Sediment Basin

Definition: A basin constructed to collect and store debris or sediment.

Purpose: To preserve the capacity of reservoirs, ditches, canals, diversions, waterways, and streams; to prevent undesirable deposition on bottom lands and developed areas; to trap sediment originating from construction sites; and to reduce or abate pollution by providing basins for deposition and storage of silt, sand, gravel, stone, and other detritus.

Condition Where Practice Applies: This practice applies where physical conditions or land ownership preclude treatment of a sediment source by the installation of erosion-control measures to keep soil and other material in place or where a sediment basin offers the most practical solution to the problem. It may be used as a permanent or temporary measure during grading and development of areas.

This standard also establishes minimum acceptable quality for design and construction of a sediment basin and dam located in a predominantly urban setting when:

1. Failure of the structure would not result in the loss of human life; damage to homes, commercial buildings, highways or railroads; interruption of public utilities; or damage to existing water impoundments, and

2. The contributing drainage area does not exceed 200 acres, and

3. The vertical distance between the lowest point along the downstream toe of the dam and the lowest point along the top of the dam does not exceed 25 feet, and

4. The sediment dam conforms to all local and state laws pertaining to the storage of water.

Structures that do not conform to the above requirements shall be designed by a registered professional engineer.

Planning Considerations

Water Quantity: The following effects on water quantity should be considered:

1. Effects on the water budget, especially volumes and rates of runoff, infiltration, evaporation, deep percolation, and ground water recharge.

2. Effects on the water table and flow downstream and the results of changes of vegetative growth.

Water Quality:
The following effects on water quality should be considered:

1. Effects on erosion, movement of sediment, pathogens, and soluble and sediment attached substances.

2. Effects on the visual quality of onsite and downstream water resources.

3. Effects of construction and early establishment of protective vegetation on the surface and ground water.

4. Effects on wetlands and water-related wildlife habitats.

Design Criteria

Embankments: The design of dams, spillways, and drainage facilities shall be in accordance with this standard when the product of the height of dam and storage, to the emergency spillway elevation, does not exceed 3,000. When this limitation is exceeded, design shall be in accordance with SCS Technical Release 60.

Temporary basins having drainage areas of 5 acres or less and a total embankment height of 5 ft. or less may be designed with less conservative criteria if conditions warrant. The embankment shall have a minimum top width of 4 ft. and side slopes of 2:1 or flatter. An outlet shall be provided of earth, pipe, stone, or other devices adequate to keep the sediment in the trap and to handle the 10-year frequency discharge without failure or significant erosion.

Sediment Storage: The capacity of the sediment basin shall equal the volume of sediment expected to be trapped at the site during the planned useful life of the basin or the improvements it is designed to protect. If it is determined that periodic removal of sediment will be practicable, the capacity may be proportionately reduced.

Figure 17 may be used to size sediment basins. The annual yield per acre is determined from the nomograph and the total capacity needed is found by multiplying the annual yield by the area to be disturbed by the number of years the area will be disturbed.

Figure 16 may be used to size the sediment basin and determine the pertinent elevations and dimensions.

Detention Storage: In addition to the required sediment storage, the basin shall store the runoff from a 2-yr.—24-hr. storm to the top of the riser or principal outlet. The water stored from this storm will be released by a lower stage, nonclogging, dewatering device. The complete release of the stored water shall be accomplished no sooner than 24 hours after the storm and no later than 8 days after the storm. The elevation of the low stage shall not be lower than the maximum elevation of the design sediment storage volume.

The trap efficiency of the basin should be at least 90 percent effective in removing the sediment carried in the runoff from the site. Considerations in improving the efficiency of the basin are to control erosion in the disturbed area, reduce the velocity entering the basin, and use chemicals to induce flocculation of the sediment.

Watershed Area: The contributing watershed area above the site should have a plan to provide the maximum protection against erosion of the disturbed areas. In as much as possible, the runoff from above the site shall be diverted around the site to prevent it adding to the erosive force of the runoff from the disturbed area itself.

Structures in Series: When structures are built in series, the principal spillway and emergency spillway sizes for the lower structure shall be based on the total drainage area above the lower structure. Construction of series sites must proceed in an

upstream direction. All upstream sites must be constructed after the lower site is constructed. This limits the initial sediment escaping from the site to only one structure installation.

When an existing upstream structure is not considered adequate or safe according to the requirements herein, a lower structure in series must be designed to consider possible failure of the upstream structure. This means the sediment capacity and detention capacity must be designed as if the upstream structure did not exist.

Principal Spillway: A drop inlet type principal spillway is required for all structures, with the following exception. Where the drainage area is less than six (6) acres total and there is no spring flow that enters the basin at any time during the year, the requirement for a pipe principal spillway is waived.

The hydrologic and hydraulic design of the principal spillway shall be in accordance with the following conditions:

1. The distance between the crest of the principal spillway and the crest of the emergency spillway shall not be less than one (1) foot.

2. The minimum diameter of conduit shall be 12 inches.

3. The inlet to the principal spillway shall be located to prevent short-circuiting. This can be achieved by having the length to width ratio of the basin 3:1 or greater, or installing baffles.

4. The minimum size for the principal spillway barrel and drop inlet shall be obtained from Table 5, Principal Spillway Criteria, and Table 6, Minimum Required Principal Spillway Size.

Layout: The principal spillway shall be a straight alignment. The minimum slope of the conduit shall be one (1) percent.

Outlet: The outlet end of the conduit must extend to an elevation at least one (1) foot above the stable channel bottom and a minimum of 6 feet beyond the toe of dam. Pipe supports shall be installed for outlets where the cantilevered portion is more than 35 percent of the length of the last section of pipe measured along the bottom of the pipe. For pipe diameters greater than 15 inches, an outlet support is required when the cantilevered portion of the last section of pipe is more than 20 percent of the total length of the section, measured along the bottom of the pipe.

Energy dissipating outlet structures are required below the pipe outlet when the bottom of the channel is not bedrock, or the pipe diameter exceeds 18-inches. The outlet structure may be constructed of rock riprap or concrete. Rock riprap shall be reasonably well-graded between the limits of 6- and 24-inches. Designs for concrete outlet structures and riprap for pipe outlets larger than 36 inches diameter shall be prepared by an engineer experienced in hydraulic design.

Pipe Conduits: Pipe conduits must withstand the internal hydrostatic pressure without leakage while subject to the full

Table 5 — Principal Spillway Criteria
Product of Height X Storage is 3,000 or less

Drainage Area Acres	Effective Height1 Feet	Pipe Diameter (in.) or minimum Design Storm Frequency[2]
0 to 50	35 or less	12 inches
50 to 75	20 or less	15 inches
	21 to 35	5 yr - 24 hr
75 to 100	20 or less	18-inches
	21 to 35	5 yr - 24 hr
100 to 150	20 or less	24 inches
	21 to 35	5 yr - 24 hr
150 to 200	20 or less	30 inches
	21 to 35	5 yr - 24 hr
200 or more	20 or less	5 yr - 24 hr
	21 to 35	10 yr - 24 hr

[1] Low point along downstream toe to crest of emergency spillway.
[2] To the top of riser or principal spillway outlet.

external load and settlement. Material guidance and minimum strength requirements are governed by the appropriate ASTM specification. Considerations for each type of pipe are detailed as follows.

1. Asbestos cement and concrete - These rigid conduits must be laid on a concrete bedding. A safety factor of at least 1.5 shall be applied to the computed three-edge bearing strength requirement to determine allowable height of fill over the conduit.

Bedding — Concrete bedding shall be placed beneath the pipe at a minimum thickness of 4 inches and extend up the sides of the pipe for at least 10 percent of the overall height of the conduit. The bedding shall have a base width of at least the outside diameter of the pipe.

Joints — Conduit joints are to be designed and constructed to remain watertight. A rubber gasket is to be set in a positive seat which will prevent displacement.

2. Corrugated metal pipe

   Iron or steel (zinc coated) — Pipe shall be close-riveted and asphalt-coated or helical-corrugated with welded seam and can be used only where the pH of the normal flow is 5.0 or greater. When the pH of the flow is expected to be less than 5.0, the pipe shall be close-riveted, asbestos-bonded, bituminous-coated, and have a paved invert. The minimum wall thickness of the pipe shall be 16 gage for conduits 18-inches or less in diameter. For larger sizes, the minimum wall thickness shall be 14 gage.

   Bituminous coatings damaged in transport or placement shall be repaired by the application of 2 coats of hot asphaltic paint or cold-applied bituminous mastic.

   Aluminum — Corrugated aluminum shall only be used in soils having a pH greater than 5.0 and less than 9.0. The minimum wall thickness of the pipe shall be 14 gage.

   Joints — All corrugated metal pipe shall be connected by a water-tight flange-type connection or by a water-tight connecting band specifically manufactured for use as a connecting band (with rods and lugs). The area between the pipe and the connecting band shall be treated with an asphalt cement during installation to insure a water-tight joint. Neoprene gaskets may be used in lieu of the asphalt cement if they have been specifically manufactured for that use.

3. Steel (smooth) - Steel pipe may be used where the pH of the normal stream flow during the life of the structure will be 5.0 or greater. Steel pipe shall be standard strength and shall be connected by a water-tight mechanical or welded joint.

4. Wrought-Iron or Cast Iron - Iron pipe may be used under all soil and water conditions. It must be of standard thickness or greater and be connected by a water-tight mechanical or welded joint.

5. Polyvinyl Chloride (PVC) Plastic Pipe - PVC1120 or PVC1220 (Schedule 40, 80, or SDR26) conforming to ASTM D-2241 or ASTM D-1785 may be used.

Drop Inlets: The drop inlet must be designed to facilitate the passage of the runoff in excess of the detention storage. The detention drawdown is accomplished by slotting the riser or by a siphon device. This will insure the desired sediment trapping.

Gravel is not recommended around the slotted risers. It will tend to seal with sediment. When non-slotted risers are used, the riser must be stable against floating. The safety factor against uplift must be at least 1.25.

Conduit-type drop inlet risers shall have a base, attached with a water-tight connection, that has sufficient weight to meet the uplift force criteria.

Anti-vortex Device: Drop inlet risers shall be equipped with an anti-vortex device when the flow through the conduit is considered in sizing an emergency spillway.

Trash Rack: A trash rack will be utilized where the drainage area is expected to contribute trash to the basin, or when the flow in the conduit is considered in sizing an emergency spillway. A trash rack is not an anti-vortex device and an anti-vortex device is not a trash rack.

Seepage Control: Where the embankment is greater than 10 feet high, and the conduit is larger than 10 inch diameter, positive antiseep measures are required along the pipe. Antiseep measures may be of two types: collar and flange, or sand diaphragm.

Collar and flange devices shall be installed with a water-tight connection to the pipe, and shall extend a minimum of two (2) feet in every direction from the pipe. The collar and flange shall be of material that is compatible with the pipe conduit. A minimum of one (1) collar and flange is required.

Sand diaphragms shall be constructed using ASTM C-33 fine concrete aggregate as a filter material. The sand diaphragm shall extend two (2) feet in every direction from the pipe and shall be a minimum of two (2) feet thick along the pipe. The outlet for the sand diaphragm shall extend along the pipe to the toe of the dam. It shall be of the same sand material and must have at least two (2) square feet of area normal to the flow. The conduit should be bedded in the outlet material with at least six (6) inches of material extending vertically below the conduit. The surface of the outlet must be protected against erosion by lining with riprap.

Drain: Provision shall be made to drain the sediment pool if the effective height of the embankment is 15 feet or more. The principal spillway may be utilized as the drain if the riser is gated to allow drawdown and the inlet can be protected against clogging. A separate drain pipe shall not be less than 1 and 1/4 inches diameter and shall be capable of draining the pool in ten (10) days or less.

Table 6 — Minimum Required Principal Spillway Size

Drain. area (acres)	Conduit Diameter (inches)	Drop Inlet Diameter (inches)	Square Drop Inlet Dimensions (feet)	Minimum Drop Inlet Height (feet)
0-50	12	18	2 X 2	2.0
50-75	15	24	2 X 2	2.5
75-100	18	30	2 X 2	3.0
100-150	24	36	2.5 X 2.5	4.0
150-200	30	42	3 X 3	5.0

Emergency Spillway: Emergency spillways are needed to convey large flows safely past the dam. They usually consist of open channels excavated in earth or rock. They can consist of structural measures such as a concrete channel.

Where the height of dam is 15 feet or less, the requirement for an emergency spillway is waived if the contributing drainage area is less than 20 acres and the principal spillway has a non-clogging drop inlet with a conduit diameter of at least 24 inches.

For all other sites, The 10-yr.—24-hr. storm runoff shall be stored with no flow out the emergency spillway.

Where the product of drainage area and effective height of dam (DA X H) is between 400 and 4,000, the emergency spillway design storm shall be a 25-yr.—24-hr. frequency. The minimum freeboard required above the emergency spillway outflow is one (1) foot.

Where the product of drainage area and effective height of dam exceeds 4,000, the emergency spillway design storm shall be the 50-yr.—24-hr. frequency. The minimum freeboard above the emergency spillway outflow is two (2) feet.

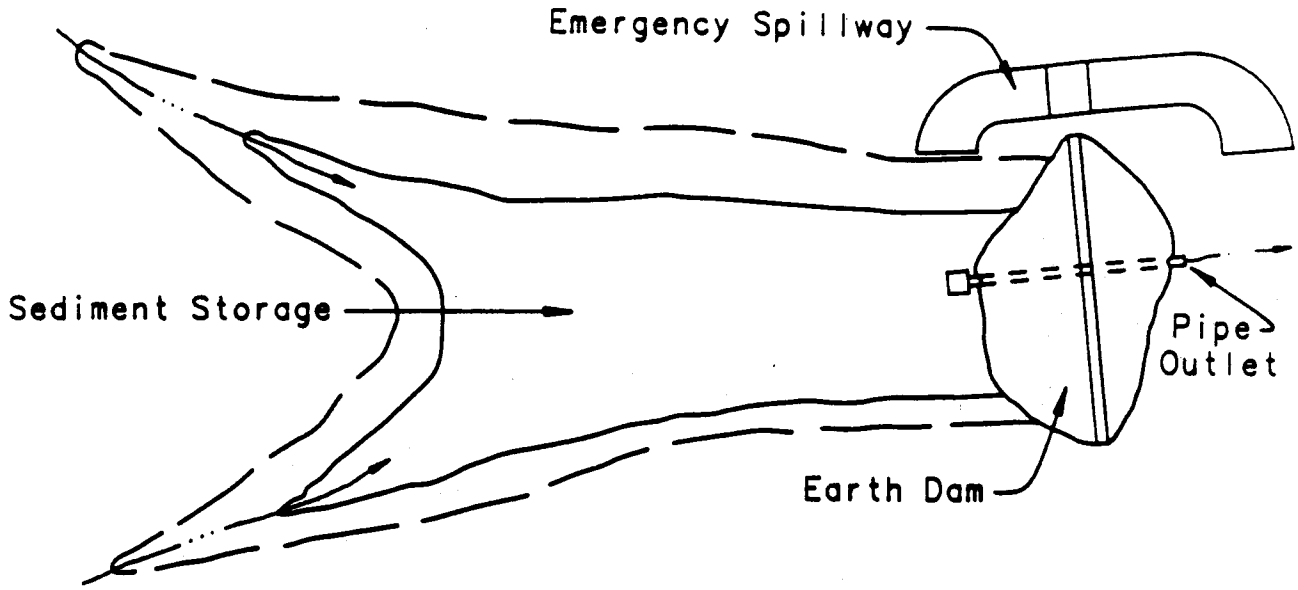
Layout: Minimum bottom width shall be 8 feet. The spillway channel shall be trapezoidal when constructed in earth materials. Side slopes shall be 2h:1v, or flatter. It may have vertical side walls where constructed in rock or of concrete.

The control section shall be located at or downstream of the centerline of dam. The inlet channel shall be level for a distance of 25 feet upstream of the control section. The level section and the exit channel shall be of the same width. The inlet channel may flare to a wider width upstream of the level section or have a curved layout upstream of the level section. The inlet channel should have a minimum slope of two (2) percent in the upstream direction.

The outlet channel shall not release flow that impinges on the toe of the dam. It shall extend to a stable grade in the valley. Curvature may be used in the outlet channel downstream of the toe of the embankment. The outlet channel shall be designed to be stable under design flow conditions. Any procedure that is generally accepted by the engineering profession may be used to design the emergency spillway. If no other procedure is desired, the spillway may be sized using either Table 8 or 9. Outlet channel allowable velocities are listed in Table 7.

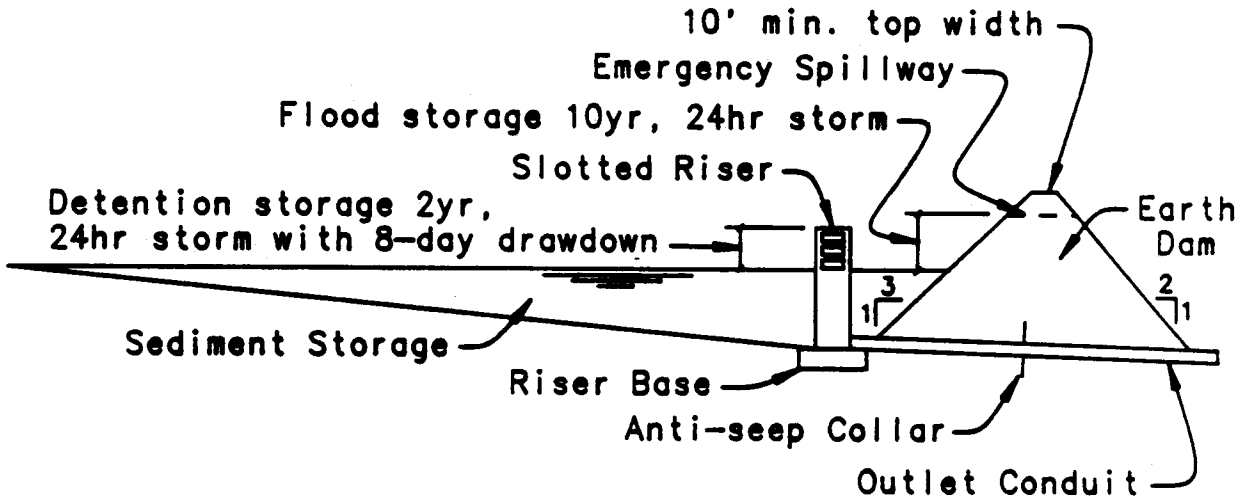
Table 7
Permissible Velocities
Feet-per-second

Vegetated, soil is	
Erosion-resistant	5.5
Erodible	3.5
Riprap lined	12.0
Rock	14.0



PLAN VIEW

not to scale



CROSS SECTION

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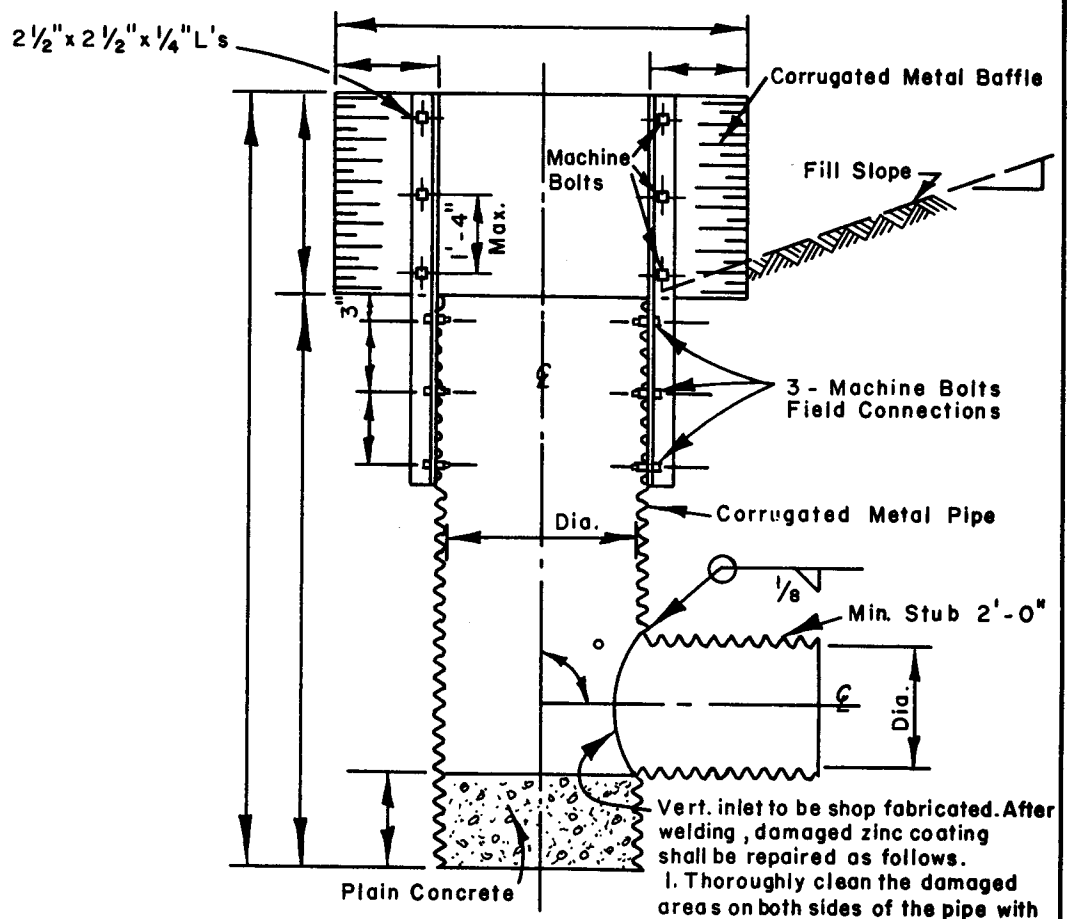
Figure 12 — Plan View and Cross Section of Sediment Basin

A Sediment basin catches and stores sediment from construction areas and keeps it out of streams.

CORRUGATED METAL (STEEL) PIPE INLET WITH SHORT SPLITTER BAFFLE

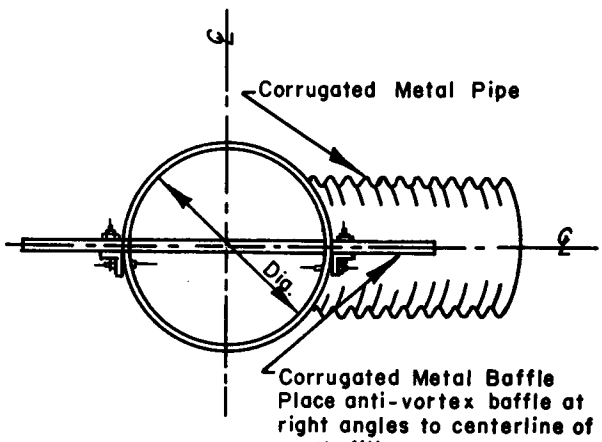


Vert. inlet to be shop fabricated. After welding, damaged zinc coating shall be repaired as follows.

1. Thoroughly clean the damaged areas on both sides of the pipe with wire brush.
2. Paint the cleaned areas with two coats of zinc oxide - zine dust paint.
3. Apply a heavy coat of asphalt over the painted areas.

BILL OF MATERIALS			
ITEM	SIZE	LENGTH	QUAN.
Angles	2½"x2½"x¼"		2
Steel Cadmium Plated Mach. Bolts W/Nuts & Lockwashers	1½" Dia.	1¼"	12
C.M. Baffle	ga.	x	1
C.M. Pipe (Riser)	"Dia. ga.		1
C.M. Pipe (Stub)	"Dia. ga.	24"	1
Volume of Concrete in Cu. Yds.			

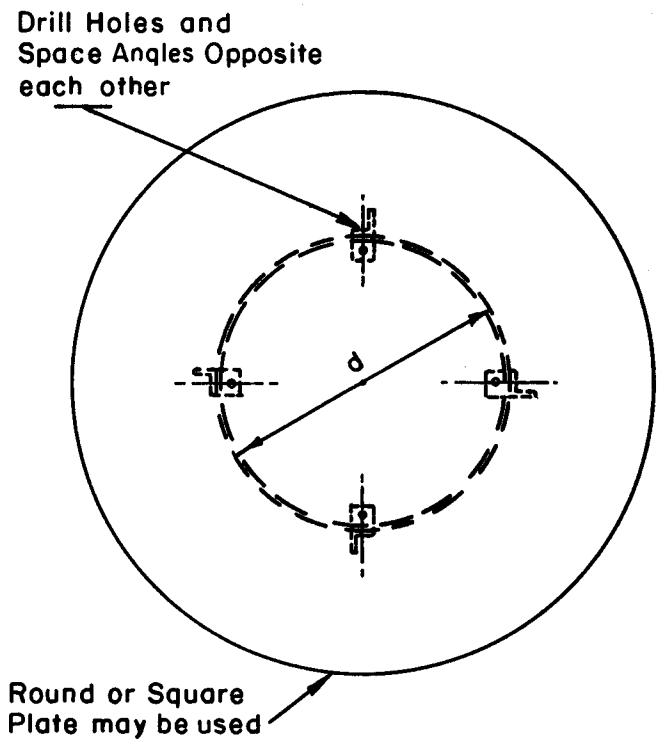
Note: All holes for bolts shall be 9/16" diameter.



PLAN

Figure 13

ANTI - VORTEX - TRASH AND SAFETY GUARD



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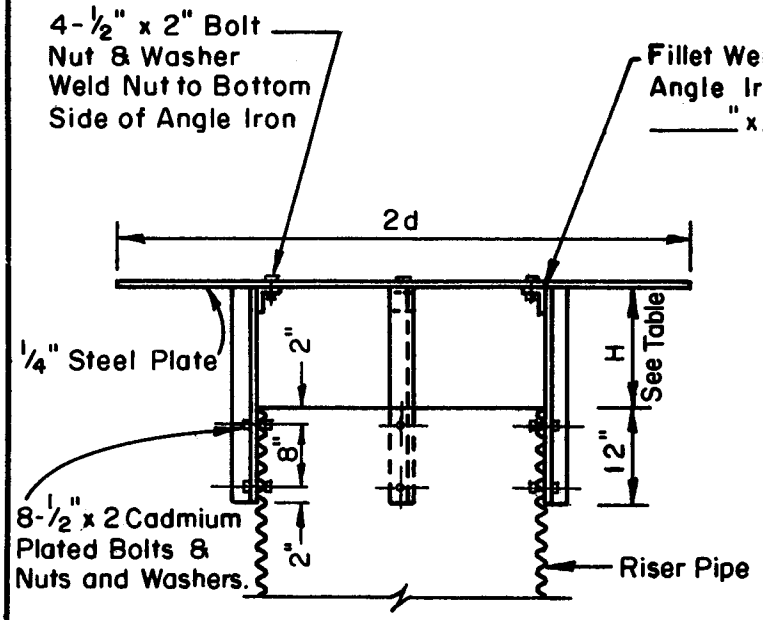


SECTION AT CENTER

Inlet d Dia. Inches	Barrel Dia. Inches	H Inches
12	6	6
12	8	6
15	10	6
15	12	7
18	12	6
24	15	7½
24	18	10
* 30	18	8½
* 30	24	13½
* 36	24	12

* Use Angle Iron Stiffeners on Plate as Specified.

Figure 14

Earth Embankments: The embankment for permanent sediment basins shall have a minimum top width of ten (10) feet. The side slopes of the embankment shall be no steeper than 3h:1v upstream and 2h:1v downstream.

Embankments for basins without emergency spillways shall have a downstream side slope of 5h:1v or flatter and the downstream slope shall be protected by a riprap lining designed to be stable, but with a minimum D_{50} of 9-inches and a maximum size of 18-inches.

The design height of embankment shall be constructed ten (10) percent higher to allow for settlement.

A cutoff trench shall be used to protect the embankment against foundation piping. It shall extend to an impervious layer below the surface soils, and be a minimum of three feet deep. The trench shall extend up the abutments to at least the crest elevation of the principal spillway. The cutoff shall be trapezoidal in cross-section, with a minimum bottom width of 8 feet. Side slopes shall be no steeper than 1:1. The most impervious material available shall be used to backfill the cutoff trench.

Other Types of Dams: Sediment basin structures may also be constructed of rock-filled pressure treated timber cribbing, rock-filled precast reinforced concrete cribbing, or rock-filled gabions. These types of retaining structures do not require the use of a pipe spillway, but do require provision for the emergency spillway frequency storm. Designs for these types of structures must be prepared by a registered professional engineer for the specific site and conditions.

Safety: Guardrails, fencing and signs should be used to control access to sediment basins.

Vegetation: Vegetation of all disturbed areas shall be accomplished in accordance with the appropriate section of this handbook.

Sediment Removal and Removal of the Basin: Sediment removed during intermediate clean out of the basin will be spread uniformly above the pool area or in other areas where it will not enter the stream. The area will be immediately fertilized, limed, seeded and mulched.

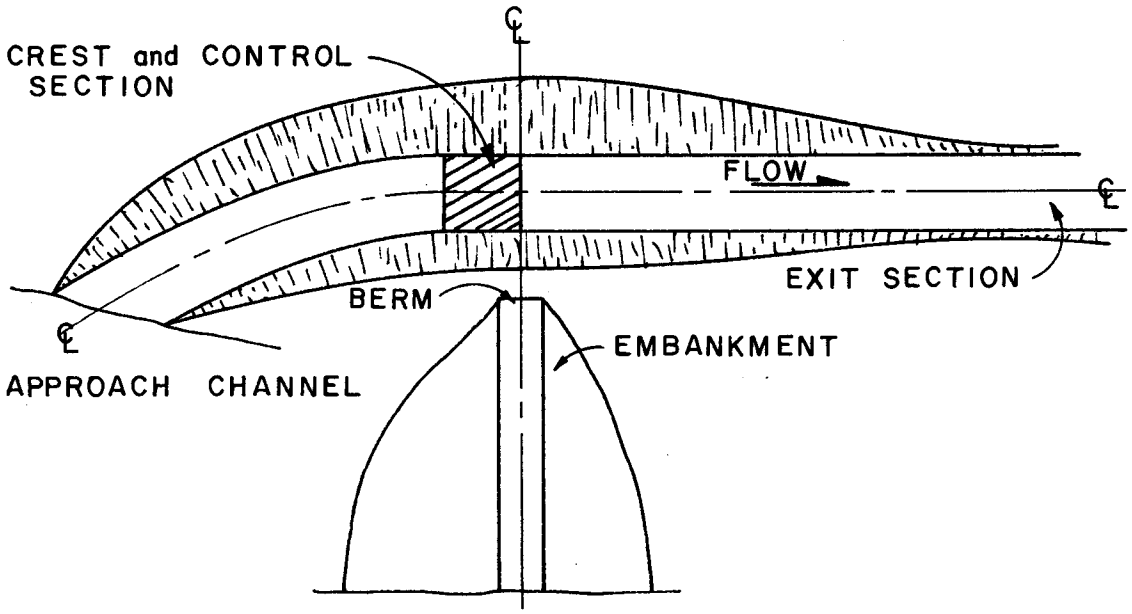
The same procedure will be applicable when the basin has reached its design life and removal is required.

Operation and Maintenance

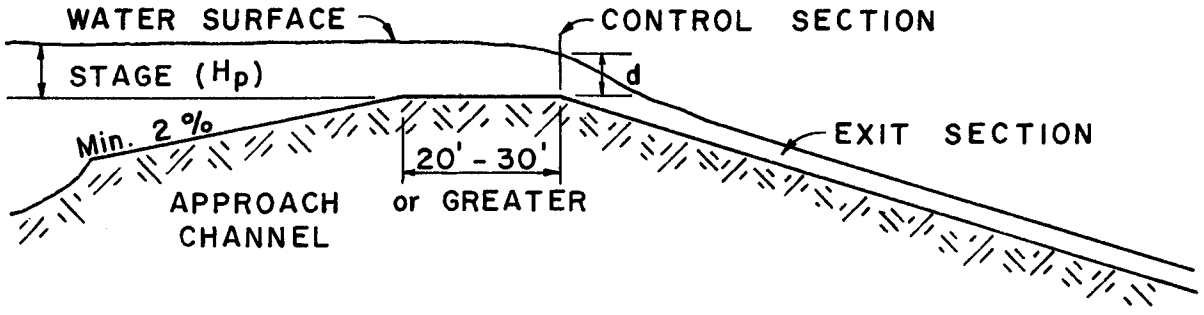
An operation and maintenance plan shall be developed for the installed basin. The plan shall outline the minimum maintenance necessary to ensure the basin functions for its design life. The plan should consider, as a minimum, the following items.

1. Inspect after every rainfall event. Clean out or repair as necessary.

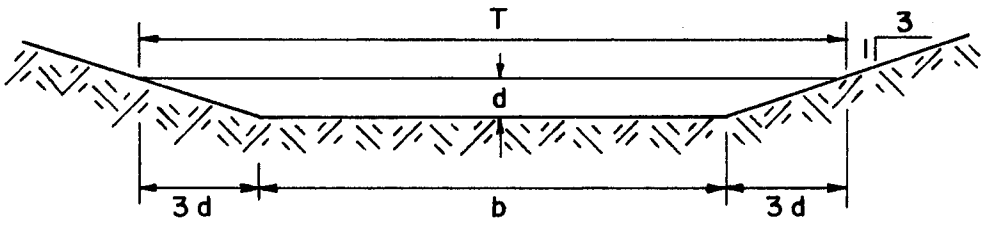
2. Keep stabilization features in proper condition. This would include vegetation, riprap, pipes, and open spillways.



PLAN VIEW OF EXCAVATED EARTH SPILLWAY



PROFILE ALONG CENTERLINE



CROSS SECTION AT CONTROL SECTION

Figure 15

Table 8 — H_p and Slope Range for Discharge and Velocity
Retardance C[1]
Crest Length 25'

Max. Velocity V	Discharge q	H_p	Exit Slope Range min.	max.
ft/s	cfs/ft	ft	pct	pct
2	0.5	0.7	1	6
2	1	0.9	1	3
3	1.25	0.9	1	6
4	1.5	1.0	1	12
4	2	1.1	1	7
5	3	1.3	1	6
6	4	1.5	1	12
8	5	1.7	1	12
9	6	1.8	1	12
9	7	2.0	1	10
10	7.5	2.1	1	12

Table 9 — H_p and Slope Range for Discharge and Velocity
Retardance D[2]
Crest Length 25'

Max. Velocity V	Discharge q	H_p	Exit Slope Range min.	max.
ft/s	cfs/ft	ft	pct	pct
2	0.5	0.6	1	6
3	1	0.8	1	6
3	1.25	0.8	1	4
4	1.25	0.8	1	10
4	2	1.0	1	4
5	1.5	0.9	1	12
5	2	1.0	1	9
5	3	1.2	1	4
6	2.5	1.1	1	11
6	3	1.2	1	7
7	3	1.2	1	12
7	4	1.4	1	7
8	4	1.4	1	12
8	5	1.6	1	8
10	6	1.8	1	12

[1] Vegetation 11 to 24 inch length.
[2] Vegetation 2 to 10 inch length.

Plans and Specifications

Plans and specifications for installation of sediment basins shall be in sufficient detail to insure the practice will function to achieve its intended purpose.

Removal and disposal of sediment and removal of the sediment basin will be addressed in the drawings or specifications.

Design Aids

Reference may be made to Appendix B for a procedure to determine runoff for a given watershed area. Other guides which may be used include Chapter 2 of the Soil Conservation Service Engineering Field Handbook and SCS Technical Release 55.

Figure 17 is a sediment volume curve to be used in computing the quantity of sediment storage needed for a sediment basin. Tables 8 and 9 provide a method for sizing the emergency spillway based on the design flow. Figure 16 is a structure design sheet which contains pertinent details leading to a structure size.

Additional design procedures may be found in SCS Engineering Field Handbook, Chapter 11; Ponds and Reservoirs.

Specifications

Construction operations will be carried out in such a manner that erosion and water and air pollution will be minimized. State and local laws concerning pollution abatement will be followed.

Site Preparation: The embankment site shall be cleared of all brush, trees, stumps, roots, and other undesirable material. Sod and topsoil shall be stripped from the embankment site and borrow area and stockpiled for use on the emergency spillway and embankment. Brush, trees, and other undesirable material shall be cleared from the sediment pool area.

Excavation and Backfill of Stream Channel: Existing stream channels crossing the foundation area shall be deepened and widened as necessary to remove all stones, gravel, sand, stumps, roots, and other objectionable material, and to accommodate compaction equipment. Such channels shall then be backfilled with suitable material as specified for earth embankment. The excavated channels shall be kept free of standing water during backfill operations.

Pipe Conduit: The pipe conduit shall be placed in a trench excavated in solid, undisturbed ground or formed by compacted earth. The conduit, except where placed on concrete bedding, shall be imbedded in a formed trench to a depth no less than one-tenth times the outside diameter of the pipe. Trench sides shall be sloped back no steeper than 1 to 1. Selected impervious backfill material shall be placed around the conduit in 4-inch layers and thoroughly compacted to at least the same density as the adjacent embankment.

All pipe joints and anti-seep collar connections to the conduit shall be watertight.

Emergency Spillway: The emergency spillway shall conform to the lines, grades, bottom width, and side slopes as shown on the plans.

Borrow Areas: All borrow excavation will have side slopes no steeper than 2h:1V and shall be graded and left in such a manner as to provide suitable drainage.

Selection and Placement of Embankment Materials: The most impervious material shall be used in the cutoff trench and center portion of the dam. When sandy gravelly material is encountered, it should be placed in the outer shell, preferably in the downstream portion of the dam. The distribution and gradation of materials throughout the fill shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use materials of varying texture and gradation, the more impervious material shall be placed in the upstream and center portions of the dam. Very dry or wet materials shall not be used. The fill material shall be free of all sod, roots, and stones, over 6 inches in diameter, and other objectionable material. The moisture content of the material should be such that when kneaded in the hand it will just form a ball that will not readily separate.

The embankment material shall be placed in uniform 6- to 8-inch layers over the entire embankment area. Compaction shall be obtained by completely traversing each layer with a minimum of four passes of the construction equipment.

Figure 16
Sediment Basin Proportioning
Computation Sheet

Project _____

Location _____

Computed by _____ Date_____ Checked by_____ Date_____

Design Factors

Drainage Area _____Ac. Max. Effective Height _____Ft. Max. Storage _____Ac. Ft.
(Ht. between ESW crest and low point)

Sediment Storage

Ave. Slope _____% Ave. Slope Length _____Ft. Area Disturbed _____Ac.

Required Sediment Storage = **Sa** x **A** x **Yr**

Sa = Annual Sediment Storage per Acre = _____Ac. Ft. (Figure 17)

A = Area Disturbed = _____Ac.

Yr = Design Life = _____Yrs.

Sediment Storage V = _____ x _____ x _____ = _____ Ac. Ft.[1]

Sediment Pool Elevation: _____

Pipe Spillway

Design Storm (If required) _____ Peak Flow (If required) (qp)_____ cfs
(Table 5) (Appendix B)

Diameter _____ In. Length _____ Ft. Material _____
(Table 5)

Drop Inlet Size _____ Material _____ Stage to ESW Crest _____Ft.
(Dia x Ht or L x W x Ht)

Pipe Peak Discharge (If required) _____ cfs Additional Seepage Protection _____
("None," "Anti-Seep Collars," or "Drainage Diaphragm")

Pipe Outlet Protection _____ PSW Inlet Protection _____
("None," "Splash Pad," "Plunge Pool," or "Riprap Line") ("None," "Anti-vortex Plate," and/or "Trash Rack")

Vegetated Earth Spillway

Soil Type _____ Vegetation _____ Resistance to Erosion _____
(USCS) (Species) ("Resistant," or "Easily Eroded")

Allowable Velocity (Va) _____fps Design Storm _____ Peak Flow (q_p)_____cfs
(Table 7) (Appendix B)

Bottom Width _____ Ft. Stage (Hp) _____ Ft. Side Slopes (Z) Inside _____ Outside _____
(Table 8 or 9)

Exit Channel Slope — max. _____ % Min. _____ % Inlet Channel Slope _____%
(Table 8 or 9) (Should be ≥ 2%)

Length of Level Section _____ Ft. Max. Design Velocity _____fps Freeboard _____Ft.
(Must be < allowable velocity) (2 ft. min.)

Top of Dam Elevation: _____

[1]May be divided by anticipated cleanouts per year.

Figure 17

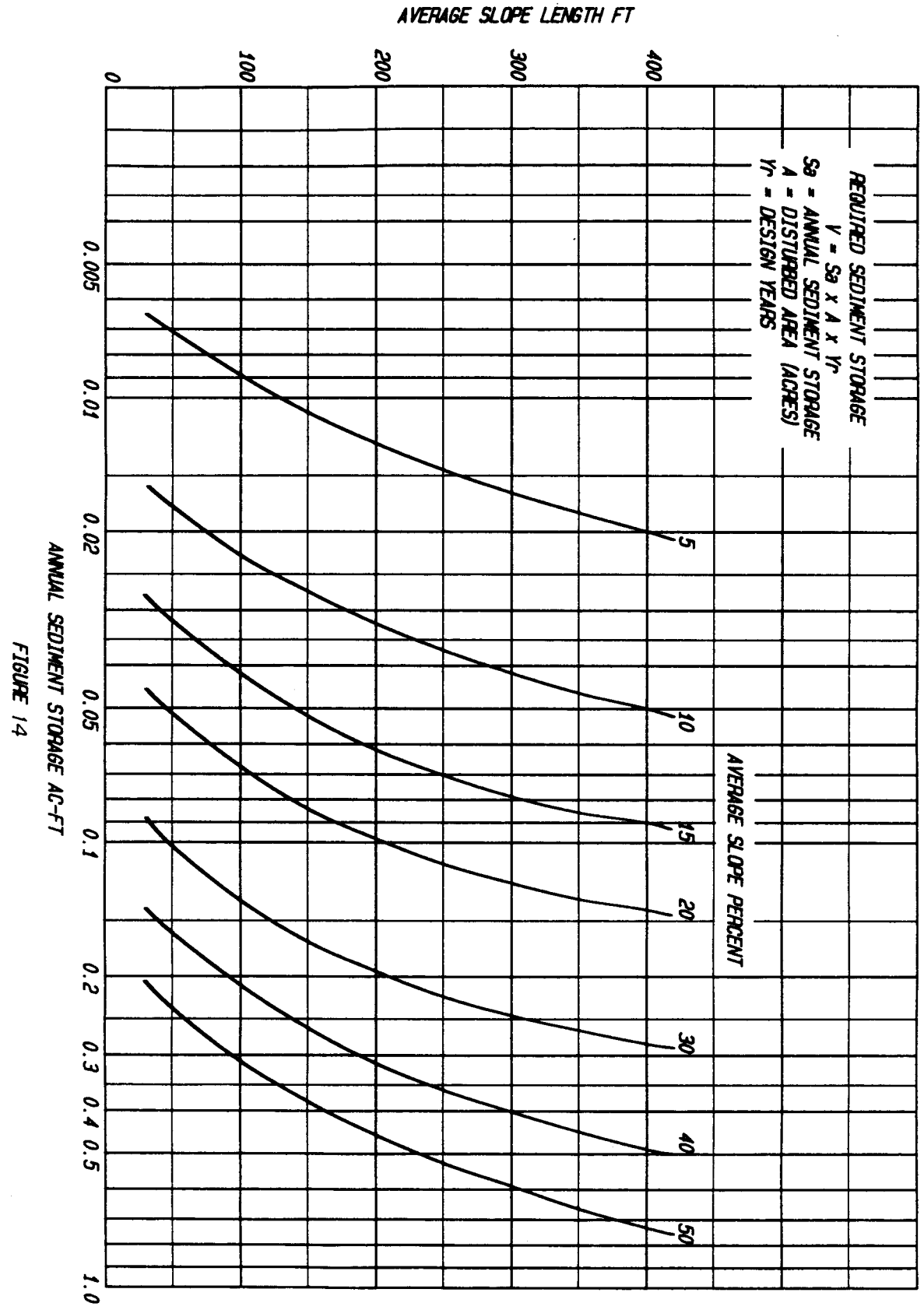


FIGURE 14