STANDARD
FOR
SEDIMENT BASIN

Definition

A barrier, dam, excavated pit, or dugout constructed across a waterway or at other suitable locations to intercept and retain sediment.

Basins created by construction of dams or barriers are referred to as "Embankment Sediment Basins" and those constructed by excavation as "Excavated Sediment Basins." Basins resulting from both excavation and embankment construction are classified as "Embankment Sediment Basins" where the depth of water impounded against the embankment at the emergency spillway elevation is 3 feet or more.

Scope

The standard covers the installation of sediment basins on sites where:

1. Failure of the sediment basin should not, within reasonable expectations, result in loss of life.

2. Failure of the sediment basin would not result in damage to homes, commercial or industrial buildings, main highways, or railroads; or interrupt the use or service of public utilities.

3. The drainage area is 320 acres or less.

4. The effective height of the dam is 20 feet or less. The effective height of the dam is defined as the difference in elevation in feet between the emergency spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no emergency spillway, the top of the dam becomes the upper limit.

Sediment basins that are not within the above scope shall be designed to meet the criteria in "Earth Dams and Reservoirs, Technical Release 60" (TR60) by the USDA-NRCS.

For dams which raise the water elevation five (5) feet or greater in height as defined in NJAC 7:20, the rules and regulations established by the New Jersey Department of Environmental Protection, Division of Engineering and Construction, Dam Safety, shall apply for all structural criteria. Flood Hazard Area Regulations NJAC 7:13-1.1 et. seq. may also apply.

Purpose

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

Conditions Where Practice Applies

This practice applies where physical conditions, land ownership, or construction operations preclude the treatment

of the sediment source by the installation or erosion control measures to keep soil and other material in place, or a sediment basin offers the most practical solution to the problem. The effectiveness of sediment removal is greatly reduced when soils are highly colloidal in nature. Additional source controls (stabilization) or flocculants must be utilized to reduce the delivery of fines to the sediment basin.

Water Quality Enhancement

During the construction process, large areas of bare soil are frequently exposed to erosion due to stormwater runoff. Suspended soils can contribute significantly to degraded water quality, both from downstream deposition as well as acting as a carrier for other pollutants which may adsorb onto soil particles. The use of a properly designed sediment basin, in combination with other erosion control standards can significantly reduce both volumetric and pollution transport problems associated with soil erosion from construction sites.

Design Criteria

Structural aspects of detention basins shall be as stipulated by applicable state, county or municipal requirements. In the absence of such criteria, Appendix A-10, "Structural Guidelines for Detention Basins", may be used. In addition, it must be shown for the peak outflow of a 10 year, 24 hour storm event (over and above basin design storage) as determined by Win TR-55, Win TR-20 , USACOE HEC HMS or other comparable methods, that there will be no soil erosion and sedimentation problems offsite. A detailed hydraulic analysis of the basin shall be submitted.

1. Sediment Basin Location:

The basin shall be designed to accommodate the individual storm runoff and sediment accumulation from the basin's total drainage area.

The basin should be located as much as possible:

a. To intercept only runoff from disturbed areas.
b. To minimize disturbance from its own construction.
c. To obtain maximum storage benefit from the terrain.
d. For ease of cleanout of the trapped sediment.
e. To minimize interference with other construction activities and construction of utilities.

2. Shape and Depth:

The length, width, and depth are measured at the principal spillway crest elevation. The basin configuration shall be such that the effective flow length is equal to at least two times the effective flow width. This basin shape may be attained by selecting the basin site, by excavating the basin to the required shape or by the installation of one or more baffles.

The minimum width shall be:

$$W = 10 \times (Q_5)^{1/2}$$

where: W = the width in ft.
Q_5 = peak discharge from a 5 year frequency storm in cfs.

The average depth shall be at least 4 feet.

When downstream damage may be severe, the minimum width should be:

$$W = 10 \times (Q_{25})^{1/2}$$

where: W = width in feet
Q_{25} = peak discharge from a 25 year frequency storm in cfs.

The average depth shall be at least 4 feet.

See Appendix A-10 for Structural Guidelines for basins.

3. Outlet for Conduits

Protection against scour at the discharge end of the spillway shall be provided in accordance with the Standard for Conduit Outlet Protection, pg. 12-1, or by suitable hydraulic structures proven effective by properly documented research.

4. Vegetation

The dam, emergency spillway, spill and borrow areas, and other disturbed areas above crest of the principal spillway shall be stabilized in accordance with the standards for temporary (pg. 7-1) or permanent (pg. 4-1) vegetative cover, whichever is applicable.

Sediment Basin Sizing

A. Sediment Basin Volume

The volume in the sediment basin below the crest elevation of the emergency spillway shall be the larger of:

1. The volume necessary to obtain 70% trap efficiency at the start of the basin's useful life, or

2. The volume necessary to provide sediment storage capacity and provide for temporary stormwater runoff storage from a 2-year frequency, 24-hour duration, Type III storm.

Flood routing to determine the required temporary floodwater storage for a 2-year frequency, 24-hour duration, Type III storm shall be done using the approximate methods in the USDA-NRCS "Engineering Field Manual," the approximate methods in the USDA-NRCS "Urban Hydrology for Small Watersheds" (Win TR55), Win TR-20, or other generally accepted methods of flood routing.

The Modified Rational Method on a drainage basin up to 20 acres, as described in Special Report 43 by the American Public Works Association, Practices in Detention of Urban Stormwater, is also applicable.

1. Trap Efficiency

Trap efficiency is the amount, in percent, of the sediment delivered to the sediment basin that will remain in the basin. The sediment basin shall have adequate volume below the crest of the emergency spillway to have an actual trap efficiency of at least 70% at the start of its useful life using Curve 26-1 and with:

C = total capacity of the sediment basin up to the crest elevation of the emergency spillway in acre feet.

I = average annual surface runoff from Figure 26-1 converted to units of acre feet.

For a normally dry sediment basin, the actual trap efficiency is reduced 10% where the incoming sediment is predominately silt, clay, or fine grained. Therefore, enter Curve 26-1 with 80% trap efficiency to achieve 70% actual trap efficiency. For a normally dry sediment basin, the actual trap efficiency is reduced 5% where the incoming sediment is sand or coarse grained. Therefore, enter Curve 26-1 with 75% trap efficiency to achieve 70% actual trap efficiency.

2. Sediment Storage Capacity plus 2 Year Storm Runoff Volume

The sediment storage capacity of a sediment basin shall equal the volume of sediment expected to be trapped at the site during the planned useful life of the sediment basin. Where it is determined that periodic removal of sediment is practicable, the sediment storage capacity may be proportionately reduced. Planned periodic removal of sediment shall not be more frequent than once a year. The capacity shall be determined by one of the following methods:

Provide sediment storage based on the following formula and figures:

$$V = (DA)(A)(DR)(TE)(1/\gamma_s)\ (2{,}000\ \text{lbs./tons})(1/43560\ \text{sq. ft./Ac.})$$

where:

V = the volume of sediment trapped in Ac. ft./yr.
DA = the total drainage area in acres.
A = the average annual erosion in tons per acre per year using the values below for the listed land use

Average Annual Erosion by Land Use Type

LAND USE	AVERAGE ANNUAL EROSION
Wooded areas	0.2 ton/ac/yr
Developed urban areas, grassed areas, pastures, hay fields, abandoned fields with good cover	1.0 ton/ac/yr
Clean tilled cropland (corn, soybeans, etc.)	10 ton/ac/yr
Construction areas	50 ton/ac/yr

DR = the delivery ratio determined from Curve 26-2
TE = the trap efficiency as determined above.
γ = the estimated sediment density in the sediment basin in lbs/cu. ft. (See Table 26-1).
γs = the submerged density in a wet sediment pool.
γa = the aerated density in a normally dry sediment pool.

TABLE 24-1 Soil Densities by Soil Type

SOIL TEXTURE	γs Submerged (lbs./cu.ft.)	γs Aerated (lbs./cu.ft.)
Clay	40-60	60-80
Silt	55-75	75-85
Clay-silt mixtures (equal parts)	40-65	65-85
Sand-silt mixtures (equal parts)	75-95	95-100
Clay-silt-sand mixtures (equal parts)	50-80	80-100
Sand	85-100	85-100
Gravel	85-125	85-125
Poorly sorted sand and gravel	95-130	95-130

The NRCS Type III 2 year Storm Runoff Volume draining to the Sediment Basin shall be added to the Sediment Storage Capacity to arrive at the total storage volume for the Sediment Basin under this criteria.

B. Sediment Basin Outlets:

1. Dewatering Hole:

If the sediment basin is de-watered by using a hole in the riser:

a. The elevation of the hole shall be the elevation that results in 50% actual trap efficiency in the basin. The value for C used to determine the 50% actual trap efficiency is the capacity of the basin between the bottom of the basin and the invert of the dewatering hole. The riser shall be completely watertight except for the inlet at the top and one hole 4 inches or less in diameter to de-water the basin.

b. The sediment shall be removed from the basin when the sediment reaches the elevation of the bottom of the hole.

c. A ‘skimmer” or “floating riser” may be utilized to draw down cleaner water from the water surface. The flexible connection to the outlet control structure must be water tight. Provision must be made to prevent the skimmer from resting on the basin floor when the pool has been completely drained. See Appendix A-7 for general details.

If the Sediment Basin has a permanent pool:

a. De-watering the Sediment Basin - Sediment basins with a permanent pool of water trap sediment more effectively than basins that are normally dry and usually create less of a mosquito problem and safety hazard. Therefore, a sediment basin with a permanent pool is usually a better design than a normal dry sediment basin.

If a normally dry or partially dry sediment basin is planned, the basin shall be de-watered by methods depicted above and in appendix A7.

If the sediment basin is de-watered by using a subsurface drain, it shall be in accordance with the Subsurface Drain Standard, pg. 32-1 and appendix A-7.

A flocculent such as “PAM” (Polyacrylamide) may be added to the basin in accordance with manufacturer’s instructions to remove fine suspended colloidal material prior to dewatering. All

dewatering discharges must be to a stabilized location. A source of free cationic ions (such as Ca 2+) may be required at a rate of 50- 60 gm Ca2+ /kg PAM to encourage bonding between colloids and PAM. Materials such as lime, CaCl, gypsum or flyash may be used to provide the cation component. The flocculent shall not cause adverse environmental conditions to develop in the area receiving the basin discharge.

Flocculent may be added through the use of 'logs' or similar devices impregnated with PAM to dose inflow water prior to entrance to the sediment basin. Such devices shall be placed to allow complete passage of the design storm and shall not obstruct flow through storm sewer systems.

2. Principal Spillway Crest Elevation – Top of Temporary Sediment Riser:

The principal spillway crest elevation shall be the lower of:

a. one (1) foot below the emergency spillway crest elevation or,

b. the elevation that provides (between the crest of the principal spillway and the crest of the emergency spillway), the required temporary floodwater storage for a 2-year frequency, 24-hour duration, Type III storm.

3. Emergency Spillways for Excavated and Embankment Sediment Basins:

Emergency spillways are provided to convey large floods safely past sediment basins.

An emergency spillway must be provided for each sediment basin, unless the principal spillway is large enough to pass the routed emergency spillway design storm and the trash that comes to it without overtopping the dam. A closed conduit principal spillway having a conduit with a cross-sectional area of 3 square feet or more, an inlet which will not clog, and an elbow designed to facilitate the passage of trash is the minimum size and design that may be utilized without an emergency spillway.

a. Excavated Sediment Basins - Excavated sediment basins may utilize the natural ground or the fill for the emergency spillway if the downstream slope is 5 to 1 or flatter, has existing vegetation, or is immediately protected by sodding, rock riprap, asphalt lining, concrete lining, or other equally effective protection. The spillway shall meet the capacity requirement for embankment sediment basins.

b. Embankment Sediment Basins - Embankment sediment basins shall meet the following requirements:

Capacity - The minimum capacity of the emergency spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 26-2 less any reduction creditable to conduit discharge and detention storage.

When discharge of the principal spillway is considered in calculating outflow through the emergency spillway, the crest elevation of the inlet shall be such that full flow will be generated in the conduit before there is discharge through the emergency spillway. The emergency spillway shall safely pass the peak flow or the storm runoff shall be routed through the reservoir. If routed, the routing shall start with the water surface at the elevation of the crest of the principal spillway. The flood routing may be done using the approximate methods in the USDA-NRCS Engineering Field Manual; the USDA-NRCS TR-55 or TR-20; the modified rational method up to 20 acres, as described in Special Report 43 by the American Public Works Association, Practices in Detention of Urban Stormwater; or other accepted methods of emergency spillway flood routing.

Table 24-2 Minimum Design Storm

DRAINAGE AREA (acres)	FREQUENCY (years)	MINIMUM DURATION* (hours)
less than 20	10	24
21 - 49	25	24
over 49	100	24

*For use by USDA-NRCS methods only.

Disposal

The sediment basin plans shall indicate the method(s) of disposing of the sediment removed from the basin. The sediment shall be placed in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the basin, in or adjacent to a stream or floodplain or in wetlands.

The plans shall also show the method of removal of the sediment basin after the drainage area is stabilized, and shall include the stabilizing of the sediment basin site. Water lying over the trapped sediment shall be removed from the basin by pumping, cutting the top of the riser, or other appropriate method prior to removing or breaching the embankment. Sediment shall not be allowed to flush into the stream or drainage way.

Sediment shall be removed from the basin for maintenance purposes when the sediment level reaches the 50 % Trap Efficiency elevation. The elevation shall be identified either by the invert elevation of the 50 % Trap Efficiency dewatering hole (if one is used) or by a marker which shall be visible from the basin edge.

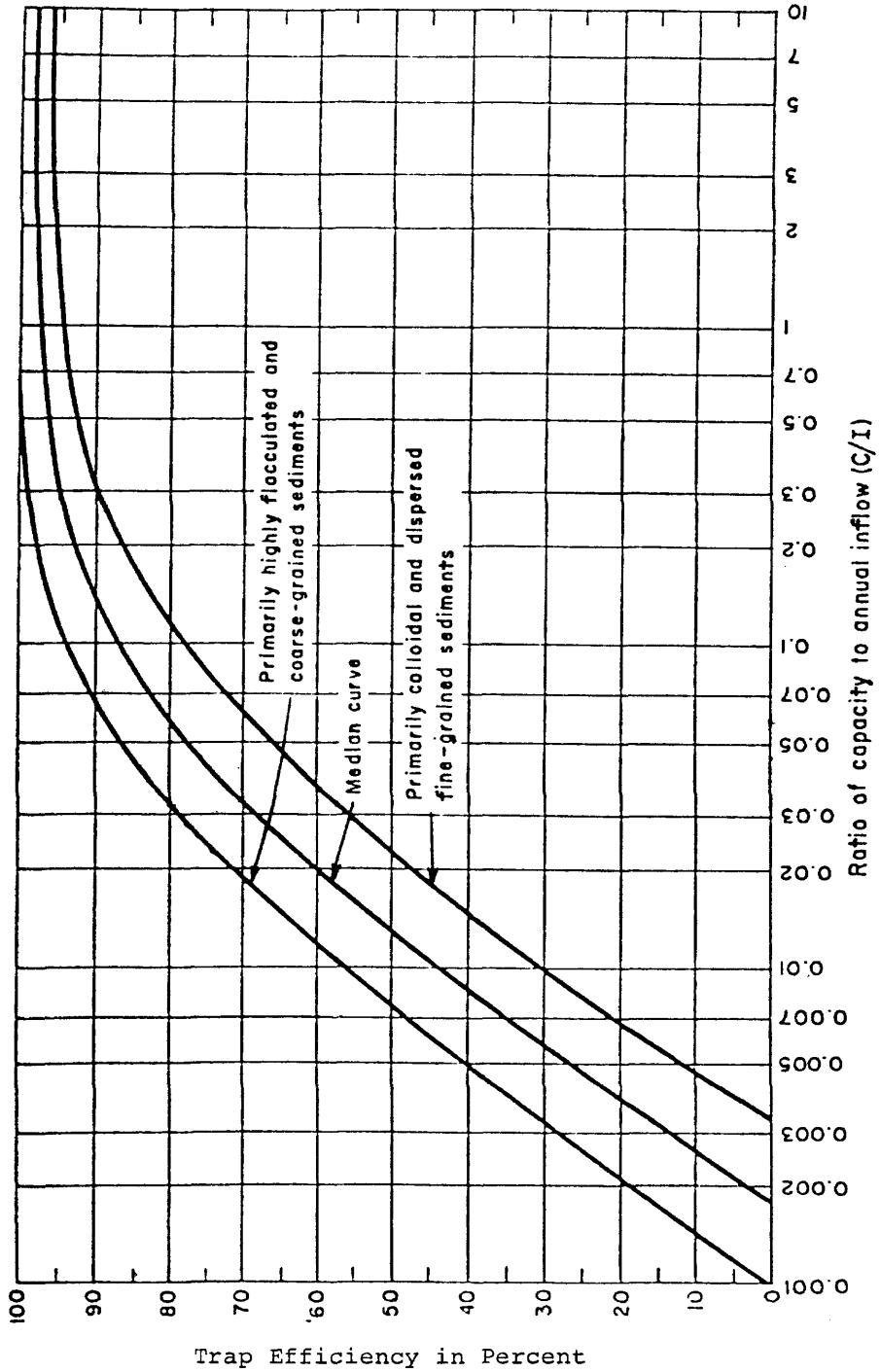
Safety - This portion of the Standard is for guidance only.

Sediment basins attract children and can be very dangerous. Local County or State ordinances and regulations regarding health and safety must be adhered to.

Maintenance

The plans shall indicate who is responsible for operation and maintenance during the life of the sediment basin.

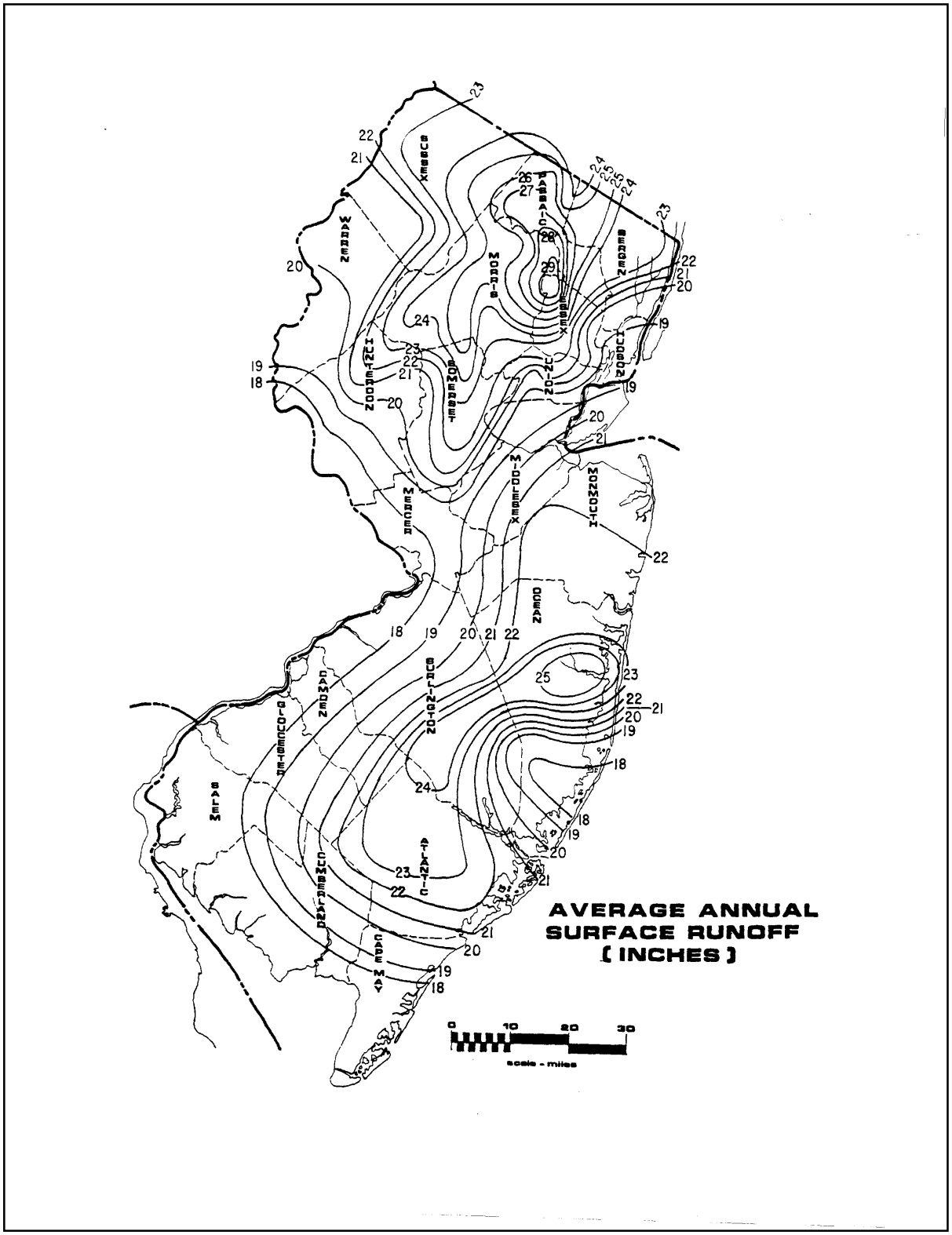
CURVE 24-1



TRAP EFFICIENCY OF RESERVOIRS

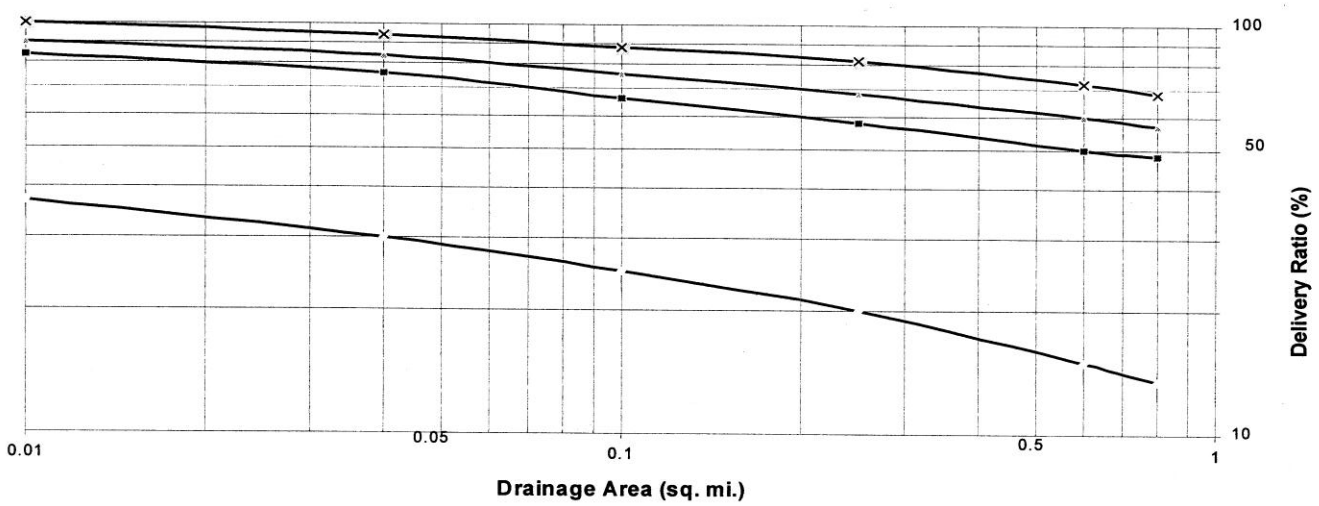
Reference: Brune, Gunnar M., "Trap Efficiency of Reservoirs", Trans. AGU, Vol. 34, No.3, pp 407-418, June 1953.

FIGURE 24-1



Curve 24-2

Sediment Delivery Ratios



Silty Clay DR = -7.7689LnX +56.642

Sandy DR = -5.398lnX + 12.399

Sandy Silty Silty Clay Clay

Silt DR = -8.5341LnX + 46.247

Clay DR = -7.2744LnX +69.152