Environmental Considerations for Marine Oil Spill

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Sand Beaches: Description

• These beaches are flat to moderately sloping and relatively hard-packed.

• There can be heavy accumulations of wrack.

• They are used by birds and turtles.

• Upper beach fauna include ghost crabs and amphipods; lower beach fauna can be moderate, but highly variable.

Predicted Oil Behavior

• Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone.

• Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide.

• Maximum penetration of oil into fine- to medium-grained sand is about 10-15 cm, up to 25 cm in coarse-grained sand. Maximum penetration of oil into

fine to medium-grained sand beaches is about 10-15 cm, and about 25 cm into coarse-grained sand beaches.

• Burial of oiled layers by clean sand can be rapid (within one day), and burial to depths as much as one meter is possible if the oil comes ashore at the

beginning of a depositional period.

• Organisms living in the beach sediment may be killed by smothering or lethal oil concentrations in the interstitial water.

• Biological impacts include temporary declines in infauna, which can affect important shorebird foraging areas.

Response Considerations

• These beaches are among the easiest shoreline types to clean.

• Cleanup should concentrate on removing oil and oily debris from the upper swash zone once most of the oil has come ashore.

• Manual cleanup, rather than road graders and front-end loaders, is advised to minimize volume of sand removed from the shore and requiring disposal.

• All efforts should focus on preventing vehicular and foot traffic from mixing oil deeper into the sediments.

• Mechanical reworking of lightly oiled sediments from the high-tide line to the upper intertidal zone can be effective along exposed beaches.

Mixed Sand and Gravel Beaches: Description

• Because of the mixed sediment sizes on these moderately sloping beaches, there may be zones of pure sand, pebbles, or cobbles.

• There can be large-scale changes in the sediment distribution patterns depending upon season, because of the transport of the sand

fraction offshore during storms.

• Desiccation and sediment mobility on exposed beaches cause low densities of attached animals and plants.

• The presence of attached algae, mussels, and barnacles indicates beaches that are relatively sheltered, with the more stable substrate supporting a richer biota.

Predicted Oil Behavior

• During small spills, oil will be deposited along and above the high-tide swash.

• Large spills will spread across the entire intertidal area.

• Oil penetration into the beach sediments may be up to 50 cm; however, the sand fraction can be quite mobile, and oil behavior is much like on a sand

beach if the sand fraction exceeds about 40 percent.

• Burial of oil may be deep at and above the high-tide line, where oil tends to persist, particularly where beaches are only intermittently exposed to waves.

• In sheltered pockets on the beach, pavements of asphalted sediments can form if oil accumulations are not removed, because most of the oil remains on

the surface.

Response Considerations

• Remove heavy accumulations of pooled oil from the upper beachface.

• All oiled debris should be removed; sediment removal should be limited as much as possible.

• Low-pressure flushing can be used to float oil away from the sediments for recovery by skimmers or sorbents. High-pressure spraying should be avoided

because of potential for transporting contaminated finer sediments (sand) to the lower intertidal or subtidal zones.

• Mechanical reworking of oiled sediments from the high-tide zone to the upper intertidal zone can be effective in areas regularly exposed to wave

activity. However, oiled sediments should not be relocated below the mid-tide zone.

• In-place tilling may be used to reach deeply buried oil layers in the mid-tide zone on exposed beaches.

Rip Rap: Description

• Riprap structures are composed of cobble- to boulder-sized blocks of granite, limestone, concrete, or other materials.

• Riprap structures are used as revetment and groins for shoreline protection, and as breakwaters and jetties around inlets and marinas.

• Attached biota are generally sparse on exposed riprap.

• They are common in highly developed waterfront areas.

Predicted Oil Behavior

• Deep penetration of oil between the blocks is likely.

• Oil adheres readily to the rough surfaces of the blocks.

• Uncleaned oil can cause chronic leaching until the oil hardens.

Response Considerations

• When the oil is fresh and liquid, high pressure spraying and/or water flooding may be effective if all liberated oil is recovered.

• Heavy and weathered oils are more difficult to remove, requiring scraping and high-pressure, hot-water flushing.

EXPOSED TIDAL FLATS: Description

• Exposed tidal flats are broad intertidal areas composed primarily of sand and minor amounts of gravel.

• The presence of sand indicates that tidal currents and waves are strong enough to mobilize the sediments.

• They are usually associated with another shoreline type on the landward side of the flat, though they can occur as separate shoals; they are commonly

associated with tidal inlets.

• Biological use can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, and use by foraging fish.

Predicted Oil Behavior

• Oil does not usually adhere to the surface of exposed tidal flats, but rather moves across the flat and

accumulates at the high-tide line.

• Deposition of oil on the flat may occur on a falling tide if concentrations are heavy.

• Oil does not penetrate water-saturated sediments, but may penetrate coarse-grained sand and coat gravel.

• Biological damage may be severe, primarily to infauna, thereby reducing food sources for birds and other predators.

Response Considerations

• Currents and waves can be very effective in natural removal of the oil.

• The use of heavy machinery should be restricted to prevent oil mixing into the sediments.

Peat Shorelines: Description

• This shoreline type includes exposed peat scarps, eroded peat, and peat slurries.

• Exposed peat scarps occur where the peat is frozen.

• They are highly erosional (>1 meter/year), resulting from wave action

• The intertidal zone is often very complex, with slumped peat blocks and a thin (and temporary) sand layer on the peat.

• Eroded peat occurs as a peat mat or veneer in a dewatered state, deposited on a sand or gravel beach; it is usually less than 20 cm thick and considered

to be relatively transient.

• Peat slurries (which have the appearance of coffee grounds) are up to 50 cm thick and 10 meters wide.

• Peat slurries are found at the foot of eroding peat scarps and in depositional areas; they are relatively permanent features that move along the shore with

the currents.

• The intertidal zone of this shoreline type is not particularly important as biological habitat.

Predicted Oil Behavior

• Light oil can penetrate peat slurries, especially when the peat is dry.

• Peat resists penetration by heavy oils, even when dry.

• Peat slurry reacts with oil like loose granular sorbent and will partially contain and prevent the oil from spreading.

Response Considerations

• The peat substrate is soft, thus cleanup will be difficult; trampling is less of concern where peat is frozen or work is conducted from boats.

• Substrate disruption is of limited concern because of high erosion rates so long as adjacent tundra is not disturbed.

• Peat slurry may be used as a natural sorbent; sorption will be more effective with liquid and fresh oils.

• With high erosion rates, stranded oil will have a short residence time.

• Tundra cliffs are commonly undercut and naturally unstable, so safety is a primary concern during response operations.

• Hot-water washing or even low-pressure flushing activities are not appropriate because large quantities of peat could be eroded from the treatment area.

Bays and estuaries: Description

• Near coastal waters partially surrounded by land and more sheltered than offshore habitats.

• Limited circulation and flushing, with depths frequently <30 feet.

• Suspended sediment concentrations can be high.

• Highly sensitive to oil spills, particularly where flushing rates are low and the probability of contact increases.

• Many species spawn in these habitats during spring, and their sensitive early life stages can persist in shallow waters.

• Large numbers of migratory or wintering waterfowl, wading, and diving birds are often found here. Bays and estuaries are also home to marine mammals

and sea turtles.

• Estuaries and bays are used by commercially or recreationally important finfish, shellfish, and other organisms that migrate seasonally.

Predicted Oil Behavior

• Oil can impact bottom habitats (benthic organisms) when water is shallow.

• Stranded oil on nearby shorelines can become a prolonged source for oil re-released to the water column.

• Tides and fresh water can substantially influence spilled oil movement.

Response Considerations

• Reducing impacts to organisms that live on or in the sea surface is often a high priority.

• Reducing the extent of impacts to sensitive nearshore subtidal or intertidal habitats should be considered.

• Spill response is not conducted from a shoreline, but from water-based vessels or aircraft.

• Use of certain response options is seasonally limited to protect sensitive life histories.

• Adverse effects to birds would be greatest during migration and overwintering when the birds form large flocks.