

Submerged Oil Recovery Tactics

USFWS AND STATE PARTNERS SHOULD BE CONSULTED PRIOR TO IMPLEMENTING TACTICS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY | Superfund Division

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Collection by Chain Drag: Manual Version

Overview

The chain drag is an oil recovery tool for use in submerged environments with minimal debris (fallen trees or submerged stumps).

- The chain drag apparatus consists of a 5-foot long, 2-inch diameter round metal spreader bar with $\frac{1}{4}$ -inch grade 8 metal chains attached at approximately 6-inch centers. A second spreader bar of the same size is attached to the chains to minimize tangling
- The chain drag is pulled either by a shore mounted system or by a boat following a grid layout to ensure complete coverage of the area
- Oil liberated from the sediment is collected by booms and pom pom snares
- The chain drag is an option in areas that meet one or more of the following conditions:
 - Open water areas with little to minimal vegetation
 - Areas where oil trapped in sediments is the removal target
 - Hard or soft bottom areas



Benefits

- The unit is relatively mobile and can access hard-to-reach areas
- Can be adapted to change depth of sediment agitation
- Prototype was relatively light and maneuverable

Limitations

- Larger units may become more difficult to handle and maneuver
- Not usable in areas with considerable submerged debris (rocks, fallen trees or submerged stumps)
- Not intended for use during weather that could interfere with floating oil removal such as rainfall
- The chain drag releases residual oil from sediment using agitation, but it may be ineffective at recovering sinking oils and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
two-5-foot long, 2-inch diameter round metal spreader bars	Framing for chain drag.	2	Minimum 2 based on the size of chain drag.
¼-inch grade 8 metal chains	Provides more surface contact with contamination	10-12 pieces, length of chain varies by design.	
Rope	Raise and Lower chain drag	Varies by depth of water	
Gas operated work boat	Pull chain drag	1	1 Boat Operator

Collection by Chain Drag: Large Equipment Version

Overview

The chain drag is an oil recovery tool for submerged environments with minimal debris (fallen trees or submerged stumps). The chain drag apparatus described here is too large for manual deployment. It consists of 5/8-inch grade 8 metal chains attached to two-5-20 foot long, 2-4 inch diameter round metal spreader bars

- It is pulled by boats, marsh buggies, pontoon excavators, and Marsh Masters
- Oil liberated from the sediment is collected by booms and pom pom snares
- A viable option in areas that meet one or more of the following conditions:
 - Open water areas with little to minimal vegetation
 - Areas where oil trapped in sediments is the removal target
 - Hard or soft bottom areas



Benefits

- The unit is relatively mobile with appropriate equipment and can access hard to reach areas
- Can be adapted to change depth of sediment agitation
- Prototype was relatively light and maneuverable

Limitations

- Larger units may become more difficult to handle and maneuver
- Not good in areas with considerable submerged debris (rocks, fallen trees or submerged stumps)
- Not intended for use during weather that could interfere with floating oil removal such as rainfall
- The chain drag releases residual oil from sediment using agitation. It may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Two-5-foot long, 2-4 inch diameter round metal spreader bars	Framing for Chain Drag	2	
5/8-inch grade 8 metal chains	Provides more surface contact with contamination	Varies by design	
Gas operated Marsh buggies or Pontoon excavators or Marsh Master	Pull chain drag		1 Operator

Woody Debris Removal

Overview

Heavy equipment is utilized to remove submerged debris, releasing trapped oil and preparing sediment for submerged oil treatment methods such as chain drag, which cannot be performed in areas with significant quantities of submerged debris.

- Can be done using Marsh Buggy or Pontoon Excavator
- Utilizes thumb attachment on excavator
- Debris is loaded onto barges or cargo boats which then transport the debris for disposal



Benefits

- Reduced Hand Work
- Larger lifts, material more intact
- Can be done in deeper waters than manual extraction could
- Opens area for work to begin

Limitations

- Impact to area
- Ability to access

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Marsh Buggy or Pontoon Excavator	Removal of Debris	1	1 Operator
Barge / Platform	Staging of Debris	Varies	1 Operator 1 Deckhand (min)

Handheld Tiller

Overview

The hand held tiller method is applicable to narrow areas with limited access. It requires that there be little to no debris (fallen trees or submerged stumps) in the target area.

- Use a hand held, gas powered tiller to agitate the top 6 to 8-inches of the sediment
- Garden tiller with two 8-inch blades, approximately 8-inches apart
- Powered by 2-cycle gas motor
- The tiller's engine must remain above the water surface at all times
- The tiller works best in areas with little to no bottom debris
- The tiller is best applied in non-vegetated and lightly vegetated areas. It can be used in both soft sediment and sand bed areas
- Allow the released oil to float to the surface to enable surface recovery at a collection point within the contained area. Sorbent materials will then be used for the collection and removal of recovered oil
- This strategy is an option in areas that meet one or more of the following conditions:
 - Open water areas
 - Areas with little to minimal debris and vegetation
 - Shallow areas
 - Moderate to soft bottom areas



Benefits

- The unit is relatively mobile and can access hard-to-reach areas
- Prototypes were relatively light and maneuverable

Limitations

- Penetration depth of sediment was limited to height of rake tines on tiller
- Larger units may become more difficult to handle and maneuver
- Not intended for use during weather that could interfere with floating oil removal such as rainfall.
- Physically demanding on operator in chest waders
- Limited to use in shallow water environments
- Creates a furrow by displacing sediment
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Garden tiller with two 8-inch blades, approximately 8-inches apart	Used to liberate contamination	1	1
2-cycle gas motor		1	

Raking

Overview

A hand held rake is used to agitate sediment, releasing submerged oil. The rake is best used in non- and lightly vegetated areas in shallow water.

- Use a hand held rake to agitate the sediment to release submerged oil
- The rake is a steel tine garden rake with a three inch depth penetration
- Sorbent materials are used for the collection and removal of recovered oil



Benefits

- A rake is very mobile and can access shallow areas
- Simple tool not requiring an engine

Limitations

- Physically demanding on operator in chest waders (requires bending and repetitive motion)
- Inconsistent application of force
- Time consuming
- Penetration depth of creek sediment is limited to height of rake tines
- Limited to use in shallow water environments
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Garden Rake	Re-suspend oil	1	1

Gabion-Type Baskets

Overview

Baskets are constructed using dog kennels and sweep boom and/or pom pom snares, and are then placed in strategic locations to catch released submerged oil.

- Dog Kennels
- Sweep / Pom Pom snares



Benefits

- Sturdy apparatuses
- Long-term installation possible
- Collection of suspended oil at varying depths in the water column
- Requires little manual intervention once placed in water

Limitations

- Heavy, awkward to place initially and to move once placed
- Replacement of underwater boom difficult, labor-intensive

Equipment and Personnel

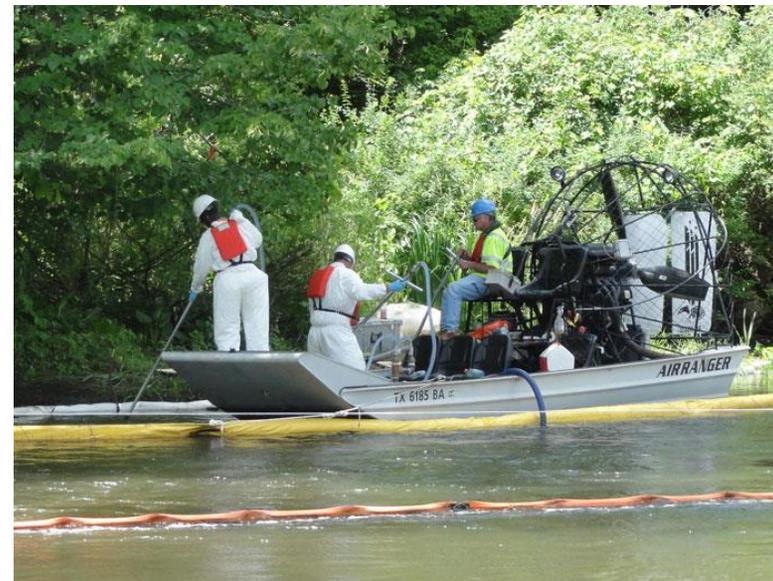
Equipment	Function	Pieces	No. Staff/Shift
Fencing		Varies	
Posts			
Anchors			
Zip Ties / Twine	Used to secure pom poms to fencing		
Rope	Secure Gabion Basket in stream	Varies	

Hand-held Stinger

Overview

A stinger consists of a hand-held discharge wand connected to a boat-mounted pump, which utilizes river water to 'inject' water into sediment, releasing submerged oil.

- The water injecting/flushing device is constructed using an 8-foot-long, 1 ½-inch diameter steel vertical pole with a 45-degree elbow fitting and a short nozzle of 1 ½-inch pipe that has been flattened to create a fan-like water discharge
- Uses high volume/low pressure supplied by a submersible, trash or water pump
- This tool can be modified to include three or four vertical pipes welded together on 6-inch to 8-inch centers with 90-degree (or greater) fittings
- Entire area is flushed using an overlapping sweeping motion to ensure complete coverage of the area
- Sorbent materials are used for the collection and removal of recovered oil



Benefits

- The single nozzle is much more forceful than the rotating stingers (see next section)
- Relatively mobile

Limitations

- Can only cover a very small area at a time
- Multiple passes through an area are required for complete coverage
- Physically demanding for operator to control its movement
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Boat			1
Stinger			Varies
Trash Pump/Submersible Pump			Minimum 1
Hose			Varies

Rotating Stinger

Overview

A rotating stinger consists of a hand-held discharge wand connected to a boat-mounted pump, which utilizes river water to 'inject' water into sediment, releasing submerged oil. Uses river water which is released from a series of holes drilled into the horizontal pipes

- A set of stingers consists of hand held discharge wands equipped with water supply
- The rotating stinger device is constructed using an 8-foot long, 1 ½-inch diameter steel vertical pole with two 6-foot long horizontal steel pipes attached approximately 1-foot from the bottom at 90-degrees to the vertical pole and 180-degrees from each other
- The drilled holes are angled toward the bottom where it will agitate and release submerged oil from the sediment.
- Uses high volume/low pressure supplied by a submersible, trash or water pump (3-5 psi)
- Recommended for large non-vegetated areas with sand or hard river bottoms and shallow or moderate water depths
- Works best in areas with submerged oil limited to the upper couple of inches of sediment. Spreading the flow across 12 feet of pipe through several small holes increases energy losses, which reduces the effective force of the water jets and limits the depth of penetration into the sediment.
- Sorbent materials are used for the collection and removal of recovered oil



Benefits

- The single nozzle is much more forceful than the rotating stingers
- Relatively mobile

Limitations

- Trash pump intake may suck in debris and mulch, clogging discharge holes on horizontal stingers
- The prototype stinger was cumbersome in vegetated areas
- The stinger device as described here could not be rotated due to vegetation, which limited the areas in which it could be used effectively
- Physically demanding for operator
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Boat		1	1 Operator
Stinger		Varies	1 Operator (min)
Hose		Varies	
Trash Pump or Submersible Pump		Varies	

Pumper / Flush Boat

Overview

A pumper boat has mounted steel pipes connected to a pump, which utilizes river water to 'inject' water into sediment, releasing submerged oil.

- 8-foot long (1 ½" diameter) steel pipe with two downward pipes attached to injection pumps
- Raised and lowered with winches
- Uses river water which is released from a series of holes drilled into the horizontal pipes
- Holes are angled toward the bottom
- Sorbent materials are used for the collection and removal of recovered oil



Benefits

- Cover a larger area quickly
- Little use of manual labor
- Relatively mobile
- Dual purpose

Limitations

- Slow
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
1-1/2" Pipe	Raise and lower	Varies by design	1
Trash Pump	Provides water to spray bar	1	
Winch	Raise and lower spray bar	1-2	
Boat	Transport spray bar	1	1 Operator

Marsh Buggy Mounted Spray bar

Overview

A steel tube is mounted to the arm of a marsh buggy and is connected to a pump which utilizes river water to 'inject' water into sediment, releasing submerged oil.

- 10-20 foot long stainless steel tube with deflector bar.
- 2-3 inch pump on support boat feeding water into the bar
- Uses river water pushed through a series of holes drilled into the horizontal bars.
- Sorbent materials are used for the collection and removal of recovered oil



Benefits

- Less reliance on manual labor
- Able to cover large areas in short period of time

Limitations

- Not very mobile
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Marsh Buggy or Pontoon Excavator	Transport and use of spray bar	1	1
Spray Bar		1	
Hose	Feeds water to spray bar	Varies	
Pump		1	

Reinforced Pipe Drag

Overview

The reinforced pipe drag is a 10-foot-long by 5-foot-wide rectangular welded aluminum structure covered with containment cloth. It is connected to a boat-mounted trash pump, which uses river water pushed through a series of holes drilled into the horizontal bars to “inject” water into the sediment, releasing trapped oil.

- Oil absorbent snares (pom-poms) attached on bottom
- Pulled horizontally over the sediment using a land-based capstan motor/pulley anchored to a tree.
- The bottom drag works best in open water areas or areas with minimal vegetation and without submerged debris. It is best used in larger areas with moderate water depths.
- Additional sorbent materials are used for the collection and removal of recovered oil



Benefits

- Covers a moderately sized area with each pass of the device over the sediment

Limitations

- Difficult to maneuver
- Not effective in areas with much vegetation or submerged debris
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Boat	Drag Pipe Drag	1	1
Pipe Drag	Manufactured	1	Multiple

Vessel Mounted Bottom Drag

Vessel Mounted Pipe Drag

Overview

The vessel mounted bottom drag device consists of an 8-foot long (2-inch diameter) steel horizontal tube with wheels attached on both ends, and is connected to a boat-mounted trash pump, which uses river water pushed through a series of holes drilled into the horizontal bars to “inject” water into the sediment, releasing trapped oil.

- The bottom drag discharges water through holes in the steel pipe
- The device is lowered to the sediment surface and then pulled horizontally over the sediment
- The bottom drag works best in open water areas or areas with minimal vegetation and without submerged debris. It is best used in larger areas with moderate water depths
- Sorbent materials are used for the collection and removal of recovered oil



Benefits

- Covered a fairly large area with each pass of the device over/through the sediment
- Relatively mobile, manageable equipment

Limitations

- Multiple passes through an area are required for complete coverage
- Submerged debris (fallen trees, logs or stumps) will interfere with proper operation of the device
- Although the unit described here has wheels, it does not roll over sediment as designed, but cuts into the sediment.
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Water Flushing Pipe Drag

Overview

- 3 horizontal 4-foot-long, 1-inch diameter steel pipes on two 3-foot-long parallel bars with steel skids.
- Injects river water through a series of holes drilled into the horizontal bars.
- Pulled horizontally over the sediment using a land-based capstan motor/pulley anchored to a tree



Benefits

- Relatively mobile, manageable equipment.
- Covers a moderately sized area with each pass of the device over the sediment.

Limitations

- Multiple passes through an area are required for complete coverage
- Submerged debris (fallen trees, logs or stumps) will prevent operation of device as designed
- Requires 4 to 5 operators to submerge and pull the device along river bottom
- The recovery of residual oil using sediment agitation may be ineffective at recovering sinking oils, and may actually serve to facilitate downstream transport and likely dispersion.

Equipment and Supplies

Equipment	Function	Pieces	No. Staff/Shift
Piping			
Trash Pump			
Hose			
Capstan Winch/Pulley			
Rope / Cable			
Boat			

Vacuum Removal

Overview

- The portable vacuum consists of a 15-inch-long by 3-inch-wide head attached to a vacuum hose. Debris collected from the vacuum is sucked through 2-inch-diameter flexible hose and deposited in a 55-gallon drum
- Vegetation should be cleared from area prior to work
- Devices can be transported by boat or ATV
- Effective when the area is previously hand raked and residual loose material can be vacuumed up. May also be used in naturally dry loose material.
- Option in areas that meet one or more of the following conditions:
 - Areas where contaminated soil has been raked and residual material can be vacuum-removed
 - Areas with little vegetation
 - Areas where tar balls and/or patties are the removal target
 - relatively dry areas or areas with granular, loose soils



Benefits

- Effective on loose, dry, granular soils
- Removes loose tar balls and patties from soil
- The unit is relatively mobile and can be deployed to hard-to-reach areas

Limitations

- Not appropriate for removing tar and contaminated soil attached to roots and vegetation
- Effective distance of vacuum is limited
- Wet and/or cohesive soils will clog the vacuum head and hose

Equipment and Supplies

Equipment	Function	Pieces	No. Staff/Shift
Drum Vac or Mobile Vacuum Tank			
Generator (if needed)			
Vac Hoses			
Boat / ATV			
Rake / Shovel			
55-gallon Drums			

Winter Excavation

Overview

Utilizes a variety of tools, equipment and methods to remove oil and oil-contaminated sediment and soil while materials are frozen or near-frozen during the winter months.

- Methods of Removal
 - Complete Solidification
 - Entire area and depth frozen before Removal execution
 - Consecutive Lifts
 - Solidification and Removal of Material in lifts
 - Excavation Delineation
 - Haul Out on Access Road
- Tools/equipment
 - Low Pressure Ground Equipment
 - Wide pads, lighter weight
 - Bombadier
 - Tracked Dump Truck
 - Dozers
 - Small Excavators
 - Pumps
 - Isolation Materials
 - Silt Fence, Portable Dams



- Methods of Solidification
 - Remove insulating material (leaves, etc.)
 - Freeze by exposure
 - Vibration increases Thermal Transfer (Principle of Thermal Dynamics)
 - Liquid to surface
 - Restoration
- Low Ground Pressure Equipment
 - Vegetation sub-structure remains in place
 - Replacement of Native seed bed
 - Erosion control devices will remain in place until vegetation has been re-established

Benefits

- Minimizes impact to the area
- Liquid materials solidify for controlled removal

Allows for continuation of clean up at large sites during winter months

Oil Recovery and Capture: Peat

Overview

Peat and moss naturally repel water due to their chemical structure. When spread on the surface of a water body, they will float on the surface while absorbing oil. Depending upon prevailing conditions (e.g. water turbulence), peat and/or sphagnum moss can float for several days before eventually taking on water and sinking. During this time it will absorb water-borne oil on contact.

- Collection points can be established at each submerged oil location to allow for the collection of sheen and globules released by submerged oil recovery operations.
- Collection will utilize a variety of techniques including peat and/or sphagnum moss.
- Broadcast the peat over the impacted area. Allow 15-20 minutes for sheen to adhere to the peat amendment.
- Utilize air diversion (airboat or leaf blower) to mobilize the commingled peat amendment and sheen to a collection point. The collection point should be downstream or downwind depending on which is stronger at the given location.
- Utilize pool nets to recover the commingled peat amendment and sheen. The impacted debris should be taken for disposal at the end of each operational period



Oil Recovery and Capture: Boom

Overview

Boom is utilized to absorb, contain, or deflect oil and sheen. Numerous configurations can be used, including the following.

- Shoreline protection – keeps oil from impacting areas of shore not already impacted
- Check mark booming
- Diversion booming
- Collection booming



Benefits

- Relatively simple to use
- Effective when deployed correctly

Limitations

- Waste volume
- Absorbent boom must be changed as it becomes oil and water-logged

Oil Recovery and Capture: Sweep Boats

Overview

Boats are outfitted with boom and are used to capture sheen and floating oil globules as it flows downstream.

- Multi-Use boats
- Materials Used
 - Absorbent Boom
 - Sweep Boom
 - Snare Boom
- Configuration
 - Bow Boom
 - Sweep Arms
 - Tag--Along Boom



Benefits

- Covers large areas quickly

Limitations

- Maneuverability of boats
- Need additional containment for sheen that is not captured as it flows downstream

Natural Attenuation

Overview

- Shoreline Protection



Benefits

- Reduced disturbance to natural environment
- Cheaper than any other treatment method
- No dependence on manual labor

Limitations

- Slow process
- Public perception of oil being “left behind”

Aerial Imagery

Overview

LIDAR (remote laser transmitting and sensing system) integrates lasers, GPS, and an Inertial Navigation System into a single system capable of acquiring data to produce accurate digital elevation models.

Fluorescent LIDAR System is a laser emitting technology that is capable of detecting a spectral fluorescent signature associated with residual oil and can theoretically detect oil below the water surface

LIDAR – Light Detection to develop a Digital Elevation Model

- Remote laser transmitting and sensing system linked to a GPS to collect Topographic Data (w/in 6")
- Initial run completed in Aug. 2010 – Used to develop Inundation Model from source to BC
 - New run will verify inundation model and complete it all the way to Morrow Dam

Aerial Photography – High resolution aerial photographs...

FLS – Fluorescent LIDAR System

- Laser emitting technology that detects a spectral fluorescent signature when reflected off contaminants, such as crude oil
- Will not detect below sediment and soil

Polarimetric Imagery – Enhanced High Resolution Aerial Imagery

- Enhanced high definition video with still frame capture that uses sunlight and non-visible light to enhance images.
- Will detect oil on surface and potentially overbank areas.
- Use to confirm FLS detection technology
- Will not detect below sediment and soil



Excavator-Mounted Submersible Pump

Overview

The submersible pump mounted to the stick of the excavator and used to remove submerged oil and oil-contaminated sediments, paired with a shore-based material handling station. The submersible pump must be able to handle up to 70% solids. The pump can be mounted to either a tracked excavator that remains on the banks of the waterbody, or a pontoon excavator that can enter the waterbody.

- Conveyance lines are utilized to pump the dredged material to a dredge pad.
- In-situ submerged oil and oiled sediments are pumped into geotextile tubes for dewatering.
- A dredge pad is utilized to contain water and oil that bleeds from the geotextile tubes.
- Oil and water is collected and treated from a sump on the dredge pad.
- A viable option in areas that meet one or more of the following conditions:
 - Large enough area on land for a dredge pad
 - Areas where submerged oil is the removal target
 - Soft bottom areas



Benefits

- Reduced Hand Work
- Proven effectiveness

Limitations

- Large land area required for dredge pad
- Ability to access

Equipment and Personnel

Equipment	Function	Pieces	No. Staff/Shift
Tracked or Pontoon Excavator w/submersible pump	Submerged oil and oiled sediment removal	1	1 Operator
Geotextile dewatering tubes	Dewatering of sediment	Varies	Varies
Conveyance Pipe	Transport of sediment	Varies	Varies
Dredge Pad	House Geotextile Tubes	1	Varies

Mechanical Dredging

Overview

An excavator is utilized to dig submerged oil and oil-contaminated sediments out of the impacted area.

- Sheet piling is utilized to isolate the targeted area.
- Pumps are utilized to remove the water within the sheet piled area.
- Dewatered sediments are mechanically excavated from the area with an excavator.
- Dredge spoils are loaded and transported to a dredge pad for further dewatering.
- A viable option in areas that meet one or more of the following conditions:
 - Access for haul trucks
 - Soft bottom areas for sheet piling



Benefits

- Proven effectiveness
- Visibility of area to be excavated

Limitations

- Access road for sediment transport
- Dewatering
- Sheet piling cannot be used in hard bottom areas
- May require hand work

Equipment and Personnel			
Equipment	Function	Pieces	No. Staff/Shift
Tracked Excavator	Submerged oil and oiled sediment removal	1	1 Operator
Trash Pump	Dewatering of area	Varies	1 Operator
Off-Road Dump Truck	Transport of sediment	Varies	1 Operator

Amphibex® Dredging

Overview

This method functions very similarly to the excavator-mounted submersible pump. The Amphibex® has an excavator arm that is mounted to the bow of the boat.

- Conveyance lines are utilized to pump the dredged material to a dredge pad.
- In-situ submerged oil and oiled sediments are pumped into geotextile tubes for dewatering.
- A dredge pad is utilized to contain water and oil that bleeds from the geotextile tubes.
- Oil and water is collected and treated from a sump on the dredge pad.
- A viable option in areas that meet one or more of the following conditions:
 - Large enough land area for a dredge pad
 - Soft bottom areas



Benefits

- Reduced Hand Work
- Proven effectiveness

Limitations

- Large land area required for dredge pad
- Ability to access

Equipment and Personnel			
Equipment	Function	Pieces	No. Staff/Shift
Amphibex®	Submerged oil and oiled sediment removal	Varies	Varies
Geotextile dewatering tubes	Dewatering of sediment	Varies	Varies
Conveyance Pipe	Transport of sediment	Varies	Varies
Dredge Pad	House Geotextile Tubes	1	Varies

Hydraulic Dredger

Overview

Submerged oil and oil-contaminated sediments are pumped from a dredger boat.

- In-situ submerged oil and oiled sediments are pumped via conveyance pipe into geotextile tubes for dewatering.
- A dredge pad is utilized to contain water and oil that bleeds from the geotextile tubes.
- Oil and water is collected and treated from a sump on the dredge pad.
- A viable option in areas that meet one or more of the following conditions:
 - Large enough area on land for a dredge pad
 - Areas where submerged oil is the removal target
 - Soft bottom areas



Benefits

- Reduced Hand Work
- Proven effectiveness

Limitations

- Large land area required for dredge pad
- Ability to access

Equipment and Personnel			
Equipment	Function	Pieces	No. Staff/Shift
Dredger	Submerged oil and oiled sediment removal	Varies	Varies
Geotextile dewatering tubes	Dewatering of sediment	Varies	Varies
Conveyance Pipe	Transport of sediment	Varies	Varies
Dredge Pad	House Geotextile Tubes	1	Varies