

**BEST MANAGEMENT PRACTICES
FOR REMOVAL OF DEBRIS
FROM WETLANDS AND OTHER INTERTIDAL AREAS**

Prepared for:
National Oceanic and Atmospheric Administration
National Ocean Service
Office of Response and Restoration
Marine Debris Program

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Introduction

Tropical storms and other severe weather, flooding, or geophysical events often mobilize and deposit large volumes of man-made debris. Much of this debris is often deposited in intertidal wetlands and other coastal environments. This document is intended to assist a wide spectrum of agencies and entities, including the National Oceanic and Atmospheric Administration, other federal and state agencies, or other organizations that may be faced with planning a post-event intertidal debris response or removal action. This document describes current Best Management Practices (BMPs) for removal of large debris such as vessels, storage tanks, and construction debris from sensitive wetland and intertidal habitats. The BMPs presented herein were compiled from those generated during recent emergency responses and similar events.

A wide variety of regulatory, permitting and consultation requirements may apply, depending upon event type, funding source, project location, scope, and duration. It is not possible to address each unique potential combination of requirements, but this document presents starting points for permitting and consultation planning. These BMPs represent an overview of generic best management practices to ensure removal is conducted in a way that avoids and minimizes adverse impacts to the affected habitats and resources. Adherence to these BMPs may also assist in conducting removal that is in compliance with the National Environmental Policy Act (NEPA) and relevant permitting and consultation requirements, if these are applicable.

Permitting and Consultation

Projects may have unique permitting and consultation requirements depending on a number of factors, including location, agency involvement, timing, and the habitats and resources involved. This section is only intended to serve as a starting point for investigation of specific permitting and consultation requirements for intertidal debris removal projects. In particular, the BMPs presented in this document will best serve as a starting point for the establishment of project-specific BMPs and procedures in direct consultation with regulatory agencies, resource agencies, and landowners.

Generally, overarching permitting or consultation requirements are driven both by the location and nature of the project, including which federal and state agencies are involved. This document deals specifically with removal of large debris from wetlands and other intertidal areas and is focused on post-event debris recovery. After large wide-scale emergency events, such projects may be funded or authorized by a variety of federal and state agencies or other entities (National Oceanic and Atmospheric Administration [NOAA], U.S. Coast Guard [USCG], Federal Emergency Management Agency [FEMA], state and local environmental, natural resource, or emergency management agencies, etc.). Projects authorized or funded by federal agencies may be required to follow NEPA requirements. NEPA establishes a national environmental policy and provides a framework for environmental planning

Advance coordination with regulatory and resource management agencies during the initial planning stages of a project is essential to a successful project.

and decision-making by Federal agencies. See NOAA's NEPA Handbook (NOAA, 2009) for additional details.

In some cases, emergency debris removal actions may have statutory exclusions from NEPA or other permitting and consultation requirements under Section 316 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) or other provisions. The Programmatic Environmental Assessment for the NOAA Marine Debris Program (MDP) (NOAA, 2013) provides additional details regarding NOAA MDP's project types and specific guidance on permitting and consultation requirements.

In addition to NEPA, there may be a number of potential permitting and consultation requirements associated with projects conducted in wetlands and intertidal areas. Each project will have unique requirements, however, and it is critical to consult with experts responsible for both state and federal permitting and consultations before beginning a debris removal project. Advance coordination with the regulatory and resource management agencies during the initial planning stages of a project is highly advisable. These may include:

- State/Tribal Historic Preservation Offices
- State Agencies
- Federal Agencies
- Tribal Government Agencies

Intertidal Lands Access and Ownership

The removal of event-generated debris from wetland and other intertidal areas is often more complex than removal of marine debris from subtidal locations due to substantially more complicated property ownership and property access issues. The seaward boundary of privately owned lands lying along the coast varies widely from State to State, and within States. This document does not address the process of establishing ownership and gaining permissions to access intertidal areas or lands for removal of debris, but agencies and entities preparing to remove event-generated debris from intertidal locations should be aware of these potential planning and access challenges. Consultation with landowners is critical at the onset of an intertidal debris removal project, both to gain access to privately owned intertidal land for debris removal or transit, and, if necessary, to develop project-specific modifications or additions to the BMPs presented here.

The seaward boundary of privately owned upland property lying along the coast can vary widely from State to State, and within States. Boundaries may extend out to the high water line, the low water line, somewhere in between the high and low water lines, or somewhere below the low water line. In some cases, the seaward boundary of upland parcels is defined by boundaries shown on recorded survey plats, without regard to any tidal datum. Further, the definition and legal meaning of tidal datums used to establish ownership is State-specific. Thus, seaward extent of private property is both deed-specific and State-specific.

Whether intertidal lands located between State-defined and measured high and low water lines may be privately owned varies from State to State. In some States, certain private property rights extend seaward past the fee-simple ownership boundary of private parcels, into State-owned intertidal or subtidal lands. If intertidal lands can be privately-owned, these parcels may or may not be owned independently of the adjacent upland property. The rights (both private and public) associated with private property are State-specific. Public rights on State-owned and privately owned submerged lands are normally related to State-specific interpretations and applications of the public trust doctrine.

In addition to ownership, project planners should be aware of significant intertidal or subtidal land leasing and easements that may exist in some regions. For example, subtidal and intertidal lands may be subject to shellfish leases. Utility, drainage, or conservation easements may also be present and require coordination. Lastly, regardless of other access or ownership issues, coordination with utilities including petroleum, water and sewer pipelines, cable, phone, electric, overhead wires, and underground utilities is critical in safely obtaining access to intertidal areas for many debris removal projects. This may require extra effort during emergency projects conducted immediately after a debris-generating incident.

Land ownership issues can be complex. Consultation with landowners is critical at the onset of an intertidal debris removal project.

Disposal and Recycling

Establishing a plan to handle disposal and recycling of materials recovered is also important prior to beginning a debris removal project. Disposal of intertidal and marine debris following major storm events or other debris-generating emergencies will likely take place alongside disposal of large volumes of land-based debris. As such, project planners may be able to leverage post-storm debris disposal processes and infrastructure, but landfill and disposal capacity may be at a premium or unavailable in the aftermath of major emergency events.

Pre-existing state and local requirements for debris and waste handling, landfill, and recycling may differ widely. Many state or local governments have pre-existing guidelines for staging and waste disposal in state and local emergency management plans which may be a valuable resource for debris removal project planning. If hazardous material (HAZMAT) debris items may be recovered, specific advance planning for disposal and recycling of these items is required. Lastly, if FEMA debris eligibility is a concern, it may be helpful to reference FEMA's Public Assistance Debris Management Guide (FEMA, 2007) for specific guidance.

Removal Methods and Best Management Practices

This document provides specific guidance for removal of large debris items from wetlands and other intertidal areas based upon recent post-event debris recovery and removal operations. The following sections present different recommendations, options, and specific removal strategies separately for intertidal vegetated wetlands such as marshes and mangroves, and un-vegetated intertidal areas such as beaches or tidal flats. These two general environments have different environmental sensitivities and debris removal considerations.

For both habitats, an important initial consideration is the trade-offs between removal of shoreline debris from the water, if possible, or the land. In many

cases, only one of these options will be possible, due to logistics and physical access constraints. Where sensitivity of benthic habitats is low and the water access to the shoreline is not difficult, it may be more effective to consider removing certain types of shoreline debris from the water, particularly if the effort may be coupled with removal of “wet” subtidal marine and intertidal debris from the water. Although shoreline debris may often be removed under different authorities, water-side operations may reduce the risk of property damage during removal and obtaining rights of entry from adjacent property owners. Therefore, marine and intertidal debris removal actions can include removal of debris on banks and shoreline within reach of the equipment being used. Conversely, where sensitive benthic habitats are present, it may be preferable to access intertidal debris from land if possible to avoid impacts to sensitive benthic habitats from turbidity, scouring, or direct impacts of equipment to the bottom.

Removal of intertidal debris from adjacent water or upland areas is usually preferable to direct access of intertidal areas by personnel or equipment.

General Debris Removal BMPs

There are a number of general BMPs that should be employed for any intertidal debris removal project regardless of specific access or removal methods. In general, these BMPs are intended to complement and elaborate upon the best practices identified in the Programmatic Environmental Assessment for the NOAA MDP (NOAA, 2013).

- Avoid collisions and contact with all wildlife. Report sightings of stranded turtles and marine mammals, and distressed or dead birds, sharks, rays, and marine mammals to the appropriate State or Federal agency.
- All removal operations should take place during daylight hours. Night operations may require establishment of additional location specific BMPs in consultation with resource agencies and landowners.
- Avoid all bird and turtle nesting or aggregation areas or marine mammal haul-out locations.
- Ensure no nesting birds are adjacent to debris, in the footprint of vehicle traffic, or in the path of debris to be removed by dragging. On sites with nesting bird sensitivity, resource agency and/or landowner representatives should be present to identify any birds nesting in the area and determine

the current status of the nesting birds and fledglings. If any of the birds in the area are still nesting (with eggs or young birds at the nest), it is preferable to delay the recovery until such time that no birds are nesting and the young birds have left the area.

- To limit disturbance to birds and other sensitive wetland and intertidal-associated species, work crews should be limited in size and number to the minimum number of personnel and equipment required to complete removal in an efficient time frame. Equipment and personnel should work as closely together as is feasible during recovery operations to minimize disturbance, rather than spread across the entire site.
- Avoid all unnecessary contact with wetland vegetation or soils on foot or by vehicle in transit to and from debris removal site.
- Use established pre-existing access/egress routes where feasible such as pre-existing roads, paths, trails, or waterways. If pre-existing access/egress routes do not exist, it may be necessary to establish temporary access/egress corridors to provide guidance and minimize traffic in wetlands and other sensitive habitats during clean-up operations.
- When conducting operations on water with vessels, avoid blocking major egress points in channels, river, passes, and bays.
- Minimize unnecessary disturbance or removal of natural sediment, organic matter, and vegetation not required to access man-made debris items. If moving organic debris is required, replace or deposit in the nearest tidally influenced area. Organic debris plays vital ecological function in many intertidal areas and should remain in place to the extent possible.
- Historic and precontact-era artifacts of any type (e.g., pot sherds, arrowheads, ship timbers, and bottles) should not be collected and should be reported to the appropriate agency.
- Staging areas for sorting or storing recovered debris should not be located in wetlands or intertidal areas if possible.
- Remove all equipment and materials deployed to facilitate debris removal operations at conclusion of operations.

Removal of Stranded Debris from Vegetated Wetlands

Generally, recovery and removal of debris from vegetated wetlands such as marshes or mangroves (Figure 1) present greater challenges than in non-wetland environments. Wetland soils and vegetation are more sensitive and more likely to be physically damaged by personnel and equipment ingress, egress, and removal activities in these lower energy environments. When evaluating trade-offs between water-side and upland edge-based recovery, planning staff should establish project-specific guidelines that minimize physical access to wetlands to the extent possible.

Depending upon debris-generating event type, specific habitat type and regional setting, debris may be more easily accessed from open water or upland edge (Figure 2). In some cases, debris may be either still semi-submerged, in contact with the water but partially stranded in or on the wetland, or stranded on the wetland fringe and can be accessed from vessels or barges from the water with or without assistance of heavy equipment such as cranes, barge-mounted excavators, etc. In other cases, debris may be stranded deep in the interior of marsh vegetation, where it is not readily accessible from the waterline or adjacent uplands using hand tools or mechanical cranes, booms, etc. Debris removal from wetland upland boundary or water edge is usually preferable to direct access of wetland interiors. Debris removal from wetland interiors (Figure 3) should be dealt with carefully, as these types of removal operations have the greatest potential for damage to wetland soils and vegetation and other wetland-associated natural resources.

Wetland vegetation and soils are particularly sensitive. All removal efforts should minimize disturbance as much as possible.



Figure 1. Examples of debris items on seaward edge or fringe (A-B), and interiors (C-F) of vegetated wetlands. Photo credits: RPI, USFWS.

Wetland Edge Recovery Techniques

- Where possible, manual removal techniques are preferred. This can include hand-picking or the use of hooks or hand tools such as rakes and shovels. This method is generally suitable for smaller debris items still in contact with the water or stranded in or on wetlands immediately adjacent to the waterline.
- Where manual recovery is not possible, the next preferred method is recovery via equipment-assisted lifting methods. Booms with grappling hooks may be used to lift smaller items out of the water onto the deck of a small removal vessel. A barge, boat, or airboat-mounted crane, boom, or excavator/backhoe may be used to lift larger items out of the water or from wetlands immediately adjacent to the waterline. Avoid recovery in areas or during times where tidal water levels are such that barges or vessels will ground or strike the bottom, particularly where sensitive benthic habitats such as coral or shellfish reefs, hard-bottom, or seagrass may be present.
- Where equipment-assisted lifting techniques are not suitable for removal of large debris items, debris may be removed by dragging/towing the debris item out of wetlands and away from the shoreline. This is generally the least preferred method, but may be the only available method for removal of large items that extend into wetland interiors. When dragging or towing debris from marsh environments, debris should be pulled straight out along longest axis where possible to minimize the footprint of the debris item along the drag path.
- In some cases, it may be necessary to dismantle or otherwise cut the debris into smaller, manageable lengths when the size of the debris is very large and difficult to handle.

Wetland Edge Recovery Specific BMPs

- In all cases, minimize foot or vessel and equipment traffic in the marsh. Wherever possible, operations should be conducted from boats on water adjacent to the marsh (or from the upland edge where applicable).
- When removing debris items from marsh water or upland edges via dragging, carefully consider environmental trade-offs between dragging multiple items along the same path and dragging items via different paths. If each item to be removed via dragging is likely to cause significant impact to marsh vegetation and soils, consider re-using paths with follow-up repair/restoration. If individual items are likely to cause more limited impacts, it may be more appropriate to drag individual items via separate paths.
- When retrieving items via lift with crane or other heavy equipment, do not disturb the soil and minimize damage to wetland vegetation.
- Special care is needed where there is evidence that the debris is weakened and could fall apart if pulled out. Teams should use hand tools to remove any smaller associated debris materials.
- If sediment disturbance is unavoidable, employ floating turbidity barriers, silt fence, or other erosion, sedimentation, and turbidity control measures where suitable.



Figure 2. Examples of equipment and removal methods suitable for removal of debris items on edge or fringe of vegetated wetlands including boom-mounted grapple on shallow draft barge (A-C), detail of combined manual and grapple removal (D), small boom crane on vessel of opportunity (E), and large crane mounted grapple on barge (F). Photo credits: RPI, USCG, NOAA MDP, USFWS.

Wetland Interior Recovery Techniques

- Manual recovery techniques are always preferred in the recovery of debris items from wetland interiors. Operation of vehicles and heavy equipment in wetland interiors may severely damage wetland soils and vegetation; this should be avoided if possible.
- Depending on wetland type, season, and wetland soil condition, foot access to the stranded debris in wetland interiors may require the use of boardwalks, walking boards, or mats composed of plywood, fiberglass grating, or other specifically approved materials to prevent damage to the marsh surface.
- In some cases, it may be necessary to dismantle the debris into smaller, manageable sizes when individual debris items are very large and difficult to handle.
- Where manual recovery is not possible, removal of debris via mechanical methods may be considered. Consider trade-offs between removal via mechanical dragging or equipment assisted lifting methods.
- When removing debris items via dragging, towlines should be attached to the stranded debris at the closest/least intrusive point. The debris may be carefully pulled out of the wetlands by boat to the waterline or to an adjacent upland area by vehicle. Vessel and vehicles/equipment should not enter wetland areas if at all possible, and towing/dragging should be conducted from adjacent open water or upland areas
- When large debris items need to be removed from marsh interiors via dragging, debris items may be dragged on gratings or boardwalks to minimize disturbance of the marsh surface and soil. Sleds can be used to facilitate transfer of the debris to boats or vehicles positioned adjacent to wetland in open water or upland areas. Cable yarding or logging applications may also be used in these situations to minimize ground disturbance.
- If removal is not possible without use of vessels or vehicles in wetland interiors, and if removal of specific debris items is mandatory due to HAZMAT or similar considerations, access to marsh interiors by heavy airboats or modified low-tire pressure or tracked vehicles (e.g., amphibious excavator or marsh buggy) may be employed. Use of heavy equipment mats is recommended when accessing wetland interiors with any mechanical equipment.
- In some case, removal of very large or difficult to access debris items from the interior of wetlands may be attempted by helicopter via sling load or grappling systems where no other access options are available.



Figure 3. Examples of equipment and removal methods suitable for removal of debris items from interior of vegetated wetlands including via manual removal to shallow draft vessel (A), use of walking boards (B-E) and helicopter sling load (F). Photo credits: RPI, USFWS.

Wetland Interior Recovery Specific BMPs

- All operations should be conducted from boardwalks where possible. Minimize foot traffic directly on the marsh surface. Trampling of marsh soils and vegetation can damage wetland soils and vegetation and should be avoided or minimized.
- Use of airboats to remove debris by dragging requires caution because the propeller slip stream may blow debris and vegetation, disturb birds, etc. Also, maneuvering airboats close to shore will be difficult because these vessels cannot reverse.
- If specialized vehicles or equipment (e.g., amphibious excavator or marsh buggy) will be used to access high priority items in wetland interiors, minimize travel to extent possible, do not reuse previous tracks to avoid creating ruts or channels, consult with resource experts regarding the least damaging route, and avoid turning maneuvers in wetland interiors.
- When removing debris items via dragging, carefully consider environmental trade-offs between dragging multiple items along the same path and dragging items via different paths. If each item to be removed via dragging is likely to cause significant impact to marsh vegetation and soils, consider re-using paths with follow-up repair/restoration. If individual items are likely to cause more limited impacts, it may be more appropriate to drag individual items via separate paths.
- Because of the sensitivity of these habitats and concern about causing additional harm during removal of debris requiring land access, it may be require special approval from resource agencies or landowners providing oversight guidance for any teams conducting these operations.
- Similarly, it may be appropriate to initially require direct supervision of teams by resource agency staff or landowners while conducting operations until competency in following BMPs can be demonstrated.
- During aerial removal operations, establish and maintain minimum altitude requirements and appropriate flight corridors where compatible with flight safety requirements to reduce disturbance to animals, particularly sensitive resources such as nesting or roosting bird concentration areas and marine mammal haul-out locations. Project specific BMPs will likely be required.

Removal of Stranded Debris from Un-vegetated Intertidal Areas

Un-vegetated intertidal substrates, including sand beaches, rocky shorelines, sand/shell berms, intertidal flats, or adjacent irregularly flooded uplands are generally less sensitive than wetland environments (Figure 4). These habitats often are situated such that access from land is simpler than wetland habitats and recovery and removal operations may be substantially simpler. However, because these types of shorelines are typically exposed to greater wave energy, if land access is not feasible then recovery can be very challenging via water-side operations, particularly for removal of very large debris items. Also, higher wave energies may lead to greater sediment mobilization such that debris items may be partially or completely buried, complicating removal activities. Figure 5 depicts a variety of removal techniques for un-vegetated shorelines.

Beaches and similar habitats are less sensitive to disturbance, but removal should minimize impact.



Figure 4. Examples of debris items on un-vegetated intertidal substrates such as beaches and flats including large stranded dock on exposed Oregon beach (A), stranded oil containment boom on Louisiana beach (B), scattered miscellaneous debris along mixed sand/gravel beach in New Jersey (C) and storm-generated demolition debris on sand beach in New York (D). Photo credits: RPI, USFWS.

Un-vegetated Intertidal Recovery Techniques

- As per recovery in vegetated wetland environments, both manual and equipment assisted lifting or dragging methods may be used.
- Manual recovery is preferred if the substrate is firm enough to support foot traffic and debris is small and light enough to be removed by hand-picking or with hand tools. This also assumes that recovery teams can walk on the substrate and remove the debris. Debris may be dismantled by hand and removed via a route that is safe and clear of vegetation.
- Where manual recovery is not possible, wheeled or tracked vehicles and equipment may be used to recover debris items via lifting or dragging if access is available and substrate is firm enough to support transit. In general, lifting techniques are preferred to dragging techniques in order to minimize the impact of removal.
- In some cases, removal of debris items of particular concern from the beaches or un-vegetated intertidal habitats may be attempted by helicopter via sling load where no other access options are available. In cases where very large debris items or debris items of particular concern are recovered via aerial access, deployment and staging of equipment or small vehicles may take place over longer periods.

Un-vegetated Intertidal Recovery Specific BMPs

- If wheeled or tracked vehicles and equipment are to be used within intertidal areas, it is preferable to establish specific routes of ingress and egress to the site to minimize the footprint of the vehicle and equipment traffic on and adjacent to the site.
- When operating wheeled vehicles on beach or mudflat habitats, use low-pressure tires (< 10 psi) to minimize impact to beach or intertidal substrate.
- When operating wheeled or tracked vehicles and equipment in non-vegetated intertidal areas, vehicles and equipment should be kept as low on the beach as possible to avoid crossing or disturbing the high tide/wrack line.
- When operating wheeled vehicles on beach habitats, avoid all dunes and similar geomorphic features where possible. Dunes and dune vegetation are particularly sensitive to damage from vehicles.
- If the excavation of sediment is required to access or remove debris, the excavated area should be returned to its original contour and topography.
- During aerial removal operations, establish and maintain minimum altitude requirements and appropriate flight corridors where compatible with flight safety requirements to reduce disturbance to animals, particularly sensitive resources such as nesting or roosting bird concentration areas and sea mammal haul-out locations. Project specific BMPs will likely be required.
- Removal operations on sand beaches in particular may require specific restrictions on timing and location of removal activities to avoid impacts to high-profile or particularly sensitive species such as beach nesting birds, sea turtle nesting areas, and beach mice.

- Removal operations on sand beaches or other un-vegetated shorelines may require specific restrictions on specific removal methods to limit erosion along shorelines where this is an issue of particular concern.
- Specific guidance regarding timing and location of removal activities may be required to minimize disturbance to human and socio-economic uses of un-vegetated shorelines, particularly high-use or amenity beaches and shorelines.



Figure 5. Examples of equipment and removal methods suitable for removal of debris items on un-vegetated intertidal substrates such as beaches and flats including manual removal (A), manual removal with limited hand excavation (B), use of small tracked equipment to assist in dismantling large debris item (C), and removal of debris components by helicopter sling load (D). Photo credits: American Littoral Society, WA Dept. of Ecology, NOAA MDP, and The Undersea Company.

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