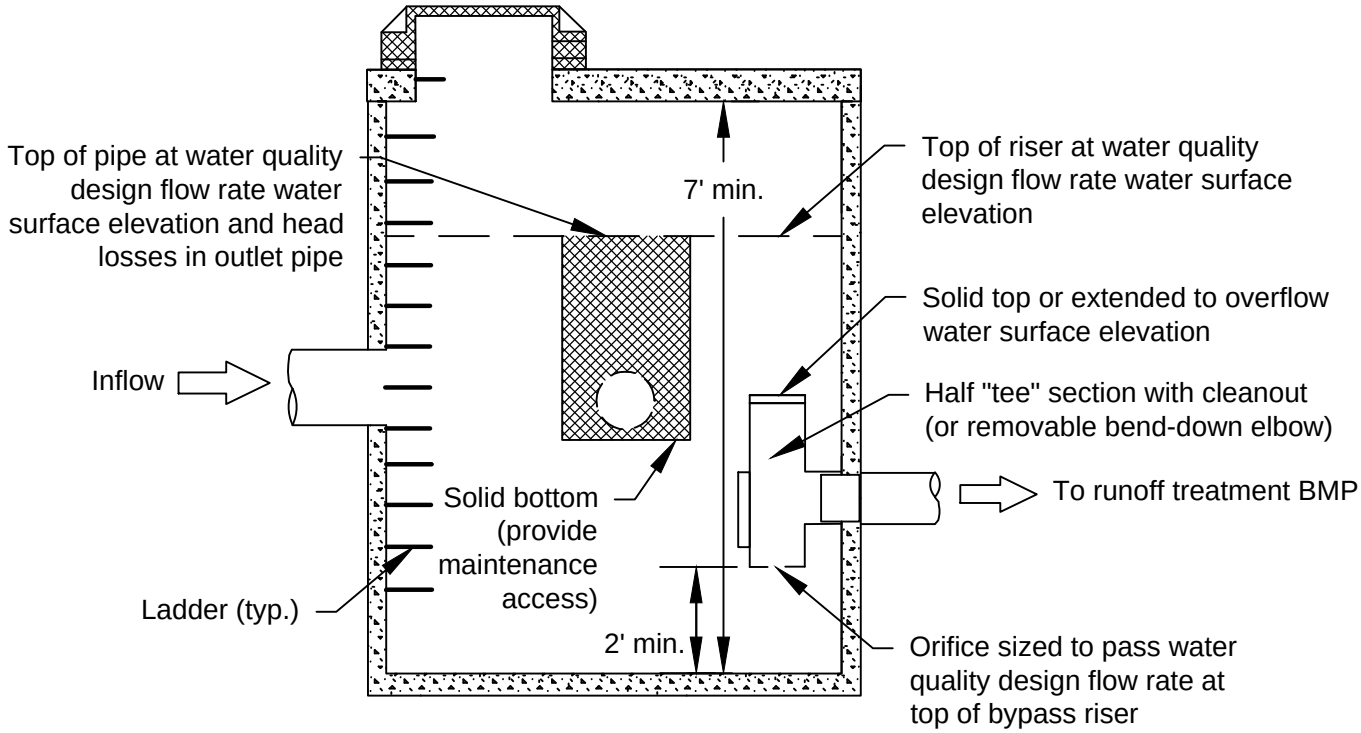
Flow Splitter, Option A

Revised May 2017



Plan View



Section A-A

*Note: Diameter of standpipe (2d) should be large enough to minimize head above water quality design water surface and to keep water quality design flows from increasing more than 10% during 100-year flows.

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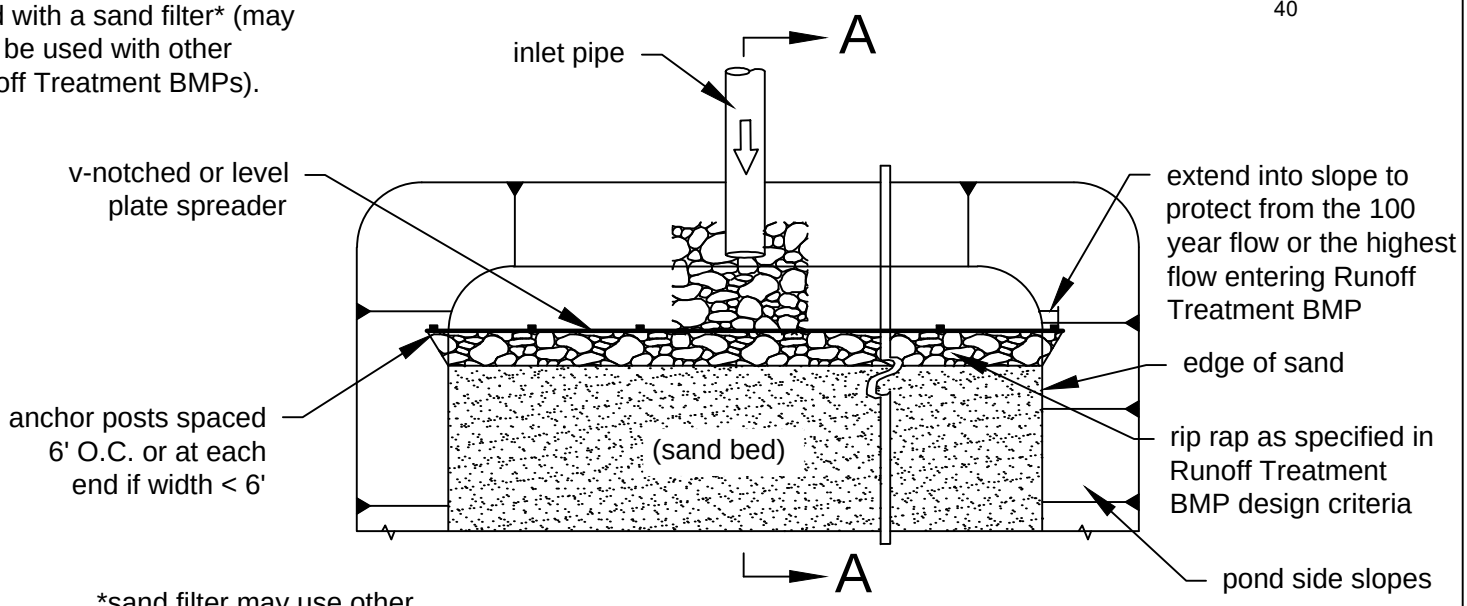
Flow Splitter, Option B

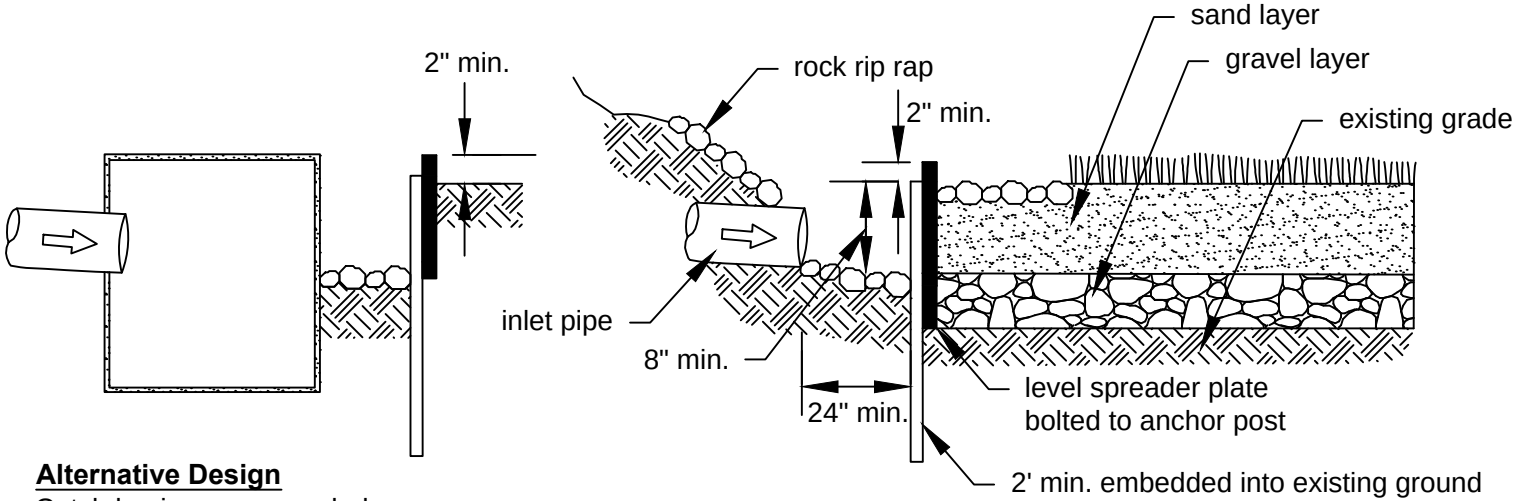
Revised May 2017

Example of anchored plate used with a sand filter* (may also be used with other Runoff Treatment BMPs).



*sand filter may use other spreading options

Plan View



Alternative Design
Catch basin recommended for higher flow situations (generally for inflow velocities of 5 fps or greater for 100 year storm).

Section A-A

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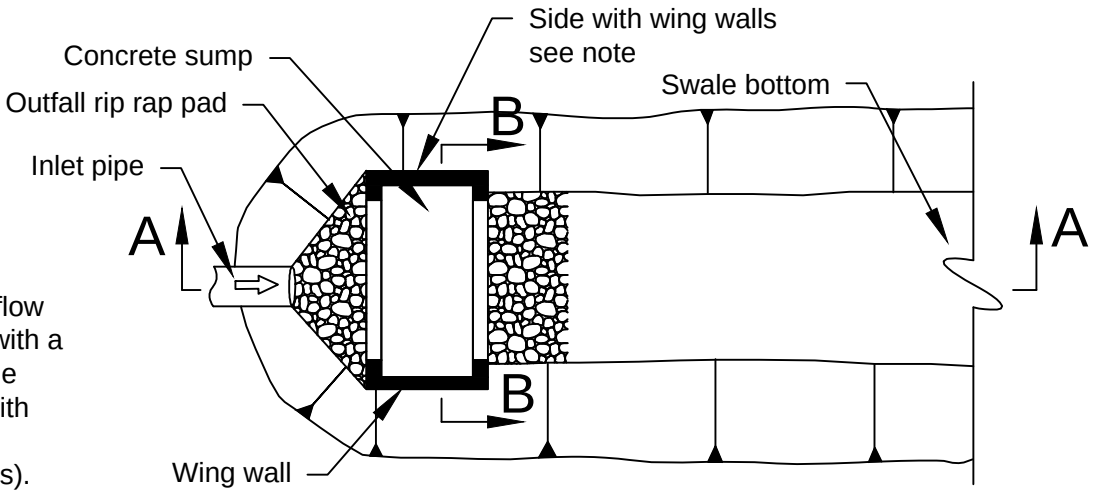
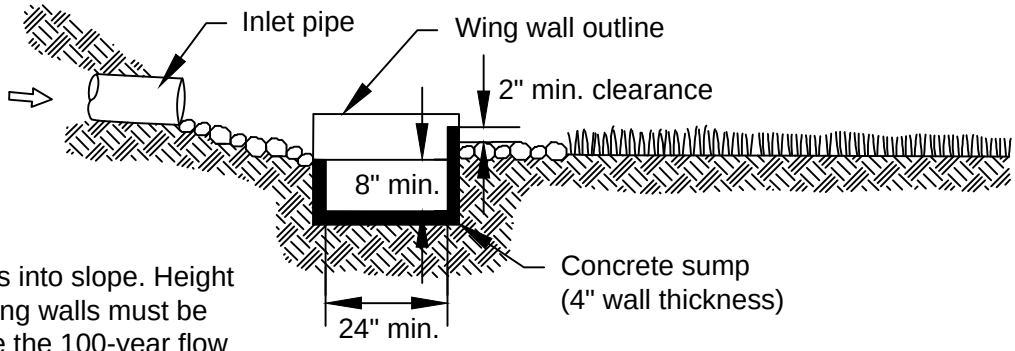
Flow Spreader Option A: Anchored Plate

Revised May 2017

Example of a concrete sump flow spreader used with a biofiltration swale (may be used with other Runoff Treatment BMPs).

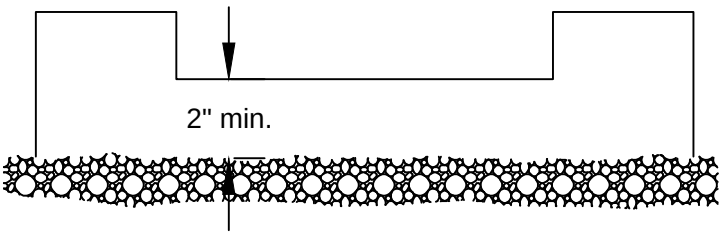


Plan View



Note: Extend sides into slope. Height of side wall and wing walls must be sufficient to handle the 100-year flow or the highest flow entering the BMP.

Section A-A



Section B-B

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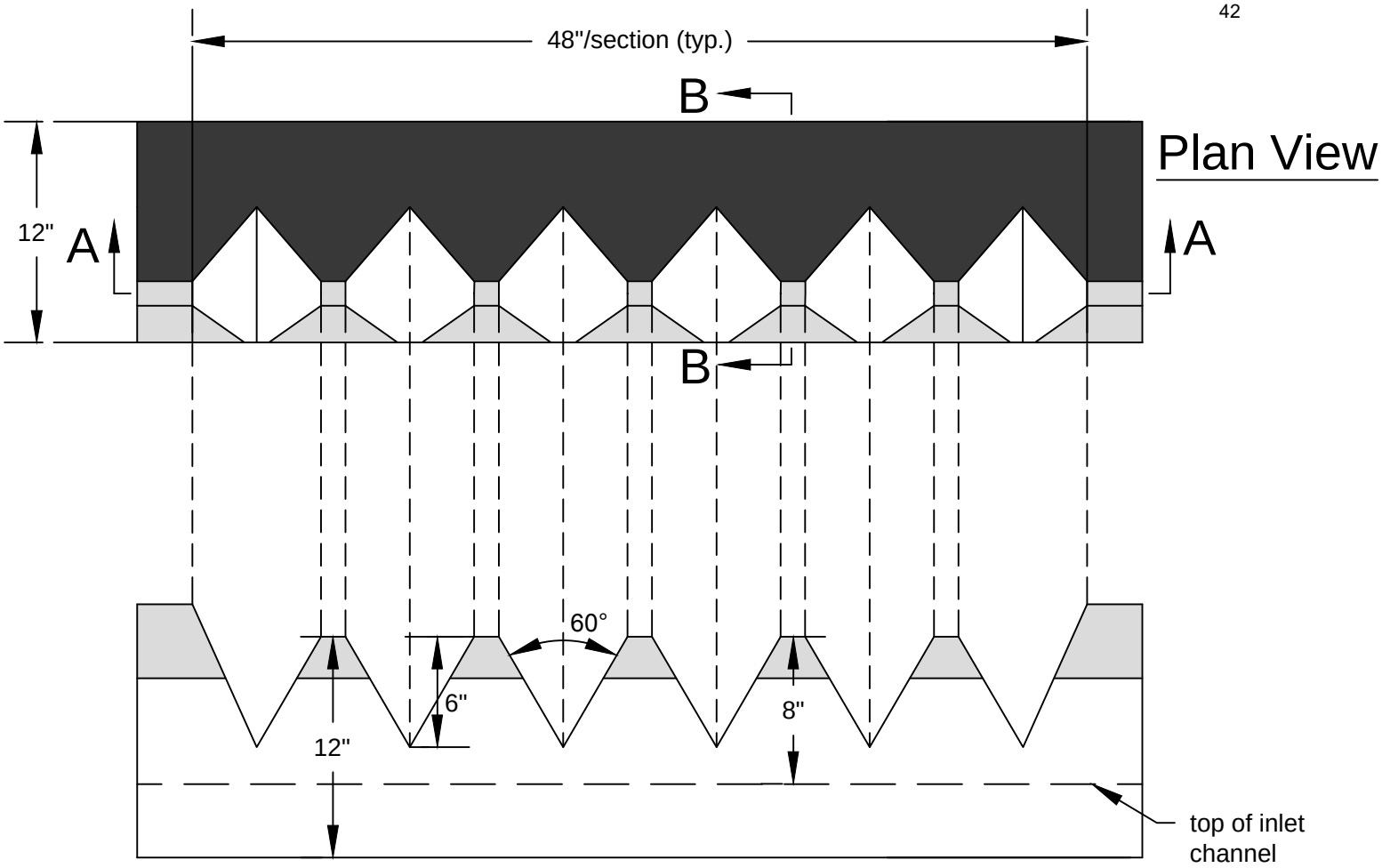
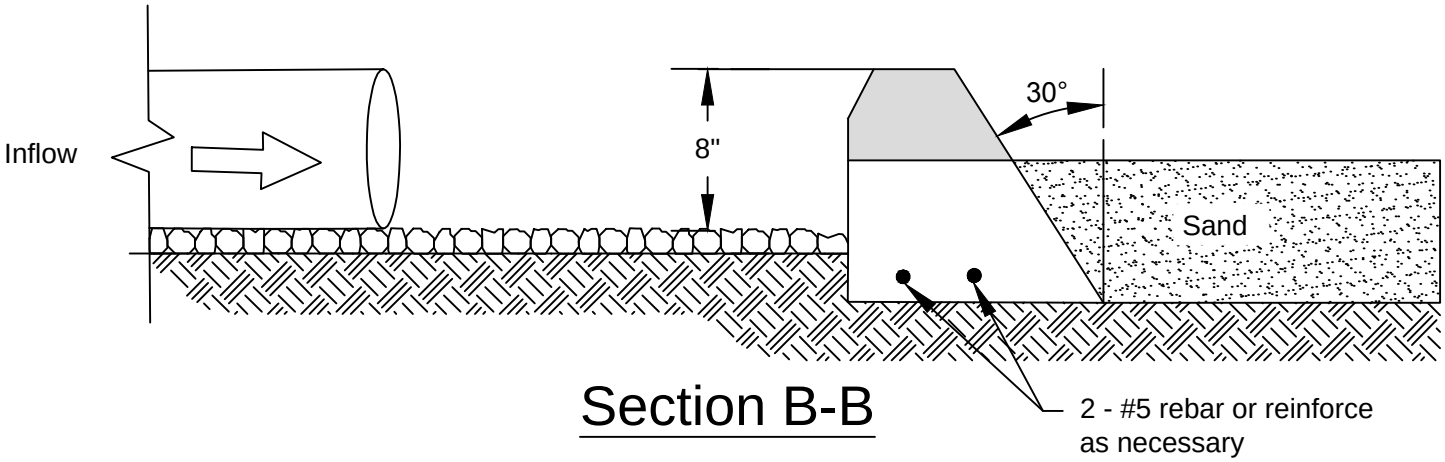
Flow Spreader Option B: Concrete Sump Box

Revised May 2017



Front View A-A



Section B-B

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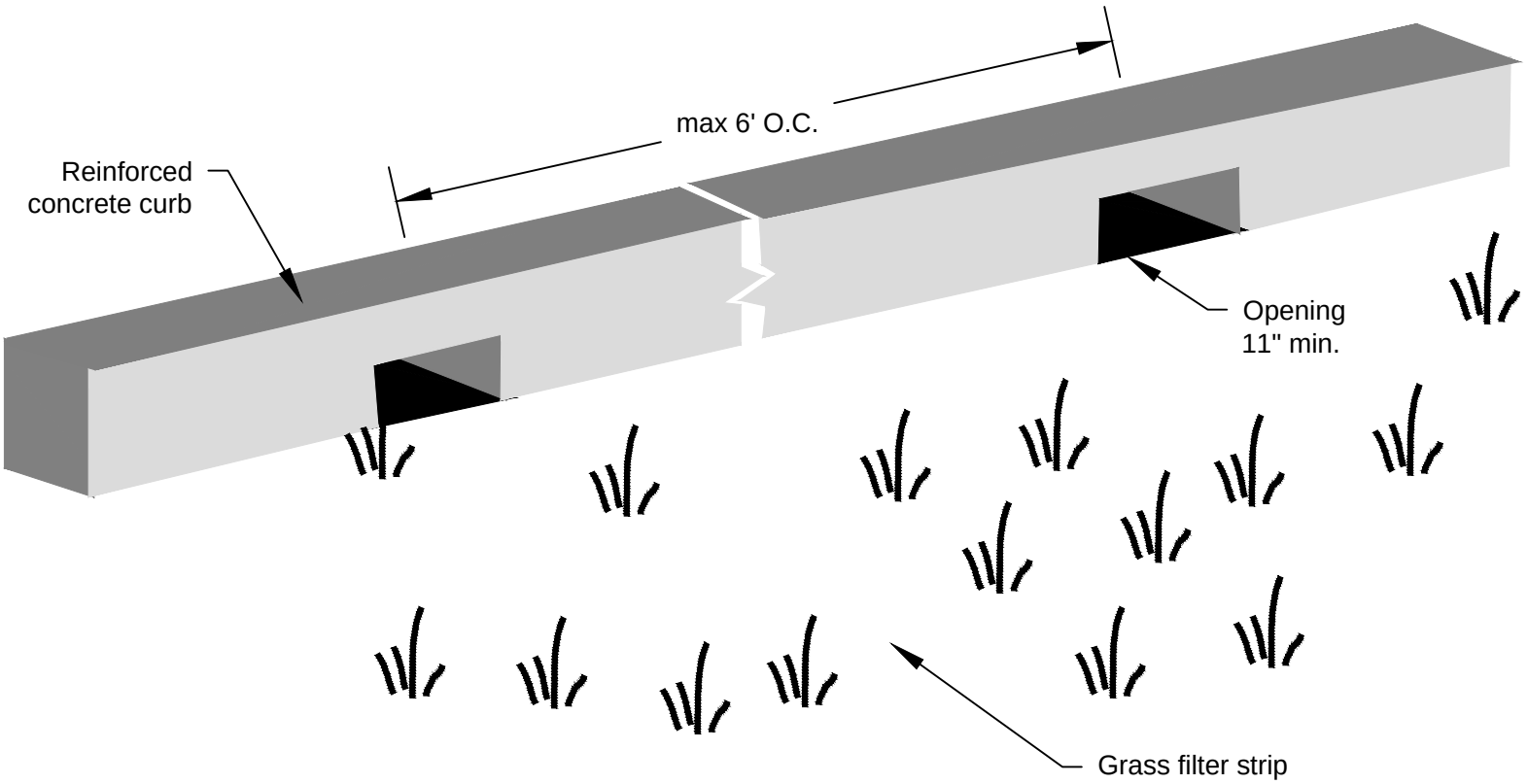
Flow Spreader Option C: Notched Curb Spreader

Revised May 2017



Curb Port

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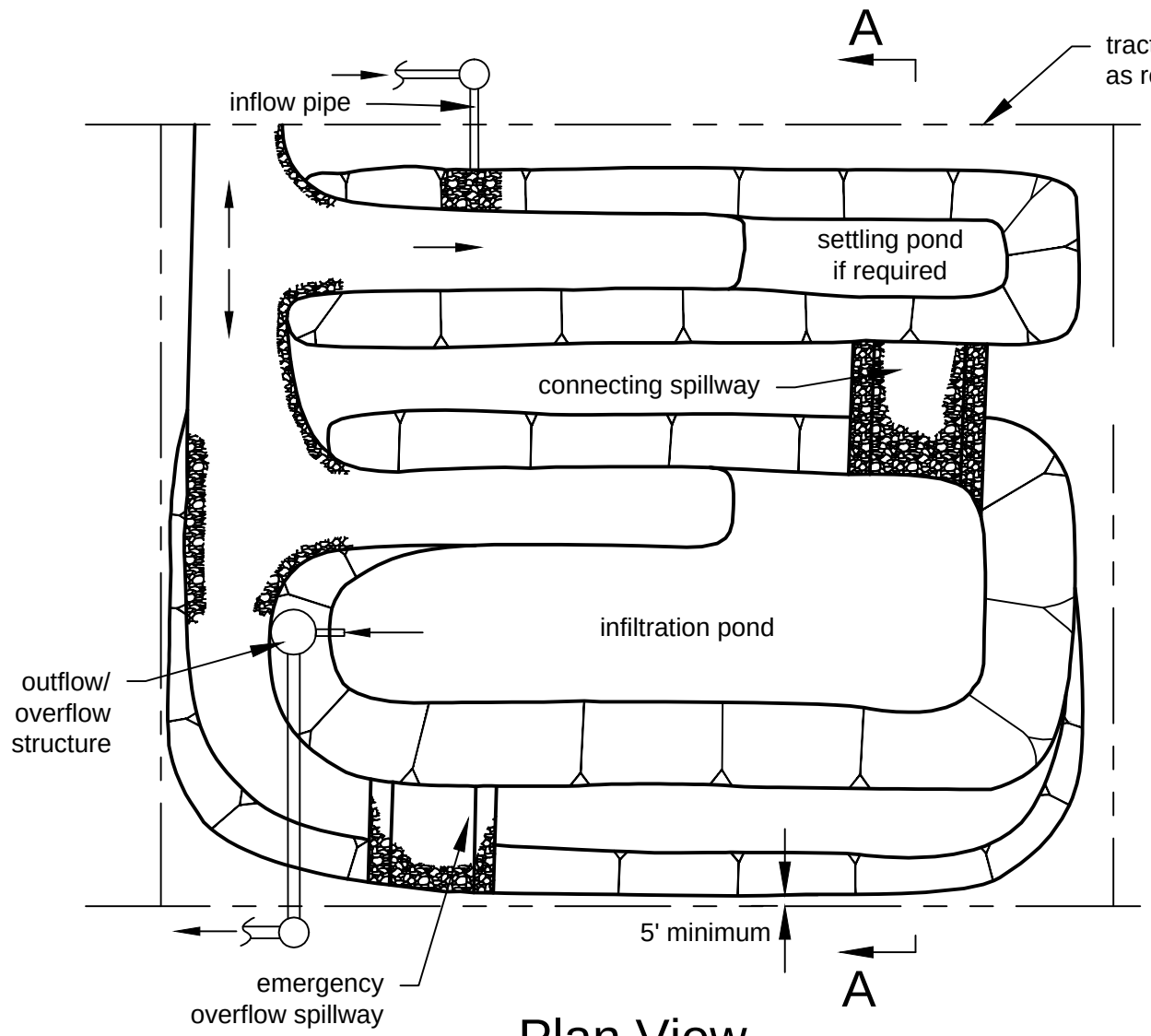
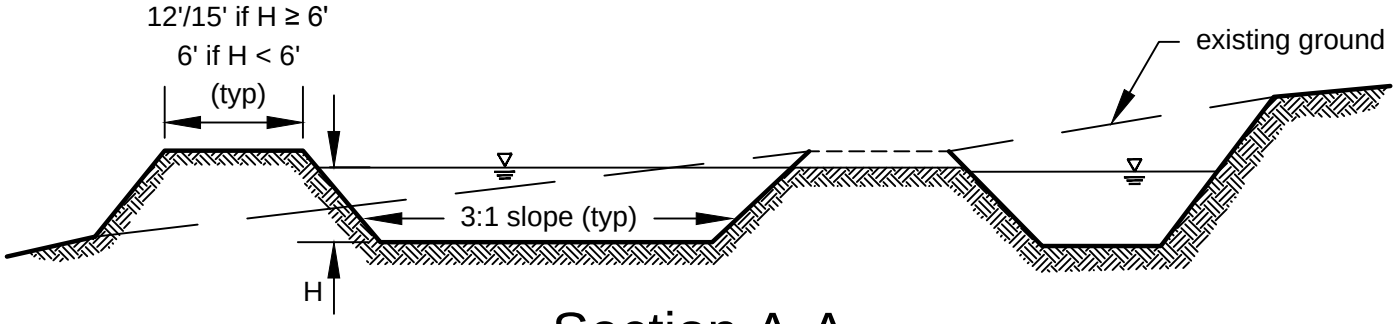
Flow Spreader Option D: Through-Curb Port

Revised June 2016



Plan View

overflow/emergency overflow



Section A-A

Note:
Detail is a schematic representation only. Actual configuration will vary depending on specific site constraints and applicable design criteria.

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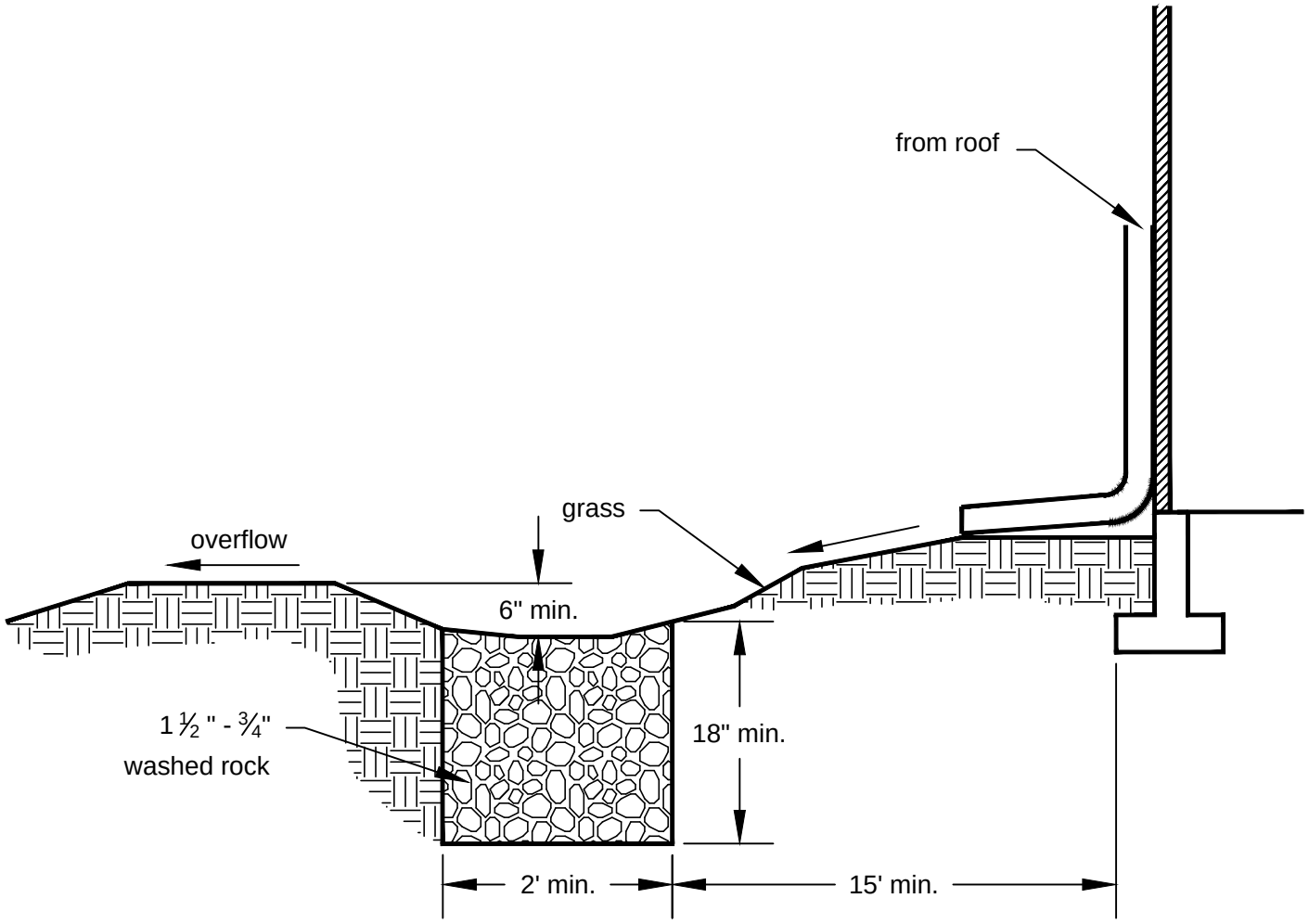
Typical Infiltration Pond/Basin

Revised June 2016



Note: Same length dimensions and site limitations as typical system

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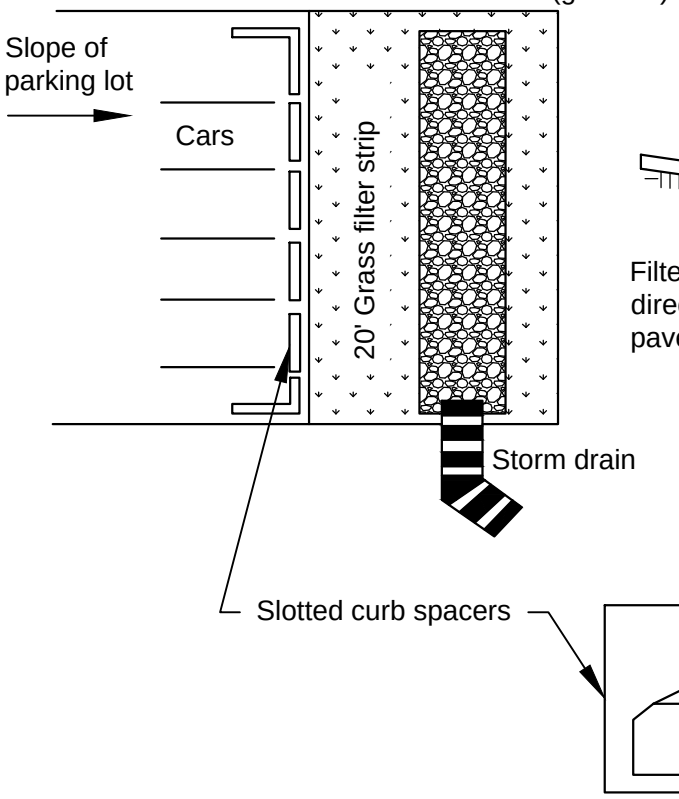
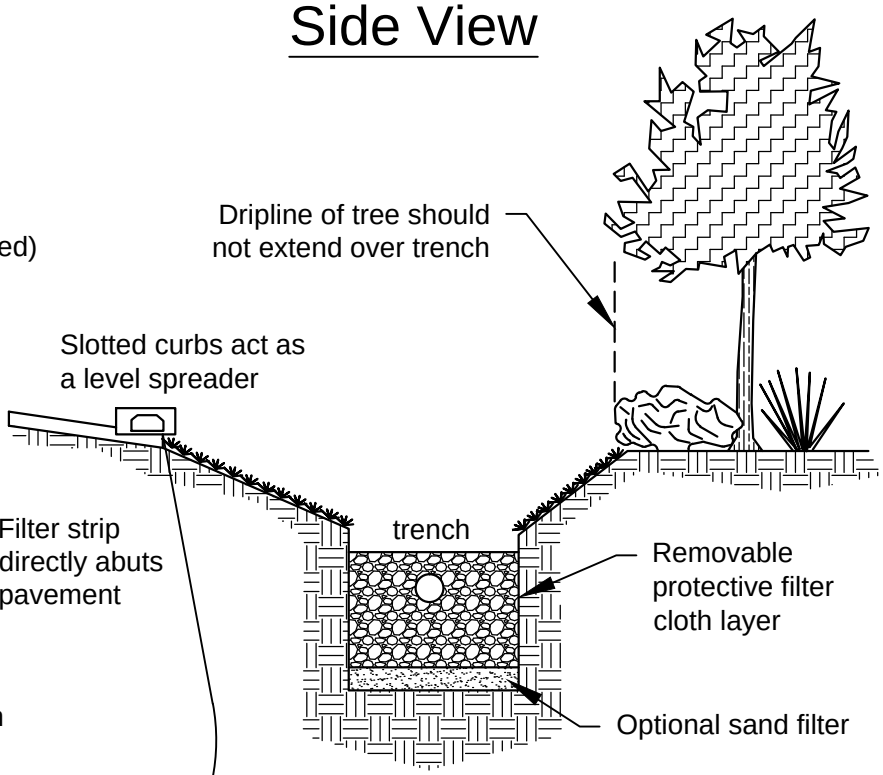
Alternative Downspout Infiltration Trench System for Coarse Sand and Gravel

Revised June 2016

Top View



Side View



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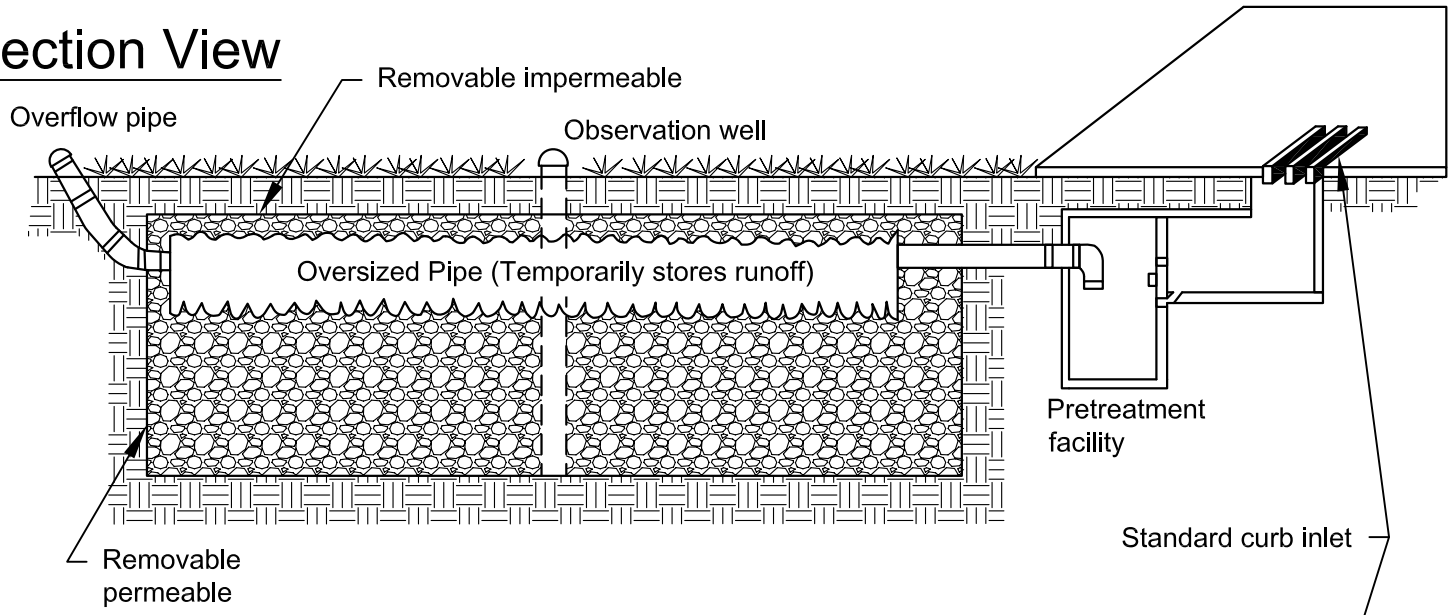
State of Washington

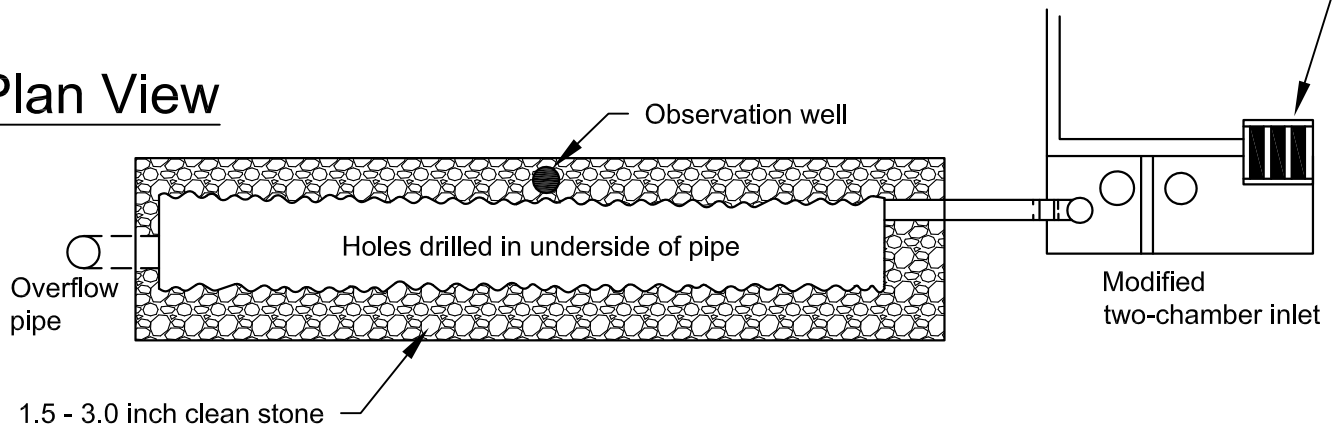
Parking Lot Perimeter Trench Design

Revised June 2016

Section View



Plan View



Note: Alternative storage devices, such as plastic arches, are also acceptable in place of oversized pipe.

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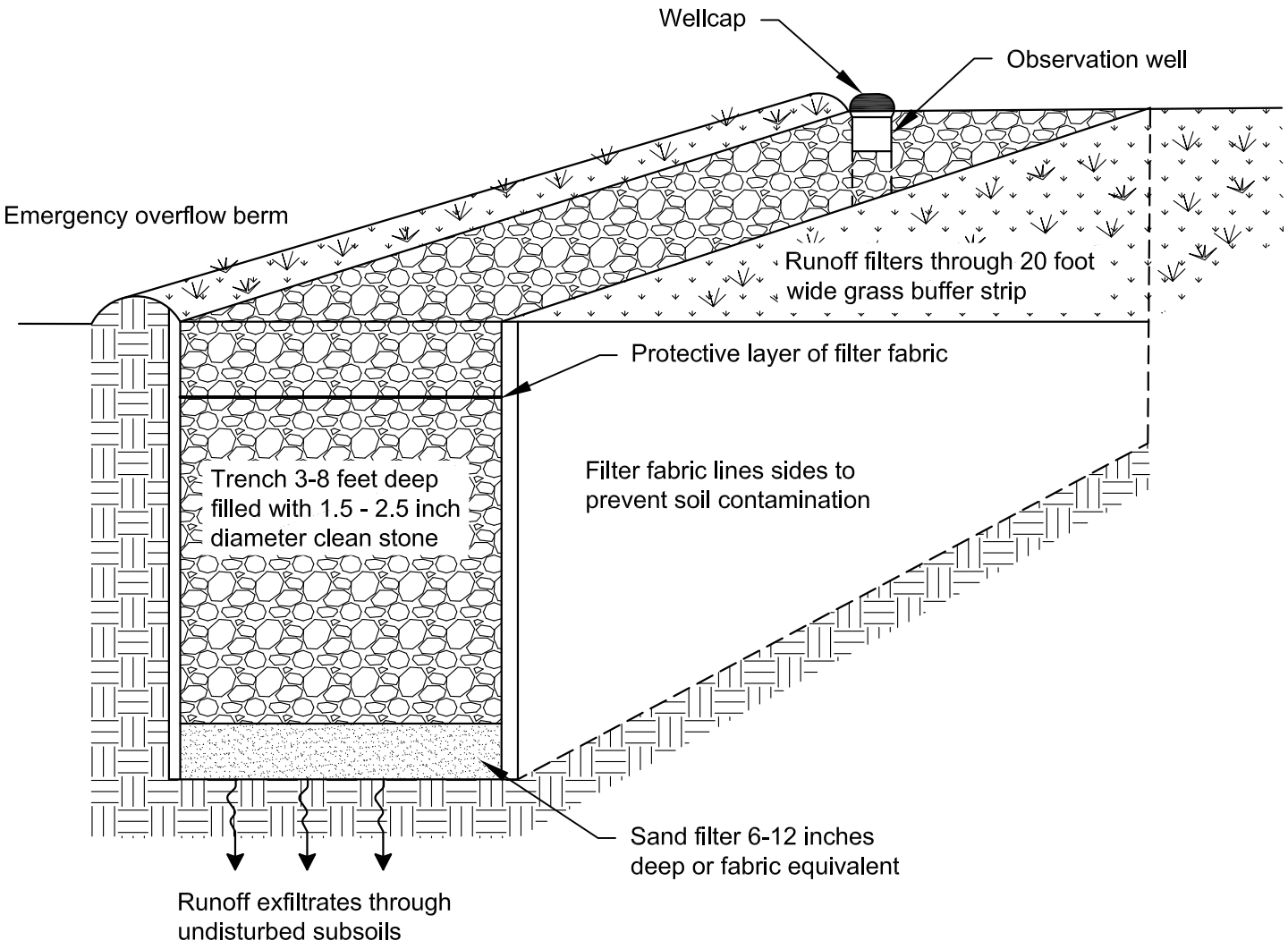
Oversized Pipe Trench Design

Revised May 2019



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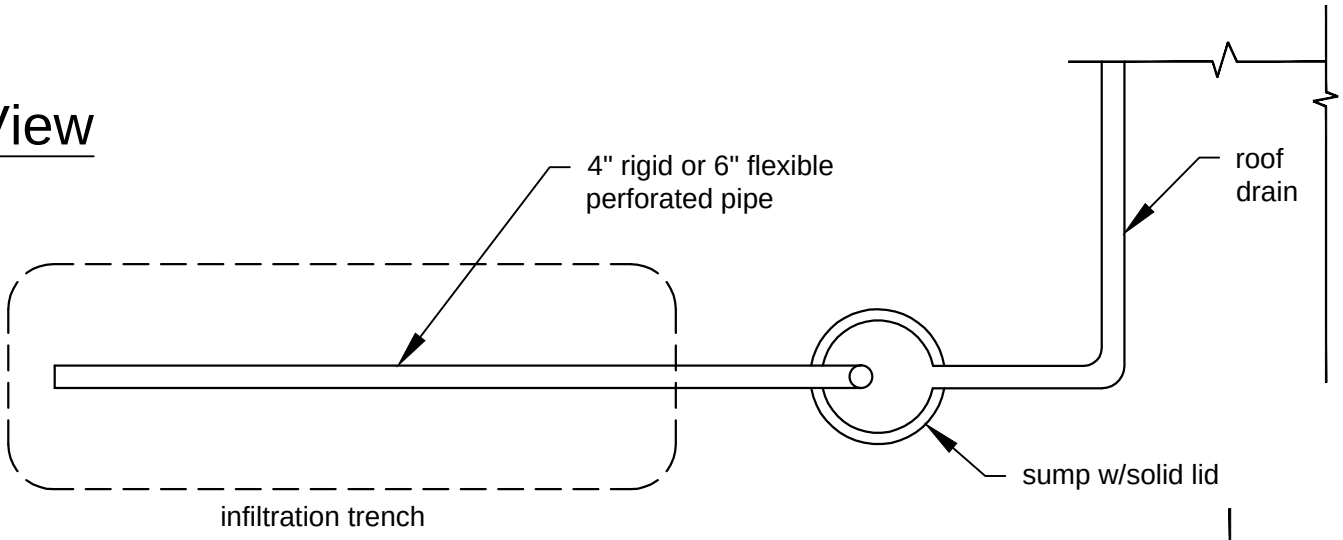
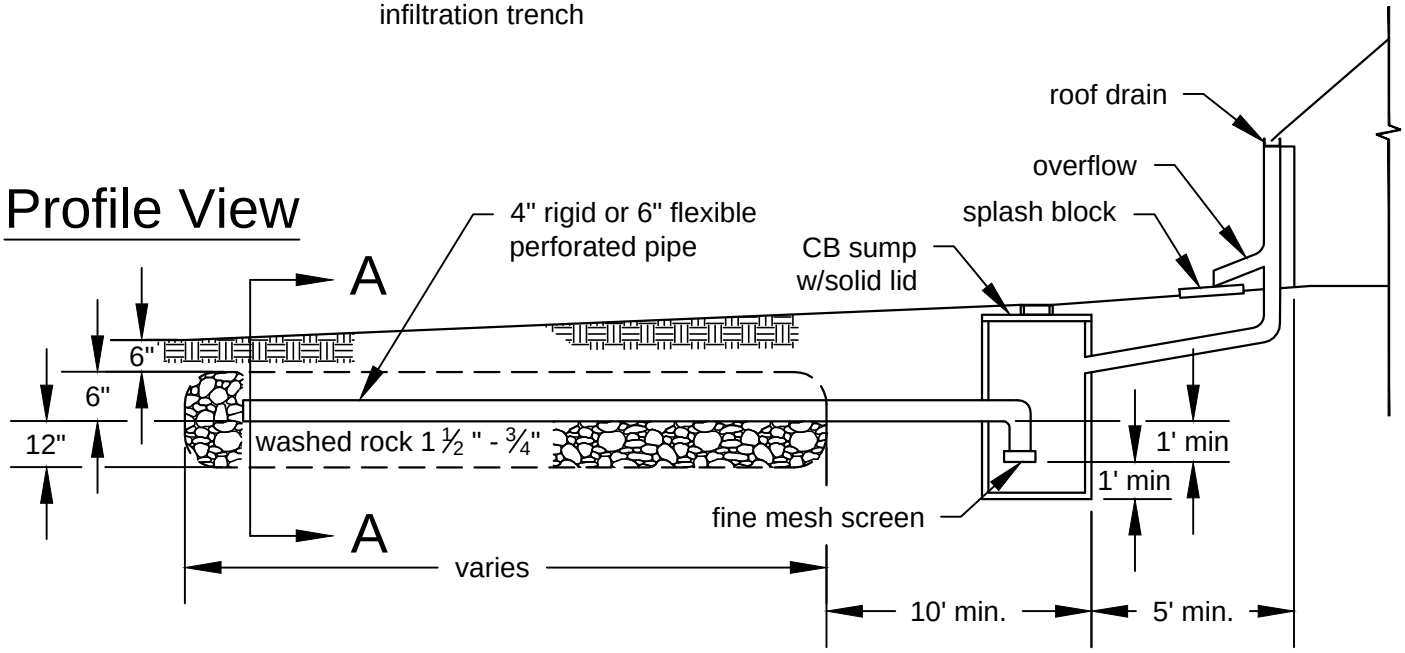
Schematic of an Infiltration Trench

Revised May 2019

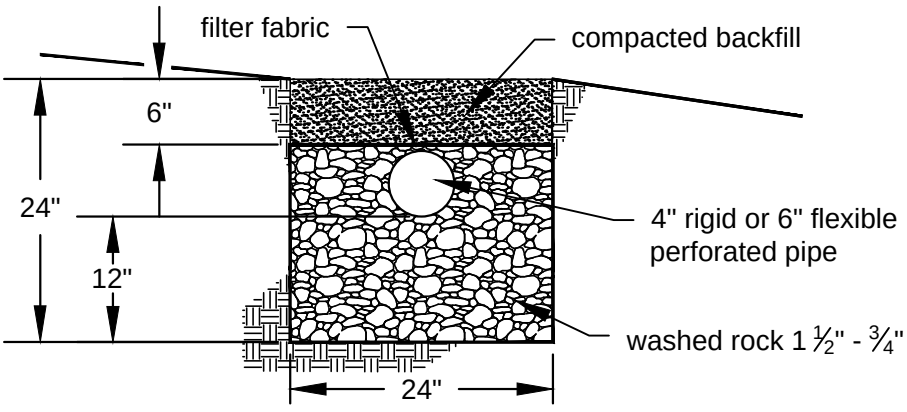
Plan View



Profile View



Section A-A



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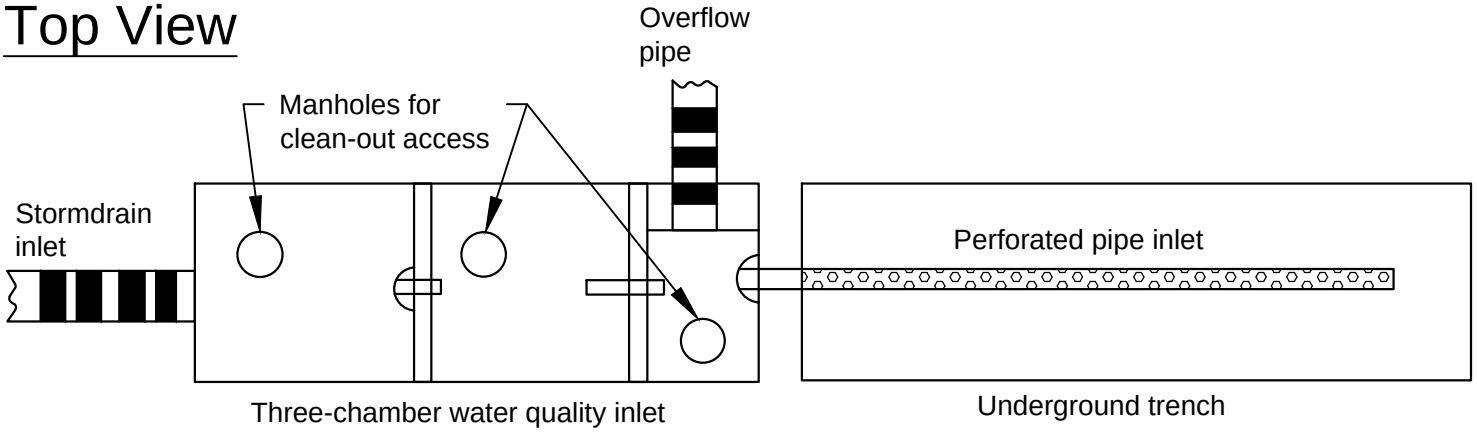
State of Washington

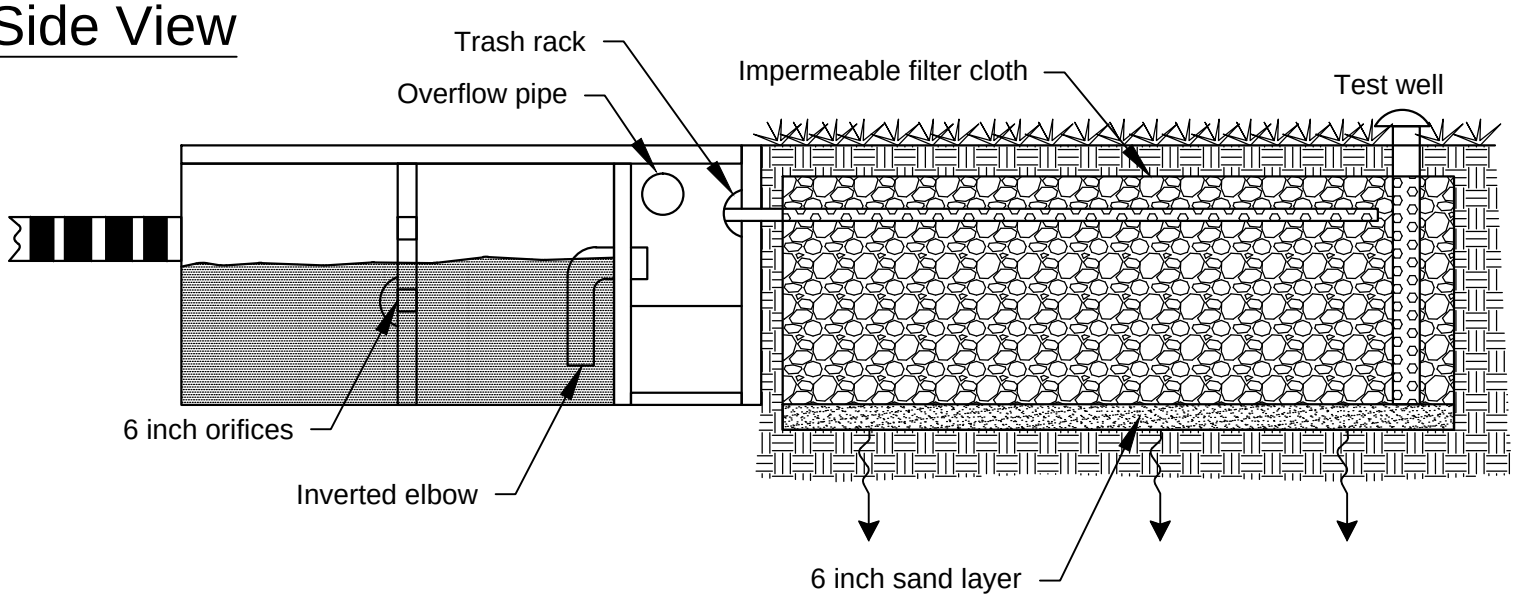
Typical Downspout Infiltration Trench

Revised June 2016

Top View



Side View



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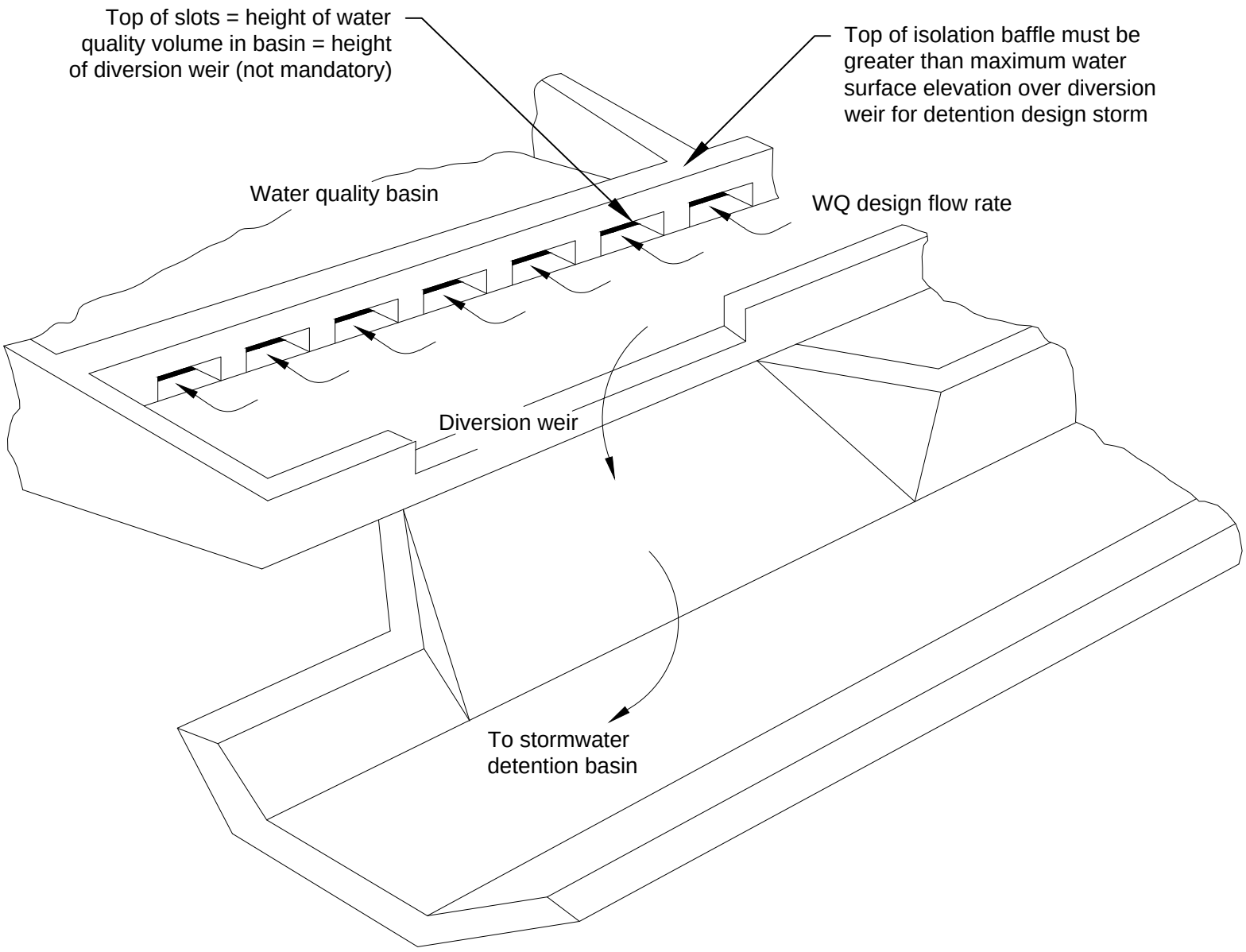
Underground Trench with Oil/Grit Chamber

Revised June 2016



Source: City of Austin

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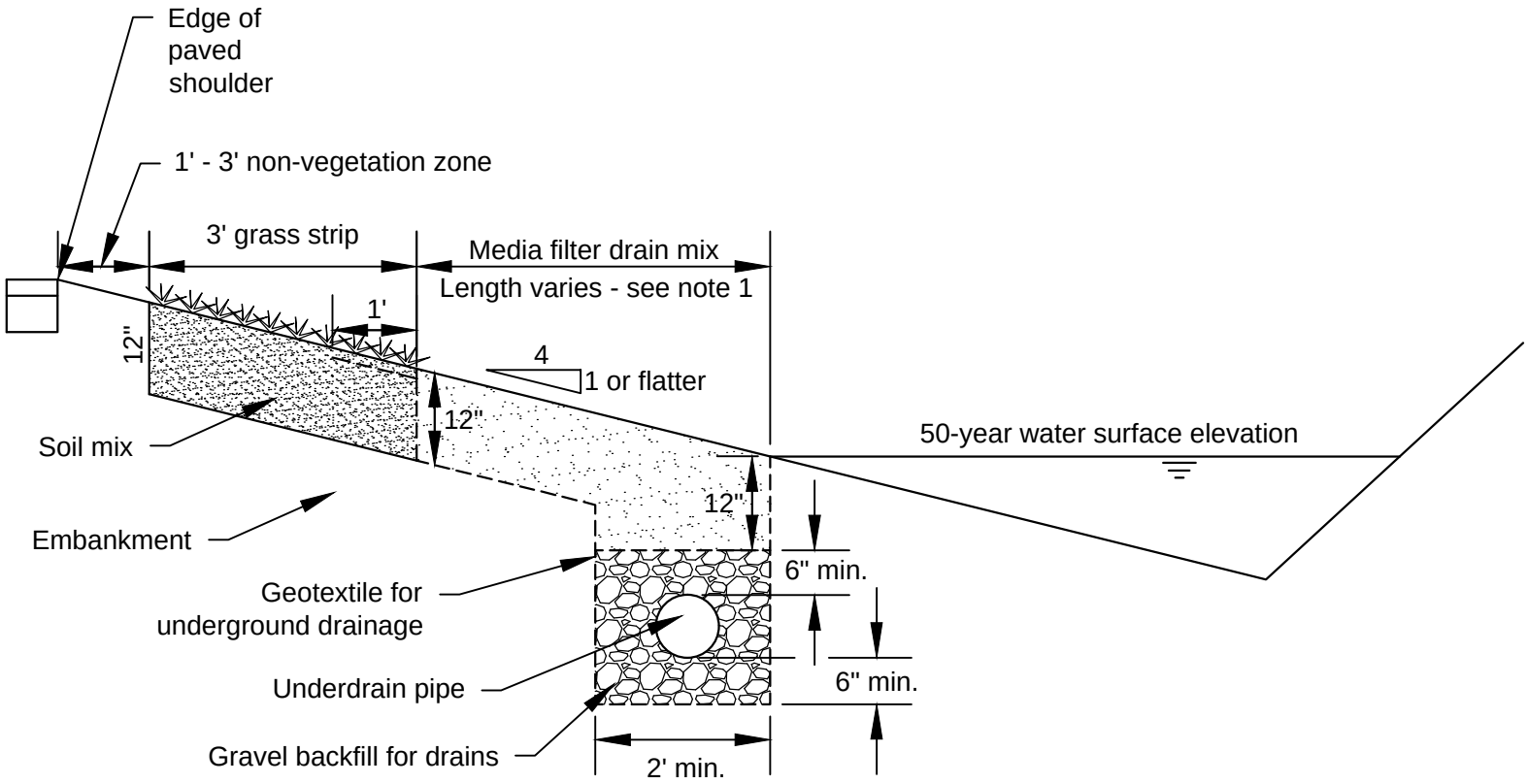
Example of an Isolation/Diversion Structure

Revised June 2016



Notes:

1. See "structural design considerations"

Side Slope Application with Underdrain

This drawing is only a template and should be modified to fit each project application.

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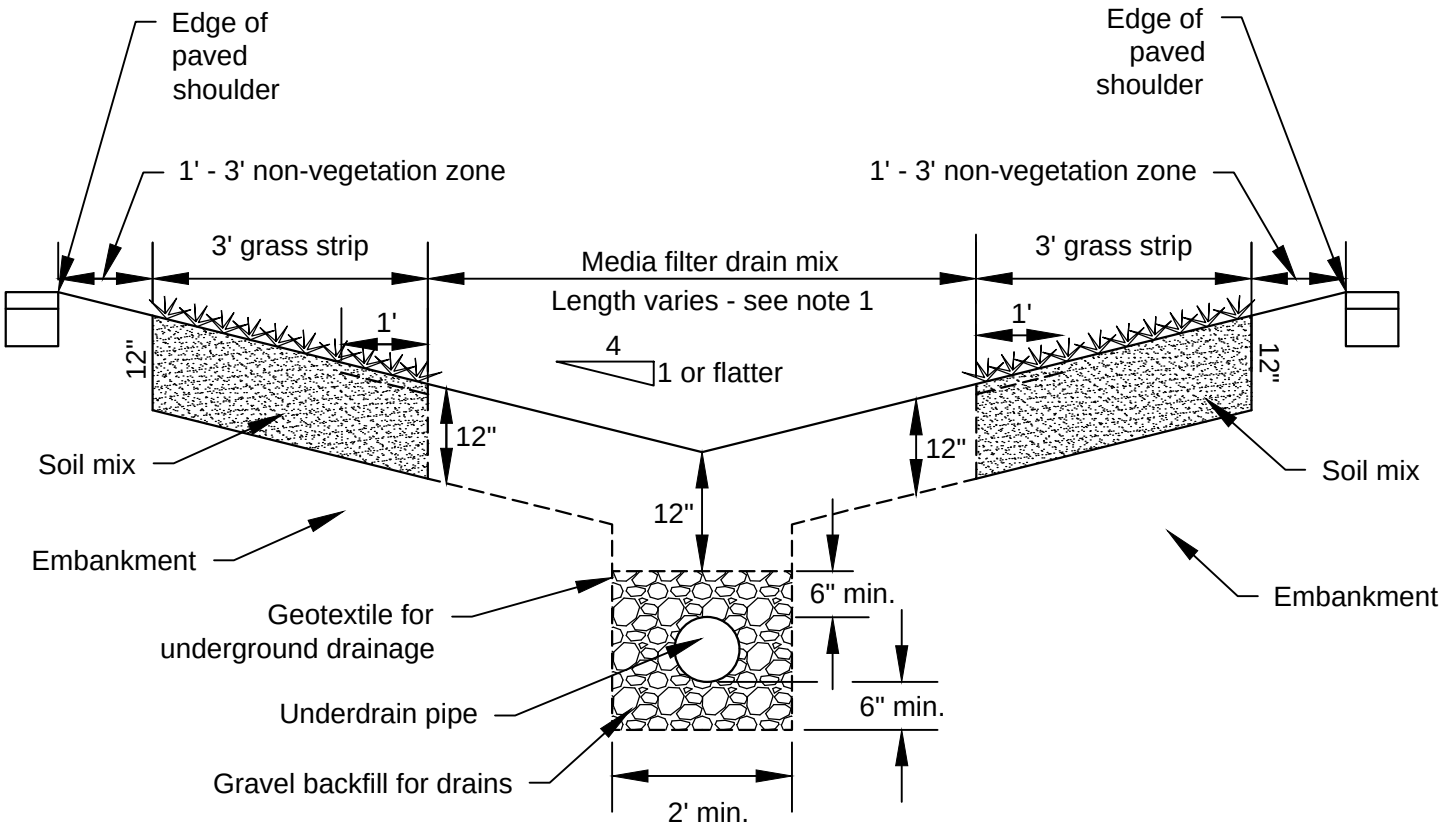
Media Filter Drain: Cross Section

Revised June 2016



Notes:

1. See "structural design considerations"

Median Application

This drawing is only a template and should be modified to fit each project application.

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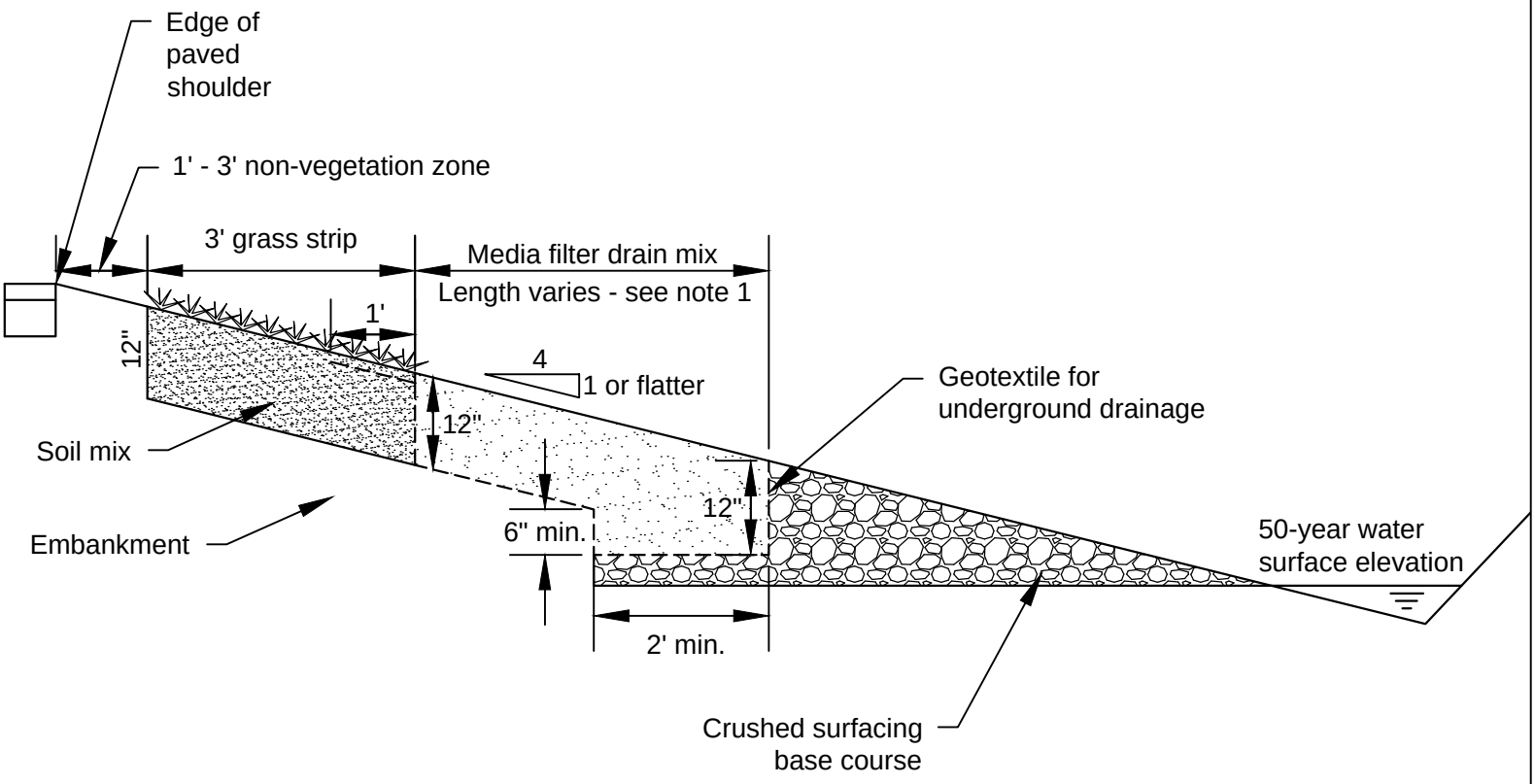
Dual Media Filter Drain: Cross Section

Revised June 2016



Notes:

1. See "structural design considerations"

Side Slope Application without Underdrain

This drawing is only a template and should be modified to fit each project application.

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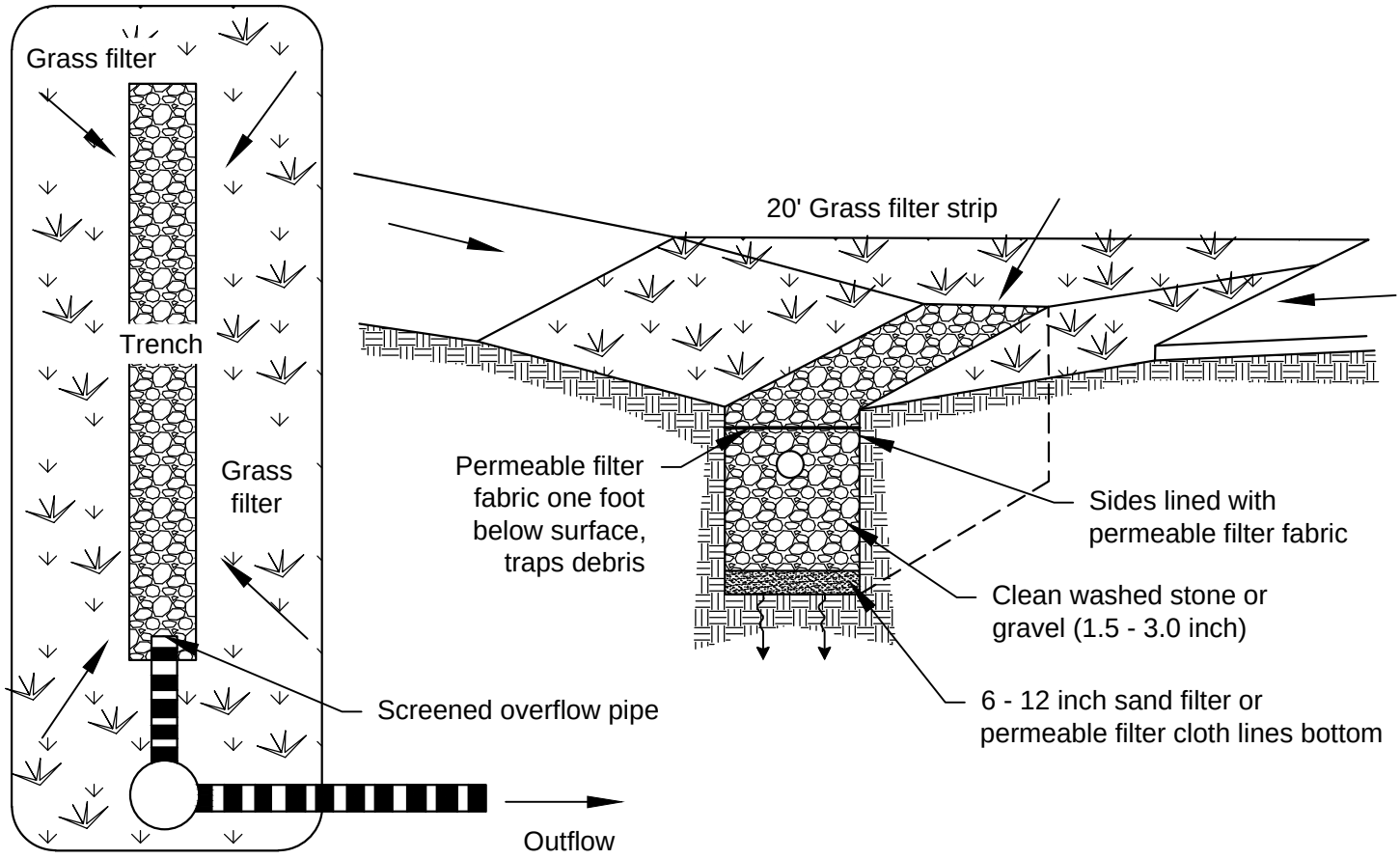
Media Filter Drain without Underdrain Trench

Revised June 2016

Top View

Side View



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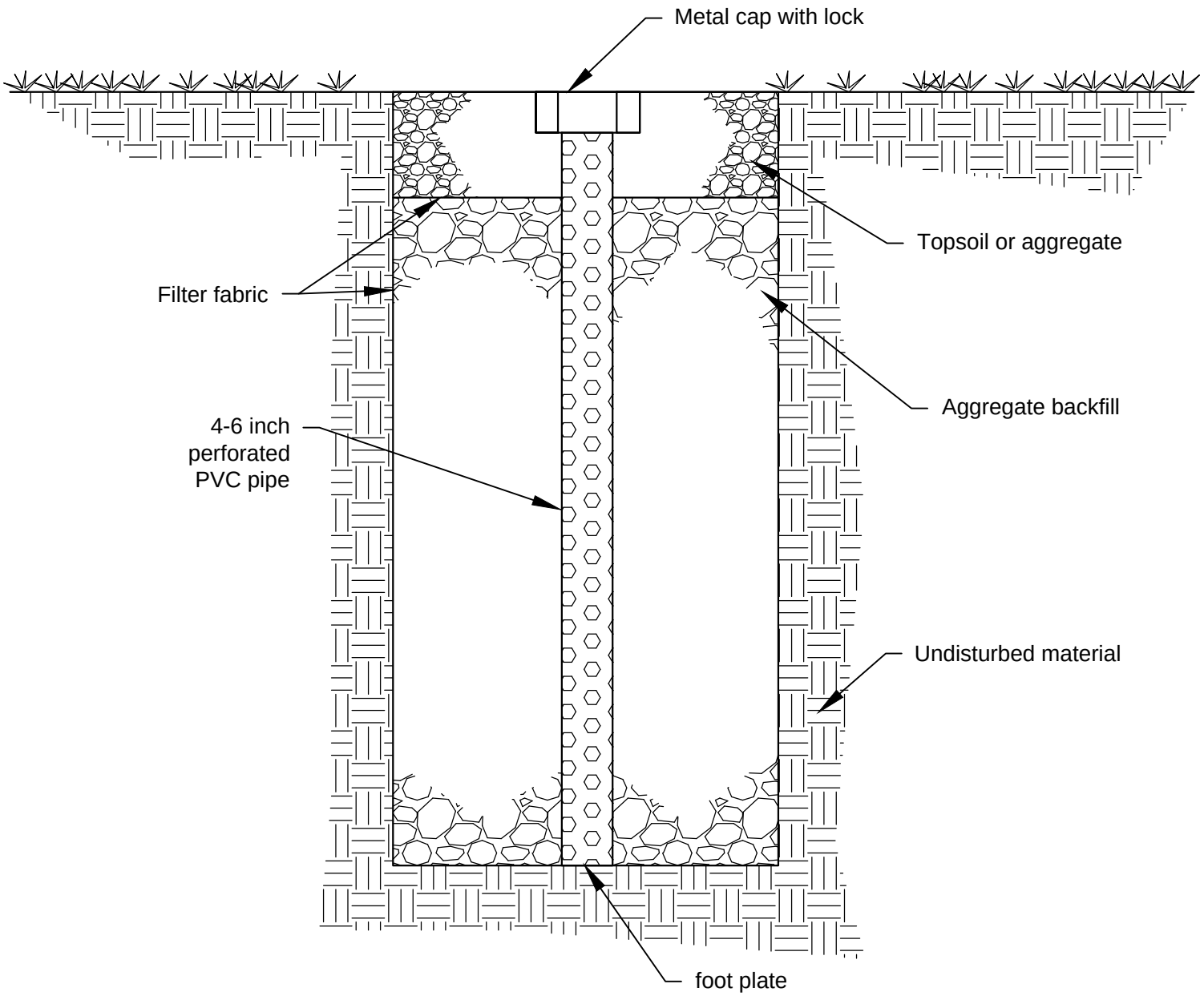
Median Strip Trench Design

Revised June 2016



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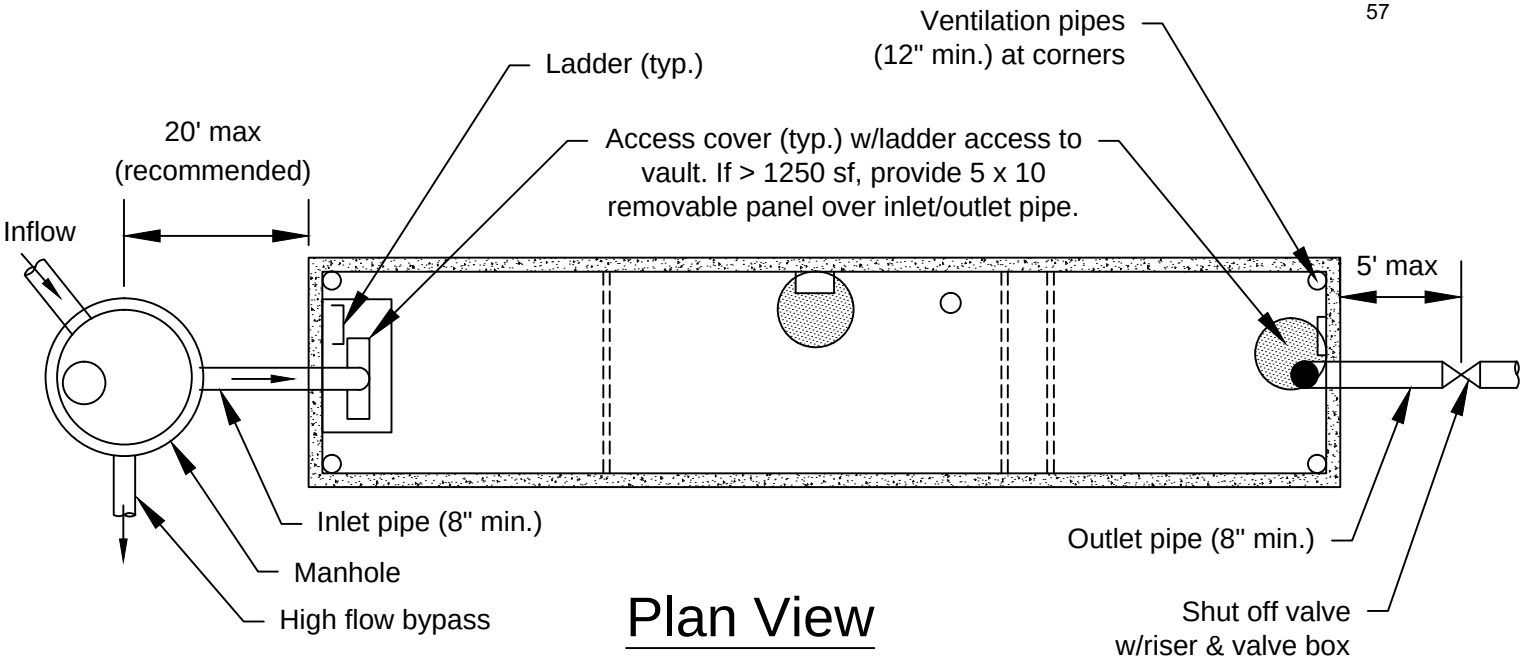
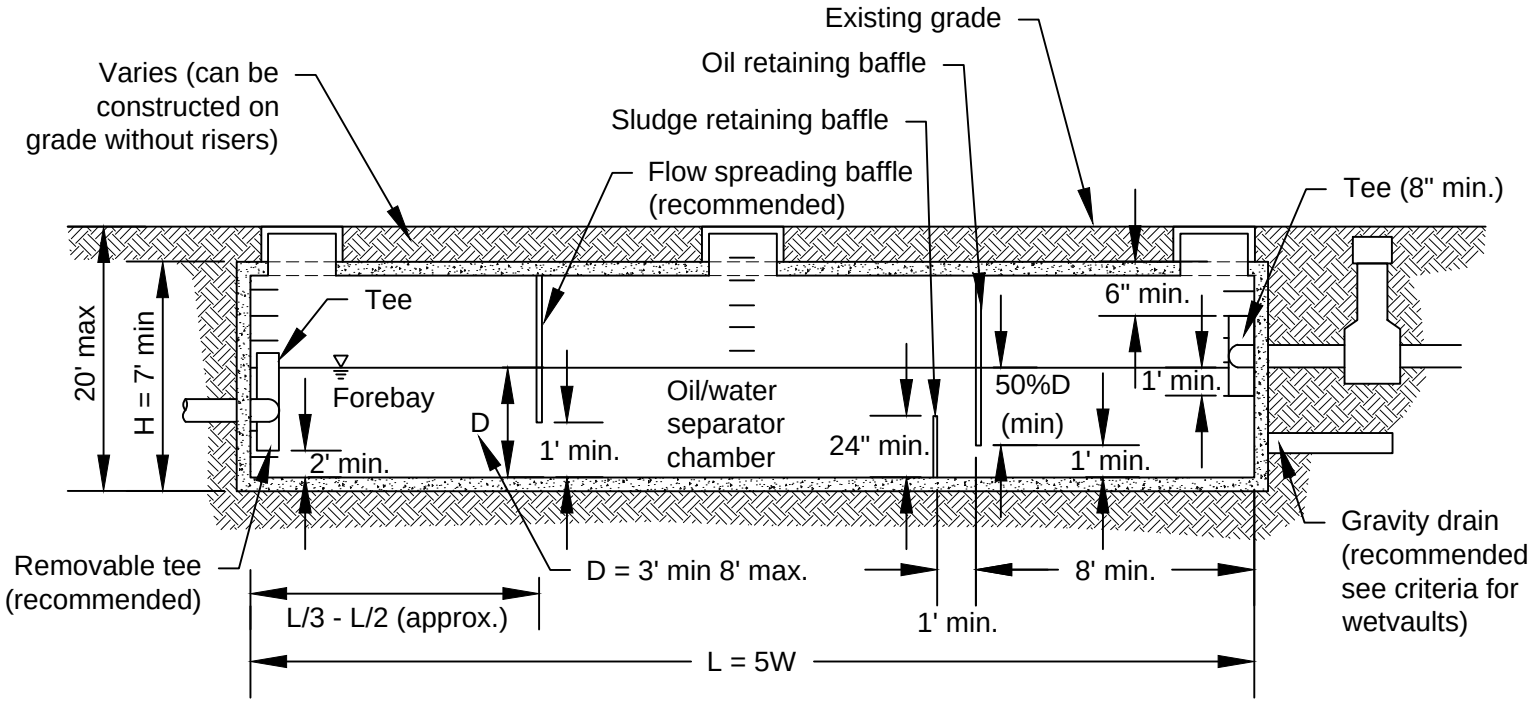
State of Washington

Observation Well Details

Revised June 2016



Plan View



Section View

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Source: King County (reproduced with permission)

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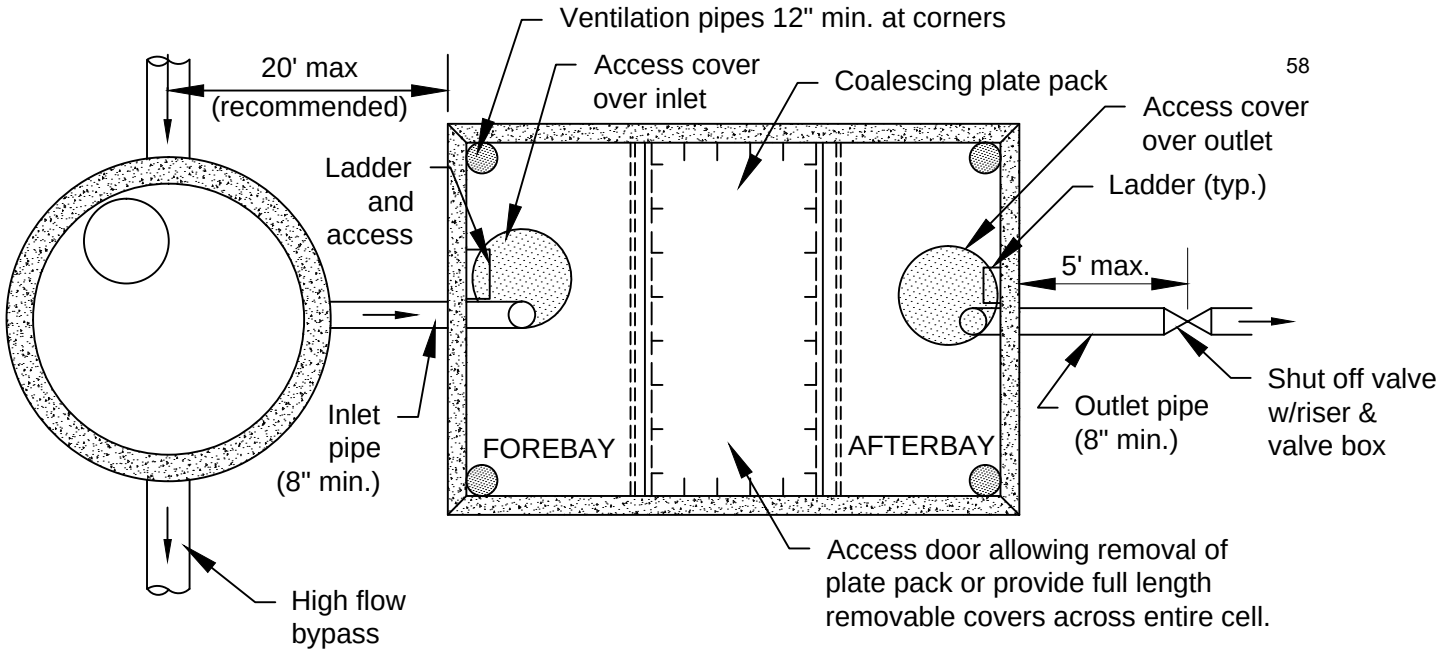
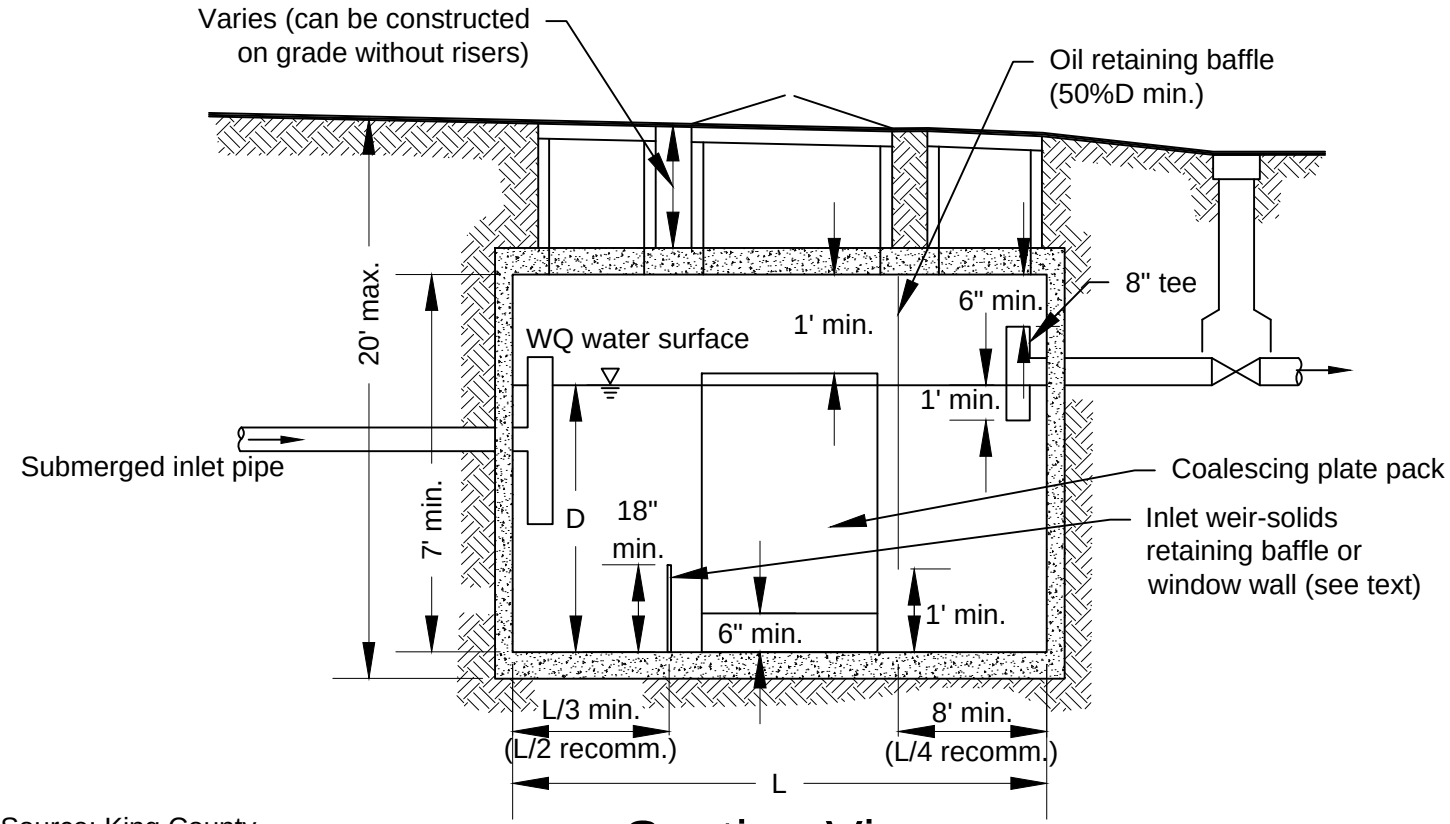
API (Baffle Type) Separator

Revised May 2018



Plan View



Section View

Source: King County
(reproduced with permission)

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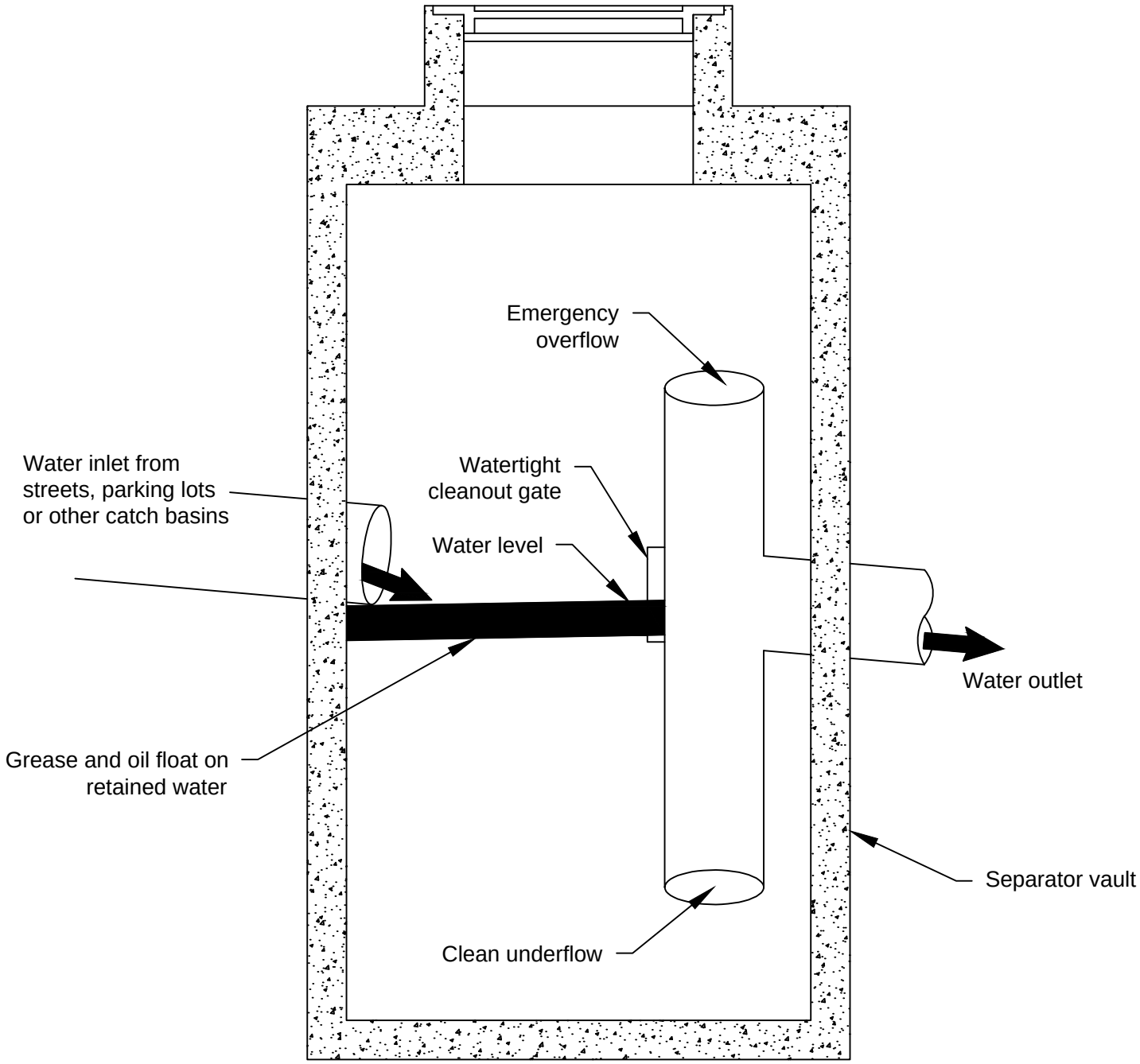
Coalescing Plate Separator

Revised June 2016



Source: 1992 Ecology Manual

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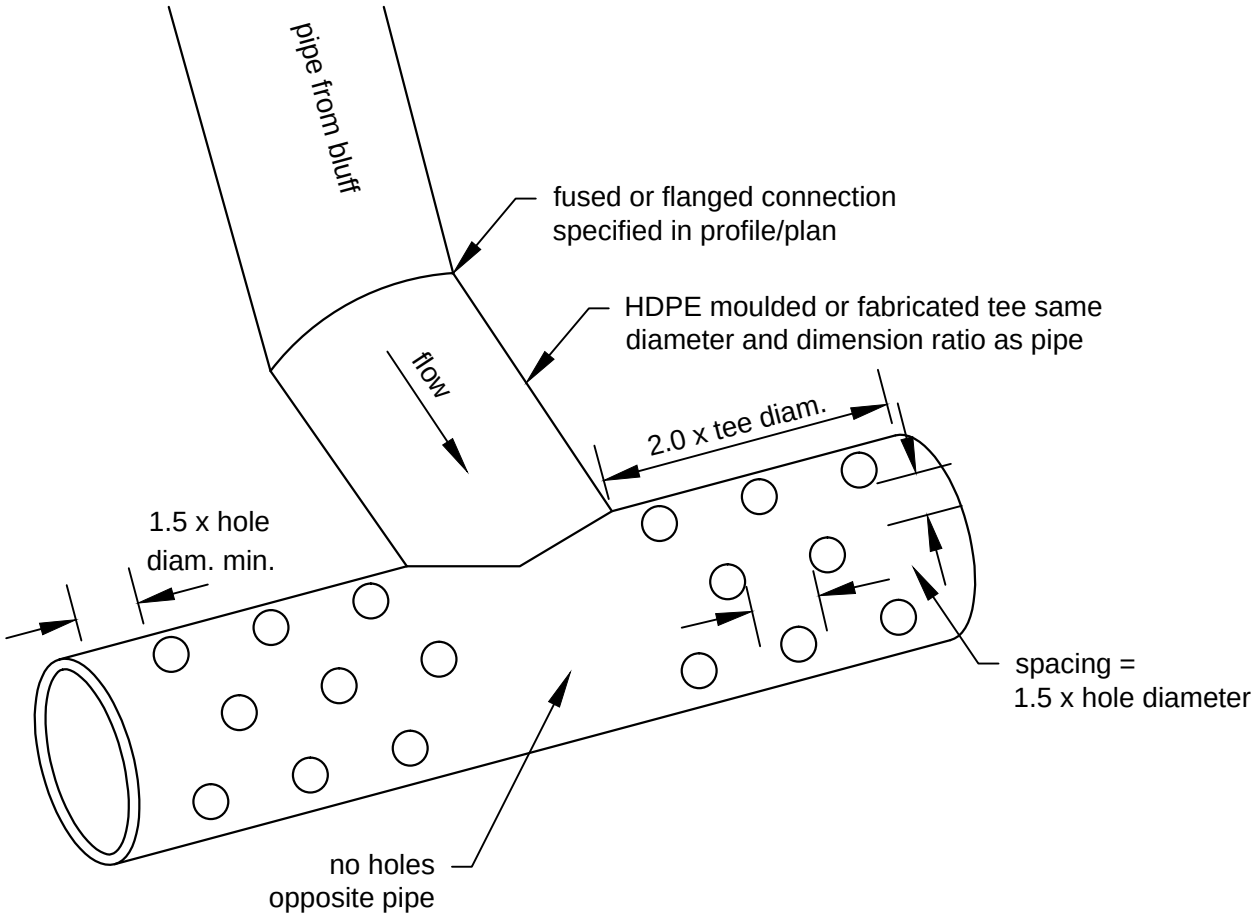
Spill Control Separator (not for oil treatment)

Revised June 2016



Drill holes in front half of tee only.
Hole diameter (inches) = tee diameter (inches) divided by 6
(ex. 6 inch tee = 1 inch holes
18 inch tee = 3 inch holes)

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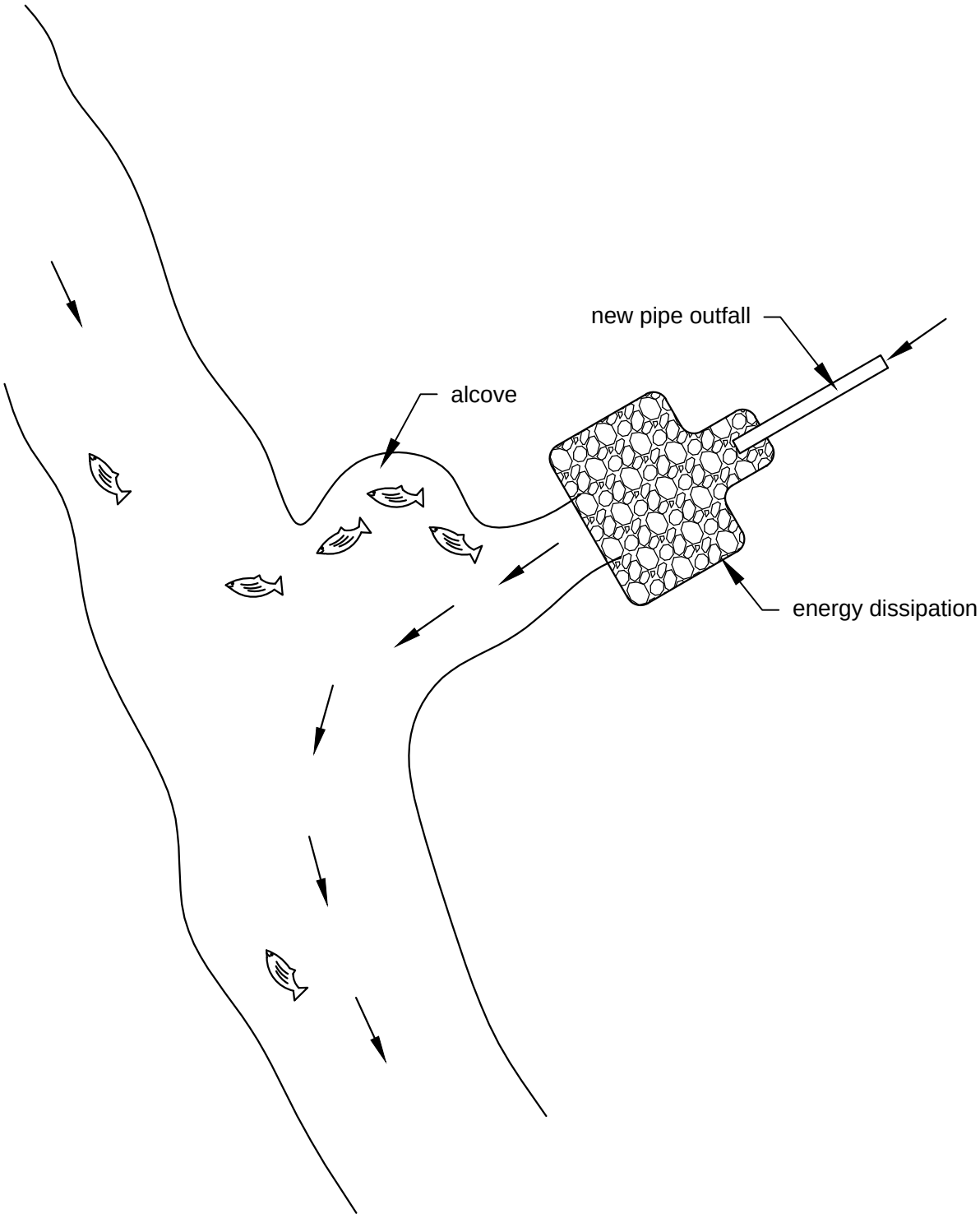
Diffuser TEE
(an example of energy dissipating end feature)

Revised June 2016



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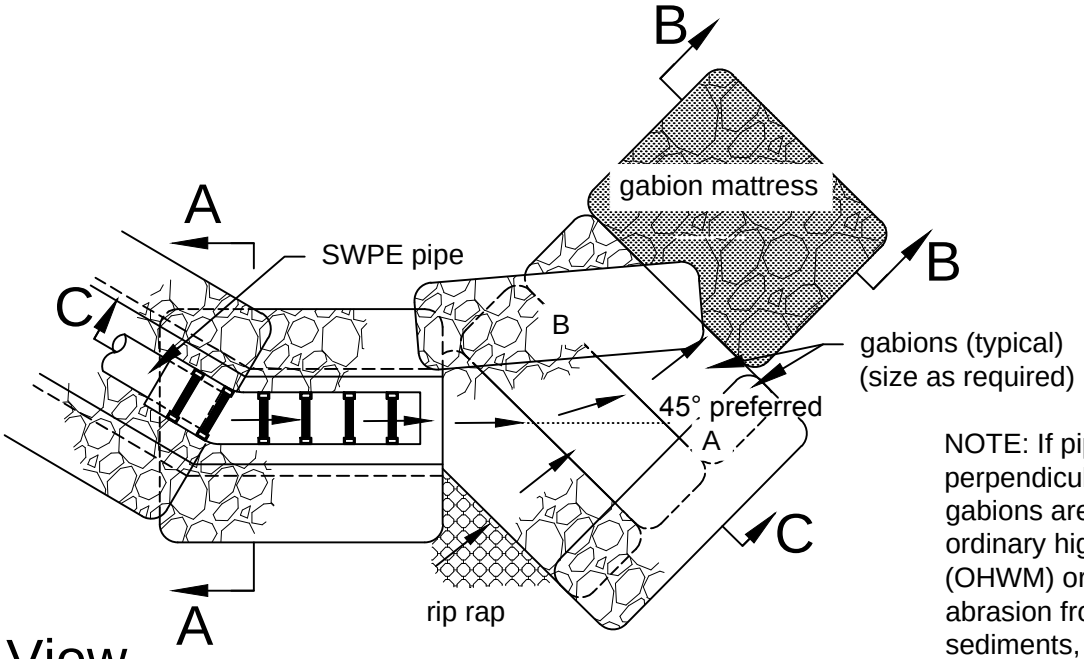
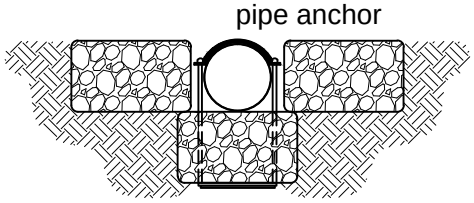
Fish Habitat Improvement at New Outfalls

Revised June 2016

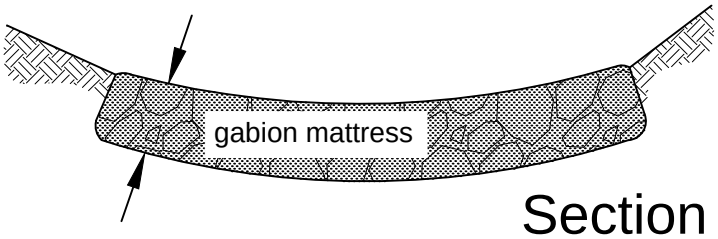


Plan View

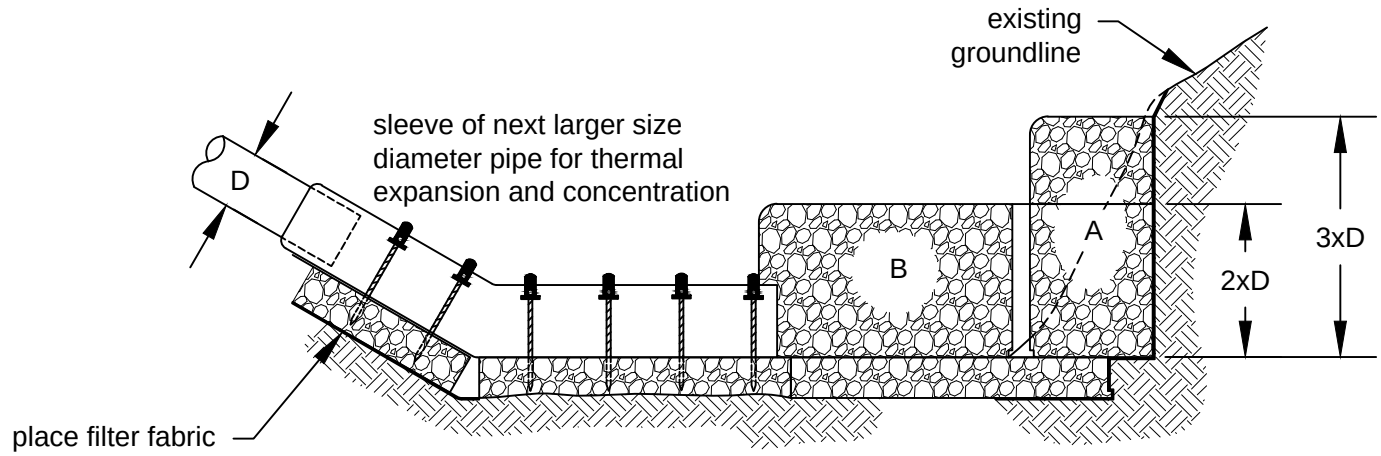
NOTE: If pipe discharges perpendicular to stream, or gabions are located within the ordinary high water mark (OHWM) or will be subject to abrasion from upstream sediments, a four-sided gabion basket located outside the OHWM should be considered.



Section A-A



Section B-B



Section C-C

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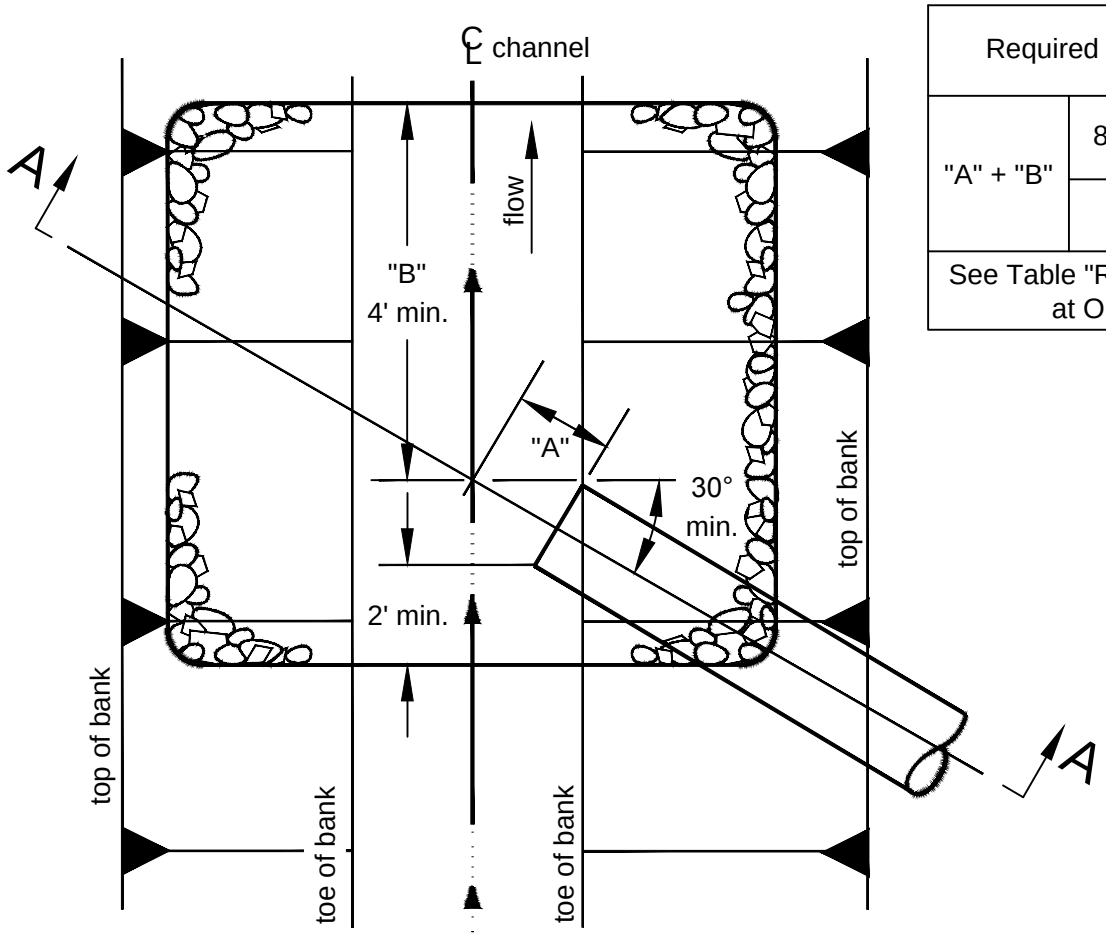
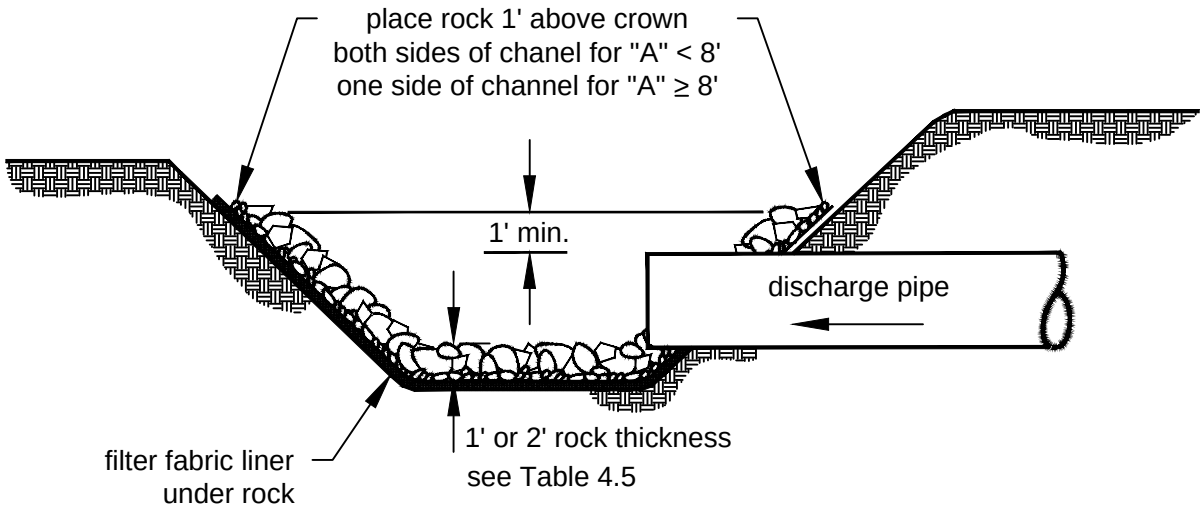
Gabion Outfall Detail

Revised June 2016

Required Dimensions	
"A" + "B"	8' for rock lining
	12' for rip rap
See Table "Rock Protection at Outfalls"	



Plan



Section A-A

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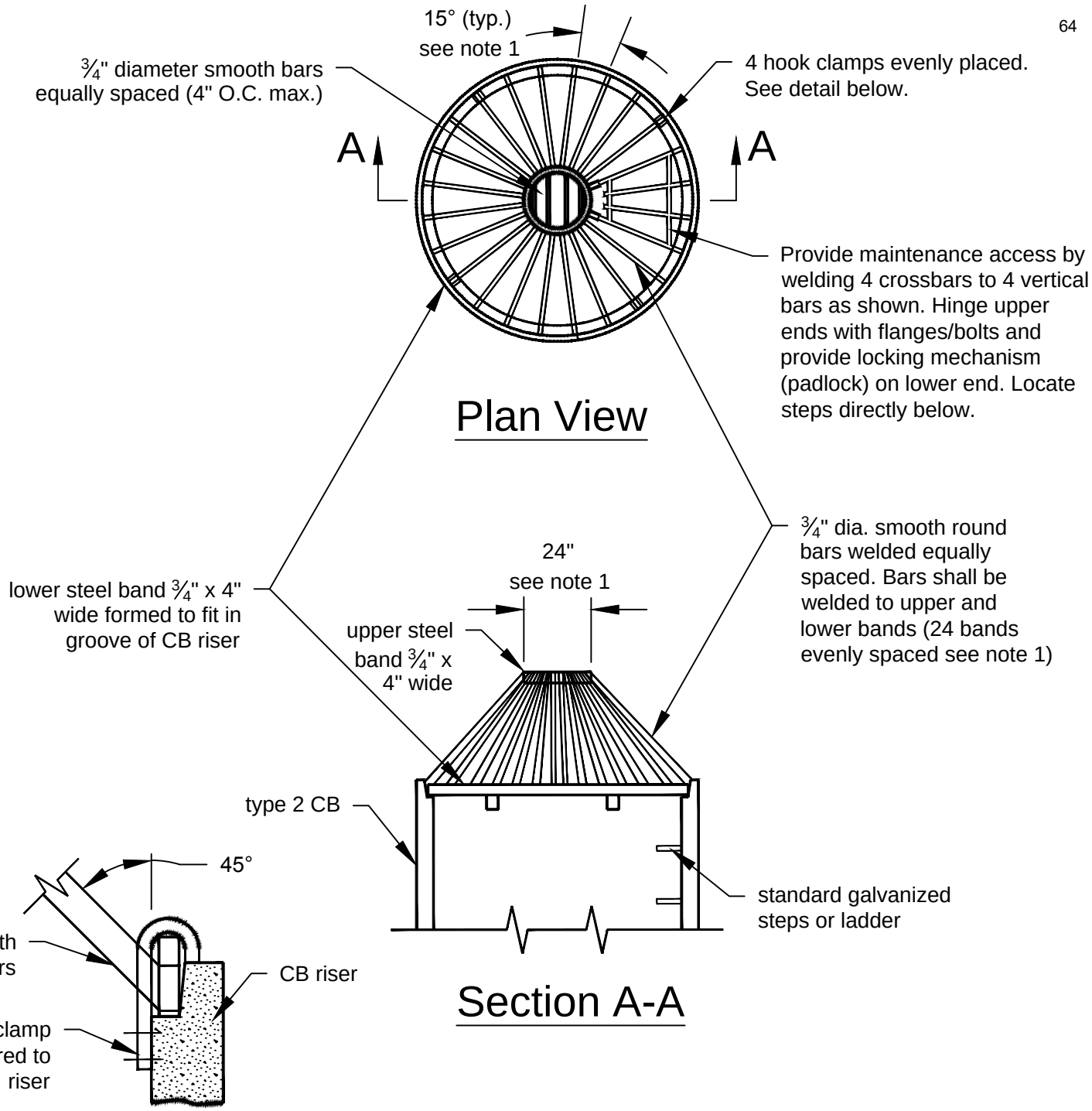
Pipe/Culvert Outfall Discharge Protection

Revised June 2017



Notes:

1. Dimensions are for illustration on 54" diameter CB. For different diameter CB's adjust to maintain 45 degree angle on "vertical" bars and 7" O.C. maximum spacing of bars around lower steel band.
2. Metal parts must be corrosion resistant; steel bars must be galvanized.
3. This debris barrier is also recommended for use on the inlet to roadway cross-culverts with high potential for debris collection (except on type 2 streams).

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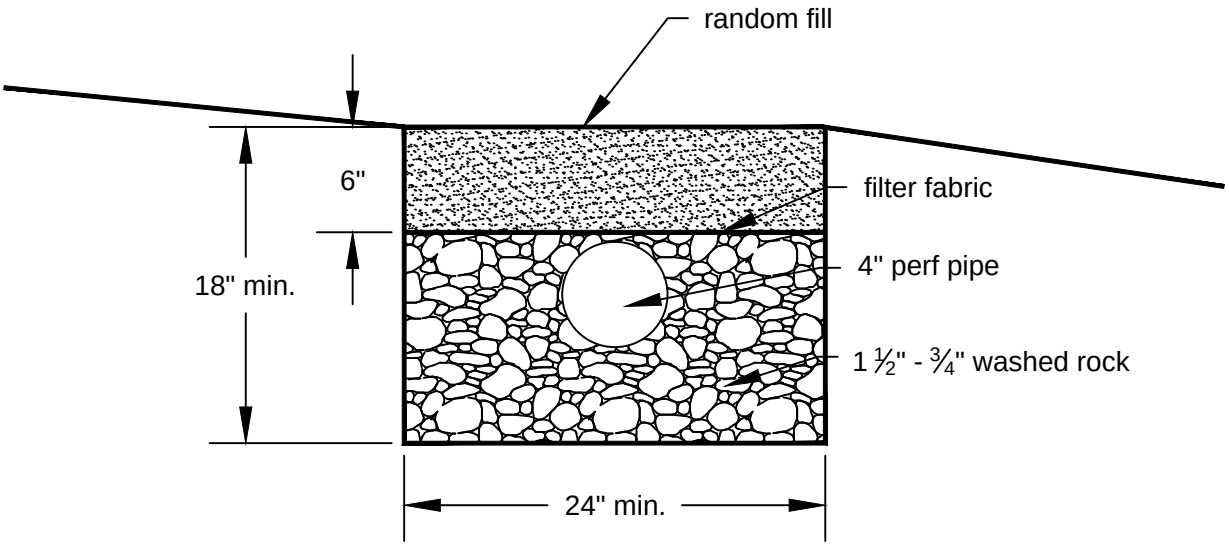
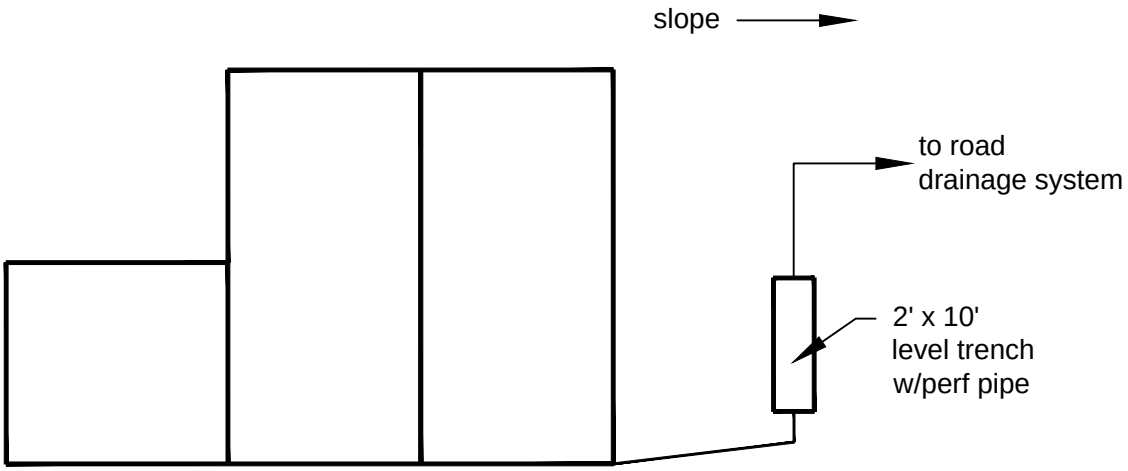
Overflow Structure

Revised June 2016



Trench X-Section



Plan View of Roof

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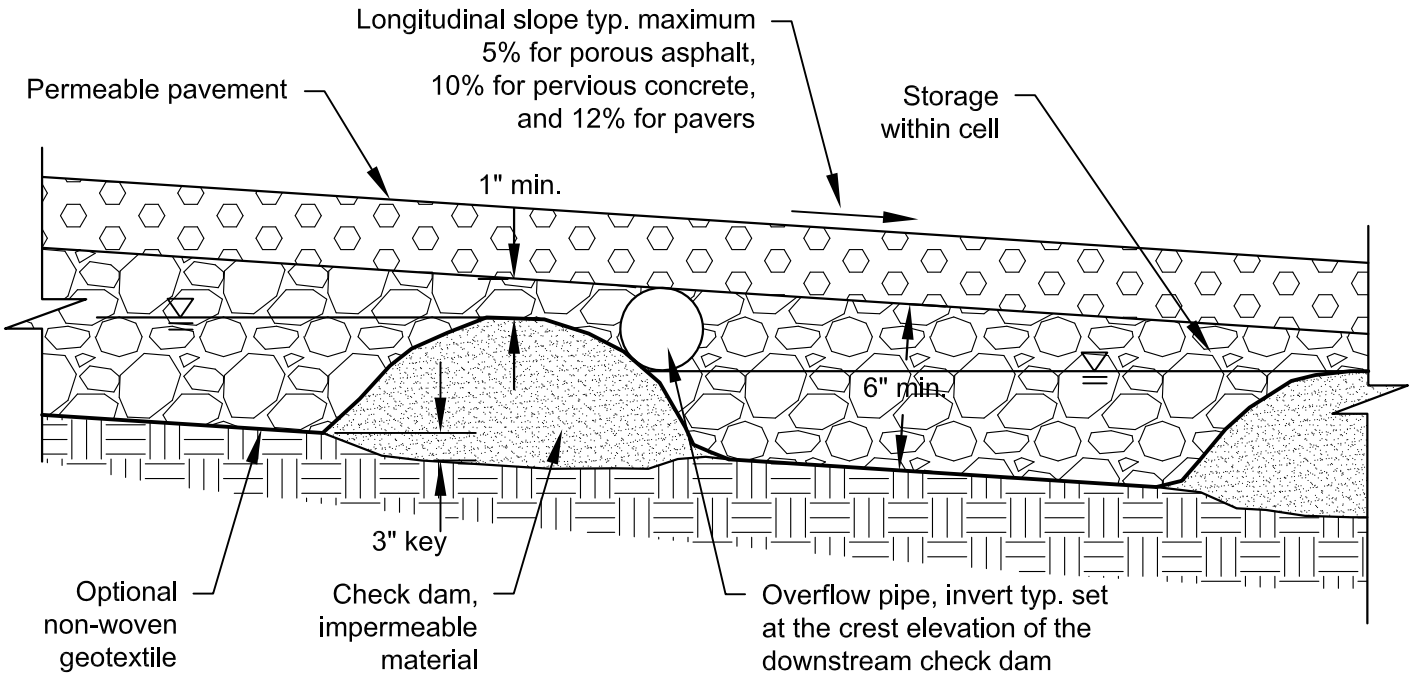
State of Washington

Perforated Stub-Out Connection

Revised June 2016



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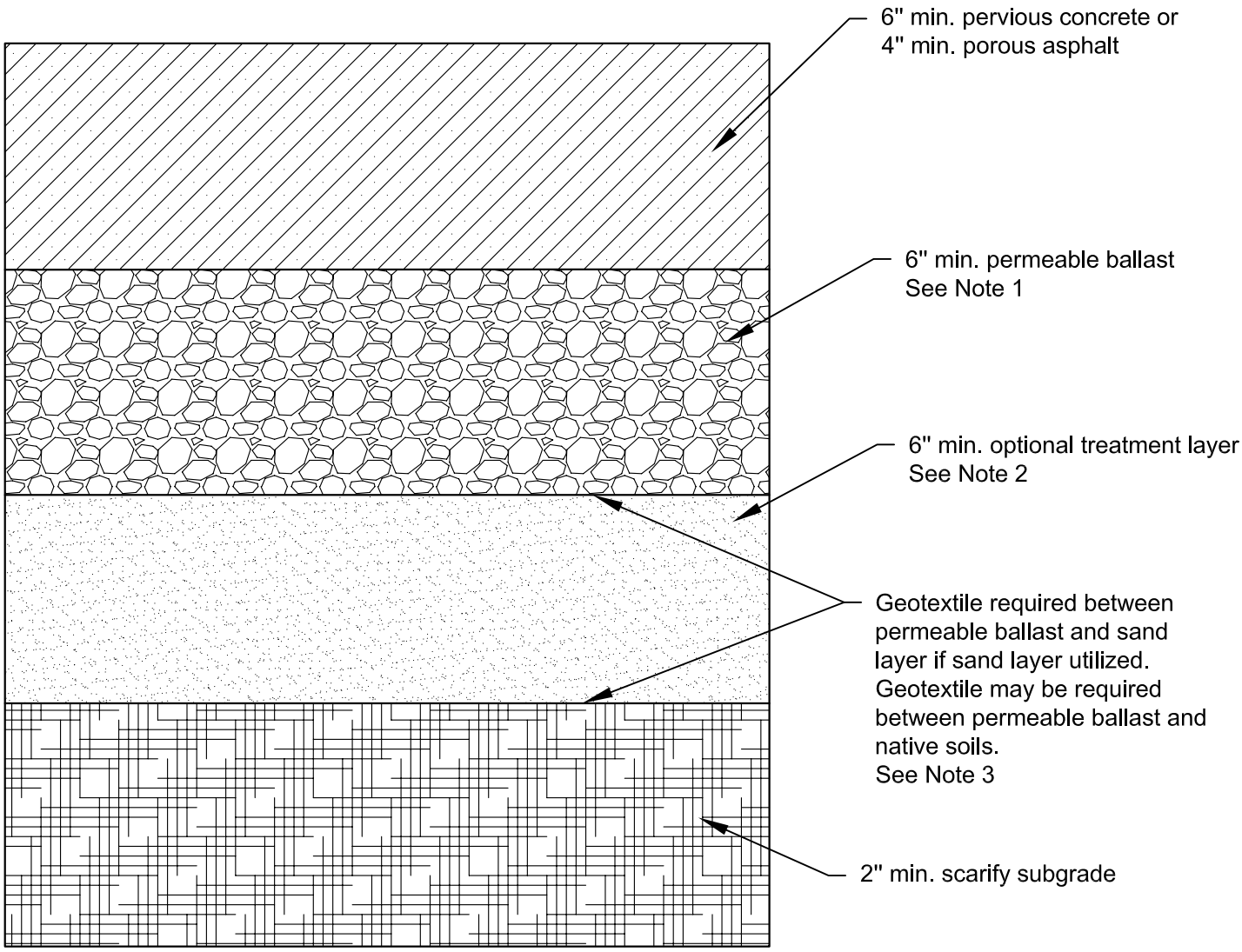
State of Washington

Example of a Check Dam Along a Sloped Section of Permeable Pavement

Revised May 2019



Notes:

1. Thicker section of ballast may be required to establish sufficient reservoir capacity. Engineer to provide calculations.
2. 6" minimum treatment layer of sand or media if required.
3. Geotextile may be required between native soils and permeable pavement section, per soils professional recommendation. Geotextile will be required between permeable ballast and sand layer. Geotextile shall be geotextile for seperation per WSDOT 9.33.2(1), woven, Table 3, and installed per WSDOT 2-12.3(1).

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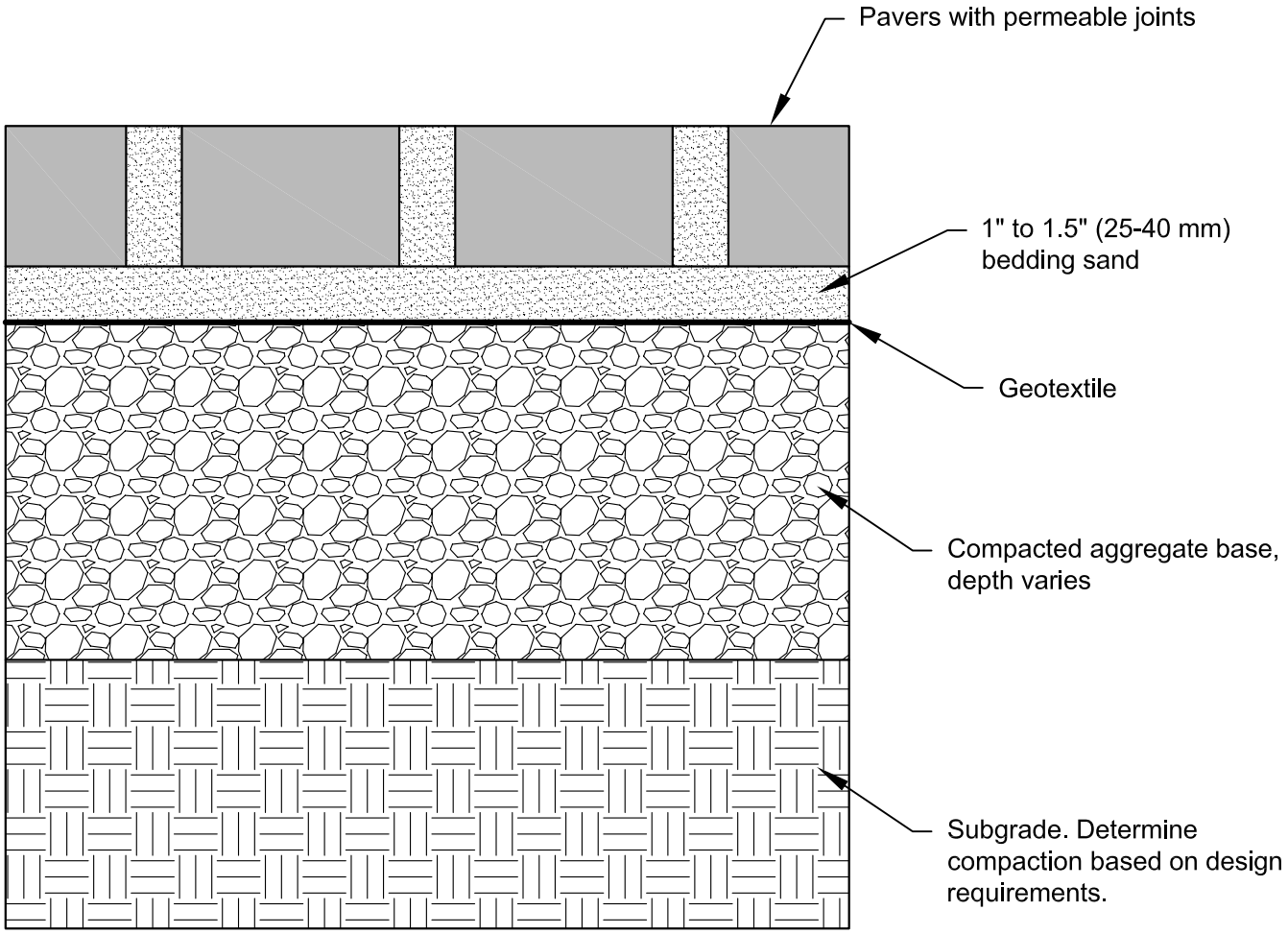
Example of a Permeable Pavement (Concrete or Asphalt) Section

Revised May 2019



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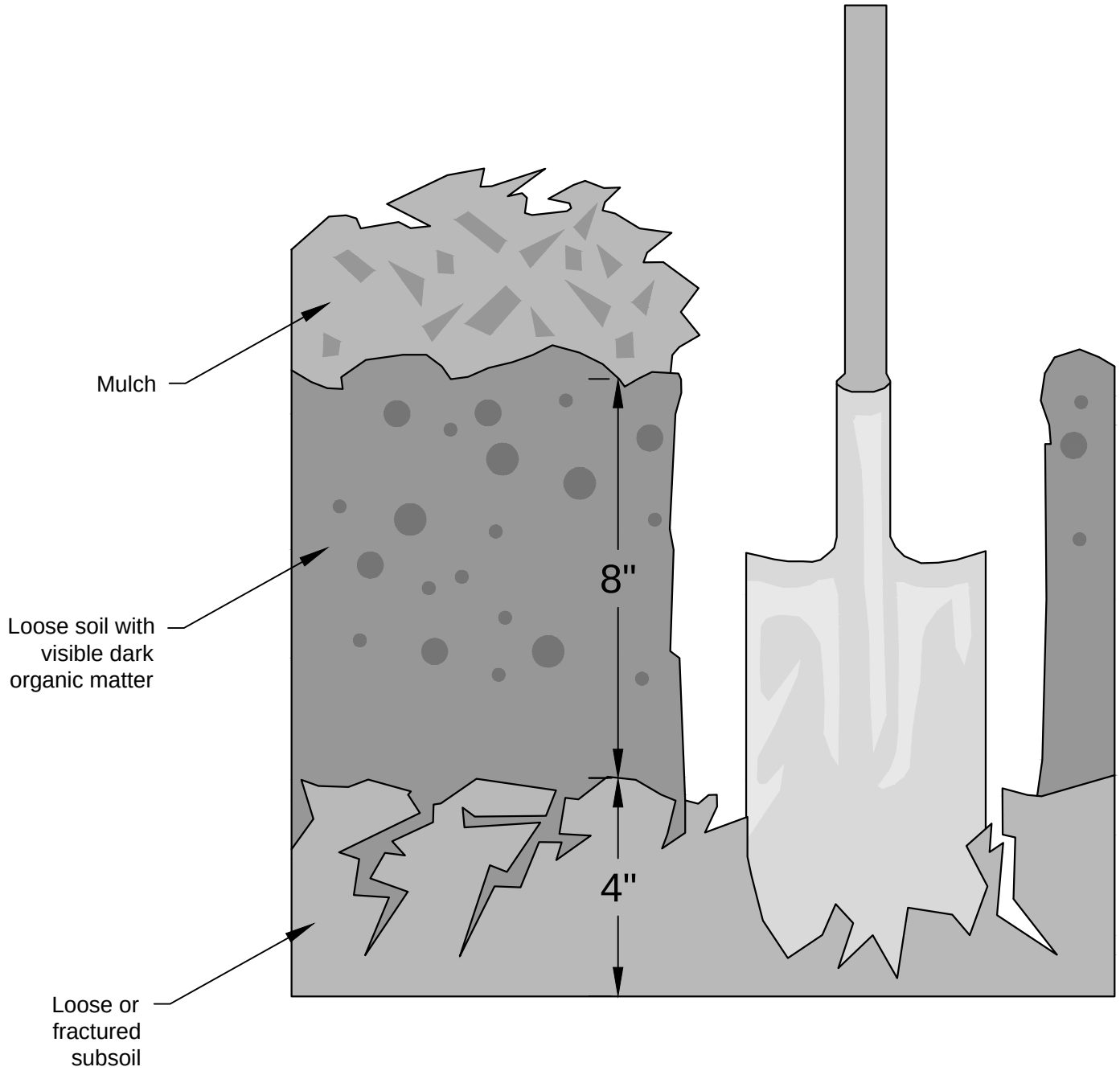
Example of a Permeable Paver Section

Revised May 2019



Reprinted from *Guidelines and Resources For Implementing Soil Quality and Depth BMP T5.13 in WDOE Stormwater Management Manual for Western Washington*, 2010, Washington Organic Recycling Council

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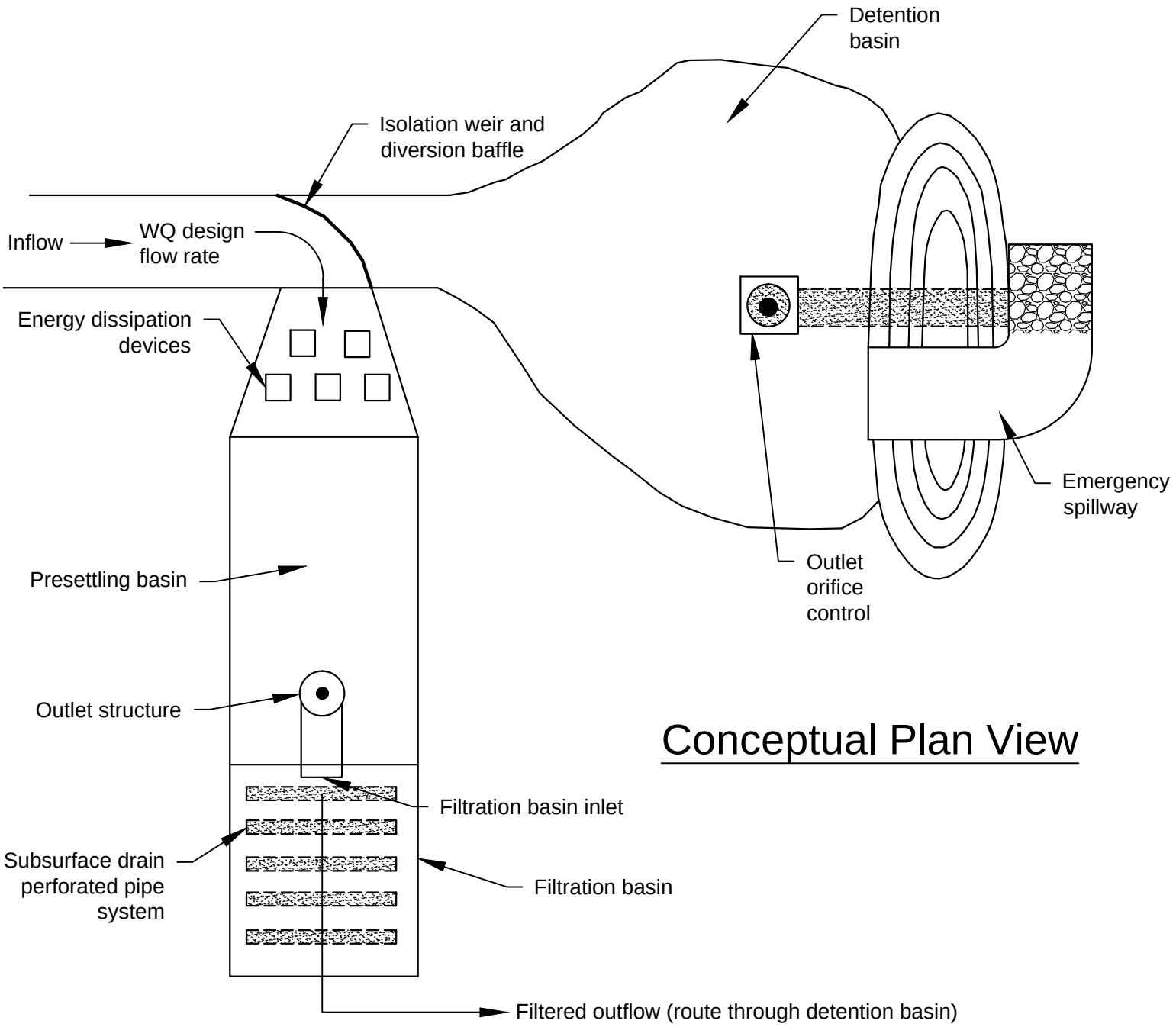
Planting Bed Cross-Section

Revised June 2016



Conceptual Plan View

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Source: City of Austin

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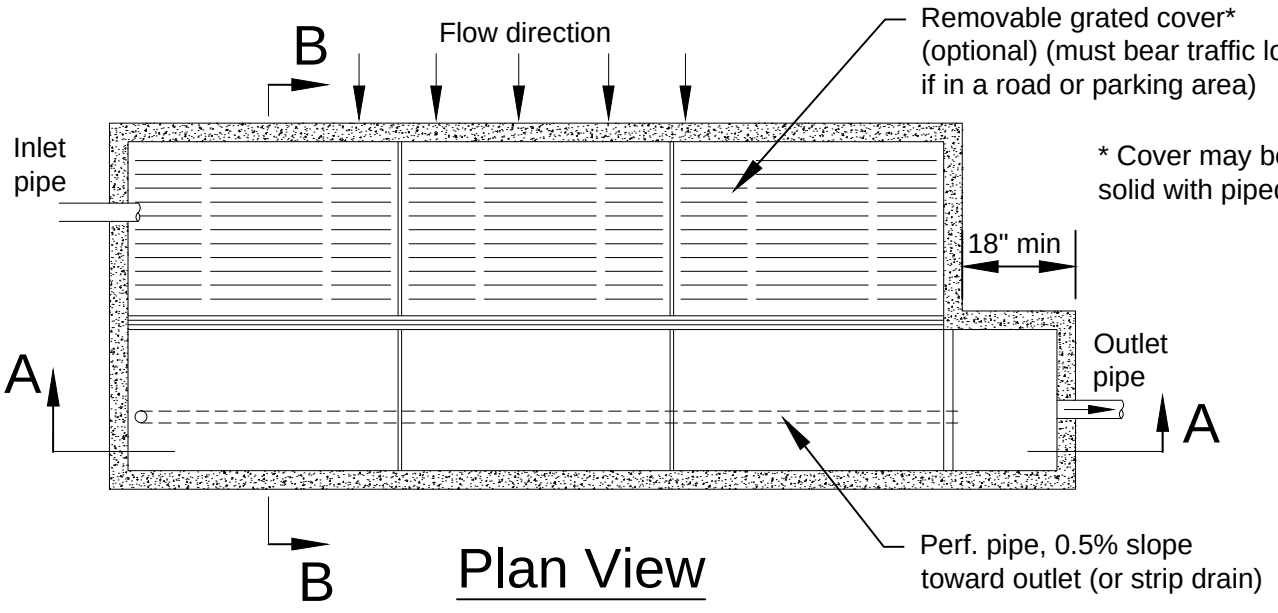
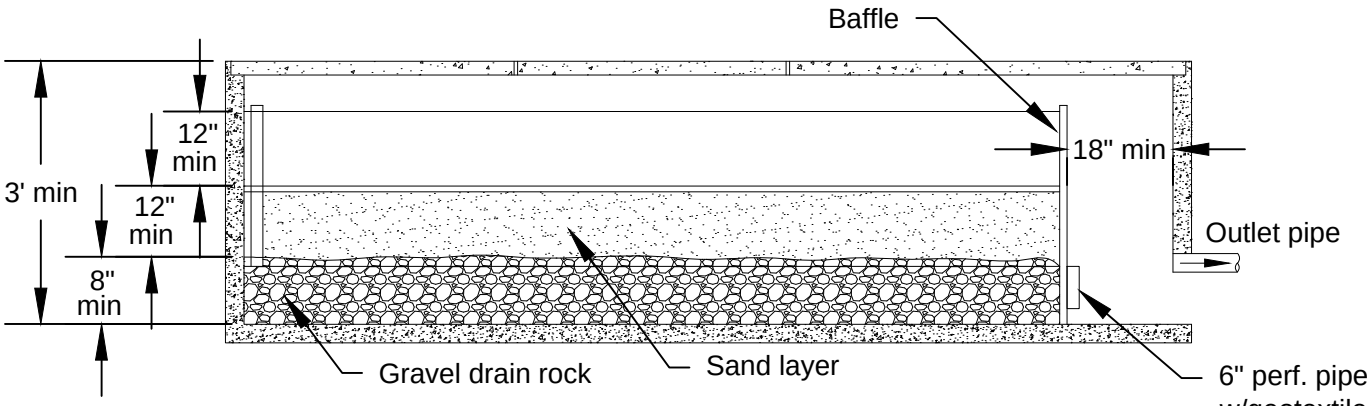
State of Washington

Sand Filtration Basin Preceded by Presettling Basin (Variation of a Basic Sand Filter)

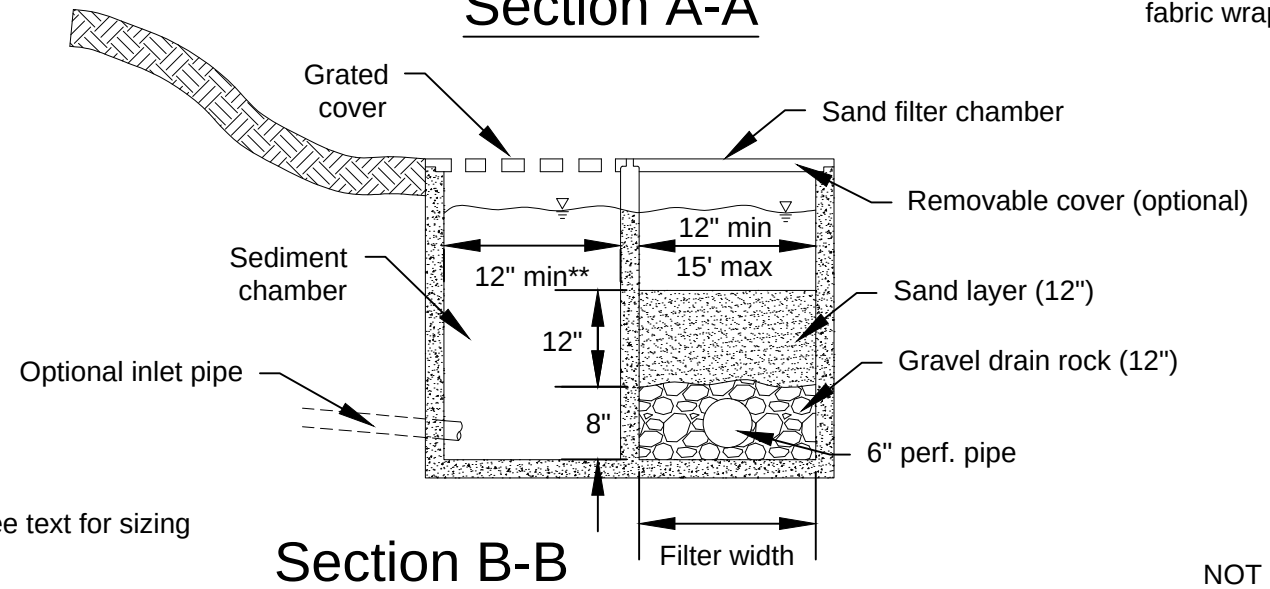
Revised June 2016



Plan View



Section A-A



** See text for sizing

Section B-B

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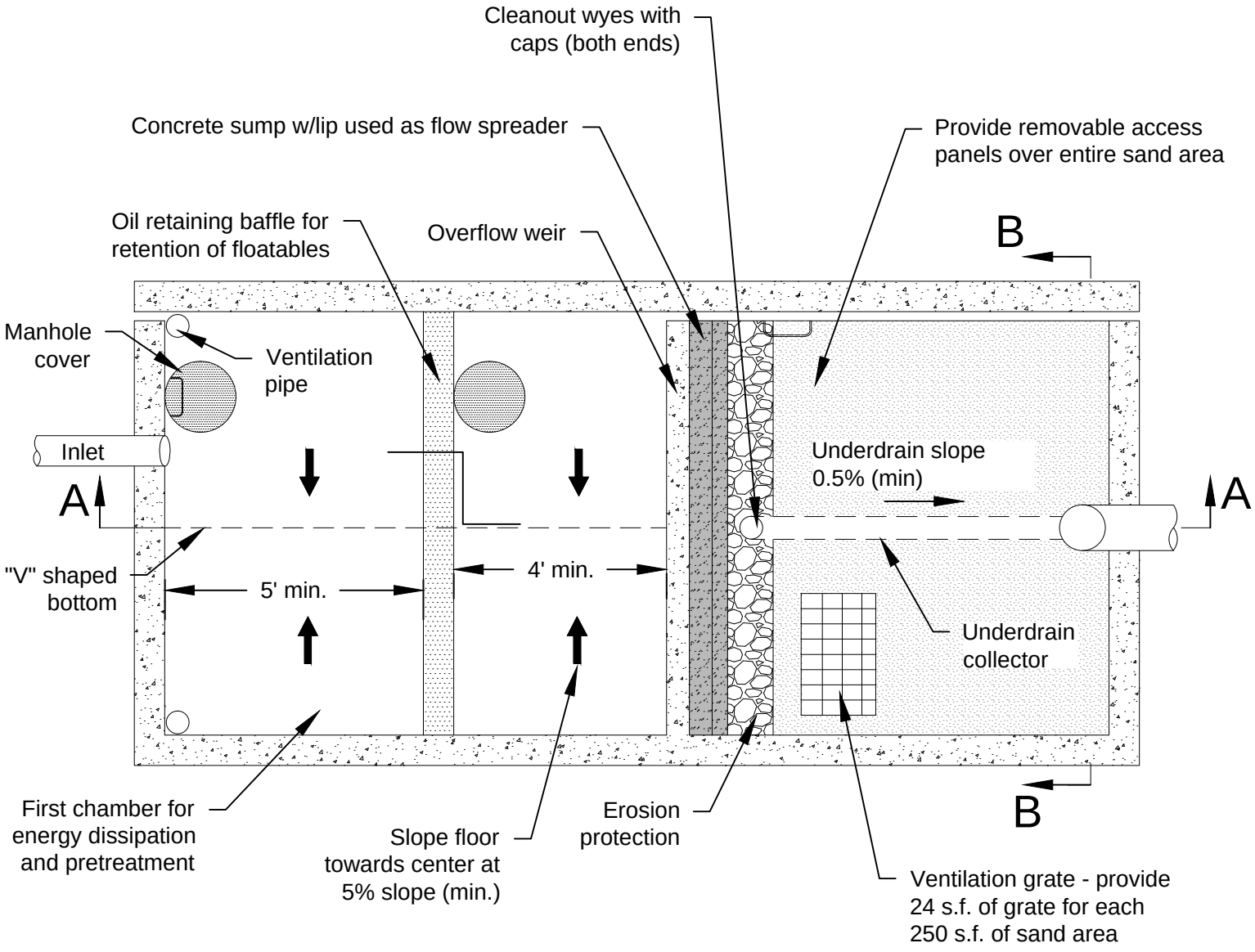
State of Washington

Linear Sand Filter

Revised June 2016



Plan View

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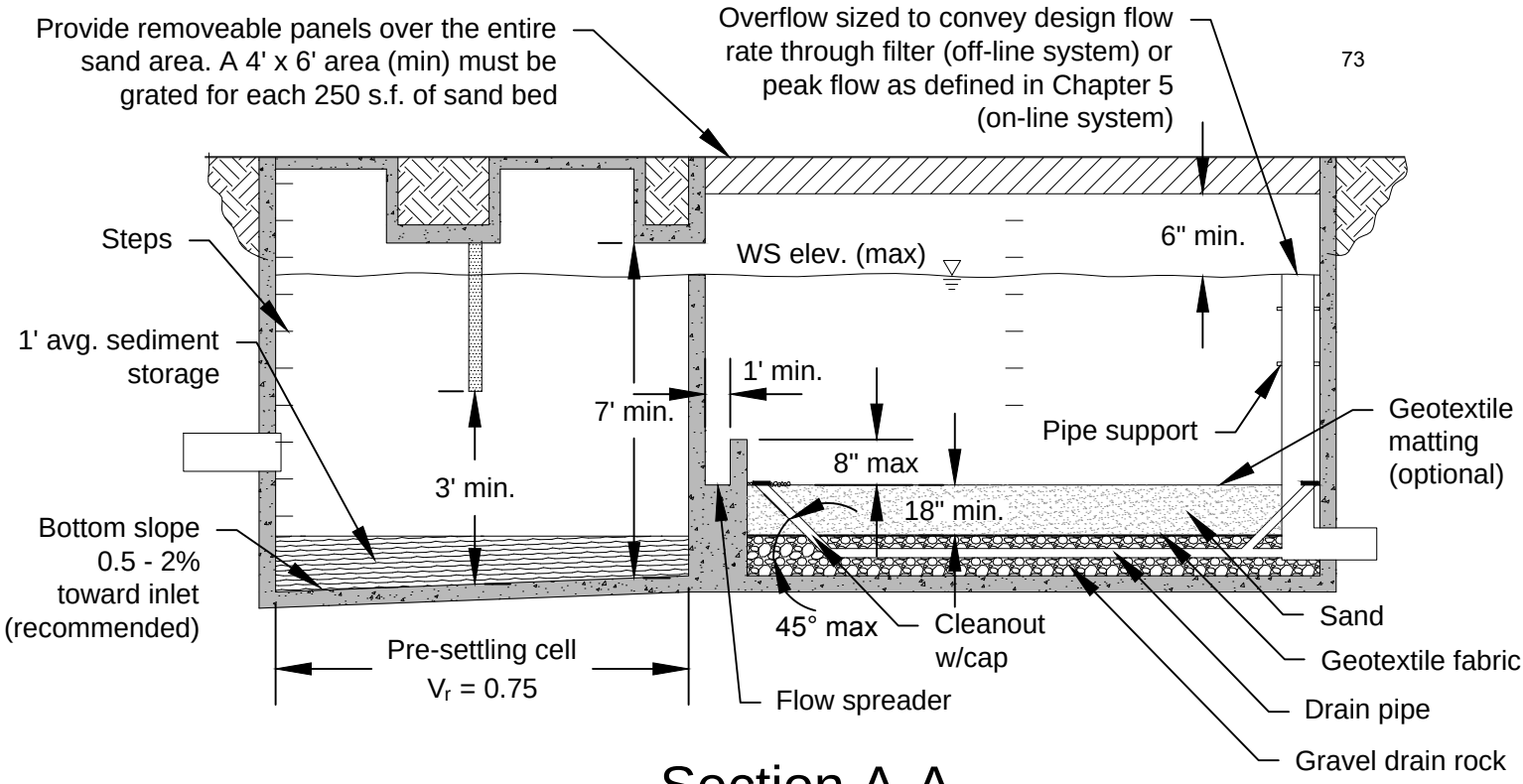
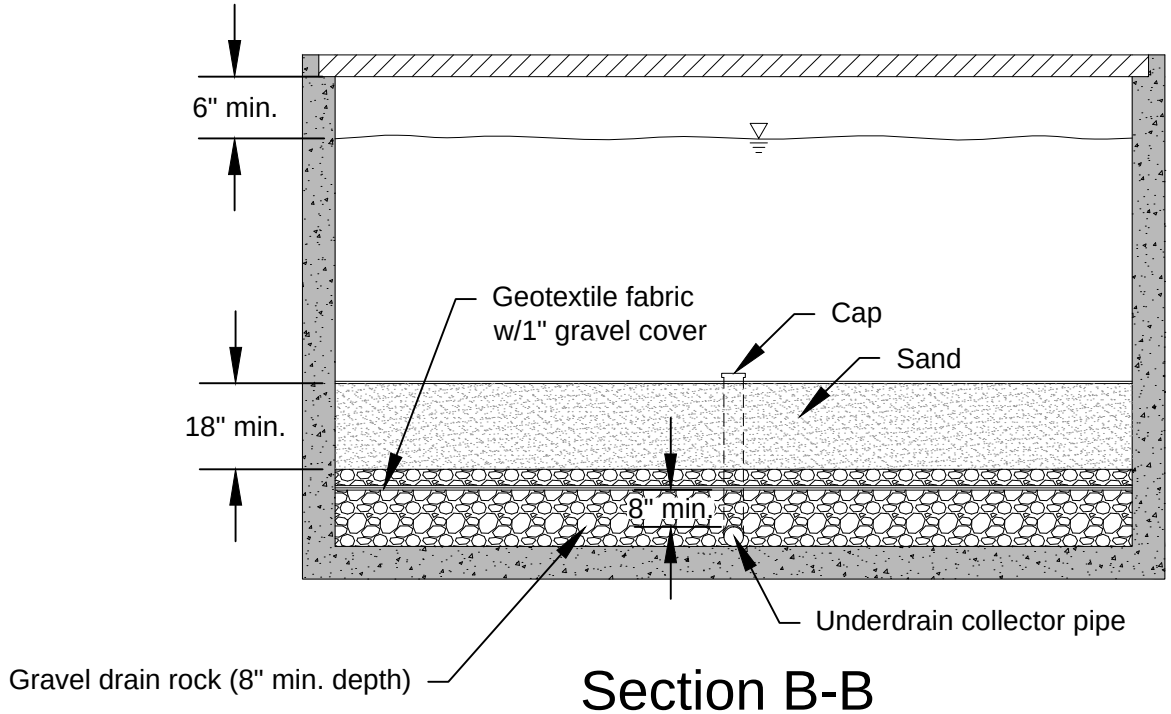
State of Washington

Sand Filter Vault (Plan View)

Revised June 2016



Section A-A



Section B-B

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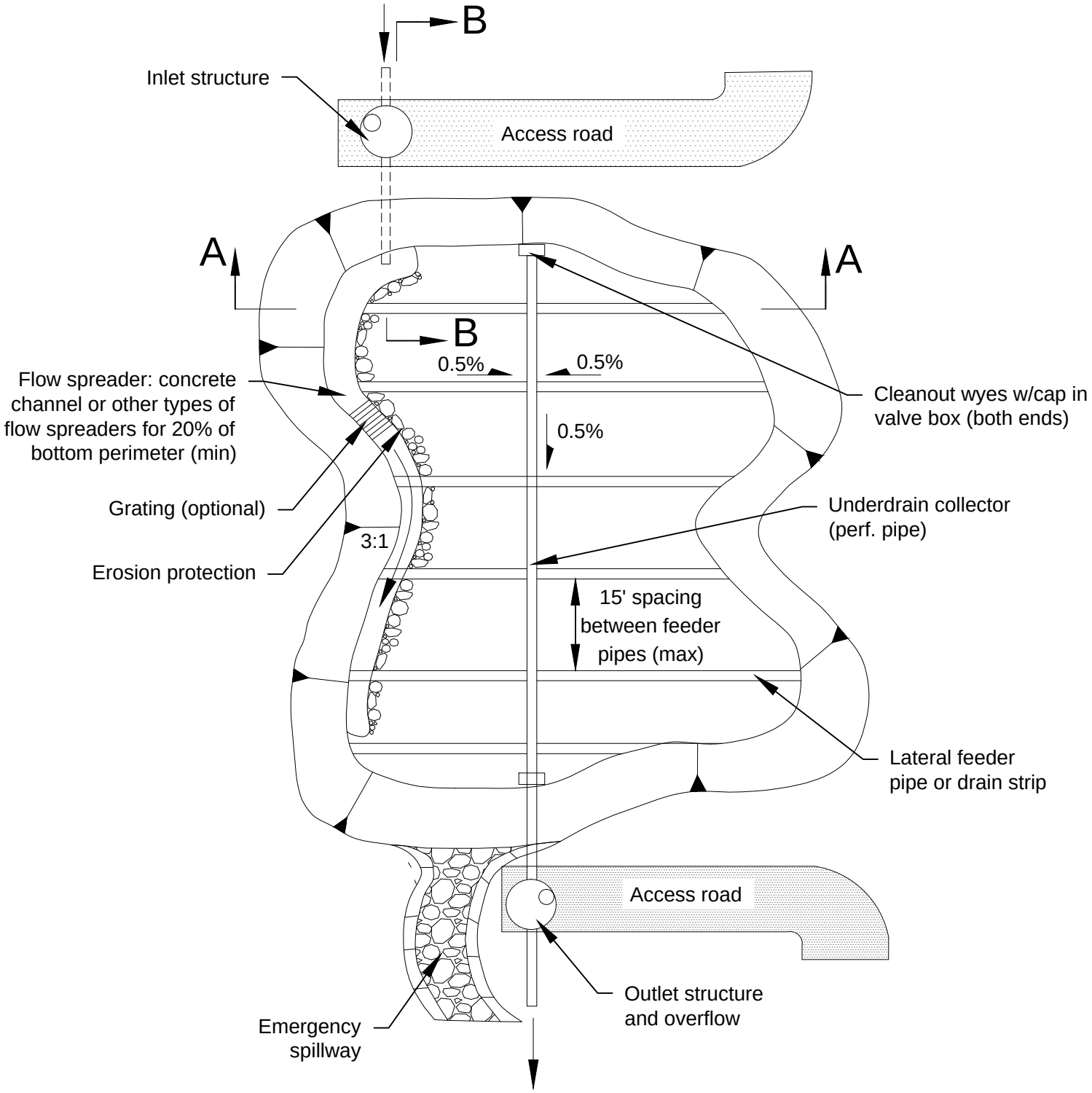
State of Washington

Sand Filter Vault (Section View)

Revised June 2016



Plan View

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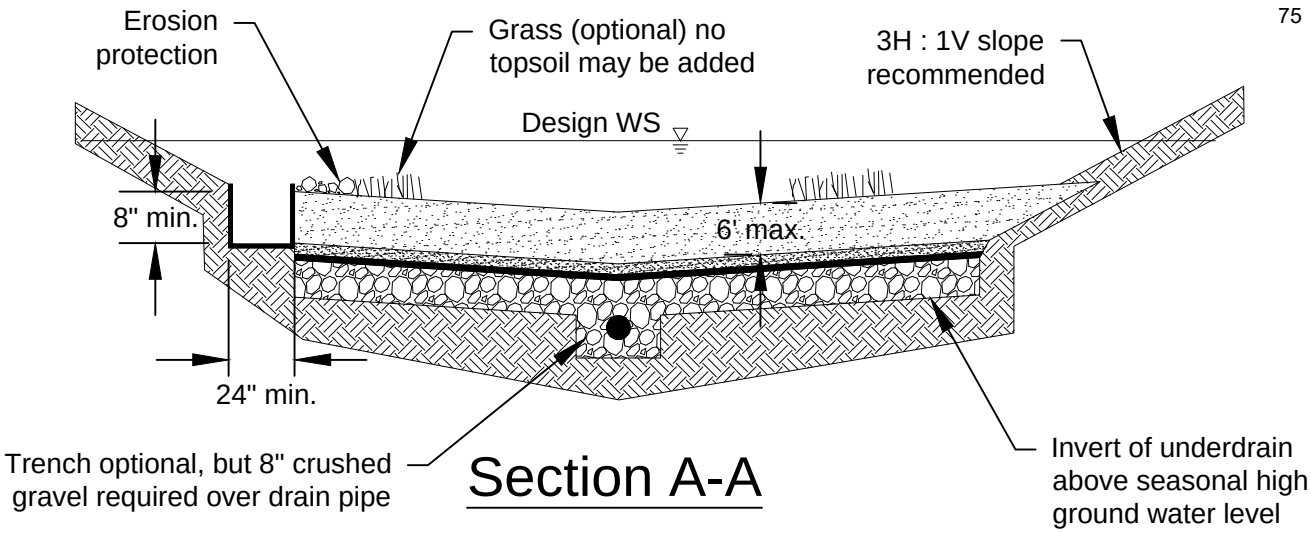
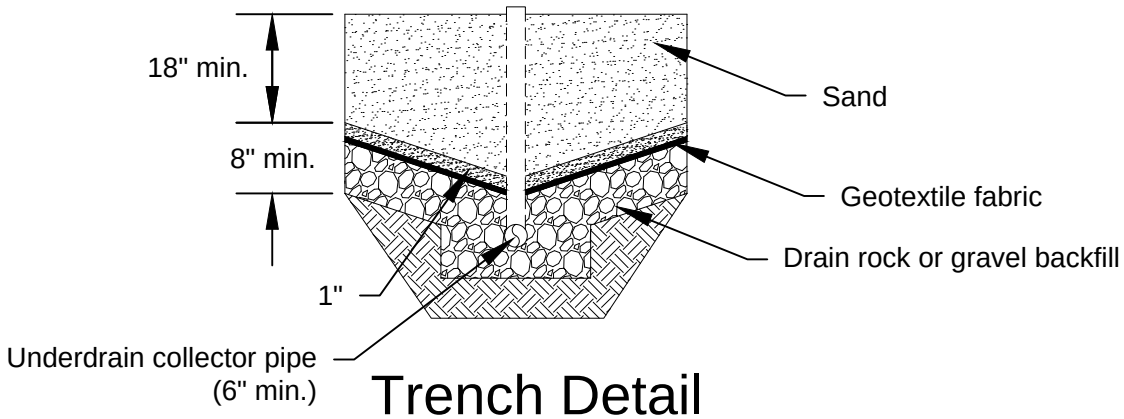
Sand Filter with Level Spreader (Plan View)

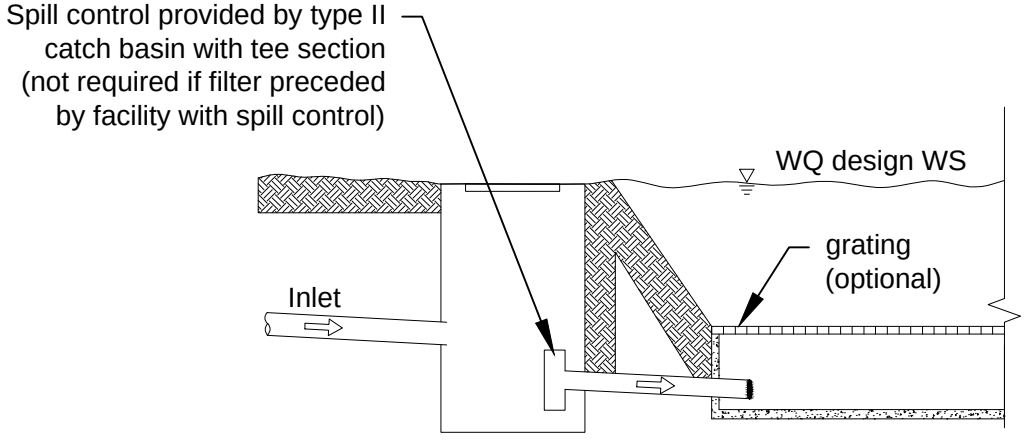
Revised June 2016



Section A-A



Trench Detail



Section B-B

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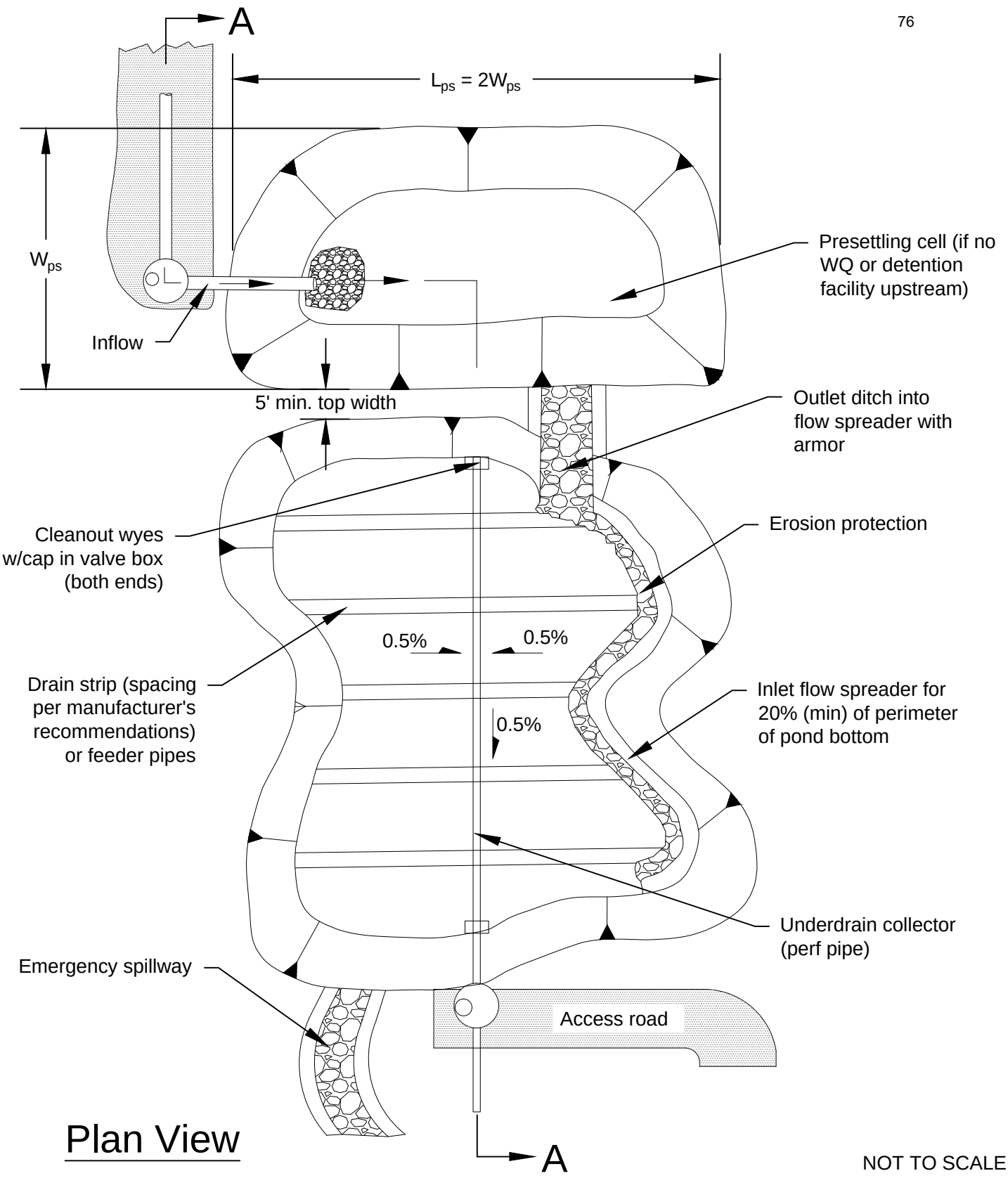
Sand Filter with Level Spreader (Section View)

Revised June 2016



Plan View

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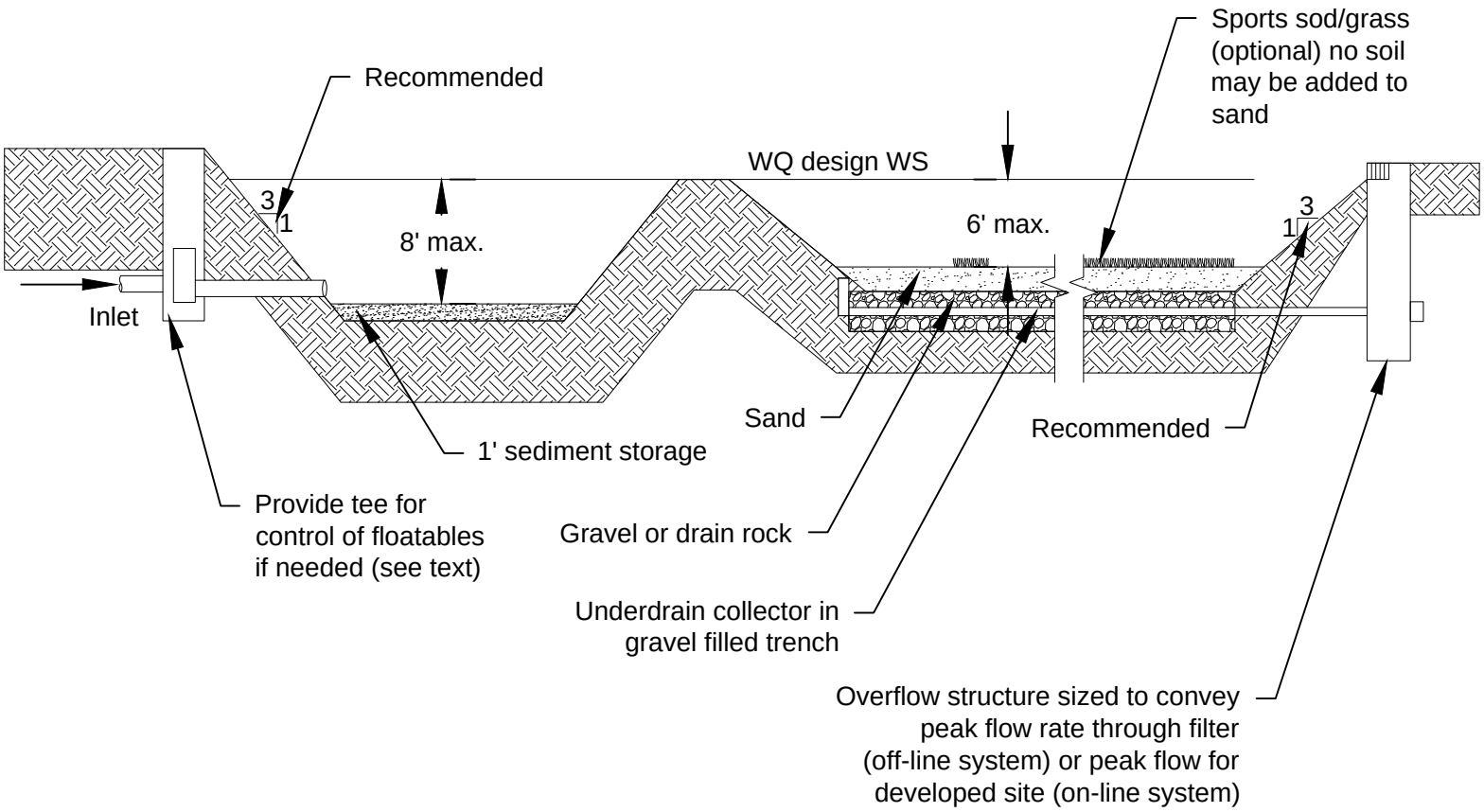
Sand Filter with Pretreatment Cell (Plan View)

Revised June 2016



Section A-A

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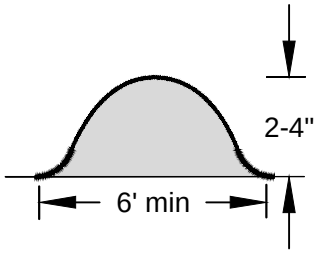
State of Washington

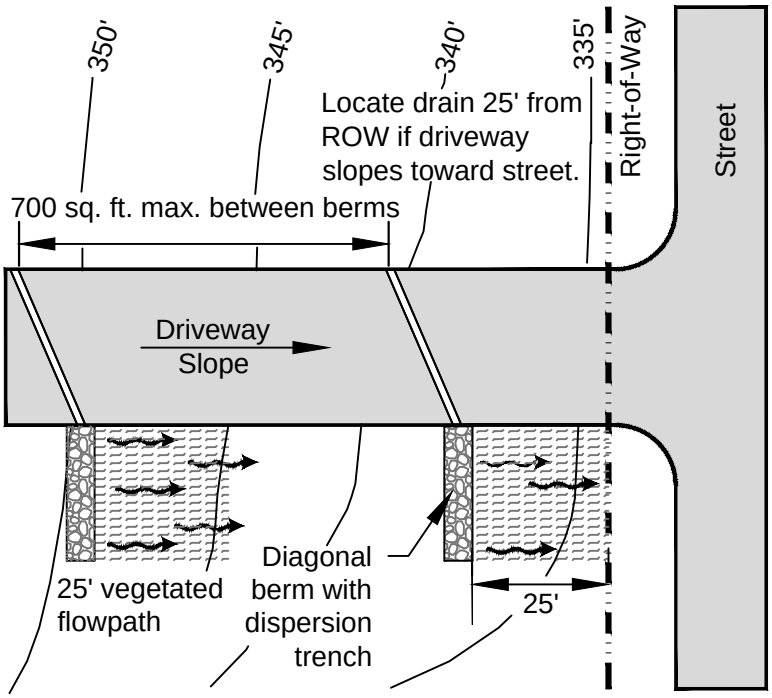
Sand Filter with Pretreatment Cell (Section View)

Revised June 2016

Source: King County Department of Natural Resources, 1998

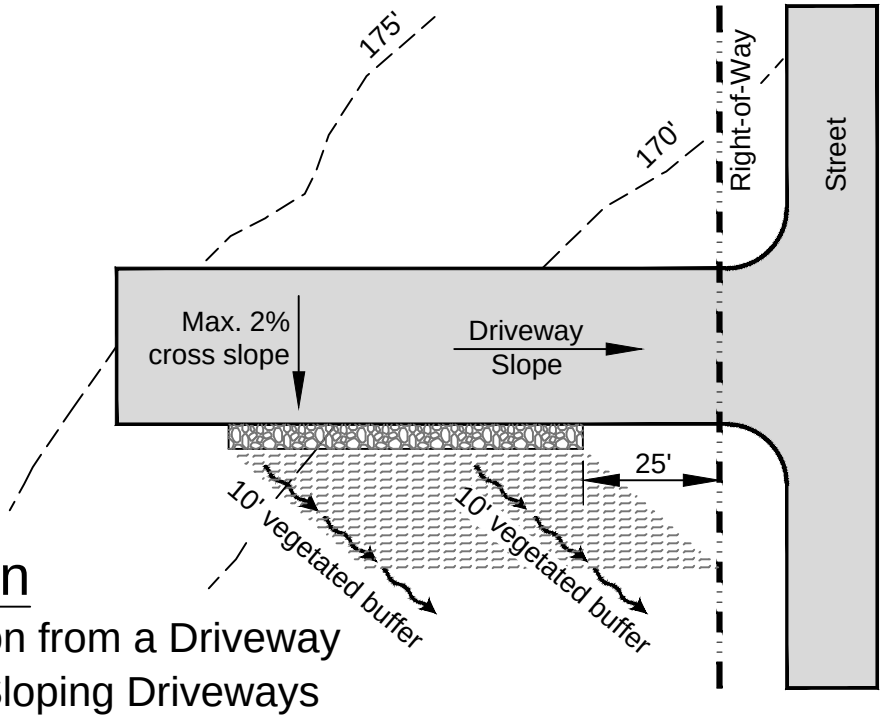


Berm Detail



Plan

Driveway Dispersion Trench
Driveway Slope Varies and Slopes Toward Street



Plan

Sheet Flow Dispersion from a Driveway
Flat to Moderately Sloping Driveways

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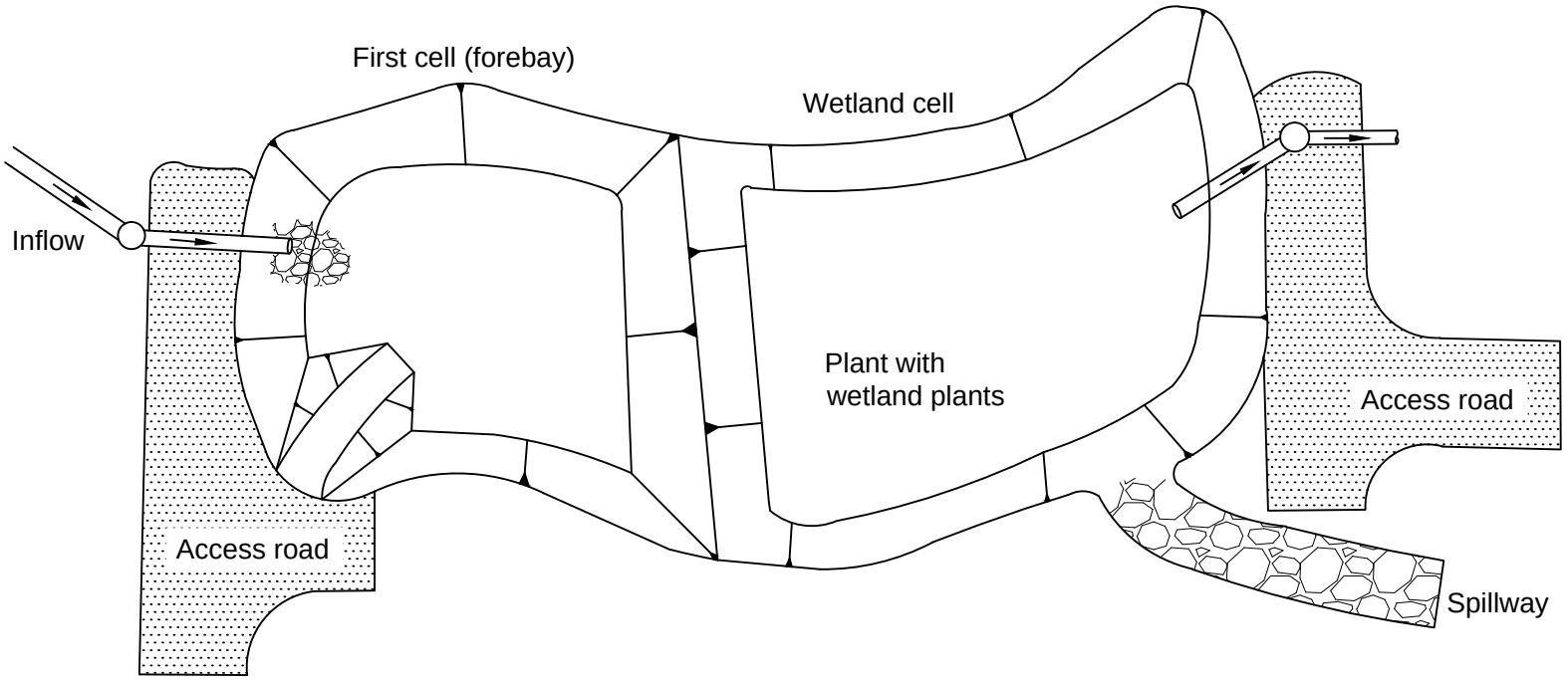
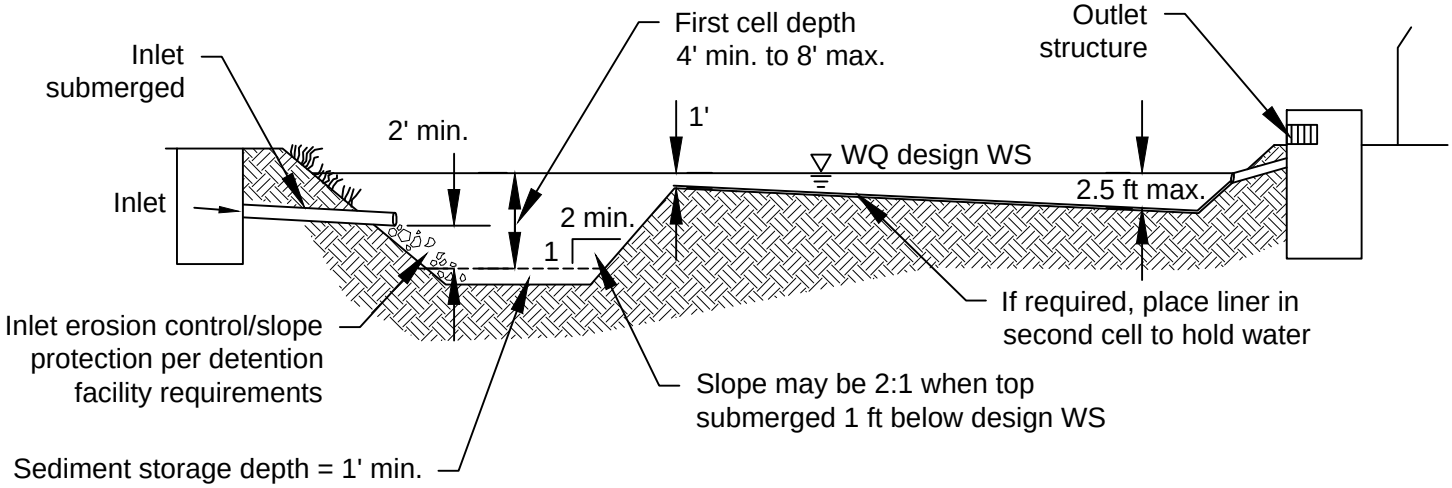
DEPARTMENT OF ECOLOGY
State of Washington

Sheet Flow Dispersion for Driveways

Revised December 2016



Plan View Option A



Section View Option A

Note: See detention facility requirements for location and setback requirements

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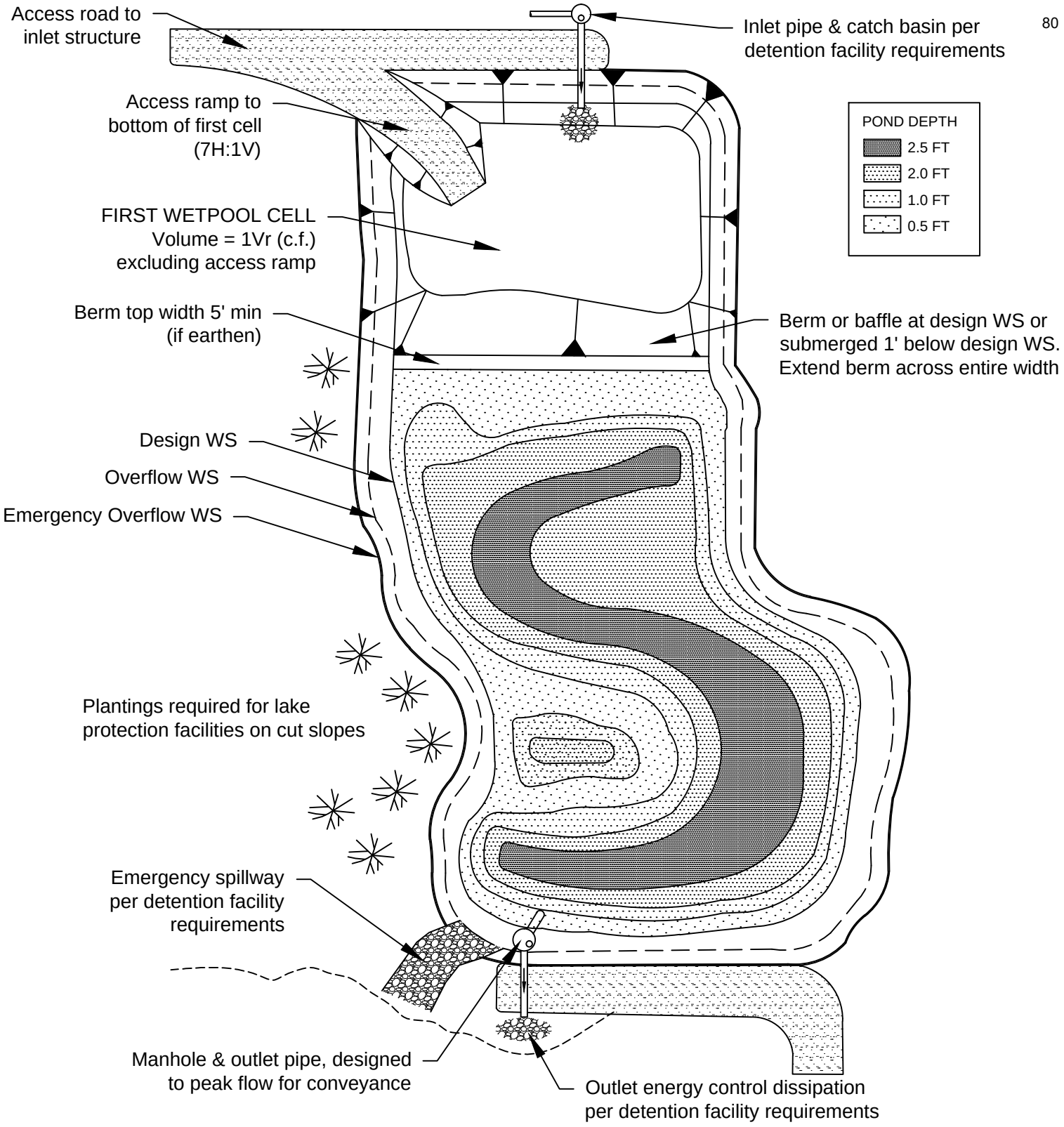
State of Washington

Stormwater Wetland - Option 1

Revised June 2016



Plan View Option B

NOT TO SCALE

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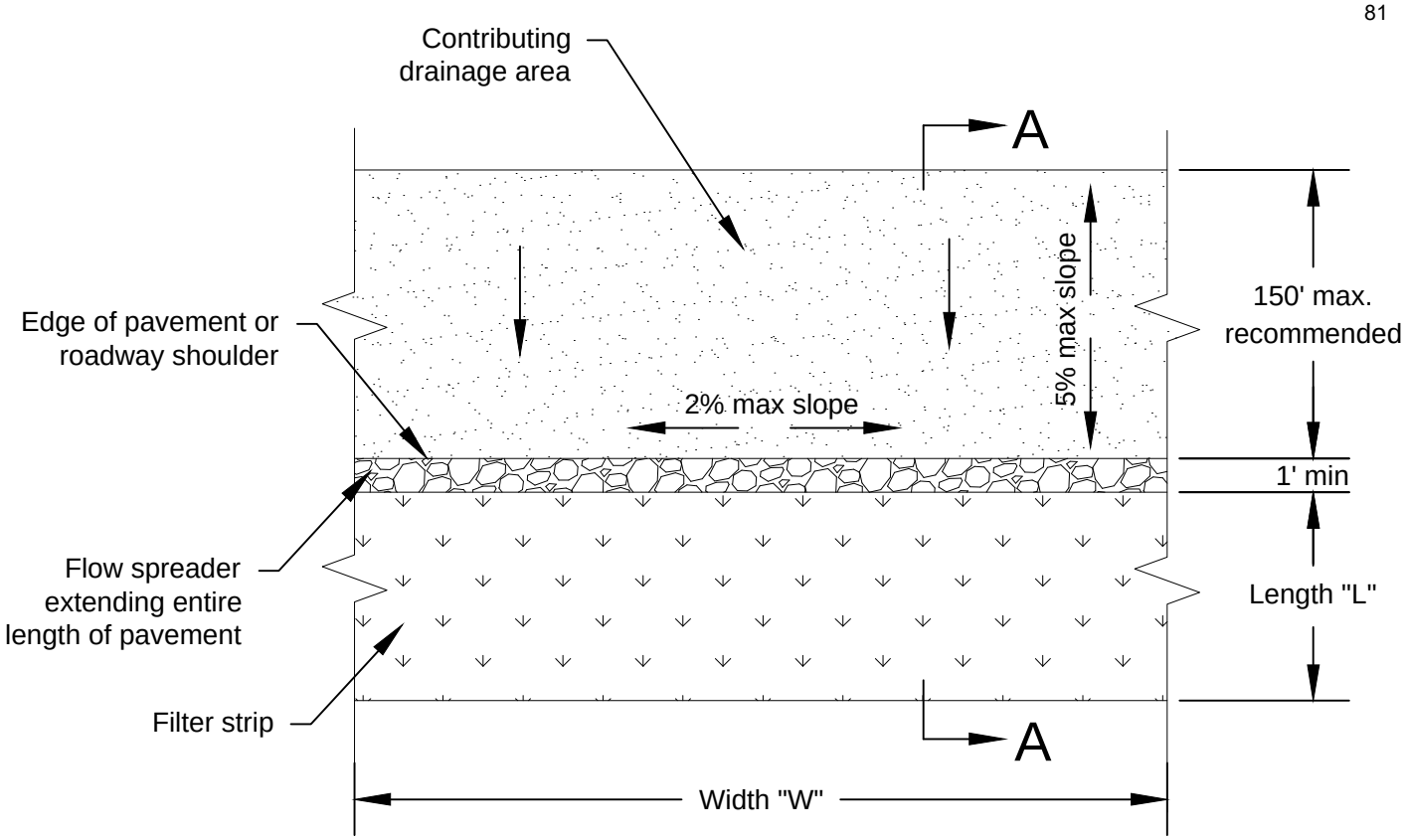
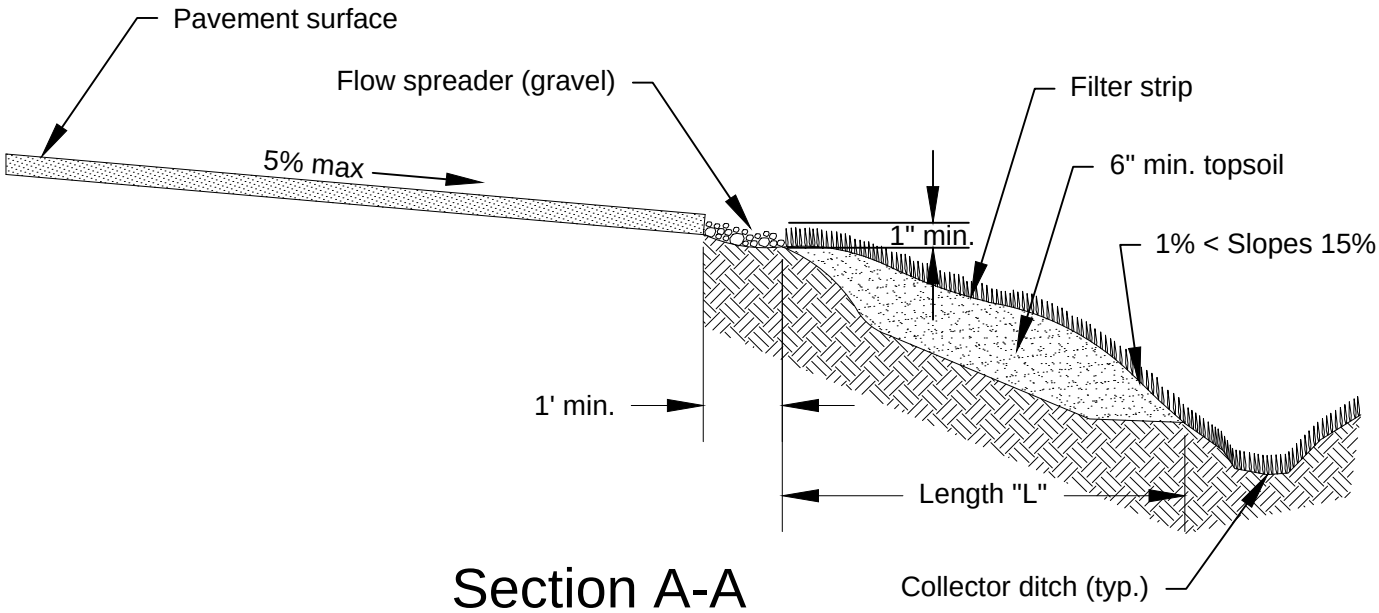
State of Washington

Stormwater Wetland - Option 2

Revised June 2016



Plan View



Section A-A

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Typical Filter Strip

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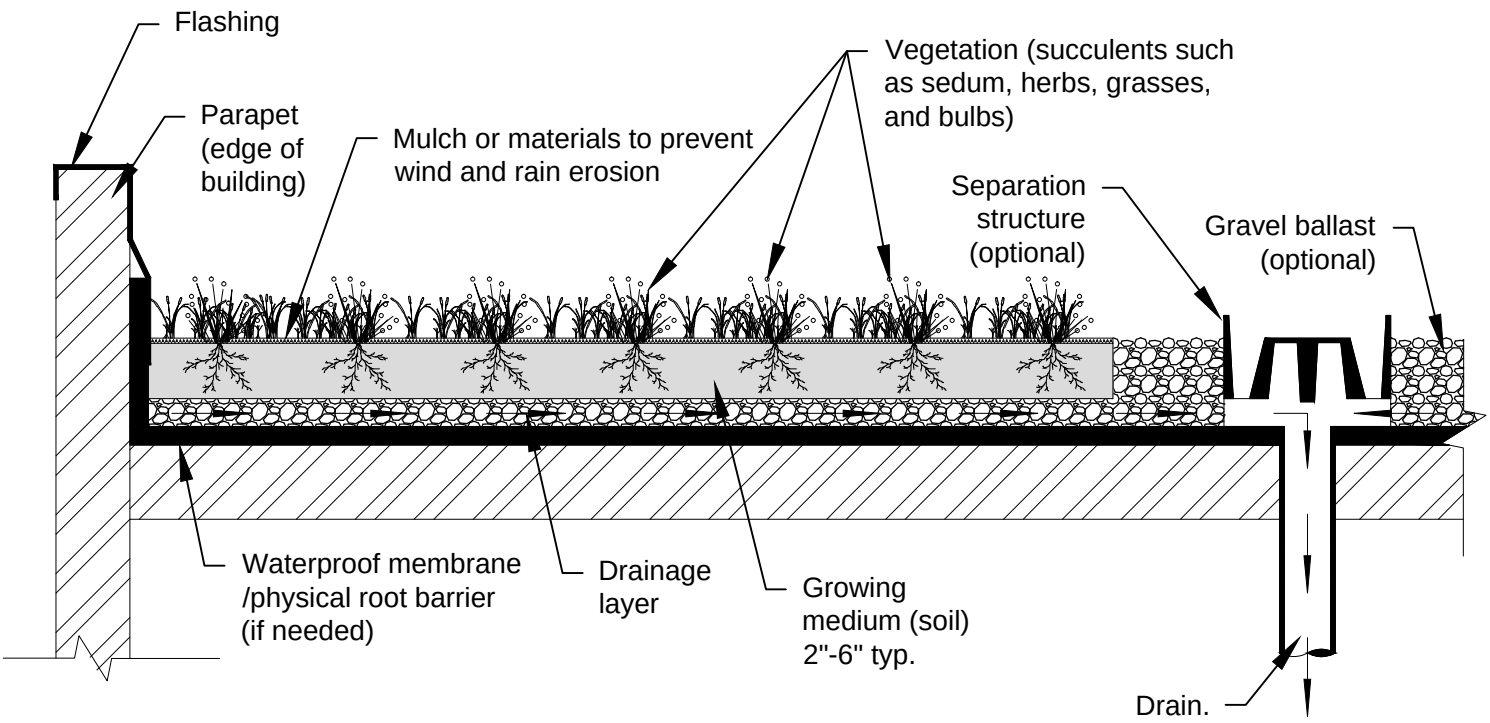

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Example of a Vegetated Roof Section

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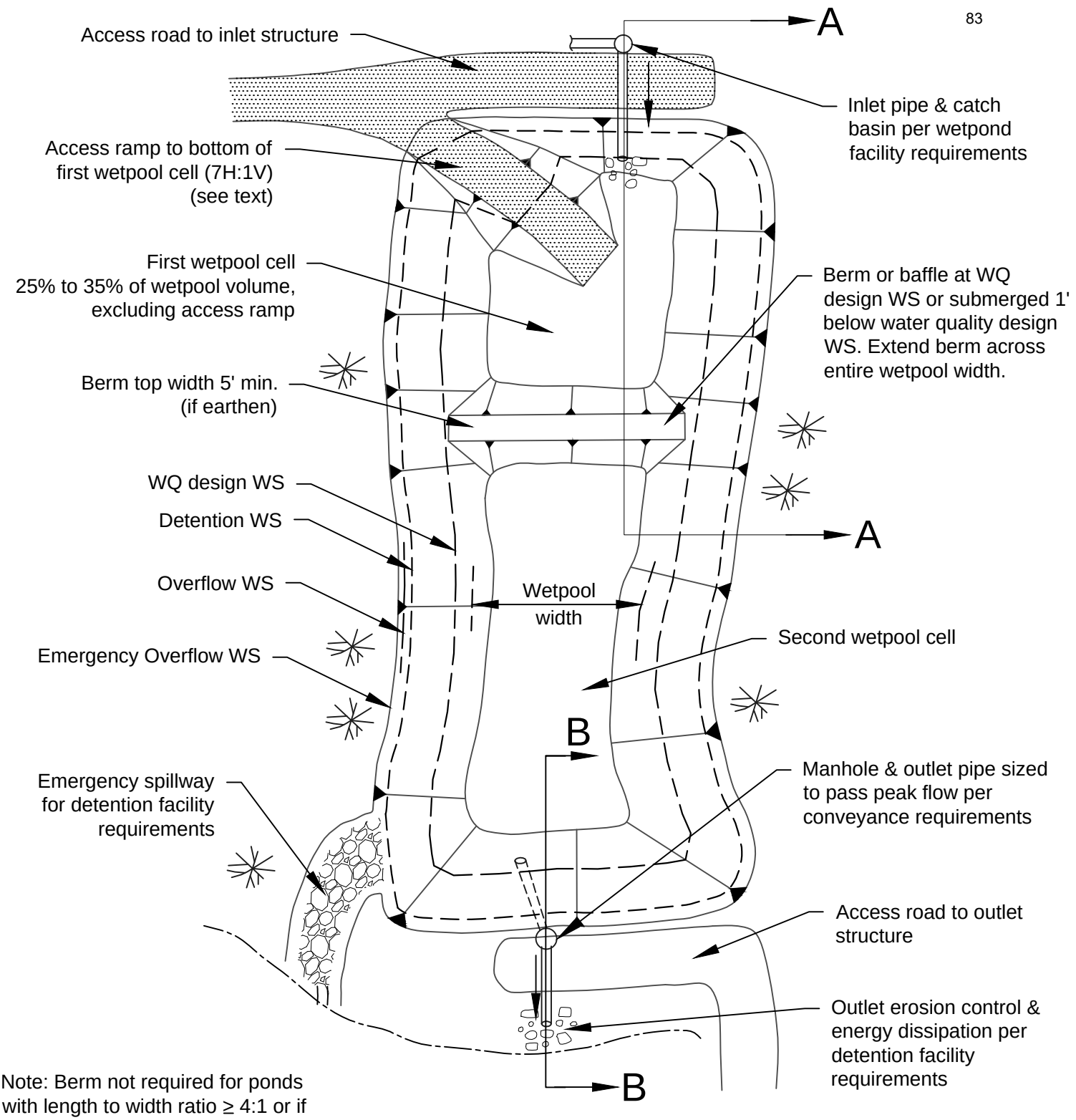

Note: Berm not required for ponds with length to width ratio ≥ 4:1 or if volume less than 4000c.f.

Plan View

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Wetpond (Plan View)

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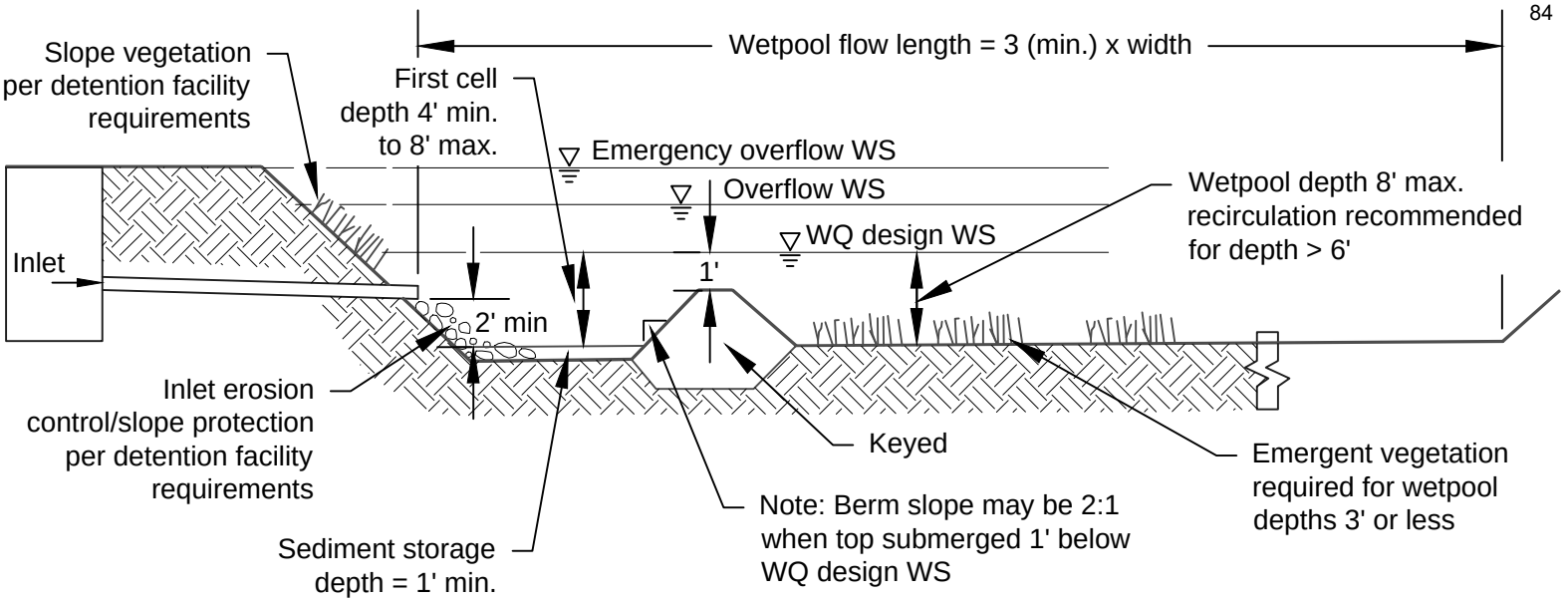
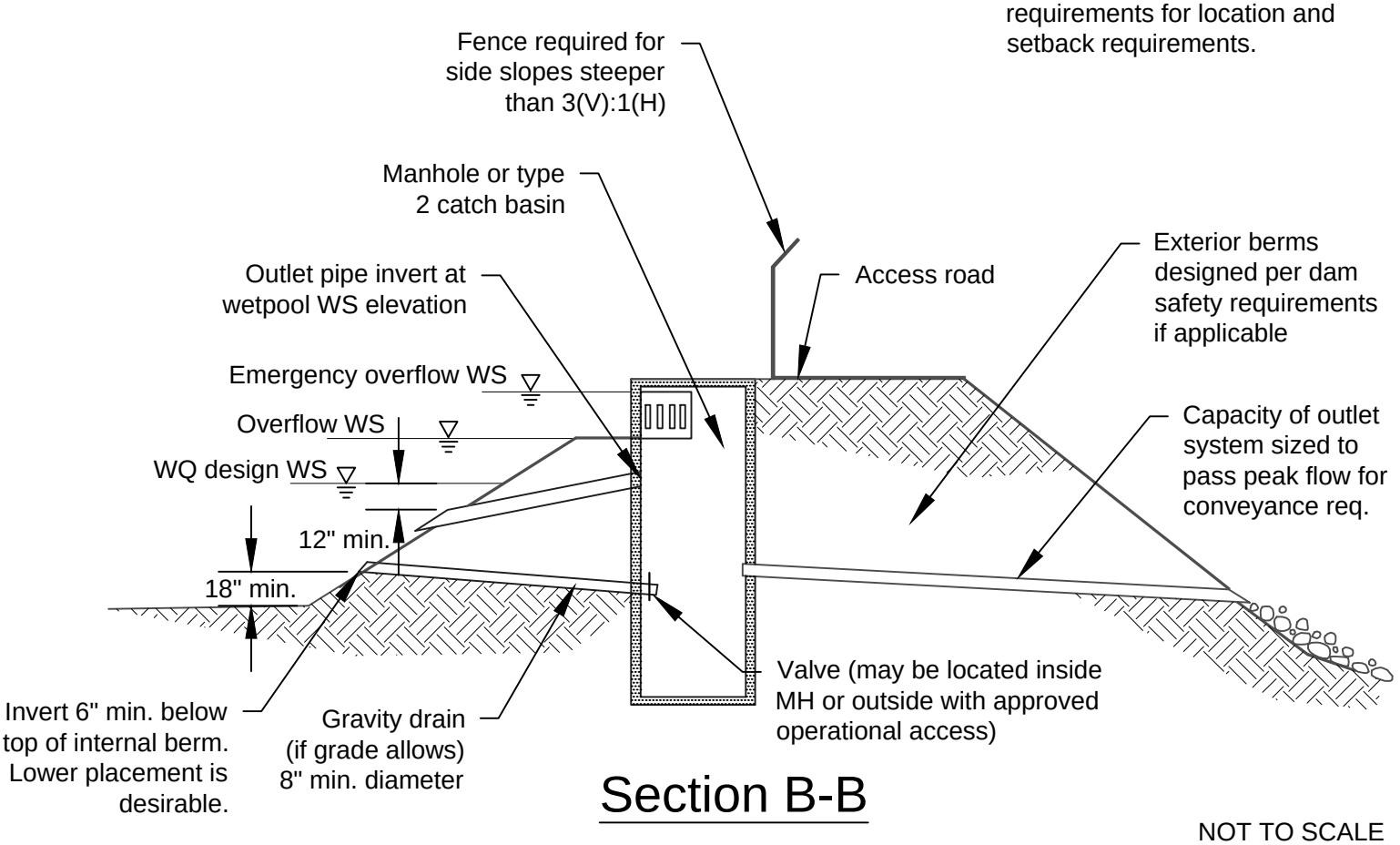


Section A-A

Note: See detention facility requirements for location and setback requirements.



Section B-B

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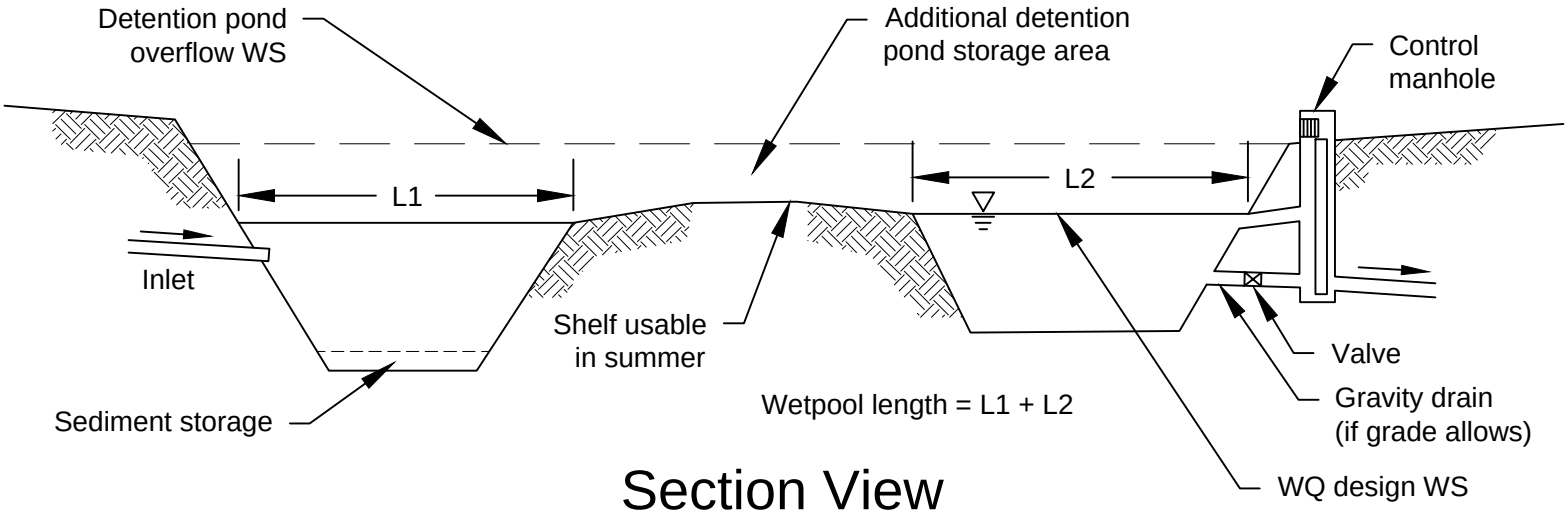
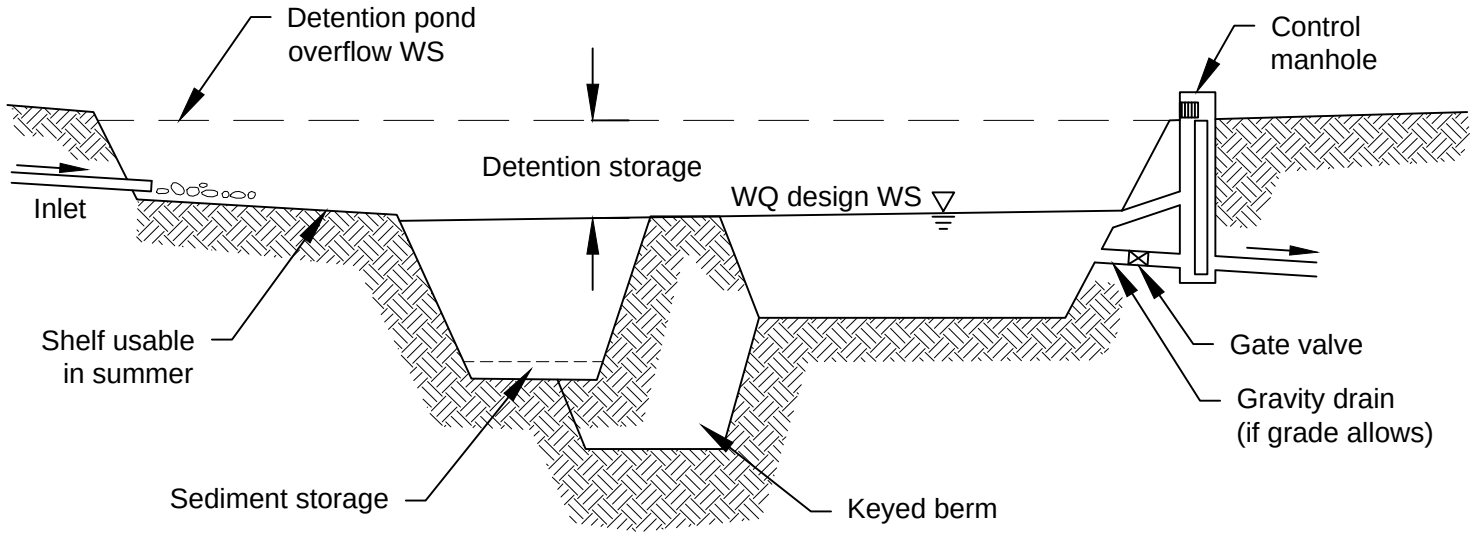
Wetpond (Section View)

Revised June 2016



Section View



Section View

Note: These examples show how the combined detention/wetpool can be configured to allow for "shelves" for joint use opportunities in dry weather. Other options may also be acceptable.

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Alternative Configurations of Detention and Wetpool Areas

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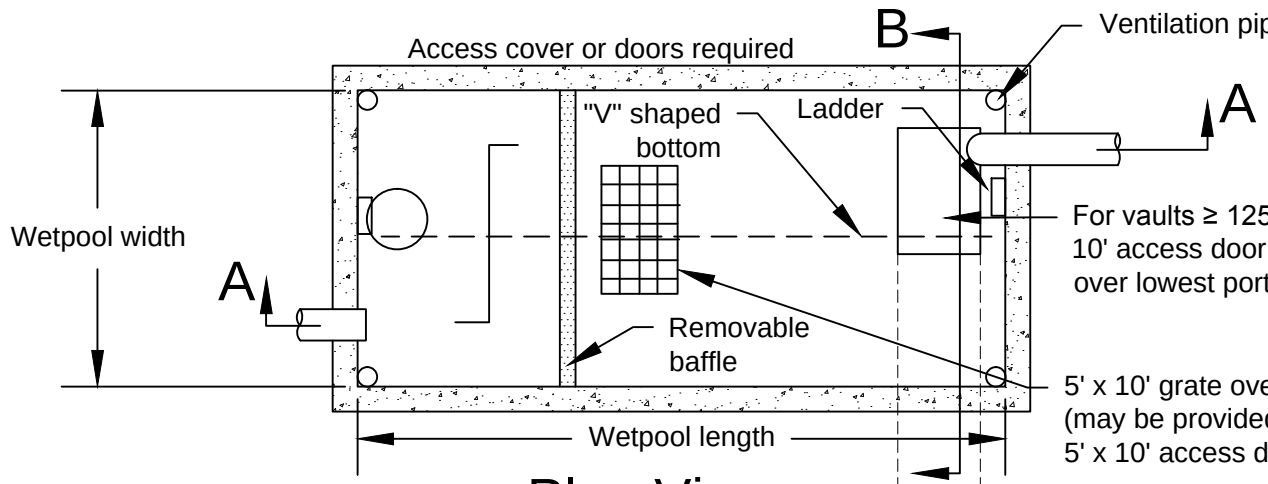
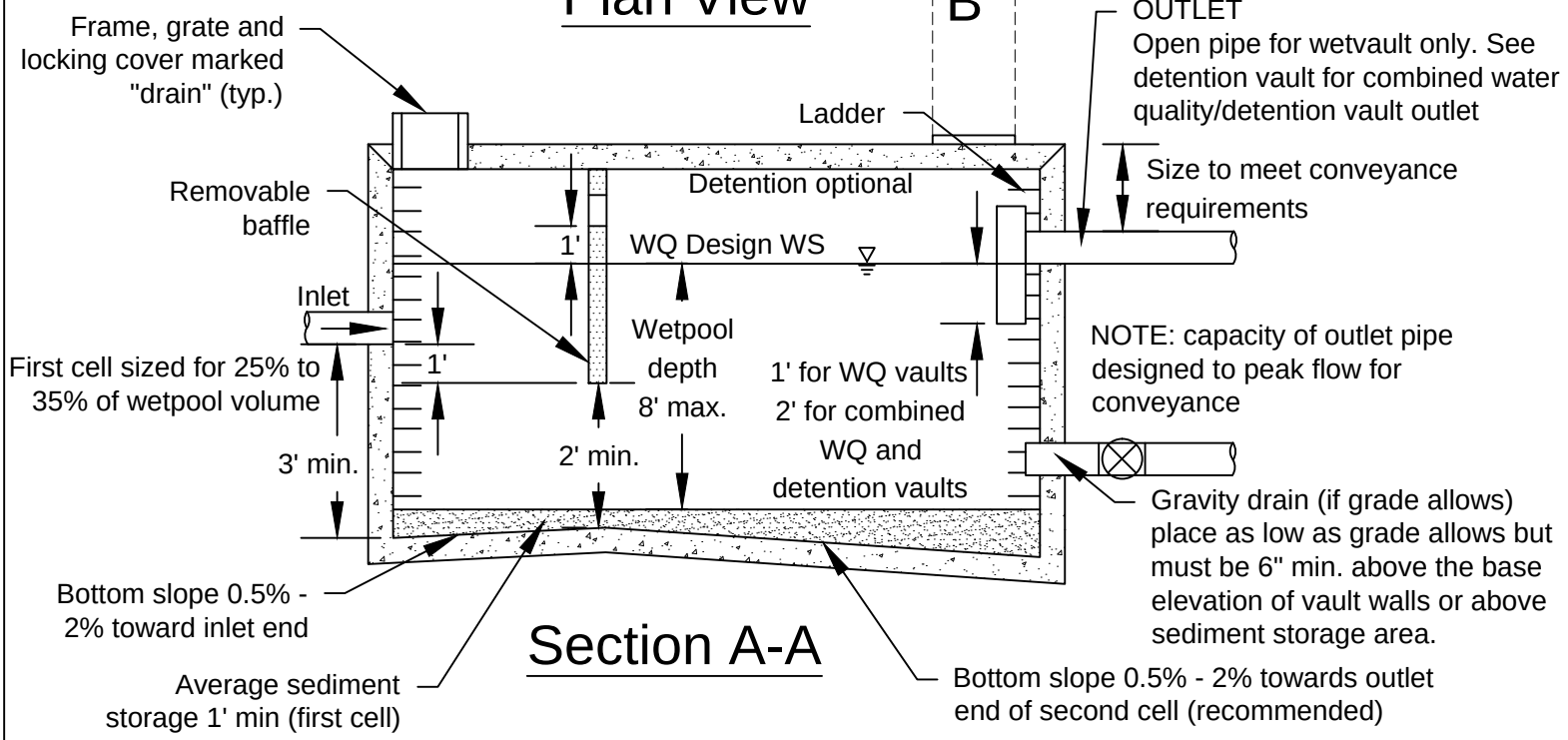
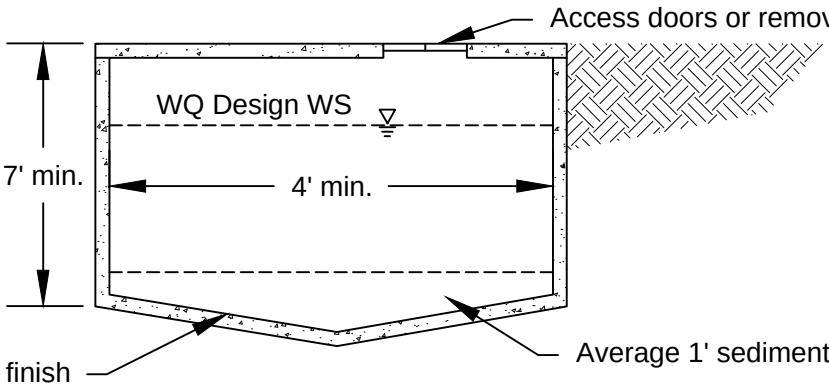


Plan View



Section A-A



Section B-B

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Wetvault

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