STAR
Spill Tactics for Alaska Responders

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SPILL TACTICS for Alaska Responders

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TABLE OF CONTENTS

SECTION A. FRONT MATTER

Part I: Introduction....A-I-5
A. Purpose of STAR....A-I-5
B. Scope....A-I-5
C. How This Document was Developed....A-I-6
D. How to Use This Document....A-I-6
1. Legend of Symbols....A-I-8
2. Sample Tactics Description....A-I-9
3. Tactic List....A-I-12
Part II: Classification Standards....A-II-1
A. Personnel Classifications (recommendations)....A-II-1
B. Vessel Classifications (recommendations)....A-II-3
C. Operating Environment Classifications (recommendations)....A-II-4
Part III: Checklists....A-III-1
A. Safety....A-III-1
B. Field Team Leader....A-III-2
C. Radio Communications....A-III-4
D. Wildlife....A-III-5
E. Historic Properties....A-III-6
F. Waste Management....A-III-7
G. Staging Area Manager....A-III-8
Part IV: Cross-Reference Table....A-IV-1
A. Operating Environments....A-IV-1

SECTION B. TACTICS

Part I: Safety
A. Introduction....B-I-i
B. Safety Tactics
1. Site Entry Criteria....B-I-1-1
2. Personal Protective Equipment....B-I-2-1
3. Site Layout & Control....B-I-3-1
4. Personnel Decontamination....B-I-4-1
Part II: Oil Spill Surveillance & Tracking
A. Introduction....B-II-i
B. Oil Spill Surveillance & Tracking Tactics
1. Plume Delineation, Land....B-II-1-1
2. Discharge Tracking On Water....B-II-2-1

3. Aerial Observation Supporting Nearshore Operations B-II-3-1
Part III: Mechanical Response
A. Introduction..... B-III-i
B. Mechanical Response Tactics
Containment and recovery tactics
1. Booming Basics B-III-1-1
2. Containment Boom B-III-2-1
3. Dikes, Berms & Dams..... B-III-3-1
4. Pits, Trenches & Slots B-III-4-1
5. Nearshore Free-oil Recovery..... B-III-5-1
6. On-water Free-oil Recovery B-III-6-1
7. On-land Recovery B-III-7-1
8. Diversion Boom B-III-8-1
9. Marine Recovery B-III-9-1
10. Shoreside Recovery.....B-III-10-1
11. Passive Recovery B-III-11-1
Sensitive area protection tactics
12. Exclusion Boom B-III-12-1
13. Deflection Boom B-III-13-1
14. Beach Berms & Exclusion Dams B-III-14-1
15. Cold-water Deluge B-III-15-1
Primary storage and transfer of recovered products and waste
16. Marine-based Storage & Transfer of Oily Liquids B-III-16-1
17. Land-based Storage & Transfer of Oily Liquids.....B-III-17-1
18. Pumping Oily Liquids B-III-18-1
19. Towing Alongside B-III-19-1
Part IV: Non-Mechanical Response
A. Introduction.....B-IV-i
B. Non-Mechanical Response Tactics
1. Dispersant Application B-IV-1-1
2. In-situ Burning, Oily Vegetation B-IV-2-1
3. In-situ Burning, On Water B-IV-3-1
4. In-situ Burning, Pooled Oil.....B-IV-4-1
Part V: Logistics
A. Introduction..... B-V-i
B. Logistics Tactics
1. Staging Area B-V-1-1
2. Vessel Decontamination B-V-2-1

Part VI: Nearshore Operations Response Strategy (NORS)
A. Introduction ..... B-VI-i
B. NORS Tactics
1. Planning and Implementation B-VI-1-1
2. Nearshore Group Logistics Base B-VI-2-1

SECTION C: REFERENCES C-1

SECTION D: APPENDICES

A. Glossary D-1
B. Acronyms & Abbreviations D-5
C. Estimating Amount of Spilled Oil D-7
D. Legend of Icons D-11

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INTRODUCTION

PURPOSE

The Spill Tactics for Alaska Responders (STAR) manual provides a standardized oil spill response tactics manual specific to the State of Alaska. The manual is intended to be a standard tactical reference for oil spill planning and response activities in Alaska. It is available for use by the spill response community, including federal, state, local, industry, and spill response organizations throughout Alaska.

The information in this manual bridges the gap between oil spill contingency planning and response by providing standard tactics and terminology that can be easily transferred from contingency plan to Incident Action Plan. The standardization will facilitate mutual aid among response organizations and may improve resource ordering and allocation during a response. The manual also has value as a field guide and training aid for oil spill responders.

The STAR manual is referenced in the Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases (Unified Plan), and the ten federal/state subarea plans. In addition, the manual may be referenced in the Oil Discharge Prevention and Contingency Plans (C-Plan) submitted to the Alaska Department of Environmental Conservation (ADEC), as well as Federal Vessel and Facility Response Plans (VRP and FRP), and Spill Prevention, Control, and Countermeasure (SPCC) Plans.

SCOPE

The STAR manual includes non-prescriptive guidance on meeting the Response Planning Standard (RPS) for C-Plans. The definitions and descriptions contained in this manual provide a clear, consistent, statewide standard for oil spill tactics and response resource classification.

The STAR manual provides a companion to Geographic Response Strategies (GRS) developed in Alaska. The tactics described in the manual are used to develop the strategies in GRS. The STAR Manual also complements the Alaska Incident Management System (AIMS) Guide for Oil and Hazardous Substance Response, as well as other response guides developed for spill response.

The tactics and equipment described in this manual specifically address the uniquely challenging and diverse operating environments that exist across the State of Alaska. Because the information in this manual reflects the response priorities and concerns of both planners and responders, it has the potential to increase the spill response efficiency of spill response organizations by providing guidance on the resources and capabilities required to accomplish the specific tasking likely to come from the Incident Management Team (IMT) during a response.

The tactics described in this manual include primarily those activities that occur during the emergency response phase (Phase I) of an oil spill.

The tactics described here are not prescriptive or exclusive; C-Plan holders and spill response organizations are free to develop and utilize other tactics or modify these tactics to meet their needs. **These tactics are also intended to be flexible; spill responders should adjust or modify these tactics to meet the prevailing conditions that they encounter in the field.**

HOW THIS DOCUMENT WAS DEVELOPED

The STAR Manual was developed through a cooperative consensus-based work group process involving federal and state spill response agencies working with representatives of oil spill response organizations and contingency plan holders. Additional input was sought from natural resource management agencies, regional citizen's advisory councils, local governments, and other stakeholders. The work group consulted a broad array of published oil spill response tactic manuals before developing the STAR Manual. Over forty (40) sources of tactics reference material, including existing spill response tactics manuals as well as field response guides, oil spill contingency plans, general reference documents, and internet reference sites were reviewed. Where feasible and appropriate, tactics from other published sources were used as a starting point in developing the STAR tactics. Copyright permission was sought and granted before adapting tactics from other published sources. The STAR Manual was developed through funding provided by the ADEC from the Oil and Hazardous Substance Release Prevention and Response Fund (the 470 Fund).

The work group established the following principles for developing the manual:

- Strive for standardization and consistency throughout the manual.
- Tactics are to be non-prescriptive in nature.
- All tactics should allow for flexibility to meet conditions in the field.
- The manual should be easy to understand and use.
- The manual should be designed for expandability.
- Plan for periodic updates.
- Embrace innovation.
- Facilitate meeting regulatory requirements by C-Plan holders.

The work group consisted of the following participants:

- Alaska Chadux Corporation
- US Environmental Protection Agency
- Alaska Department of Environmental Conservation
- Alaska Clean Seas
- ConocoPhillips Alaska Inc.
- Alyeska Pipeline Service Company
- US Coast Guard
- US Navy Supervisor of Salvage
- Tesoro Alaska Company
- Cook Inlet Spill Prevention & Response Inc.
- Southeast Alaska Petroleum Resource Organization
- BP Exploration Alaska
- US Department of the Interior

The STAR Manual was first published in 2006. The manual was revised in 2013 to incorporate an entirely new part (Part VI) that addresses a Nearshore Operations Response Strategy (NORS) as well as two new tactics focused on Nearshore Free-oil Recovery using best available technology. These new tactics were developed in conjunction with the NORS strategy to address the need for nearshore free-oil

recovery planning by outlining the tactics and resources required to accomplish on-water recovery in shallow nearshore operating areas with limited local infrastructure and logistical support. Part VI additionally contains two NORS-specific tactics; 1) Planning & Implementation and 2) Nearshore Group Logistics Base. Other 2013 updates include two new tactics including Booming Basics and Towing Alongside, both in Part III. Minor changes were made to other sections of the plan to reflect the addition of nearshore response tactics.

HOW TO USE THIS DOCUMENT

Because the manual targets two distinct audiences, it has been published in two different formats. The Planning/Incident Management Team (IMT) version has been published as an 8.5 by 11-inch notebook for use by contingency planners and incident management teams (IMT). A more condensed field operations version has also been published for easy use by response crews. The manual is available electronically via CD-Rom or the Internet (http://www.dec.state.ak.us/spar/perp/star/index.htm).

Checklists and cross-reference tables have been included to aid responders. The checklists are intended for general use by responders in the field. Cross-reference tables allow planners and responders to determine appropriate tactics for the operating environments.

The STAR manual is organized according to six general categories of oil spill response tactics: Safety, Oil Spill Surveillance and Tracking, Mechanical Response, Non-Mechanical Response, Logistics, and Nearshore Operations Response Strategy (NORS). Mechanical Response tactics are sub-divided into Containment and Recovery, Sensitive Area Protection, and Primary Storage and Transfer of Recovered Products and Waste.

Each tactic sheet includes a pictographic tactic description, which shows a typical deployment configuration or configurations as well as a summary of the tactic objectives and strategies that may be utilized. The tactic sheet also contains resource information that summarizes the types and quantities of personnel and equipment recommended to implement the tactic as described. Resource information is displayed in tables that show both direct and supporting resource requirements.

The manual uses short names and icons to describe oil spill response tactics. Icons are also used to represent other parameters, including operating environment, and tactic type (e.g. safety, surveillance and tracking, etc.) The Legend of Symbols shows all icons used in the manual.

The Sample Tactics Description contains a diagram that shows how each tactic is organized.

LEGEND OF SYMBOLS

OPERATING ENVIRONMENTS

The following symbols are used throughout this document in order to assist in the identification of the operating environments.

Water

- Open Water
- Calm Water
- Broken Ice
- Protected Water
- Fast Water
- Solid Ice

Land-based

- Tundra
- Shoreline
- Marsh
- Other Land

TACTIC CATEGORIES

The following symbols are used throughout this document in order to assist in the identification of the tactic category.

Safety Tactics

Mechanical Tactics

Non-mechanical Tactics

Logistics Tactics

Surveillance & Tracking

Nearshore Operations Response Strategy

TACTIC ICONS

The following symbols are used throughout this document in order to assist in the identification of the tactic strategies.

SAFETY:

- SEC — Site Entry Criteria
- PPE — Personal Protective Equipment
- SCL — Site Layout & Control
- Dp — Personnel Decontamination

OIL SPILL SURVEILLANCE & TRACKING:

- PD — Plume Delineation, Land
- DT — Discharge Tracking On Water
- AO — Aerial Observation Supporting Nearshore Operations

MECHANICAL RESPONSE:

- C — Containment Boom
- DBD — Dikes, Berms & Dams
- DBD eme — Dikes, Berms & Dams, with Earth Moving Equipment
- DBD ml — Dikes, Berms & Dams, with Manual Labor
- PTS — Pits, Trenches & Slots
- NFO — Nearshore Free-oil Recovery
- FO — On-water Free-oil Recovery
- OR — On-land Recovery
- DV — Diversion Boom
- MR — Marine Recovery
- SR — Shoreside Recovery, Restricted Access
- SR — Shoreside Recovery, No Access Restriction
- PR — Passive Recovery

MECHANICAL RESPONSE, Continued:

- EX — Exclusion Boom
- DF — Deflection Boom
- BB — Beach Berms & Exclusion Dams
- BB m — Beach Berms & Exclusion Dams, w/Earth Moving Equipment
- BB mm — Beach Berms & Exclusion Dams, w/Manual Labor
- CWD — Cold Water Deluge
- MST — Marine-based Storage & Transfer of Oily Liquids
- LST — Land-based Storage & Transfer
- POL — Pumping Oily Liquids
- TA — Towing Alongside

NON-MECHANICAL RESPONSE:

- DS — Dispersant Application
- ISv — In-situ Burning, Oily Vegetation
- ISw — In-situ Burning, On Water
- ISo — In-situ Burning, Pooled Oil

LOGISTICS:

- S — Staging Area
- Dv — Vessel Decontamination

NEARSHORE OPERATIONS RESPONSE STRATEGY (NORS):

- PI — Planning and Implementation
- LB — Nearshore Group Logistics Base

SAMPLE TACTICS DESCRIPTION

Each of the five tactic categories has a specific icon assigned for ease in identification.

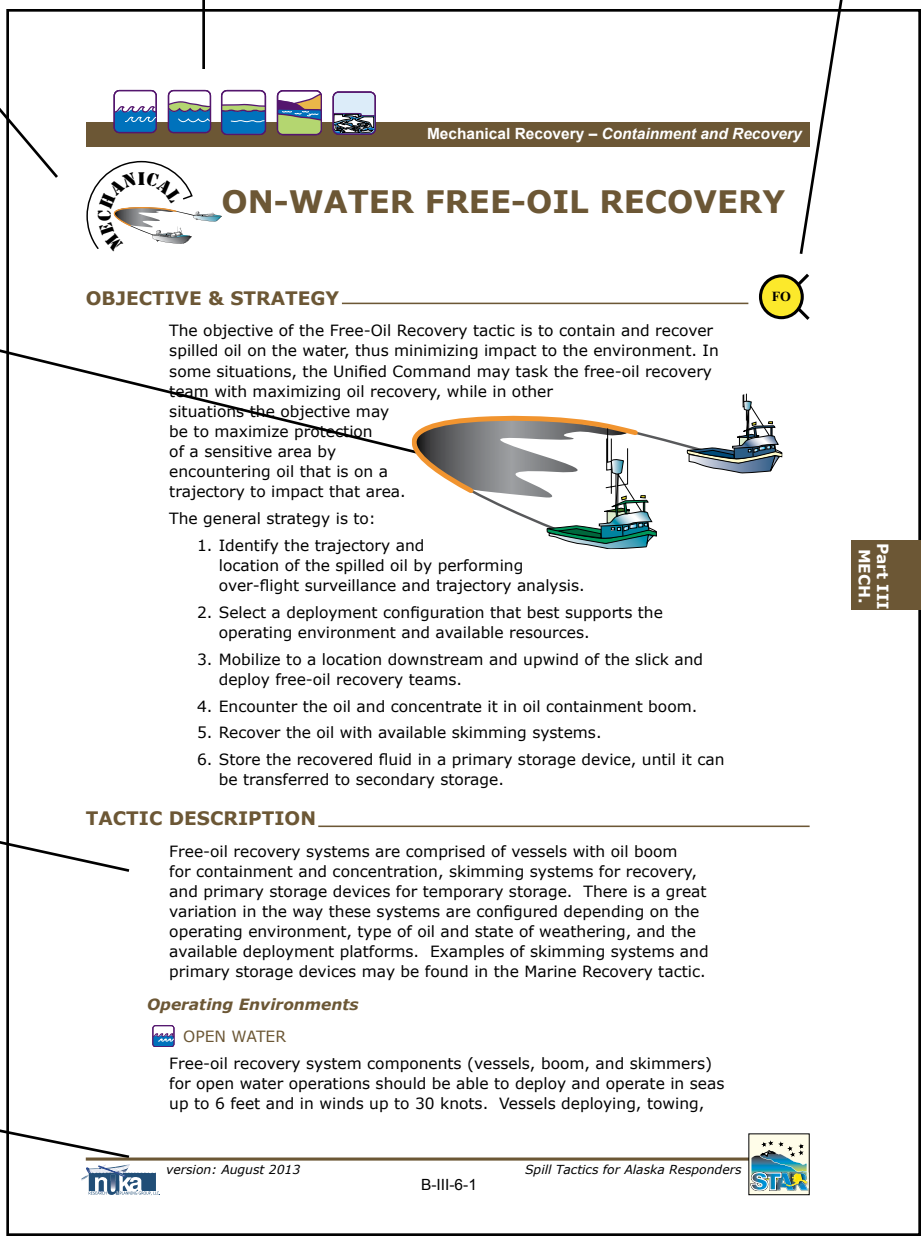
Possible operating environments are indicated using icons (described in the legend).

Each tactic contains an identifying symbol for that specific tactic.

The illustration depicts a typical deployment configuration for the tactic. Sometimes, more than one option is provided.

A concise description of how the tactic is deployed is provided to explain the illustration.

Version date



Mechanical Recovery – *Containment and Recovery*

MECHANICAL

ON-WATER FREE-OIL RECOVERY

FO

OBJECTIVE & STRATEGY

The objective of the Free-Oil Recovery tactic is to contain and recover spilled oil on the water, thus minimizing impact to the environment. In some situations, the Unified Command may task the free-oil recovery team with maximizing oil recovery, while in other situations the objective may be to maximize protection of a sensitive area by encountering oil that is on a trajectory to impact that area.

The general strategy is to:

1. Identify the trajectory and location of the spilled oil by performing over-flight surveillance and trajectory analysis.
2. Select a deployment configuration that best supports the operating environment and available resources.
3. Mobilize to a location downstream and upwind of the slick and deploy free-oil recovery teams.
4. Encounter the oil and concentrate it in oil containment boom.
5. Recover the oil with available skimming systems.
6. Store the recovered fluid in a primary storage device, until it can be transferred to secondary storage.

Part III MECH.

TACTIC DESCRIPTION

Free-oil recovery systems are comprised of vessels with oil boom for containment and concentration, skimming systems for recovery, and primary storage devices for temporary storage. There is a great variation in the way these systems are configured depending on the operating environment, type of oil and state of weathering, and the available deployment platforms. Examples of skimming systems and primary storage devices may be found in the Marine Recovery tactic.

Operating Environments

OPEN WATER

Free-oil recovery system components (vessels, boom, and skimmers) for open water operations should be able to deploy and operate in seas up to 6 feet and in winds up to 30 knots. Vessels deploying, towing,

version: August 2013 *Spill Tactics for Alaska Responders*

B-III-6-1

Various operational and environmental considerations are presented here.

Images describing the tactics are provided as visual representation.

On-water Free-Oil Recovery

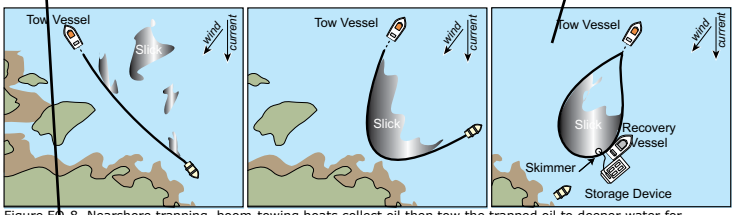


Figure FO-8. Nearshore trapping, boom-towing boats collect oil then tow the trapped oil to deeper water for recovery.

NEARSHORE TRAPPING

Shallow draft vessels can be used to capture oil in shallow water by encircling it and slowly dragging the slick into deep water. A marine recovery system is then used to remove the oil (see Figure FO-8).

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment and tactic. Local knowledge is preferred.
- Vessels setting and tending the boom should be able to safely transit seas that exceed the boom's operating limitation.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Site conditions may influence deployment configuration options.
- Combinations of Free-oil Recovery and Diversion tactics are often used together.
- Combinations of configurations may optimize recovery.
- Procedures and permits for decanting recovered water should be considered.

Each section of the manual has a colored tab on the outer edge of the page to assist in finding the tactic.

Safety and Deployment considerations.

A dedicated icon is used for each tactic.

The equipment and personnel tables can be used to determine typical equipment and personnel needs. Actual equipment and personnel needs will be site and situation specific.

"Equipment" is the list of equipment needed to deploy the tactic. "Function" describes what the equipment will be used for. And "Quantity" is the amount or number of each piece/item. "Notes" describes any necessary additional information.

Mechanical Recovery – *Containment and Recovery*

On-water Free-Oil Recovery

- Open water systems, typically operate two 12-hour shifts per day. Other systems typically operate one 12-hour shift per day.
- Logistics for oil transport and disposal should be considered.

REFERENCES TO OTHER TACTICS

Other tactics associated with On-water Free-oil Recovery include:

- MR Marine Recovery
- DV Diversion Boom
- MST Marine Based Storage and Transfer

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels, boom, skimmers, primary storage devices, and personnel. Configuration type and quantity of strike teams required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Part III MECH.

Open Water Free-oil Recovery System

Typical Equipment	Function	Quantity	Notes
Oil boom, > 42" height	Contain and concentrate oil	1,000 to 3,000 ft.	Depending on configuration and oil concentration
Skimming system(s), open water	Remove concentrated oil	1 minimum	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Enhanced recovery device	Concentrate oil	1 optional	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Primary storage device	Store recovered fluid	2 times the effective daily recovery capacity of the skimming system(s)	Typically large barges or bladders are used for open water systems
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1 or 2	Platform for skimming and handling recovery device	1 or 2	Depending on configuration
Class 3, 4, 5 or 6	Boom towing	1 to 4	Depending on configuration
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open water	Masters of response vessels	2 to 5	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	4 to 7	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians	2 to 5	Depending on number of vessels

TACTIC LIST

	Revision Date
SAFETY	
(1) Site Entry Criteria	April 2006
(2) Personal Protective Equipment	April 2006
(3) Site Layout & Control	April 2006
(4) Personnel Decontamination	April 2006
OIL SPILL SURVEILLANCE & TRACKING	
(1) Plume Delineation, Land	April 2006
(2) Discharge Tracking On Water	April 2006
(3) Aerial Observation Supporting Nearshore Operations	December 2013
MECHANICAL RESPONSE	
Containment and recovery tactics	
(1) Basic Booming Tactics	March 2013
(2) Containment Boom	April 2006
(3) Dikes, Berms & Dams	April 2006
(4) Pits, Trenches & Slots	April 2006
(5) Nearshore Free-oil Recovery	December 2013
(6) On-water Free-oil Recovery	April 2006
(7) On-land Recovery	April 2006
(8) Diversion Boom	April 2006
(9) Marine Recovery	April 2006
(10) Shoreside Recovery	April 2006
(11) Passive Recovery	April 2006
Sensitive area protection tactics	
(12) Exclusion Boom	April 2006
(13) Deflection Boom	April 2006
(14) Beach Berms & Exclusion Dams	April 2006
(15) Cold Water Deluge	April 2006
Primary storage and transfer of recovered products and wastes	
(16) Marine-based Storage & Transfer of Oily Liquids	April 2006
(17) Land-based Storage & Transfer of Oily Liquids	April 2006
(18) Pumping Oily Liquids	December 2013
(19) Towing Alongside	
NON-MECHANICAL RESPONSE	
(1) Dispersant Application	April 2006
(2) In-situ Burning, Oily Vegetation	April 2006
(3) In-situ Burning, On Water	April 2006
(4) In-situ Burning, Pooled Oil	April 2006
LOGISTICS	
(1) Staging Area	April 2006
(2) Vessel Decontamination	April 2006
NEARSHORE OPERATIONS RESPONSE STRATEGY (NORS)	
(1) Planning and Implementation	December 2013
(2) Nearshore Group Logistics Base	December 2013

PERSONNEL CLASSIFICATIONS *RECOMMENDATIONS*

GENERAL TECHNICIAN

◇ Minimal or no field experience in spill response.

◇ Must be physically able to perform the duties assigned (which may include lifting 50 lbs.).

◇ Current respiratory fit test, if required.

◇ Duties associated with mobilization, deployment, and support functions.

◇ Tasks include:

- Boom Deployment. • Loading and unloading equipment. • Assembly of anchor systems.
- Decontamination of equipment. • Assembly of temporary storage devices.

◇ Meets the following annual minimum training requirements:

- HAZWOPER Refresher.

◇ Possesses documentation of:

- Current 24 Hour (or higher) HAZWOPER.
- Current HAZWOPER medical exam, if required.

SKILLED TECHNICIAN

◇ Possesses documentation of minimum training requirements of the General Technician.

◇ Possesses training and experience in spill response.

◇ Usually performs related activities as part of regular employment.

◇ Tasks include:

- Operation of skimmers, power packs, and transfer pumps.

◇ Has training/experience (any combination) with:

- Response equipment deployment and use. • Response tactics and equipment requirements.
- Boat safety, navigation, or operation. • Emergency response management. • Contingency plan familiarization.

◇ Has actual spill response, exercises, field deployment experience:

- Operation of recovery equipment systems. • Decontamination procedures.
- Deployment and use of containment systems.
- Operation of transfer and storage equipment systems.
- Wildlife hazing, capture, and stabilization (field training/experience).

TEAM LEADER

◇ Possesses documentation of compliance with the following minimum training:

- Meets training requirements for General Technician.
- Meets training requirements of Skilled Technician.
- Completed HAZWOPER On Scene Incident Commander or HAZWOPER Management and Supervisor Training.

◇ Categories include Division & Group Supervisors, Task Force Leader, and Strike Team Leader.

◇ Attended training in the actions, responsibilities and tasks associated with incident management.

VESSEL OPERATOR, PROTECTED WATER OR CALM WATER

◇ Possesses documentation of compliance with the following minimum training:

- Meets training requirements for General Technician.
- Meets one of the following criteria:
  - Completion of 40 hours of training/experience on vessels including navigation, charting, vessel electronics, docking, and maneuvering procedures.
  - Current USCG Operator of Uninspected Passenger Vessel (or higher) license.

◇ Tasked with safe operation of vessels under 30 feet in length and designed for operation in protected water or calm water environments or occasionally in conjunction with larger vessels in offshore response.

◇ Duties include:

- Towing and placing containment boom.
- Setting and tending anchors.
- Movement of equipment to remote sites.

VESSEL OPERATOR, OPEN WATER

◇ Possesses documentation of compliance with the following minimum training:

- Meets training requirements for General Technician.
- Meets one of the following criteria:
  - Completion of 40 hours training/experience on vessels larger than 30 feet, including navigation, anchoring, vessel electronics, docking, and maneuvering procedures.
  - Current USCG 25 GT Near Coastal, or larger, license.

◇ Tasked with safe operation of vessels larger than 30 feet designed for sustained operations in an offshore environment.

◇ Duties include:

- Towing of containment boom.
- Working in conjunction with barge containment operations.
- Towing mini-barges.
- Operating skimmers to recover oil.
- Providing management support to offshore operations.

STAGING AREA MANAGER

◇ Knowledge of the primary functions and layout of a Staging Area and the procedures and personnel needed for safe, effective Staging Area operations.

◇ Familiarity with Staging Area purpose and functions (may be covered in ICS training).

◇ Familiarity with Staging Area layout and resource requirements (may be covered in contingency plan training).

◇ Familiarity with roles and responsibilities of Staging Area Management personnel (sometimes covered in contingency plan training).

◇ Familiarity with procedures for safe, effective Staging Area operations and required documentation (may be covered in company's materials management practices).

◇ Familiarity with logistical issues relating to their specific geographic area of operation.

VESSEL CLASSIFICATIONS *RECOMMENDATIONS*

CLASS 1 – OFFSHORE RESPONSE VESSEL

Class 1 vessels are large, deep draft, steel hull vessels generally longer that 150 ft. and over 1,500 HP. These vessels are capable of providing all offshore services required during a response, i.e., major skimming systems, berthing, command vessel, hauling cargo, etc. They generally have large open rear decks, elevated wheelhouses and are USCG inspected. They can be used in any offshore region of Alaska. These vessels may be able to provide limited support services to other vessels in the fleet, i.e., berthing, meals, fuel, water, repair, etc. They are not restricted by seasonal or most sea ice constraints.

CLASS 2 – LARGE RESPONSE VESSEL

Class 2 vessels are slightly smaller that Class 1 vessels, typically less that 150 ft. in length. All have steel hulls with drafts generally less than 12 ft. They can include larger landing crafts, have forward or aft houses, and have adequate deck space for deployment/operation of VOSS systems, boom deployment/towing, and barge assist. They may have limited accommodation space. These vessels may be able to provide limited support services to other vessels in the fleet, i.e., fuel, water, repair, etc. They are not restricted by seasonal or most sea ice constraints.

CLASS 3 – LARGE FISHING/WORK VESSEL

Class 3 vessels are dedicated oil spill response vessels and the largest vessels of the fishing fleet, including large seiners, longliners, gillnet boats, and tenders. They may have steel, aluminum or fiberglass hulls. Deck space is adequate for small skimming system deployment/operation. HP is generally over 400, allowing them to tow boom up to open water size. These vessels may have accommodations, but are usually limited to the vessel crew plus one or two. They are not restricted by seasonal use, but will be restricted in sea ice concentrations over 70% ice cover.

CLASS 4 – SMALL FISHING/WORK VESSEL

Class 4 vessels are smaller fishing vessels, including seiners, longliners, and gillnet boats. They have limited deck space and accommodations. They are well-suited for towing protected water or calm water boom, but can be used for towing ocean boom in areas of lower current speed. These vessels work best in nearshore areas with support from Class 1, 2, or 3 vessels. They are perfect for bays and protected waters. They are shallow draft vessels, made of aluminum or fiberglass, and usually have no additional accommodations. They may be limited by seasonal constraints and are not expected to work in sea ice concentrations over 50% ice cover.

CLASS 5 – GENERAL VESSEL

Class 5 vessels are small, generally less than 30 ft., with no accommodations. These day-use vessels are used for placing and towing protected water or calm water boom in nearshore areas or river mouths. They may be used for scouting, wildlife hazing/capture, and miscellaneous assignments within various on-water task forces. These vessels may be limited by seasonal constraints.

CLASS 6 – WORK BOAT OR SKIFF

Class 6 vessels are work boats, jitneys, skiffs, or other open small boat type vessels, generally with outboard motors and no accommodations. They may be used to handle protected water or calm water boom in nearshore areas or river mouths, and other miscellaneous assignments within on-water task forces. Class 6 vessels are generally not suited for transport/towing/working in exposed waters or handling long arrays of boom.

CLASS 7 – PASSENGER VESSEL

Class 7 vessels are passenger charter vessels designed and licensed to carry passengers such as supervisors, media, or regulatory agency representatives. They are generally for day use and can also be used to support field command/safety staff, wildlife hazing/capture, and logistics.

CLASS 8 – TOW VESSEL

Class 8 vessels are inspected or uninspected towing vessels, designed and equipped for towing large or small barges.

CLASS 9 – DIVE VESSEL

Class 9 vessels are dive vessels, designed or equipped to support diving operations.

CLASS 10 – SALVAGE VESSEL

Class 10 vessels are salvage vessels, designed or equipped to support marine salvage operations.

CLASS 11 – TANK BARGE

Class 11 vessels are tank barges or tank vessels designed and equipped to carry liquid cargoes.

OPERATING ENVIRONMENT CLASSIFICATIONS *RECOMMENDATIONS*

The operating environment classification system used in this manual follows the system used in the World Catalog of Oil Spill Response Products – Eighth Edition.[1] The World Catalog in turn follows the standards of the American Society of Testing and Materials (ASTM), in particular F625-94(2000) Standard Practice for Classifying Water Bodies for Spill Control Systems. Equipment is rated to perform in one of the following operating environments:

Operating Environment	Significant Wave Height	Examples of General Conditions
 Open Water	≤ 6 ft.	Moderate waves, frequent white caps
 Protected Water	≤ 3 ft.	Small waves, some white caps
 Calm Water	≤ 1 ft.	Small, short non-breaking waves
 Fast Water	≤ 1 ft.	Small, short non-breaking waves with currents exceeding 0.8 knots, including rivers
 Broken Ice	≤ 1 ft.	Ice coverage exceeds 10%
 Solid Ice	not applicable	Ice coverage is 100% and is of sufficient strength to support response operations.
 Marsh	not applicable	Marshes are low-lying waterlogged land that are poorly drained and difficult to cross on foot or vehicle.
 Tundra	not applicable	Tundra has permanently frozen subsoil. Tundra is often waterlogged land that is poorly drained and difficult to cross on foot or vehicle.
 Other Land	not applicable	All other land types except Marsh and Tundra.
 Shorelines	not applicable	All shoreline types adjacent to open, protected, calm, and fast water.

NOTES:

Some equipment is transferable between operating environments; flexibility is a key tenet of any oil spill response. Shoreline types and descriptions can be found in the Alaska State/Federal Unified Plan.

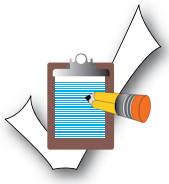
[1] *Potter, Steve, ed. 2004. World Catalog of Oil Spill Response Products. Ottawa, Ontario, Canada: SL Ross Environmental Research Ltd.*

SAFETY CHECKLIST

Everyone working on a spill response must understand that safety is the number one objective. The Safety Officer is responsible for the health and safety of all response personnel in the field, which includes establishing safety zones, personal protective equipment (PPE) requirements, hazard identification, and preparation of Site Safety Plan(s). The Safety Officer also supports establishment of site entry criteria and decontamination facilities. The following checklist is a general safety checklist that should be used by all incident personnel.

General Safety Checklist:

- ☐ Obtain a safety briefing from your supervisor or the Safety Officer before beginning work.
- ☐ Read, understand, and follow the Site Safety Plan developed for the incident.
- ☐ Read the Material Safety Data Sheet (MSDS) for all products that you will be working to contain or remove.
- ☐ In all cases of an unknown chemical, the Safety Officer will assist/verify identification prior to any containment or removal actions.
- ☐ Wear the appropriate personal protective equipment (PPE) as directed by the Site Safety Plan.
- ☐ Assess the safety of the situation on a regular basis. Consider the following types of hazards:
  - ☐ Fire and explosion risk
  - ☐ Chemical exposure
  - ☐ Safety of on-water or on-ice operations
  - ☐ Temperature extremes (i.e., heat stress and hypothermia)
  - ☐ Report any sightings of bears to your supervisor and request a bear guard if appropriate
  - ☐ Other physical hazards, including noise
- ☐ Report any unsafe conditions to your supervisor or the Safety Officer.
- ☐ Report any accidents and/or injuries to your supervisor.
- ☐ Do not attempt any tasks that you are not trained to perform.
- ☐ Use the "Buddy System" in all controlled access areas.
- ☐ Follow decontamination procedures established for the incident.
- ☐ Segregate wastes according to procedure established for the incident, as directed by the Waste Management Plan.
- ☐ Participate in an incident safety critique prior to departing the incident.
- ☐ Maintain integrity of safety zone (hot, warm, cold) to prevent the spread of contamination.



FIELD TEAM LEADER CHECKLIST

Everyone working on a spill response must understand their position, duties, and responsibilities in the response organization. All field teams will work under the Operations Section, led by the Operations Section Chief. Depending on the size and complexity of the incident, the Operations Section may be divided into Division, Branches or Groups. A Field Commander will be assigned to supervise one or more field operations. Field response teams will be assigned to carry out specific tasks under the direction of the Field Commander. **Field response teams may be designated as Task Forces or Strike Teams and will be supervised by a team leader.** The following general checklist has been developed for field team leaders.

General Field Team Leader Checklist:

- ☐ Obtain a briefing from your supervisor before beginning work.
- ☐ Review your work assignment, as directed by ICS Form 204 Field Assignment.
- ☐ Safety is the highest priority; review the General Safety Checklist, including the buddy system.
- ☐ Muster and account for your team. Make sure all team members are checked in to the incident and assigned to your team.
- ☐ Brief your team on the following prior to beginning work:
  - ☐ Safety (see Safety Checklist).
  - ☐ Locations of work assignment, Field Command Post, Staging Area and Decontamination Area.
  - ☐ Weather/Sea conditions.
  - ☐ Current incident situation.
  - ☐ Operational objective(s) and priorities.
  - ☐ Task(s) to be accomplished.
  - ☐ Task(s) assignments.
  - ☐ Communications procedures and schedules (see Communications Checklist).
  - ☐ Equipment check-in and check-out procedures.
  - ☐ Personal protective equipment (PPE) requirements.
  - ☐ Site entry (check-in and check-out) procedures.
  - ☐ Decontamination procedures.
  - ☐ Waste management procedures (see Waste Management Checklist).
  - ☐ Evacuation procedures.
  - ☐ Questions.
- ☐ Verify that your team members have the proper training and certifications for the tasks that they are assigned to accomplish.
- ☐ Establish status report expectations with your supervisor and subordinates, including:
  - ☐ Time.
  - ☐ Location.
  - ☐ Current weather conditions.

- ☐ Status of resources and activities and task force specific information.
- ☐ Additional needs or requirements.

☐ Ensure that there is an escape route and evacuation plan for your team should the situation deteriorate.

☐ Ensure that your team has adequate shelter, food, drinking water, first aid, toilet facilities, transportation, and bear/wildlife guards if appropriate.

☐ Ensure that your team follows communications, site-entry, decontamination, and waste management procedures.

☐ Brief your team members on their responsibilities pursuant to the historic properties checklist, and on any incident-specific historic properties-protection protocols.

☐ Brief your team members on their responsibilities pursuant to the wildlife checklist, and on any incident-specific wildlife-related protocols.

☐ Account for your team members on a regular basis and at the end of your shift.

☐ Conduct a post-shift debriefing of your team and document safety issues and lessons learned.

☐ Maintain a log (such as the ICS Form 214) and turn-in to your supervisor or the Documentation Unit at the end of your shift.

☐ Follow buddy system.

RADIO COMMUNICATIONS CHECKLIST

Radio communications during a spill response are directed by an Incident Communications Plan (ICS Form 205), which is developed by the Communications Unit. Clear and accurate radio communication is critical to a successful response. The following general radio communications checklist has been developed for all response personnel.

General Radio Communications Checklist:

- ☐ Obtain, review, and follow the Incident Communications Plan (ICS Form 205). In some cases communications channels are specified on the Field Assignment Sheet (ICS Form 204).
- ☐ Determine your primary and alternate communications channels.
- ☐ If you are assigned a radio, perform a function test on your assigned channel(s).
- ☐ Obtain extra batteries and/or a battery charger.
- ☐ Establish a communications schedule with your supervisor or the radio dispatcher. Follow the schedule.
- ☐ Establish a procedure for failed communications with your supervisor or the radio dispatcher.
- ☐ Establish a procedure for emergencies with your supervisor or the radio dispatcher.
- ☐ **Use only assigned channels.**
- ☐ Monitor your radio.
- ☐ Minimize all radio communications to essential information.
- ☐ Determine footprint of radio communications, and report if there is a problem.
- ☐ If you are required to use phonetic spelling, use the following system:

A - ALPHA	**J** - JULIET	**S** - SIERRA
B - BRAVO	**K** - KILO	**T** - TANGO
C - CHARLIE	**L** - LIMA	**U** - UNIFORM
D - DELTA	**M** - MIKE	**V** - VICTOR
E - ECHO	**N** - NOVEMBER	**W** - WHISKY
F - FOXTROT	**O** - OSCAR	**X** - X-RAY
G - GOLF	**P** - PAPA	**Y** - YANKEE
H - HOTEL	**Q** - QUEBEC	**Z** - ZULU
I - INDIA	**R** - ROMEO	

WILDLIFE CHECKLIST

Including Oiled or Potentially-Oiled Wildlife

The following considerations apply to all field response personnel *except* those assigned specifically to wildlife-related activities.

General Wildlife Checklist:

- ☐ Be aware that wildlife, including birds, marine mammals (e.g., sea otters, seals, or whales) and terrestrial mammals (e.g., foxes or bears) may be encountered while you are performing field-based response activities.
- ☐ **Do not** approach, disturb, scare, deter, haze, touch, harass, handle, throw objects at, or capture any wildlife, since those activities may be unlawful and must be overseen and/or permitted by appropriate State or Federal wildlife resource agency personnel. In addition, exposure to, or handling wildlife can cause injury and/or illness to the responder.
- ☐ Report all sightings of wildlife, including animal carcasses and live wildlife, to your supervisor, noting the time and location of the observation.
- ☐ Report any sightings of bears to your supervisor, who may in turn, request a bear guard, if appropriate.
- ☐ Follow all incident-specific wildlife-related protocols included in the Incident Action Plan.
- ☐ Additional information on activities related to oiled or potentially-oiled wildlife may be found in Annex G of the Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substances Discharges/Releases (see http://akrrt.org/UnifiedPlan/G-Annex.pdf).

HISTORIC PROPERTIES CHECKLIST

The following general historic properties checklist has been developed for all response personnel.

General Historic Properties Checklist:

- ☐ Be aware that historic properties (also known as historic and prehistoric archaeological resources) may be encountered when you are performing field-based response activities. Because these heritage sites are irreplaceable, the Unified Command has a site identification and protection program to help protect these resources.
- ☐ Historic and prehistoric archaeological resources include a wide range of sites, deposits, structures, ruins, buildings, graves, artifacts, fossils, and other objects of antiquity. It is unlawful to collect or disturb, remove, or destroy any historic property or suspected historic property.
- ☐ If you see historic properties, or if you are not sure, do not touch or disturb them. Instead, immediately report the information (including the location) to your supervisor according to the incident-specific Cultural Resources Policy.
- ☐ In addition to the incident-specific Cultural Resource Policy, information on historic properties protection during an incident may be found in Annex M of the Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substances Discharges/Releases (see http://akrrt.org/UnifiedPlan/M-Annex.pdf) or via the Alaska Regional Response Team web site (see http://akrrt.org/AK_IPG.pdf).

WASTE MANAGEMENT CHECKLIST

The proper handling and disposal of wastes generated during a spill response is directed by an incident-specific Waste Management Plan, which is developed by the Environmental Unit. A Waste Management and Disposal Group may be formed to collect and dispose of generated wastes, but everyone working on the incident is responsible for the proper management of the wastes that they create or recover. The following general waste management checklist has been developed for all response personnel.

General Waste Management Checklist:

- ☐ If you generate or handle waste, you must obtain, review, and follow the Waste Management Plan.
- ☐ Minimize all waste where practical. Reuse or recycle as much as possible.
- ☐ Identify all wastes. If you cannot identify a particular waste, ask for the assistance of your supervisor or a Waste Management Specialist.
- ☐ Do not co-mingle wastes, unless directed to do so. Segregate all wastes into at least the following categories:
  - ☐ *Recovered Liquid Waste*
    - Recovered Oil
    - Recovered Oily Water
    - Recovered Oily Sludge
    - Recovered Oily Liquids mixed with other chemicals
  - ☐ *Recovered Solid Wastes*
    - Oily Snow or Ice
    - Oily Sand, Gravel, or Soil
    - Oily Debris or Vegetation
    - Oily Sorbents, Boom or Personal Protective Equipment
    - Non-oily Debris or Vegetation
    - Animal Carcasses
  - ☐ *Wastes Generated through the Response Effort*
    - Recyclables (corrugated cardboard, newspaper, aluminum cans, glass containers, plastic containers)
    - Sewage or Sanitary Wastes (toilets)
    - Trash (household/office items that are not recyclable)
    - Oily water from Decontamination Processes (wash-down water)
    - Hazardous Wastes (chemicals)
- ☐ Properly store all wastes as directed by the Waste Management Plan.
- ☐ **Do not decant water from recovered fluids without a permit from ADEC.** If decanting is approved, document the amount of water that is decanted on a form provided with the permit and in your log (such as the ICS Form 214).
- ☐ Dispose of all waste in an approved manner. Necessary permits must be obtained for the transportation or disposal of any wastes. Unauthorized disposal will not be tolerated and may result in disciplinary actions.
- ☐ Maintain good housekeeping practices; keep work areas neat and clean.
- ☐ Document quantities of all wastes generated and stored or disposed in your log (such as the ICS Form 214).
- ☐ Ensure all personnel are briefed on hazards, PPE, and safety (see Safety Checklist).

STAGING AREA MANAGER'S CHECKLIST

Under the Operations Section Chief, the Staging Area Manager (SAM) is responsible for managing all activities within the designated staging areas. The SAM is responsible for tracking and accounting for all resources (people, equipment and material) entering or exiting the designated staging area. Review general ICS procedures and common responsibilities.

General Staging Area Manager's Checklist:

- ☐ Receive a briefing on the incident from Operations Section Chief per parent organization procedures.
- ☐ Identify/activate/establish Staging Areas, as required.
- ☐ Establish check-in procedures in coordination with Resource Unit.
- ☐ Organize the Staging Area(s) Layout (coordinated with and assisted by Operations (Site Safety, others), Planning (Environmental, others), and Logistics (Security, Medical, others):
  - ☐ Accommodate incoming equipment, yard equipment, Office/check-in area, break area/s, decontamination and donning, waste accumulation (per Environmental Unit), security/access, equipment storage and maintenance area.
  - ☐ Develop a traffic plan for the movement of resources into and out of Staging Area(s).
  - ☐ Post signs for identification and traffic control. Establish and maintain boundaries of staging areas.
  - ☐ Organize Staging Areas to segregate resources by kind and type. Plan and direct layout and setup of Staging Areas Office(s), and organize support personnel.
  - ☐ Report resource status changes as required.
  - ☐ Maintain Staging Area(s) in an orderly condition.
- ☐ Determine and request logistical support for personnel and/or equipment as needed:
  - ☐ Identify staffing and resource needs to operate Staging Area(s), such as sanitation facilities, feeding, security, lighting, etc.
  - ☐ Arrange for necessary equipment transportation support (including fueling). Request maintenance services for equipment at Staging Area(s) as needed.
- ☐ Respond to requests for resource assignments:
  - ☐ Receive and process resource assignments (resource orders, resource transfer requests) generated by field response personnel (including forms processing) per parent organization procedures.
  - ☐ Work with Communications Unit to establish necessary communications.
  - ☐ Obtain and issue receipts for all response and communications equipment and other supplies issued or received at the Staging Area(s).
- ☐ Respond to requests for reporting and information as required:
  - ☐ Establish direct lines of communications with other Staging Area Manager(s) and the IMT, per parent organization procedures.
  - ☐ Work with Resources Unit and Staging Area personnel to update personnel, equipment, and materials check-in/out status (available resources).
  - ☐ Obtain and issue receipts for supplies distributed and received.
  - ☐ Advise Operations Section Chief/Field Command of all changing situations/conditions on scene.
  - ☐ Report special occurrences or events (e.g., accidents, sickness) per parent organization procedures.

- ☐ Reposition and/or demobilize as needed, and per any Demobilization Plan.
- ☐ Prepare and maintain a log (such as the ICS 214 Unit Log) for significant activities throughout each day of the incident.
- ☐ Maintain and submit all documentation, records, and logs to the Documentation Unit after the incident has been terminated.
- ☐ Demobilize staging area in accordance with incident Demobilization Plan.

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OPERATING ENVIRONMENTS CROSS-REFERENCE TABLE

Spill Tactics for Alaska Responders Cross Reference Table	Operating Environments									
	Water						Land			
	Open Water	Protected Water	Calm Water	Fast Water	Broken Ice	Solid Ice	Marsh	Tundra	Shore-lines	Other
Safety										
Site Entry Criteria	■	■	■	■	■	■	■	■	■	■
Personal Protective Equipment	■	■	■	■	■	■	■	■	■	■
Site Layout & Control	■	■	■	■	■	■	■	■	■	■
Personnel Decontamination	■	■	■	■	■	■	■	■	■	■
Oil Spill Surveillance & Tracking										
Plume Delineation. Land						■	■	■	■	■
Discharge Tracking On Water	■	■	■	■	■					
Aerial Observation Supporting Nearshore Operations		■	■							
Mechanical Response										
Containment and Recovery Tactics										
Basic Booming	■	■	■	■	■					
Containment Boom	■	■	■	■						
Dikes, Berms & Dams						■	■	■	■	■
Pits, Trenches & Slots						■	■	■	■	■
Nearshore Free-oil Recovery	■	■	■							
On-water Free-oil Recovery	■	■	■	■	■					
On-land Recovery						■	■	■	■	■
Diversion Boom	■	■	■	■	■					
Marine Recovery	■	■	■	■	■				■	
Shoreside Recovery		■	■	■	■				■	
Passive Recovery	■	■	■	■	■	■	■	■	■	■
Sensitive Area Protection Tactics										
Exclusion Boom		■	■	■	■					
Deflection Boom	■	■	■	■	■					
Beach Berms & Exclusion Dams									■	
Cold Water Deluge									■	
Primary Storage/Transfer of Recovered Products/Wastes										
Marine-based Storage & Transfer Systems of Oily Liquids	■	■	■	■	■					
Land-based Storage & Transfer Systems of Oily Liquids						■	■	■	■	■
Pumping Oily Liquids	■	■	■	■	■	■	■	■	■	■
Towing Alongside	■	■	■	■	■					
Non-Mechanical Response										
Dispersants	■	■	■							
In-situ Burning, Oily Vegetation							■	■	■	■
In-situ Burning, On Water	■	■	■		■					
In-situ Burning, Pooled Oil						■	■	■		■
Logistics										
Staging Area	■	■	■	■	■	■	■	■	■	■
Vessel Decontamination	■	■	■	■	■					
Nearshore Operations Response Strategy (NORS)										
Planning and Implementation		■	■							
Nearshore Group Logistics Base		■	■							

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SAFETY TACTICS

INTRODUCTION

Safety is the number one objective for spill response operations. Protection of worker health and safety should be a constant consideration throughout the spill response. Section A, Part III of this manual contains a Safety Checklist which should be consulted frequently throughout the response.

The safety tactics in this section are applicable to all spill types and sizes, in all environments. For the purpose of this manual, safety tactics are divided into four main categories, and their sequence in this manual roughly corresponds to the order in which they will be addressed during a spill response.

- ***Site Entry Criteria*** provides guidance on establishing minimum standards for site entry by properly trained spill responders.
- ***Personal Protective Equipment*** provides guidance on protective equipment to be worn during site entry by properly trained spill responders.
- ***Site Layout and Control*** provides guidance on establishing the work site layout and control boundaries for site entry by properly trained spill responders.
- ***Personnel Decontamination*** provides guidance on establishing minimum standards for decontamination by properly trained spill responders.

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SITE ENTRY CRITERIA

OBJECTIVE & STRATEGY

SEC

The objective of this section is to protect worker safety and health by giving guidance on establishing minimum standards for site entry by properly trained oil spill response workers. Safety is always the primary objective of any response.

Either of the following two documents supersedes this guidance:

- **Incident-specific Site Safety Plan**
- **Corporate or Agency safety procedures and training for employees/responders**

This section contains recommended site safety entry guidelines for crude oil/petroleum spill cleanup operations. In all cases, physical hazards of entry must be considered along with health hazards. The exposure limits in this section are based on standards established by the Occupational Safety and Health Administration (OSHA). More restrictive limits may be set by your employer. Verify your exposure limits before site entry.

See references for additional information.

TACTIC DESCRIPTION

General Limits to Entry

The decision as to whether or not any given entry shall be attempted is ultimately the responsibility of the On-Scene Commander with advice and guidance from:

- The Site Safety Officer
- The Field Team Leader
- Unified Command

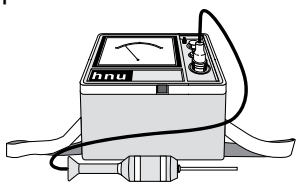
Site Safety Assessment

Before commencing oil spill response operations, a site safety assessment should be completed by a Site Safety Officer, or a properly trained field team member. Once the site safety assessment is completed, the proper level of Personal Protective Equipment (PPE) will be determined.

The following are four levels of respiratory protection for entry into varying conditions listed in descending order of protection. Other PPE, such as splash suits, hard hats, safety glasses, steel-toed boots,

Site Entry Criteria

etc., will also be needed, depending on the situation, to ensure the health and safety of the responders. It is required to consult with a "competent person" for job specific PPE requirements. All employees must have had the necessary training pertaining to their tasks prior to entering any site.



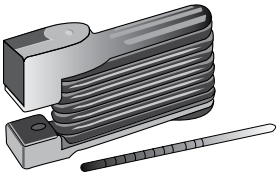
Please note that the recommended levels reflect a 12-hour shift.

*Level A – Highest Level of Protection**

Entry by two or more workers dressed in fully-encapsulated suits and SCBAs is allowed under the following conditions:

- Back-up observers with SCBAs standing by
- Oxygen atmospheric concentration should be below 23.5%
- Percentage of LEL is less than 10% as measured by a calibrated direct reading handheld instrument

*Level B**



Entry by two workers with SCBAs is allowed under the following conditions:

- Back-up observers with SCBAs standing by
- Oxygen atmospheric concentration should be below 23.5%
- Percentage of LEL is less than 10% as measured by a calibrated direct reading handheld instrument
- Normal natural or mechanical ventilation is available
- No visible mist or fog of oil present

Level C

Entry with full-face or half-face air purifying respirator and organic vapor cartridges is allowed by any number of workers without back up observers under the following conditions:

- Oxygen atmospheric concentration is between 19.5% and 23.5%
- Percentage of LEL is less than 10% as measured by a calibrated direct reading handheld instrument
- Total hydrocarbon concentration is less than 500 ppm
- H2S air concentration is less than 10 ppm
- Benzene air concentration:
  - Full-face respirator - less than 10 ppm
  - Half-face respirator - less than 5 ppm

*NOTE: When available, positive-pressure supplied air respirators with an escape SCBA can be used instead of SCBAs.

- Normal natural or mechanical ventilation is available
- No visible mist or fog of oil present

Level D – Lowest Level of Protection

Entry without respiratory protection is allowed for any work required under the following conditions:

- Oxygen atmospheric concentration is between 19.5% and 23.5%
- Percentage of LEL is less than 10% as measured by a calibrated direct reading handheld instrument
- Total hydrocarbon concentration is less than 50 ppm
- H2S air concentration is less than 10 ppm
- Benzene air concentration is less than 0.6 ppm
- Normal natural or mechanical ventilation is available
- No visible mist or fog of oil is present

Note that in environments in which excess dust and debris are present, an organic vapor/high efficiency particulate air filter is recommended (OV/HEPA).

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

- A trained person using properly calibrated equipment must conduct air monitoring prior to and periodically during response operations, and as necessary when conditions change.
- If permissible entry conditions change outside of allowable criteria during entry, the entry must be terminated.
- The team conducting the site assessment should enter the site from an upwind or cross-wind aspect and progress slowly. After the airborne flammability, oxygen, and toxicity have been determined, the team should assess the site's chemical and physical hazards so that proper decisions can be made regarding PPE and other safety and health issues.
- Respiratory protection should only be worn by responders operating under respirator operating procedures (i.e., regular training, fit-testing, medical monitoring, inspection, cleaning, storage and periodic program evaluations) as required by OSHA 29 CFR 1910.134.

REFERENCES TO OTHER TACTICS

- PPE • Personal Protective Equipment
- SCL • Site Layout & Control
- Dp • Personnel Decontamination

Site Entry Criteria

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PERSONAL PROTECTIVE EQUIPMENT

OBJECTIVE & STRATEGY

The objective of this section is to protect worker safety and health by giving guidance on selecting Personal Protective Equipment (PPE) to be worn during site entry by properly trained oil spill response workers. Safety is always the first objective of any response. Either of the following two documents supersedes this guidance:

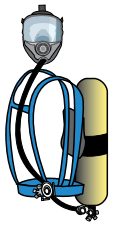
- Incident-specific Site Safety Plan
- Oil Spill Response Organization safety procedures and training for employees/responders

The following are recommended PPE guidance for crude oil/ petroleum spill cleanup operations.

Personal Protective Equipment is designed to protect workers from safety and health hazards, and to prevent injury resulting from incorrect use and/or malfunction of equipment. In general, the greater the level of risk, the greater the level of PPE required.

TACTIC DESCRIPTION

Personal Protective Equipment includes:



- Respiratory protection with respirators: Self Contained Breathing Apparatus (SCBA), air-purifying respirator
- Skin protection: full body covering including protective clothing with appropriate gloves and boots
- Eye protection with safety glasses, goggles, and/or face shields

- Head injury protection with a hard hat
- Thermal protection, as required, with cold weather clothing, including steel-toed footwear or arctic boots

- Hearing protection with earplugs or earmuffs

PPE is divided into four categories based on the level of personal protection afforded:

- **Level A** provides the greatest level of skin, respiratory and eye protection.
- **Level B** offers the highest level of respiratory protection but lesser level of skin protection (e.g., skin protection is required for exposure to liquids but not vapor).

Personal Protective Equipment

- **Level C** is used when concentrations and types of airborne substances are known and the criteria for using air-purifying respirators are met.
- **Level D** consists of work clothing affording minimal protection, used for nuisance contamination only.

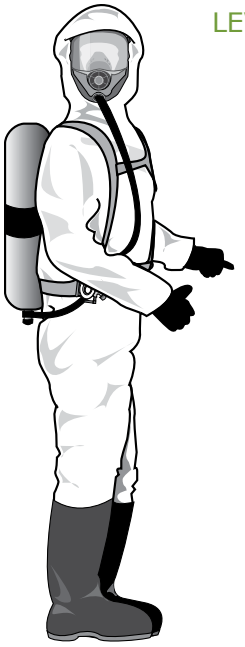
Most spill site workers will use Levels C and D.

Personal Protective Equipment Categories

Note: * indicates optional equipment.

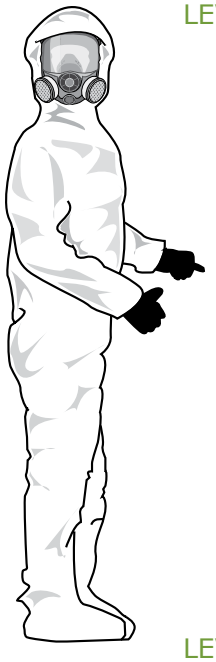
LEVEL A – HIGHEST LEVEL OF PROTECTION

- SCBA or positive-pressure, supplied-air respirator with escape SCBA
- Totally encapsulating chemical-protective suit with vapor barrier
- Coveralls*
- Long underwear*
- Gloves - outer, chemical resistant*
- Gloves - inner, chemical resistant
- Boots - chemical resistant, steel toe and shank
- Boot covers*
- Hard hat (under suit)*
- Disposable protective suit, gloves, and boots (may be worn over or under encapsulating suit depending on suit design)
- Hearing protection*



LEVEL B

- SCBA or positive-pressure, supplied-air respirator with escape SCBA
- Hooded chemical-resistant clothing (overalls and long-sleeved jacket coveralls; one- or two-piece chemical splash suit; disposable chemical-resistant overalls). May also be encapsulating.
- Coveralls*
- Gloves - outer, chemical resistant
- Gloves - inner, chemical resistant
- Boots- chemical resistant, steel toe and shank
- Boot covers*
- Hard hat*
- Face shield*
- Hearing protection*
- Personal Flotation Device (PFD)*



LEVEL C

- Full-face or half-face mask air-purifying respirators with appropriate cartridges
- Chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls.)
- Coveralls*
- Gloves - outer, chemical resistant
- Gloves - inner, chemical resistant
- Boots - steel toe and shank as appropriate to spilled product
- Boot covers*
- Hard hat*
- Face shield*
- Hearing protection*
- Personal Flotation Device (PFD)*

LEVEL D – LOWEST LEVEL OF PROTECTION

- Coveralls
- Gloves*
- Boots/shoes - steel toe and shank as appropriate to spilled product
- Boot covers*
- Safety glasses or chemical splash goggles
- Hard hat
- Hearing protection*
- Face shield*
- Personal Flotation Device (PFD)*

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

- Maintaining adequate supplies of PPE is often a logistical challenge; Team Leaders should provide the Supply Unit with anticipated PPE needs in advance and on a regular basis.
- Respiratory protection should only be worn by responders operating under respirator operating procedures (i.e., regular training, fit-testing, medical monitoring, inspection, cleaning, storage and periodic program evaluations) as required by OSHA 29 CFR 1910.134.

Personal Protective Equipment

REFERENCES TO OTHER TACTICS

- SEC • Site Entry Criteria
- SCL • Site Layout & Control
- Dp • Personnel Decontamination

SITE LAYOUT & CONTROL

OBJECTIVE & STRATEGY

SCL

The objective of this section is to protect worker safety and health by giving guidance on establishing the work site layout and control boundaries for site entry by properly trained oil spill response workers. Safety is always the first objective of any response. Either of the following two documents supersedes this guidance:

- Incident-specific Site Safety Plan
- Oil Spill Response Organization safety procedures and training for employees/responders

This section contains recommended site layout and control guidelines for crude oil/petroleum spill cleanup operations. In all cases, physical hazards of entry must be considered along with health hazards.

TACTIC DESCRIPTION

Control boundaries must be established for any spill site to ensure that workers and the public are not exposed to the spilled substance. Three distinct zones should be established by the Site Safety Officer around the spill site:

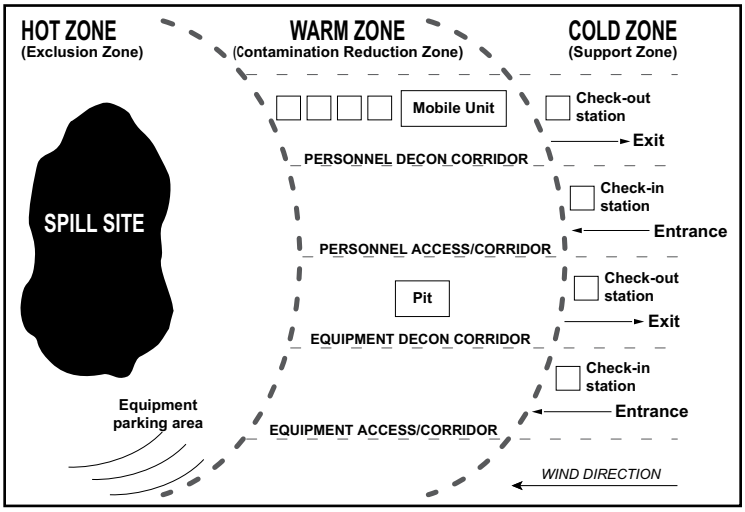


Figure SLC-1. Spill site zones layout.

- **Hot Zone or Exclusion Zone** — control zone perimeter established by the Safety Officer where site safety assessment and site entry criteria have been applied.
- **Warm Zone or Contamination Reduction Zone** — allows for a orderly transition from the Hot Zone to the cold zone: workers shed contaminated clothing, equipment and personnel are decontaminated.
- **Cold Zone or Support Zone** — free of contamination: support facilities, staging area, warm-up trailer, bathroom facilities, and mobile command post.

Site Layout & Control

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

The following guidance should be considered when establishing site layout and control:

- The Hot Zone should be as small as possible to prevent the spread of contamination, but large enough to accommodate emerging conditions, such as migration of the spilled product or changes in the direction of the wind.
- The Hot Zone should provide for parking/storage of contaminated equipment in order to minimize decontamination until the work is completed.
- Walking boards or other type of traffic control will assist in minimizing the spread of contamination with the Hot Zone.
- To the extent possible, warm zone facilities should be located up-wind and up-hill from the Hot Zone.
- Security should be established around the Hot and Warm Zones to protect the public health and safety.
- Check-in/check-out procedures should be established for all personnel and equipment entering the Hot Zone.
- If the PPE for the site is designated as Level A or B, the "buddy system" should be used to account for all personnel in the Hot Zone.
- For on-water operations, the Warm Zone may be on the deck of a support vessel, with the Hot Zone on one side of the vessel and the Cold Zone on the opposite side.
- All eating and living areas must be kept in the Cold Zone.
- Keep in mind that the Site Layout and Control Plan may be implemented into the Safety Plan, Waste Management Plan, and the Decontamination Plan. Coordination with staff developing these plans could save duplication of work.

REFERENCES TO OTHER TACTICS

- SEC • Site Entry Criteria
- PPE • Personal Protective Equipment
- Dp • Personnel Deconamination
- Dv • Vessel Decontamination

PERSONNEL DECONTAMINATION

OBJECTIVE & STRATEGY

Dp

The objective of this section is to protect worker safety and health and prevent the spread of contamination. This section provides guidance to be used in establishing minimum standards for decontamination by properly trained oil spill response workers. Safety is always the first objective of any response. Either of the following two documents supersedes this guidance:

- Incident-specific Decontamination Plan (usually part of the Site Safety Plan)
- Oil Spill Response Organization decontamination procedures and training for employees/responders

The following are recommended decontamination guidelines for crude oil/petroleum spill cleanup operations.

TACTIC DESCRIPTION

Decontamination involves the removal of oil or other contaminants from personnel or equipment after they leave the Hot Zone. The purposes of decontamination are to:

- Minimize worker contact with contaminants.
- Prevent spread of contaminants to clean areas and exposure to personnel there.
- Remove contaminants from equipment to allow its reuse.

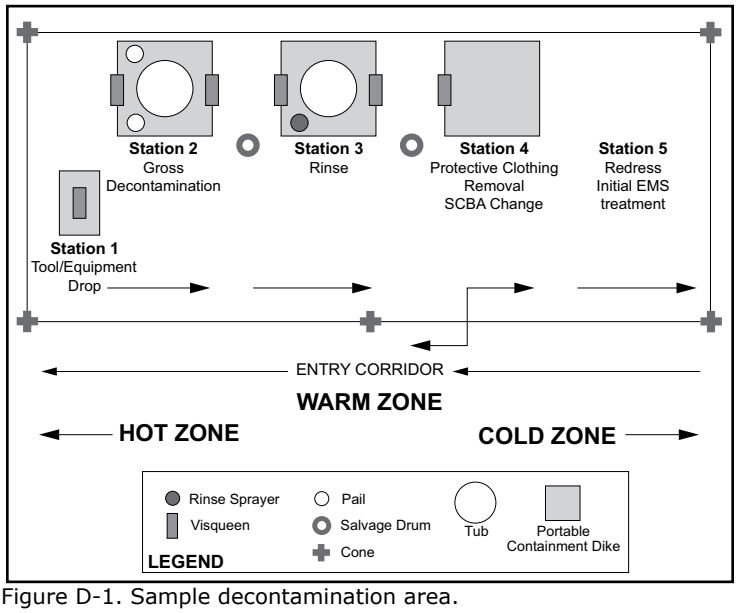


Figure D-1. Sample decontamination area.

Decontamination is conducted in the Warm Zone, which is the control point for personnel and equipment entering and leaving the Hot Zone. Decontamination is divided into four categories based on the level of personal protective equipment (PPE) being used for the spill zone. In general, personnel and equipment move through

various steps of decontamination to ensure that gross contamination is removed first, and that uncontaminated clothing/equipment do not become contaminated by the decontamination process. Flow charts are presented below for each of the four levels of protection, with the highest level being Level A.

Level A

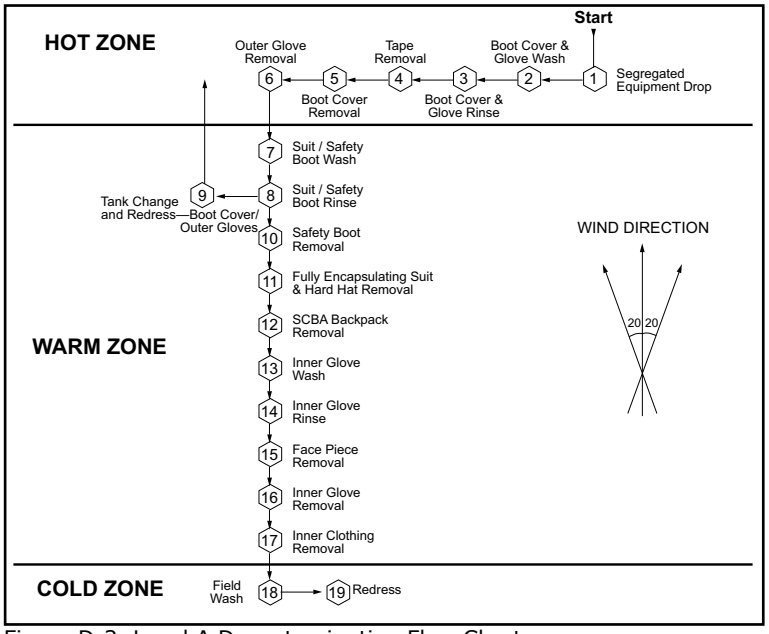


Figure D-2. Level A Decontamination Flow Chart.

Level B

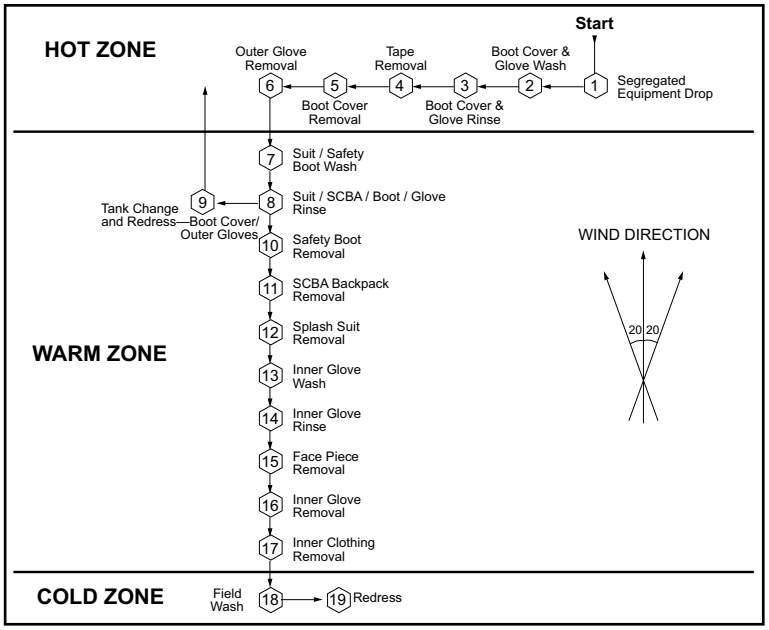


Figure D-3. Level B Decontamination Flow Chart.

Level C

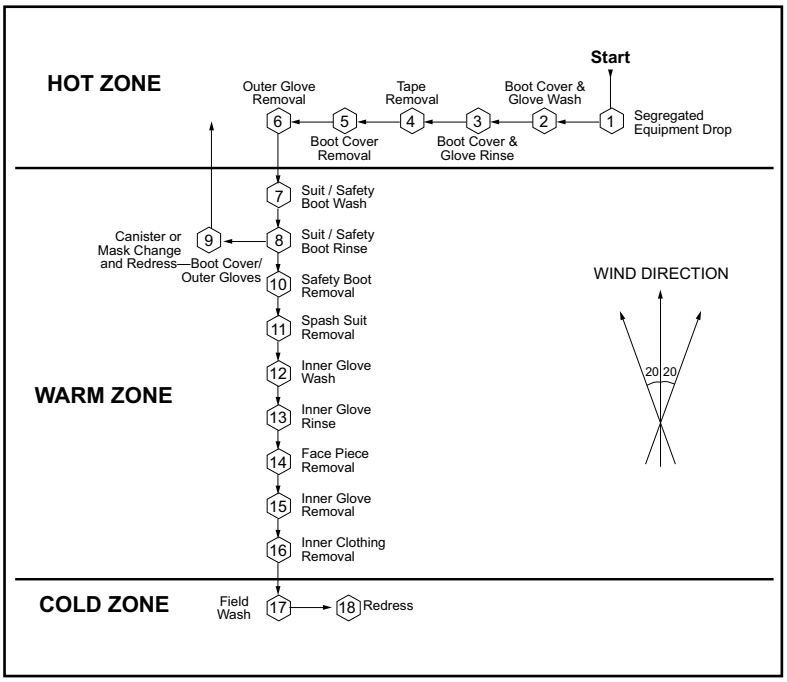


Figure D-4. Level C Decontamination Flow Chart.

Level D

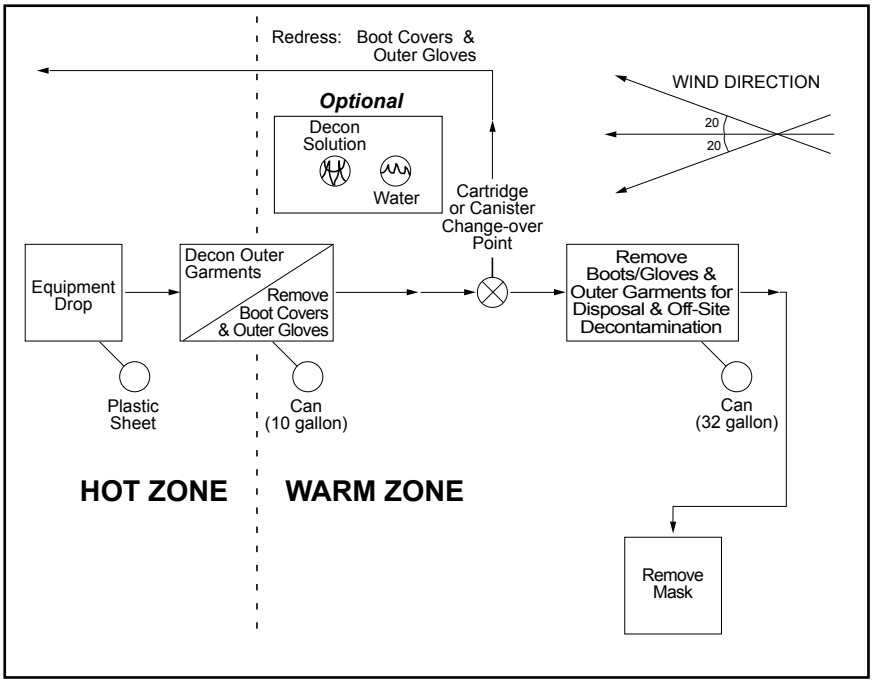


Figure D-5. Level D Decontamination Flow Chart.

Personnel Decontamination

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

- Plan for containment, collection, and disposal of contaminated solutions and wastes generated from decontamination.
- Develop separate decontamination processes for heavy equipment and machinery to prevent cross-contamination of personnel.
- Separate decontamination stations to prevent personnel cross-contamination.
- Develop distinct entry and exit points, and physically separate entry paths from contaminated area to clean area and vice versa.
- Establish procedures for minimum decontamination for restroom use and medical emergencies.
- Locate medical/first aid stations to avoid exposure to contaminants.
- Stress the use of extra steps to avoid contact with or handling of contaminants.
- Wrap sampling/monitoring equipment in disposable see-through plastic bags.
- Where possible, use disposable protective clothing and equipment, such as PPE and chemical-protective clothing (CPC).
- Use strippable coatings for equipment where possible.
- Use double containerization of contaminated wastes and recovered materials (e.g., plastic liners in overpack drums).
- Inspect all PPE/CPC for cuts, tears, punctures, abrasions, and other signs of deterioration prior to use or reuse.
- Assure proper fastening and sealing of CPC and PPE.
- First-stage decontamination personnel must wear the same, or one level lower, PPE as clean-up workers.
- Consider placing containment boom around vessels where on-water decontamination is performed.
- Consider placing containment boom along shoreline where decontamination is performed adjacent to a water body.
- Use plywood walking board, or other similar material to establish pathways for heavy foot traffic areas.

Personnel Decontamination

REFERENCES TO OTHER TACTICS

- SEC • Site Entry Criteria
- PPE • Personal Protective Equipment
- SCL • Site Layout & Control
- Dv • Vessel Decontamination

EQUIPMENT AND PERSONNEL RESOURCES

Resources required for decontamination and decontamination setup will depend on the following:

- Availability of potable water, electric power, and waste disposal.
- Mobilization time and duration of site activities.
- Level and type of cleanup and response activity expected at site, and site conditions.
- Available space for decontamination setup and location requirements for decontamination line.
- Health hazards presented by contaminants at cleanup/response site.
- Need for additional controls (e.g., vapor diffusion/dispersion, movement/transfer of gross waste).

Typical Decontamination Equipment and Personnel Needs for Level C and D

Dp

Typical Equipment	Function	Quantity	Notes
Wash tubs, scrub brushes, disposable rags	Decontamination	>3	
Portable decon berm	Decontamination	>4	
Galvanized bucket	Decontamination	>2	
Sprayer	Decontamination	>2	
Salvage drum	Decontamination	>2	
Traffic cone	Designate decon area	>4	
Caution tape	Designate decon area	>2 rolls	
Visqueen	Decon area	> 1 roll	
Trash cans (with liners)	Waste receptacle	>1	
Oily waste dumpster	Waste receptacle	1	
Light plant/generators	Illumination/power	>1	
Portable building/tent/heater	Keep personnel warm and dry	Optional	
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Skilled Technicians	Crew vessels and operate response equipment	1 to 2	
General Technicians	Work under the direction of skilled technicians	2 to 10	

Personnel Decontamination

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OIL SPILL SURVEILLANCE & TRACKING

INTRODUCTION

Before spill response tactics are selected and equipment deployed, spill management personnel must first have a clear picture of the geographic extent and movement of the spilled oil. The location, thickness, and movement of the oil must be regularly and accurately defined.

This section contains two tactics to assist spill managers in surveying and tracking spilled oil.

- ***Plume Delineation*** describes the tactics and equipment used to determine the size, shape, and trajectory of an oil spill on land.
- ***Discharge Tracking On Water*** describes the tactics and equipment used to track the movement of an oil slick on the water's surface.

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PLUME DELINEATION, LAND

OBJECTIVE & STRATEGY

PD

The objective of the Plume Delineation tactic is to determine the extent and trajectory of an oil spill plume both on the surface and subsurface. This tactic may be used on land and on solid ice.

The general strategy used in performing Plume Delineation is to:

1. Identify the approximate location of the spill.
2. Assess the site characteristics and determine equipment and personnel needs.
3. Deploy equipment and personnel to the location.
4. Commence delineation operation.
5. Repeat as necessary to determine oil movement and trajectory.

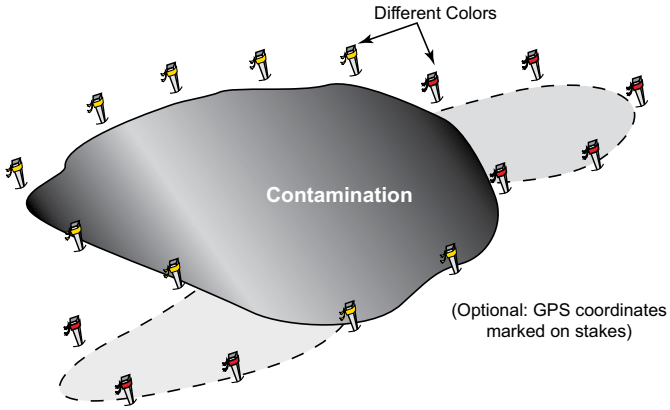

Figure PD-1. Marking different layers in the plume.

TACTIC DESCRIPTION

When oil spills on land or solid ice it behaves in predictable ways; it will begin to spread laterally and it will sink through soil or snow. Given sufficient quantity and time, the plume will migrate down until it reaches an impermeable layer or a water table. The oil plume will migrate over time, driven by topography, wind, and water movement. The rate and direction of oil plume movement is dependent on the characteristics of the oil, air temperature, soil temperature, water table hydrology, and the permeability of the soil.

The extent and movement of the sub-surface oil plume can be very different from the surface plume. Oil spilled on porous gravel may show little surface contamination, yet sink to a flowing water table and spread over a large area. Oil spilled on a wetland will usually remain on the surface, floating on the water-saturated soil. Oil spilled on solid ice may find its way through cracks, reach the water below, and migrate away from the surface site. Oil deposited on a mixed sand and gravel shoreline may sink down to a fine sand layer, migrate down slope, and resurface on an incoming tide. Oil spilled during the winter may be covered by subsequent snowfall or wind blown drifting snow.

Plume Delineation, Land

The purpose of the Plume Delineation tactic is to use simple methods to quickly assess the spatial extent of surface and subsurface oil to aid in response planning during the emergent phase of the spill response. Repeating the delineation will establish the direction and rate of any movement of the plume, establishing a trajectory. A more detailed quantification of the spill plume for the cleanup and remediation phases of the response may be required and those techniques are not covered in this manual.

Operating Environments

Plume Delineation can be used in the following operating environments:


- Solid Ice,


- Marsh,


- Tundra,


- Shoreline, and


- Other Land.

Deployment Configurations

THE SPILL PLUME IS VISIBLE AND ACCESSIBLE

The tactic is deployed by mapping the edges of the plume. If the plume has distinctly different levels, layers, or concentrations, then each facet of the plume is mapped separately. The edges of the plume are marked and labeled with surveyor's stakes, wooden laths, or something similar (Figure PD-1). Different color paint or flagging tape may be used to indicate different layers or concentrations in the plume. Simultaneously, a record is made of the location of each stake with a handheld GPS. This may be done by setting waypoints in the GPS, using the same label as marked on the stakes. The same GPS may be used to record a track of the plume edge. A hand drawn map is sketched in the field to assist in developing final maps with the aid of computer software. The Situation Unit in the Planning Section may have map software. Repeating the delineation procedure after a period of time has passed will aid in the assessment of the direction and rate of movement of the spill.

One or two crews walk around the perimeter of the spill, placing stakes in the ground every 50 to 100 feet while recording the stake locations with a handheld GPS. Setting waypoints on the GPS is a convenient way to record the stake locations. Once the stakes are set, a track of the spill edge can be recorded with the GPS. Many GPS have a function to calculate the area of a track that forms an enclosure. Digital photographs of the site, taken from several perspectives after the color-coded stakes are in place, are also very useful.

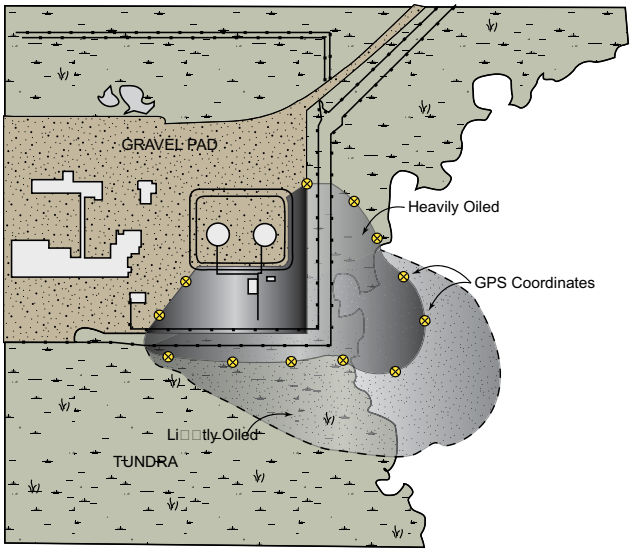

Figure PD-2. Plan view of plume delineation map.

For large spills, an ATV or snow vehicle can be used to assist in moving around the spill, if vehicle use is approved and will not damage the environment. Very large spills may require a helicopter.

An initial hand-drawn sketch is best drawn on a topographic map, as-built survey, aerial photograph, or other depiction of the site. Contingency plans usually have line drawings and maps of facilities. The sketch should have as much detail and labeling as possible. Make sure to note the time, date, and person making the drawing. The sketch can be used to produce more precise maps when combined with GPS data (Figure PD-2).

THE SPILL PLUME IS NOT VISIBLE

If the perimeter of the spill cannot be seen, because it is below ground or under snow or ice, then a different approach is required. First assess the probable location of the spill and the surrounding terrain to determine the likely migration path of the plume. In this case a grid may be used to delineate the plume (Figure PD-3). The grid is first laid out from a starting point where the spill is known or suspected to have occurred. From this origin, the grid is set in all directions. The grid is established with stakes set a consistent distance apart. If the spill is thought to be less than an acre in size, the grid should be set on a 25 foot spacing. If the spill is over one acre, the grid spacing can be increased accordingly.

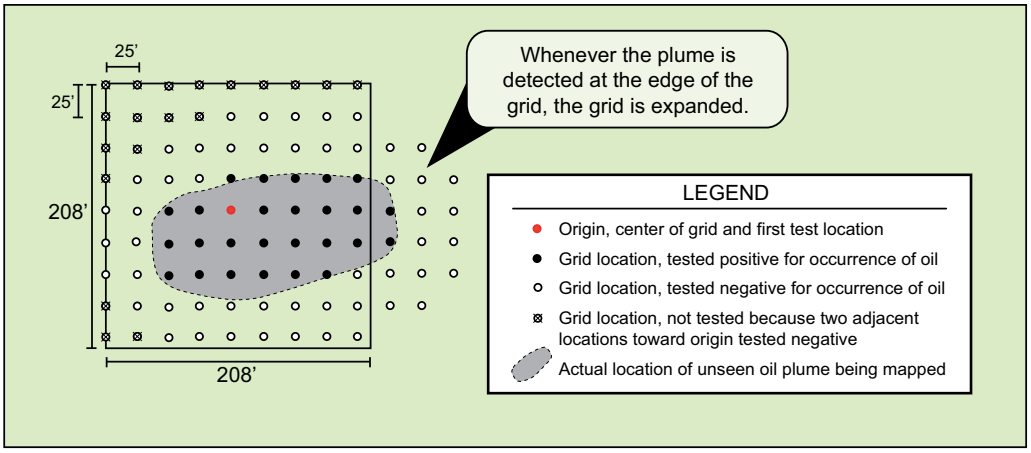

Figure PD-3. Plume Delineation using a grid for a location about one acre in size.

Plume Delineation, Land

Once the grid is established, a method to test for the occurrence of oil must be established. The method usually involves digging or drilling a hole to the water table or some pre-determined depth to assess for the presence of oil. Other remote sensing technology, such as infrared cameras or Photo Ionization Detection (PID), can be used. The test method is first applied at the origin/center of the grid and then to adjacent grid locations in a systematic fashion. If oil is not detected at the origin, re-assess the most likely location of the spill and re-set the grid if necessary. If oil is detected, the adjacent untested grid locations are tested too. When an adjacent location tests negative for oil, its adjacent locations are also tested. When two successive locations test negative for oil, subsequent locations in the direction away from the oil are not tested. If a location on the edge of the grid tests positive for oil, then the grid must be expanded. This tactic may have to be modified depending on the terrain and situation.

Once the tests are completed, the stakes marking the grid locations should be color coded to indicate if they were tested and if so, the results of the test. A hand sketch and digital photographs, as described above, should also be completed for the site.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- PPE is required of all personnel in the Hot Zone; consult the incident-specific Site Safety Plan for requirements.
- Worker exposure to contaminants should be minimized.
- The buddy system should always be used in the Hot Zone.
- If heavy equipment is used, a spotter should be present.

DEPLOYMENT

- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics that may be involved in Plume Delineation include:

- PPE Personal Protective Equipment
- SEC Site Entry Criteria
- Dp Personnel Decontamination

EQUIPMENT AND PERSONNEL RESOURCES

PD

Resources for delineating a plume include hand-held GPS, a digital camera, a diagram or map, marking pens/pencils, log book, paint or flagging tape, stakes, and a hammer to drive stakes. If the oil is not visible, test holes will have to be dug with an auger, rock drill, excavator, or other equipment suitable to the situation.

Equipment	Function	Quantity	Notes
Hand held GPS	Determine locations	1 or more	Personnel should be familiar with operation for the model and the Situation Unit should be capable of downloading data from the GPS. Extra batteries and antenna.
Digital camera	Capture images of the stakes, once color coded	1	Extra batteries and media.
Surveyor stakes or equivalent	Marking the edge of the plume or locations in a grid	100 for a one acre spill, more if the spill is larger	Make sure the stakes are long enough to be seen above snow, grass and terrain
Paint or flagging tape	Color coding stakes	4 different colors	Bright colors work best
Log book and maps or diagrams	Taking notes, drawing sketches, and recording data	As necessary	
Hand tools	Driving stakes, digging holes, clearing brush	Situation specific	
Digging system (hand tools, auger, rock drill, excavator, or other)	Digging holes to determine the presence of oil	Situation specific	Only needed if subsurface oil is to be detected
Vessel/Vehicles	**Function**	**Quantity**	**Notes**
ATV or Snow Vehicle with or without a trailer	Access the site and move around the perimeter of the spill	1 to 2 optional	Vehicles should only be used if they will not cause damage to the environment
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations under the Direction of the Operations Section Chief	1 or more	Should be trained in plume delineation
Skilled Technicians	Work under the direction of Field Team Leader	1 to 2	Depending on situation/activities
General Technicians	Work under the direction of Skilled Technician	0 to 3	Depending on size of spill
Operators	Operate heavy equipment or drilling equipment	0 to 3	Depends on equipment utilized

Plume Delineation, Land

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DISCHARGE TRACKING ON WATER

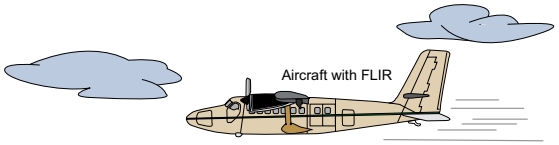
OBJECTIVE & STRATEGY

DT

The objective of the Discharge Tracking On Water tactic is to determine the extent and trajectory of an oil spill slick on the surface of the water.

The general strategy used in performing Discharge Tracking On Water is to:

1. Identify the approximate location of the spill.
2. Assess the site characteristics and determine equipment and personnel needs.
3. Deploy equipment and personnel to the location.
4. Commence tracking operation.
5. Repeat as necessary to determine oil movement and trajectory.



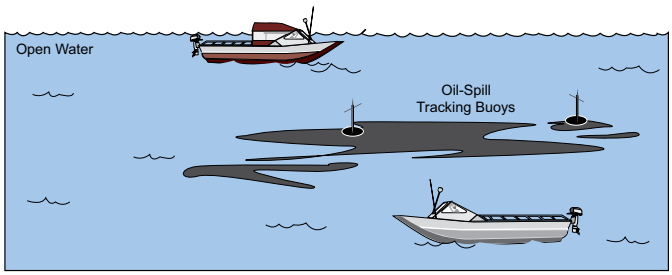


Figure DT-1. Discharge Tracking using aircraft, marine vessel viewing platforms, and tracking buoys.

TACTIC DESCRIPTION

One of the first steps in a response to an oil spill on the water is to assess the location, character and spatial extent of the oil slick. When oil spills on water it behaves in predictable ways; it will begin to spread laterally and it will begin to change character through a process called weathering. The oil slick will move and change shape and size over time, driven by wind, sea state, currents, and tides. Weathering is caused by evaporation, dissolution, dispersion, and emulsification. The rate of weathering is dependent on the characteristics of the oil, wind, sea state, air temperature, water temperature, and exposure to sunlight.

The purpose of the Discharge Tracking On Water tactic is to use simple methods to quickly assess the spatial extent of surface oil to aid response planning during the emergent phase of the spill response (Figure DT-1). Repeat observations will establish the direction and rate of movement of the slick, establishing a trajectory. The process of predicting the movement and weathering of oil using vector analysis or computer modeling is not covered in this manual.

Discharge Tracking On Water

The best and most direct method of tracking oil slicks is by direct observation. Oil spill observations should be done by a trained observer using an aircraft or marine vessel as a viewing platform. No other method can accurately document the location, shape, size, thickness, coverage, state of weathering, and trajectory of an oil slick. Aircraft, either fixed-wing or rotary-wing, are the most common viewing platforms. Fixed-wing aircraft usually travel farther and faster than rotary-wing aircraft and allow for a rapid assessment over a larger area. Rotary-aircraft can fly slower and lower, allowing the observer a better view of the slick. After site characterization has taken place, marine vessels can be used to make direct observations, but the observer does not have the advantage of perspective available from an aircraft. However, an observer aboard a marine vessel can actually sample the oil and better assess its consistency and thickness and is less likely to misidentify other naturally-occurring slicks as oil. It is useful to have correlated aerial and marine observations taken at the same time and place.

Aerial and marine observations should be made by a team of observers comprised of representatives of each organization in the Unified Command (RP, FOSC, SOSC). The observation team should strive for consensus agreement on the area, type, and thickness of the oil observed to negate later disagreements about what was observed.

If the oil slick cannot be directly observed, due to non-availability of aircraft or vessels, visibility, darkness, or remoteness, then indirect methods, such as infrared technology or tracking buoys, may be used. These indirect methods are useful to keep track of the slick until direct observations can be made.

Operating Environments

Discharge Tracking On Water can be used in the following operating environments:


- Open Water,

- Protected Water,


- Calm Water,


- Fast Water, and


- Broken Ice.

Deployment Configurations

THE SPILL SLICK IS VISIBLE

If the oil spill is visible and accessible, it should be assessed and mapped by a trained observer. If the slick has distinctly different thicknesses, as evidenced by different colors, then each thickness of the slick is mapped separately. Repeating the observation procedure after a period of time has passed will aid in the assessment of the direction and rate of movement of the spill. The accuracy of the

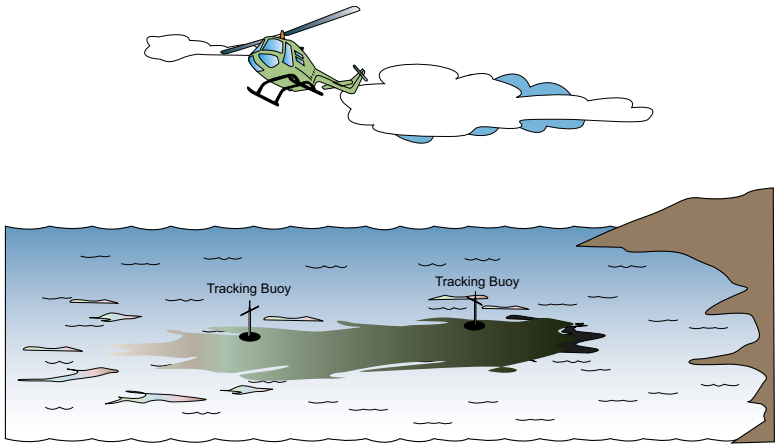


Figure DT-2. Discharge Tracking using tracking buoys.

technique is largely dependent on the experience and training of the observer. NOAA has developed an Open-Water Oil Identification Job Aid for Aerial Observation which includes: checklists, example photographs and sketches, and coverage charts. Other oil observation standards have been developed by the American Society for Testing and Materials (ASTM) International.

If the oil slick is reasonably continuous, a track of the edge of the slick can be recorded with the GPS. Many GPS have a function to calculate the area of a track that forms an enclosure. Digital photographs of the slick, taken from several perspectives, are also very useful.

An initial hand-drawn sketch is best drawn on a nautical chart, topographic map, aerial photograph, shoreline map or other depiction of the area. The sketch should have as much detail and labeling as possible. Make sure to note the time, date, and person making the drawing. Logs, GPS data, maps, and photographs of oil slick observations should be given to the Situation Unit in the Planning Section as soon as possible.

THE SPILL SLICK IS NOT VISIBLE

If the oil slick cannot be seen, because of fog, darkness, or lack of an observation platform, then a different approach is required. Two alternative methods are observation with the aid of infrared technology and tracking buoys.

Infrared technology involves using an infrared camera to detect the difference in temperature between the oil slick and the surrounding water. As the slick spreads and cools to the ambient temperature, infrared technology becomes less effective. Infrared cameras are available as handheld and fixed/mounted devices. Infrared sensors can be an effective remote sensing system when mounted on an aircraft, vessel, or helicopter. Using infrared technology requires training specific to the system in use and works best when calibrated by comparison with visual observations. Use the same procedures described above to map the slick when using infrared technology.

Discharge Tracking On Water

Tracking buoys are another alternative to visual tracking of oil slicks on the water (Figure DT-2). Tracking buoys are floating radio devices that broadcast a signal, which can be used to remotely locate the buoy. Some buoys contain a GPS device that allows a very precise location. Some tracking buoy systems transmit to portable radio receivers and other systems transmit to satellites. If the tracking buoy remains within the slick, then relocating the oil spill is greatly simplified. Unfortunately, experience has shown that tracking buoys often do not remain within an oil slick. Tracking buoys do not indicate the thickness, area, coverage, or consistency of the oil slick.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- PPE is required of all personnel in aircraft and marine vessels, see the incident Site Safety Plan and check with the aircraft operator for PPE and PFD requirements.
- Flight following procedures should be observed for all observation aircraft.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.

DEPLOYMENT

- Consider wildlife impacts.
- The time on digital cameras used for aerial surveys should be set to coincide with the GPS or a photograph of the GPS time can be taking allowing the time tags on the photographs to be adjusted later.
- All GPS used for surveys should be set to the same datum, i.e. NAD 27, NAD 83, or WGS.
- It is best to have multiple observers from different organizations on aerial surveillance flights. The surveillance team should strive for "consensus of observations", resulting in a single report (map, GPS tract, etc.) being given to the Situation Unit or Documentation Unit.

REFERENCES TO OTHER TACTICS

Other tactics that may be involved in Discharge Tracking On Water include:

- ISw In-Situ Burning on Water
- DS Dispersant Application

EQUIPMENT AND PERSONNEL RESOURCES

DT

Resources for Oil Spill Tracking On Water include a GPS, a digital camera, a diagram or map of the area, marking pens/pencils, log book, and an aircraft or vessel to be used as an observation platform. If the oil is not visible, tracking buoys or an infrared sensor will be needed.

Equipment	Function	Quantity	Notes
GPS	Determine locations	1 or more	Personnel should be familiar with operation for the model and the Situation Unit should be capable of downloading data from the GPS. Should have extra battery and antenna.
Digital camera	Capture images of oil slick	1	Extra batteries and media
Log book and maps or diagrams	Taking notes, drawing sketches, and recording data	As necessary	Folding knee board or clip board
Infrared camera or video system	Detection of oil in low visibility	Situation specific	Requires trained operator and should be calibrated on the specific spill
Tracking buoy system (transmitting buoys and receivers)	Detection of oil in low visibility	Situation specific	Does not indicate thickness, area, coverage, or consistency
Vessel/Vehicles	**Function**	**Quantity**	**Notes**
Aircraft, helicopter, or marine vessel with crew	Observation or buoy deployment platform	1 to 2 optional	Situation dependent
Personnel	**Function**	**Quantity**	**Notes**
Observer(s)	Observe and assess the nature of the slick and record data	1 or more	Should be trained in oil observation and any equipment that is being used
Skilled Technicians	Work under the direction of Lead Observer	0 to 2	Operates infrared cameras or tracking buoy system as dictated by the situation

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AERIAL OBSERVATION SUPPORTING NEARSHORE OPERATIONS

OBJECTIVE & STRATEGY

AO

The objective of the Aerial Observation Supporting Nearshore Operations tactic is to provide effective, continual aerial observation in support of free-oil recovery task forces to maximize their effectiveness.

This tactic is not intended to determine the extent and trajectory of an oil spill slick like the Discharge Tracking on Water tactic; however, observers and resources used to accomplish this tactic may serve to supplement other Oil Spill Surveillance and Tracking operations and will report observations to the Nearshore Group Supervisor as well as the Operations Section, Situation Unit, and Documentation Unit.

TACTIC DESCRIPTION

The purpose of the Aerial Observation Supporting Nearshore Operations tactic is to provide continual aerial surveillance to maximize effectiveness of the Nearshore Response Group (NRG). Aerial observers will locate oil slicks, determine which slicks are most likely to impact sensitive areas, and direct on-water oil recovery operations to intercept and contain free-oil.

Rotary wing surveillance aircraft can be staged at the Nearshore Response Group Logistics Base as outlined in the Nearshore Group Logistics Base tactic. Fixed-wing surveillance aircraft will be staged at a land-based air field.

Nearshore aerial observation planners will utilize data gathered from Discharge Tracking on Water (DT) resources to determine daily flight plans and establish task

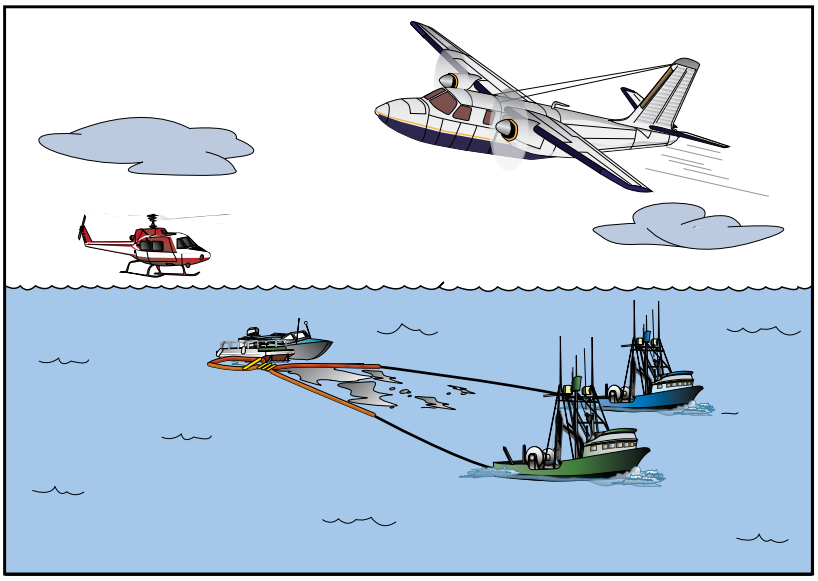


Figure DT-NS 1. Nearshore Aerial Observation using aircraft.

Aerial Observation Supporting Nearshore Operations

orders for Near Shore Task Forces (NSTF). Aerial observers will direct NSTF resources into appropriate areas to conduct on-water oil recovery operations.

Operating Environments

Nearshore Aerial Observation will generally take place in the nearshore environment or wherever Nearshore Free-Oil Recovery (NFO) task forces are operating including:

- Protected Water,

- Calm Water

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- PPE is required of all personnel in aircraft. See the incident Site Safety Plan and check with aircraft operator for PPE and PFD requirements.
- Flight following procedures should be observed for all observation aircraft.
- A communications schedule must be established and followed between the aerial observers and the incident Air Operations Branch/Tactical Group/Support Group.
- Obtain aviation weather forecasts for the area of operation. Strictly adhere to weather restrictions for the specific aircraft used.

DEPLOYMENT

- Data collected by DT tactical resources will be relayed to Aerial Observation Supporting Nearshore Operations personnel who will then vector appropriate NRG NSTF resources into identified slicks to maximize oil recovery.
- If wildlife or historic properties are encountered, see Wildlife Checklist or Historic Properties Checklist.

REFERENCES TO OTHER TACTICS

Other tactics that may be involved in Nearshore Aerial Observation include:

- Discharge Tracking On Water

- Nearshore Free-Oil Recovery

- Nearshore Group Logistics Base

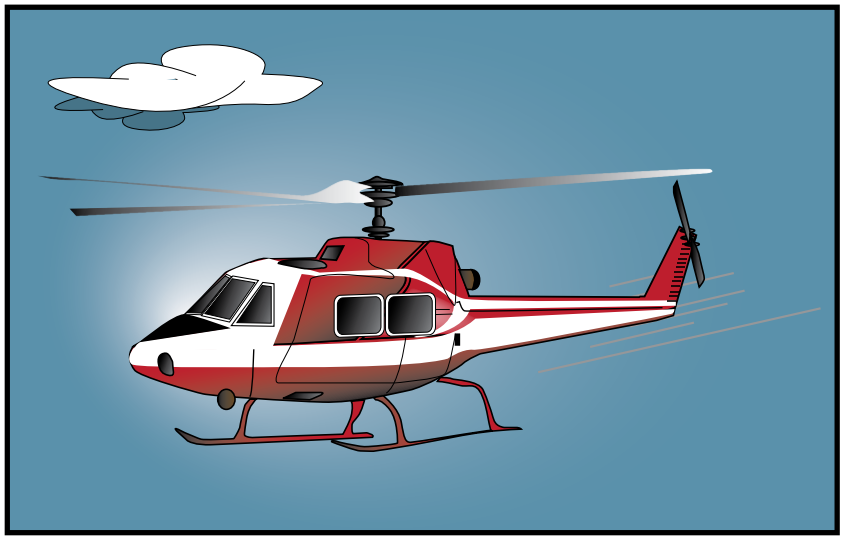
- Nearshore Operations Planning and Implementation

Aerial Observation Supporting Nearshore Operations

EQUIPMENT AND PERSONNEL RESOURCES

Nearshore Aerial Observation platforms can be either rotary (Figure DT-NS-2) or fixed (Figure DT-NS-3) wing aircraft. In addition to the equipment listed below, the following installed or portable sensors may prove helpful but are not critical to successful execution of this tactic:

- Infrared (IR)
- Forward Looking Infrared Radar (FLIR)
- Ultra-Violet (UV)
- Side-Looking Airborne Radar (SLAR)
- Microwave Sensors



HELICOPTER SPECIFICATIONS

- Type: Twin Engine Multipurpose Utility Transport
- Cruising Speed: 130 kts
- Observation Speed: 80-90 kts
- Observation Altitude: 400-500 ft.
- Range: 245 nm
- Sling Capacity: 2,500 lbs
- Seats: up to 4

Figure DT-NS 2. Nearshore Aerial Observation Helicopter.

FIXED WING SPECIFICATIONS

- Type: Twin Engine, Turbo-prop, Good all around visibility (high mounted wings), Suitable navigation aids
- Range: 200nm (minimum)
- Hours Aloft: 5-8
- Observation speed: 110 kts
- Observation Altitude: 150-1,500 ft.

Figure DT-NS 3. Nearshore Aerial Observation Fixed Wing aircraft.

Aerial Observation Supporting Nearshore Operations

Rotary wing resources will be assigned to the NRG and will stage from an appropriate NRG Logistics Base.

A single aircraft is dedicated to a NRG to support its operations.

Support for fixed wing aircraft would have to be from a shore-based facility. Depending on the supported task force(s) location, this could be done from several airstrips, although fuel supply and crew accommodations would have to be taken into account.

Many different types of aircraft could be used to fill this role, but aircraft selection must take into account airfield capabilities in remote locations throughout Alaska.

Additional resources for Nearshore Aerial Observation include a GPS, a digital camera, a diagram or map of the area, marking pens/pencils, and a log book.

Equipment	Function	Quantity	Notes
GPS	Determine locations	1 or more	Personnel should be familiar with operation for the model and the Situation Unit should be capable of downloading data from the GPS. Should have extra battery and antenna.
Digital camera	Capture images of oil slick	1	Extra batteries and media
Log book and maps or diagrams	Taking notes, drawing sketches, and recording data	As necessary	Folding knee board or clip board
Infrared camera or video system	Detection of oil in low visibility	Situation specific	Requires trained operator and should be calibrated on the specific spill
Tracking buoy system (transmitting buoys and receivers)	Detection of oil in low visibility	Situation specific	Does not indicate thickness, area, coverage, or consistency
Personnel	**Function**	**Quantity**	**Notes**
Observer(s)	Observe and assess the nature of the slick and record data	1 or more	Should be trained in oil observation and any equipment that is being used
Skilled Technicians	Work under the direction of Lead Observer	0 to 2	Operates infrared cameras or tracking buoy system as dictated by the situation

MECHANICAL RECOVERY

INTRODUCTION

Mechanical response describes spill response methods where specialized equipment is used to divert, collect, and/or remove spilled oil from the environment. In Alaska, mechanical response methods are the primary and preferred techniques for responding to an oil spill.

The Mechanical Response Tactics in this manual are divided into three main categories. Most tactics apply either to on-water or on-land spills, but there is some limited overlap where response methods may be used in either instance. In most cases, a combination of tactics from one or more of these categories will be used to accomplish the spill response objectives.

- ***Containment and Recovery Tactics*** provide strategies for concentrating and collecting oil in a designated area in order to facilitate recovery from the environment.
- ***Sensitive Area Protection Tactics*** provide strategies for minimizing the impact of spilled oil to environmentally-sensitive areas.
- ***Primary Storage and Transfer of Recovered Products and Wastes Tactics*** provide strategies for storing recovered oil and waste products and for transferring them from response vessels to storage locations.

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BASIC BOOMING TACTICS

GENERAL CONSIDERATIONS

Boom is a containment barrier used to intercept, control, contain, and concentrate spreading oil on water. Boom comes in a variety of forms and may be deployed in a number of possible configurations. Booming tactics are a dynamic process and considerations need to be given to the ongoing maintenance of the system as environmental conditions change.

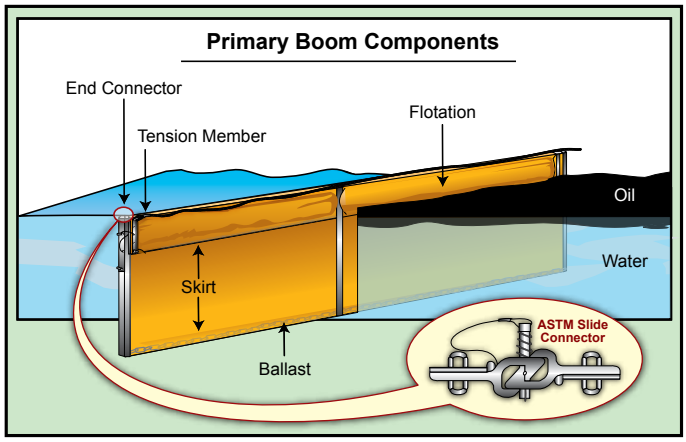


Figure B-1. Boom Components and Bridle Components.

Boom Components

Figure B-1 shows the typical components of boom. The portion of the boom above the water surface is referred to as the sail and usually includes a flotation mechanism; the portion below the surface is referred to as the skirt. A tension member (such as a piece of cable) of greater strength than the fabric prevents the fabric from tearing under stress and some sort of ballast, such as chain or weights, is attached to the bottom of the fabric to keep the boom vertical in the water.

Flotation material keeps the boom afloat. There are several different designs and methods of flotation. Floats may be rigid or flexible. Inflatable air chambers may be used to provide flotation. Freeboard is the vertical height of a boom above the water line. The freeboard prevents oil from washing over the top of the boom. If there is too much freeboard, however the boom may be pushed over in high winds. The skirt prevents oil from being swept underneath the boom. End connectors are used to connect sections of boom together. Since there are many different types of boom, there are many different end connectors, with the vast majority of end connectors being standard American Society for Testing and Materials (ASTM) slide connectors as shown in Figure B-1.

Boom Types and Classification Systems

Different types and sizes of boom may be referred to by a variety of names, some of which may vary regionally. There are two major classification systems for selecting boom according to water body classification. The STAR manual uses the classification

Basic Booming Tactics

system developed by the ASTM, as it corresponds to the operating environment classifications used in this manual. The ASTM classification system divides boom into four categories, based on the operating environment in which it may be used:

- Calm water boom (sometimes referred to as "harbor boom")
- Fast water boom (calm water/fast current boom)
- Protected water boom
- Open water boom (sometimes referred to as "ocean boom")

The following table describes the properties of these four boom types.

Boom Property	Calm Water	Calm Water-current (fast water)	Protected Water	Open Water
Height (in)	6 to 24	8 to 24	18 to 42	36 to 90+
Minimum reserve buoyancy to weight ratio	2:1	3:1	3:1	7:1
Minimum total tensile strength (lbs)	1,500	5,000	5,000	10,000
Minimum skirt fabric tensile strength (lbs/in) 2TM=2 tension members; 1TM=1 tension member	2TM - 300 1TM - 300	2TM - 300 1TM - 300	2TM - 300 1TM - 400	2TM - 400 1TM - 400
Minimum skirt tear strength (lbs)	100	100	100	100

Boom Angles

Effective booming tactics require that boom be placed and adjusted to maximize efficiency. If boom is not deployed correctly, oil may entrain (escape underneath the boom) and the boom may sustain damage or fail.

A key consideration in deploying boom is the boom angle, which is directly related to the velocity of the current. Figure B-2 may be used to select the appropriate boom angle to keep oil from entraining under the boom. Note that the angle relative to the current decreases rapidly as the current increases. Where currents exceed three knots, the boom must be almost parallel to the current to prevent entrainment. In currents exceeding three knots, a cascade of boom arrays may be used; the first boom array will slow the velocity of the slick allowing subsequent arrays to deflect the oil.

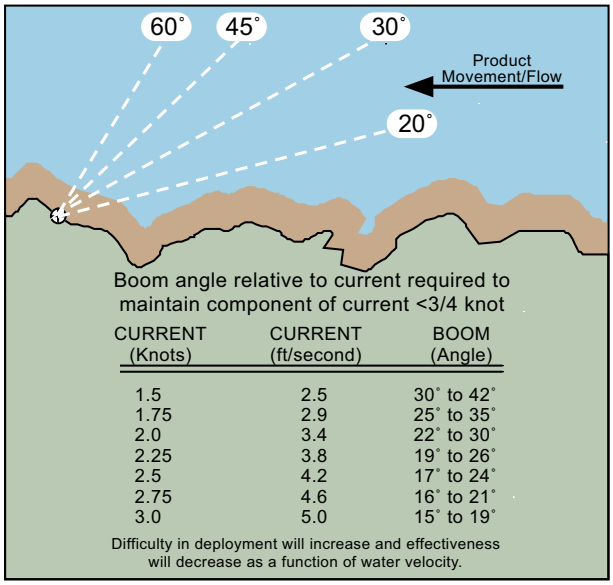


Figure B-2. Boom angles for various current velocities.

Anchoring Systems

Boom is secured in place using standard anchoring systems. Anchor sizes will vary depending on the boom type and the operating environment.

Anchor systems must be selected based on the maximum stress that might be expected to occur on the boom array, considering stronger currents and winds than when the anchor is set.

The scope of the anchor line should be at least three times the depth of the water. If the anchor fails to hold, responders should try increasing the line scope to five times the depth of the water and/or double the length of the anchor chain. Finally, if additional anchor holding is required, anchors can be ganged or set in series.

Figure B-3 shows a typical boom anchoring system.

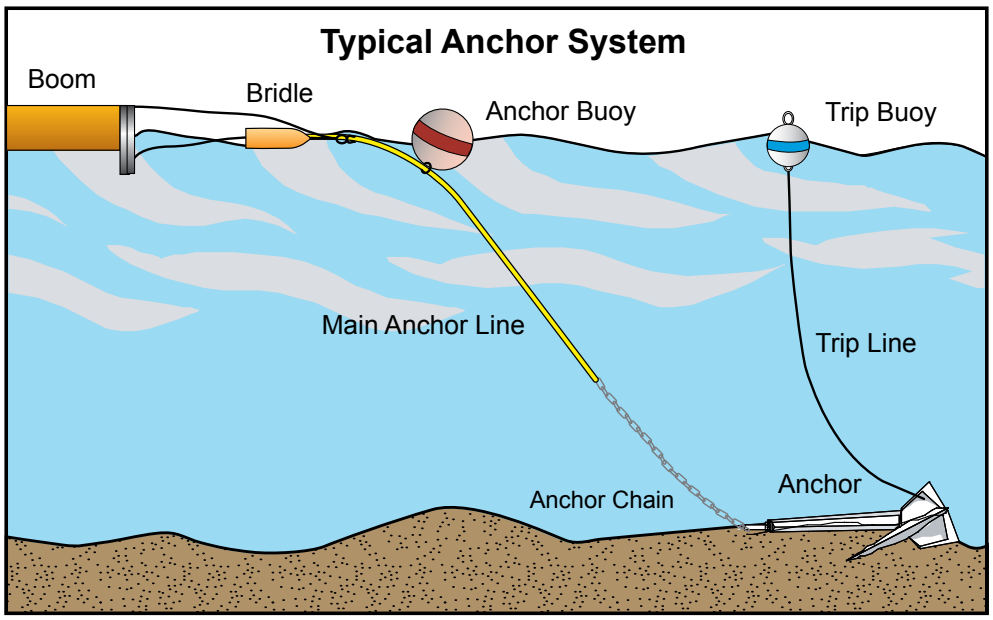


Figure B-3. Typical anchor/boom/bridle configuration system.

Towing and Setting Boom

Most booming tactics will require responders to tow boom from a boat ramp or dock to the deployment site. Towing boom requires experienced vessel operators. It is also important that the vessel be appropriately powered to manage the amount of boom being towed. Figure B-4 provides a rule-of-thumb reference to make sure that a vessel is appropriately powered to tow boom to a deployment site, at various towing speeds. Vessels towing boom should operate slowly and must have at least one crewmember in addition to the operator, to keep an eye on the boom. Particular care should be taken in areas with navigational hazards such as fishing floats or mooring buoys. It is important to note that these speeds refer to vessels towing boom to and from a spill site. Towing speeds for active booming tactics are typically much slower, and are specified in the tactic considerations.

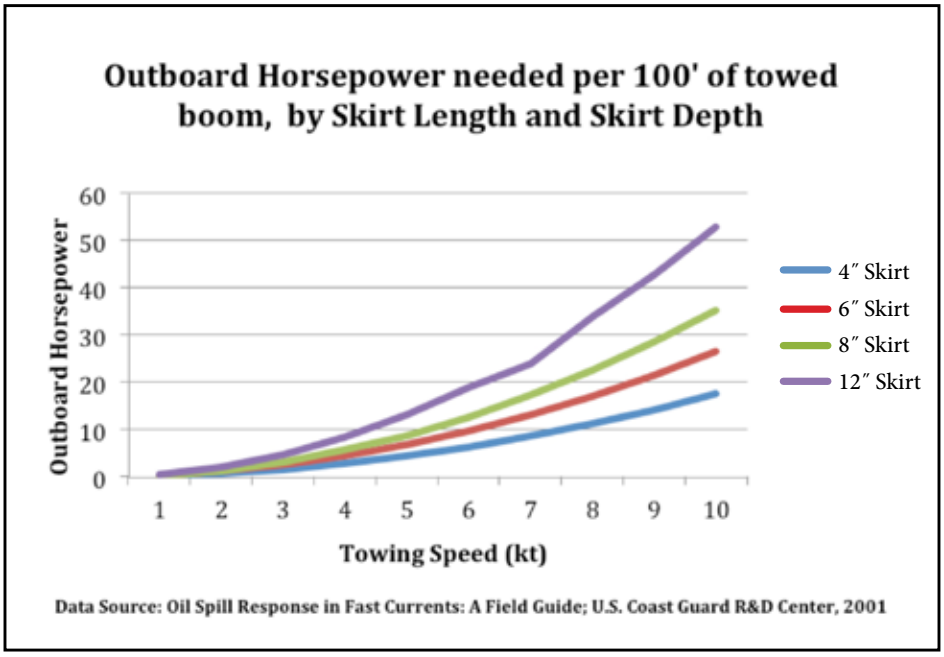


Figure B-4. Rule-of-thumb reference to make sure that a vessel is appropriately powered to tow boom to a deployment site.

OPERATING ENVIRONMENTS

Operating environments generally correspond to those tactics referenced below.

REFERENCES TO OTHER TACTICS

Other tactics associated with Basic Booming include:

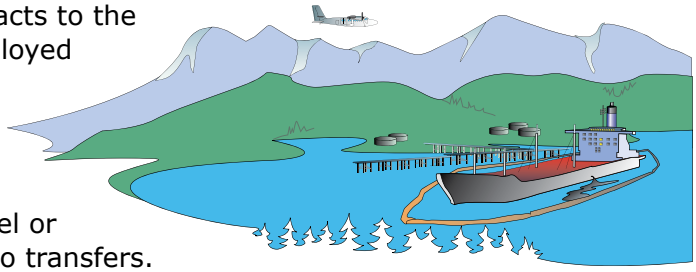
- C • Containment Boom
- FO • On-Water Free-Oil Recovery
- NFO • Nearshore Free-Oil Recovery
- DV • Diversion Boom
- SR • Shoreside Recovery
- PR • Passive Recovery
- EX • Exclusion Boom
- DF • Deflection Boom

CONTAINMENT BOOM

OBJECTIVE & STRATEGY

C

Containment Booming is a fixed-boom tactic. The objective is to corral spilled oil on the water, usually near the source, thus minimizing spreading and impacts to the environment. It is usually deployed in association with a recovery tactic, either Marine Recovery or Shoreside Recovery. Containment Booming is often associated with vessel-to-vessel or vessel-to-shore fuel or oil cargo transfers. This tactic can also be deployed for any oil spill migrating downstream or downhill to water or through water.



The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Select a deployment configuration that best supports the operating environment and available resources.
3. Mobilize to the location and deploy the tactic.
4. Place boom, using secure anchor system or mooring points.
5. Monitor the boom on an appropriate basis.
6. If oil collects in the boom, utilize an appropriate recovery tactic to remove it.

TACTIC DESCRIPTION

Containment boom systems are comprised of the appropriate oil boom for containment and concentration, and anchoring systems to hold the boom in place. There is considerable variation in how these systems are configured depending on the operating environment, type of oil, state of weathering, and available deployment platforms.

Operating Environments

OPEN WATER

Containment boom systems may be difficult to deploy and maintain in the open water environment because of the high probability of fixed-boom failure and the difficulty of anchoring in this environment. The On-water Free-oil Recovery tactic may work better in this environment, due to its inherent mobility.

Containment Boom

Containment boom system components (boom and anchor systems) for open water operations should be able to withstand seas up to 6 feet and winds up to 30 knots.

PROTECTED WATER

Boom and anchors for protected water containment boom systems should be able to withstand seas up to 3 feet and winds up to 25 knots. Vessels deploying containment boom systems may be deep draft or shallow draft, depending on the water depth.

CALM WATER

Calm water containment boom systems are composed of boom and anchors that can operate in seas of 1 foot and in winds up to 15 knots. Vessels deploying calm water containment boom systems typically work in depths as shallow as 3 feet.

FAST WATER

Containment boom systems are not recommended for the fast water environment, where currents exceed 0.8 knots, because of the high probability of fixed-boom failure and the difficulty of anchoring in this environment. The Diversion Boom tactic may work better in this environment because of its ability to move oil into calmer water for recovery. Containment boom systems may work well in calm water adjacent to fast water to keep the oil from moving into the faster water. Examples of this include trapping oil in a slough or eddy until it can be recovered.

BROKEN ICE

Containment boom systems are not recommended for the broken ice environment, because of the high probability of fixed-boom failure and loss due to ice encounters.

Deployment Configurations

Anchoring systems are often deployed first and then the boom is set from one anchor to the adjacent anchor. Figure C-1 depicts the standard components of an anchor system.

Boom can be placed from shoreline to shoreline around a vessel at dock or around a spot where oil is running off the land into the water (See Figure C-2). This configuration can be used to trap oil in a natural collection point such as a slough, inlet, or backwater.

Boom is placed around an anchored vessel or underwater pipeline leak in a diamond or hexagon shape (See Figure C-3).

To some extent, boom angles can be used to deflect debris and concentrate oil into a suitable skimming pocket.

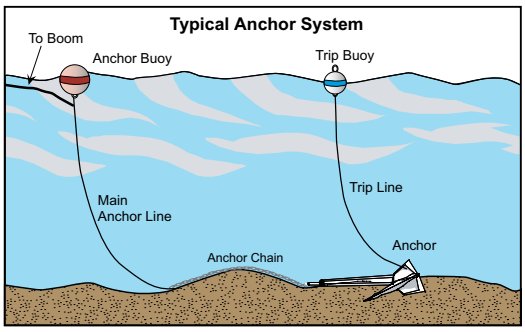


Figure C-1. Anchor system components.

Containment Boom

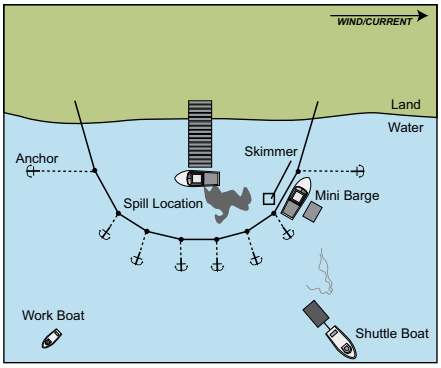


Figure C-2. Containment boom of a vessel at dock.

A second layer of containment boom, outside the primary boom, has two advantages:

1. It breaks the sea chop and reduces its impact on the primary boom,

2. It may capture oil that has escaped if the primary boom fails.

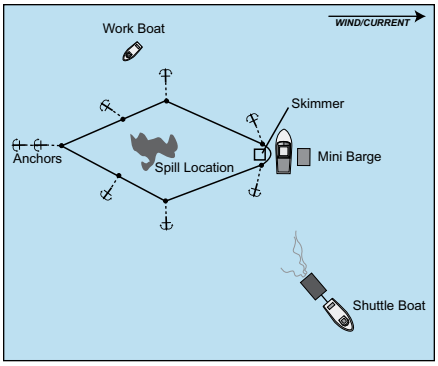


Figure C-3. Containment boom of a submerged pipeline spill.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluations are recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment. Local knowledge is preferred.
- Vessels setting and tending the boom shall be able to safely transit seas which exceed the boom's operating limitation.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Extreme care should be used when taking strains on anchoring systems using the aft cleats of small vessels and skiffs.
- Buoy lights should be considered for night operations.
- Anchor trip lines should be made of material strong enough to handle a moderate strain during boom reconfigurations. Responders normally use the trip line to reposition and reset the anchors.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- It is often advisable to "line" the containment boom with sorbent materials (passive recovery) to recover the sheen and reduce decontamination costs.

Containment Boom

- If the oil slick is moving, due to wind or current, consider containment at the source and ahead of the leading edge.
- If spill is moving in excess of 1 knot, or if the spill site is exposed to potential wave conditions greater that 2 feet, consider the Diversion Boom Tactic.
- Anchor systems must be selected based on the maximum stress that might be expected to occur on the boom array, considering stronger currents and winds than when the anchor is set.
- The scope of the anchor line should be at least 3 times the depth of the water. If the anchor fails to hold, try increasing the line scope to five times the depth of the water and/or double the length of the anchor chain. Finally, if additional anchor holding is required, anchors can be ganged or set in series.
- Anchor vessels fore and aft, before deploying containment boom around them. Estimate the boom length at 3 times the vessel's length.
- Site conditions will influence deployment configuration options.
- Combinations of Containment Boom and Diversion Boom tactics are often used together to optimize success.
- Logistics for monitoring fixed boom should be considered.
- All screw pin shackles shall be seized with wire.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with Containment Boom include:

- SR • Shoreside Recovery
- MR • Marine Recovery
- PR • Passive Recovery
- DV • Diversion Boom

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels, boom, anchoring or mooring systems, response personnel, and associated equipment and materials. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Open Water Containment Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, > 36" height	Contain and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Large anchor systems, moorings, or shore-based anchors	Secure boom in selected configuration	1 per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 2, 3, 4 or 5 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states. Boom rollers and deck winches may also be useful when heavy response equipment is used.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, and boom type

Protected Water Containment Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 18" to 42" height	Contain and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, moorings, or shore-based anchors	Secure boom in selected configuration	1 per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5 or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on number of vessels, configuration, and boom type

Containment Boom

Calm Water Containment Boom System

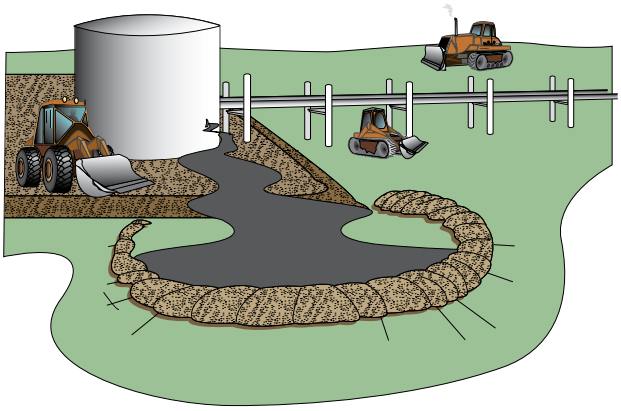
Typical Equipment	Function	Quantity	Notes
Oil boom, 6" to 24" height	Contain and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, moorings, or shore-based anchors	Secure boom in selected configuration	1 per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5 or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states. Vessel may not be necessary – some water bodies can be waded.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 3	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on number of vessels, configuration, and boom type

DIKES, BERMS, AND DAMS

OBJECTIVE & STRATEGY

DBD

Dikes, Berms, and Dams are land-based tactics, with the objective of containing spilled oil and limiting spreading of oil slicks, thus minimizing impacts to the environment. Dikes, berms and dams are embankment structures built-up from the existing terrain, placed to contain and accumulate oil for recovery. These barriers can serve to:



- Contain and stabilize a contaminated area.
- Contain or divert oil on water or oil that has potential to migrate.
- Create cells for recovery.
- Use natural depressions to act as containment areas for recovery.

The tactic may be deployed in association with a recovery tactic, such as Shoreside Recovery or On-land Recovery. Dikes, berms, and dams are most effective when placed before oil arrives. Dikes, berms, and dams can also be used to exclude oil from a sensitive area, which is covered in the Beach Berms and Exclusion Dams tactic. The tactic can also be used in conjunction with an excavation tactic to enhance containment volumes (see Pits, Trenches, and Slots).

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Plan a deployment configuration that best supports the operating environment and available resources.
3. Mobilize to the location and deploy response resources.
4. Construct the containment structure and ensure it does not leak.
5. Consider the need to remove any water-bottom that may collect beneath the oil inside the structure.
6. Monitor the containment structure on an appropriate basis.
7. If oil collects in the structure, utilize an appropriate recovery system to remove the oil.

Dikes, Berms, and Dams

TACTIC DESCRIPTION

This tactic involves building an embankment perpendicular to the flow of the oil slick or around a contaminated area. Dike, berm, and dam structures can be constructed with a wide variety of materials including: soil, gravel, snow, sand bags, oil boom, timbers and logs. Selection of the construction material depends on the operating environment, location, available materials, and whether the structure is to be temporary or permanent. The containment area should be lined with an impermeable membrane, such as plastic sheeting, to keep oil and oily water from leaking or migrating into the soil. The structure may include a method to regulate flow, such as a weir or spill way. Dikes, berms, and dams can be built by manual labor or with earth-moving equipment depending on the location and available resources.

Dikes, berms, and dams can cause significant impacts to the environment. If time allows, the Operations Section Chief should consult with the Environmental Unit Leader before authorizing the construction of any dike, berm or dam.

Operating Environments

MARSH AND TUNDRA

Marsh and tundra are wetlands that are sensitive habitats, where extra care must be taken to minimize damage when constructing and operating barriers. Excavation and other ground disturbances in these environments can cause more damage than a spill. Any activity that has the potential to push the contamination into the soft soils should be avoided. In some cases, it may be best to wait for cold weather to freeze the substrate before working on tundra or marsh. In other cases, the Environmental Unit may recommend no clean-up activity at all, leaving the marsh/tundra to recovery naturally.

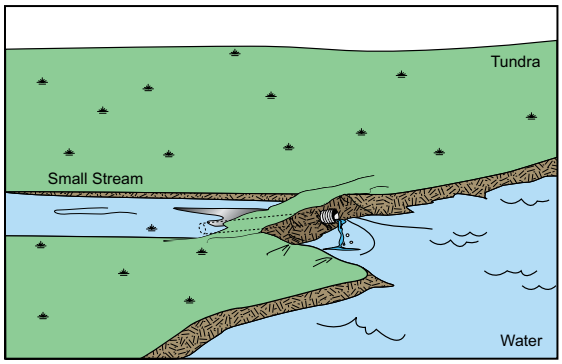


Figure DBD-1. Underflow dam configuration.

Travel across marsh and tundra with tracked vehicles, heavy equipment, and even foot traffic can seriously damage these sensitive habitats. Disturbance is greatly reduced by using sheets of plywood, outdoor carpet, or other similar material as a traveling surface and minimizing trips with equipment.

Before excavating in marsh or tundra, check for the presence of groundwater or permafrost. Do not excavate into frost-laden (cemented) soils, since disruption of the permafrost could accelerate thermal erosion. The depth of the excavation is limited by the depth of the permafrost or the water table.

OTHER LAND

Land and shorelines other than marsh and tundra are better places to construct dikes, berms, and dams. Still, care should be taken

to minimize damage during construction, especially if the structure blocks the flow of a creek or stream that contains fish or other aquatic life. Such structures should only be used to block stream flow during emergencies and should be opened or removed as soon as possible.

SOLID ICE AND FROZEN GROUND

Snow and ice work well as construction materials for embankment structures on solid ice and frozen ground, but other construction materials can be utilized.

Deployment Configurations

There are many deployment configurations for dikes, berms, and dams. A few examples follow.

BERMS

A containment berm can be constructed of available materials such as earth, gravel, or snow. Use earth-moving equipment or manual labor to construct the berm. Form the materials into a horseshoe shape ahead of the flow of oil. Use plastic sheeting to line the walls of a soil berm to prevent oil penetration. Sandbags filled with sand or other heavy material also make excellent containment barriers.

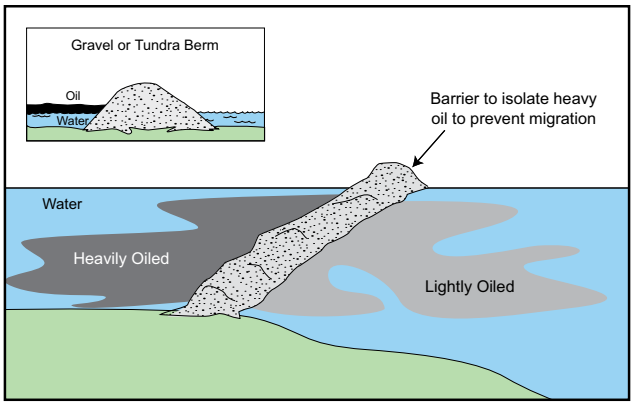


Figure DBD-2. Berm configuration.

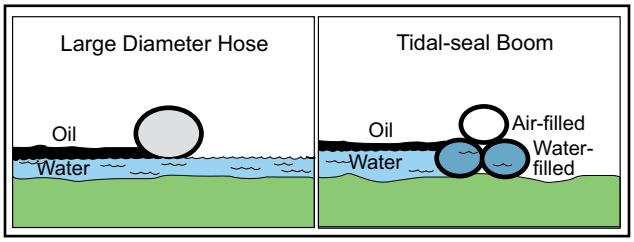


Figure DBD-3. Using boom to form a berm

DAMS

An underflow dam can be used when there is too much water flow to allow for a complete blockage of a drainage channel. The dam is built of earth, gravel, or other barriers such as sandbags or plywood sheets. Wherever possible, line the upstream side of the dam with plastic sheeting to prevent erosion and penetration of oil into the dam material.

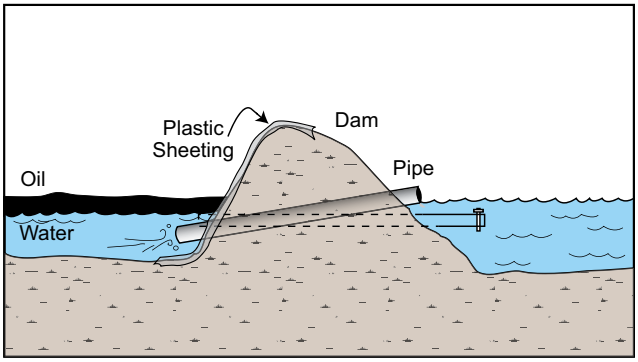


Figure DBD-4. Underflow dam.

Underflow dams use inclined culverts or pipes to move water downstream while leaving the spill contained behind the dam. The capacity of the pipe(s) should exceed the stream flow rate. It may be necessary to use pumps to remove water behind a dike. Valves or culvert plugs can also be used to control flow rate.

Dikes, Berms, and Dams

Pipes must be placed on the upstream side of the dam, with the elevated end on the downstream side. Make sure that the upstream end of the pipe is submerged and below the oil/water interface. The height of the elevated downstream end of the pipe will determine the water level behind the dam.

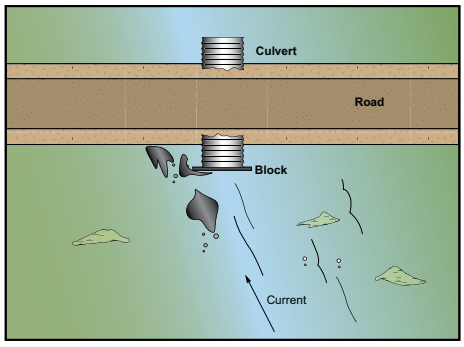


Figure DBD-5. Using a roadway as a dike.

EXISTING ROADS

Roadways that are built up above the terrain can be used as dikes. However, road construction usually allows for natural drainage through culverts or bridges. These drainage structures must be controlled to turn the road into a barrier.

CULVERT BLOCKING

A culvert can be blocked using sheet metal, plywood barriers, or inflatable culvert plugs. Use a full block only when the culvert will be blocked for the entire cleanup operation, if the oil floating on the water will not contaminate additional soil or tundra, and if blocking the water flow will not threaten the road. Otherwise, an adjustable weir or culvert plug should be used.

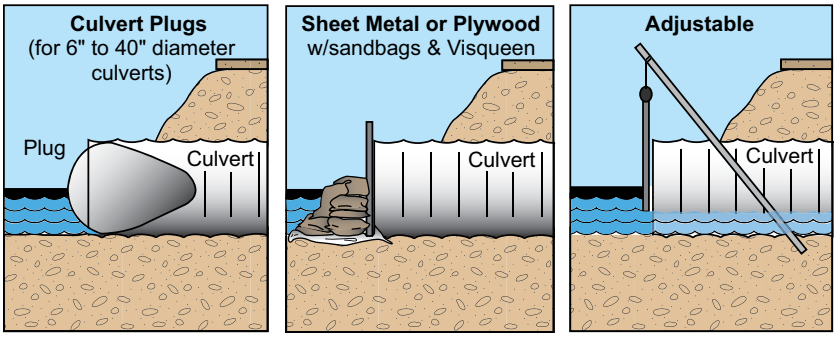


Figure DBD-6. Culvert blocking options.

Plywood and/or sandbags can also be used as culvert blocks, but are more labor-intensive and pose a higher potential for injury. A wood block may require a headwall with kickers oriented to support the boards or plywood. Place the blocking materials over the upstream end of the culvert. Plastic sheeting over the outside of the block will prevent oil penetration.

EARTH MOVING EQUIPMENT

A bulldozer, road grader, or front-end loader drives around the spill with its blade angled towards the spill, pushing earth or snow into a berm. Once the perimeter has been covered with an initial berm, shore-up areas as necessary.

SNOW

Because of the absorbent quality of snow, it makes an excellent berm for both containment and recovery. A snow berm can be strengthened by spraying it with a fine water mist that forms an ice layer on top of the snow. A snow berm is built around the areas of heaviest oiling to contain oil or diesel spilled to tundra and/or ice in winter.

MESH FENCE

Plastic mesh fencing may be used to quickly construct an underflow dam system. The mesh fencing is placed across the drainage and held in place with stakes. Absorbent boom, oil boom, plywood, or even dry dead grass can be placed on the upstream side of the fencing. Running water will find its way under the barrier fence, but oil floating on top of the water will be trapped. The advantages of this system are that it is lightweight and mobile.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- A spotter is recommended when working with earth-moving equipment.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- A Title 41 Fish Habitat permit is required to work inside any anadromous stream. Due to the possibility of contaminating spawning habitat, avoid diverting and/or collecting oil inside a stream mouth if possible.
  - Damming of stream mouth may block fish passage. The dam must be removed immediately after it is no longer needed.
  - In larger streams, consider the use of bulk bags for dam construction.
- Consult with the Environmental Unit to determine if permits are required before constructing a dike, berm, or dam.
- Select location to avoid or minimize damage to historic property sites and biologically-sensitive habitats.
- A plastic liner or sheeting can be used on the walls of the soil or gravel embankments to inhibit spill penetration into the soils or gravel.
- Disposal of construction material should be taken into account before using this tactic.
- The least intrusive methods for building berms are preferred on tundra and marsh.
- Do not excavate where excavation will cause more damage than the spill.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.
- Ice-reinforced snow berms are useful to contain oil that melts out during breakup.
- Check dams periodically for leakage and integrity, replace eroded materials, and continually monitor the water/oil interface. Valved pipes, pumps, or a number of siphons may require periodic adjustment to compensate for minor changes in stream flow.

- If sufficient underflow cannot be maintained, or if excessive overflow occurs, additional dams downstream may be required.
- Gravel or topping may have to be added continually to the dam if erosion is a problem.
- Sandbags are labor-intensive and should be the last consideration.

REFERENCES TO OTHER TACTICS

Other tactics associated with dikes, berms, and dams include:

- BB Beach Berms and Exclusion Dams
- PTS Pits, Trenches, and Slots
- SR Shoreside Recovery
- OR On-land Recovery

EQUIPMENT AND PERSONNEL RESOURCES

There are too many variations of dikes, berms, and dams to be specific on equipment and personnel resources. The following tables provide typical resource requirements for construction using earth moving equipment and manual labor.

Dikes, Berms, and Dams Built with Earth Moving Equipment

Typical Equipment	Function	Quantity	Notes
Bulldozer, road grader, front-end loader, excavator	Construct dikes, berms, or dams	Site-specific	Depending on configuration
Dump truck	Optional - for moving construction materials	Site-specific	Depending on configuration, currents, and sea states
Typical Supplies	**Function**	**Quantity**	**Notes**
Soil, gravel, sand, or snow	Material for embankments	Site-specific	May be available on-site or may have to be transported to the location
Culvert	Optional for underflow dam	Site-specific	Sized to be capable of handling surface water flow
Culvert plug, weir, or blocking materials	Optional to control flow through underflow dam	1 per culvert	
Plastic sheeting or other impermeable membrane	Liner to prevent the embankment from leaking	Site-specific	Care must be taken when placing the sheeting to maintain its integrity
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Equipment Operators	Operate earth moving equipment	1 per equipment per shift	Depending on number of pieces of equipment
General Technicians	Work under the direction of field team leader as laborers and spotters	2 to 8	Depending on configuration and pieces of equipment

Dikes, Berms, and Dams Built with Manual Labor

Typical Equipment	Function	Quantity	Notes
ATV with trailer	Optional - for moving construction materials	Site-specific	Depending on configuration, currents, and sea states
Hand tools, shovels	Filling sand bags, modifications to structure	12	
Typical Supplies	**Function**	**Quantity**	**Notes**
Sand bags	Optional material for embankments	Site-specific	Sand may be available on-site or may have to be transported to the location
Plywood sheets	Optional material to protect marsh or tundra during site access	Site-specific	Plywood may be reused
Culvert	Optional for underflow dam	Site-specific	Sized to be capable of handling surface water flow
Culvert plug, weir, or blocking materials	Optional to control flow through underflow dam	1 per culvert	
Hose and tidal-seal boom	Optional for creating berms on level ground or ice to block the spread of oil	Site-specific	
Plastic sheeting or other impermeable membrane	Optional liner to prevent the embankment from leaking	Site-specific	Care must be taken when placing the sheeting to maintain its integrity
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Equipment Operators	Operate ATV	1 per ATV per shift	Depending on number of ATVs
General Technicians	Work under the direction of field team leader as laborers and spotters	4 to 12	Depending on configuration and site

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PITS, TRENCHES, AND SLOTS

OBJECTIVE & STRATEGY

PTS

The objective of the Pits, Trenches, and Slots tactic is to contain oil and aid in the recovery of the oil. This is done by excavating a depression or opening in a down-slope/down-current location from the spill into which the oil will pool. This tactic uses local topography and hydrology to move the oil to a collection spot where it can be mechanically recovered. Pits and trenches are deployed on land as well as on ice and ice-covered waters. Slots are used where oil is present under ice-covered waters. These tactics should be deployed in conjunction with a recovery operation, such as Passive Recovery, On-land Recovery, Shore-side Recovery, or In-situ Burning.

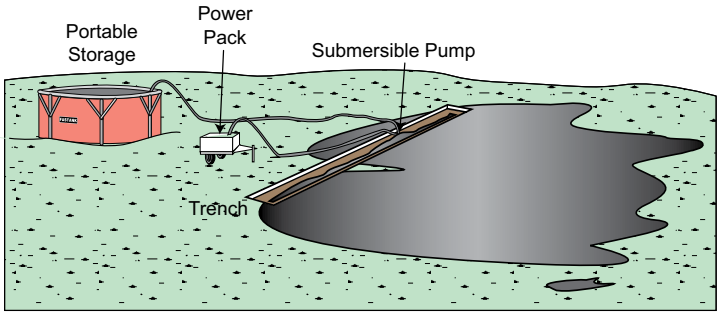


Figure PTS-1. Trench collects oil to be recovered and pumped into a primary storage device.

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Select a configuration that best supports the operating environment and available resources.
3. Identify, locate, and mobilize equipment and personnel to the location.
4. Construct the pit, trench, or slot and, if needed, ensure impermeability using plastic or geotextile lining.
5. Utilize an appropriate recovery system or in-situ burning to remove collected oil.
6. Monitor the pit, trench or slot to ensure that it does not overflow and maintains integrity.

TACTIC DESCRIPTION

Pit, trench, or slot structures are constructed using heavy earth-moving equipment for larger structures and hand tools for smaller structures. The down-slope/down-current migration of the oil is anticipated and materials are excavated in this pathway to create a recovery sump. Excavated materials should be placed on the down-slope/down-current side of the hole to augment the structure and

Pits, Trenches, and Slots

minimize material contamination. Also, do not place excavated material in the way of recovery operations. A layer of plastic sheeting or geotextile may be placed in the depression to prevent penetration of oil into the substrate. These structures create a physical barrier to the migration of oil into the sensitive areas and concentrate the oil for recovery. If oil collects in the pit, trench, or slot, recovery can begin with a system suited to the type, concentration and debris content of the oil (Figure PTS-1).

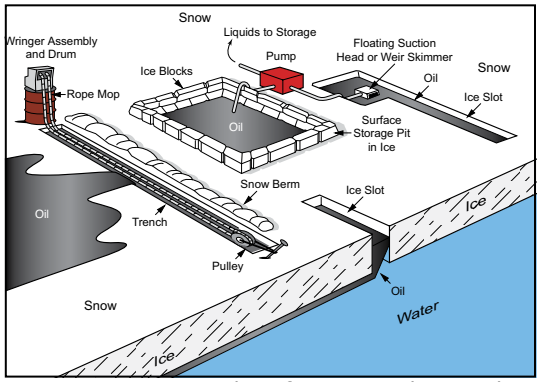


Figure PTS-2. Examples of Pits, Trenches, and Slots oil recovery systems.

Pits are constructed in situations where the volume of oil is greater and may require short-term storage prior to removal (Figure PTS-2). They may also be used for storage if other methods are not available. Pits are appropriate for recovery operations in soil conditions that will not support the sheer wall of a trench.

Trenches are excavated in environments that will support a steep wall structure. They can be deeper and narrower than a pit to concentrate the oil in greater depth for recovery operations (Figure PTS-3). Trenches are also used to divert and funnel oil into a pit for recovery operations.

Slots are typically used during operations on ice-covered waters where oil is trapped underneath (Figure PTS-2). A slot is cut through the ice to allow a void for oil to accumulate. The slot may be cut at an angle with plywood inserted to aid in containment (Figure PTS-5). Generally, a ≥0.5 knot current is required to move oil under an ice cover. If the currents are not sufficient, oil will collect in pockets under the ice. In this case, a slot can be cut above the pocket. Pit, trench, and slot systems are configured depending on the operating environment, type of oil, the state of weathering, type of soil/ice conditions, and available equipment.

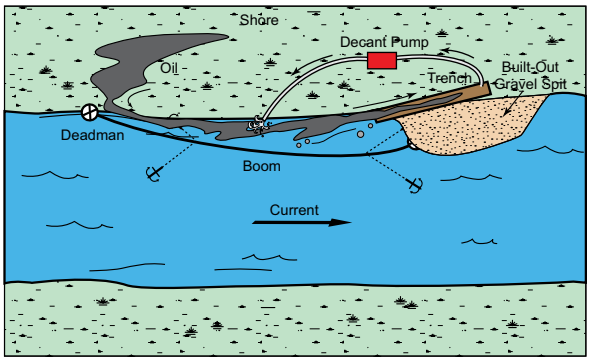


Figure PTS-3. Trench system deployed on shoreline using current and boom to collect oil.

Operating Environments

Pits, trenches and slots are deployable in the following environments:

- Tundra,
- Marsh,
- Shoreline,
- Other Land, and
- Solid-Ice.

TUNDRA AND MARSH

Tundra and marsh environments present challenges for operations due to their sensitivity. Because the water table is at or near the surface, it is usually not necessary to dig very deep in tundra or marshes. However, wetlands do not easily recover from soil disturbance. Plywood sheeting, outdoor carpet, or other similar material should be used to establish pathways for foot and ATV traffic to the site. If possible, the initial response should be to remove the oil on the surface with vacuum systems. The flow direction of the oil should be anticipated and an interception trench cut and/or dug into the surface of the tundra or marsh ahead of the flow. Trenches should not disturb or expose the permafrost and the excavated materials should be protected from contamination. If the trench remains dry after excavation it should be lined with plastic sheeting to prevent migration of contamination into the substrate. When conditions permit, the area uphill of the trench can be flushed with high volume, low-pressure fresh water from tanker trucks or nearby sources to mobilize the oil and move it to the trench. The volume of the water should be carefully monitored to ensure that the trench is not overflowed. The oil then can be removed via shallow skimming or vacuum systems.

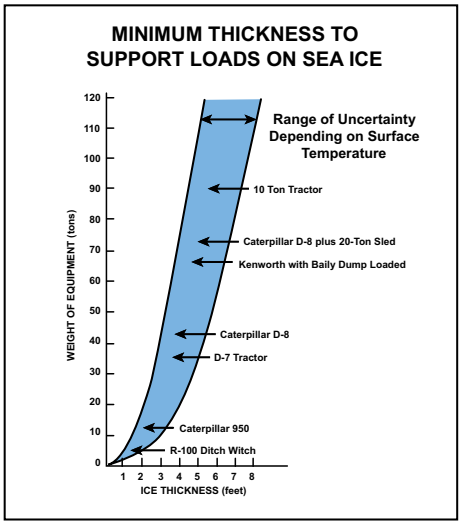


Figure PTS-4. Load bearing capacities of sea ice [Source: Alaska Clean Seas Training Manual].

SOLID-ICE

Pits, trenches, and slots may also be utilized on ice-covered environments. On ice covered waters the ice must be thick enough to support responders and equipment (Figure PTS-4). As with tundra and marsh environments, interception trenches are very effective in collecting moving oil for recovery or burning. The flow direction of the oil should be anticipated and an interception trench cut and/or dug into the ice ahead of the flow. The use of liners is not necessary in ice. The area can be flushed to hasten the movement of the oil to the recovery area. Pits may be constructed to intercept the flow of oil on ice, but are primarily used for temporary storage for oil removed from trenches and slots.

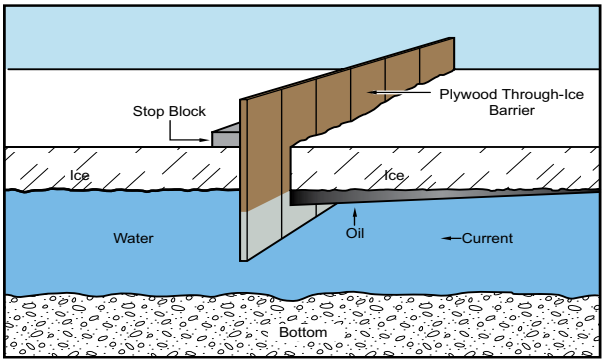


Figure PTS-5. Ice Slot deployment configuration example.

If oil is trapped under the ice on ice-covered waters, a slot can be cut entirely through the ice to allow for the oil to float to the surface where it may be collected as in a trench.

Pits, Trenches, and Slots

Deployment Configurations

Typical configurations are shown in Figures PTS-5 through PTS-7, but responders should consider the actual conditions, and modify their deployment accordingly.

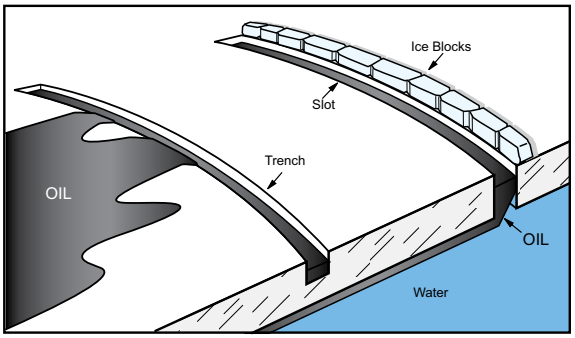


Figure PTS-6. Trench and Ice Slot deployment configuration examples.

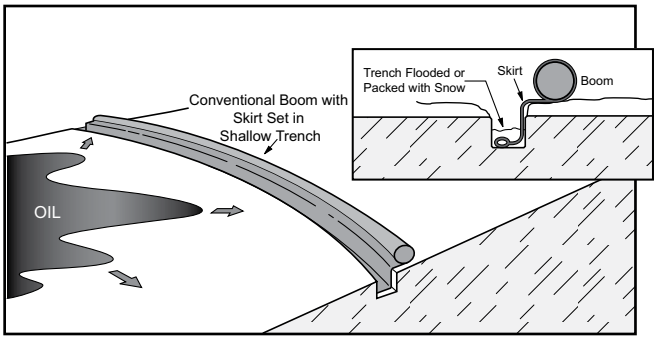


Figure PTS-7. Trench deployment using boom to enhance the oil barrier.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- During operation of heavy equipment, a spotter should be present to ensure safe operations.
- Operations on ice-covered water should be conducted only on ice with sufficient thickness to support responders and equipment. Ice thickness surveys should be completed prior to moving equipment and personnel on to the ice.
- When excavating, be aware of and locate all buried pipe, lines, or cable.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- A Title 41 Fish Habitat permit is required to work inside any anadromous stream. Due to the possibility of contaminating spawning habitat, avoid diverting and/or collecting oil inside a stream mouth if possible.
  - Damming of stream mouth may block fish passage. The dam must be removed immediately after it is no longer needed.
  - In larger streams, consider the use of bulk bags for dam construction.
- Consult with the Environmental Unit to determine if permits are required before constructing a pit, trench, or slot.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

- Disposal and removal of oiled construction materials should be in accordance with the incident Waste Management Plan and considered prior to deployment.
- Do not excavate materials if activities will cause more damage than the spill.
- Check structures periodically for leakage and overflow.

REFERENCES TO OTHER TACTICS

Other tactics associated with free-oil recovery include:

- DBD • Dikes, Berms, and Dams
- ISo • In-situ Burning, Pooled Oil
- CWD • Cold-water Deluge
- PR • Passive Recovery
- OR • On-land Recovery

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include vehicles, equipment, supplies, and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Pits, Trenches, and Slots System on Ice

Equipment	Function	Quantity	Notes
Hand tools, front-end loader, chainsaw, ice trimmer	Excavate ice	Varies	Depending on site conditions and oil volume
Recovery system	Remove oil	1	Includes primary storage unit, power pack, hoses, fittings, and rigging
Plywood sheeting	Increases containment when placed in slot	Varies	Use angled slot with plywood
Vehicle	**Function**	**Quantity**	**Notes**
Truck, snow machines with sleds	Transportation to and operations at the site	Varies	Depending on site conditions
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Heavy Equipment Operator	Operation of equipment	1 to 2	Depending on recovery system and hours of operation
Spotter	Ensure safe operations of heavy equipment during response activities	1 to 2	Depending on recovery system and hours of operation
Skilled Technicians	Operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on recovery system and hours of operation

Pits, Trenches, and Slots

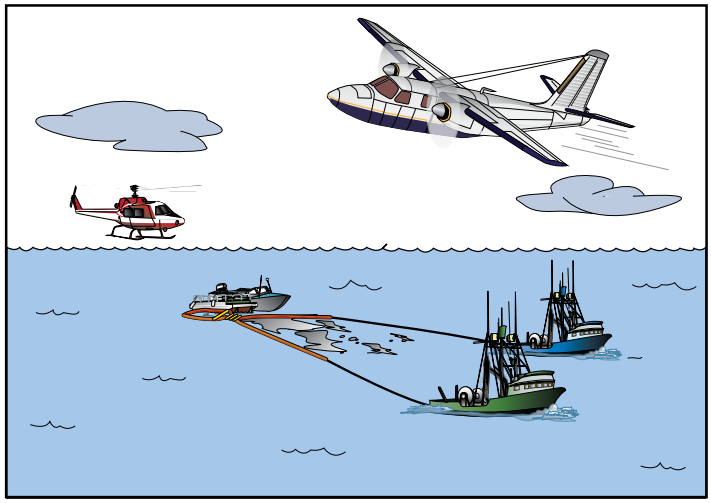
Pits, Trenches, and Slots System in Tundra, Marsh, and Other Lands

Equipment	Function	Quantity	Notes
Hand tools, excavator, or other heavy equipment	Excavate soil to create the containment structure	1 or more	Depending on site conditions and oil volume
Recovery system	Remove oil	1	Includes primary storage unit, power pack, hoses, fittings, and rigging
Plywood	Create access path to the site	Optional	Use from established access to sensitive sites, such as tundra and marsh
Pump	Provide water for flushing actions	Optional	High flow, low pressure is required. Includes hoses, fittings, etc.
Plastic sheeting or Geotextile	Line the excavated area	Varies	Use if penetration into the substrate is expected
Vehicle	**Function**	**Quantity**	**Notes**
Truck, ATV with trailers, snow machines (for winter option)	Transportation to and operations at the site. Removal of materials from the recovery site.	Varies	Depending on site conditions
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Heavy Equipment Operator	Operation of equipment	1 to 2	Depending on heavy equipment requirements
Spotter	Ensure safe operations of heavy equipment during response activities	1 to 2	Depending on heavy equipment requirements
Skilled Technicians	Operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on recovery system and hours of operation

NEARSHORE FREE-OIL RECOVERY

OBJECTIVE & STRATEGY

The objective of the Free-Oil Recovery tactic is to contain and recover spilled oil in the Nearshore environment. The Nearshore Free-Oil Recovery tactic utilizes Best Available Technology to contain and recover oil in the nearshore environment. This tactic was added to the STAR manual as part of the 2013 revision to incorporate the Nearshore Response Strategy (NORS). This tactic incorporates enhanced recovery devices and coated/fuzzy disc skimmer technology (with capabilities similar to Current Buster™ and Crucial™ skimmers) which was not widely available when the STAR manual was first developed (2006).



This tactic may be used to contain and recover floating oil, similar to the Open Water Recovery Tactic. Nearshore free-oil recovery may also support the Geographic Response Strategies to protect sensitive areas and shoreline.

The general strategy is to:

1. Identify the trajectory and location of the spilled oil by performing aerial surveillance and trajectory analysis.
2. Select a deployment configuration that best supports the operating environment and available resources.
3. Mobilize to a location downstream and upwind of the slick and deploy nearshore free-oil recovery strike forces.
4. With assistance from aerial observation aircraft, encounter the oil and concentrate it in enhanced recovery systems or other BAT/enhanced boom configurations.
5. Recover the oil utilizing the best available technology.
6. Store the recovered fluid in a primary storage device, until it can be transferred to secondary storage.

Nearshore Free-Oil Recovery

TACTIC DESCRIPTION

Like other free-oil recovery systems, nearshore free-oil recovery systems are comprised of vessels with oil boom for containment and concentration, skimming systems for recovery, and primary storage devices for temporary storage. Enhanced recovery systems allow for greater speed of advance for the boom system and concentrate oil to a deeper depth for more efficient collection (Figure NFO-1). This configuration can improve system efficiency and reduce the costs of operation; however, they may limit the maneuverability of the recovery system.

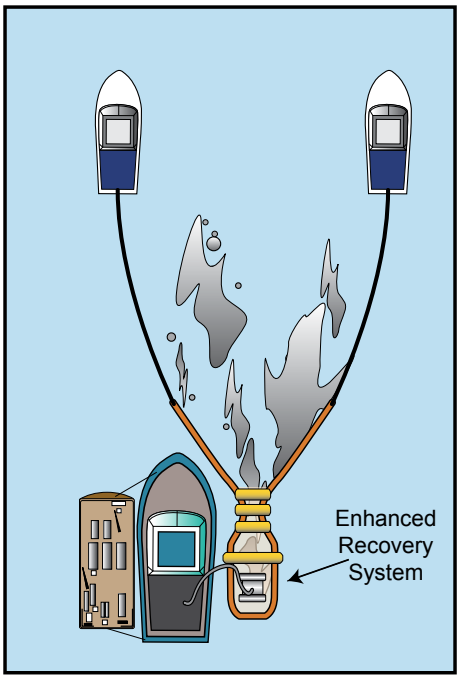


Figure NFO-1. Nearshore Free-oil Recovery using an enhanced recovery system.

Coated and Fuzzy disc skimmers (Figure NFO-2) represent the current best available technology in oil skimming. These types of skimmers are highly efficient at recovering oil without collecting water. This increased recovery efficiency means that less water is being collected and increases overall recovery rate. Increased recovery efficiencies and recovery rates can significantly decrease the amount of free water that must be stored, treated, and disposed of as well as decreasing the need to decant (when authorized). Additional benefits include a potential decrease in the overall amount of time spent conducting on-water oil recovery operations (depending on encounter rate).

Operating Environments

Nearshore free-oil recovery is most commonly configured for the Protected Water operating environment, but it is possible to configure for the Open Water and Calm Water environments depending on the circumstances.

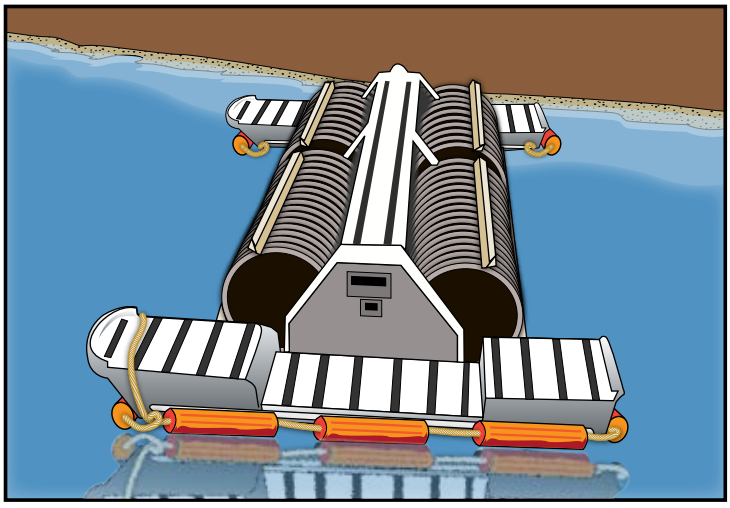


Figure NFO-2. Coated disc skimmer system.

OPEN WATER

Free-oil recovery system components (vessels, boom, and skimmers) for open water operations should be able to deploy and operate in seas up to 6 feet and in winds up to 30 knots. Vessels deploying, towing, and tending the boom should be able to safely transit

seas which exceed the boom's operating limitation. Open water free-oil recovery systems are usually based on large vessels with high volume skimmers and large primary storage devices, such as barges. In many cases, the components of these systems are dedicated to oil spill response. Open water systems are usually deep draft, operating at depths of greater that 6 feet.

PROTECTED WATER

Vessels, boom and skimmers for protected water free-oil recovery systems should be able to deploy and operate in seas up to 3 feet and in winds up to 25 knots. Vessels deploying, towing, and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Protected water free-oil recovery systems are often based on vessels of opportunity, such as fishing vessels, fitted with portable skimmers and primary storage devices. Protected water systems may be deep draft or shallow draft, depending on the water body.

CALM WATER

Calm water free-oil recovery systems are composed of vessels, boom and skimmers that should be able to deploy and operate in seas of 1 foot and in winds up to 15 knots. Vessels deploying, towing, and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Calm water free-oil recovery systems are usually based on small fishing vessels, work boats or skiffs fitted with portable skimmers and primary storage devices. Calm water free-oil recovery systems typically work in depths as shallow as 3 feet.

Deployment Configurations

Deployment configurations to accomplish this tactic are similar to those outlined in the FO tactic and based on criteria established to employ a Nearshore Response Group (NRG) in remote environments as outlined in Part VI: Nearshore Operations Response Strategy.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is required, and should include distance to closest NRG Staging Area, or safe harbor/potential place of refuge, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment and tactic. Local knowledge is preferred.
- Vessels setting and tending the boom should be able to safely transit seas that exceed the boom's operating limitation.
- If possible, vessels in transit to/from an operating or staging area should transit in pairs or larger groups.
- A communication schedule should be established and followed,

between vessels in transit and the NRG Supervisor, Operations Section or Radio Dispatcher.

- Vessels, including skiffs, must have a minimum of two crew aboard.
- PPE is required of all personnel. See the incident Site Safety Plan for PPE and PFD requirements.
- A communications schedule should be established and followed, between the aerial observation aircraft and the incident Air Operations Branch/Tactical Group/Support Group.

DEPLOYMENT

- A Nearshore Strike Team typically has resources to deploy four skimmers utilizing this tactic, but site conditions may influence deployment configuration options.
- Supported by a minimum of one aircraft to provide oil spill tracking and observation.
- Combinations of free-oil recovery and shoreline protection tactics are often used together.
- Combinations of configurations may optimize recovery. For instance a gated boom can be used to concentrate oil if the encounter rate of the enhanced oil recovery device is too low.
- Procedures and permits for decanting recovered water should be considered. Decanting permit applications can be found at: http://dec.alaska.gov/spar/perp/permits/index.htm
- Open water systems typically operate two 12-hour shifts per day. Other systems typically operate one 12-hour shift per day during daylight hours.
- Logistics for recovered oil transport to secondary storage must be considered.
- If wildlife or historic properties are encountered, see Wildlife Checklist or Historic Properties Checklist.

REFERENCES TO OTHER TACTICS

Other tactics associated with the Nearshore Free-oil Recovery Tactic include:

- PI • Nearshore Operations Planning and Implementation
- LB • Nearshore Response Group Logistics Base
- NFO • On-Water Free-Oil Recovery
- AO • Aerial Observation supporting Nearshore Operations
- MR • Marine Recovery
- DV • Diversion Boom
- MST • Marine Based Storage and Transfer of Oily Liquids
- TA • Towing Alongside

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic are similar to those of the FO tactic, see figure NFO-3 below. This tactic has been developed for use by NRG free-oil recovery strike team as outlined in Part VI: Nearshore Operations Response Strategy. Configuration type and quantity for strike teams required will be determined by operating environment, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

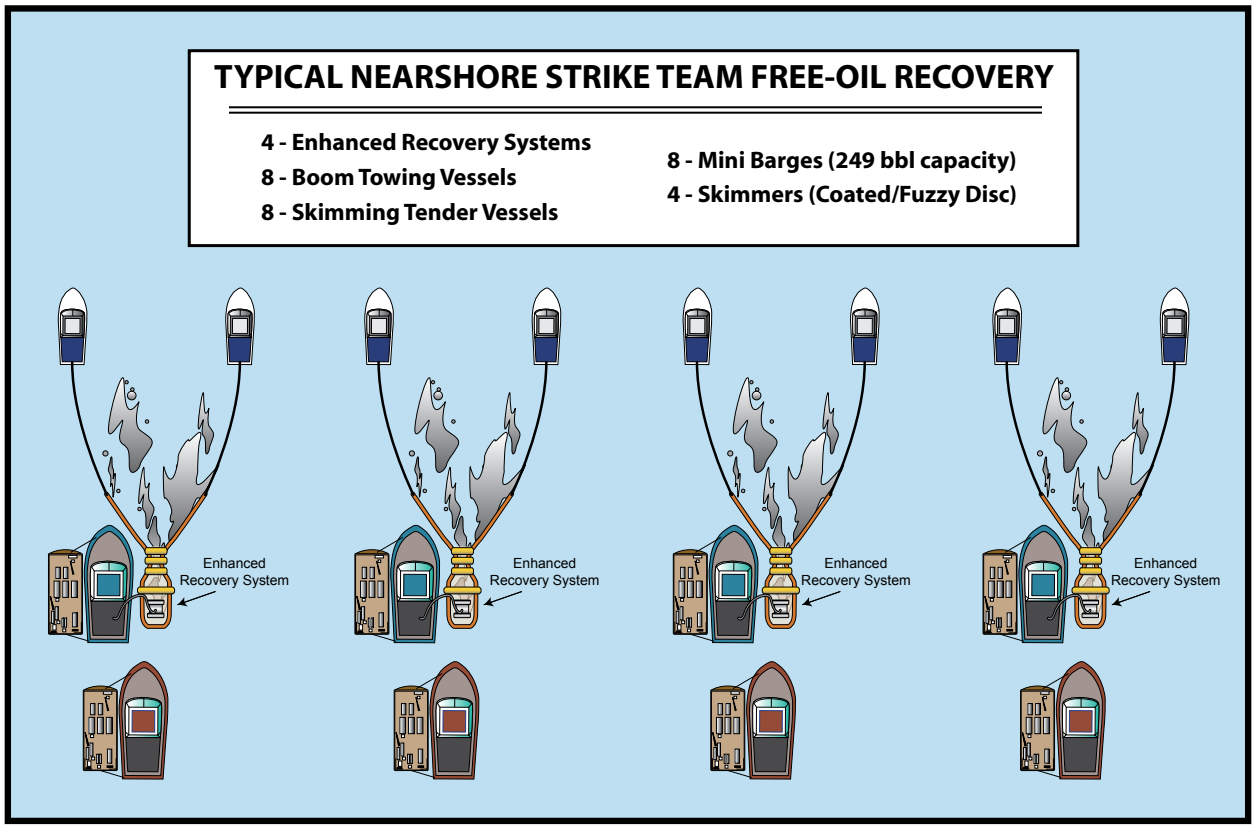


Figure NFO-3. Typical Nearshore Strike Team - Free-oil Recovery.

Nearshore Free-Oil Recovery

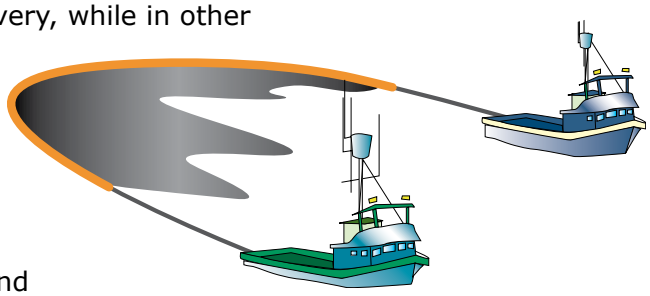
Typical Equipment	Function	Quantity	Notes
Enhanced recovery device	Concentrate oil	4	Current-Buster TM or equivalent
Coated/fuzzy disc skimmer (or other appropriate recovery device)	Remove concentrated oil	4	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment. Typically a Crucial 13 Disk Skimmer
Primary storage device	Store recovered fluid	4 ea.	249 mini-barge or equivalent
Decanting system	Removing recovered water	Optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Boom Towing Vessel	Vessel to tow enhanced recovery device or U-boom	8	
Skimming	Platform for skimming and handling primary storage device	4	
Primary storage device tending vessel	Vessel to transport primary storage device to secondary storage,	4	
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May be one of vessel crew or may be a Task Force Leader assigned to multiple strike teams.
Vessel Crew	Operates vessels and response equipment. Two crew aboard each vessel, except the skimming vessel which requires 3.	36	

ON-WATER FREE-OIL RECOVERY

OBJECTIVE & STRATEGY

FO

The objective of the Free-Oil Recovery tactic is to contain and recover spilled oil on the water, thus minimizing impact to the environment. In some situations, the Unified Command may task the free-oil recovery team with maximizing oil recovery, while in other situations the objective may be to maximize protection of a sensitive area by encountering oil that is on a trajectory to impact that area.



The general strategy is to:

1. Identify the trajectory and location of the spilled oil by performing over-flight surveillance and trajectory analysis.
2. Select a deployment configuration that best supports the operating environment and available resources.
3. Mobilize to a location downstream and upwind of the slick and deploy free-oil recovery teams.
4. Encounter the oil and concentrate it in oil containment boom.
5. Recover the oil with available skimming systems.
6. Store the recovered fluid in a primary storage device, until it can be transferred to secondary storage.

TACTIC DESCRIPTION

Free-oil recovery systems are comprised of vessels with oil boom for containment and concentration, skimming systems for recovery, and primary storage devices for temporary storage. There is a great variation in the way these systems are configured depending on the operating environment, type of oil and state of weathering, and the available deployment platforms. Examples of skimming systems and primary storage devices may be found in the Marine Recovery tactic.

Operating Environments

OPEN WATER

Free-oil recovery system components (vessels, boom, and skimmers) for open water operations should be able to deploy and operate in seas up to 6 feet and in winds up to 30 knots. Vessels deploying, towing,

and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Open water free-oil recovery systems are usually based on large vessels with high volume skimmers and large primary storage devices, such as barges (see Figure FO-1). In many cases, the components of these systems are dedicated to oil spill response. Open water systems are usually deep draft, operating at depths of greater that 6 feet.

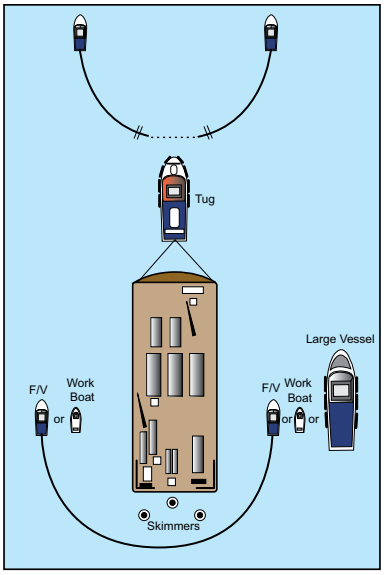


Figure FO-1. Open water barge-based free-oil recovery system.

PROTECTED WATER

Vessels, boom and skimmers for protected water free-oil recovery systems should be able to deploy and operate in seas up to 3 feet and in winds up to 25 knots. Vessels deploying, towing, and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Protected water free-oil recovery systems are often based on vessels of opportunity, such as fishing vessels, fitted with portable skimmers and primary storage devices. Protected water systems may be deep draft or shallow draft, depending on the water body.

CALM WATER

Calm water free-oil recovery systems are composed of vessels, booms and skimmers that should be able to deploy and operate in seas of 1 foot and in winds up to 15 knots. Vessels deploying, towing, and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Calm water free-oil recovery systems are usually based on small fishing vessels, work boats or skiffs fitted with portable skimmers and primary storage devices. Calm water free-oil recovery systems typically work in depths as shallow as 3 feet.

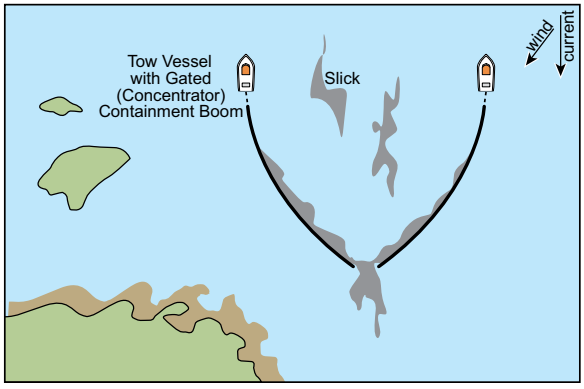


Figure FO-2. Gated U-boom concentrator boom, towed in front of free-oil recovery system.

FAST WATER

Fast water free-oil recovery systems are designed to operate in moving water where the current exceeds 0.8 knots. This includes rivers and areas with significant tidal current. Vessels, boom, and skimmers used in tidal waters should be able to deploy and operate in seas up to 1 foot and in winds up to 15 knots. Vessels, boom, and skimmers used in river waters should be able to deploy and operate in waves up to 2 feet and in winds up to 15 knots. Vessels deploying, towing, and

tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Fast water current free-oil recovery systems are equipped with high-current boom and skimmers. These systems are usually deployed from small vessels or skiffs.

BROKEN ICE

Free-oil recovery in broken ice may be difficult to deploy and operate because of ice interfering with the boom and skimming system. Free-oil recovery systems deployed in broken ice should be highly maneuverable, utilizing vessels that can safely operate in ice. Sometimes, ice leads can act to contain and concentrate oil so that a Marine Recovery system can be used for collection. Oleophilic rope skimmers are preferred over brush or weir skimmers in broken ice, because ice tends to clog weir and brush skimmers. Skimming system efficiency is generally reduced in broken ice.

Deployment Configurations

There are three typical deployment configurations for Free-Oil strike teams.

U-BOOM CONFIGURATION

The U-Boom System consists of vessels towing boom in a "U" configuration concentrating spilled oil into the back of the pocket formed by the boom (see Figure FO-3). This technique can also be used solely for oil concentration by leaving an opening secured by chain in the apex of the boom (see Figure FO-2). This is referred to as a "gated U–Boom." Typically, combinations of these configurations are used to enhance concentration and containment effectiveness. The spilled oil is then collected with a recovery device (skimmer), typically deployed by an additional vessel, and stored in a primary storage device.

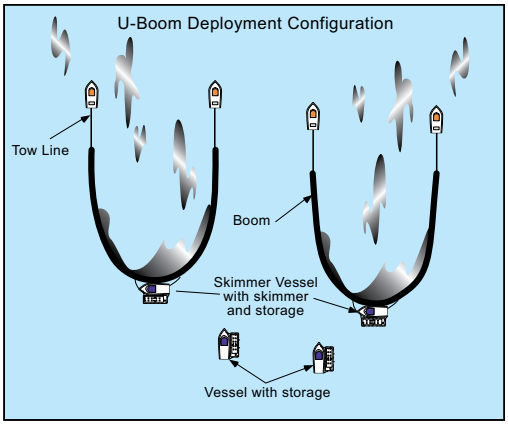


Figure FO-3. U-boom configuration.

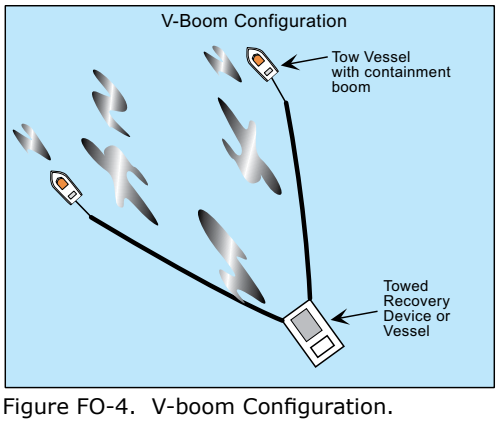


Figure FO-4. V-boom Configuration.

V-BOOM CONFIGURATION

The V-Boom Configuration consists of vessels towing boom and a recovery device (skimmer) in a "V" configuration (see Figure FO-4). The spilled oil is concentrated by the boom toward the back apex where a skimmer is located for oil recovery. Typically, these recovery systems are designed with a limited amount of storage built in and are either offloaded frequently or are augmented with additional storage devices and transfer systems.

On-water Free-Oil Recovery

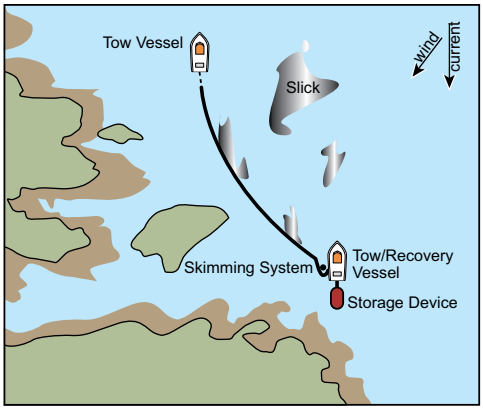


Figure FO-5. J-boom configuration.

J-BOOM CONFIGURATION

The J-Boom Configuration consists of vessels towing boom in a "J" configuration, concentrating the spilled oil for recovery into the back of the pocket formed by the boom (see Figure FO-5). The rear towing vessel is outfitted with a recovery device (skimmer) for deployment along the vessel side where the apex of the boom is formed. The oil is then collected with the skimmer and stored in a primary storage device, such as a mini barge. This system is often utilized in place of the U-Boom system, when the response is limited by the amount of vessels available, when maneuverability is not as critical, and when the oil is concentrated in windrows.

BOOM CONTROL AND ENHANCED RECOVERY DEVICES

Recent improvements in boom control devices, such as the Boom Vane™, allow a single vessel to deploy and control a U-Boom system (Figure FO-6). Enhanced recovery devices, such as the Current Buster™, allow for greater speed of advance for the boom system and concentrate oil to a deeper depth for more efficient collection (Figure FO-7). These configurations can improve system efficiency and reduce the costs of operation, however, they may limit the maneuverability of the recovery system.

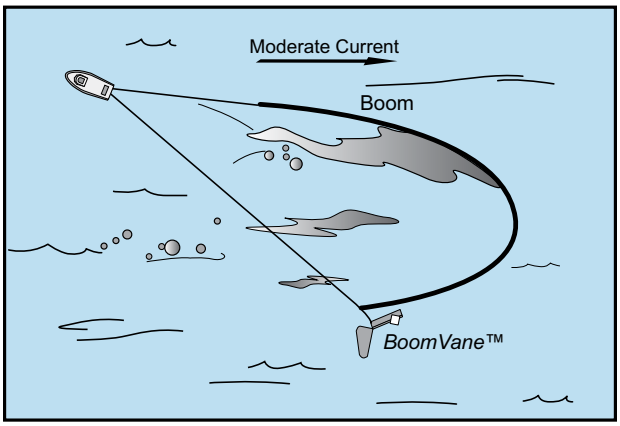


Figure FO-6. Free-oil recovery using a BoomVane™ to control one end of a U-boom.

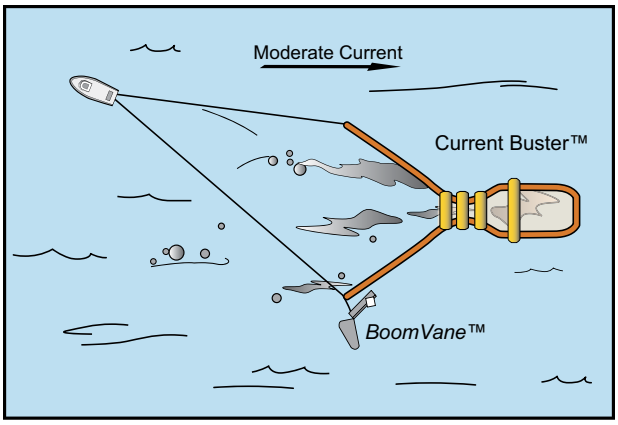


Figure FO-7. Free-oil recovery using a BoomVane™ to control one end of a Current Buster™.

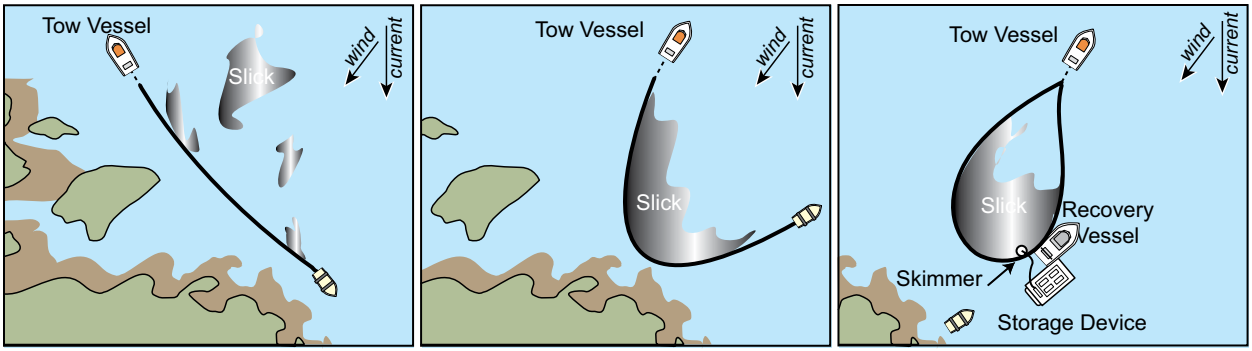


Figure FO-8. Nearshore trapping, boom-towing boats collect oil then tow the trapped oil to deeper water for recovery.

NEARSHORE TRAPPING

Shallow draft vessels can be used to capture oil in shallow water by encircling it and slowly dragging the slick into deep water. A marine recovery system is then used to remove the oil (see Figure FO-8).

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment and tactic. Local knowledge is preferred.
- Vessels setting and tending the boom should be able to safely transit seas that exceed the boom's operating limitation.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Site conditions may influence deployment configuration options.
- Combinations of Free-oil Recovery and Diversion tactics are often used together.
- Combinations of configurations may optimize recovery.
- Procedures and permits for decanting recovered water should be considered.

On-water Free-Oil Recovery

- Open water systems, typically operate two 12-hour shifts per day. Other systems typically operate one 12-hour shift per day.
- Logistics for oil transport and disposal should be considered.

REFERENCES TO OTHER TACTICS

Other tactics associated with On-water Free-oil Recovery include:

- MR Marine Recovery
- DV Diversion Boom
- MST Marine Based Storage and Transfer

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels, boom, skimmers, primary storage devices, and personnel. Configuration type and quantity of strike teams required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Open Water Free-oil Recovery System

Typical Equipment	Function	Quantity	Notes
Oil boom, > 42” height	Contain and concentrate oil	1,000 to 3,000 ft.	Depending on configuration and oil concentration
Skimming system(s), open water	Remove concentrated oil	1 minimum	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Enhanced recovery device	Concentrate oil	1 optional	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Primary storage device	Store recovered fluid	2 times the effective daily recovery capacity of the skimming system(s)	Typically large barges or bladders are used for open water systems
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1 or 2	Platform for skimming and handling recovery device	1 or 2	Depending on configuration
Class 3, 4, 5 or 6	Boom towing	1 to 4	Depending on configuration
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open water	Masters of response vessels	2 to 5	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	4 to 7	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians	2 to 5	Depending on number of vessels

On-water Free-Oil Recovery

Protected Water Free-oil Recovery System

Typical Equipment	Function	Quantity	Notes
Oil boom, 18" to 42" height	Contain and concentrate oil	500 to 1,000 ft.	Depending on configuration and oil concentration
Enhanced recovery device	Concentrate oil	1 optional	Examples are: Current Buster™ or River Lagoon™
Boom control device	Control one end of boom array	1 optional	May be used in place of one vessel, however, a larger vessel may be required
Skimming system(s), protected water	Remove concentrated oil	1 minimum	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Primary storage device	Store recovered fluid	2 times the effective daily recovery capacity of the skimming system(s)	Typically mini-barges or small bladders are used for protected water systems
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1, 2, or 3	Platform for skimming and handling recovery device	1	Depending on configuration
Classes 3, 4, 5, or 6	Boom towing	1 to 3	Depending on configuration
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 4	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians	1 to 4	Depending on number of vessels

Calm Water Free-oil Recovery System

Typical Equipment	Function	Quantity	Notes
Oil boom, 6" to 24" height	Contain and concentrate oil	200 to 1,000 ft.	Depending on configuration and oil concentration
Enhanced recovery device	Concentrate oil	1 optional	Examples are: Current Buster™ or River Lagoon™
Boom control device	Control one end of boom array	1 optional	May be used in place of one vessel, however, a larger vessel may be required
Skimming system(s), calm water	Remove concentrated oil	1 minimum	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Primary storage device	Store recovered fluid	2 times the effective daily recovery capacity of the skimming system(s)	Typically mini-barges or portable tanks are used for calm water systems
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Classes 4, 5, or 6	Platform for skimming and handling recovery device	1	Depending on configuration
Classes 4, 5, or 6	Boom towing	1 to 3	Depending on configuration. Use of a boom control device, such as a Boom-vane™, may necessitate less vessels.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 2	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians	0 to 4	Depending on number of vessels

On-water Free-Oil Recovery

Fast Water Free-oil Recovery System

Typical Equipment	Function	Quantity	Notes
Oil boom, 8" to 24" height	Contain and concentrate oil	200 to 500 ft.	Depending on configuration and oil concentration
Enhanced recovery device	Concentrate oil	1 optional	Examples are: Current Buster™ or River Lagoon™
Boom control device	Control one end of boom array	1 optional	May be used in place of one vessel, however, a larger vessel may be required
Skimming system(s), calm water current	Remove concentrated oil	1 minimum	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment
Primary storage device	Store recovered fluid	1	Typically mini-barges or small bladders are used for fast water systems
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Classes 5 or 6	Platform for skimming and handling recovery device	1	Depending on configuration
Classes 5 or 6	Boom towing	1 to 2	Depending on configuration. Use of a boom control device, such as a Boom-vane™, may necessitate less vessels.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/ calm water	Masters of response vessels	2 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians	0 to 3	Depending on number of vessels

Broken Ice Free-oil Recovery System

Typical Equipment	Function	Quantity	Notes
Oil boom, 8" to 24" height	Contain and concentrate oil	200 to 500 ft.	Depending on configuration and oil concentration
Enhanced recovery device	Concentrate oil	1 optional	Examples are: Current Buster™ or River Lagoon™
Skimming system(s), calm or protected water	Remove concentrated oil	1 minimum	Type and capacity of skimmer depends on oil type, oil weathering state, and operating environment - oleophilic rope/brush skimmer preferred
Primary storage device	Store recovered fluid	1 or 2	Typically mini-barges with sufficient hull strength for ice
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Classes 2, 3, or 4	Platform for skimming and handling recovery device	1	Depending on configuration. Steel hull required.
Classes 2, 3, or 4	Boom towing	1 to 2	Depending on configuration. Steel hull required.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open/ protected/calm water	Masters of response vessels	2 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on number of vessels
General Technicians	Work under the direction of skilled technicians	0 to 3	Depending on number of vessels

ON-LAND RECOVERY

OBJECTIVE & STRATEGY

OR

The objective of On-land Recovery is to remove free-oil from the land's surface and transfer it into primary storage, while minimizing impacts to the environment. This tactic does not include the removal of sub-surface oil or oiled soil/ gravel.

On-land Recovery is usually deployed in association with containment tactics such as Dikes, Berms, and Dams; Pits, Trenches and Slots; or Passive Recovery.

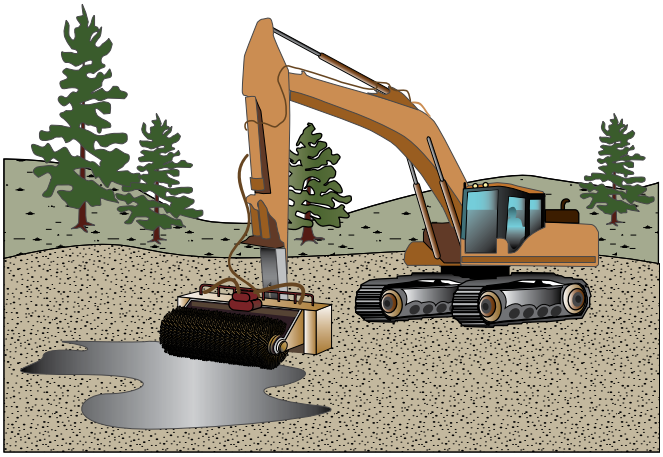


Figure OR-1. On-land recovery using a bucket skimmer attached to an excavator.

The general strategy is to:

1. Identify the recovery site and assess the site conditions.
2. Determine the appropriate recovery and storage systems based on oil type and site conditions.
3. Mobilize and deploy equipment to recover and store the oil at the designated recovery site.
4. Man and monitor the system as appropriate.
5. Store and transfer recovered oil and debris according to an approved waste management plan.

TACTIC DESCRIPTION

If oil spilled on land has not penetrated the surface, it will move to and pool in the lowest part of the landscape. Responders should seek to minimize the spread of oil and remove pooled oil. This can be achieved through immediate recovery of the oil, containment using existing land depressions, or by mechanically creating pits, trenches, slots, dikes, berms, or dams. Where oil has incorporated in the surface materials, mechanical removal will be necessary using hand tools and/or heavy machinery. In both situations on-land recovery is comprised of a removal system, oil storage system, and associated vehicles and personnel. Differing types of recovery systems and primary oil storage devices are available for a variety of oils in numerous operating environments (see Land-based Storage and Transfer).

Oil Removal Systems

Typical equipment used for oil removal on-land consists of earth-moving equipment from shovels to heavy machinery, skimmers/ vacuums or sorbents, associated hoses (suction and discharge with fittings), and repair kits (tools and extra parts).

The primary methods of collecting oil that has not entered the subsurface is through the use of sorbents or skimming systems. There are a variety of sorbents and skimmer systems available. The most appropriate for on-land recovery are:

- Sorbents may be used in different configurations, such as loose or continuous materials. In cold weather environments oil can be incorporated with snow, using it as a sorbent material. Continuous material can be booms, pads, mops, pom-poms, etc. Loose materials are smaller particulates such as peat moss. Sorbents are spread over a spill and then removed with a vacuum or by raking and collecting (Figure OR-4). Sorbents should be minimized for larger spills due to the considerable solid waste stream that is produced. See the Passive Recovery tactic for further description.
- Suction skimmers use a vacuum to lift oil from a surface (Figure OR-3). These skimmers require a vacuum pump or air conveyor system. Suction skimmers may also collect large amounts of water and debris if not properly operated. Most land-based suction skimmers are truck-mounted and require road access nearby the spill site, although trailer-mounted systems are available that may allow access to more remote sites.
- Oleophilic skimmers may also be used in situations with adequate amounts of pooled oil or if the oil has pooled on water (Figure OR-2). These skimmers pick up oil that adheres to a collection surface, leaving most of the water and debris behind. The oil is then scraped from the collection surface and pumped to a storage device. Oleophilic skimmers can be used in any type of oil and are most effective for on-land recovery. Some manufacturers have adapted brush systems that can be mounted on the buckets of front-end loaders or excavators for land based recovery (Figure OR-1). These versatile "bucket skimmers" can be used in several modes. Oleophilic skimmers may be used where oil is very thin on the surface of pooled water and are useful for land-based recovery.

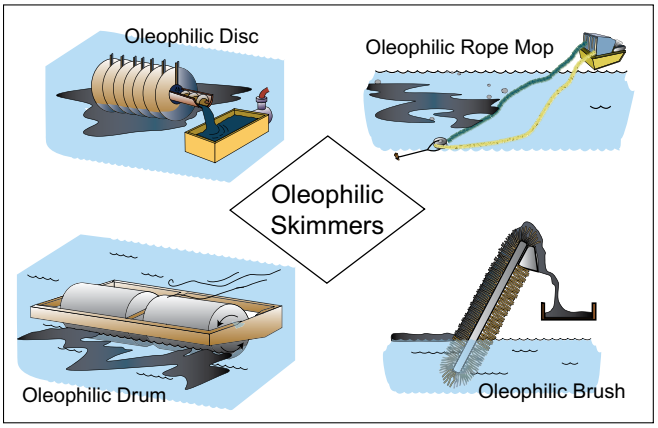


Figure OR-2. Oil recovery using oleophilic skimmers.

Primary Oil Storage Devices

Primary oil storage can be provided by tank trucks, portable tanks, or lined pits (Figure OR-5). Tank trucks are mobile and do not require additional transfer of recovered fluids in the field, but they are usually limited to road access.

Portable tanks can be quickly set up in remote locations, but usually cannot be moved when they contain oil, thus requiring additional transfers.

Lined pits are the least preferred primary storage system, because building them may require soil disturbance and necessitate additional oil transfers. Lined pits are good choices for oiled debris and soils.

Vehicles

Transportation to the site should be on established roads or with all-terrain vehicles or helicopters for sensitive environments. Foot traffic and small motorized vehicles, like ATVs, can traverse sensitive areas such as marsh and tundra by using paths created with sheets of plywood, outdoor carpet, or other material.

Operating Environments

The On-land Recovery tactic is used to collect oil in a variety of terrestrial environments. These include snow/ice, tundra/marsh, and other lands. The strategies described here should be adapted to the environment encountered.

SNOW/ICE

On-land recovery operations in snow should utilize the sorbent properties of the snow. Use the snow to create containment berms and dikes and, if conditions are predicted to remain below freezing, incorporate heavily oiled snow with lightly oiled snow to create a "mulch-like" consistency for removal. For small spills, use hand tools to remove the oiled snow and small containers for transfer. For larger spills, where access is available, use front-end loaders and dump trucks for removal and transportation to disposal sites. If the snow will not remain solid when handled, remove with a vacuum skimmer or move to a lined pit for temporary storage.

If the oil is frozen in place, a trimmer may be used to break up the surface and ready it for loading. If these activities create safety concerns or risk more harm to the environment, stabilize the area, create berms, and otherwise prepare for recovery operation with vacuum systems when break-up occurs.

TUNDRA/MARSH

Tundra and marsh environments present challenges for operations due to their sensitivity. Plywood or similar material should be used to establish foot and ATV routes to the site. Initial response should be to remove the oil on the surface with vacuum systems. When conditions

permit, the area can be flushed downslope into natural depressions or containment structures. Oil then can be removed via shallow skimming or vacuum systems. Another option is to construct a berm around the spill with soil, sand bags, or boom. The content inside the berm is then flooded and the oil is removed either by skimming or passive recovery.

OTHER LANDS

Removal techniques on other lands differ depending on the permeability of the soil. In porous, large-grain, well-drained soils, thin oil may immediately drain and become a sub-surface plume. Such plumes will move down through the sediment, contaminating the soil matrix until it reaches the water table or an impermeable soil layer. This manual is not intended to deal with such sub-surface contamination. An oil contamination remediation project is usually required for the sub-surface component of land-based spills.

In other cases the permeability of the soil or the volume or viscosity of the oil is such that all or part of the oil remains at the terrestrial surface. In these cases, quick removal of the oil and contaminated surface soils is recommended, unless the response would cause more environmental damage than the oil contamination itself. Responders should define the oil plume (see Plume Delineation), anticipate its movement, and consider using berms, dikes, dams, trenches, or pits to contain and concentrate oil for recovery (see Dikes, Berms and Dams, Pits, Trenches, and Slots). Consider using an artificial water table to float the oil for recovery. Recovery tactics are discussed below.

Deployment Configurations

Typical configurations are shown below, but responders should consider the actual conditions and modify their deployment accordingly.

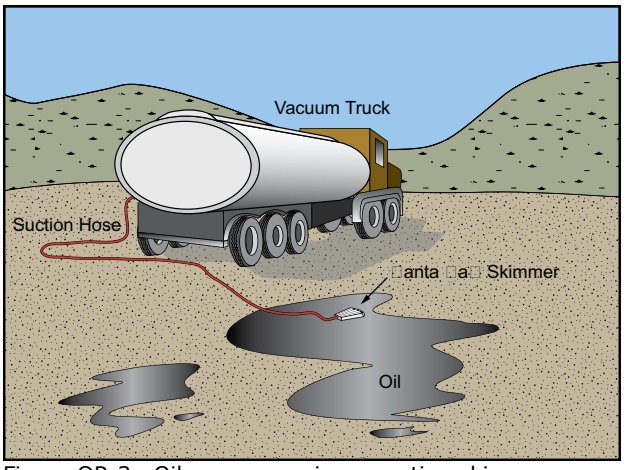


Figure OR-3. Oil recovery using a suction skimmer.

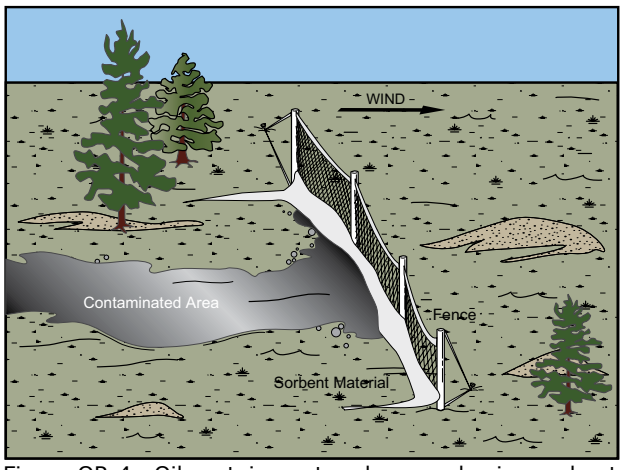


Figure OR-4. Oil containment and removal using sorbent material.

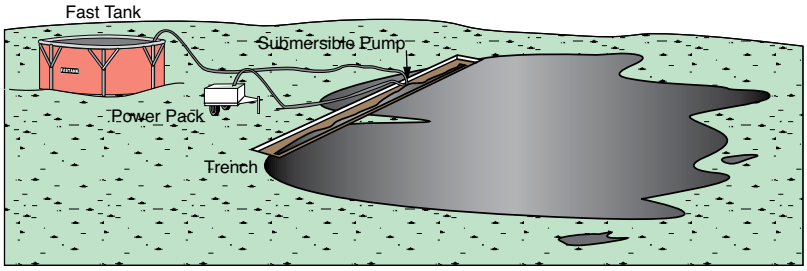


Figure OR-5. On-land Recovery using trench containment, submersible pump, skimmer, and portable storage tank.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- A spotter should be used around heavy equipment.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Do not excavate materials if these activities will create more damage than the spilled oil.
- Do not excavate into frost laden soil or permafrost.
- Lightly oiled snow contains 0.3 bbl per cubic yard of snow.
- Constant monitoring of system efficiency is required.
- Procedures to decant should be considered; a permit is required to decant.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with On-land Recovery include:

- DBD • Dikes, Berms, and Dams
- PTS • Pits, Trenches, and Slots
- PR • Passive Recovery
- ISv • In-situ Burning, Oily Vegetation
- ISo • In-situ Burning, Pooled Oil
- LST • Land-based Storage and Transfer

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this module have been defined as a recovery system, a storage device, associated vehicles, support personnel, equipment, and materials. Quantity of units required will be determined by operating environment, site conditions, and resource availability.

On-land Recovery System on Snow/Ice

Equipment	Function	Quantity	Notes
Hand tools, front-end loader, excavators, trimmer, scraper	Move snow into berms, recover oil and snow mixture	Varies	Depending on site conditions and oil volume
Vacuum skimmer	Remove oil/slush mixture	Optional for liquid phase oil	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil and saturated snow	Depending on recovery operations and volume of oil	Depending on site conditions
Vehicle	**Function**	**Quantity**	**Notes**
Truck, snow machines with sleds, dump truck	Transportation to and operations at the site. Removal of snow/oil from the recovery site	Varies	Depending on site conditions
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervise operations	1	
Heavy Equipment Operator	Operation of equipment	Varies	Depending on equipment and hours of operation
Spotter	Ensure safe operations of heavy equipment during response activities	Varies	Depending on equipment and hours of operation
Skilled Technicians	Operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on recovery system and hours of operation

On-land Recovery System in Tundra, Marsh, and Other Lands

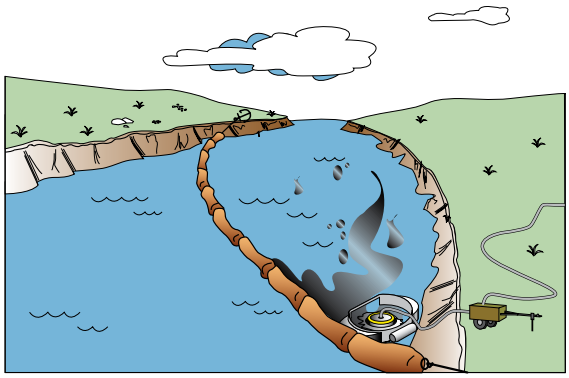
Equipment	Function	Quantity	Notes
Hand tools, front-end loader, backhoe, trimmer, scraper	Move soils into berms, recover oil and oiled debris	Varies	Depending on site conditions and oil volume
Vacuum skimmer, oleophilic skimmer	Remove the liquid phase of the oil	1	Includes power pack, hoses, fittings, and rigging
Plywood	Create access path to the site	Optional	Use from established access to site
Pump	Provide water for flushing actions	Optional	High flow, low pressure is required
Tidal-seal or other boom	Containment	Optional	Use to isolate the oil and float within the boom
Vehicle	**Function**	**Quantity**	**Notes**
Trucks, ATV with trailers, front-end loaders, or excavators	Digging containment structures and removal of contaminated materials from the recovery site	Varies	Depending on site conditions
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervise operations	1	
Heavy Equipment Operator	Operation of equipment	1 to 2	Depending on amount of equipment and hours of operation
Spotter	Ensure safe operations of heavy equipment during response activities	1 to 4	Depending on recovery system and hours of operation
Skilled Technicians	Operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on recovery system and hours of operation

DIVERSION BOOM

OBJECTIVE & STRATEGY

DV

The objective of the Diversion Boom tactic is to redirect the spilled oil from one location or direction of travel to a specific site for recovery. For the purposes of maintaining consistent and clear terms, diversion is always associated with oil recovery, in contrast with the term deflection, which is used to describe the tactic where oil is redirected away from an area but not recovered.



TACTIC DESCRIPTION

The Diversion Boom tactic is for water-born spills where there is some current, usually from 0.5 to 3.0 knots. The boom is placed at an optimum angle to the oil trajectory, using the movement of the current to carry oil along the boom to a recovery location. The angle is chosen to prevent oil from entraining beneath the boom skirt. Oil can be diverted to a shoreline or away from a shoreline or shoal waters. This tactic is always associated with a recovery tactic, either Shoreside Recovery or Marine Recovery. Boom may be held in place by anchors, vessels, or a boom control device.

Anchor Systems

Boom is secured in place using standard anchoring systems (Figure DV-1). Anchor sizes vary depending on the boom type and the operating environment.

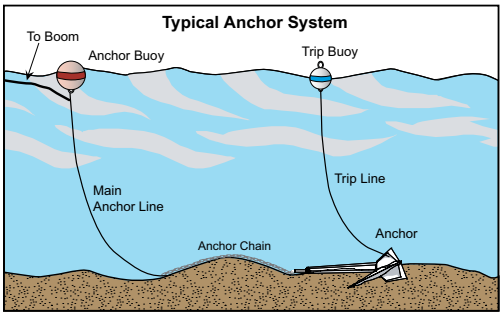


Figure DV-1. Typical anchor system.

Boom Control Devices

An alternative to anchoring deflection boom on the offshore end are boom control devices. Boom control devices have the advantage of allowing continuous control over the angle and position of the boom. They can also allow the boom to be moved to allow a vessel or drifting debris to pass by without interfering with the diversion operation. One type of boom control device is a vessel, which continuously controls the offshore end of the

Diversion Boom

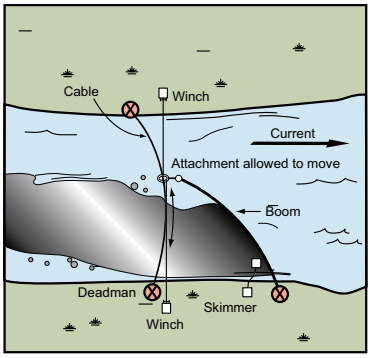


Figure DV-2. Diversion boom configuration using a trolley.

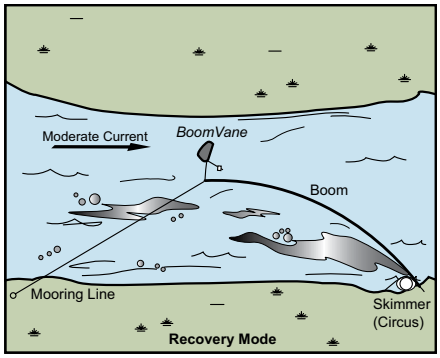


Figure DV-3. Diversion boom configuration using a BoomVane™.

boom. Controlling a diversion boom with a vessel takes considerable skill and a vessel suited for the purpose. Another type of boom control system is a trolley as shown in Figure DV-2. Trolleys require that a line be strung from one shoreline to another, thus they are mostly used in rivers. Trolleys may block a river to passage by vessels and they are susceptible to impacts from debris. A relatively new type of boom control device is built on the principle of a wing or rudder. Devices such as the Boom Vane™, allow the boom to be deployed and controlled from the shoreline (Figure DV-3). This decreases the need for vessels and anchor systems, while allowing superior control of the boom angle.

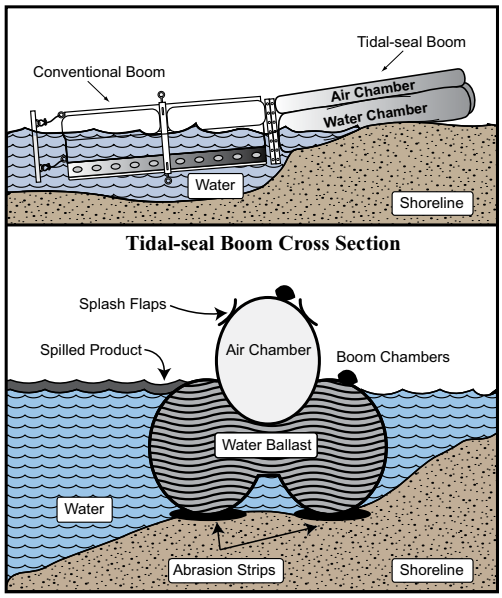


Figure DV-4. Tidal-seal boom configuration.

Tidal-seal Boom

A special type of boom, tidal-seal boom, is used on some boom arrays where the array contacts the shoreline to prevent oil from escaping. Tidal-seal boom typically contains three chambers as shown in Figure DV-4. Two of the chambers are filled with water, and contact the shoreline in shallow water and shoreline areas. The third chamber is usually filled with air, and provides flotation as the water level rises. Tidal-seal boom should be used in areas with a smooth bottom of gradual slope and avoided where there are large rocks and sharp breaks in the bottom. If tidal-seal boom is not available, sorbent materials such as pom-poms or snare on rope can be placed next to or attached to conventional boom to hinder oil entrainment under the boom at the beach water interface. Plans should be made to change out oiled sorbent on each low water tide cycle.

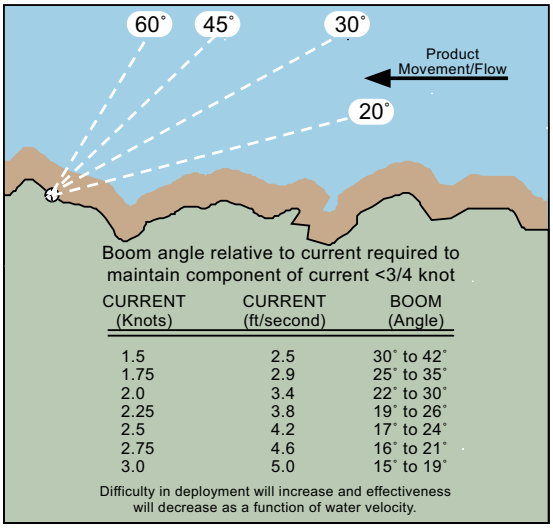


Figure DV-5. Boom angles for various current velocities.

Boom Angle

Figure DV-5 is used to select the appropriate boom angle to keep oil from entraining under the boom. Note that the angle relative to the current decreases rapidly as the current increases. Where currents exceed 3 knots the boom must be almost parallel to the current to prevent entrainment. In currents exceeding 3 knots, a cascade of boom arrays may be used; the first boom array will slow the velocity of the slick allowing subsequent arrays to deflect the oil.

Operating Environments

OPEN WATER

Diversion Boom is rarely used in the open water environment. Diversion Boom system components (vessels, boom and anchors) for open water operations should be able to deploy and operate in seas up to 6 feet and in winds of up to 30 knots. Open water systems are usually deep draft, operating at depths of greater than 6 feet.

PROTECTED WATER

Vessels, boom and anchors for protected water Diversion Boom systems should be able to deploy and operate in seas up to 3 feet and winds up to 25 knots. Protected water diversion boom systems are often based on vessels of opportunity, such as fishing vessels. Protected water systems may be deep draft or shallow draft, depending on the water body.

CALM WATER

Calm water diversion boom systems are composed of vessels, booms and skimmers that should be able to deploy and operate in seas of 1 foot and winds up to 15 knots. Calm water diversion boom systems are usually based on small fishing vessels, work-boats or skiffs fitted with portable skimmers and primary storage devices. Calm water diversion boom systems typically work in depths as shallow as 3 feet.

FAST WATER

Fast water diversion boom systems are designed to operate in moving water where the current exceeds 0.8 knots. This includes rivers and areas with significant tidal current. Vessels, boom and anchors used in tidal waters should be able to deploy and operate in seas up to 1 feet in winds up to 15 knots. Fast-water diversion boom systems are equipped with high-current boom and skimmers. These systems are usually deployed from small vessels or skiffs.

BROKEN ICE

Diversion boom is difficult in the Broken Ice environment due to ice interfering with the boom. A boom control system may be used to quickly collapse the boom system to avoid ice impacts. Vessels used in broken ice should have sufficient hull strength to safely work in ice.

Diversion Boom

Deployment Configurations

There are many variations for deployment of Diversion Boom. Several configurations are described below, but responders should consider the actual conditions and modify their deployment accordingly.

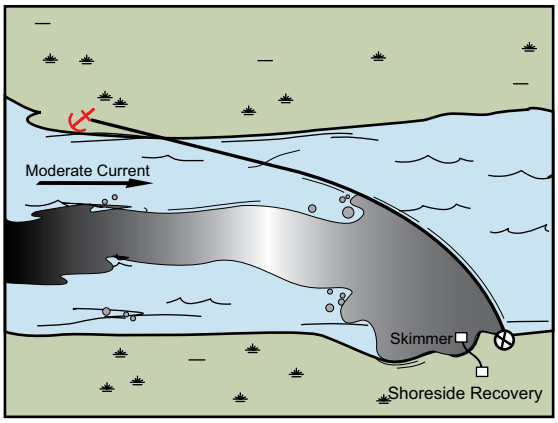


Figure DV-6. Single boom diversion configuration.

SINGLE BOOM – DIVERT INSHORE

A basic diversion technique is to divert oil from a current to a recovery site along a shoreline (Figure DV-6). The recovery site is chosen where there is minimal current (an eddy, quiet water, or collection beach) and a suitable recovery system can be deployed. In some cases, with approval, a trench can be dug to create a quiet skimming area. The boom is then anchored at the site and deployed at an optimum angle to the current and secured/anchored to divert the oil to the shoreline for recovery. The offshore end of the boom can be secured with an anchor in the water, an anchor on a far shore, a boom control device or with a vessel.

DIVERT OFFSHORE

A single boom can also be set to divert oil away from the shore or shoal water, where it can be recovered by On-water Free-oil Recovery or Marine Recovery Systems.

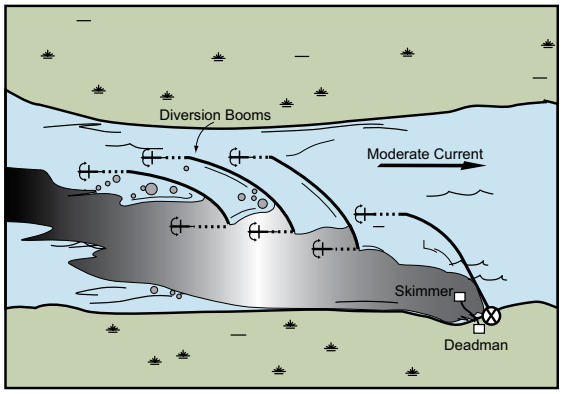


Figure DV-7. Cascade boom diversion configuration.

CASCADE

Several booms can be deployed in a cascade configuration when a single boom cannot be used because of fast current or because it is necessary to leave openings in the boom for vessel traffic, etc. (Figure DV-7) This configuration can be used in strong currents where it may be impossible to effectively deploy one continuous section of boom. Shorter sections of boom, when used in a cascade deployment, are easier to handle in faster water, thereby increasing safety and efficiency. Additional equipment will be required to set and maintain this system in comparison to the single boom configuration.

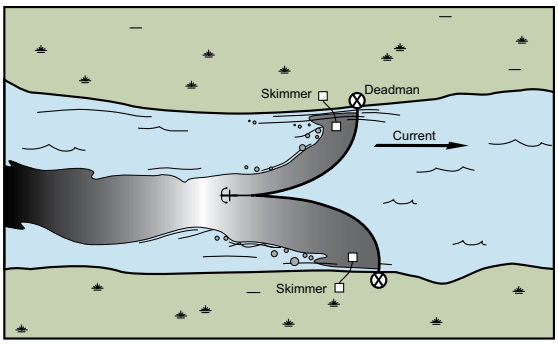


Figure DV-8. Closed chevron diversion configuration.

CHEVRON

Chevron boom configurations may be used in fast water. Two booms are

deployed from an anchor in the middle of the stream/river and then attached to each bank (Figure DV-8). A closed chevron configuration is used to divide a slick for diversion to two or more recovery areas. An open chevron can be used where boat traffic must be able to pass (Figure DV-9). In the open chevron configuration the two booms are anchored separately midstream, with one anchor point up-stream or downstream of the other. An inverted chevron can also be used to funnel an oil slick to a marine recovery unit anchored mid-channel (Figure DV-10).

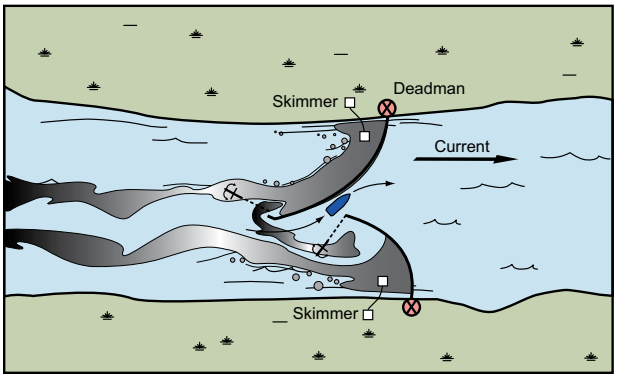


Figure DV-9. Open chevron diversion configuration.

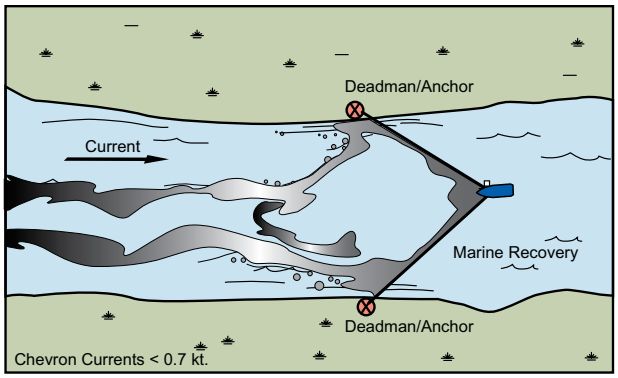


Figure DV-10. Inverted chevron diversion boom configuration.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment and tactic. Local knowledge is preferred.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- Vessels setting anchors and tending the boom should be able to safely transit seas which exceed the boom's operating limitation.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Extreme care should be used when taking strains on anchoring systems using the aft cleats of small vessels and skiffs.
- Extreme care should be given when selecting deadmans for the anchoring systems onshore.
- Buoy lights should be considered for night operations.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

Diversion Boom

- For fast water deployments, consider adding a spotter/rescue person downstream for potential recovery of a casualty, i.e. overturned boat or man overboard.
- Anchor trip lines should be made of material strong enough to handle a moderate strain during boom reconfigurations. Responders normally used the trip line to reposition and reset the anchors.

DEPLOYMENT

- Calm/Protected/Fast water environments are most commonly used for this tactic.
- If the spill is in still water under calm conditions, consider Containment Booming.
- Boom control devices, such as the Boom Vane™, allow diversion booms to be set and retrieved from shore without a vessel. They also allow for continuous adjustment of boom angles.
- Do not assume 100% efficiency with one boom system.
- When deployed by vessels/crews of opportunity, remember that this tactic requires more training and skill than towing a U-boom.
- Readjust angles and widths between boom sections as necessary to meet changing conditions.
- Continuous monitoring of system efficiency is required.
- Planning for a marine environment should be based on average high tidal conditions.
- A Title 41 Fish Habitat permit is required to work inside any anadromous stream. Due to the possibility of contaminating spawning habitat, avoid diverting and/or collecting oil inside a stream mouth if possible.
- See Shoreside Recovery for methods to keep oil from contaminating beaches at recovery points.
- Anchor systems must be selected based on the maximum stress that might be expected to occur on the boom array, considering stronger currents and winds than when the anchor is set.
- The scope of the anchor line should be at least 3 times the depth of the water. If the anchor fails to hold, try increasing the line scope to five times the depth of the water and/or double the length of the anchor chain. Finally, if additional anchor holding is required, anchors can be ganged or set in series.
- All screw pin shackles shall be seized with wire.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

Diversion Boom

REFERENCES TO OTHER TACTICS

Other tactics associated with Diversion Boom include:

- Shoreside Recovery
- Deflection Booming
- Marine Recovery
- Containment Booming
- On-water Free-oil Recovery

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include: vessels; boom; anchoring, mooring, or control systems; and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

*Open Water Diversion Boom System**

Typical Equipment	Function	Quantity	Notes
Oil boom, > 36" height	Divert and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Large anchor systems or shore-based anchors	Keep boom in selected configuration	Site specific	Depending on configuration, currents, and sea states
Boom control device	Controls boom angle	1 optional	Control devices are useful for adjusting the boom angle and avoiding debris
Recovery system	Remove oil	Site Specific	Select the appropriate recovery system for the situation, depending on configuration
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 2, 3, 4, or 5 *At least one vessel with a crane is recommended*	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states. Boom rollers and deck winches may also be useful when heavy response equipment is used.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, recovery system

*Diver.sion Boom may be difficult to deploy and operate in the open water environment.

Diversion Boom

Protected Water Diversion Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 18" to 42" height	Divert and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Tidal-seal boom	Seal containment across the inter-tidal zone	Site-specific, optional	Best for sand and gravel beaches with gradual slope
Medium anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb - 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Boom control devices	Controls boom angle	1 optional	Control devices are useful for adjusting the boom angle and avoiding debris
Recovery system	Remove oil	Site-specific	Select the appropriate recovery system for the situation, depending on configuration
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states. Boom rollers and deck winches may also be useful when heavy response equipment is used.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/ calm-water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, recovery system

Calm Water Diversion Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 6" to 24" height	Divert and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Tidal-seal boom	Seal containment across the inter-tidal zone	Site-specific, optional	Best for sand and gravel beaches with gradual slope
Small anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb - 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Boom control devices	Controls boom angle	1 optional	Control devices are useful for adjusting the boom angle and avoiding debris
Recovery System	Remove oil	Site-specific	Select the appropriate recovery system for the situation, depending on configuration
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states. Boom rollers and deck winches may also be useful when heavy response equipment is used.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/ calm-water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 3	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, recovery system

Fast Water Diversion Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 8" to 24" height	Divert and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Boom control devices	Controls boom angle	1 optional	Control devices are useful for adjusting the boom angle and avoiding debris
Recovery system	Remove oil	Site-specific	Select the appropriate recovery system for the situation, depending on configuration
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/ calm-water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 3	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, recovery system

Broken Ice Diversion Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 8" to 24" height	Divert and concentrate oil	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb - 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Boom control devices	Controls boom angle	1 optional	Control devices are useful for adjusting the boom angle and avoiding debris
Recovery system	Remove oil	Site-specific	Select the appropriate recovery system for the situation, depending on configuration
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 2 or 3	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states. Steel hull required.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/ calm-water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 3	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, recovery system

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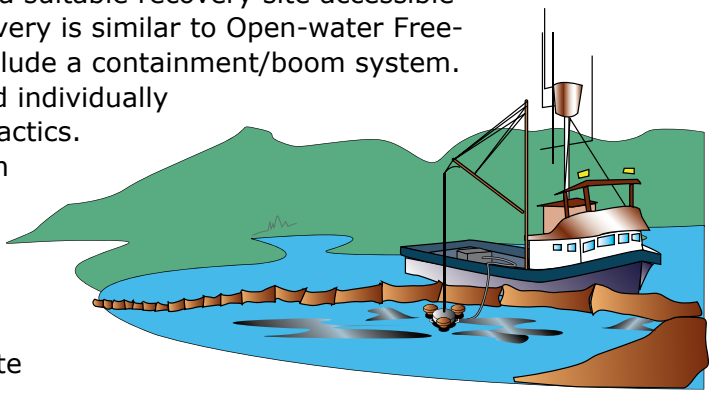
MARINE RECOVERY

OBJECTIVE & STRATEGY

MR

The objective of Marine Recovery is to remove spilled oil that has been diverted or collected at a suitable recovery site accessible from the water. Marine Recovery is similar to Open-water Free-oil Recovery, but does not include a containment/boom system. Marine Recovery may be used individually or in conjunction with other tactics. When it is used in conjunction with other tactics, fewer personnel may be required.



The general strategy is to:

1. Identify the recovery site and assess the site conditions.
2. Determine the appropriate recovery and storage systems based on available equipment, oil type, site conditions, and deployment vessel capabilities.
3. Mobilize and deploy equipment to recover and store the oil from the designated recovery site.
4. Man and monitor the system as appropriate.
5. Store and transfer recovered oil and oily water according to an approved waste management plan.

TACTIC DESCRIPTION

Marine recovery systems are comprised of a skimming system, oil storage system, and associated vessels and personnel. Numerous types of recovery systems and primary oil storage devices are available to recover a variety of oils in various operating environments. Recovery system efficiency varies depending on oil type and encounter rates.

Skimming Systems

Marine recovery requires at least one portable skimming system to remove spilled oil. The typical portable skimming system includes:

- Skimmer with pump and power pack
- Hose (suction and discharge with fittings)
- Oil transfer and decanting pump(s)
- Repair kit (tools and extra parts)

There are many models of skimmers to choose from, but they all fall into three types:

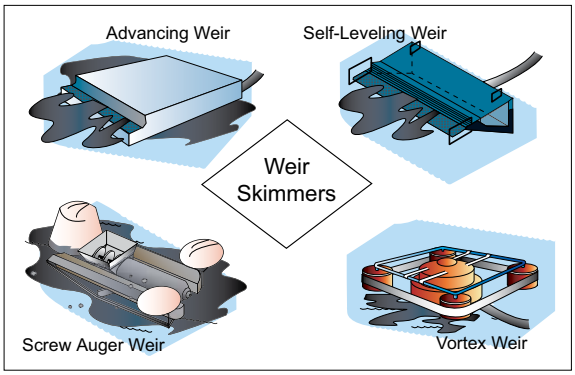


Figure MR-1. Various types of weir skimmers.

- **Weir skimmers** draw liquid from the surface by creating a sump in the water into which oil and water pour. The captured liquid is pumped from the sump to storage. The operator can usually adjust the working depth of the weir, controlling the liquid recovery rate. Weir skimmers can recover oil at high rates, but they can also recover more water than oil, especially when the oil is in thin layers on the surface of the water. This creates the need to separate the water from the oil and decant the water back into the environment. Otherwise, the recovered water will take up available storage volume. Weir skimmers are best employed where oil has been concentrated into thick pools or where there are very large volumes of oil and recovered liquid storage capacity. Avoid using centrifugal pumps to transfer liquids recovered by a weir skimmer, as this will cause the oil and water to emulsify; use a diaphragm pump instead.

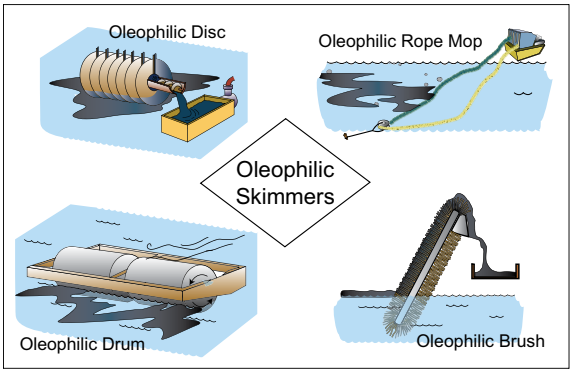


Figure MR-2. Various types of oleophilic skimmers.

- **Oleophilic skimmers** pick up oil that adheres to a collection surface, leaving most of the water behind. The oil is then scraped from the collection surface and pumped to a storage device. The collection surfaces in oleophilic skimming systems include rotating disks, brushes and drums, or continuous belts or ropes. Belt, brush and rope skimmers can be used in any type of oil, while disk and drum skimmers are best in fresh oil. Oleophilic skimmers do not recover oil as fast as weir skimmers, but they have the advantage of recovering very little water. Oleophilic skimmers may be used where oil is very thin on the surface.

- **Suction skimmers** use a vacuum to lift oil from the surface of the water. These skimmers require a vacuum pump or air conveyor system. Like weir skimmers, suction skimmers may also collect large amounts of water if not properly operated. Most suction skimmers are truck mounted and work best on land. However, suction skimmers for the marine environment have been made by converting fish pumps to oil recovery purposes, or loading a vacuum truck on a vessel.

Primary Oil Storage Devices

Primary oil storage devices for the marine environment can be tanks, bladders, drogues, or barges. There are two categories of portable oil storage devices to choose from: onboard storage and towable on-water storage. Onboard oil storage systems can be on deck or below deck, but both types are subject to numerous US Coast Guard regulations and should only be used when approved by a Coast Guard inspector. Towable on-water storage is the preferred method for Marine Recovery. Towable on-water storage devices include: barges, bladders, drogues, and open storage devices.

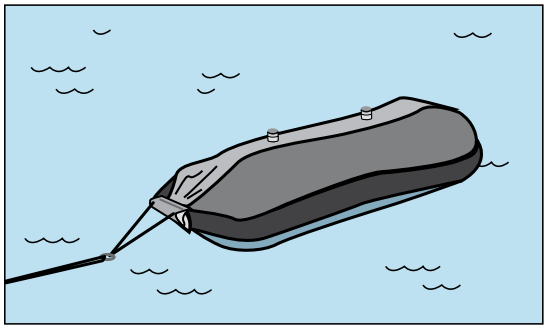


Figure MR-3. Towable, flexible storage device.

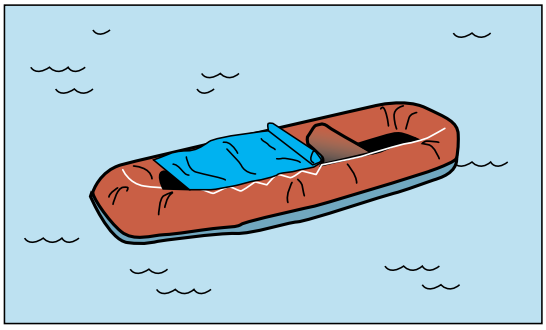


Figure MR-4. Towable open storage device.

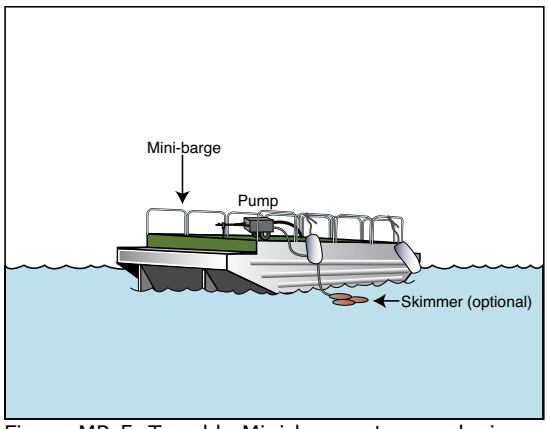


Figure MR-5. Towable Mini-barge storage device.

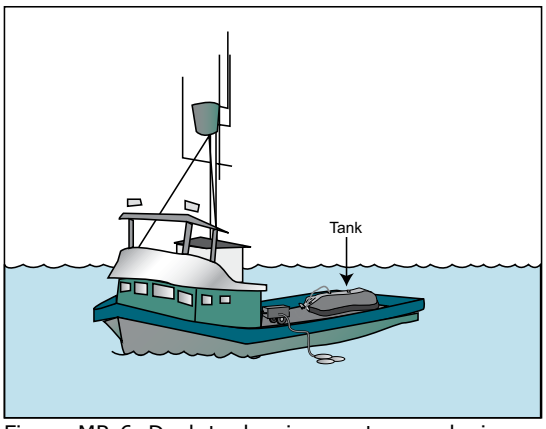


Figure MR-6. Deck tank primary storage device.

Vessels

Access to recovery sites is often restricted to shallow draft vessels due to proximity of the shore and water depths at low tide. The water depth, including area of maneuverability, should be considered in selection of vessels and storage systems. The size of recovery and storage devices varies and needs to be considered when matching with the deployment vessel. Capability of the vessel to lift and deploy the recovery devices, and to handle the storage devices in shallow water and possibly fast currents should also be considered.

Marine Recovery

Operating Environments

OPEN WATER

Marine recovery system components (vessels, skimmers, and storage devices) for open water operations should be able to withstand seas up to 6 feet and winds up to 30 knots. For safety, vessels should be able to transit higher seas from the recovery location to protected waters especially if towing a primary oil storage device.

PROTECTED WATER

Vessels, skimmers and storage devices for protected water marine recovery systems should be able to withstand seas up to 3 feet and winds up to 25 knots. Vessels deploying marine recovery systems in the protected water environment may be deep draft or shallow draft, depending on the water depth.

CALM WATER

Calm water marine recovery systems are composed of vessels, skimmers, and primary storage devices that can operate in seas of 1 foot and in winds up to 15 knots. Vessels deploying calm water marine recovery systems typically work in depths as shallow as 3 feet.

FAST WATER

Marine Recovery in fast water is difficult and not recommended if it is possible to divert the oil into calm water. Fast water marine recovery systems are designed to operate in moving water where the current exceeds 0.8 knots. This includes rivers and areas with significant tidal current. An oil concentrator/accumulator device, such as a Current Buster™ or River Circus™, may be useful for recovery systems in fast water. Vessels and skimmers used in tidal waters should be able to deploy and operate in seas up to 1 foot and in winds up to 15 knots. Vessels, boom, and skimmers used in river waters should be able to deploy and operate in waves up to 2 feet and in winds up to 15 knots. Fast water marine recovery systems are usually deployed from small vessels or skiffs.

BROKEN ICE

Marine recovery systems may be useful in the broken ice environment, where the ice serves to contain and concentrate oil in leads. However, the vessels and storage systems used must be appropriate for an ice environment. Towable, flexible oil storage devices should not be used. Only steel or aluminum hull and storage barges should be used in broken ice. In heavy concentrations of ice, the preferred tactic is to keep the oil storage devices outside the ice and to have recovery vessels transit to the storage devices for transfer of the recovered product.

Deployment Configurations

Typical configurations are shown below, but responders should consider the actual conditions, and modify their deployment accordingly.

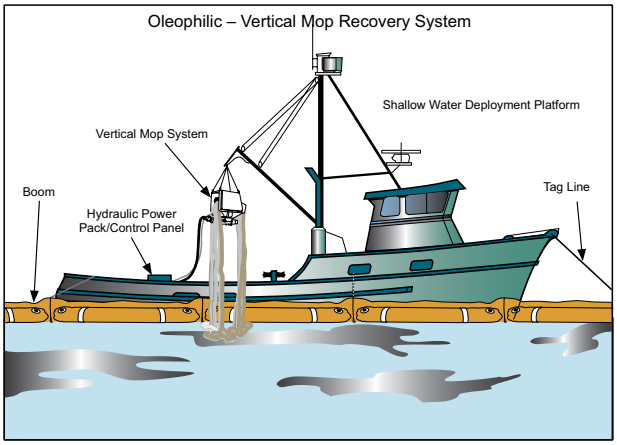


Figure MR-7. Vertical mop recovery system.

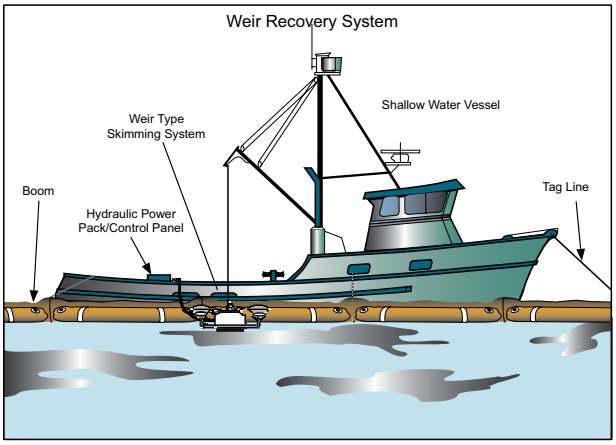


Figure MR-8. Weir recovery system.

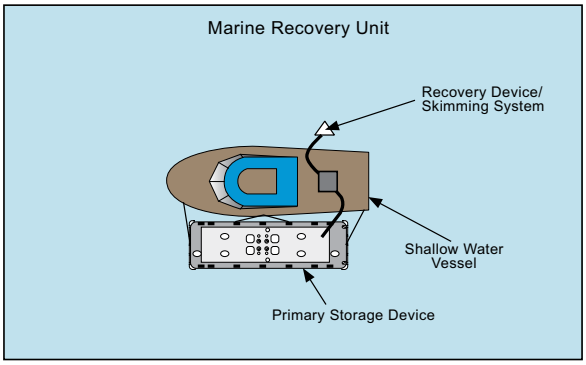


Figure MR-9. Typical Marine Recovery System

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Consider vessel stability when placing equipment and recovered liquids onboard any vessel.
- Daily weather evaluation is recommended, and should include distance to safe harbor and transit times.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- Vessel masters should have experience in the appropriate operating environment and tactic. Local knowledge is preferred.
- Vessel master should use extreme caution when maneuvering primary storage devices around submerged or sharp objects.
- Vessels setting and tending the skimmers and storage devices should be able to safely transit seas which exceed the operating limitations of the equipment.

- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Water depth and oil type may influence equipment options.
- Recovery vessels should coordinate closely with Open Water Recovery and Diversion Booming units.
- Constant monitoring of system efficiency is required.
- Procedure to decant should be considered; a permit is required to decant.

REFERENCES TO OTHER TACTICS

Other tactics associated with Marine Recovery include:

- DV • Diversion Boom
- SR • Shoreside Recovery
- FO • On-water Free-oil Recovery

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this module have been defined as a recovery system, a storage device, and a deployment vessel along with the associated support personnel, equipment, and materials. Quantity of units required will be determined by operating environment, site conditions, and resource availability.

Open Water Marine Recovery System

Typical Equipment	Function	Quantity	Notes
Open water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	2 times the effective daily recovery capacity of the skimming system(s)	Depending on configuration, currents, and sea states
Decanting system	For removing recovered water	1 minimum	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1, 2, or 3 Crane is recommended	Platform for skimming and handling oil storage device	1	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open water	Masters of response vessels	1 to 2	Depending on recovery system and hours of operation
Skilled Technicians	Crew vessels and operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on recovery system and hours of operation

Protected Water Marine Recovery System

Typical Equipment	Function	Quantity	Notes
Protected water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	2 times the effective daily recovery capacity of the skimming system(s)	Depending on configuration, currents, and sea states
Decanting system	For removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, or 5 Crane is recommended	Platform for skimming and handling oil storage device	1	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open water	Masters of response vessels	1 to 2	Depending on recovery system and hours of operation
Skilled Technicians	Crew vessels and operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 2	Depending on recovery system and hours of operation

Calm Water Marine Recovery System

Typical Equipment	Function	Quantity	Notes
Calm water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	2 times the effective daily recovery capacity of the skimming system(s)	Depending on configuration, currents, and sea states
Decanting system	For removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Platform for skimming and handling oil storage device	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 3	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels, configuration, recovery system

Fast Water Marine Recovery System

Typical Equipment	Function	Quantity	Notes
Fast water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	Equal to the effective daily recovery capacity of the skimming system	Depending on configuration, currents, and sea states
Decanting system	For removing recovered water	1 optional	Permit is required to decant
Enhanced recovery device	Concentrate oil to improve skimming efficiency	1 optional	May be part of the booming system
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 4, 5, or 6	Platform for skimming and handling oil storage device	1	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open water	Masters of response vessels	1 to 2	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 2	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	1 to 4	Depending on number of vessels, configuration, recovery system

Broken Ice Marine Recovery System

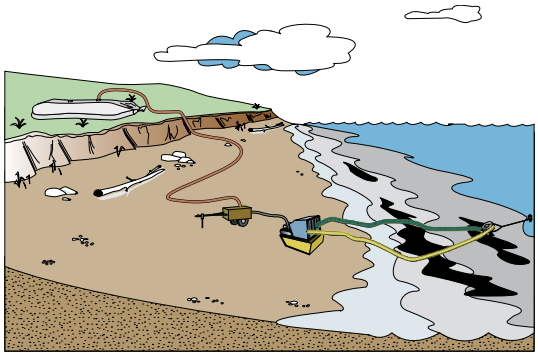
Typical Equipment	Function	Quantity	Notes
Protected/calm water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	2 times the effective daily recovery capacity of the skimming system	Depending on configuration, currents, and sea states
Decanting system	For removing recovered water	1 optional	Permit is required to decant
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1, 2 or 3	Platform for skimming and handling oil storage device	1	Must be rated to work in broken-ice. Steel hull required.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open water	Masters of response vessels	1 to 2	Depending on hours of operations
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on hours of operations
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on hours of operation and configuration of recovery system

SHORESIDE RECOVERY

OBJECTIVE & STRATEGY

SR

The objective of Shoreside Recovery is to remove spilled oil that has been diverted to a designated recovery site accessible from the shore. Shoreside Recovery is usually deployed as part of another tactic, such as Diversion Boom strategy. When deployed in conjunction with another tactic, fewer personnel may be required.



The general strategy is to:

1. Identify the primary recovery site.
2. Assess site conditions and access routes.
3. Determine the appropriate recovery and storage systems based on oil type, access, and deployment restrictions.
4. Mobilize and deploy equipment to recover and temporarily store the oil from the recovery site.
5. Take precautions to minimize contamination of the shoreline at the collection site.
6. Man and monitor the system as appropriate.
7. Store and transfer recovered oil and oily water according to an approved waste management plan.

TACTIC DESCRIPTION

Shoreside recovery systems are comprised of a skimming system, oil storage system, and associated personnel. Shoreside recovery systems can be deployed from land access routes (roads, beaches, all-terrain vehicles), water access (marine vessels), or air access (helicopter). Access to the recovery site and the oil type will influence/ dictate the options of equipment to be used.

Skimming Systems

Shoreside recovery requires at least one portable skimming system to remove spilled oil. The typical portable skimming system includes:

- Skimmer with pump and power pack
- Hose (suction and discharge with fittings)
- Oil transfer and decanting pump(s)
- Repair kit (tools and extra parts)

There are many models of skimmers to choose from, but they all fall into three types:

- **Weir skimmers** draw liquid from the surface by creating a sump in the water into which oil and water pour. The captured liquid is pumped from the sump to storage. The operator can usually adjust the working depth of the weir, controlling the liquid recovery rate. Weir skimmers can recover oil at high rates, but they can also recover more water than oil, especially when the oil is in thin layers on the surface of the water. This creates the need to separate the water from the oil and decant it back into the environment. Otherwise, the recovered water takes available storage volume. Weir skimmers are best employed where oil has been concentrated into thick pools or where there are very large volumes of oil and recovered liquid storage capacity. Avoid using centrifugal pumps to transfer liquids recovered by a weir skimmer, as this will cause the oil and water to emulsify; use a diaphragm pump instead. Weir skimmers are a good choice where large volumes of oil can be concentrated and where liquid storage is not an issue.

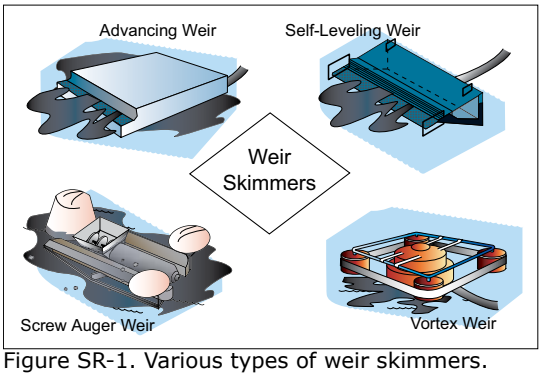


Figure SR-1. Various types of weir skimmers.

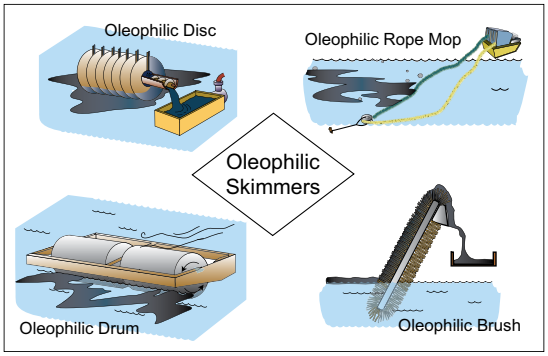


Figure SR-2. Various types of oleophilic skimmers

- **Oleophilic skimmers** pick up oil that adheres to a collection surface, leaving most of the water behind. The oil is then scraped from the collection surface and pumped to a storage device. The collection surfaces in oleophilic skimming systems include rotating disks, brushes and drums; or endless belts or ropes. Belt, brush and rope skimmers can be used in any type of oil, while disk and drum skimmers are best in fresh oil. Oleophilic skimmers do not recover oil as fast as weir skimmers, but they have the advantage of recovering very little water. Oleophilic skimmers may be used where oil is very thin on the surface. Oleophilic skimmers are a good choice where liquid storage capacity is limited.

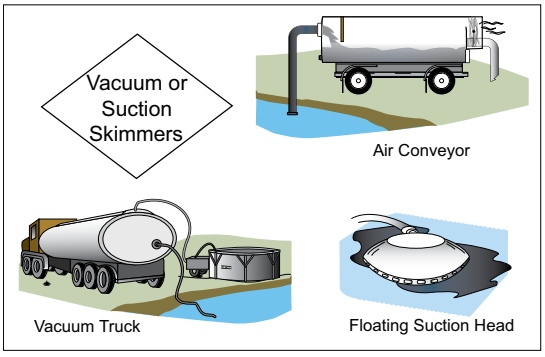


Figure SR-3. Various types of vacuum/suction skimmers.

- **Suction skimmers** use a vacuum to lift oil from the surface of the water.

These skimmers require a vacuum pump or air conveyor system. Like weir skimmers, suction skimmers may also collect large amounts of water if not properly operated. Most suction skimmers are truck mounted and work best at sites with road access.

Primary Oil Storage Devices

Primary oil storage devices for shoreside recovery can be portable tanks, bladders, or truck-mounted tanks on the shoreline. Small barges can also be anchored just offshore or beached at low tide. If access is restricted to All-terrain Vehicles (ATV), then the systems chosen need to be light enough to be transported by ATV and capable of being set-up/deployed by a minimal number of personnel. If access is not restricted, larger systems can be used and deployed by heavy lifting equipment. If the site is accessible by road, vacuum trucks may be used for oil recovery, storage, and transport.

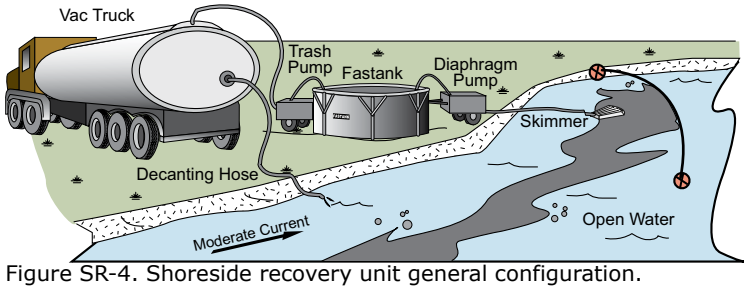


Figure SR-4. Shoreside recovery unit general configuration.

Recovery Location

Selection of a shoreside recovery location is critical to the success of this tactic. A recovery site should be in calm water with minimal currents. One option is to construct a quiet recovery spot by excavating a recovery lagoon or trench in the shoreline (Figure SR-5). However, a permit may be required to perform such an excavation. Commercial oil recovery enhancement devices, such as the River Circus™ and Current Buster™, are also available to provide a quiet recovery impoundment.

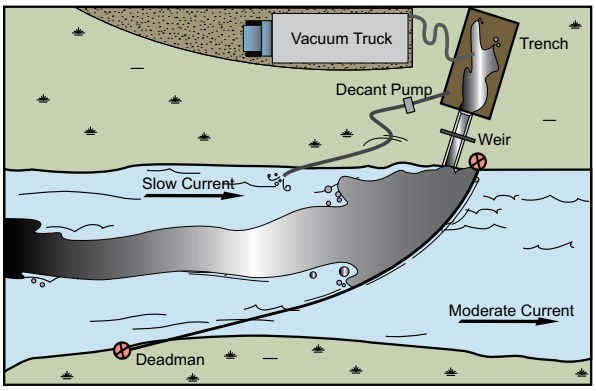


Figure SR-5. Shoreside recovery unit skimming lagoon.

The site must have enough level ground to set up and operate a power pack and portable tanks. Sites with road access are preferred, but if not available, the site must have some other suitable access. Shelter, food and water for the response crew must also be considered in selecting a site.

Shoreside Recovery

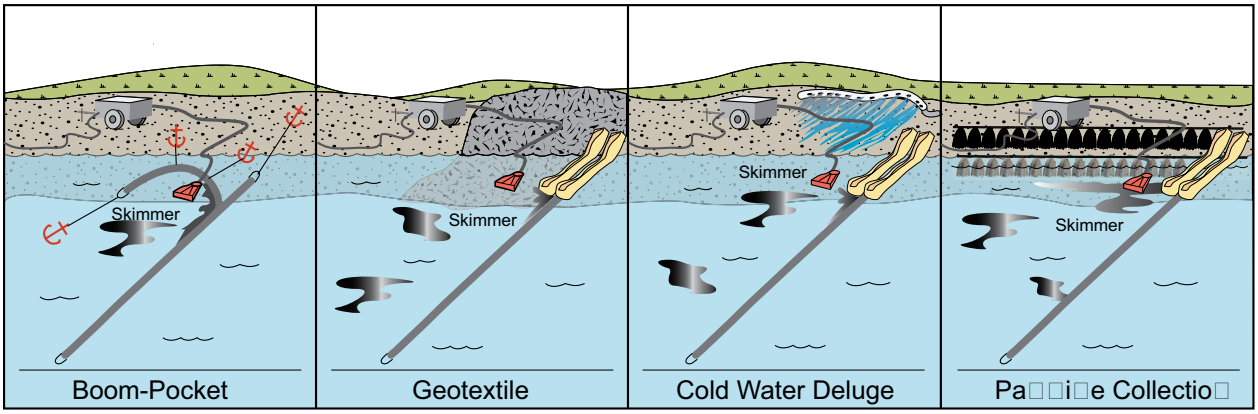


Figure SR-6. Methods to keep oil from contaminating collection beaches.

It is important to minimize shoreline contamination at the recovery site. If possible, oil should not be allowed to contact the inter-tidal zone or shoreline. Oil contamination can be avoided by constructing a boom-pocket in the water off the shoreline, covering the shore with a geotextile at the recovery location, using a cold-water deluge to keep the collection location wetted, or using passive materials to collect the oil prior to its reaching the shoreline (Figure SR-6). If oil does reach the beach, efforts should be taken to avoid pushing the oil down into the substrate. Do not walk on oiled muddy soils and avoid driving or operating equipment on oiled surfaces.

Operating Environments

Oil recovery on land and solid ice is covered under On-land Recovery. Shoreside Recovery is not recommended for open water environments.

PROTECTED WATER

Shoreside Recovery can be deployed in areas considered protected water, but it is only feasible to operate from shoreline in calm conditions. In some cases, oil can be diverted from protected water into calm water for recovery.

CALM WATER

Calm water shoreside recovery systems are composed of skimmers that can be deployed and operated in seas of 1 foot. Wind is normally not a limiting factor for shoreside recovery. If vessels are used to transport and support the recovery system, they should be able to safely transit seas up to 3 feet and winds up to 20 knots.

FAST WATER

Shoreside Recovery is often deployed in areas considered fast water, but oil is usually diverted from high current areas into calm water for recovery.

Deployment Configurations

Typical configurations are shown in the diagram below (Figure SR-7), but responders should consider the actual conditions, and modify their deployment accordingly.

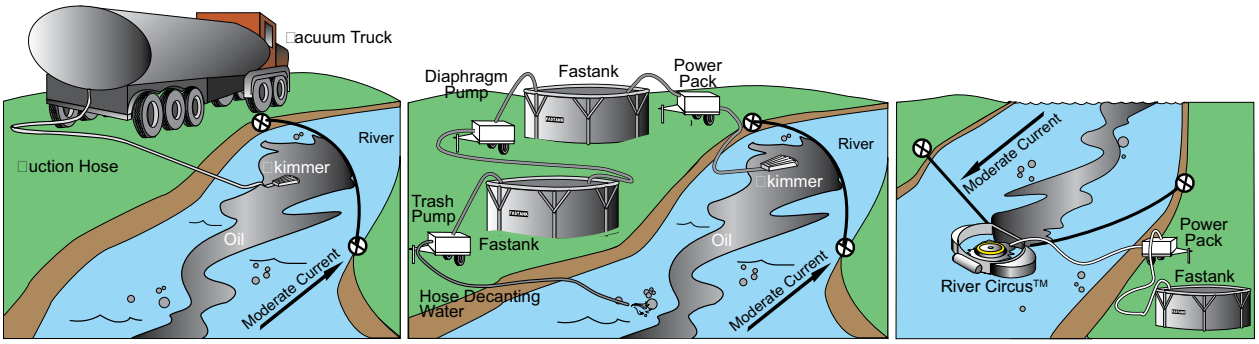


Figure SR-7. Shoreside Recovery deployment configurations.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe shelter and transit times.
- If mobilizing by water, consider vessel stability when placing equipment on deck.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Access and oil type will influence equipment options.
- Team leader should coordinate closely with diversion booming units.
- Constant monitoring of system efficiency is required.
- Where access is restricted, system efficiency should be increased to minimize excess waste/water, and decant options should be reviewed.
- A transfer pump may be required to move oil from storage to vacuum truck or other mobile storage.

Shoreside Recovery

- May need to request a permit from ADEC to decant free water from storage back into recovery area.
- Identify and order resources needed to sustain 24 hr operations, such as portable bathroom, warm-up tents, and lighting.
- Walking boards should be used to control traffic and minimize impact to uplands vegetation.
- A lay down area should also be identified for oily and non-oily solid waste.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with Shoreside Recovery include:

- MR • Marine Recovery
- OR • On-land Recovery
- DV • Diversion Boom
- MST • Marine-based Oil Storage and Transfer
- LST • Land-based Oil Storage and Transfer
- POL • Pumping Oily Liquids

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this module have been defined as a recovery system, a storage device, deployment vehicle/vessel along with the associated support personnel, equipment, and materials. Quantity of units required will be determined by operating environment, site conditions and resource availability.

The following tables provide basic components for the two types of shoreside recovery systems: restricted access, where the system must be deployed by vessel, ATV, or helicopter; and no access restriction, where the system can be reached from the road system.

Shoreside Recovery System – Restricted Access

Typical Equipment	Function	Quantity	Notes
Calm/protected water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	Depends on logistics of transporting recovered liquids, recommend a minimum of at least the daily recovery capability of the skimming system	Should be portable and easy to set up
Decanting system	Removing recovered water	1 minimum	Permit is required to decant
Typical Mobilization Options	**Function**	**Quantity**	**Notes**
Vessel Class 2, 3, 4, 5, or 6	Deploy system to recovery locations accessible from the marine environment	1 or more	Locations with marine access
ATV with trailer	Deploy system to recovery location at an off-road location	1 or more	Locations with ATV access
Helicopter	Deploy system to recovery location at an off-road location	1 or more	Locations with a helicopter landing zone
Typical Personnel*	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations including helicopter landings	1	
Skilled Technicians	Operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians	1 to 3	Depending on recovery system and hours of operation

** Personnel may be part of a Diversion Booming team.*

Shoreside Recovery System - No Access Restriction

Typical Equipment	Function	Quantity	Notes
Calm/protected water rated skimming system	Remove oil	1	Includes power pack, hoses, fittings, and rigging
Primary oil storage system(s)	Store recovered oil	Depends on logistics of transporting recovered liquids, recommend a minimum of at least the daily recovery capability of the skimming system	May be part of a truck mounted system, such as a vacuum truck
Decanting system	Removing recovered water	1 optional	Permit is required to decant
Typical Mobilization Options	**Function**	**Quantity**	**Notes**
Truck or truck with trailer	Deploy system to recovery locations accessible by road system	1 or more	Locations accessible by road system
Typical Personnel*	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Skilled Technicians	Operate response equipment	1 to 2	Depending on recovery system and hours of operation
General Technicians	Work under the direction of skilled technicians	0 to 3	Depending on recovery system and hours of operation

** Personnel may be part of a Diversion Booming team.*

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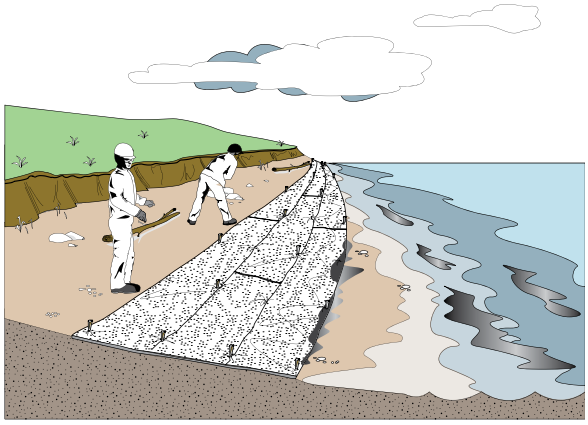
PASSIVE RECOVERY

OBJECTIVE & STRATEGY

PR

The objective of the Passive Recovery tactic is to remove spilled oil by collecting it in a sorbent material. The sorbent material and associated oil are then removed from the environment and disposed of according to an approved Waste Management Plan.

TACTIC DESCRIPTION



Passive Recovery is performed through the process of adsorption on sorbent materials, such as sorbent pads, rolls, and boom; pom-poms (oil snare); and natural products. Sorbent boom and pom-poms are made from substances like polypropylene, a synthetic material that is oleophilic (oil-attracting) and hydrophobic (water-repelling). When left in an oily water mixture, they can collect many times their own weight in oil while collecting very little water. Their effectiveness depends on the type of oil, how they are placed, and the environmental conditions at the recovery site. The tactic is usually deployed by anchoring rows of sorbent boom or oil snare along the shoreline or in the intertidal zone. A variation for marine mammal haulouts is accomplished by broadcasting natural sorbent material, such as peat moss or sphagnum moss, on the haulout sites (Figure PR-4).

The general strategy is to:

1. Identify the trajectory of the spilled oil and select areas to be protected. Identify natural collection sites where floating debris is usually found.
2. Evaluate access restrictions and select appropriate deployment vehicles.
3. Mobilize and deploy personnel with tools and materials.
4. Secure sorbents with anchors or stakes.
5. Monitor the sorbent on a regular basis for oil content and security of the anchor systems.
6. Replace saturated sorbents as necessary.
7. Store and dispose all recovered sorbents according to the waste management plan.

Passive Recovery

Passive Recovery can be deployed along shorelines prior to impact to reduce the quantity of oil that might otherwise impact sensitive habitats. The tactic can also be applied to shorelines that have already been oiled to help keep the re-mobilizing oil from refloating and migrating to other non-impacted shorelines. Passive recovery can also be used to line the inside of containment or exclusion boom as an effective collection technique. Likewise, passive recovery can be used with diversion boom in cases where small amounts of oil are anticipated. Sorbents can be used with tidal-seal boom or fences to create an adsorption barrier. In all cases, the sorbent material must be monitored after each tide and replaced as necessary.

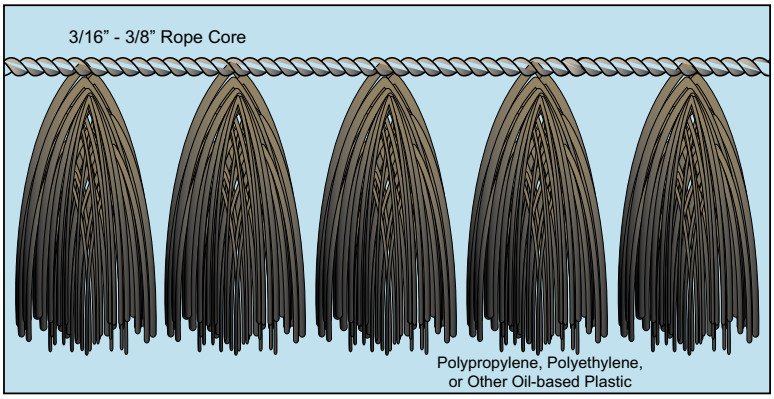


Figure PR-1. Snare line.

Fibrous polypropylene sorbents, such as pads, rolls, and sorbent boom, work well on non-persistent oil such as diesel. These sorbents can recover approximately 15:1 oil to sorbent by weight. Polypropylene strips, such as pom-poms, work best in persistent oil and may recover up to 20:1 oil to sorbent by weight. Natural material, such as peat, are effective sorbents, but are difficult to recover from the environment once oiled.

Passive recovery operations can produce a significant solid waste stream; all wastes generated must be measured, stored, and disposed of according to an approved Waste Management Plan. Logistical support for this waste stream should be mobilized early in the spill event. One way to reduce solid oily wastes is to wring out oil from the sorbents and reuse them.

Access to selected areas may be accomplished from the water, land, or air. Deployment from the water usually involves using shallow water platforms such as landing craft and skiffs. Access from a land-based response utilizes trucks, ATV's, or other four-wheel drive vehicles, while access from the air may be possible by helicopter.

Passive Recovery is often combined with debris removal, where concentrations of driftwood and other debris are relocated or removed from a likely impact area. The impact area is typically the area between the low and high tide lines in marine areas or the present waterline of the inland water body.

Operating Environments

OPEN WATER

Passive Recovery is not recommended in the open water operating environment due to the likelihood of losing sorbent materials.

PROTECTED WATER

Consider placing sorbents from the shoreside in the protected water environment. Sorbent materials and anchors for protected water passive recovery systems should be able to deploy and operate in seas up to 3 feet and winds up to 25 knots. Vessels setting and tending the sorbents should be able to safely transit seas which exceed the sorbent's operating limitation. Sorbent arrays must be monitored often, due to the forces applied on the anchor systems by wind, currents, and waves.

CALM WATER

Calm water passive recovery systems should be able to deploy and operate in seas of 1 foot and winds up to 15 knots. Vessels setting and tending the sorbents should be able to safely transit seas which exceed the sorbent's operating limitation. Calm water passive recovery systems may be based on small fishing vessels, work-boats, or skiffs. Calm water passive recovery systems typically work in depths as shallow as 3 feet.

FAST WATER

Passive recovery systems are not usually effective in fast water environments, but are often utilized where the currents slow to calm water conditions.

BROKEN ICE

It is difficult to keep passive recovery systems anchored securely in broken ice conditions. As an alternative to anchoring, sorbent materials may be placed in leads and openings in the ice, closely monitored, and retrieved once free from the ice.

SOLID ICE

An effective passive recovery method on solid ice is to use snow as a natural sorbent material.

MARSH AND TUNDRA

Sorbents can be an effective recovery technique on wetlands, but care must be taken not to damage sensitive habitat when accessing and working on the recovery site. Minimize travel across tundra and marsh and avoid walking on oil-contaminated soils. Place sorbents to remove small pools of oil and to intercept lightly oiled waters that are migrating away from the contaminated site. Take care to ensure that sorbent material is not blown away by high winds.

Passive Recovery

OTHER LAND-BASED SPILLS

Use of sorbents should be minimized because of solid waste disposal problems. Use sorbents when overland flow is minor and terrain has a low slope.

Deployment Configurations

Typical configurations are shown below, but responders should consider the actual conditions, and modify their deployment accordingly.

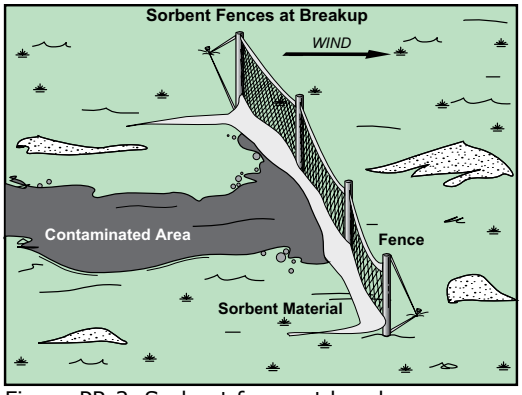


Figure PR-2. Sorbent fence at break-up.

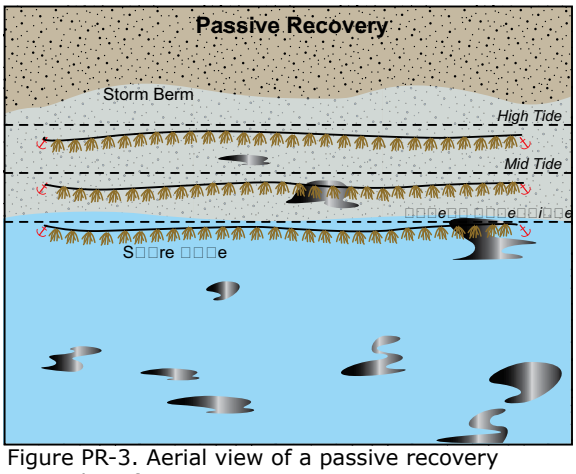


Figure PR-3. Aerial view of a passive recovery general configuration.

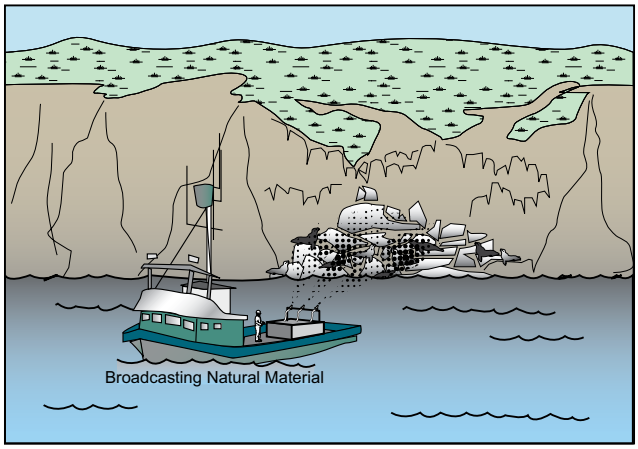


Figure PR-4. Marine mammal broadcast passive recovery.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Passive recovery teams may require bear guards when working in bear habitat.
- Daily weather evaluation is recommended, and should include distance to safe shelter and transit times.
- Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Shoreline access may influence deployment platform options.
- Passive recovery materials require periodic tending and replacement.
- Logistics for solid waste transport and disposal need to be considered.
- Contact National Marine Fisheries Service (NMFS) before disturbance of marine mammals.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.
- Take proper measures to prevent sorbents from freezing into (incorporated into) the ice. If this occurs, sorbent recovery will be delayed until break-up.

REFERENCES TO OTHER TACTICS

Other tactics associated with Passive Recovery include:

- DV Diversion Boom
- C Containment Boom

Passive Recovery

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic have been defined as personnel with tools, transportation, and sorbent materials. Quantity of units required will be determined by site conditions and resource sets may need to be refined as site-specific requirements dictate.

Typical Passive Recovery System

Typical Equipment	Function	Quantity	Notes
Sorbent boom, typically 8" diameter by 10' long	Collect non-persistent oil	Site-specific	Best for diesel and non-weathered crude oil
Pom-poms attached to a line, typically in 50' lengths	Collect persistent oil	Site-specific	Best for weathered crude, Bunker C, IFO, and other persistent oils
Anchor systems, small	Secure sorbent in selected configuration	1 system per 200' of boom/line	Use in sub-tidal collection
Anchor stakes	Secure sorbent in selected configuration	1 stake per 100' line	Use on land and in inter-tidal areas
Hand tools: rakes, pitchforks, shovels, sledge hammer	Deploy anchor, stakes, etc.	Site-specific	
Oily waste bags and duct tape	Storage of recovered sorbent materials	4 to 8 bags per 100'	
Typical Mobilization Options	**Function**	**Quantity**	**Notes**
Vessel Class 2, 3, 4, 5, or 6	Deploy system to recovery locations accessible from the marine environment	1 or more	Locations with marine access
ATV with trailer	Deploy system to recovery location at an off-road location	1 or more	Locations with ATV access
Helicopter	Deploy system to recovery location at an off-road location	1 or more	Locations with a helicopter landing zone
Trucks and other 4-wheel drive vehicles	Deploy system to recovery location accessible by road	1 or more	Locations with road access
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/ calm waters	Operate Response Vessels	1 per vessel, optional	If vessels are required
Skilled Technicians	Lead crews	1 or 2	Depending on crew size
General Technicians	Work under the direction of skilled technicians or field team leader	2 to 15	3 to 5 per crew leader

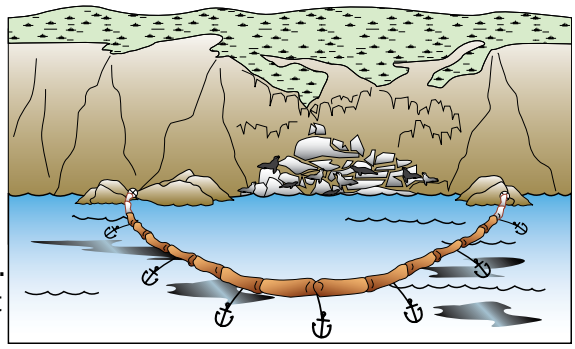
EXCLUSION BOOM

OBJECTIVE & STRATEGY

EX

Exclusion Booming is a fixed-boom strategy, with the objective of prohibiting oil slicks from entering a sensitive area.

TACTIC DESCRIPTION



This technique requires the area to be completely boomed off, forming a protective barrier. Conventional oil boom, tidal-seal boom, or a combination of each can be used to exclude spilled oil from a sensitive area. Typically, tidal-seal boom is deployed at the shoreline/water interface on both shores and is secured/anchored into position. Conventional oil boom is then connected to the tidal-seal boom and is secured with additional anchor systems to form a barrier and to maintain shape.

This technique is most efficient in low current areas. Freshwater outflow from a river or stream may assist in maintaining boom configuration and pushing oil away from the area inside the boom.

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Identify, prioritize, and select sensitive areas to be protected from impact.
3. Select a deployment configuration that best supports the operating environment and available resources.
4. Mobilize to the location and deploy the equipment.
5. Secure boom with anchor systems and/or mooring points.
6. Monitor the boom on an appropriate basis.

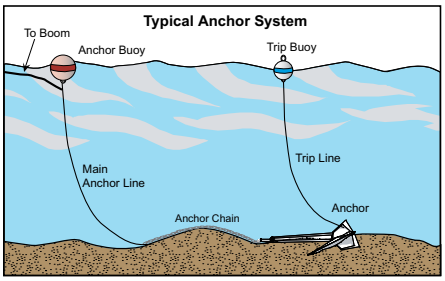


Figure EX-1. Typical anchor system.

7. If oil contacts the outside of the boom, utilize an appropriate recovery system to remove it.

Anchor Systems

Boom is secured in place using standard anchoring systems that are shown in Figure EX-1. Anchor sizes vary depending on the boom type and the operating environment.

Exclusion Boom

TIDAL-SEAL BOOM

A special type of boom, tidal-seal boom, is used on some boom arrays where the array contacts the shoreline to prevent oil from escaping. Tidal-seal boom typically contains three chambers as shown in Figure EX-2. Two of the chambers are filled with water, and contact the shoreline in shallow water and shoreline areas. The third chamber is usually filled with air, and provides flotation as the water level rises. Tidal-seal boom should be used in areas with a smooth bottom of gradual slope and avoided where there are large rocks and sharp breaks in the bottom.

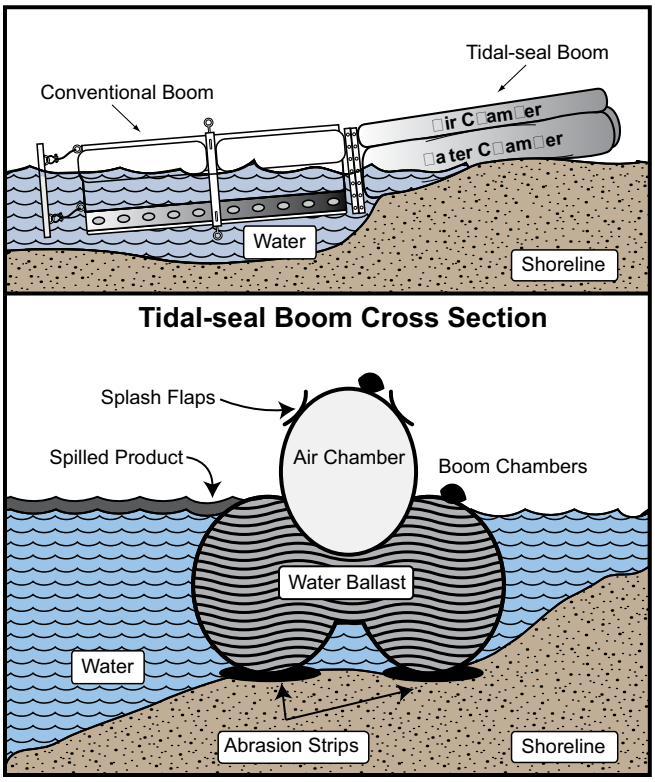


Figure EX-2. Tidal-seal boom configuration.

Operating Environments

OPEN WATER

Exclusion Boom is not recommended for use in the open water environment, because of the high probability of boom and anchor failure; consider On-water Free-oil Recovery, Diversion Booming, or Deflection Booming instead.

PROTECTED WATER

Vessels, boom and anchors for protected-water exclusion boom systems should be able to deploy and operate in seas up to 3 feet and winds up to 25 knots. Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Protected water exclusion boom systems are often based on vessels of opportunity, such as fishing vessels. Protected water systems may be deep draft or shallow draft, depending on the water body.

CALM WATER

Calm water exclusion boom systems are composed of vessels, booms and skimmers that should be able to deploy and operate in seas of 1 foot and winds up to 15 knots. Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Calm water exclusion boom systems are usually based on small fishing vessels, work-boats or skiffs fitted with portable skimmers and primary storage devices. Calm water exclusion boom systems typically work in depths as shallow as 3 feet.

FAST WATER

Exclusion Boom is not recommended for fast water operating environments; consider Diversion Boom or Deflection Boom tactics instead.

BROKEN ICE

Exclusion Boom may be difficult for broken ice operating environments; consider Marine Recovery instead.

Deployment Configurations

Two configurations are described below, but responders should consider the actual conditions and modify their deployment accordingly.

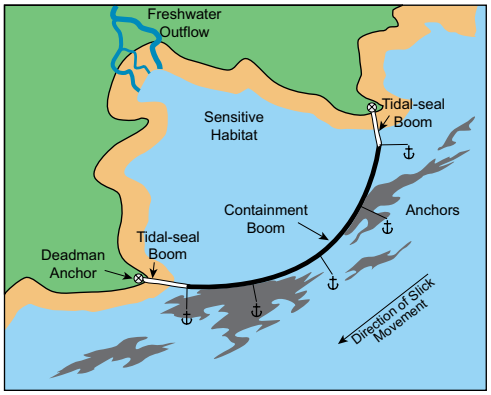


Figure EX-3. Exclusion booming configuration.

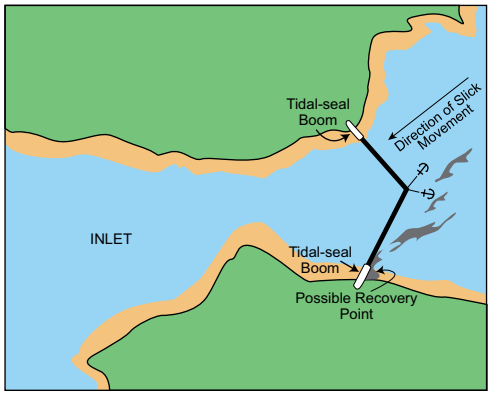


Figure EX-4. Exclusion booming with apex for exposed shores or currents.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment and tactic. Local knowledge is preferred.
- Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.

- Anchor trip lines should be made of material strong enough to handle a moderate strain during boom reconfigurations. Responders normally used the trip line to reposition and reset the anchors.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.
- Buoy lights should be considered for night operations.

DEPLOYMENT

- Do not try to exclude oil from too large of an area; a single failure will result in contamination of the entire area. It is better to deploy more booms arrays covering smaller areas.
- Do not assume 100% efficiency with one boom system.
- Readjust anchors to maintain boom shape through tide cycles.
- Constant monitoring of system is required.
- Deployment planning should be based on average high tidal conditions.
- Expect boom failure where currents over 0.75 knots encounter the boom.
- A gate may be installed to allow vessels to pass.
- If tidal-seal boom is not available, sorbent materials such as pom-poms or snare on rope can be placed next to or attached to conventional boom to hinder oil entrainment under the boom at the beach water interface. Plans should be made to change out oiled sorbent on each low water tide cycle.
- Anchor systems must be selected based on the maximum stress that might be expected to occur on the boom array, considering stronger currents and winds than when the anchor is set.
- The scope of the anchor line should be at least 3 times the depth of the water. If the anchor fails to hold try increasing the line scope to five times the depth of the water and/or double the length of the anchor chain. Finally, if additional anchor holding is required, anchors can be ganged or set in series.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with Exclusion Boom include:

- BB Beach Berms and Exclusion Dams
- DV Diversion Boom
- DF Deflection Boom

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels, boom, anchoring systems, and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Protected Water Exclusion Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 18" to 42" height	Exclude oil from sensitive area	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Tidal-seal boom	Seal containment across the inter-tidal zone	Site-specific, optional	Best for sand and gravel beaches with gradual slopes
Small anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5 or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 4	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	1 to 4	Depending on number of vessels, configuration, recovery system

Calm Water Exclusion Boom System

Typical Equipment	Function	Quantity	Notes
Oil boom, 6" to 24" height	Exclude oil from sensitive area	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Tidal-seal boom	Seal containment across the inter-tidal zone	Site-specific, optional	Best for sand and gravel beaches with gradual slopes
Small anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, protected/ calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 4	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	1 to 4	Depending on number of vessels, configuration, recovery system

Exclusion Boom

Broken Ice Exclusion Boom System

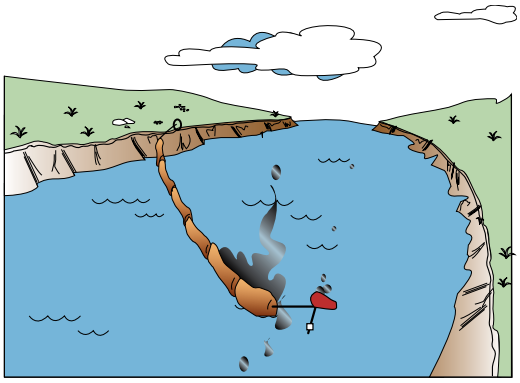
Typical Equipment	Function	Quantity	Notes
Oil boom, 6" to 42" height	Exclude oil from sensitive area	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Tidal-seal boom	Seal containment across the inter-tidal zone	Site-specific, optional	Best for sand and gravel beaches with gradual slopes
Anchor systems or shore-based anchors	Secure boom in selected configuration	Rule of Thumb 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1, 2, or 3	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states. Steel hull required.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators, open/ protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 4	Depending on number of vessels, configuration, recovery system
General Technicians	Work under the direction of skilled technicians or vessel operators	1 to 4	Depending on number of vessels, configuration, recovery system

DEFLECTION BOOM

OBJECTIVE & STRATEGY

DF

The objective of Deflection Boom is to direct spilled oil away from a location to be protected or simply to change the course of the slick. For the purposes of maintaining consistent and clear terms, "deflection" is used to describe the tactic where oil is redirected away from an area but not recovered, in contrast with the term "diversion", which is always associated with oil recovery.



TACTIC DESCRIPTION

The Deflection Boom tactic is for water-born spills where there is some current, usually from 0.5 to 3.0 knots. The boom is placed at an optimum angle to the oil trajectory, using the movement of the current to carry oil along the boom and then releasing it into the current again with a new trajectory. The angle is chosen to prevent oil from entraining beneath the boom skirt. Boom may be held in place by anchors, vessels, or a boom control device.

Deflection Boom may be used to temporarily avoid impacts to a sensitive area, but there is no recovery associated with the tactic, thus no oil is removed from the environment. For this reason, Diversion Boom or Free-oil Recovery is preferable to Deflection Boom whenever feasible. However, Deflection Boom may be more effective than Exclusion Boom at protecting a sensitive location, where currents over 0.75 knots exist.

The two alternatives for this tactic are Fixed Deflection and Live Deflection. In Fixed Deflection, boom is anchored to the shoreline or bottom. In Live Deflection, the boom is attached to vessels and held in position by the power of the vessels or one end of the boom is anchored and the other end held in position with a vessel. Live deflection is a very difficult tactic to execute. It should only be utilized where fixed deflection cannot be achieved, usually because deep water precludes anchoring.

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Identify, prioritize, and select sensitive areas to be protected from impact.

Deflection Boom

3. Select a deployment configuration that best supports the operating environment and available resources.
4. Mobilize to the location and deploy the tactic.
5. Place boom using secured anchor systems, mooring points, vessels, boom control devices, etc.
6. Monitor and adjust the boom on an appropriate basis.

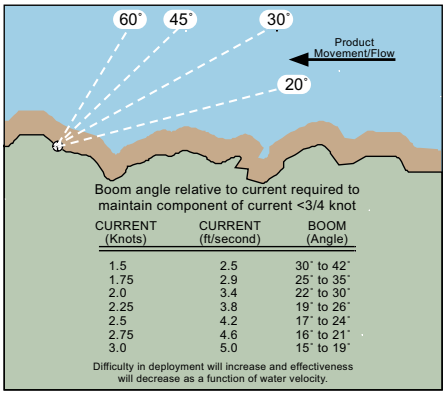


Figure DF-1. Boom angle relative to current.

Boom Angle

Figure DF-1 is used to select the appropriate boom angle to keep oil from entraining under the boom. Note that the angle relative to the current decreases rapidly as the current increases. Where currents exceed 3 knots the boom must be almost parallel to the current to prevent entrainment. In currents exceeding 3 knots, a cascade of boom arrays may be used; the first boom array will slow the velocity of the slick allowing subsequent arrays to deflect the oil.

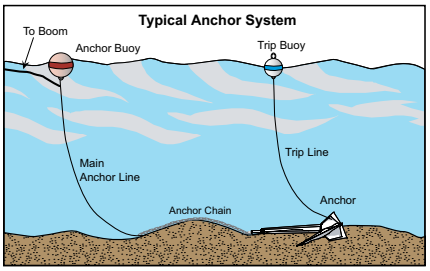


Figure DF-2. Typical anchor system components.

Anchor Systems

Boom is secured in place using standard anchoring systems that are shown in Figure DF-2. Anchor sizes vary depending on the boom type and the operating environment.

Boom Control Devices

Boom control devices are an alternative to anchoring deflection boom on the offshore end. Boom control devices have the advantage of allowing continuous control over the angle and position of the boom. They can also allow the boom to be moved to allow a vessel or drifting debris to pass by without interfering with the deflection operation. One type of boom control device is a vessel, which continuously controls the offshore end of the boom. Controlling a deflection boom with a vessel takes considerable skill and a vessel suited for the purpose. Another type of boom control system is a trolley. Trolleys require that a line be strung from one shoreline to another, thus they are mostly used in rivers. Trolleys may block a river to passage by vessels and they are susceptible to impacts from debris. A relatively new type of boom control device is built on the principle of a wing or rudder. Devices such as

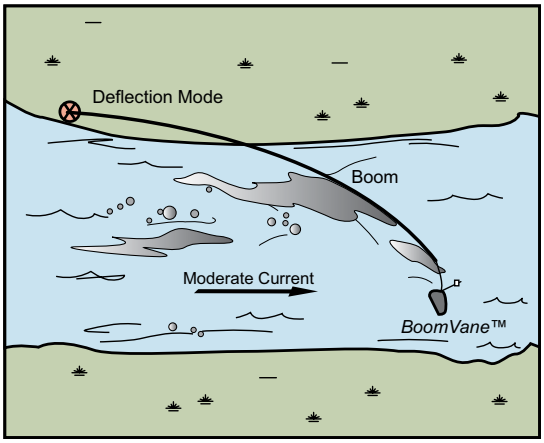


Figure DF-3. Using the BoomVane™ in deflection mode.

the BoomVane™, allow the boom to be deployed and controlled from the shoreline (Figure DF-3). This decreases the need for vessels and anchor systems, while allowing superior control of the boom angle.

Operating Environments

OPEN WATER

Fixed deflection boom systems are not recommended for the open water environment because of the high probability of fixed boom failure and the difficult of anchoring in this environment. The Live Deflection Booming and On-water Free-oil Recovery tactic may work better in this environment, due to their inherent mobility.

Deflection boom system components (vessel and boom) for open water operations should be able to withstand seas up to 6 feet and winds up to 30 knots.

PROTECTED WATER

Boom, anchors and vessels for protected water deflection boom systems should be able to withstand seas up to 3 feet and winds up to 25 knots. Vessels deploying deflection boom systems may be deep draft or shallow draft, depending on the water depth.

CALM WATER

Calm water deflection boom systems are composed of boom and anchors that can operate in seas of 1 foot and in winds up to 15 knots. Vessels deploying calm water deflection boom systems typically work in depths as shallow as three feet.

FAST WATER

Fast water deflection boom systems are designed to operate in moving water where the current exceeds 0.8 knots. This includes rivers and areas with significant tidal current. Vessels, boom, and anchors used in tidal waters should be able to deploy and operate in seas up to 1 feet and in winds up to 15 knots. Vessels, boom, and anchors used in river waters should be able to deploy and operate in waves up to 2 feet and in winds up to 15 knots.

BROKEN ICE

Deflection boom systems may be difficult for the broken ice environment because of the high probability of boom failure and loss due to ice encounters.

Deployment Configurations

There are many variations for deployment of Deflection Boom. Several configurations are described below, but responders should consider the actual conditions and modify their deployment accordingly.

Deflection Boom

SINGLE BOOM

Boom is deployed from a site at an optimum angle to the current and anchored to deflect the oil away from a location.

CASCADE

Several booms are deployed in a cascade configuration when a single boom cannot be used because of fast current or because it is necessary to leave openings in the boom for vessel traffic, etc. This configuration can be used in strong currents where it may be impossible to effectively deploy one continuous section of boom. Shorter sections of boom used in a cascade deployment are easier to handle in faster water, thereby increasing efficiency. Additional equipment may be required to set and maintain this system as compared to the single boom configuration.

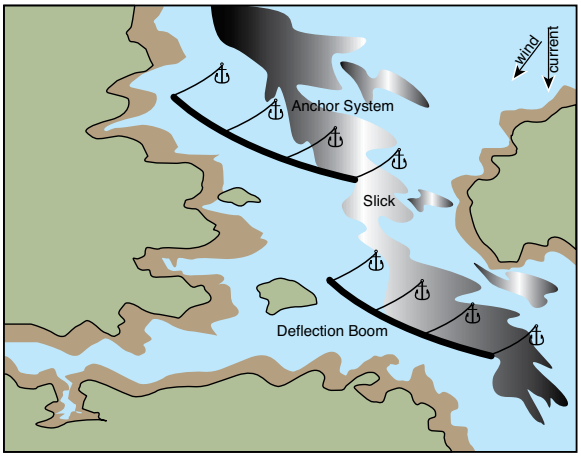


Figure DF-4. Deflection booming, fixed cascaded array.

LIVE

Booms are held in position by vessels. It takes practice and considerable skill in vessel handing to execute this effectively.

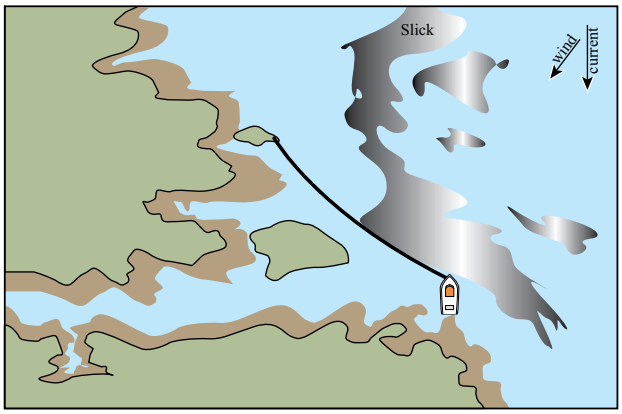


Figure DF-5. Deflection booming, half-live.

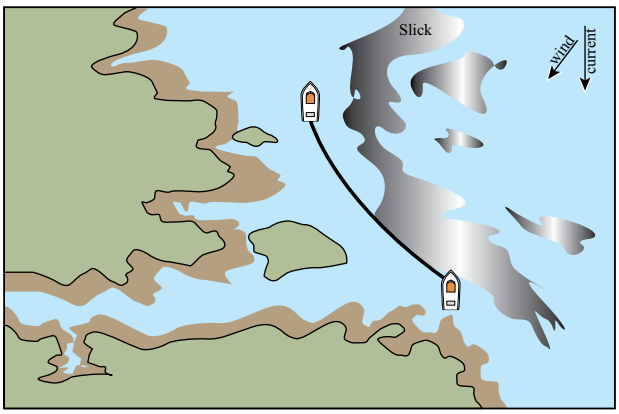


Figure DF-6. Deflection booming, live.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment. Local knowledge is preferred.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Anchor trip lines should be made of material strong enough to handle a moderate strain during boom reconfigurations. Responders normally used the trip line to reposition and reset the anchors.
- Buoy lights should be considered for night operations on fixed systems.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Calm/Protected water boom (6" x 24" / 18" x 42") are most commonly used for this tactic.
- Do not assume 100% efficiency with one boom system.
- Readjust angles and widths between boom sections as necessary to meet changing conditions (tides, currents, and winds).
- Constant monitoring of system efficiency is required.
- Deployment planning should be based on average high tidal conditions.
- If oil is being deflected away from the shoreline, tidal-seal boom is not usually required.
- Anchor systems must be selected based on the maximum stress that might be expected to occur on the boom array, considering stronger currents and winds than when the anchor is set.
- The scope of the anchor line should be at least 3 times the depth of the water. If the anchor fails to hold try increasing the line scope to five times the depth of the water and/or double the length of the anchor chain. Finally, if additional anchor holding is required, anchors can be ganged or set in series.

- All screw pin shackles shall be seized with wire.
- Extreme care should be used when taking strains on anchoring systems using the aft cleats of small vessels and skiffs.
- The type of bottom and slope needs to be considered when selecting anchoring systems for fixed systems.
- If tidal-seal boom is not available, sorbent materials such as pom-poms or snare on rope can be placed next to or attached to conventional boom to hinder oil entrainment under the boom at the beat water interface. Plans should be made to change out oiled sorbent on each low water tide cycle.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with Deflection Boom include:

- DV Diversion Boom
- C Containment Boom

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels; boom; anchoring, mooring, or control systems; and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, as well as resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Open Water Deflection Boom System[1]

Typical Equipment	Function	Quantity	Notes
Oil Boom, > 36" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Large anchor systems, boom control devices, or shore-based anchors	Keep boom in selected configuration	Site-specific	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 2, 3, 4, 5, or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels and configuration

[1] Not recommended, see Operating Environment.

Protected Water Deflection Boom System

Typical Equipment	Function	Quantity	Notes
Oil Boom, 18" to 42" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on number of vessels and configuration

Calm Water Deflection Boom System

Typical Equipment	Function	Quantity	Notes
Oil Boom, 6" to 24" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 3	Depending on number of vessels and configuration

Fast Water Deflection Boom System

Typical Equipment	Function	Quantity	Notes
Oil Boom, 8" to 24" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervise operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crews vessels and operates response equipment	1 to 3	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 3	Depending on number of vessels and configuration

Deflection Boom

Broken Ice Deflection Boom System

Typical Equipment	Function	Quantity	Notes
Oil Boom, 8" to 42" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1, 2, or 3	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states. Steel hull required.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open/protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 3	Depending on number of vessels and configuration

BEACH BERMS & EXCLUSION DAMS

OBJECTIVE & STRATEGY

BB

The objective of Beach Berms and Exclusion Dams is to exclude spilled oil from impacting sensitive resources by constructing a barrier from natural materials. Beach berms and exclusion dams are embankment structures built-up from the existing terrain (Figure BB-1). Dams are typically deployed at the mouths of inlets, lagoons, or streams to exclude oil from entering the area as the tide rises. Beach berms are used to prevent oil from entering the upper inter-tidal zone or over washing the storm berm and impacting sensitive habitat behind the storm berm. The tactic may be deployed in conjunction with a recovery tactic such as Passive Recovery or Shore-side Recovery. Beach berms and exclusion dams are most effective when they are deployed prior to the spill impacting an area.

Figure BB-1. Beach berm construction.

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Select a configuration that best supports the operating environment and available resources.
3. Identify, locate and mobilize equipment and personnel to the location.
4. Construct berm or dam using local materials and ensure it does not leak using plastic or geotextile lining.
5. Monitor the berm or dam to ensure that it remains intact.
6. If oil collects on or behind the berm or dam, utilize an appropriate recovery tactic to remove it.

TACTIC DESCRIPTION

Beach berm and exclusion dam systems are primarily constructed from local materials, soils, sand, rock, and gravel, using heavy earth moving equipment for larger areas, as in Figure BB-1, and hand tools

for smaller areas. The materials are moved and placed to create a physical barrier to the migration of oil into the sensitive area. To construct a berm, typically, beach materials are removed from the beach area and piled at or directly above the high tide mark. The berm may be covered with secured plastic sheeting or geotextile to reduce erosion and oil penetration. Dams are similar, but are constructed in an inlet to exclude the migration of water and oil into an area (Figure BB-2). If there is a constant water out-flow of the area, consider the use of an underflow dam (Figure BB-3). Measures should also be taken to ensure the dam is not breached or undermined by surf activity or currents. These systems are configured depending on the operating environment, type of beach, type of oil, the state of weathering, and available equipment.

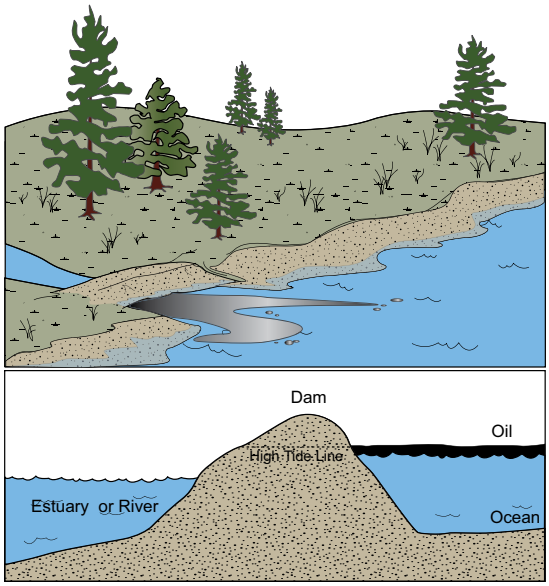


Figure BB-2. Exclusion dam construction.

Operating Environments

Beach berms and exclusion dams are utilized in the shoreline operating environment.

Beaches are broken down into 2 types:

- steep inclined beach – fine or course grained substrate
- low angled beach- fine or course grained substrate

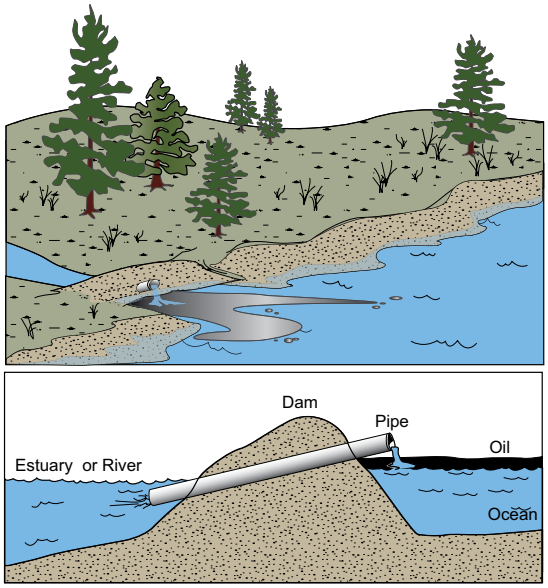


Figure BB-3. Underflow dam construction.

Deployment Configurations

STEEP INCLINED SHORELINE

It is difficult to build and maintain a dam or berm on a steeply inclined fine-grain shoreline; especially with wave action exceeding 1 foot. These high energy beaches are typically very mobile.

Dams deployed to exclude cuts on steep shoreline should be evaluated regarding the force of the water current entering the lagoon or backwater.

LOW ANGLED SHORELINE

Deployment of Beach Berms and Exclusion Dams on low angled shoreline works best if the wave height is less than 3 feet.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- During operation of heavy equipment a spotter should be present to ensure safe operations.
- For marine transportation to the beaches, the vessel masters should have experience in the appropriate operating environment. Local knowledge is preferred.
- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Do not excavate materials if activities will cause more damage than the spill.
- Consult with the Environmental Unit to determine if permits are required before constructing a beach berm or exclusion dam.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.
- Removal and disposal of oiled construction materials should be considered prior to deployment.
- Check berms and dams periodically for leakage and breaches, and top with material to ensure erosion control.
- Damming a stream mouth may block fish passage. Dams should be removed immediately when no longer needed.
- A Title 41 Fish Habitat Permit is required to work inside any anadromous stream. Due to the possibility of contaminating spawning habitat, avoid diverting and or collecting oil inside the stream mouth.
- Evaluate the out-flow potential of streams behind exclusion dams to avoid wash-out of culverts or dams. Construct an underflow dam, if necessary.

REFERENCES TO OTHER TACTICS

Other tactics associated with Beach Berms & Exclusion Dams include:

- DBD • Dikes, Berms, and Dams
- PTS • Pits, Trenches, and Slots
- CWD • Cold-water Deluge

Beach Berms & Exclusion Dams

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include vessels, equipment, supplies and response personnel. Configuration and specific resources required will be determined by site conditions, oil type and volume, area of coverage, and resource availability. Resource sets should be refined as site-specific requirements dictate.

Beach Berms and Exclusion Dams Built with Earth Moving Equipment

Equipment	Function	Quantity	Notes
Bulldozer, front-end loader, excavator	Construct dikes, berms, or dams	Site-specific	Depending on configuration
Supplies	**Function**	**Quantity**	**Notes**
Gravel, sand	Material for embankments	Site-specific	May be available on-site or may have to be transported to the location
Geotextile, plastic sheeting or other impermeable membrane	Liner to prevent the embankment from leaking	Site-specific	Care must be taken when placing the sheeting to maintain its integrity
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Equipment Operators	Operate earth moving equipment	1 per equipment per shift	Depending on number of pieces of equipment
Spotter	Ensures safe operation of heavy equipment	1 per equipment per shift	Depending on number of pieces of equipment
General Technicians	Work under the direction of field team leader as laborers and spotters	2 to 8	Depending on configuration and pieces of equipment

Beach Berms and Exclusion Dams Built with Manual Labor

Equipment	Function	Quantity	Notes
ATV with trailer	Moving construction materials to site	Optional	
Hand tools, shovels	Filling sand bags, modifications to structure	2 to 8	
Supplies	**Function**	**Quantity**	**Notes**
Gravel, sand	Material for embankments	Site-specific	May be available on-site or may have to be transported to the location
Geotextile, plastic sheeting or other impermeable membrane	Liner to prevent the embankment from leaking	Site-specific	Care must be taken when placing the sheeting to maintain its integrity
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site after construction
General Technicians	Work under the direction of field team leader as laborers	2 to 8	Depending on configuration and pieces of equipment

COLD-WATER DELUGE

OBJECTIVE & STRATEGY

CWD

The objective of Cold-water Deluge is to use high volume/low pressure water flow to wet the surface of a shoreline segment. If there is no previous oil impact, the wetting will prevent oil from adhering to the shoreline. Flooding the beach segment may actually raise the water-table, thus lifting any oil from the sediment. Cold-water Deluge is most effective when deployed before oil impact. If oil has impacted a shoreline segment, Cold-water Deluge may be used as a clean-up technique. In this case the oil is washed down slope to the water and recovered.

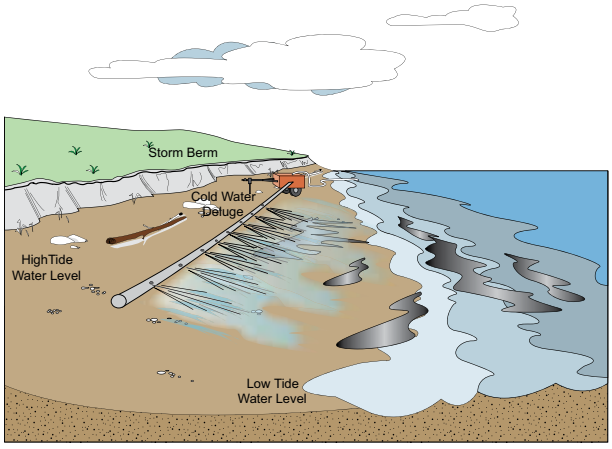


Figure CWD-1. Cold Water Deluge in protection mode.

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Select equipment and a configuration that best supports the operating environment.
3. Deploy equipment and personnel to the location.
4. Set up equipment and begin operations.
5. Utilize an appropriate recovery tactic if oil has impacted the shoreline and is being remobilized.
6. Monitor the pumps and water flow to ensure that sufficient flow is maintained.

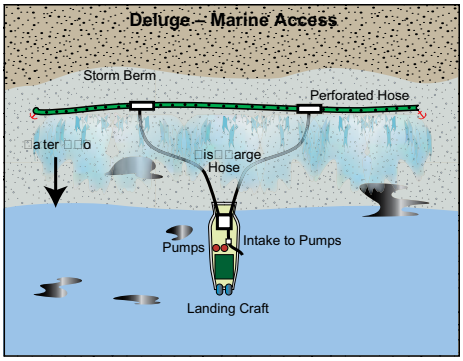


Figure CWD-2. Aerial view of a deluge configuration marine access.

TACTIC DESCRIPTION

Cold-water deluge systems consist of high volume/low pressure pumps, intake hoses, perforated discharge hoses or pipes and associated hardware. Generally a large diameter perforated header hose/pipe is laid parallel to the water at the high tide line. Using high volume/low pressure pumping systems, a large amount of ambient seawater is then pumped through the hoses and washed down the beach. These systems are configured depending

Cold-Water Deluge

on the operating environment, type of beach material, type of oil, the state of oil weathering, and available equipment.

Operating Environments

Cold-water Deluge is used in the Shoreline operating environment.

Deployment Configurations

Cold-water Deluge is recommended for use on beaches with a substrate courser than sand and on low angled rocky shorelines. In clean-up mode, boom is deployed around the flooded area to ensure that oil is captured for recovery.

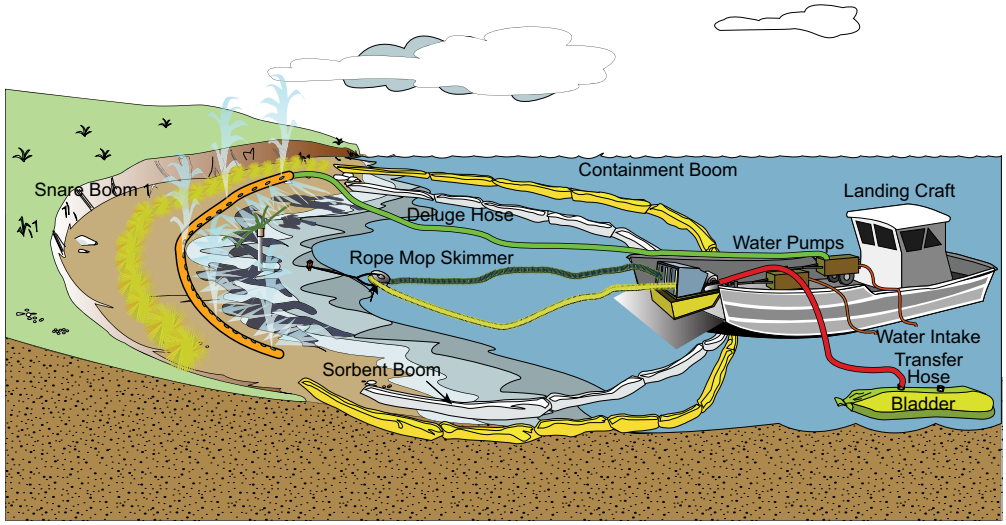


Figure CWD-3. Cold-water Deluge in clean-up mode.
Note: Other shoreline clean-up tactics are not included in this manual, but the Cold-water Deluge tactic can be converted to a shoreline clean-up tactic by adding containment boom, a wash-down system, and a marine recovery system.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended.
- Consideration should be given to surf.
- For areas with high concentrations of brown bears, consider using bear guards.
- Response Personnel should wear PPE as required by the incident-specific Site Safety Plan.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.

DEPLOYMENT

- On beaches with rich inter-tidal areas, deluge should be used during periods when the rich area is submerged.
- Cold-water Deluge is generally not recommended for fine grained sand, mud, vegetated, or steep rocky shorelines.
- Remobilized oil should be recovered during operations.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with Cold-water Deluge include:

- SR Shoreside Recovery
- MR Marine Recovery
- DV Diversion Boom and Recovery

EQUIPMENT AND PERSONNEL RESOURCES

Resources for the Cold-water Deluge tactic include pumps, suction hose, discharge hose, perforated header hose/pipe, and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Cold-water Deluge, Marine Access

Typical Equipment	Function	Quantity	Notes
Pumps and power pack	Moving seawater	Site-specific	Depending on configuration and length of beach
Suction hose	Moving ambient seawater to the pump	Site-specific	Depending on configuration and distance from water to high tide line
Discharge hose	Moving ambient seawater from the pump to the perforated header	Site-specific	Depending on configuration and distance from water to high tide line
Perforated hose or pipe	Supply water along the length of the beach	Site-specific	Depending on the length of beach being addressed
Typical Vessels	**Function**	**Quantity**	**Notes**
Class 2, landing craft	Platform for equipment and pumps	1	
Class 6, skiff	Safety and transportation to beach	1	
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Vessel Operators Protected/ Calm Waters	Operate landing craft and skiff	3 to 4	Depending on vessel size
Skilled Technicians	Operate response equipment	1 to 2	Depending on number of pumps and configuration
General Technicians	Work under the direction of skilled technicians	2 to 4	Depending on configuration

Cold-Water Deluge

Cold-water Deluge, Land Access

Typical Equipment	Function	Quantity	Notes
Portable pumps and power pack	Moving seawater	Site-specific	Depending on configuration and length of beach
Suction hose	Moving ambient seawater to the pump	Site-specific	Depending on configuration and distance from water to high tide line
Discharge hose	Moving ambient seawater from the pump to the perforated header	Site-specific	Depending on configuration and distance from water to high tide line
Perforated hose or pipe	Supply water along the length of the beach	Site-specific	Depending on the length of beach being addressed
Typical Vessels	**Function**	**Quantity**	**Notes**
4 wheel drive truck	Transport equipment to site	Site-specific	Depending on access and terrain
ATVs with trailers	Transport equipment to site	Optional	Depending on access and terrain
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Truck driver/ATV operator	Transport equipment	1 to 2	Depending on site
Skilled Technicians	Operate response equipment	1 to 2	Depending on number of pumps and configuration
General Technicians	Work under the direction of skilled technicians	2 to 4	Depending on configuration

MARINE-BASED STORAGE & TRANSFER OF OILY LIQUIDS

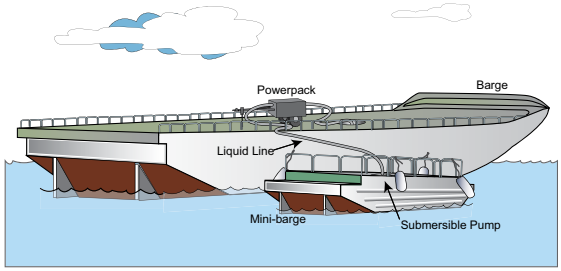
OBJECTIVE & STRATEGY

MST

Marine-Based Storage and Transfer is used to relocate recovered oil and wastes that have been collected in primary storage during Marine Recovery, Open-water Free-oil Recovery, or Shoreside Recovery into marine-based storage devices for transportation to disposal.

The general strategy is to:

1. Identify the transfer site and assess the conditions.
2. Determine the appropriate transfer and storage systems based on oil type, site conditions, and vessel capabilities.



3. Mobilize and deploy transfer and storage equipment to the site.
4. Transfer recovered oil from on-scene primary storage to on-water tanks, bladders, or barges.
5. Man and monitor the system as appropriate.

TACTIC DESCRIPTION

Marine-based storage and transfer requires vessel crews and technicians skilled in mooring and anchoring techniques. Vessel-to-vessel transfer presents significant safety concerns for personnel and equipment and requires planning and training to execute properly. The equipment used in the storage and transfer should be adaptable to the specific site considerations and waste types being handled. Components include pumps, hoses, fittings, fendering, and storage systems consisting of storage tanks, bladders, or barges. Site considerations include the operating environment and the distance and elevation the liquid has to be moved. Components should be selected to maximize safety and efficiency and transfers should be kept to a minimum to reduce the risk of secondary spills.

Follow the requirements of the incident specific Waste Management Plan and review the Waste Management Checklist in Section A of this document. Waste considerations include explosive potential, debris content, and viscosity of the fluids.

Pumping Systems

Pumping systems should be configured to meet the requirements of the task. Consideration of the abilities and weaknesses of a pumping system and the site specific conditions will inform responders of the

best pump for the job. Refer to the Pumping Oily Liquids tactic for further review of pump systems and procedures.

Storage Systems

The two options for marine-based storage are onboard tanks and towable on-water storage. Onboard systems include tankers and deck tanks. These are subject to significant regulation and require prior inspection and approval by the US Coast Guard. Towable on-water storage includes barges, bladders, and open storage devices. A brief description of each follows.

Tank vessels – This onboard option should be considered for larger spills and when lightering operations may be necessary. Depending on vessel size, drawbacks include high freeboard, deep draft, and lack of immediate availability in most spill scenarios.

Deck tanks – Use of these onboard systems requires extreme caution as vessel stability can be significantly altered. Onboard oil storage systems can be on deck or below deck, with both types subject to numerous US Coast Guard regulations and inspection.

Barges – For most recovery scenarios, barges are the preferred on water storage devices. Consideration must be given to the amount of freeboard when pumping from small skimming systems. Barges containing less than 250 barrels of storage volume (sometimes called mini-barges) are considered equipment and do not require a US Coast Guard inspection or a US Coast Guard Tankerman's document.

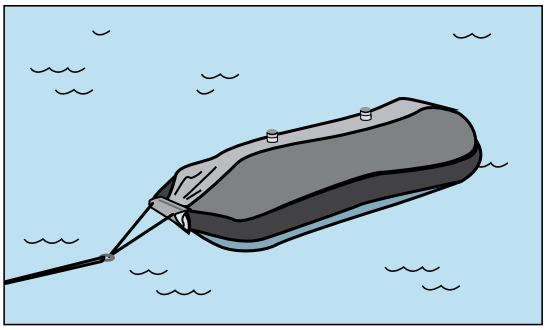


Figure MST-1. Towable, flexible storage device.

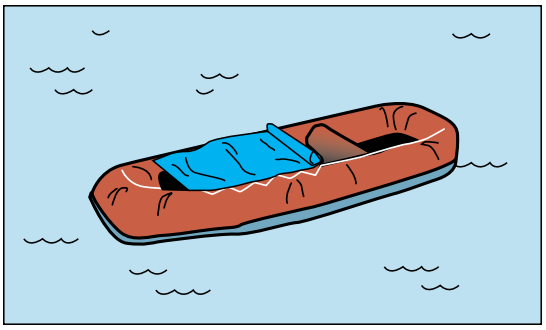


Figure MST-2. Towable open storage device.

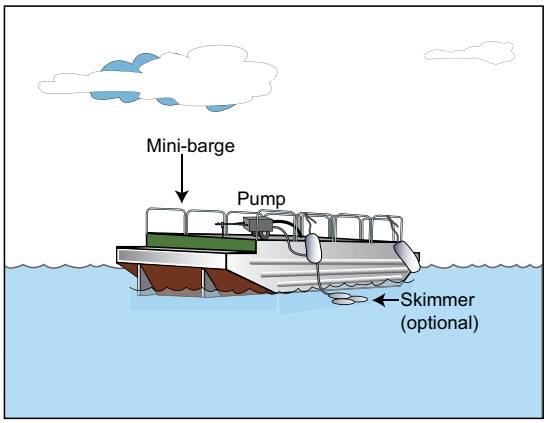


Figure MST-3. Towable mini-barge storage device.

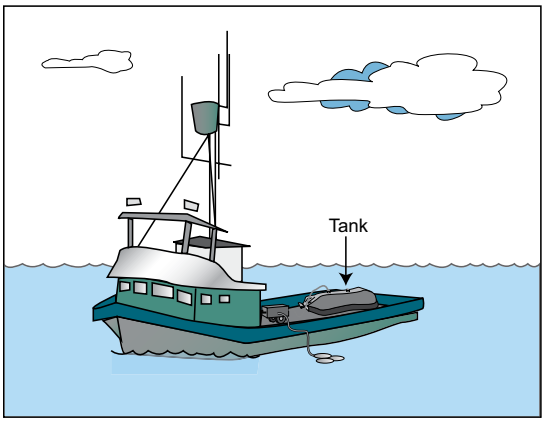


Figure MST-4. Deck tank primary storage device.

Bladders and Tanks – Flexible tow tanks (dracones) must be towed at slow rates and can be fragile. They may be difficult to handle in high seas.

Open Storage Devices – These inflatable barge type devices provide some freeboard and protection from seas.

Operating Environments

Recommended operating environments for marine-based storage and transfer are protected and calm water. Operation may occur in open and fast water under safe weather and sea state conditions. Transfer operations in broken ice environments require careful consideration and planning.

OPEN WATER

A successful marine-based storage and transfer operation in open water requires safe weather and sea state conditions. Although possible, operations are not recommended in open water environments because of the potential for secondary spills and the difficulty of vessel-to-vessel mooring. If the option is available, transfers and storage will be safer if moved to protected waters.

Components for open water operations should be able to withstand seas up to 6 feet and winds up to 30 knots while towing storage vessels.

PROTECTED WATER

Vessels used in protected water for storage and transfer should be able to withstand seas up to 3 feet and winds up to 25 knots. Vessels involved in marine-based transfer and storage may be deep draft or shallow draft, depending on the water depth.

CALM WATER

Marine-based storage and transfer systems operating in calm water are composed of vessels and storage devices that can operate in seas of 1 foot and in winds up to 15 knots. Vessels involved in calm water storage and transfer systems typically work in depths as shallow as 3 feet.

FAST WATER

Marine-based storage and transfer systems are not recommended for the fast water environment, where currents exceed 0.8 knots, because of the potential for secondary spills and the difficult of anchoring and mooring in this environment.

BROKEN ICE

Marine-based storage and transfer systems are difficult in the broken ice environment because of potential damage and loss due to ice encounters. If possible, transfers should take place in ice-free areas.

Marine-based Storage and Transfer of Oily Liquids

Deployment Configurations

As discussed earlier, the deployment configurations for marine-based storage and transfer will be largely dictated by the site considerations and the waste type. The placement of pumps will be determined by the head or suction needed, the transfer rates required and the receiving storage devices. For long distances, multiple pumps in a series may be required. Figure MST-5 shows the most common option for mini-barge to large barge recovered liquid transfer. Figure MST-6 shows the most common option for mini-barge to shore tank recovered liquid transfer. Other configurations are possible.

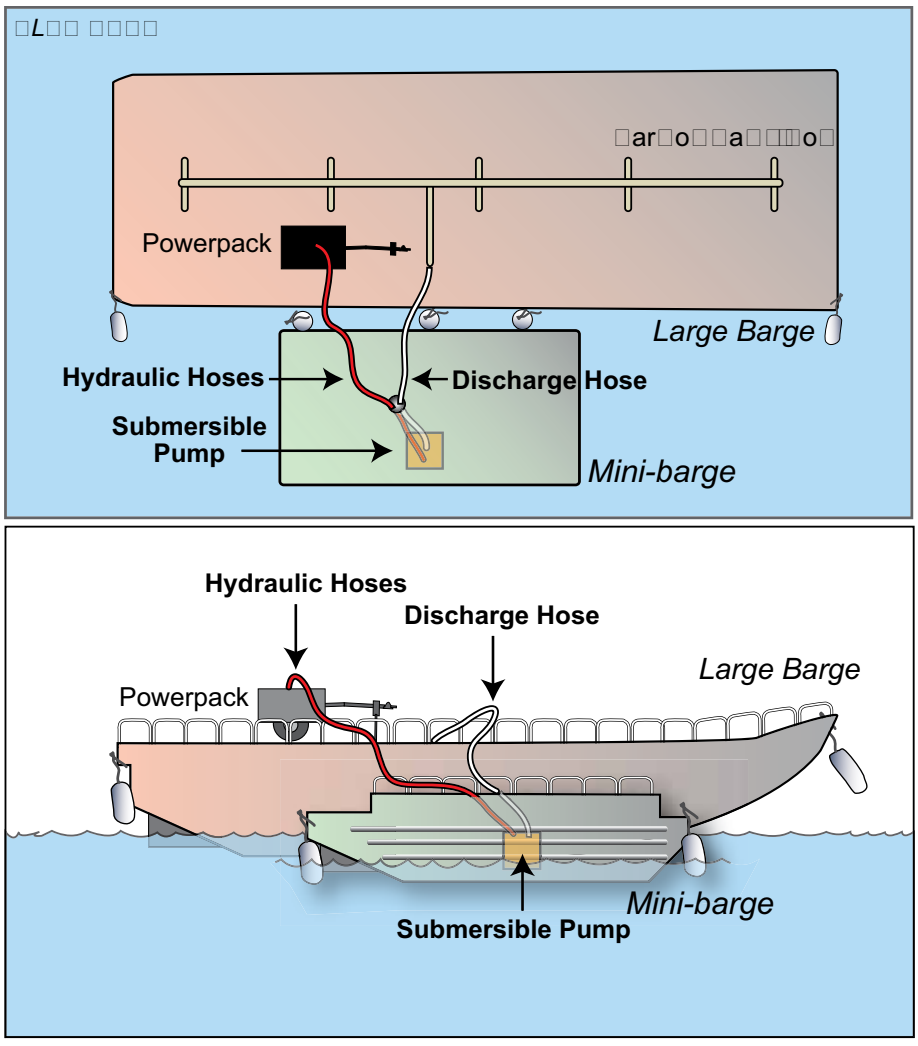


Figure MST-5. Transferring recovered liquids from a mini-barge to a large barge using a submersible pump energized by a power-pack on the deck of the large barge.

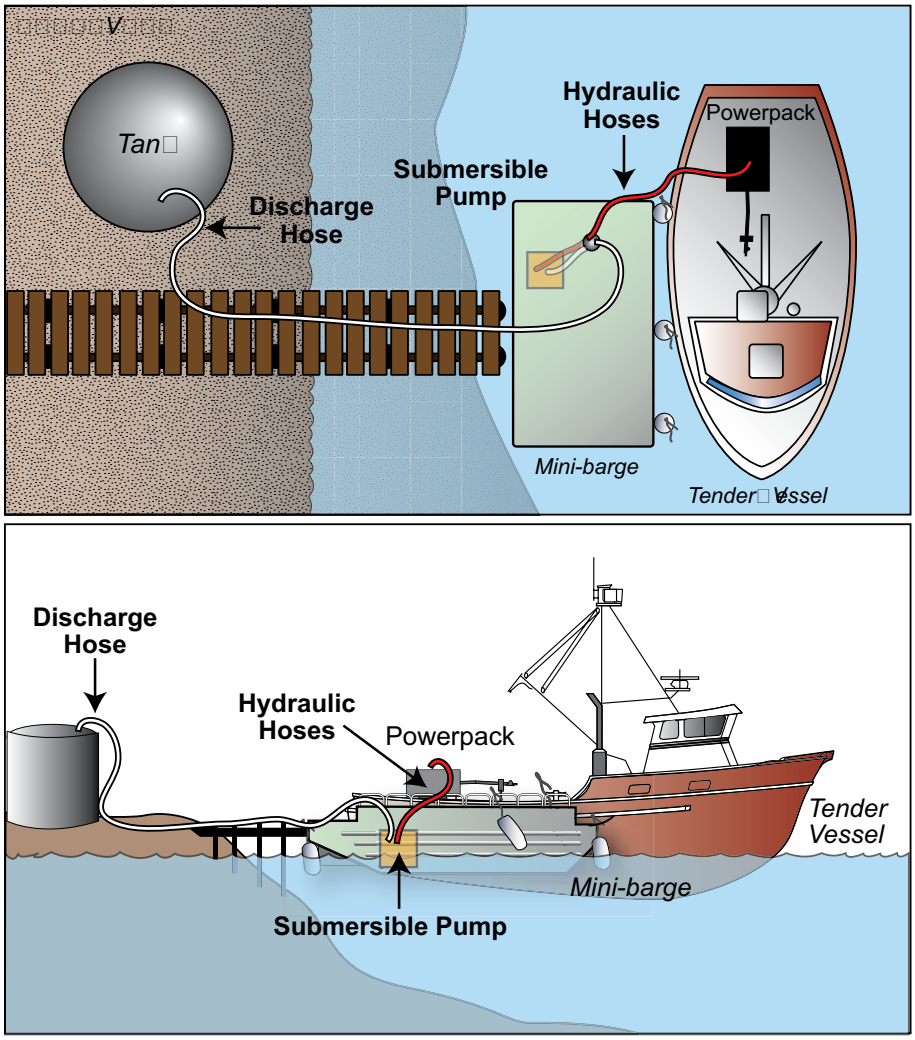


Figure MST-6. Transferring recovered liquids from a mini-barge to a shore-based tank using a submersible pump energized by a power-pack on the deck of the tender vessel.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Mooring operations should be planned and discussed with the vessel and barge crews prior to execution. These should include emergency procedures and contingency plans.
- Consider vessel stability when placing equipment and recovered liquids onboard any vessel.
- Avoid free falling liquids, as static electricity may be produced.
- When explosive potential is present, ground and bond barges and equipment to dissipate static.

- Vessel masters should have experience in the prevalent and predicted sea and weather conditions. Local knowledge is preferred.
- Transfer hoses must be hydro-tested annually on vessels/barges with a cargo capacity greater than 249 barrels.
- Vessel master should use extreme caution when maneuvering storage devices around sharp or submerged objects and nearshore.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.
- Vessel stability documents should be reviewed prior to placing heavy equipment and recovered liquids in approved containers on deck. If a stability document is not available for the vessel, then extreme caution should be used when loading vessel.
- The storage device manifold system should be used at all times. Loading over the top through hatchways exposes personnel to vapors and create opportunities for personnel to step into hatchways.
- Transferring equipment to vessels using booms and cranes presents significant hazards. A safety briefing should be held before operations commence to ensure a safe operation. Items discussed in the briefing should cover: communication procedures, including hand signals; inspection of wire ropes, bridals, and straps; and the use of tag lines.

DEPLOYMENT

- During the transfer, the pump controls and manifolds should be manned with responsible crew with two-way communication present to ensure rapid response to any spillage or changing circumstances.
- Support and monitor hoses throughout the operation to ensure they are not under stress or chafing.
- Secondary spill response equipment and sorbent materials should be in place.
- For large barges, a load plan may be required. Follow vessel-specific transfer procedures.

Marine-based Storage and Transfer of Oily Liquids

- Be aware that there are US Coast Guard regulations pertaining to transfer operations from a barge or tank vessel with a capacity of greater than 249 barrels (10,458 gallons). Transfer procedures are not a requirement for a vessel with a capacity of less than 249 barrels, but they are encouraged.
- All tanks should be gauged and the information recorded in the unit log prior to any transfers.
- Portable containment should be placed under couplings, fittings, etc. to catch leaks or spills when fittings are disconnected.

REFERENCES TO OTHER TACTICS

Other tactics associated with Marine-based Storage and Transfer include:

- POL • Pumping Oily Liquids
- FO • On-water Free-oil Recovery
- MR • Marine Recovery
- SR • Shoreside Recovery

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include pumps, hoses, couplings, storage devices, tow vessels, anchoring and mooring equipment. Specific equipment requirements will be determined by site consideration described earlier and outlined in the Pumping Oily Liquids tactic, and resource availability. Resource sets will need to be refined as requirements dictate.

Typical Marine-based Storage and Transfer System

Typical Equipment	Function	Quantity	Notes
Pump	Fluid transfer	Site-specific	Determined by distance and lift, fluid viscosity, debris content, explosive potential. See "Pumping Oily Liquids" for additional information.
Hoses, couplings, and portable containment	Fluid transfer	Site-specific	Ensure that the pump and hoses are compatible. Transfer hoses must be hydro-tested annually for vessels with a cargo capacity greater than 249 bbl.
Storage device	Receives fluids from the initial storage device	Incident and site specific	Tankers, barges, floating tanks (dracones), bladders, or deck tanks
Fendering	Making up one vessel to another	Vessel specific	Fenders vary in size depending on sea state and vessel/barge size
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 2, 3 or 8	Maneuvering and towing of barges and tanks.	Minimum one per barge/tank	Depending on barge/tank volume, currents, and sea states
Typical Personnel*	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open water	Masters of tow vessels	2	Depending on number of vessels
Tankerman	Operation of the barge and director of transfer operations	1 to 2	Depends on the size of the barge
Skilled Technicians	Crew vessels and operate transfer equipment	2 to 4	Depending on number of vessels/barges
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels and transfer configuration

* Personnel required for this tactic may be the same personnel listed in another tactic.

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LAND-BASED STORAGE & TRANSFER

OBJECTIVE & STRATEGY

LST

The Land-based Storage and Transfer tactic is used to move recovered liquid oil and/or oily liquids that have been collected during recovery efforts into land-based storage devices. This transfer may be for final disposition or for intermediate storage. The general strategy is to:

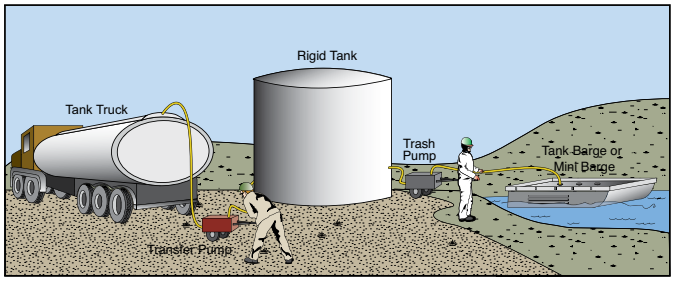

Figure LST-1. Transfer of recovered liquids using rigid tank, tank truck, and portable pumps.

1. Select a transfer site with adequate space that is easily accessed by field operations.
2. Determine the appropriate transfer and storage systems, based on oil type, site conditions, and available equipment.
3. Mobilize and deploy transfer and storage equipment to the site.
4. Transfer recovered wastes from one storage device to another.
5. Monitor transfer pumps and storage containers for leaks and breeches.

TACTIC DESCRIPTION

Adequate land-based storage and proper transfer of liquids is a critical link in recovery operations. Capacities for storage and transfer of oil need to be carefully selected to ensure adequate volume and movement of recovered oil and liquids through the waste stream. Improper or inadequate storage and transfer systems can disrupt the entire continuity of a response. Oil recovery may be disrupted if storage containers are unavailable or undersized. Selection of storage containers depends on the size of the spill, the expected recovery rate, and time that the waste will be stored before final disposal.

The equipment used in the storage and transfer should be adaptable to the specific site and fluid types being handled. Components include pumps, hoses, fittings, and storage systems. Storage containers may consist of rigid tanks, portable tanks, or lined pits. Site considerations include the operating environment and the distances and elevation the liquid has to be moved. Other considerations include explosive/flammability potential, debris content, and viscosity of the fluids. Components should be selected to maximize safety and efficiency. Transfers should be kept to a minimum to reduce the risk of secondary spills.

Land-based Storage and Transfer

Follow the requirements of the incident specific Waste Management Plan and review the Waste Management Checklist in Section A of this document. Waste considerations include explosive potential, debris content, and viscosity of the fluids.

Pumping Systems

Pumping systems should be configured to meet the requirements of the task. Consideration of the abilities and weaknesses of a pumping system and the site specific conditions will inform responders of the best pump for the job. Refer to the Pumping Oily Liquids tactic for further information on pump systems and procedures. Viscous oil pumping techniques may be necessary to move thick fluids.

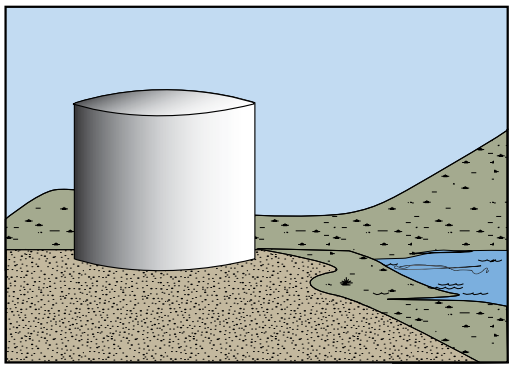

Figure LST-2. Rigid tank-of-opportunity used for intermediate or final storage of recovered fluids.

Storage Systems

Options for land-based storage are rigid tanks, portable tanks, and lined pits. A brief description of each follows:

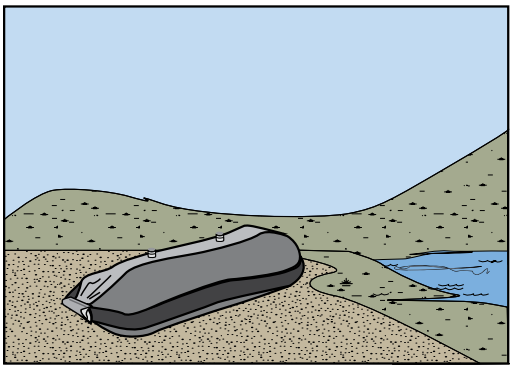

Figure LST-3. Pillow tank or bladder, an example of a portable tank used for intermediate storage of recovered fluids.

Rigid Tanks – Rigid tanks are constructed of steel, aluminum, or plastic and may include: tanks-of-opportunity located near the response site or tanks delivered to the transfer site. Rigid tanks are the preferred means of storage, especially if the storage is for a long period (Figure LST-2). Rigid tanks also include open-top lined dumpsters, ore bins, or similar resources. Rigid tanks should be inspected prior to use.

Portable Tanks – Portable tanks are constructed of fabric and may include: collapsible tanks, inflatable tanks, and pillow tanks (Figure LST-3). Collapsible "open pool" type tanks are made of a liner supported by a tubular frame that can be easily transported to a site and quickly erected to provide intermediate storage of liquids. Capacities range from 3 barrels to 130 barrels. Inflatable tanks use a liner supported by inflated tubes that form the frame of the tank. Inflatable tanks have capacities ranging from 3 to 300 barrels. Pillow tanks are closed, coated

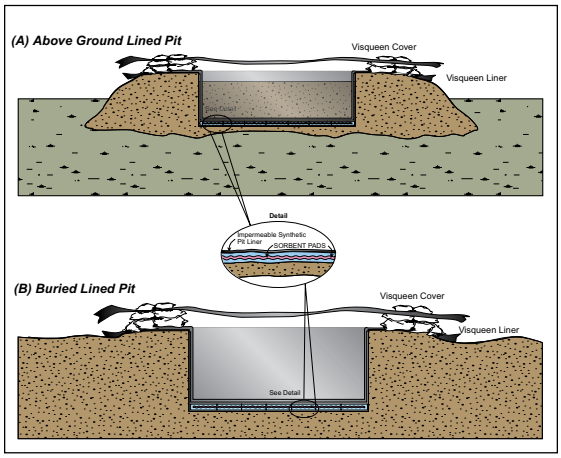

Figure LST-4. (A) Above ground lined pit used for intermediate storage of recovered fluids and debris. (B) Buried, lined pit used for intermediate storage of recovered fluids and debris.

bladder tanks with capacities from 1 to 4,800 barrels. All portable tanks are susceptible to abrasion and failure if not properly maintained and monitored.

Lined Pits – Lined pits, either excavated or built-up above ground, can be used for emergency storage of oily liquids, debris, and solid wastes (Figure LST-4). Built-up pits may be constructed by building a berm from sand bags, timbers, snow, soil, or gravel around the desired storage site. The resulting pit is lined (or double lined) with a continuous impermeable membrane material. The liner must be strong enough to prevent punctures. Excavated pits can also be used in some situations, but may result in more environmental damage. Pits should be covered to prevent accumulation of rain and snow and they should be inspected regularly for leaks. Lined pits should only be used for temporary storage; wastes should be removed as soon as possible. The pit must then be decontaminated or removed and disposed of according to the Waste Management Plan.

Operating Environments

Land-based Storage and Transfer of oily liquids may occur on all land-based environments where response activities take place, including: Marsh, Tundra, Other Land, and Solid Ice. Consideration should to be given to protect sensitive areas such as tundra and marsh environments.

Deployment Configurations

Deployment configurations for land-based storage and transfer will be largely dictated by site considerations and waste types. The placement of pumps will be determined by the head or suction needed, the transfer rates required and the receiving storage devices. For long distances, multiple pumps in a series may be required. The following figure is an example of one of the most common configurations used during response activities.

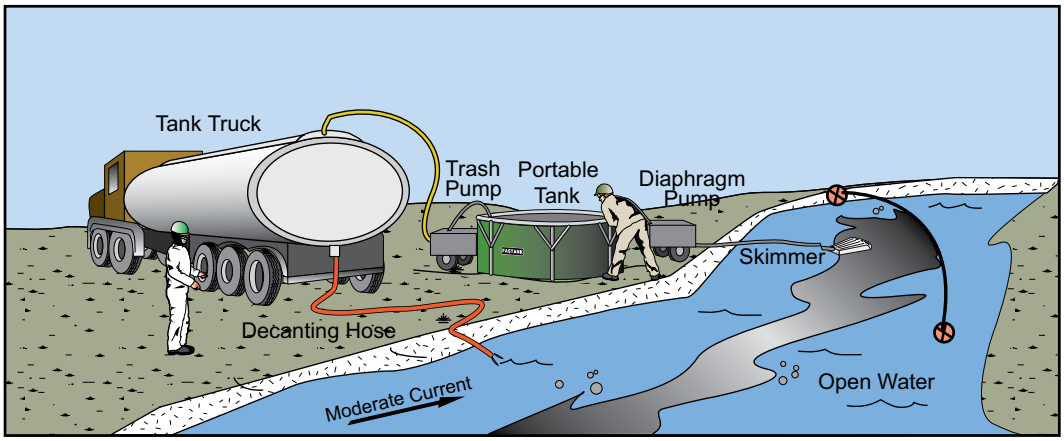

Figure LST-5. Transfer of recovered fluids from primary storage in a portable tank to a tank truck.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Avoid free falling liquids, as static electricity may be produced.
- Ground vehicles and equipment to dissipate static and prevent explosions.
- Spotters should be present during heavy equipment operations.
- Storage devices must be vented.
- Transfer personnel must have PPE in accordance with the incident-specific Site Safety Plan.

DEPLOYMENT

- Open tanks and pits are best for liquid containing a lot of debris.
- Open tanks and pits will collect rain and snow and are susceptible to overflow if not monitored, decanted, and/or covered.
- Consider stability when placing tanks on soft soils or beaches.
- During liquid transfers, pump controls and valves must be manned to ensure rapid response to any leaks, overflows, or changing circumstances.
- All personnel participating in the transfer should have common two-way communications.
- Support and monitor hoses throughout the operation, to minimize stress or chaffing.
- Secondary spill response equipment and sorbent materials should be easily accessible.
- A 40 ft. warm-up container should be considered if operations are expected to maintain a 24 hour operation. Frozen hoses are not uncommon during a cleanup operation in sub-freezing temperatures.
- Prior to start of transfer, a tailgate meeting should be conducted to ensure the rapid response to any leaks, overflows, or changing circumstances.
- Consider placing drip-pans under hose connections.
- Tanks of opportunity should be inspected prior to use.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

Land-based Storage and Transfer

REFERENCES TO OTHER TACTICS

Other tactics associated with Land-based Storage and Transfer include:

- Personal Protective Equipment
- Pumping Oily Liquids
- Marine-based Storage and Transfer
- Pits, Trenches, and Slots

EQUIPMENT AND PERSONNEL RESOURCES

Resources for the Land-based Storage and Transfer tactic include pumps, suction hose, discharge hose, storage devices, and response personnel.

Equipment	Function	Quantity	Notes
Pump	Moving oil or oily liquid	1 or more	Highly viscous oils may require an enhanced pumping system such as annular injection
Suction hose	Moving oil or oily liquid	Site-specific	
Discharge hose	Moving oil or oily liquid	Site-specific	
Storage device	Containment of transferred oil	Site-specific	
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Skilled Technicians	Operate response equipment	1 to 2	Depending on number of pumps and configuration
General Technicians	Work under the direction of skilled technicians	As required	Depending on configuration

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PUMPING OILY LIQUIDS

OBJECTIVE & STRATEGY

POL

The objective of the Pumping Oily Liquids tactic is to transfer liquid wastes into storage in preparation for disposal.

The general strategy is to:

1. Identify the transfer site and assess the conditions.
2. Determine the preferred pumping system based on site considerations and waste characteristics.
3. Mobilize and deploy the equipment.
4. Transfer oily liquids to secondary storage.
5. Monitor the system during operations.

TACTIC DESCRIPTION

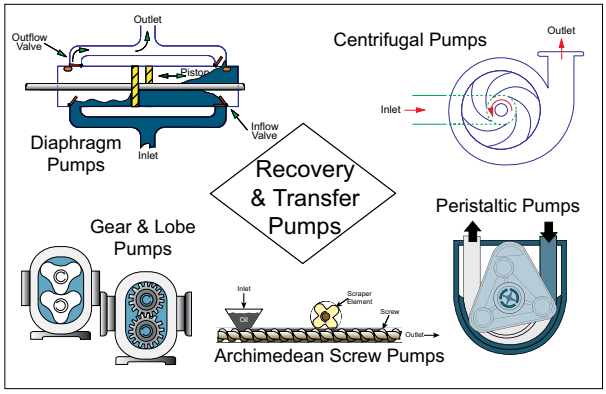

Figure POL-1. Transfer pump options.

Pumping oily liquids requires a system of pumps, hoses, fittings, oil storage devices, and trained personnel. This tactic contains an expanded description of pumping oily liquids, a task that is integral to several other tactics. Therefore, the personnel required for this tactic are already listed in the parent tactic. The components are selected to maximize safety and efficiency and are adaptable to site considerations and the waste characteristics. Site considerations include the operating environment and distances the oil is to be moved. Waste characteristics include possible explosive potential or flash point, debris content, and viscosity of the fluids.

Pumping Systems

Successful oil spill response often hinges on the effectiveness and reliability of the transfer pumps. The capabilities of the pumps used during the transfer of oily liquids should be matched with the situational factors encountered during operations. This is especially true in a long term response where efficiency and maintenance become critical. The factors to be considered in selection of the pumping system are:

- Viscosity of the fluids
- Debris content

Pumping Oily Liquids

- Transfer rates required
- Suction head or pressure required
- Possible loss of prime
- Possibility to run dry
- The pump's ability to safely move hazardous material
- Distance the product has to moved

A general description of the typical pumps used in oil spill response follows.

Centrifugal pump These pumps have high capacities for moving low viscosity fluids. Output decreases rapidly with increases in viscosity. They are able to tolerate small diameter debris.

Diaphragm pump A diaphragm pump can handle a wide range of fluids reasonably well. They are safer for transfer of hazardous materials.

Gear/lobe/screw pump These pumps are able to pump very viscous fluids but do not tolerate abrasive debris.

Hose/peristaltic pump These pumps are capable of handling fluids of all viscosities, and handle hazardous materials.

Piston pump These pumps are able to pump a wide range of fluids at a high output rate. They cannot be run dry and are generally unable to handle debris due to tight tolerances.

Progressive cavity pump These pumps can handle small amounts of debris, but may be damaged by large debris. They generally handle low-to-medium viscosity fluids. They produce uniform discharge and can be operated with reduced fluid intake, but should not be operated dry.

Archimedean screw pump These pumps offer very little suction by using mechanical lifting properties to move highly viscous material. It can handle most debris.

Vane Pump These pumps can manage a wide range of viscosity reasonably well, but can be damaged by debris and cannot be run dry.

Vacuum systems These units use a vacuum to bring fluids through the hoses. They are able to handle debris well and can provide significant head pressures. They require specific suction hoses to ensure the vacuum pressure.

When a variety of pumps is available, the following table will assist in matching a pump with the transfer needs.

For example, a smaller recovery barge containing crude oil and oily water needs to be pumped into a storage barge so that the smaller barge may resume recovery operations. The factors presented here would lead to the choice of a pump that can tolerate a range of viscosity (crude oil and water), handle small amounts of debris (recovered during skimming operations), provide good suction or

head pressure (oil must be pushed or pulled up to a larger barge), and complete the transfer quickly to enable the barge to resume operations. Explosive potential should always be considered. Personnel will monitor the operation during the entire transfer; therefore the ability to run dry is a non-factor.

	Viscosity	Output/ Transfer Rate	Debris Tolerance[1]	Self Priming	Suction Head/ Pressure	Able to Run Dry
Centrifugal	Low/Medium	High	Yes	No	Poor	No
Hose/peristaltic	Wide range	High	No	Yes	Good	Yes
Vacuum	Wide range	High	Yes	Yes	Good	Yes
Piston	Wide range	High	No	Yes	Good	No
Progressive cavity	Low/Medium	Med	Yes	Yes	Good	No
Diaphragm	Wide range	Med	No	No	Good	No
Vane	Wide range	Med	No	Yes	Fair	No
Gear/Lobe/Screw	High/Medium	Low	No	Yes	Fair	No
Archimedean screw	High	Low	Yes	Yes	Poor	No

NOTE: [1]Debris can damage the hose used with any pump.

Operating Environments

The Pumping Oily Liquids tactic will be used in all areas of operation that are deemed safe. Refer to the specific tactic in which the pumping is to occur for individual considerations during operation.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Explosive potential should be assessed prior to operations.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.
- Gasoline driven pumps should not be used if there is potential for explosive vapors.

DEPLOYMENT

- Hoses and fittings should be inspected and replaced if they are questionable.
- All hoses, prior to use, need to be inspected to ensure they have gaskets. Any air leaks on the suction side will hinder pumping operations.
- Select hose types that are compatible with the product(s) that are being transferred.
- Tank levels need to be continuously monitored and confirmed to prevent overfilling.
- Position pumps and hoses to ensure they are protected from damage by vehicles or equipment.

Pumping Oily Liquids

- Adequate surface liners and sorbents should be placed under any potential spill sites.
- Large debris needs to be separated and disposed of as oily solid waste.
- All individuals involved in the transfer need to be informed of the estimated pumping rate, time to complete the operation, and emergency stop procedures.
- Pumping should start at lower rates of transfer to ensure there are no leaks and that valves are properly aligned, and then the rate may be increased.
- When the hose is disconnected, it should be positioned to drain back into the tank and then the end should be fitted with a suitable cap or blank to minimize secondary spills.
- Environmental operating conditions need to be considered when selecting prime mover pumping systems; as an example, pneumatic pumps are problematic in freezing temperatures.
- All transfers should be documented in the unit log.
- Make sure hose cam fittings are secured to prevent accidental spills.
- Place absorbent pads or drip pan under fittings as an extra precaution.

REFERENCES TO OTHER TACTICS

Other tactics associated with Pumping Oily Liquids include:

- MST Marine-based Storage and Transfer
- LST Land-based Storage and Transfer

EQUIPMENT AND PERSONNEL RESOURCES

Refer to recovery tactic being used to adapt the personnel and equipment needs.

Oily Liquid Pumping System

Typical Equipment	Function	Quantity	Notes
Pump	Fluid Transfer	Task-specific	Depending on site considerations and fluid characteristics
Hoses and couplings	Fluid Transfer	Task-specific	Ensure component compatibility prior to deployment
Storage device	Receive Fluids	Task-specific	Ensure component compatibility prior to deployment
Typical Personnel*	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Skilled Technicians	Operates pumping equipment	2 to 4	Depending on number of pumps and distance of transfer
General Technicians	Work under the direction of skilled technicians	2 to 8	Depending on number of pumps and distance of transfer

*Personnel required for this tactic may be the same personnel listed in another tactic. For example, the personnel listed in Marine Recovery may also be responsible for pumping oily liquids they recover into a secondary storage device.

TOWING ALONGSIDE

OBJECTIVE & STRATEGY

TA

The objective of the Towing Alongside tactic, also know as a towing at the hip, is to ensure the safe towing and transport of Towable Storage Devices (TSD) including barges, bladders, and open storage devices during On-Water Free-Oil Recovery and Marine Recovery operations. This tactic should be used in congested areas, for towing short distances, or where constant control of the towed vessel is required (such as during skimming operations).

Figure AT-1. Towing Alongside

The general strategy is to:

1. Identify the transfer site (destination for the TSD) and assess the conditions at the site and en-route.
2. Determine the type of TSD that requires towing.
3. Prepare on-scene vessel for alongside towing or mobilize and deploy appropriate towing vessel to the site.
4. Establish and safely configure alongside tow in accordance with this tactic and secure TSD for transit in a manner that minimizes the risk of damage to the towing vessel and TSD.
5. Man and monitor the alongside tow as appropriate.

Towing Alongside

TACTIC DESCRIPTION

When configured properly, towing alongside affords greater control of the TSD and should be used at all times unless long duration tows are required, in which case stern towing procedures should be followed. Since bit and cleat arrangement varies from vessel to vessel, vessel masters and crew should configure the alongside tow in the arrangement that best suits their specific configuration while still following the general principals outlined in this tactic and the preferred towing arrangement (depicted in Figure AT-2).

Operating Environments

Recommended operating environments for towing alongside are protected and calm water. Operation may occur in open and fast water under safe weather and sea state conditions. Operations in broken ice environments require careful consideration and planning.

OPEN WATER - *Not Recommended*

Successfully towing alongside in open water (sea states up to 6 feet) requires safe weather and sea state conditions. Although possible, operations are not recommended in open water environments because of the potential for secondary spills and the difficulty of vessel-to-vessel mooring. If the option is available, preparing for and making-up an alongside tow will be safer if moved to protected waters. Components for open water operations should be able to withstand seas up to 6 feet and winds up to 30 knots while towing storage vessels.

PROTECTED WATER

Vessels used in protected water for towing alongside should be able to safely handle seas up to 3 feet and winds up to 25 knots. Vessels involved in towing alongside may be deep draft or shallow draft, depending on the water depth.

CALM WATER

Towing Alongside in calm water can be conducted by vessels and storage devices that can operate in seas of 1 foot and in winds up to 15 knots. Vessels involved in towing alongside in calm water should be able to operate in water depths of 3 feet or less.

FAST WATER - *Not Recommended*

Towing alongside is not recommended for the fast water environment, where currents exceed 0.8 knots, because of the potential for secondary spills and the difficulty in maneuvering a composite unit in this environment.

BROKEN ICE - *Not Recommended*

Extreme care should be taken when towing alongside in a broken ice environment because of potential damage and loss due to ice

encounters. Towing vessels should constantly monitor the gap between the vessels to ensure that ice does not become lodged between the vessels and cause damage to either. Other risks include ice piling up in front of and between the vessels. This type of broken ice build-up can drive the vessels apart placing undue strain on the towing lines.

Deployment Configurations

Towing alongside can involve vessels and TSDs of various sizes and consideration must be given when selecting an appropriate towing vessel for the barge or device to be towed.

Prior to rigging the tow, fenders of the appropriate size and construction based (on the towing vessel and TSD) must be rigged over the side on the tow side of one or both of the involved vessels prior to rigging the towlines and should be adjusted as necessary during the rigging process. Additionally, chaffing gear should be readily available and utilized appropriately during the rigging process.

RIGGING THE TOW – STERN TOW TO ALONGSIDE TOW

When preparing to take a TSD alongside from a stern tow the following steps should be followed:

Shortening the tow:

- If manned, towing vessel master or operator should advise the TSD of your intentions.
- Reduce speed gradually, and keep the tow line in view and control at all times.
- Be aware of any set or drift and of any obstacles and hazards.
- Heave in the slack from the towline as the vessels close.

Secure the tow alongside (Using tow line as bow line):

- When the tow has stopped all forward movement, remove the towline from the towing bitt (break the bitt).
- The towing vessel slowly backs and towline is hauled in. The towing vessel should keep some space abeam until the TSD is in the proper fore and aft position.
- Lead the towline to the bow for a bowline. Take a working turn on a suitable bow fitting and take in all slack. The towing vessel should be positioned so that its propeller is far enough aft of the TSD stern to turn the tow in either direction. As a general rule, always ensure that the stern of the barge or primary storage device is forward of the towing vessel rudder.
- Secure the bow line, keeping the bow of the towed vessel slightly angled in towards the bow of the TSD.
- Secure the forward spring line (tow strap).

Towing Alongside

- Pass the stern line and move ahead. Slack the bowline to allow the stern to come along side, taking the slack out of the stern line. Secure the stern line.
- Pass the after spring line (backing line), take the slack out, and secure the backing line.
- With a crewman ready to take the slack of the forward spring line, the towing vessel should back down hard allowing all the slack to be removed from the tow strap.
- Check all the lines to ensure that they are as taut as possible. Perform this by easing the tow vessel forward, then aft, to see that all the towlines are secure. The tug and the tow should be made up tight and behave as a single unit

RIGGING THE TOW – FREE APPROACH OR DOCKSIDE

This procedure can be used when making a free approach to a TSD on-water or while the TSD is alongside a pier. The first line over will be the bowline. There will not be a spring line to check forward motion with respect to the TSD.

- The master or operator of the towing vessel directs the crew to pass the bowline once alongside the TSD.
- Once alongside, with the bowline connected, position the TSD so that the towing vessel's propeller(s) and rudder(s) are well aft of the TSD's stern.
- Fender placement should be checked and adjustments made so they provide maximum protection at contact points.

If there is little or no movement from wind, seas or current, rig lines in the following order:

- Rig a stern line from the TSD's stern to the towing vessels stern.
- Rig a forward spring line (tow strap) from the towing vessel bow or forward mooring fitting to a point aft on the TSD.
- Rig a after spring line (backing line) from a quarter location on the towing vessel to a location forward on the TSD.
- Check all the lines to ensure that they are as taut as possible. Perform this by easing the tow vessel forward, then aft, to see that all the towlines are secure. The tug and the TSD should be behave as a single unit.

Figure AT-2 depicts three potential deployment configurations for Towing Alongside with one preferred method that affords the towing vessel the greatest amount of maneuverability and reduces movement between the towing vessel and the TSD being towed.

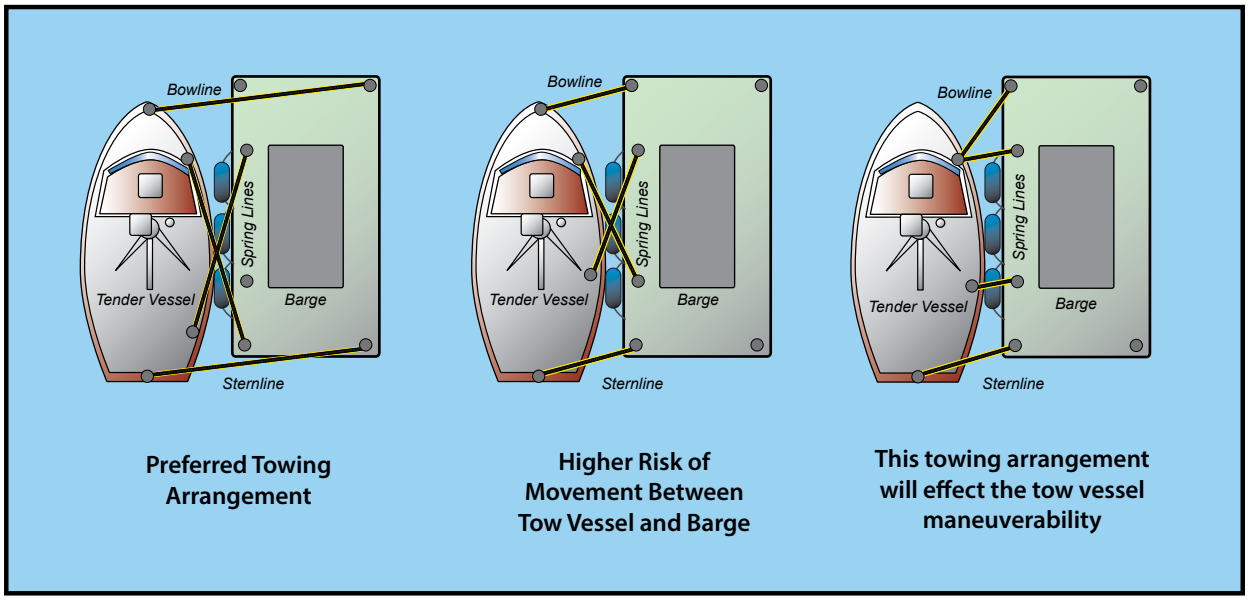

Figure AT-2. Towing Alongside - Configurations

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to closest Staging Area or safe harbor, transit times and exposure of vessels.
- Vessel masters are always responsible for the safety of their vessel and crew. They should have appropriate local knowledge of the operating area, operating environment, and tactic and should:
  - Know the speed and direction of the current, set, drift, and tidal state for the area to be transited.
  - Proceed at a speed prudent for the weather, visibility, traffic density, tow draft, possibility of wake damage, speed of the current, and local speed limits.
- Never attempt to fend off a moving vessel or barge by hand. Utilize fenders. Maintain situational awareness and ensure all crewmembers can quickly and safely move to a safe area should there be a danger of the two vessels making contact with each other without fenders.
- Never stand near lines under heavy strain. Seek safe shelter if there is a chance that a line under heavy strain may part.
- If possible, vessels in transit to/from an operating or staging area should transit in pairs, using the buddy system.

Towing Alongside

- A communication schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Vessels, including skiffs, must have a minimum of two crewmen aboard.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- When engaged in alongside towing, USCG Navigation Rules, Rule 24 – Towing and Pushing regarding lights, must be followed. (See http://www.navcen.uscg.gov/?pageName=navRulesContent#rule24)
- The towing vessel master or operator who is directing and controlling the movement of the towing vessel must understand the arrangement of the tow and the effects of maneuvering on the towing vessel and on the TSD being towed.
- Vessel master and/or operators must ensure that all towing lines and related equipment:
  - Are appropriate for the vessels horsepower
  - Are appropriate for the arrangement of the tow
  - Are frequently inspected
  - Remain serviceable
- Never secure the towlines so they cannot be thrown off quickly and easily.
- When coming alongside a dock, barge, or other primary storage device, approach it at minimum control speed with the TSD on the dockside.
- Site conditions may influence alongside towing configuration options. Sometimes the lee side of the barge or primary storage device is the only option.

REFERENCES TO OTHER TACTICS

Other tactics associated with Alongside Towing (Hip Tow) Tactic include:

- MST • Marine-Based Storage and Transfer of Oily Liquids
- MR • Marine Recovery
- FO • On-Water Free-Oil Recovery
- LB • Nearshore Response Group Logistics Base

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include adequate towing line(s) based on the size of the towing vessel and TSD, messenger/ throwing lines, fenders, and chafing gear. Resource sets will need to be refined as requirements dictate.

Typical Equipment	Function	Quantity	Notes
Class 1, 2, 3, 4, or 5	Towing Vessel	1	Vessel class dependent upon general availability, barge configuration, operating environment, weather and sea state
Towing lines	Towing Alongside	Vessel specific	Lines can be 3-strand or double braided as appropriate for vessel size and tow configuration
Messenger/Throwing lines	Passing towing lines to and from towing vessel and barge	Vessel specific	Messenger lines are typically 3-strand polypropylene
Fenders	Prevents damage to boats, vessels and berthing structures	Vessel specific	Should be secured with a slip-type hitch in the event the fender needs to be moved
Chafing gear	Prevents wear on towing lines where they make contact with chocks and other parts of a vessel when tied off for long periods of time and when under strain	Vessel specific	Various materials and sizes. Each vessel should have an ample supply prior to undertaking towing operations. Potential chafe locations should be inspected hourly to minimize damage to lines
Typical Personnel	**Function**	**Quantity**	**Notes**
Vessel Operators, open-water, protected/calm water	Masters of towing vessels	2*	*Personnel numbers dependent upon vessel class, duration of voyage, and any local, state, and federal vessel licensing and manning requirements
Skilled or General Technicians	Crew vessels, oversee and monitor towing alongside configuration	2*	*Personnel numbers dependent upon vessel class, duration of voyage, and any local, state, and federal vessel licensing and manning requirements

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NON-MECHANICAL RECOVERY

INTRODUCTION

Non-mechanical response describes spill response methods where chemical countermeasures or similar tools are used to treat spilled oil in order to minimize the environmental impacts of the oil spill. Non-mechanical response methods require special authorization or approval by state and federal authorities. Non-mechanical response tactics are used in cases where mechanical response is not feasible or when mechanical response must be augmented due to the size of the spill.

There are two main types of non-mechanical response tactics included in this manual.

- ***Dispersant Tactics*** involve the application of chemical formulations that contain surface active agents (surfactants) that lower the surface tension between oil and water, promoting the formation of oil droplets and reducing the tendency of oil to stick to other droplets or surfaces, thereby enhancing dispersion into the water column. In Alaska, dispersant tactics are only applicable to on-water oil spills.
- ***In-situ Burning Tactics*** involve the collection and concentration of oil within a designated area, the controlled burning of that oil, and the removal of the burn residue. In-situ burning tactics are organized based on the spill location and type of environment.

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DISPERSANT APPLICATION

OBJECTIVE & STRATEGY

DS

The objective of the Dispersant Application tactic is to chemically disperse spilled oil while it is floating on the sea's surface. Dispersants do not remove the oil, but break it into very small droplets that mix into the upper water column, promoting rapid degradation. Dispersants are used to augment mechanical recovery. Dispersants are usually applied as a spray from an airplane, helicopter, or boat. Correct targeting is essential to ensure effective dispersant application, as are several other factors, including dispersant droplet size, concentration, and rate of application.

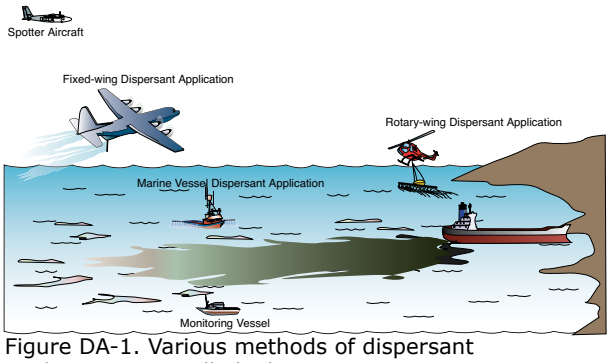

Figure DA-1. Various methods of dispersant applications on spilled oil.

Dispersant application differs from mechanical response methods because the State of Alaska and the Alaska Regional Response Team (ARRT) require that authorization be obtained prior to use in certain coastal areas. The ARRT's Dispersant Use Guidelines, which outline the approval process, may be found in the Unified Plan. The general strategy is to:

1. Identify the location and extent of the spill.
2. Determine that other mechanical methods for recovery are not feasible or must be augmented.
3. Obtain regulatory approval through the Unified Command.
4. Select equipment and a configuration that best supports the operating environment.
5. Mobilize personnel, appropriate chemical dispersants, and application equipment to the location.
6. Calculate application dosage and rates.
7. Apply dispersants to thickest areas of oil slick.
8. Monitor the dispersant application, using the appropriate protocols, to ensure accuracy, effectiveness, and to prevent misapplication.

Dispersant Application

TACTIC DESCRIPTION

Spill Detection

Effective dispersant application requires accurate spill detection. The slick location, thickness, and movement must be clearly identified and communicated to response managers and operations personnel. Spill detection can be accomplished through visual observation, infrared imagery, or satellite imagery (see Discharge Tracking Open Water).

Application Systems

Dispersants are applied using either a vessel- or aircraft-mounted spraying unit. All spray systems consist of tanks for dispersant storage; a power source (gasoline engine or electrical power source); a pump; control valves and metering equipment; spray arms; and nozzles (Figure DA-2).

Spray systems need to be able to apply the appropriate dispersant dosage in droplets that are the appropriate size. Droplets that are too small can be subject to wind drift; those that are too large will pass right through the oil slick. Both the flow rate and the droplet size are a function of the spray bar pressure and nozzle type. Application systems should be calibrated prior to use, preferably with the specific dispersant type to be used.

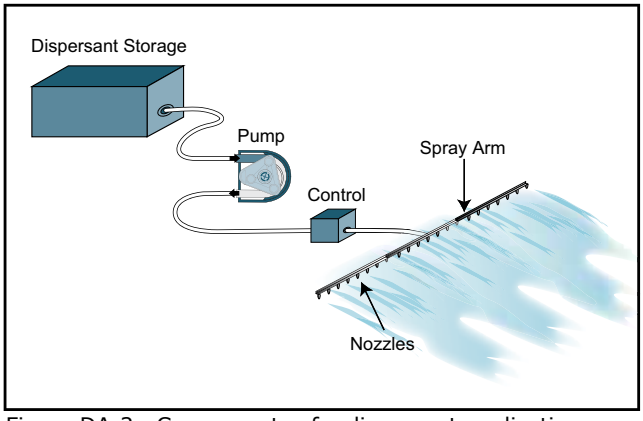

Figure DA-2. Components of a dispersant application system.

Aerial application can be accomplished from either fixed-wing or rotary-wing aircraft. Aerial application systems are usually faster than vessel-based systems because aircraft travel at much higher speeds than boats. However, aerial application may be less precise than vessel-based systems, resulting in irregular application or loss of dispersants. Aerial systems apply dispersants at a constant rate and cannot be adjusted during the sortie except by changing aircraft speed. Aerial systems may also be more limited by low visibility than vessel application.

The term "*application rate*" refers to the volume of sprayed product divided by the surface area covered by the spray and is usually expressed in liters/hectare or gallons/acre. The term "*coverage rate*" refers to the surface area covered by the spray divided by the length of time required to spray it, and is usually expressed in hectares/hour or acres/hour. The "*encounter rate*" refers to the area of oil that can be sprayed in a specific time. This can be calculated as the ship or aircraft spraying speed multiplied by the width of the spray deposits on the surface.

"*Payload*" refers to the total amount of dispersant carried by the aircraft or ship. Each dispersant application run is referred to as a sortie.

Dispersants are applied either pre-diluted or neat. Conventional dispersants are applied neat, at a comparatively higher application rate. Concentrated dispersants may either be diluted and then applied at a similar rate as conventional dispersants, or they may be applied neat at a lower application rate.

Dispersant Stockpiles

Some dispersants have a limited shelf life; therefore, stocks must be periodically rotated. Before a dispersant can be used in US waters, it must be approved by the EPA. Approved dispersants are listed in Subpart J of the National Oil and Hazardous Substances Pollution Contingency Plan. In Alaska, dispersant stockpiles are maintained by some of the Primary Response Action Contractors.

Regulatory Approval

In Alaska, dispersants may be used for on-water spills in the open, protected, or calm water operating environments. The ARRT Dispersant Use Guidelines divide Alaska waters into three zones, based on the requisite approval criteria. In Zone 1, dispersants use is pre-authorized and only requires approval of the Federal On-Scene Coordinator, although state and federal authorities must be notified. In Zone 2, dispersant use is conditional and requires the consultation with and approval of state and federal authorities. In Zone 3, the use of dispersants is not recommended in most instances. The Unified Plan contains maps with Zone designations for Prince William Sound and Cook Inlet.

Dispersant effectiveness depends on the type of dispersant, type and weathering state of the oil product, sea state, sea salinity, and wind. Viscous and emulsified oil does not disperse well. Dispersants work best when there is wave energy to mix the dispersant into the oil. Most dispersants work better in salt water than in fresh water.

Operating Environments

Dispersant Application is utilized in the following operating environments:


- Open Water,


- Protected Water, and


- Calm Water.

Deployment Configurations

Before dispersant applications proceed, a small test should be conducted where dispersants are sprayed on a portion of the slick. Once dispersant operations are underway, a monitoring/observation program should be established to monitor the effectiveness of the application.

Dispersant Application

Dispersants should be applied to the areas of the slick with moderate to high thickness, and not to sheen areas. Application runs should begin at the edge of the slick and proceed using parallel, continuous runs, treating the slick from upwind.

AERIAL APPLICATION

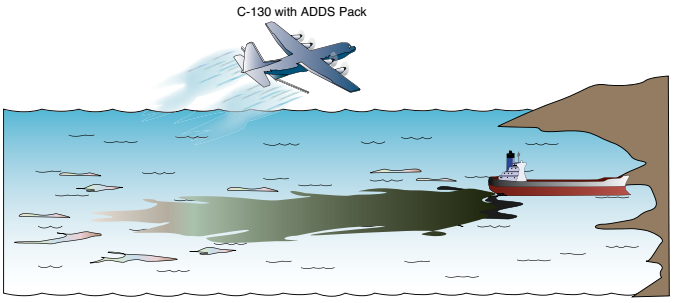

Figure DA-3. Fixed-wing dispersant application.

Aerial spraying can be done from helicopters as well as from small or large fixed-wing aircraft. Aerial application methods are more commonly used than vessel-based systems. Aerial application allows dispersants to be applied neat, or undiluted, which is preferable to the dilution required for vessel-based spraying. Aerial systems can also cover a larger area than vessel-based systems.

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Fixed-wing Application Systems

Fixed-wing aerial application may be accomplished by a variety of aircraft, ranging from large multi-engine cargo aircraft, such as Lockheed's C-130 HERCULES, to small single-engine planes, such as Cessna's 188 AGWAGON (Figure DA-3). Fixed-wing aircraft application systems provide a constant application rate, and are generally used for neat application. Like all aerial application systems, fixed-wing aircraft may operate independent of sea state. However, runways and other infrastructure are necessary to support dispersant operations.

Large, multi-engine planes are best equipped for handling large off-shore spills. Aircraft dispersant spraying has many significant advantages, including rapid response, good visibility, high treatment rates, and optimum dispersant use. Usually, aircraft allow treatment of spills at greater distances from shore than with vessels. A number of planes originally designed for agricultural or pest control operations have also been modified for dispersant application. The endurance, fuel consumption, turnaround time, payload, and the ability to operate from short or improvised landing strips are all important. In addition, the aircraft should be capable of operating at low altitude and relatively low speeds (50-150 knots) while remaining highly maneuverable. Fixed-wing aircraft can operate independent of sea state; however, fixed-wing operations are limited to daylight conditions with relatively good visibility and flying conditions.

The Airborne Dispersant Delivery System (ADDS) pack is a portable dispersant spraying unit that can be rapidly fitted inside an available aircraft. The ADDS pack, and other similar devices, remove the need to dedicate specially fitted aircraft to dispersant operations.

Rotary-wing Application Systems

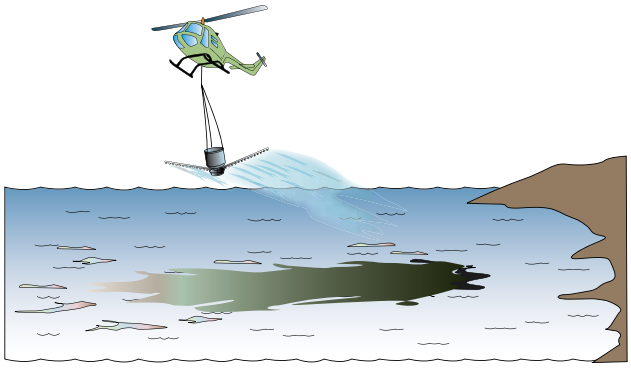

Figure DA-4. Rotary-wing aircraft dispersant application.

Helicopters (rotary-wing aircraft) may also be used to apply dispersants (Figure DA-4). One benefit of rotary wing aircraft over fixed wing aircraft is their ability to adjust speed and therefore application rate. Helicopter application systems apply neat dispersants. Limitations of rotary-wing application systems are small load size, and short flying time and distance. Rotary-wing aircraft can be configured to use either an internal or, more commonly, an underslung bucket application system.

In general, helicopters have a faster transit speed than vessels, even when carrying a slung load. The hovering ability of a helicopter also makes it ideal for some nearshore operations. Helicopters can operate independent of sea state; however, helicopter operations are limited to daylight conditions with relatively good visibility and flying conditions.

The dispersants load that a helicopter can carry varies by model. Transit distance and prevailing conditions also factor into determining the load size.

VESSEL-BASED APPLICATION SYSTEMS

Dispersants can also be applied from vessels (Figure DA-5). Unlike aerial application systems, vessel-based systems provide the ability to adjust dispersant dosage during operations, which may lead to more effective application or dosing. However, vessel-based application systems operate more slowly than aerial systems, and are sea state dependent. They cover a much smaller area of spill, and are generally favored for small slicks. Vessels that are used to spray dispersants need to be equipped with a boom system, an adapted fire monitor system, or a ducted fan.

Boom systems spray dispersant through a set of nozzles fixed on outboard booms. Typically, the booms are mounted as far forward as possible to ensure the dispersant is applied ahead of the bow wave. This helps to mix the dispersant and oil properly. Spray units can be portable or permanently installed on a vessel. Systems are available that deliver neat dispersant or, with a separate water pump, apply dispersant diluted with water.

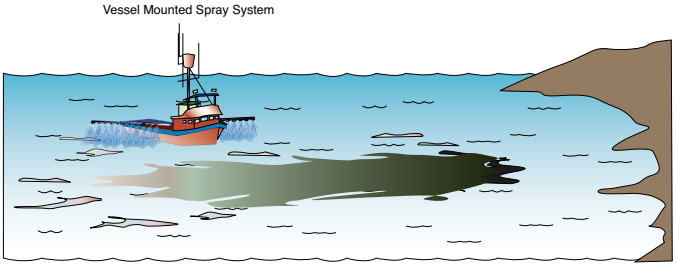

Figure DA-5. Marine vessel dispersant application.

Dispersant Application

Specially adapted fire monitors can be used to apply diluted dispersant. Fire monitors are low-cost, rugged, and easily installed and operated. The high pump capacity of this type of system allows the vessel to travel at a greater speed and eliminates the problems caused by booms striking the water surface as the vessel pitches and rolls during operations. A boat equipped with two fire monitors may be able to cover three to four times the area of a boom-equipped boat.

Table DA-1. Comparison of different vessel-based application systems.

System	Advantages	Disadvantages
Conventional spray-boom (diluted dispersant)	• Uniform dosage across swath. • Wide range of adjustment possible for vessel speed and dosage without changing nozzles.	• Heavy piping suspended over side. • Loss of dispersant effectiveness due to dilution prior to application. • Limitation of swath to boom length. • Fine droplets easily blown off target due to wind. • Need to change nozzles to adjust vessel speed or dosage.
Conventional spray-boom (un-diluted/ neat dispersant)	• Uniform dosage across swath. • Most effective use of dispersant.	• Heavy piping suspended over side. • Fine droplets easily blown off target due to wind. • Limitation of swath to boom length. • Small nozzles tend to clog easily. • Need to change nozzles to adjust vessel speed or dosage.
Fire monitor	• Covers 3-4 times area of boom systems. • Droplets are less sensitive to wind than system below. • Rugged enough to withstand permanent installation. • Can be permanently mounted without interfering with other operations.	• Variations in dosage across swath. • Slight loss of dispersant effectiveness due to dilution prior to application.
Ducted Fan	• Can cover 3-4 times area of boom systems. • No loss of effectiveness due to dilution before application.	• Very wind sensitive. • Need to change nozzles to vary dosage or vessel speed.

Source: Major, Nicholson and Chen, 1994

Table DA-2. Typical characteristics of dispersant spray equipment.

Platform	Dispersant Load (gallons)	Coverage (acres/hour)	Coverage (acres/day)*
Small boat	250	25	200
Small ship	800	50	400
Supply ship	2,500	75	600
Small helicopter	200	420	700
Large helicopter	525	690	2,000
Agriculture spray plane	100	420	700
DC-3	1,200	1,300	6,000
DC-4	2,100	2,100	12,000
DC-6	3,000	2,500	18,000
C-130 (Hercules)	3,500	2,500	21,500

*Presuming a working day of 8 hours and typical sorties 25 nm from base, and a target dosage of 38.5 gallons per acre.
Source: Fingas 2000

Table DA-3. Comparison of fixed-wing aircraft and vessel application systems.

	C-130/ADDS Pack	Typical Vessel System
Payload	5,000 gal	1,000 gal*
Maximum speed	150 kts	10 kts
Minimum speed	130 kts	3 kts
Maximum pump rate	800 gal/min	12 gal/min
Swath width	150-200 ft	90 ft
Mobilization time (hr)	8	5
Total time per sortie (hr)	2.7	5.7
Dispersant time window (hr)	81	84
Sorties possible per unit	14	7
Number of units	1	1
Dispersants applied (gal)	70,000	7,000
Maximum amount of oil that could be treated at dispersant:oil ratio of 1:20 bbl	33,000	3,300

** Depends on vessel size*

Monitoring and Observation

Determining whether the dispersants have actually reached the oil in the proper dosage and with sufficient coverage and whether the dispersant is effectively breaking up the oil requires monitoring. Monitoring allows the response team to determine whether the application method needs to be modified in any way and whether application needs to be repeated in some areas. NOAA has developed a dispersant use protocol – Special Monitoring of Advanced Response Technologies (SMART) – that should be used in conjunction with dispersant operations. The protocol offers three tiers of monitoring, based on the incident needs:

- Tier 1: Visual monitoring only (aerial observation if possible).
- Tier 2: Combination of visual monitoring with real-time on-site water column fluorometry at a single depth and water sample collection for later analysis and comparison.
- Tier 3: Expanded version of Tier 2, including fluorometric data and samples from multiple depths. It also includes an option to collect water quality information such as temperature, dissolved oxygen, pH, salinity, and conductivity using a portable analyzer to provide information on the fate and transport of the dispersed oil.

While observing dispersant applications, consider these important points:

- Observers should be trained in dispersant monitoring.
- The monitoring observer should not make operational decisions (e.g., how much dispersant to apply, when or where to apply it). These decisions are made by operational units.
- Oil surface slicks and plumes look different for many reasons; for example, oil or product characteristics, time of day (different sun angles), weather, sea state, and rate at which oil disperses.
- Low-contrast conditions (e.g., twilight, haze) make observations difficult.

- For best viewing, the sun should be behind you, with the aircraft at an altitude of 500-1000 feet observing the slick at a 30-degree angle.
- Appearances of dispersant action can range from brown to white (cloudy) to no visible plume. The visibility of the dispersed plume will vary according to water clarity. In some cases, remaining surface oil and sheen may mask oil dispersing under the slick and thus interfere with observations of the dispersed oil plume.
- Sometimes other things, such as suspended solids or algal blooms, may resemble dispersed oil.
- Dispersed oil plume formation may not be instantaneous after dispersant application. In some cases, such as when oil is emulsified, it can take several hours and may not show a visible plume at all.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include sea state and visibility conditions as they affect application systems and monitoring.
- Vessel masters and pilots should have experience in the appropriate operating environment. Local knowledge is preferred.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.
- Communication and clear understanding of responsibilities is crucial to execution and safety during the dispersant application process.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- For dispersant use in Zones 2 and 3, consultation must be initiated with the ARRT, and the US Department of Commerce (NOAA, NMFS) and the US Department of the Interior must be consulted when practicable. For Zone 1, dispersant use must be approved by the FOSC and the ARRT must be notified.
- Wind conditions should be monitored.

REFERENCES TO OTHER TACTICS

Other tactics associated with Dispersant Application include:

- DT Discharge Tracking On Water

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include a delivery vehicle (airplane, helicopter, vessel); a spray system with tanks to hold the dispersant; a control system; and dispersant monitoring team and equipment. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, as well as resource availability.

Table DA-4. US National Contingency Plan Recommended Dispersant Application Procedures for Corexit 9500 and Corexit 9527.

Product	Application Method	Concentration/ Application Rate	Conditions for Use
Corexit 9527	*Aerial spraying:* Apply undiluted at altitude 30-50 ft. Careful selection of spray nozzles critical to achieve proper dose (through droplet size control). 1/4-inch open pipe with aircraft traveling at 120 mph (104 knots) or more.	2-10 gallons per acre or a 1:50 to 1:10 dispersant to oil ratio is recommended	Timely application assures highest degree of success. Early treatment reduces mousse formation. Useful in saltwater.
	Boat spraying: Use spray booms mounted ahead of bow wake or as far forward as possible. Use low-volume, low-pressure pump to apply undiluted or use spray equipment designed for application of 5-10% solution. Apply as droplets, not fogged or atomized. Fire monitor modified with screen cap for droplet size can be used.	Application rate depends on type of oil, degree of weathering, temperature, and slick thickness.	
Corexit 9500	*Aerial spraying:* Apply undiluted at altitude 30-50 ft. Careful selection of spray nozzles critical to achieve proper dose (through droplet size control).1/4-inch open pipe with aircraft traveling at 120 mph (104 knots) or more.	2-10 gallons per acre or dispersant to oil ratio of 1:50 to 1:10 is recommended.	Timely application assures highest degree of success. Early treatment reduces mousse formation. Useful in freshwater or saltwater at any temperature. Viscous oils require higher dosage rates.
	Boat spraying: Use spray booms mounted ahead of bow wake or as far forward as possible. Use low-volume, low-pressure pump to apply undiluted or use spray equipment designed for application of 5-10% solution. Apply as droplets, not fogged or atomized. Fire monitor modified with screen cap for droplet size can be used.	Application rate depends on type of oil, degree of weathering, temperature, and slick thickness.	

Vessel-based Dispersant Application System

Equipment	Function	Quantity	Notes
Spray unit	Dispersant storage and spraying capability	Minimum 1 per dispersant vessel	
Consumables	**Function**	**Quantity**	**Notes**
Dispersant	Oil treatment	At least 1:20 dispersant to oil ratio for estimated oil being treated	Corexit 9500, Corexit 9527, or equivalent
Vessels/Aircraft	**Function**	**Quantity**	**Notes**
Spray vessel with crew	Application platform	1	Must be suitable for operating environment
Spotter aircraft with crew	Spill detection, tracking, and application	1	
Monitoring vessel with crew	Monitoring dispersant application	Minimum 1 depending on area of coverage	Must be suitable for operating environment
Communication systems (radios)	Intra-task force communications	3 minimum	All vessels and aircraft must be able to communicate on a common frequency
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	Must be trained in dispersant application
Dispersant application technicians	Operate spraying equipment	2 to 4	Must be trained in dispersant application with the spray system utilized in the operation. These technicians may also load dispersants into the vessel.
Aerial Observer	Visual observation of slick	2	Should be trained in aerial oil observation and dispersant monitoring/reporting
Monitoring Team with equipment	Conducts monitoring using SMART protocol	2 to 3	Must be trained in SMART monitoring

Dispersant Application

Fixed-wing Aircraft Dispersant Application System

Equipment	Function	Quantity	Notes
ADDS Pack or equivalent	Storage and application of dispersant	Minimum 1 per dispersant aircraft	System consists of a tank, twin spray booms and remote control to release dispersant. Tanks must be refilled on the ground using transfer pumps.
Transfer pumps	Refill dispersant tanks	1 to 3	Depending on configuration
Consumables	**Function**	**Quantity**	**Notes**
Dispersant	Oil treatment	At least 1:20 dispersant to oil ratio for estimated oil being treated	Corexit 9500, Corexit 9527, or equivalent
Vessels/Aircraft	**Function**	**Quantity**	**Notes**
Spray aircraft with crew	Application platform	1 per task force	Crew must be trained in dispersant application
Spotter aircraft with crew	Spill detection, tracking, and application	1	
Monitoring vessel with crew	Monitoring dispersant application	Minimum 1 depending on area of coverage	Must be suitable for operating environment
Communication systems (radios)	Intra-task force communications	3 minimum	All vessels and aircraft must be able to communicate on a common frequency
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	Must be trained in dispersant application
Dispersant Application Technicians	Operate spraying equipment	2 to 4	Must be trained in dispersant application with the spray system utilized in the operation. These technicians may also load the dispersants into the aircraft on the ground.
Aerial Observer	Visual observation of slick	2	Should be trained in aerial oil observation and dispersant monitoring
Monitoring Team and equipment	Conducts monitoring using SMART protocol	2 to 3	Must be trained in SMART monitoring

Rotary-wing Aircraft Dispersant Application System

Equipment	Function	Quantity	Notes
Helicopter dispersant bucket system	Store and spray dispersants	Minimum 1 per dispersant vessel	Bucket system consists of storage tanks with spray booms attached. Tanks must be refilled on the ground using transfer pumps.
Transfer pumps	Refill dispersant tanks		
Consumables	**Function**	**Quantity**	**Notes**
Dispersant	Oil treatment	At least 1:20 dispersant to oil ratio for estimated oil being treated	Corexit 9500, Corexit 9527, or equivalent
Vessels/Aircraft	**Function**	**Quantity**	**Notes**
Helicopter and crew	Dispersant application platform	1 or 2 per task force	Crew must be trained in dispersant application
Spotter aircraft with crew	Spill detection, tracking, and application	1	
Monitoring vessel with crew	Monitoring dispersant application	1	Must be suitable for operating environment
Communication systems (radios)	Intra-task force communications	3 minimum	All vessels and aircraft must be able to communicate on a common frequency
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	Must be trained in dispersant application
Dispersant Application Technicians	Operate spraying equipment	2 to 4	Must be trained in dispersant application with the spray system utilized in the operation. These technicians may also load dispersants into the bucket on the ground.
Aerial Observer	Visual observation of slick	2	Should be trained in aerial oil observation and dispersant monitoring
Monitoring Team and equipment	Conducts monitoring using SMART protocol	2 to 3	Must be trained in SMART monitoring

IN-SITU BURNING, OILY VEGETATION

OBJECTIVE & STRATEGY

ISv

The objective of In-situ Burning, Oily Vegetation is to burn oil-covered vegetation in place to prevent impacts to wildlife and to speed re-vegetation. Burning may be used to augment mechanical removal of large amounts of oil and may cause less damage to marsh and tundra environments than mechanical removal. In-situ burning is most effective when ignited as soon as possible after the oil has impacted an area, so that volatile components of the oil can be utilized to sustain the burn.

Figure ISv-1. Burning oily vegetation by raking to enhance flammability.

The general strategy is to:

1. Identify the location and extent of the spill.
2. Select equipment and a configuration that best supports the operating environment.
3. Notify and seek approval from appropriate authorities, including the local fire department.
4. Review and follow the current In-situ Burning Guidelines.
5. Mobilize burning and fire suppression equipment and personnel to the location.
6. Prepare the area and begin burning process.
7. Monitor the area to ensure that vegetation does not reignite.
8. If oil collects into pools, utilize an appropriate recovery system to remove it.

TACTIC DESCRIPTION

An in-situ burning system for oily vegetation consists of hand tools, an ignition system (such as a propane weed burner), and fire suppression equipment. Burning is initiated after pooled oil has been removed from the impacted area. Fire suppression equipment and operators must be present before burning operations are begun. The burning is done in a controlled fashion in small segments. To enhance flammability,

In-Situ Burning, Oily Vegetation

vegetation may be raked up into a semi-vertical position. Then a weed burner is used to ignite the vegetation and it is allowed to burn until a small amount of the plant or "stubble" remains above ground (Figure ISv-1). This removes the oil, but does not damage the root systems needed for regeneration. If the area is at risk of igniting into a larger fire or if burning will result in damaging the root systems, the soil can be saturated with fresh-water before ignition. If residues from heavy oils and crude are produced, these may have to be mechanically removed.

Operating Environments

In-situ Burning, Oily Vegetation is recommended for use on ground covering vegetation where risks of wild fire are minimum. This would include tundra, marshes, shoreline, and other grass and sedge covered environments. Burning in wooded wetland vegetation is not recommended.

TUNDRA OR MARSH

Tundra and marsh environments present challenges for operations due to their sensitivity. Plywood or other similar material may be used to establish a pathway for heavy foot and ATV traffic to the site. Alaska Department of Natural Resources approved tundra vehicles or helicopters may also be used for transportation to remote sites. Initial response should be to remove the pooled oil on the surface with the appropriate removal system, then initiate burning to remove oiled vegetation. Under dry conditions, the area can be flushed with low-pressure fresh water to protect the root systems and prevent uncontrolled wildfire.

SHORELINE

In-situ burning can be used to remove oiled vegetation above the high tide mark (Figure ISv-2). These areas can contain significant vegetation with large root systems that are critical to preventing beach erosion. Care must be taken to ensure that root damage is kept to a minimum. Larger wood debris should be removed prior to burning.

Figure ISv-2. In-situ burning on beach environment.

Deployment Configurations

Work on the upwind edge of the oiled area to minimize the amount of smoke the responders are exposed to and to reduce the risk of further spreading of the oil.

In-Situ Burning, Oily Vegetation

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Consider the effects of smoke on responders and populated areas.
- Fire retardant clothing and other PPE should be worn by responders as required by the incident-specific Site Safety Plan.
- Evaluate respiratory protection for response personnel. Respirators should be readily available.
- Anticipate and prevent secondary fires.
- Wind conditions should be monitored to ensure responder safety and fire control. Burning is not recommended in winds exceeding 15 knots.
- Refined products generally burn more efficiently and produce fewer residues but can produce smoke that is more toxic.

DEPLOYMENT

- Sorbents may be utilized during and after burning to remove pooled oil.
- Place plywood, outdoor carpet, or other protective material across any tundra or marsh that must be traversed by heavy traffic.
- An open burn permit from ADEC may be required and should be on site for operations or areas not covered by ISB Guidelines.
- In order to speed plant regeneration, root systems should not be burned.
- One weed burner is capable of burning approximately 50 square feet in an hour.
- Consider the possible effects of smoke on nesting birds and other wildlife.

REFERENCES TO OTHER TACTICS

Other tactics associated with In-situ Burning, Oily Vegetation include:

- OR On-land Recovery
- ISo In-situ Burning, Pooled Oil

In-Situ Burning, Oily Vegetation

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include ignition systems, rakes, fire suppression equipment and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets should be refined as site-specific requirements dictate.

In-Situ Burning, Oily Vegetation

Equipment	Function	Quantity	Notes
Ignition system (handheld burner, propane tank and hoses)	Burn oiled vegetation	Site-specific	
Rakes	Prepare vegetation for burning	Site-specific	
Fire suppression system	Control burn if necessary	Site-specific	Use of large hand held fire extinguishers is acceptable for small areas. Consider use of tanker trucks for larger operations.
Plywood sheeting	Traversing sensitive environments; tundra/marshes	Site-specific	Use for foot and ATV traffic to access site
Sorbent material	Remove oil	Incident-specific	Remove any small pools of oil that can be easily accessed
Vehicle	**Function**	**Quantity**	**Notes**
Pick-up truck, ATV	Transportation to site	1	Depending on number of responders
Tanker truck	Provide water to site to flood the area in dry conditions and provide fire suppression if necessary	1	Depends on area covered and site conditions
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervise operations	1	May not always be on-site
Skilled Technicians	Operate weed burner and direct general technicians	1 per unit deployed	Depending on area covered
General Technicians	Work under the direction of skilled technicians to prep areas for burning	1 per unit deployed	Depending on area covered

IN-SITU BURNING, ON WATER

OBJECTIVE & STRATEGY

ISw

The objective of the In-situ Burning, On Water tactic is to conduct a controlled burn of spilled oil while it is pooled on the water's surface. In-situ Burning, On Water may be used to augment mechanical removal of oil under certain conditions. It is most effective when it is deployed as soon as possible after the oil has impacted an area so that volatile components can be utilized in burning the oil.

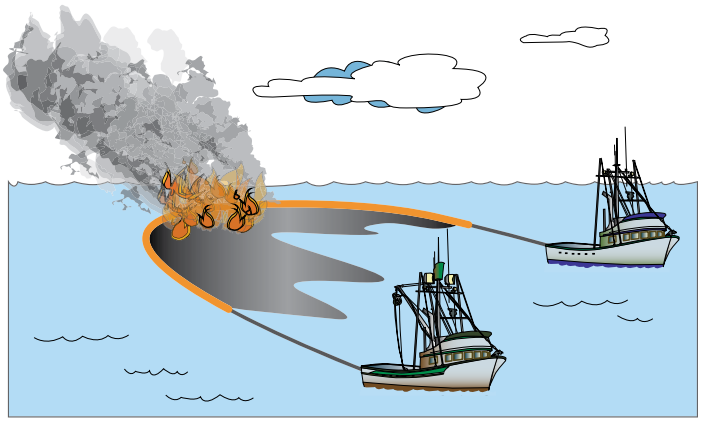

Figure ISw-1. In-situ Burning On Water deployment "U" configuration.

The general strategy is to:

1. Identify the trajectory and location of the spilled oil by performing Discharge Tracking, On Water and/or trajectory analysis.
2. Determine that conditions are appropriate for in-situ burning by reviewing the current version of the In-situ Burning (ISB) Guidelines.
3. Obtain regulatory approval through the Unified Command.
4. Review and follow the current In-situ Burning Guidelines.
5. Plan burning operation so as not to interfere with other on-water operations.
6. Select equipment and a configuration that best supports the operating environment.
7. Mobilize personnel, response equipment, and fire suppression equipment to the location.
8. Encounter the oil and concentrate it on the water's surface to a thickness of 2-3 mm (1/16 to 1/8 inch) using fire-resistant boom.
9. Ignite the oil.
10. Constantly monitor the burn and surrounding area to ensure safe operations and containment of the fire.
11. Remove any burn residuals from the water's surface.

In-Situ Burning, On Water

TACTIC DESCRIPTION

In-situ burning systems on water generally consist of a containment mechanism, an ignition system, and fire suppression equipment. Oil must be fresh (less than 2-3 days of exposure), collected in sufficient enough amounts to sustain combustion and have a minimum thickness of:

- 1 mm (< 1/16 inch) for fresh, volatile crude oil
- 2-5 mm (1/16 - 3/16) for aged, unemulsified crude oil and diesel fuel
- 5-10 mm (3/16 - 3/8) for emulsions and intermediate fuel oils.

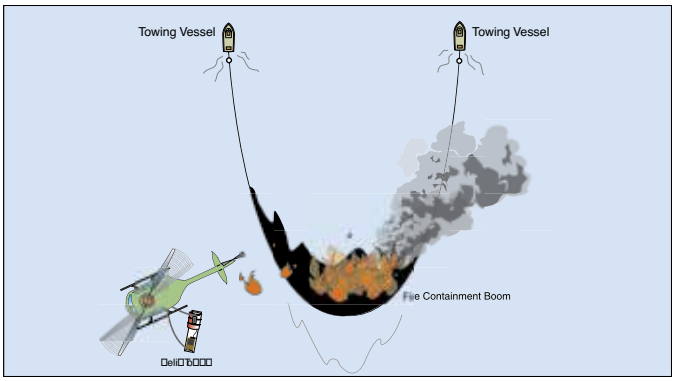

Figure ISw-2. In-situ Burning, On Water deployment configuration.

In order for the burning operations to be effective, the EPA recommends that the oil not be more than 25% emulsified or more than 30% evaporated. In order for a burn to be successful, wind speeds should be less than 20 knots and wave height should be less than 3 feet in choppy, wind-driven seas and less than 5.7 feet in large swells (wave period >6 seconds). Like conventional oil boom, fire boom cannot usually be effectively deployed in currents greater than 1 knot. For optimal burning conditions, currents should be less than .75 knots. In some cases, it may be possible to contain the oil in a higher current, if the boom array and towing vessels drift down-current while holding a relative velocity of less than 1 knot.

Oil must be contained within fire-resistant boom (Figure ISw-2) using the techniques shown in the On-water Free-oil Recovery tactic. Fire boom deployment is subject to the same weather and operational constraints as boom used in mechanical recovery, although the fire boom is typically heavier and less flexible. Fire boom is typically constructed of either fabric coated with a fire-resistant substance or metal. Some types of fire boom use a seawater cooling system. Oil may also be contained by ice.

With fire suppression equipment/plans and adequate response personnel present, the oil can be ignited. Ignition systems for small fresh oil spills can be a handheld weed burner/torch or incorporate gelled fuel (NAPALM) that is placed in the oil and ignited. For larger areas, a heli-torch may be used to ensure rapid ignition and provide aerial monitoring of the burn.

The ignitability of oil slicks on water is affected by oil type, wind speed, emulsification of the oil, igniter strength, ambient temperatures, and sea state. When oil is ignited and begins to burn, it is actually the

oil vapor that burns, and not the oil itself. In order for an oil slick to burn, the fire must be hot enough to maintain a vapor flow. Most oils will burn on water if the oil is present in sufficient thickness to avoid the heat sink effect, caused when heat from the oil layer is transferred to the water and thus extinguishes the fire.

The burning is done in a controlled fashion and requires adequate personnel and equipment to monitor the burning process. If burn residues from heavy oils and crude are produced, these should be mechanically removed. Downwind emissions must be below threshold levels for sensitive populations.

In-situ Burning, On Water is initiated only after authorization is granted by the Alaska Department of Environmental Conservation, the US Environmental Protection Agency, and the US Coast Guard; and consultation with the U.S. Department of the Interior and the US Department of Commerce (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). Specific requirements are set forth in the ISB Guidelines. Plume delineation or other methods should be used to ensure that downwind emissions do not threaten sensitive populations.

Operating Environments

In-situ burning may be used in Open, Protected, Calm water, or Broken-Ice environments assuming other physical and environmental parameters are within safe operating limits. In any case, a safe distance must exist between the burn site and human populations. On water that is more than 3 miles from shore, the safe distance between the burn and downwind human populations is considered to be 1 mile. On water that is less than 3 miles from shore, the safe distance is 3 miles.

In-situ burning may be used in sea ice under certain conditions. In circumstances where the ice concentrates the oil and prevents it from spreading (usually in ice concentrations greater than 70%), burning may be able to remove a high percentage of the slick. Solid ice may also slow the evaporative loss process. However, broken ice conditions may complicate vessel operations and fire boom deployment if booming is necessary to concentrate the oil. During spring breakup, oil may accumulate in melt pools, while subsurface oil slowly migrates to the surface through brine channels and cracks. During freeze-up, spilled oil becomes contained by new thin or slush ice.

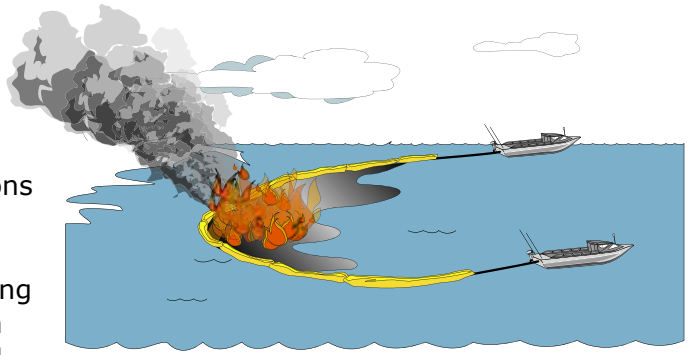

Figure ISw-3. In-situ Burning, On Water deployment "U" configuration.

Deployment Configurations

When towing fire boom, two response vessels deploy the fire-proof boom between them in a "U" configuration, with one end attached to each vessel (Figure ISw-3). The boom is typically between 300-500 feet in length and is towed by the two vessels at speeds of between one-half and three-fourths of a knot. It is not essential that all of the boom used in this tactic be fire boom, but instead, may be a combination, i.e. regular boom for the legs and fire boom for the apex.

Oil that gathers inside the "U" is moved to a location away from the main spill slick where it is ignited. By controlling the speed of the vessels, the rate of the burn can be increased, decreased, or even extinguished. Any residues left in the boom after the burn must be recovered by conventional means.

In-situ burn operations may involve one or more U-boom configurations organized into task forces. Vessel pairs may work independently, with each pair towing and then burning a portion of the oil slick; or, they may coordinate their efforts, with one or more pairs towing oil in conventional booms and concentrating the oil into one or more fire boom containment areas.

In-situ burn operations are generally conducted in one of two distinct modes. In "batch" mode, oil is collected in a section of fire-resistant boom towed by two vessels until the back third of the boom is filled. Next, the filled boom is maneuvered to a safe distance crosswind. The contained oil is then ignited, and the oil is burned then extinguished. The burn residue is collected and the boom is inspected for damage and replaced as needed. Finally, the boom is towed back to the slick to collect more oil and begin the process again.

"Continuous" mode operations involve positioning the fire boom at a safe down-drift distance from a continuous oil leak, such as a well blowout, and then burning the oil continuously or intermittently as it accumulates at the back of the boom. Caution must be taken to make sure the fire does not burn back up the slick to the source. This mode of operations can also be carried out without the use of fire boom in instances where uncontained oil slicks are thick enough to support combustion.

The burn can be extinguished in several ways. The tow speed can be increased to force the oil under the boom; however this has the potential to temporarily increase the burn diameter by as much as 10 times before the slick is extinguished. A second method involves the release of the boom by one of the vessels or the stopping of both vessels, allowing the oil to spread and become too thin to sustain a burn. This, too, can temporarily increase the burn diameter by as much as tenfold.

Monitoring

In-situ Burning, On Water is initiated only after authorization is granted by the Alaska Department of Environmental Conservation, the US Environmental Protection Agency, and the US Coast Guard; and consultation with the US Department of the Interior and the US Department of Commerce (National Oceanic and Atmospheric Administration and National Marine Fisheries Service). Specific requirements are set forth in the ISB Guidelines. Plume delineation or other methods should be used to ensure that downwind emissions do not threaten sensitive populations. NOAA has developed a Special Monitoring of Advanced Response Technologies (SMART) protocol for use with in-situ burning operations.

Residue Recovery

The amount and type of residue that remains after burning operations may vary depending upon a number of factors. Most burns result in taffy-like layers of weathered, viscous material that is relatively buoyant. Some residues may become neutrally or negatively buoyant quickly after combustion and/or sediment uptake. If the residue is sufficiently buoyant, it may be possible to retain it in the apex of the U-boom configuration. By combining the residue with fresh oil in subsequent burns, a major portion of the residue may be eliminated.

If the residue remains buoyant and it is practical to recover it before collecting and burning additional oil, the residue can be released to secondary containment booms or nets. Whether recovered from secondary booms or the fire boom, the burn residue can normally be picked up with large strainers or hand tools, with viscous-oil sorbents, or with standard viscous-oil skimmers (Figure ISw-4).

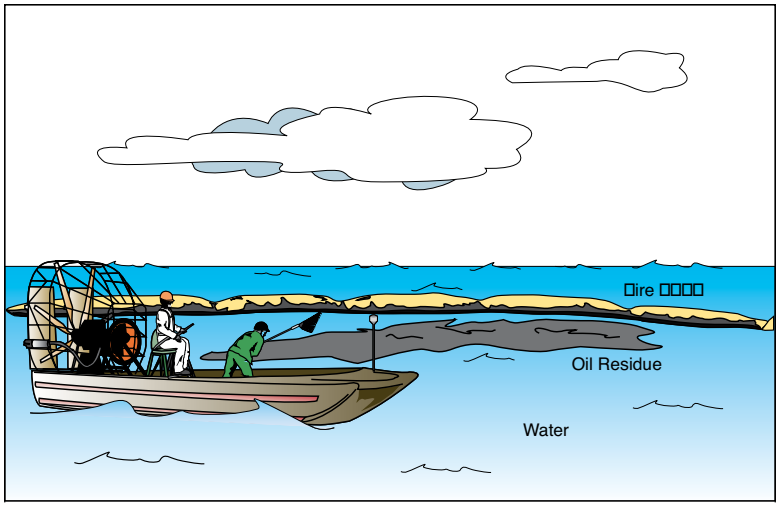

Figure ISw-4. Removing residue by hand after a burn.

If it is not recovered, burn residue will usually break up into smaller tar balls or tar mats and sink or disperse.

In-Situ Burning, On Water

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Consider the possible effects of smoke on responders, populated areas, and wildlife.
- Fire retardant clothing and other PPE should be worn by responders as required by the incident-specific Site Safety Plan.
- Evaluate the need for respiratory protection for responders. This protection should be readily available in case the wind shifts.
- Communication and clear understanding of responsibilities is crucial to execution and safety during the burn process.
- Secondary fires need to be anticipated and prevented. Allow residue to cool before approaching.
- ADEC, USCG, and EPA approval (through the Unified Command) must be obtained using the ARRT "Application for In-situ Burning."
- Wind conditions should be monitored to ensure responder safety and fire control, burning should not be commenced in wind greater than 20 knots.
- Vessels towing boom need to be ready to cast off or cut the lines towing the boom in an emergency.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.

DEPLOYMENT

- Conventional boom combined with fire boom in the apex can be used to form a boom array, if enough fire boom is not available.
- Refined products generally burn more efficiently and produce less residue, but can contain higher toxicity.
- ADEC, USCG, and EPA approval (through the Unified Command) must be obtained prior to commencing burn operations.

REFERENCES TO OTHER TACTICS

Other tactics associated with In-situ Burning, On Water:

- On-water Free-oil Recovery
- Discharge Tracking On Water

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include vessels, fire boom, ignition systems, fire suppression equipment and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

In-situ Burning, On Water

Equipment	Function	Quantity	Notes
Ignition system (handheld burner, propane tank and hoses, heli-torch, or gelled fuel)	Burn collected oil	Site-specific	Depending on configuration, oil concentration
Fire suppression system	Control burn if necessary	Site-specific	Use of multiple hand held fire extinguishers is acceptable onboard vessels
Fire boom with tow lines and bridles	Contain oil to sufficient thickness for burning	300-500 ft. per U-boom configuration	Fire boom has a limited number of cycles, so replacement boom should be available
Anchors	Moor boom when not in use	1 or more	Optional
Boom repair kit	Repair boom	1	
Vessel/Aircraft	**Function**	**Quantity**	**Notes**
Tow vessels with crews	Pull fire boom	2 to 8 per task force	Crews should have in-situ burning training
Helicopter with crew	Ignite oil and provide area monitoring	1	Necessary if using heli-torch ignition system
Aircraft with aerial observer	Tracking	1	
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Skilled Technicians	Operate ignition systems and direct general technicians	2 to 4	Depending on number of vessels in operation
General Technicians	Work under the direction of skilled technicians to prep areas for burning	0 to 4	Depending on number of vessels in operation

Residue Recovery

Equipment	Function	Quantity	Notes
Hand tools	Recovery	Site-specific	
Large strainers	Recovery	Site-specific	
Viscous-oil sorbent	Recovery	Site-specific	
Viscous-oil skimmers	Recovery	Site-specific	
Fire extinguisher	Fire suppression	Site-specific	
Vessel	**Function**	**Quantity**	**Notes**
Work boat with crew	Recovery platform	1 to 2	Class 3, 4, or 5
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Skilled Technicians	Conduct residue recovery operations	2 to 4	Depending on area covered
General Technicians	Work under the direction of skilled technicians to recover residue.	2 to 4	Depending on area covered

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IN-SITU BURNING, POOLED OIL

OBJECTIVE & STRATEGY

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The objective of In-situ Burning, Pooled Oil is to remove oil that has been mechanically pooled or has collected in natural depressions on land. In-situ Burning, Pooled Oil may be used to augment mechanical removal of oil if mechanical removal is not feasible or would cause additional damage to the environment. It is most effective when it is deployed as soon as possible after the oil has impacted an area so that volatile components can be utilized in burning the oil.

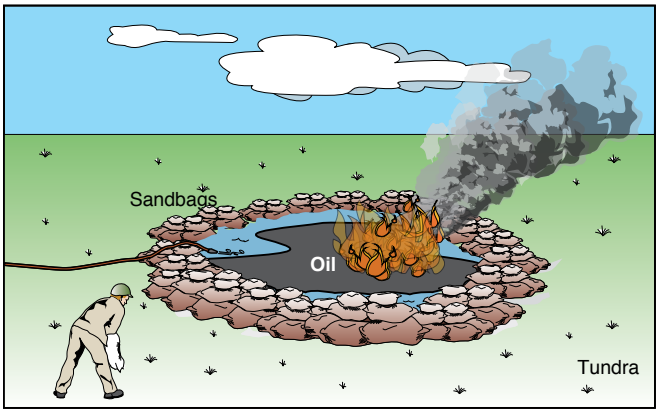

Figure ISo-1. In-situ Burning, Pooled Oil on tundra.

The general strategy is to:

1. Identify the location and extent of the spill.
2. Determine that mechanical recovery is not feasible.
3. Obtain regulatory approval through the Unified Command.
4. Review and follow the current In-situ Burning Guidelines.
5. Select equipment and a configuration that best supports the operating environment.
6. Mobilize personnel, response equipment and fire suppression equipment to the location.
7. Concentrate oil in natural depressions, ice pits, snow berms or other constructed features.
8. Ignite the isolated pooled oil.
9. Constantly monitor the burn and surrounding area to ensure safe operations and containment of the fire.
10. Remove any burn residuals from the site.

TACTIC DESCRIPTION

In-situ burning, pooled oil systems generally consist of a containment mechanism, an ignition system and fire suppression equipment. Oil must be fairly fresh, collected in sufficient quantity to sustain combustion and have a minimum thickness of:

- 2-3 mm (1/16 -1/8 of an inch) for crude oil
- 3-5mm (1/8 -3/16 of an inch) for diesel and weathered crude

- 5-10mm (3/16 -3/8 of an inch) for emulsions, intermediate fuel oils, and Bunker C

Oil that has been in contact with water cannot be greater than 50% emulsified.

If the oil has not naturally collected, utilize the tactics in Pits, Trenches, and Slots or Dikes, Berms, and Dams to concentrate the oil (Figure ISo-1). Once collected, the oil should be isolated from other combustion sources to ensure that the fire remains contained and controlled. With adequate fire suppression equipment and personnel present, the oil can be ignited. Ignition systems for small fresh oil spills can be a handheld torch (propane weed burner or flare) or gelled fuel (NAPALM) that is placed in the oil and ignited. For larger areas, a helicopter equipped with a heli-torch may be used to ensure rapid ignition and provide aerial monitoring of the burn. The burning should be done in a controlled fashion and requires adequate personnel and equipment to monitor the burning process. If residues from heavy oils and crude are produced, these should be mechanically removed after the burn.

Operating Environments

In-situ Burning, Pooled Oil is recommended for use on land where risks of wild fires are minimum. This would include solid surfaces such as ice, rock, gravel, mud flats and other similar shorelines. Pooled oil may also be burned on tundra, marshes and other land where there is a low danger of igniting an uncontrolled wildfire. Burning in wooded environments is not recommended.

ISo-i TUNDRA OR MARSH

Tundra and marsh environments present challenges for operations due to their sensitivity. Plywood sheeting or similar material can be used to establish pathways for foot and ATV traffic to the site. When possible, mechanically remove recoverable oil before igniting any unrecoverable oil. To protect the root systems and prevent uncontrolled wildfire, the spill area should be isolated with a dike or berm built utilizing sand bags or other material. Then the area is flooded with water to an approximate depth of 1/2 - 1 inch. The floating oil can then be ignited and burned.

ISo-i ICE, SNOW

In-situ burning in ice and snow environments presents the opportunity to remove large amounts of oil with minimal environmental damage. Oil should be pooled using berms, pits or natural depressions (Figure ISo-2).

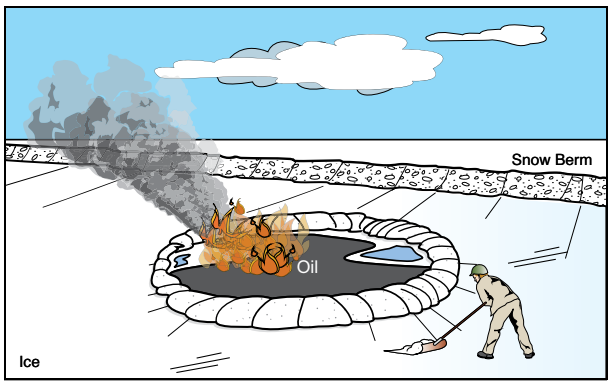

Figure ISo-2. In-situ Burning, Pooled Oil in ice and snow environment.

Oil incorporated in snow can be plowed into piles and ignited if there is enough oil present to sustain the burn. The resulting oily water and residue can then be removed using recovery systems.

ISo-c CONCRETE, ROCK, AND GRAVEL SURFACES

In-situ Burning on concrete, rock, and gravel surfaces should be used as a last option after mechanical recovery tactics have been deemed not feasible. The effects of heat on the structural integrity of materials should be considered. The oil can be contained with the use of natural depressions or through the use of sand bag berms or other materials.

Deployment Configurations

Work is begun on an upwind edge of the oiled area to minimize the amount of smoke the responders are exposed to and to reduce the risk of further spreading of the oil.

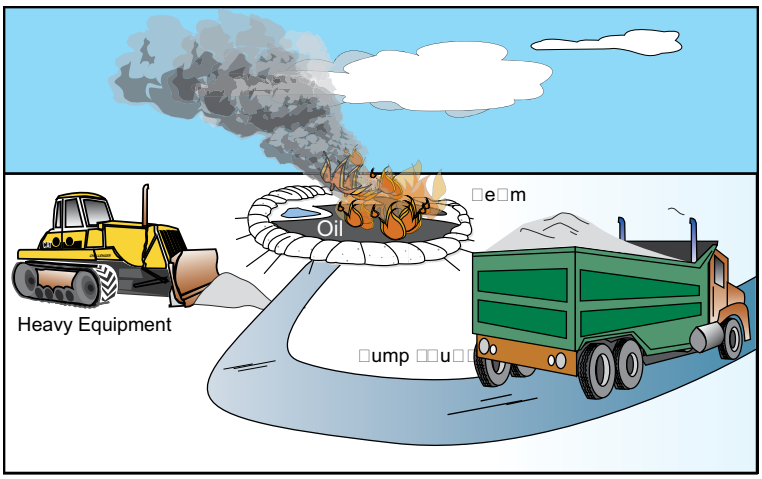

Figure ISo-3. Construction of berms to contain oil for burning.

Residue Recovery

The amount and type of residue that remains after burning operations may vary depending upon a number of factors. Most burns result in taffy-like layers of weathered, viscous material that is relatively buoyant. The burn residue can normally be picked up with large strainers or hand tools, with viscous-oil sorbents, or with standard viscous-oil skimmers.

In-Situ Burning, Pooled Oil

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Consider the possible effects of smoke on responders and populated areas.
- Consider respiratory protection for responders. This protection should be readily available in case the wind shifts.
- Communication and clear understanding of responsibilities is crucial to execution and safety during the burn process.
- Anticipate and prevent secondary fires.
- Wind conditions should be monitored to ensure responder safety and fire control. Burning operations should not occur in winds exceeding 15 knots.
- Fire retardant clothing and other PPE should be worn by responders as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Consider the possible effects of smoke on wildlife.
- An open burn permit from ADEC and approval through the Unified Command must be obtained prior to commencing burn operations.
- Refined products generally burn more efficiently and produce less residue, but can contain higher toxicity.
- Place plywood across tundra/marsh that must be traversed.
- Root systems should not be burned to allow for regeneration.
- Burn residuals must be removed from the site.

REFERENCES TO OTHER TACTICS

Other tactics associated with In-situ Burning, Pooled Oil include:

- OR On-land Recovery
- ISv In-situ Burning, Oily Vegetation
- PTS Pits, Trenches, and Slots
- DBD Dikes, Berms, and Dams

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include ignition systems, fire suppression equipment, and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Marsh, Tundra, and Other Land

ISo-*t*

Equipment	Function	Quantity	Notes
Ignition system (handheld burner, propane tank and hoses, heli-torch, or gelled fuel)	Burn pooled oil	Site-specific	Depending on configuration, oil concentration
Fire suppression system	Control burn	Site-specific	Use of multiple hand held fire extinguishers is acceptable for small areas. Consider use of tanker trucks for larger operations.
Plywood sheeting	Traversing sensitive environments; tundra/marshes	Site-specific	Use for foot and ATV traffic to access site
Sand bags	Berm materials	Site-specific	Must be adequate to create a continuous barrier to prevent oil spreading
Pumps and associated hoses	Flood tundra	1-2	Must maintain 1/2 - 1 inch of water under the burn area
Vehicle	**Function**	**Quantity**	**Notes**
Pick-up truck, ATV	Transportation of personnel and equipment to the site	Response-specific	Depending on number or responders
Tanker truck	Provide water to site to flood the area in dry conditions and provide fire suppression if necessary	Optional	Depends on area covered and site conditions
Helicopter	Ignite oil and provide area monitoring	Optional	Necessary if using heli-torch ignition system
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Skilled Technicians	Operate ignition systems and direct general technicians	2 to 4	Depending on area covered
General Technicians	Work under the direction of skilled technicians to prep areas for burning	2 to 4	Depending on area covered

Ice, Snow

ISo-*i*

Equipment	Function	Quantity	Notes
Ignition system (handheld burner, propane tank and hoses, heli-torch, or gelled fuel)	Burn pooled oil	Site-specific	Depending on configuration, oil concentration
Fire suppression system	Control burn if necessary	Site-specific	Use of multiple hand held fire extinguishers is acceptable for small areas. Consider use of tanker trucks for larger operations.
Earth moving equipment (backhoe, hand tools)	Concentrate oil by plowing or creating pits, trenches, berms	Site-specific	See tactics Pits, Trenches, and Slots or Dikes, Berms, and Dams
Vehicle	**Function**	**Quantity**	**Notes**
Pick-up truck, ATV	Transportation of personnel and equipment to the site	Response-specific	Depending on number or responders
Tanker truck	Provide water to site to flood the area in dry conditions and provide fire suppression if necessary	Optional	Depends on area covered and site conditions
Helicopter	Ignite oil and provide area monitoring	Optional	Necessary if using heli-torch ignition system
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Skilled Technicians	Operate ignition systems and direct general technicians	2 to 4	Depending on area covered
General Technicians	Work under the direction of skilled technicians to prep areas for burning	2 to 4	Depending on area covered

In-Situ Burning, Pooled Oil

ISo-c

Concrete, Rock, and Gravel Surfaces

Equipment	Function	Quantity	Notes
Ignition system (handheld burner, propane tank and hoses, heli-torch, or gelled fuel)	Burn pooled oil	Site-specific	Depending on configuration, oil concentration
Fire suppression system	Control burn if necessary	Site-specific	Use of multiple hand held fire extinguishers is acceptable for small areas. Consider use of tanker trucks for larger operations.
Vehicle	**Function**	**Quantity**	**Notes**
Pick-up truck, ATV	Transportation of personnel and equipment to the site	Response-specific	Depends on number or responders
Tanker truck	Provide water to site to flood the area in dry conditions and provide fire suppression if necessary	1	Depends on area covered and site conditions
Helicopter	Ignite oil and provide area monitoring	1	Necessary if using heli-torch ignition system
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	
Skilled Technicians	Operate ignition systems and direct general technicians	2 to 4	Depending on area covered
General Technicians	Work under the direction of skilled technicians to prep areas for burning	2 to 4	Depending on area covered

LOGISTICS

INTRODUCTION

Logistics tactics address the practical considerations involved in various oil spill support functions. Logistics functions are critical to the overall success of the spill response.

This section contains two tactics to assist spill responders in planning for spill support functions:

- The ***Staging Area*** tactic provides strategies for establishing a location where equipment and personnel can be received and prepared for deployment to the spill site, and where demobilized equipment returning from the field can be received and prepared for either remobilization or demobilization.
- The ***Vessel Decontamination*** tactic provides strategies for removing oil contamination from vessels that are exposed to oil and oily waste during spill response operations.

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STAGING AREA

OBJECTIVE & STRATEGY

S

The primary objective of the Staging Area tactic is to provide a location where equipment and personnel can be received and prepared for deployment to the spill site. The staging area also receives demobilized equipment returning from the field and prepares it for either remobilization or demobilization. Staging may also provide an interim waste storage location, which would be identified in the Waste Management Plan. The Staging Area Manager will establish a system to track resources and personnel to ensure an efficient, organized, and safe response.

Other response activities that may occur at/near a staging area are: personnel and equipment sign-in and sign-out, a field or forward command center, security, personnel and equipment decontamination, wildlife treatment, and responder break areas. The Operations Section Chief will work with the Staging Area Manager to establish the scope of the operations that occur in the staging area.

The general strategy used in establishing a Staging Area is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Establish scope of operations.
3. Select a site that best supports the operations.
4. Deploy equipment and personnel to the location.
5. Set up equipment and begin operation.
6. Receive response resources for transfer to the field.
7. Demobilize equipment and return to long-term storage.

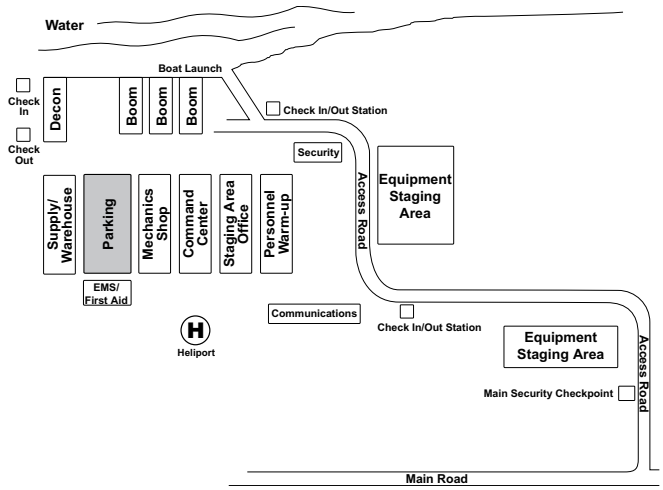

Figure SA-1. Example of a layout for a Staging Area.

Staging Area

TACTIC DESCRIPTION

A staging area is a designated place, but more importantly it is a system, established and monitored by a Staging Area Manager, that assembles functional response units/teams that can be deployed to achieve response objectives. During larger protracted spills involving numerous response and recovery sites, a Rear Supply Area may be established for the entire response effort with Forward Staging Areas near individual response operations. Every staging area requires a manager or a deputy manager.

Considerations for locating the staging area include:

- Enough area for maneuvering anticipated equipment,
- Space for receiving, temporary storage, maintenance, and deployment of equipment,
- Space and equipment for repair and refurbishment of response equipment,
- Communications systems,
- Medical first aid and shelter for responders,
- Space for storing and distributing supplies for responders,
- Space for providing food, water, shelter, and sanitation facilities for responders,
- Space for storing and providing supplies, fuel, and parts for equipment,
- Decontamination areas for personnel and equipment, if appropriate,
- Ease and safety in accessing with the anticipated modes of transport (trucks, helicopter, boats, etc.),
- Close proximity with easy access to the incident site,
- Electric power, telephone, and fax, and
- Office space.

All staging areas should be established as close to the spill site as safely feasible. The staging area should always be in a safe place in the Cold Zone. Anticipate changes in wind direction and the possibility of an increase in size of the Hot Zone when selecting a staging area. Staging Areas should be scalable to the expected maximum size of the response and provide safety, ease of access, and comfort for operations. Forward staging areas may be established in the area where the spill occurs. They are used as a platform to land, temporarily store and prepare equipment for immediate deployment. These areas should be as flat as possible with firm ground and adequate space for equipment. Frequently, in marine based responses, a larger vessel at an anchorage may serve as a staging area.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Staging areas should be monitored to ensure a safe environment. Consider the following hazards:
  - Aircraft and heavy equipment operations,
  - Slips, trips and falls,
  - Hypothermia,
  - Exposure to contamination and hazardous materials,
  - Heavy equipment and crane operations,
  - Hearing impairment,
  - Respiratory exposure, and
  - Eye protection.
- Select PPE based on the incident-specific Site Safety Plan.

DEPLOYMENT

- Consider historical properties and wildlife impacts when selecting staging areas.
- The Staging Area Manager serves under the direction of the Operations Section Chief and coordinates closely with the Logistics Section and the Resource Unit.
- Inventory contained in the area should be determined by the Operations Section Chief and must be tracked and maintained to ensure adequate resources for field operations.
- Resources should be ready for deployment at times specified by the Operations Section.
- The staging areas should be maintained in an orderly fashion.
- Establish a one way traffic pattern if possible.

REFERENCES TO OTHER TACTICS

Other tactics associated with Staging Area include:

- Dp Personnel Decontamination
- Dv Vessel Decontamination

Staging Area

EQUIPMENT AND PERSONNEL RESOURCES

Resources for establishing a Staging Area will be determined by the size and the needs of the response. Resource sets may need to be refined as site-specific requirements dictate.

Staging Area

Equipment	Function	Quantity	Notes
Staging area office	Office operations	1	Portable offices are available from most Primary Response Action Contractors
Generator	Provide electricity for operations	2	Deployed at remote sites
Loader	Move equipment and resources at the site	1	Deployed during larger response
Fork Lift	Move equipment and resources at the site	1	Organize and prep of equipment
Pickup trucks	Misc. support	Response specific	Delivery of personnel and equipment
Communication systems	Communications	1	Establish communication with the Command and field operations
Temporary shelters	Shelter for activities	Response specific	Shelter for working, breaks, first aid, repair, supplies, communications, and check-in/out recorders
Portable restroom facilities	Sanitary wastes	Response specific	Number of units depends on area functions
Mechanical truck or shop	Repair and support of equipment	1	May be established in portable shelters
Decontamination Unit	Decontamination	1	Depending on response activities
Portable lighting	Visibility at night	Response specific	Proper lighting is a safety and security concern
Personnel	**Function**	**Quantity**	**Notes**
Staging Area Manager	Supervises operations under the direction of the Operations Section Chief	1	Managers established for permanent or high volume, active sites
Office Support	Assist in tracking equipment and personnel	1 to 2	Depending on response activities
Skilled Technicians	Work under the direction of Staging Area Manager	2 to 4	Depending on response activities
General Technicians	Work under the direction of Skilled Technician	2 to 4	Depending on response activities
Security	Site security	Optional	Depending on site location

VESSEL DECONTAMINATION

OBJECTIVE & STRATEGY

Dv

The objective of the Vessel Decontamination tactic is to remove oil contamination from vessels that are exposed to oil and oily waste during spill response operations. The level of decontamination will depend on whether the vessel is to be demobilized or returned to spill response service. When a vessel is demobilized, it will be cleaned to a non-oiled state throughout the vessel. Vessels returning to service should be decontaminated sufficiently to not reintroduce oil into the environment or cross-contaminate response personnel and equipment. The purpose is to expedite cleanup of oiled vessels in a safe, organized and effective manner while minimizing waste and damage to the environment.

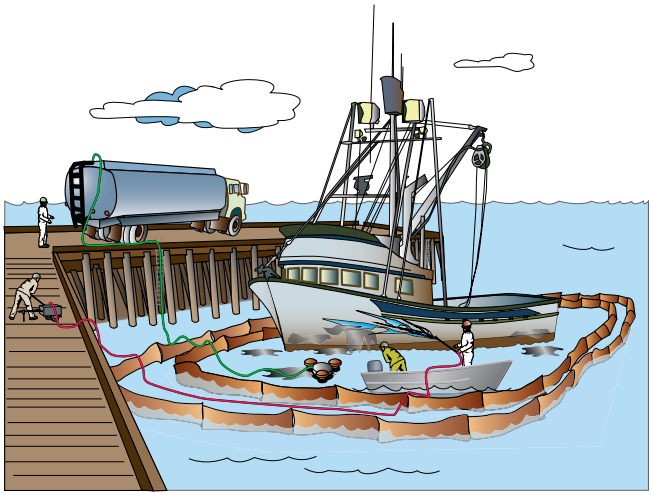

Figure Dv-1. On-water vessel decontamination deployment configuration at a dock.

The general strategy used in performing vessel decontamination is to:

1. Identify the appropriate location for decontamination operations.
2. Establish a site plan.
3. Obtain necessary permits for operations.
4. Deploy equipment and personnel to the location.
5. Set up equipment and begin operation.
6. Monitor operations to ensure that vessels are cleaned to established criteria and oil is removed from the environment.
7. Dispose oil contamination, solid wastes, PPE, and cleaning fluids according to the incident Waste Management Plan.

Vessel Decontamination

TACTIC DESCRIPTION

Decontamination involves the removal of oil or other contaminants from vessels when they leave the Hot Zone, while still in the Warm Zone. Vessel decontamination is conducted as part of the overall incident Decontamination Plan that is established by the Unified Command. An approved incident-specific Decontamination Plan supersedes the guidance in this manual.

Operations are conducted by designated decontamination teams and are broken down into different methods for larger vessels that cannot be removed from the water and smaller vessels that can be removed from the water. Controls must be in place to ensure that contamination is contained, removed from the environment, and properly disposed. Access should be limited and all personnel and equipment should be tracked in and out of the decontamination area to ensure that no cross contamination occurs. PPE is required in accordance with the incident Safety Plan.

While the general tactics are the same for small and large vessels, the approach will be adjusted depending on the size of the vessel and availability of equipment.

All vessels awaiting decontamination should be isolated inside oil containment boom so that oil and wastes cannot re-enter the environment. The site should be integrated into the overall decontamination site plan and situated in the Warm or Contamination Reduction Zone immediately adjacent to the Hot Zone.

General Procedures

All vessels should undergo gross decontamination of oil that is easily accessed by manual removal with sorbent pads and a detergent if necessary. After gross oil is recovered, all contaminated areas of the vessel are washed with pressurized warm/hot water spray. Detergents or degreasers may be used if the pressure wash does not remove all the oil. To keep wastes to a minimum, degreasing agents should not encourage emulsification of oil. Oil recovery operations should be conducted concurrently with washing operations. Recovery can consist of skimmer operations outlined in the tactics Marine Recovery and On-land Recovery or may be accomplished with Passive Recovery depending on oil type and amount expected.

Vessels That Can be Removed From the Water

Vessels that can be physically removed from the water with available equipment, i.e., travel lifts, cranes, or trailers, should be removed and cleaned in a designated area surrounded by berms or dikes that are lined to contain and recover the run-off of oil and water (Figure Dv-2). A warehouse or a large area with a concrete floor is preferred for containment of wastes. The area may also be used for other equipment decontamination. Sorbents, vacuum skimmer systems, and

storage devices should be present to recover wastes that are collected in the bermed area. All wastes are then disposed of in accordance with the incident Waste Management Plan.

Vessels That Cannot be Removed From the Water

Decontamination of vessels that cannot be removed from the water will be conducted on-water using a berth (Figure Dv-1) or established anchorage in protected waters (Figure Dv-3). The location should be immediately adjacent to the spill site outside the Hot Zone. It must be boomed off with a doubled, adequately anchored, containment boom, and have a gate for access. If the site is in open water, and multiple vessels are to be cleaned, a mooring should be established prior to operations. Adjacent sensitive areas should have protection plans in place to prevent contamination in the event of boom failure.

A recovery and primary storage system that is sized and suited to the operation should be present to recover oil floating in the boomed area. This might include sorbents, skimming systems, storage systems, and one or more platforms for operations. Sorbents should be floated inside the boomed area for removal of sheens and residual oil. When light contamination is expected, pads and sheets may be used. Sausage type booms may be deployed inside the exclusion boom for long-term deployments when significant oil is to be removed. Sorbents should be tended daily to ensure effectiveness.

After the initial cleaning, the surrounding waters should be monitored for sheening. If sheening is present and continuous, then the vessel should be cleaned again to remove any trace oil. Once cleaned, the vessel should be placed in a clean holding/staging area and logged out of the decontamination area.

The entry into any confined space, such as tanks or holds, should only be accomplished with trained and certified responders with specialized equipment and the approval of the Safety Officer. **Confined space entry is not covered by this manual.** Consult individual vessel decontamination plans and the incident specific decontamination plan for details.

Operating Environments

All decontamination areas should be established as close to the spill site or Hot Zone as feasible and should be scalable to the expected maximum size of the response vessels and provide safety, ease of access, and comfort for operations. For large vessels being cleaned at anchor, it is recommended that operation take place in calm waters. Decontamination of smaller vessels may occur adjacent to the spill site. Measures should be taken at the decontamination site to protect the area from contamination. Geotextile sheeting or sorbents should be placed in these areas.

Vessel Decontamination

Deployment Configurations

Figure Dv-2. On-land vessel decontamination deployment configuration.

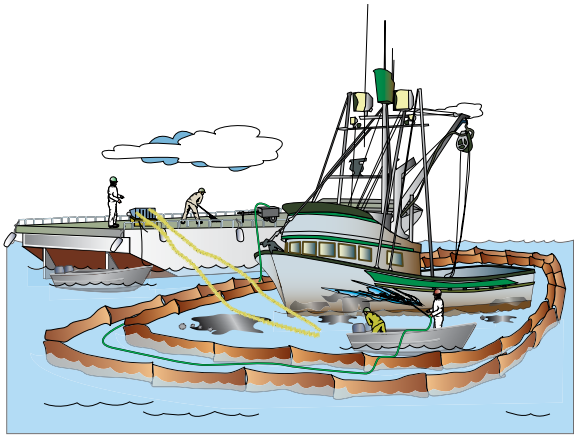

Figure Dv-3. On-water vessel decontamination deployment configuration at an anchorage.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- PPE is required of all personnel in the decontamination area. Consult the incident Site Safety Plan for specific requirements.
- Confined space entry is not to be allowed, unless specifically authorized by the incident Safety Officer.
- Worker exposure to contaminants should be minimized.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.

DEPLOYMENT

- Avoid historic properties and archaeology sites. See checklist on page A-20.
- The decontamination area should have a security check point for controlling access and tracking all equipment entering and leaving.
- Resources that are to be redeployed should be decontaminated first.
- Personal decontamination must be integrated into the site plan to prevent cross contamination.
- Any detergent or degreasing solutions discharged into open water must be approved by the EPA and listed in the Product Schedule in the National Contingency Plan. Approved products may include citrus-based solvents such as Citri-solve, Simple Green, PES51.
- Lightly contaminated waste-water from the cleaning operations may be re-circulated and re-used if the cleaning solution does not emulsify oil.

- Vessels must be fully decontaminated prior to demobilization.
- Permits must be obtained prior to on-water operations.

REFERENCES TO OTHER TACTICS

Other tactics that may be involved in Vessel Decontamination include:

- PPE, SCL, SEC • Safety Tactics
- C • Containment Boom
- OR • On-land Recovery
- PR • Passive Recovery
- MST • Marine-based Storage and Transfer
- Dp • Personnel Decontamination
- FO • On-water Free Oil Recovery
- MR • Marine Recovery
- LST • Land-based Storage and Transfer

EQUIPMENT AND PERSONNEL RESOURCES

Resources for establishing a Vessel Decontamination Area will be determined by the size and the needs of the response. Refine resource sets as site-specific requirements dictate.

On-water Vessel Decontamination

Equipment	Function	Quantity	Notes
Warm/hot water pressure wash system	Oil removal	1 or more	Include adequate hoses and connections
Oil boom, 6" to 24" height	Contain oil around vessel	Site-specific	Depending on configuration, currents, sea states and oil concentration
Small anchor systems	Secure boom	1 per 200 ft. of boom	Depending on configuration, currents, and sea states
Sorbents	Oil removal and recovery	Response specific	Pads, rolls and boom may be used
Detergents	Oil removal	Response specific	For manual removal deliver from spray bottles. May be incorporated in high pressure wash.
Storage tanks	Storage of recovered wastes	Response specific	Deployed during operation at a berth or dock
Marine oil recovery system	Oil recovery	1	Select based on oil type and amounts encountered
Mooring system or berth	Hold vessels in place during cleaning	1	Use if multiple vessels are to be cleaned to avoid contamination of vessel anchors
Lighting system	Illuminate operations	1	May be used to augment existing lighting
Vessel	**Function**	**Quantity**	**Notes**
Class 6 skiffs	Access to vessel being decontaminated and platform for pressure washing operations	1 to 2	Delivery of personnel and equipment
Decontamination platform (vessel or barge)	Storage of recovered wastes and platform for operations	Optional	Deployed when decon activities are conducted at anchor/mooring
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader or Group Supervisor	Supervises operations under the direction of the Operations Section Chief	1 or more	Should be familiar with the Site Safety Plan, Waste Management Plan, and Decontamination Plan.
Skilled Technicians	Work under the direction of Field Team Leader or Group Supervisor	1 to 6	Depending on decontamination activities
General Technicians	Work under the direction of Skilled Technician	2 to 8	Depending on decontamination activities
Vessel/Skiff Operators	Maneuver skiffs during cleaning operations	1 to 2	May not be necessary during decon at a berth/dock

Vessel Decontamination

On-land Vessel Decontamination

Equipment	Function	Quantity	Notes
Warm/hot water pressure wash system	Oil removal	1 or more	Include adequate hoses and connections
Berm or dike materials	Contain oil and contaminated water	Site-specific	Depending on size of vessels
Polyethylene sheeting	Provide barrier to contain oil	Site-specific	Use to line decon areas
Sorbents	Oil removal and recovery	Response specific	Pads, rolls and boom may be used
Detergents	Oil removal	Response specific	For manual removal deliver from spray bottles. May be incorporated in high pressure wash.
Storage tanks	Storage of recovered wastes	Response specific	A vacuum truck would be optimal
Vacuum system	Oil recovery	1	Select based on oil type and amounts encountered
Crane, travel lift, trailer	Remove vessel from water	1	Take steps to protect from contamination
Lighting system	Illuminate operations	1	May be used to augment existing lighting
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader or Group Supervisor	Supervises operations under the direction of the Operations Section Chief	1 or more	Should be familiar with the Site Safety Plan, Waste Management Plan, and Decontamination Plan
Skilled Technicians	Work under the direction of Field Team Leader or Group Supervisor	1 to 6	Depending on decontamination activities
General Technicians	Work under the direction of Skilled Technician	2 to 8	Depending on decontamination activities

Nearshore Operations Response Strategy (NORS)

INTRODUCTION

The Nearshore Operations Response Strategy (NORS) concept was developed to define a spill response system capable of operating in Alaska's nearshore waters, especially in remote regions with limited infrastructure. A NORS work group, led by the Alaska Department of Environmental Conservation (ADEC), met several times during 2011-2013 to develop the NORS strategy. The goal of the NORS strategy is to protect the Alaska coastline from a large oil spill by identifying the resources and response infrastructure needed to implement nearshore protection tactics. Timely and effective nearshore response is critical to protecting the sensitive areas and areas of public concern within the State.

A response to a large marine spill can be considered in three phases. The first phase of the response is to contain and remove the oil at the scene of the spill or while it is still on the open water, thereby reducing or eliminating impact on shorelines or sensitive habitats. If some of the spilled oil escapes this phase, the second phase, which is no less important, is to intercept, contain and remove the oil in the nearshore area. The intent of phase two is the same as phase one: remove the spilled oil before it impacts sensitive environments. If phases one and two are not fully successful, phase three seeks to protect sensitive areas in the path of the oil. The purpose of phase three is to protect the selected sensitive areas from the impacts of a spill or to minimize that impact to the maximum extent practical.

NORS is designed to provide a response capability to implement phases two and three – nearshore recovery and sensitive area protection, for the purpose of protecting sensitive areas, cultural resources, and areas of public concern. Nearshore recovery operations (described by NORS tactics) are necessary to recover oil that has escaped the on-scene recovery operations, and will become the primary means of recovery as the oil spreads into a thinner sheen and breaks up into isolated patches over the first few days of an oil spill. Sensitive area protection focuses on deployment of resources to protect environmentally sensitive areas ahead of the oil trajectory. In some cases, a Geographic Response Strategy (GRS) may provide a plan to protect a specific sensitive area. In other cases, the protection strategy may have to be developed on-scene.

The circumstances of each oil spill are unique, depending on the volume and type of product spilled, location of the spill, season, wildlife present, and many more factors. The appropriate response

to a spill is also unique. Because mounting an effective nearshore response in the remote regions of Alaska is a daunting task, the NORS seeks to support planning and implementation of a remote, nearshore response by providing guidance and examples.

These strategies and tactics are intended to be flexible and may be modified by spill responders to fit prevailing conditions at the time of a spill. The extent to which typical protected water conditions prevail will vary around the state. Seasonal constraints, such as ice or weather, may preclude implementation of some of the strategies in the winter months. Only those components that are needed will be implemented; it is not intended that all components be automatically implemented at the beginning of a spill. Spill responders should focus on minimizing environmental damage, utilizing as small a footprint as needed to support the response operations, and operating in a manner that will not cause more damage than the spilled oil.

NORS was created as a stand-alone section of the STAR Manual and is comprised of the following tactics:

- Nearshore Operations Planning and Implementation tactic provides information for planners and responders to implement a Nearshore Response Group (NRG).
- Nearshore Group Logistics Base tactic describes the logistical support requirements for a NRG utilizing marine vessels for staging personnel and resources. This tactic focuses on the requirement to support operations in remote areas of Alaska without resupply for up to 21 days.

Many response tactics in other sections of the STAR Manual might be implemented by a Nearshore Operations Group. These tactics include but are not limited to:

Nearshore Free-oil Recovery

Aerial Observation supporting Nearshore Operations

Exclusion Boom

Deflection Boom

Marine Recovery

Shoreside Recovery

Passive Recovery

Marine-based Storage and Transfer of Oily Liquids

Staging Area

Vessel Decontamination

PLANNING & IMPLEMENTATION

OBJECTIVE & STRATEGY

PI

This section describes general planning and implementation considersations related to the NORS strategy.

This tool is intended for command and general staff within an Incident Command System (ICS), and supplements guidance already contained in the STAR Manual and Alaska Incident Management System (AIMS) Guide by illustrating how component parts of the STAR Manual and AIMS may be applied to implement a robust and sustainable nearshore response. This tactic also includes information about equipping and staffing a nearshore response.

DESCRIPTION

NORS is based on the assumption that the Unified Command overseeing a spill has decided to form a Nearshore Response Group (NRG) to implement nearshore recovery and sensitive area protection tactics. A NRG will deploy and support up to five Nearshore Task Forces (NSTF). A marine logistical support base of tugs, barges and other vessels provides the necessary staging, oil storage, support infrastructure, and supplies for 21 days of operation. Additional support includes aerial observation and spill tracking by aircraft that may be stationed with the marine support base or may be deployed from a nearby airport, depending on local resources.

Planning Assumptions

The following planning assumptions were used to develop the NORS system and strategy:

- ***Spill Type and Weathering*** – NORS is designed for a very large offshore spill (>10,000 bbl) of crude oil or other persistent oil that threatens coastal resources over a broad area for an extended period of time. The oil is assumed to range from being somewhat emulsified to tar balls by the time it reaches the nearshore environment. The slick is not a solid mass of oil but broken into windrows of various thicknesses, spread over a wide area.
- ***Spatial Coverage*** - A NRG is assumed to operate in an area with a radius of between 5 to 15 miles from the marine response base depending on task force make-up and strike team options. This distance is based on the time necessary to transfer

recovered oil between primary and secondary storage units at the support base, responder safety, and weather conditions.

- ***Operating Environment*** - The NRG is assumed to operate in a Protected Water operating environment of up to 3-foot seas and 25-knot winds. In general, response vessels are assumed to operate in water depths greater than 6 feet. Special conditions such as shallow water (< 6 feet) and broken ice must be accommodated but are not considered in the basic strategy. Conditions may vary considerably by both location and season, and direction of the NRG will ultimately be determined by the Group Supervisor and Safety Officer. While this is a statewide document, region-specific planning should consider expected local conditions which will vary.
- ***Operational Period*** - A 12-hour per-day operational period is assumed for planning purposes. It is also assumed that all operations will be conducted in daylight, because of the danger of conducting coordinated small boat operations in shallow waters close to shore at night. It is also difficult to track oil in darkness.
- ***Duration*** – It is assumed that once deployed, the NRG will be capable of operating for up to 21 days without resupply.
- ***Best Available Technology*** – It is assumed that the NRG will utilize the best available technology for nearshore response, thus allowing for maximum effectiveness.
- ***Tactics*** – It is assumed that the NRG will be capable of implementing mechanical tactics associated with nearshore oil skimming and shoreline protection. This includes implementing Geographic Response Strategies (GRS) if they exist in the area of operations. Non-mechanical tactics, such as in-situ burning and dispersants, are not considered.
- ***Logistics Support*** – It is assumed that the NRG will be marine-based. Land-based support should be considered where the infrastructure exits, but for planning purposes the NRG is considered to be self-supporting.
- ***Aerial Support*** – It is assumed that nearshore operations will require aerial support, especially for oil tracking and spotting to support oil recovery. Aerial support from land should be utilized whenever possible, but for planning purposes it is assumed that this support will have to be stationed at the marine Logistics Base.
- ***Vessel Speed*** – It is assumed that vessels towing boom will travel at 10 knots unless towing a storage device. In that case, 5 knots is assumed.
- ***Enhanced Recovery Device*** – 72-foot boom swath, 3-knot tow speed.

- ***High Efficiency Oleophilic Skimmer*** – 550 bbl/hr, 93% recovery efficiency, 75% throughput efficiency
- ***Primary Storage Device*** – 249-bbl capacity and capable of 5-knot tow speed.
- ***Secondary Storage*** – 50,000-bbl capacity barge, may need to be lightered to tanker of opportunity or replaced with like kind depending on recovered fluids.

Composition

The NRG consists of up to 5 NSTF and a Logistics Support Base comprised of one or more support vessels/barges, and one or more aircraft to support response operations. Each NSTF consists of up to five Nearshore Strike Teams (NSST) incorporating recovery systems, primary storage devices, oil containment boom, and response vessels with trained crew. Figure NORS-1 shows how a NRG would fit into the incident command structure and how the group might be organized with five NSTF each containing five NSST.

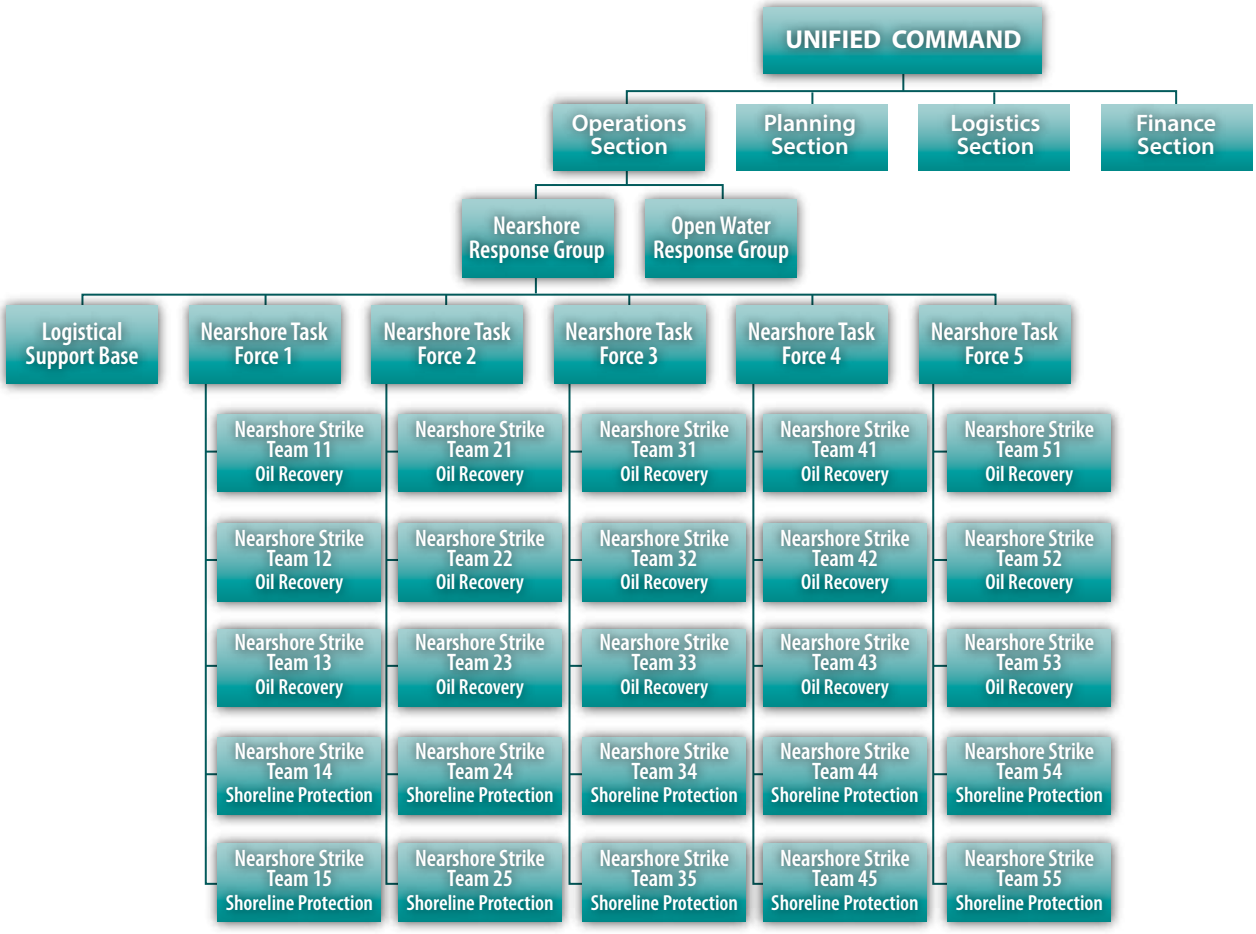

Figure NORS-1. Nearshore Response Group (NRG).

Logistics Support Base

The logistical support for a NRG should include the following functions:

- Forward staging area for assembling NSTF and NSST
- Secondary storage for recovered oil
- Waste management for solid and sanitary wastes
- Supplies and consumables (including fuel) for the NRG
- Berthing and food for personnel not berthed onboard response vessels
- Transportation, storage, and deployment of response assets, such as skimmers, boom, anchor systems, and storage devices
- Decontamination of responders, vessels, and equipment
- Aerial support to detect oil slick and direct resources to the highest priority concentrations

In remote areas, all of these functions will have to be provided by marine vessels without direct support from shore. When practical, these functions could be supplemented from shore, but for planning purposes we assume that only marine-based support will be used.

There are two options for logistical support vessel/barge configuration: a single all-in-one vessel/barge may support the NRG logistics in their entirety, or a series of smaller vessels/barges may provide logistical support responsibilities.

The first type of all-in-one nearshore staging platform has been employed in Prince William Sound by Alyeska Ship Escort and Response Vessel Service and has proven capable of supporting and sustaining nearshore recovery operations. Support services would need to be developed elsewhere.

A second option is the use of several vessels of opportunity to serve as a NRG logistical support fleet. This option would create a more significant logistical burden and would increase the size of the fleet required to support the entire NRG. However, this may be a more realistic option for developing a NRG in remote areas without pre-spill capitalization.

Nearshore Task Force

A NSTF is comprised of up to five NSST tailored to their operational objectives: free-oil recovery or shore line protection. Strike teams are composed of marine vessels used to accomplish group objectives. Free-oil recovery requires vessel platforms to deploy skimmers, tow boom, and manage oil storage devices (e.g mini-barges). Shoreline protection task forces typically transport boom, place anchoring systems and boom arrays, set out passive recovery systems, and recover oil collected by booming tactics.

Figure NORS-2 shows one possible configuration of a NSTF. For planning purposes it is assumed that each task force will have three oil recovery strike teams and two shoreline protection strike teams. (Actual composition will be determined by the circumstances of the spill.) Equipment in the NSTF is generally smaller than equipment used in open water recovery operations. Vessels typically have shallower drafts and are more maneuverable than those used for open water operations. The boom can also be smaller near the shore and therefore easier for smaller vessels to tow.

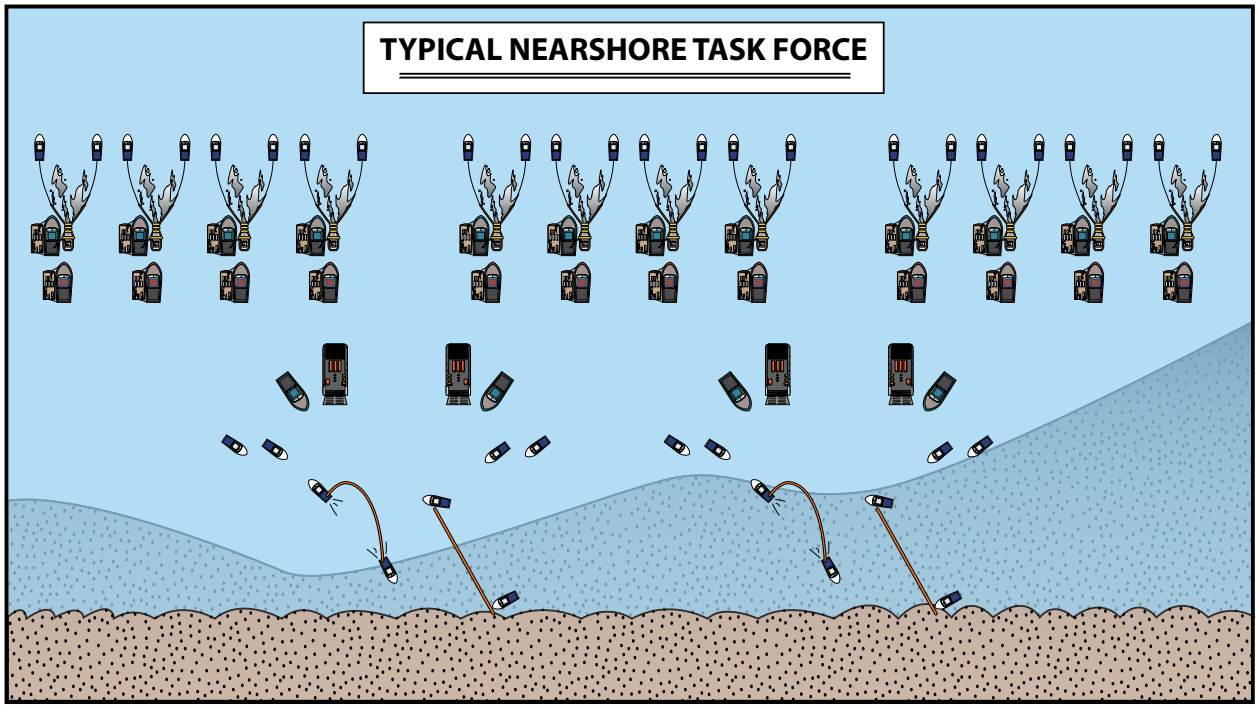

Figure NORS-2. Typical Nearshore Task Force.

Nearshore Strike Team – Free-oil Recovery

Containing and removing free-floating oil from water is central to the NORS strategy. A NSST is designed to find, intercept, contain, and skim oil in to a primary storage device. An oil slick is constantly moving and spreading from the forces of winds and tides. Locating and tracking the slick with aerial support is the first step in the recovery process. Aerial support is covered in the Aerial Observation Supporting Nearshore Operations Tactic in Section B-II of the STAR Manual.

The NSST must be mobile enough to intercept the oil slicks. Vessel speed dictates the area of coverage. Typically vessels are dispatched from the support base, travel to the slick, deploy containment and recovery systems, and commence skimming operations. At the end of the operating period, the strike team must decontaminate and return to the logistics base or other anchorage.

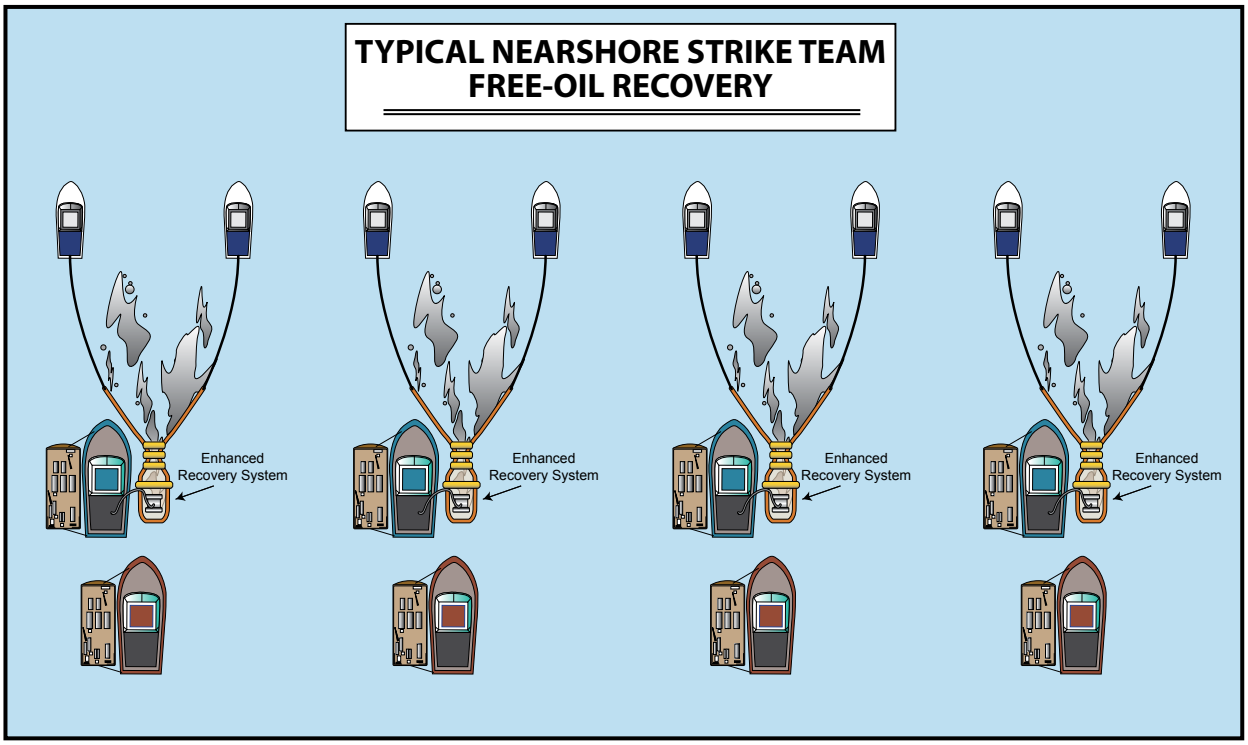

Figure NORS-3. Typical Nearshore Strike Team – Free-oil Recovery.

Recovered oil must be shuttled to secondary storage, which can complicate adequate primary storage capacity at the skimming vessels if distances to the support base are too great.

The best available technology for nearshore free oil recovery uses enhanced recovery devices and high efficiency disc skimmers. The Nearshore Free-oil Recovery Tactic in Section B-III of the STAR Manual provides further details on the tactic and resources required.

A free oil recovery strike team deploys four skimming systems and associated concentration boom or enhanced recovery devices. Depending on the volume recovered, an entire strike team may be tasked with shuttling storage devices between the skimming strike team and the secondary storage vessel.

Nearshore Strike Team – Shoreline Protection

Protecting sensitive areas is a critical element of environmental protection during an oil spill. Not all nearshore sensitive areas can be protected during a spill due to timing and equipment limitations, so sites that can be protected become even more important.

Booming is the primary method to protect sensitive areas. Booming either excludes oil or deflects it away from sensitive sites. Other

methods include Beach Berms, Inlet Dams, Sorbent Barriers, and use Geotextiles to protect beaches. Having equipment in place before oil arrives is the key to successfully protecting these sensitive areas. Once a shoreline protection strike team has deployed boom, that boom must be tended to ensure it maintains the proper configuration as tides and weather change.

A Shoreline Protection NSST, as shown in Figure NORS-4, is composed of up to 10 small vessels and two landing craft. These vessels and crew should be able to transport boom and anchoring systems to the site, deploy anchors and boom arrays, and tend boom. Each strike team should be supplied with up to 5,000 feet of protected water boom, 50 anchor systems, 500 feet of shore-seal boom, and 5,000 feet of snare boom. The Shoreline Protection Tactics in Section B-III of the STAR Manual provides detailed information on the tactics and resource requirements.

Nearshore sensitive area protection may be accomplished by deploying Geographic Response Strategies (GRS) where they have been developed. GRS are site-specific plans to protect environmentally sensitive areas from oil spill impacts, and they have been developed for many of Alaska's coastal areas. More information about GRS can be found at http://dec.alaska.gov/spar/perp/grs/home.htm.

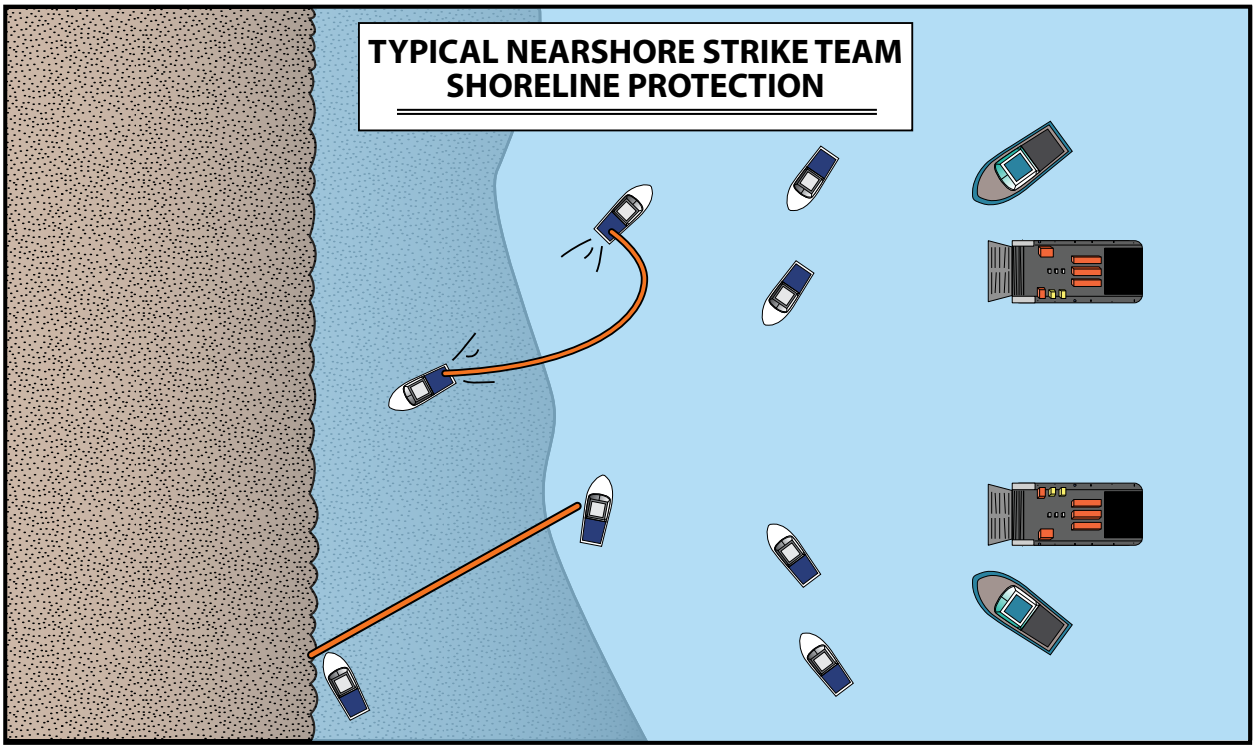

Figure NORS-4. Typical Nearshore Strike Team – Shoreline Protection.

CAPACITY

Defining the capacity of a NRG is challenging, because the group's objective is to protect sensitive resources, not necessarily to maximize oil recovery. However, understanding the capability of a NRG is useful for planning purposes.

Free-oil Recovery – The volume of oil recovered depends on many variables, including: type of oil, environmental conditions, type of response equipment, and the crew's experience and skill. The most important variable is the amount of time oil since the spill, because oil will spread and weather. Considering best available technology and the most favorable assumptions, an oil recovery strike team with three skimmers could recover and transport 4,275 bbl each 12-hour operational period. A NSTF with three such NSST could recover 12,825 bbl and a NSRG with five NSTF could recover 64,125 bbl in this period. It should be stressed that this is the most favorable estimate of capacity; in reality, the amount recovered would likely be far less, especially if oil has spread and weathered. Knowing this, secondary storage for the Logistics Base is assumed to be 50,000 bbl when a NSRG is utilized.

Shoreline Protection – The capacity to implement shoreline protection is also very situation dependent, but a shoreline protection NSST with 12 vessels should be able to deploy and maintain three GRS or the equivalent. Correspondingly, a NSTF with two NSST could implement priority site protection strategies for 6 high priority protection sites and a NRG with five NSTF could protect 30 sites.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

- A NRG will be supported by a marine-based Logistics Base that will allow responders to safely remain in the response area while providing:
  - Command and control
  - Recovered fluid and solid waste transfer and storage
  - Personnel support, berthing, meals, etc.
  - Aircraft, vessel, and equipment maintenance and support
  - Equipment storage

  This Logistics Support Base is further described in the Nearshore Logistics Base Tactic in Section B-VI-2 of the STAR Manual.
- A NRG will be supported by a minimum of one aircraft to provide oil spill tracking and observation for oil recovery strike teams.

  This is further described in the Aerial Observation Supporting Nearshore Operations Tactic in Section B-II of the STAR Manual.

- A NRG is generally intended to operate in seas of less than 3 feet and winds of less than 25 knots, or otherwise as appropriate based on regional variation in conditions. Vessels should be able to transit safely in 6-foot seas and 30-knot winds.
- Vessels assigned to a NRG should be capable of housing and feeding their own crew, but will receive fuel, food, and consumables from the Logistics Support Base.
- The Group Supervisor and Logistics Base personnel will be housed at the support base. The support base should have additional berthing and food capabilities to accommodate all personnel assigned to the NRG.
- There may be impacts to coastal communities due to the influx of responders, a temporary reassignment of community members to the response, and logistical support needs (housing, food, other services) for numerous responders.
- Large quantities of resources may be required to sustain the nearshore response. Regulatory approvals, trans-boundary issues, and financial limitations may impact how quickly resources and equipment can be brought into the response. Pre-planning should facilitate these processes.
- Pre-planning for NORS should be addressed at the Subarea Contingency Plan level.

REFERENCES TO OTHER TACTICS

The NRG will utilize many tactics from other sections of the STAR Manual to accomplish their operational objectives. These tactics include but are not limited to:

- LB Nearshore Response Group Logistics Base
- AO Aerial Observation Supporting Nearshore Operations
- NFO Nearshore Free-oil Recovery
- EX Exclusion Boom
- DF Deflection Boom
- MR Marine Recovery
- SR Shoreside Recovery
- PR Passive Recovery
- MST Marine-based Storage and Transfer of Oily Liquids
- S Staging Area
- TA Towing Alongside
- Dv Vessel Decontamination

VESSEL, EQUIPMENT, AND PERSONNEL REQUIREMENTS

Preparation for nearshore response operations should be undertaken as early as possible. The scope and scale of these operations pose significant logistical challenges and resource burdens, particularly in remote areas.

Successful nearshore response implementation requires sufficient equipment and personnel to perform assigned tasks. NRG staffing will vary depending on the platforms and vessels utilized and can generally be determined by referring to the NORS-specific tactics described below as well as to other applicable tactics within this manual. Table NORS-1 contains the typical vessel, equipment, and personnel requirements for the two types of NSST.

Nearshore Strike Team Requirements

	Free-oil Recovery Strike Team[1]	Shoreline Protection Strike Team
Vessel Platforms	8 - Class 3 or 4 Boom Towing Vessels 4 – Class 2 or 3 Skimmer Tending Vessels 4 – Class 3 or 4 Primary Storage Tending Vessels	10 – Class 3 or 4 Boom Deployment Vessels 2 – Class 2 or 3 Support Vessels (Class 1 or 2 Landing Craft or equivalent)
Containment	4 – Enhanced Recovery Systems	5,000-ft Protected Water Boom 500-ft Shoreseal Boom 5,000-ft Snare Boom 50 ea. Anchor Systems
Skimming	4 – High Efficiency Oleophilic Skimmers (Crucial 13 disc or equivalent)	1 - Small Skimming System
Primary Storage	8 – 249-bbl Primary Storage Devices (mini barges or equivalent towable bladders)	1 – 50-bbl Primary Storage Device
Personnel	1 – Strike Team Leader 16 – Tow Boom Vessel Crew 12 – Skimmer Tending Vessel Crew 8 – Storage Tending Vessel Crew	1 – Strike Team Leader 20 – Tow Boom Vessel Crew 6 – Support Vessel Crew

Nearshore Logistic Base Requirements

	Free-oil Recovery Strike Team[2]
Vessel Platforms	2 or more - Class 1 Berthing Vessels 2 or more – equipment, consumable, solid waste storage vessel/barge
Secondary Recovered Oil Storage	50,000-bbl Oil barge and attendant tug (or equivalent)
Staging Area	Equipment, consumable, solid waste storage capability
Berthing and Feeding Capability	80 Personnel
Personnel	1 – Group Supervisor 30 – Recovered Oil Transfer Crew 15 – Decontamination and Waste Management Crew 8 – Deck Crew 11 – Other Crew

A NSTF with three free-oil recovery strike teams and two shoreline protection strike teams could require up to:

- 96 vessels
- 12 enhanced recovery devices
- 10,000 feet of protected water boom
- 14 skimming systems
- 26 primary storage devices
- 165 trained response personnel

A NRG with five NSTF could require up to:

- 483 vessels
- 60 enhanced recovery devices
- 50,000 feet of protected water boom
- 70 skimming systems
- 130 primary storage devices
- 50,000 bbl secondary storage
- 832 trained response personnel
- 73 support personnel
- Associated consumables and ancillary equipment

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NEARSHORE GROUP LOGISTICS BASE

OBJECTIVE & STRATEGY

LB

The objective of the Nearshore Logistics Base tactic is to support the operations of the Nearshore Response Group (NRG) by providing the following functions:

- Forward staging area for assembling Nearshore Task Forces (NSTF) and Strike Teams (NSST)
- Secondary storage and waste management for recovered oil/emulsion and solid wastes (contaminated or not), and sanitary wastes.
- Providing supplies and consumables (including fuel)
- Accommodations and food for personnel not berthed onboard response vessels
- Transportation, storage, and deployment of response assets, such as skimmers, boom, anchor systems, and storage devices
- Decontamination of responders, vessels, and equipment
- Aerial support to detect oil slick and direct NSST to the highest priority concentrations for recovery.

This tactic describes typical logistic support required for a NRG, based on the Nearshore Free-oil Recovery Tactic and the Nearshore Operations Response Strategy (NORS) concept described in the Nearshore Operations Planning and Implementation tactic.

In remote areas of coastal Alaska, there is little to no infrastructure, and marine-based logistical support will be the only way to support long-term on-water oil recovery operations. Marine-based logistics are challenging and expensive. Land-based operations are simpler and should be considered where shore-based infrastructure is available.

The logistical support base is managed by a Base Manager who reports to the Nearshore Response Group Supervisor in the Operations Section of the Incident Command System. The Base Manager will establish a system to track resources and personnel to ensure an efficient, organized, and safe response. Other response activities that may occur at a NRG staging area are: personnel and equipment tracking, field command center, communications base, emergency medical treatment, security, wildlife treatment, and responder rest areas.

The NRG Supervisor and the Base Manager work together to establish

the scope of operations that occur in the support base. The general process is to:

- Identify the location and trajectory of the spill or potential spill.
- Determine the operational objectives and geographic scope from the Unified Command.
- Select a site for the base that best supports marine and helicopter operations as well as a safe location with a lee and good anchorage bottom in case of severe weather.
- Deploy vessels, equipment, and personnel to the location.
- Set up equipment and begin operations.
- Receive inventory response resources for transfer to the field.
- Receive recovered oil and response wastes for secondary storage.
- Demobilize equipment and prepare for long-term storage.

TACTIC DESCRIPTION

The Logistics Base may utilize either a single large, purpose-built barge (Figure LB-1) or smaller barges or vessels in a "fleet" configuration with each having a specific function (accommodation, secondary storage, etc). These barges/vessels provide a staging platform(s) for oil recovery operations.

General Procedures

The Logistics Base is a location where functional response unit teams are assembled, staged and supported during response operations. Logistics Base operations are established during large, protracted spills involving numerous response and recovery sites, a Rear Supply Area may be established for the entire response effort with Forward Staging

RECOMMENDED SPECIFICATIONS
(approximate)

Length: 400 ft

Beam: 100 ft.

Draft: 20 ft.

Accommodations: 80

Deck Space: Adequate to service up to five NRG Nearshore Task Forces.

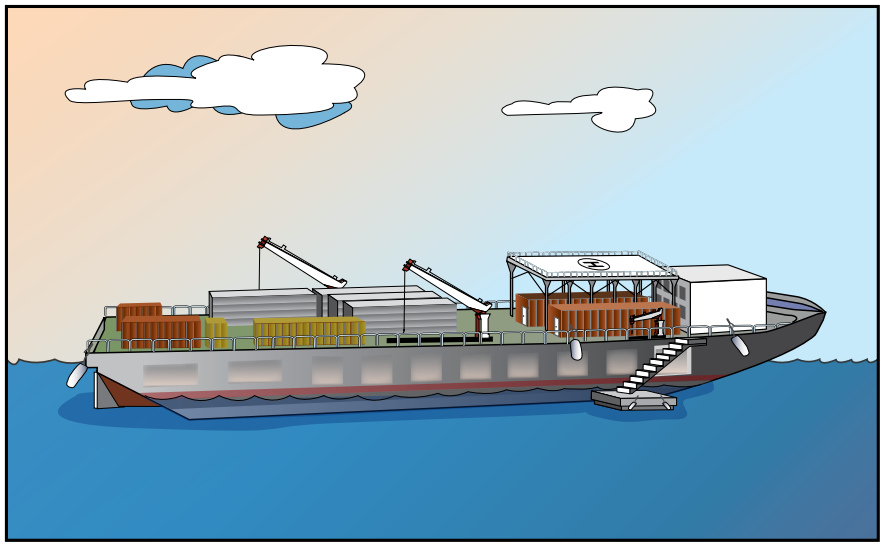

Figure LB-1. Single barge configuration for a Nearshore Logistics Base.

Areas positioned near individual response operations. Every staging area requires a manager and a deputy manager.

Considerations for locating the logistics base include, does the location provide:

- Enough area for maneuvering anticipated equipment,
- Space for receiving, temporary storage, distribution, and deployment of supplies and equipment,
- Space and equipment for maintenance, repair and refurbishment of response equipment,
- Landing pads for helicopters,
- Space and equipment for aircraft, vessel and equipment refueling, replenishment, and maintenance,
- Medical first aid and shelter for responders,
- Space for providing food, water, shelter, and sanitation facilities for responders,,
- Decontamination areas for personnel and equipment,
- Ease and safety for accessing transportation (helicopter, vessels, etc.),
- Close proximity and easy access to the incident site,
- Electrical power, telephone, fax, VHF/UHF radio communications, satellite phone capability, and
- Office space.

A Logistics Base should be established as close to the spill site as safely feasible, but, should always be in the Cold Zone. (See the Site Control and Layout tactic in Part B-I.) Anticipate changes in wind direction and the possibility of increased Hot Zone size when selecting a mooring area for near-shore staging barges/vessels.

Operating Environments

While draft restrictions may preclude Logistics Base barges/vessels from operating in some nearshore areas, they should be capable of operating near the same environments as NRG Task Force elements.

PROTECTED WATER

Vessels, boom, and skimmers for protected water systems should be able to deploy and operate in seas up to 3 feet and in winds up to 25 knots. Vessels deploying, towing, and tending boom should be able to safely transit seas which exceed the boom's operating limitation. Protected water systems are often based on vessels of opportunity, such as fishing vessels, fitted with portable skimmers and primary storage devices. Protected water systems may be deep draft or shallow draft, depending on the water body.

CALM WATER

Calm water systems are composed of vessels, boom, and skimmers that should be able to deploy and operate in one-foot seas and 15 knot winds. Vessels deploying, towing, and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Calm water systems are usually based on small fishing vessels, work boats or skiffs fitted with portable skimmers and primary storage devices. Calm water systems typically work in depths as shallow as 3 feet.

Deployment Configurations

SINGLE-BARGE NEARSHORE STAGING

A single large, multi-purpose nearshore staging barge is the preferred tactical platform for supporting NRG Free-oil Recovery Task Force elements on water. While similar barges are in use for other response functions, this type of barge would have to be specifically built for use by NRG resources. This type of platform serves multiple functions, including:

- Accommodation and messing facilities
- Equipment storage
  - Skimming equipment
  - Boom storage, maintenance and deployment
  - Parts and equipment maintenance/repair
  - Mini-barge storage and support
  - PPE storage and distribution
- Secondary storage for recovered oil
- Decontamination
- Temporary storage for oily solid waste
- Potable water storage
- Helicopter support (Heli-Pad)
- Command center

MULTI-VESSEL NEARSHORE STAGING

Multiple smaller barge/vessel staging areas will require function-specific vessels including:

- Accommodation
- Equipment storage, maintenance and distribution
- Supply
- Helicopter access
- Secondary storage of recovered oil
- Waste management

Vessels that serve single functions are more readily available, come in a wide variety of sizes and configurations, and can sometimes perform multiple functions (i.e. accommodation and staging) depending on the size and type.

Comparison of Logistics Base Options

	Free-oil Recovery Strike Team[1]	Shoreline Protection Strike Team
Vessel Platforms	8 - Class 3 or 4 Boom Towing Vessels 4 – Class 2 or 3 Skimmer Tending Vessels 4 – Class 3 or 4 Primary Storage Tending Vessels	10 – Class 3 or 4 Boom Deployment Vessels 2 – Class 2 or 3 Support Vessels (Class 1 or 2 Landing Craft or equivalent)
Containment	4 – Enhanced Recovery Systems (Current Buster or equivalent)	5,000-ft Protected Water Boom 500-ft Shoreseal Boom 5,000-ft Snare Boom 50 ea. Anchor Systems
Skimming	4 – High Efficiency Oleophilic Skimmers	1 - Small Skimming System
Primary Storage	8 – 249-bbl Primary Storage Devices (mini barges or equivalent towable bladders)	1 – 50-bbl Primary Storage Device
Personnel	1 – Strike Team Leader 16 – Tow Boom Vessel Crew 12 – Skimmer Tending Vessel Crew 8 – Storage Tending Vessel Crew	1 – Strike Team Leader 20 – Tow Boom Vessel Crew 6 – Support Vessel Crew

System	Advantages	Disadvantages
Logistics Base - Single Barge	• Single primary support barge for all nearshore task forces • Smaller support fleet • Support tug crew can be assigned to work on barge	• Long lead time • Must be custom built prior to incident • Expensive • Draft-restricted for nearshore environment
Logistics Base – Multiple Vessels	• Shorter lead time • More readily attainable • Smaller, easier to reposition • Shallow draft	• Larger support tug/vessel fleet required • Portable docking facilities may need to be provided to accommodate smaller task force vessels • Larger overall "footprint" than single barge

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

Safety

- Predetermine potential places of refuge where vessels can take shelter during severe weather.
- Monitor the following hazards to ensure a safe environment:
  - Severe weather,
  - Aircraft, crane, and heavy equipment operations,
  - Slips, trips, and falls,
  - Hypothermia,

- Exposure to contamination and hazardous materials,
- Hearing impairment,
- Respiratory exposure, and
- Eye protection.

- Select PPE based on incident-specific Site Safety Plan.

Deployment

- Consider historical and culturally significant sites, environmentally sensitive areas, and wildlife impacts when choosing a base location.
- Inventory contained in the area should be determined by the NRG Supervisor and must be tracked and maintained to ensure adequate resources for field operations.
- Resources should be ready for deployment when specified by the Operations Section.
- Decks and work areas should be maintained in an orderly fashion.
- Due to the inherent dangers of working on a floating platform, it is imperative that personnel and vehicle traffic patterns are clearly established.

REFERENCES TO OTHER TACTICS

Other tactics associated with NRG Staging Area include:

- PI Nearshore Operations Planning and Implementation
- S Staging Area
- NFO Nearshore Free-oil Recovery
- Dp Personnel Decontamination
- Dv Vessel Decontamination
- SCL Site Control and Layout
- POL Pumping Oily Liquids
- MST Marine-based Storage and Transfer of Oil Liquids
- TA Towing Alongside

EQUIPMENT AND PERSONNEL RESOURCES

This section describes the typical resources needed to support Nearshore Logistics Base operations. Exact quantities will vary based on vessel configurations and other resource needs. Resource requirements are generally designed to support up to five NSTFs as outlined in the Nearshore Operations Planning and Implementation Tactic. This list is not comprehensive as the need for ancillary equipment, supplies, parts, etc. depends on the resources and assets on the barge(s) during any given operation.

Nearshore Logistics Base Resource Requirements

Material Handling and Storage		
Containers, storage (8'x20')	40	Requirements will vary based on equipment needs and available on-deck storage space.
Container, refrigerated (8'x20')	1	Storage of perishables.
Container, frozen (8'x20')	2	Storage of frozen goods. Storage of biological samples, evidence, and other chain-of-custody
Large crane	2	35-ton
Small crane or lifting davits	6	Fixed; articulating. For general cargo handling.
Forklift	2	7-ton to move containers 2-ton for general cargo handling
Portable docking	6	Movable accommodation ladder and floating platform for personnel embarkation/ debarkation.
Rigging	Variable based on platform/ ancillary equipment needs	Lifting bridles/straps, tie-down chain/straps, chain, shackles, thimbles, sling load pennants, cargo nets.
Utilities		
Electric power generation	Variable based on platform/ ancillary equipment needs	Each facility should have integral power generation and lighting.
Hydraulic power	Variable based on platform/ ancillary equipment needs	
Lighting, fixed and temporary	Variable based on platform/ ancillary equipment needs	
Water and sanitary waste systems		Potable, Non-potable, grey, and black water systems. Fittings to connect with modular facilities as required
Secondary Storage and Waste Management		
Secondary storage of recovered oil	50,000 bbl	Tankage certified for oil storage
Oil transfer stations	15 simultaneous	Oil transfer equipment, pumps, hoses, and fitting to transfer oil from primary oil storage to secondary, sufficient to offload at two 249 mini-barge in an hour.
Mixed oily waste and transfer	55 gallon drums	50 drums
Oily solid waste	40x40 lay-down mat	All material to establish oily solid waste lay-down area: 2 rolls - 20' X 100' X 20mm liner 25 ea - 20' X 20' cargo nets 25 ea - Sling load pennants rated for helicopter use
Non-oiled solid waste	20x20 lay-down	Compactor and bagging system
Personnel decontamination stations	25	See personnel decon (Section B-I-4-1)
Vessel decontamination stations	5	See vessel decon (Section B-V-2-1)
Personnel Support		
Berthing[1]	80 personnel	Segregated 3:1 men:women

Nearshore Group Logistics Base

Kitchen[1]	1	Sufficient to serve 80 personnel, 3 times per day.
Shower[1]	16	6 showers/6 sinks ea.
Toilet[1]	8	Segregated 3:1 men:women
Laundry[1]	8-10	Washer and dryer
Medical		
First aid room and supplies	1	
Command and Communications		
Office[1]	2	1 room, 2 desks, 4 lockers; can accommodate 2 beds; satellite capable
Command post facility[1]	1	Conference space for up to 10 people
Computers, laptops	5-7	For NSG Supervisor, Staging Area Manager, Site Safety Officer and admin support staff.
Communications	Adequate communication suite for scale of operation	Should include fixed comms suite for command center/office space as well as adequate hand held radios for staging area personnel. UHF, VHF, SSB, satellite phone and internet.
Personnel		
Near Shore Response Group Supervisor	2	General oversight of NRG. See USCG Incident Management Handbook and/or appropriate C-Plan.
Natural Resource Specialist	1	
Staging Area Manager	2	Oversight of staging area/barge.
Site Safety Officer	2	
Helicopter Pilot/Mechanic	2	With assigned aircraft.
Cook	4	
Electrician	1	
Mechanic/Plumber (vessels)	1	
Mechanic/Tech (Response equipment)	1	
Technician (Computer)	1	
General Technician	20	See Personnel Classifications in Section A, Part II of this manual.
Skilled Technician/Tankerman	25	See Personnel Classifications in Section A, Part II of this manual.
Deckhand	4	Can fulfill other roles when not undertaking primary responsibilities.
Fork Lift Operator	2	Can fulfill other roles when not undertaking primary responsibilities.
Crane Operator	2	Can fulfill other roles when not undertaking primary responsibilities.
Load Master	2	
Medic/EMT	1 (minimum)	
Administrative Support	2	
Fuel		
Aviation fuel and dispensing system	20,000 gallons	Rotary wing fuel requirements variable and highly dependent upon exact type and kind of aircraft selected and projected number of daily flight hours (based on need for 21 day supply). Two 1,000-gallon portable fuel tanks should also be provided for helicopter onshore support.

Diesel and dispensing system	50,000 gallons	Equipment/Vessels
Gasoline and dispensing system	20 drums	Equipment/Vessels
Hydraulic oil and dispensing system	10 drums	Equipment/Vessels
Lubricating oil and dispensing system	30 drums	Equipment/Vessels
Propane and dispensing system	1,000 gallons	Cooking/Forklifts
Coolant/refrigerant	Adequate to replenish/repair on board equipment	
Consumables		
Personnel protective equipment	200 sets	Each set includes: 20 Tyvek suits 40 heavy gloves 100 Nitrile gloves 2 rain suits 1 hard hat 3 safety glasses 50 foam ear plugs
Oil waste bags	500 cases	6 mil, closure system, color coded for waste type.
Sorbents	500 bundles pads 100 bundles boom	
Line	Variable based on platform/ ancillary equipment needs	Inventory should include adequate supplies of nylon, polypropylene, and natural fiber line in various sizes. Line types should include three-strand and double-braid nylon. Knives, fids, duct tape, paper tape and other splicing supplies should also be stocked.
Cooking supplies	Adequate for type size of kitchen facility	Pots, pans, utensils. May not require separate acquisition if provided with modular kitchen facility, trash bags.
Food[2]	Adequate for feeding 80 people three meals daily	
Office supplies	Adequate for 5-7	Paper, pens, pencils, notepads, file folders, staplers, staples, staple pullers, dry erase boards/markers/erasers, etc. waste receptacles, trash bags.
Paper/plastic goods	Adequate for 80 personnel for 21 days	Includes, plates, cups, flatware, paper towels (for food service and shower/toilet facilities). Modular kitchen facilities may have reusable items.
Linens/sleeping bags/pillows	Adequate for 80 personnel for 21 days	
Cleansers	Adequate for platform needs	Includes kitchen, living, and sanitary space use. Requires both standard and heavy duty cleansers for personal use.

[1]All modular facilities listed are standard ISO 9001:2008 8' x 20' containers. Need for specific units would be based on available barge specifications.

[2]The US Dept. of Agriculture estimates that the average person in the United States eats 0.5 lbs of meat, 1.6 lbs of dairy products, 0.2 lbs of fats and oils, 0.8 lbs of fruits, 0.7 lbs. of vegetables, 0.5 lbs of grains, and 0.4 lbs of sugars per day for a total of 4.7 lbs of food per day.

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A. GLOSSARY

Anchor Systems:

Large Anchor System – A large anchor system cannot be deployed by hand, thus requires the use of a crane or boom to lift and deploy. Typically, any anchor over 50 pounds is considered a large anchor.

Small Anchor System – A small anchor system can be deployed by hand, without the aid of a boom or crane. Typically, any anchor less than 50 pounds is consider a small anchor.

Application Rate – Refers to the volume of sprayed product divided by the surface area covered by the spray and is usually expressed in liters/hectare or gallons/acre.

Branch – ICS organizational level based on functional or geographic responsibility. A Branch is below a Section and above a Division or Group in an ICS organization chart.

Broken Ice – An operating environment where a body of water has incomplete coverage of ice. Broken ice varies from less than 10% coverage to greater than 90% coverage. Oil spill response operations in broken ice are generally limited to less than 70% coverage.

Buddy System – An arrangement in which persons are paired for mutual safety or assistance.

Calm Water – An operating environment where the sea state is usually less that 1 foot and currents are less than 0.8 knots. Includes waters that are very sheltered from wind and waves or very small bodies of water. This is the least demanding operating environment for water borne oil spills.

Cold Zone – A zone in the site layout of a spill response. The Cold Zone is also called the Support Zone and is free of oil contamination. Support facilities, staging areas, warm-up trailers, command posts, etc. are located in the Cold Zone.

Competent Person – An individual with the skill, knowledge, practical experience and training to enable him/her to assess the risks arising from work activities involving substances hazardous to health.

Coverage Rate – Refers to the surface area covered by the spray divided by the length of time required to spray it. It is usually expressed in hectares/hour or acres/hour.

Decant – To remove free-water from an oil/water mixture by drawing the water off the bottom of the oil/water interface.

Decontamination Plan – A plan approved by the Unified Command for the removal of oil contamination from personnel and equipment.

Demobilization Plan – A plan approved by the Unified Command for the orderly and timely demobilization of resources no longer needed in the oil spill response.

Division – ICS organizational level based responsibility for a defined geographic area or function. A Division is usually assigned to a specific area, such as the Gulf of Alaska Division or the Yukon River Division. A Division is below a Branch and above a Task Force or Strike Team.

Dispersant – A chemical formulation containing surface active agents (surfactants) that lowers the surface tension between oil and water and facilitates the breakup and dispersion of oil into the water column in the form of finely divided droplets to allow for natural biodegradation.

Emulsification – A process by which oil forms an emulsion or "mousse" consisting of many small droplets of water incorporated into the oil.

Encounter Rate – For dispersant applications, refers to the area of oil that can be sprayed in a specific time. This can be calculated as the ship or aircraft spraying speed multiplied by the width of the spray deposits on the surface. For mechanical recovery applications, it is area of oil that is contained in a specific time. This is calculated as the width of the boom opening times the speed of advance.

Environmental Unit – ICS organizational category that is part of the Planning Section. The Environmental Unit is responsible for: the identification and prioritization of environmentally sensitive areas to be protected; wildlife response; acquiring permits for dispersant, in-situ burning, and land access; and shoreline assessments.

Fast Water – An operating environment where the sea state is usually less that 1 foot but the current exceeds 0.8 knots. Fast Water includes rivers, streams and marine waters with moderate to strong tidal currents.

Flash point – The temperature at which a liquid gives off sufficient vapor to ignite in the presence of an open flame.

Geographic Response Strategy (GRS) - GRS are site-specific spill response methods used to protect sensitive coastal environments from the deleterious effects of petroleum or other hazardous substance spills. GRS provide first responders with specific guidance for a rapid deployment of pre-identified actions to protect priority sensitive sites.

Geotextile – A manufactured fabric material, usually woven from Polyester or Polypropylene, used in earth construction projects. Geotextile is oleophilic and will act as a passive recovery material, while allowing water to pass through the fabric. Geotextile can be used to protect a shoreline or soil from oil contamination at oil recovery locations.

Group – ICS organizational level-based responsibility for a particular function, such as Non-mechanical Operations Group, Wildlife Recovery Group, or Shoreline Protection Group. A Group is below a Branch and above a Task Force or Strike Team.

Hot Zone – A zone in the site layout of a spill response. The Hot Zone is also called the Exclusion Zone and is where oil contamination is found. The Hot Zone perimeter is established by the Safety Officer. Site safety assessment and site entry criteria are applied to the Hot Zone in order to prevent the spread of contamination, and to ensure the health and safety of responders and the public.

Incident Commander – The individual responsible for the management of all incident operations.

Intermediate Storage – Secondary or tertiary storage for oil, recovered liquids, and oily solid wastes collected from a recovery operation. Storage devices that receive wastes from primary storage or other intermediate storage devices, such as a rigid tank that is filled from a vacuum truck or a tank truck filled from a portable tank.

Marsh – A wetland operating environment that is considered sensitive to disturbance from oil spill response activities. Marshes are low-lying, waterlogged land that are poorly drained and difficult to cross on foot or vehicle. Care must be take in oil spill operations to minimize the disturbance of marshes and prevent introducing oil below the surface.

Mousse – An emulsified mixture of water in oil. Mousse typically has a thick consistency compared with fresh oil, and can incorporate up to 75 percent water into the oil, increasing apparent oil volume by up to four times. Colours can range from red, orange or tan to dark brown. Mousse can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp. See also emulsification.

Nearshore – An operating environment generally accepted to be the area extending from the baseline seaward to 3 nautical miles, which is also the extent of State waters. Water depth is generally less than 33 feet (10 meters).

Nearshore (shallow) – Nearshore waters between 6 ft. and 33 ft.

Nearshore (deep) – Nearshore waters in excess of 33 ft.

Open Water – An operating environment where the sea state can reach 6 feet and moderate waves and white caps may occur. Includes open waters that are not sheltered from wind and waves. This is the most demanding operating environment for water borne oil spills.

Operations Section – ICS organizational category responsible for all operations directly applicable to the primary mission of the incident.

Operations Section Chief – The individual responsible for executing all field operations approved by the Unified Command. The Operation Section Chief reports directly to the Incident Commander.

Payload – Refers to the total amount of dispersant carried by the aircraft or ship.

Preapproval – The state of being accepted for use as a spill treatment agent in a particular location without further bureaucratic authorization procedures under the conditions set forth by the responsible authorities.

Preauthorization – Same as preapproval.

Primary Storage – The initial storage for oil, recovered liquids, and oily solid wastes collected directly from a recovery operation. The initial storage once the oil, oily liquid, or oily solid waste is picked-up, such as a mini-barge associated with a skimming vessel or a portable tank associated with a shore-side recovery tactic.

Protected Water – An operating environment where the sea state can reach 3 feet and small waves and white caps may occur. Protected Waters have limited shelter from wind and waves. Protected Water falls between Open Water and Calm Water in the classification scheme.

Safety Officer – A member of the Command Staff responsible for monitoring and assessing safety hazards or unsafe situations, and for developing measures to ensure personnel safety.

Sheen – A very thin layer of oil (less than 0.003 millimeters in thickness) floating on the water surface. Sheen is the most commonly-observed form of oil during the later stages of a spill. Depending on thickness, sheens range in color from dull brown for the thickest sheens to rainbows, grays, silvers, and near-transparency in the case of the thinnest sheens. Natural sheens can result from biological processes.

Site Safety Plan – A plan prepared by the Safety Officer and approved by the Unified Command that establishes safety procedures and practices for the incident.

Slick – Oil spilled on the water, which absorbs energy and dampens out surface waves, making the oil appear smoother (or slicker) than the surrounding water.

Solid Ice – An operating environment where a body of water has complete coverage of ice. Spill response activities may occur on Solid Ice only after it is determined that the ice is of sufficient thickness to safely support response personnel and equipment.

Sortie – Refers to each dispersant application run.

Spreading – The thinning out of an oil slick onto the surface of water.

Staging Area – Location where incident personnel and equipment are available for tactical deployment. Can serve as a check-in location for equipment and personnel reporting to the incident.

Staging Area Manager – The individual responsible for overseeing and managing the Staging Area. The Staging Area Manager reports to the Operations Section Chief.

Streamers – A narrow line of oil, mousse, or sheen surrounded on both sides by clean water. Streamers result from the combined effects of wind, currents, and/or natural convergence zones. Heavier concentrations are often present in the centre, with progressively lighter sheen along the edges. Streamers are also often called "fingers", "ribbons", or "windrows".

Strike Team – An ICS operations team that consists of the same kind and type of resources with common communication and leader.

Supervisor – The individual responsible for the command of a Division or Group.

Tar ball – Oil weathered into a pliable ball up to approximately 30 cm. Sheen may or may not be present.

Task Force – A group of resources with common communications and a leader assembled for a specific mission.

Tundra – An operating environment that is considered sensitive to disturbance from oil spill response activities. Tundra has permanently frozen subsoil. Tundra is often waterlogged land that is poorly drained and difficult to cross on foot or vehicle. Care must be take in oil spill operations to minimize the disturbance of tundra that can cause melting of the subsurface ice and permanent damage to the ecosystem.

Unified Command – A command team that allows all parties responsible for the incident to manage the incident by establishing a common set of objectives and strategies. This is accomplished without relinquishing agency responsibility, authority, or accountability. The Unified Command is comprised of the Responsible Party Incident Commander, Federal On-Scene Coordinator, and State On-Scene Coordinator and may also include a Local On-Scene Coordinator.

Unified Plan – The State/Federal contingency plan for Alaska, officially titled Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan).

Warm Zone – A zone in the site layout of a spill response. The Warm Zone is also called the Contamination Reduction Zone and is where decontamination activities occur. The Warm Zone allows for an orderly transition from the Hot Zone to the Cold Zone. Workers shed contaminated clothing and equipment and personnel are decontaminated in the Warm Zone.

Waste Management Plan – A plan approved by the Unified Command that establishes waste management practices and procedures for the incident.

Waste Management Specialist – An individual with the skill, knowledge, practical experience and training to enable him/her to assess the character of a waste or hazardous material and determine the proper handling and disposal methods.

Weathering – The chemical and physical changes that occur once oil has spilled, including spreading, evaporation, dissolution, photo-oxidation, dispersion, biodegradation, and emulsification.

Windrows – Oil or sheen oriented in lines or streaks in the direction of the wind. Windrows typically form early during a spill when the wind speed is at least 10 knots (5.1 meters per second). Sheen is the form of spilled oil that most frequently windrows.

B. ACRONYMS & ABBREVIATIONS

ACC	Alaska Chadux Corporation
ACS	Alaska Clean Seas
ADDS	Airborne Dispersant Delivery System
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AIMS	Alaska Incident Management System
APSC	Alyeska Pipeline Service Company
ARRT	Alaska Regional Response Team
ASTM	American Society for Testing and Materials
ATV	All Terrain Vehicle
BAOAC	BONN Agreement Oil Appearance Code
BAT	Best Available Technology
BPXA	BP Exploration Alaska
CISPRI	Cook Inlet Spill Prevention and Response Inc.
CPAI	ConocoPhillips Alaska Inc.
CPC	Chemical Protective Clothing
C-Plan	Contingency Plan
DOC	US Department of Commerce
DOI	US Department of the Interior
DOR	Dispersant-to-oil ratio
DT	Discharge Tracking
EPA	US Environmental Protection Agency
FC	Field Command
FLIR	Forward Looking Infrared
FO	Free Oil
FOSC	Federal On-Scene Coordinator
FRP	Facility Response Plan
GIS	Geographic Information System
GRD	Geographic Resources Database
GPS	Global Positioning System
GRS	Geographic Response Strategy
GT	Gross Ton
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air (filter)
HP	Horsepower
H2S	Hydrogen Sulfide Gas
IAP	Incident Action Plan
IC	Incident Commander
ICS	Incident Command System
IMT	Incident Management Team
IPIECA	International Petroleum Industry Environmental Conservation Association
IPEC	Integrated Petroleum Environmental Consortium
IR	Infrared
ISB	In-situ Burning
LEL	Lower Explosive Limit
LOSC	Local On-Scene Coordinator
MSDS	Material Safety Data Sheet
NAVSUPSALV	Navy Supervisor of Salvage
NCP	National Contingency Plan

NFO	Nearshore Free-oil
NMFS	National Marine Fisheries Service, US Department of Commerce
NOAA	National Oceanic and Atmospheric Administration, US Department of Commerce
NORS	Nearshore Operations Response Strategy
NRG	Nearshore Response Group
NSTF	Nearshore Task Group
NTV	Non-tank Vessel
OSHA	Occupational Safety and Health Administation
OSRO	Oil Spill Response Organization
OV	Organic Vapor
PFD	Personal Flotation Device
PID	Photo Ionization Detection
PPE	Personal Protection Equipment
PPOR	Potential Places of Refuge/Place of Refuge
PRAC	Primary Response Action Contractor
RP	Responsible Party
RPS	Response Planning Standard
SAM	Staging Area Manager
SAR	Search and Rescue
SCBA	Self-Contained Breathing Aparatus
SEAPRO	Southeast Alaska Petroleum Resource Organization
SERVS	Ship Escort Response Vessel System
SLAR	Side-Looking Airborne Radar
SMART	Special Monitoring of Applied Response Technologies
SOSC	State On-Scene Coordinator
SPCC	Spill Prevention Control and Countermeasures Plan
SSC	Scientific Support Coordinator
STAR	Spill Tactics for Alaska Responders
UC	Unified Command
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
UV	Ultra-Violet
VRP	Vessel Response Plan

C. ESTIMATING AMOUNT OF SPILLED OIL

SPILL VOLUME ESTIMATION

Oil in or on Soils

- It is difficult to estimate the amount and extent of subsurface pollution from hydrocarbons spilled and trapped in soil.
- Hydrocarbons in soil may exist in three phases:
  - As vapors within the pore spaces
  - As residual liquid attached to or trapped between soil particles
  - As dissolved components of oil in moisture surrounding soil particles
- Generally, oil retention increases with: decreasing grain size, poorer sorting of soils, and increasing oil viscosity.
- Oil retention of initially water-saturated soils is generally lower than initially dry soils.
- The "retention capacity" factor for different types of soils provides an estimate of volume of liquid retained per unit pore volume. The following are rules of thumb for retention capacity of soil types:

	Silt	Sand	Gravel
Crude Oil & Other Persistent Oils	12% - 20%	4% - 13%	0% - 5%
Diesel	7% - 12%	2% - 8%	0% - 2%
Gasoline	3% - 7%	1% - 5%	0% - 1%

Oil on Ice and Snow

- Field experience and data from actual spills indicate that oil-holding capacities of ice and snow range as high as 1,600 barrels per acre.
- Equations for estimates:

  $V\ (bbl) = (4.14 \times 10^{5}) \times A\ (mi^2) \times t\ (in.)$

  $V\ (bbl) = 647 \times A\ (acres) \times t\ (in)$

  $V\ (bbl) = (1.48 \times 10^{-2}) \times A\ (ft^2) \times t\ (in.)$

  $V\ (gal) = 42 \times V\ (bbl)$

  V = Volume of oil spill

  A = Area of oil slick or contaminated zone

  t = Thickness of oil slick or contaminated zone (with snow, t = equivalent oil thickness)

Oil on Water

- Oil Color – The BONN Agreement Oil Appearance Code (BAOAC) Oil Layer Thickness Estimates:

CODE	Description	Layer Thickness Interval (μm)	Litres per Km^2
1	Sheen (silvery/grey)	0.04 - 0.30	40 - 300
2	Rainbow	0.30 - 5.0	300 - 5,000
3	Metallic	5.0 - 50	5,000 - 50,000
4	Discontinuous true oil colour	50 - 300	50,000 - 200,000
5	Continuous true oil colour	More than 200	More than 200,000

- Equations for estimates:

  $V\ (bbl) = 4.14 \times 10^5\ A\ (mi^2) \times t\ (inches)$

  $V\ (bbl) = 647\ A\ (acres) \times t\ (inches)$

  $V\ (bbl) = 1.48 \times 10^{-2}\ A\ (ft^2) \times t\ (inches)$

  $V\ (gal) = 0.624\ A\ (ft^2) \times t\ (inches)$

  V = Volume of oil spill

  A = Area of slick at thickness t

  t = Thickness of oil slick

Encounter Rate Calculations

- Calculations used to estimate the amount of oil moving past in a stream, entering a collection boom, or in a windrow/patch of oil.

  $EnR\ (gpm) = 37 \times W\ (ft) \times V\ (ft/sec) \times t\ (in)$

  $EnR\ (bbl/hr) = 53.33 \times W\ (ft) \times V\ (ft/sec) \times t\ (in)$

  $EnR\ (bbl/day) = (1.28 \times 10^3) \times W\ (ft) \times V\ (ft/sec) \times t\ (in)$

  W = Width of oil swath

  V = Velocity in feet per second (1 knot = 1.68 ft/sec)

  t = Thickness of oil slick

ESTIMATING SPILL SOURCE VOLUMES AND FLOW RATES

Leak Rate Calculations

One drop/second = 1 gallon per day

Thin stream breaking to drops = 24 gallons per day

Small stream (about 1/8 inch) = 84 gallons per day

Large stream (about 1/4 inch) = 936 gallons per day

A simple rule of thumb is to divide 10,000 by the number of seconds it takes to fill a five-gallon pail.

Estimates for Capacity

- Pipeline per linear foot
  - For volume in gallons per foot: square the inside diameter (in inches) and multiply by 4 percent (0.04)
  - For volume in barrels per foot: square the inside diameter (in inches) and divide by 1,000
  - To find the volume of a pipeline in barrels per mile: square the inside diameter (in inches) and multiply by 5.13
- For vertical cylindrical tanks:

  V (gal) = 0.0034 d (in.) x d (in.) x h (in.)

  V (gal) = 5.88 D (ft) x D (ft) x H (ft)

  d = diameter in inches

  D = diameter in feet

  h = height of liquid in inches

  H = height of liquid in feet

NOTES:

The National Oceanic and Atmospheric Administration publishes an observer's guide that contains more information on estimating oil spill volumes.

Information in this Appendix was taken from the Alaska Clean Seas Technical Manual Vol. 1, and the BONN Agreement Oil Appearance Code (BAOAC).

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D. LEGEND OF ICONS USED ON MOST ALASKA GRS MAPS

STRATEGY ICONS

The following symbols are used in Geographic Response Strategies in Alaska.

- Paved Road
- Improved Gravel Road
- Un-improved Gravel Road
- ATV Trail
- Hiking Trail
- Bridge
- Landing Strip
- Small Gravel Strip
- Helicopter Landing Zone
- Staging Area
- Dock
- PPOR Dock/Pier
- Boat Ramp
- PPOR Boat Harbor
- USGS Navigation Light Marker
- Direction True North
- Restricted Access, contact Unified Command before entering
- Buildings
- Cabin
- Camping
- Water Depths, fathoms & tenths
- Rocks Awash at Low Tide
- Eddy
- Eagles Nest
- Seal Haulout
- Reef
- Mariculture Pens
- Marsh
- Sand Bar
- Salmon Spawning Stream
- Nesting
- Keeper Beach
- Seabird Colony
- Exclusion Zone
- Snare Boom
- Sorbent Boom
- Tidal-seal Boom
- Calm-water Boom
- Protected-water Boom
- Protected-water Boom/Flood Tide
- Open-water Boom
- Open-water Boom/ Flood Tide
- Fast-water Boom
- Dam
- Gate
- Anchor
- Skimmer
- Equipment
- Mooring
- PPOR Mooring Site
- Crane
- Bears in Area, guards needed

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