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Still - some really good stuff to review on inland oil spills in waterways.

Oil Spill Response

Inland Operations Field Guide

An operational guide to the containment and recovery of oil spills

in the inland environment

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Disclaimer

This Field Guide has been developed as a guide to provide an overview of responding to oil spills in the inland environment. It is intended to act solely as a guidance document and the advice given should be incorporated into company philosophy for oil spill response operations alongside suitable training and exercises to ensure safe and appropriate operations. Whilst every effort has been made to provide accurate and complete information, no responsibility can be accepted for loss or damage, howsoever caused, as a result of actions taken based on the contents of this Field Guide.

Foreword

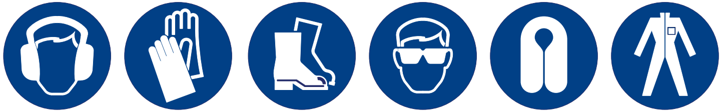
This short Field Guide is intended to be used by anyone seeking an overview of the strategic and technical aspects of oil spill response within the inland environment. Included is information on the key steps to inland response, how to prepare for inland operations, and the optimal response techniques for the containment and recovery of oil in different inland environments.

Inland operations require a good knowledge of the environment in and around where the oil spill has occured. To ensure a successful response, it is important to:

- Adhere to advice on health and safety aspects of oil spill response.
- Prepare and train for predicted risks.
- Choose and implement the response strategies most suitable to the environment.
- Ensure communication is effective amongst all parties, from Incident Managers to Oil Spill Responders.

Contents

Safety



If inland equipment and techniques are used correctly, good operational procedures are followed and the correct use of Personal Protective Equipment (PPE) adhered to, operations should pose a minimum risk to health. However, there are, as with other such activities, potential risks to the health and safety of responders and the public.

These risks can be minimised by:

- Identifying the risks through a comprehensive risk assessment process and implementing mitigation measures to reduce them where applicable.
- Communicating the risks and mitigation measures in place through a safety brief prior to any operations being carried out.

Minimum PPE standards:

- Overalls
- Oil resistant suit (such as Tyvek)
- Life jacket (If operating near water)
- Safety glasses
- Gloves
- Ear defenders (to be worn whilst machinery is running)
- Steel toe cap boots

RISKS	IMPACTS	MITIGATION MEASURES
Noise (>85dBA).	Danger of damage to hearing if exposed to loud machinery for prolonged periods of time.	Ear defenders to be provided and worn. Exclusion of non-essential staff from a zone around the noise source. Move the source away from the working area. Explore alternative machinery / methods
Exposure to Volatile Organic Compounds (VOCs) and potentially Hydrogen Sulphide (H_2S) from the oil.	Could cause nausea and in the case of H_2S death in extreme cases. Presence of hydrocarbon vapours may also present an explosion risk.	Enforce a site entry protocol. Provide gas monitoring devices and appropriate respiratory PPE as required.
Slips, trips and falls.	Potential for minor injuries such as cuts, bruises or minor fractures.	Dangers should be highlighted in the safety brief given prior to operations commencing. Appropriate footwear to be worn. Recognise high risks of working on or around oily surfaces. Ensure a secure access route to work area.
Dangerous wildlife.	Potential for bites, poisoning or contracting disease leading to loss of limbs, illness or death.	Refer to local knowledge. Appoint a lookout and communicate the risks. Ensure that an emergency plan is in place.
Small boats operating in water.	Possible injury from propeller when handling towing lines.	Ensure that boat operators are trained. Keep the propeller pointing away from the boom. Engine kill cord to be worn whilst operating the boat.
Manual handling.	Potential for back injuries.	Before any deployment manual handling training should be given to anyone involved in the deployment. Ensure that weights are clearly marked on equipment. Make sure that lifting equipment is available and employ group lifts where appropriate.
Water/currents.	Potential for falling and drowning.	Site safety survey to be conducted and communicated. Ensure awareness of currents. No lone working near water bodies.
Hydraulic hose failure.	Potential injury to eyes, skin penetration of hydraulic oil.	Ensure that equipment deployed has adequate maintenance schedule which has been adhered to. Conduct a visual inspection before use.
Dermatitis skin contamination.	Developing dermatitis from skin contact with recovered oil.	Wear gloves/barrier cream and PPE to cover the skin. Ensure type of PPE is suited to oil type, likely exposure and environmental conditions.
Hypothermia/Heatstroke	Can lead to fatigue, confusion, loss of consciousness, and if left untreated, death.	Take regular breaks during working periods in shaded areas or shelters. Wear appropriate clothing for the response environment. Keep hydrated and regulate core temperature.

Whilst this table lists some of the common hazards that are likely to be present whilst conducting inland operations, a full site specific risk assessment should always be conducted prior to operations commencing.

Key Steps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Plan and Train
!
Spill
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Preparation
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Contain the Oil
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Recover the Oil
5
Manage the Oil
6
Record and Report

Plan and Train

To ensure the maximum success of inland operations, key assets and personnel should be identified and/or trained prior to any incident occurring.

Planning and Local Engagement

In the event of an oil spill incident within the inland environment, there will be many competing demands from different parties to prioritise their area of interest.

It is recommended that prior to any incident occurring, consultation with the different parties occurs to determine priority areas for protection or clean up operations using the principle of Net Environmental Benefit Analysis (NEBA). The consultation should involve:

- Local authorities
- Local environmental groups
- Community Representatives
- Other stakeholders

Open and clear communication is an integral part of response operations.

Inland Operations Supervisor

Roles and Responsibilities:

- Ensure the health and safety of those involved in the clean up operations and the general public.
- Conduct asssessments and provide recommendations on the suitable treatment methods for the site.
- Ensure the successful deployment, set up and operation of equipment.
- Ensure the environmental impacts of any inland operations are minimised.
- Supervise and assist the deployment of inland booming and damming. Record and report to Incident Command on the activities of the inland site.

Training and Knowledge

- Health and safety aspects of inland operations.
- Set up and operation of inland equipment and techniques.
- Inland response strategies and tactics.
- Understanding the information that Incident Command will require.
- Supervisor training
- Environmental impacts.

A basic course could be run covering the roles and responsibilities of the Inland Operations Supervisor.

Plan and Train: Net Environmental Benefit Analysis

NEBA is a qualitative comparative analysis technique that aims to decrease the overall effect of oil on environmental and economic resources whilst achieving an acceptable standard of clean-up, ensuring the response strategy will provide an overall benefit to the environment. It is important to conduct a preliminary NEBA during the evaluation process in contingency planning. When assessing the inland environment, the following should be considered:

1. DEFINE THE GEOGRAPHICAL AREA

- Outline location and type(s) of substrate.
- What is the approximate area of each substrate?
- Identify the sediment type (small grained sand, soil, large rocks)
- What is the topography - identify water courses, water table levels, spill migration paths etc.
- What are the seasonal weather conditions?
- How exposed is the area - is there shelter from weather?

2. IDENTIFY ENVIRONMENTAL SENSITIVITIES

- What biota is present - is it a seasonal presence?
- Where are the individual species located?
- Rank biota in terms of ecological sensitivity to the chemical and physical presence of oil.
- Identify biota susceptible to damage
- What is the duration of exposure?
- Are there any 'protected species' in the vicinity?

3. IDENTIFY SOCIO-ECONOMIC SENSITIVITIES

- What activities are present - are they seasonal?
- Are the activities reliant on the area for resources and/or access?
- Are there sites of historical or cultural significance in the vicinity?
- How will the activities be affected by a potential oil spill?
- What is the duration of exposure?
- Are there any 'protected sites' in the vicinity i.e. drinking water resources?

! The above should be summarised and mapped onto a 'Inland Sensitivity Map' that helps identify and prioritise the sensitive resources of the area.

4. IDENTIFY STAKEHOLDERS

- Who uses the area?
- Are there any local authorities present?
- Which environmental groups would be involved?
- Identify political and technical stakeholders.
- Who represents the local communities and businesses?

5. OBTAIN BACKGROUND DATA

- Does the area have a spill history?
- Is there any pre-spill data available, so the site can be bought back to (as close to) pre-spill conditions?
- Are there previous signs of ecological and socioeconomic effects of oil?
- Have response strategies previously been used in the area? To what effect and efficiency did they work?

6. PREDICT POSSIBLE OUTCOMES

- Previous experience from spills or experiments can help predict possible outcomes in a new situation.
- Using spill history and background data, predict the likely environmental outcome if a proposed response strategy is used or if the area is left for natural clean-up. e.g. what would be the impact of removing all oiled vegetation.

7. WEIGH THE ADVANTAGES AND DISADVANTAGES OF RESPONSE

- Inland spills tend to take longer to naturally remediate without the flushing effects of tides.
- If case history shows a good natural cleaning capacity, it may be wise to leave the area to recover naturally with minimal intervention
- Response may be necessary if:
  - ! Oil can be a threat to wildlife.
  - ! Bulk oil is present and may spread and contaminate a wider area.
  - ! Natural cleaning time is unacceptably long for the main stakeholders.

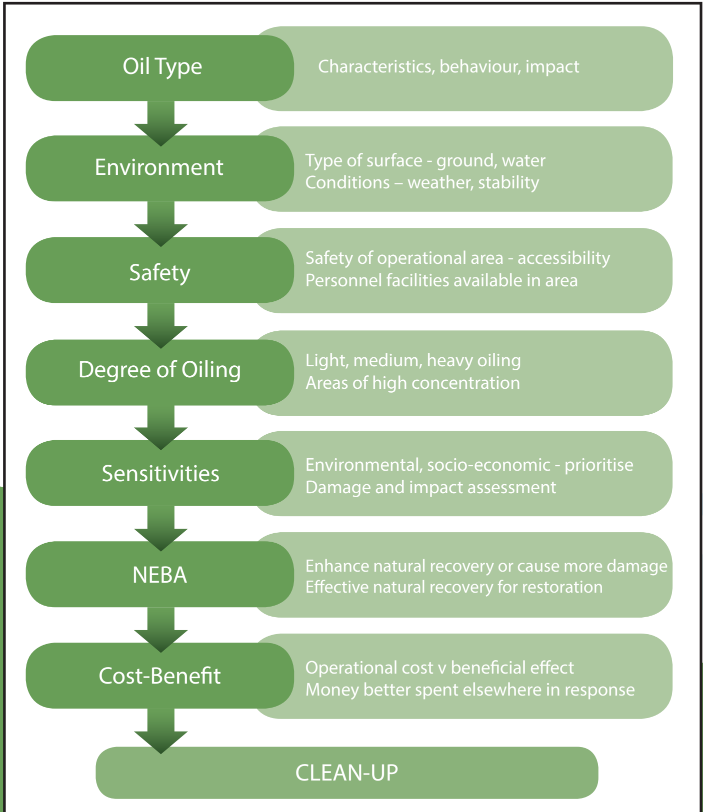
8. IDENTIFY POTENTIAL RESPONSE STRATEGIES

- The advantages and disadvantages of different responses techniques should be compared with each other, as well as natural recovery.
- In the event of a spill, the response option decisions can then be taken on the basis of sound scientific and technical assessment of the environmental benefits and impacts of response intervention.

! Response options should be reviewed and fine-tuned throughout the response period as information about the distribution and degree of oiling is updated.

Preparation: Chosing a Response Strategy

There are many different factors that will affect the decision in choosing the most appropriate response strategy for inland environments. In order to conduct successful response operations, these factors need to be understood and taken into consideration from the outset.



Stages of Response

A staged approach to clean up ensures efficiency of the response and helps to reduce the amount of waste.

Stage One

This should focus on the removal of gross contamination. Debris and solid waste should be removed and segregated on-site. Methods to conduct this include the use of manual efforts and/or mechanical means.

Stage Two

This stage should focus on the removal of moderate contamination. Any trapped or stranded oil and materials should be removed. Oil will permeate through the surface sediment into the subsurface. Low pressure flushing can remobilise oil whilst methods to remove it can be through manual means.

Stage Three

This is the last stage of clean up; a final polish of the area, removing light contaminated materials and oil stains. If the oil has permeated into the soil, it is highly recommended that at this stage contaminated land expertise is sought to assist.

Preparation: Organise Operations

Establishing effective methods of communication for containment, protection and recovery operations can greatly enhance the success of the response.

Communications Plan

In order to ensure effective communications it is important to produce a communications plan which will document:

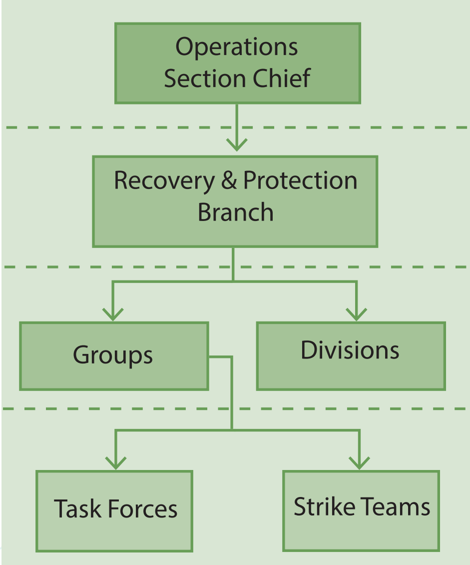
- A communications protocol for operational communication.
- Who to call in the event of an emergency.
- Names of assets deployed, call signs and frequencies they are operating on.

Span of Control

To ensure the safety and success of any inland response, it is important that personnel involved in the operations are adequately supervised. The Incident Command System (ICS) recommends a finite 'span of control' of 5-7 direct reports to ensure correct levels of supervision.

Command and Control Organisation

Inland clean-up and protection operations will be managed by the Operations Section. Inland operations can be structured as follows dependant on the size of the response operation:



The Operations Section Chief is responsible for managing all operations directly applicable to the primary mission.

Branches can be either geographic or functional, responsible for overseeing and implementing activities.

Groups are responsible for deployment activities in designated locations/divisions used to seperate geographic areas.

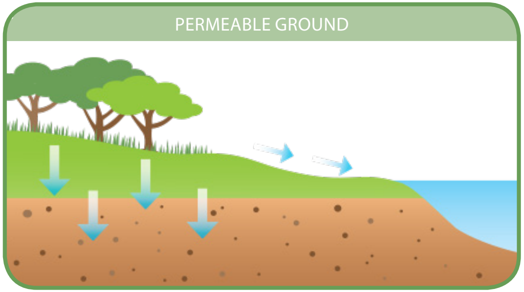
If inland operations occur over a large area, further dividing Groups into Task Forces or Strike Teams will help maintain span of control.

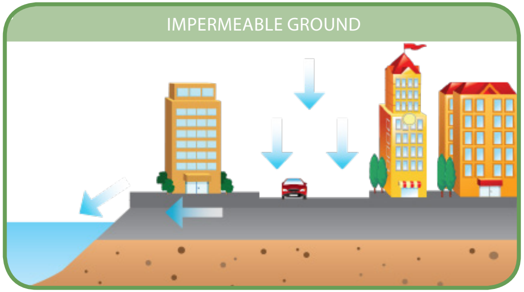
More information regarding the Incident Command System can be found in the Incident Management Handbook (IMH).

Preparation: Understanding Inland Environments - Ground

An inland spill can occur in a number of different environments. The type of environment will influence the most appropriate technique to be used within your response strategy, whilst the fate of oil will be influenced by many situational and local factors. The response can be complicated due to geophysical and environmental factors that can affect the oil spill's behaviour.

Determine inland environment type:	GROUND	
	PERMEABLE GROUND	IMPERMEABLE GROUND
Understand oil behaviour:	Oil on permeable ground will flow in both horizontal and vertical directions. Penetration of ground will depend on the oil type and the porosity and permeability of the surface materials.	Oil on impermeable ground will either remain relatively static on the terrain or follow the path of least resistance if a slope is present. It is likely to collect in depressions and watercourses.
Identify resources at risk:	Examples of resources needing protection include: ✓ Non-vegetated: mud/silt; sand; pebble/boulders. ✓ Vegetated: grassland; forest; wetland.	Examples of resources needing protection include: ✓ Drainage systems ✓ Watercourses ✓ Utilities
Response Considerations:	• Penetration of soil below the uppermost layer must be minimised. • Prevent oil from entering areas with ground water. • Drains and inlets should be blocked.	• Oil should be contained as soon as possible. • Any flowing oil should be intercepted quickly to prevent further contamination of the surface. • Drains and inlets should be blocked.





Preparation: Understanding Inland Environments - Water

It is important to understand the different water environments in which inland spills can occur, along with the factors which can affect the oil's behaviour.

Determine inland environment type:

INLAND WATER

	STATIC WATER	MOVING WATER
Understand oil behaviour:	Oil on static water will float, spreading to form a thin surface layer. Water is rarely truly "static", with wind-induced waves causing spilled oil to drift.	Oil can be rapidly transported by moving water, following the direction of both wind and tide currents. The oil generally spreads to form a thin surface layer and will also be subjected to significant weathering processes.
Identify resources at risk:	Examples of resources needing protection include: ✓ Ponds ✓ Lakes ✓ Resevoirs	Examples of resources needing protection include: ✓ Rivers ✓ Water intakes ✓ Streams ✓ Fishing areas
Response Considerations:	• Prevent oil from spreading beyond the water body and contaminating further surfaces. • Consider impact of oil moving into vegetated areas such, as reed beds. This will act to trap oil making it more difficult to recover.	• Oil should be contained as soon as possible and collected. • Intercept oil flowing downstream to prevent further contamination, whilst protecting resources at risk.

STATIC WATER

MOVING WATER

Contain the Oil: Oil on Permeable Ground

Permeable ground poses challenges to the containment of oil as it flows in both a horizontal and vertical direction and will travel with the direction of groundwater flow once it is reached.

1. Response Priorities

When responding to spills on permeable surfaces, it is important to minimise the amount of oil that can penetrate below the surface; this may require the oil to be spread over a large surface area in the attempt to reduce head pressure on the surface to prevent penetration. This may well be the preferable option compared to long-term operations of subsoil and groundwater clean-up.

Prevent penetration of oil and further contamination sub-surface

BUNDED AREAS

- Introduce a water bottom under the oil to reduce penetration.
- Block all inlets except to oily water drains.
- Dig trenches to intercept the oil.

UNBUNDED AREAS

- Block all inlets.
- Try to increase the spread of oil on the surface to prevent deep infiltration of the oil on or over saturated spots.
- Pump out collected free oil as quickly as possible.
- Increase the sorption capacity of surface layers by spreading sorbents e.g. minerals, chemicals, sawdust, peat.

Recover oil and undertake appropriate clean-up action

2. Oil Retention Capacities in Permeable Surfaces

Each type of permeable surface will allow oil to permeate at different rates and will retain oil at varying capacities. Although the pore spaces in coarser soils are larger, oil will flow through more readily (due to gravity) thus giving a lower retention capacity.

Finely packed sediments retain the oil in two ways; firstly the oil molecules cannot pass so easily between the particles due to their size and secondly because the forces associated with capillary action hold the oil in the pore spaces.

Surface area is also a factor in retention capacities; small grain sediments have a higher surface area and therefore hold more oil on the surface of the grains than larger grained sediments.

SURFACE TYPE	CAPACITY (ltrs/m^3)
Stones / Coarse Gravel	5
Gravel / Coarse Sand	8
Coarse Sand / Medium Sand	15
Medium Sand / Fine Sand	25
Fine Sand / Silt	40

SUBSURFACE AND GROUNDWATER INFILTRATION

Groundwater movement is very slow, usually between 0.5 m and 1.5 m per day. If oil reaches below subsurface layers, there is time to study the underlying hydrogeology and identify the most optimal location for the recovery of oil. Different recovery methods can then be put in place, preventing both the further spread of the oil and flushing from the groundwater system. It is worth noting that typically, groundwater flow follows in the direction of the topography, however, this is not always the case.

Contain the Oil: Oil on Impermeable Ground

Oil will remain static on impermeable ground until it is recovered, unless a gradient is present that may cause it to spread.

1. Response Priorities

If oil spills on impermeable ground, the response should first prevent the oil from further spreading and potentially contaminating other surface areas. Once contained, the oil will then need to be recovered through either manual or mechanical methods.

Prevent spread of oil and further contamination of the surface area

BUNDED AREAS

- Ensure all oil is contained within the bunded area.
- Block all inlets except to oily water drains.
- Consider adding a water bottom to protect against any breaches in the bund floor.

UNBUNDED AREAS

- Construct a bund around the oil spill using resources available such as water filled boomsm soils and snow.
- Use sorbents as a means of controlling any secondary contamination.
- Concentrate the oil so that it can be collected into containers.
- Pump out collected free oil as quickly as possible.

Recover oil and undertake appropriate clean-up action

2. Oil Spilled in Urban Areas

Urban and built up areas will contain a vast amount of man-made surface areas sitting alongside natural environments. These man-made surface areas will often be impermeable in nature, so prevention of spread and containment remains the main priority, however, urban areas also pose a significant health and safety risk.

Urban areas are likely to feature intricate drainage and sewage systems, pipe and cable ducts, and ventilation ducts for rail or road tunnels. It is therefore important to prevent the spread of oil to these highly sensitive areas where there is a risk of either contamination with sewage treatment plants and/or watercourses by:

- Using dams formed from soil, sand bags or sorbents to protect inlets.
- Seal drain gratings with plastic bags filled with water and sand.

Oil and the associated fumes can also be highly volatile. As the vapours are heavier than air, it will gather in underground lines, wells and troughs. This leads to an increased explosion risk, therefore, it is essential to minimise the potential of ignition, ensuring that:

- Traffic is stopped and other ignition sources are extinguished.
- Any affected system operators such as utilities, telephone, railways and tunnels are informed.

Contain the Oil: Oil on Water

Inland water bodies can either be static, such as ponds or lakes, or moving, such as a river. Oil is likely to spread on the surface and where subject to wind and current, can also drift moving down or across the water body. Whilst containment takes place, it is important to maintain any water flow.

1. Oil on Static Water

On larger areas of static water, boom can be used to contain the floating oil. The water bodies can be subject to wind-induced wave action, causing the oil to drift, therefore making it necessary to prioritise the containment to prevent further spreading. Where lakes etc. are fed and drained by watercourses, their inlets and outlets need to be protected, methods described in oil on moving water can be utilised.

Contain oil slick on the surface of the static water

CHANNEL < 2m WIDE

Use the appropriate type of dam to block water courses to prevent further spread and collect oil.

CHANNEL > 2m WIDE

Use booms to block water courses to prevent further spread and collect oil.

Recover oil and undertake appropriate clean-up action

2. Oil on Moving Water

As over 60% of inland oil spills occur in rivers with currents in excess of 0.5 metres per second, various techniques and equipment, including booms and dams, have been developed to suit the relevant environmental conditions. In currents faster than 1 metre per second, it is advisable to use techniques that allows water to flow freely subsurface whilst containing the oil solely on the surface of the water, such as a spade, wooden plate or even a sand bag dam.

Control oil movement using booms to direct oil towards collection areas

Contain oil slick on the surface of the moving water using booms and dams

CURRENT < 0.5 m/s^{-1}

Use booms and dams to collect oil and contain it on the water's surface.

CURRENT > 0.5m/s^{-1}

Use the appropriate type of dam to collect oil and contain it on the water's surface. Booms can also be used with consideration given to length.

Recover oil and undertake appropriate clean-up action

Contain the Oil: Oil on Water - Booming Techniques

Booms can be used to direct the flow of oil, limit any further spread and then contain it on the water's surface ready for recovery. Different techniques can be employed depending on the quantity of oil spilled and the surrounding operational and environmental conditions, such as the width of the channel and the presence of meanders.

1. CHOOSE AN ACCESSIBLE AREA ON THE RIVERBANK TO CARRY OUT RECOVERY

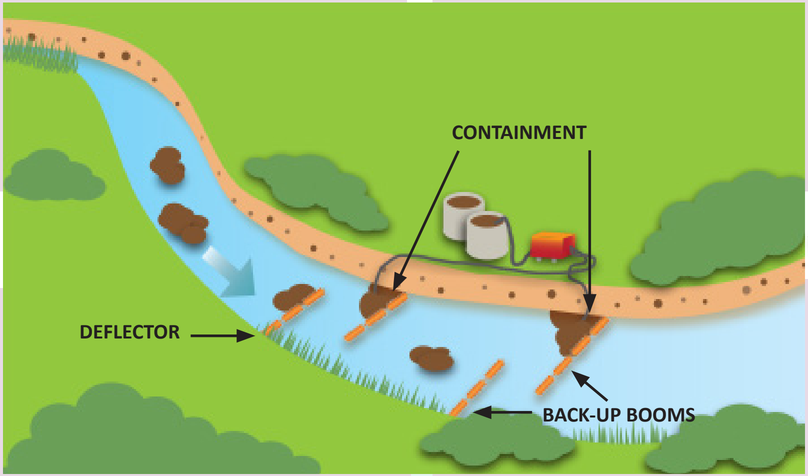
- Position collection areas where there are natural collection points, or where water movement is slowest, such as the inside of the river bend, or where access allows.
- Ensure there is safe access for personnel and vehicles, including temporary storage areas and access.

2. IDENTIFY AND ANTICIPATE OPERATIONAL AND ENVIRONMENTAL CONDITIONS

- Estimate river speed and plan to deploy boom out at the correct angle.

Do not exceed the maximum angle for the current. See Graph in Fast Water Booming section.

- Use weather forecasts to predict future conditions.



CONDUCT RECOVERY

PLAN BOOM DEPLOYMENT

3. PREPARE EQUIPMENT

- Draw out booming plans.
- Lay out booms ready to deploy upstream of the planned position.
- In currents of more than 1 m/s^{-1}, shorter lengths of booms should be used to provide more anchor points at the connections.
- Identify anchorage points in the river or on the banks.

Prepare boom ancillaries and moorings.

4. DEPLOY BOOMS AND ANCILLARY EQUIPMENT

- Deploy booms to deflect oil from the fast side to the slow side of the river and into the collection areas.
- Deploy booms to deflect oil from the fast side to the slow side of the river and into the collection areas.
- Deploy backup deflector and containment booms to ensure all oil is collected.

Ensure distance between booms are sufficient to allow for oil resurfacing.

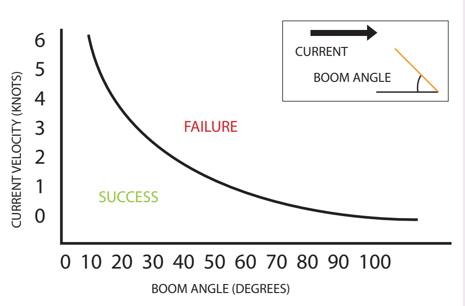
Contain the Oil: Oil on Water - Fast Water Booming

Deploying boom in a fast water environment can be difficult to execute effectively. Different techniques and booming strategies can be employed to ensure the spilled oil is successfully contained in challenging environmental conditions.

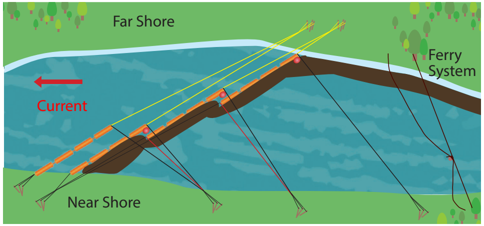
Deploying Booms in Fast Moving Water

Fast moving water can cause booms to fail by placing too much stress on the boom causing anchor points to break. If the current is flowing fast enough, such as in the case of flood waters, there is a risk that the boom will break. To prevent failure, booms should always be secured to ropes with less breaking strain.

In addition, the angle at which the boom is deployed can help improve the success of boom operations. As the velocity of the current increases, the angle of the boom should decrease. Boom deployment will be most successful when deployed in low current speeds at an angle of 70 to 90 degrees.

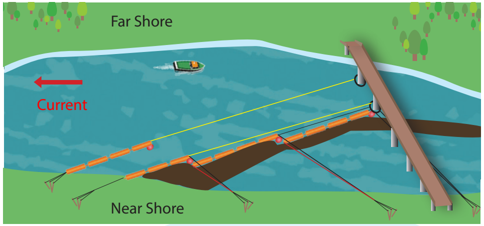


Bank to Bank Booming



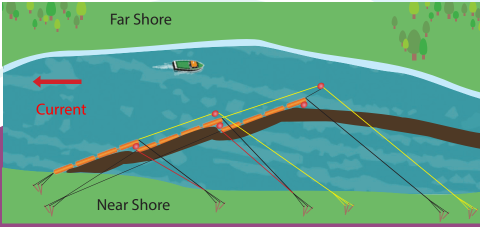
The booms are prepared and layed out on the near shore bank. All booms are connected by lines to the near shore anchor point. Diagonal control lines (black) are prepared and connected to near shore anchor points determined by the position of the booms on the bank. Pull lines (yellow) are transferred to the far shore bank using the static line and ferry system. The pull lines are secured to anchor points on the far shore bank and the booms pulled out. The boom is positioned using the diagonal control lines and tensioned. A safety line (red) is connected to the back of each boom section to prevent the current forcing it into the adjacent section.

Bank to Bridge Booming



The booms are prepared and layed out on the near shore bank. All booms are connected by lines to the near shore anchor point. Diagonal control lines (black) are prepared and connected to near shore anchor points determined by the position of the booms on the bank. A floating collar and pulley system is positioned around the supporting member of the bridge in use. Pull lines (yellow) are connected to the floating collar pulley system and transferred to the anchor point on the near shore. The boom is positioned using the diagonal control lines and tensioned. A safety line (red) is connected to the back of each boom section to prevent the current forcing it into the adjacent section.

Bank to Buoy Booming



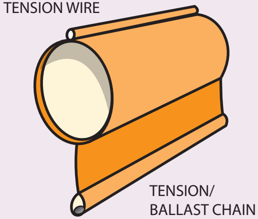
The booms are prepared and layed out on the near shore bank. All booms are connected by lines to the near shore anchor point. Diagonal control lines (black) are prepared and connected to near shore anchor points determined by the position of the booms on the bank. Bouys are layed in position determined by the boom angle current speed graph and anchored in place. Pull lines (yellow) are connected to the bouys using a pulley system and transferred to the anchor point on the near shore. The boom is positioned using the diagonal control lines and tensioned. A safety line (red) is connected to the back of each boom section to prevent the current forcing it into the adjacent section.

Contain the Oil: Oil on Water - Boom Types

FAST WATER BOOM

Boom filled with solid foam in the flotation chamber with added tension member and tension chain at the bottom of the skirt.

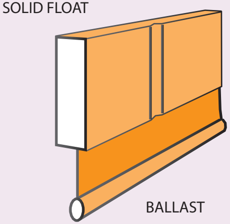
- ✓ Good water movement characteristics.
- ✓ High buoyancy reserve.
- ✗ Requries significant storage space



RIGID/FENCE BOOM

Boom filled with solid material in the flotation chamber and ballast at the bottom of the boom skirt.

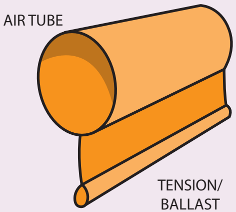
- ✓ Quick to deploy.
- ✓ Functions well in calm conditions.
- ✓ Functions well in mangrove areas.
- ✗ Requires significant storage space.
- ✗ Less effective water movement characteristics than inflation boom.



INFLATION CURTAIN BOOM

Chamber filled with air. Ballast at the bottom of the skirt.

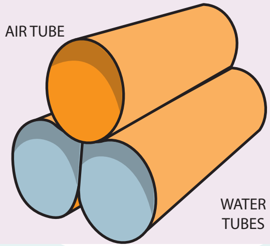
- ✓ Good water movement characteristics.
- ✓ Are deflated for storage therefore require less storage space.
- ✗ Additional ancillaries are required (air fan to fill air chamber).



SHORE SEALING BOOM

Chamber filled with air. Ballast at the bottom of the skirt.

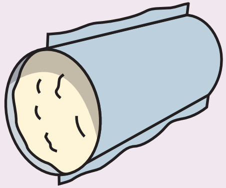
- ✓ Forms an effective barrier in intertidal areas.
- ✓ Are deflated for storage therefore require less storage space.
- ✗ Ancillaries are required (water pump to fill water chambers, air fan to fill air chamber.



SORBENT BOOM

Chamber filled with absorbent material, may sometimes have a small skirt although this is not common.

- ✓ Useful for small spills.
- ✓ Can be used with other types of boom.
- ✗ Contributes to the generation of waste, use should be controlled.



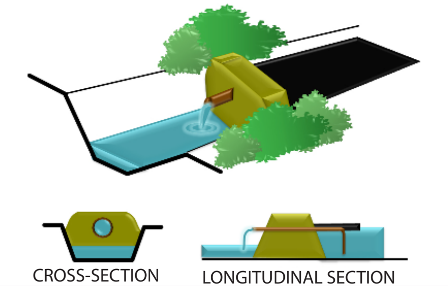
! These booms can be used for protection, deflection and oil containment. The method of deployment will be dependent upon the purpose of the boom.

Contain the Oil: Oil on Water - Damming Techniques

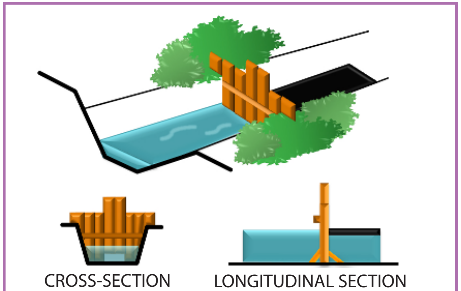
If oil escapes into a water course, a dam may need to be constructed to contain the oil and prevent it from flowing further downstream and contaminating the surrounding area. It is important to maintain a water flow through the dam in order to avoid having a negative impact on the ecosystem downstream. Dams can be used in both narrow waterways and water courses with steep sides.

Different Dam Types

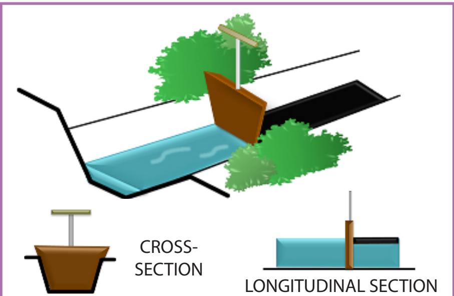
There are two basic types of dams; those which allow water flow to continue and those which seal it off.



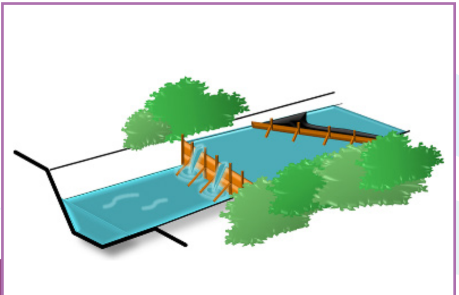
SAND BAG DAM WITH WATER DISCHARGE



WOODEN PLATE DAM



SIMPLE SPADE DAM



WEIR AND BARRIER DAM

DO

- Raise water level to assist recovery of the oil.
- Slow water flow at the surface to allow the oil to gather. Maintain river flow from close to the bottom of the stream.
- In sandbag dams, use pipes to maintain flow. An 'elbow' in the pipe can be used (or install the pipe at a gradient) to ensure that water flow is maintained from beneath the surface.
- Ensure a good seal with the bank.
- Ensure access for recovery equipment/ storage.

AVOID

- Excessive flooding by maintaining adequate flow past the dam.
- With sandbag and soil dams, avoid scouring of the river bed undermining the dam.
- Low banks which could cause flooding and spreading of oil.
- Damming channel or streams over 2 metres wide.
- Stopping the flow altogether.

Recover the Oil: Clean-Up Methods

A range of response strategies are available to the inland responder, dependent on resources accessibility. Each strategy will require a level of expertise, coordination and is likely to generate waste. These factors should also be considered when deciding on the most appropriate clean-up method to use.

NATURAL RECOVERY

In some areas, it may be less environmentally damaging to allow the area to recover naturally. Natural recovery is a slow process, however, it may be the only course of action from a safety and operational perspective.

USE OF WATER

Flooding can cause the oil to float on the water, this allows it to be recovered later by pumps and skimmers. Flushing can be used to remobilise the oil from the soil and/or wash it from the surface. Both techniques should be used carefully, and containment boom in place to prevent further spread.

MANUAL CLEAN UP

Manual recovery is a labour intensive strategy that utilises large numbers of people collecting stranded oil with the necessary tools; shovels etc.

SORBENTS

Sorbents, made of oleophilic materials; natural (straw) and synthetic (polypropene), can be introduced to the area to selectively absorb the oil whilst repelling water.

MECHANICAL RECOVERY

Oil can be removed from the surface using a multitude of machinery, including (specialist) pumps and vacuum equipment, scrapers, graders and oil skimmers.

IN-SITU BURN

In-situ burning may be considered when physical recovery is not feasible. It is best used in remote areas, especially where roots are protected by high water levels. Some environments may recover from burning more readily than if left oiled without treatment.

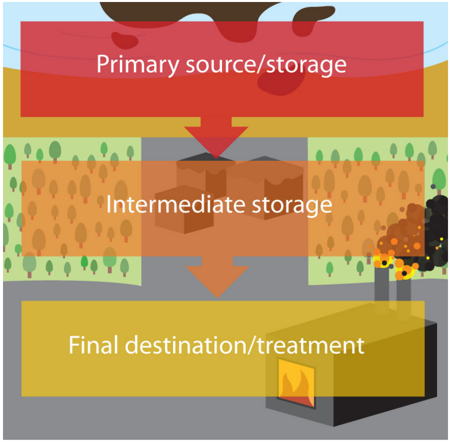
Manage the Oil: Storage of Oil and Waste

During and after the response, the collected oil and associated waste must be segregated and stored, ensuring that temporary storage sites meet the required regulations.

Storage

Adequate storage facilities must be put in place during the early stages of a response. Primary and intermediate storage should allow oil to be removed from the spill site, and act as temporary 'buffers' in the waste disposal stream before the oil is eventually transported to its final disposal. Temporary storage beyond 48hrs may require a waste management licence, so it is important to ensure there is a robust waste management stream in place to collect the oiled waste from site.

- Liquid oil should be separated from soil, sand, vegetation, plastics and sorbents.
- Waste should be classified, labelled and segregated to minimise the volume of disposable waste produced.
- Likely waste products include: recovered liquid waste, oiled sediments, oiled PPE and oiled debris.



Temporary Storage Options

Careful consideration must be given when selecting temporary storage locations for all types of storage, including but not limited to; access, egress, environmental, security, location from watercourse.

STORAGE PITS

Typically, a pit is dug with excavation equipment and lined with plastic sheeting.

- ✔ Easily constructed with available resources
- ✔ Ability to hold large quantities of waste
- ✘ Risk of overflow
- ✘ Ground water dependant
- ✘ Difficult to cover from the elements

ABOVE GROUND STORAGE TANKS

Open top containers with plastic linings.

- ✔ Portable and easily assembled
- ✔ Re-useable and durable
- ✘ Limited on capacity
- ✘ Needs level ground

Manage the Oil: Transportation and Disposal of Oil and Waste

During and after the response, the stored waste must be transported and disposed of appropriately ensuring that the methods used meet the required regulations.

Transportation

From the storage facilities, waste has to be transported to final disposal. To reduce the transport volumes of waste, it is best to try to separate the oil and water at the spill site. Vacuum trucks and tank trucks can be used to transport oil and water waste to final disposal areas whilst transportation by barge is an option for large waterways when access could be an issue.

- Ensure the shipment for transporting contaminated waste meets requirements and regulations.
- Ensure that any vehicles are decontaminated after use and prior to exiting the spill hot zone to prevent secondary contamination.

Final Disposal

Final disposal of waste will depend on the properties, consistency and degree of contamination of the materials which make up the waste (plus regulatory framework and available disposal facilities). It may be possible to recycle some of the oil, however, much of the solid waste will require treatment. Liquid waste can undergo various physical processes to separate oil from water. Solid oiling waste will need to be cleaned or, as a last resort, referred to landfill.

- Any disposal method for the contaminated waste must meet local requirements and regulations.

Record and Report

The recording and reporting procedures for inland environments will vary by the type of environment in which the spill has occured. However, below are some key points which should be considered:

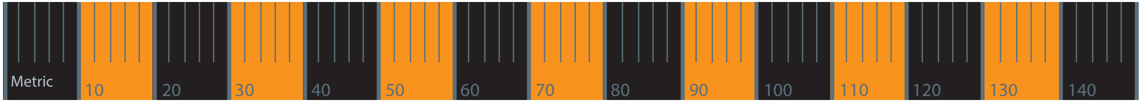
1. FOR INLAND SURVEYS RECORD AND REPORT:

- Time, date and location of survey
- Composition of the substrate
- Features of the area (suitable access locations etc.)
- The area profile
- The extent of the surface oiling (if present)
- The extent of the subsurface oil (if present)
- The presence of any sensitivities (either environmental, socio-economic or cultural)

2. FOR INLAND CLEAN UP OPERATIONS RECORD AND REPORT:

- The amount of waste recovered
- Any specific health and safety risks regarding the area or type of operation
- Any health and safety incidences

See the 'Shoreline Operations Field Guide' for more information on recording and reporting.



CONVERSION TABLE

VOLUME		
1 US Oil Barrel	42 US Gallons	159 Litres
1 US Oil Barrel	35 Gallons (Imp)	
1 Gallon (Imp)	1.2 US Gallons	4.546 Litres
1 US Gallon	0.833 Gallons (Imp)	3.785 Litres
1 Cubic Metre	1000 Litres	6.29 US Oil Barrels
1 Litre	0.26 US Gallons	0.03531 Cubic Feet
1 Cubic Yard	0.765 Cubic Metres	
1 Cubic Foot	0.0283 Cubic Metres	
1 Cubic Decimetre	0.001 Cubic Metres	1 Litre
1 Met Tonne	7.33 US Oil Barrels	257 Gallons (Imp)
AREA		
1 Acre	0.405 Hectares	4050 Square Metres
1 Hectare	10,000 Square Metres	2.471 Acres
1 Square Kilometre	100 Hectares	247 Acres
1 Square Metre	1.196 Square Yards	
1 Square Yard	0.836 Square Metres	9 Square Feet
1 Square Foot	0.093 Square Metres	
1 Square Mile	2.59 Square Kilometres	640 Acres
LENGTH/DISTANCE		
1 Kilometre	0.54 Nautical Miles	0.622 Miles
1 Nautical Mile	1.852 Kilometres	1.151 Miles
1 Mile	1.609 Kilometres	1760 Yards
1 Metre	1.094 Yards	3.282 Feet
1 Yard	0.914 Metres	
1 Foot	0.305 Metres	
1 Inch	25.4 Millimetres	

SPEED		
1 Knot	1.85 km/Hour	0.51 Metres/Second
1 Metre/Second	3.6 km/Hour	1.94 Knots
MASS		
1 Metric Tonne	1000 Kilogrammes	0.984 Tons
1 Ton (Imp)	20 Hundredweight	1016.05 Tonnes
1 Hundredweight	50.8 Kilograms	112 lbs
1 Kilogramme	2.205 lbs	1 Litre of Water
1 Gramme	0.025 ounces	
FLOW		
1 Cubic Metre/Hour	16.7 Litres/Minute	3.671 Gallons (Imp) /Minute
1 Litre/Second	2.119 Cubic Feet/Minute	13.21 Gallons (Imp)/Minute
1 Cubic Foot/Minute	0.1039 Gallons (Imp)/Second	0.472 Litres/Second
1 US Gallon/Minute	0.0631 Litres/Second	
1 Gallon (Imp)/Minute	0.0767 Litres/Second	0.5825 Gallons (Imp)/Minute
1 Barrel/Hour	2.65 Litres/Minute	
1 US Gallon/Acre	9.354 Litres/Hectare	
1 Gallon (Imp)/Acre	11.224 Litres/Hectare	
PRESSURE		
1 Psi	0.069 Bar	6901 Pascal
1 Bar	100,000 Pascal	14.49 Psi
1 Bar	30 Feet of Water	
ENGINE POWER		
1 Horsepower	0.7457 Kilowatts	

TEMPERATURE

F to C - deduct 32, multiply by 5, divide 9. C to F - mulitply 9, divide 5, add 32

Celcius	0	10	20	30	40	50	60	70	80	90	100
Farenheit	32	50	68	86	104	122	140	158	176	194	212