

Section C – DIKES & DIVERSIONS

10.0 STANDARDS AND SPECIFICATIONS

FOR

EARTH DIKES

Definition

A temporary berm or ridge of soil, compacted, stabilized and located in such a manner as to direct water to an approved location.

Purpose

The purpose of the earth dike is to direct runoff to a sediment trapping device, which reduces the potential for erosion and sedimentation. Earth dikes can also be used for diverting clean water away from disturbed areas.

Conditions Where Practice Applies

Earth dikes are often constructed across disturbed areas and around construction sites such as parking lots and subdivisions. The dikes shall remain in place until the disturbed areas are permanently stabilized.

Earth Dikes are constructed:

1. To divert sediment laden runoff from a disturbed area to a sediment trapping device.
2. Across disturbed areas to shorten overland flow distances.
3. To direct sediment laden water along the base of slopes to a trapping device.
4. To divert clear water from an undisturbed area to a stabilized outlet. Runoff shall be discharged at non-erosive rates.

Table 4 Design Criteria

	<u>Dike A</u>	<u>Dike B</u>
Drainage Area	(See Table 5)	(See Table 5)
Slope (of dike)	(See Table 5)	(See Table 5)
Dike Height (a)	18 in.	30 in.
Dike Width (b)	24 in.	36 in.
Flow Width (c)	4 ft.	6 ft.
Flow Depth in Channel (d)	12 in.	24 in.
Side Slopes	2 : 1 or flatter	2 : 1 or flatter

Note: 1. For slopes or drainage areas other than specified on Table 5, an engineering design is required. If the slope or the earth dike or the drainage area contributing to the dike falls between values on Table 5, round up to the next higher slope or drainage area.

2. Stabilization of the earth dike shall be completed within seven days of installation.

Construction Specifications

1. All temporary earth dikes shall have uninterrupted positive grade to an outlet. Earth dikes having longitudinal slopes flatter than 1% should have spot elevations along the flow line.
2. Diverted runoff from disturbed areas shall be directed to a sediment trapping devices.
3. Diverted runoff from undisturbed areas shall outlet directly onto an undisturbed, stabilized area at a non-erosive velocity (≤ 4 fps for grass).
4. All trees, brush, stumps, and obstructions shall be removed and disposed of so as not to interfere with the proper functioning of the earth dike berm and flow channel.
5. The dike shall be excavated or shaped to line, grade and cross section as required to meet the criteria specified herein and be free of bank projections or other irregularities which will impede normal flow.
6. Fill shall be compacted by earth moving equipment.
7. All earth removed and not needed for construction shall be placed so that it will not interfere with the functioning of the earth dike berm and flow channel.

8. Inspection and maintenance must be provided periodically and after each rain event.

Stabilization

Stabilization of the earth dike shall be completed within 7 days of installation in accordance with the standards and specifications for Vegetative Practices (Section J). The earth dike flow channel shall be stabilized in accordance with Table 5, and the following criteria:

Flow Channel Stabilization

1. Seed and cover with straw mulch.
2. Seed and cover with Erosion Control Matting or line with sod.
3. 4" - 7" stone or recycled concrete equivalent pressed into the soil in a minimum 7" layer.

The earth dike type (A or B) and lining (1, 2, or 3) shall be shown on the plans using the standard symbol and A-1, or B-3, etc. Earth dike type and lining may vary along its length.

In highly erodible soils, as defined by the local approval agency, refer to the next higher slope grade for the type of stabilization needed.

Engineering Design Criteria

Engineering design may preempt the use of Table 5. The basis for the engineering design shall be the 2-year frequency storm using SCS criteria, assuming the worst soil cover conditions to prevail in the contributing drainage area over the life of the earth dike. Manning's Equation shall be used to determine earth dike flow channel velocities associated with the developed discharges. The Manning's Roughness coefficients to be used in the equation are 0.025 for seed and mulch, 0.03 for soil stabilization matting or sod, and for 4"- 7" stone use 0.045 for flow depths up to 1 foot (Dike A) and 0.038 for flow depths between 1 and 2 feet (Dike B). The allowable flow channel velocities shall be < 4 fps for Seed and Mulch, < 6 fps for Stabilization Matting or sod, and < 8 fps for 4"- 7" stone.

Outlet

1. Earth dikes must have an outlet that functions without causing erosion.
2. Runoff from disturbed areas shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin until the drainage area above the earth dike is adequately stabilized.
3. The on-site location may need to be adjusted to meet field conditions.
4. Clear water diversions around disturbed area shall be discharged into an undisturbed, stabilized area or watercourse at a non erosive velocity.

Removal

Following completion of all construction and stabilization at a site with established vegetation, all temporary earth dikes shall be removed and the areas occupied by the dikes shall be graded and stabilized with vegetation.

Directions for Using Table 5

1. Determine the location on the Erosion and Sediment Control plan where using the earth dike to divert runoff is feasible. Determine the longitudinal slopes of the proposed temporary earth dike location.
2. Determine the maximum drainage area to various design points along the proposed earth dike alignment.
3. Enter Table 5 with the slope and drainage corresponding to the previously determined design points along the earth dike. Using Table 5 choose an earth dike type (A or B) and lining (1, 2, or 3) for the earth dike alignment between the design points.
4. Review the slopes along the earth dike alignment between the design points to insure that the slope/drainage area relationship does not exceed the chosen lining.

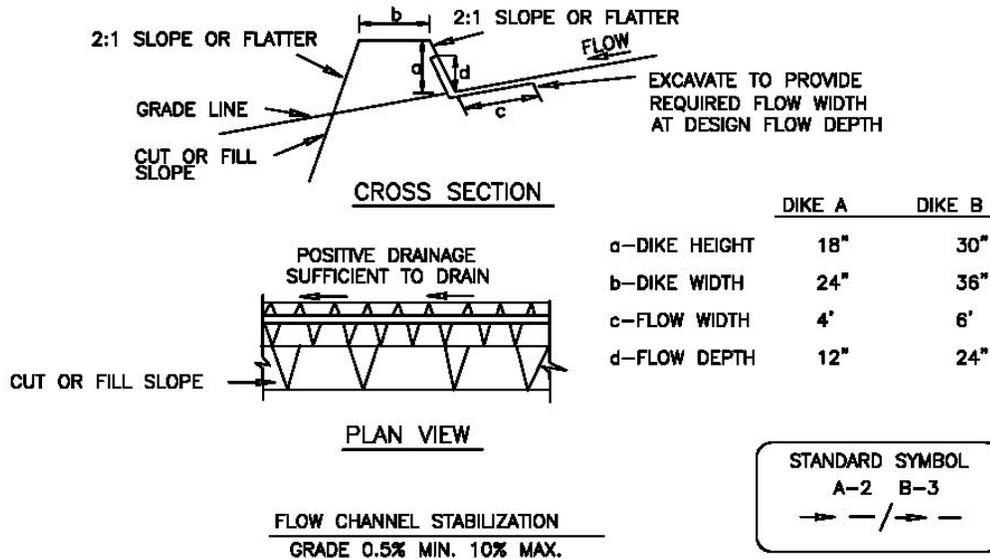
Table 5: Earth Dike Selection

	Drainage Area (acres)									
Slope % **	1	2	3	4	5	6	7	8	9	10
1	SEED	AND	4							
2	MULCH	4		SEED	AND	SOIL	STABILIZATION			
3				MATTING				6	6	6
4	4*						6			
5					6	6				
6				6		4" - 7"		STONE	PRESSED	
7			6			7" (Min)		INTO	GROUND	
8										
9										
10		6								

*Velocity of discharge in feet/second

** For slopes steeper than 10%, refer to Standards and Specifications 16.0, 17.0, 18.0, and 19.0

DETAIL 10 — EARTH DIKE



1. Seed and cover with straw mulch.
2. Seed and cover with Erosion Control Matting or line with sod.
3. 4" - 7" stone or recycled concrete equivalent pressed into the soil 7" minimum

Construction Specifications

1. All temporary earth dikes shall have uninterrupted positive grade to an outlet. Spot elevations may be necessary for grades less than 1%.
2. Runoff diverted from a disturbed area shall be conveyed to a sediment trapping device.
3. Runoff diverted from an undisturbed area shall outlet directly into an undisturbed, stabilized area at a non-erosive velocity.
4. All trees, brush, stumps, obstructions, and other objectional material shall be removed and disposed of so as not to interfere with the proper functioning of the dike.
5. The dike shall be excavated or shaped to line, grade and cross section as required to meet the criteria specified herein and be free of bank projections or other irregularities which will impede normal flow.
6. Fill shall be compacted by earth moving equipment.
7. All earth removed and not needed for construction shall be placed so that it will not interfere with the functioning of the dike.
8. Inspection and maintenance must be provided periodically and after each rain event.

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCE CONSERVATION SERVICE	PAGE C - 11 - 6	WATERSHED PROTECTION DIVISION DISTRICT OF COLUMBIA DEPARTMENT OF HEALTH
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11.0 STANDARDS AND SPECIFICATIONS

FOR

TEMPORARY SWALES

Definition

A temporary, excavated drainage way constructed and located to convey runoff to an approved location.

Purpose

The purpose of a temporary swale is to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet or to intercept sediment laden water and divert it to a sediment trapping device.

Conditions Where Practice Applies

Temporary Swales are constructed:

1. To divert sediment laden runoff from a disturbed area to a sediment trapping device.
2. Across disturbed areas to shorten overland flow distances.
3. To direct sediment laden water along the base of slopes to a trapping device.
4. To divert clear water from an undisturbed area to a stabilized outlet. Runoff shall be discharged at non-erosive rates.

Table 6 Temporary Swale Design Criteria

	<u>Swale A</u>	<u>Swale B</u>
Drainage Area	(see Table 7)	(see Table 8)
Slope of swale	(see Table 7)	(see Table 8)
Bottom Width of Flow Channel	4' min.	6' min.
Depth of Flow Channel	1' min.	1' min.
Side Slopes	2 : 1 or flatter	2 : 1 or flatter

Note: 1. For slopes or drainage areas other than specified on Table 7 or 8, an engineering design is required. If the slope of the swale or the drainage area

contributing to the swale falls between values on Table 7 or 8, round up to the next higher slope or drainage area.

2. Stabilization of the swale shall be completed within seven days of installation.

Construction Specifications

1. All temporary swales shall have uninterrupted positive grade to an outlet. Swales having longitudinal slopes flatter than 1% should have spot elevations along the flow line.
2. Runoff diverted from a disturbed area shall be conveyed to a sediment trapping device.
3. Runoff diverted from an undisturbed area shall outlet directly into an undisturbed stabilized area at a non-erosive velocity (≤ 4 fps for grass).
4. All trees, brush, stumps, obstructions, and other objectional material shall be removed and disposed of so as not to interfere with the proper functioning of the swale flow channel.
5. The swale shall be excavated or shaped to line, grade and cross section as required to meet the criteria specified herein and be free of bank projections or other irregularities which will impede normal flow.
6. Fill, if necessary, shall be compacted by earth moving equipment.
7. All earth removed and not needed on construction shall be placed so that it will not interfere with the functioning of the swale flow channel.
8. Inspection and maintenance must be provided periodically and after each rain event.

Stabilization

Stabilization of the temporary swale shall be completed within 7 days of installation in accordance with the standards and specifications for Vegetative Practices (Section J). The temporary swale flow channel shall be stabilized in accordance with Table 7 or 8, and the following criteria:

Flow Channel Stabilization

1. Seed and cover with straw mulch.
2. Seed and cover with Erosion Control Matting or line with sod.
3. 4"- 7" stone or recycled concrete equivalent pressed into the soil in a minimum 7" layer.

The temporary swale type (A or B) and lining (1, 2, or 3) shall be shown on the plans using the standard symbol and A-1, or B-3, etc. Temporary Swale type and lining may vary along its length.

In highly erodible soils, as defined by the local approval agency, refer to the next higher slope grade for the type of stabilization needed.

Engineering Design Criteria

Engineering design may preempt the use of Table 7 or 8. The basis for the engineering design shall be the 2-year frequency storm using SCS criteria, assuming the worst soil cover conditions to prevail in the contributing drainage area over the life of the temporary swale. Manning's Equation shall be used to determine temporary swale flow channel velocities associated with the developed discharges. The Manning's Roughness coefficients to be used in the equation are 0.025 for seed and mulch, 0.03 for soil stabilization matting or sod, and for 4"- 7" stone use 0.045 for flow depths up to 1 foot. The allowable flow channel velocities shall be < 4 fps for Seed and Mulch, < 6 fps for Stabilization Matting or sod, and < 8 fps for 4"- 7" stone. For site conditions exceeding those where Temporary Swale criteria apply, refer to 32.0 Lined Waterway or Outlet.

Outlet

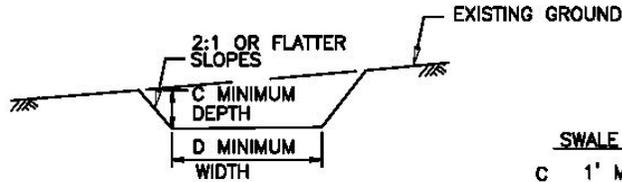
1. Temporary swales must have an outlet that functions without causing erosion.
2. Runoff from disturbed areas shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin until the drainage area above the swale is adequately stabilized.

3. The location may need to be adjusted to meet field conditions.
4. Clear water diversions around disturbed areas shall be discharged onto an undisturbed, stabilized area or watercourse at a non erosive velocity.

Removal

Following completion of all construction and stabilization at a site with established vegetation, all temporary earth swales shall be removed and the areas occupied by the swales shall be graded and stabilized with vegetation.

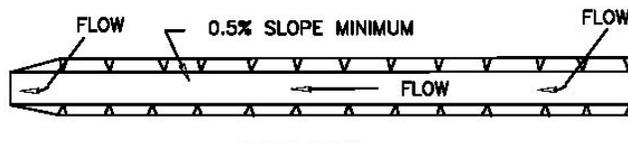
DETAIL 11 - TEMPORARY SWALE



CROSS SECTION

	<u>SWALE A</u>	<u>SWALE B</u>
C	1' MIN.	1' MIN.
D	4' MIN.	6' MIN.

OUTLET AS REQUIRED



PLAN VIEW

DRAINAGE AREA = 10 ac (MAX)
SLOPE = 10% (MAX)

FLOW CHANNEL STABILIZATION
GRADE 0.5% MIN. 10% MAX.

STANDARD SYMBOL

A - 2 / B - 3

1. Seed and cover with straw mulch.
2. Seed and cover with Erosion Control Matting or line with sod.
3. 4"-7" stone or recycled concrete equivalent pressed into soil in a minimum 7" layer.

Construction Specifications

1. All temporary swales shall have uninterrupted positive grade to an outlet. Spot elevations may be necessary for grades less than 1%.
2. Runoff diverted from a disturbed area shall be conveyed to a sediment trapping device.
3. Runoff diverted from an undisturbed area shall outlet directly into an undisturbed stabilized area at a non-erosive velocity.
4. All trees, brush, stumps, obstructions, and other objectional material shall be removed and disposed of so as not to interfere with the proper functioning of the swale.
5. The swale shall be excavated or shaped to line, grade and cross section as required to meet the criteria specified herein and be free of bank projections or other irregularities which will impede normal flow.
6. Fill, if necessary, shall be compacted by earth moving equipment.
7. All earth removed and not needed for construction shall be placed so that it will not interfere with the functioning of the swale.
8. Inspection and maintenance must be provided periodically and after each rain event.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCE CONSERVATION SERVICE

PAGE
C - 12 - 5

WATERSHED PROTECTION DIVISION
DISTRICT OF COLUMBIA DEPARTMENT OF HEALTH

Table 7: Temporary Swale Selection

Swale A; D.A. ≤ 5ac.

4' Flat Bottom

Slope %	Drainage Area (acres)									
	1	2	3	4	5	6	7	8	9	10
1	SEED	AND				4				
2	MULCH		4	4	4					
3		4		SEED	AND	SOIL	STABILIZATION		6	6
4					MATTING			6		
5	4*						6			
6						6				
7					6		4" - 7" STONE	PRESSED		
8				6			7" (Min.) INTO	GROUND		
9										
10			6							

*Velocity of flow in feet/second

Table 8: Temporary Swale Selection

Swale B; 5ac. < D.A. ≤ 10 ac.

6' Flat Bottom

Slope %	Drainage Area (acres)									
	1	2	3	4	5	6	7	8	9	10
1	SEED	AND				4				
2	MULCH		4	4	4					
3		4		SEED	AND	SOIL	STABILIZATION		6	6
4					MATTING			6		
5	4*						6			
6						6				
7					6		4" -7" STONE PRESSED			
8							7" (Min.) INTO GROUND			
9										
10				6						

*Velocity of flow in feet/second

12.0 STANDARDS AND SPECIFICATIONS

FOR

DIKE/SWALE

Definition

A temporary ridge of soil excavated from an adjoining swale located along the perimeter of the site or disturbed area.

Purpose

The purpose of a perimeter dike/swale is to prevent storm runoff from entering a disturbed area and to prevent sediment laden storm runoff from leaving the construction site or disturbed area.

Conditions Where Practice Applies

A perimeter dike/swale is constructed to divert flows around disturbed areas, or along tops of slopes to prevent flows from eroding the slope, or along the base of slopes to direct sediment laden flows to a trapping device. The perimeter dike/swale shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

An engineering design is not required for perimeter dike/swale. The following criteria shall be used:

Drainage area - Less than 2 acres (for drainage areas larger than 2 acres see Earth Dike or Temporary Swale).

Height- 12 inches minimum from bottom of swale to top of dike evenly divided between dike height and swale depth. Bottom width of dike - 3 feet minimum.

Width of swale - 3 feet minimum (see standard drawing).

Grade - Dependent upon topography, but shall have positive drainage (sufficient grade to drain) to an adequate outlet. **Maximum allowable grade not to exceed 10 percent.**

Stabilization - The disturbed area of the dike and swale shall be stabilized within 7 days of installation, in accordance with the following:

<u>PD/S Type</u>	<u>Drainage Area</u>	<u>Stabilization</u>
PD/S - 1	1 acre or less	Seed and Mulch
PD/S - 2	1-2 acres	Seed and cover with erosion control matting or line with sod

Construction Specifications

1. All perimeter dike/swales shall have an uninterrupted positive grade to an outlet. Spot elevations may be necessary for grades less than 1 %.
2. Runoff diverted from a disturbed area shall be conveyed to a sediment trapping device.
3. Runoff diverted from an undisturbed area shall outlet into an undisturbed stabilized area at a non-erosive velocity (≤ 4 fps for grass).
4. The swale shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified in the standard.
5. Fill shall be compacted by earth moving equipment.
6. Stabilization of the area disturbed by the dike and swale shall be completed within 7 days and in accordance with the stabilization specifications on the plans (Ref: 42.0 Vegetative Stabilization).
7. Inspection and required maintenance shall be provided after each rain event.

Note: The maximum drainage area for this practice is 2 acres.

Outlet

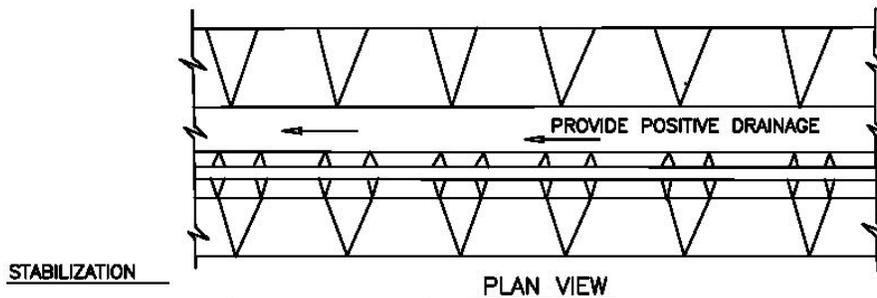
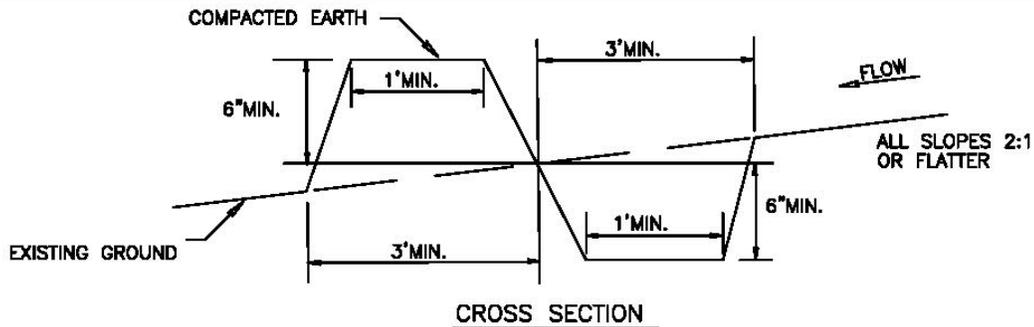
1. A perimeter dike/swale shall have an outlet that functions without causing erosion.
2. Runoff diverted from a protected or stabilized upland area shall outlet directly onto an undisturbed stabilized area.
3. Runoff diverted from a disturbed or exposed upland area shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin.

4. The location of a dike/swale may need to be adjusted in the field in order to provide positive drainage to a trapping device and to utilize the most suitable outlet.

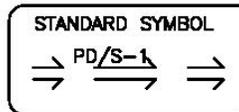
Removal

Following completion of all construction and stabilization at a site with established vegetation, all temporary dike/swales shall be removed and the areas occupied by the dike/swales shall be graded and stabilized as specified on the plans.

DETAIL 12 - PERIMETER DIKE / SWALE



- PD/S-1 SEED AND MULCH (DRAINING \leq ACRE)
- PD/S-2 SEED AND COVER WITH SOIL
STABILIZATION MATTING OR
LINE WITH SOD (DRAINING BETWEEN 1 AND 2 ACRES)



Construction Specifications

1. All perimeter dike/swales shall have an uninterrupted positive grade to an outlet. Spot elevations may be necessary for grades less than 1%.
2. Runoff diverted from a disturbed area shall be conveyed to a sediment trapping device.
3. Runoff diverted from an undisturbed area shall outlet into an undisturbed stabilized area at a non-erosive velocity.
4. The swale shall be excavated or shaped to line, grade, and cross-section as required to meet the criteria specified in the standard.
5. Fill shall be compacted by earth moving equipment.
6. Stabilization with seed and mulch or as specified of the area disturbed by the dike and swale shall be completed within 7 days upon removal.
7. Inspection and required maintenance shall be provided after each rain event.

Note: The maximum drainage area for this practice is 2 acres.

U.S. DEPARTMENT OF AGRICULTURE NATURAL RESOURCE CONSERVATION SERVICE	PAGE C - 13 - 4	WATERSHED PROTECTION DIVISION DISTRICT OF COLUMBIA DEPARTMENT OF HEALTH
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13.0 STANDARDS AND SPECIFICATIONS
FOR
TEMPORARY STORM SEWER DIVERSION

Definition

Temporary storm drain diversions redirect a storm sewer system or outfall channel to discharge into a sediment trap or basin.

Purpose

To prevent sediment laden water conveyed by the storm sewer system from reaching a watercourse or off-site property.

Conditions Where Practice Applies

One of the following practices or procedures shall be used to temporarily divert storm drain systems. A special exception may be given, at the discretion of the local plan approval agency, where site conditions make this procedure impossible.

Design Criteria

1. Construction of a sediment trap or basin below a permanent storm drain outfall: the storm drain system outfalls into a temporary basin or trap constructed below the permanent outfall channel.
2. In-line diversion of storm sewer at an inlet or manhole: this diversion requires installing a pipe stub in the side of a manhole or inlet and temporarily blocking the permanent outfall pipe from that structure. A temporary outfall ditch or pipe may be used to convey storm flow from the stub to a sediment trap or basin. This method may be used just above a permanent outfall or prior to connecting into an existing storm sewer system.
3. Delay completion of the permanent storm drain outfall and temporarily divert storm flow into a sediment basin or trap: an earth dike, swale or designed diversion, can be used depending on the drainage area, to direct flow into a sediment basin or trap.
4. Installation of a stormwater management basin early in the construction

sequence: install temporary measures to allow use as a sediment basin. Because these structures are designed to receive storm drain outfalls, diversion should not be necessary.

5. Inlet protection is not required if storm drain diversions have been installed and are functioning properly.
6. A 6 foot fence around the basin is required if it is not protected by a construction site fence.

Removal and Restoration

When the areas contributing sediment to the storm sewer system have been stabilized, restore the system to its planned use.

The following removal and restoration procedure is recommended and must be included in the sequence of operations for the sediment control plan:

1. Flush the storm drain system prior to removal of the trap or basin to remove any accumulated sediment.
2. Establish a permanent stabilized outfall channel as noted on the plans.
3. For sites where an inlet was modified, plug the temporary pipe stub and open the permanent outfall pipe.
4. Remove the sediment control devices, such as traps, basins, dikes, swales, etc.
5. Restore the area to grades shown on the plan and stabilize with vegetative measures.
6. For basins that will be converted to stormwater management, remove the accumulated sediment, open the low flow orifice, and seed all disturbed areas in the basin to permanent vegetation in accordance with 42.0 Vegetative Stabilization.