

BMP-27

BMP: TURBIDITY CURTAIN

Definition

A floating geotextile material which minimizes sediment transport from a disturbed area adjacent to or within a body of water.

Purpose

To provide sedimentation protection for a watercourse from up-slope land disturbance or from dredging or filling within the watercourse.

Conditions Where Practice Applies

Applicable to non-tidal and tidal watercourses where intrusion into the watercourse by construction activities and subsequent sediment movement is unavoidable.

Planning Considerations

Soil loss into a watercourse results in long-term suspension of sediment. In time, the suspended sediment may travel large distances and affect wide-spread areas. A turbidity curtain is designed to deflect and contain sediment within a limited area and provide enough residence time so that soil particles will fall out of suspension and not travel to other areas.

Turbidity curtain types must be selected based on the flow conditions within the water body - whether it be a flowing channel, lake, pond, or a tidal watercourse. The specifications contained within this practice pertain to minimal and moderate flow conditions where the velocity of flow may reach 1.5 meters per second (5 feet per second), or a current of approximately 6 kilometers per hour (3 knots). For situations where there are greater flow velocities or currents, a qualified engineer and product manufacturer should be consulted.

Consideration must also be given to the direction of water movement in channel flow situations. Turbidity curtains are not designed to act as water impoundment dams and can not be expected to stop the flow of a significant volume of water. They are designed and installed to trap sediment, not to halt the movement of the water itself. In most situations, turbidity curtains should not be installed across channel flows.

In tidal or moving water conditions, provisions must be made to allow the volume of water contained within the curtain to change. Since the bottom of the curtain is weighted and external anchors are frequently added, the volume of water contained within the curtain will be much greater at high tide versus low tide and measures must be taken to prevent the curtain from submerging. In addition to allowing for slack in the curtain to rise and fall, water must be allowed to flow through the curtain if the curtain is to remain in roughly the same spot and to maintain the same shape. Normally, this is achieved by constructing part of the curtain from a heavy woven filter fabric. The fabric allows the water to pass through the curtain, but retains the sediment pollutants. Consideration should be given to the volume of water that must pass through the fabric and sediment particle size when specifying fabric permeability.

Sediment which has been deflected and settled out by the curtain may be removed if so directed by the on-site inspector or the Plan-Approving Authority. However, consideration must be given to the probable outcome of the procedure - will it create more of a sediment problem resuspension of particles and by accidental dumping of the material by the equipment involved? It is, therefore, recommended that the soil particles trapped by a turbidity curtain only be removed if there has been a significant change in the original contours of the affected area in the watercourse. Regardless of the decision made, soil particles should always be allowed to settle for a minimum of 6-12 hours prior to their removal by equipment or prior to removal of a turbidity curtain.

It is imperative that the intended function of the other controls in this chapter, to sediment out of the watercourse, be the strategy used in every erosion control plan. However, when proximity to the watercourse makes successfully mitigating sediment loss impossible, the use of the turbidity curtain during land disturbance is essential.

Design Criteria

1. Type I configuration (see Figure 27-1) should be used in protected areas where there is no current and the area is sheltered from wind and waves.
2. Type II configuration (see Figure 27-1) should be used in areas where there may be small to moderate current running up to 4 km/hr or 1 m/sec (2 knots or 3.5 feet per second) and/or wind and wave action can effect the curtain.
3. Type III configuration (see Figure 27-2) should be used in areas where considerable current up to 6 km/hr or 1.5 m/sec (3 knots or 5 feet per second) may be present, where tidal action may be present and/or where the curtain is potentially subject to wind and wave action.

FIGURE 27-1: TURBIDITY CURTAIN

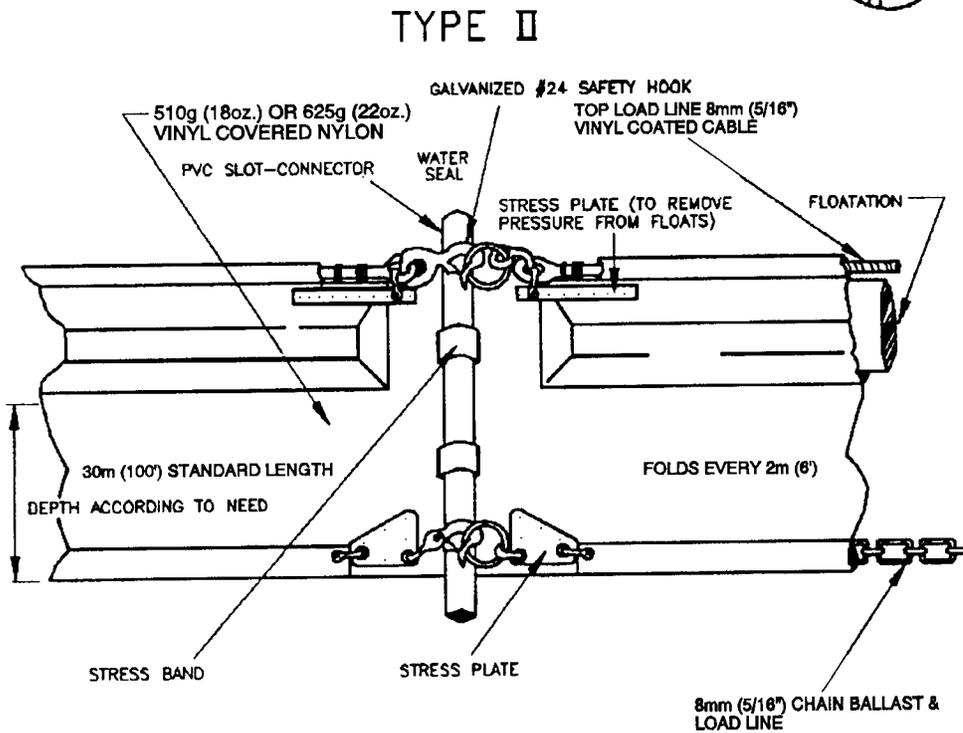
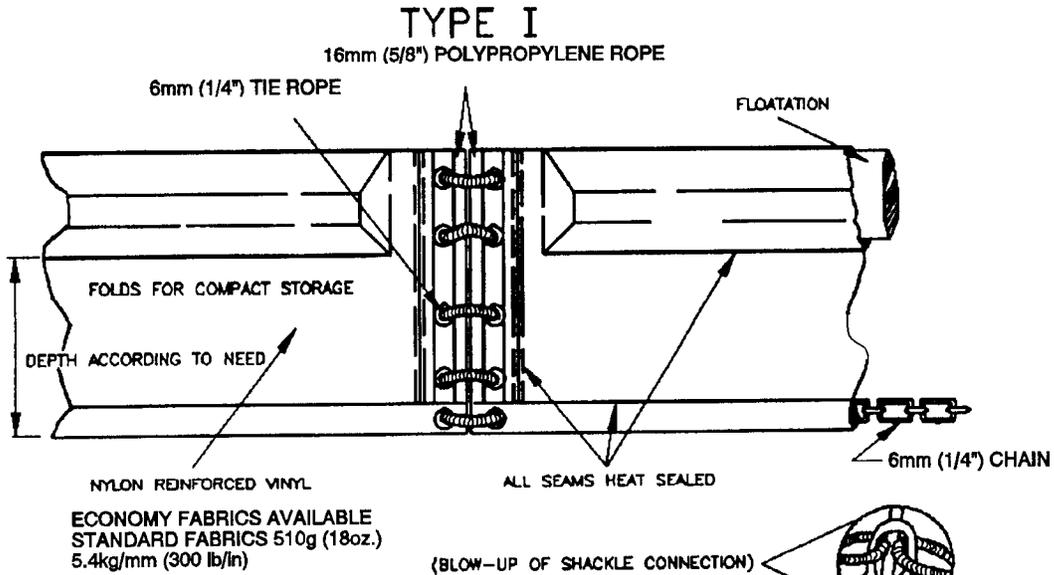
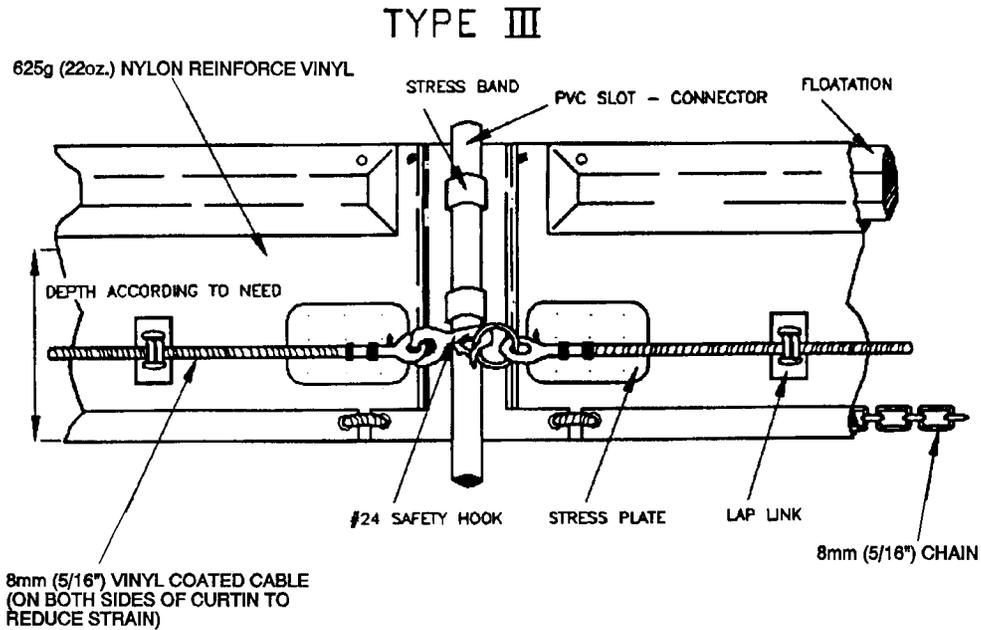
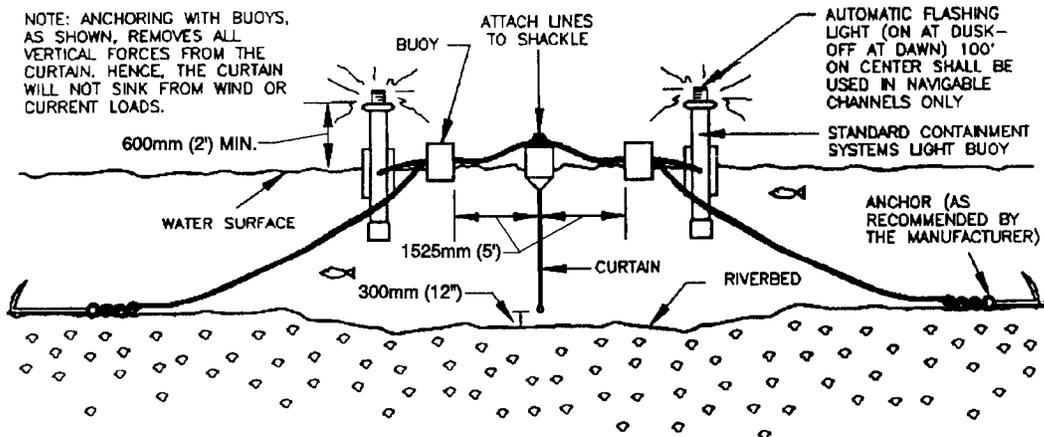


FIGURE 27-2: TURBIDITY CURTAIN



**ORIENTATION WHEN INSTALLED
(TIDAL SITUATION - TYPE III)**



4. Turbidity curtains should extend the entire depth of the watercourse whenever the watercourse in question is not subject to tidal action and/or significant wind and wave forces.
5. In tidal and/or wind and wave action situations, the curtain should never be so long as to touch the bottom. A minimum 300 millimeter (1-foot) "gap" should exist between the weighted lower end of the skirt and the bottom at "mean" low water. Movement of the lower skirt over the bottom due to tidal reverses or wind and wave action on the flotation system may fan and stir sediments already settled out.
6. In tidal and/or wind and wave action situations, it is seldom practical to extend a turbidity curtain depth lower than 3 to 4 meters (10 to 12 feet) below the surface, even in deep water. Curtains which are installed deeper than this will be subject to very large loads with consequent strain on curtain materials and the mooring system. In addition, a curtain installed in such a manner can "billow up" towards the surface under the pressure of the moving water, which will result in an effective depth which is significantly less than the skirt depth.
7. Turbidity curtains should be located parallel to the direction of flow of a moving body of water. Turbidity Curtains should not be placed across the main flow of a significant body of moving water.
8. When sizing the length of the floating curtain, allow an additional 10-20% variance in the straight line measurements. This will allow for measuring errors, make installing easier and reduce stress from potential wave action during high winds.
9. An attempt should be made to avoid an excessive amount of joints in the curtain; a minimum continuous span of 15 meters (50 feet) between joints is a good "rule of thumb."
10. For stability reasons, a maximum span of 30 meters (100 feet) between joints (anchor or stake locations) is also a good rule to follow.
11. The ends of the curtain, both floating upper and weighted lower, should "tend well up into the shoreline, especially if high water conditions are expected. The ends should be secured firmly to the shoreline (preferably to rigid bodies such as trees or piles) to fully enclose the area where sediment may enter the water.
12. When there is a specific need to extend the curtain to the bottom of the watercourse in tidal or moving water conditions, a heavy woven pervious filter fabric may be substituted for the normally recommended impervious

geotextile. This creates a "flow-through" medium which significantly reduces the pressure on the curtain and will help to keep it in the same relative location and shape during the rise and fall of tidal waters.

13. Typical alignments of turbidity curtains can be seen in Figure 27-3. The number and spacing of external anchors may vary depending on current velocities and potential wind and wave action; manufacturer's recommendations should be followed.

Construction Specifications

Materials-

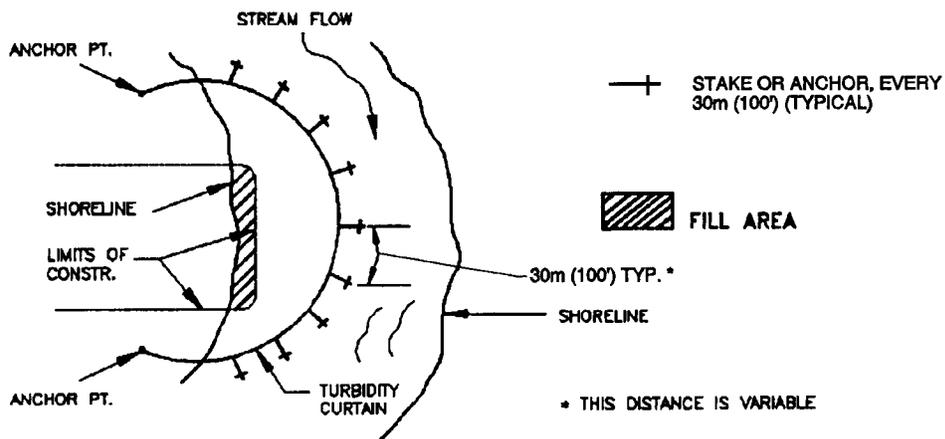
1. Barriers should be a bright color (yellow or "international" orange are recommended) that will attract the attention of nearby boaters.
2. The curtain fabric must meet the minimum requirements noted in Table 27-1.
3. Seams in the fabric shall be either vulcanized welded or sewn, and shall develop the full strength of the fabric.
4. Floatation devices shall be flexible, buoyant units contained in an individual floatation sleeve or collar attached to the curtain. Buoyancy provided by the floatation units shall be sufficient to support the weight of the curtain and maintain a freeboard of at least 3 inches above the water surface level (see Figure 27-2).

**TABLE 27-1
PHYSICAL PROPERTIES OF TURBIDITY CURTAIN FABRIC**

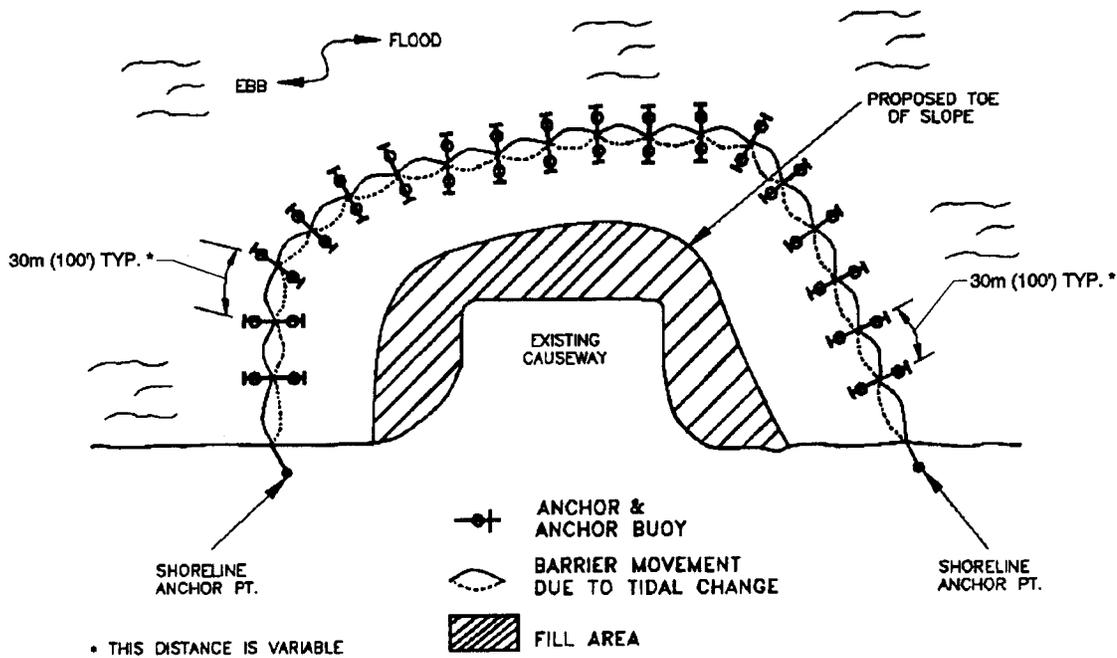
Physical Property	Requirement	
Thickness	45 mills	
Weight	grams per square meter	ounces per square yard
Type I	610	18
Type II	610 or 746	18 or 22
Type III	746	22
Grab Tensile Strength	136 kilograms	300 pounds
UV Inhibitor	Must be included	

FIGURE 27-3: TURBIDITY CURTAIN

**TYPICAL LAYOUTS:
STREAMS, PONDS & LAKES (PROTECTED & NON-TIDAL)**



TIDAL WATERS AND/OR HEAVY WIND & WAVE ACTION



5. Load lines must be fabricated into the bottom of all floating turbidity curtains. Type II and Type III must have load lines also fabricated into the top of the fabric. The top load line shall consist of woven webbing or vinyl-sheathed steel cable and shall have a break strength in excess of 4,500 kilograms (10,000 pounds). The supplemental (bottom) loadline shall consist of a chain incorporated into the bottom hem of the curtain of sufficient weight to serve as ballast to hold the curtain in a vertical position. Additional anchorage shall be provided as necessary. The load lines shall have suitable connecting devices which develop the full breaking strength for connecting to load lines in adjacent sections (see Figures 27-1 and 27-2 which portray this orientation).
6. External anchors may consist of wooden or metal stakes 50 x 100 millimeters (2 x 4 inch) or 60 millimeter (2.5-inch) minimum diameter wood or 2 kilogram per linear meter steel (1.33 pounds/linear foot) when Type I installation is used; when Type II or Type III installations are used, bottom anchors should be used.
7. Bottom anchors must be sufficient to hold the curtain in the same position relative to the bottom of the watercourse without interfering with the action of the curtain. The anchor may dig into the bottom (grappling hook, plow or fluke-type) or may be weighted (mushroom type) and should be attached to a floating anchor buoy via an anchor line. The anchor line would then run from the buoy to the top load line of the curtain. When used with Type III installations, these lines must contain enough slack to allow the buoy and curtain to float freely with tidal changes without pulling the buoy or curtain down and must be checked regularly to make sure they do not become entangled with debris. As previously noted, anchor spacing will vary with current velocity and potential wind and wave action; manufacturer's recommendations should be followed. See orientation of external anchors and anchor buoys for tidal installation in Figure 27-2.

Installation

1. In the calm water of lakes or ponds (Type I installation) it is usually sufficient to merely set the curtain end stakes or anchor points (using anchor buoys if bottom anchors are employed), then tow the curtain in the furled condition out and attach it to these stakes or anchor points. Following this, any additional stakes or buoyed anchors required to maintain the desired location of the curtain may be set and these anchor points made fast to the curtain. the furling lines should be cut to let the curtain skirt drop.
2. In rivers or in other moving water (Type II and Type III installations) it is important to set all the curtain anchor points. Care must be taken to ensure

that anchor points are of sufficient holding power to retain the curtain under the existing current conditions, prior to putting the furled curtain into the water. Again, anchor buoys should be employed on all anchors to prevent the current from submerging the flotation at the anchor points. If the moving water into which the curtain is being installed is tidal and will subject the curtain to currents in both directions as the tide changes, it is important to provide anchors on both sides of the curtain for two reasons:

- a) Curtain movement will be minimized during tidal current reversals.
- b) The curtain will not overrun the anchors and pull them out when the tide reverses.

When the anchors are secure, the furled curtain should be secured to the upstream anchor point and then sequentially attached to each next downstream anchor point until the entire curtain is in position. At this point, and before unfurling, the "lay" of the curtain should be assessed and any necessary adjustments made to the anchors. Finally, when the location is ascertained to be as desired, the furling lines should be cut to allow the skirt to drop.

3. Always attach anchor lines to the flotation device, not to the bottom of the curtain. The anchoring line attached to the flotation device on the downstream side will provide support for the curtain. Attaching the anchors to the bottom of the curtain could cause premature failure of the curtain due to the stresses imparted on the middle section of the curtain.
4. There is an exception to the rule that turbidity curtains should not be installed across channel flows; it occurs when there is a danger of creating a silt build-up in the middle of a watercourse, thereby blocking access or creating a sand bar. Curtains have been used effectively in large areas of moving water by forming a very long sided, sharp "V" to deflect clean water around a work site, confine a large part of the silt-laden water to the work area inside the "V" and direct much of the silt toward the shoreline. Care must be taken, however, not to install the curtain perpendicular to the water current.
5. See Figure 27-3 for typical installation layouts.

Removal

1. Care should be taken to protect the skirt from damage as the turbidity curtain is dragged from the water.
2. The site selected to bring the curtain ashore should be free of sharp rocks, broken cement, debris, etc. so as to minimize damage when hauling the curtain over the area.
3. If the curtain has a deep skirt, it can be further protected by running a small boat along its length with a crew installing furling lines before attempting to remove the curtain from the water.

Maintenance

1. The developer/owner shall be responsible for maintenance of the filter curtain for the duration of the project in order to ensure the continuous protection of the watercourse.
2. Should repairs to the geotextile fabric become necessary, there are normally repair kits available from the manufacturers; manufacturer's instructions must be followed to ensure the adequacy of the repair.
3. When the curtain is no longer required as determined by the inspector, the curtain and related components shall be removed in such a manner as to minimize turbidity. Remaining sediment shall be sufficiently settled before removing the curtain. Sediment may be removed and the original depth (or plan elevation) restored. Any spoils must be taken to upland area and be stabilized.