Winter deployment is similar to warmer weather deployment as long as the water is not frozen. Snow and ice will add to cleanup requirements, as shown in Figure C.1r.

Figure C.1r Winter Boom Deployment

- **Maintenance**

  To prevent boom damage, constant inspection and removal of accumulated debris is necessary. Oil must also be periodically removed from the downstream end of the boom by skimming, pumping, or using vacuum trucks. A containment pit dug into the shoreline can expedite the containment and recovery process. Periodically check the boom for leakage and adjust its placement angle, if necessary. Also check the boom for twisted, damaged, or submerged sections. Check anchors for security.

- **Demobilization**

  Remaining sheens may be recovered with sorbents. Booms should be removed and transported to a decontamination area for cleaning and repairs. Log all boom movements and condition. Refer to the recovery section of this Appendix for shoreline cleanup methods.

- **Variations**

  For wide rivers, deploy two or more booms from each bank with one positioned slightly downstream from the other. Anchor the free ends so that they overlap slightly past the midstream point. If not enough boom is available for multiple deployments, place available boom to collect oil where debris collects naturally.

C.1.3 Fast Water Booming

C1.3.1 Application

Floating oil only. Any situation where currents may exceed 1 and 1/2 knots, such as in intake / discharge structures and streams during high flow. Containment booming in high current situations is, at best, only partially effective and multiple deployments are normally required to achieve acceptable control. Following discussion does not include experimental equipment or techniques.

- **Limitations**

Control of floating oil under high current conditions is difficult at best. Incomplete containment at any individual deployment can be expected, and use of multiple sequential deployments may be necessary for adequate control. Attempts to contain oil by booming under extreme weather conditions (Freezing/Frozen/thawing) are not recommended.

- **General Instructions**

Three general rules apply to fast current booming. First, deployments should be diagonal across the stream, with as low an angle to the current flow as possible, to minimize forces on the boom and probability of oil entrainment under the boom. Second, deployment must work with the current. Attempts to deploy boom against high current will generally be unsuccessful. Third, oil will be directed to a collection point where it must be remove as rapidly as possible. Boom having bottom tensioning cables or chains is preferred.

  - Deployment: Determine and preferably set boom anchor(s) before deploying the boom. Attach the boom to the upstream anchoring point. To facilitate boom deployment, extend the boom upstream from the anchoring point on the shoreline (if possible) or tow the boom directly into the current next to the shoreline, to its maximum extent. Have a line attached to the boom for connection to the downstream anchoring point. Work the boom into the current and to the opposite side as rapidly as possible, allowing for downstream drift. Attach to the downstream anchoring point as quickly as possible. Depending on stream width, it may be necessary to use midstream anchoring points and use this deployment process in steps. You should be able to tow the boom directly into the current and across it diagonally downstream, but not directly across it or diagonally across it upstream.

In general, bottom tension booms should be used for fast water applications. In addition, specially designed fast water booms are available. A typical specialized fast water boom is shown in figure C.1s. This type of boom is less prone to laying over in response to high current, but regardless, all booms are subject to entrainment when currents are excessive, whether they remain vertical or not.

Figure C.1s Specialised Fast Water Boom

Regardless of boom type and deployment, all booms are subject to failure and/or loss of oil as a result of entrainment at flow rates exceeding around 1.5 knots. In these situations, particular care should be given to selection on deployment sites associated with lower flow areas (below rapids or below turns in the channel, for example) and places where debris naturally accumulates. In addition, multiple deployments may be necessary to control minor leakage. Contained oil should be recovered as rapidly as possible. Fast water boom performance can be also be improved through use of a cascading configuration, such as shown in Figure C.1t.

Figure C.1t. Cascading Berms in High Current

Shoreline Termination: Bury end of boom or seal termination point with sorbent.

Sumps: Collected oil should be removed from the boom as quickly as possible. Sumps can be constructed along the shoreline for this purpose. In some areas, sumps and natural depressions already exist and can be utilized for emergency oil holding. A typical existing sump is shown in Figure C.1u. In utilizing features of this nature, or constructing new sumps, it must be kept in mind that these sumps must be cleaned and restored following the incident. Sumps are also subject to flooding should river water levels rise in response to runoff or other factors raising the water level.

Figure C.1u. Use of Existing Shoreline Sump for Temporary Oil Containment.

- **Maintenance**

  Booms are subject to mechanical damage, twisting and fouling, particularly in tidal or high flow situations. Deployments should be checked periodically (at least several times per day) for correct deployment and/or damage and reset or repaired as necessary. When used in the collection mode, collected material must be removed on a regular basis.

- **Demobilization**

  Remove boom and other equipment to decontamination area for cleaning and repair. Remove or treat oiled beach materials and fill in or restore sumps.

- **Variations**
  - **Multiple Booms:** In areas of high current velocity or oil loadings exceeding boom capacity, it may be desirable to install multiple sets of booms such as shown in Figure C.1v. In this case, a combination of boom types is deployed.

Figure C.1v. Multiple Boom Deployment

C.2 Exclusion/Diversion Booming

C.2.1 Objectives

Booms are deployed to keep oil away from sensitive features.

C.2.2 Limitations

To be effective, booms must be deployed before arrival of oil. Accessibility, adequate water depth for effective boom placement, wave action, and current velocities also limit effectiveness of the technique. Exclusion and diversion booming is generally limited to non-frozen conditions. Boom deployed during freezing is likely to be frozen in place and not recoverable until spring thaw.

C.2.3 General Instructions

- **Exclusion Booming**: Place booms across the area to be protected and anchor both ends to the shore for inlets or harbours entrances, booms should be placed inside the openings where currents velocities and wave action are lowest. Currents tend to be higher in these areas, and backup booming may be appropriate. In addition, additional measures taken outside of the exclusion zone (diversion away from the area or diversion to a shoreline recovery point) may be appropriate for protection of particularly sensitive areas. A typical installation protecting an irrigation canal is shown in Figure C.2a.

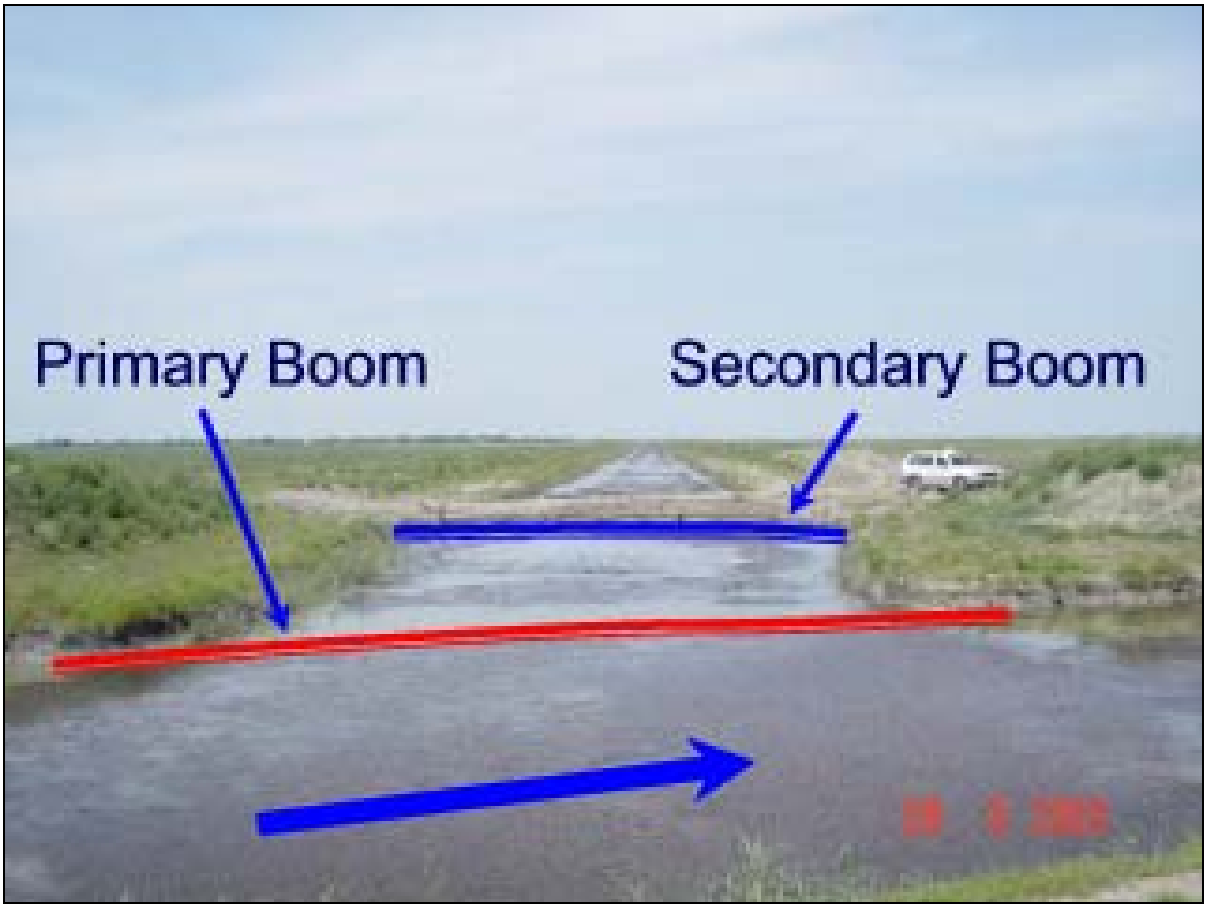

Figure C.2a Exclusion Booming

Booms can also be deployed to restrict oil movement into larger channels, as shown in Figure C.2b.

Figure C.2b. Channel Exclusion Booming (Photo courtesy of Vikoma)

- **Deflection Away from Feature**: Set anchors before deploying boom, working from upstream to downstream. Connect the lead (up current) boom section to its upstream shore or anchor point first. Tow the boom directly into the current to its full length, and the angle toward its downstream anchor point, working with the current, and attach. Repeat with each boom segment until feature to be protected is by-passed. See Figure C.2c. Amount of boom overlap will depend on local conditions (20% overlap suggested for initial application).

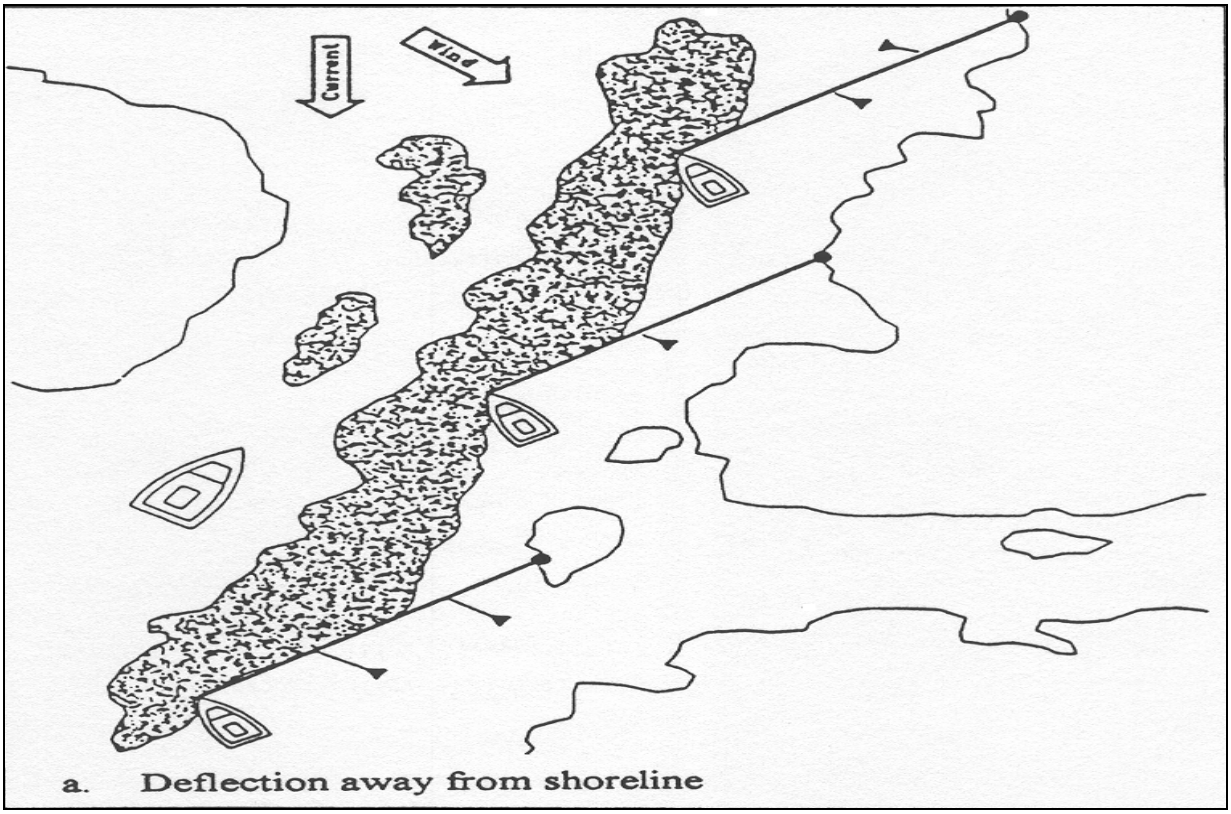

Figure C.2c Deflection Away From Feature

To maintain boom integrity, anchors should be placed at 100 foot intervals if substantial lengths are required. High wind and wave conditions may necessitate use of additional or heavier anchors.

- **Maintenance**

Check boom periodically for position, leakage, and/or twisted, broken or submerged sections. In tidal waters or areas with fluctuating water levels, reposition the boom and/or anchor points as water levels change.

- **Demobilization**

  Remove oiled boom to decontamination station for cleaning and repair. Remove attachment points and any contaminated soil or sediment. Return all excavations to original grade.

- **Variations**

Double or triple booming may be employed in areas with high currents or unusual sensitivity. Exclusion booms may also be constricted out of locally available materials such as logs connected by a cable. Improvised booms of this type are generally applicable only for very quiet locations.

Extensive fish traps exist long the Gulf of Iskenderun shoreline. A typical structure is shown in Figure C.2d. These extensive linear structures can support light boom and/or sorbent boom, and may be suitable for oil spill control. Unfortunately, the irregular bracing on the seaward side of the structures would likely foul any boom or sorbent. To be effective, booming on the seaward side would have to be independently anchored. However, hard or sorbent boom could be attached to the inland side of the structure. In this event, oiled portions of the structures would have to be replaced.

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Figure C.2d. Fish Fence

C.3 Sorbent

C.3.1 Objectives

Commercial sorbent booms can be used to contain and recover oil floating on any water depth. Sorbent booms can also be used to improve the performance of conventional booms by catching oil which is entrained by currents, over splash, or bleed through connectors. Other sorbent materials and configurations are available for special applications and control and cleanup of spills on land.

C.3.2 Limitations

Application of sorbent boom is generally limited to very quiet water conditions. Sorbent type and configuration should be matched to oil type and environmental conditions for optimum performance (see guidelines below). Experience has shown that snare and snare sweeps are generally most effective with viscous oil. Sorbents will typically become waterlogged and may sink and/or loose effectiveness. Maximum recovery requires periodic turning of the sorbent to expose clean areas. Sorbent effectiveness may be diminished or completely lost in the presence of surfactants (dispersants, detergents and other surfactants). Sorbent effectiveness during winter is expected to be significantly diminished.

C.3.3 General Instructions

- **Sorbent Materials**: Sorbents are constructed of a variety of materials including polyurethane, poly ethylene, and a variety of natural organic materials. Some of these materials are biodegradable (for practical purposes, it is seldom possible to recover 100% of the sorbent materials deployed), and some may be recycled. Sorbents utilizing plastic mesh backing should be avoided in that the backing may present an environmental hazard if the spent sorbent is not recovered. In general most sorbents will require handling and disposal as waste.
- **Configurations:** Select appropriate type and sorbent configurations for the desired application. Sorbent materials are available in configurations including:
- **Sorbent Booms** Sorbent materials enclosed in mesh bags. Typically have a rope strengthening member and snap connectors.
- **Pads** Typically 18 x 18 inch pads, useful for general cleanup operations, including land.
- **Rolls** Generally made of the same materials as pads, but supplied in long rolls. Useful for light open water oil collection, land cleanup, and for protection of work areas, decon Stations, etc.
- **Sweeps** Typically consist of sorbent pads connected at intervals to a rope. Generally used between two boats or points to “sweep: an area during final stages of cleanup.

- **Snare** Mop-like fibres. May be single units or attached to handles. Effective in heavy oil.
- **Snare Sweeps** A series of snares connected to a rope. Can be used to "sweep" areas during final cleanup, or deployed along shorelines for protection of prevention of re-contamination in the case of existing oiling.
- **Pillows** Pillow-shaped mesh bags of loose sorbent
- **Granular (loose)** Loose sorbent is simple to apply and efficient, as it offers a larger surface area than other types of sorbent. However, it is difficult to collect after it is broadcast, and not recommended for open water or flowing water application. Primary application is to land where control and recovery are easier. Loose sorbent can be used to immobilize oil and restrict its movement. It therefore has application in wetlands and areas where soil penetration is of concern. Wetland applications should utilize biodegradable types, as complete recovery may not be possible.
- **Snow/Earth** Snow and soil make excellent sorbents, with snow having the extra benefit of cooling the oil and increasing its viscosity or dropping its temperature to below its pour point. If snow is used, provisions must be included for its recovery or secondary containment prior to melting. Soil should only be used if other options are not available. Like conventional sorbent, contaminated soil must be contained and recovered.
- **Local Materials** Straw is the most commonly utilized regionally available sorbent substitute. Planning for the use of local sorbent materials must consider the need for their recovery.

C.3.4 Containment/Recovery (water)

Lengths of sorbent boom (sausage) are commonly connected together to form barriers across waterways or for deployment along shorelines, piers, docks, etc. Deployment procedures are similar to those describe for conventional booms, although the anchoring requirements are less demanding. See Figure C.3a. Sorbent boom connections typically do not provide good seals, and overlapping double booming is recommended. Sorbent booms require continual maintenance, including repositioning and turning to expose clean surfaces, and must be replaced when they are either oil and/or water saturated. For heavy oil, sweeps constructed of snare are typically more effective than sorbent boom, and are recommended for general application for on-water use.

Figure C.3a Sorbent Boom Used to Keep Oil On Shoreline

C.3.5 Containment / Recovery (Land)

Roll sorbent, pads and loose sorbent have been used successfully on land for containment and immobilization of spilled oil. Roll sorbent can be applied to impound oil on very shallow water or overland (sheet) flow of oil as suggested in Figure C.3b. Loose sorbent is useful in the recovery of oil on hard surfaces such as streets when the accumulations are too thin to recover by skimming or suction.

Figure C.3b Roll Sorbent

Containment – Wetlands: Sorbent boom is commonly deployed along wetland fringes and channels to prevent oil from entering interior areas. In addition, loose sorbents may be used for wetland protection. When applied along a wetland fringe, loose sorbents will tend to concentrate, forming a floating barrier just inside the fringe. Application can be by hand as shown in Figure C.3c or by using mechanical particle blowers.

Figure C.3c Application of Loose Sorbent To Wetland Fringe

Loose sorbents can also be applied to open surfaces as shown in Figure C.3d. Loose sorbents tend to immobilize fluid oils, minimizing their adherence and penetration into plants and substrate, and facilitating their natural degradation by keeping them above the surface.

Figure C.3d Application of Loose Sorbent to Wetland Interior Surface

While loose sorbents can be recovered by flushing them into nets or using vacuum devices, complete recovery will not be possible. Consequently, only biodegradable materials should be used.

Sorbent rolls can also be used for shoreline and backshore protection as shown in Figure C.3e.

Figure C.3e Shoreline and Backshore Protection

Other uses have ranged from protection of surfaces at decon stations and equipment deployment areas (rolls are laid out like carpet with seams attached with duct tape , to lining of storage bins and transport vehicles.

- **Maintenance** Most sorbent materials tend to loose effectiveness when the surface exposed to the oil is covered. Turn booms or sorbents regularly for maximum absorbency and replace them when they are completely saturated with oil (or water). Check booms and barriers periodically for proper positioning, exhaustion, water saturation, and/ or damage.

- **Cleanup** Segregate spent sorbent in the field (bag separately from other materials). Oil in sorbent materials can warm and become mobile if warmed in the sun, and can contaminate other areas. Store used sorbents in leak-proof containers and inside a secondary impoundment pending removal for recycling or disposal.
- **Variations** Soil, sawdust and other common materials have excellent sorbent qualities, and are acceptable for land application in emergencies. Oil saturated materials must ultimately be collected and treated, so application of sorbent, commercial or improvised, should consider alternatives and weight the economic advantages and disadvantages.

C.4 Filter Barriers

C.4.1 Objectives

Filter barriers are designed to allow the passage of water while retaining oil. They are intended to be rapidly constructed in remote areas and have application in smaller streams and creeks, and in the control of overland flow of oil and oil/water mixtures.

C.4.2 Limitations

Applications of filter barriers are limited to conditions of relatively low flow.

C.4.3 General Instructions

- **Water Applications:** Filter barriers utilize nets or fencing to impound sorbent materials. The floating oil is trapped by the sorbent, and the water is allowed to pass through or under the structure. Barriers are typically constructed using nets, fencing or other structures stretched across the stream to be controlled. The sorbent material is placed up stream from the net or fencing and allow to collect on its upstream side (material must be coarse enough to be retained on the net or fence). Properly constructed, the sorbent will float up and down, adjusting to water level variations.

Typical installations are shown in Figures C.4a and C.4b, for one direction of flow and tidal flow, respectively. Wooden stakes or metal fence posts are added at intervals for support. If necessary, rope or cable can be used to re-enforce the application.

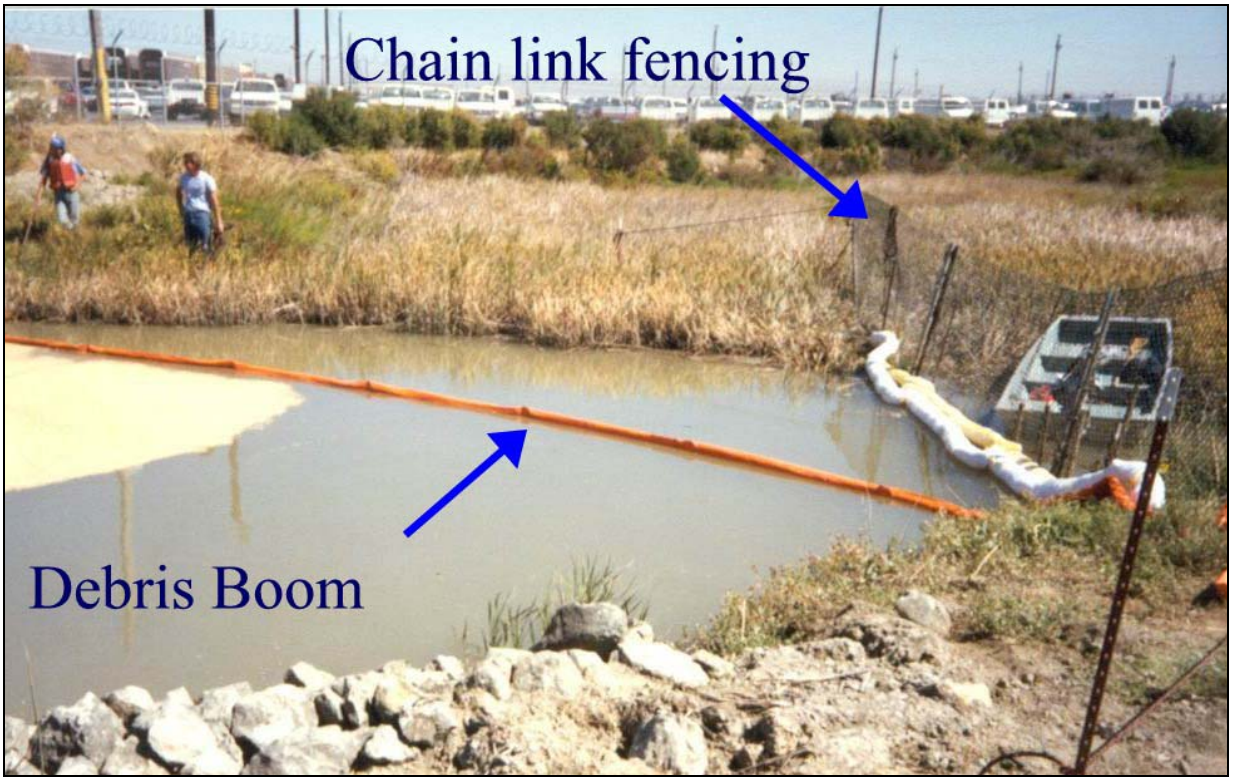

Figure C.4a Filter Fence–One Direction of Flow

Figure C.4b Filter Fence – Tidal Flow