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**UK Documentation**

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| **Reference** | **Type** | **Title** |
| [ENV-TB-0010a](https://home360.balfourbeatty.com/ghoreferencecentre/Group%20BMS/_layouts/DocIdRedir.aspx?ID=2KHUWT73P6SE-1572-8735) | Toolbox Talk | Silt Mitigation Measures |
| [ENV-AD-0010a](https://home360.balfourbeatty.com/ghoreferencecentre/Group%20BMS/_layouts/DocIdRedir.aspx?ID=2KHUWT73P6SE-1572-9521) | Advice Note | Avoiding Silt Pollution |
| [ENV-AD-0010b](https://home360.balfourbeatty.com/ghoreferencecentre/Group%20BMS/_layouts/DocIdRedir.aspx?ID=2KHUWT73P6SE-1572-10161) | Advice Note | Use of Stone in Watercourses |

1. **Introduction**

Balfour Beatty is committed to preventing pollution from its projects and will take a proactive and risk-based approach to silt prevention and control, based on a hierarchy of control methods, as outlined below.

1. **Hierarchy of controls**

The following principles will be adopted to reduce silt pollution issues on site:

**Source Controls (SC)** - preventing the silt from being generated in the first place:

* Keep clean water clean – divert clean surface water away from works areas
* Reduce silt mobilisation – surface haul roads with a stone which produces less sediment; stabilise haul road surface material through use of a binding agent
* Minimise exposed soil – reinstate or protect exposed areas once works are complete; cover or seal stockpiles

**Pathway Controls (PC)** - preventing the silt from reaching sensitive receptors:

* Contain and treat silty water on site – capture run-off in lagoons to allow settlement or treatment with flocculants (where permitted)
* Slow the release of silty water from site – use techniques such as check dams, silt traps etc. to slow flows
* Treat silty water prior to leaving site – use filtration methods or chemical flocculants (where permitted) to remove silt particles

**Receptor Controls (RC)** - protecting the receptor from the impacts of silty water:

* Reuse silty water on site e.g. for dust suppression
* Divert silty water into non-sensitive areas away from watercourses to allow dispersal and diffuse drainage

1. **Techniques**
2. **Clean Water Diversion Ditches/Bunds (SC)**

**Purpose:** To keep clean surface water away from exposed soil and dirty water systems, reducing the volume of water requiring silt removal. Clean water diversion ditches should be installed prior to stripping of any soils.

**Installation & Maintenance:** Upslope or to the sides of works areas. Keeping the clean water within existing vegetated areas is preferential (e.g. by blocking its path using visqueen fencing or sheet piles); if new diversion ditches are created, they need to be lined with visqueen or terram. A series of check dams within the ditch is useful to slow the flows down. Alternatively, a bund can be created from excavated material to act as a barrier.

**Visual example:**



**Advantages:**

* Reduces the volume of water entering works areas
* Reduces the volume of water requiring treatment

**Disadvantages:**

* Area may not be accessible
* Can require additional ground disturbance to create ditches

1. **Surface Binders (SC)**

**Purpose:** To stabilise the surface of site roads or soils and bind the particles together, to reduce the amount of silt generated by heavy plant movements and rainfall.

**Installation & Maintenance:** Binding products can be applied either neat or diluted (depending on the application and advice from the supplier) using a water bowser or spray bar attachment.

**Visual example:**



**Advantages:**

* Binds surface particles, reducing both run-off and dust
* Single application can last several months

**Disadvantages:**

* Variable effectiveness depending on material type
* Potentially expensive
* May require regulator agreement depending on location.

1. **Protection of Exposed Soil (SC)**

**Purpose:** To minimise the amount of silt being mobilised by erosion caused during rainfall events.

**Installation & Maintenance:** Stockpiles should be compacted and graded to reduce rainwater infiltration. If they are in a sensitive area e.g. near a watercourse, they should be covered over e.g. with tarp, visqueen, terram, to prevent erosion.

If stockpiles are to be left in place for longer than 6 months, consideration should be given to seeding them with a grass mix to prevent erosion.

**Visual example:**



**Advantages:**

* Reduces the quantity of silty water to be dealt with
* Preserves the stockpiled soil

**Disadvantages:**

* Large stockpiles require significant amounts of material to cover them

1. **Attenuation Ponds (PC)**

**Purpose:** To intercept and retain silty water before it leaves site, to give it a chance to settle out and to protect sensitive sites and watercourses below the site from silt pollution.

**Installation & Maintenance:** Attenuation ponds should be as large as it is possible to build them. Ponds should not be used in sequence – if more than one pond is available, split the incoming flow between them rather than weir one over into the other.

Ponds should be constructed before any construction work takes place and sized based on the area of exposed land which will drain to it.

Clay and other fine particles will not settle out without additional chemical assistance (see Flocculants) but larger particles will, given time.

The inlet to and outlet from the attenuation pond should be protected to prevent scouring e.g. with stone or straw bales. It may also help to line the pond with a porous material e.g. terram to prevent further silt being picked up from the surrounding soil but allowing the contents to drain away if conditions allow.

Attenuation ponds need to be emptied of settled silts to maintain capacity. Care needs to be taken over where the excavated material is placed, to ensure that it doesn’t cause further run-off.

**Visual Examples:**





**Advantages:**

* Provides a short-term solution to prevent silty water from reaching sensitive receptors during heavy rainfall events
* Provides settlement time when used in conjunction with chemical flocculants

**Disadvantages:**

* Requires regular cleaning of settled silt, which requires suitable plant e.g. long-reach excavator
* Cleaning out will almost certainly rip any lining material

1. **Cross-track Drainage (PC)**

**Purpose:** To take clean water to a water course or silty water to a suitable location for treatment from one side of a track to the other.

**Installation & Maintenance:** Ideally, cross-track drainage needs to be installed at the same time as the access track is put in. This should be identified in the surface water planning for the location.

If cross-track drainage is needed on an existing track, this can be achieved by installing a grip or cut-off drain across the road surface, if it would be difficult to excavate a trench and install a pipe.

The drain should be in a suitable location to capture the water from one side of the track and have suitable mitigation measures or vegetated ground on the opposite side to accept the flow.

Ensure that the discharge point does not cause further erosion – line the surrounding area with rocks or terram if needed.

If the drain is carrying clean water, it must be a sealed pipe to prevent contamination.

**Visual examples:**

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**Advantages:**

* Ensures that silty water is captured and dealt with in a controlled manner
* Ensures clean water is prevented from mixing with dirty water

**Disadvantages:**

* Difficult to install in existing tracks
* Site activities sometimes obstruct the most suitable locations

1. **Check Dams & Sumps (PC)**

**Purpose:** To slow down the flow of water, preventing erosion and trapping small amounts of silt by giving it time to settle out

**Installation & Maintenance:** Check dams can be made from a variety of materials, including:

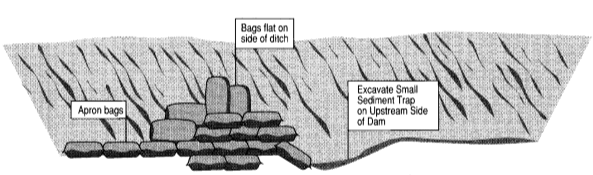
* Silt fences
* Stone
* Straw bales
* Sand bags
* Soil / clay

Install within drainage ditches – secure with stakes and wrap stone or straw bales with terram for additional filtration. The check dam needs to be keyed into the base and sides of the ditch to prevent water from running around or under it.

Numerous check dams should be installed along the length of a ditch, every 10-20m if possible. Excavate a sump area behind each check dam, to provide space for trapped sediment – this can be lined with geotextile to help reduce further silt generation. Consider protecting the area in front of each check dam e.g. with rocks to prevent further erosion from the water overtopping the dam.

The sumps behind the dams will require emptying of silt on a regular basis and after each episode of heavy rainfall.

**Visual examples:**

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**Advantages:**

* Variety of available materials allows for installation in most circumstances
* Relatively inexpensive if made from readily available materials

**Disadvantages**

* Require ongoing maintenance to repair edges and remove trapped sediment

1. **Filter Dams (PC)**

**Purpose:** To slow down the flow of water and provide some filtration within drainage ditches.

**Installation & Maintenance:** Filter drains are gravel-filled trenches lined with geotextile. Clean stone (max. 40mm in size) should be used over a geotextile membrane to line the ditch and prevent further silt being generated.

The geotextile can also be ‘lipped’ at intervals along the length of the stone, to provide an additional barrier and filtration system for the water flowing through the gravel.

**Visual Example:**



**Advantages:**

* Relatively simple to install
* Can be fitted in any size or shape ditch

**Disadvantages:**

* Stone has to be completely removed and replaced once full of silt
* Difficult to monitor effectiveness as water is invisible in the stone

1. **Silt Fences (PC)**

**Purpose:** To capture and slow the flow of silty water, allowing relatively clean water to seep through and filtering out the silt particles.

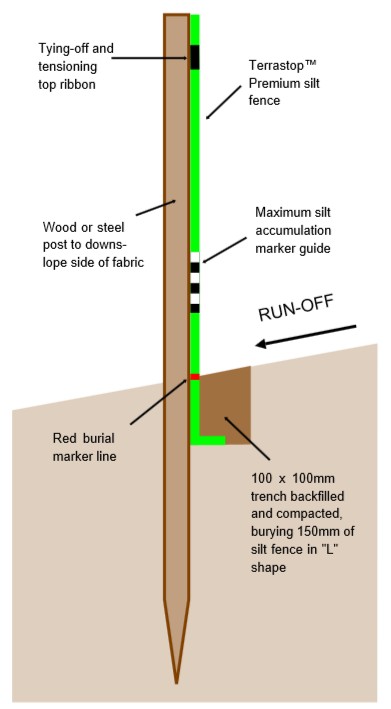
**Installation & Maintenance:** Silt fences can be bought as a specific branded product (e.g. Terrastop Premium from Hy-Tex) or can be made from a geotextile material such as terram.

The fence needs to be supported on stakes and the bottom edge trenched into the soil to prevent water from undermining it. The silt fencing can be installed in a curved formation to intercept the flow of water and provide an area for it to pool behind, or in a straight line alongside a watercourse or drainage ditch as a last line of defence.

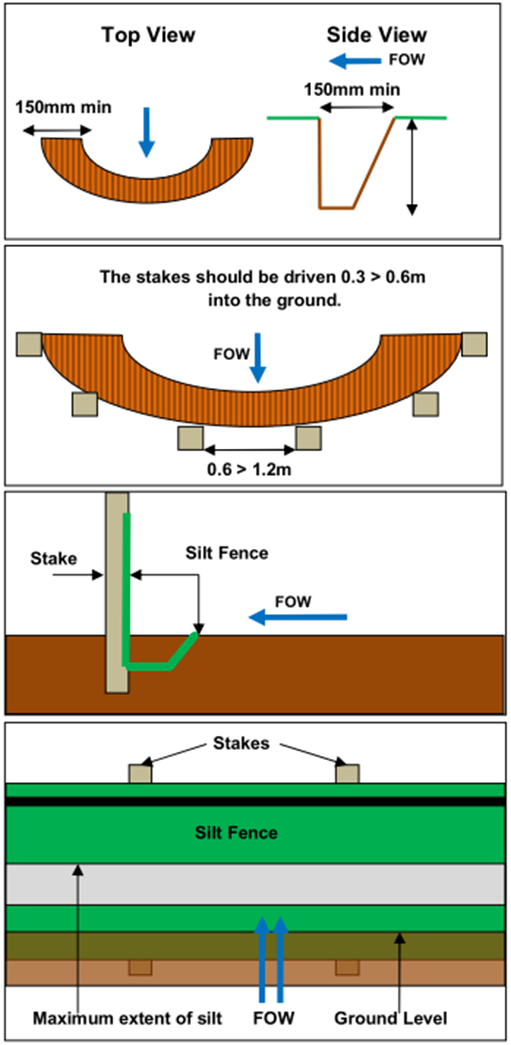
The fabric will gradually become blocked up with particles and require either disturbing to dislodge the fines or replacement with new fabric. High flow rates may also cause the fences to be undermined or bypassed, so regular inspection and maintenance is required.

**Visual examples:**





The guidelines below show how to correctly install a Silt Fence:



1. Determine the position and amount of silt fencing required **before** works begin. Dig out a curved ditch to the specs shown in the diagram. Consider that it will need to be wider than the flow of water **(FOW)**
2. Install the supporting stakes into the ground at regular intervals (depending on the flow rate of the water) on the downstream side of the ditch. Ensure that the stakes are driven in at least 0.3m.
3. Attach the fence fabric to the stakes using the looped tape at the top of the fabric and a staple gun. Ensure that the fabric goes at least 150mm into the trench and line it round. Then backfill the trench with spoil and compact.
4. When the silt fencing has been properly installed the side collecting the sediment should look like the diagram. Additional layers of silt fence will provide greater retention of sediment. Sufficient space should be left between layers. Once the sediment has built up to the top of the white strip it will need to be dug out.

**Advantages:**

* Acts both as a barrier to slow flows and allow settlement and as a filtration system to remove particles

**Disadvantages:**

* Require significant maintenance to repair and remove silt following heavy rainfall events

1. **Silt Bags & Filters (PC)**

**Purpose:** For water to be pumped into during dewatering operations, to provide filtration of silt particles. They can also be used to accept a gravity feed from a settlement lagoon or drainage pipe.

**Installation & Maintenance:** A variety of silt bags, constructed from geotextile fabrics, are available on the market, ranging in capacity, pore size and flow rate. Some are also reusable.

The neck of the bag fits to the discharge hose from the pump. The silty water is then pumped into the bag, which traps the majority of particles inside and allows the filtered water to flow through the geotextile fabric.

Silt bags can be placed directly onto the ground, or to increase efficiency, place on a layer of aggregate or a pallet to allow water to also flow through the base.

The resulting water is unlikely to be completely clean, so it should either be placed on vegetated ground to provide further filtration, or feed into a further series of mitigation measures.

Silt bags will eventually become clogged with silt so require ongoing monitoring – once it is no longer effectively filtering silt or passing water at a reasonable rate, it requires replacing.

**Visual Examples:**

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**Advantages:**

* Passive, non-mechanical treatment solution
* Do not require a large area of ground

**Disadvantages:**

* Can be heavy once full

1. **Sedimats (PC)**

**Purpose:** To capture mobilised silt in flowing water and trap it for later removal

**Installation & Maintenance:** Lay flat in the path of flowing water, secured with stakes or stones if needed. Can be used within watercourses or combined with other silt mitigation techniques e.g. at the end of a series of check dams or the outfall of a settlement lagoon.

**Visual examples:**

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**Advantages:**

* Lightweight and easy to store, handle & transport
* Does not impede water flows

**Disadvantages:**

* Needs to be monitored and replaced once saturated with silt

1. **Flocculants and Coagulants (PC)**

**Purpose:** A chemical solution for very fine silt particles that will not settle out by gravity alone.

**Installation & Maintenance:** Flocculants and coagulants can be used together to force very fine particles to clump together and settle out of silty water. They are available in both liquid and solid form.

‘Floc blocks’ are solid blocks of slow-release flocculant. They need to be placed in a wire mesh holder directly in the flow of the water – this will then gradually dissolve and dose the water. A settlement area needs to be provided after the point of treatment, to give the flocculant a chance to work and the particles to settle out.

Solid flocculants may not be permitted in certain areas e.g. drinking water catchments. In this instance, a mechanical dosing system such as a Siltbuster unit will be needed. This may require a pump, settlement tank, dosing unit, chemicals and generator and the chemical doses adjusted to suit the silt type & content.

Floc blocks will require regular replacing as they dissolve; chemical dosing systems require regular monitoring to ensure that the dosing is effective and that the settlement tank is emptied of settled solids as needed.

**Visual Examples:**





**Advantages:**

* Effective even on the finest particles
* Mechanical dosing systems adapt to the flow rates

**Disadvantages:**

* Mechanical dosing systems are expensive and require time to be set up to suit the site circumstances
* Their use requires approval from the environmental regulator and any other organisations that could be affected e.g. water authority reservoirs, fishery

1. **Interceptor/Dispersion Ditches (RC)**

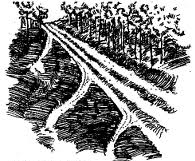
**Purpose:** To disperse a concentrated flow of silty water into less sensitive, vegetated areas in small quantities, to allow it to filter naturally and prevent it from reaching more sensitive receptors e.g. watercourses.

**Installation & Maintenance:** If a suitable vegetated area is present, it may be better to divert silty water into it and allow it to filter through naturally than to overwhelm other silt control measures in place on site.

The area needs to be large enough to accept the additional volumes of water being diverted into it, not be on too steep a slope (as water will simply run across the surface instead of drain away) and not be ecologically sensitive.

Ensure that there are no ditches or channels within the vegetated area for the flow to re-converge in.

**Visual examples:**

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**Advantages:**

* Reduces pressure on other silt mitigation measures
* Natural form of treatment

**Disadvantages:**

* Risk that the water will run off across the surface rather than filter into it so must be frequently monitored

1. **Splash Netting (RC)**

**Purpose:** To prevent mud being splashed into watercourses by passing vehicles and plant.

**Installation & Maintenance:** Splash netting should be installed either side of tracks where they pass over or near to a watercourse. They act as a physical barrier to any splashes of mud from the track, and if dug into the ground, a barrier to any run-off from the track.

Splash netting can be made from a variety of materials, including silt fencing, terram, visqueen etc.

**Visual example:**



**Advantages:**

* Relatively simple to install and maintain

**Disadvantages:**

* Can get into disrepair from excessive mud or being run over by passing vehicles

1. **Silt Curtains (RC)**

**Purpose:** Effectively act as a screen within a watercourse or water body to prevent silt particles from being able to travel outside of the containment area.

**Installation & Maintenance:** Silt curtains are a last line of defence to prevent silt from travelling further downstream once it has made it into a water body. If there is a risk of pollution entering a river, lake, or reservoir, a silt curtain can be installed as an extra precaution.

The silt curtain is attached to both sides of the bank, or to two points along a single bank, and consists of a floating boom along the top and a skirt with a weighted chain to keep it vertical. The curtain can be left in place for the duration of the works once installed.

Silt curtains can be made of impermeable PVC or a permeable geotextile material. The PVC versions will hold silty water within the containment area until it settles or gradually disperses with the water as it finds its way under the curtain. Geotextile curtains allow the water to gradually pass through and capture some of the silt; however, they require replacing once saturated.

**Visual example:**





**Advantages:**

* Can be left in place for the duration of the project once installed

**Disadvantages:**

* Installation has safety implications as the curtains need to be transported to the water body and attached to both banks
* Geotextile curtains require replacement and can be very heavy once saturated