NRT

Oil Spill Response Strategies for Coastal Marshes during the Deepwater Horizon MC252 Spill

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Chair

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The National Response Team (NRT) acknowledges the NRT member agencies, and state and federal agencies participating on the Regional Response Teams (RRTs), for their contributions in preparing this document. We invite comments or concerns on the usefulness of this document in all-hazard planning for responses. Please send comments to:

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Because coastal marshes are biologically productive, ecologically important, and highly sensitive to oiling, they receive high priority for protection during oil spills. When protection fails and marshes are oiled, decision-makers must address the advantages and disadvantages of oil spill cleanup in these sensitive habitats. Past studies show that while appropriate cleanup methods can enhance marsh recovery, cleanup techniques that are inappropriate for the site specific vegetation and oiling conditions can further damage oiled marshes. Less clearly delineated are conditions when cleanup of an oiled marsh is the right approach, what methods are best to employ, and when cleanup ceases to be useful.

To address these issues the National Incident Command (NIC) has established the Interagency Alternative Technology Assessment Program (IATAP) to provide an orderly and unified mechanism for initial screening, evaluation, and application of new and promising technologies which include marsh restoration and cleanup. The U.S. Environmental Protection Agency (EPA), along with the U.S. Coast Guard (USCG), Minerals Management Service (MMS), U.S. Department of Agriculture (USDA), and the National Oceanic and Atmospheric Administration (NOAA) staffs participate in the IATAP. Under the structure established by the NIC, EPA is assigned with evaluating promising Alternative Response Technologies (e.g., in situ burn, alternative chemical treatment, innovative applications not commonly used for oil responses, etc.). The overall objective is to deliver the best technological tools for coastal protection and clean up of our coastal marshes.

In order to further the scientific discussion, EPA, NOAA, USDA, USCG, and the NIC held a workshop at the University of New Orleans Lindy Boggs Conference Center in New Orleans on June 5, 2010 with key emergency response and local ecosystem technical experts. The workshop consisted of a full discussion of the NIC process and other federal efforts. The participants then divided into three working groups focused on technologies and techniques that fell into three areas: "Keep it out" (containment and prevention measures), "Get it out" (short term approaches to oiled systems), and "Get rid of it" (bioremediation). This workshop helped the local community to understand the current processes and provided feedback in to the NRT and NIC processes for addressing the contamination of these ecosystems.

This document outlines the current response plan for marshes and other nearshore and shoreline areas impacted by the Deepwater Horizon MC252 oil spill, describes the relationship between degree of oiling and choice of cleanup strategy, defines levels of oiling of marshes (in terms of heavy, moderate, or light/very light oiling). It then lists and describes current cleanup methods to consider for marshes oiled during this spill event. The selection of any cleanup strategy will be determined on a case-by-case basis in consultation with appropriate natural resource experts and trustees.

Clean up operations will be conducted by the responsible party and overseen by the Federal, State and Tribal Agencies with authority.

Nearshore and Shoreline Response Plan

The Nearshore and Shoreline Response Plan for the Deepwater Horizon spill consists of three Stages, as defined below. Note that these stages are, in the case of the Deepwater Horizon Spill, concurrent, not purely consecutive, due to the ongoing nature and potential for re-oiling during this incident.

Stage I: On-water recovery of floating oil slicks in nearshore waters. This type of response is included in the plan because it will be conducted in and around extensive areas of broken and fragmented wetlands where the intertidal zone is very narrow. It is likely that the oil will be transported into these nearshore waters and accessible only from the water. On-water recovery will include:

- Oil removal using skimming systems in conjunction with flushing where appropriate
- Oil removal using vacuum systems (in areas too shallow to use skimmers) in conjunction with flushing where needed
- Booming to temporarily contain mobile slicks
- Other appropriate methods

Stage I activities are being repeated as floating slicks recur during ongoing releases from the source.

Stage II: Removal of bulk oil which is defined as: 1) mobile oil in intertidal areas that poses a threat to adjacent habitats or resources, and 2) stranded oil on a segment or zone that is defined by a combination of surface oil thickness, percent distribution, and width. Stage II cleanup would remove stranded oil that is:

- Oil Coat (0.1 – 1.0 cm) or thicker, greater than 10% distribution, and at least 3 ft wide
- Oil Cover (0.01 – 0.1 cm) or thicker, greater than 50% distribution and at least 1 ft wide

Again, Stage II activities will be repeated as areas are re-oiled due to the ongoing release from the source.

Stage III: Normally, in an oil spill, a detailed shoreline cleanup and assessment technique (SCAT) process will be implemented once source control has been achieved and the bulk of the remaining oil has come ashore. At that time, a detailed shoreline cleanup and assessment technique (SCAT) process is fully implemented, involving appropriate agencies to establish for every shoreline segment the following:

- The nature and degree of oiling
- Appropriate cleaning techniques
- Agreed cleanup endpoints
- A formal signoff procedure

However, in the Deepwater Horizon spill, since it is an ongoing and significant release, the federal response has begun the SCAT process. In this incident, the SCAT strategy includes aerial surveillance and observation followed by targeted on the ground surveys. The SCAT teams are reviewing the coastline before oil reaches the shore, under the approved NearShore and Shoreline Response Plans approved by the Unified Command, and develop “Shoreline Treatment Recommendations” (STRs). STRs are grouped into two categories – General STRs which provide Stage I and II cleanup recommendations that can occur without further input from the SCAT team and Individual STRs which are developed for areas that require cleanup methods other than Stage I or II (manual recovery or skimming of free floating oil). This is allowing

cleanup to move forward as necessary or advised in particular areas. Once source control has been achieved and the bulk of the remaining oil has come ashore, the SCAT will identify appropriate cleaning techniques, monitor work, and review and approve work completion.

Cleanup teams are sent out by various entities, including the USCG. Regardless of the source of the cleanup team, the SCAT will monitor all aspects of the cleanup.

Oil Spill Response Strategies for Marshes

To determine whether cleanup is the right choice, decision-makers must assess the severity and nature of the injury (using SCAT survey observations), and they must estimate the time it will take for the marsh to recover in the absence of cleanup (typically considering short-term recovery to be from 1 to 3 years, medium-term from 3 to 5 years, and long-term more than 5 years).

Documented recovery times for oiled marshes range from a few weeks to decades. Case histories suggest that lightly oiled marshes, especially than those in warmer locations such as the Gulf of Mexico, will recover more quickly on their own than heavily oiled marshes, especially in colder climates. Therefore, cleanup strategies vary by degree of oiling.

For the Deepwater Horizon spill, degree of oiling in marshes is characterized as follows:

Heavily Oiled Marshes: Bulk oil present, either floating on the water surface in the marsh fringe or in the marsh interior, or stranded on the intertidal sediment surface. Stems have a coat or stain; in some areas, the leaves are also coated. Wrack, "coffee grounds" (a dense mixture of peat, sediment and organic debris), or other organic debris are often present and mixed with the oil. Below are example photographs of heavily oiled marsh near Pass a Loutre (left) and Blind Bay (right), both located on the southeastern part of the Mississippi Delta birdsfoot.

Moderately Oiled Marshes: A narrow band (less than 3 to 6 ft wide) of oil in the marsh fringe, consisting of patches of mousse trapped in wrack, with coat or stain on the stems. Below are example photographs of moderately oiled marsh.

Lightly or Very Lightly Oiled Marshes: a narrow band (less than 3 ft wide) of oil consisting of coat or stain on the stems. Below are photographs of a lightly oiled marsh (left) and a very lightly oiled marsh (right).

Most of the oiling has occurred, and is expected to occur, along the marsh fringe, except in areas of highly broken marsh. Also, under summer wind patterns, water levels in the marshes are expected to be high, so that most of the time the oil is expected to remain floating on the water

As with most shoreline cleanup activities, no "one size (or method) fits all." Each marsh in need of cleaning will have to be evaluated on a number of variables such as: degree of oiling, weathered oil state, marsh vegetation type, re-oiling, other species present, season, access, etc. Potential cleanup methods to consider for marshes oiled during the Deepwater Horizon spill are outlined in the following table, which shows the applicable marsh oiling condition, and the advantages and disadvantages of each method.

Table 1: Potential oil spill response methods for marshes.

Note: This table provides a list of potential response activities to be taken in an oiled marsh. This list is not to be construed as approval by the NRT, but rather to show potential activities that can be considered by the Incident Command.

Response Method	Oiling Condition	Advantages	Disadvantages
Natural Recovery (allow the oil to degrade in place or be removed by tidal and wave action)	Lightly or very lightly oiled marshes	Minimal impact, avoids physical disturbance from cleanup actions; studies have shown rapid recovery.	Potential oiling of birds or wildlife using the marsh during the time it takes the oil to be removed.
Vacuuming/Skimming (mostly conducted from boats, in conjunction with flushing to increase recovery rates)	Moderately or heavily oiled marshes	Removes large quantities of oil from the marsh; bulk oil removal will speed natural recovery of remaining oil.	Difficult to bring equipment into marsh without causing some impacts such as crushing of vegetation; impacts may be considerable if not conducted properly. Only very shallow-drafted vessels would be able to access some marsh areas. Collected oil and water must be transported and stored (small oil/water separators would reduce volume of oil to be treated).
Low-pressure Flushing (with water comparable to marsh type, or near water source)	Moderately or heavily oiled marshes	Can assist in oil removal by herding oil to collection points (used with vacuuming/skimming); lifts oil off sediment surface (when marsh is not flooded).	Pressure must be carefully controlled to prevent eroding the marsh soils (erosion would expose vulnerable rhizomes). Must be carefully monitored; can cause physical impacts during placement of hoses and pumps. Can be difficult to achieve without removing above-ground vegetation. Can be difficult to flush oil in desired seaward direction without penetrating into marsh, but foot traffic on oiled marsh greatly compromises recovery prospects. May wash away loose soils exposing roots and making them susceptible to further oiling in tidal areas.
Manual Removal (by hand or mechanized equipment)	Moderately or heavily oiled marshes	Can be best way to access pooled oil in the marsh interior, using boardwalks to minimize soil disturbance.	Can result in significant damages to the marsh, including soil compaction; Very slow, with challenging logistics for waste management.

Response Method	Oiling Condition	Advantages	Disadvantages
Natural Sorbent Materials (Technique A) **A) Shredded sorbents applied to oiled marsh shorelines (including bagasse, hay, rice hulls, and cotton lint)**[1]	Potentially all oiling conditions. Materials can be applied both independently and in coordination with other remediation methods.	Shoreline application of sorbents in strips (2 inches deep by 4-6 feet wide) can prevent further penetration of oil into the interior portions of marsh areas. Low impact on marsh vegetation and soils, as sorbents are applied from shallow-draft boats with blowers onto oiled shoreline areas. Natural materials absorb oil off vegetation and from contaminated soil. Sorbents provide substrate for in situ microbes to attenuate oil, speeding rate of oil degradation. Sorbent materials will also biodegrade quickly. Reduces risk of residual oil to wildlife from both contact with oiled vegetation and released sheens. Available in large quantities at low cost in the Gulf Coast region.	Recovery of loose sorbents is not likely, so use is not appropriate in areas with lots of free-floating bulk oil. Loose materials may be eroded by wave and tidal action from marsh fringe, where the oil is most likely to strand. Limited prior use and wide-scale application or information on effectiveness. Heavily oiled material could be more persistent. Loose natural sorbents may contain residual pesticides and should be tested.
Natural Sorbent Materials (Technique B) **B) Shredded sorbents applied to unoiled marsh shorelines at imminent risk of oiling (including bagasse, hay, rice hulls, and cotton lint)**	Pretreatment of unoiled marsh shorelines in imminent danger of oiling	Pretreatment prior to oiling may prevent damage to shoreline vegetation and soils. Shoreline application of sorbents in strips (2 inches deep by 4-6 feet wide) can prevent further penetration of oil into the interior portions of marsh areas. Applied with minimal physical disturbance (by blower from shallow-draft boats). Sorbents provide substrate for natural microbes to attenuate oil, speeding the rate of oil degradation. Sorbent materials will also biodegrade quickly. Reduces risk of residual oil to wildlife from both contact with oiled vegetation and released sheens. Available in large quantities at low cost in the Gulf Coast region.	Loose materials may be eroded by wave and tidal action from marsh fringe, where the oil is most likely to strand. Limited prior use and wide-scale application or information on effectiveness. If removed after oiling, increases the total amount of material to be removed. Oiled material will be transported to other areas. Heavily oiled material could be more persistent. Oiled materials that disperse into open water may sink. Loose natural sorbents may contain residual pesticides and should be tested.

[1] According to USDA's Natural Resources Conservation Service standard, natural sorbent materials (e.g., bagasse, grass hays, rice hulls, and cotton lint) are preferred over fertilizer to accelerate the biodegradation of oil, as these materials provide a substrate for in situ microbes to attenuate oil. This use of natural sorbent materials is supported by research findings.

Response Method	Oiling Condition	Advantages	Disadvantages
Natural Sorbent Materials (Technique C) **C) Sorbents in booms to clean off-shore waters (materials contained, such as in a sausage boom, snare, and sweep)**	Potentially all oiling conditions	After oiling, easier to dispose of and breakdown. Recovers oil as it is being released from the marsh; used mostly along the outer marsh fringe, so no vegetation disturbance if properly deployed.	May not have as high of an absorption rate as synthetic depending upon the material. Improper use creates large volumes of lightly oiled wastes. Must be properly deployed and maintained to be most effective and not cause harm. Requires re-entry into marshes areas for removal of oiled sorbents further risking damage from entry.
In-situ Burning	Heavily oiled marshes, with large amounts of free-floating oil trapped in the vegetation. Best suited for marsh in intertidal zone, when water covers sediment surface.[2]	Can remove oil quickly; can minimize impacts from other physical removal methods; conditions of appropriate use are known; only considered once the source is controlled because of the risk of re-oiling.	Burning is a high risk technique. Burning can remove a substantial portion of oil, but does not remove all of it. Recovery of burned oil residue may be necessary for the in-situ burn option which could cause compaction, if done on foot. Any residue that forms may also refloat and be carried to other areas, perhaps beaching and requiring recovery. Localized air quality concerns for workers and communities; impacts to birds and wildlife in the burned area; may be difficult to control burn. Burning in areas not covered by water can cause some heated oil to penetrate into sediment. Elevated soil temperatures can destroy rhizomes needed for recovery (not suitable for areas that can't be replanted). Burning in summer or fall is contrary to standard marsh management practice in Louisiana (burning is done in winter when vegetation is dormant). Replanting with plants tall enough that leaves reach above high tide level may facilitate recovery.
Vegetation Cutting (only to provide access to pooled oil in marsh interior)	Moderately or heavily oiled marshes	Increases the recovery rate for pooled oil in otherwise inaccessible interior marshes; has been conducted successfully in roseau cane habitats in the Delta NWR, under close supervision. For most other marsh types, only consider cutting once the spill source is controlled because of the risk of re-oiling.	Cut vegetation may die, particularly if re-oiled or if water levels increase greatly after cutting. Can be difficult to avoid risk of foot traffic mixing oil deeper into sediment. May increase rate of marsh loss. Must be carefully monitored. Difficult to remove large volumes of cut vegetation. Cutting plants without foot traffic in oiled marsh is difficult, and walking on oiled marsh will mix surface oil into the sediment, compromising the potential for recovery. If re-oiling of the area occurs as plants regrow, death of plants and their roots, as well as loss of organic substrate, can be increased.
Surface Washing Agents	Where the entire above-ground vegetation is heavily oiled	May increase vegetation survival and reduce contact hazards to wildlife; consider only those products shown to be non-toxic to plants.	Becomes less effective as the oil weathers, therefore, likely a narrow window of opportunity. Requires extensive logistics. Application to interior marshes by foot may result in physical damage to the marsh.

[2] When in-situ burning is conducted in oiled marshes covered by deeper water, vegetation may not recover because rhizomes may not receive enough oxygen.

Response Method	Oiling Condition	Advantages	Disadvantages
Bioremediation (addition of amendments such as N, P, or oxygen where they are found to be limiting natural degradation)	Mostly as a secondary treatment after bulk oil removal	The spilled oil is highly biodegradable, thus could proceed quickly and with minimal residuals.	Lots of uncertainty as to what factors may be limiting natural degradation rates, and how to effectively overcome them. Oxygen, rather than nutrients, will be the most limiting in marshes; however, there are no proven methods to add oxygen to muddy, water-saturated marsh soils.