Settling Ponds

DE-WATERING SEDIMENT CONTROL TECHNIQUE

Low Flow Rates	✓	Low Filtration	✓	Sandy Soils	✓
Medium Flow Rates	✓	Medium Filtration	[1]	Clayey Soils	✓
High Flow Rates		High Filtration		Polluted Soils	[2]

[1] Some settling ponds have limited capture potential of fine sediments such as silt & clay particles.

[2] Can be used to capture pollution spills on a construction site if the outlet structure can be shut-off to prevent discharge.

Symbol

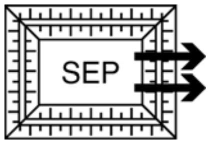

Photo 1 – Settling pond with internal baffles

Photo 2 – Settling pond with rock filter dam outlet system

Key Principles

1. The key design parameters are the hydraulic travel time through the pond, and the hydraulic capacity of the outlet structure.
2. The mechanics and performance of a settling pond are similar to that of a standard 'dry' sediment basin.
3. Unlike a *Stilling Pond* the sediment trapping efficiency of a settling pond is dependent on flow entry conditions and the dissipation of inflow jetting, which if not adequately controlled, can resuspend settled sediment.

Design Information

Hydraulic capacity of the settling pond can be governed by various factors including:

- maximum flow rate of the inflow pipe;
- the head–discharge relationship of the low-flow outlet system;
- the weir flow rate of the spill-through weirs incorporated into internal baffles (if any exist);
- the allowable flow velocity through the settling pond.

Design procedures are similar to those adopted for 'dry' (Type C) *Sediment Basins*; however, the design discharge is based on the required hydraulic capacity of the pond, rather than a particular storm event.

Table 1 provides the ideal pond surface area per unit discharge, and the allowable flow velocity. The calculated pond surface area applies to the pond water level just prior to discharge over the overflow spillway.

Table 1 – Recommended minimum surface area of settling pond per unit discharge, plus allowable through-flow velocity (m/s)

Design standard	Critical sediment size (mm)	Surface area of settling pond per unit discharge ($m^2/m^3/s$) [1]			Maximum allowable pond velocity (m/s) [3]
		10° C [2]	15° C [2]	20° C [2]	
Type 3 sediment trap	0.50	7.2	6.3	5.5	0.3
	0.20	45	40	35	0.3
	0.15	80	70	62	0.3
Type 2 sediment trap	0.10	180	160	140	0.2
	0.05	720	630	550	0.2
Type 1 sediment trap	0.04	1125	980	865	0.2
	0.02	4500	3920	3560	0.2

[1] Includes a 20% increase in the theoretical surface area to account for inflow turbulence.

[2] Temperature of water within the settling pond.

[3] Maximum allowable flow velocity through the settling pond is based on the average flow velocity at which point sediment re-suspension is likely to occur.

Minimum desirable depth of settling pond is 0.6m.

Pumped inflow must be appropriately baffled to dissipate inflow energy (jetting) and avoid the re-suspension of settled sediment.

The length to width ratio (L:W) is generally not important if inflow can be distributed across the width of the settling pond, and flow velocities through the settling pond are low enough to prevent the re-suspension of settled sediments.

An estimate of the maximum allowable flow velocity to prevent sediment re-suspension is provided in Table 1. This velocity will vary depending on various site factors including water temperature and the speed and direction of local winds.

If flow entry conditions cannot be adequately controlled, then an *area correction factor* (A_e) should be applied to the settling pond surface area determined from Table 1. Table 2 provides recommended values of the area correction factor.

Table 2 – Area correction factor (A_e)

Inflow conditions	Effective [1] length:width	A_e
Concentrated inflow not distributed across the full width of the settling pond.	1:1	1.2
	2:1	1.1
	3:1	1.0

Maximum allowable depth of settled sediment (prior to clean-out) is 0.1m, or 10% of the water depth, whichever is the greater.

Recommended maximum bank slopes for formed embankments are provided in Table 3.

Table 3 – Recommended maximum bank gradients

Site conditions	Gradient (H:V)
Internal banks for unfenced ponds within public-accessible urban areas	5:1
Internal banks for fenced ponds and ponds located within rural areas	2:1
External banks greater than 1m high	2:1
External banks <u>not</u> greater than 1m high	1.5:1

Guidelines for the design of an energy dissipater located at the base of the overflow spillway (if required) can be found in the separate fact sheets for either *'Chutes – General'*, or *'Energy Dissipaters'*.

Table 4 – Maximum allowable flow rate (m^3/s) through the settling pond prior to sediment re-suspension for a water temperature of 10° Celsius

Particle size (mm)	Max vel. (m/s)	Theoretical settling velocity (m/hr) [1]	Ratio of pond length to pond width (L/W)						
			1	2	3	4	6	8	10
0.5	0.3	600							
0.2	0.3	96	0.98				[2]		
0.15	0.3	54	2.1	0.81					
0.1	0.2	24	2.3	0.99	0.54	0.29			
0.05	0.2	6.0	10	4.9	3.2	2.3	1.4	0.99	0.72
0.04	0.2	3.8	16	7.8	5.1	3.8	2.4	1.7	1.3
0.03	0.2	2.2	28	14	9.3	6.9	4.5	3.3	2.6
0.02	0.2	0.96	64	32	21	16	11	7.8	6.2

[1] Actual settling velocity can be significantly slower due to wind and residual inflow turbulence.

[2] Blacked out segments indicate that the pond surface area must be increased above the minimum requirements to avoid sediment re-suspension.

Table 5 – Maximum allowable flow rate (m^3/s) through the settling pond prior to sediment re-suspension for a water temperature of 15° Celsius

Particle size (mm)	Max vel. (m/s)	Theoretical settling velocity (m/hr) [1]	Ratio of pond length to pond width (L/W)						
			1	2	3	4	6	8	10
0.5	0.3	688							
0.2	0.3	110	0.78				[2]		
0.15	0.3	62	1.8	0.62					
0.1	0.2	28	2.0	0.82	0.42				
0.05	0.2	6.9	8.7	4.2	2.7	2.0	1.2	0.82	0.58
0.04	0.2	4.4	14	6.8	4.4	3.2	2.1	1.5	1.1
0.03	0.2	2.5	25	12	8.1	6.0	3.9	2.8	2.2
0.02	0.2	1.10	56	28	19	14	9.1	6.8	5.4

[1] Actual settling velocity can be significantly slower due to wind and residual inflow turbulence.

[2] Blacked out segments indicate that the pond surface area must be increased above the minimum requirements to avoid sediment re-suspension.

Table 6 – Maximum allowable flow rate (m^3/s) through the settling pond prior to sediment re-suspension for a water temperature of 20° Celsius

Particle size (mm)	Max vel. (m/s)	Theoretical settling velocity (m/hr) [1]	Ratio of pond length to pond width (L/W)						
			1	2	3	4	6	8	10
0.5	0.3	782							
0.2	0.3	125	0.61				[2]		
0.15	0.3	70	1.5	0.46					
0.1	0.2	31	1.7	0.68	0.31				
0.05	0.2	7.8	7.7	3.7	2.4	1.7	1.0	0.68	0.46
0.04	0.2	5.0	12	5.9	3.9	2.8	1.8	1.2	0.93
0.03	0.2	2.8	22	11	7.1	5.2	3.4	2.5	1.9
0.02	0.2	1.25	49	25	16	12	8.0	5.9	4.7

Notes [1] and [2] as above.

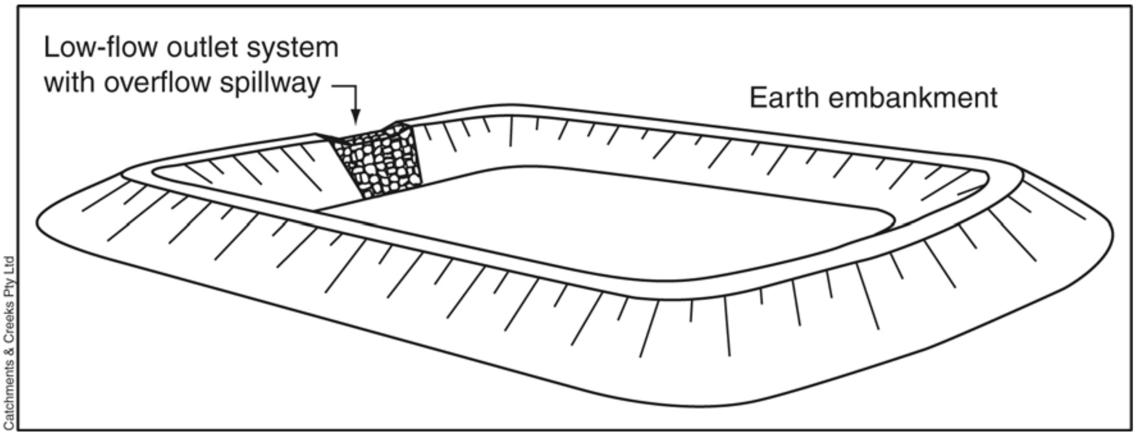

Figure 1 – Settling pond with *Rock Filter Dam* outlet structure

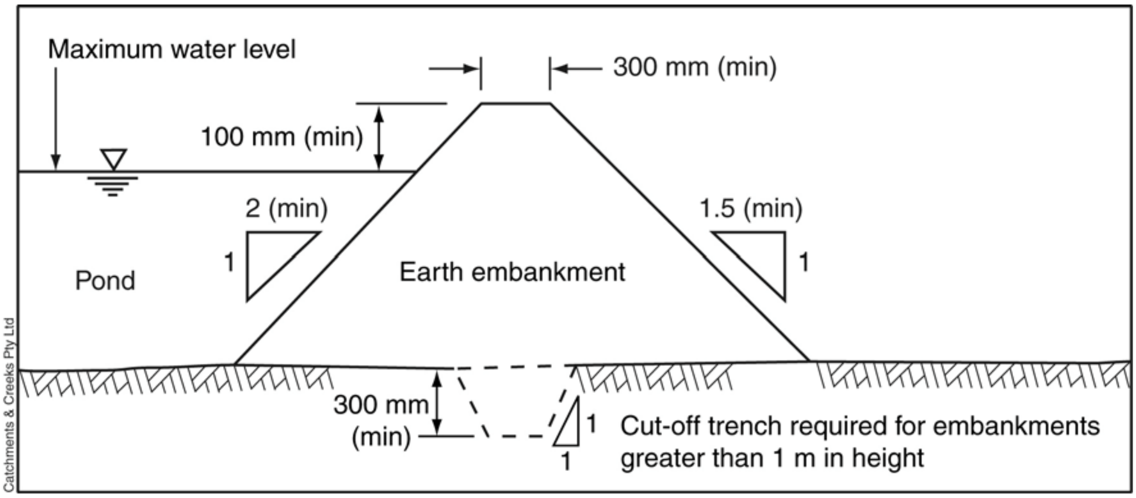

Figure 2 – Typical profile of earth embankments over 1m in height

The low-flow outlet structure may consist of any suitable filtration system such as a *Rock Filter Dam* (with combined aggregate and geotextile filter), or *Filter Tube Dam*. The outlet structure must be design to satisfy the required stage-discharge relationship to achieve appropriate settlement within the settling pond (i.e. maximum pond depth at the maximum inflow rate).

Flow rate through a *Rock Filter Dam* outlet structure is regulated by appropriately sizing the dam (i.e. depth and width), selection of aggregate size, and determination of thickness of aggregate layer. Refer to the separate fact sheet for guidelines on the design of *Rock Filter Dams*.

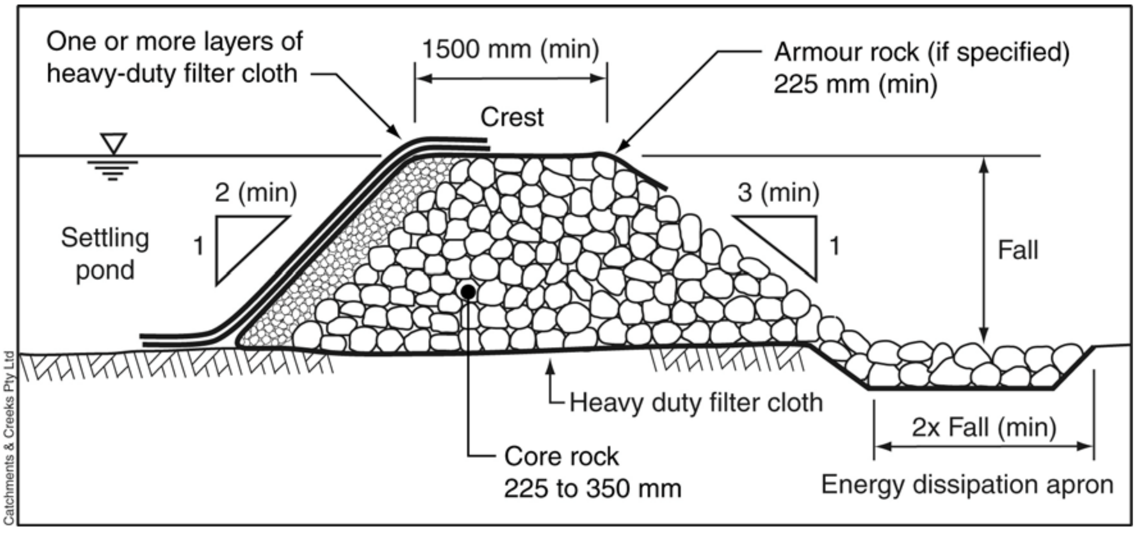

Figure 3 – Typical profile of Rock Filter Dam outlet structure with geotextile filter

Design procedure for continuous flow settling pond:

Step 1 Determine the maximum inflow rate (Q).

Step 2 Determine the critical sediment particle size based on the required treatment standard.

If a treatment standard has not been set, then consider adopting a critical particle size of 0.02mm. Otherwise, determine the maximum settling pond surface area based on space limitations.

Step 3 Determine the required settling pond surface area per unit discharge from Table 1.

Determine the total settling pond surface area (just prior to discharge to overflow).

Surface area (A_s) = Q x surface area per unit discharge

Step 4 Determine the maximum allowable flow velocity through the pond from Table 1.

Estimate the likely water temperature within the settling pond during its operation.

Given the water temperature, the critical particle size, and the maximum inflow rate (Q), determine the preferred length-to-width ratio (L:W) of the pond from Tables 4 to 6.

If the tables identify an outcome within the shaded zone, then a larger pond size may be needed to avoid the re-suspension of settled sediment during peak discharge.

Step 5 Nominate the maximum water depth prior to overflow.

Unless otherwise specified, or required to achieve the desirable outcomes, select a maximum water depth no less than 0.6m.

Step 6 Nominate the internal and external bank slopes based on the recommendations of a geotechnical report or Table 3.

Step 7 Nominate the low-flow outlet system.

If a *Rock Filter Dam* outlet system is chosen, then refer to the relevant fact sheet for design guidelines.

If a *Filter Tube Dam* outlet system is chosen, then using either Equation 1 or Table 7, determine the required orifice plate diameter to achieve the required head–discharge relationship. The head-discharge relationship is based on the maximum hydraulic head (H, see Figure 4) adjacent the orifice plate, relative to the required discharge per filter tube.

Step 8 Determine if an inlet baffle will be required to achieve uniform flow conditions across the full width of the settling pond. This will depend on the type and velocity of the pumped inflow. Refer to Section (b) of this fact sheet for design guidelines.

If flow entry conditions cannot be adequately controlled, then an *area correction factor* (Table 2) should be applied to the calculated settling pond surface area.

Step 9 Determine if additional internal baffles will be required. In most cases, internal baffles will not be required—in fact, if not appropriately designed, internal baffles can adversely affect the performance of the settling pond.

Refer to Section (c) of this fact sheet for design guidelines for internal baffles.

Step 10 Nominate the type of overflow spillway system. Typically the overflow system consists of either an overflow pipe or a rock spillway. Refer to Section (e) of this fact sheet for design guidelines.

Guidelines on the design of an energy dissipater located at the base of the overflow spillway (if required) can be found in the separate fact sheets for either *'Chutes – General'*, or *'Energy Dissipaters'*.

Step 11 Determine the maximum pond overflow water level (based on overflow spillway design), and the minimum embankment height (based on a minimum freeboard of 100mm).

Design procedure for plug flow (batch system) settling pond:

Step 1 Determine the maximum inflow volume (**V**).

The batch volume represents the maximum volume of treated water during a single treatment (batch) cycle. This volume may need to be determined using a water balance model that analysis both inflow and outflow during a worst-case batch cycle.

The minimum desirable batch cycle time is generally 18 hours.

Step 2 Determine the critical sediment particle size based on the required treatment standard.

If a treatment standard has not been set, then consider adopting a critical particle size of 0.02mm. Otherwise, determine the maximum settling pond surface area based on space limitations.

Step 3 Determine if an overflow spillway will be required. An overflow spillway may not be required if the inflow volume will be strictly regulated to prevent overflows.

If an overflow spillway is required, nominate the type of overflow spillway system. Typically the overflow system consists of either an overflow pipe or a rock spillway. Refer to Section (e) of this fact sheet for design guidelines.

Guidelines on the design of an energy dissipater (if required) can be found in the separate fact sheets for either *'Chutes – General'*, or *'Energy Dissipaters'*.

Step 4 Nominate the maximum water depth.

If an overflow spillway is required, then determine the maximum pond overflow water level (based on overflow spillway design), and the minimum embankment height (based on a minimum freeboard of 100mm).

Unless otherwise specified or required to achieve the desirable outcomes, select a maximum water depth no less than 0.6m.

Step 5 Estimate the likely water temperature within the settling pond during its operation.

Determine the theoretical settling velocity of the critical particle size from Tables 4 to 6.

Determine the minimum settling time based on the maximum pond depth (prior to overflow) and the theoretical settling velocity (ensure appropriate units are used).

Step 6 Nominate the low-flow outlet system. The low-flow outlet system must **not** allow the maximum pond volume to drain in less then twice the theoretical settling time.

If a *Rock Filter Dam* outlet system is chosen, then refer to the relevant fact sheet for design guidelines.

If a *Filter Tube Dam* outlet system is chosen, then using either Equation 1 or Table 7, determine the required orifice plate diameter to achieve the required head–discharge relationship. The head-discharge relationship is based on the maximum hydraulic head (H, see Figure 4) adjacent the orifice plate, relative to the required discharge per filter tube.

Step 7 Determine the total batch time, that being the sum of fill time plus the maximum decent time. Compare the batch time with the assumptions made in Step 1.

Step 8 Nominate the internal and external bank slopes based on the recommendations of a geotechnical report or Table 3.

Step 9 Determine if an inlet baffle will be required to achieve uniform flow conditions across the full width of the settling pond. This will depend on the type and velocity of the pumped inflow. Refer to Section (b) of this fact sheet for design guidelines.

Step 10 Determine if additional internal baffles will be required. In most cases, internal baffles will not be required—in fact, if not appropriately designed, internal baffles can adversely affect the performance of the settling pond.

Refer to Section (c) of this fact sheet for design guidelines for internal baffles.

(a) Hydraulic analysis of orifice flow:

Flow rate through a *Filter Tube Dam* outlet structure is regulated by appropriately sizing the orifice plate attached to the inlet of each filter tube. Table 7 provides typical stage–discharge relationships for various circular orifice plates.

Equation 1 provides the flow characteristics for a circular orifice plate discharging into a chamber (or discharge pipe) containing atmospheric pressure (i.e. partial full flow conditions).

Rectangular weir: $Q = C_d A_o \sqrt{(2 g H)}$ (Eqn 1)

where: Q = Design flow rate $[m^3/s]$

A_o = Open flow area of orifice plate = $(0.25 \pi d^2)$ $[m^2]$

d = diameter of the orifice [m]

π = pi = 3.142

g = acceleration due to gravity = 9.8 $[m/s^2]$

H = Hydraulic head = depth of water above centre of the orifice [m]

Table 7 – Hydraulic capacity (L/s) for an orifice plate attached to a partial full (atmospheric) discharge pipe [1]

Water depth H (m)	Orifice diameter 'd' (mm)										
	20	**25**	**30**	**40**	**50**	**60**	**80**	**100**	**150**	**200**	**250**
0.1	0.27	0.43	0.61	1.09	1.70	2.45	4.36	6.82	15	27	43
0.2	0.39	0.60	0.87	1.54	2.41	3.47	6.17	9.64	22	39	60
0.3	0.47	0.74	1.06	1.89	2.95	4.25	7.56	11.8	27	47	74
0.4	0.55	0.85	1.23	2.18	3.41	4.91	8.73	13.6	31	55	85
0.5	0.61	0.95	1.37	2.44	3.81	5.49	9.76	15.2	34	61	95
0.6	0.67	1.04	1.50	2.67	4.17	6.01	10.7	16.7	38	67	104
0.8	0.77	1.21	1.74	3.09	4.82	6.94	12.3	19.3	43	77	121
1.0	0.86	1.35	1.94	3.45	5.39	7.76	13.8	21.6	49	86	135
1.2	0.94	1.48	2.13	3.78	5.90	8.50	15.1	23.6	53	94	148

[1] Tabulated flow rates are based on orifice flow equation (C_d = 0.62) assuming atmospheric pressure within the outlet pipe immediately downstream of the orifice.

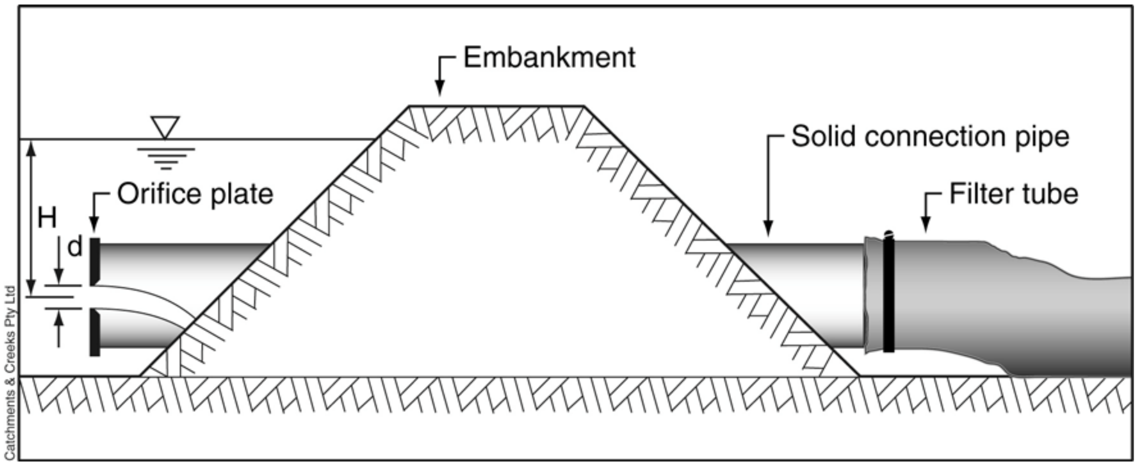

Figure 4 – Discharge control using an orifice plate

(b) Use of inlet baffles:

Pumped inflow must be appropriately baffled to dissipate inflow energy (jetting) and avoid the re-suspension of settled sediment. If flow entry conditions cannot be adequately controlled, then an *area correction factor* (A_e) should be applied to the calculated settling pond surface area. Table 2 provides recommended values of the area correction factor.

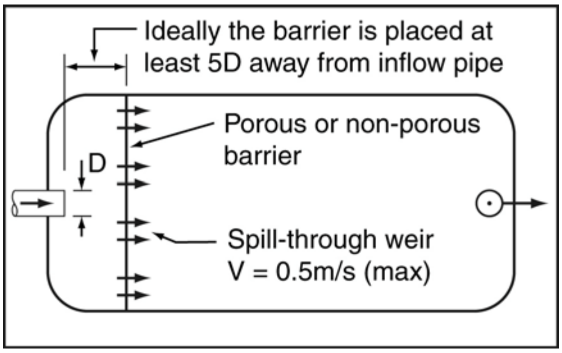

Figure 5a – Inlet baffle with multiple spill-through weirs

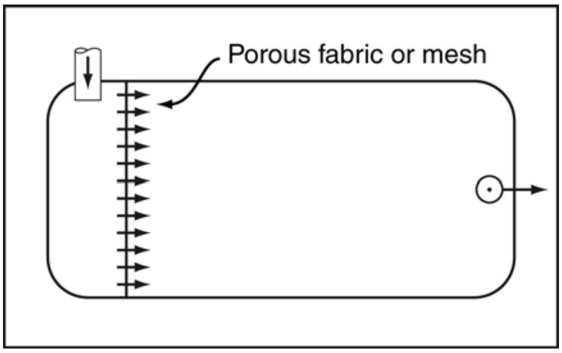

Figure 6a – Inlet baffle

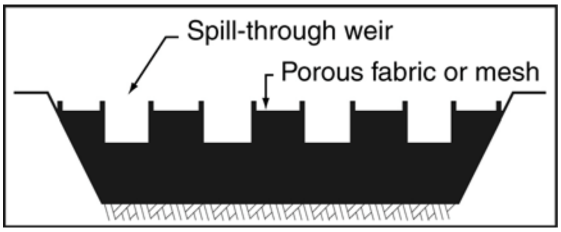

Figure 5b – Inlet baffle (left) with multiple spill-through weirs

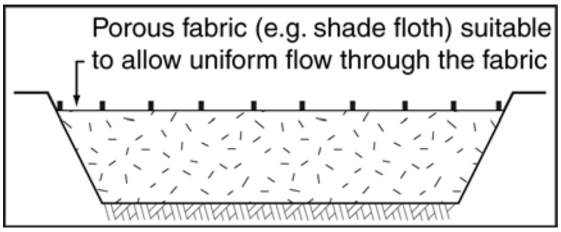

Figure 6b – Porous inlet baffle (above) with no spill-through weirs

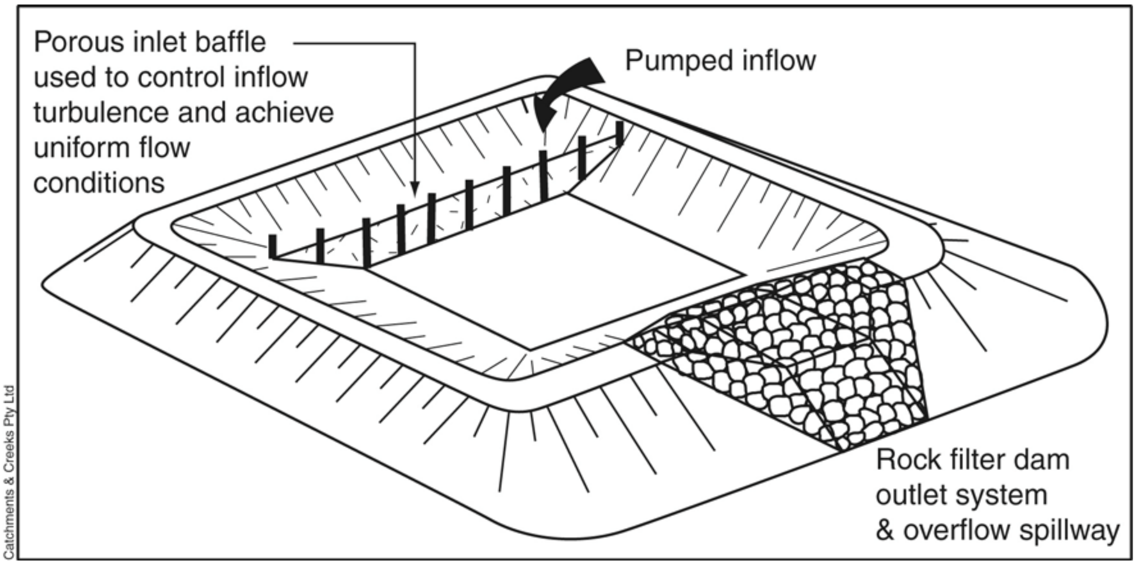

Figure 7 – Settling pond with inlet baffle

The porous fabric may consist of the following materials:

- knitted high-density polyethylene shade cloth with 30 to 50% nominal shade, and 90 to 200 gsm (g/m^2) – composite kitted fabrics with tape filler or mono-filament fabrics may be used;
- kitted or woven privacy fence mesh (shade cloth) 90 to 200gsm;
- leno weave polyproplene safety mesh 60 to 150gsm (**not** polyethylene welded or drawn mesh).

The lighter the unit weight (gsm) the lower the flow resistance.

(c) Use of internal baffles:

Baffles may be placed within the settling pond to increase the hydraulic efficiency and help dissipate inflow turbulence. These baffles can also be used to keep sediment deposits away from the outlet structure, thus reducing maintenance requirements.

A minimum of 2 settling chambers is recommended if inflow jetting cannot be adequately managed to prevent short-circuiting and sediment re-suspension.

The width of any spill-through weir should not exceed 25% of the individual chamber length (in the direction of flow).

The length of an individual settling chamber should ideally not be less than 4 times its width (perpendicular to the direction of flow).

The surface area of the 'largest' settling chamber divided by the design discharge (Q) should not be less than the required surface area per unit discharge determined from Table 1.

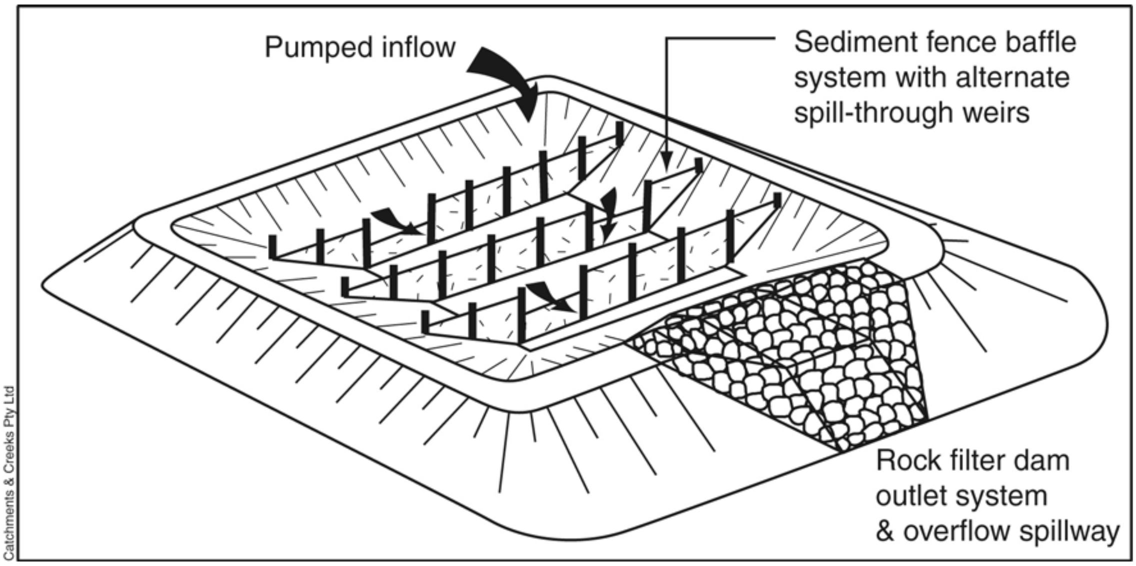

Figure 8 – Settling pond with internal baffles

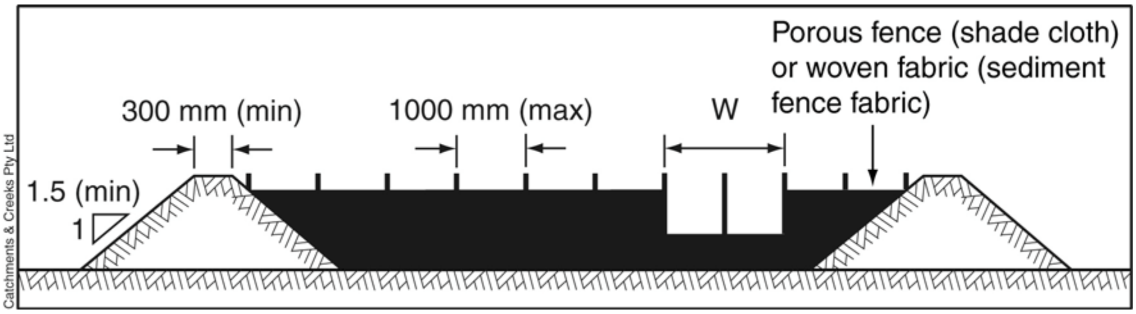

Figure 9 – Typical arrangement of a low porosity internal baffle

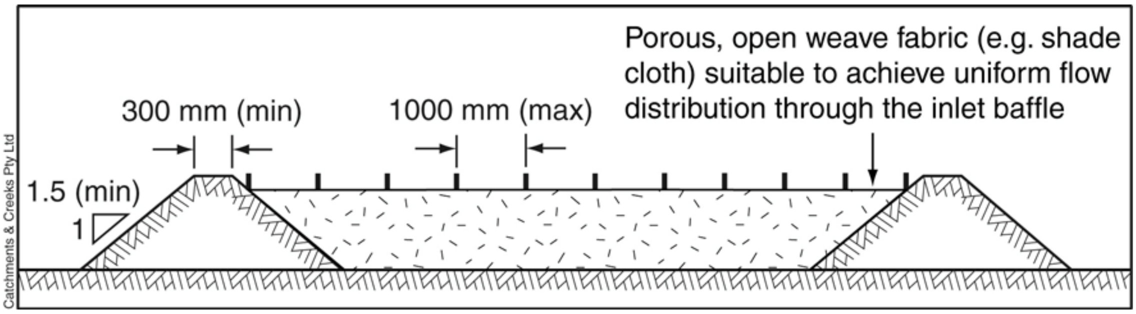

Figure 10 – Typical arrangement of a high porous internal baffle

(d) Weir flow equation for a rectangular spill-through weir:

Equation 2 provides the typical weir flow characteristics for a rectangular spill-through weir.

Rectangular weir: $Q = 1.7\,W\,H^{3/2}$ (Eqn 2)

where: Q = Design flow rate [m^3/s]
W = Weir width (Figure 9) [m]
H = Hydraulic head = height of upstream water level above weir crest [m]

Table 8 – Flow rates passing over a spill-through weir (L/s)

Hydraulic head, H (m)	Spill-through weir width, W (m)									
	0.3	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
0.10	16	27	54	81	108	135	160	185	215	240
0.15	30	49	99	145	195	245	295	345	395	445
0.20	46	76	150	225	305	380	455	530	610	685
0.25	64	105	210	320	425	530	635	745	850	955
0.30	84	140	280	420	560	700	835	980	1115	1255
0.35	105	175	350	525	705	880	1055	1230	1410	1585
0.40	130	215	430	645	860	1075	1290	1505	1720	1935

Tables 9 and 10 provide the minimum required width of individual settling chambers based on a maximum through-flow velocity of 0.2 and 0.3m/s (refer to Table 1), and a spill-through weir crest set 300mm above bed level.

Table 9 – Minimum width of individual settling chambers (m) for a through-flow velocity, V = 0.2m/s (minimum width limited to 0.3m)

Hydraulic head, H (m)	Spill-through weir width, W (m)									
	0.3	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
0.10	0.3	0.4	0.7	1.0	1.3	1.7	2.0	2.4	2.7	3.0
0.15	0.3	0.6	1.1	1.6	2.2	2.7	3.3	3.8	4.4	4.9
0.20	0.5	0.8	1.5	2.3	3.0	3.8	4.6	5.3	6.1	6.8
0.25	0.6	1.0	1.9	2.9	3.9	4.8	5.8	6.8	7.7	8.7
0.30	0.7	1.2	2.3	3.5	4.7	5.8	7.0	8.1	9.3	11
0.35	0.8	1.4	2.7	4.1	5.4	6.8	8.1	9.5	11	12
0.40	0.9	1.5	3.1	4.6	6.1	7.7	9.2	11	13	14

Table 10 – Minimum width of individual settling chambers (m) for a through-flow velocity, V = 0.3m/s (minimum width limited to 0.3m)

Hydraulic head, H (m)	Spill-through weir width, W (m)									
	0.3	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**
0.10	0.3	0.3	0.5	0.7	0.9	1.1	1.3	1.6	1.8	2.0
0.15	0.3	0.4	0.7	1.1	1.5	1.8	2.2	2.6	2.9	3.3
0.20	0.3	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.1	4.6
0.25	0.4	0.7	1.3	1.9	2.6	3.2	3.9	4.5	5.2	5.8
0.30	0.5	0.8	1.6	2.3	3.1	3.9	4.7	5.4	6.2	7.0
0.35	0.6	0.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1
0.40	0.6	1.0	2.0	3.1	4.1	5.1	6.1	7.2	8.2	9.2

(e) Overflow system:

The overflow spillway may consist of either an overflow pipe (Figure 11), or a rock spillway (Figure 12). The spillway overflow should have a minimum capacity equal to the maximum inflow rate.

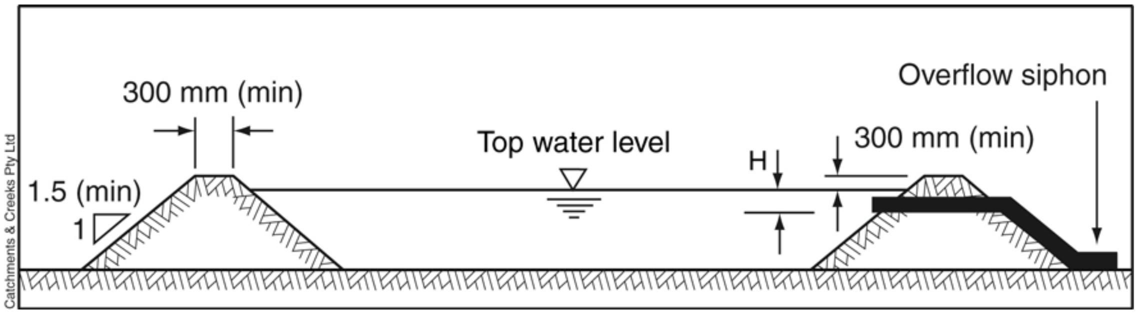

Figure 11 – Siphon overflow system

Siphon outlet pipe can be designed using the design guidelines presented for *Slope Drains*. Table 11 provides inlet flow capacities for pipe diameters of 300 and 375mm.

Table 11 – Hydraulic capacity (L/s) of slope drains with 300 and 375mm diameter pipe [1]

Pipe dia 'D'	Upstream water level 'H' (m) relative to the slope drain invert at its inlet												
	0.20	**0.25**	**0.30**	**0.32**	**0.34**	**0.36**	**0.38**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.70**
300mm	36	49	62	67	72	76	81	85	96	106	115	123	138
375mm	43	63	82	89	96	104	11	118	134	150	166	180	207

[1] Tabulated flow rates assume partial full flow conditions exist within the pipe. If the inlet and outlet are drowned, full-pipe siphon flow conditions may commence within the pipe, in which case the flow rate will be governed by the total fall in water level from inlet to outlet.

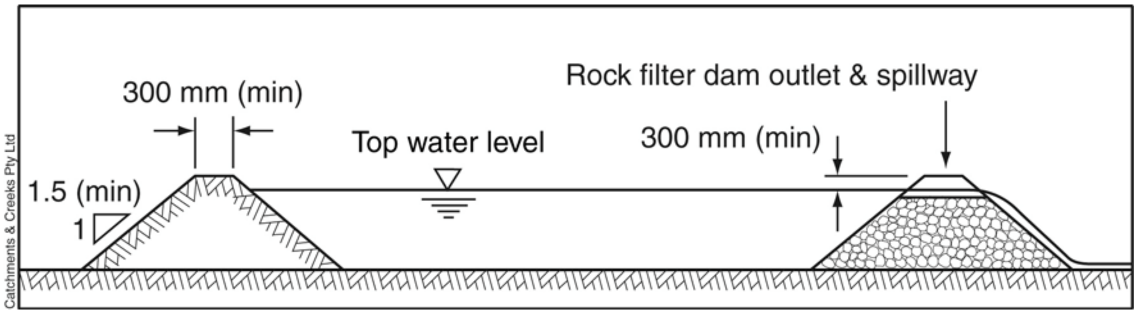

Figure 12 – Rock filter dam low-flow outlet system with overflow spillway

Rectangular or trapezoidal overflow spillways (Figure 13) are designed using an appropriate weir flow equation (Table 12).

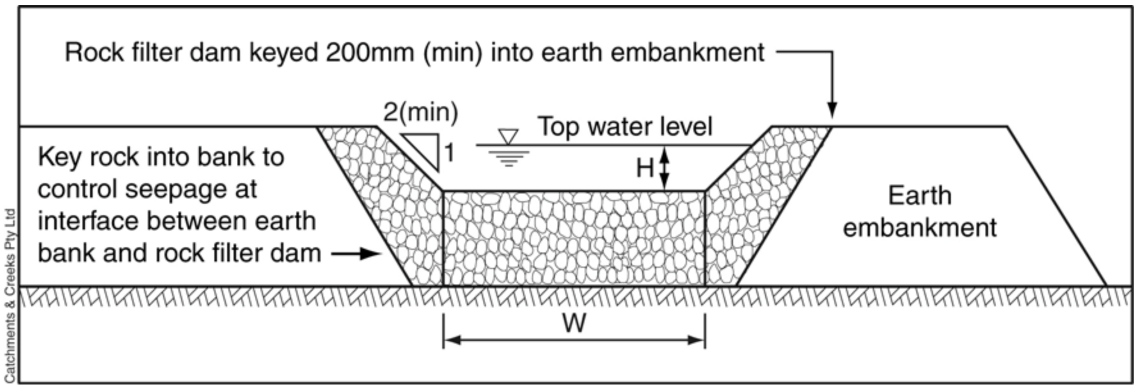

Figure 13 – Typical spillway profile

Table 12 – Weir equations for spillways with a short crest length

Weir cross sectional profile	Side slope (H:V)	Weir equation
Rectangular (b = base width)	vertical sides	$Q = 1.7\ b\ H^{1.5}$
Trapezoidal	1:1	$Q = 1.7\ b\ H^{1.5} + 1.26\ H^{2.5}$
where : b = base width	2:1	$Q = 1.7\ b\ H^{1.5} + 2.5\ H^{2.5}$
and m = side slope	3:1	$Q = 1.7\ b\ H^{1.5} + 3.8\ H^{2.5}$
	4:1	$Q = 1.7\ b\ H^{1.5} + 5.0\ H^{2.5}$
	m:1	$Q = 1.7\ b\ H^{1.5} + 1.26\ m\ H^{2.5}$

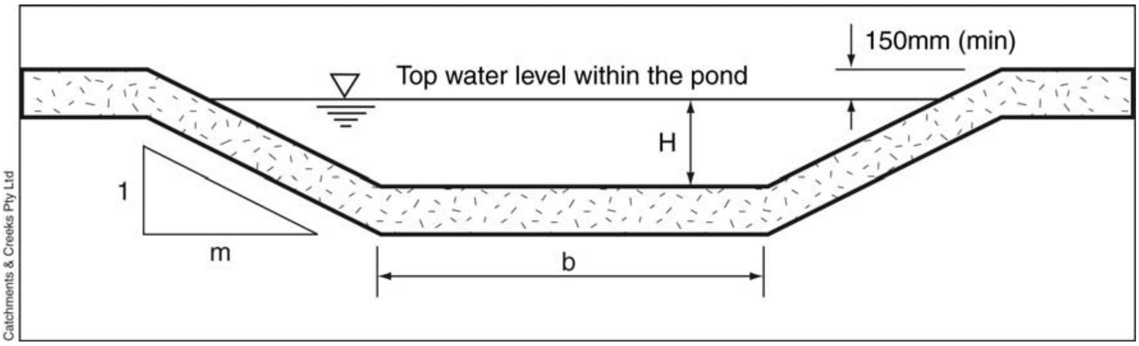

Figure 14 – Inlet profile of a trapezoidal overflow spillway

Table 13 provides the head–discharge relationship for a trapezoidal weir with 2:1 (H:V) side slopes and base width (b).

Table 13 – Inlet weir capacity for trapezoidal chute with 2:1 side slopes [L/s]

Head (H) required upstream of the chute entrance (m)	Crest width (b) of a rectangular chute (m)				
	b = 0.3	**b = 0.5**	**b = 1.0**	**b = 1.5**	**b = 2.0**
0.1	24	35	62	89	115
0.2	91	121	197	273	349
0.3	208	265	405	540	680
0.4	385	470	685	900	1,115
0.5	625	745	1,045	1,345	1,645
0.6	940	1,095	1,490	1,885	2,280

Photo 3 – Settling pond with siphon pipe overflow system

Photo 4 – Settling pond with rock spillway overflow system

Description

A temporary pond typically above ground and formed by an earth embankment; however, it can be set below ground if low-flows are discharged through a traditional sediment basin riser pipe system.

Settling ponds differ from *Stilling Ponds* in that they have a low-flow outlet system that allows continuous discharge. Most settling ponds are free draining structures.

Settling ponds are the de-watering equivalent of a 'dry' sediment basin.

Purpose

Used for the treatment of continuous flow or batch flow de-watering operations.

Commonly used for long-term or high-volume de-watering jobs such as de-watering large excavations at the commencement of a new working day. The pond can usually also be used to receive continuous, low-volume process water from daily operations.

Limitations

Best used when working in good settling soils, otherwise consider the use of a *Stilling Pond*.

Advantages

Above ground installations avoid damage to in-situ soils.

Usually more effective than a *Filter Pond*.

Disadvantages

Typically less efficient than *Stilling Ponds* and larger than a *Filter Pond*.

Can be expensive to construct, if used on short-term jobs.

Special Requirements

Requires suitable flow entry conditions and the dissipation of inflow jetting.

Site Inspection

Check for leakages through the embankment (e.g. piping failures).

Check discharge water quality.

Materials (embankment)

- Earth fill: clean soil with Emerson Class 2(1), 3, 4, or 5, and free of roots, woody vegetation, rocks and other unsuitable material. Soil with Emerson Class 4 and 5 may not be suitable depending on particle size distribution and degree of dispersion. Class 2(1) should only be used upon recommendation from geotechnical specialist. This specification may be replaced by an equivalent standard based on the exchangeable sodium percentage.

Materials (inlet and internal baffles)

- Fabric (woven): polypropylene, polyamide, nylon, polyester, or polyethylene woven or non-woven fabric, at least 700mm in width and a minimum unit weight of 140gsm. The fabrics should contain ultraviolet inhibitors and stabilisers to provide a minimum of 6 months of useable construction life (ultraviolet stability exceeding 70%).
- Fabric (permeable):
  - knitted high-density polyethylene shade cloth with 30 to 50% nominal shade, and 90 to 200gsm (g/m^2) – composite kitted fabrics with tape filler or mono-filament fabrics may be used;
  - kitted or woven privacy fence mesh (shade cloth) 90 to 200gsm;
  - leno weave polyproplene safety mesh 60 to 150gsm (**not** polyethylene welded or drawn mesh).
- Fabric reinforcement: wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.
- Support posts/stakes: 1500mm^2 (min) hardwood, 2500mm^2 (min) softwood, or 1.5kg/m (min) steel star pickets suitable for attaching fabric.

Materials (outlet structure)

- Refer to separate specifications.

Installation

1. Refer to approved plans for location, size, and construction details. If there are questions or problems with the location, size or method of installation, contact the engineer or responsible on-site officer for assistance.
2. Clear the location of the sediment trap. Remove trees, stumps, roots and other surface and sub-surface matter that would interfere with installing and maintaining the trap.
3. If the proposed earth embankment exceeds a height of 1m, then clear, grub and strip topsoil from the embankment footprint. Appropriately scarify (roughen) the earth and/or excavate a cut-off trench along the centreline of the embankment.
4. Ensure the fill material contains sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction.
5. Place fill material in 150 to 250mm continuous layers over the entire length of the fill area and then compact it. Unless otherwise specified on the approved plans, compact the soil at about 1-2% wet of optimum and to 95% modified or 100% standard compaction.
6. Install the low-flow outlet system. If the outlet system involves the construction of a *Rock Filter Dam*, then refer to separate specifications for construction of *Rock Filter Dams*.
7. If required by the plans, install any internal baffles and spill-through weirs, including:

- securing the support posts into the ground spaced no greater than 1.5m;
- ensuring the mesh and fabric are attached to the upstream face of the support posts;
- wherever possible, constructing the baffles from a continuous roll of fabric;
- securely attaching the fabric to the support posts using 25mm staples.

8. Place a suitable marker post, at least a 100mm wide, to indicate the depth at which accumulated sediment must be removed.
9. Install all appropriate measures to minimise safety risks to on-site personnel and the public caused by the presence of the pond. Avoid the use of steep, smooth internal bank slopes.

Maintenance

1. Inspect the pond regularly and at least daily during de-watering operations. Make repairs as needed to the pond, its outlet system and embankments.
2. Check the embankment for leaks, and repair as necessary.
3. Check the embankment for excessive settlement, slumping of the slopes and make all necessary repairs.
4. Clean out accumulated sediment when it reaches the top of the indicator post or 10% of the pond depth.
5. Place sediment in a suitable disposal area, or if appropriate, mix with on-site soil.
6. Do not dispose of sediment in a manner that will create an erosion or pollution hazard.
7. If a *Rock Filter Dam* is used as an outlet structure, then maintain the outlet structure in accordance with the separate specifications provided for *Rock Filter Dams*.

Removal

1. Remove all materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
2. Rehabilitate/revegetate the disturbed ground as necessary to minimise the erosion hazard.