Day 8: Sedimentation Ponds for Downslope Control at Construction Sites

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Erosion Controls
Control Site Discharges

- Filter fencing for small sites (but only for slope lengths less than about 100 ft). Expect about 10 to 50% control of suspended solids.
- Sediment ponds for areas larger than 10 acres. Expect up to 80% control of suspended solids.

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Wet Detention Ponds for Sediment Control at Construction Sites

- The upflow-velocity concept can be used to predict the performance of wet ponds for capturing sediment.
- Effectiveness based on the amount of runoff and the particle size distributions.

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Basic Pond Design Elements

- Need at least three feet of permanent standing water over most of the pond to protect sediments from scouring. Additional depth is also needed for sediment storage between cleanout operations.
- Ideally, the pond length should be about three to five times the width for maximum detention efficiency and the inlets and outlets need to be widely spaced to minimize short-circuiting.

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• Correct pond side slopes are very important to improve safety and to minimize mosquito problems. An underwater shelf near the pond edge needs to be planted with rooted aquatic plants to hinder access to deep water, if the pond will be in place for several years. Short-term temporary ponds commonly used at construction sites will not enable vegetation to become established.

• Outlet structures should be designed for low outflows during low pond depths to maximize particulate retention. Place underwater dams or deeper sediment trapping forebays near pond inlets to decrease required dredging areas.

• Protect the inlet and outlet areas from scour erosion and cover the inlets and outlets with appropriate safety gratings. Provide an adequate emergency spillway.

Stormwater Detention Basin Classifications (*Alabama Handbook*, USDA 2003)

Type	Maximum water surface area (acre)	Maximum dam height (feet)	Emergency spillway design storm frequency	Freeboard (feet)
1	20	7	10-yr 24-hr	0.5
2	20	10	10-yr 24-hr	0.5
3	50	15	25-yr 24-hr	1.0

Sediment pond dredging, replanting, and final pond at construction site

Construction Site Erosion and Sediment Controls Listed in 95 US and International Guidance Manuals

Erosion and Sediment Control Tool	included in % of 95 reviewed US and international manuals
Sediment Basin/Trap	91
Floating Turbidity Barrier	31
Chemical Stabilization (PAM) water application	19
Treatment/Coagulation Unit	1

Effectiveness of Sediment Traps and Dry Ponds at Construction Sites

	number of events X locations per treatment	TSS influent (mg/L) avg	TSS effluent (mg/L) avg	% TSS reduc	Turbidity influent (NTU) avg	Turbidity effluent (NTU) avg	% Turbidity reduc
number	8	7	8	7	2	6	2
average	21	4,030	2,546	37	200	3,969	11
min	2	230	220	5	150	140	8
max	42	12,200	8,420	69	250	12,640	14
COV		1.1	1.1	0.60	0.35	1.2	0.39

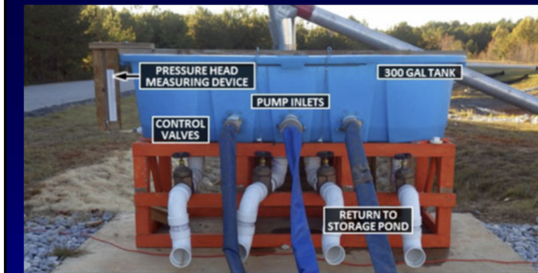
Effectiveness of Sediment Traps and Dry Ponds with Polymers at Construction Sites

	number of events X locations per treatment	TSS influent (mg/L) avg	TSS effluent (mg/L) avg	% TSS reduc	Turbidity influent (NTU) avg	Turbidity effluent (NTU) avg	% Turbidity reduc
number	6	4	6	4	4	6	4
average	9	215 (pre-treated)	308	6	205	407	80
min	2	190	40	45	150	30	66
max	31	270	820	80	260	1,560	88
COV		0.17	1.2	0.23	0.31	1.6	0.13

Effectiveness of Wet Ponds at Construction Sites

	number of events X locations per treatment	TSS influent (mg/L) avg	TSS effluent (mg/L) avg	% TSS reduc	Turbidity influent (NTU) avg	Turbidity effluent (NTU) avg	% Turbidity reduc
number	3	3	3	1	0	1	n/a
average	14	About 3,500	98	Likely >90	n/a	130	n/a
min	12	n/a	37	34	n/a	130	n/a
max	17	n/a	177	>90	n/a	130	n/a
COV	0.18	n/a	0.74	n/a	n/a	n/a	n/a

Dry sediment pond at construction site monitored by McCaleb, et al. (2008)



Sediment pond test facility for enhanced performance (floating barriers, polymer use, floating outlets) by Vacconcelos, *et al.* (2017).

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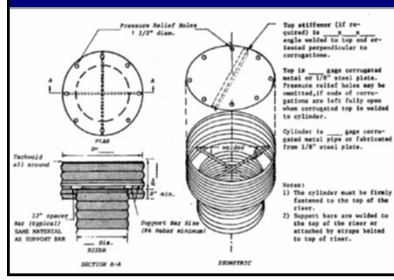
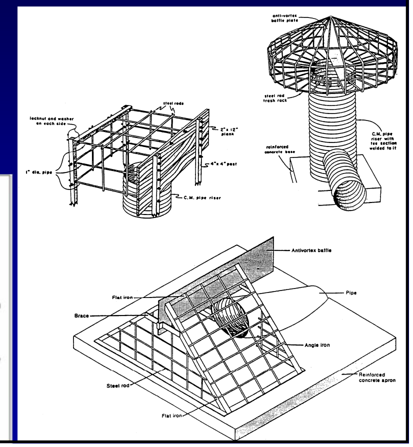
Safety of Detention Ponds

Numerous design features to maximize pond safety:
- Side slopes
- Depth
- Safety ledge
- Accessibility
- Outlet structure protection
- etc.





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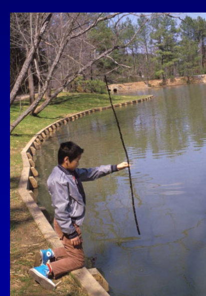
Steep walkway leading to water

Winter ice skating dangers near pond edges

Some pond safety issues in urban areas



Deep drop-off at pond edge

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Age	% accidental drowning deaths by age group in the US
<1 yr	8.5%
1 to 4 yrs	27.0%
5 to 14 yrs	12.6%
15 to 24 yrs	4.6%
25 to 34 yrs	3.6%
35 to 44 yrs	3.1%
45 to 54 yrs	2.9%
55 to 64 yrs	2.9%
65 to 74 yrs	2.3%
75 to 84 yrs	1.3%
> 85 yrs	0.6%
not stated	28.2%

National Vital Statistics Report (2002)

The drowning rate for North Carolina residents was 3.2 per 100,000 persons between 1980 and 1984. Swimming and wading were involved in 41% of the deaths.

Drowning victims 15 years of age and older tested positive for alcohol in more than half of the cases, with 38% having very high blood alcohol.

Most of the drowning victims in North Carolina were between 5 and 34 years of. They reported that 37% of the drownings were in "incidental" waters which temporarily held water, such as drainage ditches. In addition, 24% of the drownings were in rock quarries.

Of the 59 unattended children drowning victims, 29 fell into a body of water (such as a swimming pool or lake), 8 were bathing, and 7 were swimming or wading in a swimming pool. 16

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Maintenance of Detention Ponds

Clear outlet
Repair erosion problems on embankments
DREDGING!!
Restore land after construction period (or rebuild for permanent stormwater pond)

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Example Construction Site Dry Sediment Ponds

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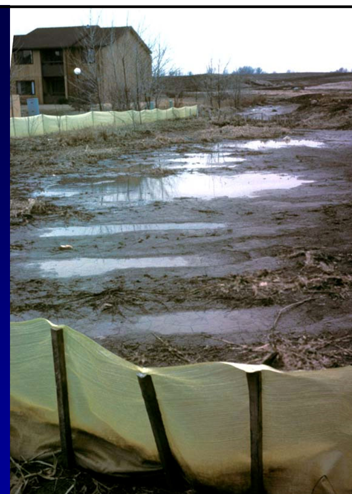

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Wet sediment ponds at construction sites

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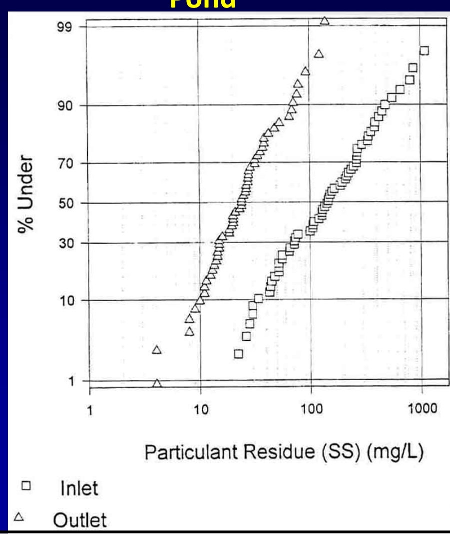
Typical Performance for Well-Designed Wet Sediment Pond



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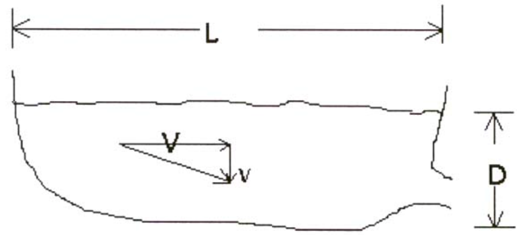

$$v = \frac{Q_{out}}{A}$$

Q_{out} = pond outflow rate (cubic feet per second),
A = pond surface area (square feet: pond length times pond width), and
v = upflow velocity, or critical particle settling velocity (feet per second)

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Pond Performance Dependent on Particle Characteristics

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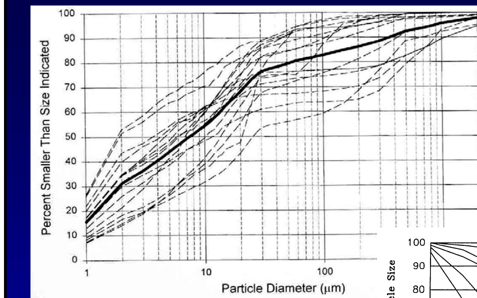
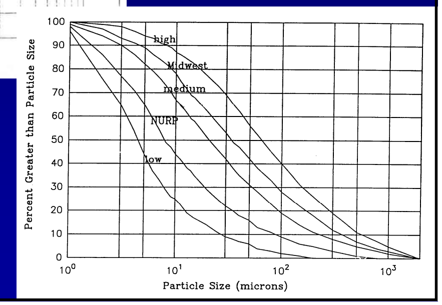
Typical Runoff Particle Size Distribution





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- Measured suspended solids concentrations ranged from 100 to more than 25,000 mg/L (overall median about 4,000 mg/L).
- Turbidity ranged from about 300 to >50,000 NTU, with an average of about 4,000 NTU
- Particle sizes: 90% were smaller than about 20 μm (0.02 mm) in diameter and median size was about 5 μm (0.005 mm).
- Measured Birmingham construction site erosion discharges range from about 100 to 300 tons/acre/year

Measured conditions:	Low intensity rains (<0.25 in/hr)	Moderate intensity rains (about 0.25 in/hr)	High intensity rains (>1 in/hr)
Suspended solids, mg/L	400	2,000	25,000
Particle size (median), μm	3.5	5	8.5

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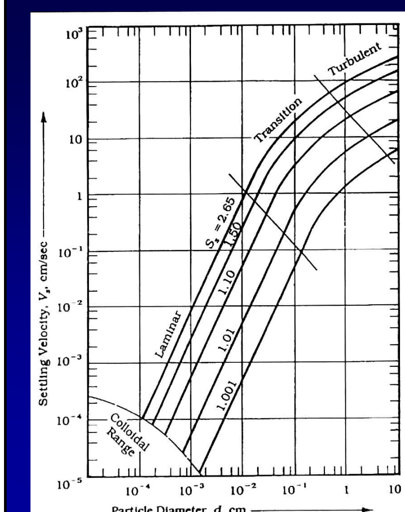
Particle Settling Rates



2 μm particle ⇒ 2 x 10^{-4} cm/s or 5.8 days for 1 meter

20 μm particle ⇒ 2 x 10^{-2} cm/s or 1.4 hours for 1 meter

200 μm particle ⇒ 2 cm/s or 50 sec for 1 meter

2000 μm (2 mm) particle ⇒ 20 cm/s, or 5 sec for 1 meter

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Design of Wet Detention Ponds for the Control of Construction Site Sediment

1. The wet pond should have a minimum surface corresponding to land use and desired pollutant control. The following is an example of how initial size guidance values can be used:

	Land Area (acres)	Pond Size Factor	Resulting Pond Surface Area (acres)
Paved area	0.6	3%	0.018
Undeveloped area	3.8	0.6%	0.023
Construction area	27.6	1.5%	0.414
Total:	32.0		0.455

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Pond Area as a Percentage of Drainage Area Type

	5 micron	20 micron
Totally paved	2.8	1.0
Industrial	2.0	0.8
Commercial	1.7	0.6
Institutional	1.7	0.6
Residential	0.8	0.3
Open space	0.6	0.2
Construction	1.5	0.5

If areas contain infiltration controls then less area needed

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Design of Wet Detention Ponds for the Control of Construction Site Sediment (cont.)

2. The pond freeboard storage should be equal to the runoff associated with 1.25 inches rain for the land use and development type. The following is an example:

	Land Area (acres)	Pond WQ Volume Factor	Pond WQ Volume
Paved area	0.6	1.1 inches	0.66 ac-in
Undeveloped area (clayey soils)	3.8	0.3	1.14
Construction site (clayey soils)	27.6	0.6	16.56
Total	32.0		18.36 ac-in (1.53 ac-ft)

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Runoff Depth Corresponding to 1.25 Inches of Rain

Based on small storm hydrology

	Sandy	Clayey
Freeways	0.35	0.40
Totally paved	1.1	1.1
Industrial	0.85	0.9
Commercial	0.75	0.85
Schools	0.2	0.4
Low density residential	0.1	0.3
Medium density residential	0.15	0.35
High density residential	0.2	0.4
Developed parks	0.5	0.6
Construction sites	0.5	0.6

Pitt 1987

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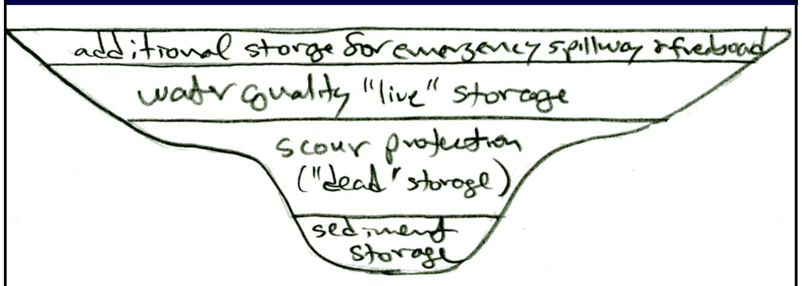

3. The "dead" storage is needed to prevent scour of previously deposited material and should be at least 3 ft deep over the sediment. Sediment storage volume is also needed and can be estimated using RUSLE for the construction site.

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Selection of Outlet Control Device (this example for two small V-notch weirs)

Head (ft)	Flow (cfs)	22.5° Storage (ac-ft)	Reqd. area (acres)	Flow (cfs)	30° Storage (ac-ft)	Reqd. area (acres)
0.5	0.1	<0.01	0.01	0.1	<0.01	0.02
1	0.5	0.03	0.1	0.7	0.05	0.1
1.5	1.4	0.1	0.2	1.9	0.2	0.3
2	2.8	0.3	0.5	3.8	0.3	0.7
3	7.8	1.2	1.4	11	1.6	1.8
4	16	3.3	2.8	22	4.4	3.8
5	28	7.2	4.9	38	9.6	6.6
6	44	14	7.7	60	18	10

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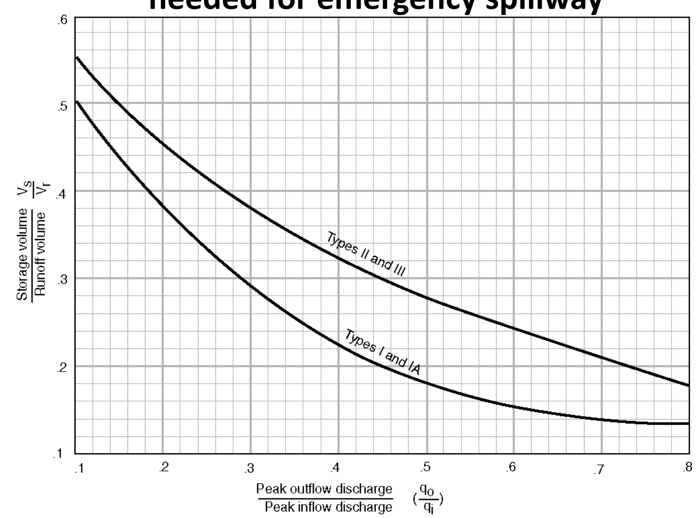
4. SCS TR-55 plot used to size additional freeboard needed for emergency spillway



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Vs = 1.53 acre-ft
Vr = 7.5 acre-ft
and Vs/Vr = 0.20

for type II or III rain categories:
qo/qi = 0.72

if the calculated peak discharge rate entering the pond (qi) = 8.7 cfs, the resulting peak discharge rate leaving the pond, qo, (through the water quality primary outlet plus the emergency spillway) is therefore: 0.72 (8.7) = 6.3 cfs

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Rain and watershed characteristics for the emergency spillway design:

P = 8 inches
CN = 86; therefore the Ia = 0.0366
Q = 6.2 inches and Ia/P = 0.041
Area (Am) = 0.021 mi^2 (13.2 acres)
Tc = 20 min (0.3 hr)

The peak unit discharge rate from the tabular hydrograph method is 498 csm/in, and the peak discharge is therefore:
Q_{peak} = (498 csm/in)(0.021 mi^2)(6.2 in) = 63.7 ft^3/sec

Also, the volume of runoff for this event is:
V_r = [(6.2 in)(13.2 ac)]/12 in/ft = 6.82 ac-ft

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The maximum desired discharge rate for this pond (for both the water quality outlet plus the emergency spillway) is given as 46.5 ft3/sec.

The ratio of the outlet to the inlet flow rate is therefore: q_o/q_i = 46.5/63.7 = 0.73

The ratio of the storage volume (V_s) to the runoff volume (V_r), for Type II rains is 0.2, for this ratio of outlet to inlet peak flow rates. Therefore the storage for the pond to meet this peak discharge rate goal is:
V_s = 0.2 (6.82 acre-ft) = 1.34 acre-ft

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The length (LW in feet) of a rectangular weir, for a given stage (HW in feet) and desired outflow rate (qo in ft^3/sec) can be expressed as:

$$L_w = \frac{q_o}{3.2H_w^{1.5}}$$

The desired q_o for the rectangular weir is 46.5 – 2.2 = 44.3 ft^3/sec. If the maximum stage for the emergency spillway is 1 ft, then length for the emergency spillway is:

$$L_w = \frac{q_o}{3.2H_w^{1.5}} = \frac{44\,ft^3/\sec}{3.2(1\,ft)^{1.5}} = 13.8\,ft$$

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Example Pond Design for Construction Site Sediment Control

	Area (acres)	% of area needed for pond surface	Pond surface area (acres)	Water quality volume (inches of runoff)	Pond volume (acre-inches)
Construction area	37	1.5%	0.56	0.6	22.2
Undeveloped area	14	0.5	0.07	0.3	4.2
Paved area	2	3.0	0.06	1.1	2.2
Total:	53		0.69		28.6

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A pond depth of 3 ft, and approximate side slopes of 12% and a top area of 0.9 acres are used. An additional 1 ft of storage to accommodate an emergency spillway is also provided, with a maximum top area needed of about 1 acre.

A 12 inch vertical riser pipe, having its opening at the normal pond water surface level, seems to be a good choice.

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Three feet of standing water is needed above the maximum sediment depth in order to minimize scour. In addition, sacrificial sediment storage must also be provided in the pond.

R = 350
LS = 4.95 (based on typical slope lengths of 600 ft at 10% slope)
k = 0.28
C = 0.25 (assuming that ¼ of the construction site area is being actively being worked, and the rest of the area is effectively protected)

The calculated unit area erosion loss for this construction period is therefore about 243 tons per acre per year. Since the construction period is one-half year and the area is 37 acres, the total sediment loss is estimated to be about 4490 tons. For a loam soil, this sediment volume is about 4600 yd^3. The pond area at the bottom of the 3 ft of standing water is about ½ acre, requiring about 2 ft of sediment storage.

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Rain range (inches)	Mid Point Rain (inches)	% of annual R in category	% particulate solids removed for pond	Weighted total annual particulate solids removal (%)
0.01 to 0.05	0.03	0.0	100	0
0.06 to 0.10	0.08	0.1	100	0.1
0.11 to 0.25	0.18	0.7	99.8	0.7
0.26 to 0.50	0.38	3.5	99.5	3.5
0.51 to 0.75	0.63	4.8	98.9	4.7
0.76 to 1.00	0.88	8.2	98.2	8.1
1.01 to 1.50	1.26	16.1	96.7	15.6
1.51 to 2.00	1.76	15.4	88.5	13.6
2.01 to 2.50	2.26	10.9	80.2	8.7
2.51 to 3.00	2.76	7.5	68.1	5.1
3.01 to 4.00	3.5	16.3	57.2	9.3
over 4.01	5.67	16.5	39.1	6.5
4583 events	41.5 years	100.0		75.9 % annual particulate solids removal

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Example Sizing of Sediment Pond at Construction Site

- the basic pond area,
- the "live" storage volume,
- the pond side slopes, top surface area, and "dead storage" volume,
- the selection of the primary discharge device,
- the additional storage volume needed for the emergency spillway,
- the sizing of the emergency spillway, and
- the sacrificial storage volume for sediment accumulation.

the basic pond area and "live" storage volume

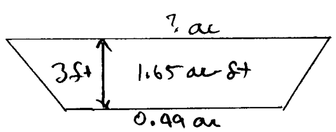
The following are the areas associated with each surface in the drainage area:
- paved areas: 0.2 acres
- undeveloped areas: 1.2 acres
- construction area: 32 acres
- total site area: 33.4 acres

Site Subarea	Pond Surface Area (acres)	Pond "Live" Volume, runoff from 1.25 inches of rain fall (acre- inches of runoff)
paved area (0.2 acres)	3% of 0.2 acres = 0.006 acres	1.1 inches x 0.2 acres = 0.22 ac-in
undeveloped area (1.2 acres)	0.6% of 1.2 acres = 0.007 acres	0.3 inches x 1.2 acres = 0.36 ac-in
construction area (32 acres)	1.5% of 32 acres = 0.48 acres	0.6 inches x 32 acres = 19.2 ac-in
Total:	0.49 acres	19.8 ac-in = 1.65 ac-ft

pond side slopes, top surface area, and "dead storage" volume

1) If 3 ft deep:

Top area:

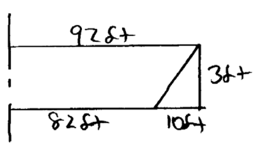


$$\frac{(0.49acres + X)3\,ft}{2} = 1.65ac - ft$$

$$X = 0.61acres$$

at 0.61 acres: $\pi r^2 = 26{,}570\,ft^2$ r = 92 ft

at 0.49 acres: $\pi r^2 = 21{,}340\,ft^2$ r = 82 ft



side slope = 3 ft/(92-82 ft) =
3 ft/10 ft = 0.3 = 30% too steep

Therefore try different pond depths and calculate diameters and slopes:

If 1 ft deep; top area = 2.81 acres and r = 197 ft and side slope = 1.2% too shallow

If 2 ft deep; top area = 1.16 acres and r = 126 ft and side slope = 4.5% suitable, but on the low side

etc.....

the selection of the primary discharge device

At the top of the live storage volume, this pond will have 2 ft of stage and 1.16 acres maximum pond area:

45º V-notch weir requires at least 1.0 acres of pond surface at 2 feet of stage in order to provide about 90% control of sediment.

30º V-notch weir would require only 0.7 acres,

60º V-notch weir would require 1.4 acres.

None of the rectangular weirs would be suitable, as the smallest 2 ft weir requires at least 2.6 acres at 2 feet of stage.

The 45º weir is closest to the area available and is therefore selected for this pond.

Another suitable outlet structure would be an 18" drop tube structure which requires at least 1.1 acres.[49]

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the sacrificial storage volume for sediment accumulation

Using RUSLE, calculate the sediment loss for the complete construction period for the site area draining to the pond:

R = 350
LS = 1.28 (based on typical slope lengths of 300 ft at 5% slope)
k = 0.28
C = 0.24 (assuming that 5 of the 32 acres of the construction area is being actively worked with a C=1, and the other 27 acres of the construction area is effectively protected with a C=0.1)
A = (350)(1.28)(0.28)(0.24) = 30 tons per acre per year.

Since the construction period is for one year and the active construction area is 32 acres, the total sediment loss is estimated to be about 960 tons. For a loam soil, this sediment volume is about 980 yd^3, or 0.8 acre-ft.[50]

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The pond water surface is about 0.5 acres. With a three feet deep dead storage depth to minimize scour, the surface area at the bottom of this 3 ft scour protection zone (and the top of the sediment storage zone), can be about 0.35 acres (about 25% underwater slope).

The sacrificial storage zone can be about 3 ft deep also, and the bottom pond area would be about 0.18 acre, as shown in the following calculations:
Top of sacrificial storage area is 0.35 acres,
at 0.35 acres:

$$\pi r^2 = 15{,}250\,ft^2$$ r = 70 ft

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Therefore, the area of the bottom of the sacrificial storage area needed to provide 0.8 acre-ft of storage, if 3 feet deep can be approximated by:

$$\frac{(0.35acres + X)3\,ft}{2} = 0.8ac - ft$$

$$X = 0.18acres$$

at 0.18 acres, r = 50 ft
side slope = 3 ft/(70-50 ft) = 3 ft/20 ft = 0.15 = 15%

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the additional storage volume needed for the emergency spillway

Therefore, this example will only consider the capacity of the emergency spillway to meet the design storm flow rate, the 25-year event. Other watershed characteristics are:

- watershed area: construction area (32 acres), paved area (0.2 acres), and undeveloped area (1.2 acres) = 33.4 acres = 0.052 mi^2
- clayey (hydrologic soil group D) soils (weighted curve number = 94)
- time of concentration (Tc): 12 minutes (0.2 hours). Since the pond is at the bottom of this watershed, there is no "travel time" through down-gradient subwatershed areas.
- rain intensity for a "25-year" rain for the Birmingham, AL, area, with a 15 minute time of concentration (from the local IDF curve): 6.6 inches/hour (type III rain)

- Ia for this curve number is 0.128 inches.
-24-hour, 25-year rain has a total rain depth (P) of 6.9 inches.
-Ia/P ratio is therefore: 0.128/6.9 = 0.019, which is much less than 0.1.

Therefore the tabular hydrograph table to be used would be Exhibit III, corresponding to a Tc of 0.2 hour. The top segment of "csm/in" (cubic feet per second per square mile of watershed per inch of direct runoff) values are therefore used, corresponding to Ia/P values of 0.1, or less. The top row is also selected as there is no travel time through downstream subwatersheds. Examining this row, the largest value is 565 csm/in, occurring at 12.3 hours. The amount of direct runoff for a site having a CN of 94 and a 24-hr rain depth of 6.9 inches is 6.2 inches. The AmQ value (area in square miles times the direct runoff in inches) for this site is: (0.052 mi^2)(6.2 inches) = 0.32 mi^2-in. This value is multiplied by the csm value to obtain the peak runoff rate for this design storm: (0.32 mi2-in)(565 csm/in) = 182 ft^3/sec.

The first trial for an emergency spillway will be a rectangular weir, with one foot of maximum stage. At the one foot of stage on this weir, the 45º V-notch weir will have 3 feet of stage. The V-notch weir will discharge 16 ft^3/sec at this stage. Therefore, the rectangular weir will need to handle: 182 – 16 ft^3/sec = 166 ft^3/sec. The rectangular weir can be sized from the rectangular weir equation:

$$L_w = \frac{q_o}{(3.2)(H_w)^{1.5}} = \frac{166\,ft^3/\sec}{(3.2)(1)^{1.5}} = 52\,ft$$

This may be large for this pond, so another alternative is to try for a rectangular weir having 2 ft of maximum stage.

Another alternative is to try for a rectangular weir having 2 ft of maximum stage. At this elevation (4 ft total), the 45º V-notch weir will discharge 33 ft^3/sec. Therefore, the rectangular weir will need to handle: 182 – 33 ft^3/sec = 149 ft^3/sec. The rectangular weir can be sized from the rectangular weir equation:

$$L_w = \frac{q_o}{(3.2)(H_w)^{1.5}} = \frac{149\,ft^3/\sec}{(3.2)(2)^{1.5}} = 16\,ft$$

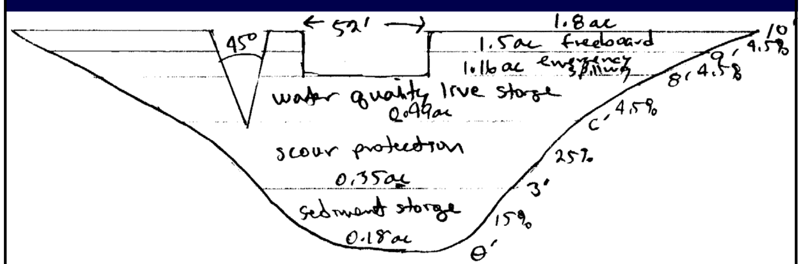
This is a suitable length, but does result in an additional foot of pond depth. For this example, the 52 foot long weir is selected.

Final pond profile and expected performance

Pond Depth (ft from bottom of pond, the datum)	Surface Area at Depth (acres)	Pond Storage below Elevation (calculated by Detpond) (acre-ft)	Pond slope between this elevation and next highest noted elevation	notes
0	0	0	-	the pond bottom (datum) must be 0 acres for the routing calculations
0.1	0.18	-	15%	the area close to the bottom can be the calculated/desired pond bottom area. This is the bottom of the sacrificial storage area for the sediment
3	0.35	0.8	25%	this is the top of the sacrificial storage area for the sediment
6	0.49	2.0	4.5%	this is the bottom of the "dead" storage area, at least 3 feet above the pond bottom (this is 6 feet above the absolute bottom, but is 3 feet above the top of the maximum sediment accumulation depth)

Final pond profile (continued)

Pond Depth (ft from bottom of pond, the datum)	Surface Area at Depth (acres)	Pond Storage below Elevation (calculated by Detpond) (acre-ft)	Pond slope between this elevation and next highest noted elevation	notes
8	1.16	3.7	4.5%	this is the bottom (invert) of the water quality outlet structure (and live storage volume), a 45° V-notch weir
9	1.5	5.0	4.5%	this is the top of live storage volume, and the bottom of the emergency spillway, a 52 ft long rectangular weir
10	1.8	6.7	-	1 foot of freeboard above maximum expected water depth, the top of the pond



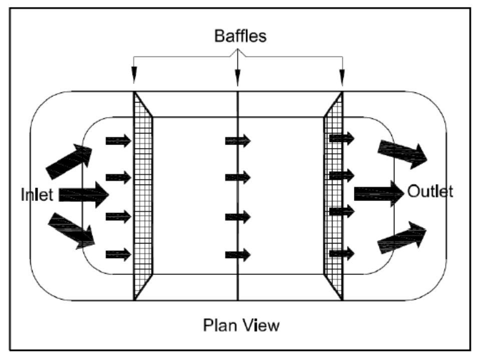
The pond performance for a 30 year period of rain (3,346 events, ranging from 0.01 to 13.6 inches) was calculated using Detpond. During these 30 years, the expected maximum pond stage is slightly more 8 ft. The emergency spillway was used a total of four times in this period. The flow-weighted particulate solids removal rate was about 92%.

	Max. Pond Stage (ft)	Event Inflow Volume (ac-ft)	Event Flushing Ratio	Flow-weighted Particle Size (µm)	Partic. Solids Removed (%)
Maximum	8.1	23	11	6.8	100
Average	6.2	0.10	0.05	n/a	n/a
Flow-weighted Average	n/a	n/a	1.4	2.6	92
Median	6.1	0.012	0.0057	0.39	99.6
Standard Deviation	0.22	0.54	0.26	0.57	1.9
COV	0.035	5.1	5.1	1.1	0.019

Therefore, this pond is likely over-designed for these conditions and could be somewhat reduced in area and depth.

Features to Enhance Pond Performance

- Floating baffle systems

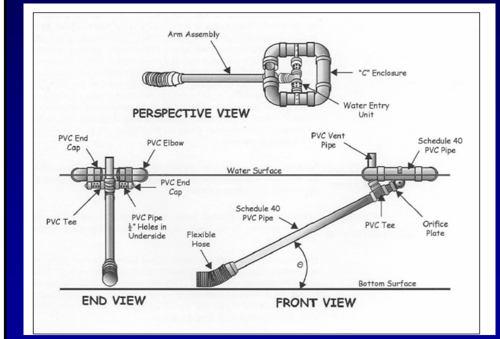


ASWCC 2014

Porous baffles effectively spread the flow across the entire width of a sediment basin or trap and cause increased deposition within the basin. Water flows through the baffle material, but is slowed sufficiently to back up the flow, causing it to spread across the entire width of the baffle). Spreading the flow in this manner utilizes the full cross section of the basin and reduces turbulence which shortens the time required for sediment to be deposited.

Features to Enhance Pond Performance (continued)

- Floating outlets (dewatering at pond surface)



Pennsylvania Erosion and Sediment Control Manual 2000

Sediment basins should be dewatered from the surface. A device often used for this is a skimmer that withdraws water from the basin's water surface, thus removing the highest quality water for delivery to the uncontrolled environment.

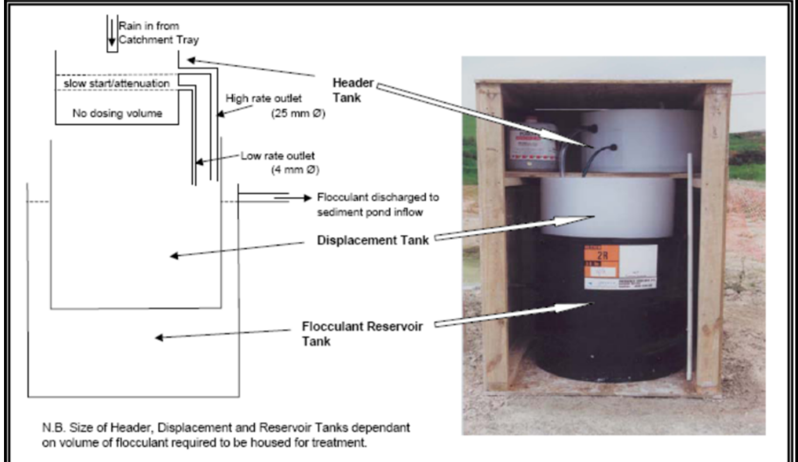
Features to Enhance Pond Performance (continued)

- Polymer additions

Inside of the control center for polymer injection to sediment pond. Monitoring of the influent and effluent turbidity levels by continuous monitors.

When properly applied at the recommended rates, flocculants can be used as polishing agents to remove sediments from turbid runoff water on a construction site. If conventional erosion and sediment control are not being properly implemented to the fullest extent, flocculants will have little or no effect on the quality of the runoff from a construction site. Most flocculant products are available in emulsions, powders, gel bars, logs, tablets, and socks.

Use of Chemical-Assisted Sedimentation



Auckland Regional Council, New Zealand

Polyaluminum Chloride (PAC) was a more suitable choice, especially for clayey soil conditions, than alum and other tested coagulants.

The overall suspended solids treatment efficiency of PAC-treated ponds has been between 90 – 99 % for ponds having good physical designs. Lower treatment efficiencies have occurred where there have been problems with decants not operating properly, or physical problems such as multiple inflow points, high inflow energy, and poor separation of inlets and outlets.

Example Performance Data for PAC-assisted Settling

Pond	Inflow		Outflow		SS Reduction
	Flow (L/sec)	SS (mg/L)	Flow (L/sec)	SS (mg/L)	(%)
Mason's Rd	3	26,300	3	144	99.4
Mason's Rd	2	5,100	2	40	99.2
OVR E	15	1,639	8	51	96
OVR E	2	749	2	56	92
23800E	8	14,800	6	966	93
23800E	1	18,700	2	67	99
B1 Gully	0.3	4,300	0.4	3	99.9
B1 Gully	0.5	16,900	3.0	59	99.6
Number	8	8	8	8	8
Average	4.0	11,061	3.3	173	97
Minimum	0.3	749	0.4	3	92
Maximum	15	26,300	8	966	99.9
COV	1.3	0.85	0.75	1.9	0.03

Conclusions

- Sedimentation ponds have been extensively used at construction sites to reduce contaminated discharges.
- Wet ponds with standing water are most effective as scour of previously deposited material is minimized.
- Enhancements, especially to dry sediment ponds, include floating barriers, surface discharges, and polymer additions.
- These enhancements at wet ponds also increase performance.
- Enhanced wet ponds are capable of achieving very low effluent turbidity values and can meet numeric effluent limits.
- Safety issues with wet ponds must also be considered, especially when located in urban areas.