IPIECA

International Association of Oil & Gas Producers

A guide to oiled shoreline assessment (SCAT) surveys

Good practice guidelines for incident management and emergency response personnel

IPIECA

The global oil and gas industry association for environmental and social issues

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Preface

This publication is part of the IPIECA-IOGP Good Practice Guide Series which summarizes current views on good practice for a range of oil spill preparedness and response topics. The series aims to help align industry practices and activities, inform stakeholders, and serve as a communication tool to promote awareness and education.

The series updates and replaces the well-established IPIECA 'Oil Spill Report Series' published between 1990 and 2008. It covers topics that are broadly applicable both to exploration and production, as well as shipping and transportation activities.

The revisions are being undertaken by the IOGP-IPIECA Oil Spill Response Joint Industry Project (JIP). The JIP was established in 2011 to implement learning opportunities in respect of oil spill preparedness and response following the April 2010 well control incident in the Gulf of Mexico.

The original IPIECA Report Series will be progressively withdrawn upon publication of the various titles in this new Good Practice Guide Series during 2014–2015.

Note on good practice

'Good practice' in the context of the JIP is a statement of internationally-recognized guidelines, practices and procedures that will enable the oil and gas industry to deliver acceptable health, safety and environmental performance.

Good practice for a particular subject will change over time in the light of advances in technology, practical experience and scientific understanding, as well as changes in the political and social environment.

Contents

How to use this guide

Oiled shoreline assessment surveys—also known as Shoreline Clean-up Assessment Technique (SCAT) surveys—are a critical component of a response operation. The information gathered by the survey teams is used by the response managers to set objectives, priorities, constraints and end points, all of which are essential in supporting the planning, decision making and implementation of an effective shoreline response programme.

This guide explains why an oiled shoreline assessment programme is an important element of a response, and outlines the benefits of systematic surveys. In addition, the guide explains why and how an effective shoreline assessment programme supports the planning, decision making and implementation process for a shoreline response, and how the key components of shoreline surveys are integrated into the data generation, decision making, and implementation and closure stages of a shoreline response programme.

The key elements of the survey process are also outlined with respect to the types of information that are collected and the purpose for which they are used by decision makers. The manner in which the data are collected is described, and a checklist is provided as a guide to the specific field and management activities within an oiled shoreline assessment programme. It should be noted, however, that this report is intended to be a guide rather than a field manual. The guide explains the important concept of shoreline segments and segmentation as a method for conducting systematic surveys and managing the data and information that is generated. Examples of the types of recommendations, maps and tables that are produced as part of the data management process illustrate how the field data are used in a shoreline response programme.

What is a shoreline assessment survey?

Despite the best intentions of an on-water response to an oil spill at sea or in a river, the likelihood is that at least some of the spilled oil will eventually reach the shoreline. When shoreline impact occurs, or is likely to occur, shoreline assessment is a critical component of the response programme and provides essential information for setting objectives, priorities, constraints and end points for an effective shoreline response.

Oiled shoreline assessment surveys are carried out to:

- define and document the scale and character of shoreline oiling;
- identify and document the shoreline type and coastal character within the affected area;
- develop recommendations for treatment end points and treatment techniques which provide a net environmental benefit (see Box 5 on page 21) based on sound science;
- provide support throughout the treatment programme so that shoreline clean-up operations personnel understand the expectations and concerns of the response managers;
- provide a process for closure once treatment has been completed; and
- involve appropriate representatives to ensure consensus throughout the shoreline response programme.

Oiled shoreline assessment surveys may have different objectives as the phases of a response develop. During the initial or reactive phase the survey information defines the overall scale of the affected area and the character of the shoreline oiling, which enables clean-up teams to focus on higher priority locations. The planning phase is characterized by systematic surveys that provide detailed information and defensible recommendations on how to treat areas where clean-up is required, and by support for the clean-up teams so that they understand the objectives and strategies of the shoreline response programme. Typically, the survey teams include representatives from agencies or land owners/managers in the affected area so that they can be part of the evaluation process. The same survey teams inspect locations when treatment has been completed to ensure that the site-specific objectives have been met, so that the clean-up teams can be deployed to other areas.

Far left: shoreline oiling is typically discontinuous. Near left: shoreline assessment teams at work.

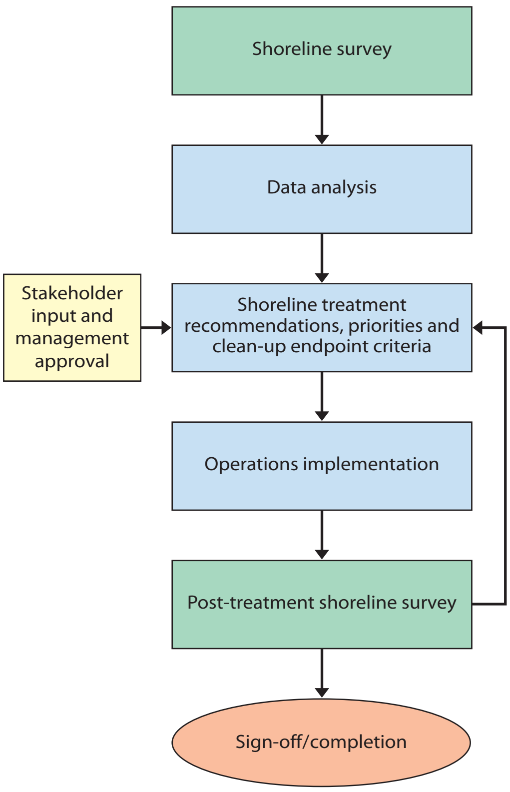
Why is an oiled shoreline assessment programme important?

A well-managed oiled shoreline assessment programme generates systematic data while fully engaging stakeholders in the response management process. An oiled shoreline assessment programme provides:

- comprehensive documentation of oiling and shoreline conditions;
- objective and defensible scientific data and recommendations;
- standard measurements, terminology and descriptions;
- recommended treatment strategies;
- recommended end point criteria for segment sign-off;
- details of operational constraints, safety and security issues;
- data on ecological, cultural and socio-economic constraints;
- the use of good management practices;
- a management decision making process which includes stakeholder and regulatory input;
- monitoring of treatment progress;
- trained and calibrated inspection teams for completion surveys; and
- data that can be useful for a number of other purposes, including damage assessment or recovery studies.

Without this set of information, effective response planning and prioritization for a shoreline response programme would not be possible, and the operations teams would have to make spontaneous, on-site decisions regarding treatment. Instead, an oiled shoreline assessment programme utilizes expert personnel to survey shorelines ahead of operations; it assesses the need for treatment, and produces recommendations and objectives that, along with stakeholder input, allow for efficient and effective planning. In addition, an oiled shoreline assessment programme provides a strategy for completion (see Figure 1) which aims to assure an efficient process and an appropriate and sensible conclusion to spill response operations, while avoiding under- or over-utilization of resources and potential negative environmental impacts due to excessive treatment. Shoreline assessment surveys therefore provide valuable information and support for decision makers, planners and operations personnel to enable the *effective treatment or cleaning of oiled shorelines* by accelerating recovery *without causing additional harm to the environment*.

Figure 1 *Strategy for shoreline treatment completion*



An oiled shoreline assessment programme provides a strategy for completion, without which a spill response would be unable to ensure an efficient process and an appropriate and sensible conclusion.

Oil spill responders have been conducting shoreline surveys in one form or another for more than forty years. Prior to 1989, shoreline assessment historically involved relatively informal surveys, which often covered only the areas with the greatest oil concentrations, and rarely involved a systematic or consistent recording or mapping process. The Shoreline Clean-up Assessment Technique (SCAT) survey programme created in 1989 during the response to the *Exxon Valdez* oil spill was designed to meet the challenge of documenting shoreline oiling, and evaluating treatment priorities and concerns in a remote area (Owens and Reimer, 2013). The SCAT concept involved a systematic survey of all shorelines in the affected area, with the data being managed using a geographic information system (GIS) database. This programme supported the planning and clean-up decisions that were the foundation for the 1989 shoreline response operation at both the strategic and tactical levels. The field procedures, the process of developing recommendations for shoreline treatment, and the data management tools have evolved since that first systematic survey, and the basic concept has stood the test of time in both large and small response operations worldwide.

Below: oiled shoreline assessment surveys being carried out in wetland environments

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What are the objectives of an oiled shoreline assessment programme?

The primary objectives of an oiled shoreline assessment programme are to:
- define the location, extent and character of the oiling;
- develop shoreline treatment recommendations;
- support operations during the treatment programme; and
- provide closure once the shoreline treatment objectives have been met.

This is achieved through:
- standardized procedures;
- good management practices;
- collection of data which are:
  - scientific;
  - systematic;
  - accurate;
  - consistent;
  - complete; and
  - defensible;
- provision of data, information and support to decision makers and operations personnel; and
- engagement of stakeholders.

In addition to these key strategic programme objectives, there may be other survey objectives during the different phases of a shoreline response programme, as described below.

Initial or reactive phase objectives

- Generate immediate information on the scale of the problem, by aerial reconnaissance and rapid ground or vessel assessment.
- In some cases, surveys can be conducted prior to oil reaching the shoreline to establish baseline conditions.
- Define the area(s) of affected shoreline and the degree and character of oiling.
- Establish immediate clean-up priorities and deploy operations to the right place(s) quickly. Prioritization is typically associated with the distribution of the heaviest oil concentrations and the oil's remobilization potential, and with the sensitivity of the affected shoreline.
- Treatment may primarily address bulk oil removal to minimize further impacts and enhance natural degradation.

Below left: aerial reconnaissance enables an initial assessment of the scale of the affected area.
Below right: video coverage with a descriptive commentary provides a rapid method of documenting shoreline oiling conditions.

Planning phase objectives

- Systematically document oiling conditions by detailed ground surveys for the development of a shoreline response plan (see Box 8 on page 25), taking into consideration the potential for oiling conditions to change over time.
- Recommend overall treatment objectives.
- Assess and recommend treatment techniques and strategies, and recommend clean-up end points and test methods.
- Define treatment constraints.

Operational phase objectives

- Provide a set of specific instructions (or 'work orders') to operations teams for the treatment of individual shoreline segments.
- Include environmental or other constraints and good management practices to prevent any additional impacts or damage that might otherwise result from treatment.
- Monitor and document the effectiveness of treatment and natural recovery.
- Track the status and progress of the treatment operations.

Completion phase objectives

- Compare treatment end points with oiling conditions during inspections so that all parties can agree that sufficient treatment has been completed on a segment-by-segment basis.
- Document the achievement of end points within segments designated for treatment, and enable sign-off or closure (see Box 2 on page 15 for an explanation of segments and segmentation).
- Identify possible locations for long-term monitoring where end points do not require removal of all of the oil, to ensure that natural weathering or self-cleaning takes place as anticipated.

Below: Shoreline surveys define the location and character of the oil: (left) oiled mangrove; (right) oiled marsh.

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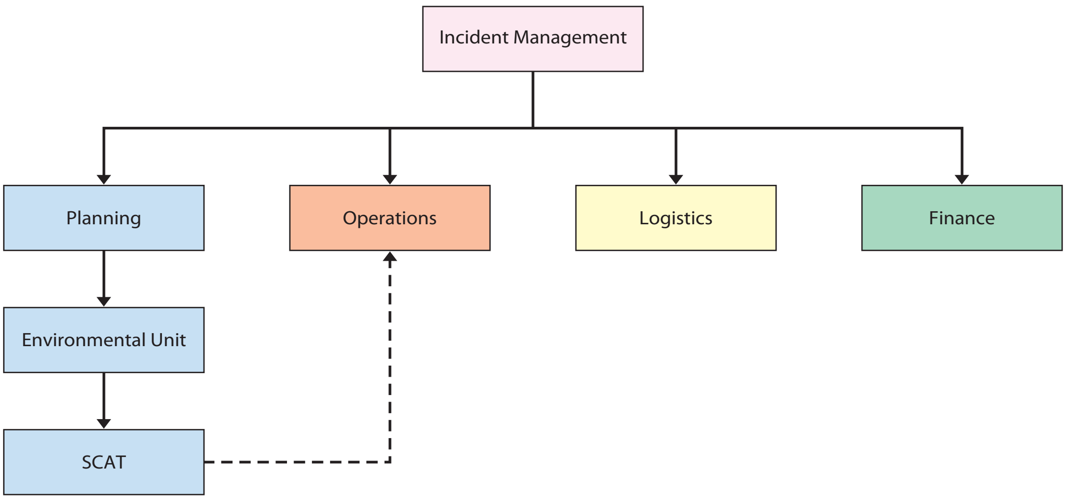
How does a shoreline assessment programme fit into a shoreline response programme?

An oiled shoreline assessment programme fits into the response management organization both vertically, under the Planning and Environment functions, and horizontally, with strong links and reciprocal communications with shoreline Operations (IPIECA-IOGP, 2016). See Figure 2, below.

A well-planned shoreline assessment programme systematically documents detailed shoreline character, oiling and logistics data for all of the affected area(s) on a segment-by-segment basis. The key objectives of a shoreline assessment programme are to:

- provide oiling data and treatment recommendations to decision makers and operations personnel in an efficient and timely manner to support the different phases of a response;
- enable rapid decision making and approval of the response plan, and to direct shoreline clean-up operations during all phases of a response;
- compile systematic, consistent and defensible documentation during all phases of a response;
- work closely with shoreline operations personnel to expedite and provide field support for the application of recommended treatment and end point criteria;
- provide accurate and informative data to stakeholders; and
- work with the spill management team to provide non-technical information to the general public.

Figure 2 *The SCAT programme's position in a typical response organization structure*



Who is involved in an oiled shoreline assessment programme?

A well-designed shoreline assessment programme involves experienced shoreline assessment field surveyors, key decision makers, planners and operations personnel, ensuring a comprehensive flow of information and data between all parties associated with the response. The programme also ensures that relevant stakeholders remain engaged, and keeps them involved with, and informed of, the decision making process.

Data management is a key component of the shoreline assessment programme, to ensure data integrity, storage and backup, and to provide a means of processing and analysing raw shoreline oiling data and presenting it in a format that can be easily communicated with decision makers and stakeholders.

Oiled shoreline assessment teams carry out the surveys ahead of the operations teams, and often recognize the hazards and constraints before anyone else; oiled shoreline assessment survey teams must therefore have a strong safety culture and should share their learnings with the rest of the response personnel.

Integration with the response management organization

The oiled shoreline assessment programme should be integrated within the function responsible for environmental decision making and recommendations. For example, within an Incident Management System (IMS) SCAT resides within the Environmental Unit, under the Planning Section. This ensures that agreement on the end points of the operation falls under one team, and that field data is passed back to those decision makers and response planners so that the response can be planned accordingly. The Planning Section is also responsible for ensuring that other relevant sections are kept informed via the Situation Unit.

A key role of the oiled shoreline assessment team is to support the response operations by communicating directly with the Operations personnel; this ensures that both teams understand each other's roles and requirements and enables each team to provide input to the other's decisions. For example, the field survey team can discuss with supervisors in the field how they can determine whether end points are reached, and the Operations personnel may provide an understanding of the practical benefits and limitations of available treatment methods.

Oiled shoreline assessment team participation

A fully functioning shoreline assessment team requires the joint participation of representatives of the responsible party and the agencies responsible for the affected area. This helps to maintain consistent reporting between the various regulators and stakeholders as well as preventing different interpretations about the location and degree of oiling. Agencies or land managers might be from the local, regional or national levels, or a combination of all three. The relevant national or local oil spill contingency plan may specify the membership of a shoreline assessment team. However, care must be taken to ensure that the membership of a shoreline assessment field team remains at a level that is easy to manage; it is not practical or efficient to have a large field team, and it may therefore be necessary to restrict field participation to selected key representatives. A team of more than five people can become inefficient and difficult to manage from both a logistical and safety perspective. As mentioned on page 11, the field survey teams must have appropriate safety training and a strong safety culture because they typically work remotely, often away from larger operational units and infrastructure. They should have the competence and authority to turn back where conditions or transportation may be deemed to be unsafe, and should pass safety reports and observations on to the Safety Officer in the response organization.

The role of a shoreline assessment survey Team Leader requires basic leadership skills. Leaders should be team players and listen to the views of each team member, with the aim of seeking a full team consensus on oiling conditions and recommendations for treatment.

Field team members who are new to shoreline assessment will require appropriate classroom and/or in-field training, and all team members require regular, spill-specific calibration to ensure consistency both between individual team members and between different teams. Consistency of data is improved by minimizing the turnover of field surveyors, and by ensuring that the same group of trained and calibrated personnel is used from the initial reconnaissance surveys through to completion. Training should include relevant safety issues and potential risks as well as shoreline assessment methods and shoreline processes specific to the geographic area to be surveyed.

The composition of an oiled shoreline assessment programme might include the following components:

- ***Oiled shoreline assessment programme management/coordination:*** responsible for designing and directing the programme, setting programme objectives, and liaising within the Environmental Unit and with other managers and decision makers within the response organization.
- ***Field survey teams:*** responsible for conducting aerial reconnaissance and ground/vessel surveys, gathering oiling (and other) data in the field, producing reports and recommendations for treatment, and inspecting segments where treatment is required to ensure end points are reached. Depending on site-specific needs, other data to be collected may include cultural resources, sensitive wildlife resources, environmental resources or operational, safety or logistical constraints.
- ***Data management:*** responsible for collecting and collating data, presenting data maps and summary tables and reports, and for coordinating with the response data management team to preserve shoreline assessment survey documentation on oil character and treatment or natural attenuation.
- ***GIS support:*** responsible for creating field maps for the survey teams and maps for survey reports.
- ***Logistics support:*** responsible for managing logistics and communications for the field teams, an important role when covering a large and/or remote area, and providing safety training and support (see Box 1 on *Safety and safety plans*, overleaf).
- ***SCAT Operations Liaison:*** responsible for direct communications between the shoreline assessment programme and Operations personnel, an important role when the field survey teams are unable to provide that function themselves, for example during a response when the field survey teams are spread over a wide area, away from operational zones.

Below: an oiled shoreline survey team, including representatives from local agencies.

Box 1 *Safety and safety plans*

As with any part of an oil spill response, safety is the number-one priority. For field survey teams there are many inherent risks to personnel, and safety plans should be produced at an early stage to ensure that teams are able to recognize, prevent and mitigate those risks.

Hazards might include, but are not limited to:

- weather:
  - cold/ice;
  - heat/sun;
  - rain/thunderstorms;
  - high winds;
  - fog;
- sea state;
- aviation operations;
- boat operations;
- working on/around water;
- driving/road conditions;
- working with heavy machinery (e.g. augers, excavators);
- slips, trips and falls;
- uneven and soft surfaces;
- wildlife;
- darkness;
- fatigue;
- dehydration;
- muscle strain;
- trash (e.g. sharps, glass, chemicals); and
- members of the public/security.

The field Team Leader should conduct daily briefings before beginning a survey to ensure that all members are aware of potential safety hazards and have the necessary knowledge and tools to minimize and mitigate risks. Because the oiled shoreline assessment survey team is often first on the scene, the team will also need to observe and identify new hazards daily and as conditions change. The safety briefing is also a means to ensure that all members understand the day's mission and objectives.

What are the key information requirements for decision makers?

Following an oil spill, an effective and efficient response depends largely on rapid and informed decision making. A well-planned shoreline assessment programme provides critical information to enable decision makers to plan and execute a successful shoreline clean-up operation. To set objectives and priorities in the early stages of a response, spill managers require a full, non-technical overview of the situation as quickly as possible. Throughout the planning and operational stages, managers look to the shoreline survey team for defensible recommendations regarding objectives, priorities and clean-up end points, including appropriate clean-up techniques and operational constraints. In addition, they rely on reports regarding temporal changes in shoreline oiling and on treatment progress. It is important to establish agreed-upon metrics in terms of distances surveyed, oil impacts (for example, oiling category percentages—see Figure 3) and treatment to communicate consistent information to managers and the public. Finally, during the completion phase, managers rely on the opinions and recommendations of the experienced field teams to agree on and document segments for which the end points have been reached so that the response may be demobilized accordingly on a segment-by-segment basis.

In Figure 3, the Deepwater Horizon *categories follow the 'Small tidal range' band width and 'Surface oil cover matrix' definition shown in Box 4 (pages 18–19); all other examples follow the 'Large tidal range' definition for oiled band width.*

Figure 3 *Percentage of total oiled shoreline by category for selected oil spills*

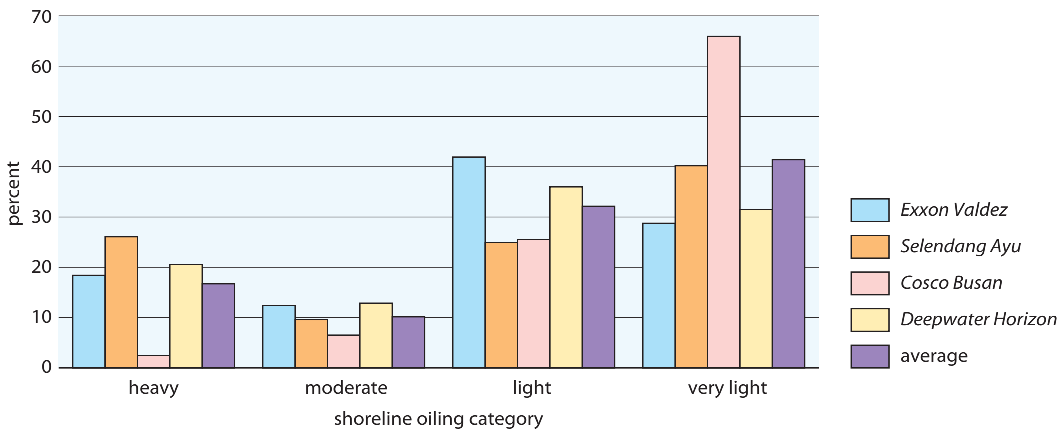
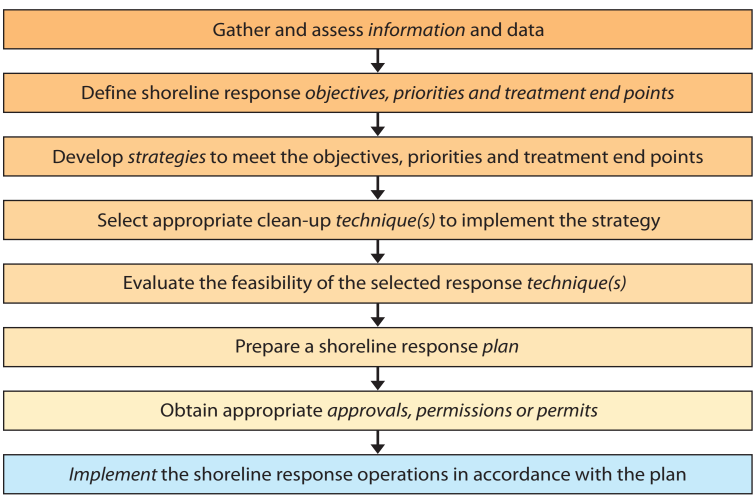


Figure 4 *Information flow and the decision process*



An efficient shoreline assessment programme produces complete systematic data, ensuring that all shorelines in the affected area are surveyed. Well-calibrated shoreline assessment teams provide data which are consistent, both between different surveys and between different individual observers/teams. Quality is enhanced by maintaining a consistent team of oiled shoreline assessment field surveyors throughout the response. Reporting forms should generate quantitative data, thereby removing the need for qualitative descriptions or opinions.

Box 2 *Segments and segmentation*

At the very beginning of (or ideally before) a response, the shoreline or river bank(s) is divided into working units called segments. These segments are delineated to provide manageable areas of the shoreline for assessment, clean-up and subsequent inspection by the shoreline assessment survey teams. Each segment should have a relatively similar shoreline character in terms of physical features and sediment type. Segment boundaries are established based on:

- prominent geological features, including inlets or stream/river mouths;
- changes in shoreline or substrate type;
- changes in oiling conditions;
- operational considerations, such as backshore character, access or staging factors; and
- jurisdictional or land ownership/management areas.

Each segment is given a unique identification number, which can then be used to cross-reference all documents and maps relating to shoreline surveys and operations. Segmentation breaks the shoreline down into manageable and practical portions for survey and operations teams, and simplifies the identification and location of different sections of shoreline (see map below). Segments where treatment is planned can correspond to operational areas or divisions.

Polygons may be used for segmentation on non-linear shorelines, such as wetlands, or in cases with highly irregular shorelines or terrestrial oiling (for an example see the oiled wetland status map on page 28).

Pre-SCAT mapping and segmentation avoids the need for reactive segmentation, or the use of multiple unconnected segmentation schemes created by different groups within a response; it can also be completed without the pressures and time constraints of a real incident. Where segmentation has been completed in advance, key shoreline sensitivity and logistical information such as shoreline type and backshore operational considerations (see map below) will be immediately available to the shoreline teams. The use of aerial videotape surveys has been found to provide a valuable source of data for shoreline segmentation, along with charts, maps and satellite imagery.

In the event of a spill, sub-segments can be created to account for variations in the degree and type of oiling. Pre-SCAT sensitivity and segmentation maps should be evaluated periodically in the field and revised as necessary to account for changes due to natural coastal processes and human activities, as well as to verify access points and staging areas.

Example of pre-SCAT shoreline segmentation that defines shore zone type (where oil could be deposited) and coastal character (the backshore where operations would be deployed and staged). In this example, the Environmental Sensitivity Index (ESI) shore type for segments DAN-022 through DAN-025 is the same (sand beach), but the backshore character changes significantly: dunes (22); man-made (23); cliff/bluff (24); and dunes (25).

Map courtesy of ACEPA, the Angola Ministry of Petroleum and Ministry of the Environment

Stranded oil distribution

A shoreline assessment survey should be designed to evaluate and document several important factors related to oiling in order to facilitate the decision making process for a response programme. Surveys should identify and report the following information on a segment-by-segment basis:

- ***Location:*** maps, GPS coordinates and descriptions of where shoreline oiling is observed, noting which segments are oiled and in which tidal zone the oil has been stranded. Segments in which there is no observed oil (NOO) should be documented.
- ***Shoreline type:*** descriptions of the primary and secondary shoreline types surveyed, ideally using standard descriptors and coding such as the Environmental Sensitivity Index (ESI) (see IPIECA/IMO/IOGP, 2012) or Environment Canada's shoreline classification system (see Box 3 on page 17).
- ***Coastal character:*** description of the backshore, specifically noting access and staging factors for operations.
- ***Oil concentration:*** quantitative descriptions of the distribution (length, width and percentage cover) and thickness of surface oil, and the location, thickness, depth and percentage cover of subsurface oil, using standard and consistent measurements and definitions (see Box 4 on pages 18–19).
- ***Character of the oil:*** standard descriptions of the character of the oil and the degree of weathering, for example, fresh oil, emulsification, oil residue, or sheen (see Box 4 on pages 18–19).
- ***Potential behaviour of the oil:*** an indication of the likely persistence (days to weeks, weeks to months, months to years) of the oil and its remobilization potential, based on the characteristics of the oil, the change of oiling with time (weathering), and the water and weather conditions.

Layer of subsurface (buried) oil residue in a hand-dug pit on a sandy beach.

This information set is initially used to develop immediate clean-up priorities, which are typically those segments with the heaviest oil concentrations and the greatest potential for remobilization of the oil.

During the subsequent planning stage, shoreline oiling data is combined with information on sensitivity and resources at risk in order to set long-term objectives and priorities. Oiling data includes the following segment-specific information:

- oiled shoreline assessment forms and associated maps, sketches, diagrams and photos;
- safety and logistical issues, such as access and constraints;
- observed resources at risk; and
- beach profile data (see *What types of data are generated?* on page 27)

Such information can be collated to produce area or regional overviews of the shoreline oiling and of the response progress, in the form of oiling and status tables and maps and time series diagrams (see pages 27–28).

Appendix 1 on pages 32–33 provides an example of an oiled shoreline assessment form. Standard forms can be modified to reflect the specific shoreline character (e.g. wetlands) or oiling conditions of a particular region or spill.

Far left: a pebble/cobble beach with oil deposited primarily above the intertidal zone.
Near left: an oiled river bank during a period with a falling water level.

Box 3 *Environment Canada's shoreline classification (for temperate and arctic environments)*

Marine shoreline types
- Bedrock—cliff/vertical
- Bedrock—sloping/ramp
- Bedrock or beach rock—platform
- Glacier/ice shelf
- Man-made solid
- Man-made permeable
- Sand beach
- Mixed sediment beach
- Pebble/cobble beach
- Boulder beach
- Mud flat
- Sand flat
- Mixed sediment flat
- Pebble/cobble/boulder flat
- Wetland
- Mangrove
- Peat shoreline
- Tundra cliff—ice rich
- Tundra cliff—ice poor
- Inundated low-lying tundra

Winter shorelines—marine and freshwater
(usually temporary)
- Ice foot
- Snow
- Frozen swash
- Frozen spray/splash
- Grounded ice floes

Marine and lake coastal character
- Cliff/hill
- Sloped
- Flat/lowland
- Beach
- Delta
- Dune
- Lagoon
- River inlet/channel
- Wetland
- Man-made

Freshwater shoreline types (lake, river, stream)
- Bedrock cliff/ramp
- Bedrock platform/shelf
- Man-made solid
- Man-made permeable
- Sediment cliff
- Mud/clay bank
- Sand beach or bank
- Mixed sediment beach or bank
- Pebble/cobble beach or bank
- Boulder beach or bank
- Peat/organic beach or bank
- Mud flat
- Sand flat
- Mixed sediment flat
- Vegetated bank
- Marsh
- Swamp
- Bog/fen
- Wooded upland

River or stream valley character
- Cliff
- Sloped
- Canyon
- Straight
- Confined or leveed
- Meander
- Flood plain valley
- Braided
- Oxbow
- Man-made

River or stream channel character
- Shoals
- Point bars
- Cascade
- Rapids
- Riffle
- Pool
- Gide
- Log jams
- Undercut banks

Box 4 *Standard terms and definitions*

A key element of shoreline assessment is the use of agreed standard terms and definitions, without which comparison between different survey forms and reports would be difficult. By using the same words or phrases to describe oiling, everyone in the response understands their meanings and there is no misinterpretation. Examples of accepted terms and their definitions to describe surface oiling character include:

Oil band width can be categorized depending on tidal range or shoreline environment:

	Small tidal range (< 2 m), lake or river shoreline	Large tidal range (> 2 m)
Wide	> 2 m	> 6 m
Medium	1–2 m	3–6 m
Narrow	0.3–1 m	0.5–3 m
Very narrow	< 0.3 m	< 0.5 m

Oil character

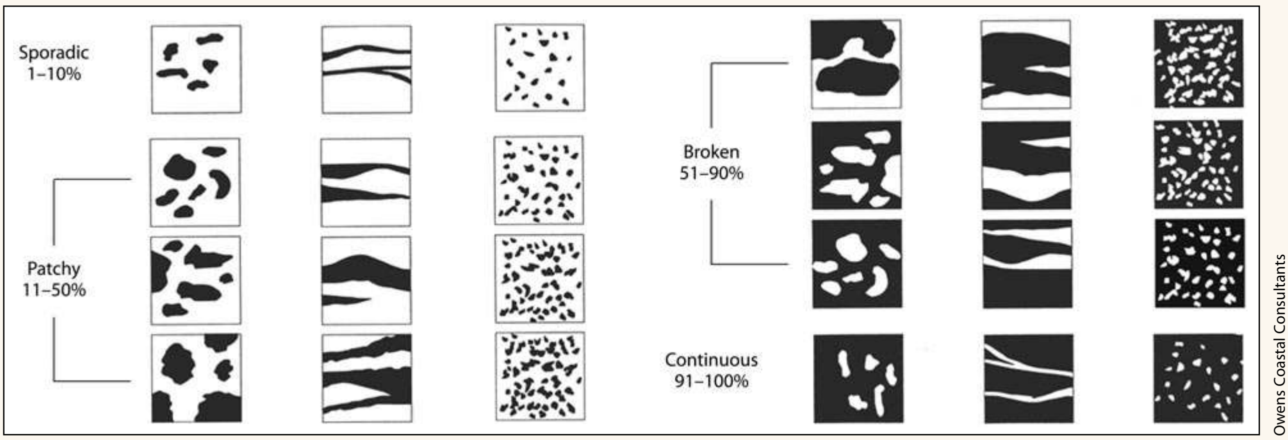
- Fresh: un-weathered, low viscosity oil
- Mousse: emulsified oil (a mixture of oil and water)
- Tar balls: discrete oil balls on a beach or adhered to the substrate (< 10 cm diameter)
- Tar patties: discrete oil patties on a beach or adhered to the substrate (> 10 cm diameter)
- Tar: weathered coat or cover of tarry, almost solid, consistency
- Surface oil residue: non-cohesive oiled surface sediments
- Asphalt pavements: cohesive mixture of oil and sediments
- No oil observed (NOO)

Oil distribution is grouped into the following categories (see Figure 5):

- Trace: < 1%
- Sporadic: 1–10%
- Patchy: 11–50%
- Broken: 51–90%
- Continuous: 91–100%

Note: Tar balls can be counted for a fixed area, also noting average and largest sizes.

Figure 5 *Percentage distribution examples*



Oil thickness is described according to the following categories:

- Thick oil: > 1 cm
- Cover: > 0.1 cm to ≤ 1 cm
- Coat: > 0.01 cm to ≤ 0.1cm (can be scratched off with a fingernail)
- Stain: ≤ 0.01cm (cannot be scratched off easily with a fingernail)
- Film: transparent or translucent film or sheen

Terms such as 'light', 'moderate' and 'heavy' are given specific definitions so that their use is consistent and comparable. Matrices (see examples in Figures 6 and 7 below) can be used to categorize oiling to provide a simple, yet standardized, description.

Figure 6 *Initial surface oil cover matrix*

		Width of oiled area			
		Wide (> 2 m)	Medium (1–2 m)	Narrow (0.5–1 m)	Very narrow (< 0.5 m)
Oil distribution	Continuous 91–100%	heavy	heavy	moderate	light
	Broken 51–90%	heavy	heavy	moderate	light
	Patchy 11–50%	moderate	moderate	light	very light
	Sporadic 1–10%	light	light	very light	very light
	Trace < 1%	very light	very light	very light	very light

***Oiled area width** (in this case for a location with a small tidal range) and **oil distribution** are combined in this 'Initial surface oil cover matrix'.*

Figure 7 *Final surface oil categorization matrix*

		Surface oil cover			
		Heavy	Moderate	Light	Very light
Average thickness	Thick oil > 1cm	heavy	heavy	moderate	light
	Cover 0.1–1.0 cm	heavy	heavy	light	light
	Coat 0.01–0.1 cm	moderate	moderate	light	very light
	Stain/Film < 0.01 cm	light	light	very light	very light

*The **initial categorization of the surface oil** from the 'Initial surface oil cover matrix' (Figure 6) is combined with the **average oil thickness** in this 'Surface oil categorization matrix.*

Treatment options and constraints

Treatment end points

Treatment end points provide measureable objectives for a shoreline response, ensuring that everyone involved, from the management level to the response operators in the field, understands which segments require clean-up and what level of residual oiling is considered acceptable in those segments. When those mutually-agreed end points are achieved, this means that no further treatment (NFT) is required and that a segment can be removed from the response, and clean-up teams redeployed elsewhere as required. The involvement of the appropriate environmental agencies in the development of end points ensures that their requirements and concerns can be fully taken into account in the decision making process.

In recommending end points to the spill management team, the shoreline assessment programme team must understand the degree of oiling, the rate of weathering, the potential for remobilization and the potential for natural recovery, as well as the shoreline type and sensitivity, and the potential for exposure to wildlife and the public. Typically, end points are defined for each of the affected shoreline types and uses. An understanding of the capabilities and limitations of the available treatment techniques is essential; in particular, the team should be aware of any negative impact that each treatment option may have on the shoreline habitat. It is important to note that it is rarely technically or economically practical to attempt to clean to pre-spill conditions or to the NOO standard, and that some treatment activities may have a negative net environmental benefit, particularly on sensitive shorelines (see Box 5 on page 21 for the principles of NEBA and ALARP). Technical Working Groups may be established to determine NFT end points and treatment options for different shoreline types (see Box 7 on page 24).

Ideally, end points should be quantitative, reducing any ambiguity from the process, for example: '*surface oiling less than 10% distribution and less than 1 cm thick*'. However, end points may also be qualitative, providing they are objective and measureable, for example: '*no oil which produces a rainbow sheen on disturbance*'. Analytical measurements could also be used to define end points, however it is likely to be difficult to agree on anything but an arbitrary concentration, so an in-situ quantitative or qualitative assessment is generally preferable. In situations where the shoreline type is particularly sensitive to physical impacts from treatment, an operational end point may be preferable, for example: '*this segment reaches 'no further treatment' (NFT) status when the recommended treatment has been completed*' (see Box 6 on page 22 for more examples of shoreline treatment end points).

Shoreline treatment recommendations (STRs)

Where a segment does not meet the end point criteria, the spill management team needs to know where the oiling is, why it does not meet end points, and how the operations personnel can clean the segment. With good data and an understanding of the shoreline oiling, characteristics and required end points, as well as a sound knowledge of available treatment techniques, the shoreline assessment programme team can make recommendations for shoreline treatment for each segment using an STR form (See NWACP 2014 for an example STR form). Where non-standard techniques, or new equipment is used, field trials or tests may be required to determine their effectiveness. In some cases, where a shoreline is particularly sensitive to physical or other impacts from treatment, recommendations of 'no treatment' and/or 'monitor recovery' may be appropriate. The STR should identify and define the oiled area(s) within the segment (see page 27) and highlight the most appropriate treatment technique(s) for the oiling and shoreline type. The STR should also include clear instructions regarding any safety, logistical and ecological issues and constraints. STR forms are reviewed and approved by the spill management team, so that they can be incorporated into the shoreline response programme, essentially becoming 'work orders' for the shoreline operations teams.

STRs should include:

- segment number(s), coordinates, maps and photos;
- description of the oiled location(s), including shoreline characteristics;
- types and degree of oiling;
- recommended treatment techniques;
- a list of the different stages/steps of treatment;
- end point criteria for the segment(s);
- environmental, cultural and social restrictions and issues; and
- safety and logistical issues.

Treatment constraints—good management practices

To limit negative impacts from the recommended treatment options, the STR should refer to good management practices. These should explain the measures required to avoid or minimize additional harm, such as reducing physical impact to sensitive shorelines, avoiding vegetation disturbance, and minimizing disturbance of wildlife, cultural or historical resources.

Box 5 *The principles of NEBA (net environmental benefit analysis) and ALARP ('as low as reasonably practical')*

The primary purpose of shoreline treatment is to *accelerate the natural recovery processes*, such as weathering and biodegradation. There typically comes a point in the treatment process when either no benefit is gained from any further treatment or the effort may result in undesired effects (such as root disturbance in wetlands), and therefore that treatment activity should either be modified or should cease. Two key principles for determining end points and treatment options are ALARP and NEBA.

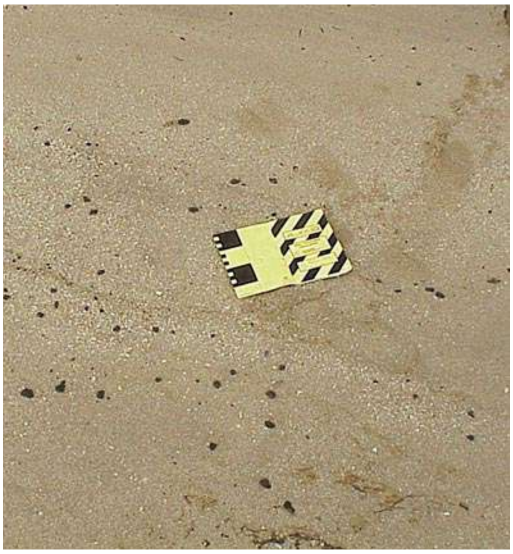
ALARP considers that a risk should be '*as low as reasonably practicable*', where the risk is greater than zero, but is tolerable and cannot be reduced further without incurring *disproportionate cost and effort*.

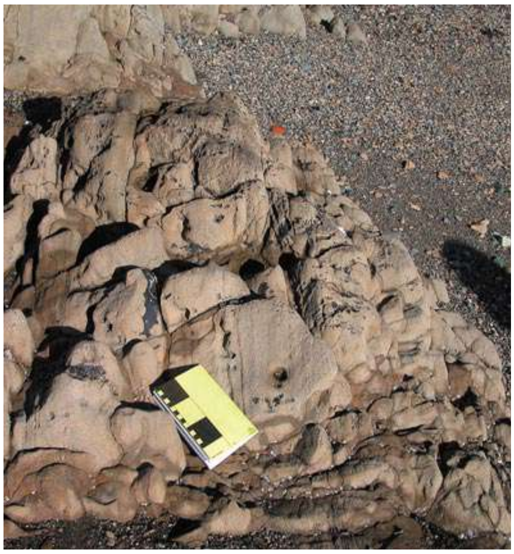
NEBA involves the assessment of the '*net environmental benefit*' of potential treatment alternatives, *including natural recovery*, by comparing the negative and positive impacts of each treatment option and defining when a particular treatment activity should cease. Different treatment options have different impacts on the environment; generally the more aggressive the technique, the greater the physical shoreline impact. NEBA is therefore used to determine which option provides the greatest overall benefit to the environment. This assessment might include the options of 'no treatment' or 'monitor the recovery' where the shoreline is particularly sensitive to physical or other impacts from treatment operations. In addition to environmental impacts, NEBA can also include the consideration of cultural and socio-economic issues. For further information on NEBA see the IPIECA-IOGP Good Practice Guide entitled *Response strategy development using net environmental benefit analysis (NEBA)* (IPIECA-IOGP, 2015b).

Box 6 *Examples of shoreline treatment end points*

- No more than 1% tar balls which are less than 2 cm in diameter.
- No oil or tar balls greater than background deposition rates (where there is good documentation of background oiling data).
- No oiling on hard substrates greater than coat (0.1 mm), and no greater than 20% distribution.
- No oil on pooled water greater than a silver sheen in a marsh or in a pit or trench.
- No surface oiling more than 10% distribution and more than 1 cm thick.
- No oil which produces rainbow sheen on disturbance.
- No oil which rubs off on contact.
- No subsurface oiling greater than oil residue which is 4 cm thick and patchy (50% distribution).
- This segment reaches NFT status when the recommended treatment has been completed.

Example end points: near right: < 1% tar balls; far right: < 10% stain





How is an oiled shoreline assessment programme implemented?

Survey planning and strategies

Scope of the project

The first step in a response is to establish the potential size of the affected oiled area and to scale the shoreline survey programme accordingly. As with response operations, shoreline assessment resources need to be flexible and can always be scaled up or down as the situation changes. As long as oil is still migrating, daily overflights with reports are necessary to plan both strategy (scale of the response programme) and tactics (where to send ground survey teams and operations crews).

Segmentation

Dividing the shoreline into manageable segments at the beginning of a response, or as part of pre-spill planning, provides a database foundation within which survey documents, photographs and maps can be easily cross-referenced, and oiled areas can be easily located (see Box 2 on page 15). The same segmentation should be used throughout the response by all responders so as to avoid confusion.

Coordination with operations personnel

Although the shoreline assessment programme resides within the Planning function, it is vital that the shoreline assessment programme is able to establish direct communications with the shoreline operations personnel. This allows for an efficient process by ensuring that the operations teams understand what is required and that they are aware of any environmental concerns. At the same time, the shoreline assessment survey teams will become aware of any practicality, feasibility and timing issues that may arise during treatment. A SCAT Operations Liaison role, either within the field teams or as a separate function, can help to facilitate two-way discussions of:

- treatment guidelines;
- techniques and strategies;
- operational limitations and good practice guidelines;
- environmental, cultural and socio-economic limitations;
- prioritization of treatment;
- the understanding and application of STRs; and
- the identification of logistical assets and liabilities (such as access points, staging areas, boat docks and launches, quality of roads and infrastructure).

Coordination with stakeholders

Relevant stakeholders, such as the responsible party and key government agencies, typically have representation within the shoreline assessment programme, either in the management team and/or in the field. This ensures good coordination and communications as well as mutually-agreed decisions relating to shoreline oiling and treatment. For large incidents with multiple stakeholders, the formation of Technical Working Groups may be appropriate to ensure that the requirements and concerns are addressed during the decision making process (see Box 7 overleaf).

Box 7 *Technical Working Groups*

The end point criteria and treatment techniques recommended by shoreline assessment teams are approved by the key decision makers at the management level. Technical Working Groups (TWGs) may be formed to ensure that key agencies representing environmental, cultural and socio-economic interests at the local to national levels, and relevant stakeholders such as the responsible party, operations and planning personnel, all have the opportunity to present their requirements and concerns during the decision making process. Where several shoreline environments have been oiled, TWGs may be established for each shoreline type (e.g. for sand beaches, wetlands and man-made shorelines). Data, information and recommendations from the shoreline assessment programme are provided for discussion within the TWG(s) and are used to provide outputs required by the response management, for example:

- definition of shoreline segments that need treatment;
- establishment of treatment priorities;
- development of end point criteria by shoreline type;
- development of shoreline treatment recommendations by habitat type;
- recommendation of field trials to evaluate and compare different treatment techniques; and
- evaluation of shoreline assessment data throughout the operational process to determine the effectiveness and effects of treatment.

TWGs add an additional layer of confidence to the decision making process so that upper level management and stakeholders can be assured that the relevant participants and experts, whose opinions or concerns have been considered throughout the process, have also been involved in making recommendations on treatment and end points. TWGs therefore help to make the approval of these recommendations a smooth process, particularly when multiple agencies are involved.

Field survey requirements

Planning for shoreline assessment surveys should include the mobilization and provision of a variety of resources, including:

- trained and calibrated multi-agency teams;
- equipment (e.g. notebook, GPS, camera, shovel, profile stakes, PPE);
- transportation (e.g. road, off-road, water, air);
- a safety plan and job safety analysis process to identify and remove or mitigate new hazards;
- communications (e.g. mobile phones, radio, satellite phones); and
- training tools (job aids, manuals, calibration presentations).

A selection of typical shoreline assessment survey resources: (near right) personal equipment including PPE, first-aid kit, foul-weather gear, GPS, camera and notebook; (far right) paperwork and information, including maps, plans, job aids and oiled shoreline assessment forms.

Plans and resources should be in place to provide the following data:

- oiled shoreline assessment forms (paper or electronic—see Appendix 1);
- sketches/maps;
- photos/videos;
- GPS positional data;
- beach profile data (see Box 9 on page 29); and
- monitoring site data (see Box 9 on page 29).

Data management

Shoreline surveys can generate large amounts of data which must be collected, reviewed, organized and preserved. Agreed-upon performance metrics must be established at the start of the response. Shoreline oiling data (see *What types of data are generated?* on page 27) should be rapidly made available to the response organization so that once the field teams have completed a survey that data may be processed quickly by the data management team. This processing includes quality assurance/quality control (QA/QC) of raw data, entry into a database within a geographic information system (GIS) function, and data analysis, through to final data presentation and preservation.

The objectives and strategies of the shoreline survey and response programme can be summarized in a shoreline response plan (see Box 8). This plan, when approved by the spill management team, defines what will be surveyed, who participates, the survey protocols, the approved treatment objectives, priorities and end points, shoreline treatment options, and the inspection process.

Box 8 *The shoreline response plan*

A shoreline response plan sets out the specific objectives, priorities and activities of a shoreline assessment programme and describes the treatment options and end points for the shoreline response programme, as agreed by the relevant stakeholders. The plan is beneficial to the shoreline assessment team and the Planning and Operations Sections as it helps each to understand the process, and the cooperation and communications that are required between the different parties.

Key components of a shoreline response plan are:

- health and safety;
- programme objectives;
- programme management;
- field team participants;
- field methods and forms:
  - aerial reconnaissance during initial stages;
  - shoreline inspections;
- shoreline treatment process;
- data management and reporting;
- logistics;
- spill management support;
- liaison with the Operations Section;
- treatment end points;
- shoreline treatment options;
- prioritization of treatment by segments; and
- the sign-off and completion process.

Time and space considerations

Shoreline assessment surveys are conducted as early as possible when oil spills affect, or are likely to affect, coastal resources. No matter what the size of the incident or where it happens, oiling location and conditions should be documented for planning, operational, legal and liability purposes. The scale of the shoreline assessment programme varies for each incident. A small, localized spill might only require one or two field teams with oversight, data and logistics coordinated by a single person in the command post; whereas a spill that affects tens or hundreds of kilometres might require multiple field teams with a large support group to provide data management, GIS support, logistics support and a liaison with the Operations Section. An important function of the shoreline assessment survey teams during the initial response phase is to debrief the Planning and Operations Sections on key information generated during the day's surveys. This information transfer has to take place in time for response personnel to incorporate that information into planning for the next day's activities. Survey teams only need to stay ahead of the operations teams by approximately two or three days during the initial stages of the response; any longer presents the risk that shoreline data may become out of date due to changes in oiling conditions, especially in the early stages of a response when the oil is still relatively fresh and mobile.

Below: mechanical trenching to determine the presence of subsurface oil on a mixed sand-pebble beach; and (bottom) inspecting a hand-dug pit for subsurface oil.

Teams should be prepared to look for subsurface oil in case the oil has penetrated beach sediments, or has been reworked or buried by sediments due to wave action. A range of detection and delineation options can be considered (API, 2013) and in some cases extensive systematic surveys may be required, for example if there are widespread and variable deposits of subsurface oil (Owens *et al.*, 1995).

When mobilizing field survey personnel it is important to consider the amount of time a person can commit to the response. A large incident might require a shoreline assessment programme to continue for several months or even years; in order to maintain consistent and accurate data, it is preferable to use the same calibrated personnel throughout the programme.

Teams should be prepared for a variety of spill environments and regional adaptations, which might require an understanding of different shoreline processes, different survey types and forms, and different transportation requirements, safety issues and clothing/PPE requirements. In tidal locations, survey planning must take into account the tidal range and tide heights so that field teams can observe the entire intertidal zone during their surveys. The range of field environments include:

- marine coasts;
- river and stream banks;
- lake shores;
- terrestrial environments; and
- regional variation, e.g.:
  - temperate;
  - tropics; and
  - arctic/ice or winter.

What types of data are generated?

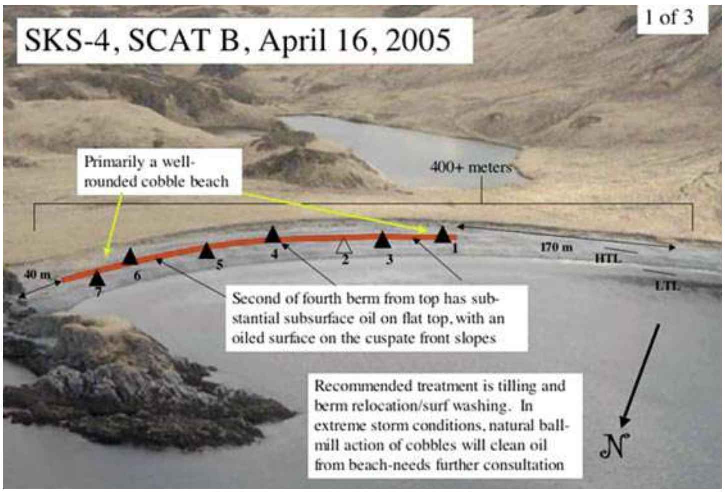
Data output from the field surveys includes tables, graphs, maps, photographs and reports. The field data are scientific and the summary outputs are designed to be easily understood by non-technical personnel and the general public.

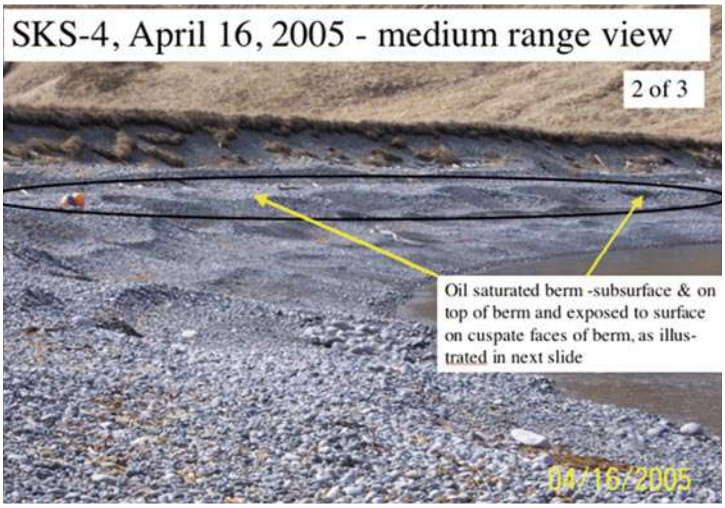
Field data, which include oiled shoreline assessment forms, sketches, photographs (see right), videos, and GPS track lines and waypoints, are collated by the data manager or data team to provide maps and other visual presentations related to segment-specific or area/regional summaries (see photographs overleaf).

Summary tables and graphs are also useful to provide situational information (see Table 1 on page 28).

Compilations of shoreline oiling data document the past and current distribution and character of oiling conditions, representing changes through time, and hence the progress of natural recovery and/or treatment of the shoreline.

Shoreline assessment data and the derived summary information are important, not only to spill management and stakeholders to aid decision making and planning, but also to the general public to understand the evolving situation.





The photographs on the right show the different levels of detail of shoreline oiling conditions in the same segment (Owens et al.*, 2008).*

Shoreline oiling status maps: (top) an oiled wetland environment (polygon segments) and lake shoreline environment (linear segments); and (bottom) linear shoreline segments in a commercial waterway.

Data sets might include:

- aerial survey forms/reports;
- oiled shoreline assessment forms;
- photographs and videos;
- GPS track lines and waypoints;
- field sketches and maps;
- shoreline treatment recommendations (STRs);
- oiling and status tables;
- oiling and status maps;
- operational maps, showing current treatment areas;
- diagrams (e.g. time series showing progress);
- history tracking (chronological segment-specific actions throughout the response);
- beach profiles and reports (see Box 9 on page 29);
- photomonitoring and time series data (Box 9);
- cultural/historical data; and
- incidental wildlife information collected during shoreline assessment surveys.

Table 1 *Oiling summary table from an assessment survey of an oiled lake shore*

Shoreline type	Oiled length (m)	% of total oiled length	Length by oiling category (m)			
			heavy	moderate	Light/very light	No observed oil
Bulrush/reed	23,315	71.3	14,464	4,669	4,182	6,512
Wetland fringe	4,545	13.9	2,525	786	1,234	10,555
Cobble-pebble	1,392	4.3	1,268	39	85	1,668
Boulder-cobble	952	2.9	54	323	575	7
Mixed sediment	806	2.5	0	260	546	5,343
Vegetated bank	676	2.1	138	53	485	4,134
Sand	295	0.9	78	30	187	940
Peat/soil	286	0.9	150	74	62	0
Man-made permeable	227	0.7	0	0	227	410
Mud	194	0.6	0	194	0	493
TOTALS	**32,688**	**100.0**	**18,677**	**6,428**	**7,583**	**30,062**

Box 9 *Supplementary field data*

In addition to oiled shoreline assessment forms, sketches and photographs, the shoreline assessment field teams can produce other data which might be useful for a response. These might include aerial and shoreline videos, beach profiles, and photomonitoring data, as well as information about ecological, cultural, socio-economic, logistical and safety issues. The field survey teams, being the 'eyes on the ground', can also locate and report stranded operational equipment, such as boom and anchors washed up on the shoreline, and oiled wildlife.

Beach profile data

Where oil has been, or is likely to become, buried by sediment due to dynamic shoreline processes, or penetrates into coarse sediments, beach profile data are essential to help response personnel understand where oil might be buried and to what depths. Data can be collected by periodically surveying regular, calibrated beach profiles to show changes in beach elevation with time. By combining beach profile data with initial oiling data, the data team can recommend to the field teams where to look for buried oil.

Photomonitoring and time-series data

Photomonitoring sites at specific locations (identified by coastal features or stakes) and camera viewpoints produce useful time-series data through forms and photographs, showing the changes in oiling conditions, vegetative cover, erosion and profile changes over time. These are very useful for illustrating the progress of natural recovery and treatment of the affected shoreline to response personnel, external parties and the public.

Time-series photographs from photomonitoring surveys of an oiled wetland showing the change of oiling over time: (top) shortly after initial oiling; (bottom) several months after initial oiling.

How are shoreline treatment programmes completed?

Calibrated and experienced shoreline assessment teams can provide a process that enables a smooth and efficient closure of shoreline treatment operations. The response is completed when all responsible parties agree that sufficient appropriate treatment has been completed and that further activities may cease to provide a net environmental benefit or are no longer practicable (see Box 5 on page 21). An integrated, inter-agency shoreline assessment programme delivers 'consensual satisfaction' between the various parties and stakeholders, and each is kept engaged from the initial shoreline assessment surveys through to the segment inspection sign-off recommendations.

Shoreline assessment surveys and reports

The key objective during shoreline assessment surveys is to reach full team consensus regarding oiling observations and treatment recommendations to ensure consistent and accurate reporting. Agreement amongst the team members should be attained for each segment in the field so that important details are not missed or forgotten when producing formal paperwork after the surveys are completed. Field data, including oiled shoreline assessment forms, maps, photographs and sketches are collated for each segment. Oiled shoreline assessment forms include a descriptive summary of the oiling conditions for the segment and recommendations for treatment if the oiling is above the agreed end point criteria, together with guidance on whether treatment would provide a net environmental benefit.

Shoreline treatment recommendations (STRs)

Where the field teams recommend treatment, STRs are generated for approval by the decision makers, and then provided to the Operations Section to guide the shoreline clean-up activities. (See *Treatment options and constraints*, on page 20.)

Sign-off and completion

When the oiled shoreline assessment survey team agrees that a segment requires no further treatment (NFT) because:

(a) the segment meets the agreed end point criteria;
(b) the survey team considers the oiling to be ALARP; or
(c) they evaluate that there would be no net environmental benefit in further treatment,

they report their recommendation on a shoreline inspection report (SIR). See NWACP 2014 for an example SIR form.

In addition:

(d) the Safety Officer may determine that risks which cannot be mitigated preclude the continuation of field activities.

The final 'approval' for segment completion is made by the response management personnel (for example, the Incident Manager) based on the recommendations from the field teams.

Figure 8 *Segment completion process*

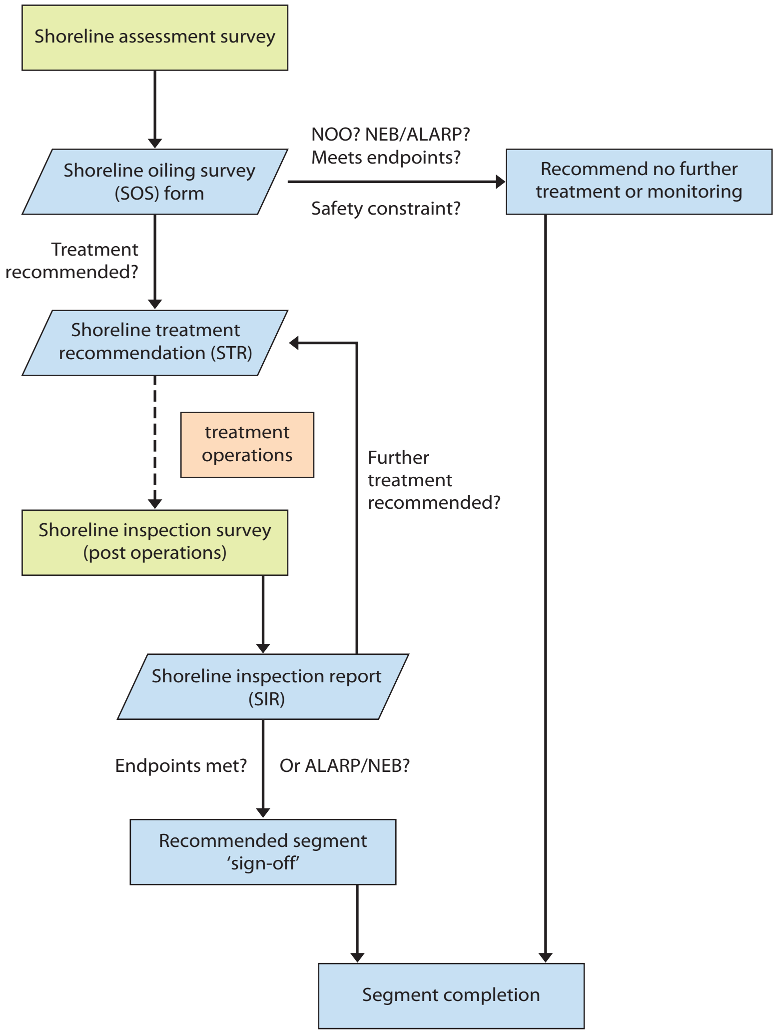


Figure 8 highlights the basic steps from initial shoreline surveys to completion on a segment-by-segment basis.

A successful shoreline assessment programme includes:

- the generation of timely information and data at the start of a response to scale the shoreline response programme;
- support for the Operations personnel to provide them with a clear understanding of what is expected in terms of treatment objectives, and what concerns or constraints apply to their actions and activities;
- the integration of parties who, through legislation, land management or other reasons, should be included in the development of treatment objectives and criteria, and the inspection/closure process; and
- the production of a formal record of oil conditions and treatment during the response.

Appendix 1: Example of an oiled shoreline assessment form

The example form below (POSOW, 2013) is designed for marine shorelines and was developed for non-technical surveyors. More technically-oriented forms are provided by MCA (2007), NOAA (2013) and Owens and Sergy (2004).

Surface and subsurface oiling conditions are recorded on the example below in boxes 6 and 7, respectively. Subsurface oil detection and delineation methods are described in API (2013).

box 1

GENERAL INFORMATION	Incident:	Date:
Commune/Region	Survey time: ....to............	Tide:

box 2

SURVEY TEAM	Organisation:	Telephone number:

box 3

SEGMENT	Segment ID: Name of site:	
Total Length: ....m	Length surveyed: .... m	
Start GPS: Lat	Long:	Other ref:
End GPS: Lat	Long:	Other ref:
Exposure: high / medium / sheltered / very sheltered / don't know		
Coastline type description (i.e estuary, boulder beach, marsh, cliff coastline, port.....):		

box 4

TOOL BOX: SHORELINE SUBSTRATE TYPE DESCRIPTION (NOT TO BE FILLED IN)	
Man-made structures [solid (quay...) / permeable (rip-rap...)]	Sand (60 µm to 2 mm)
	Mud (<60 µm) (grains not visible)
Cliff [rocky / soft]	Mixed sediments
	Sand with vegetation (dune)
Bedrock platform	Mud with vegetation (saltmarsh)
Boulder (> 25 cm)	
Cobble (6 cm to 25 cm)	
Pebble (2 cm to 6 cm)	
Granule (2 mm to 2 cm)	

box 5

OPERATIONAL FEATURES		
Direct backshore access? yes/ no	Suitable: pedestrian / trucks	
Accessible from the neighbouring segment? yes / no	Suitable: pedestrian / trucks	
Debris ? yes / no	Not much / a lot / don't know /approx. volume:	Oiled? yes / no
Algae/posidonia deposit? yes / no	Not much / a lot / don't know /approx. volume:	Oiled? yes / no
Oiled fauna? yes / no	Type	Nbr: ....
Uses: tourism / fishing / other:	Conservation: yes/no. If yes, specify: historical / archaeological /nature	

boxes 6 & 7

SURFACE OIL / SUBSURFACE OIL	If the segment has relatively uniform oiling conditions along or across shore, complete one section: zone A. If not, subdivide the segment into as many zones as necessary and complete as many sections : B, C, D....

ZONE A Level: upper beach / middle beach / lower beach (circle option). If necessary: Long:....... Lat:........

Substrate	6. Surface oil? yes / no					7. Subsurface oil: yes / no / don't know				
								Buried		
(choose type from Box 4)	Length (m)	Width (m)	Distr*	Thick**	Charact***	Pit ID	Penetration depth (cm)	depth (cm)	thickness (cm)	water (cm)

* **Distr**ibution: **Tr**ace < 1%; **SP**oradic (1-10%); **PA**tchy (11- 50%); **BR**oken (51-90%); **CO**ntinuous (91-100%)
** **Thick**ness: **TO** = **T**hick **O**il >1 cm; **CV** = **C**o**V**er 1 mm to 1 cm; **CT** = **C**oa**T** <1 mm; **FL** = **F**i**L**m = transparent sheen
*** **Charact**eristics: **FR** = **FR**esh; **MS** = **M**ou**S**se; **TB** = **T**ar **B**alls <10 cm; **PT** = Tar **P**a**t**ties: 10 cm to 1 m; **PA** = **PA**tches:1 to 30 m; **SR** = **S**urface oil **R**esidue: non cohesive oiled sediment; **AP** = **A**sphalt **P**avement: cohesive mixture; **TA** = **TA**rry: almost solid weathered oil.

boxes 6 & 7

ZONE B Level: upper beach / middle beach / low beach (circle option). If necessary: Long:....... Lat:........

Substrate	6 Surface oil? yes / no					7. Subsurface oil: yes / no / don't know				
(choose type from Box 4)	Length (m)	Width (m)	Distr*	Thick**	Charact***	Pit ID	Penetration depth (cm)	Buried depth (cm)	Buried thickness (cm)	Buried water (cm)

ZONE C Level: upper beach / middle beach / lower beach (circle option). If necessary: Long:....... Lat:........

Substrate	6 Surface oil? yes / no					7. Subsurface oil: yes / no / don't know				
(choose type from Box 4)	Length (m)	Width (m)	Distr*	Thick**	Charact***	Pit ID	Penetration depth (cm)	Buried depth (cm)	Buried thickness (cm)	Buried water (cm)

ZONE D Level: upper beach / middle beach / lower beach (circle option). If necessary: Long:....... Lat:........

Substrate	6 Surface oil? yes / no					7. Subsurface oil: yes / no / don't know				
(choose type from Box 4)	Length (m)	Width (m)	Distr*	Thick**	Charact***	Pit ID	Penetration depth (cm)	Buried depth (cm)	Buried thickness (cm)	Buried water (cm)

BACK TO BOX N° 3 TO FILL IN THE LENGTH SURVEYED!

box 8

GENERAL COMMENTS / SKETCH

* **Distr**ibution: **Tr**ace < 1%; **SP**oradic (1-10%); **PA**tchy (11- 50%); **BR**oken (51-90%); **CO**ntinuous (91-100%)

** **Thick**ness: **TO** = **T**hick **O**il >1 cm; **CV** = **C**o**V**er 1 mm to 1 cm; **CT** = **C**oa**T** <1 mm; **FL** = **F**i**L**m = transparent sheen

*** **Charact**eristics: **FR** = **FR**esh; **MS** = **M**ou**S**se; **TB** = **T**ar **B**alls <10 cm; **PT** = **T**ar **P**atties: 10 cm to 1 m; **PA** = **PA**tches:1 to 30 m; **SR** = **S**urface oil **R**esidue: non cohesive oiled sediment; **AP** = **A**sphalt **P**avement: cohesive mixture; **TA** = **TA**rry: almost solid weathered oil.

Appendix 2: Oiled shoreline assessment programme checklist

This checklist is adapted from NWACP, 2014.

Initial reactive phase

- Deploy aerial reconnaissance and/or rapid ground response teams to gather preliminary information on the oiled shoreline.
- Establish communications and coordination with Operations and Safety personnel.
- Establish a shoreline assessment programme coordinator.
- Establish the objectives of the shoreline assessment programme, using the overall response objectives as guidance.
- Determine the scope and scale of the initial area to be surveyed by shoreline assessment field teams.
- Determine who will participate in the field survey (that is, who is represented on the field teams).
- Determine the number of field survey teams and appropriate level of support personnel.
- Segment the survey area (if the area is pre-segmented, check the need for any revisions and make any necessary amendments).
- Establish a data management system and, if possible, access an appropriate digitized shoreline.
- Select, and if necessary modify, the appropriate shoreline assessment forms to be used by the field teams and coordinate with the data manager to ensure compatibility.
- Establish and develop shoreline assessment reporting metrics.
- Develop a survey and reporting schedule to introduce key survey information in time for incorporation into the planning schedule for shoreline operations.
- Identify incident-specific health and safety considerations for shoreline assessment operations.
- Identify and assemble the essential logistics and survey equipment for the field teams.
- Begin drafting a shoreline response plan.

Planning phase

- Finalize the shoreline response plan.
- Determine which areas are to be surveyed, and prioritize segments (may require overflight data).
- Prepare, deploy and manage field survey teams.
- Establish a process for summarizing field data and communicating data as appropriate to response managers and planners, using agreed-upon metrics.
- Develop procedures for translating field oiling data into shoreline treatment recommendations, which must include stakeholder input, regulatory compliance (site specific), and management approval.
- Determine how treatment end points are selected (for example, through Technical Working Groups, if needed).
- Develop and submit initial clean-up guidelines and end points to the response management for approval.

Operational phase

- Ensure that all elements of the shoreline response plan are being addressed and documented.
- Monitor the effectiveness of the clean-up.
- Monitor and document changes in oiling locations, character and extent.
- Develop periodic summary and progress reports (initially these may be daily data reports but would transition into weekly summaries).

Completion phase

- Determine the formal completion inspection and approval process/procedures.
- Establish a communications protocol with the Operations Section that notifies the programme coordinator when clean-up treatments have been completed on a given segment.
- Evaluate the need for establishing a post-treatment assessment survey as a dress rehearsal for final sign-off and closure inspections with the land-owners/managers.
- Deploy shoreline assessment teams to conduct post-clean-up inspections to confirm that the end points have been achieved.
- Ensure that all of the documents are collected and archived.
- Document and disseminate lessons learned from shoreline assessment and treatment.

Acronyms

ALARP	As Low As Reasonably Practicable
GIS	Geographic Information Systems
GPS	Global Positioning System
IMS	Incident Management System
IMO	International Maritime Organization
IPIECA	The Global Oil and Gas Industry Association for Environmental and Social Issues
NEBA	Net Environmental Benefit Analysis
NFT	No Further Treatment
NOO	No Oil Observed
PPE	Personal Protective Equipment
QA/QC	Quality Assurance/Quality Control
SCAT	Shoreline Clean-up Assessment Technique
SIR	Shoreline/Segment Inspection Report
SOS	Shoreline Oiling Summary
STR	Shoreline Treatment Recommendation
TWG	Technical Working Group

Acknowledgements

The text for this guide was prepared by Ed Owens and Helen Chapman Dubach (Owens Coastal Consultants).

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www.shorelinescat.com A website for SCAT resources.

IPIECA

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance; and is the industry's principal channel of communication with the United Nations. Through its member led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.

www.ipieca.org

IOGP International Association of Oil & Gas Producers

IOGP represents the upstream oil and gas industry before international organizations including the International Maritime Organization, the United Nations Environment Programme (UNEP) Regional Seas Conventions and other groups under the UN umbrella. At the regional level, IOGP is the industry representative to the European Commission and Parliament and the OSPAR Commission for the North East Atlantic. Equally important is IOGP's role in promulgating best practices, particularly in the areas of health, safety, the environment and social responsibility.

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Shoreline response programme guidance

A technical support document to accompany the IPIECA-IOGP guidance on oiled shoreline assessment and shoreline clean-up techniques

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Shoreline response programme guidance

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Contents

Preface

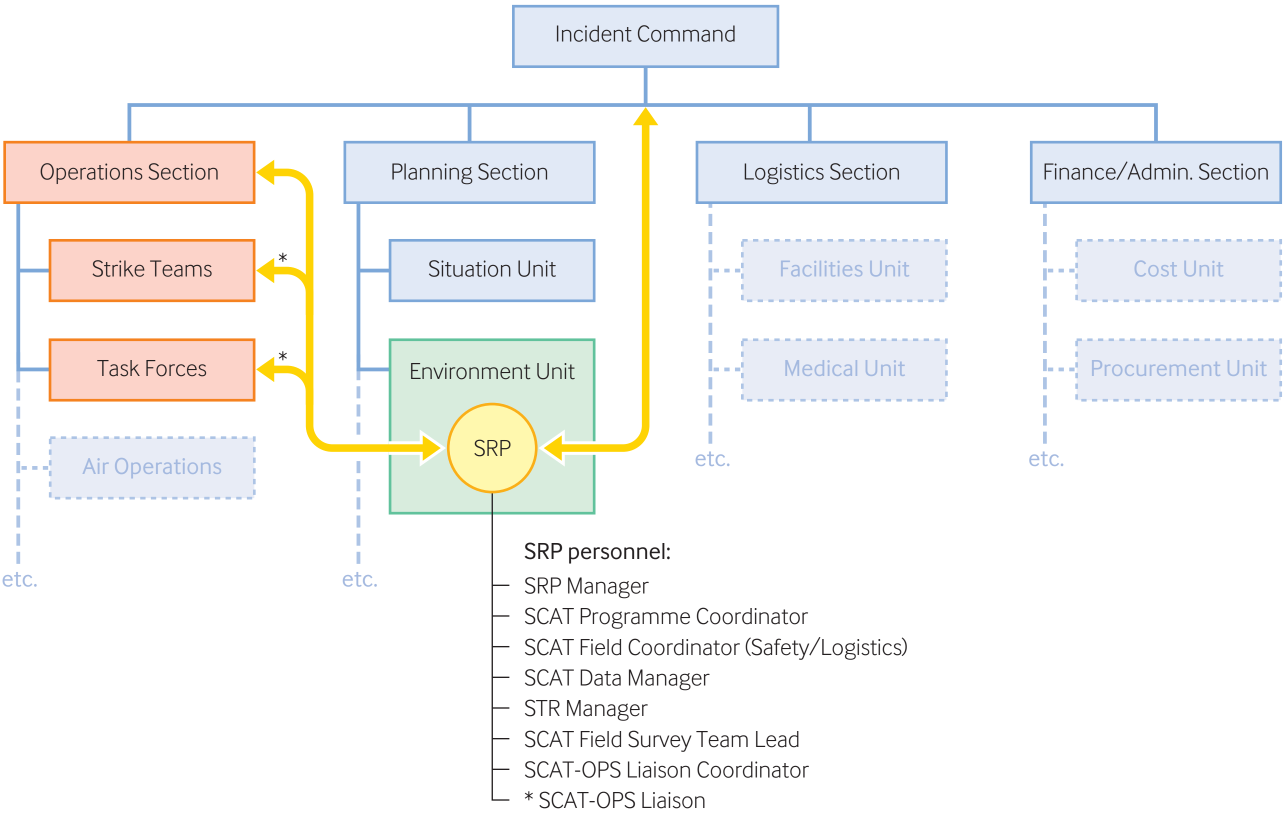
This publication is an extension of the IPIECA-IOGP Good Practice Guide Series which summarizes current views on good practice for a range of oil spill preparedness and response topics. The series aims to align industry practices and activities, inform stakeholders, and serve as a communication tool to promote awareness and education.

This publication builds on the good practice guide entitled *A guide to oiled shoreline assessment (SCAT) surveys* (IOGP-IPIECA 2014a) which sets out the broad principles regarding the processes of conducting surveys of oiled or potentially oiled shorelines using a systematic and objective approach.

This technical support document goes further, to describe how this approach is incorporated into a comprehensive shoreline response programme (SRP) that is fully integrated into the incident management system (IMS). The document is designed as an enabling tool to help oil companies and other stakeholders implement an SRP, and uses the latest experience and knowledge gained from actual oil spills and exercises to demonstrate how to embed the SRP within the IMS. This approach formally establishes the SRP function under the Planning Section and within the Environment Unit, and is founded upon strong liaison connections with the Operations Section and Incident Command (see Figure 1).

Further information on the IMS in the context of oil spill preparedness and response can be found in the good practice guide entitled *Incident management system for the oil and gas industry* (IOGP-IPIECA 2014b).

Figure 1 Simplified organizational structure of a typical IMS, showing the integration of an SRP which incorporates the SCAT programme and serves as the single point of contact for all shoreline-related issues and activities



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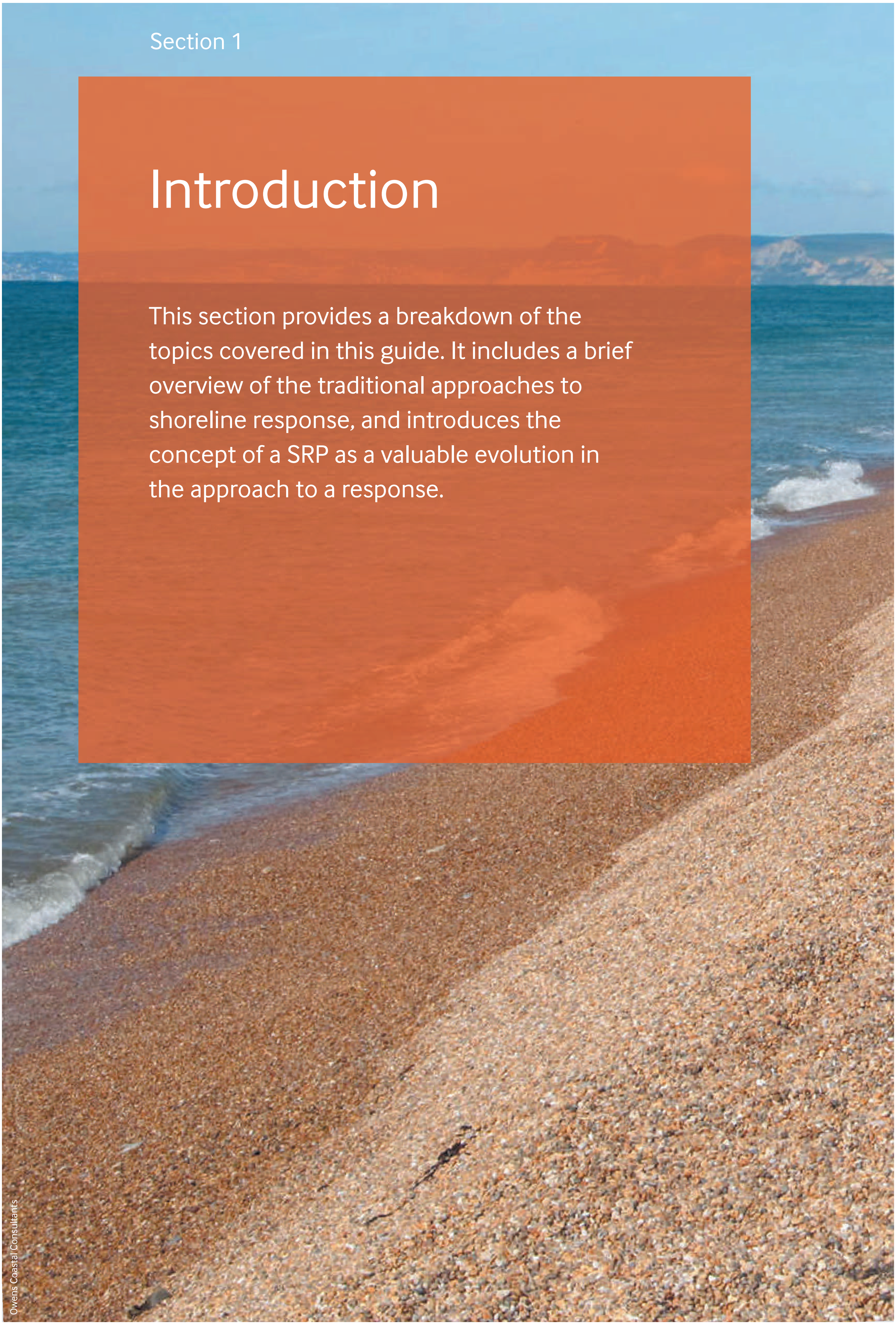
Section 1

Introduction

This section provides a breakdown of the topics covered in this guide. It includes a brief overview of the traditional approaches to shoreline response, and introduces the concept of a SRP as a valuable evolution in the approach to a response.



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Introduction

HOW THIS GUIDE IS ORGANIZED

This structure of this guide is shown in Figure 2.

Figure 2 Structure of the guide

Section 1: Introduction	• Traditional approaches to shoreline response • What is an SRP? • A valuable evolution in the approach to shoreline reponse
Section 2: Overview	• Objectives and functions of an SRP • Key improvements and benefits of an SRP compared to the current IMS
Section 3: Organization	• The SRP management structure • The Environment Unit and the SRP • The SRP and the Operations Section • Roles and responsibilities of SRP staff
Section 4: Operation of a shoreline response programme	• The first response phase: 'Getting it right from the start' • The planned phase: (a) decision-making and the SRP plan; (b) SRP project implementation • The completion phase • The SRP role in the planning cycle • SCAT as part of the SRP • Stakeholder engagement
Section 5: Training, drills and continued improvement	• Training and drills are an essential part of the SRP concept
Appendices: Job aids	• Appendix 1: SRP summary information (a stand-alone description of an SRP and its value in an IMS) • Appendix 2: SRP activity steps and checklists • Appendix 3: Generic template for an SRP plan • Appendix 4: Generic shoreline treatment recommendation (STR) form for use in the initial response phase (sand beach example)

TRADITIONAL APPROACHES TO SHORELINE RESPONSE

The shoreline component of an oil spill response involves the greatest resource commitment, effort, time and cost elements of most oil spill responses, large or small, and continues far longer than the higher-profile on-water phase of a response. The initial response to most marine spills has, appropriately, been focused on controlling the source and containing and/or removing floating oil. Typically, attention does not begin to shift to the shoreline response until after a shoreline has become oiled. This shift often involves creating and staffing a Shoreline Response Branch within the Operations Section, mobilizing shoreline clean-up resources, establishing the necessary infrastructure to support shoreline operations, developing an oiled shoreline assessment programme—also known as a shoreline clean-up assessment technique (SCAT) programme—within the Environment Unit, along with various other activities, during which time oil continues to impact the shorelines.

Once a SCAT programme is operational, the traditional onshore response process involves shoreline assessment surveys to detect and document the degree of oiling, and the development of recommendations for the most appropriate and effective technique(s) for treating or cleaning each segment of oiled shoreline (i.e. segment/shoreline treatment recommendations or STRs — see Section 4). The STRs are processed by the Environment Unit, and may or may not include stakeholder input; these are then submitted to the Incident Command for approval or modification. Once approved, the STRs are incorporated into the incident action plan (IAP) which is provided to the Operations Section for implementation.

TERMINOLOGY

The terms 'shoreline treatment' and 'shoreline clean-up' are essentially synonymous and both are used in the guide. The term 'treatment' is usually more accurate because 'clean-up' implies that all of the oil is removed from the shoreline. In most response operations, the reality is that some surface or subsurface oil residues may be left intentionally to weather and attenuate naturally.

Once operational, a traditional shoreline clean-up programme can be effective in removing stranded oil, reducing environmental, socio-economic and cultural impacts, and accelerating natural recovery. However, the length of time it usually takes for such a clean-up programme to become fully operational often results in greater initial and sustained shoreline impacts, as well as more costly shoreline response operations taking place over a longer duration. Another drawback with the traditional approach is that, typically, there is no direct communication between the SCAT teams/programme responsible for creating the STRs and the field operations clean-up crews responsible for their implementation. Consequently, operations supervisors and clean-up crews may not have fully understood how, or even exactly where, to conduct the recommended shoreline clean-up activities. This lack of communication has led to reduced efficiency and, in some cases, collateral environmental impacts from the clean-up operations.

WHAT IS AN SRP?

The SRP model addresses planning, preparation, training and response management for the shoreline component of an Incident Management Team (IMT). This guide describes why and how an SRP is created when a shoreline is threatened by oil or has been oiled. The document supports the IPIECA-IOGP good practice guides entitled *A guide to oiled shoreline assessment (SCAT) surveys*[1] and *A guide to oiled shoreline clean-up techniques*[2] which were published in 2014 and 2015, respectively, to provide guidance on managing the response to an oil spill incident. The SCAT good practice guide provides a greater level of detail on the planning and implementation of field survey missions than this guide.

An SRP provides a robust and focused framework to manage, coordinate, integrate and streamline strategic shoreline response planning and recommendations for shoreline treatment and clean-up, from the initiation of the response to the completion of treatment operations.

[1] IPIECA-IOGP, 2014a.

[2] IPIECA-IOGP, 2015a.

More specifically, an SRP provides a single source for information and data related to shoreline impacts, treatment recommendations, tracking the progress of operations, etc. as well as creating direct communication links between the SCAT programme, the Environment Unit, Incident Command and, most importantly, the field operations supervisors and crews conducting the response activities. Additionally, an SRP can facilitate stakeholder input into the STRs through the formal incorporation of this process into the SRP within the Environment Unit.

The SRP is a paradigm shift that creates a management culture, and a planning and preparation structure, to elevate shoreline response to a higher priority and level of support within the current organization of an IMT. An SRP focuses on strategic and tactical planning that integrates streamlined decision and operational implementation processes in order to minimize short- and long-term shoreline impacts and the costs of shoreline clean-up. The concept harnesses the recognized strengths of a SCAT programme within an integrated and focused approach in a manner that constitutes an adjustment to, rather than a change of, the IMT structure.

IN SUMMARY:
What is an SRP?

- The SRP is an arrangement within the IMS that focuses on strategic and tactical planning to minimize the short- and long-term impacts of oil on shorelines and the costs of the shoreline response.
- An SRP builds on the recognized strengths of an IMS-based organization (known as an Incident Management Team or IMT) and a SCAT programme, and utilizes an integrated and focused approach that streamlines and better coordinates the decision and planning processes and the operational implementation activities.

A VALUABLE EVOLUTION IN THE APPROACH TO SHORELINE RESPONSE

Creating an SRP as soon as a shoreline threat is identified is critical to 'getting it right from the start' when responding to an oil spill. The creation of an SRP establishes a shoreline response with an appropriate level of management and operational support during a period when there is competition for these resources, and when a higher priority is typically placed on the on-water activities. Lessons learned from oil spills over the past 20 years have shown that when a shoreline response has been assigned a much lower priority, the initiation of shoreline clean-up is delayed significantly, resulting in:

- missed opportunities to recover the stranded oil when it is most concentrated and before it remobilizes to other areas;
- increased impacts of the stranded oil (environmental, economic and social) due to longer oil exposure times;
- increased waste generation and waste management; and
- increased duration and costs of shoreline clean-up efforts.

These missed opportunities result, at least in part, from the lack of understanding of the SRP concept and its inclusion in drills, exercises and preparedness training. As a consequence, the concept and benefits of 'getting it right from the start' for the shoreline component of a response to a spill incident are often not fully appreciated or understood by planners, trainers or senior decision makers.

Many shoreline response actions, such as sourcing equipment and resources or locating potential staging areas, can be completed before oil reaches a shoreline. The momentum gained by these types of planning activities can save a considerable amount of time during the initial response, and enable clean-up operations to start within a shorter time frame.

After the initial response phase, shoreline operations require a long-term (weeks to months) strategy that does not fit easily into the short-term (days) focus of the typical initial IMS process.

Traditionally, shoreline response planning has been assigned to the Environment Unit, and the implementation of strategies and tactics to the Operations Section. On occasion, this has resulted in accountability and communications issues. The Environment Unit is one of the more complex components of an IMT, as this is the point of convergence of many operational and decisional elements that support the strategies and tactics which drive the direction and pace of a response. The Environment Unit is the primary source of all information for the decision-making processes, and the demands placed upon it are always high at the onset of a response.

During the initial response phase, the focus and efforts of the Environment Unit are typically concentrated on supporting on-water operations, and an SRP should work in parallel with these activities. For example, initial or pre-planned generic STRs for bulk oil removal can be prepared by the SRP Manager to facilitate the immediate progress of shoreline response objectives (see Section 4). These initial STRs for high-value and low-impact locations are developed in accordance with standard accepted practices, such as manual removal or low pressure flushing, and contain recommended good management practices (GMPs) with appropriate concerns or constraints relating to ecological, cultural/human resources and safety issues. The STRs are reviewed by the Environment Unit Leader (ENVL), approved by the Incident Command and passed to the Operations Section to facilitate an immediate shoreline response.

The SRP resides in the Environment Unit and can streamline planning and implementation by providing focused support and an integrated perspective on shoreline issues for the decision-making and planning processes that take place throughout the response. This redefinition of the manner in which data and information are generated and processed, and how shoreline response treatment decisions are implemented, is a significant process shift, yet it does not involve any restructuring or reorganizing of the traditional SCAT field programme or the IMS/IMT.

A communications innovation in the SRP concept is the SCAT-Operations Liaison (SCAT-OPS Liaison) function that is based within the Environment Unit but liaises directly with, and supports, the Operations Section.

This is discrete from the SCAT data collection or inspection functions and is carried out either by the SCAT Field Survey Team or by an assigned individual, depending on the scale of the response. The SCAT-OPS Liaison function facilitates a solid working relationship and builds trust with the Operations Section and their field teams, as well as ensuring that the STRs are appropriately followed.

IN SUMMARY:
A valuable evolution in shoreline response

The response to oil threatening a shoreline, or already on the shoreline, has typically had a much lower priority, and been assigned fewer management and response resources than on-water operations. This has led to the following results:

- Shoreline clean-up has not been effective at a time when the best gain can be obtained.
- Sensitive and vulnerable coastal resources have been exposed for longer periods of time.
- The shoreline clean-up programme has taken longer to complete.

An SRP is a single point of contact within the Environment Unit for all shoreline activities and issues, and provides the following advantages:

- A more rapid and effective response capability at the start of a response.
- A long-term focus for an operation that often continues for several months, or longer, at a time when the management is typically focused on short-term issues related primarily to the on-water response.
- A sustainable and consistent shoreline response through to completion of operations while maintaining effective span of control.
- A communications protocol that bridges the previously separate responsibilities of the Environment Unit (shoreline decision-making and planning processes, including stakeholder engagement) and the Operations Section (implementation of shoreline clean-up activities).
- A streamlining of activities in the Environment Unit which is the point of convergence of the many decision and planning elements that drive the direction and pace of a response.

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Overview

This section provides an overview of the objectives and functions of an SRP, and highlights the key improvements and benefits of an SRP compared to the current IMS.

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Overview

OBJECTIVES AND FUNCTIONS OF AN SRP

The objectives and primary functions of the SRP are to:

- focus an appropriate level of management and response resources on the shoreline treatment components at the start of the response before a shoreline is oiled or as soon as it is oiled;
- maintain span of control through to completion of the SRP; the key functions of an SRP may all be filled by one person on a small-scale response, or by multiple people as the scale of the response expands and contracts;
- recommend a feasible and effective SRP and strategy with the appropriate priority level;
- recommend a shoreline oil removal strategy during the initial response phase before the oil reaches the shoreline or while oil is still concentrated, so that the greatest gain can be obtained before the oil is reworked, buried or remobilized by natural processes;
- develop a long-term shoreline treatment strategy in coordination with the IMT decision makers—Planning Section Chief (PSC), Environment Unit Leader (ENVL) and Operations Section Chief (OSC)—to generate, implement and manage an SRP plan;
- implement and manage a SCAT programme, with the SCAT plan being embedded within the SRP plan;
- provide systematic survey data, and processed information and interpretations (maps and tables) to the IMT decisions makers;
- provide products such as shoreline oiling maps, STR tracking maps and associated statistics to enhance situational awareness as well as external communications;
- participate in stakeholder engagement, initiated by the ENVL, to build a consensus on treatment priorities and methods, and on clean-up criteria, based on a net environmental benefit analysis (NEBA)[3]/spill impact mitigation assessment (SIMA);[4]
- incorporate STRs into the IAP (the STRs are derived from the SCAT database, prepared by the SRP team, reviewed by the Environment Unit and approved by the Incident Command);
- liaise with the Operations Section, both in the Command Post and in the field, through the SCAT-OPS Liaison process to ensure that the SRP plan and the STRs in the IAP are understood and implemented appropriately;
- develop and test new or improvised shoreline treatment tactics, and track and monitor STRs and operational progress; and
- manage the inspection of completed STRs (with stakeholder participation) and removal of approved shoreline segments from the response.

OSRL

Shoreline sensitivity assessment exercise in the UK as part of an effort to develop a shoreline response strategy

[3] See IPIECA-IOGP, 2015c

[4] See IPIECA-API-IOGP, 2017

KEY IMPROVEMENTS AND BENEFITS OF AN SRP COMPARED TO THE CURRENT IMS

The following five areas identified for improvement over the current IMS process are addressed by the creation of an SRP:

1. **Separation of responsibility:** The current IMS concept is a proven and effective system but can be prone to communication and accountability issues. In this system the responsibility for a shoreline programme is shared between the Planning and Operations Sections, with the decision processes lodged in the Environment Unit and implementation of those decisions managed by the Operations Section. An SRP acts as a bridge between these two key components of an IMS, and is assigned the overall responsibility for the strategic planning and appropriate implementation of shoreline treatment strategies. Accountability for the SRP is maintained within the Environment Unit through the STR approval process.
2. **Streamlining:** The Environment Unit is the point of convergence of many operational and decisional elements that support the strategies and tactics which drive the direction and pace of a response. An SRP, under the direction of the SRP Manager, can streamline the planning and decision-making processes within the Environment Unit, and enable more effective span of control by providing focused support and an integrated perspective on all shoreline treatment issues, including the collection of shoreline oiling assessment data (SCAT) and STR implementation (see *The Environment Unit and the SRP* on page 18).
3. **Communications:** An SRP offers a single point of contact for the wide range of management and operational issues and activities that relate to a shoreline response; it provides a direct bridge between the Environment Unit and the Operations Section to better coordinate and streamline the decision-making and implementation activities (see *SCAT-OPS Liaison* on page 31).
4. **Operations support:** In the current IMT structure there is no mechanism in place for the Environment Unit to provide direct support for the Operations Section's shoreline clean-up task forces or strike teams in the field; this support is provided by the SRP through the SCAT-OPS Liaison function (see *The SRP and the Operations Section* on page 23 and *SCAT-OPS Liaison* on page 31).
5. **Preparedness and training:** Missed opportunities at the outset of a response—the time when shoreline treatment is typically able to provide the best potential gain—largely result from the lack of inclusion of an SRP concept in drills, exercises and preparedness training. As a consequence, the concept and benefits of setting up an SRP prior to shoreline oiling, or as soon as the shoreline is oiled, by 'getting it right from the start' are typically not fully appreciated or understood by planners or senior decision makers (see Section 5).

An SRP provides numerous benefits and advantages associated with these and other improvements, as described below:

- An SRP elevates shoreline response activities to a higher level of recognition within the IMT prior to shoreline oiling, and during the initial assessment and response phase, so that SRP efforts are initiated immediately and receive an appropriate level of management and operational support.
- Following the initial impacts of an oil spill, an SRP enables a more rapid shoreline response to recover bulk or mobile oil before it is reworked, buried or remobilized through natural processes.
- A more rapid shoreline response minimizes long-term impacts on shorelines and reduces the generation of waste and restoration efforts.
- An SRP provides a single point of contact on all shoreline-related issues, improving communication, decision-making, consistency and accountability.
- An SRP develops objectives and criteria for the initial response when shoreline response actions can be most effective, and maintains a sustained shoreline response effort with span of control as the effort expands and contracts through to completion of operations.
- Time and effort are saved by streamlining the span of control within the Environment Unit, as this is the point of convergence of many operational and decisional elements that support the strategies and tactics which drive the direction and pace of a response.
- An SRP creates a vehicle for long-range strategic planning from the beginning of a response when the focus and decision-making processes are typically concentrated only on the short-term on-water response.

IN SUMMARY:
Overview of an SRP

The key objectives and functions of an SRP are to:

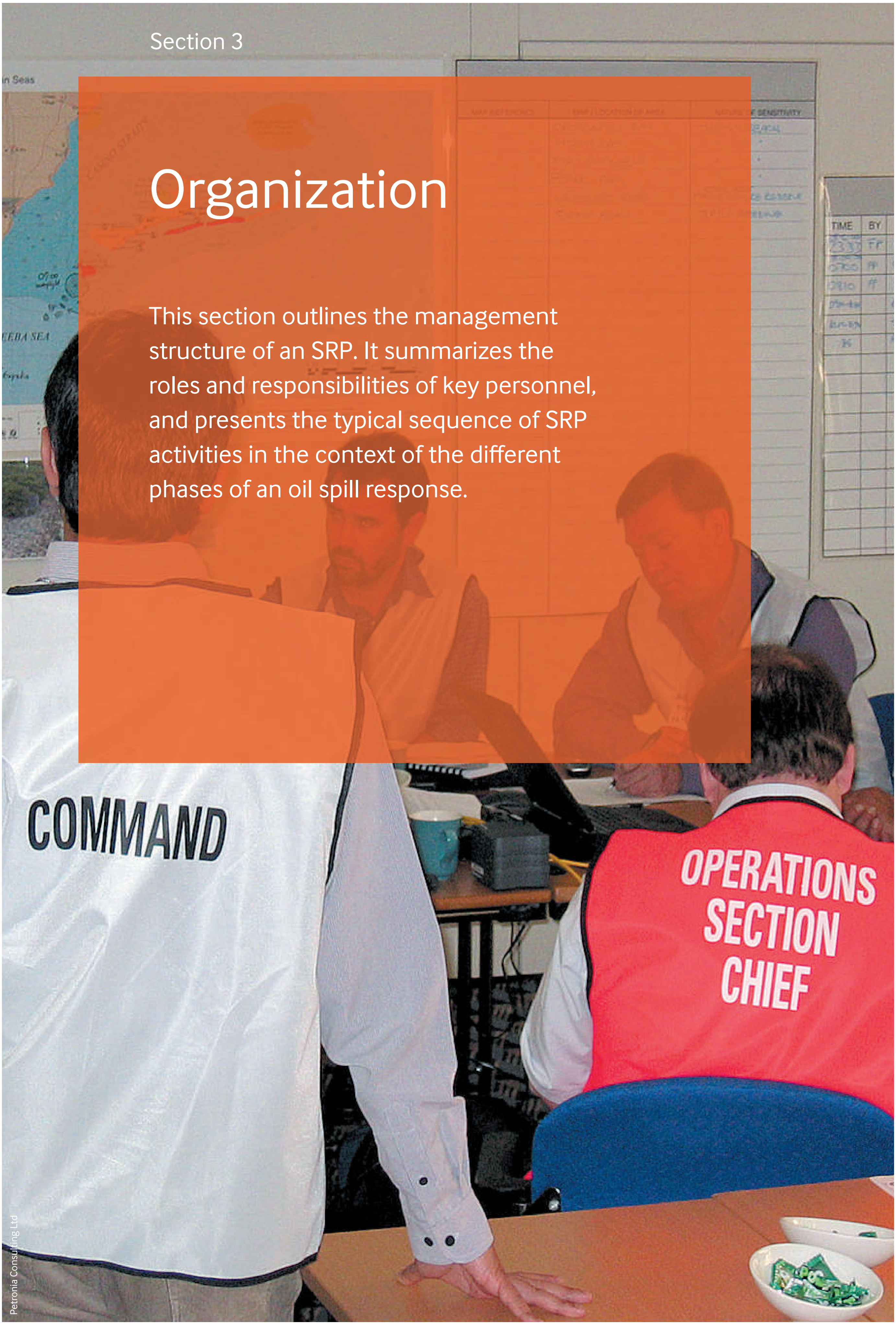
- focus an appropriate level of management and response resources on the shoreline treatment components at the start of the response and, if possible, before oil reaches a threatened shoreline, and maintain span of control through to completion of the SRP;
- manage a SCAT programme as an integral part of the SRP, and liaise with the Operations Section through the SCAT-OPS Liaison process to ensure that STRs are understood and appropriately implemented; and
- manage the inspection of treated shoreline segments, preferably with stakeholder involvement, and manage the removal of approved segments from the response.

The SRP addresses the following four areas identified for improvement in the current IMS process:

1. The current separation of responsibility and accountability for the planning and decision-making processes lodged in the Environment Unit, and the implementation of those decisions managed by the Operations Section, is bridged by the SRP which serves as the single point of contact for all shoreline issues.
2. Planning and decision-making processes are streamlined within the Environment Unit—which is responsible for a wide range of diverse technical and decision-making activities—by providing focused short-term (daily) support and a long-term strategic integrated perspective on all shoreline treatment issues that drive the direction and pace of a response.
3. This single point of contact provided by an SRP enables better coordination and communication between the Planning Section/Environment Unit and the Operations Section.
4. Currently there is no mechanism in place for the Environment Unit and SCAT teams/programme to provide direct support for the Operations Section's shoreline clean-up task forces or strike teams in the field; this is provided by the SRP team through the SCAT-OPS Liaison function.

Organization

This section outlines the management structure of an SRP. It summarizes the roles and responsibilities of key personnel, and presents the typical sequence of SRP activities in the context of the different phases of an oil spill response.



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Organization

THE SRP MANAGEMENT STRUCTURE

The SRP is an innovation to improve the functionality and effectiveness of an IMS. Traditionally, the responsibility for shoreline response planning has been assigned to the ENVL and/or a shoreline clean-up assessment technical specialist (SCA-TS) in the Environment Unit, whereas the implementation and management of strategies and tactics have been assigned to the Operations Section. The Environment Unit is, typically, a large multifunctional group with as many as a dozen or more technical specialists. An SRP that includes the SCAT programme may be a large component of the Environment Unit effort, and typically requires individual leadership for effective span of control. The management structure for an SRP still resides within the Environment Unit; however, it is the SRP Manager rather than the ENVL who functions as the single point of contact for the Incident Command on all shoreline-related issues.

While the Environment Unit continues to focus on environmental issues, and on achieving consensus within the IMT and with stakeholders regarding decisions that define the shoreline response objectives, priorities, constraints and treatment end-point criteria, the SRP team consolidates SCAT and other relevant shoreline oiling data with those decisions to create, implement and manage an SRP through an SRP plan.

The SRP team and the Operations Section work together to confirm that the STRs presented in the IAP are practical and are understood and implemented correctly, and to determine the effectiveness of clean-up treatments.

The role of the SRP Manager is structured around three key areas:

- working with members of the IMT;
- managing the systematic SCAT process; and
- recommending strategic plans for the shoreline response.

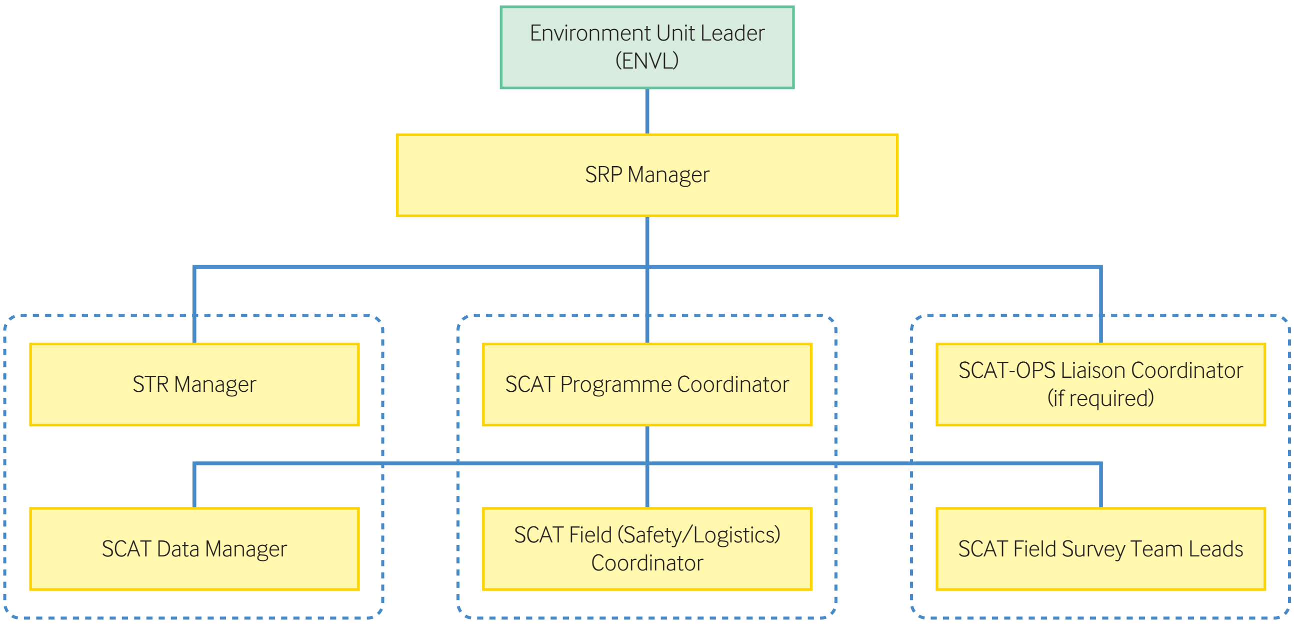
The key functions of an SRP may all be filled by one person on a small-scale response or by multiple people (Figure 3) as the scale of the response and the appropriate span of control expands and contracts.

The SRP is embedded in the Environment Unit, and the SRP Manager reports directly to the ENVL. At a minimum, the SRP would involve the SRP Manager working with the IMT and a SCAT Field Survey Team Lead to conduct the field assessment survey. When a response involves the deployment of two or more SCAT teams it is important that a SCAT Data Manager is mobilized immediately to ensure rapid processing and turnaround of the field data and the generation of STRs. The SCAT Data Manager should ensure that quality assurance (QA) and quality control (QC) of the data are maintained. Data management can quickly become a bottleneck at the outset of a response. The SCAT Data Manager would work with the SCAT Field Survey Team Lead to generate and monitor the STRs.

At the next response level, for a short-term response (days to weeks), the SRP Manager may be supported by a:

- SCAT Programme Coordinator (page 27) who would provide field safety and logistics support for the SCAT Field Survey Teams;
- SCAT Data Manager/STR Manager (pages 29 and 30);
- SCAT Field Survey Team Lead (page 30); and
- in a response with multiple concurrent STRs, a SCAT-OPS Liaison Coordinator (page 32).

Figure 3 Vertical integration for a medium- or large-scale response operation



Initially the SCAT Data Manager could be responsible for the STRs, but for a medium- or large-scale, long-term response with increasing span of control issues (IPIECA, 2015b), there will typically be a need for an STR Manager to coordinate the preparation and approval of STRs, and to track the progress of the individual STRs through to completion (Figure 3). At this level, the SCAT Programme Coordinator would be responsible for:

- the delegation of field activities to a SCAT Field (Safety and Logistics) Coordinator who would work directly with the Team Leads;
- data QA/QC, data management, storage and dissemination (through the SCAT Data Manager); and
- maintaining strong links and communications with the Operations Section through the STR Manager.

Initially the SCAT Field Survey Teams provide support to the Operations teams in the field to interpret and explain the STRs and other Environment Unit decisions, guidelines or constraints (see *The SRP and the Operations Section* on page 23). As the scale of a response and the number of STRs increases, the SCAT Field Survey Team Lead may not have sufficient time or spatial capability to maintain this support, and separate dedicated field SCAT-OPS Liaisons may be deployed as the SRP representatives under the direction of a SCAT-OPS Liaison Coordinator (Figure 3).

IN SUMMARY:
The SRP Management structure

- An SRP is easily integrated into the IMS with a few adjustments at the Unit level, as the SRP Manager would report directly to the Environment Unit Leader (ENVL).
- Span of control within the Environment Unit can be improved by separation of the two primary functions:
  1. SCAT data collection, interpretation and recommendations, and SCAT-OPS Liaison, led by the SRP Manager; and
  2. the decision-making process, supported by a range of technical specialists, stakeholders and Technical Working Groups (TWGs), led by the ENVL or a Deputy or Assistant ENVL.
- As the scale of a response increases, the SRP Manager could become a Deputy or Assistant ENVL.
- To maintain span of control at the medium to large scale, the SRP Manager may be supported by a SCAT Programme Coordinator, a SCAT Field (Safety and Logistics) Coordinator, a SCAT Data Manager, an STR Manager and a SCAT-OPS Liaison Coordinator.

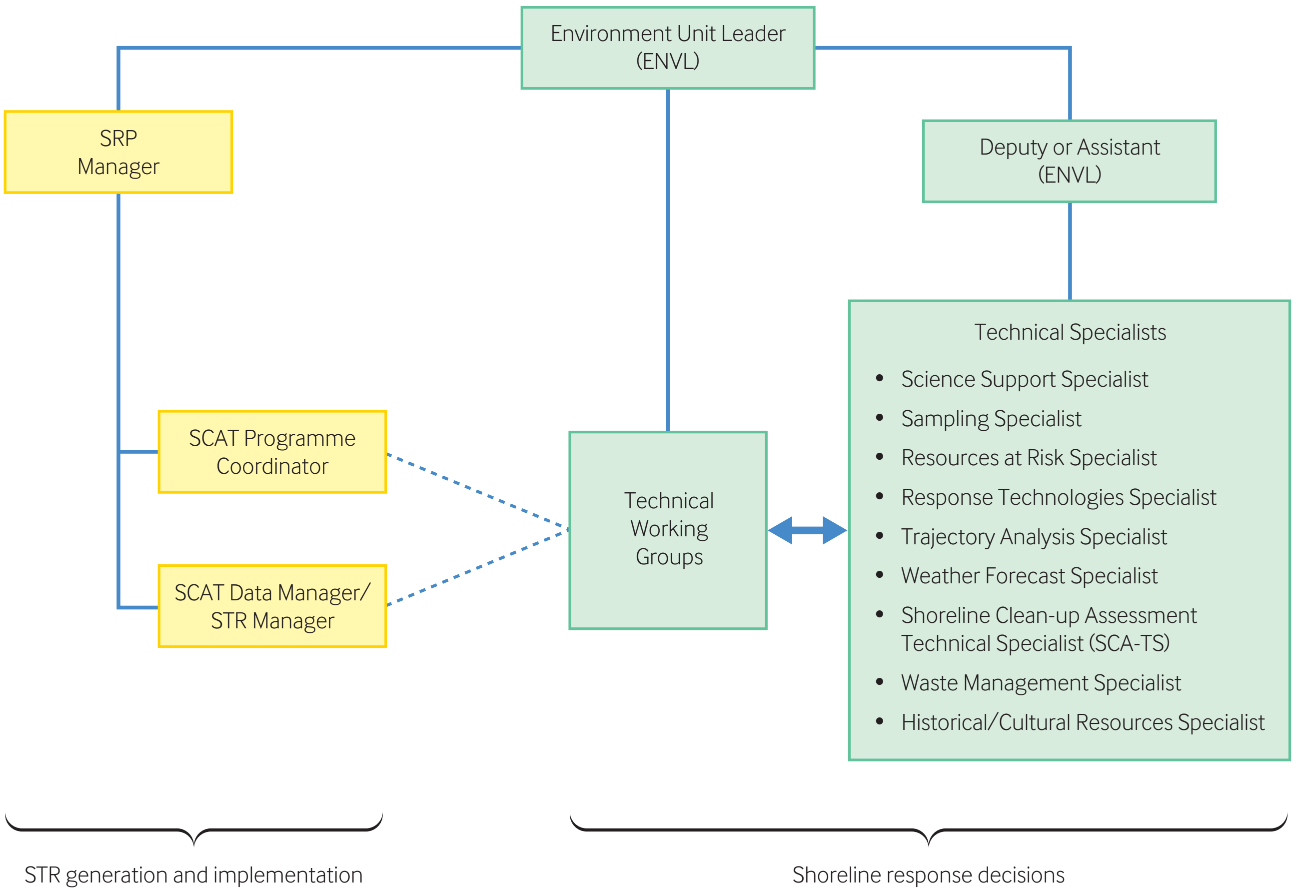
THE ENVIRONMENT UNIT AND THE SRP

The SRP operates within the Environment Unit to help develop the decisions that define the strategy and pace of a shoreline response. Recommendations from the SRP team are provided to the ENVL, who typically consults with Technical Working Groups (TWGs) or Technical Advisory Groups (TAGs) (see Figure 4), and then upward through the Planning Section Chief (PSC) for Incident Command approval of treatment objectives, priorities, clean-up options, constraints (GMPs) and treatment end-point criteria.

At the intermediate scale, during a tiered response (IPIECA, 2015b), span of control for the ENVL may involve the creation of one or more Deputy or Assistant ENVLs. Logically, one or more Deputy or Assistant ENVLs could be assigned to manage the numerous technical specialists within the Environment Unit as, collectively, these provide specific individual technical and scientific functions and subject matter expertise. A separate Deputy or Assistant ENVL could also be assigned to manage the SRP. This arrangement separates and streamlines two distinctly different functions of the Environment Unit (Figure 4), i.e.:

- the decision process that evaluates the data collected by the SCAT team and other field teams, along with data generated by technical specialists, to reach consensus within the TWGs on response (treatment) priorities, strategies and tactics, and completion criteria; and
- the SRP which collects and processes the SCAT field data, generates STRs based on the treatment end-point criteria established by the Environment Unit/TWGs, and works with the Operations Section to implement the STRs and GMPs.

Figure 4 Example of the potential horizontal integration of the Environment Unit and an SRP for intermediate- and large-scale responses



The following activities are undertaken to establish shoreline response priorities, clean-up options, constraints and treatment end-point criteria:

- The SRP team collects and interprets shoreline oiling data and other relevant shoreline information, and presents this to the Environment Unit with recommendations on priorities, objectives, clean-up options, constraints and treatment end-point criteria. The SRP team engages with the Environment Unit's TWGs on matters relating to shoreline issues.
- Once treatment end-point criteria have been agreed, the SRP generates STRs for sections of shoreline that do not meet those criteria, and liaises with the Operations Section on the practicality, implementation and execution of the STRs in the IAP.
- The ENVL is responsible for stakeholder engagement, and for gaining consensus within the IMT and with external stakeholders on decisions that define priorities, clean-up options, constraints, treatment end-point criteria and inspection/closure protocols (see Section 4).
- The Environment Unit works with stakeholders, typically through the TWG process, to:
  - define constraints or GMPs for shoreline treatments;
  - develop treatment end-point criteria;
  - obtain necessary approvals and permits;
  - monitor and protect threatened and endangered species and other wildlife, or historical and cultural resources; and
  - reach consensus on individual or generic STRs.

The SRP function in the Environment Unit is directed by the SRP Manager, with a focus on:

- collection, interpretation and presentation of SCAT shoreline information;
- generation of SRP recommendations for the Environment Unit technical specialists/stakeholder group;
- development and implementation of an SRP/SCAT plan;
- generation of STRs for shoreline segments or zones that do not meet the treatment end-point criteria;
- implementation of the SRP objectives and decisions approved by the Incident Command; and
- liaison with the Operations Section.

The Environment Unit function to support the SRP may be assigned or delegated to a SCA-TS—an existing defined position in most IMTs. Under the guidance of the ENVL, the Environment Unit SCA-TS would focus on:

- synthesis of available shoreline data and information, including SCAT and shoreline operations data, and communicating these summaries internally within the IMT to other specialists in the Environment Unit, the Planning Section and Incident Command, or externally;
- engagement of a range of internal and external technical specialists and subject matter experts;
- establishment and coordination of TWGs or TAGs, such as a Shoreline Treatment Advisory Group (STAG); and
- engagement of stakeholders.


ITOPF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Shoreline assessment teams collecting oiling data and other relevant shoreline information

Box 1 The three phases of a response to an oil spill

Initial response phase

The initial response phase is the period when oil first threatens a shoreline, begins to wash ashore, or is already on the shoreline as the response operation commences. At first, larger quantities of oil typically accumulate within limited areas where they can be recovered before being reworked, buried or remobilized by natural processes. SCAT teams may not have sufficient time to undertake detailed shoreline surveys during this phase due to the fast-moving pace of the response; the timely development of initial treatment end-point criteria and tactics may therefore need to be based on reconnaissance information to enable immediate gross oil removal by non-intrusive techniques. During this phase the ENVL may have limited involvement with shoreline issues due to numerous other initial response demands, and may rely on the SRP Manager for leadership of the SRP and the identification of high-value, low-impact options.

Planned phase

The planned phase of a response is a proactive, sequenced long-term project strategy developed by the Environment Unit and the SRP team based on data from a detailed SCAT ground survey. A key function of the SRP Manager is to facilitate the transition of the shoreline response from the initial response phase to the planned phase as early as possible. The planned phase typically has two components: the decision-making stage that provides the basis for the SRP/SCAT plan and the STRs, and the project implementation stage during which the STRs are implemented. Decisions made during the planned phase may result in more than one set of treatment targets. Typically, the first operational priority is to target locations with the heaviest (bulk oil) concentrations with an interim set of treatment end-point criteria. Once this treatment is completed, the Operations teams may return to some of these locations to apply further treatment to meet more stringent end-point criteria, or the SRP may allow for natural weathering and attenuation to remove the residual oil.

Completion phase

The completion phase begins once the implementation of STRs has begun, hence there is a degree of overlap with the planned phase. Each of the treated areas are inspected to ensure that the treatment has met the recommended end-point criteria. New STRs may be generated while existing STRs are being implemented or have been signed off. This evolving process is coordinated by the SRP Manager and/or the STR Manager, depending on the scale of the response and the number of STRs (see Figures 3 and 6, and Figure 8 in IPIECA-IOGP, 2014a).

The sequence of activities that is typical of most response operations is presented in Figure 5 on page 21 and Table 1 on page 22. These illustrate the separate, but complementary, roles of the SRP team, which include both SCAT programme and Environment Unit activities (SRP and SCAT activities are shown in yellow, and Environment Unit activities in green).

This sequence involves an initial SCAT reconnaissance (initial response phase) to determine the scale and degree of shoreline oiling. This enables the Environment Unit to decide where to quickly mobilize the Operations clean-up crews to attend to first priority, high-value and low-impact shoreline locations to undertake oil recovery. The SCAT reconnaissance is followed by detailed ground shoreline assessments undertaken by the SCAT teams.

A decision-making stage then follows, in which the SRP uses the data collected by the SCAT teams to develop guidance, criteria and a strategy to define the shoreline response, and enable the SRP to prepare STRs and an SRP plan.

Step E5 in Table 1 (page 22) is one of the critical drivers of a shoreline response, as it involves the engagement of the Environment Unit with the IMT and stakeholders, to reach a consensus on the shoreline response objectives, priorities, treatment end-point criteria and operational end points recommended by the SRP. At some point, this decision process may involve approvals by regulatory bodies for the use of non-standard treatment techniques. The process culminates in approval of these decisions by the Incident Command.

These decisions enable the SRP's SCAT Data Manager to develop a procedure by which the SCAT database automatically determines which shoreline segments or oiled zones do not meet the treatment end-point criteria, and are therefore actionable and require an STR. The proposed STRs for segments or zones to be actioned are prepared by the SCAT teams and the STR Coordinator, reviewed by the Environment Unit and approved by the Incident Command for inclusion in the IAP. The STRs then effectively become the work orders for implementation by the Operations field teams.

Figure 5 Typical sequence of activities for an SRP

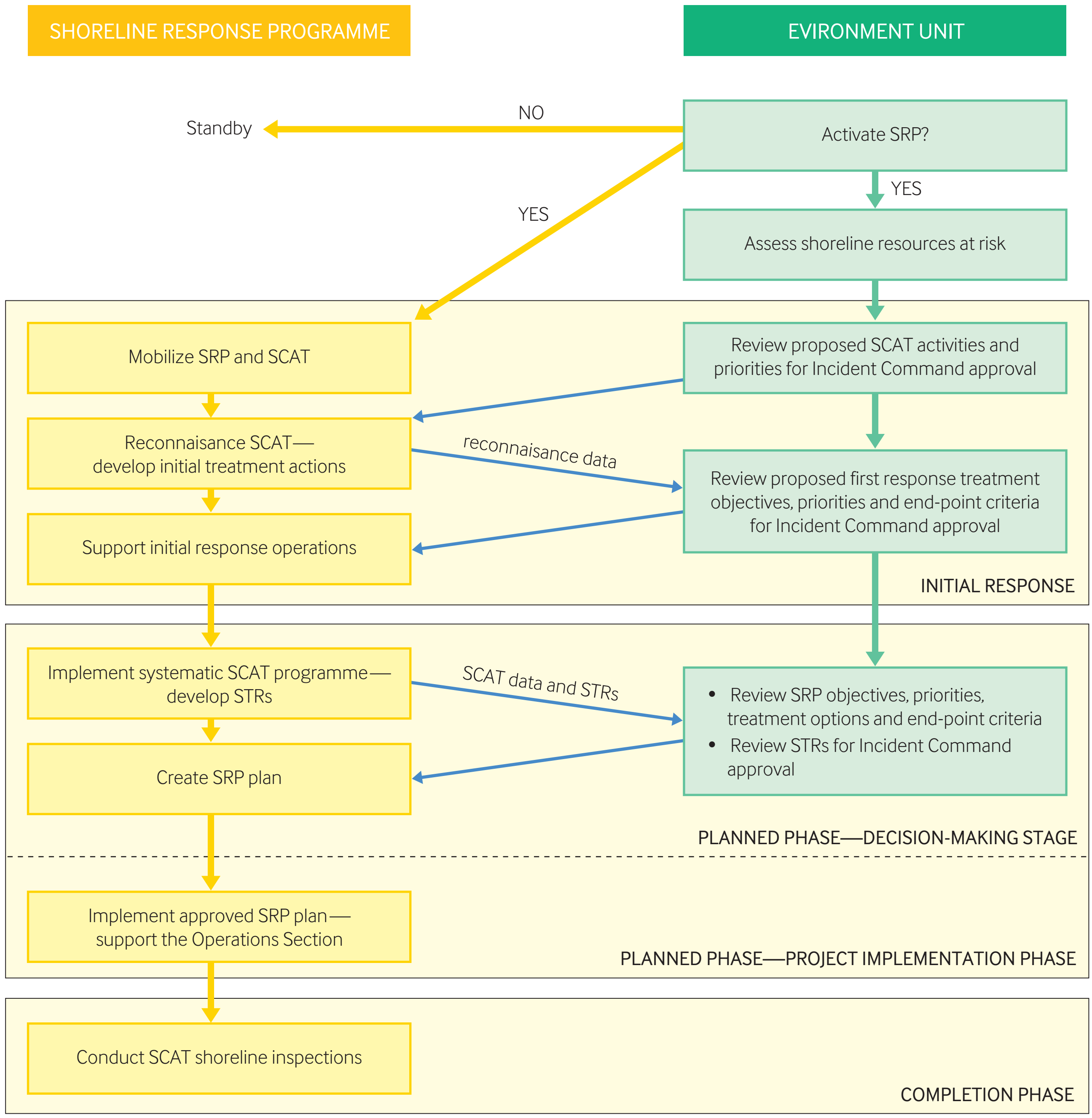


Table 1 Step-wise sequence of shoreline-related SRP activities and Environment Unit responsibilities

SHORELINE RESPONSE PROGRAMME ACTIVITIES	ENVIRONMENT UNIT RESPONSIBILITIES
	STEP E1 Activate the SRP team, if possible prior to shoreline oiling.
STEP S1 Mobilize the SRP and SCAT to the appropriate scale.	STEP E2 Assess shoreline resources at risk (factors include oil presence, volumes, transport, weathering, etc.).
	STEP E3 Develop initial response SCAT activities, priorities and recommendations, and communicate the decisions to the SRP Manager.
STEP S2 • Undertake initial response SCAT shoreline reconnaissance missions. • Provide initial shoreline oiling data, along with proposed objectives, priorities and STRs, to the Environment Unit based on the field observations.	
	STEP E4 • Process SCAT reconnaissance data. • Review and approve initial response SRP objectives, priorities and recommendations. • Provide decisions approved by the Incident Command to the SRP Manager.
STEP S3 • Provide support for initial response shoreline treatment activities via the SCAT-OPS Liaison function. • Prepare the SRP plan, which includes proposed shoreline treatment objectives, priorities, options, end-point criteria and the SCAT plan. • Prepare draft STRs, in consultation with the Operations Section, based on the decisions approved in STEP E5.	STEP E5 • Review and obtain acceptance (TWGs with stakeholders) and Incident Command approval of planned phase shoreline treatment objectives, priorities, options and end-point criteria proposed by the SRP Manager. • Provide decisions approved by the Incident Command to the SRP Manager.
STEP S4 • Undertake planned phase (decision-making stage) SCAT data collection surveys and other missions including SCAT-OPS Liaison. • Conduct testing, experimentation, effectiveness, etc. of treatment options.	STEP E6 • TWGs and Safety Coordinator review draft STRs with regard to constraints and good practices. • Include completed STRs in the IAP for approval by the Incident Command and implementation by the Operations Section.
STEP S5 • Carry out the SRP plan (planned phase—project implementation stage) • Conduct SCAT-OPS Liaison activities at the Command Post and in the field to support the STRs. • Conduct monitoring of treatment and recovery.	
STEP S6 • SCAT teams conduct STR inspections, and the SRP implements a progressive closure process (completion phase).	

IN SUMMARY:
The Environment Unit and the SRP

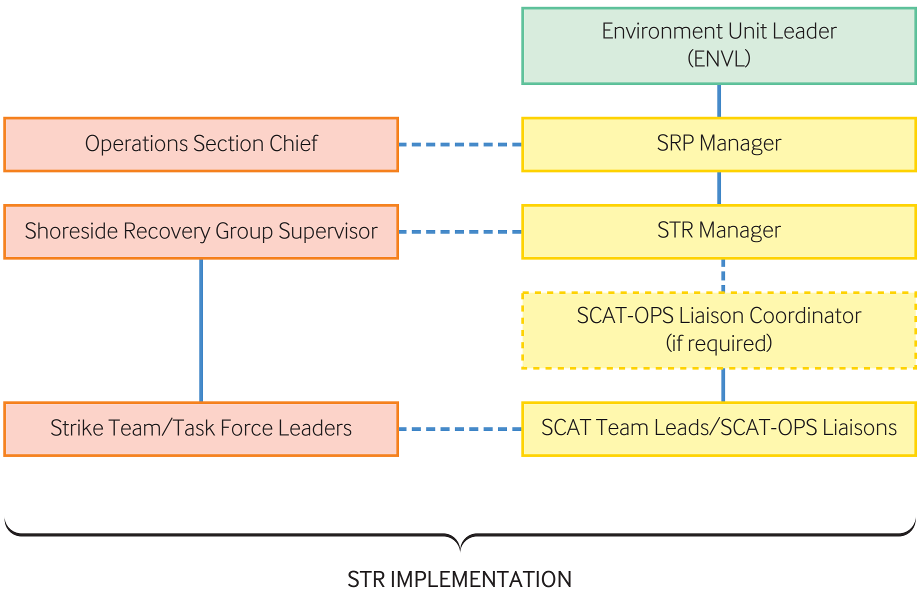
- The Environment Unit reviews shoreline treatment objectives, priorities, clean-up options, constraints (GMPs) and treatment end-point criteria recommended by the SRP Manager based on data collected by the SCAT survey and other field programmes.
- Decisions are developed, typically in TWGs or TAGs, by consultation with technical specialists, subject matter experts and stakeholders.
- The SRP prepares STRs for sections of shoreline that require treatment actions based on these decisions; the Environment Unit reviews and obtains approval of the STRs, and the SRP or STR Manager oversees the implementation and completion of the STRs.

THE SRP AND THE OPERATIONS SECTION

For medium- and large-scale responses, the SRP team works closely with the Operations Section, both in the Command Post and in the field (Figure 6).

The SCAT Field Survey Team Leads that initiate the STRs are well suited to explain the various aspects and nuances of the STRs to the clean-up crews. However, as the scale of the response increases, the SCAT Field Survey Team Leads often do not have the time available, or the spatial capability, to serve in this role of SCAT-OPS Liaison. In such cases, technical specialists in shoreline clean-up can be brought in to fill the liaison role. The SCAT-OPS Liaisons represent the SRP, and may be embedded full- or part-time in the Operations Section at the Command Post, or in field shoreline clean-up task forces or strike teams (see *SCAT-OPS Liaison* on page 31). The SCAT-OPS Liaisons provide field support to the Operations teams, interpreting and explaining the STRs and other Environment Unit decisions, constraints or guidelines (GMPs). SCAT-OPS Liaison field representatives should have a single full- or part-time point of contact in the Operations task forces or strike teams, to ensure and maintain effective communication. It may be appropriate to appoint a SCAT-OPS Liaison Coordinator to provide span of control for medium- or large-scale incidents with multiple concurrent STRs and field operations, and with multiple SCAT-OPS Liaison personnel (Figure 6).

Figure 6 Example of the potential horizontal integration of the Operations Section and an SRP on intermediate- and large-scale responses



The SRP team and the Operations teams will view implementation of the shoreline treatment decisions from different perspectives, and will look to each other to ensure alignment between the intent of the STRs and the outcomes from their implementation (see *SCAT-OPS Liaison* on page 31). The Operations side recognizes that the SCAT-OPS Liaison provides an explanation and interpretation of the intent of the STRs, and acts as a communication bridge between the decision-makers, planners and stakeholders in the Command Post and the Operations teams in the field. The SRP side relies on the Operations teams to provide a reality check on the clean-up activities recommended in the STRs, and to implement them appropriately. The Operations teams continuously monitor the effectiveness of the treatment activities and any operational concerns or challenges that may arise during the implementation of the STRs; they advise and recommend, through the SCAT-OPS Liaison, appropriate adjustments or reassessments to ensure that the treatment end-point criteria can be met in accordance with GMPs. This consultation between the Operations Section and SCAT provides the mechanism by which modifications to an STR can be recommended to the Environment Unit.

SRP/SCAT activities and deliverables may not follow the same pace or time schedule as Operations activities or other field components assigned in the work orders in an IAP. Frequently, SCAT field information collected on a particular day may not be not available, or necessary, for planning Operations activities for the following day. SCAT surveys quickly outpace the ability of the Operations teams to complete the assigned STRs so that the SRP/SCAT rhythm may appear to be out of synchronization with the IAP, when in fact the SRP/SCAT Programme is following a carefully designed longer-term process.

IN SUMMARY:
The SRP and the Operations Section

- The SRP team consults with the Operations Section on the preparation of STRs to ensure that the proposed activities are safe, reasonable/feasible and can achieve the intended objectives.
- The SCAT Field Survey Team Leads or SCAT-OPS Liaison support the Operations Section to ensure that supervisors at the Command Post and in the field understand the intent of treatment end-point criteria and the constraints and GMPs described in the STRs during STR implementation.
- Operations supervisors in the field communicate with the Command Post through the SCAT team leaders or SCAT-OPS Liaisons, regarding progress, concerns or challenges, and treatment effectiveness.
- As treatment progresses, the SCAT-OPS Liaisons and Operations supervisors assess the effectiveness of the treatment activities and decide on an appropriate timing for a SCAT inspection on part or all of the shoreline covered by an STR.

ROLES AND RESPONSIBILITIES OF SRP STAFF

The various roles involved in the staffing of an SRP are described below. Only the primary responsibilities of each assignment are included, and it should be borne in mind that, in practice, many additional responsibilities would be involved in managing and running an SRP. The roles and functions described are likely to change depending on the specific situation, and therefore need to be flexible and adaptable.

SRP Manager

The SRP Manager reports to the Environment Unit Leader and is responsible for the SRP. Primary responsibilities of the SRP Manager include the following:

- Providing input to the Planning and Operations Section Chiefs, and ensuring that the IMT understands the role of the SRP (to minimize shoreline impacts) and SCAT programme (to assess shoreline oiling and support the Operations Section) in the high-level objectives from the outset.
- Communicating SRP objectives and strategies to the SRP team.
- Creating the SRP plan, and acting as the single point of contact for the IMT on all shoreline-related issues.
- Establishing and monitoring the SCAT programme.
- Ensuring that accurate information is communicated on all shoreline response issues.
- Working with the Environment Unit SCA-TS to develop the SCAT and SRP plans and strategies, tracking STRs, and determining the need for, and managing, any shoreline treatment trials or equipment field tests.
- Working with the SCAT Programme Coordinator to set up the SCAT Programme and, with the ENVL and Environment Unit SCA-TS, coordinating the decision-making process that helps define the shoreline response.
- Ensuring that the intent of shoreline treatments, constraints and GMPs are understood and implemented by the Operations Section, and overseeing field treatment trials or tests (through the SCAT-OPS Liaison process).
- Providing information to the ENVL to support the PSC at planning and tactics meetings.
- Working with the Environment Unit SCA-TS to manage the expectations of the Environment Unit, TWGs and external stakeholders regarding practicable treatment methods for different oiled shore types, treatment rates, and the consequences of different treatment end-point criteria.
- Mobilizing resources, and reorganizing/demobilizing as shoreline targets are achieved and the SRP moves towards closure.

After the response transitions from the initial phase to the planned phase (decision-making stage), a high proportion of the SRP Manager's time and effort is focused initially on planning and decision-making activities. This involves communicating and working with the IMT to establish the systematic SCAT survey programme and generate the SRP plan, and ensuring that the STR process is understood, both internally within the IMT and by external stakeholders (see Figure 7 on page 26).

After the next transition, into the project implementation stage of the planned phase, the emphasis of the SRP Manager's role changes to include greater engagement with the ENVL and stakeholders, to maintain confidence in the programme and help them to understand how completion and closure will be achieved. The SRP Manager monitors the evolving response to ensure that the SRP is aligned with the objectives of the Incident Command, and provides input as necessary to maintain that alignment.

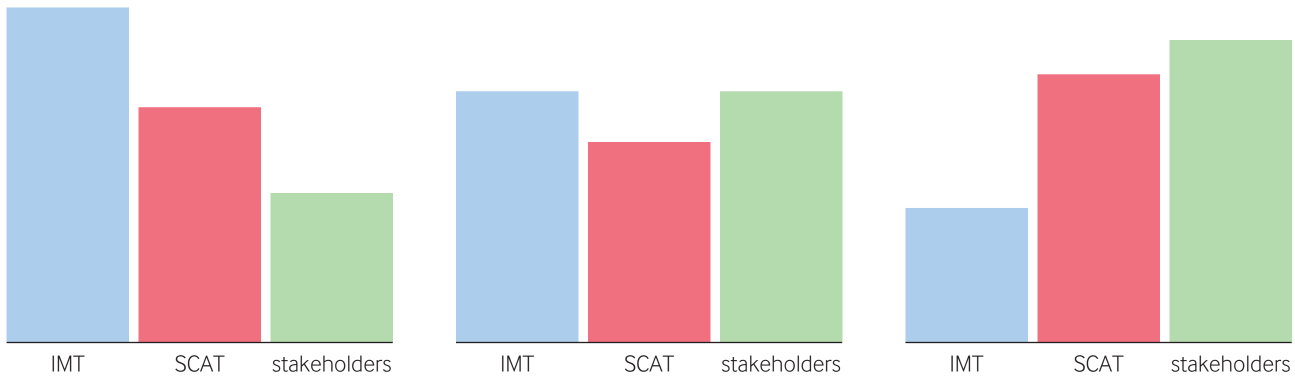
The level of engagement with stakeholders typically increases with the transition to the completion phase, as STR inspection reports (SIRs) often recommend that oil is left for natural attenuation, either where concentrations are below those required by the treatment end-point criteria or for SIMA/NEBA reasons.

The typical daily activities of an SRP Manager following the initial response phase are described and summarized in Appendix 1.

A Deputy or Assistant SRP Manager is an optional role which may be established to maintain span of control within an SRP team. The Deputy/Assistant SRP Manager would report to the SRP Manager and focus on establishing and maintaining good communication and cooperation between the SRP/SCAT programme and the Operations Section, while the SRP Manager focuses on interactions with the ENVL and the Planning and Operations Sections' Chiefs.

A Deputy SRP Manager could be responsible for directing the SCAT programme through the SCAT Programme Coordinator. In addition, the Deputy SRP Manager could be responsible for tracking the generation, review and approval of STRs during the planning stage, and the operational status of STRs during the operational stage. In the case of larger incidents with multiple concurrent active STRs in the IAP, this duty may be delegated to an STR Manager.

Figure 7 The relative time and effort spent by the SRP Manager on different elements of the IMT (colour blocks indicate changes over time after the initial response)



PLANNED PHASE—DECISION PROCESS

- Engage with the IMT—this is critical for ensuring that the SRP process is working properly.
- Oversee the SCAT process to ensure that it settles into a steady rhythm.
- Encourage stakeholders to recognize that a systematic process is emerging; it is understandable that stakeholders may be concerned, hence it is important to provide reassurance about committing to the STRs and how future activities will unfold.

PLANNED PHASE—IMPLEMENTATION

- Manage pressure from the IMT to 'go faster' and get things done more quickly.
- Once the systematic SCAT process is in place and running well, it requires little attention other than dealing with unexpected events.
- As stakeholders become more confident and start to see results, engage with them and look ahead to the next phase.

COMPLETION PHASE

- Work with the IMT to reorganize and downsize as shoreline targets are achieved and the programme moves towards closure.
- Ensure that the SCAT process remains focused on the treatment end-point criteria, and recognize when sufficient treatment has been completed for each STR.
- Stakeholders may become concerned as some segments are not fully clean; work with them to understand the principles of NEBA/SIMA and to accept that natural recovery may be the best option.

SCAT Programme Coordinator

The SCAT Programme Coordinator is the primary point of contact, through the SRP Manager, within the IMT for all SCAT activities. Primary responsibilities of the SCAT Programme Coordinator include:

- acting as the project manager for the SCAT programme, and working with the SRP Manager to develop the SCAT programme objectives and plan, and to address the requirements or concerns of relevant stakeholders;
- designing and directing the SCAT programme and coordinating the SCAT Field Survey Teams;
- working with the SCAT Data Manager to ensure that the planned SCAT field survey data and terminology are aligned with the treatment or end-point criteria so that the appropriate types of information and levels of detail are generated;
- implementing and managing the SCAT programme plan and day-to-day activities, including:
  - ensuring that field teams are properly trained, remain calibrated, and are familiar with current good practices;
  - establishing GMPs and safety protocols for the field teams;
  - chairing SCAT Field Survey Team briefings and debriefings; and
  - producing daily and weekly summaries of field reports;
- managing the SCAT Field (Safety/Logistics) Coordinator and SCAT Data Manager, as well as the SCAT Field Survey Teams; and
- medium-term planning, with the STR Manager, regarding priorities and staffing, and working with the Environment Unit to coordinate with agencies and other organizations (land managers, land owners, etc.) that may not be directly involved through the IMT.

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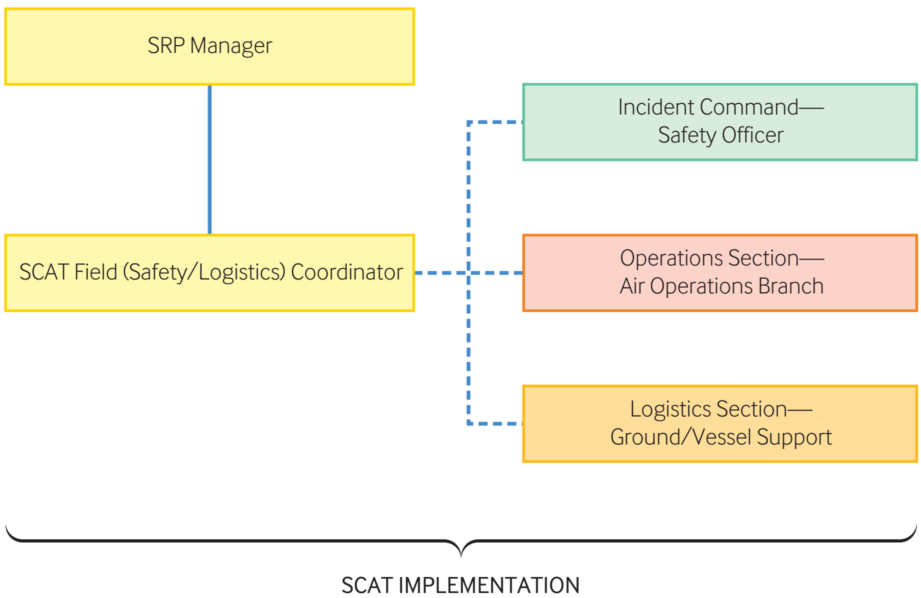
A shoreline response team inspects an oiled shoreline for subsurface oil.

SCAT Field (Safety and Logistics) Coordinator

The SCAT Field Coordinator works with the SCAT Programme Coordinator to develop daily missions and a rolling strategy for the field teams, and to provide the necessary logistics support and equipment that they require. Primary responsibilities of the SCAT Field Coordinator include the following:

- Producing the SCAT Safety Plan and Job Safety Analysis (JSA) and submitting these for review and approval by the Safety Officer.
- Planning logistics for future missions and working with the SCAT Programme Coordinator and other members of the Environment Unit to generate short- and long-term mission plans.
- Submitting requests for personnel, equipment, field supplies and transportation.
- Providing information to the Resources Unit for the next operating period on the positions and number of personnel in the SCAT programme, and on the number of active field teams, their assigned missions and geographic locations.
- Ensuring that the Operations Section is aware of the current and future missions and assignments of the SCAT Field Survey Teams whenever they are engaged in areas of active operations and, if applicable, the intended locations of SCAT-OPS Liaison personnel.
- Coordinating with the Logistics Section, Air Operations and Safety Officer on transportation, equipment and safety issues, respectively (see Figure 8).
- Tracking and maintaining communications with the field teams throughout the day.

Figure 8 Example of horizontal integration between the SCAT Field Coordinator and Safety and Logistics in an IMT



SCAT Data Manager

The SCAT Data Manager reports to the SCAT Programme Coordinator and is responsible for processing field data, quality assurance, data storage and dissemination within the IMT, and for providing the SCAT Field Survey Teams with the maps and data required to conduct their missions. Primary responsibilities of the SCAT Data Manager include the following:

- Working with the SCAT Programme Coordinator to ensure that the planned SCAT field survey data and terminology are aligned with the treatment or end-point criteria so that the appropriate types of information and levels of detail are generated.
- Overseeing the production of reports, maps and data summaries, both for the Planning Section and Incident Command staff, as well as for the supporting field teams (in the case of a small response, the Data Manager could input data and produce the reports).
- Responsibility for the following three distinct QA/QC steps involved in processing the field data and generating any data products:
    1. SCAT Field Survey Team Lead review of the content of the Shoreline Oiling Summary (SOS) form and any other field data (e.g. SIR form) for correctness, accuracy and consistency (for example, with regard to field notes or photographs);
    2. SCAT Data Manager or data technician review of the field data and information required for completeness at the time of entry of the SOS form and any other information into the database; and
    3. SCAT Programme Coordinator review of daily SCAT data reports as well as any oiling category summary maps and tables generated from the database to ensure that the field mission objectives are accomplished and that the data/information are consistent with the survey protocols and SCAT programme objectives.
- Ensuring that all three QA/QC components are completed before any products are delivered to the Situation Unit for distribution, or to the Documentation Unit for archiving or sharing with other internal IMT staff, and with external users as might be defined in a data-sharing agreement. (If this process is not followed, data may have to be revised at a later time, which reduces the credibility and confidence in the data if SCAT maps and tables have to be changed.)
- Responsibility for incorporating digital methods for data collection that are compatible with the technology platform established by the Situation Unit.
- Responsibility for initiating STRs from the SCAT database when oiling conditions documented by the shoreline assessment surveys do not meet the treatment end-point criteria, and for communicating to the SRP Manager or SCAT Programme Coordinator that an STR is required for a shoreline segment if the SCAT Field Survey Team Lead has not already made this determination in the field.
- Responsibility for data products, such as maps and associated statistics on shoreline oiling conditions, and for the status of STRs for situational awareness as well as external communications.
- Responsibility for the archiving of all SCAT data and documentation.
- Ensuring that legal protocols are followed to preserve the original SOS forms — SCAT forms are a factual legal document that may be used for claims, liabilities or damage assessment.

OSRL

The SCAT Data Manager is responsible for a range of data quality, processing and dissemination duties, which include providing SCAT Field Survey Teams with maps and data required to conduct their missions.

STR Manager

The Shoreline Treatment Recommendations (STR) Manager is responsible for the preparation of STRs, on the basis of the SCAT oiling data, in consultation with the SCAT Field Survey Team Leads, the Environment Unit (SCA-TS and TWGs) and Operations Section for shoreline segments or zones that do not meet the treatment end-point criteria. Additional primary responsibilities of the STR Manager include the following:

- Working with the Environment Unit's Technical Specialists, subject matter experts and stakeholders to ensure that their requirements and constraints are incorporated in the recommendations.
- Working with the Environment Unit to:
  - obtain reconnaissance information to assess priority areas for initial SCAT surveys, and gain approval for land access where appropriate; and
  - obtain approvals as required by local or regional regulations (e.g. concerning endangered species, cultural and historical resources, etc.) prior to undertaking shoreline activities.
- Working with the Operations Section in the Command Post to:
  - obtain advice and guidance on the feasibility, practicality and effectiveness of potential treatment strategies and tactics;
  - ensure that the methods and priorities proposed in the STRs, which are effectively the work orders for Operations Section activities, can be implemented safely and appropriately; and
  - ensure that the intent of the constraints, GMPs and treatment end-point criteria described in the STRs incorporated in the IAP are understood.
- Tracking the progress of recommended STRs through the decision and approval process, and providing any necessary support, such as clarifications or additional field data/observations.
- Tracking the status of approved STRs and providing information to the SCAT Data Manager to generate and continuously update progress reports (including maps and/or tables).

SCAT Field Survey Team Lead

A SCAT Field Survey Team Lead is responsible for the activities and safety of a SCAT team once they depart to the field. The primary responsibilities of the SCAT Field Survey Team Lead include the following:

- Before deployment, ensuring that the team has all of the appropriate clothing, equipment and data packages (maps, STRs, SCAT field activity GMPs, etc.) required for the mission.
- Conducting 'tailgate' safety briefings at the site prior to the mission, with an emphasis on the mitigation of potential risks specific to a location.
- Conducting shoreline clean-up assessment (SCA) surveys to observe and systematically collect data on shoreline oiling conditions from aerial reconnaissance and ground surveys, or completing other survey mission objectives (e.g. post-treatment assessments (PTAs), STR inspections, beach profiling, or photographic monitoring).
- Monitoring and documenting any changes in oiling conditions and the effectiveness of treatments, and comparing these with the treatment objectives and treatment end-point criteria.
- Ensuring consensus within the survey team so that products such as the SOS report or SIR forms reflect an agreed characterization or documentation of the field observations.
- Working with field team members to develop initial STR recommendations where appropriate.
- Maintaining communications with Operations team supervisors in the field if a SCAT-OPS Liaison role has been assigned.
- Identifying possible locations for long-term monitoring.

The SCAT Field Survey Team Lead plays a critical role in the engagement and education of stakeholders who participate in the field surveys. Agency or stakeholder representatives may have little or no experience or knowledge regarding the shoreline character, coastal processes, the behaviour of oil on shorelines, treatment methods or field safety protocols. Representatives typically participate on rotation or for a single deployment, so that the composition of a team changes constantly, sometimes daily.

The Team Lead is responsible for ensuring continuity and consistency of the survey programme while providing information on shoreline oiling and treatment activities that can be communicated and shared with the agency or stakeholder group that is represented. This process is vital to gaining confidence in the SCAT programme itself as well as in the SRP process as a whole.

SCAT-OPS Liaison

SCAT-OPS Liaison is a separate function from the SCAT field surveys missions, and is carried out either by SCAT Field Survey Team Leads or by an assigned individual, depending on the size and scale of the response. The SCAT-OPS Liaison supports the Operations teams in the field to ensure that Operations supervisors understand the treatment end-point criteria, constraints and GMPs described in the STRs. In effect, the SCAT-OPS Liaison function wears two hats to ensure alignment between the intent of an STR and the actual implementation of the STR by the Operations teams in the field. In Figure 9, a red 'operations hat' and a blue 'SRP/SCAT hat' represent the bridge between the Operations and SRP perspectives (see also Table 2).

Figure 9 The SCAT-OPS Liaison function (see also Table 2)
(adapted from BP, 2019)

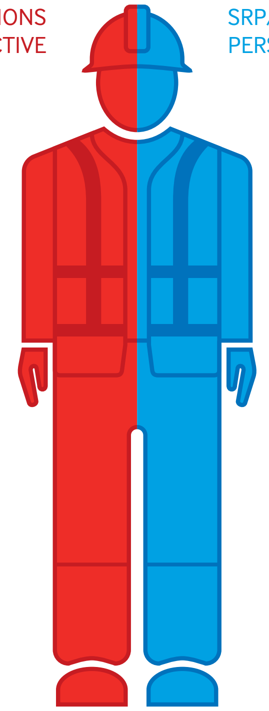


Table 2 The SCAT-OPS Liaison function seen from the Operations and SRP/SCAT perspectives

THE OPERATIONS PERSPECTIVE	THE SRP/SCAT PERSPECTIVE
• Evaluates the reality of the activities that are taking place to achieve the requirements of the STRs. • Provides advice on the equipment and resources required for the job. • Helps to address any concerns and overcome any operational challenges on-site. • Ensures that staging areas are properly set up and operating correctly in accordance with GMPs.	• Ensures that the intent behind the STR is understood. • Ensures that any constraints and GMPs are understood and respected. • Ensures that the outcomes of what needs to be achieved in the STR (treatment completion criteria) are understood. • Provides sustained support to the Operations teams as they work at different sites.

The SCAT-OPS Liaison function is a fundamental component of the SRP process to support the implementation of STRs and assess the effectiveness of treatment activities. Five key questions may help to guide an assessment by the SCAT-OPS Liaison when considering intent versus reality in relation to an STR:

- Is the Operations team doing what is set out in the STR?
- Is the treatment programme going well?
- Are the treatment techniques working as expected or is there need for adjustment?
- Is the Operations team respecting any constraints or GMPs outlined in the STR?
- When will the end-point criteria/transition criteria be reached?

The answers to these questions can provide a useful overview of how the clean-up is progressing, and constitute a template for preparing progress reports on an STR.

The appointment of a SCAT-OPS Liaison Coordinator may be appropriate to provide span of control for responses that involve multiple concurrent STRs and field operations, and which therefore require several SCAT-OPS Liaison field personnel to support these activities (see Figure 6 on page 23).

IN SUMMARY:
Roles and responsibilities of SRP staff

The staffing of an SRP is a function of the scale of a response. Responsibilities include, and assignments can be based on, as many as seven key functions, including:

- SRP Manager;
- SCAT Programme Coordinator;
- SCAT Field Coordinator (Safety/Logistics);
- SCAT Data Manager;
- STR Manager;
- SCAT Field Survey Team Lead; and
- SCAT-OPS Liaison Coordinator.

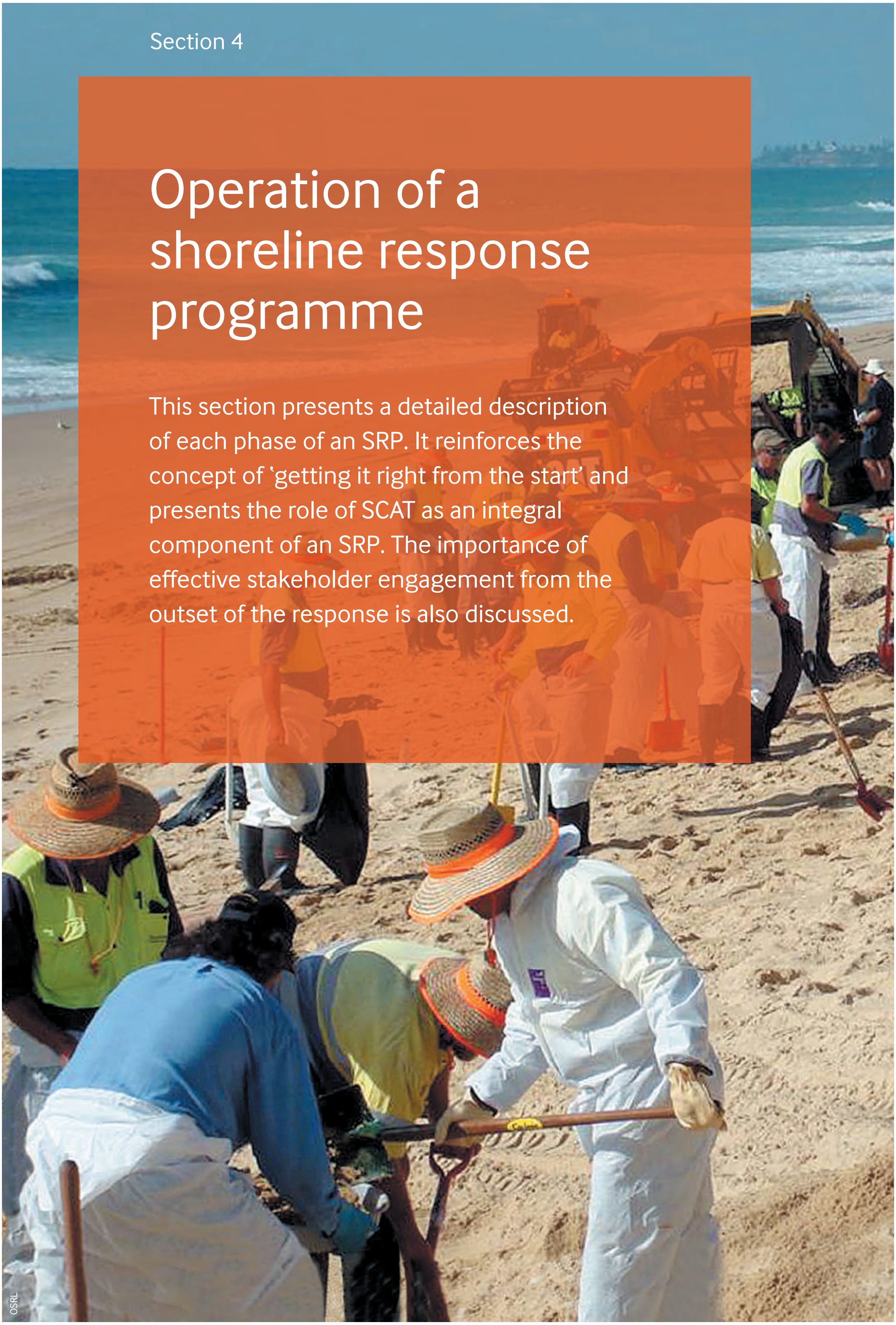
OSRL

Shoreline clean-up operations in progress

Section 4

Operation of a shoreline response programme

This section presents a detailed description of each phase of an SRP. It reinforces the concept of 'getting it right from the start' and presents the role of SCAT as an integral component of an SRP. The importance of effective stakeholder engagement from the outset of the response is also discussed.



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Operation of a shoreline response programme

An oil spill response evolves and changes, from the initial response to operational completion, as it moves through a sequence of phases (see Table 3 below and Box 1 on page 20).

The effectiveness of a response often depends on the ability to intercept the oil before it reaches a shoreline, or the speed with which the majority of the oil can be quickly removed once it has washed ashore.

The inclusion of an SRP concept in drills, exercises and preparedness training can directly improve the ability to respond quickly and effectively during the initial response phase, and can help to reduce the potential for long-term environmental and operational consequences.

Table 3 Characteristics of the different phases of an oil spill response

PHASE OF THE RESPONSE	CHARACTERISTICS
Initial response phase	• Requires a rapid assessment of the situation. • Requires quick decisions on the best uses of management and operational resources as they become available.
Planned phase—decision-making stage	• The transition begins as early as is practicable in the initial response phase. • Generates the long-range objectives, priorities, strategies and completion criteria. • Results in the creation of an SRP/SCAT plan.
Planned phase—project implementation stage	• The SRP/SCAT plan is implemented, with adjustments as appropriate.
Completion phase	• Involves an inspection of the treatment activities. • Closes out and demobilizes the operation.

ITOPF

THE INITIAL RESPONSE PHASE: 'GETTING IT RIGHT FROM THE START'

The driving forces behind an SRP

Competition for management and resources is always greatest during the initial phase of a spill response, when the objectives are often focused solely on the on-water source control and on floating oil containment and removal activities. Shoreline response generally has a much lower priority, particularly if the oil has not yet impacted the shoreline (Figure 10). Securing the necessary management, logistical support and resources early in the process to respond quickly and effectively (in most cases before oil even reaches the shoreline) is one of the key challenges facing an SRP team. Raising the profile of the shoreline response by including shoreline objectives from the very beginning is essential, and enables an SRP to be initiated to run in parallel with the on-water operations.

The critical value of 'getting it right from the start' is achieved through the establishment of an SRP that includes the appropriate level of management and infrastructure support and the prepositioning of response resources with the highest potential for effectiveness, so that on-shore response activities can begin before, or immediately following, shoreline oiling. This is the period of greatest gain, as bulk oil concentrations can be quickly removed from the shoreline prior to burial, reworking or remobilization which, in turn, minimizes:

- the oiled shoreline area;
- the potential environmental, social or economic effects; and
- the overall duration of the response operation time.

In many incidents, an SRP has been initiated only after the on-water and shoreline protection response activities are well under way or have been completed, and after oil has impacted the shoreline. This often delays the shoreline response until after the period of greatest gain. An SRP should therefore be activated as soon as the Incident Command determines that shoreline impacts are probable or imminent, and should be implemented in parallel with other initial response activities. Many activities, such as sourcing shoreline response equipment and resources, or the identification of staging areas, can be completed before oil reaches a shoreline. These actions can save a considerable amount of time at the outset of an operation, and can enable the clean-up to start earlier in the response time frame. If the shoreline is not oiled, the SRP can be placed on standby, so that momentum is achieved in anticipation of the situation changing.

The greatest effort (time and money) put into an oil spill response is always associated with shoreline treatment and clean-up rather than on-water operations (Figure 11).

Figure 10 The relative level of effort associated with an SRP during the initial response phase

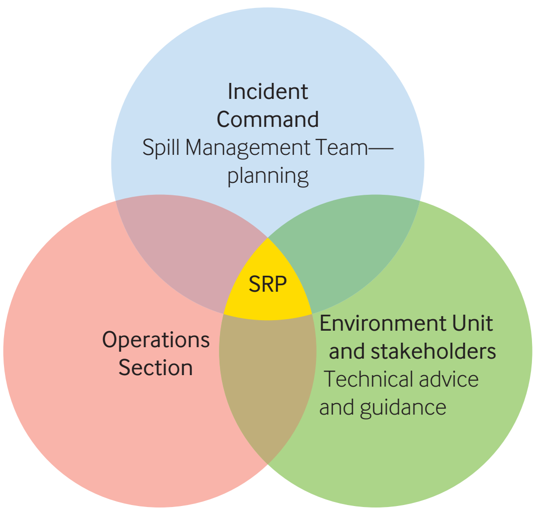
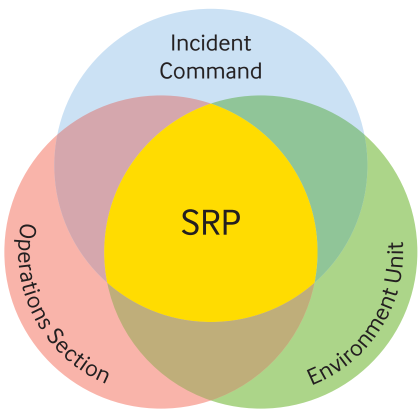


Figure 11 The relative level of effort associated with an SRP during the long-term, planned phase of a response

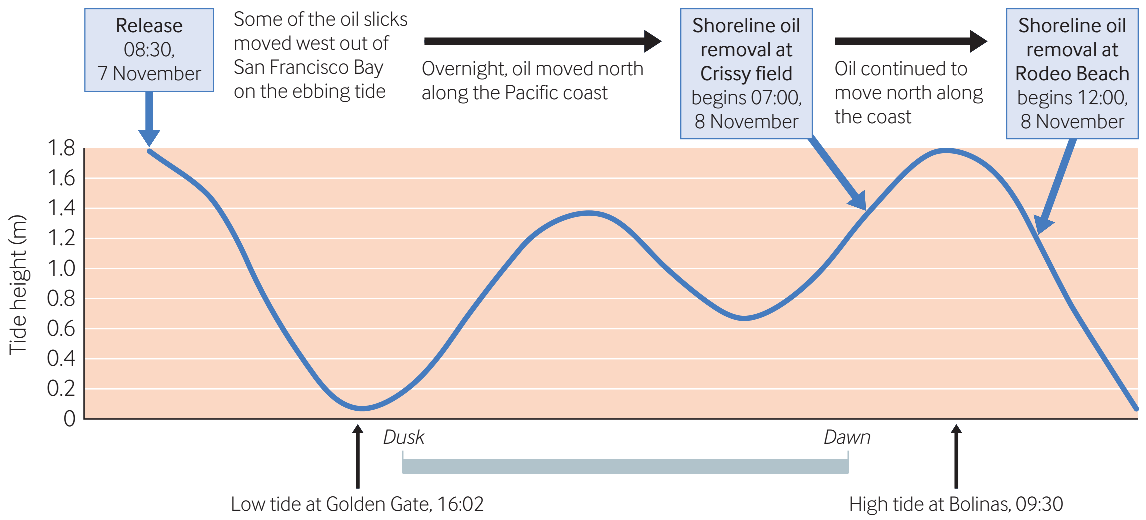


Box 2 Case study:
The shoreline initial response to the motor vessel (M/V) *Cosco Busan* oil spill in San Francisco Bay, November 2007

The vessel spilled 54,000 gallons of IFO-380 oil onto San Francisco Bay, California, at 08:30 during a high tide on 7 November 2007 during foggy conditions. The response was rapid due to the presence of several local on-call response organizations in the area. By 21:30 an IAP was developed for the operational period 07:00 on 8 November to 07:00 on 9 November (USCG, 2008). Currents in the area where the spill occurred initially ebbed westwards and out of the Golden Gate into the Pacific Ocean. Aerial observations and slick tracking were constrained by heavy fog and, subsequently, night-time conditions, for the first 24 hours of the response. This constraint meant that little information was available on the first day (7 November) with respect to the locations of oil on the water or on shorelines. Although the locations of stranded oil were not known at the time, the IAP included the deployment of shoreline clean-up crews to accessible shorelines in San Francisco between Fisherman's Wharf and the Golden Gate Bridge, for example along the heavily used shorelines in the San Francisco Maritime National Historic Park and at Crissy Field Beach, and at National Park beaches near and outside of the Golden Gate Bridge on the Pacific Coast. Clean-up crews were actively removing oil from northern San Francisco beaches shortly after dawn on the morning of 8 November less than 24 hours after the spill. On the same day, oil was tracked from the air and high ground observation locations, moving north along the Pacific Coast, and was observed as it washed ashore in a National Park on Rodeo Beach on the falling tide of the morning of 8 November. By midday, during the low tide period, clean-up crews began to manually remove oil that had stranded before it could be reworked, buried or remobilized during the next high tide.

continued on page 37 ...

Schematic timeline of tidal water levels and events during the initial shoreline response, 7–8 November 2007



Box 2 (continued): The shoreline initial response to the M/V Cosco Busan *oil spill*

The response involved four SCAT Field Survey Team Leads, each of whom was assigned to one of the four Operation Divisions to serve as SCAT-OPS Liaison, as well as the interagency shoreline assessment survey Team Lead. An interagency report on the initial response phase (USCG, 2008) noted that 'SCAT was deployed quickly and to effect, initially, working with Operations to recover gross oil from the beaches.' Subsequent multiple shoreline surveys which included pits and mechanically dug trenches on the outer coast beaches did not detect any subsurface oil.

The majority of the 176 STRs were completed by June 2008 as part of the shoreline clean-up programme for this relatively small spill. By this time only 'spot check' clean-up crews remained active for seven of the segments that had not met the treatment end-point criteria due to the presence of buried oil, ongoing leaching from rip rap, or safety constraints.

The initial rapid response and deployment of shoreline clean-up teams, even before aerial observations or SCAT reconnaissance information became available, enabled oil removal to commence within the first low tide window after the oil became stranded, concurrently and without detracting from the on-water recovery and protection operations; an example of an SRP running in parallel with on-water operations right from the start.

Owens Coastal Consultants

Above and below: manual removal of surface oil in the upper intertidal zone on Rodeo Beach, 15:30 on 8 November 2008.

Owens Coastal Consultants

'Getting it right from the start' involves having management commitment and the necessary resources in place from the outset, based on scope, scale and complexity. In addition, having an SRP already in place means that the shoreline response components are much easier to manage as the management and operations transition into the more systematic planned (project implementation) phase of the response. Initial guidance for shoreline treatment operations may be provided through generic STRs that do not require detailed assessments and recommendations by SCAT teams. Generic STRs describe treatment methods and bulk oil removal criteria that apply to a specific shore type, such as a sand beach or a salt marsh. The treatment methods are typically non-intrusive with minimal or no collateral environmental impacts.

'Getting it right from the start' also involves deciding when to transition out of the initial response phase. The Environment Unit, SRP team and Operations Section cooperate and agree on the level of effort required for the removal of bulk oil during the initial response phase, and on whether to leave minor or lesser concentrations for a later phase of clean-up or for natural attenuation. The SCAT-OPS Liaison provides support to the Operations field teams to interpret this initial level of effort and determine the treatment end-point criteria for the initial phase of the response. In many cases, shoreline segments that meet the end-point criteria following treatment during the initial response phase (bulk oil removal) may not meet subsequent, more definitive treatment end-point criteria, and may therefore require additional clean-up during the planned phase of the response.

Implementation of an SRP at the start of a response

'Getting it right from the start' involves asking some simple but critical questions:

- When and where is the oil predicted to impact the shorelines and what are the probabilities?
- What is the quickest way to find out where oil has stranded on the shorelines?
- What is the quickest way to find out which locations have vulnerable and sensitive resources that may be affected by the oil or be at risk?
- How can available resources be best used to mitigate the existing or potential effects of the oil?
- Who needs to be involved, and who is available, to decide and agree on the initial response actions?
- What are the consequences of using the majority of available resources for on-water recovery and shoreline protection, which may have a low impact on the volume of oil that reaches the shoreline, versus recovering the bulk or mobile oil that reaches the shoreline while it is concentrated and before it is reworked, buried or remobilized onto the coastal waters?
- Can the Operations teams be mobilized in time to recover the bulk or mobile oil?
- What resources are available, and where are the staging areas located, that are necessary to enable shoreline clean-up to be mobilized should it be deemed necessary?
- What are the treatment end-point criteria for bulk oil removal? When is the right time to move on, and how much oil can/should be left for later clean-up or natural attenuation?
- What happens to the recovered oiled material? Can it be removed quickly from the site?

Key activities involved in the initial response phase are listed in Box 3 (further details can be found in the checklists presented in Appendix 2).

Box 3 Key activities involved in the initial response phase

The objective of the initial response phase is to define the overall scale of the shoreline oiling or potential oiling, and the overall characteristics of the oiling conditions. This information is obtained quickly and is used to develop the initial response recommendations for bulk oil clean-up priorities and to direct the operation's activities during this phase. This is the period of greatest gain for shoreline clean-up, and is also the time when the competition for management and response resources is greatest. The key activities involved in the initial response phase are summarized below:

- Setting up the SRP and SCAT programmes:
  - Engage with the IMT to understand the situation.
  - Evaluate the potential for shoreline impacts.
  - Mobilize SRP resources that relate to the span of control required for the scope, scale and complexity of the response for shoreline treatment operations.
  - Create a list of personnel to be sourced to fill the required positions including, in particular, the SCAT Field Survey Team Lead(s) and SCAT-OPS Liaison(s).
  - Determine where, when and how the mobilized resources are to be deployed.
- Conducting initial aerial reconnaissance to identify affected shoreline locations and relative levels of oil concentration.
- Setting/recommending SCAT survey priorities and shoreline treatment operations priorities, and identify any background oiling issues.
- Developing the outline for a long-range strategic programme for the transition to a planned/project phase, and develop a picture of what that phase would look like after the transition (for Incident Command planning).
- Setting initial (bulk or mobile oil) removal criteria.
- Setting up a SCAT data management system and develop an interim SCAT plan.
- Establishing a working relationship and a continued liaison process with the Operations Section.
- Engaging with stakeholders through the Environment Unit and any TWGs on SRP-related activities.
- Engaging with the Environment Unit concerning any permitting or access issues for SCAT surveys and missions.

IN SUMMARY:
'Getting it right from the start'

- Shoreline response objectives should be stated at the start of a response to enable and provide for the appropriate level of support.
- Creation of an SRP plan at the outset of a response enables the IMT to plan and prepare for a shoreline response with the same level of commitment that is typically applied to on-water responses.
- The initial response phase is the period of greatest gain for shoreline clean-up, and is also the time when the competition for management and response resources is greatest.
- 'Getting it right from the start' reduces the effects of the oil, the size of the affected area, and the level of effort required to clean up oiled shorelines.
- The initial shoreline treatment objectives may be to remove only the bulk oil and leave minor or lesser concentrations for a later phase of clean-up or for natural attenuation.
- The SCAT-OPS Liaison provides support to the Operation Section's field team to interpret this level of effort and the phased treatment end-point criteria.

THE PLANNED PHASE—DECISION-MAKING AND THE SRP PLAN

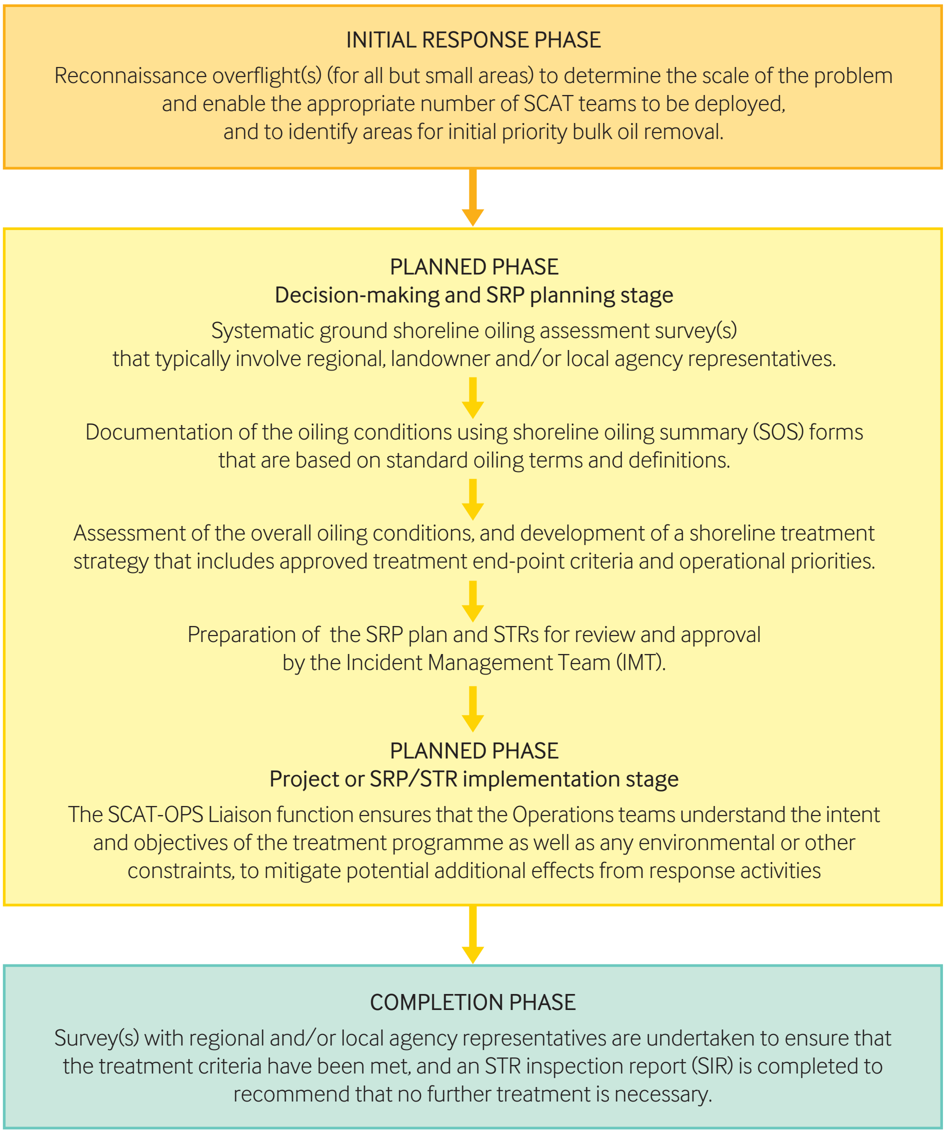
The SRP plan is developed based on the decisions and directions that relate to the objectives of the response, and on the character of the response proposed by the Environment Unit and approved at the Incident Command level. In general, the SRP plan is developed using the following process:

- The ENVL establishes TWGs to develop treatment objectives, priorities, clean-up options, constraints (GMPs) and treatment end-point criteria.
- The SRP team provides recommendations on these issues to the TWGs through the ENVL.
- Once the development of these issues is completed by the TWGs, the ENVL submits them to the Incident Command for approval.
- Following Incident Command approval, an SRP plan, which includes the SCAT plan, is generated by the SRP team.

The SRP/SCAT plan focuses on medium-term (weeks) and long-term (months) strategic planning in terms of the collection of SCAT field survey data and other SCAT support missions, and on the generation and implementation of the STRs. The STR programme effectively drives the operational programme (see Figure 12 on page 40).

Development of the SRP plan begins as early as is practicable in the initial response phase, and can be initiated once the Incident Command provides details of the objectives, long-term strategy and character of the response. A generic template or 'table of contents' for an SRP plan is provided in Appendix 3.

Figure 12 A progressive SRP from the initial reconnaissance to the completion of treatment



Adapted from IPIECA-IOGP, 2014a

The long-term strategy may involve a phased approach to achieve the treatment end-point criteria. This concept may be more acceptable to stakeholders that are not familiar with shoreline treatment and natural attenuation, and can help to ensure that any concerns are addressed based on different shoreline types, levels of usage and specific environmental sensitivities.

Managers and stakeholder representatives involved in the development of criteria that define treatment completion may be reluctant to finalize these criteria at the beginning of a response. In addition, there may be a desire to review, and possibly revise, the treatment end-point criteria part-way through a response.

To address this issue, the SRP team can recommend a process of phased treatment end-point criteria, rather than the development of 'final' treatment end points at the outset. This flexible approach was used by the SRP developed during the response to the Macondo incident (Gulf of Mexico, 2010) during which 'no further treatment' (NFT) criteria were developed for different phases of the response (2010 NFTs, 2011 NFTs, etc.) (Owens *et al.*, 2011; Santner *et al.* 2011). With a phased approach, there is no immediate need to define the 'final' treatment end-point criteria at the start of the response. This provides an opportunity for subsequent further discussion in the TWGs, so that a better understanding of treatment actions and natural attenuation can evolve compared to the level of understanding that was present during the initial response. The downside of this approach may be that some segments may have to be treated again at a later time if the subsequently-agreed end-point criteria are more stringent than the original or interim criteria.

Key features of the planned (decision-making) phase that generates the SRP plan are listed in Box 4 (further details can be found in the checklists presented in Appendix 2).

Box 4 Key features of the planned phase (decision-making stage)

The objective of the decision-making stage of the planned phase is to systematically survey affected shorelines to enable long-term objectives, priorities, strategies and treatment end-point criteria to be defined for the shoreline response. In addition, based on the treatment end-point criteria, STRs are prepared for individual segments; these are reviewed by the Environment Unit and TWGs, and submitted to the Incident Command for approval.

- Priorities:
  - Engage with the ENVL, Environment Unit SCA-TS and TWGs to ensure that there is agreement on the SRP plan objectives, strategies, tactics, GMPs and timing.
  - Engage with the Operations Section to ensure that they understand the SRP programme objectives, strategies, tactics and timing, and agree that these are practical and achievable.
- Establish appropriate operations phases, each of which should include defined objectives, methods and phased treatment end-point criteria, and determine transition points between the phases, for example:
  - Initial response bulk/mobile oil removal by strike teams, with partial oil removal.
  - Long-term geographic task force deployments based on STRs.
  - Completion and closure phase with demobilization plan, and establishment of potential long-term monitoring programme to observe the natural attenuation of oil at locations where not all of the oil has been removed.
- Define the pace or rhythm of the SCAT survey programme strategy to collect timely and relevant data:
  - Having too many teams can potentially generate data at a time when it is not required (see next bullet point) and can make consistency difficult.
  - Data and STRs in the IAP may become outdated and may not be applicable if the SCAT surveys are conducted too far ahead with respect to the timing of STR activities.
- Engage with the IMT to make sure that the SRP processes are properly in place, for example to ensure that:
  - the Situation Unit receives timely data updates;
  - the Safety Officer is consulted and approves the SCAT safety plan;
  - SCAT field missions are aligned with the Logistics Section processes; and
  - liaison and public information officers are engaged, communication lines are established, and timely information is provided through the Situation Unit, following the QA/QC process.

IN SUMMARY:
The planned phase—decision-making and the SRP plan

- Shoreline response objectives, priorities, clean-up options, constraints (GMPs) and treatment end-point criteria are generally developed by the Environment Unit TWG process.
  - Based on these factors, the SRP team develops a medium-term (weeks) and long-term (months) strategic plan to generate and implement the STRs, which in effect drives the operational programme.
- The STR Manager tracks and supports the progress of the STRs though the decision process.
- The SRP plan defines:
  - the SRP management structure and staffing, with roles and responsibilities;
  - coordination within the Environment Unit and with the Operations Section;
  - the SCAT field survey and SCAT-Operations Section support programme;
  - how the treatment end-point criteria are used to initiate and generate STRs;
  - operational phases based on 'initial' and 'final' treatment end-point criteria;
  - monitoring and evaluation of treatment effectiveness; and
  - the inspection and STR completion process.

Cheryl Casey/Shutterstock.com

Beach clean-up team at Pensacola following the Macondo spill in the Gulf of Mexico, 2010

THE PLANNED PHASE—SRP PROJECT IMPLEMENTATION

The SRP plan organizes all of the many components of a response operation, including SRP/SCAT staffing (rotations; upsizing and downsizing), the strategy for different SCAT missions, the operational strategy and timing for STR activities, daily and weekly SCAT and STR progress reporting and the agreed protocol for STR completion inspections.

The SRP/SCAT plan is flexible to allow for adjustments over time. No real-world environment is static, and SCAT reassessments or resurveys are typically necessary if there is a change in shoreline oiling conditions after an STR has been approved, or during a treatment activity. Shoreline processes, such as the impact of storm waves, may bury surface oil or expose previously-spilt subsurface oil on beaches. The timing of activities may also change as seasonal constraints, such as breeding and nesting activities, begin or end, or when a treatment method that was effective is no longer appropriate as the remaining oil weathers through time. Each adjustment involves gathering and interpreting SCAT information and providing recommendations to the TWGs for consideration. The SRP concept provides a single point of contact for all of the shoreline issues and adjustments as the decision-making and planning processes evolve.

Key features of the planned phase (project implementation stage) are listed in Box 5 (further details can be found in the checklists presented in Appendix 2).

Box 5 Key features of the planned phase (SRP project implementation stage)

The objective of the project implementation stage of the planned phase is to carry out the SRP plan and commence STR activities.

- The SRP supports the Operations Section in the Command Post.
- The SCAT Field Survey Teams and the SCAT-OPS Liaison support the Operations field teams in the treatment of individual shoreline segments.
- The effectiveness and progress of treatment activities are monitored through the SCAT-OPS Liaison process.
- The IMT is kept informed of STR progress and constraints or challenges.
- The SRP/SCAT teams work with the Environment Unit to engage stakeholders if STRs are not effective and need to be reassessed, or if oiling conditions have changed.

IN SUMMARY:
The planned phase—SRP project implementation

- The SRP Manager:
  - monitors treatment activities and provides regular progress reports to the PSC, the ENVL and Incident Command; and
  - recommends adjustments to treatment activities or schedules based on the effectiveness of the treatment actions and the rate of progress to meet the treatment end-point criteria.
- The SCAT Field Survey Teams and SCAT-OPS Liaison support the Operations teams treating individual segments to assess the effectiveness of the activities.
- The STR Manager tracks the progress of STR implementation through to completion.

THE COMPLETION PHASE

The STR Manager tracks the progress of STR activities and provides routine updates. As treatment progresses, the Operations teams and SCAT-OPS Liaison decide on the appropriate timing for a SCAT inspection on part or all of the shoreline covered by a particular STR. They may decide that an internal SCAT PTA mission, involving the appropriate agency and landowner/land manager representatives, could be appropriate prior to undertaking the formal completion inspection process and approval of SIRs. When a PTA or an interagency inspection results in additional effort, the SCAT-OPS Liaison works with the Operations teams to ensure that the requirement(s) for completion are understood and achievable. If the expectations or treatment end-point criteria are not achievable for reasons of safety, logistics or net environmental benefit, or are not operationally practicable, the SCAT team and SCAT-OPS Liaison communicate with the ENVL and TWGs to assess the situation for that location and agree on a course of action.

Key activities involved in the inspection and completion phase of the SRP are listed in Box 6 (further details can be found in the checklists presented in Appendix 2).

Box 6 Key activities involved in the completion phase

The objective of the completion phase is for all parties to agree that segment treatment end-point criteria have been achieved, and to identify locations for potential long-term monitoring where the treatment end-point criteria do not require removal of all of the oil.

- If additional effort is required to meet the designated treatment end-point criteria, the SCAT-OPS Liaison works with the Operations Section and the ENVL/TWGs to agree on a course of action.
- As the response needs diminish, the SRP team is demobilized and reorganized, and the organization contracts.

IN SUMMARY:
The completion phase

- The SCAT Programme Coordinator, SCAT-OPS Liaison and ENVL evaluate the need for internal SCAT PTA missions prior to undertaking the interagency STR completion inspections and the approval of SIRs.
- Inspection surveys typically include the appropriate agency and landowner/manager representatives.
- Where an inspection determines that a segment meets the treatment end-point criteria, treatment operations on that segment are demobilized and the resources are deployed elsewhere.

THE SRP ROLE IN THE PLANNING CYCLE

A key function of an SRP is to collect and interpret shoreline oiling data and information through a SCAT programme, and to use that data to generate recommendations for the Environment Unit and Planning Section decision makers. Interpretation of the data involves both real-time scales and projections to estimate oil retention and persistence on shorelines with different substrate materials and different wave energy levels. The projections are used to develop the long-term treatment strategy and tactics plan to guide the STR process.

Similarly, the SRP Manager is directly involved in the short-term planning cycle that sets objectives, tactics, work assignments and schedules for the IAP, which may be issued on a daily basis in the first weeks of a response. The SRP Manager is also directly involved in recommending and updating the long-range strategy.

IN SUMMARY:
The SRP role in the planning cycle

- The SRP supports the PSC and ENVL in the daily cycle of preparation and participation in the tactics and planning meetings. Assignments are generated at these meetings in relation to the STRs, and are presented for inclusion in the IAP for the next operational period.
- The SRP team develops a medium-term (weeks) and long-term (months) strategic plan to generate and implement the STRs, which in effect drives the overall operational programme, and makes recommendations for any adjustments to the plan that may be required as the programme evolves.
- The SRP Manager monitors the response objectives to ensure that they support the SRP strategies.

SCAT AS PART OF THE SRP

SCAT is an integral component of an SRP. The SRP generates an SRP plan that focuses on strategic planning, within which a tactical SCAT programme is embedded. SCAT is a generally-accepted technique, with regional or national variations, for collecting data and information, developing treatment recommendations, and supporting the Operations Section. A SCAT programme is not intended to provide strategic planning nor to make decisions, but to support that process by data collection and input through the Environment Unit TWGs (IPIECA-IOGP, 2014a).

While a SCAT team may be involved in a wide range of activities, the key basic functions of a SCAT programme are to:

- collect and deliver information on initial and subsequent shoreline oiling conditions;
- generate shoreline response recommendations for Environment Unit and Planning Section decision makers;
- support the Operations teams through the SCAT-OPS Liaison process; and
- facilitate the completion of STR activities through an inspection process.

A SCAT programme is managed within the Environment Unit/SRP organization and involves cooperation and consensus between the ENVL, Environment Unit, SCA-TS, SCAT Programme Coordinator, STR Manager and the decision makers in the Environment Unit TWGs or TAGs, to:

- evaluate SCAT data to develop treatment objectives, priorities and treatment end-point criteria;
- review STRs and reach a consensus on appropriate inputs or constraints (e.g. NEBA/SIMA, GMPs, etc.) in relation to environmental or social/cultural resources; and
- evaluate treatment monitoring information, treatment adjustments and SIRs.

This relationship is a critical component of a successful decision-making and implementation process. The SRP Manager and the ENVL work closely together to ensure that good communication is maintained within that team and with the Operations teams through the SCAT-OPS Liaison process.

The list of field missions or types of surveys that might be conducted during a SCAT programme includes:

- reconnaissance surveys of oiled shorelines (air, ground or on-water);
- systematic SCA surveys that generate SOS forms;
- liaising with, and supporting, the Operations teams via the SCAT-OPS Liaison function;
- monitoring of shoreline treatment operations;
- PTA surveys;
- STR completion inspection surveys that provide the basis for SIRs;
- photographic monitoring; and
- beach profiling.

Completion of the SIRs is a specific responsibility of the Environment Unit/SCAT team, and involves consensus agreements with agency and stakeholder representatives in the field, as well as approval at the Command Post.

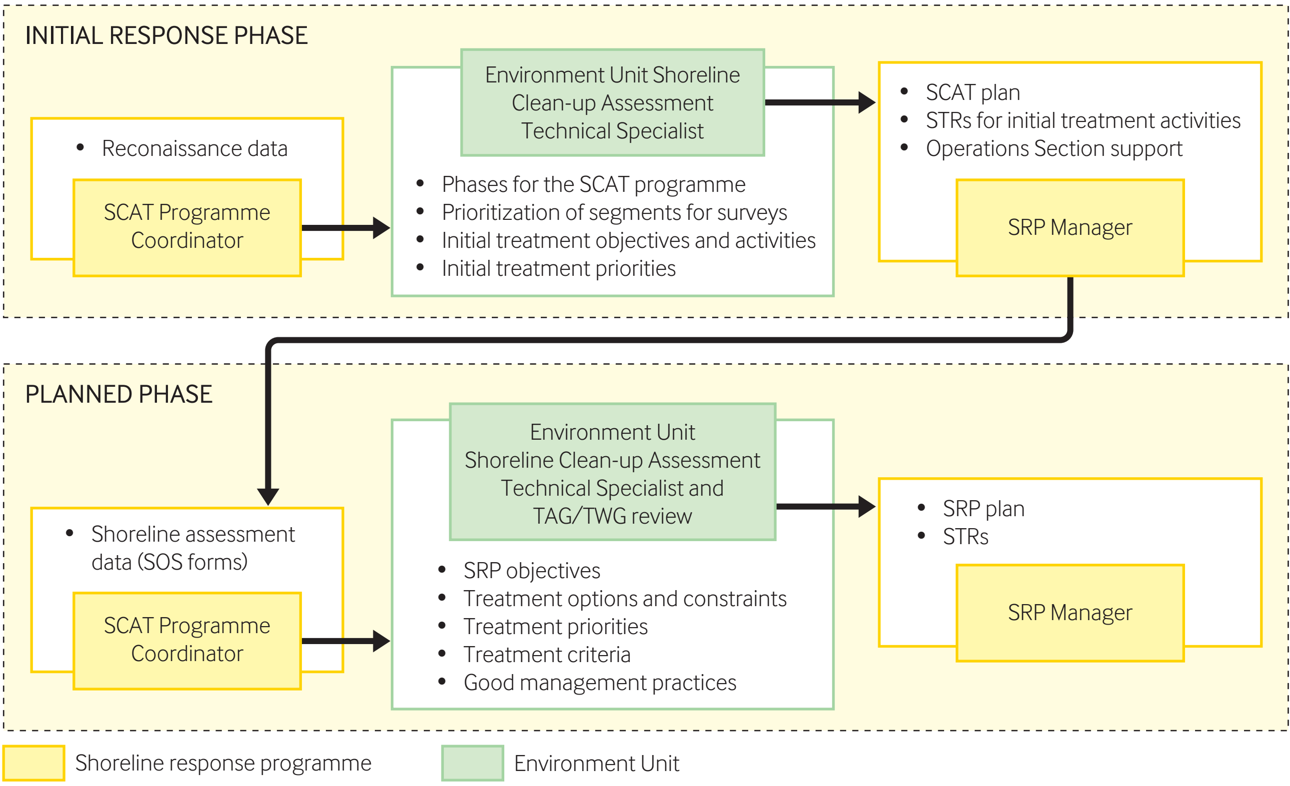
The role of SCAT in an SRP is illustrated schematically in Figures 5 (page 21) and 13 (below) which describe the flow of activities and data in the initial response and planned phases. The reconnaissance data in the initial response phase are used to:

- generate STRs, which may be generic, in order to initiate treatment as quickly as possible following guidelines set by the Environment Unit;
- develop a SCAT survey plan; and
- initiate the medium- and long-term strategy for the SRP/SCAT Plan.

The systematic ground SCA survey data collected in the planned phase are documented on the SOS forms. These data determine one of three results:

- no observed oil;
- oil is present but no further treatment is required because the segment or zone meets the treatment end-point criteria; or
- an STR is generated to describe the actions necessary to achieve the treatment end-point criteria.

Figure 13 Typical process flow from collection of data via SCAT reconnaissance surveys through to development of the SRP plan and STRs



Phased treatment end-point criteria are important and, in the initial response, the SCAT Field Survey Team Leads or SCAT-OPS Liaison support the Operations Section to ensure that the teams do not 'over-clean' oiled areas. It is expected that some cleaned segments may meet the initial response treatment end-point criteria but not subsequent later-phase treatment end-point criteria (see discussion on pages 40–41).

SCAT OPS-Liaison support is a separate function in a SCAT programme that is needed when SCAT teams and Operations personnel are not working in the same geographic area, or if SCAT teams do not have sufficient capacity to support all divisions of the Operations Section at the same time. In addition, it may be more efficient to have a single SCAT-OPS Liaison person support a task force or strike team rather than a full SCAT Survey Team. SCAT Field Survey Teams may not necessarily work in the same area(s) as Operations personnel on a day-to-day basis, particularly when the oiling is extensive. In this case, separate logistics and safety support from the Logistics Section and Air Operations Branch will be required.

IN SUMMARY:
SCAT as part of the SRP

- The SCAT programme is implemented and managed within the SRP.
- Data collected by SCAT is used by the SRP team to develop recommendations on treatment issues for the ENVL and the TWGs.
- The SCAT Team Leads or SCAT-OPS Liaison(s) support the field operations teams in the interpretation of STRs, and monitor the effectiveness and progress of STR activities.

STAKEHOLDER ENGAGEMENT

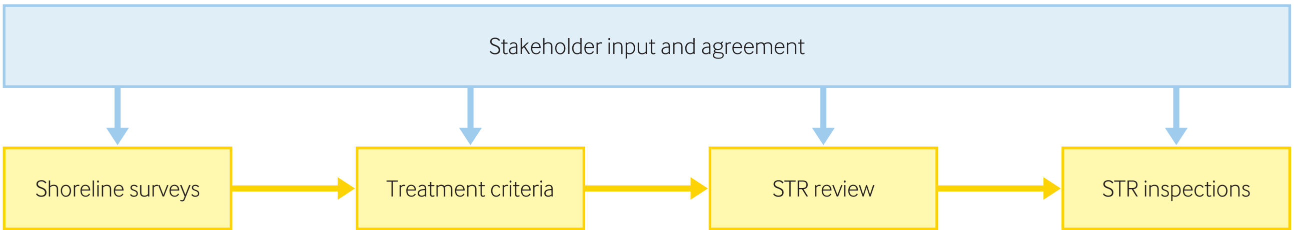
The ENVL is responsible for stakeholder engagement in the SRP process, primarily by participation in TWG meetings led by the Environment Unit (see Figure 4 on page 18). Stakeholders include national, regional and local government agencies or organizations with a regulatory mandate, as well as landowners, land managers, and other interested or concerned parties. The SRP team is involved in the decision process for defining the SRP plan and, based on those decisions and on SCAT data, makes recommendations, via the STRs, to the Environment Unit and TWGs for their agreement and approval.

Stakeholder involvement in the SRP process (see Figure 14 on page 48) can include:

- representation on SCAT missions, including aerial reconnaissance surveys and systematic ground survey field teams;
- involvement with the design of constraints or GMPs for shoreline tactics and support activities which provide for the monitoring and protection of threatened and endangered species and other wildlife (e.g. nesting birds, turtles, spawning areas, etc.);
- participation in TWGs and TAGs formed within the Environment Unit to develop and agree on the treatment end-point criteria, and to review the content of STRs recommended by the SRP/SCAT programme; and
- participation in SCAT inspection missions, and in the process by which agreement is reached that sufficient treatment has been completed and that the treatment end-point criteria have been achieved.

Participation of stakeholders in initial aerial reconnaissance surveys and in the systematic ground shoreline oiling assessment surveys is an important element in establishing an agreed understanding of the distribution and character of the stranded oil. A fundamental SCAT concept is that a field survey team agrees on the documented oiling conditions so that only one data set is created. This involvement is critical to building consensus during the decision process that develops shoreline treatment objectives, priorities, options, constraints and treatment end-point criteria. Prospective field team members should have some level of SCAT training, together with relevant safety training, prior to deployment. If necessary, an appropriate level of training can be provided on an emergency basis.

Figure 14 Stakeholder engagement in the SRP



A direct benefit of the participation of stakeholders in SCAT survey missions is that representatives with minimal or no oil spill experience or knowledge can learn about shoreline characteristics, coastal processes, the behaviour of oil on shorelines, and treatment methods from the SCAT Field Survey Team Lead. This knowledge of shoreline oiling and treatment can then be communicated and shared with the agency or stakeholder group that is represented. One limitation is that opportunities for stakeholder participation in field missions may be limited by logistical constraints, in most cases to one or two positions in each SCAT Field Survey Team, so that one person may represent multiple stakeholders.

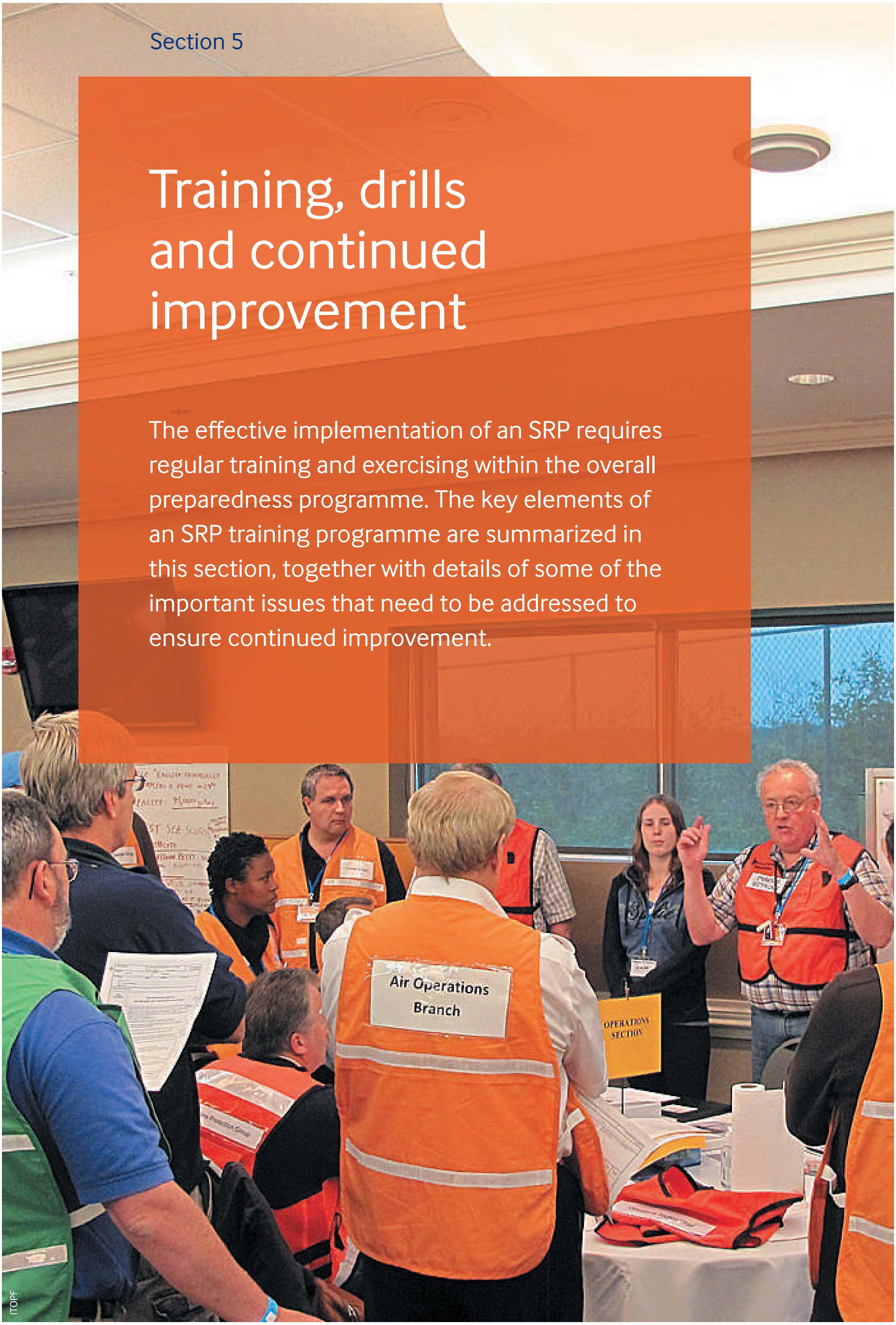
IN SUMMARY:
Stakeholder engagement

- The ENVL ensures that stakeholders are engaged in the planning and decision-making processes.
- Participation begins during the initial response reconnaissance survey(s), and continues through the SRP to the inspection and completion process.

Section 5

Training, drills and continued improvement

The effective implementation of an SRP requires regular training and exercising within the overall preparedness programme. The key elements of an SRP training programme are summarized in this section, together with details of some of the important issues that need to be addressed to ensure continued improvement.



ITOPF

Training, drills and continued improvement

TRAINING AND DRILLS ARE AN ESSENTIAL PART OF THE SRP CONCEPT

With a few exceptions, exercises and drills rarely have a realistic shoreline response component, often due to the emphasis in the design which typically focuses on the initial organizational setup of an IMT and the on-water activities. An SRP is usually not considered when establishing the initial set of objectives for any spill or drill, and is typically only referred to in general statements that relate to minimizing the effects of the release. As a consequence, an SRP is often not part of a preparedness training programme, and is little understood by response managers and senior decision makers; hence the concept of an SRP is not always sufficiently engrained to enable the 'getting it right from the start' approach to an oil spill response. This lack of preparedness may have significant long-term consequences regarding the effects of the spilled oil on shorelines, as well as on the time and level of effort required for a shoreline treatment programme (see also *A valuable evolution in the approach to shoreline response* on pages 8–9).

A paradigm shift in the approach to oil spill preparedness and response is therefore necessary to create a planning and preparation culture which elevates the SRP to a higher level of priority and acceptance so that it can be integrated into an IMT system more successfully. Once the benefits and value of an SRP are recognized and accepted, the effective implementation of the concept will require regular training and exercising within the overall preparedness programme.

Design options for drills and exercises should include imminent and actual shoreline oiling scenarios to ensure that IMTs can practice carrying out the SRP function to reinforce the strategic importance of establishing an SRP prior to, or immediately following, oil impacting a shoreline.

The development of an SRP training programme could address different levels of staff for learning and development:

- For IMT Commanders, Planning and Operations Sections Chiefs, and shoreline activity-related unit leaders, training should focus on:
  - the importance and benefits of an SRP in terms of 'getting it right from the start';
  - an overview of SRP organization and management;
  - relationships, information flow, and responsibilities within an SRP team and the IMT;
  - the role of SCAT and SCAT-OPS Liaison; and
  - the decision process.
- For SRP Leaders, SCAT Programme Coordinators, SCAT Data Managers and SCAT-OPS Liaison Coordinators, training should focus on:
  - the objectives and purpose of an SRP in a response;
  - roles and responsibilities within an SRP team and in the IMT;
  - relationships within the SRP team and with the IMT in the planning cycle and the decision process;
  - shoreline treatment methods;
  - SCAT management, field missions and surveys, and data generation/management; and
  - STRs, PTAs and SIRs.
  - Training could also include a tabletop exercise and use of the checklists provided in Appendix 2.

Lessons learned from exercises and drills during training, as well as during response operations, provide the basis for continued development and improvement of the training programme, as well as the development of a sustained and effective shoreline response capability.

The primary purpose of the review process should be to identify what worked well and where improvement is required. The checklists of SRP activities presented in Appendix 2 could provide the basis for a post-exercise or post-response review of an SRP. Some important issues that could be reviewed as topics, rather than the specific individual action items in the checklists, are summarized below.

- Review the initial response decision process in setting initial objectives and priorities to ensure that:
  - the initial Incident Command objectives include strategic objectives for an SRP;
  - the organization of the Operations Section and Environment Unit support an SRP; and
  - initial response STRs are included in the IAP.
- Review the effectiveness of the initial shoreline treatment actions, and evaluate whether and how the initial response actions:
  - decreased the immediate effects of the oil on the environment;
  - reduced the exposure time of resources at risk;
  - accelerated ecological and socio-economic recovery; and
  - reduced the subsequent long-term level of effort required for the response.
- Review the STR process.
- Evaluate the effectiveness of liaison activities between the Environment Unit, Operations Section and Logistics Section on shoreline response issues and activities.
- Evaluate how shoreline processes and oceanographic conditions were monitored and understood in the context of the fate and behaviour of shoreline oil deposits.
- Evaluate how changes in shoreline oiling characteristics were monitored over time.
- Evaluate how testing and demonstrations of accepted treatment tactics were conducted to verify their applicability for use under the prevailing spill conditions, and evaluate how the lessons learned can be applied.
- Evaluate how any promising new oil detection and clean-up technologies were tested.
- Review the application of field performance indicators (key performance indicators—KPIs) to monitor treatment effectiveness and to adjust treatment tactics.
- Evaluate the procedures by which completion inspections were undertaken to recommend treatment completion and when treatment end points were achieved.
- Recommend modifications in the SRP process or documents to improve planning, preparation, evaluation, training and implementation.

IN SUMMARY:
Training, drills and continued improvement

- Currently, an SRP as an integrated activity is not part of the IMS culture; an SRP is typically not a point of focus in an exercise or drill, and is rarely part of a preparedness training programme. Although SCAT training is a common practice, this is only one element of an SRP.
- Exercising the SRP component of an IMS is essential in order for senior managers to understand and embrace the concept of 'getting it right from the start' for a shoreline programme, either before the shoreline is oiled or as soon as it has been oiled.
- The inclusion of an SRP concept in drills, exercises and preparedness training can directly improve the ability to respond quickly and effectively during the initial response phase, which can have long-term environmental and operational consequences.
- To develop a better appreciation for an SRP, the Operations Section Shoreside Recovery Group should, at a minimum, be activated for drills and exercises.
- A training programme should provide for different levels of learning and development, as well as providing a process to capture lessons learned from drills, exercises and spill incidents.

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Appendices: Job aids

Appendix 1: SRP summary information

The treatment of oiled shorelines is typically the largest component, in terms of time and effort, of most oil spill response projects, and it is recommended that an SRP is established at the outset of an oil spill incident when a shoreline is oiled or threatened by oil. The SRP described in this guide supports the IPIECA-IOGP good practice guides entitled *A guide to oiled shoreline assessment (SCAT) surveys* (IPIECA-IOGP, 2014a) and *A guide to shoreline clean-up techniques* (IPIECA-IOGP, 2015a).

'GETTING IT RIGHT FROM THE START'

Establishing a shoreline strategy with an appropriate level of management and operational support is critical during the initial response. At the start of a response, a shoreline assessment survey and a shoreline treatment or clean-up programme requires the coordination and management of a wide range of Command Post and field activities that are currently shared between the Planning and Operations Sections. Typically, at the start of a response when there is competition for these resources, the Incident Command and Planning Section teams place a higher priority on the on-water activities, with the result that:

- shoreline clean-up is not as effective as it could be in many instances when the stranded oil is most concentrated and mobile;
- the environmental, economic and social effects of stranded oil are not minimized as much as they could be, due to longer oil exposure times; and
- shoreline clean-up efforts take much longer, and waste generation and costs can be considerably greater than they would have been if action had been taken more promptly at the start of the response.

ROOM FOR IMPROVEMENT

1. **Separation of responsibility:** The current IMS concept is a proven and effective system but can be prone to communication and accountability issues. In this system the responsibility for a shoreline programme is shared between the Planning and Operations Sections, with the decision processes lodged in the Environment Unit and implementation of those decisions managed by the Operations Section. An SRP acts as a bridge between these two key components of an IMS, and is assigned the overall responsibility for the strategic planning and appropriate implementation of shoreline treatment strategies. Accountability for the SRP is maintained within the Environment Unit through the STR approval process.
2. **Streamlining:** The Environment Unit is the point of convergence of many operational and decisional elements that support the strategies and tactics which drive the direction and pace of a response. An SRP, under the direction of the SRP Manager, can streamline the planning and decision-making processes within the Environment Unit, and enable more effective span of control by providing focused support and an integrated perspective on all shoreline treatment issues, including the collection of shoreline oiling assessment data (SCAT) and STR implementation.
3. **Communications:** An SRP offers a single point of contact for the wide range of management and operational issues and activities that relate to a shoreline response; it provides a direct bridge between the Environment Unit and the Operations Section to better coordinate and streamline the decision-making and implementation activities.
4. **Operations support:** In the current IMT structure there is no mechanism in place for the Environment Unit to provide direct support for the Operations Section's shoreline clean-up task forces or strike teams in the field; this support is provided by the SRP through the SCAT-OPS Liaison function.

5. **Preparedness and training:** Missed opportunities at the outset of a response—the time when shoreline treatment is typically able to provide the best potential gain—largely result from the lack of inclusion of an SRP concept in drills, exercises and preparedness training. As a consequence, the concept and benefits of setting up an SRP prior to shoreline oiling, or as soon as the shoreline is oiled, by 'getting it right from the start' are typically not fully appreciated or understood by planners or senior decision makers.

HOW AN SRP IMPROVES THE IMS

The Environment Unit is a critical function in the decision-making process relating to the response, and the ENVL is faced with the challenge of organizing and managing a wide range of technical and scientific specialists as well as agency and/or stakeholder representatives. The Environment Unit is the primary source of all information for the decision processes, and the demands placed upon it are always high at the onset of a response. An SRP integrates, within a single team in the Environment Unit, all issues related to shoreline data (SCAT), decisions regarding shoreline treatment options and priorities, monitoring the implementation of those decisions, and post-treatment inspections, without restructuring or reorganizing the traditional IMS or SCAT field programme (see Figure 3 on page 17). This concept addresses each of the potential areas for improvement in an IMS, and offers a streamlined, natural separation of functions for span of control as the scale of a response increases (IPIECA, 2015b).

The primary benefits of an SRP are that it provides:

- an understanding, for response managers and senior decision makers, of the benefits of the shoreline initial response activities and the ramifications of delaying shoreline clean-up;
- a rapid response capability at the time when oil at the shoreline is most mobile, and when clean-up can be more efficient and effective in helping to reduce short- and long-term impacts on shorelines and in reducing waste generation;
- a single point of contact for all shoreline issues, which improves communication, decision-making and accountability;
- a long-term (from weeks to months) strategic focus on the shoreline response for the Incident Command and Planning Section during the initial response when the decision-making process is typically focused on short-term (days) issues, and primarily on-water activities;
- a streamlined assessment and response process so that treatments and approved STRs can be modified as oiling conditions change or as treatment methods become less effective;
- a sustained shoreline response through to completion of operations, while maintaining span of control with a robust framework for shoreline response operations that improves operational and geographical consistency; and
- the opportunity to manage expectations through medium- and long-term strategic planning.

KEY COMPONENTS OF AN SRP

The SRP resides within the Environment Unit, and the SRP Manager reports directly to the ENVL (Figure 3, page 17). For a large-scale response, or when the response moves to the project implementation stage and the SRP becomes the dominant operational component in an IMT (Figure 11, page 35), the SRP Manager may be elevated to a Deputy or Assistant ENVL (Figure 4, page 18).

In order to maintain span of control, as the scale of a response increases, the SRP Manager may be supported by a SCAT Programme Coordinator and a SCAT Data Manager/STR Programme Manager. In turn, with a further increase in scale, the SCAT Programme Coordinator may be supported by a SCAT Field Coordinator (responsible for SCAT team safety and logistics), and separate roles could be assigned for the SCAT Data Manager, the STR Manager and the SCAT-OPS Liaison Coordinator.

Currently, a SCAT programme generates data on shoreline information that is fed to the Environment Unit, prepares STRs for actionable oiled shorelines, and facilitates inspections and treatment closure reports under the management of a SCAT Programme Coordinator. This component would be unchanged and fully integrated within an SRP with the addition of the SCAT-OPS Liaison function.

TYPICAL DAILY ROUTINE FOR AN SRP MANAGER FOLLOWING THE INITIAL RESPONSE

Briefing and information exchange

- Daily **SCAT Field Survey Team briefings** (safety, missions objectives and logistics) are held with the SCAT Programme Coordinator and/or the SCAT Field Coordinator; SCAT 'packages' are created by the SCAT Data Manager and provided to the SCAT Field Survey Team Leads with the maps and data required to conduct the missions; SCAT teams deploy to the field.
- The SRP Manager discusses the previous day's activities and decisions with the ENVL and the **Operations Section's shoreline programme representative(s)** and, collectively, they agree on SRP priorities, activities and upcoming assignments and deliverables.
- An **internal SRP team meeting** is held to share information on the previous day's activities and decisions, and to brief on upcoming assignments and expectations. For example, data technicians typically work on an off-cycle schedule, and may report in during the day and then remain at work in the evening until all data entry has been completed in accordance with appropriate QA/QC.

Daytime activities

- The **SRP Manager** takes time each day to assess the long-range (weeks and months) SRP picture, and look ahead for potential issues, concerns or challenges that may arise, or for adjustments that may be appropriate. In addition, he or she considers how to strategize for any upcoming transitions or changes of pace in the SRP.
- The **SRP Manager** participates in tactics and planning meetings to support the ENVL and PSC, and attends any shoreline-related TWG meetings. The SRP Manager also coordinates with the SCAT Programme Coordinator and SCAT Field Coordinator on upcoming (i.e. the following day and longer-term) field missions and strategies, reviews the SRP/SCAT plan to ensure that activities are meeting the Incident Command's objectives, and that those activities are on target and on schedule.
- Together with the **SCAT Field Coordinator**, the SRP Manager ensures that regularly scheduled prearranged contacts with the SCAT Field Survey Teams and SCAT-OPS Liaison are maintained (for safety), discusses the mission plan for the following day as well as the short-term rolling 7- or 10-day mission plan, and discusses the rotation schedule for the SRP office and field staff based on the rolling long-term (one month or longer) mission plan.
- Together with the **STR Manager**, the SRP Manager prepares STRs and their associated GMPs, and liaises with technical specialists and other representatives to move STRs through the review and approval process.
- Together with the **SCAT Data Manager**, the STR Manager ensures that the SCAT 'packages' are prepared for the following day's missions.

Debrief and data management

The **daily debrief** involves the full SRP team, and is usually attended by the ENVL and representatives from the Environment Unit SCA-TS and the Operations Section.

A typical daily debrief may include the following:

- A safety moment to provide an opportunity to share issues or concerns from the day.
- SCAT Field Survey Team Leads summarize activities, results and key observations.
- SCAT-OPS Liaison field teams summarize activities and observations.
- The SCAT Field Coordinator outlines the field plan and logistics for the following day.
- The SRP Manager shares information regarding what is happening outside the SRP group, and describes upcoming assignments and expectations.

Before the team leads leave, the SRP Manager and the **SCAT Data Manager** ensure that QA/QC have been conducted on the SCAT data and information, so that any necessary revisions or additions can be captured and the data entry completed. The data are then distributed to the Situation Unit and Documentation Unit.

Appendix 2: SRP activity steps and checklists

CONTENTS OF THIS APPENDIX

- A summary of the typical sequence of activities in an SRP.
- Checklist: The initial response.
- Checklist: The planned phase (decision-making stage).
- Checklist: The planned phase (project implementation stage).
- Checklist: Completion phase.

The summary of activities and the checklists presented in this Appendix identify some of the major activities and actions that characterize a typical SRP. The information is presented in the context of the sequence of steps that is typically followed as a response is initiated and implemented through to completion (see also Figure 12 on page 40). It is intended as a guideline only, and some activities may be concurrent and overlapping, for example when there is a phased approach to shoreline treatment. This is only a partial summary of the activities and actions involved, and the exact scope and character of an SRP should be flexible and should adapt to the scale, size and location of the response operation. More detailed checklists for the SCAT component of an SRP are provided by a Job Aid in the ECCC SCAT Manual (ECCC, 2018).

continued ...

THE TYPICAL SEQUENCE OF ACTIVITIES IN AN SRP

1. Initial response — activation

If the shoreline is oiled, and the Incident Command determines that there should be a shoreline response, the PSC or ENVL activates the SRP and SCAT programmes.	If the shoreline is NOT expected to be oiled, the PSC or ENVL would place the SRP and SCAT programmes on standby.

2. Initial response — mobilization

Estimate the 'scale of the problem' and mobilize the SRP/SCAT programmes to an appropriate level of staffing.	Monitor mobilization of the SRP and SCAT programmes.	Engage with the PSC, ENVL and Environment Unit SCA-TS on SRP/SCAT objectives, roles, responsibilities and expectations.

3. Initial response phase — implementation of SCAT reconnaissance missions

Provide reconnaissance shoreline oiling data to the Environment Unit.	Recommend generic STRs for initial shoreline treatment objectives, priorities, and treatment end-point criteria for the removal of oil while it is concentrated and before it is reworked, buried or remobilized. *	Define the initial SCAT survey strategy and develop a short-term (rolling 7-day) mission plan. *

4. Initial response phase — implementation of the SRP and initial response treatment activities

Monitor and decide how to bring closure to the initial response bulk oil removal activities. *	Manage SCAT field activities (safety and logistics support).	Define long-range strategy and begin preparation of the SRP and SCAT plans *

5. Planned phase (decision-making stage) — preparation of the SRP and SCAT plans

Define treatment options by shore type and oiling conditions in consultation with the Operations Section. *	Define SRP objectives, strategy and treatment end-point criteria (by phase and by shore type). *	Develop GMPs for SCAT field activities and STRs. *	Define the monitoring and inspection process for STR closure. *

* *indicates a joint activity with the SCA-TS based in the Environment Unit*

continued ...

The typical sequence of activities in an SRP (continued)

6. Planned phase (project implementation stage) — implementation of SCAT programme surveys and field missions

Manage SCAT field activities, safety plan and support.	Provide processed (post QA/QC) field data to the Environment Unit, Documentation Unit and Situation Unit.	SRP team prepares STRs for review by the Environment Unit, engaging with stakeholders as necessary.	Conduct and report on equipment field tests and treatment trials as required. *

7. Planned phase (project implementation stage) — shoreline treatment and delivery of the SRP/SCAT plan

Monitor engagement by SCAT or SCAT-OPS Liaison with the Operations teams in the field.	Monitor short- and long-range strategies (to closure), and adjust as appropriate. *	Provide input to daily meetings or IAP-related activities. *

8. Completion phase — inspection and completion of the SRP/SCAT plan

Engage with the Operations Section to arrange for internal post-treatment assessments (PTAs) and, subsequently, for interagency inspections.	Work with the Environment Unit to engage stakeholders in the inspection process following STR completion.	Submit signed SIR forms for segments that meet the treatment end-point criteria. *

* *indicates a joint activity with the SCA-TS based in the Environment Unit*

CHECKLIST: THE INITIAL RESPONSE

1. Activation of an SRP

- [ ] The **PSC** and **ENVL** determine whether a shoreline impact has occurred, or has the potential to occur, using overflight information and trajectory models.
- [ ] If no shoreline impact has occurred, or has the potential to occur, the **SRP Manager** and **Environment Unit SCA-TS** are placed on standby.
- [ ] If a shoreline impact has occurred, or is deemed to have the potential to occur, the **PSC** or **ENVL** activates the SRP, which includes a SCAT programme. For all but small incidents, the initial SRP team includes the **SRP Manager**, the **SCAT Programme Coordinator**, the **SCAT Data Manager** and the **Environment Unit SCA-TS**.
- [ ] The **SRP Manager** coordinates with the **ENVL** to provide **Incident Command** with high-level strategic objectives for the SRP and SCAT programmes, and develop specific short-term objectives for the initial SRP/SCAT response.

2. Mobilization of an SRP/SCAT programme

- [ ] The **ENVL** provides the **SRP Manager** with overflight information, trajectory maps, sensitivity maps and information on shoreline resources at risk.
- [ ] The **SRP Manager** uses the overflight information, trajectory maps and other available information to assess the geographic extent of the response, and estimate the potential time scale of the incident response and therefore the required size of the SRP/SCAT programme.
- [ ] The **SRP Manager** and **SCAT Programme Coordinator** mobilize personnel to the appropriate level of staffing and provide an organizational chart to the **ENVL**.
- [ ] The **SRP Manager** and **SCAT Programme Coordinator** prepare assignment sheets for each SCAT team, that include the resources needed by each team.
- [ ] The **SRP Manager** monitors the mobilization of the SRP/SCAT programme, ensuring that the staffing remains at a level appropriate to the response and that appropriate support equipment is sourced (including accommodation, vehicles/drivers, boats, aircraft, etc.).
- [ ] The **SRP Manager** and **SCAT Programme Coordinator** develop separate tactics sheets for the IAP for each type of SCAT mission (reconnaissance, shoreline assessment, SCAT-OPS Liaison, etc.).
- [ ] The **SRP Manager** establishes communications and engages with the **PSC**, **ENVL**, **SCAT-TS** and the **Operations Section Chief** on objectives, roles, responsibilities, expectations and stakeholder engagement.

continued ...

Checklist: The initial response *(continued)*

3. SCAT reconnaissance missions
☐ Key SRP and SCAT personnel conduct an aerial or ground-based orientation of the impacted or potentially affected shoreline area; this field orientation could include one or more of the **SCAT Programme Coordinator**, **SCAT Field Coordinator**, **SCAT Data Manager**, **Environment Unit SCA-TS**, **SCAT Field Survey Team Leads** and potentially agency/stakeholder representatives.
☐ The **SCAT Data Manager** segments the shoreline, in consultation with the **Environment Unit SCA-TS** and **SCAT Field Survey Team Leads** or, if the shoreline is pre-segmented, verifies the segmentation using current data.
☐ The **SCAT Data Manager** communicates the segmentation, as maps or GIS files, to the **Situation Unit Leader**, **Operations Section Chief**, **PSC**, **ENVL** and **Logistics Section Chief**.
☐ The **SRP Manager** consults with the **SCAT Programme Coordinator** and **Environment Unit SCA-TS** to define the initial SCAT shoreline reconnaissance survey strategy and priorities.
☐ The **SRP Manager** and **Environment Unit SCA-TS** determine the agency or other stakeholder representation that would be appropriate or required for the SCAT field and support teams, and communicate this information to the **SCAT Programme Coordinator** and the **ENVL**.
☐ The **SCAT Programme Coordinator** and **SCAT Field Coordinator** deploy **SCAT Field Survey Teams** to conduct aerial reconnaissance and/or rapid ground/vessel assessments to gain a complete picture of the extent, locations and character of shoreline oiling.
☐ **SCAT Field Survey Teams** assess the shoreline for access, logistics and safety, and document this information on SOS forms.
☐ The **SCAT Data Manager** determines the required scope of the SCAT database, establishes the physical database, and arranges for GIS support to generate maps and other graphic materials.
☐ The **SCAT Data Manager** enters reconnaissance and SOS data into the SCAT database.
☐ The **SCAT Programme Coordinator** or **SCAT Data Manager** provides initial reconnaissance and rapid assessment data to the **SRP Manager**, **ENVL**, **Environment Unit SCA-TS**, **PSC**, **Situation Unit Leader**, and **Operations Section Chief**.
☐ The **SCAT Programme Coordinator** provides initial access, logistics and safety assessments (from SOS forms) to the **Operations Section Chief**, **Safety Officer** (in the Incident Command general staff) and **SRP Manager**.
☐ The **SRP Manager** and the **SCAT Programme Coordinator** develop a shoreline clean-up 'initial response' plan, including generic STRs as appropriate, that provides recommendations to the **ENVL**, **Environment Unit SCA-TS**, **PSC** and **Operations Section Chief** for shoreline clean-up priorities to remove as much oil as quickly as is safe and practical when the stranded oil is most concentrated and mobile before it is reworked, buried or remobilized.

continued ...

Checklist: The initial response *(continued)*

4. Implementation of the SRP and initial response treatment activities
☐ The **Environment Unit SCA-TS** assesses the initial shoreline reconnaissance information and treatment activities and priorities in the 'initial response plan', in coordination with the **SRP Manager**, **SCAT Field Survey Teams**, **SCAT Programme Coordinator** and the **Shoreline Treatment Assessment** (or **Technical Advisory**) **Group (STAG)**, if one has been created.
☐ The **ENVL** coordinates the with the **SRP Manager** and with external stakeholders and agencies, and has the option of establishing **Technical Working Groups (TWGs)** or **Technical Advisory Groups (TAGs)**, such as a **STAG**.
☐ The **SRP Manager** coordinates with the **PSC**, **ENVL**, **Environment Unit SCA-TS**, **STAG** and the **Operations Section Chief** to obtain approval by **Incident Command** of the recommended: (1) objectives; (2) initial phase treatment end-point criteria; and (3) geographic priorities for the initial treatment of the shoreline.
☐ The **SRP Manager** coordinates with the **Environment Unit SCA-TS** and **SCAT Programme Coordinator** to use initial SCAT field data and recommendations to: (1) monitor and decide how to bring closure to the initial response shoreline treatment operations; (2) determine ongoing shoreline survey objectives, strategies and phases; and (3) plan and prioritize SCAT field missions and surveys.
☐ The **SRP Manager** coordinates with the **PSC**, **ENVL**, **Environment Unit SCA-TS**, **STAG** and the **Operations Section Chief** to develop the long-range response strategy and begin preparation of the SRP and SCAT plans (these may constitute a single document with the SCAT plan embedded within the SRP plan).

CHECKLIST: THE PLANNED PHASE (DECISION-MAKING STAGE)

5. Preparation of the SRP and SCAT plans
☐ The **Environment Unit SCA-TS** uses SCAT data and recommendations to develop proposals for the selection of end-point criteria for long-term or phased treatment, and ensures that relevant internal and external stakeholders are involved in the decision-making process, along with the **STAG** or other TAGs/TWGs if they have been established.
☐ The **Environment Unit SCA-TS** coordinates with the **SRP Manager** and **SCAT Programme Coordinator** to use SCAT data and recommendations to develop proposed SCAT and shoreline operations objectives, strategies, priorities, options, constraints and treatment end-point criteria, as well as (KPIs); these are submitted to the **ENVL** and **PSC** for approval, ensuring that all relevant internal and external stakeholders are involved in the decision-making process, including the **STAG**, if one is established.
☐ The **Environment Unit SCA-TS** assesses shoreline treatment options and tactics by shoreline type and oiling conditions, in coordination with the **SCAT Programme Coordinator**, **SCAT Team Leads** and **STAG**. This may include field trials and equipment demonstrations, which are directed by the **SRP Manager** and coordinated with **shoreline operations**.
☐ The **SRP Manager** determines the need for, and manages, any field treatment trials or demonstrations for specific treatment options or operational equipment field tests.
☐ The **SRP Manager** and **SCAT Programme Coordinator** coordinate with the **Environment Unit SCA-TS** to use SCAT data and recommendations as the basis for developing STRs; this may involve a phased approach to the treatment operation.
☐ The **Environment Unit SCA-TS** coordinates with the **SRP Manager**, **SCAT Programme Coordinator**, **STAG**, **Wildlife Specialist** and **Historical/Cultural Resources Technical Specialist or Advisor** to develop GMPs for the SCAT field activities and the STRs.
☐ The **SRP Manager** coordinates with the **Environment Unit SCA-TS** and **SCAT Programme Coordinator** to: (1) determine the monitoring, inspection and approval process/procedures for STR treatment completion; and (2) produce the SRP/SCAT plan that carries the treatment programme through to completion.
☐ The **SRP Manager** coordinates with the **Operations Section** to ensure that they understand the proposed treatment objectives, priorities, strategies and tactics, and to understand any concerns or issues that the Operations Section may have with regard to the SRP plan.
☐ The **SRP Manager** seeks **Incident Command** approval of the SRP/SCAT plan, through the **ENVL** and **PSC**.
☐ The **SRP Manager** ensures that the **SCAT Data Manager** understands the data and reporting requirements of the SRP and other key stakeholders, including the **Planning Section** (in particular the **Situation Unit**), **Operations Section** and **Incident Command**.
☐ The **SRP Manager** provides STRs to the **ENVL** for review and GMP consultation that includes the **Wildlife Technical Specialist** and **Historical/Cultural Resources Technical Specialist or Advisor**.
☐ The **SRP Manager** coordinates with the **Operations Section** to ensure that they understand the STRs, constraints (GMPs) and the treatment end-point criteria.
☐ The **SRP Manager** seeks **Incident Command** approval of STRs via the **ENVL** and **PSC**.
☐ The **SRP Manager** (or **STR Manager**) tracks the generation, review and approval of STRs and ensures that approved STRs are included in the IAP.
☐ After the QA/QC process, the **SCAT Programme Coordinator** or **SCAT Data Manager** provide SCAT summary data, maps and reports to the **SRP Manager**, **ENVL**, **Environment Unit SCA-TS**, **Situation Unit Leader** and **Operations Section Chief**, as required.
☐ The **SRP Manager** ensures that data and reports reach the appropriate Sections/Units/Branches and personnel, including the **ENVL**, **PSC**, **Situation Unit Leader**, **Operations Section Chief**, **Logistics Section Chief** and **Incident Command**.

CHECKLIST: THE PLANNED PHASE (PROJECT IMPLEMENTATION STAGE)

6. Implementation of SCAT programme surveys and field missions
☐ The **SCAT Programme Coordinator** and **SCAT Field Coordinator** schedule and deploy SCAT field missions and surveys in accordance with the priorities set out in the approved SCAT plan.
☐ The **SCAT Data Manager** ensures that the planned SCAT field survey data are aligned with the treatment or end-point criteria so that the appropriate types of information and levels of detail are generated.
☐ The **SCAT Field Survey Teams** conduct systematic SCA surveys and complete SOS forms.
☐ The **SCAT Data Manager** ensures that SCAT field data are uploaded to the database and that QA/QC reviews are performed.
☐ The **SCAT Data Manager** initiates STRs from the SCAT database for segments that do not meet the treatment end-point criteria.
☐ The **SCAT Field Survey Team Leads** and the **SCAT Programme Coordinator** (or **STR Manager**) prepare recommendations for treatment using STR forms based on the SRP treatment objectives, priorities, options, constraints, GMPs and treatment end-point criteria approved by the Incident Command.
☐ The **SCAT Programme Coordinator** or **STR Manager** provides field data and STRs to the **SRP Manager** and the **Environment Unit SCA-TS** for review.
☐ The **SCAT Field Survey Teams** coordinate with the **SRP Manager**, **SCAT Programme Coordinator**, **Environment Unit SCA-TS**, and **STAG** to conduct and report on equipment field tests and treatment trials, if these are required or recommended.
☐ The **SCAT Programme Coordinator** and **SCAT Field Coordinator** conduct daily SCAT briefs and debriefs with the **SCAT Field Survey Teams** and support team (**SCAT Programme Coordinator**, **SCAT Data Manager**, **agency representatives**).
☐ The **SCAT Data Manager** provides SCAT summary data, maps and reports to the **SRP Manager**, **ENVL**, **Environment Unit SCA-TS**, **PSC**, **Situation Unit Leader** and **Operations Section Chief**, as required.

continued ...

Checklist: The planned phase (project implementation stage) *(continued)*

7. SRP/SCAT plan delivery
☐ The **SRP Manager** and **SCAT Programme Coordinator** implement and monitor the operational implementation of the SRP/SCAT plan.
☐ The **Environment Unit SCA-TS** works with the **SRP Manager** and **SCAT Programme Coordinator** to establish a treatment review process, allowing modification of guidelines and STRs as oiling conditions change, treatment becomes ineffective or no longer presents a net environmental benefit, or where any residual risk presented by the remaining oil is considered to be 'as low as reasonably practicable' (ALARP).
☐ The **Environment Unit SCA-TS** coordinates with the **SCAT Programme Coordinator** to determine the areas to be monitored by the SCAT Field Survey Teams, and prioritizes segments.
☐ The **SCAT Programme Coordinator** and **SCAT Field Coordinator** deploy **SCAT Field Survey Teams** to monitor the recovery of shoreline segments defined by the STRs in the IAP, and to monitor the effectiveness of treatment operations to establish whether the treatment end-point criteria are being met.
☐ The **SCAT Data Manager**, **SRP Manager** and **STR Manager** track the progress of treatment operations and the operational status of active STRs.
☐ The **SCAT Field Survey Teams** or **SCAT-OPS Liaison** liaise with **shoreline operations** to ensure that they understand all elements of the SRP plan and the STRs in the IAP, and to address any concerns or issues raised by the Operations teams with regard to the shoreline clean-up.
☐ The **SRP Manager** coordinates with the **Environment Unit SCA-TS** to review and revise (if necessary) treatment strategies and STRs, and communicates the effectiveness, and areas for improvement, of shoreline operations to the **Operations Section Chief**.
☐ The **SRP Manager**, in coordination with the **Environment Unit SCA-TS** and **ENVL**, provides input to daily or IAP-related activities, such as briefings and meetings.

CHECKLIST: COMPLETION PHASE

8. Inspection and completion of the SRP/SCAT plan
☐ The **SRP Manager** coordinates with the **ENVL** and **SCAT Programme Coordinator** to determine the membership of the STR completion inspection teams, based on the SRP/SCAT plan and on which team members have signatory authority and are therefore able to provide comments .
☐ The **SCAT Programme Coordinator** or **SCAT-OPS Liaison** establishes a system for the **Operations Section Chief** to communicate to the **SRP Manager** and **SCAT Programme Coordinator** that treatment is considered to have been completed for a particular STR.
☐ The **Operations Section** communicates via the **SCAT-OPS Liaison** to the **SRP Manager** and **SCAT Programme Coordinator** to advise when STR segments or partial segments are considered ready for completion inspection.
☐ The **SCAT Programme Coordinator**, **SCAT-OPS Liaison** and **ENVL** evaluate the need for SCAT PTA missions (prior to undertaking the STR completion inspections), which would include the appropriate agency and landowner/land manager representatives.
☐ The **SCAT Programme Coordinator** and **SCAT Field Coordinator** deploy **SCAT Field Survey Teams** to conduct PTA missions as necessary.
☐ The **SCAT Programme Coordinator** liaises with the **Environment Unit SCA-TS** to deploy **SCAT Field Survey Teams** to conduct STR completion missions and, if the treatment end-point criteria are not met, the inspection teams make recommendations (via SIRs) for achieving the STR 'no further treatment' (NFT) criteria as appropriate.
☐ The **SRP Manager** seeks **Incident Command** approval, through the **ENVL** and **PSC**, of SIR recommendations for STR completion on a particular segment (or segments) if further actions are required, or approval of an SIR if no further treatment is required.
☐ The **SRP Manager** ensures that, when further treatment is required, the **Operations Section Chief** understands why this is the case and what needs to be done to meet the treatment end-point criteria; and the **SCAT Team Leads** or **SCAT-OPS Liaison** ensure that, when further treatment is required, the **shoreline operations field supervisors** also understand why this is the case and what needs to be done to meet the treatment end-point criteria.
☐ The **SRP Manager** ensures that SCAT inspection completion data and reports (SIRs) reach the appropriate sections/units/branches and personnel, including the **ENVL**, **PSC**, **Situation Unit Leader**, **Operations Section Chief**, **Logistics Section Chief** and **Incident Command**.
☐ The **SRP Manager** and **SCAT Programme Coordinator** ensure that SRP and SCAT personnel are demobilized as the appropriate level of effort is reduced during the response.
☐ The **Operations Section Chief** ensures that operations personnel are demobilized as the requirements for shoreline operations reduce.

Appendix 3: Generic template for an SRP plan

At the outset of a response, the SRP Manager, with input from the ENVL and the Environment Unit SCA-TS, develops an SRP plan for shoreline treatment that defines the objectives, management structure, scope and scale of response necessary to implement comprehensive shoreline response activities. Each plan is unique to the incident in question as the requirements depend on a variety of incident-specific factors. Oiling and/or environmental conditions typically change during a response so that the specifics of the plan, including the scale of the response, require appropriate and continuous review and revision to ensure applicability and appropriateness. The SCAT survey programme is embedded within the SRP plan, although it may be used as a standalone document for that component of the SRP.

The following 'table of contents' presents the typical elements of an SRP plan:

SECTION 1: SRP PLAN OVERVIEW

- Shoreline response objectives (linked to Incident Command objectives).
- Incident description (shore types, oiling conditions, key resource sensitivity and vulnerability of the shorelines in the affected area).
- Safety issues (wildlife, weather, access, communications, unexploded ordinance, etc.).
- Shoreline treatment priorities.
- Operational and logistical constraints.
- Regulatory requirements (permits/permission requirements).
- Transboundary issues (if any exist), and resolutions (including import of equipment/services).
- Translator/translation requirements.

SECTION 2: SRP MANAGEMENT PLAN

- Organization and structure.
- Manpower/support (internal within the SRP and IMT, and external support resources):
  - Roles and responsibilities of key SRP team members.
  - Staffing schedule and rotation plan.
  - Scale-up/scale-down procedures.
- Support services (office and field).
- Coordination with other components of the IMT:
  - Safety.
  - Environment Unit.
  - Situation Unit.
  - Operations Section.
  - Logistics Section.
- Stakeholder engagement:
  - Coordination with the Environment Unit Leader (ENVL) and identification of stakeholders.
  - Engagement plan.
  - Participation in Technical Working Groups (TWGs) or Technical Advisory Groups (TAGs).

continued ...

SECTION 3: SRP IMPLEMENTATION PLAN

Planned operations (description and checklists)

- SRP plan phases:
  - Phase 1 (initial response).
  - Phases 2 and 3 (planned and completion phases):
    - Treatment monitoring and effectiveness assessment activities.
    - Post-treatment assessment (PTA) surveys.
    - Shoreline treatment recommendation (STR) completion surveys (STR inspection report (SIR) protocols).
- Shoreline assessment (SCAT) surveys plan:
  - Mission planning, schedule and priorities.
  - Shoreline segmentation and oiling categorization.
  - SCAT Field Survey Team safety plan, including JSAs.
  - Survey forms, training, orientation, calibration and oiling job aids.
  - SCAT-OPS Liaison support for Operations Section activities:
    - Task forces, strike teams and embedded 'complete as you go' (CAYG).
  - SCAT data management, quality assurance (QA)/ quality control (QC) procedures, geographic information system (GIS) and other data products.
- SRP briefings/meetings/reporting.
- Shoreline treatment evaluation plan:
  - Prospective treatment options.
  - Effectiveness monitoring (key performance indicators—KPIs).
  - Bench-scale, field trials and demonstrations.
  - Third-party screening procedures.
- Clean-up and treatment (end-point) criteria:
  - 'No further treatment' definitions.
- Demobilization plan.

Appendix 4:
Generic STR form for use in the initial response phase (sand beach example)

Shoreline or Segment Treatment Recommendation **STR # 1**
Operational Permit to Work
Segment Number/ID: Survey Date:

Start Latitude: **End Lat:**
Start Longitude: **End Long:** **Length (m):** _______
Shoreline Type: *Primary* *Sand Beach* *Secondary*___________________________________

Oiled Areas for Treatment:

GENERIC SAND BEACH STR
Heavy and Moderate oiling conditions during the Initial Response Phase

Clean-up Recommendations:

Bulk oil removal of Wide/Medium width (>3 m) AND Continuous (91–100%) or Broken (51–90%) Distribution by mechanical removal where access/trafficability suitable.

Small areas of HEAVY— Manual removal with rakes and shovels into plastic bags

Staging and/or Logistics Constraints/Waste Issues:

TBD[1] in consultation with the **Operations Section Shoreside Recovery Group Supervisor**

Ecological – Wildlife Concerns/Constraints:

TBD[1] in consultation with the **Environment Unit Resources-at-Risk Specialist**

Cultural – Historical – Human Use Concerns/Constraints:

TBD[1] in consultation with the **Environment Unit Leader**

Safety Concerns/Constraints:

TBD[1] in consultation with the **Safety Officer**

Attachments: ☐ Segment Map ☐ Photo/Sketch ☐ SCAT Form ☐ Fact Sheet ☐ Other

STR prepared by: ______________________________ Date STR prepared: ____________________

Reviewed by:

SRP Manager	Environment Unit Leader	Operations Section	Safety Section	

Final approvals (as required): __________________ __________________ __________________
Incident Commander

** When treatment is completed, send a Segment Completion Report to SCAT **

[1] TBD = To Be Determined

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List of acronyms

List of acronyms

ALARP	As low as reasonably practicable
API	American Petroleum Institute
CAYG	Complete (or clean)-as-you-go
ENVL	Environment Unit Leader
GIS	Geographic information system
GMP	Good management practice
IAP	Incident action plan
IMS	Incident management system
IMT	Incident Management Team
JSA	Job safety analysis
KPI	Key performance indicator
NEBA	Net environmental benefit analysis
NFT	No further treatment
OPS	Operations (Section)
PSC	Planning Section Chief
PTA	Post-treatment assessment (survey)
QA/QC	Quality assurance/quality control
SCA	Shoreline clean-up assessment (survey)
SCA-TS	Shoreline Clean-up Assessment Technical Specialist (in the Environment Unit)
SCAT	Shoreline clean-up assessment technique
SIMA	Spill impact mitigation assessment
SIR	STR (or segment or shoreline) inspection report
SOS	Shoreline oiling summary
SRP	Shoreline response programme
STAG	Shoreline Treatment Assessment (or Technical Advisory) Group
STR	Shoreline treatment recommendation
TAG	Technical Advisory Group
TWG	Technical Working Group

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A guide to shoreline clean-up techniques

Good practice guidelines for incident management and emergency response personnel

IPIECA

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IOGP Report 521

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A guide to shoreline clean-up techniques

Good practice guidelines for incident management and emergency response personnel

Preface

This publication is part of the IPIECA-IOGP Good Practice Guide Series which summarizes current views on good practice for a range of oil spill preparedness and response topics. The series aims to help align industry practices and activities, inform stakeholders, and serve as a communication tool to promote awareness and education.

The series updates and replaces the well-established IPIECA 'Oil Spill Report Series' published between 1990 and 2008. It covers topics that are broadly applicable both to exploration and production, as well as shipping and transportation activities.

The revisions are being undertaken by the IOGP-IPIECA Oil Spill Response Joint Industry Project (JIP). The JIP was established in 2011 to implement learning opportunities in respect of oil spill preparedness and response following the April 2010 well control incident in the Gulf of Mexico.

The original IPIECA Report Series will be progressively withdrawn upon publication of the various titles in this new Good Practice Guide Series during 2014–2015.

Note on good practice

'Good practice' in the context of the JIP is a statement of internationally-recognized guidelines, practices and procedures that will enable the oil and gas industry to deliver acceptable health, safety and environmental performance.

Good practice for a particular subject will change over time in the light of advances in technology, practical experience and scientific understanding, as well as changes in the political and social environment.

Contents

Introduction

This Good Practice Guide is divided into four sections. The first section sets out ten important factors to be considered when contemplating the clean-up of an oiled shoreline. In Section 2, the steps to be taken in managing shoreline clean-up operations are discussed. The third section describes some of the most frequently used clean-up techniques, and sets out the advantages and limitations of each one, as well as the stages in the overall operation when a particular technique is likely to be most useful. The fourth section examines the interaction between stranded oil and different shoreline types, and suggests some possible approaches to addressing the challenges that this interaction can present. A brief summary is provided on page 59, followed by a *References* section and suggestions for further reading. Finally, the two Appendices provide examples of a volunteer registration form and daily worksite sheet, respectively.

Section 1: Guiding principles

Ten key principles drive strategic decisions on shoreline clean-up. Decisions on issues such as which clean-up techniques are best suited to which shoreline type, what equipment can be used, the numbers of personnel that should be deployed and the criteria for terminating operations are all finely balanced. Matrices can be drawn up which match different oils, degree of oiling and shoreline types with optimal clean-up techniques, but other factors can sometimes weigh more heavily and move the balance from a recommended approach to one which better fits the circumstances, perhaps, for example, due to safety concerns. The guiding principles presented below are therefore intended to provide a brief overview of some of the most important factors which influence decisions on shoreline clean-up, although the weight given to each will be determined by the unique circumstances of a specific incident.

Important principles guiding decisions towards successful shoreline clean-up include:

1. recognizing that shoreline clean-up is a local issue calling for local support;
2. minimizing the movement of stranded oil;
3. planning comprehensive contingency arrangements in anticipation of potential incidents;
4. building an organizational structure that provides effective support and strong oversight, to ensure both the safety of personnel working on the shoreline and that clean-up techniques are properly executed;
5. adopting a standardized protocol for reporting shoreline oiling (Shoreline Clean-up Assessment Technique—SCAT);
6. selecting clean-up techniques on the basis of a net environmental benefit assessment (NEBA) taking into account shoreline type, degree of oiling and oil characteristics;
7. agreeing realistic end points, achievable by available clean-up techniques and matched to shoreline 'use' or 'services' provided;
8. working with the weather and tides;
9. minimizing secondary contamination by maintaining separation between hot (dirty) and cold (clean or treated) zones; and
10. managing and minimizing oily waste and, where possible and appropriate, segregating waste streams at the source.

A local issue

Spill statistics, especially for ship-source spills, have shown a welcome decline in recent years but global statistics are of little comfort to the local communities suffering a major spill. These are the communities that feel the brunt of a spill, whether due to the effect on local businesses such as tourism and fisheries, the temporary loss of coastal amenities that are enjoyed by the local population and tourists alike, or simply the disruption caused by the influx of large numbers of personnel and machines necessary to clean the shoreline. Shoreline clean-up is the most visible element of spill response, and is inevitably a focus for media attention. The shoreline is usually accessible by the media and special interest groups, and with the availability of a wide range of communication channels, disquiet in the local community can quickly spread to a much wider audience with unpredictable repercussions.

However, local communities can also be an invaluable resource and their participation in the response is vital. Not only can their representatives advise on local issues and reflect the concerns and sensitivities that exist, their local knowledge can be indispensable. This may include, for example, a knowledge of the available resources that could be drawn upon to support clean-up operations, shoreline access points, ownership of coastal farmland over which access is required and areas presenting particular hazards to personnel working on the shoreline. Additionally, since prevailing winds and currents tend to drive oil to the same shoreline locations as they do for floating debris, local knowledge of where debris typically accumulates along the shoreline can help to prioritize the shoreline assessment activities.

Minimizing the movement of stranded oil

A balance has to be struck between waiting for all the oil to come ashore to avoid repeatedly cleaning the same areas with each new stranding, and collecting the oil as quickly as possible. In almost all circumstances the balance will fall in favour of rapid collection as the oil reaches the shore, to avoid it becoming buried or refloating and moving elsewhere, including to unoiled areas and areas already cleaned. The circumstances of the incident may, however, dictate otherwise, for example, in the case of a single oil loss from a vessel and depending on the risks of oil movement and burial, it may be beneficial to wait until all the oil has come ashore, not only to avoid repeated cleaning but also to minimize the amount of waste generated. On the other hand, a continuous leak such as from a production or exploration well would call for the regular removal of oil as it reaches the shoreline.

In some situations, however, the remobilization of stranded oil from sensitive shorelines may be a preferred strategy to enable nearshore recovery operations, or to encourage oil to strand on less sensitive shorelines from where it can be more easily removed. This is particularly relevant for wetlands and mud shorelines.

Contingency planning

Regional or area contingency plans consider the risk of spills in terms of potential frequency and likely consequences by first looking at potential spill sources, the most likely spill size and, if they can be foreseen, the types of oil that might be spilled. Oil spill trajectory modelling based on prevailing weather and water currents helps to identify the most vulnerable resources in the path of a spill. Essentially, during the development of a contingency plan, the most appropriate response strategies are addressed in a calm atmosphere without the immediate pressures associated with a spill event. Once the most probable scenarios have been identified, the response options for each scenario can be reviewed and the appropriate levels of manpower, equipment and materials considered together with the structure of the response organization needed to manage the most likely events. Although contingency arrangements will need to be adapted to the particular circumstances of an incident, a number of decisions will have already been made during the planning process. For example, the organizations or agencies from which personnel could be drawn will be known, as will the details of contractors able to provide equipment and personnel to work on the shoreline. Additionally, oily waste issues will have been considered, including identification of suitable locations for temporary storage and available options for final disposal with sufficient capacity to cope with the expected volume of waste.

Regular exercising of contingency plans affords the opportunity for problems to be recognized and rectified. Exercises also allow the individuals involved to develop working relationships and get to know each other's roles within the organizational structure. Further information on contingency planning and oil spill exercises is presented in the respective IPIECA-IOGP Good Practice Guides (IPIECA-IOGP 2015a and 2014a).

Organizational structure

An effective and successful clean-up operation cannot be achieved without efficient management of all aspects of the response. No amount of specialized equipment can compensate for poor organization. Responding to a spill calls for a coherent organizational structure that spans the entire response, combining source control, tracking the spill from the air, on-water operations and shoreline clean-up. Operations onshore depend on an organization that supports the rapid exchange of reliable information between SCAT specialists on the shoreline, the management team and the workforce back on the beach. The system should be able to adapt to a continuously changing situation, responding to feedback from the shoreline and ensuring that all the necessary logistics are in place to supply materials, remove collected waste, and ensure the well-being and motivation of the workforce, while at the same time keeping track of costs and securing sufficient funds to finance the response.

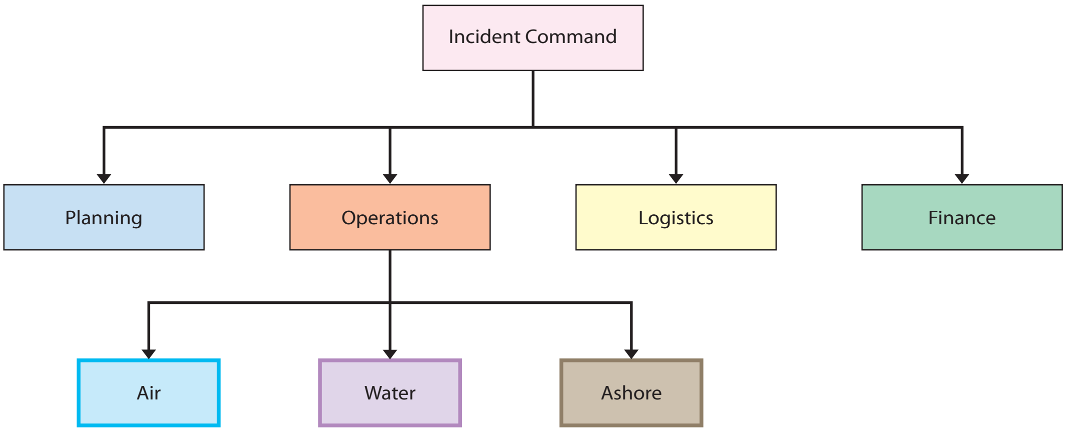
A key feature of effective management is that management capacity should be well matched to the number of people working on the shoreline. Simply increasing personnel numbers working on the shoreline is unlikely to improve outcomes unless properly managed. The initial deployment of personnel and equipment should be closely monitored and escalated or decreased to optimize efficiency and effectiveness. A realistic appraisal of progress and of any adjustments necessary to meet changing conditions is needed, as is the ability to increase the number of personnel if need be, or to scale down the response as work reaches completion. Strong oversight is required to ensure the safety of crews working on the shoreline, and to make certain that recommended clean-up techniques and working practices are being followed, so as to make the most effective use of available resources.

In different countries around the world, spill response management is organized in various ways, but one approach that has been widely adopted is the Incident Command System (ICS) employed by the United States Coast Guard (USCG) and others (see Figure 1 on page 8). One of the major advantages of ICS is that the system provides a template for a number of different organizations to be quickly brought together into a coherent structure where the chain of command, lines of communication, common terminology and individual roles are clearly established.

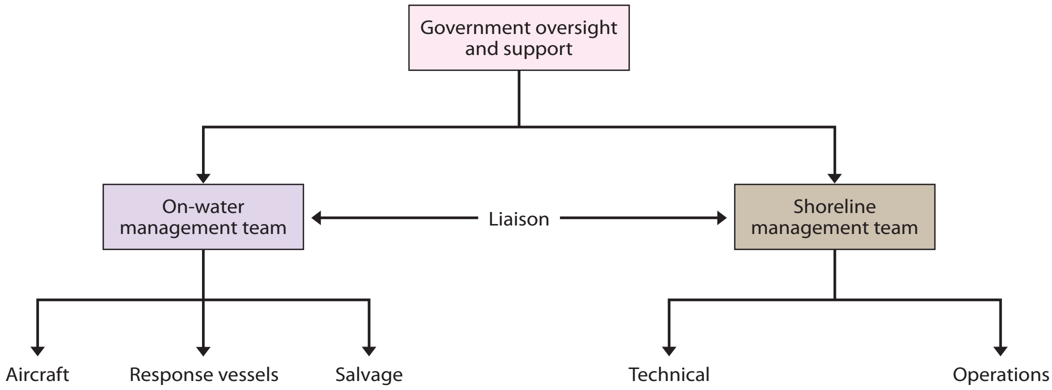
Figure 1b shows a simplified diagram of an alternative organizational structure, variations of which are used in a number of countries. This is often the case where responsibilities are split between responses on the water and on the shoreline. For example, a national navy or coast guard may be responsible for the on-water response whereas shoreline clean-up may be the responsibility of an environmental agency or ministry, or the regional or local authorities. With such a division of responsibilities, close liaison between the organizations accountable for on-water operations and those managing the shoreline clean-up is essential.

Figure 1 *Comparison of organizational structures for the management of an oil spill response*

(a) ***Incident Command System***



(b) ***An alternative organizational structure***



In the event of a spill, many oil industry personnel who have been trained on ICS will find themselves working alongside authorities using an alternative organizational structure. The opportunity should be taken to conduct oil spill exercises with such authorities to allow industry personnel and government authorities to develop ways of working together and to encourage integration into a single working structure.

Readers may wish to refer to the IPIECA-IOGP Good Practice Guide on incident management (IPIECA-IOGP, 2014b) for further information on this topic.

Shoreline clean-up assessment (SCAT) surveys

Various approaches to carrying out SCAT surveys have been developed but, at their core, they all have the same objective—to provide a protocol for the systematic reporting of shoreline oiling. Without this it is very difficult to allocate priorities to cleaning work since, depending on the observer, one person's 'completely covered in oil' could be another's 'light scattering'. In addition, as the clean-up proceeds, it is important to have standardized references by which to judge progress. The situation on the shoreline will be in constant flux, and it is therefore essential that the results of shoreline surveys are reported as quickly as possible and disseminated to those who will make use of the information in directing operations. A standardized reporting format facilitates the rapid collection of the necessary information.

The IPIECA Good Practice Guide on oiled shoreline assessment surveys (IPIECA-IOGP, 2014c) deals with the subject in detail, and readers may wish to refer to that publication for further information. The terms used throughout the following sections to describe the level and character of shoreline oiling have been taken from the SCAT Good Practice Guide.

Net environmental benefit analysis (NEBA) and the selection of clean-up techniques

A number of factors are drawn together in the assessment of the net environmental benefit of using a particular clean-up technique, including: shoreline type, for example, whether it is mud, sand or rock; how exposed it is; it's environmental and social sensitivity and related seasonality; and the amount, persistence, toxicity and rate of natural removal of the spilled oil.

Readers are advised to refer to the IPIECA-IOGP Good Practice Guide on net environmental benefit analysis (IPIECA-IOGP, 2014d) for a full discussion of the methodologies involved in NEBA. In essence, the process leads to an evaluation of available clean-up options to ensure that the selected techniques offer an appreciable environmental and/or economic benefit compared with doing nothing, that is, relying on natural recovery, while at the same time not causing more harm than the oil itself. The process also calls for conflicting factors to be weighed against each other to achieve the best possible compromise. This often involves finding a balance between the conflicting demands for mitigating environmental versus socio-economic impacts. Typical examples include decisions to use aggressive cleaning techniques such as hot water/high pressure washing, or the use of dispersant or other chemical agents nearshore or on the shoreline itself. The trade-off being made is that the risk of localized environmental damage, which may result from the use of such techniques, is offset against the benefit of rapid and effective clean-up.

The assessment itself is usually based on qualitative or semi-quantitative judgment reached by taking all relevant factors into account. The key elements are:

i) an even–handed review of the ecological importance of the natural resources within the area affected by the spill, and the human uses supported by these resources (also referred to as the environmental and socioeconomic services);
ii) a full understanding of the fate and effects of the spilled oil together with a clear appreciation of the limitations, advantages and disadvantages of a proposed clean-up technique; and

iii) on the basis of past experience and current knowledge, an assessment of the expected outcome of the proposed clean-up technique compared with the natural processes of oil removal, and consideration of whether any clean-up operation may cause more harm than good.

Although the acronym NEBA is widely used, it may be slightly misleading on two counts, First, net environmental benefit *analysis* suggests a formal quantitative evaluation whereas, more often than not, NEBA involves qualitative judgements in which the different environmental and economic factors to be considered are weighed according to their significance for the affected area; a pragmatic decision should be reached on the basis of balanced argument. In any event, the process should be proportionate to the scale of the impact and preferably, much of the required debate would have taken place during contingency planning, well in advance of any spill. Second, as indicated previously, the *environmental* aspect of the NEBA terminology incorporates the benefit of clean-up to both the environment and the economic use of the affected shoreline. However, given that shoreline clean-up is most often driven by human use, both commercial and amenity, it is important to emphasize that these socio-economic (and political) demands need to be balanced against the environmental impact of the selected clean-up technique.

While it might seem logical that operations to remove oil would reduce environmental damage, a review[1] of post-oiling recovery rates for shoreline types including rocky shores and saltmarshes found that clean-up did not provide any significant benefit to the recovery of organisms living on the affected shorelines. The review suggested that, in some cases, notably sensitive wetlands, the the clean-up could slow the rate of recovery.

Realistic and achievable end points

Officials representing communities that have suffered an oil spill frequently require shorelines to be returned to their pre-spill condition and that there should be no trace of oil at the end of the clean-up operation. While on the face of it this might seem a reasonable demand, in the short term it is neither achievable nor, in many cases, necessary. In terms of what is achievable, each of the techniques described in Section 3 is capable of removing a certain amount of the oil, with very few but the most aggressive able to achieve the removal of all traces of oil. The importance placed on the aesthetic appearance, relative to other factors, will determine the required end point and whether the active removal of such traces is necessary. In time, oil residues remaining on exposed surfaces will fade and are slowly removed by natural processes so that, usually within about three seasonal cycles, few traces remain. For oil incorporated into anaerobic sediments, however, the rate of oil removal can be so slow as to be measured in decades.

Shoreline clean-up is often thought of as a three-phase process, with phase one involving the collection of bulk oil, either floating against the shoreline or stranded on it, phase two involving removal or in-situ treatment of shoreline substrates subject to moderate to heavy contamination such as polluted sand or shingle[2], and phase three involving removal of the remaining residues of

[1] Sell, D. *et al.*, 1995.

[2] The term 'shingle' is used throughout this document to mean gravel or mixed and coarse sediment shorelines comprising any combination of sand, granules, pebbles and cobbles (see Table 2).

Table 1 *Operational phases of shoreline clean-up*

Phase one	Gross contamination removal—recovery of oil floating against the shoreline and bulk, pooled oil ashore
Phase two	Removal of moderate to heavy contamination—collection of stranded oil and removal or in-situ treatment of oiled substrate
Phase three	Final treatment or polishing—treatment of lightly contaminated sediments and removal of oil residues and stains.

oil to complete the clean-up (final polish)—see Table 1. The first phase is often thought of as the *emergency phase* because of the urgency of collecting oil before it has the chance to move elsewhere, whereas phases two and three are often referred to as the *project phase* when there is usually less time pressure and the opportunity to plan operations more thoroughly.

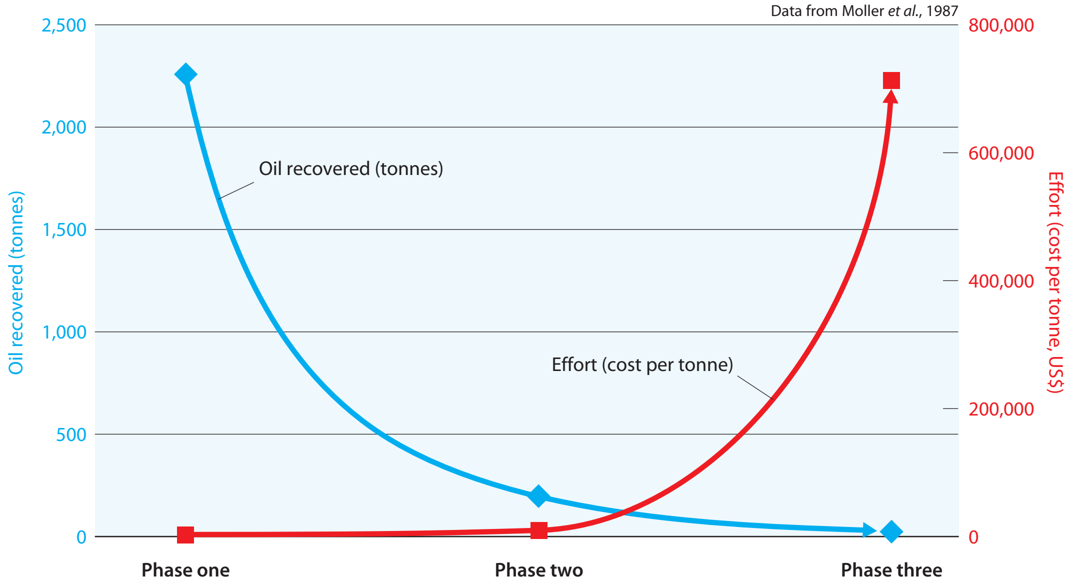
The different public, commercial and environmental 'uses' that a particular shoreline segment supports call for different end points to be achieved. For example, an exposed and remote rocky shoreline with difficult access would demand quite a different end point to an amenity beach during or just before the tourist season.

Natural cleaning processes, especially exposure to the full force of the sea, may mean that clean-up beyond removal of mobile oil (phase one) is unnecessary and is potentially a waste of resources. Clearly, in the case of the amenity beach, all three clean-up phases would need to be completed. A key factor in deciding when the operations should be terminated and whether they should proceed through all three phases is the outcome of the NEBA assessment made at each phase.

An interim end point is sometimes appropriate. In temperate climates with winter storms approaching, work might be stopped to allow the opportunity for natural cleaning to take place over the winter with a check made in the spring to see whether any further clean-up is necessary. In tropical climes, the typhoon or hurricane seasons may similarly provide a break point for cleaning operations.

This type of approach is particularly relevant when it is recognized that, as the amount of oil remaining diminishes, the effort required to remove this residue becomes ever greater (see Figure 2 on page 12). Typically, just 10–20% of the overall clean-up effort is expended to remove 90% of recoverable oil whereas the last 10% can involve the remaining 80% of the effort, depending on the end point being sought. At some point, the effort required outweighs the benefit of any further work. The point at which this happens is different for different shoreline types. In general, it is easier to bring sand beaches to a higher standard of cleanliness than shingle or cobble shores. Similarly, different oil types lead to greater or lesser difficulty, with heavy fuel oils generally being more difficult to clean up than spills of crude or lighter oils due to the greater persistence of heavy fuel oil.

Figure 2 *Diminishing returns—an example of clean-up costs for a spill in the Far East*



In summary, five broad questions can be asked to help decide whether further clean-up is necessary:

1. Is the remaining oil a potential source of harm to environmentally sensitive resources?
2. Would further cleaning do more harm than good?
3. Does the oil interfere with the aesthetic appeal or recreational use of the shoreline?
4. Does the residual level of contamination adversely affect economic resources or disrupt economic activities?
5. Does the effort involved in further cleaning outweigh the environmental or economic benefits that could be delivered?

Weather and tides

The expression, '*Time and tide wait for no man*' is particularly true for work on shorelines. There are clear safety concerns that need to be borne in mind when working on tidal shorelines. Working patterns will also need to be considered, both as an important part of these concerns as well as for practical reasons. Although contracted hours might be based on a normal working day, tides do not follow the same regime. Under certain tidal conditions, some shorelines will be inaccessible and it will be necessary for working hours to be adjusted according to the tides. In some cases stranded oil may be submerged at mid- to high tide levels, making it inaccessible to clean-up crews. In addition, monthly and seasonal tidal variations will need to be taken into account when organizing the temporary storage of waste, usually at the top of a beach, and also when considering current strengths for boom deployment. Storm conditions combined with a high tide can bring water levels to extreme heights, particularly at the equinox in March and September. Oil stranded above normal high water is often released during the equinoxes, so it is advisable to be alert to the potential for oil redistribution during these periods.

If work on the shoreline is called for in conditions of extreme heat or cold, or even heavy rain, work periods will also need to be adjusted to ensure the well-being of the workforce. The appropriate personal protective equipment (PPE) and clothing suited to the prevailing weather should also be made available. The effect of high temperatures on the behaviour of stranded oil also has to be taken into account; this may lead to work being conducted at cooler times of the day. For example, viscous water-in-oil emulsions can break up in the heat and release liquid oil. Semi-solid tar balls can also lose consistency in higher temperatures, impairing the efficiency of beach-cleaning machines that rely on sieving sand to remove tar balls.

Separation of 'hot' (dirty) and 'cold' (clean or treated) zones

The implementation of 'hot', 'warm' and 'cold' contamination zones at each worksite helps to avoid the unnecessary spread of secondary contamination, i.e. contamination of clean areas where decontamination facilities are not provided, most often due to oil being transferred to these areas via the uncontrolled movement of equipment, vehicles and personnel. The number of vehicles moving within the oiled zone should be limited in order to minimize the amount of oil forced into the sediment, and their movement restricted to these 'hot' zones. Such measures and the restriction of vehicles carrying oily waste from entering the 'cold' zones will help to avoid the spread of oil onto roads and to minimize the amount of waste material that is generated. Decontamination stations can be set up for personnel leaving the oiled section of the beach, and may also be required when moving oiled equipment and machinery from one worksite to another or removing it at the close of operations. Arrangements for controlling the run-off from these 'wash-down' areas will also need to be carefully considered to avoid the spread of contamination.

The designation of temporary waste storage sites in the planning process should include surveys of prospective sites, with a clear notion of the mechanisms to be put in place to avoid these also becoming sources of secondary contamination. Apart from physical controls, such mechanisms might incorporate the appointment of operations personnel specifically to implement and enforce these arrangements.

Waste management, minimization and segregation

Waste management, transport and disposal often constitute the largest component of the overall cost of responding to a major incident. An analysis of the amounts of waste being generated is also a useful indicator of how well the operation is being conducted. Following a major spill, a massive quantity of waste, often as much as ten times the volume of oil spilled, is generated in a very short time. This will almost certainly overwhelm the capacity of existing disposal routes since they will be geared only for the much smaller amounts of waste that are typically generated by routine local industrial and municipal activities. In practice, the number of workable disposal options is likely to be limited and, in some jurisdictions, waste with relatively high oil content may be treated as a hazardous material calling for more specialized treatment. As a result, waste disposal can become a bottleneck in the clean-up operation, sometimes delaying work on the shoreline until suitable options for storing and disposing of collected waste can be arranged. One of the most important elements of contingency planning is the identification of viable waste disposal routes or, as a minimum, temporary storage sites. In some situations, the excessive removal of beach material can lead to destabilization of the shoreline and subsequent enhanced levels of erosion. In recognition of these difficulties, attention to waste generation and minimization is strongly advocated throughout this Good Practice Guide.

As previously noted, one way to achieve waste minimization is to avoid the use of heavy equipment on shorelines and to rely, as far as possible, on manual collection whenever practical. On sand beaches, mechanical methods typically generate five times as much waste for the same amount of oil collected by manual methods. Put another way, the oil content of manually collected contaminated sand is, on average, 5–10% oil while for mechanically collected waste the oil content is only 1–2%. It is accepted, however, that it may not be practical to consider manual clean-up for long segments of heavily oiled beaches. The amount of waste generated can also be significantly reduced by the use of techniques that avoid the removal of shoreline substrates, such as surf washing or tilling with a harrow or plough. Waste generation is a crucial factor in the application of NEBA in deciding on the most suitable clean-up techniques.

Another frequently offered recommendation is that responders should ensure that waste is segregated at the source into different waste streams so that different waste options can be adopted for each stream. For example, liquid waste may follow one route, highly contaminated oily sand another, and other oily debris, including oiled PPE, might follow a third route. This waste segregation has the benefit of reducing the amount of material that may need to be disposed of as hazardous waste and easing the load on facilities of restricted capacity. However, there is no benefit in separating waste into different streams if there is only one disposal route and if all the waste ends up in the same place. Even in this latter situation, there may be some treatment options worth considering, for example, avoiding the unnecessary transport of excess water by decanting on site or compressing sorbent materials prior to transport so that the bulk volume is reduced. Depending on local regulations, it may be possible to allow the water released to return to the spill site, or arrangements may be required for its subsequent treatment.

For further guidance on this topic see the IPIECA-IOGP Good Practice Guide on oil spill waste minimization and management (IPIECA-IOGP, 2014e).

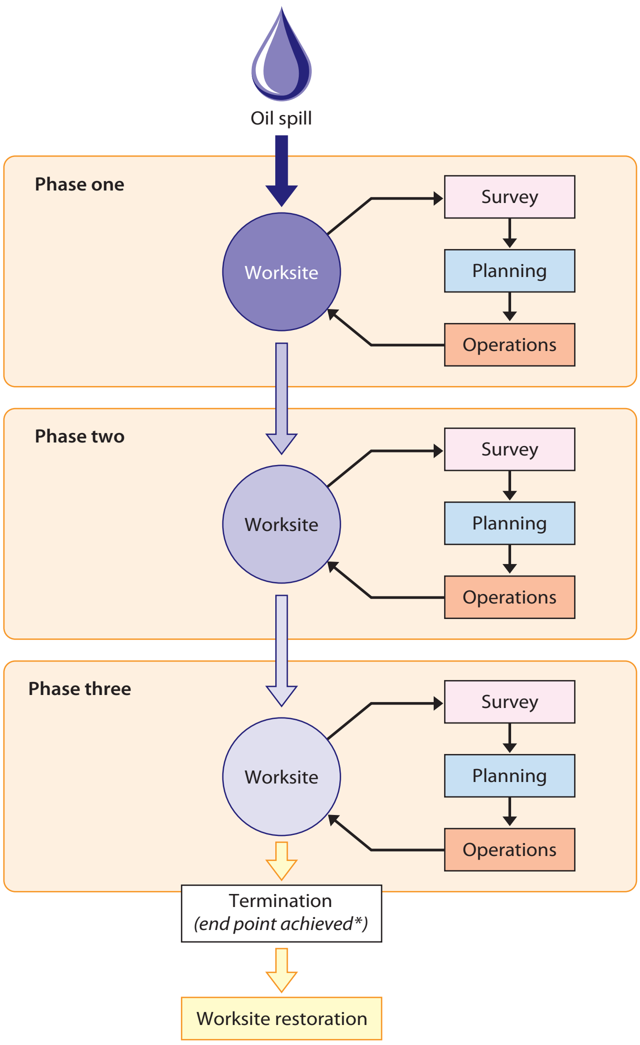
Section 2: Steps in the management of shoreline clean-up

Although clean-up operations can be considered in terms of the three phases described on pages 10–11, the following four steps in the management of shoreline clean-up can be recognized:

- **surveillance and monitoring:** evaluation of the scale of operations required;
- **planning:** setting the parameters of the operations including establishing end-point criteria;
- **operations:** implementing clean-up operations; and
- **termination:** bringing operations to a close at the agreed end points.

In the simplest terms: the *surveillance and monitoring* function identifies what work needs to be carried out; technical advice on how best to conduct that work informs decisions taken at the *planning* step; and the *operational* function implements that advice to get the work done. As the work proceeds, each step forms part of a continuous cycle: evaluating the progress made; adjusting the technical advice in recognition of the changing situation; and modifying operational procedures accordingly until the agreed end points have been reached and operations are brought to a close (Figure 3).

Figure 3 *Shoreline clean-up management cycle*



** Depending on the agreed end point, operations may be terminated on completion of phases one, two or three*

Surveillance and monitoring

Key elements of surveillance and monitoring include: aerial surveys; shoreline survey and monitoring (SCAT) teams; reporting protocols.

Unless the source and extent of pollution is immediately obvious, for example where a spill is contained within a port, one of the first response actions following a spill is to conduct an aerial survey. Its purpose is to gather information on the nature of the incident, the extent of the pollution and the likely immediate consequences. Aerial surveillance provides a rapid initial assessment of the probable scope and scale of the required response.

Once oil reaches the shoreline, helicopters provide the most flexible platform for observations, having better manoeuvrability than fixed-wing aircraft and, depending on local regulations, offering the possibility of landing on the shoreline to make detailed inspections. These initial surveys provide information on the distribution of oil along the shoreline, and on which areas have been most heavily impacted. They also enable the identification of environmental resources already affected and those under threat, as well as potential access routes to affected shorelines. These data are used to inform more detailed surveys (i.e. SCAT) to be undertaken on foot or by boat. It is essential to 'ground truth' any observations made from the air, i.e. to visually verify the results of those surveys by carrying out subsequent surveys on the ground. Some features, for example mineral deposits, algae and peat outcrops, can easily be mistaken for oil because of their appearance when viewed from the air. Most importantly, it is not possible to get a reliable estimate of the thickness of stranded oil from aerial observations. In addition, on sand beaches, stranded oil may be covered by a layer of windblown sand or by sand accreted on subsequent tides. On shingle and cobble beaches, the oil is likely to have penetrated into the substrate, and without surveys on the ground it is impossible to know how far this penetration extends. Similarly, the depth of oil pooled on rocky shores can only be determined by close inspection.

The requirement to keep one or more helicopters on-site once surveys on the ground are under way and clean-up operations have started depends on the circumstances of the incident. If the geographical extent of pollution and distribution of stranded oil is likely to change over time, due to more oil coming ashore or mobile oil moving along the shoreline, helicopters may continue to be required. Aerial transport of shoreline survey and monitoring (SCAT) teams to more remote locations that are inaccessible by road vehicles may also need to be considered.

The composition of the SCAT teams are important. Typically such groups would be led by a technical specialist well versed in shoreline clean-up, coastal geology and survey protocols, and also include representatives of the jurisdictional authorities and affected communities. Having taken all the relevant factors into account, final decisions on how best to respond will be taken by the spill management team, but the SCAT team should nevertheless be sufficiently competent to make reliable operational recommendations so that clean-up operations can begin as quickly as possible. To a large extent the observations reported by these teams determine the course of the shoreline response, and the entire response organization relies heavily on their recommendations.

In some response organizations the responsibility of the survey team is restricted to reporting the distribution of oil and levels of oiling, and on the basis of this report a second team is deployed to propose optimum clean-up techniques. The disadvantage of this approach in a situation that is in constant flux is that it introduces delays at each stage, and by the time the second group have made their recommendations and the required personnel and equipment are deployed, the situation may have changed considerably.

The number of SCAT team members should be limited. If a group becomes too large, it will not only face challenges with regard to transport logistics but will also find it increasingly difficult to reach a consensus. However, in an incident covering a large geographical area, multiple SCAT teams may need to be deployed. To ensure consistency between teams and between consecutive surveys, the importance of standardized reporting protocols cannot be overemphasized. Standardized descriptions of shoreline characteristics follow the widely established classification system known as the Environmental Sensitivity Index (ESI), which is based on vulnerability to oil pollution, with values ranging from 1–10 where 1 is robust and resilient and 10 represents the most vulnerable (Figure 4).

Figure 4 *The Environmental Sensitivity Index*

1A Exposed rocky shore
1B Exposed, solid man-made structures
1C Exposed rocky cliffs with boulder talus base

2A Exposed wave-cut platforms in bedrock, mud or clay
2B Exposed scarps and steep slopes in clay

3A Fine- to medium-grained sand beaches
3B Scarps and steep slopes in sand

4 Coarse-grained sand beaches

5 Mixed sand and gravel beaches

6A Gravel beaches (granules and pebbles)

6B Riprap structures and gravel beaches (cobbles and boulders)

7 Exposed tidal flats

8A Sheltered scarps in bedrock, mud or clay and sheltered rocky shore

8B Sheltered, solid man-made structures

8C Sheltered riprap
8D Sheltered rocky rubble shores
8E Peat shorelines

9A Sheltered tidal flats
9B Vegetated low banks
9C Hypersaline tidal flats

10A Salt and brackish water marshes

10B Freshwater marshes

10C Swamps

10D Mangroves

Standardized shoreline descriptions also include the average substrate dimension (grain size) of the affected shoreline (Table 2).

Table 2 *Shoreline descriptors*

Description	Grain size (mm)
Mud/silt/clay	0.00024–0.625
Sand	0.625–2.0
Pebbles/granules (gravel)	2.0–64
Cobbles	64–256
Boulders	>256

Source: adapted from MCA, 2007

Terms such 'light', 'moderate' and 'heavy' can be used to categorize the initial surface oil cover (factoring the oil's distribution and the width of oiling across the shore) and the same terms can also be used by factoring this initial categorization of surface oil with average oil thickness to generate an overall surface oil categorization. This is a very useful metric for the management team, when tracking shoreline oiling conditions and treatment progress on a shoreline segment-by-segment basis. The use of standard terms and definitions is described in the various SCAT guides and manuals cited in the *References* and *Further reading* sections of this guide, and are summarized in Table 3, below.

Table 3 *Standard terminology for oil location, distribution, thickness and character*

Location on shoreline	
Lower Intertidal Zone	Lower third of tidal range
Mid Intertidal Zone	Middle one-third
Upper intertidal Zone	Upper one-third
Supratidal Zone (Splash Zone)	Above high water mark
Distribution	
Trace	<1%
Sporadic	1–10%
Patchy	10–50%
Broken	50–90%
Continuous	90–100%
Thickness	
Thick oil	>10 mm
Cover	1–10 mm
Coat	0.1–1 mm
Stain	<0.1 mm
Film	Iridescent sheen
Stranded oil characteristics	
Fresh	Un-weathered oil
Mousse	Water-in-oil emulsion
Tar balls	Discrete pieces (balls) of weathered oil generally, dimension <100 mm
Tar patties	Weathered oil, dimension >100 mm
Tar	Highly weathered 'coat' or 'cover'
Surface oil residue	Mobile oil and sediment mixtures on surface or within interstices
Asphalt pavement	Stable mixture oil and sediment (generally shingle)
No oil observed	No visible oil

Planning

Key planning elements include: the use of SCAT data and sensitivity maps; setting priorities; matching clean-up techniques to shoreline types and degree of pollution; segmentation and end point selection.

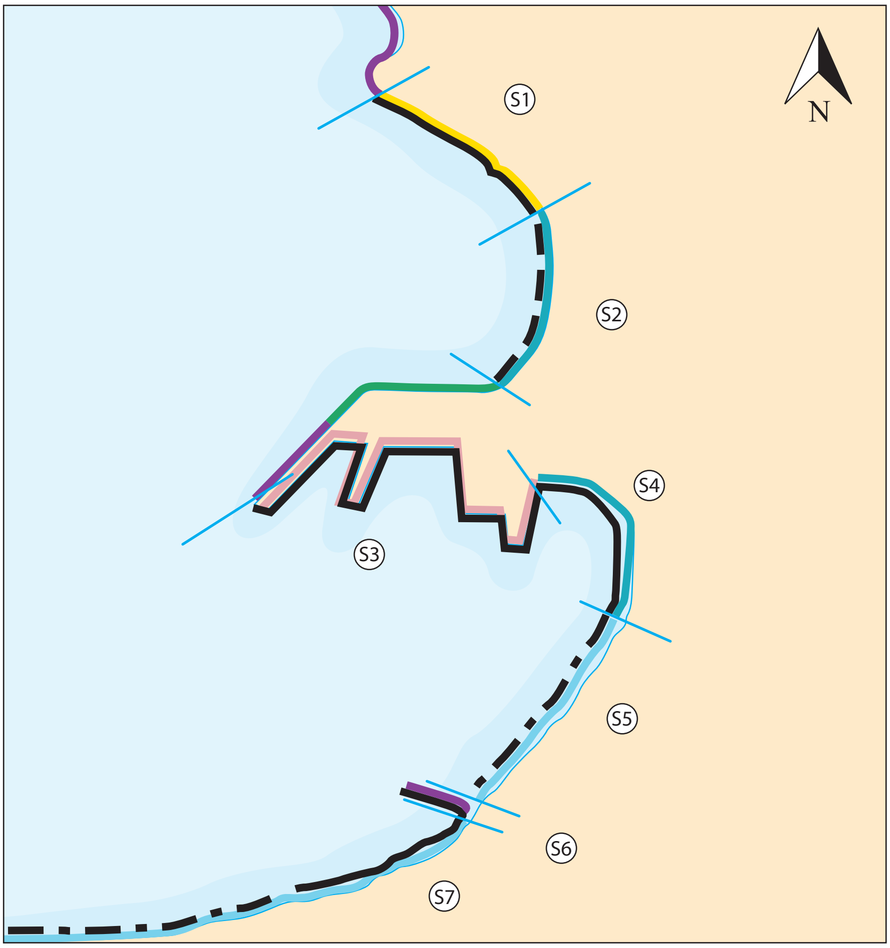
One of the products of the contingency planning process in locations where detailed response arrangements have been put in place is likely to be sensitivity maps, which highlight, among other things, areas of particular environmental vulnerability or socio-economic importance. The information collated and presented in sensitivity maps, together with the information from the initial SCAT surveys on the levels of oiling, oil distribution and characteristics, provide the basis for setting the priorities for shoreline clean-up. Accumulations of fresh oil which may mobilize and move to previously unoiled areas or to areas of greater vulnerability are usually the priority target. Once the risk of further movement of the oil has passed, the ranking of areas for priority clean-up operations is based on a balance between those most heavily polluted and an area's importance or vulnerability as indicated by sensitivity maps. Sensitivity mapping for oil spill response is the subject of a Good Practice Guide of the same title (IPIECA-IMO-IOGP, 2012).

By maintaining the same composition of the SCAT team throughout the response, the same people that recommended the use of a particular clean-up technique are able to monitor its implementation and, if necessary, adapt their recommendations accordingly. SCAT team members will then be well-placed to judge whether the desired end point has been reached, as they will have a clear appreciation of the condition of the shoreline at the start of the operation and the level of cleanliness that can realistically be achieved by the end of it.

Typical applications for individual clean-up techniques, their suitability for use on particular shoreline types and an analysis of when each technique might be used to best effect during the response operation, are discussed in more detail in Section 3. In order to manage operations effectively, the affected shoreline is divided into workable segments within which the shoreline type or level of oiling is more or less uniform and the boundaries are easily identifiable. Segment boundaries are usually identified by a change in shoreline type but may also rely on a natural feature such as a river or stream, or a specific landmark such as a conspicuous building or access point. Segment boundaries may also be defined by a significant change in oil conditions (e.g. from moderate oiling to no oiling) The purpose of dividing the shoreline into segments is to facilitate the management of clean-up operations by allocating worksites according to shoreline type or oiling conditions, matched with clean-up techniques, and to assign specific end points to each segment (see Figure 5 on page 20).

It is important that the end points for clean-up phases two or three are determined for each shoreline segment at the outset of shoreline operations when planning the response, taking into account the outcome of NEBA assessments. Since different clean-up techniques achieve different end points, the choice of end point strongly influences the clean-up technique to be used on each shoreline segment. Not only do the assigned end points provide clean-up teams with a clear idea of the level of cleanliness that they are aiming to achieve, they also help to moderate expectations of what the clean-up operations can accomplish.

Figure 5 *Example segmentation of an oiled shoreline*



Segment	ESI *(see Figure 4)*		Oiling *(see Table 3)*
S1	8A	Sheltered rocky shore	Heavy, continuous, thick, without emulsion (mousse)
S2	3A	Fine to medium-grained sand beach	Moderate, broken, thick, mouse
S3	8B	Sheltered, solid man-made structures	Heavy, continuous, cover, mousse
S4	3A	Fine to medium-grained sand beach	Heavy, continuous, thick, mousse
S5	4	Coarse-grained sand beach	Moderate, patchy, cover, mousse
S6	1B	Exposed solid man-made structure	Heavy, continuous, cover, mousse
S7	4	Coarse-grained sand beach	Heavy continuous thick mousse in north of segment reducing to moderate patchy cover in south

Consistent descriptors must be used to ensure a clear understanding of when the end point has been reached. These descriptions are the same as those used to express the level of contamination during the initial SCAT surveys but with emphasis on the use of the semi-quantitative criteria for oil distribution as illustrated in Table 4. Additional descriptions are sometimes used, particularly for the end point for recreational sand beaches, such as, '*no buried oil, no greasy texture, no sheen and no oily smell*'. Iridescent, silver or colourless oil films or sheens floating at the water's edge are commonly associated with oiled shorelines but represent very small amounts of oil due their extremely low film thickness. For weathered stains or films on amenity rocky shores '*oil that does not rub off on clothing*' might also be considered as a test for a possible end point.

Table 4 *Illustrative examples of possible end points*

Shoreline type	Example proposed end point
Concrete sea defences	Patchy oil cover to continuous coat. No mobile oil released during natural flushing (some sheening acceptable)
River bank vegetation	Patchy oil cover—no mobile oil released during natural flushing (sheening acceptable)
Mudflats	Sporadic surface oil residue
Recreational sand beach	No visible oil, no buried oil, no greasy texture, no sheen and no oily smell
Publically accessible rocky cove and cobble beach	Patchy tar coat for rock outcrops (not to rub off on clothing); sporadic surface oil residue for cobbles (oil in interstices)—warning signs to be erected.

When taken together with the terminology set out in Table 3 (page 18), the end points suggested above are semi-quantitative observations that can be easily interpreted in practical terms. On occasion, an end point may be proposed that involves proceeding with the clean-up until oil concentrations in the beach sediment decline to a specified level, and some local regulations may require that such criteria are met before reopening a beach for bathing or recreational use (cf. Blue Flag criteria below). However, there are considerable difficulties with this approach, not least that of estimating when a specified oil concentration level has been achieved in practice during clean-up operations to address environmental impacts or impairment of amenity use of the shoreline. Furthermore, because of the extreme variation in the distribution of oil through the sediment, it is particularly difficult to take representative samples, and the approach is open to unintentional bias through the selection of samples of more heavily contaminated sediment.

For bathing beaches, the Blue Flag criteria are widely accepted internationally. The Blue Flag is a voluntary label awarded to more than 3,850 beaches and marinas in 48 countries across Europe, South Africa, Morocco, Tunisia, New Zealand, Brazil, Canada and the Caribbean. The required level of cleanliness is measured against a range of different parameters which, for oil pollution, are:

1. There must be no oil film visible on the surface of the water and no odour detected. On land the beach must be monitored for oil, and emergency plans should include the required action to be taken in case of such pollution.
2. There has to be an absence of floatables such as tarry residues, wood, plastic articles, bottles, containers, glass or any other substance.

In Europe, bathing beaches are also subject to the provisions of the European Community Bathing Waters Directive (2006/7/EC) which is primarily concerned with routine monitoring of potential pollutants including oil.

Operations

Key operational elements include: worksite delineation; risk assessment and management; work programme; volunteer management; reporting and briefing schedules.

With priorities established and segments identified, worksites within each segment can be set up. A worksite might comprise the entire segment, or the segment may be further subdivided according to the clean-up technique to be applied, the access required for equipment and the nature of the group working on the shoreline. Individual worksites tend to be allocated to a single organization or agency, a team from within that organization or agency, or an individual contractor, so that the scope of work is clearly defined both geographically and in terms of the end point to be delivered. For example, a segment may include a length of shoreline comprised of a sand beach interspersed by rock-armour groynes; the manual cleaning of the sand beach might constitute one worksite and the groynes, which are to be cleaned using high-pressure washing, constitute another.

Before work can begin, a risk assessment should be conducted for each worksite. This should identify the particular hazards associated with the location (such as strong waves, rock falls, slippery rock surfaces, the effects of heat or cold), together with the types of equipment to be used or likely to be moving around on the shoreline, and the types of materials to be used, especially if these include chemicals. Such risks can be managed through daily safety briefings to ensure that personnel are aware of the hazards associated with the environment in which they are working. Examples of ways to manage risks include: ensuring that workers take regular rest periods; taping off areas to segregate vehicular traffic from manual clean-up crews; ensuring that the correct PPE is worn; and briefing workers on the use of each specific type of chemical that may be utilized. It is important to ensure that personnel do not carry oil into clean zones (e.g. rest areas) as this would present the risk of skin contact with the oil or of the oil being ingested with food and drink. Decontamination zones should be arranged at the worksite access points to allow workers to remove contaminated PPE before entering the clean zones. Further advice on oil spill responder health and safety can be found in the IPIECA-IOGP Good Practice Guide on this topic (IPIECA-IOGP, 2012).

For each clean-up technique there is an optimum team size, and worksites can be subdivided accordingly, for example to match the anticipated work rate of the team. This tactic promotes a methodical approach so that a shoreline is cleaned along its length at a rate of so many metres per day, thereby allowing progress to be easily monitored, and facilitating planning and logistics for the following days. It avoids the random movement of workers over the shoreline and the risk of secondary pollution resulting from oil being walked into clean areas. In addition it helps to ensure that cleaning is consistent along the length of shoreline and that no areas are missed.

The example in Box 1 illustrates the use of simple estimates in initial planning. For example, if only front-end loaders (FELs) are utilized and each has a capacity of 2 m^3, 150 m^3 of oily waste

Box 1 *Example of initial planning considerations with regard to the optimum size of a clean-up workforce*

In the initial planning of the size of the workforce, the rules of thumb described in Section 1 can be drawn upon. By way of illustration, a sand beach 2 kilometres long has been identified as a priority clean-up site and the SCAT team reports stranded fresh oil, with patchy cover over a band averaging 5 metres wide. This leads to the following estimate the amount of oil present:

$$2{,}000 \text{ m } \times \text{ } 5 \text{ m } \times \text{ } ^{5}/_{1000} \text{ m (cover = 1–10 mm thickness) } \times \text{ } 30\% \text{ (patchy = 10–50\%)}$$

$$\text{or} \sim 15 \text{ m}^3 \text{ of oil.}$$

From experience it has been found that, over the duration of an incident, manual recovery leads to a concentration of 5–10% oil in collected waste. However, in the early stages of a clean-up operation (as in the scenario above) the selectivity of manual recovery should result in oil concentrations at the upper end of this range or higher. Together, the oil and sand might then amount to some 150 m^3 oily waste material to be collected. For planning purposes, given the expectation that each person could collect some 1–2 m^3 per day, this represents some 75–150 man days. Five teams of ten with two front-end loaders (to transport collected material off the beach) should be sufficient to collect this material in two to three days, depending upon the distribution of oil, the characteristics of the beach and the distance to temporary storage.

represents more than 75 (say 80) FEL movements. With two machines over two days, each machine must make 20 movements per day. In an eight-hour day, that equates to a movement every 24 minutes or so. Depending on the configuration of the worksite, such an estimate can assist in deciding on the appropriate number of machines. Theoretically, 100 clean-up workers deployed in 10 teams would be able to clear the beach more quickly, but (a) the coordination of 10 teams is more difficult than five, (b) more front-end loaders would be required and (c) the size of the working space would also need to be considered—in this case each of the 100 workers would be occupying a stretch of sand beach just 20 metres long. (This working space requirement is a particularly important consideration for mechanical collection with heavy machinery and also where high-pressure washing is to be used.)

The optimum number of workers in a manual clean-up team is usually found to be about 10, headed up by a team leader. This size of team can be replicated a number of times with team leaders reporting to a worksite supervisor or beachmaster. As shoreline operations progress and the tasks become more routine, the number of workers each team leader can manage effectively may increase to a worker:team-leader ratio higher than the initial planning levels of 10:1. For high-pressure washing, smaller teams comprising two or three personnel are required to operate the equipment, with the work of each team coordinated by a worksite supervisor. As for manual clean-up, it is useful to delineate the working area for each team to promote a methodical approach.

In general, it is more efficient to start with a smaller number of teams, properly set up the worksite with logistics support in place, and monitor the progress of the deployed teams. A reassessment of what further work is required can then be made and a decision taken on whether changes in the numbers of personnel are merited, either up or down.

Whether professionally employed clean-up workers or volunteers are deployed, the same considerations apply, although the productivity of volunteers is likely to be lower due to inexperience and lack of training. Professional clean-up workers are generally easier to manage because they are more disciplined, follow instructions and remain committed throughout the response; volunteers, on the other hand, do not have the same incentive and may try to follow their own imperatives. Given these and other issues, such as the need to provide transport, accommodation, food and additional emergency medical cover, management teams may prefer not to use volunteers, and avoid the potential liability should a volunteer become injured while working on the spill. Nevertheless, the extensive media coverage that accompanies any major spill often attracts large numbers of volunteers into the affected area. Consequently, political pressures are likely to result in a need for volunteers to be integrated into the response effort. Careful management of these issues is needed so that the well-meaning intentions of the volunteers are put to good use and that their inclusion in the response does not disrupt the clean-up operation.

It is therefore essential that the volunteer contribution is controlled from the start by managing the influx of volunteers, which can be best achieved by requiring volunteers to register with the response organization (see the example volunteer registration form in Appendix 1 on page 63). Registration also offers the opportunity to assess whether volunteers have any particular skills that can be utilized, such as medical, veterinary or logistics expertise, or whether basic training is required. Unskilled volunteers will need operational and safety training so that they can be used effectively and are aware of the safety issues involved in working on the shoreline. Ideally, unskilled volunteers would not be put to work until phase two of the clean-up operation, after bulk oil has been removed. Volunteers may also be used in many other positions, such as logistics support for volunteers, arranging food and accommodation or, if suitably skilled, assisting with administrative tasks within the response organization.

A clear chain of command is of paramount importance for the proper supervision of all personnel working on the shoreline, particularly in the case of volunteers, to avoid conflicting instructions and any ambiguity about who is in charge of assigning tasks. Worksite supervisors should make sure that volunteers remain motivated and focused on allotted tasks, and should ensure their safety, whether they operate as a separate workforce or within teams of professional workers. Daily records of the worksites attended by each individual and of the work undertaken should be maintained.

Professional workers and volunteers alike should be required to attend briefings at the beginning and end of each working day. The morning briefings include a site-specific safety briefing, details of procedures to be followed in case of an accident, an overview of the work to be undertaken during the day and individually allotted tasks within the worksite. The evening meeting reviews the day's progress, allows any problems that have arisen to be discussed and suggestions for improvements to working practices to be considered. The site supervisor can then report progress and any logistics issues to the management team so that personnel, equipment, materials, evacuation of waste and logistics support can be organized for the following days (see Appendix 2 on page 64).

Termination

Key elements include: closing worksites; restoration.

In order for worksites to be closed there should be consensus that the agreed end points have been reached so that cleaning operations can cease. The final phase of terminating shoreline clean-up is the restoration of worksites. Each site is inspected to ensure that any rubbish which accumulated during the work, such as food wrappers, discarded PPE, plastic bags, etc., are collected and disposed of appropriately and that, as far as possible, temporary storage sites and access points are returned to a pre-spill state. This may mean levelling, re-seeding or replanting where worksite traffic has impacted vegetation, reinstating habitats where access roads have been constructed or undertaking remedial works to the local road network to repair any damage caused by heavy vehicles.

Section 3: Shoreline clean-up techniques

Defensive/passive clean-up techniques

Debris removal

One of the most effective ways to minimize both the effort required to clean a shoreline and the amount of oily waste for disposal is to remove debris from the shoreline or out of the path of the spill before the oil arrives and so avoid the debris becoming contaminated. This may be general flotsam and jetsam that has accumulated in natural collection points, seaweed thrown up by winter storms, or even tree trunks. However, in some situations large natural debris stabilizes the shoreline and its large-scale removal could lead to erosion. Furthermore, stranded seaweed provides a valuable source of nutrients to littoral ecosystems. To take account of both these concerns, an assessment of net environmental benefit should be conducted to determine whether, on balance, removal would be the best option.

The areas where oil is most likely to strand are usually the same natural collection points where debris accumulates. These should be highlighted as priority areas for pre-stranding debris removal (also referred to as pre-impact debris removal). Aerial observations of the movement of oil and trajectory modelling can also provide some forewarning of where there is an imminent threat of oil stranding. Given enough time, clearing beach debris prior to it becoming oiled may also allow the collected waste to be disposed of at non-hazardous waste processing facilities, depending on local regulations.

Below: shoreline before and after pre-impact debris removal

Source: ITOPF

Source: ITOPF

Passive cleaning—'natural cleaning'

Although the term 'passive cleaning' is sometimes used to describe placement of sorbent arrays to collect oil leaching from shorelines, the most commonly used passive cleaning technique is 'natural cleaning'. Once mobile oil has either been recovered or has remobilized elsewhere, the primary processes that lead to the natural removal of oil remaining on the shoreline are biodegradation, photo-oxidation, abrasion, oil-mineral aggregation (also referred to as clay-oil flocculation) and dispersion. Biodegradation and photo-oxidation usually proceed relatively slowly in terms of removal of oil from shorelines, and the most significant short-term processes are abrasion, the formation of oil/mineral aggregates (OMAs) and their dispersion through the water column. Abrasion is the mechanical scraping of a surface by pebbles and sand particles carried by waves breaking on the shoreline. OMAs are formed by the interaction of dispersed oil droplets and small mineral particulates to form neutrally buoyant agglomerates which disperse over a wide area and are eventually either accommodated within the sediment and/or broken down through biodegradation.

Typical applications

- Exposed rocky headlands, and shorelines exposed to wave action but where access is difficult or dangerous or where amenity, recreational or aesthetic value is not of primary importance.
- Wetlands where an assessment of the risks to the habitat from clean-up operations (for example damage to plant roots and compression of fragile substrate by trampling) points to a lower risk of damage if the oil is left for removal by natural cleaning processes and degradation.

Method outline

- Establish transects along the shorelines that are periodically monitored to assess the rate of natural oil removal.
- For rocky exposed shorelines, monitor the effect of wind, waves and weather.
- For wetlands, monitor the impact of oil and subsequent recovery in case intervention is called for, e.g. if the seasonal arrival of birds or other animals is anticipated.

Timing

Passive or natural cleaning is typically applicable to lightly oiled shorelines or during phases two and three of the clean-up operation (see Table 1).

On rocky shores a black residual coating of oil will weather and degrade naturally over time, fading to a stain, and over two or three seasonal cycles will become less and less visible. In wetlands, depending on the characteristics of the oil, it may become incorporated into the sediment and degrade only very slowly.

Advantages and disadvantages

✓ Relies on natural cleaning processes.
✓ Very low labour and equipment requirements.
✓ Low biological impact on rocky shores whereas impact variable for wetlands.
✗ Requires removal of bulk mobile oil or risks its release and movement elsewhere.
✗ Potential for residual oil to create chronic biological impacts.

CASE STUDY 1: Example of defensive techniques to minimize damage from an oil release

***Sergo Zakariadze*, San Juan, Puerto Rico, 1999**

In November 1999 the cement carrier *Sergo Zakariadze* stranded at the foot of the historic fort, El Morro, at the entrance to San Juan harbour. Spill contingency arrangements were put in place while salvage operations were conducted, which included an example of a defensive technique that involved wrapping the target in polythene sheeting or geotextile materials. This approach was used to protect another historic fort, El Cañuela, part of a UNESCO recognized cultural heritage site, which was at risk from a spill of bunker fuel from the casualty stranded directly up wind. If oil had been lost from the vessel, windblown oil, thrown up by waves breaking on the adjacent shoreline, could have led to severe staining of the weathered sandstone walls of the fort. Experience from a similar previous incident had shown that removal of the oil stain would have called for aggressive cleaning techniques, risking damage to the fabric of the historic monument. Polythene sheeting was laid in vertical strips around the sections of the building facing the sea and held in place with sand bags, top and bottom.

Source: ITOPF

Left: one of the forts of Old San Juan, a National Historic Site overseen by the US National Parks Service, part of the US Department of the Interior.

Bioremediation

All shorelines possess naturally occurring oil-degrading microorganisms and these play a significant role in the longer-term removal of oil. The rate of natural biodegradation, whereby oil is ultimately converted to carbon dioxide and water, can vary from days to years and depends upon various factors including the:

- type and quantity of oil;
- shoreline type;
- availability of nutrients and oxygen;
- degree of water flushing through tidal or wave action; and
- climate and seasonal weather factors.

Bioremediation is not strictly a passive technique, but is introduced here because, in principle, it is an extension of natural cleaning through the enhancement of natural biodegradation.

Nutrients including nitrogen, phosphate, and iron are essential to any biological process and crude oils are naturally deficient in these major nutrients. Furthermore many, though not all, marine ecosystems are naturally nutrient-poor. Thus, when an oil spill results in a sudden increase in available food (oil hydrocarbons), there may not be enough nutrients in the water to support microbial growth. Nutrient addition ('biostimulation') to relieve this limitation may enhance biodegradation and various strategies (such as granular slow-release products) have been used on cobble and boulder shorelines to provide additional nutrients in a suitable form. Although bioremediation may accelerate the process, it is unlikely to reach the same pace as physical clean-up methods.

Microbes that can degrade oil constituents are ubiquitous and there is little convincing evidence that bioaugmentation (addition of more microbes) significantly enhances either the rate or the extent of oil biodegradation on marine shorelines.

The indigenous community of microorganisms will be adapted to the specific shoreline locality. It is the larger, more complex oil molecules that are most resistant to microbial attack, and which are likely to remain for the longest periods, though mainly as biologically inert residues.

Taking into account all the factors summarized above, it is clear that bioremediation is rarely likely to provide a practicable technique for shoreline clean-up of either bulk or moderate oiling. It is likely to be limited to clean-up phase three, if considered.

Advantages and disadvantages

✓ Under controlled conditions may increase the rate of biodegradation on cobble and boulder shorelines, where nutrients are limiting.
✓ Low environmental impact compared to other intervention techniques for clean-up phases two and three.
✗ Requires slow release mechanism and risk of dilution on tidal shores.
✗ Remains a relatively slow oil removal process.

Sorbents used in passive mode

Sorbents are either man-made or natural materials that preferentially soak-up oil rather than water. More information on sorbent types is provided under the section on the recovery of floating oil (pages 31–32).

Typical applications

- Arrays of sorbents can be used to recover oil leaching from riprap or other sea defences, or along the sea margin of mangroves and temperate wetlands.
- Sorbent nets are used to recover oil released from a number of different shoreline types ranging from coarse sand beaches to rocky shorelines.

Method outline

An array of sorbent filaments (pom poms) is tied at intervals along a rope which is anchored so that it can move freely with the tidal rise and fall, and capture oil released through the tidal cycle or by wind-driven water movement. The application works better with viscous oil, though sorbent booms can replace pom poms for lighter oils. To remain effective, sorbent materials must be changed once they become saturated with oil. Fixings need to be checked regularly to ensure that they remain secure and that net mops have not become buried by beach material.

Timing

The technique is used to recover relatively moderate volumes of mobile oil (clean-up phases two and three) and oil released from flushing or surf washing operations (see later in this section).

Suggested end point

The end point is reached when the release of oil from the shoreline subsides. If further cleaning of the shoreline is called for, alternative active techniques will need to be considered.

Advantages and disadvantages

✓ Relies on natural water movement.
✓ Low labour requirement—sorbent materials need to be exchanged when saturated.
✓ Low biological impact.
✗ End point leaves surface oil residue, cover or coat and, depending on location, further treatment may be required or the oil may be left for natural cleaning.
✗ Sorbents used in a passive mode do not retain low viscosity oils very well.
✗ Roped arrays of pom-poms deployed off wetlands can be difficult to recover if left in place for too long, as they can become entangled with vegetation.
✗ Spent sorbent requires proper disposal.

Active clean-up techniques

Recovery of floating oil

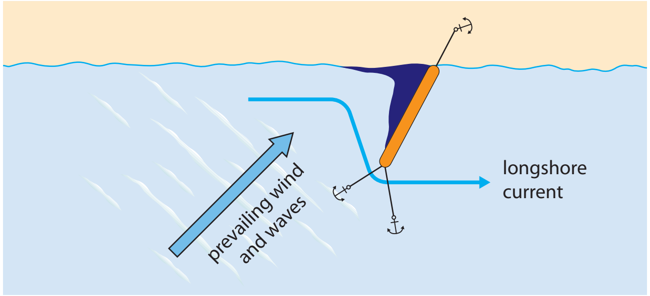
Oil stranded on shorelines can become mobile and re-float with changing tides and weather. Consideration should be given to techniques to recover such mobile oil, which is most prevalent at clean-up phases two and three.

Typical applications

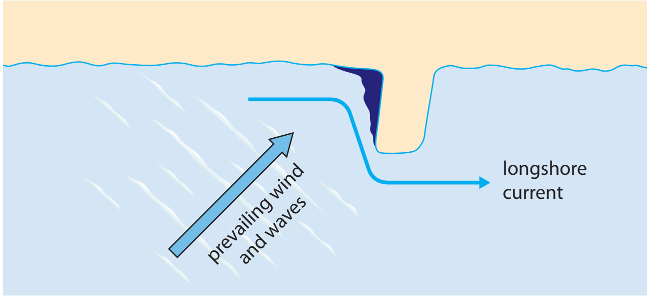
- Floating oil pressed against the shoreline by the wind or contained within a shoreline boom.
- Collection points where oil accumulates, which provide an opportunity to recover free oil using a variety of methods, for example:
  - collection points—longshore drift: classically this refers to the transport of sediment along the coast due to waves breaking obliquely on the shoreline, but a similar transport of sediment can also be caused by a longshore current. Prevailing onshore winds generate wind-driven surface currents towards the shore, but because the wind direction is rarely exactly at right angles to the coast the water is deflected along the shoreline. Spilled oil follows the longshore current, accumulating in natural collection points, where flotsam and jetsam also pile up. In the absence of natural collection points, a collection point can be created either by placing a boom projecting into the sea at an acute angle to the longshore current, or by taking beach material and building a temporary, solid promontory (Figure 6). The technique is restricted to conditions of light breezes and slight seas (i.e. wave heights between 0.5 and 1.25 metres high) since, in stronger winds and sea conditions, breaking waves are likely to interfere with the recovery of oil from collection points and may lead to booms becoming damaged.

Figure 6 *Creation of collection points on shorelines subject to longshore drift*

(a) Positioning of an anchored boom



(b) Construction of a temporary solid promontory



  - collection points—beach weirs: these can be utilized on sand or shingle beaches in non-tidal waters, or where the tidal range is low and the area is subject to either prevailing onshore winds or diurnal, onshore/offshore winds. A trench is dug at the top of the beach, level with the high water mark, and when the water level rises, induced by the onshore wind, oil floating at the water's edge flows over into trench from where it can be pumped to storage. On some lower energy beaches with small tidal range it may be possible to extend the trenches into the mid-intertidal zone. It should be noted that man-made alterations to the geomorphology of the beach may have a short-term impact on active shorelines, and the net environmental benefit of such disruption needs to be fully assessed.

Method outline

- Pumps: in calm waters with vehicular access to the shoreline, such as within a port or harbour, oil can be pumped directly from the containment area to temporary storage tanks or into a road tanker, vacuum truck or slurry tanker. The type of pump selected will depend on the viscosity of the oil, with positive displacement pumps required to transfer the more viscous and emulsified oils. Many vacuum and slurry tankers have a fully opening rear door to allow the discharge of highly viscous oils; if the oil is to be transferred directly to a road tanker which has no rear door, careful attention needs to be given to ensuring that the loaded oil is not too viscous to be discharged easily. Some slurry tankers rely on centrifugal pumps to fill the tank, and it important to note that these do not function well with viscous or emulsified oils. Vacuum trucks range in power, from those used to empty septic tanks to industrial vacuum vehicles that have a suction power an order of magnitude greater.

  Oils with high pour points (i.e. a pour point higher than ambient or seawater temperatures) and which are therefore in a semi-solid state, or oils that are very highly emulsified and cannot be pumped, can sometimes be recovered with an excavator bucket provided there is adequate access for such machinery. Emulsified oils may stick to the inside of the bucket making it difficult to empty.

  In all cases, oil transferred directly from the water surface is likely to be associated with some free water which, after being allowed to settle in the receiving tank, can be decanted. Depending on local regulations it may be possible to return the decanted water back to the sea or it may require separate treatment prior to return to the environment.
- Skimmers: in slight seas wave motion makes it difficult to pump oil directly into an open hose, though floating attachments can improve recovery. With sufficient water depth, smaller or medium-sized skimmers of various designs can be used at the water's edge to recover oil and pump it ashore. (See the Good Practice Guide on at-sea containment and recovery (IPIECA-IOGP, 2015b)). Rope mop skimmers are not restricted by water depth and can be used even in shallow waters provided an arrangement to fix the rope mop and associated pulley system can be devised.
- Manual scooping from boats: in calm to slight seas, shallow-draft boats can be used for collecting oil if access to the shoreline is difficult by land. The oil can be manually scooped from the water surface into 200-litre drums or, for viscous oils, into 1 m^3 'big bags' or 'jumbo bags'. Scoops used to collect more viscous oils can be made from a mesh or perforated metal to allow water to drain while retaining the oil (see photograph below).

Collection of oil from the water surface using scoops

Source: ITOPF

- Sorbents: if no vehicular access is available it may still be possible to collect floating oil from the shore using sorbents; these may include proprietary materials as well as naturally-occurring materials such as bagasse (fibrous waste from sugar cane processing) and straw. It should be noted however, that dried vegetation, such as straw, does not make particularly good sorbent material as it quickly becomes waterlogged and therefore needs to be collected very soon after it has been applied. Oil-soaked sorbents can be bagged and carried to a temporary storage area. In general, the large-scale use of sorbents on shorelines is not advocated since it adds to the quantities of waste for both transportation and disposal. However, where no other methods of collecting free-floating oil are viable, it is one possible solution.

Timing

The technique is used to recover mobile oil in the first phase of the response.

Suggested end point

The end point is reached when no significant quantities of floating oil remain, i.e. no recoverable oil.

Advantages and disadvantages

✓ Removal of bulk floating oil.
✓ Low biological impact.
✗ End point leaves surface oil residues, cover or coat and, depending on location, further treatment may be required or the oil may need to be left for natural cleaning.
✗ Use of sorbents for bulk oil collection adds to volumes of waste for transport and disposal.

Trenching

Typical application

- Mobile oil stranded on shallow sloping beaches on tidal shorelines.

Method outline

- Trenches dug by an excavator across the beach slope, parallel to the water's edge, can provide collection points for the recovery of fluid oil. Oil lying on the surface is encouraged to flow into the trench either manually with a squeegee (a smooth, flexible rubber blade attached to a broom handle) or by flushing the oil down the beach with volumes of water at low pressure. Once contained within the trench, the oil (and water) can be pumped into slurry tankers or temporary storage tanks or recovered by vacuum trucks. As far as possible the quantity of water recovered with the oil should be minimized, for example, by the use of skimming heads.
- Although trenching has been used successfully on tidal hard-packed sand and shingle beaches, the trenches tend to get filled in with each tide and may need to be reopened at the subsequent low tide.

Use of a trench to recover oil

Source: ITOPF

Timing

The technique is used to recover fluid stranded oil in the first phase of the response.

Suggested end point

As time goes on this technique will produce less and less recoverable oil. The end point is reached when the quantities of fluid oil recovered are no longer significant, i.e. no recoverable oil.

Advantages and disadvantages

- ✓ Removal of stranded fluid oil.
- ✓ Low biological impact.
- ✗ End point leaves oil contaminated beach substrate (surface oil residues) and, depending on location, further treatment may be required or the oil may need to be left for natural cleaning.
- ✗ If trenches are not lined, oil can penetrate into the walls and create a subsurface oiling issue.
- ✗ Without careful marking and recording of the location, trenches can be difficult to find subsequently. If not found and cleaned, trenches can become a sporadic and unpredictable source of oil contamination for some time after the spill.

Manual recovery of stranded oil

Typical application

- Non-fluid stranded oil and oiled beach materials (sand and shingle) on any shoreline accessible on foot.

Method outline

- Stranded oil and contaminated substrates can be removed with a variety of implements depending on the type of shoreline and texture of the material to be recovered. Suitable implements range from trowels, scrapers, rakes and shovels to rags and sorbents. Recovered oil is usually placed in heavy-duty plastic bags (e.g. >400 gauge/100 µm thick), rubble and fertilizer bags, or woven polypropylene sacks such as those used for packaging sugar and rice. Lighter-gauge plastic bags deteriorate quickly in sunlight and risk becoming a secondary source of pollution. Suitable bags are those with a nominal capacity of 25 kg, and should be filled no more than about ¾ full, or approximately 15 kg in weight, for ease of handling and to avoid spillage.
- If the shoreline supports machinery, collected waste can be put straight into the bucket of a front-end loader for transfer to a staging area.
- On sand beaches in the earlier stages of the clean-up when the gross contamination is being removed, shovels will be the tool of choice; as the operation nears its end, rakes are preferred.
- In contrast, on rocky and cobble shores where there is no vehicular access and no possibility of high-pressure washing, wiping by hand and the use of hand trowels may be the only possible means of cleaning. The method is highly labour-intensive and slow but may be appropriate in some circumstances, especially where labour is plentiful.
- If oil is to be collected manually from sensitive wetlands, whether temperate or tropical, or from saltmarshes or mangroves, careful consideration of the merits of physical intervention are required. If a decision is made to remove the oil, close supervision of the workforce and precautions such as the use of duckboards are called for to avoid damaging the vegetation by excessive trampling.

- Oily waste should be consolidated at a staging area, higher up the shoreline and well above the high-water mark to avoid the bags being washed away before they can be collected. The collected material might be loose, bagged, placed in bulk bags (~1 m^3 capacity, also known as 'jumbo bags', 'ton bags', 'super sacks' or 'big bags') or loaded into skips or dumpsters. In all cases, however, the staging area should be prepared with polythene sheeting or a bund so that the oil can be contained if the collected material is spilled or if bags or other containers should leak. Where possible, the location should also be selected so that it is accessible to road vehicles to allow the waste to be picked up and transported for disposal or taken to temporary storage.
- A variety of situations may preclude vehicular access to recover waste from staging areas, including, for example, oil collected in rocky coves, below cliffs or along sensitive shorelines such as sand dunes where vehicle traffic is prohibited; in such cases, alternative means of transferring the bagged waste will be required. Solutions to this challenge include: human chains; use of all-terrain vehicles (ATVs) to transfer the material along the shoreline to an access point; cranes; and zip wires or aerial ropeways. Helicopters have also been used but, given the cost, this solution will need to be evaluated carefully. To make optimum use of any of these resources, the chosen operation will need to be extremely well coordinated. In certain circumstances, such as in remote collection areas with long transit distances, direct transport by helicopter to a disposal facility or temporary storage area might well offer the most cost-effective solution when compared, for example, with evacuating the waste by boat; the latter would probably involve repeated handling of the waste, for example, loading the vessel at the shoreline before sailing to a dock where the waste is offloaded and then reloaded onto trucks for onward transport.

Timing

The technique is used to recover stranded oil and contaminated sediments through all three phases of the response, and is sometimes even used to recover floating oil. As the predetermined end point is approached, further treatment such as sieving or harrowing may be necessary for high amenity beaches, but in many cases manual clean-up can achieve a satisfactory end point.

Suggested end point

Depending on the season, the likelihood of natural cleaning and the services provided by the shoreline, end points might vary from the removal of gross contamination, or removal of light to moderate surface oil residue, to no visible oil, no buried oil, no sheen, no greasy texture and no oily smell.

Advantages and disadvantages

✓ Removal of stranded oil from all types of shoreline as well as contaminated sediments from sand and shingle shorelines.
✓ Highly selective, leading to a high oil content in oily waste with relatively small amounts of clean substrate, thereby minimizing the amount of waste for transport and disposal.
✓ Can achieve a range of end points including those for amenity use.
✓ Low biological impact.
✗ Labour-intensive and slow; as an indication, one person can typically collect 1–2 m^3 of oiled sand per day.
✗ A large workforce needs to be well organized with a high level of supervision to maintain focus, ensure selective recovery of oil (thereby minimizing amounts of waste generated) and to avoid secondary pollution.
✗ The coordination of large numbers of volunteers in this role calls for significant management effort.

Mechanical recovery of stranded oil

Typical application

- Non-fluid stranded oil and heavily oiled beach sediments on sand and shingle shorelines accessible by heavy machinery.
- The oil or contaminated sediment to be recovered needs to be of a consistency sufficient to allow concentration into cohesive piles or mounds which retain their structure long enough for subsequent collection by front-end loaders or excavators.
- The technique generates large quantities of lightly oiled waste, and is generally only applicable to high amenity shorelines immediately prior to, or during, the tourist season when the need to respond as quickly as possible may override environmental and waste minimization concerns.

Method outline

- Excavators, road graders, and tracked and wheeled loaders (also known as front-end loaders or payloaders) have all been used in the recovery of oil and oily sediments from shorelines.
- Graders can be used on hard-packed, fine-grain sand beaches where oil penetration is likely to be limited. By setting the grader blade to skim just below the surface of the beach, oil and sand can be concentrated in rows for collection with front-end loaders (see the *Alvenus* case study on page 38).
- Loader buckets can be used to concentrate oil and oily sediments, and collect oil and sediments directly. However, the depth to which the bucket digs into the beach cannot be controlled to the same extent as a grader, and much more clean substrate will be mixed with the oil, resulting in considerable quantities of clean sediment being collected with the contaminated material.
- The ability of the shoreline to support heavy vehicular traffic depends on the type of substrate and whether it's wet or dry, and on the shoreline gradient. Dry soft sand, impassable by wheeled vehicles, may be passable by tracked vehicles but the amount of oil mixed into clean substrate is likely to be greater if tracked vehicles are used.
- For the reasons outlined above, the use of bulldozers is not usually recommended for mechanical collection due to the likelihood of excessive mixing of clean and contaminated sediments.

Timing

Recovery of stranded oil and contaminated sediments is carried out from early in the response, through phase one to phase two.

Suggested end point

Light to moderate contamination. In cases of greater oil penetration, it may not be possible to achieve a better end point than moderate contamination. Alternative techniques may be needed to achieve a higher level of cleaning such as surf washing or, for sandy shores, ploughing/harrowing.

Advantages and disadvantages

✓ Removal of stranded oil and contaminated sediments from sand and shingle shorelines.
✓ Rapid removal of large volumes of stranded oil and contaminated sediments.
✓ Low labour requirement.
✓ Low to moderate biological impact; some loss of infauna.
✗ Potential for production of excessively large quantities of waste with typically low but variable oil content;

- ✗ Movement of heavy machinery over oiled shorelines mixes the oil further into the substrate; some shorelines, such as soft coarse sands, do not support heavy machinery which risks sinking and becoming stuck once loaded.
- ✗ Potential risk of heavy machinery damaging habitats such as dunes, together with the risk that excessive removal of substrate can create adverse geomorphological changes to shoreline profiles and/or erosion.
- ✗ It is strongly recommended that heavy machinery is not used on sensitive shorelines such as saltmarshes due to the risk of causing long-term damage to the habitat.

Surf washing

Typical application

- Sand, shingle, pebble and cobble shorelines accessible to heavy machinery and exposed to breaking waves with moderate to light levels of contamination but not significant quantities of stranded oil.
- Separation of bulk oil from sediments where it is buried or intimately mixed into the sediment.

Method outline

- Equipment such as front-end loaders, excavators or bulldozers is used to move oiled beach material into the high-energy surf zone.
- In the absence of machinery, the material can be moved towards the surf zone manually, observing sensible precautions when working on a dynamic shoreline.
- The material is agitated and cleaned by wave energy, relying on the natural processes of abrasion, oil/mineral aggregates and dispersion. Some evaporation may also occur with lighter and less-emulsified products and is clearly apparent from the oily smell during the operation.
- In conditions where there is a likelihood of significant quantities of free oil being released using this technique, the use of sorbents is recommended to collect the oil—sorbent nets for viscous oils and proprietary sorbent mats or booms for lighter oils. Oil stranding on the beach surface can be recovered manually (see the *TK Bremen* case study on page 39).
- In most cases, wave energy will redistribute the beach substrate back up the beach over time but larger cobbles may need to be replaced to maintain the beach profile.

Timing

The technique is used during phases two and three, after removal of bulk stranded oil but before undertaking any final clean-up of adjacent high amenity areas, as the oil and sheens released may re-contaminate these areas. Alternatively, the use of the technique should be restricted to wind and tide conditions that would carry any released oil away from sensitive shorelines.

Suggested end point

To reach a final end point acceptable for high amenity shorelines, repeated treatment or ploughing/harrowing might be required, as well as reinstatement of the beach profile. For shorelines where natural cleaning can be allowed to proceed more slowly, the beach material is left in the surf zone and, over time, will become redistributed through the action of waves and tides according to grain size to reform the natural beach profile. Any residual stains or films will weather and degrade naturally.

Advantages and disadvantages

- ✓ Relies on natural cleaning processes.
- ✓ Low labour requirement.
- ✓ Method for treating buried oil.
- ✓ Minimizes the amounts of oily waste for evacuation and disposal.
- ✗ Potential release of oil and sheens.
- ✗ Temporary disruption of beach profile.
- ✗ Potential for low levels of infauna loss.

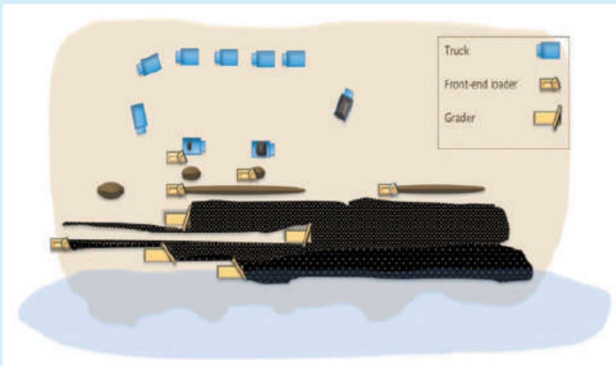
CASE STUDY 2: Example of mechanical clean-up using graders and dump trucks on a hard-packed sand beach

***Alvenus*, Louisiana, USA, 1984**

In July 1984, the tanker *Alvenus* grounded in the Calcasieu River and spilled approximately 8,500 tonnes[3] of viscous Merey and Pilon crudes. Most of the oil stranded along some six miles of the Galveston seawall and along 13 miles of Galveston West Beach, a hard-packed sand beach where, because of the scale of shoreline contamination and the touristic importance of the location at that time of year, a massive mechanical clean-up operation was undertaken. At its peak approximately 50 graders and 100 dump trucks,[3] each with a capacity of 25 cubic yards, were engaged in the operation which resulted in some 100,000 cubic yards[4] (~76,500 m^3) of sand being removed from the shoreline.

Working from the top and the bottom of the beach, the graders were used to draw the contaminated sediment into rows parallel to the water's edge. The rows of oily sand were then worked into piles by front-end loaders before being loaded onto trucks.

Despite the large quantity of sediment removed, the quantity of waste generated in the Galveston beach clean-up did not greatly exceed the amount of waste that, as a rule of thumb for shoreline clean-up, is often as much as ten times the amount of oil spilled. In addition, because significant sand movement occurs annually along this coastline, it was judged that there was no need for sand replenishment.



Right: schematic of the mechanical clean-up of the Galveston shoreline.

Below: Galveston West Beach, and one of 50 graders engaged in the shoreline clean-up operation.

Source: ITOPF

Source: www.oil-spill-info.com

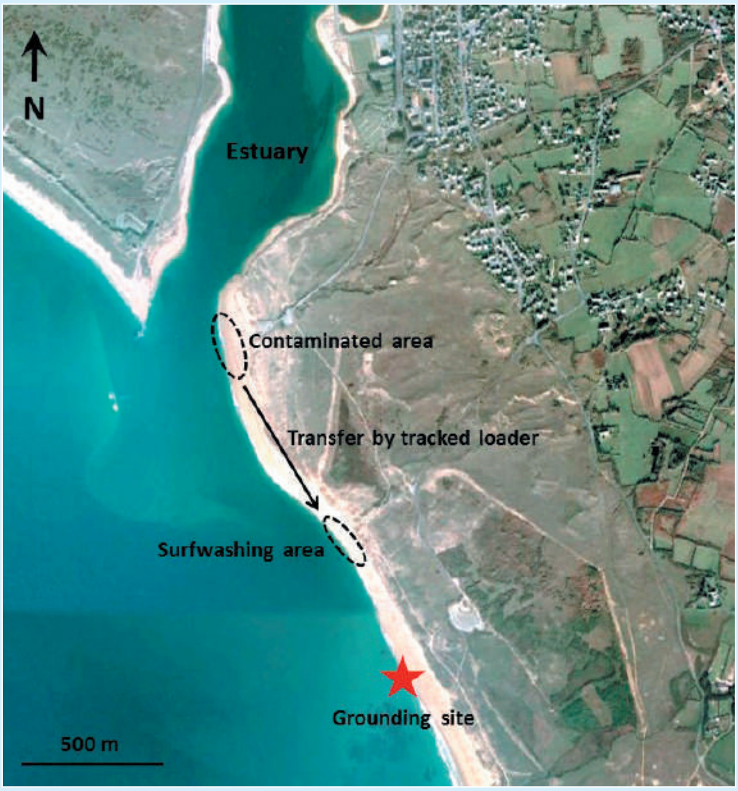
[3] Alejandro and Buri, 1987 [4] NOAA Incident News website: http://incidentnews.noaa.gov/incident/6267

CASE STUDY 3: Example of surf washing used to clean several thousand metres of oiled sandy beach

***TK Bremen*, Brittany, France, 2011**

In December 2011, the cargo ship *TK Bremen* grounded during a storm on a sandy beach spilling IFO 120 and diesel oil onto the shoreline. The grounding location was close to protected dunes and an ecologically sensitive estuary, which supports an important oyster fishery. The bulk of the stranded oil was removed from the beach during the first few days by manual and mechanical means, but considerable quantities of buried oil and oil-impregnated sand remained at the mouth of the estuary. The environmental and socio-economic sensitivities of the surrounding area meant that any further clean-up operations had to carefully consider sea state, wind and tides, in order to prevent further contamination of these shorelines. Natural cleaning was discounted due to the potential for oil being released on rising spring tides, particularly in rough winter seas, and entering the estuary. The large volume of sand to be treated meant that ex-situ cleaning was also not practicable.

Source: ITOPF



Source: ITOPF

Surf washing was therefore used to clean several thousand cubic metres of oiled sand, in just a few days. Commonly conducted on a rising tide, this technique can also be used at ebb tide to enable better recovery of the released oil. The most appropriate site for surf washing was selected at a distance from the original location of the oily sand, to ensure that released oil was carried away from the estuary, and that the cleaned sand stayed within the beach's sediment system. Oil was recovered from the water immediately downstream of the surf washing point by fine mesh nets, attached at intervals to ropes, parallel to the water line and offset in the direction of the drift, anchored using 1 m^3 'big bags' filled with sand and buried in the beach. As the tide went out, the surf washing point was shifted down shore and in the direction of the drift. To ensure that any remobilized oil/sheen was not carried towards the mouth of the estuary, the operation could only be implemented in periods of moderate to strong wave action and north to north-westerly winds, and during the first three or four hours of the ebb tide.

Due to the fluidity of the oil, the nets did not collect all the pollutant released: some of it escaped in the form of sheen, which ultimately dissipated at sea. On the sea surface, beyond the surf zone, two small boats equipped with scoop nets and sorbent booms for trawling recovered any floating oil. Subsequent tidal cycles finalized the clean-up and gradually redistributed the shifted sediment.

Flushing/flooding

Typical application

- Sand or shingle beaches with buried oil where surf washing is not viable.
- Rock boulder shores and sea defences where oil is trapped within cavities.
- Oil trapped under wharves.
- In conjunction with high pressure washing to carry run-off to collection points.
- Sensitive shorelines such as saltmarshes and mangrove stands.

Method outline

- The technique uses high volumes of seawater at low to moderate pressure to dislodge and remobilize stranded, trapped or buried oil and channel it to collection points.
- Portable self-priming centrifugal pumps (30 to 60 m^3/h) can be used to supply seawater to fire hoses or flushing lances (hand-held lengths of rigid pipe) directed into the beach to agitate the substrate and release trapped oil. Proprietary flushing lances exist that introduce air into the water flow through a venturi arrangement that is intended to provide both additional agitation and flotation to bring the oil to the surface.
- The oil released can be floated down to collection points by flooding the section of the shoreline being treated with water pumped through perforated pipes laid along the top of the beach.
- It may also be possible to use high volumes of water at low pressure to flush fluid stranded oil from sensitive shorelines such as saltmarshes and mangroves, and so avoid the levels of physical intervention and risk of damage associated with manual removal.

Timing

Flushing is generally applicable for use during phase two of the response. It should be undertaken prior to final clean-up of adjacent shorelines; if the remobilized oil is not recovered it presents a risk of contamination to surrounding areas.

Suggested end point

The end point is reached when no more oil can be released by flushing, i.e. no recoverable oil. Depending on the shoreline type the result may range from a greasy texture for sand beaches to a relatively heavy coating for viscous oils attached to rocks or sea defences, where only mobile oil has been removed by this technique.

Advantages and disadvantages

✓ Removal of buried and trapped oil.
✓ Removal of mobile oil from sensitive shorelines.
✓ Minimal disruption of beach profile (see also 'surf washing' on page 37).
✓ Low biological impact.
✗ Moderate to high labour requirement.
✗ Restricted area treated by a single flushing lance results in slow progress.
✗ Heavy coating of oil remains for some shoreline types, e.g. rocks and sea defences.

Use of concrete ('cement') mixers

Typical application

- Sheltered pebble/cobble beaches where significant amounts of oil remain trapped but where shoreline is low-energy (not suitable for surf washing) or non-tidal.
- Higher energy pebble/cobble shorelines where, if surf washing were to be used, there is a significant risk that the oil released could contaminate adjacent sensitive resources, such as mariculture, sea water intakes or recreational beaches.

Method outline

- The drum of a concrete mixer truck is part loaded with contaminated pebbles/cobbles. (To avoid damage to the drum and mixer elements, stones should not exceed 150 mm in diameter). A typical mixer truck has a capacity of 5–6 m^3. Large debris, e.g. driftwood, should be removed prior to loading.
- A solvent, such as a shoreline cleaner (see *Use of chemical cleaning agents* on page 44) or odourless kerosene is added at 1–2%, i.e. a ratio of solvent to contaminated pebbles between 1:50 and 1:100 depending on the degree of contamination The solvent and oiled pebbles are mixed thoroughly by rapid rotation of the drum for a period of about five minutes.
- The speed of rotation is slowed to allow the concrete mixer to be filled to capacity with water, and the contents of the drum mixed for a further 30–60 minutes depending on the average size of the pebbles; smaller aggregates will need longer than large ones.
- Oily wash water is decanted into a temporary storage tank to allow separation of the oil, and the pebbles are discharged ready for transport back to the source shoreline.
- Oil separating from the wash water can be recovered with sorbents or a small skimmer, and efforts should be made to recycle as much of the wash water as possible. Spent wash water will require separate disposal arrangements according to local regulations.
- A cleaning station set up with several concrete mixers working in parallel can optimize logistics and take advantage of the benefits of scale by working with associated equipment such as loaders, pumps and tanks.
- The process produces stones that are still slightly contaminated with a greasy film. These can be placed at the water's edge for final rinsing. During periods of heavy weather these pebbles will be redistributed and any residual films removed.

Timing

This is a final clean-up technique used during phase three of the clean-up operation, and requires the removal of bulk oil prior to its use.

Suggested end point

The process leaves a greasy film removed through natural cleaning at the water's edge.

Advantages and disadvantages

- ✓ Depending on the size of the concrete mixer, can achieve a batch treatment rate of 5–6 tonnes/hour.
- ✓ Allows cleaned material to be returned to source shoreline.
- ✓ Equipment is mobile and a washing station can be set up with several machines working in parallel.

- ✗ Moderate labour but high equipment requirement.
- ✗ Relatively slow and consequently costly.
- ✗ Requires double handling and transport of material from shoreline to washing station and back again.
- ✗ Fine particles of sand and grit accumulate within mixer drum and may need separate disposal arrangements.
- ✗ High volumes of wash water may need further treatment and separate disposal arrangements according to local regulations.

In-situ washing

Typical application

- Shorelines comprising small boulders and cobbles accessible to machinery and where significant amounts of oil and oily debris remain trapped.
- Areas where relocation of the contaminated material into the surf zone is not possible or where the shoreline is non-tidal.
- Higher energy shorelines where, if surf washing or flushing were to be used, there is a significant risk that the oil released could contaminate adjacent economically or environmentally sensitive resources.
- This technique provides a very limited treatment rate in terms of tonnes of oiled substrate treated per day, and is therefore likely to be restricted to short sections of shoreline or coves where environmental or economic concerns are particularly high.

Method outline

- Two methods:
  1. An excavator is required to move the material to a suitably strong and watertight tank, such as a sectional tank (Braithwaite tank), a skip placed on a flat surface, or any other container available locally that could be adapted for the purpose. The excavator bucket is used to agitate the material in the tank with surface cleaners or odourless kerosene and seawater in much the same way as with the concrete mixer described above. Oil released can be collected both from the surface of the washing tank and from oily water pumped into temporary storage tanks were the oil is allowed to separate.
  2. The excavator is used to load material onto a heavy-duty grill with an appropriate mesh size to retain the material to be cleaned above the tank. The material is then cleaned with high-pressure washers and the wash water collected in the tank from where it can be pumped to temporary storage tanks for oil separation and recovery. This method can also be used to clean the individual elements of sea defences, e.g. Tetrapods, Dolos, Xblocs, etc., if the defences are dismantled for cleaning.
- The cleaned material is placed in the surf zone for final cleaning.

Timing

This is a clean-up technique used during phases two and three after mobile, free oil has been recovered but heavily contaminated substrate remains.

Suggested end point
Removal of gross oil contamination, and end point to suit shoreline use.

Advantages and disadvantages
- ✓ Removes gross contamination from cobbles, boulders and sea defence elements, and with high pressure washing can achieve a high degree of cleaning.
- ✓ Avoids transfer of oiled material from the shoreline.
- ✗ Very limited batch treatment rate with relatively high equipment demands.
- ✗ Wash water may need further treatment and separate disposal arrangements according to local regulations.

High-pressure washing

Typical application
- Boulders and bedrock where a coating remains that is not exposed to sufficient wave action and has therefore become, or is likely to become, weathered and hardened.
- Manmade structures.
- Rocky foreshores with easy public access; high amenity shorelines.

Method outline
- Proprietary pressure washers offer systems with either hot or cold water at high pressure, but the more resistant the oil residue, the higher the temperature required to remove it. For hot water washers it is recommended that the temperature is set to no higher than 95°C, as vapour under pressure is not as efficient as water. Operating pressures may vary from 50 to 150 bar with a water flow rate in the range 10–20 litres/minute. A test area should be selected to optimize the efficiency of the technique using a range of pressures and temperatures.
- While some systems are designed for use with seawater, most rely on a freshwater supply which needs to be portable to allow it to be moved with the work area as the operation progresses. Seawater systems can be supplied by submersible pumps fitted with gross filters to avoid ingress of shells and algae, etc., with the seawater then being passed to a settling tank before entering the high-pressure pumps.
- With a team of two people per washer (one operating the lance, the other monitoring effluents and maintenance issues) an average of 1–3 m^2/hour can typically be cleaned depending on the skill of the operator, ease of access and the level of contamination.
- Cleaning from the top of the shoreline allows effluents to flow over areas not yet cleaned. Depending on the shoreline type and configuration, effluents can be contained in trenches or rock pools, or at the water's edge with sorbent booms.
- Where effluents cannot be contained, such as on flat rocky platforms, a supplementary water flow, or flooding, can be used to direct effluents to a collection point. When cleaning rocks at the margins of a sand or shingle beach, geotextiles or plastic sheeting can be used to prevent effluents from penetrating the substrate. Sorbents placed at the base of the rocks being cleaned are used to recover as much oil as possible as the effluents pass through them.
- At high operating pressures, the spattering of surfaces adjacent to the work area can be a problem. Areas which may already have been cleaned or which have not been oiled need to be protected.

Timing

This is a final (phase three) clean-up technique. To avoid re-oiling of cleaned surfaces, it should not be commenced until all mobile oil has been recovered. It is usually restricted to high amenity areas or where natural cleaning is unlikely to be effective or sufficient, such as in ports and harbours.

Suggested end point

Thin residual stains or films may remain, which are best left to weather and degrade naturally. Repeated treatment or use in conjunction with chemical cleaning agents may be necessary if the removal of traces of oil is required, such as when cleaning promenades and marinas.

Advantages and disadvantages

✓ Can achieve a high degree of cleanliness.
✓ Equipment is relatively easily sourced and mobile.
✓ Moderate labour requirement.
✗ Biologically destructive.
✗ High levels of 'spatter' present the risk of contamination of areas adjacent to the work area.
✗ Potential damage to the surface of concrete, soft rock (e.g. sandstone) and jointing materials in concrete structures.
✗ Relatively slow and consequently costly.

Use of chemical cleaning agents

Typical application

- Usually in conjunction with moderate to high pressure washing where supported by NEBA and permitted by national regulations. Typically used for cleaning:
  - boulder and bedrock areas;
  - manmade structures; and
  - rocky foreshores with easy public access; high amenity shorelines.
- Use of chemicals on shingle/cobble shorelines is not recommended since oil/chemical mixtures tend to penetrate deeper into the shingle where tidal flushing is likely to be less effective.

Method outline

- Two chemical categories:
  1. Surface cleaning agents are applied to the surface to be cleaned according to the manufacturer's instructions. The combined solvent-surfactant action of the surface cleaners reduces the viscosity of the oil and alters its surface tension to facilitate lifting the oil from the surface being cleaned. Crucially, unlike dispersant use (see below), the intention is not to disperse the released oil but to collect it, either directly using sorbents, or by flushing it to a collection point for recovery by sorbents, pumps or skimmers.
  2. Where permitted, dispersants are applied to the oily surface and mixed into the oil with vigorous brushing. The oil/dispersant mixture is then flushed off. For planning purposes, an oil to dispersant ratio of 20:1 is used. An estimate is made of the average quantity of oil per unit area, based on the oil thickness, and the appropriate application rate for the area to be treated is determined. By way of illustration, an oil layer 2 mm thick represents 2 litres of oil/m^2, calling for $^2/_{20}$ litres of dispersant, or 1 litre of dispersant for each 10 m^2 of oiled surface.

- The use of dispersant may be more highly prescribed than surface cleaners because the oil released by surface cleaners is recovered, whereas dispersants are intended to promote the dispersion of oil into nearshore waters. For that reason their use should be restricted to areas where there is adequate water movement to bring about the rapid dilution of the dispersed oil.

Timing

This is a final clean-up technique, typically used during phase three of the clean-up operation and in high-amenity areas.

Suggested end point

Minimal traces of oil stain or film. A repeat application may be necessary for particularly resilient stains.

Advantages and disadvantages

✓ Can achieve a high degree of cleanliness.
✗ If the use of chemicals on shorelines is permitted, only those products approved for that purpose under national regulations should be used and only at recommended dose rates.
✗ Moderate to high labour requirement.
✗ Requires close supervision to ensure proper application of chemicals and the correct use of PPE.
✗ Potential for localized biological impact.
✗ Oil released by surface cleaning agents needs to be recovered.
✗ Dispersants require sufficient water movement to allow the rapid dilution of dispersed oil.
✗ Not suitable for large-scale treatment.
✗ Not suitable for shingle/cobble shorelines.
✗ Relatively costly.

Use of particulate sorbent as a masking agent

Typical application

- Rocky shores with limited access.
- Seal, penguin or otter haul-outs.
- Marsh vegetation to protect wildlife.

Method outline

- Particulate mineral (vermiculite) or organic (peat, bark, straw, etc.) sorbents are broadcast onto the affected shoreline.
- Mineral sorbents tend to be used exclusively on rocky shorelines, whereas organic sorbents can be used on both rocks and marshes.
- On rocky shores, and on marshes where accessible, the sorbent may be worked into heavier accumulations of oil and the oil/sorbent mixture recovered manually.
- More often, however, once applied, the oil and sorbents are left to degrade naturally. While the mineral sorbents themselves will not degrade, they are removed naturally over time and distributed over a wide area.
- If the sorbents are washed off prematurely leaving oily surfaces that are still tacky, repeat applications may be required.

Timing

This technique is applicable for use during phases two to three of the clean-up operation. After removal of mobile oil, particulate sorbents are used to mask the covering of oil on rocks and marsh vegetation to protect wildlife.

Suggested end point

When used to protect wildlife, no further treatment is foreseen and the oil is usually left to degrade naturally.

Advantages and disadvantages

- ✓ Provides a means of masking oil while still tacky and transferable, until the oil weathers and natural cleaning processes lead to its removal and degradation.
- ✓ Minimizes contact between the oil and wildlife (birds and mammals).
- ✗ Potential localized biological impact for fauna other than target groups.
- ✗ Sorbent/oil mixture is largely unrecoverable, so this is usually unsuitable as an effective clean-up technique.

Sieving

Typical application

- Dry sand, amenity beaches contaminated with tar balls or pellets of weathered oil, and sand remaining after manual clean-up.

Method outline

- In principle, contaminated sand is placed on a fine-mesh screen with a hole size that allows the dry clean sand to drop through as the screen is shaken or vibrated but retains tar balls and oily pellets.
- The scale of the operation ranges from small, hand-held garden sieves through static sieves of 1–2 metres and vibrating screens of table-top dimensions, to commercial-scale units used in the mineral processing industry. While static sieves and medium-sized vibrating screens can be loaded by hand, larger industrial units require heavy machinery to move the sand for treatment, load the screen and return the clean product.
- At the smallest scale, the use of garden sieves is highly labour-intensive and would probably prompt a decision to terminate operations on the basis of a determination of whether that level of effort could be justified.

Timing

This is a final (phase three) clean-up technique for recreational amenity beaches.

Suggested end point

The target end point is no visible tar balls or pellets of weathered oil and sand.

Advantages and disadvantages

✓ Can achieve a high degree of cleanliness.
✓ Most equipment is relatively mobile.
✓ Reduces the amount of waste for disposal.
✓ Minimal biological impact.
✗ Large-scale sieving operations require the transfer of material to the sieve location and the return of clean product to the beach.
✗ Very small-scale operations are highly labour-intensive.

Beach-cleaning machinery

Typical application

- Sand amenity beaches contaminated with tar balls or the residue from manual clean-up, or pellets of weathered oil and sand. The technique requires that shorelines are accessible by vehicles including tractors and trailers.

Method outline

- Beach-cleaning machines are primarily used for the collection of flotsam and jetsam and litter left by beach users on recreational beaches. The main approaches used in their design are a rotating rake system, a sieve system or a combination of these two. For rake systems, sprung tines are mounted across a rotating belt. The collected material is lifted by the tines and dropped into a hopper. In the sieve system, sand is removed from the beach surface to a predetermined depth and conveyed up to a vibrating screen. The clean sand drops through the screen back onto the beach and the oily debris is transferred to a collection hopper. Available machines include pedestrian controlled devices about the size of a lawnmower, those towed behind a tractor, and self-propelled machinery.
- Another design which operates best on wet, hard-packed sand is an oleophilic drum which picks up oil as it is rolled along the beach. The oil is then scraped from the drum and transferred to a storage compartment.

Source: ITOPF

A tractor-towed beach-cleaning machine

Timing
This is a final (phase three) clean-up technique for recreational amenity sand beaches.

Suggested end point
No visible tar balls or pellets of weathered oil and sand.

Advantages and disadvantages
- ✓ Can achieve a high degree of cleanliness.
- ✓ Mobile equipment.
- ✓ Very low labour requirement.
- ✓ Minimizes the amount of waste for disposal.
- ✓ Large areas of shoreline can be treated relatively quickly.
- ✓ Minimal biological impact.
- ✗ Low availability of beach-cleaning machines outside major beach resorts.
- ✗ Tar balls may fragment during processing (particularly in warmer weather) resulting in small tar balls falling back onto the beach.

Harrowing/ploughing

Typical application
- Tidal shorelines of sand or fine shingle with trafficability sufficient to support tractors using ploughs or harrows.

Method outline
- A variety of clean-up techniques can leave sand and shingle shorelines with low levels of contamination but with a residual greasy texture and oily smell. The use of agricultural equipment, e.g. ploughs and harrows, to turn over and aerate the beach material usually leads to the rapid removal of residual nuisance levels of contamination.
- The action of the cultivation equipment is equivalent to surf washing but without the wholesale movement of substrate to the surf zone. It brings the oiled beach material to the surface, promoting biodegradation and the dispersion of oil mineral aggregates.
- Repeated 'cultivation' of the beach over consecutive tidal cycles may be required to obtain the required end point.

Timing
This is a final (phase three) clean-up technique used to enhance natural cleaning.

Suggested end point
No visible oil, no buried oil, no sheen, no greasy texture and no oily smell.

Advantages and disadvantages
- ✓ Can achieve a high degree of cleanliness by enhancing natural processes.
- ✓ Required equipment is widely available.
- ✓ Low labour requirement.
- ✗ Potential for infauna loss.

Source: ITOPF

Ploughing an oiled shoreline

Sand replenishment

Typical application

- Sand and shingle shorelines accessible to the public at the height of, or immediately prior to, the tourist season where the loss of recreational services has the potential for significant economic consequences. Replacement material must be closely matched to that which was removed, both in terms of its mineral composition and grain size. If different from the original, it is likely to respond differently to the hydraulic conditions, possibly resulting in the new material being quickly washed away. A further consideration is the likelihood of natural replenishment. Most sand beaches are in a constant cycle of accretion and erosion, and with strong wind conditions or combined wind and tidal surges beach profiles can change dramatically in a 24-hour period. Such changes can sometimes be measured in terms of metres of sand depth lost or gained.
- The technique might also be considered for other shorelines where significant amounts of material have been removed as a result of clean-up operations and where the source of natural replenishment has been depleted so that there is little prospect of material being replaced without intervention. The difficulty in such a situation is finding materials locally which closely match the original to avoid it being quickly eroded.
- Given the above considerations, it is important to recognize that the circumstances in which this technique would be appropriate or successful are highly limited.

Method outline

- Sand or shingle is trucked from a local source of suitable replacement materials and distributed over the beach either manually or by heavy equipment.

Timing

This is a final (phase three) clean-up operation suitable in highly limited circumstances.

Suggested end point

Worksite overlain with clean sand or shingle, hence no visible oil, no buried oil, no sheen, no greasy texture and no oily smell.

Section 4: Shoreline types and associated oiling features

As oil strands on a shoreline the interaction between the oil and shoreline depends on both the characteristics of the oil and the shoreline type. This section describes the oiling features resulting from that interaction and discusses the clean-up implications for a selection of representative shoreline types.

Wetlands

In general, oil deposited on mudflats does not penetrate into the substrate because the water table is sufficiently high to provide a barrier against the downward migration of oil, including light oils. It is most likely that the oil will refloat and migrate elsewhere. However, there are exceptions. For example, oil can get into muddy sediments through the open stems of broken plants, and through animal burrows, wormholes, etc. Alternatively, if the oil is spilled during a storm, rough seas can lift substantial quantities of sediment into suspension which then becomes associated with dispersed oil. When the storm abates the mixture of suspended solids and oil is deposited and the oil is incorporated into the sediment. Without agitation the oil can remain within the sediment undergoing very slow anaerobic degradation unless another storm of similar proportions brings about its redispersal. Two well-studied examples of this phenomenon, which are often cited, are the *Florida* barge incident (Massachusetts, USA, 1969) and the *Braer* incident (Shetland, UK, 1993). In the *Florida* barge incident[5], evidence of the oil incorporated into the sediment of a marsh has been observed two decades after the original incident. In the case of the *Braer*,[6] oil/sediment mixtures representing some 30% of the oil lost were accounted for in sediments around the Shetland islands, a substantial proportion of which was found on the seabed close to Fair Isle, some 120 km from the site of the spill.

While an open water response can minimize the amount of oil approaching wetlands, the typically large geographical extent of such habitats makes them difficult to defend. However, erecting barriers across major inlets can sometimes restrict the amount of oil that gets into a wetland system. In some cases impermeable earth barriers have been built but, where water exchange is important, barriers have to be designed to let water pass through while keeping the oil out. For saltmarshes, straw, netting and oyster shells have all been used successfully, although attention should be given to the tidal currents that such barriers need to withstand.

Example of an oyster shell barrier

Source: ITOPF

On oiled muddy shores, the greatest challenges can be presented by the oil trapped in vegetation, i.e. in mangrove root systems in tropical regions, and saltmarsh vegetation in temperate zones. In most cases the drivers are environmental concerns rather than socio-economic, and the dilemma is how best

[5] Teal, J. M. *et al.*, (1992). [6] Davies, J. M. and Topping, G. (eds) (1997).

to minimize the impact of the spill while taking care not to do more harm than good by intervening in these sensitive habitats. On the one hand, leaving the oil in place is likely to result in mortalities of the plants and animals that these habitats support, while on the other, the clean-up operations themselves could damage the habitat, delaying recovery and leading to much longer-term damage. For this reason, oiled wetlands are often left to recover naturally.

Mangroves

Mangroves are known to be highly susceptible to the effects of oil spills depending on the type of oil spilled. Experience shows that in, general, light refined products are more damaging than crude oils and crude oils are more damaging than heavy fuel oils. The sediment type also seems to have a bearing on the degree of damage inflicted, with mangroves in fine sediments (muds) being more susceptible than those in coarser grain sediments. The implication from these observations is that, while heavy oils can, with care, be removed manually, efforts to remove lighter refined products should be made at the earliest opportunity to flush the oil away from the mangroves and into open water from where it can be recovered.

Source: ITOPF

Manual clean-up of a heavy fuel oil spill in mangroves

Saltmarshes

The experience drawn from a number of incidents, in particular the *Amoco Cadiz* incident (Brittany, France, 1978), has informed responders for many years on the damage which results from overzealous clean-up operations in saltmarshes. The use of heavy equipment, poorly supervised manpower and the removal of oiled sediment have led to long-term damage due to trampling, damage to root systems and consequent erosion. Closely supervised manual removal with the use of duckboards to avoid compression of the substrate, in-situ burning and cutting of oiled vegetation have all been used with varying degrees of success. The viability of cutting or burning oiled vegetation depends on the time of year when a spill occurs and the type of oil spilled. At the end of the year, when vegetation is dying back, cutting and burning would be less damaging than in the spring when new shoots are pushing through. In general, cutting vegetation has not been found to improve recovery rates except for spills of heavy fuel oil or heavy crude oils. In-situ burns are restricted to light and medium oils since heavy oils tend not to burn well. Controlled burning is found to be most effective if initiated shortly after the oil has stranded and before the oil penetrates into the marsh substrate. Oil within the substrate is likely to survive the burn. The attraction of burning over cutting is that it requires less intervention on the ground although it also represents a greater risk to fauna living or sheltering within the marsh, especially since it can be difficult to control the fire and keep it within the oiled area; in several cases where oiled marsh vegetation was set on fire, large areas of unoiled marsh were also burned.

Restoration

For both oiled saltmarshes and mangroves, once gross contamination has been removed and residual oil has weathered with the dissipation of toxic components, replanting has successfully enhanced recovery rates. However, replanting programmes, especially those involving mangroves, should be assessed against the potential for natural recolonization from adjacent surviving trees. This allows for the prevailing mangrove biodiversity and an ecologically-driven distribution to remain in place (as opposed to planting rows of a single species).

If, following such an assessment, replanting is determined to be an appropriate restoration measure, a supply of healthy seedlings of the appropriate species will be required, either from an undamaged area or by cultivating seeds in a nursery. Seedlings are planted with a large volume of good quality, clean sediment surrounding them to allow good growth before the roots extend into contaminated sediments.

Sand beaches

Buried oil

While oils can more easily penetrate into coarse, dry sand, finer-grained sands form wet, hard-packed beaches, less likely to permit oil penetration. However, as noted earlier, if oil is left lying on the surface of the beach and not removed in a timely manner, it can become buried by wind-blown sand or by natural sand accretion. Beach profiles can change dramatically in a matter of hours under the right sea conditions, with a depth of sand as much as a metre or more being washed away from one location and deposited at another. The existence of significant quantities of buried oil can be ascertained by digging a series of exploratory holes to get an idea of how extensive this might be. Once established, the first considerations are whether the processes that brought about the burial of the oil are just as likely to result in its rapid removal, and whether natural sand movement will occur faster than clean-up operations could achieve the same result. This depends on expected weather and sea conditions and whether there is a predictable cycle of deposition and accretion. If the oil became buried in storm conditions, it is likely that it will take another storm to remove it, but it is also under such conditions that the rapid dispersion of the oil released would occur. Nevertheless, if the area of buried oil appears to be extensive or if it seems likely to remain buried in the beach for some time, and if there is an environmental or, more probably, an amenity driver for its removal, its extent needs to be mapped and its removal addressed.

The mapping of buried oil requires a methodical survey with a series of transects established across the beach perpendicular to the water's edge at low tide. Holes are dug at intervals along each transect, or a trench is dug along its length, and the presence of oil is noted together with its depth below the surface and the thickness of the oil layer. The separation between transects depends on the estimated scale of the area, and new transects may need to be added if seams of oil are lost between transects. By interpolating between the transects, a three dimensional representation of the buried oil can be developed (Figures 7 and 8).

Source: ©Shutterstock.com

Removal of oil from a sandy beach; if oil is left lying on the surface, it can become buried by wind-blown sand or by natural sand accretion.

The options for removal of buried oil include lifting the clean overburden and moving it aside to expose the band of buried oil to be removed and transported off the beach for disposal. Another option is to transport the band of buried oil to the water's edge for surf washing. If relatively close to the surface, the oil might be mobilized through harrowing or ploughing, or by using flushing lances to release the oil and flush it to the water's edge where it can be recovered with skimmers or sorbents.

Figure 7 *Simplified diagram of a buried oil survey*

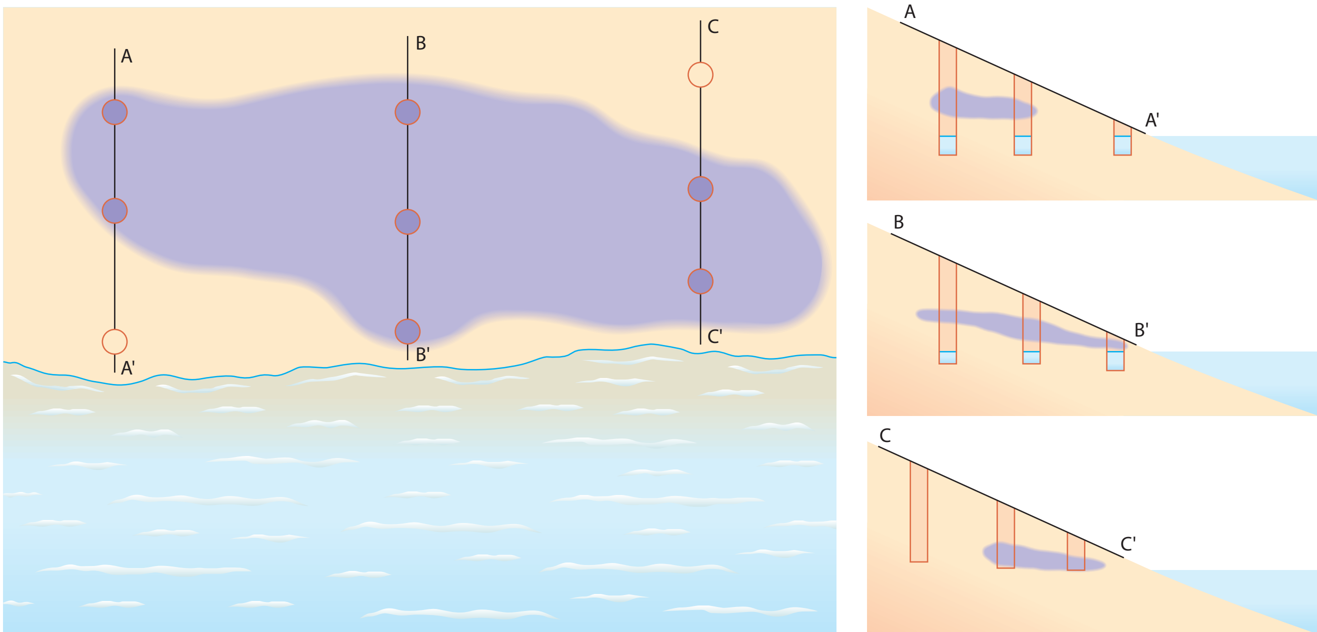
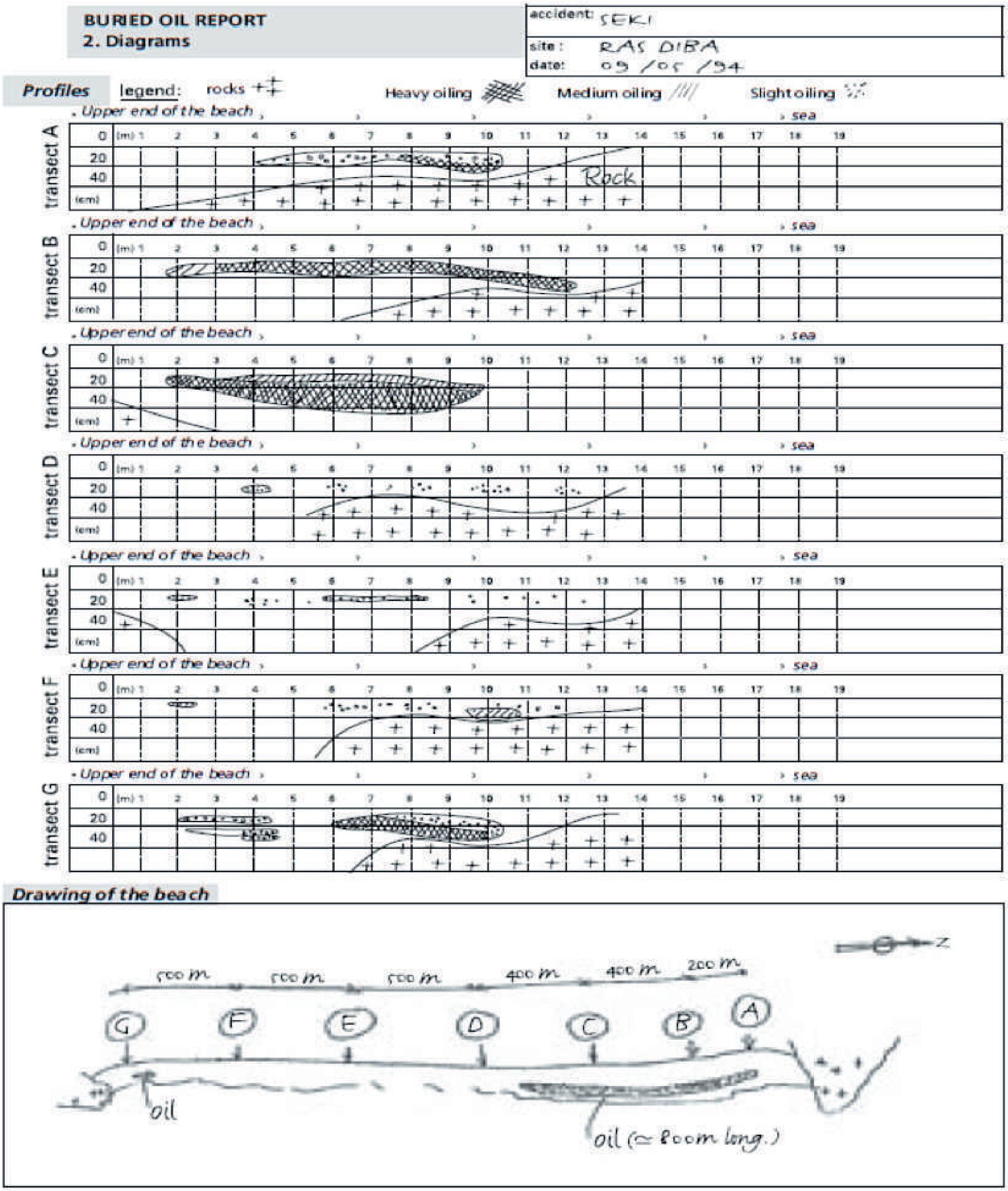


Figure 8 *Example diagram from a buried oil survey*



Source: CEDRE, 2006

The 'strand-sink-strand' cycle

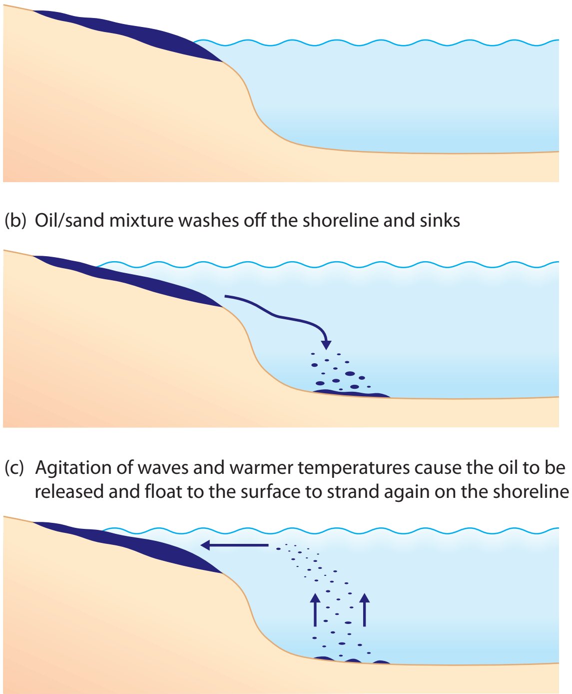
Another commonly observed feature of oil stranding on coarser sand beaches, particularly for heavier or weathered oils, is that the oil penetrates sufficiently to form a weak agglomeration of oil and sand. A subsequent rise in water level driven by storms, tides or onshore winds can lead to some of this material being washed back into the sea where the additional density of the incorporated sand causes it to sink. Depending on the conditions under which it was removed from the shoreline, this mixture of oil and sand may simply remain on the bottom in nearshore waters. For example, if the oil was washed off the beach in storm conditions it may take similar sea conditions to drive it back onto the shoreline. For less stable agglomerates, warmer daytime temperatures and the agitation of waves breaking on the shoreline may be sufficient to release some of the oil, allowing it to float back to the water surface and strand once again (Figure 9).

Figure 9 *The 'strand-sink-strand' cycle*

(a) Heavy oil strands on a coarse sand beach

(b) Oil/sand mixture washes off the shoreline and sinks

(c) Agitation of waves and warmer temperatures cause the oil to be released and float to the surface to strand again on the shoreline



To break the cycle of repeated stranding, sinking and oil release, oil has to be removed from the system. Three options are available depending to some extent on the depth of water into which the oil/sand mixture has settled. Perhaps the simplest option is to continuously remove the oil as it strands so that, over time, progressively less oil remains available to strand. A second option, which is more applicable in deeper waters, is to use divers to recover the oil manually from the seabed. In one incident where this technique was implemented, a novel approach involved providing an incentive to recover the most heavily contaminated material by rewarding the diving contractor according to the calorific value of the oil/sand mixture recovered. A third solution, where sea conditions and water depths allow, is to use semi-amphibious excavators to lift the oil which has sunk close to the shore.

Shingle and cobbles

Oil penetration into shingle and cobble shorelines

These are among the most difficult shoreline types to clean because oils, particularly lighter oils such as crude oil, are able to penetrate deeply into this type of substrate. The loose structure allows water to move freely through it and, as the water level falls, oil floating on the water surface follows it down through the shingle. Heavily contaminated shorelines can be flushed to move fluid oil into trenches or to other collection points for recovery with skimmers, pumps or sorbents. On exposed tidal coasts a passive cleaning approach using sorbent mops made from fine mesh nets has been used successfully for collecting heavier oils.

The most successful technique for treating oil that has penetrated into shingle is surf washing but, as the name implies, the technique requires an active shoreline with strong wave action to be effective. The oil released is largely dispersed by the interaction with mineral fines (OMAs) but some free oil is also likely to be released which may need to be recovered with sorbents. Since the distribution of shingle and cobbles is determined by the wave energy to which the shoreline is exposed, large cobbles and boulders may need to be redistributed higher up the shoreline and away from the water's edge once clean, to maintain the shoreline's original profile.

Another approach that is more appropriate for areas where wave action is less vigorous is to use lances to provide water jets to agitate the substrate and dislodge oil trapped between the stones. The technique is usually combined with low-pressure flooding to carry the released oil to the water's edge for recovery.

An alternative technique in areas where there is insufficient wave energy for surf washing is for the oiled shingle to be transported to a location where batch washing in concrete mixers can take place. If the material has to be returned to the same site after it has been washed it will be important to keep track of each batch. If the cleaned product is then deposited at the water's edge, the greasy texture that often remains after being discharged from the concrete mixer will soon dissipate.

Attempts to wash shingle and cobbles in a continuous process, rather than a batch process, using industrial mineral processing plant has met with mixed success primarily because of the difficulties of dealing with the accumulation of fine sand particles. In addition, the size of the equipment is substantial and, once constructed, is not easily moved. Even if the practical issues can be overcome, transport between the source of the material to be washed and the processing plant will dictate whether the approach is viable.

Asphalt pavement

If oil stranded on a shingle beach is allowed to weather it can form what is known as an asphalt pavement, so called because the agglomeration of weathered oil and pebbles forms a resilient surface reminiscent of tarmac. It is resistant to further wave action and the oil beneath this protective layer is trapped within the beach substrate where it can remain unchanged almost indefinitely. Degradation of the oil proceeds only slowly because the oil is not exposed to air or light. Once the surface layer has been broken up, and if necessary removed for disposal, the oil in the underlying layer can be flushed out or the material transported to a wash station for treatment.

Cliffs and rocky coves

In many cases the base of cliff faces can be accessed only with great difficulty, and can present an extremely hazardous working environment. Typically, cliffs and inaccessible rocky coves are highly exposed and are best left to clean naturally unless there are overriding reasons to do otherwise. Unless the oil has been thrown up to extreme heights by exceptional weather conditions, and is therefore unlikely to be reached by the sea under normally prevailing conditions, residual staining would be expected to diminish markedly over two or three seasonal cycles. However, if cleaning is necessary, for example, due to specific environmental issues, public accessibility or visibility from commercially important amenity areas, strict safety precautions are called for. Such precautions are vital to manage the risks of hazards such as rock falls or becoming cut off by the tide or strong waves, or simply to ensure that personnel can be recovered safely in the event of a work-related injury.

A further consideration is how to retrieve waste from such locations. If there is foot access, bagged waste can be passed hand-to-hand along a human chain. Depending on the configuration of the cliff face or rocky cove, an aerial ropeway might be a possible alternative, or a crane located at the cliff top could be used both to lower personnel to the worksite and to lift out oily waste. In cases where a substantial quantity of waste needs to be removed, an approach from the sea might be considered, but even in clement weather swells can produce dangerous conditions, not least with regard to submerged rocks which are frequently found at the base of cliffs. The use of heavy-lift helicopters has been employed where there is no other option. However, because of the constraints on recovering waste by air or sea, and to make the most effective use of these resources, the retrieval of waste will need to be undertaken as a single one-off operation where possible. Careful consideration should also be given to choosing an appropriate site where waste can be amassed and stored securely until it can be collected; such a site will need to be accessible either from the water or the air depending on which option is chosen.

Ports and harbours

One of the main concerns when working in ports is that clean-up operations are appropriately managed so that the disruption of port activities is minimized. However, in principle, once bulk oil floating within a port or harbour has been recovered, the solid faces of wharves are relatively easy to clean. On the other hand, wharves or docks suspended on piles may present a more difficult task once oil has drifted underneath them.

Mobile oil migrating beneath wharves can be a continuing source of oil contamination and sheens, as water currents generated by vessel movements flush it out. It may be possible to position vessels intentionally and use propeller wash to flush out free oil from underneath the wharf so that it can be recovered from the water surface. The remaining residues may require physical intervention. If clean-up crews are able to access the area beneath the wharf, issues such as adequate ventilation and tidal rise and fall should be carefully evaluated. In areas of significant tidal range in may be possible to work from the water at certain states of the tide, or from negative-reach hydraulic platforms (i.e. ‘cherry pickers’ where the working platform is able to extend below the level of the base unit) operating from on top of the wharf or quay.

In ports and harbours hot-water high-pressure washing is almost exclusively used to clean residual oil from berths and wharves in conjunction with light inshore booms and skimmers or sorbents to contain and recover the oil released. However, as well as removing the oil from concrete structures, hot water applied at high pressure can also remove the protective surface layer of the concrete, exposing the less resistant material beneath. It is therefore advisable to optimize temperatures and pressures on a test area before embarking on a full-scale operation.

In many ports, various residues such as mixtures of sediment, algae and historic oily residues tend to accumulate along the waterline at the same points where spilled oil accumulates. When oil is removed using hot-water high-pressure washing these deposits fall into the water and sink, and can become a source of persistent sheens. To avoid this, it is advisable to incorporate the use of nets, sorbent mats or a gutter arrangement to catch this material as it is washed off.

Oiled marine fouling, such as shellfish and algae attached to the surfaces of port structures or under wharves can also be a source of continuous sheens. If accessible, such fouling can usually be scraped off with little difficulty, carrying the oil with it. As mentioned earlier, material removed in this way needs to be caught before it drops into the water, for example by using nets or by working off a floating pontoon where debris falling onto the deck can be collected and bagged.

Sea defences

The wide variety of sea defences, including broken rock or rip rap, rock armour, gabions, concrete blocks of various designs (Tetrapods, Dolos, Xblocs, Accropodes, etc.), that are used to build revetments and breakwaters present significant difficulties for clean-up. They are designed to absorb wave energy by presenting a permeable barrier, allowing seawater to pass through them while dissipating its energy. Unfortunately this also allows all types of flotsam and jetsam to become lodged within the open structures as well as allowing floating oil to move freely through it. The trapped debris acts as a sorbent material, retaining oil and providing a source of continuous oil release and sheens that diminish slowly over time.

With the appropriate safety measures in place (e.g. recognizing the risks of being washed off the structure by waves, slipping on oily surfaces and falling into the gaps between the blocks) the exterior of these structures can be cleaned with high-pressure washing. However, cleaning inside the structures is more difficult. If it is possible to enter safely into the structure it may be possible to take out much of the contaminated debris, thereby removing the source of leeching oil. Even with most of the debris removed, some of the oil may continue to flush out for some time. Flushing lances might be used to flush out oil from within the structure or, in temperate climates with the approach of summer, a passive approach might be considered as warmer water temperatures encourage the remaining oil to be flushed out naturally. The released oil might be left to dissipate naturally or a sorbent array could be deployed to recover it.

The clean-up approach selected will depend on the degree of contamination and level of sheening produced, but more importantly on the types of services provided by the adjacent shoreline. Passive cleaning with sorbents may be an appropriate solution in certain circumstances, but in cases where sheens affect a prestigious tourist facility or aquaculture centre it may be justifiable to consider more radical remedial action. One option in extreme circumstances might be to dismantle the structure during the summer months when there is less need for sea defences and transfer the individual components to a cleaning station; after cleaning, the components can then be returned and reassembled. Whether this is economically viable depends on the risk of significant commercial consequences being weighed against the cost of such an operation. In countries where sea defences form a significant part of the coastal infrastructure and manipulation of the block-work is carried out routinely, the necessary machinery is likely to be readily available and the costs may not be prohibitive. However, in most countries, putting in sea defences represents a one-off civil engineering undertaking of considerable proportions, and the cost of dismantling them would probably be judged disproportionate.

Summary

Shoreline clean-up is the most publically visible aspect of oil spill response, and its success very often depends on how it is perceived by the public. This, in turn, is usually determined by how well the incident management team are able to interact and communicate with the public and the media, explaining the actions that are being taken and providing up-to-date information on progress but also on any setbacks suffered. In many cases, public interest will focus on the effects of the spill on the environment and the efforts being made for the rehabilitation of oiled wildlife. The incident management team will be concerned as much with these aspects as with the appropriate response strategies, volunteer management, effective supervision of a large workforce and the various types of equipment necessary to clean the shoreline.

The clean-up techniques selected should be informed by NEBA which provides a process for balancing environmental concerns against the demands of human uses of the shoreline. When tested against NEBA, the techniques that are likely to score highly are those that minimize the quantities of waste for disposal; these are often likely to include techniques involving manual rather than mechanical removal of contaminated sediment. In the right conditions, techniques that avoid the removal of beach materials entirely, such as surf washing, are likely to score higher still.

The skills and abilities of the management team will be fully tested in achieving the agreed end-point criteria and in reaching consensus on the consequent termination of the shoreline response. Authorities and officials who become involved in the response to a spill would be well advised to note these pressures. Ultimately a successful and effective response can only be achieved by all concerned parties making active and constructive contributions and working together towards the common goal of mitigating the impact of the oil spill, both with respect to the environment and to the affected communities.

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Appendix 1: Example volunteer registration form

Volunteer details

Registration date (DD/MM/YY) : ....
Time: ....

Full name: ....
Address: ....
E-mail: ....
Phone number: Home: .... Mobile: .... Work: ....

Assigned to team: .... Assigned to task: ....

Availability: (specify period)..

Skills and Training

Organisation membership? (specify): ....
Profession: ....
Previous training: ....

Health and Welfare

Allergies	☐ none	☐ yes, specify		
Dietary requirements	☐ none	☐ yes, specify		
Particular chronic disease	☐ none	☐ yes, specify		
Blood group	☐ A+	☐ B+	☐ AB+	☐ 0+
	☐ A-	☐ B-	☐ AB-	☐ 0-
Vaccination	☐ Tetanus	☐ Polio	☐ Hepatitis A	
	☐ Hepatitis B	☐ Rabies		

Family doctor

Full name: ....
Adress: ....
....
....
Phone number: ....

Contact in case of emergency

Full name: ....
Relationship: ....
Address: ....
....
Phone number: ....

Image Rights

While volunteering, I am liable to be photographed and videoed for non-commercial use, for educational and worksite monitoring purposes. I agree to give up my image rights by ticking this box ☐

Registered by

Full name (authority): ....
Date and location: ....
Signature ....

The volunteer

Full name (volunteer): ....
Date and location: ....
Signature: ....

Source: ISPRA, 2013

Appendix 2: Example daily worksite sheet

ONE SHEET PER WORKSITE

MUNICIPALITY:

DATE:

SITE:

to be sent each evening to .... fax n°: .... email: ....

PERSONNEL		TECHNIQUES [2]	EQUIPMENT USED			POLLUTED WASTE		ADDITIONAL COMMENTS	EXPECTED REQUIREMENTS FOR NEXT DAY
NUMBER	ORIGIN [1]		QUANTITY	TYPE [3]	ORIGIN [1]	QUANTITY [m3]	NATURE [4]	INCIDENTS, BREAKDOWNS, TEAM CHANGES	PERSONNEL / EQUIPMENT

ORIGIN [1]		TECHNIQUES [2]	TYPE OF EQUIPMENT [3]			NATURE OF POLLUTANTS[4]
Equipment*	**Personnel***		**Heavy machinery**	**Specialised equipment**	**Disposable products**	
Municipality Nearby municipalities, fire brigade, stockpile... Civil protection, Army, private* Other*	same as equipment + • Local fire brigade • Nearby fire brigades • Municipality reserve • Volunteers	Manual collection Mechanical sand screening Pressure washing	Earthmoving equipment (e.g. excavator) Farm machinery (e.g. tractor, trailer...) Water supply means Tyrolean traverse, nautical means, Other*	Booms, skimmer Sand screeners, pressure washers, transfer pump, impact hose Storage: tanks, containers, big bags... suction pumps...	Geotextile, sorbents washing agents Other*	Liquids to pastes Heavily polluted solids Lightly polluted solids Polluted stones Polluted sorbents/nets Polluted seaweed Polluted litter

* Specify

Source: Cedre, 2013a

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IPIECA

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance; and is the industry's principal channel of communication with the United Nations. Through its member led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.

www.ipieca.org

International Association of Oil & Gas Producers

IOGP represents the upstream oil and gas industry before international organizations including the International Maritime Organization, the United Nations Environment Programme (UNEP) Regional Seas Conventions and other groups under the UN umbrella. At the regional level, IOGP is the industry representative to the European Commission and Parliament and the OSPAR Commission for the North East Atlantic. Equally important is IOGP's role in promulgating best practices, particularly in the areas of health, safety, the environment and social responsibility.

www.iogp.org.uk