

# E&S Control Deficiencies in Basin Designs

Westmoreland Conservation District Engineers' Workshop  
Chelsea Gross, Erosion Control Specialist

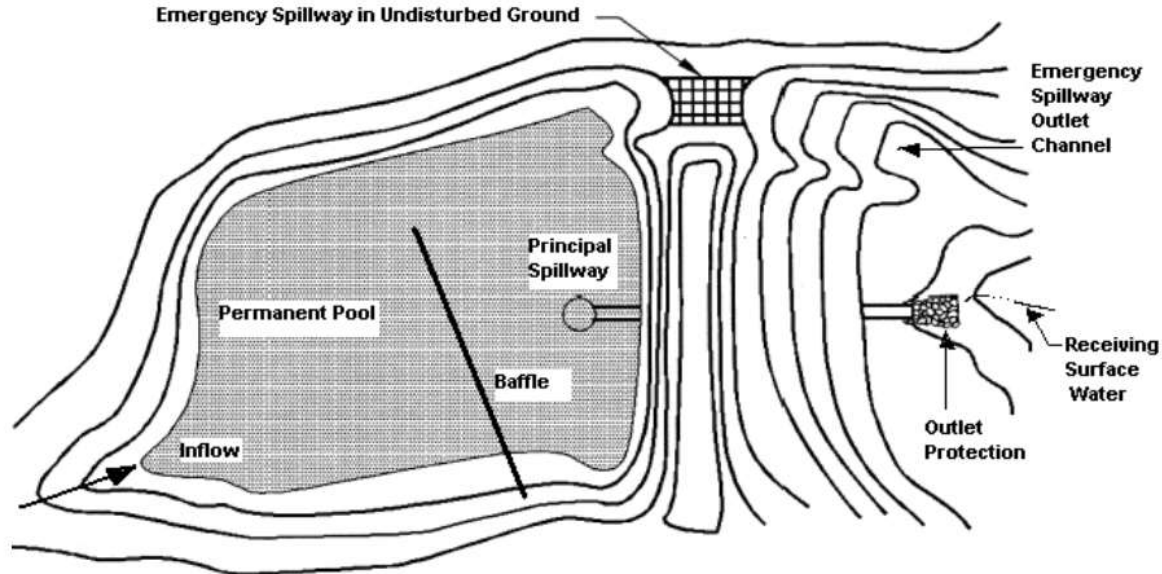
Webinar Series 1  
March 5, 2021



# Agenda

- Typical deficiencies found in reviews
- Supporting criteria from the PA DEP E&SCP manual
- Standard details used in basin designs
- E&S controls when basins are not proposed as a sediment basin

**FIGURE 7.1  
Sediment Basin**

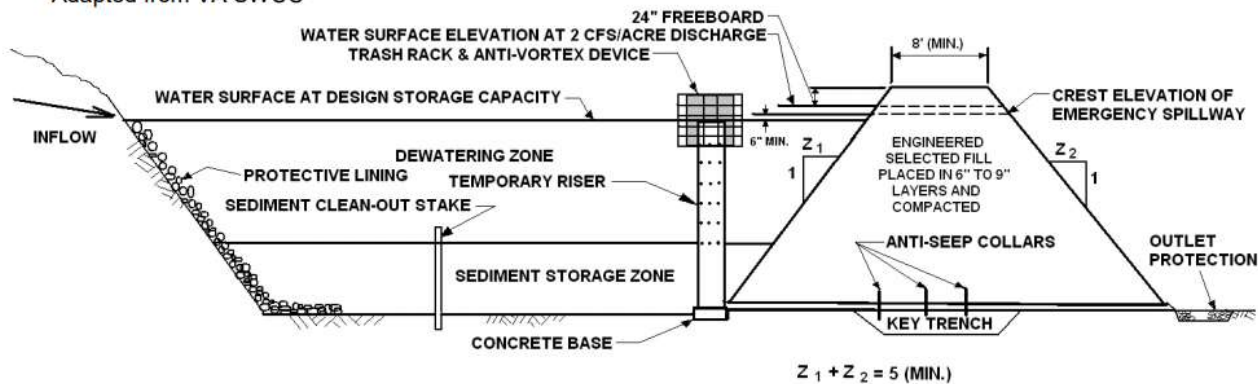


$$\text{AVERAGE WIDTH (W)} = \frac{\text{AREA AT ELEVATION 3}}{L}$$

WHERE: L = MAXIMUM LENGTH OF BASIN AT ELEVATION 3

**PLAN VIEW**

Adapted from VA SWCC



PA DEP

**TYPICAL SECTION**

**NOTE:** This figure is for illustration purposes only and should not be used as a construction detail.

Figure 7.1 depicts a typical plan view of a sediment basin.

**STANDARD E&S WORKSHEET # 12**  
**Sediment Basin Capacity Requirements**

PROJECT NAME: \_\_\_\_\_  
 LOCATION: \_\_\_\_\_  
 PREPARED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

BASIN NUMBER		
PERMANENT OR TEMPORARY BASIN?	(P or T)	
SPECIAL PROTECTION WATERSHED?	(YES OR NO)	
Karst soils?	(YES OR NO)	
(A) MAXIMUM TOTAL DRAINAGE AREA	(AC)	
IS DRAINAGE AREA (A) MORE THAN 10% LARGER THAN THE PRECONSTRUCTION CONDITION?	(YES OR NO)	
(A <sub>r</sub> ) DISTURBED ACRES IN DRAINAGE AREA (AC)		
(I) INITIAL REQ'D DEWATERING ZONE (5,000 X A)	(CF)	
(T) REDUCTION FOR TOP DEWATERING (-700 X A)	(CF)	
(P) REDUCTION FOR PERMANENT POOL (-700 X A)	(CF)	
(L) REDUCTION FOR 4:1 FLOW LENGTH:WIDTH (-350 X A)	(CF)	
(D) REDUCTION FOR 4 TO 7 DAY DEWATERING (- 350 X A)	(CF)	
(S <sub>v</sub> ) REQUIRED DEWATERING ZONE $[1 - (T+P+L+D)]^1$	(CF)	
(S <sub>d</sub> ) REQUIRED SEDIMENT STORAGE VOLUME (1000 X A <sub>r</sub> )	(CF)	
(S <sub>t</sub> ) TOTAL REQUIRED STORAGE VOLUME (S <sub>v</sub> + S <sub>d</sub> )	(CF)	
TOTAL STORAGE VOLUME PROVIDED (@ ELEV 3) <sup>2</sup>	(CF)	
DEWATERING TIME FOR DEWATERING ZONE	(DAYS)	
REQUIRED DISCHARGE CAPACITY (2 X A)	(CFS) <sup>3</sup>	
PRINCIPAL SPILLWAY TYPE (PERFORATED RISER, SKIMMER, etc.)		
PEAK FLOW FROM 10 YR/24 HR STORM FOR DRAINAGE AREA (A)		
PRINCIPAL SPILLWAY CAPACITY (@ ELEV 5)	(CFS) <sup>4</sup>	
EMERGENCY SPILLWAY CAPACITY (@ ELEV 5)	(CFS) <sup>4</sup>	
TOTAL BASIN DISCHARGE CAPACITY (@ ELEV 5)	(CFS)	
EMERGENCY SPILLWAY PROTECTIVE LINING <sup>5</sup>		
OUTLET TO A SURFACE WATER?	(YES OR NO) <sup>6</sup>	
PEAK FLOW FROM A 100 YR/24 HR STORM FOR DRG. AREA (A)		

- 1 The minimum dewatering zone capacity for sediment basins is (3,600 X A). No reduction is permitted in Special Protection (HQ and EV) Watersheds.
- 2 Total Storage Volume provided at riser crest.
- 3 Or provide calculations to show peak flow from 25 yr./24 hr. storm for area (A) is routed through the basin.
- 4 Provide supporting computations.
- 5 If grass lining is proposed, spillway should be constructed in original ground unless a suitable TRM lining is used. Wherever a TRM is used, riprap should be placed at the bottom of the embankment to prevent scour.
- 6 If no, and basin is permanent or drainage area is more than 10% larger than pre-construction, provide supporting calculations to show accelerated erosion will not result from the proposed discharge. For discharges increasing volume or rate of flow onto a neighboring property prior to entering a surface water, an easement should be obtained prior to plan submittal.

Standard worksheets #12-18 or equivalents should be submitted when proposing a sediment basin.

Note: Some worksheets may not apply to all basin designs.

# Deficiency: Basin is located at a high point of the site

- Basins should be located at the low point of the site
- In some cases sediment basins may need to have water pumped to an upslope location
  - For example, large excavations where there is a need to pump water from the pit/trench at a higher capacity than what can be handled by a filter bag

# Deficiency: Embankment design fails to meet stabilization standards

- Core and key trench is required to lock in the embankment
- Include proper soils and compaction notes to prevent piping
- Concrete cradles and anti-seep collars should be proposed
- Trees and shrubs should not be located on embankments
- Minimum top width of the embankment is 8 feet
- In permanent basins inside and outside slopes should be 3:1 or flatter
- Outlet barrel should be installed during construction of embankment

# Deficiency: The outlet barrel is proposed using a HDPE pipe

- Outlet barrels should be constructed from concrete or material that is not susceptible to crushing (ex. high performance polypropylene pipe (HPPP), SDR-35, schedule 40 or 80 PVC)
- HDPE/N-12 pipe with a gravel enclosure is not acceptable

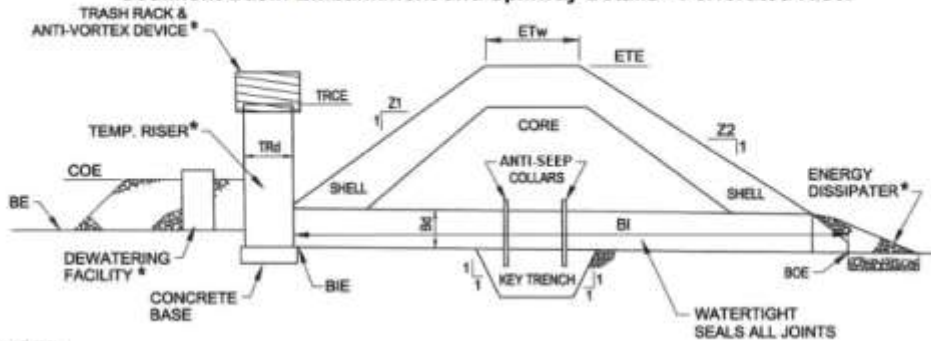


HPPP installation

Photo credit: <https://www.ads-pipe.com/>

**STANDARD CONSTRUCTION DETAIL # 7-6**

**Sediment Basin Embankment and Spillway Details - Perforated Riser**



PA DEP

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

BASIN NO.	Z1 (FT)	Z2 (FT)	TEMPORARY RISER			BARREL					
			DIA TRd (IN)	CREST ELEV TRCE (FT)	MAT'L	DIA Bd (IN)	INLET ELEV BIE (FT)	MAT'L	LENGTH BI (FT)	OUTLET ELEV BOE (FT)	

EMBANKMENT					
TOP ELEV ETE (FT)	TOP WIDTH ETW (FT)	KEY TRENCH DEPTH (FT)	KEY TRENCH WIDTH (FT)	CLEANOUT ELEV COE (FT)	BOTTOM ELEV BE (FT)

\*Also refer to sediment basin temporary riser, emergency spillway, energy dissipater, trash rack and anti-vortex device, and sediment storage dewatering facility details.

Sediment basins, including all appurtenant works, shall be constructed to the detail and dimensions shown on the E&S plan drawings.

Area under embankment shall be cleared, grubbed, and stripped of topsoil to a depth of two feet prior to any placement and compaction of earthen fill. Fill material for the embankments shall be free of roots, or other woody vegetation, organic material, large stones, and other objectionable materials. The embankment shall be compacted in layered lifts of not more than 6" to 9". The maximum rock size shall be no greater than 2/3 the lift thickness. Upon completion, the embankment shall be seeded and mulched or otherwise stabilized according to the specifications of the E&S plan drawings. Trees shall not be planted on the embankment.

Access shall be provided for sediment removal and other required maintenance activities.

A clean out stake shall be placed near the center of each basin. Accumulated sediment shall be removed when it has reached the clean out elevation on the stake and restore the basin to its original dimensions. Dispose of materials removed from the basin in the manner described in the E&S plan.

Inspect all sediment basins on at least a weekly basis and after each runoff event. Check basin embankments, spillways, and outlets for erosion, piping and settlement. Necessary repairs shall be made immediately. Displaced riprap within the outlet energy dissipater shall be

Standard detail #7-6 or #7-8 provide embankment and outlet barrel details



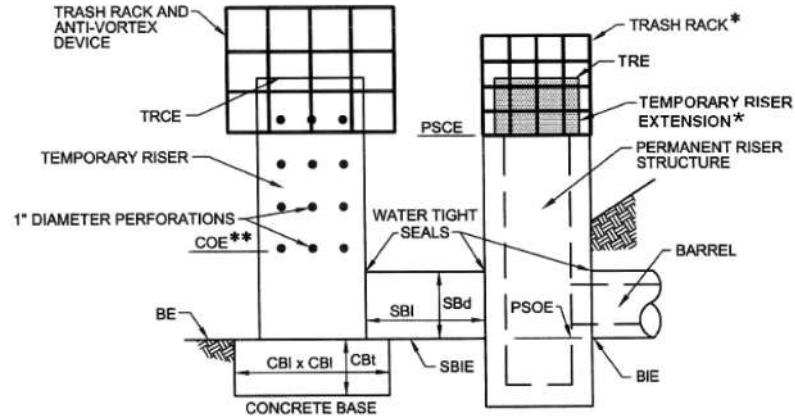
# Deficiency: The temporary sediment control device is designed inadequately for the sediment basin

- Sediment basins should propose a temporary riser or skimmer
- Temporary riser requirements:
  - Concrete base
  - Trash rack and anti-vortex device
  - 1.25x larger than the outlet pipe
    - Minimum diameter of temporary riser is 15”
    - Minimum diameter of outlet pipe is 12”
  - 1” diameter perforations
    - The rule of thumb may be used for non-special protection watersheds
    - Special protection watersheds are to use standard worksheets #15 and #16 for calculating perforations needed

# Deficiency: The temporary sediment control device is designed inadequately for the sediment basin

- Permanent riser elevation should be the same height as the temporary riser elevation
- Permanent risers should not have an inlet filter bag proposed
- Skimmers should have a stone berm
  - Half circle berm
  - Single landing pad with guide rails
- A cleanout stake elevation and location should be identified

**STANDARD CONSTRUCTION DETAIL # 7-9**  
**Sediment Basin/Detention Pond Riser Structures**



PA DEP

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

BASIN NO.	TEMPORARY RISER			PERFORATIONS			CONCRETE BASE		
	DIA TRd (IN)	CREST ELEV TRE (FT)	MAT'L	LOWEST ROW OF HOLES ELEV. (FT)	NO. ROWS**	NO. HOLES PER ROW	VERTICAL SPACING OF ROWS (FT)	LENGTH and WIDTH CBI (IN)	THICK. CBT (IN)

BASIN NO.	TEMPORARY STUB				PERMANENT STRUCTURE			BARREL INLET ELEV BIE (FT)
	DIA SBd (IN)	INVERT ELEV SBIE (FT)	MAT'L	LENGTH SBI (FT)	CREST ELEV PSCE (FT)	CREST ELEV TRE (FT)	OUTLET ELEV PSOE (FT)	

\* See Standard Construction Detail #7-5, Trash Rack and Anti-vortex Device and Standard Construction Detail #7-7, Sediment Basin Temporary Riser. Top of temporary riser extension (TRE) shall be equal to or above temporary riser crest elevation (TRCE) and 6 inches (minimum) below crest of emergency spillway. Remove flat grate from permanent riser for as long as basin functions as a sediment removal BMP.

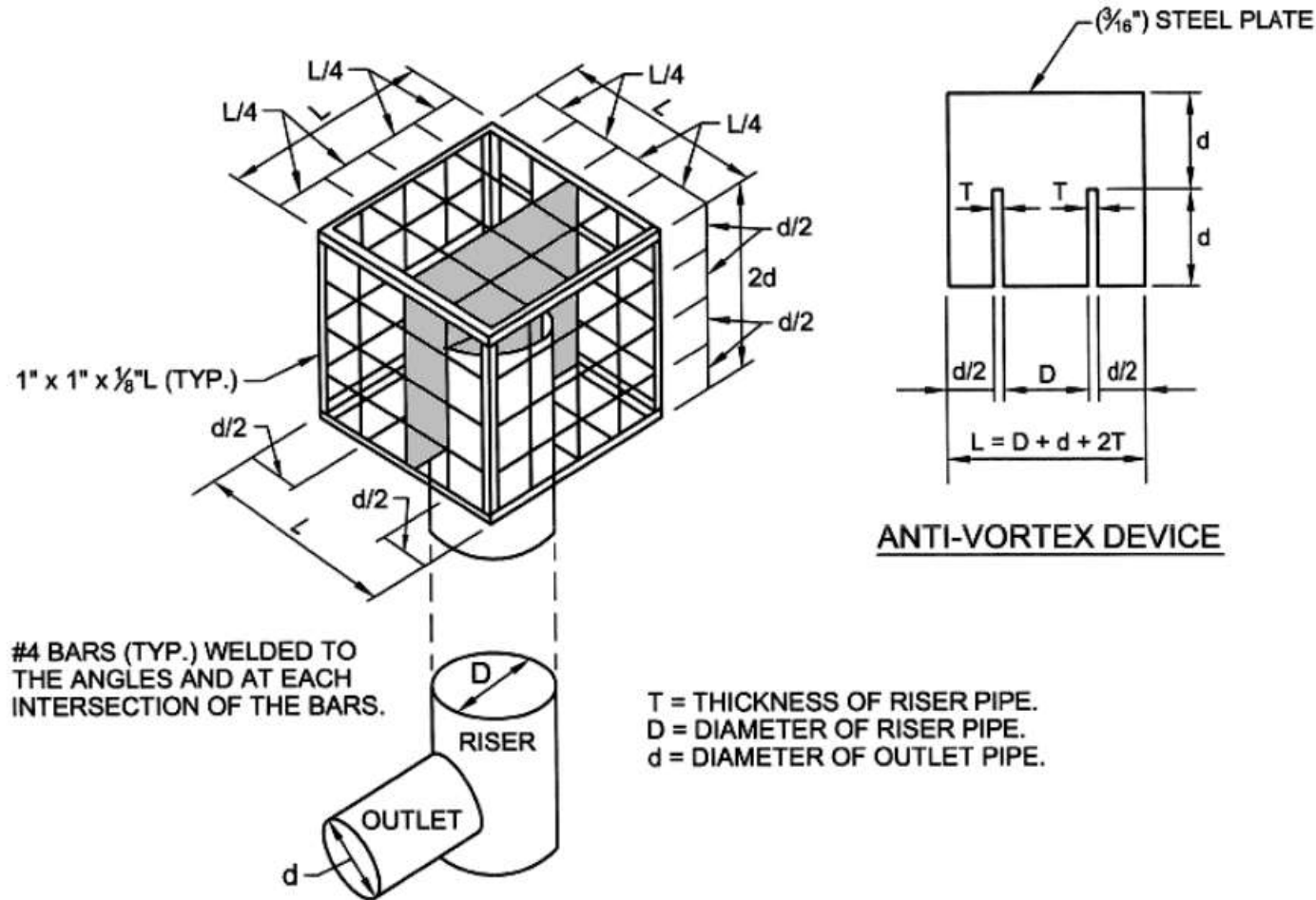
\*\* Lowest row of holes at sediment clean-out elevation

A minimum 2 #8 rebar shall be placed at right angles and projecting through sides of riser to anchor it to concrete base. Rebar shall project a minimum of ¼ riser diameter beyond outside of riser.

Concrete base shall be poured in such a manner to insure that concrete fills bottom of riser to invert of the outlet pipe to prevent riser from breaking away from the base. Minimum base width equals 2 times riser diameter.

Standard detail #7-9 provides information when using a temporary riser connected to the permanent outlet structure

**STANDARD CONSTRUCTION DETAIL # 7-5**  
**Trash Rack and Anti-vortex Device**



Adapted from PennDOT Pub.RC-72M

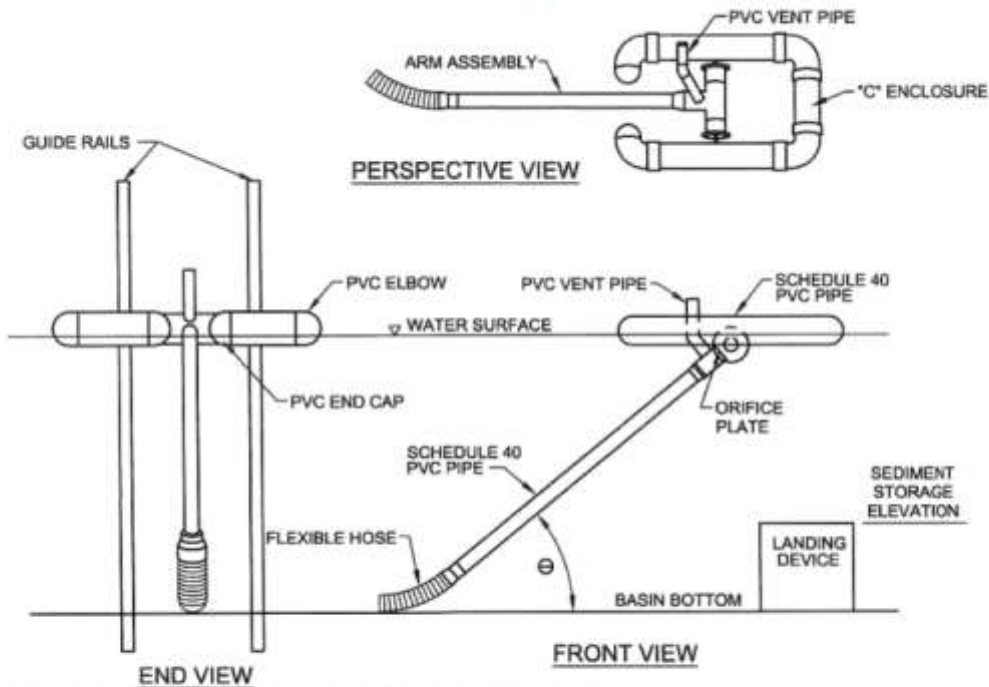
Standard detail #7-5 provides information for the trash rack and anti-vortex device



Trash racks and  
anti-vortex  
device installed

**STANDARD CONSTRUCTION DETAIL # 7-1**

**Skimmer**



Adapted from Penn State Agricultural and Biological fact Sheet F-253

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

Basin No.	Water Surface Elevation (ft)	Arm Length (ft)	Arm Dia. (in)	Orifice Size* (in)	Top of Landing Device Elevation (ft)	Flexible Hose Length (in)	Flexible Hose Attachment Elevation (ft)

\* Must be equal to or less than arm diameter

A rope shall be attached to the skimmer arm to facilitate access to the skimmer once installed.

Skimmer shall be inspected weekly and after each runoff event.

Any malfunctioning skimmer shall be repaired or replaced within 24 hours of inspection.

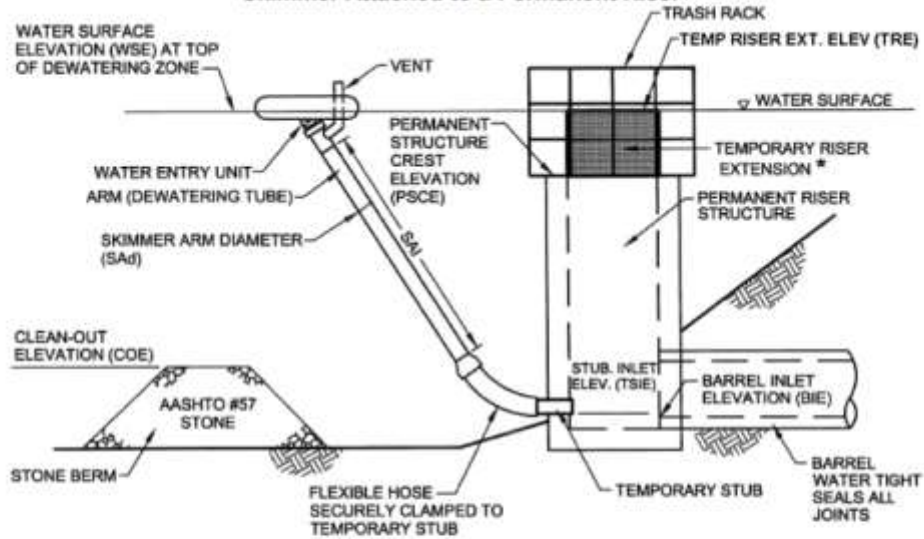
Ice or sediment buildup around the principal spillway shall be removed so as to allow the skimmer to respond to fluctuating water elevations.

Sediment shall be removed from the basin when it reaches the level marked on the sediment clean-out stake or the top of the landing device.

A semi-circular landing zone may be substituted for the guide rails (Standard Construction Detail # 7-3).

Standard detail #7-1 provides information for the skimmer

**STANDARD CONSTRUCTION DETAIL # 7-2**  
**Skimmer Attached to a Permanent Riser**



PA DEP

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

BASIN NO.	WATER SURFACE ELEV. WSE (FT)	SKIMMER							
		ORIFICE		ARM			FLEXIBLE HOSE		
		DIA (IN)	HEAD (FT)	DIA SAAd (IN)	LENGTH SAI (FT)	MAT'L	DIA (IN)	LENGTH (IN)	MAT'L

TEMPORARY STUB			PERMANENT RISER			RISER EXTENSION			BARREL
INSIDE DIA (IN)	INVERT ELEV. TSIE (FT)	MAT'L	CREST ELEV. PSCE (FT)	HORIZ OPENING LENGTH EI (IN)	WIDTH Ew (IN)	CREST ELEV. TRE (FT)	HORIZ OPENING LENGTH (IN)	WIDTH (IN)	INLET ELEV. BIE (FT)

All orifices on permanent riser below temporary riser extension shall have water-tight temporary seals provided. Temporary stub invert elevation shall be set at or below sediment clean-out elevation.

A rope shall be attached to the skimmer arm to facilitate access to the skimmer once installed.

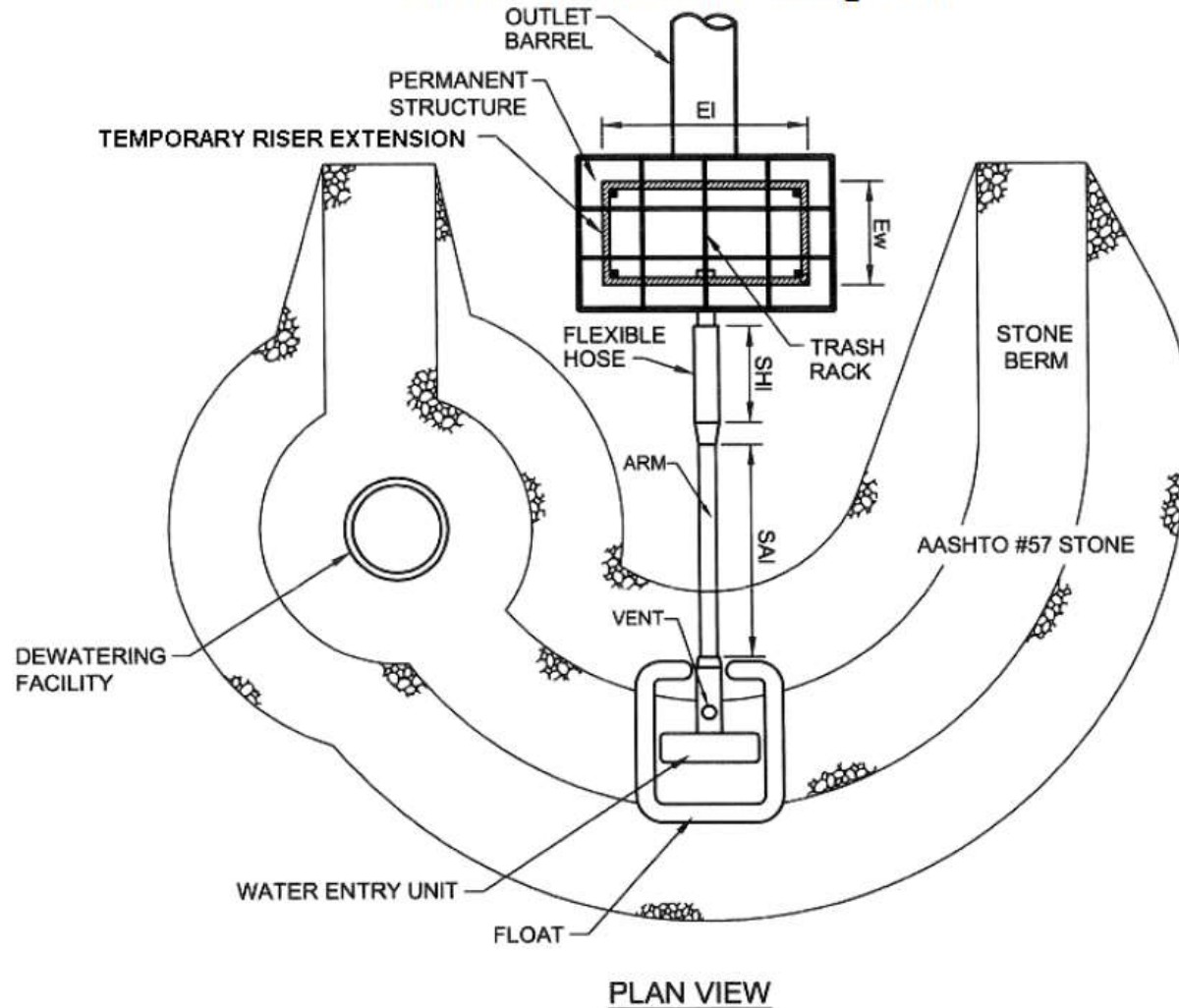
Skimmer shall be inspected weekly and after each runoff event.

Any malfunctioning skimmer shall be repaired or replaced within 24 hours of inspection.

Ice or sediment buildup around the principal spillway shall be removed so as to allow the skimmer to respond to fluctuating water elevations.

Standard detail #7-2 provides information on the skimmer attachment to the permanent outlet structure

**STANDARD CONSTRUCTION DETAIL # 7-3  
Skimmer with Stone Landing Berm**



PA DEP

**No guide rails shall be required for this installation.**

**This detail shall be used in conjunction with Standard Construction Details # 7-2 and # 7-4.**

Standard detail #7-3 indicates guide rails are not needed when using a half circle landing berm

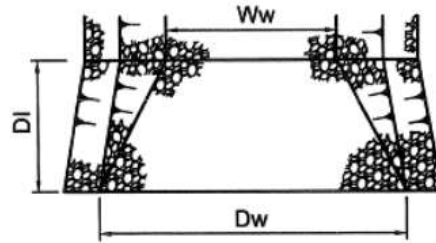
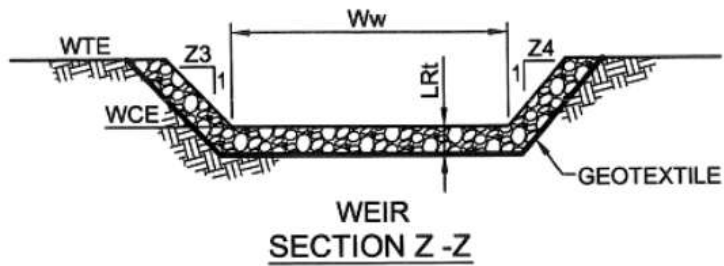


# Deficiency: The emergency spillway elevation is lower than the principle spillway elevation

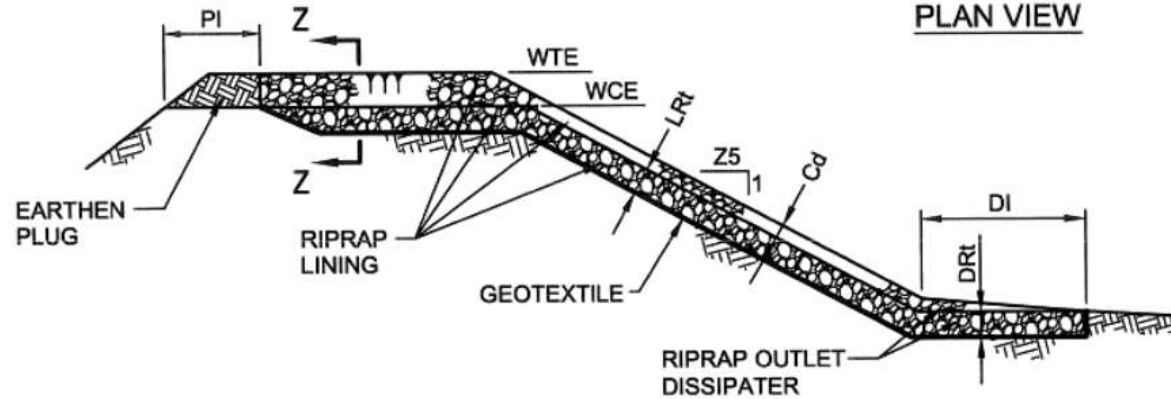
- The emergency spillway elevation should be at least 6” above the principle spillway elevation



**STANDARD CONSTRUCTION DETAIL # 7-12**  
**Sediment Basin Emergency Spillway with Riprap Lining**



**RIPRAP OUTLET DISSIPATER  
 PLAN VIEW**



**EMBANKMENT SECTION ALONG EMERGENCY SPILLWAY**

PA DEP

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

BASIN NO.	WEIR			LINING		CHANNEL		DISSIPATER					
	Z3 (FT)	Z4 (FT)	TOP ELEV WTE (FT)	CREST ELEV WCE (FT)	WIDTH Ww (FT)	RIPRAP SIZE (R-___)	RIPRAP THICK. LRt (IN)	Z5 (FT)	DEPTH Cd (FT)	LENGTH DI (FT)	WIDTH Dw (FT)	RIPRAP SIZE (R-___)	RIPRAP THICK. DRt (IN)

Dimension PI shall be 5' minimum.

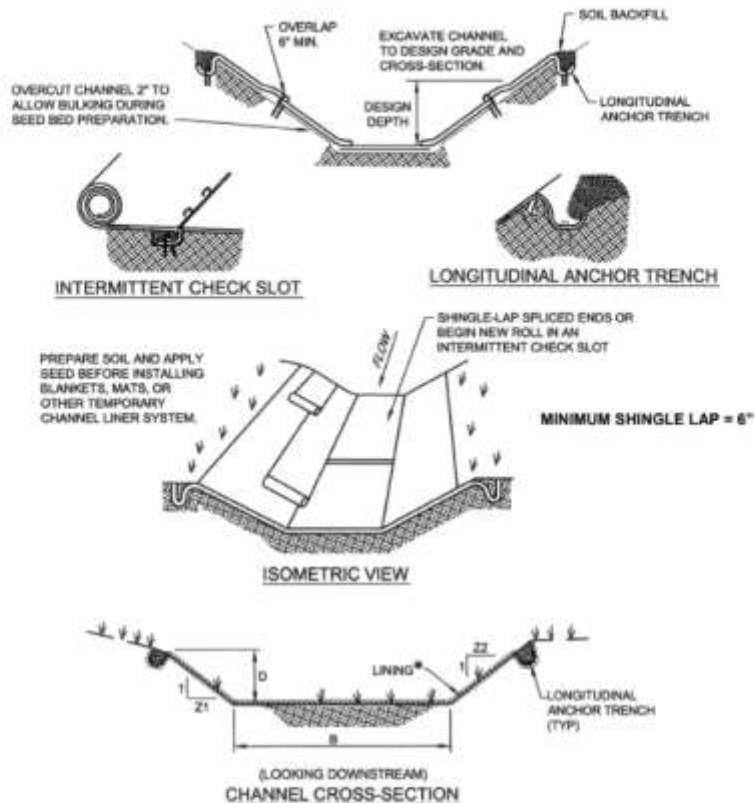
Displaced riprap within the spillway and/or outlet channel shall be replaced immediately.

Standard detail #7-12 provides information on a riprap lined emergency spillway

# Deficiency: Conveyance channels are not extended to the basin

- Channels should extend to the basin with proper outlet protection
- Conveyance channels should be lined to prevent erosion

**STANDARD CONSTRUCTION DETAIL # 6-1  
Vegetated Channel**



\* SEE MANUFACTURER'S LINING INSTALLATION DETAIL FOR STAPLE PATTERNS, AND VEGETATIVE STABILIZATION. SPECIFICATIONS FOR SOIL AMENDMENTS, SEED MIXTURES AND MULCHING INFORMATION.

Adapted from Salix Applied Earthcare - Erosion Draw 5.0

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

CHANNEL NO.	STATIONS	BOTTOM WIDTH B (FT)	DEPTH D (FT)	TOP WIDTH W (FT)	Z1 (FT)	Z2 (FT)	LINING*

Anchor trenches shall be installed at beginning and end of channel in the same manner as longitudinal anchor trenches.

Channel dimensions shall be constantly maintained. Channel shall be cleaned whenever total channel depth is reduced by 25% at any location. Sediment deposits shall be removed within 24 hours of discovery or as soon as soil conditions permit access to channel without further damage. Damaged lining shall be repaired or replaced within 48 hours of discovery.

Standard  
Detail #6-1  
provides  
information  
on channel  
lining  
installations.

**STANDARD E&S WORKSHEET # 11**  
**Channel Design Data**

PROJECT NAME: \_\_\_\_\_  
 LOCATION: \_\_\_\_\_  
 PREPARED BY: \_\_\_\_\_ DATE: \_\_\_\_\_  
 CHECKED BY: \_\_\_\_\_ DATE: \_\_\_\_\_

CHANNEL OR CHANNEL SECTION				
TEMPORARY OR PERMANENT? (T OR P)				
DESIGN STORM (2, 5, OR 10 YR)				
ACRES (AC)				
MULTIPLIER (1.6, 2.25, or 2.75) <sup>1</sup>				
Q (REQUIRED CAPACITY) (CFS)				
Q (CALCULATED AT FLOW DEPTH d) (CFS)				
PROTECTIVE LINING <sup>2</sup>				
n (MANNING'S COEFFICIENT) <sup>2</sup>				
V <sub>a</sub> (ALLOWABLE VELOCITY) (FPS)				
V (CALCULATED AT FLOW DEPTH d) (FPS)				
τ <sub>a</sub> (MAX ALLOWABLE SHEAR STRESS) (LB/FT <sup>2</sup> )				
τ <sub>d</sub> (CALC'D SHEAR STRESS AT FLOW DEPTH d) (LB/FT <sup>2</sup> )				
CHANNEL BOTTOM WIDTH (FT)				
CHANNEL SIDE SLOPES (H:V)				
D (TOTAL DEPTH) (FT)				
CHANNEL TOP WIDTH @ D (FT)				
d (CALCULATED FLOW DEPTH) (FT)				
CHANNEL TOP WIDTH @ FLOW DEPTH d (FT)				
BOTTOM WIDTH: FLOW DEPTH RATIO (12:1 MAX)				
d <sub>50</sub> STONE SIZE (IN)				
A (CROSS-SECTIONAL AREA) (SQ. FT.)				
R (HYDRAULIC RADIUS)				
S (BED SLOPE) <sup>3</sup> (FT/FT)				
S <sub>c</sub> (CRITICAL SLOPE) (FT/FT)				
.7S <sub>c</sub> (FT/FT)				
1.3S <sub>c</sub> (FT/FT)				
STABLE FLOW? (Y/N)				
FREEBOARD BASED ON UNSTABLE FLOW (FT)				
FREEBOARD BASED ON STABLE FLOW (FT)				
MINIMUM REQUIRED FREEBOARD <sup>4</sup> (FT)				
DESIGN METHOD FOR PROTECTIVE LINING <sup>5</sup>				
PERMISSIBLE VELOCITY (V) OR SHEAR STRESS (S)				

Standard worksheet #11 should be provided for channel designs

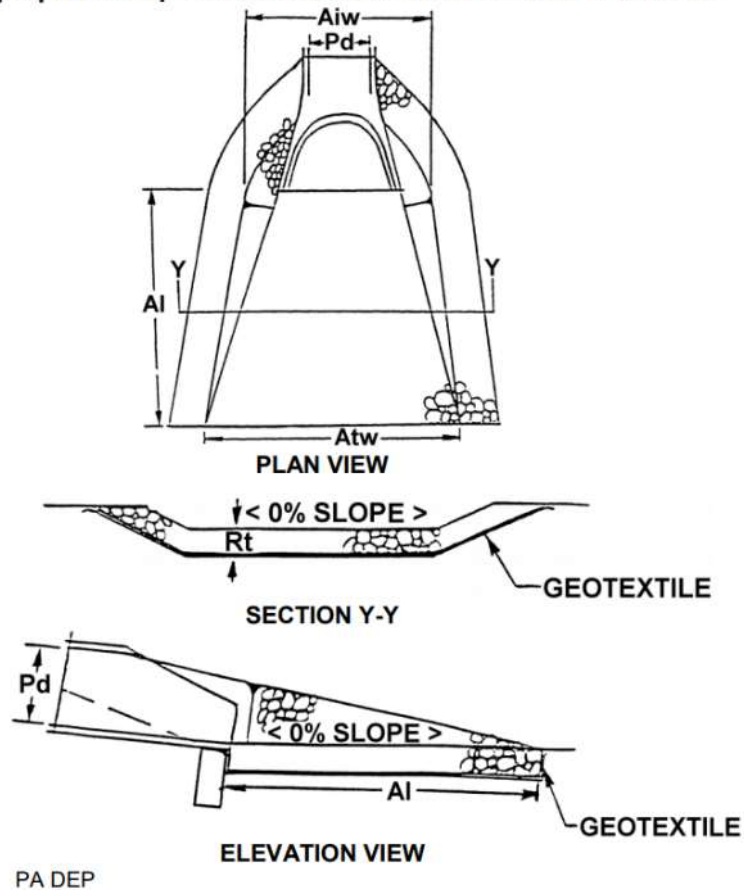
1. Use 1.6 for Temporary Channels; 2.25 for Temporary Channels in Special Protection (HQ or EV) Watersheds; 2.75 for Permanent Channels. For Rational Method, enter "N/A" and attach E&S Worksheets 9 and 10. For TR-55 enter "N/A" and attach appropriate Worksheets.  
 2. Adjust "n" value for changes in channel liner and flow depth. For vegetated channels, provide data for manufactured linings without vegetation and with vegetation in separate columns.  
 3. Slopes may not be averaged.  
 4. Minimum Freeboard is 0.5 ft. or ¼ Total Channel Depth, whichever is greater.  
 5. Permissible velocity lining design method is not acceptable for channels with a bed slope of 10% or greater. Shear stress lining design method is required for channels with a bed slope of 10% or greater. Shear stress lining design method may be used for any channel bed slope.

# Deficiency: Riprap aprons are not proposed or they are proposed discharging on a slope

- Riprap aprons should extend to the toe of the inside basin slope
- Riprap aprons are to be installed at 0% grade
- Riprap aprons at the outlet pipe should extend to a surface water or storm sewer when applicable
  - If an outlet channel is proposed to the receiving water it should be designed to convey the calculated basin discharge flow
- Riprap aprons should not be proposed on steep slopes
- Discharge analysis should be provided when proposing to discharge somewhere other than a surface water
  - Easements should be obtained if discharging the flow onto a neighboring property prior to reaching surface water



**STANDARD CONSTRUCTION DETAIL # 9-1**  
**Riprap Apron at Pipe Outlet with Flared End Section or Endwall**



NOTE: This table is intentionally blank and should be filled in by the plan preparer.

OUTLET NO.	PIPE DIA Pd (IN)	RIPRAP			APRON	
		SIZE (R- )	THICK. Rt (IN)	LENGTH Al (FT)	INITIAL WIDTH Aiw (FT)	TERMINAL WIDTH Atw (FT)

All aprons shall be constructed to the dimensions shown. Terminal widths shall be adjusted as necessary to match receiving channels.

All aprons shall be inspected at least weekly and after each runoff event. Displaced riprap within the apron shall be replaced immediately.

Standard details #9-1, #9-2, or #9-3 should be provided. Information should be consistent with standard worksheet #20

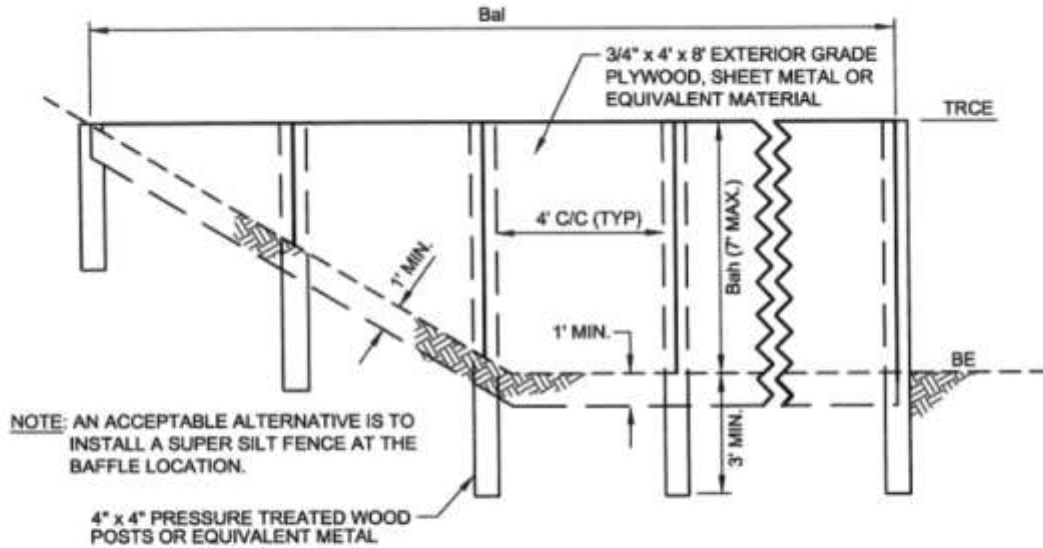


# Deficiency: Baffles are not proposed to meet the required flow path

- Baffles should be proposed when the minimum 2L:1W (non-special protection watersheds) flow path is not achieved
  - 4L:1W flow path for special protection watersheds
- Baffles can be constructed of plywood, super silt fence, or concrete barriers
  - Posts to secure plywood and super silt fence
  - Water-tight seals are required between concrete barriers
- Turbidity curtains or forebays may also be proposed

**STANDARD CONSTRUCTION DETAIL # 7-14**

**Baffle**



**NOTE:** AN ACCEPTABLE ALTERNATIVE IS TO INSTALL A SUPER SILT FENCE AT THE BAFFLE LOCATION.

4" x 4" PRESSURE TREATED WOOD POSTS OR EQUIVALENT METAL

PA DEP

In pools with depths exceeding 7', the top of the plywood baffle does not need to extend to the temporary riser crest. Super Silt Fence baffles need not extend to TRCE elevation.

NOTE: This table is intentionally blank and should be filled in by the plan preparer.

BASIN OR TRAP NO.	BAFFLE		TEMPORARY RISER	BOTTOM
	LENGTH Bal (FT)	HEIGHT Bah (FT)	CREST ELEV TRCE (FT)	BOTTOM ELEV BE (FT)

See appropriate basin detail for proper location and orientation.

Baffles shall be tied into one side of the basin unless otherwise shown on the plan drawings.

Substitution of materials not specified in this detail shall be approved by the Department or the local conservation district before installation.

Damaged or warped baffles shall be replaced within 7 days of inspection.

Baffles requiring support posts shall not be installed in basins requiring impervious liners.

Standard detail #7-14 provides information on baffle installations.



Baffle  
installation  
using super  
silt fence

# Deficiency: Erosion control blanket is not proposed on the basin slopes

- Slopes 3:1 or steeper require erosion control blanket
- The basin must reach 70% uniform perennial vegetative cover
- Hydroseed with a tackifier is an acceptable alternative to erosion control blanket

Deficiency: The construction sequence does not include the conversion of the sediment basin to the permanent stormwater basin

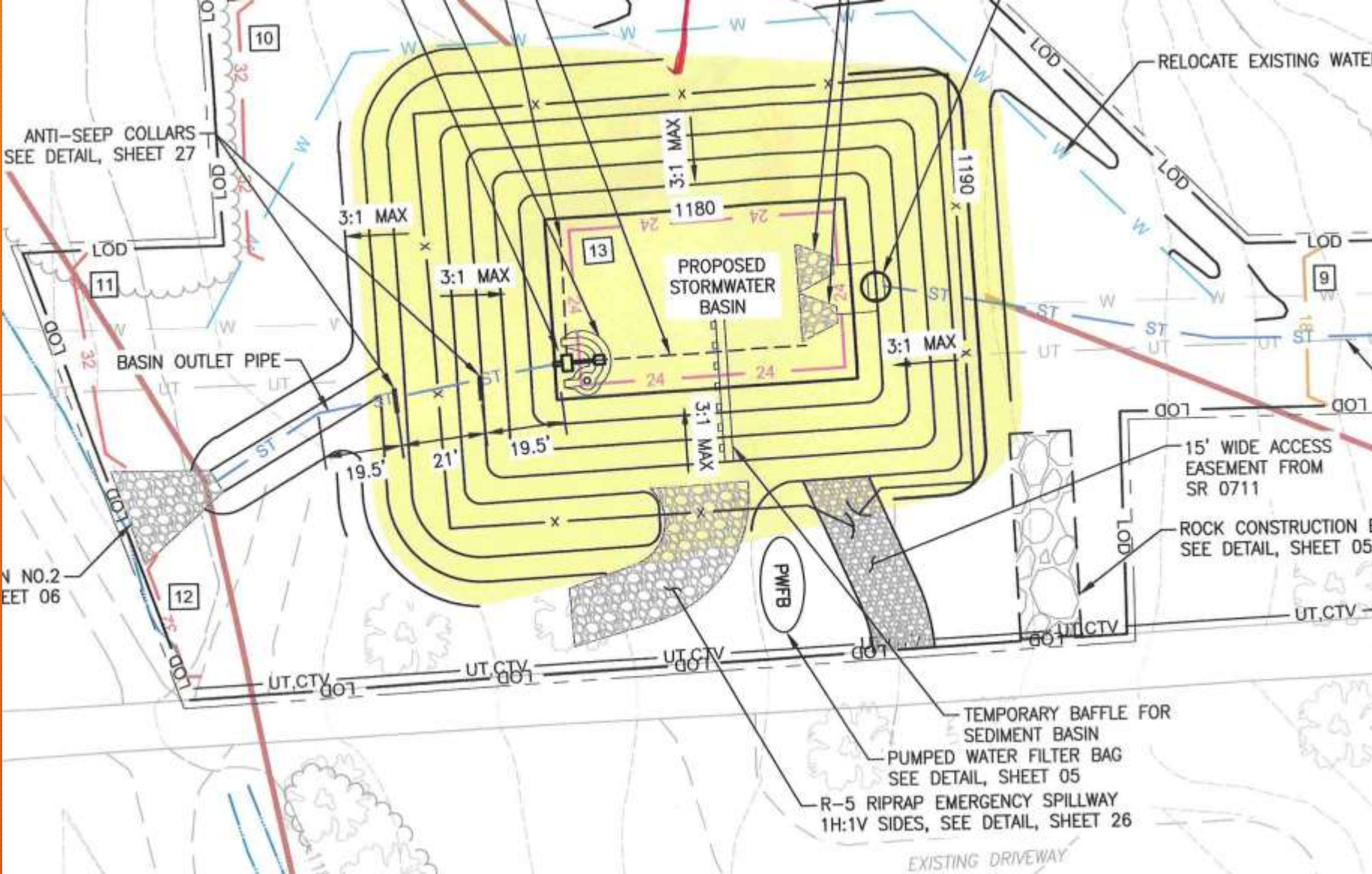
- Conversion should occur once the site is stabilized
- The construction sequence on the E&S plan should mention when this conversion is to occur
- The basin should be dewatered by pumping through a filter bag, dewatering device in the basin, or portable sediment tank
- All accumulated sediment is to be removed
- Amended soils are to be installed

# Deficiency: The proposed stormwater basin does not have E&S control protection

- When stormwater basins will not be utilized as sediment basins they should be protected with E&S controls
  - Perimeter protection
  - Inlet protection
  - Erosion control blanket



Compost  
filter sock  
installed  
upslope of  
the  
stormwater  
basin



A good example of a sediment basin design



Questions???



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