SAPIA South African National Capability Review

TNPA

Document Number: PRJ00976TNPA

Date: August 2020

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Abbreviation List

ALARP	As Low as Reasonably Practicable
AMSOL	Africa Marine Solutions
ARPEL	Regional Association of Oil, Gas and Biofuels Sectors Companies in Latin America and the Caribbean
C&R	At Sea Containment and Recovery
DEFF	Department for Environment Forestry and Fisheries
DoT	Department of Transport
GIWACAF	The Global Initiative for West, Central and Southern Africa
JBS	Joint Bunkering Service
H_2S	Hydrogen Sulphide
IFO	Intermediate Fuel oil
IM	Incident Management
IMO	International Maritime Organisation
IMS	Incident Management System
IOGP	International Association of Oil and Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for the Conservation of Nature
IV	Island View
JBS	Joint Bunkering Services
MARPOL	Marine Pollution Act
MFO	Marine Fuel Oil
MGO	Marine Gas Oil
MPA	Marine Protected Area
NDMC	National Disaster Management Centre
NEBA	Net Environmental Benefit Analysis
NEMA	National Environmental Management Act
NOSCP	National Oil Spill Contingency Plan
OPCSA	Oil Pollution Control South Africa
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Ltd
OSRP	Oil Spill Response Plan
OWR	Oiled Wildlife Response
SAMSA	South African Maritime Safety Authority
SANCCOB	Southern African Foundation for the Conservation of Coastal Birds
SAPIA	South African Petroleum Industries Association
SCAT	Shoreline Clean-up Assessment Technique
SG	Specific Gravity
SOPEP	Shipboard Oil Pollution Emergency Plan
SRP	Site Response Plan
TEU	Twenty-Foot Equivalent Unit
TNPA	Transnet National Ports Authority
TMNP	Table Mountain National Park
TPR	Tiered Preparedness and Response
TRP	Tactical Response Plan

UAV	Unmanned Aerial Vehicles
V&A	Victoria & Alfred Waterfront
VLCC	Very Large Crude Carriers
VOO	Vessel of Opportunity
VTS	Vessel Tracking System

Executive Summary

The South African Petroleum Industries Association (SAPIA) has contracted Oil Spill Response Ltd (OSRL) to carry out a National Oil Spill Capability Review for South Africa. This will investigate the current level of oil spill preparedness for their major coastal stakeholders in South Africa. Gaps in Tier 2 preparedness will be identified, and improvements recommended.

The recommendations in the review suggest appropriate investment in oil spill capability to meet the needs of the operations and associated risks. Recommendations are made based on risk reduction and international good practice.

This document summarises the findings for TNPA. The project team visited the following TNPA ports in South Africa:

- Saldanha
- Cape Town
- Mossel Bay
- Port Elizabeth and Port of Ngqura (Coega)
- East London
- Durban
- Richards Bay

Site visits were conducted in late July/early August 2019 and the gaps identified in this review represent the situation observed at the time of visit:

. The worst credible risks identified were shipping risks, whereby a large tanker could lose cargo following a collision or other incident. As the South African coast is a major shipping route, all sizes of vessel carrying all types of oil cargo have the potential to be spilt along the South African coastline. Due to the nature of shipping, accidents may occur in transit or at the destination or originating port, so an oil spill could occur at any point along the South African coast.

The high priority recommendations are summarized in Table 1 overleaf.

Table 1 Summary of Major Gaps Identified for TNPA

Gaps Summary	Recommendation Summary
No dispersant resources available. Dispersant is listed in the National Oil Spill Contingency Plan as the primary response technique for large scale offshore oil spill pollution, but no equipment or trained operators are available.	Review dispersant resources as part of a national capability for South Africa. Dispersant, spray equipment and trained operators should be available either at, or ready for mobilisation to, major ports in South Africa including Saldanha, Cape Town, Port Elizabeth and Durban. The 'holders' of dispersant need to be agreed between agencies – it may be that this is officially held by a different agency (for e.g. SAMSA), but a clear mobilisation process should be in place and TNPA should be linked into that process.
No trained spill observers are available in country. TNPA helicopters are available in some ports and it is thought that they could be chartered for others during a spill. These could provide a platform for aerial surveillance; but there are no agency or operator staff trained in surveillance.	Train a group of port staff in aerial surveillance. Make available in an oil spill. These could be a shared resource with each region in South Africa having trained observers.
Lack of operator level oil spill response training. It was unclear who was trained to which level to fulfil each response role. There was a lack of awareness of the most appropriate techniques to use – for example an overuse of sorbents for on-water spills.	Conduct training needs analysis. Implement training program. Record details of who has conducted what training, when, what role and when refresher training needs to be completed. Where spill response contractors are employed, spill response knowledge of a variety of techniques should be a condition of the contract.
Lack of evidence of oil spill exercises. Oil spill exercises keep responders up to date with skills and allow for continuous improvement by identifying improvements that can be made.	Run oil spill exercises to identify knowledge gaps. Every port should run a deployment exercise every 6 months to keep operators up to date with equipment and an integrated exercise with an operator every 2 years. Exercises should be a combination of table top (including NEBA) and deployment exercise involving different stakeholders. Records should be kept of exercises conducted, who performed what role and a summary of findings / outcomes and recommendations.
Lack of understanding of jurisdictional boundary and commitment to respond outside of operational areas. In most ports, TNPA will not respond to oil spills outside the inner port limits / breakwater. In some ports, TNPA see their area of responsibility to spills to be the wider port area.	DEFF / SAMSA to clarify jurisdiction and responsibility for responding to oil spills within outer port limits (but outside immediate harbour area).

Details of moderate and minor gaps are provided in the gap analysis sections for each site. The gap classification definitions are provided in Table 2.

1. Introduction

There are many parts to be considered when developing an in depth and robust oil spill response system. OSRL has over 30 years of hands-on spill response and integrated preparedness planning experience. OSRL has incorporated guidance from key industry organisations to review TNPA's oil spill preparedness and response capability to provide recommendations to enhance their oil spill response preparedness.

The organisations include:

- ITOPF;
- The Regional Association of Oil, Gas and Biofuels Sectors Companies in Latin America and the Caribbean (ARPEL)[1];
- IPIECA; and
- The International Association of Oil and Gas Producers (IOGP).

1.1. Tiered preparedness

Tiered preparedness and response is used in this gap analysis to categorize and structure levels of oil spill response capability to allow for response escalation. The definitions used are consistent with the IPIECA/IOGP tiered preparedness and response good practice guide[2].

Tier 1 resources	• Resources necessary to handle a local spill and/or provide an initial response
Tier 2 resources	• National or regional resources necessary to supplement a tier 1 response
Tier 3 resources	• Global resources necessary for spills that require a substantial additional response due to incident scale, complexity and/or impact potential

Due to the nature of this definition, whereby all on-site resources have been classified as Tier 1, note that Tier 1 resources are not necessarily under the direct control of TNPA and may be from a contracted service provider.

This capability review has:

- created and used planning scenarios to indicate the level of oil spill risk that could arise from TNPA's operations in South Africa;
- assessed oil spill response resources available in the eight South African Ports where TNPA are based;

[1] ARPEL Oil Spill Response Planning and Readiness Manual (v 2.0) 2014
[2] IPIECA/IOGP Tiered preparedness and response: Good practice guidelines for using the tiered preparedness and response framework revision 2016

- assessed compliance of current oil spill activities to South African oil spill guidance and typical best industry practice; and
- assessed completeness and currency of existing emergency response documents to suit the current operations.

This report for TNPA's operations is part of a series of reports from the SAPIA National Oil Spill Capability Review.

The reports produced were:

- site visit reports for each SAPIA stakeholder; and
- national level gap analysis recommendations.

Aims

This oil spill capability review identifies gaps in TNPA's oil spill response readiness and offers recommendations to bring it in line with industry good practice.

Methodology

TNPA's oil spill risk profile is required to effectively assess oil spill preparedness. This information was collected and discussed with TNPA during the site visit to South Africa.

Recommendations are given corresponding to the risk. Each recommendation is based on an observation. It has been assigned a level of priority based on the definitions in Table 2:

Table 2 Gap Classification Definition

Gap Classification	Definition
Major	• No conformance with industry good practice, • Not defined, • No indicator of implementation in place, • Non-compliance to local legislation.
Moderate	• Little conformance with industry good practice, • Partially defined, • Example indicators of implementation partially identified but there are gaps that may impact implementation/delivery, • There are no systematic processes in place to maintain conformance.
Minor	• Partial conformance with industry good practice, • Largely defined, • Example indicators of implementation identified with systematic process in place to implement/deliver the requirements, • Well understood and practiced, with clear accountabilities and defined competencies, • A monitoring process/procedure to control and verify conformance to the requirement over time is identified but not yet fully implemented/practiced.
No Gap / Full Conformance	• Full conformance with industry good practice, • Clearly defined, • Example indicators of implementation identified with systematic process in place to implement/deliver the requirements, • Well understood and practiced, with clear accountabilities and defined competencies, • A monitoring process/procedure to control and verify conformance to the requirement over time is in place and well-practiced.

It is acknowledged that not all recommended changes can be made at once and not all can be or will need to be made immediately. A gradual process of change is suggested based on the gap classification rating.

These recommendations are a guide for TNPA. Improvements and measures suggested by this review can only be driven and acted upon by TNPA. It is at the discretion of TNPA to implement the recommendations, when each recommendation should be addressed by and to what extent.

1.2. Legislation

1.2.1 International Legislation

There is various international and national legislation that South Africa has adopted. Table 3 shows a summary of the international conventions South Africa has signed up to.

Table 3 International Conventions and Agreements (GIWACAF, 2017)

International Conventions	
OPRC'90	• International framework for cooperation in combating and responding to major incidents or threats of oil pollution. • The convention strives to: o Prevent marine pollution by oil, in accordance with the precautionary principle o Advance the adoption of adequate response measures if oil pollution does occur o Provide for mutual assistance and co-operation between States for these aims • Parties adhering to the convention are required to establish: o Measures for dealing with pollution incidents, either nationally or at a regional and global level, in co-operation with other countries. o Stockpiles of oil spill response equipment for oil spill response exercise and the development of detailed pollution incident response plans. o Oil pollution emergency plans for ships, offshore units and seaports under their jurisdiction.
MARPOL 73/78	• Prohibits the discharge of oil or oily mixtures from ships into the sea, except where '*the oil content of the effluent without dilution does not exceed 15 parts per million*'. • Allowance for oil spill operations for '*the discharge into the sea of substances containing oil, approved by the Administration, when being used for the purpose of combating specific pollution incidents in order to minimize the damage from pollution. Any such discharge shall be subject to the approval of any Government in whose jurisdiction it is contemplated the discharge will occur*.' o Local regulation and guidance should always be sought prior to carrying out any decanting operations. • Requires ships to have a Shipboard Oil Pollution Emergency Plan (SOPEP), in accordance with IMO guidelines and approved by the government of the state under whose authority the ship is operating. • The SOPEP must include: o Procedures for reporting oil pollution incidents o List of authorities and persons to be contacted in an incident o Detailed description of immediate action to be taken to reduce or control discharge of oil o Procedures and point of contact for co-ordinating spill response actions with national and local authorities
CLC 1992 and Fund 2003	• Convention on Civil Liability for Oil Pollution Damage • Ensures adequate compensation is available to persons who suffer oil pollution damage resulting from oil-carrying ships. • Does not cover oil spills from offshore installations, drilling facilities or inland spills.

1.2.2 National Legislation

The main national legislation that relates to pollution and response is listed below.

Marine Pollution Control and Civil Liability Act 6 of 1981

This Act provides for the protection of the marine environment from pollution by oil and other harmful substances. The Act provides for criminal and civil liability following a discharge which causes pollution into the sea.

The Department of Transport (DoT) is responsible for making sure the appropriate actions are taken to minimise the effect of releases of harmful substances (e.g. oil) from ships, tankers or offshore installations. While the Act is administered by the DoT, the combating of at sea oil pollution was assigned to the then Minister of Environmental Affairs and Tourism (now Department of Environment, Forestry and Fisheries, DEFF).

Many of the administrative functions were transferred to the South African Maritime Safety Authority (SAMSA) in 1998. The Act gives SAMSA extensive powers to prevent pollution of the sea where a harmful substance (e.g. oil) is likely to or is being discharged from ships, tankers or offshore installations. Such powers include requiring the master or owner of a ship or tanker to unload the harmful substance from the ship or tanker, to dispose of any harmful substance unloaded or to move the ship or tanker to a place specified by SAMSA.

Marine Pollution Act (Prevention and pollution) Act 2 of 1986 (MARPOL).

The MARPOL Act gives effect to the MARPOL Convention, by providing for the protection of the sea from pollution by oil and other harmful substances discharged from ships. This Act is administered by the Department of Transport.

The Act provides for the Minister to make regulations to give effect to the provisions of the Convention. This includes the Minister making regulations to exempt certain classes of ships from the provisions of the Convention so South Africa is not entirely restricted by the provisions of the Convention.

South African Maritime Safety Authority Act No. 5 of 1998

This Act provides for the formation of SAMSA whose objectives are to ensure the safety of life and property at sea, to prevent and combat pollution of the marine environment by ships and to promote South Africa's maritime interests. SAMSA may perform a function itself, in co-operation with another person or by delegating or assigning the power or duty concerned.

National Ports Act, 2005 Act No. 12 of 2005

The main functions of the TNPA are to own, manage, control and administer ports to ensure their efficient and economic functioning. This includes regulating and controlling pollution and the protection of the environment within the port limits.

National Environmental Management Act (NEMA) 107 of 1998:

NEMA is administered by the Department of Environmental Affairs (now DEFF) and provides for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment.

Oils spills are ordinarily dealt with as emergency incidents under section 30 of NEMA and section 30 defines an incident as an unexpected, sudden and uncontrolled release of a hazardous substance, including from a major emission, fire or explosion, that causes, has caused or may cause significant harm to the environment, human life or property.

Under this Act, the costs of remedying pollution, environmental degradation and consequent adverse health effects, and controlling further pollution, environmental damage or adverse health effects must be paid for by those persons responsible for harming the environment.

Section 30 of NEMA is relevant to oil spills as it deals with the control of emergency incidents. The responsible party must as soon as reasonably practicable after knowledge of the incident, take all reasonable measures to contain and minimize the effects of the incident, undertake clean up procedures, remedy the effects of the incident and assess the immediate and long-term effects of the incident on the environment and public health.

National Disaster Management Act, Act No.57 of 2002

This Act provides for, among others, an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risks of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post-disaster recovery.

Section 27 of the Act states that the Minister in the event of a national disaster, by notice in the Gazette, may declare a national state of disaster if the existing legislation and contingency arrangements do not adequately provide for the national executive to deal effectively with the disaster or if other special circumstances warrant the declaration of a national state of disaster.

1.3. National plan and guidance

National Oil Spill Contingency Plan (NOSCP) (Adopted on October 31, 2018)

The NOSCP aims to promote the planned and nationally co-ordinated response to any marine oil spill to:

a. Protect human health and safety;

b. Minimise-detrimental environmental impacts; and

c. Provide for the restoration of the environment, as nearly as is practicable, to pre-spill conditions.

The NOSCP sets out the roles and responsibilities of most parties likely to be involved in a national response to a marine oil spill in South Africa.

Under the Marine Pollution (Control and Civil Liability) Act6 of 1981, the DoT is responsible for responding to a national marine oil spill incident. Under the Maritime Safety Authority Act 5 of 1998, SAMSA administers these responsibilities.

The priorities for response identified in the NOSCP are:

a. Human health and safety;

b. Natural environment;

c. Commercial resources;

d. Amenities;

e. Reputation.

The NOSCP states that a Net Environmental Benefit Analysis (NEBA) will be used to decide which response techniques to use.

If an oil spill occurs the incident owner should activate their own Oil Spill Contingency Plan (OSCP) and notify SAMSA. If the incident owner cannot deal with the incident it would then be handed over to the national

maritime incident management (IM) structure. Should the national maritime IM structure not be able to cope with an incident, they would then approach the National Disaster Management Centre (NDMC) to assist.

The Draft Policy on the use of Oil Spill Dispersant in South African Waters. Written by the DEA (now DEFF), 2016

The draft policy was published in 2016 and is subject to change. It contains different sections on the dispersant use and approval process.

- A description of how dispersants work, their advantages and disadvantages.
- How dispersant types will be approved. DEFF would consider products which have been approved/certified under the dispersant approval process of the UK, USA, France and Australia. DEFF recommends that anyone wanting to use a dispersant verify with the department that the dispersant meets the criteria of being certified by these countries or have successfully undergone South Africa's approval process (which has similar standards for toxicity and efficacy testing as UK, France, USA and Australia).

Table 4 Dispersant Use Restriction Summary

Water body characteristics	Oil slick characteristics
Dispersants should only be used in waters: • more than 3 nautical miles (5.6 km) from land • with a depth of more than 20 meters	Dispersants should not be used on: • Slicks ≥ 0.5 cm in thickness; • Slicks that appear as solely as sheen or colour bands; • Diesel or light fuel oil; • Viscous, weathered or emulsified oil; • Oils with pour points close to or above ambient temperature.

1.4. Agency Interdependencies

SAMSA and DEFF have a joint responsibility for oil spill response. SAMSA is the lead for oil spill prevention. If a ship is in distress, casualty response and salvage are under SAMSA's responsibility. DEFF has responsibility for combatting an oil spill and is the overall coordinator of clean-up operations. DEFF is typically a buffer between different groups (for example between environmental, local SAMSA and salvors). DEFF compiled 24 local coastal Oil Spill Contingency Plans (OSCPs) that detail appropriate actions to be taken upon threatened or actual impact.

TNPA have jurisdiction over their individual port areas which typically stretch 3-5 miles from the main harbour port areas. There was a variation in where different TNPA port authorities saw their area of responsibility to respond to an oil spill. Some (Saldanha and Mossel Bay) saw their area of responsibility to respond to oil spills to match the wider port area where they would take vessel tracking system (VTS) control of a vessel. Others saw their oil spill response area to be the inner port area only (usually up to a harbour breakwater).

If an oil spill was declared a national emergency and the NDMC were assembled, then this committee would arrange authorisation for additional resources. This could include organising authorisation to mobilise the naval resources at Simon's Town.

2. Operations Overview

2.1. Shipping

South Africa is positioned on the heavily relied upon the Cape Route and has ships passing around the coast from the Atlantic Ocean to the Indian Ocean with vessels visiting each of the main ports to load/offload.

A study conducted by the DEA[3], looked at reported oil spill incidents along the approximately 3000 km of South African coastline with the aim to generate an oil spill hot spot model to identify areas of risk. Aerial surveillance observations were taken over the period 2008-2013 across the coastline to monitor for oil slicks/spills. The reports were analysed only on spill location and divided into three categories, which were based on the possible source of the spill: wreck (oil entering the water from vessels scuttled/sunk/grounded at sea), slick (oil illegally discharged into the coastal waters of South Africa) and transfer spills (unintentional release of oil into the coastal waters due to an incident or fuel transfer activity).

The results showed a high frequency of illegal slick related discharges along the Agulhas bank off the coast of South Africa. It also showed a high probability of vessel groundings within this area but largely along the South Coast of Southern Africa. The high occurrence of incidences within this area can be attributed to the adverse unpredictable weather conditions and strong currents experienced along the Agulhas bank.

The results show oil spills occurring along the coast of South Africa are clustered spatially, resulting in the formation of oil spill “hot spots”. The oil slick data points show a hot spot along the Agulhas Coast and a greater chance than expected normally of an oil slick with smaller grid sizes reveal micro hot spots over the Cape Metro, Sunshine Coast, and Wild Coast respectively. This information gives insight into potential locations that could be impacted and frequency of incidences in the coastal environment however major oil spill incidents have the potential to happen anywhere along the South African coast.

A large percentage of the observed and reported oil spills in South Africa are slick related from vessels discharging into the coastal environment. Other such reports are based on incidence’s resulting in oil spills which cannot be subject to deliberate discharges.

Consequently, the risks to environmental impacts on the coast from oil spill hotspots are dependent on the location and its associated bio sensitivity. Furthermore, the physical nature of the shoreline influences the mitigation measure that would be implemented for clean-up if oil incidences were to occur at a specific location.

[3] University of Western Cape and Department of Environmental Affairs, Coastal oil spill hot spot assessment in South African coastal waters: Analysis of aerial surveillance reports and vessel related incident data , 2017

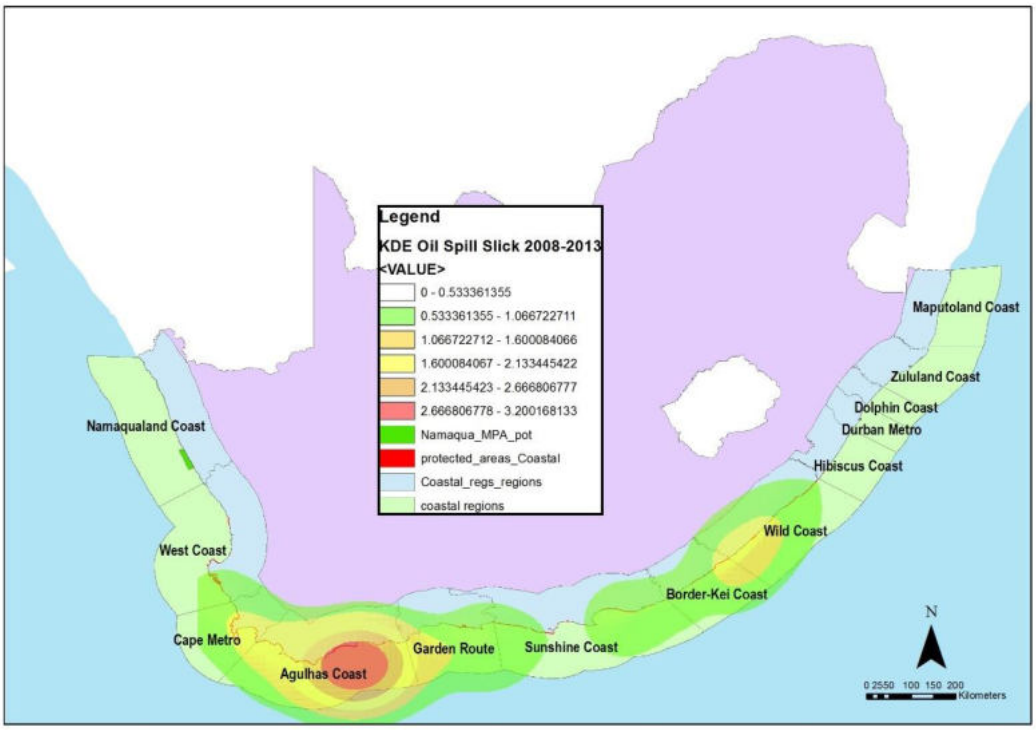


Figure 1 Oil spill hotspots based on spills data 2008-2013.

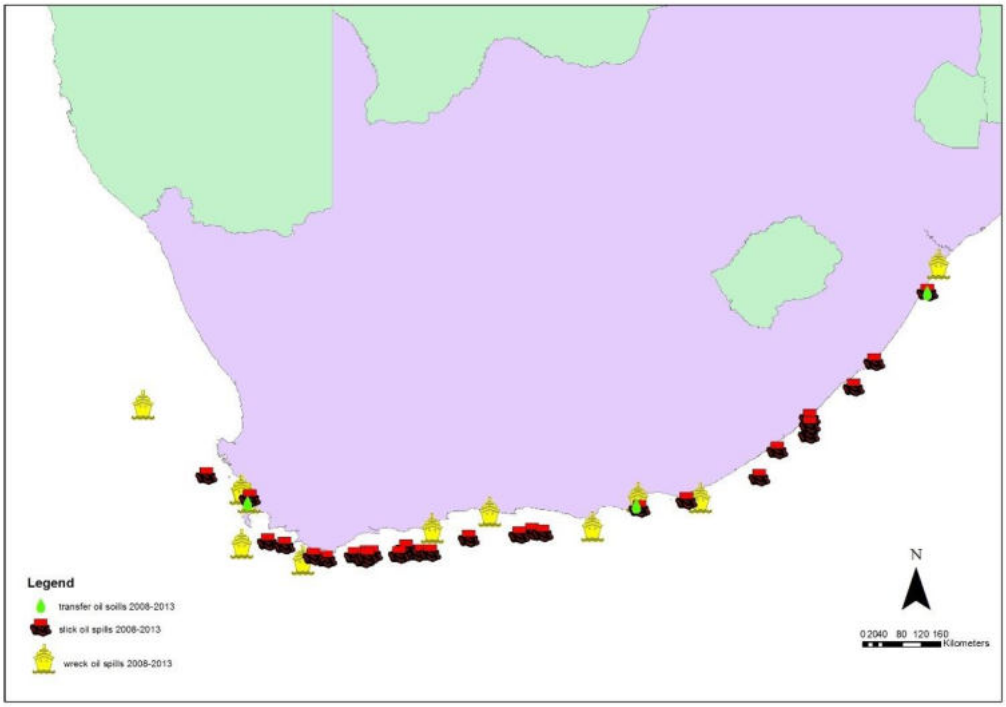


Figure 2 Location of oil spills from the three categories of spills observed.

Low Sulphur Fuel Oils

Since January 1, 2015, in accordance with Annex VI of the MARPOL Conventions, ship emissions must contain no more than 0.1% sulphur in such Emission Control Areas (ECAs) protected areas and ships globally will now

have to use low sulphur marine fuel oils with a sulphur ≤0.50 % in contrast to the former sulfur limit of 3.50 %. Increasing numbers of ships passing by South Africa are using this type of fuel.

The characteristics of max. 0.50%-sulphur fuels will be governed by the petroleum crude source from which they are derived, coupled with the availability of refinery processing and blending components. Fuel characteristics are expected to vary considerably, especially for the residual fuel grades, as it is anticipated that a range of residue streams and cutter stocks from refinery process units may be used as blending components. Fuel characteristics—especially density and viscosity—are also likely to vary with location and supplier. However, it is fully expected that fuel oils as supplied, meeting the 0.50% sulphur limit, will range from light distillates through to heavy residual fuel oil with a range of widely differing fuel oil formulations in between.[4] Theses oils have varying pour points (typically high), asphaltene and wax contents.

2.2. Regional Operations

Saldanha

The Port of Saldanha is the largest and deepest natural port in the southern hemisphere, taking vessels with a draft of up to 21.5 m. There are two dry bulk berths, four break bulk berths and a liquid bulk berth capable of handling very large crude carriers (VLCC's). An oil import and iron ore export jetty extends approximately three kilometres into the bay. There is a 365 m tanker berth at the end of the ore jetty with a permitted draught of 21.25 m alongside.

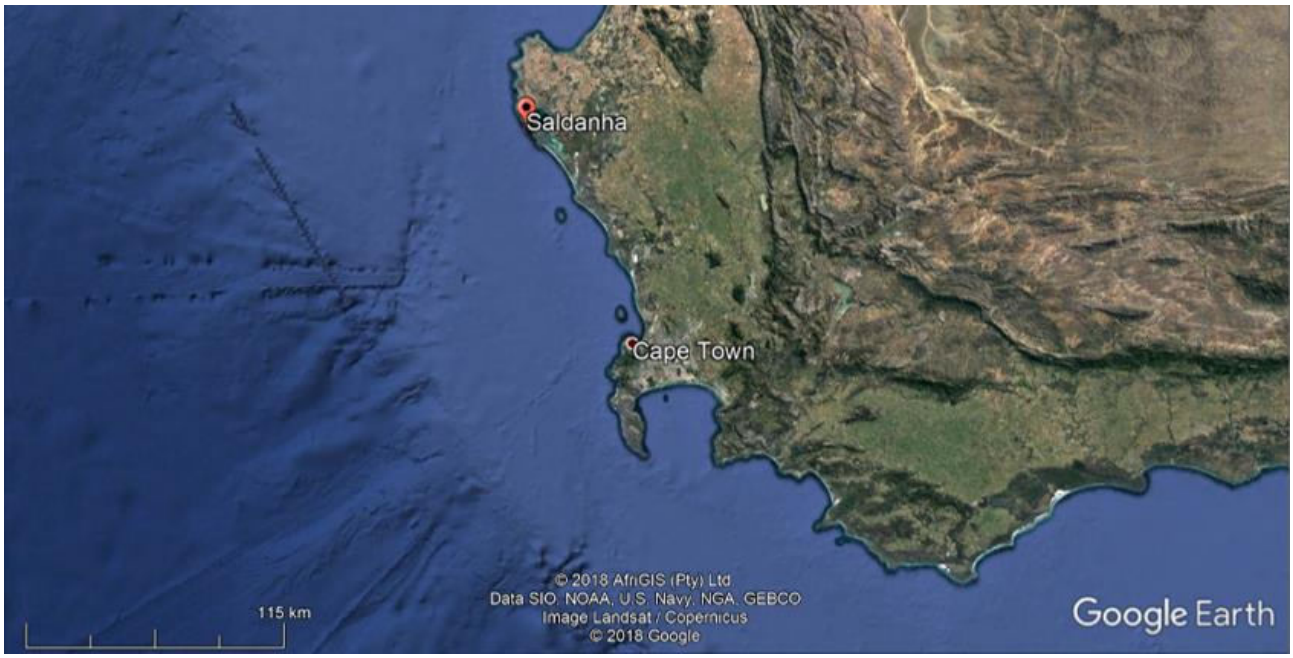


Figure 3 Saldanha Area Google Earth image.

Approximately 500 vessels a year call at the Port of Saldanha. In 2015 Saldanha Bay handled a total of 618 ships with a total gross tonnage of 40 225 933.

[4] Joint Industry Guidance- The supply and use of 0.50%-sulphur marine fuel, 2019

Port activities are expected to increase as import and export throughput increase. Presently, Saldanha is not a recognised bunker port but ship to ship bunkering does occasionally take place. The process for this is that either a ship goes to anchor within the bay or alongside, and the bunkering tanker double banks to this vessel and bunker transfer hoses are rigged between the two.

Saldanha has the potential to be exposed to crude and light, medium or heavy fuel oil. Two to three oil carrying tankers are discharged per month for petroleum companies. The oil is pumped from the jetty to six storage tanks with a capacity of 46,000 m³ with a pipeline with a diameter of 4 inches and approximate length of 9 km from port discharge to tank farm. The berth can handle VLCCs with a maximum offloading speed of 12,000 m³ per hour. Oil Pollution Control South Africa (OPCSA) provides protective booming around offloading tankers, to reduce the risk of an uncontained spill should an incident occur. OPCSA would recover any oil contained within the boomed area. Any uncontained oil would become the responsibility of TNPA, and their oil spill service provider Spilltech.

The Port of Saldanha operates under open sea conditions. Discharge of oil is not done when swells are more than 2 - 2.5 m.

Figure 4 Saldanha Bay.

Figure 5 Saldanha Bay with OSR Equipment Stockpiles.

Oil Characteristics

Saldanha port handles a variety of crude oils. Vessels chartered run on a range of fuel oils, typically an intermediate or heavy fuel oil.

Table 5 Oil Inventory

Location	Oil Type	Volume	Characteristics
Saldanha port handled oils			
Loading jetty	Crude	VLCC capacity of ~160,000 m^3	Various crudes: Specific Gravity (SG): 0.79 – 0.97 Viscosity: <0.9 cSt - >20000 cSt @ 40°C (104°F) Could contain hydrogen sulphide (H_2S)
Loading jetty	Fuel oils	VLCC fuel tanks estimated capacity of 10,000 m^3	IFO or HFO: Characteristics vary depending on the type of oil (more information below).
Bunkering barges	Fuel oils	No bunkering barges are permanently based in Saldanha but typical capacity is 7,000 m^3	IFO or HFO: Characteristics vary depending on the type of oil (more information below).
Small Vessels	Diesel	Up to 100 m^3	Diesel Specific Gravity (SG): 0.84 – 0.88 Viscosity: <1.3 cSt – 4.5 cSt @ 40°C (104°F)
Vessels	Hydraulic Oil	Dependant on equipment on board. < 10 m^3	°API: <35 Viscosity: 100 cSt @ 30°C
Vessels	Lube oil	< 1 m^3	°API: 29 Viscosity: 79-86 cSt @ 20°C

Diesel

Diesel fuel is a light petroleum distillate. Diesels vary in their properties but have a specific gravity in the range 0.84-0.88 g/cm^3 (30-37^{o}API), with pour points of between -17^{o}C and -30^{o}C. As such they are generally classed as Group II oils, i.e. light persistent oils, under the ITOPF classification of oil according to their specific gravity. Diesel will evaporate to the extent of 60% in approximately 3 days on warm water and 6 days in very cold water.

Marine Gas Oil

Marine Gas Oil (MGO) describes marine fuels that consist exclusively of distillates. Distillates are all those components of crude oil that evaporate in fractional distillation and are then condensed from the gas phase into liquid fractions. MGO usually consists of a blend of various distillates. It has a boiling point > 170 °C, flash point of > 60 °C, boiling point of <-7 °C, upper explosion limit of 7% and lower explosion limit of 0.6%. Its density at 20 °C is 0.8900 kg/m^3 and kinematic viscosity at 40 °C is 11 mm^2/s. MGO typically evaporates and disperses into the water column readily.

Intermediate Fuel Oil

Intermediate Fuel Oil (IFO) can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61^{o}C and boiling point > 204 °C. Its density at 20^{o}C is 0.9850 g/cm^3 and kinematic viscosity of 180 mm^2/s at 50^{o}C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Heavy Fuel Oil

Heavy Fuel Oil (HFO) is a mixture of the heavy residual oil, left after the lighter components of crude oil are removed during the refining process, this is then blended with lighter oils to meet specifications for viscosity, pour point and specific gravity. HFOs can also be a blend of heavy and light oils but they generally contain more of the heavier components. In the MARPOL Marine Convention of 1973, heavy fuel oil is defined either by a density of greater than 0.9 g/cm³ at 15°C or a kinematic viscosity of more than 180 cSt at 50°C. Heavy fuel oils have large percentages of heavy molecules such as long-chain hydrocarbons and aromatics with long-branched side chains.

Crude Oil

Crude oils offloaded at the Saldanha jetty by petroleum companies are very varied. Their ^{o}API varies between 14.4 and 49.7 (SG of 0.79 to 0.97).

Hydraulic oil

Hydraulic oil (specific gravity 0.88 g/cm3, ˚API < 35, viscosity 100 cSt @ 30°C, pour point < 0°C, flash point >60^{o}C) is a relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Hydraulic oil has a low volatility and moderate flash point, so there is no major safety issue when dealing with this oil. However, this oil is fairly persistent in the environment. Expect limited spread and minimal loss

through evaporation and natural dispersion. The action of mixing energy on hydraulic oil is likely to produce a frothy emulsion.

Lubricating oil

Lubricating oil or 'lube oil" (specific gravity 0.87 g/cm3, °API 29, viscosity = 79-86 cSt @ 20°C, pour point -35°C, flash point >60°C) is relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Lube oil flows easily and is easily dispersed if treated promptly. However, this oil tends to persist in the environment. There is a likelihood that the action of mixing energy on lube oil will produce frothy emulsions. With the low volatility and moderate flash point, there is no major safety issue when dealing with this oil.

ITOPF classifies crude oils into four categories[5]. OSRL obtained a list of 124 crude oils that had been offloaded at Saldanha jetty. Most (58.1%) were group 3 oils with 36.3% being classified as group 2 oils. More information is in Table 6.

Table 6 Crude Oils Handled at Saldanha

ITOPF Group	°API	% of Oils Handled	Characteristics
1	>45	4.8	• Spread rapidly with wind and current when spilled on water. • Tend to dissipate completely through evaporation and physical dispersion within 1-2 days, so they do not have time to form emulsions. • Small globules of semi-solid oil may persist if the oil contains wax or other persistent components. • High concentration of toxic (soluble) compounds can cause localised and severe impacts to water column and intertidal resources. • Extremely low flash point means high risk of fire or explosion.
2	35-45	36.3	• Light oils which spread rapidly with wind and current when spilled on water. • Light ends evaporate quickly (up to 40% by volume), but the heavier components (up to one-third of spill volume) persist long enough to warrant a response. • Do not tend to form viscous emulsions, but there are exceptions.
3	17.5-35	58.1	• Evaporate moderately (~ 1/3 within 24 hours[6]) leaving behind substantial heavier components that can have severe and long-term environmental effects. • Classified as persistent as they cannot be completely removed from the environment by weathering processes or clean-up operations. • Variable pour points and tendency to emulsify, though normally form emulsions.
4	<17.5	0.8	• Heavy oils that persist due to their high viscosity. • Can cause heavy and long-term contamination on contact with shoreline. • Weather very slowly with little or no evaporation, dissolution and/or physical dispersion[6]. • Composed mostly of heavy fractions which tend to form very fine, solid particles. The particles stabilise a water-in-oil emulsion because of natural surfactants. • Emulsions are highly viscous and have densities close to that of seawater. • A Group 4 oil slick may significant increase in volume as emulsions typically contain 30-80% water.

[5] ITOPF handbook 2019

[6] NOAA. 1992. Introduction to Coastal Habitats and Biological Resources for Spill Response. Oil Behaviour and Toxicity.

Wind and Current

Wind

A wind rose diagram is a tool which graphically displays wind speed and wind direction at a particular location over a period of time. Figure 6 shows the predominant wind speeds and directions annually for Saldanha taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10m above the sea surface.

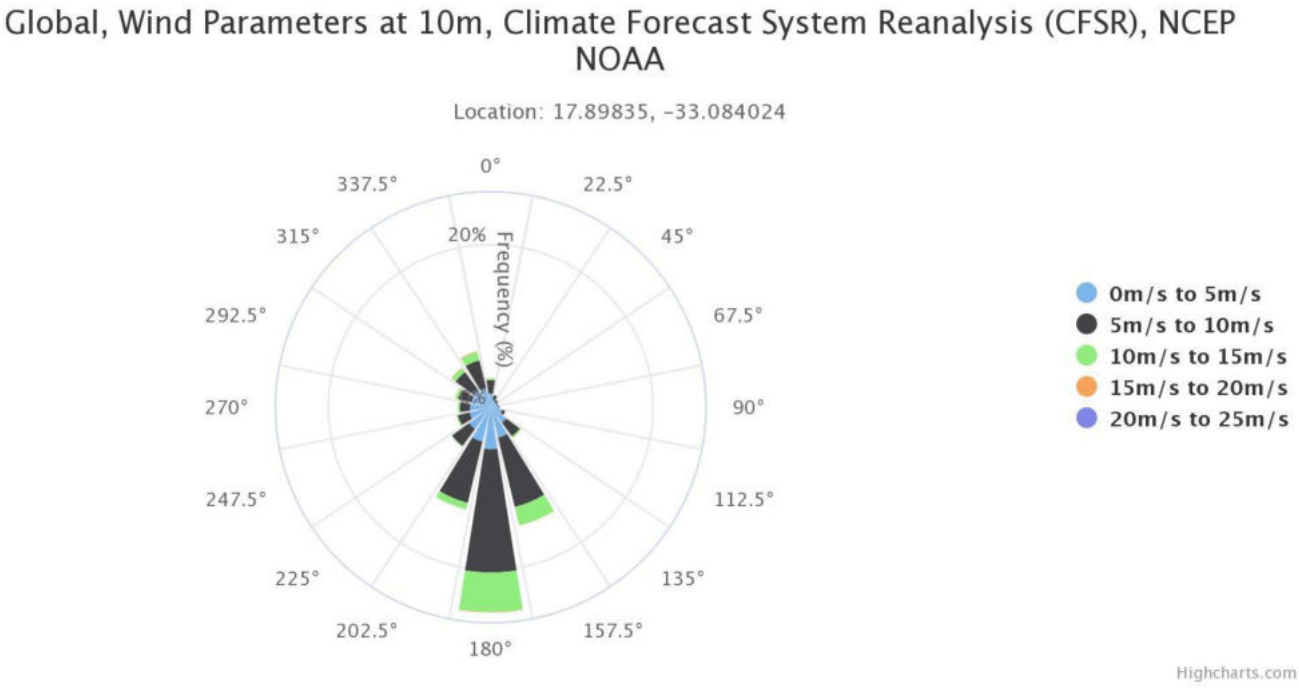


Figure 6 Wind Rose for Saldanha.

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant winds in the Saldanha area are from the south to south-southeast in summer and northwest in winter. Based on the yearly dominant wind direction (south) 20% of the total time the wind blows less than 10 m/s and 5% of the total time the wind blows above 10 m/s. 89% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Based on this differing guidance it suggests that dispersant application and containment and recovery are feasible response techniques for oil spills in Saldanha and should be attempted if safe and practical to do so.

Current

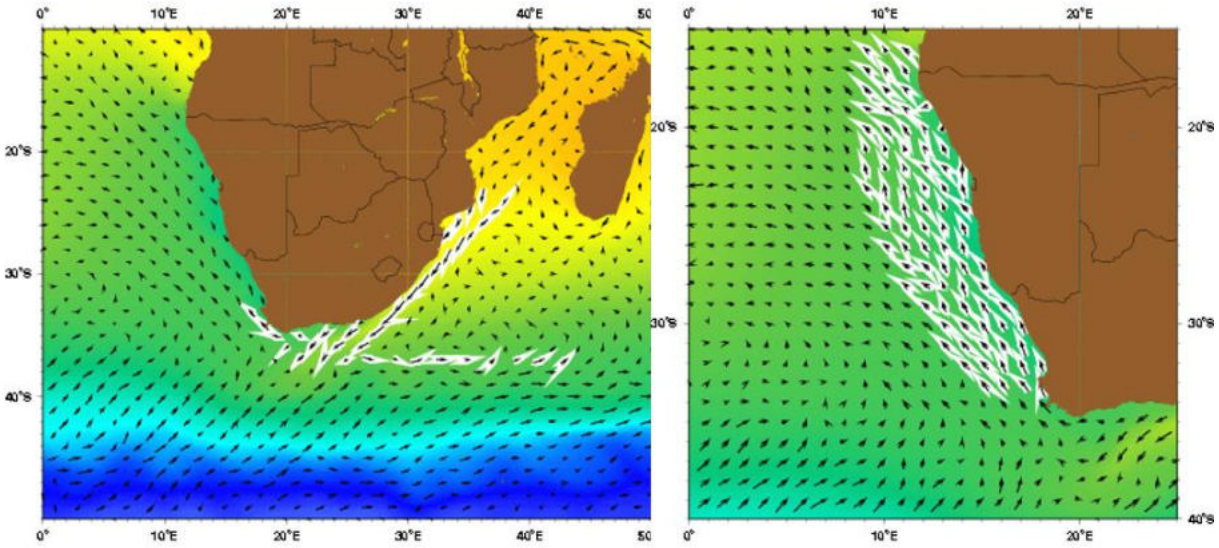


Figure 7 The Agulhas Current and the Benguela Current Yearly Average Direction.
Source: www.oceancurrents.rsmas.miami.edu

The Agulhas Current is the western boundary current of the South Indian Ocean. It flows down the east coast of Africa from 27°S to 40°S. Like other western boundary currents, the Agulhas Current is quite fast. At the surface, it can reach maximum speeds of 3.8Kts. As one of the major currents in the Southern Hemisphere, the Agulhas Current system transports large volumes of water. As the Agulhas Current reaches the southern tip of the continental shelf of Africa, it begins to turn toward the west. Once it reaches the Southern Ocean, the current retroflects, or turns back on itself, and flows eastward as the Agulhas Return Current.

The Benguela Current is the eastern boundary current of the South Atlantic subtropical gyre. It begins as a northward flow off the Cape of Good Hope, where it skirts the western African coast equatorward until around 24°S-30°S. The Benguela Current has a well-defined mean flow that is mostly confined near the continent and a more variable transient flow on its western side. The transient flow is dominated by large eddies shed from the Agulhas Retroflection.

Environmental and Socioeconomic Sensitivities

The main sensitivities as identified in the Swartland Zone Coastal Oil Spill Contingency Plan are:

- Important breeding sites for endangered and threatened species such as penguins, gannets, cormorants and other seabirds;
- Multiple estuaries and lagoons which are important for bait organisms, fish, water birds and recreational amenities;
- Langebaan Lagoon is a large salt water lagoon, regarded as a protected wetland. It is divided into three zones: Controlled, Restricted and Sanctuary. Recreational fishing and power boating are only allowed in northern most zone, north of a line joining Beacons, in Kraal Bay and at the Oesterwal;
- Recreational amenities such as popular beaches, surfing and sailing areas;

- Commercial considerations such as shellfish and seaweed collection, rock lobster catches, demersal and linefish landings;
- Seawater intakes for diamond diggings and fish factories; and
- Offshore diamond recovery operations.

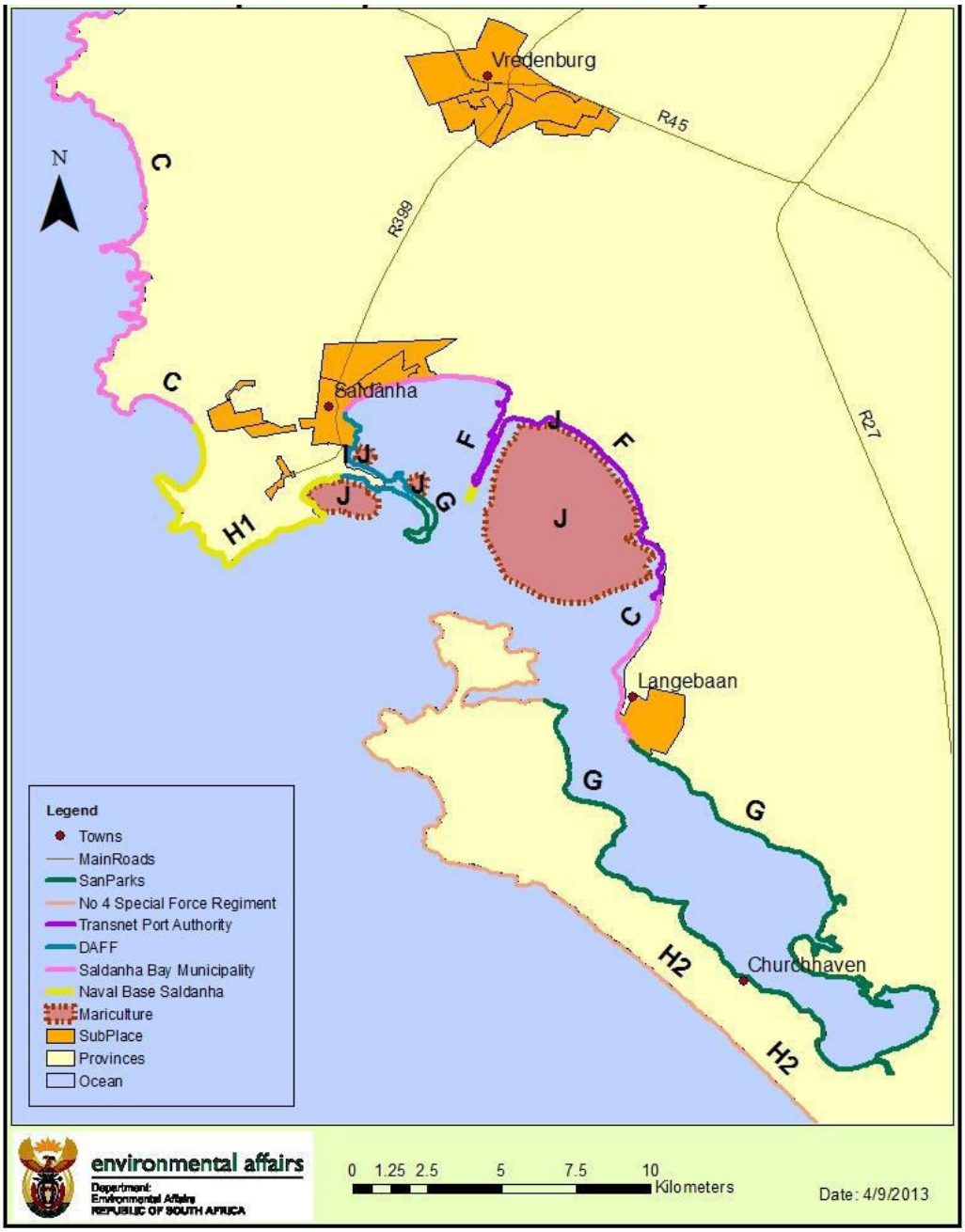


Figure 8 Map of the Saldanha Area

Source: Coastal Oil Spill Contingency Plan No.2: Swartland Zone

The main protection priorities for Saldanha are listed in Table 7.

Table 7 Protection Priorities Saldanha

Type of Sensitivity	Name (s)	Details
Estuaries	Langebaan and Great Berg River	Langebaan Lagoon: marine reserve with ecologically rich sand/mudflats and is a stopover for numerous migrant waders. Berg River: which is tidal for 40 km, has a large bird population and is the site of Port Owen Marina, salt pans and Laaiplek fishing industry.
Seabirds and mammals	Malgas, Marcus Schaapen Meeu, Jutten Vondeling Dassen Islands	Seabirds and seal colonies: numerous Islands supporting these colonies.
Aquaculture	West Coast Mussel Growers, Saldanha bay Oyster Company (PTY) LTD West Coast Seaweeds African Olive Trading, Blue Ocean Mussels Imbaza Mussel Farm (Pty) Ltd Blue Sapphire Pearls CCD Southern Atlantic Seafarms	Rock Lobster fishing: (50% of annual South African catch) as well as sanctuaries in St Helena Bay and Saldanha Bay. West Coast trawling grounds: pelagic and demersal fish. The area is also an important spawning, nursery and recruitment ground.
Intakes	Fish processing plants at: Pioneer (Orania) Fishing Plants West Point Processing Plant Food Corp, Oceana.	Seawater intakes can be closed to act as protection in the event of a spill.

Resources Available to Saldanha

Equipment

The full list of equipment is in Appendix 1.

TNPA hold no equipment at Saldanha but contract this service to Spilltech. Spilltech hold a small stockpile of equipment within the Saldanha port area which contains sorbents, fence containment boom, two older style weir skimmers and sorbents as well as a utility vehicle for access in the port. This equipment would be supplemented by additional stock from the Spilltech warehouse in Cape Town if required. The Cape Town warehouse contains a large amount of sorbent material, absorbent pads, detergents, skips and hand tools. All of the equipment stored appeared to be response ready.

Personnel

A spill in the port would initially be responded to by the TNPA contracted responders, Spilltech. Numbers on site at Saldanha vary but 2 personnel are expected to be on site during working hours, with more Spilltech personnel available on a 24/7 call out service. Additional personnel would be supplied initially from Cape Town and further afield from Spilltech's national network if required. These staff have not received any IMO accredited spill response training but have experience in deploying Spilltech equipment.

Supporting information: Emergency Response Documents

Robust Oil Spill Contingency Plans and Emergency Plans are essential to respond to an oil spill effectively. These documents need to include robust systems and procedures, which allow for a good oil spill response.

The following document has been reviewed:

The Port of Saldanha Oil Spill Contingency Plan covers the area within the jurisdiction of the Port of Saldanha which is clearly illustrated within the plan. It refers to the various national acts and agreements that are in place for combating oil spill response in South Africa. It identifies the main oil types encountered and the spill risks within the port remit and defines their risk based on a given risk rating. Incident reporting is outlined including initial actions, example reporting form and the process for reporting, roles and responsibilities and a contact directory. The available response equipment from the service provider is documented in the appendix.

Gaps identified for this section are described in the Gap Analysis.

Risk Assessment

The oil spill risk assessment is an important phase of the gap analysis and is used to identify whether the tiered response capability in place is appropriate for the risks identified. Potential oil spill scenarios risks identified for the South Africa coastline and ports and harbours have been identified through documentation collected in advance of the site visits, and observation and conversations during the site visits. The resultant risk has been assessed by the project team.

Risk Assessment Methodology

To keep the capability review consistent across all SAPIA stakeholders, standard OSRL risk matrix severity / likelihood definitions have been used. The definitions of each category are provided in Table 8 and Table 9.

The resulting assessment for the current project is presented in the Risk Register in Table 10.

Table 8 Description of Severity Categories

Severity	Description of Severity Categories
1 Low	Minor spill with no observable or measurable damage on habitats, species or ecosystem services.
2 Medium Low	Moderate spill within site limits or immediate proximity causing observable or measurable short-term and reversible degradation on habitats, species or ecosystem services.
3 Medium	Serious spill affecting the site vicinity or third parties causing important observable or measurable damage on habitats, species or ecosystem services.
4 High	Major pollution extending beyond the site and its vicinity causing very serious and long-term environmental damage on habitats, species or loss of ecosystem services with respect to ground state. High probability of observable or measurable permanent residual damage on ecosystem services.
5 Very High	Catastrophic and widespread pollution with irreversible environmental consequences. Observable or measurable permanent damages on habitats, species or loss of ecosystem services despite applying remediation measures.

Table 9 Description of Likelihood Category Definitions

Likelihood	Description of Likelihood Category Definitions
1 Remote	Remote chance of happening. Very rare combination of factors.
2 Possible	May happen less than once during the facility/project lifetime/considered time period. Rare combination of factors.
3 Likely	Expected to occur in the facility/ project lifetime/ considered time period.
4 Very Likely	Expected to occur several times in the facility/ project lifetime / considered time period.
5 Almost Certain	Occurs once or more per year in the facility/ project lifetime / considered time period.

Risk Register

Table 10 Oil Spill Risk Scenarios – Saldanha Bay

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[7]
1	Mechanical equipment on vessel or jetty	Small operational spill	Various – lube oil, diesel, hydraulic oil	< 10 litres	Minimal – sheen on water surface	5	1	L	• Monitoring, contain on deck/land where possible, assisted natural dispersion.
2	Vessel	Bilge pumping	Various – lube oil, diesel, hydraulic oil	< 500 litres	Sheen and oiling around pumping location and surrounding area. Severity will be dependent on oil type and location.	4	2	M	• Monitoring and assisted natural dispersion.
3	Loading/ offloading jetty	Loading arms minor failure	Crude oil	1 m^3	Sheen and oiling around jetty and surrounding area. All oil should be contained within the protection boom (hence being assigned a severity of 1).	3	1	L	• Monitoring and assisted natural dispersion. • Containment and recovery - all oil should be contained within the protection boom (hence being assigned a severity of 1) so skimming to recover oil should be possible – skimmer type will depend on crude viscosity.
4	Loading/ offloading jetty	Loading arms major failure	Crude oil	300 m^3 based on a maximum pumping rate of	Affecting aquaculture area. Shoreline oiling within Saldanha Bay. Possible shoreline oiling in Langebaan lagoon.	2	3	M	• Monitoring and surveillance to predict spill spread. • Containment and recovery of oil on water surface. • Protection of sensitive resources.

[7] For more information on these techniques refer to Appendix 2.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[7]
				12 000 m^3 / hour x 90 secs to shut down.					• Shoreline clean-up.
5	Tanker at loading/ offloading jetty	Leaking seals/valves	Crude oil	<1 m^3	Sheen and oiling around jetty and closely surrounding area. All oil should be contained within the protection boom (hence being assigned a severity of 1).	4	1	L	• Monitoring and assisted natural dispersion. • Containment and recovery - all oil should be contained within the protection boom so skimming to recover oil should be possible – skimmer type will depend on crude viscosity.
6	Loading/ offloading jetty	Pipeline failure with partial loss of line volume	Crude oil	2.5 m^3	Sheen and oiling around jetty and closely surrounding area.	3	2	L	• Monitoring and assisted natural dispersion.
7	Loading/ offloading jetty	Vessel collision with jetty – loss of pipeline volume	Crude oil	203 m^3 based on a 20" line and 1 km length	Affecting aquaculture area. Shoreline oiling within Saldanha Bay. Possible shoreline oiling in Langebaan lagoon.	2	3	M	• Monitoring and surveillance to predict spill spread. • Containment and recovery of oil on water surface. • Protection of sensitive resources. • Shoreline clean-up.

8	Vessel – ship to ship refuelling	Fuel transfer spill: leaking valve whilst refuelling vessel	IFO or HFO	< 1 m^3	Oiling expected to be contained within preventative boom. (hence severity of 1)	3	1	L	• Lighter fuel oils (MGO, MDO):
									  • assisted natural dispersion
									  • attempt to recover with an oleophilic skimmer if enough volume
									• Heavier fuel oils (IFO/HFO):
									  • recover by mechanical skimmer.

9	Vessel – ship to ship refuelling	Fuel transfer spill: split	IFO or HFO	25 m^3	Likely to be partially contained by boom at	2	2	L	• Lighter fuel oils (MGO, MDO): • assisted natural dispersion

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[7]
		hose whilst refuelling vessel			bunkering site. If breached boom then could spread to aquaculture areas.				• recovery with oleophilic skimmer • Heavier fuel oils (IFO/HFO): • recovery by mechanical skimmer.
10	Container Ship / Cargo Vessel	Grounding/ collision with loss of oil from fuel storage tank(s)	IFO or HFO	500 m^3	Spread from accident site to wider port area. Severity dependant on spill location and spread. But expected to be contained within preventative boom. (hence severity of 1)	2	3	M	• Monitoring and surveillance to determine spill spread. • Assisted natural dispersion and/or sorbent boon sweeps if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for HFO. • Potential shoreline clean-up.
11	Tanker	Grounding/ collision with loss of oil from crude from single storage tank	Crude oil	25 000 m^3	Spread from accident site to wider port area and beyond. Severity dependant on spill location and spread. Potential for oil to reach Langebaan lagoon.	2	4	M	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable; note this will not be suitable in the lagoon). • Containment and recovery. • Potential shoreline clean-up.
12	Tanker – inside port	Grounding / collision inside port areas with loss of oil from storage tanks.	Crude oil	100 000 m^3	Major impact in and around spill location and surrounding sites. Potential for oil to travel great distance. Severity of 5 assumes that oil spreads in Langebaan lagoon.	2	5	H	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
13	Tanker – outside port	Grounding / collision outside port areas with loss of oil	Crude oil	100 000 m^3	Major impact in and around spill location and surrounding sites. Potential for oil to travel great distance.	2	4	M	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[7]
		from storage tanks.							
14	Tanker – place of refuge	Place of refuge for damaged tanker, with loss of oil from storage tanks.	Crude oil	100 000 m^3	Major impact in and around spill location and surrounding sites. Potential for oil to travel great distance.	1	5	H	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
15	Fishing Vessel	Fire / collision / grounding / sinking inside harbour	Diesel	100 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	3	M	• Monitoring and assisted natural dispersion.
16	Fishing Vessel	Fire / collision / grounding / sinking outside harbour	Diesel	100 m^3	Sheen and oiling in immediate area.	3	3	M	• Monitoring and assisted natural dispersion.
17	Recreational Yachting	Fire / collision / grounding / sinking inside harbour	Diesel	5 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
18	Recreational Yachting	Fire / collision / grounding / sinking outside harbour	Diesel	5 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.

Risk Assessment Summary

The Risk Assessment Matrix shows that TNPAs highest risk in Saldanha comes from a tanker collision or grounding with major loss of product. Saldanha is unusual in that the sensitivities within the wider port area (aquaculture; Langebaan lagoon) are greater than those seen in most other port areas.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium or low risk.

The highest risk incidents for Saldanha are a major tanker incident for a tanker in transit. The scenarios for incidents involving an offloading tanker would have been higher risk but the risk is reduced by the preventative booming that is in place for petroleum company tankers.

Table 11 Risk Matrix for Saldanha Scenarios

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**			3, 17	5	1
	2		9	6, 8, 18	2	
	3		4, 7, 10	15, 16		
	4		11, 13			
	5	14	12			

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

Gaps identified that are specific to Saldanha are described in Table 12 below.

Table 12 Gaps Identified in Saldanha

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	Gas monitors were not seen in any response equipment stockpile.	Offloading tankers will have gas monitors on board as standard, which would warn personnel in the vicinity of noxious or flammable gasses above safe limits. But response personnel could be exposed to vapours above safe limits if working away from these areas.	Evaluate potential oil spill working areas that are away from fixed gas monitor areas. Have appropriate gas monitors for response teams.	SD1
Equipment				
Moderate	No equipment in place suitable for protecting Langebaan lagoon from oil contamination.	Booms available to TNPA were conventional fence boom and shore boom. The current at Langebaan lagoon entrance would cause conventional boom across the lagoon entrance to fail.	Fast river boom or an integrated boom system suitable for use in medium currents should be available to stop oil entering Langebaan lagoon, with trained and experienced staff ready to use it.	SD2
Moderate	Granular sorbents in stock are incorrectly described by TNPA contractors Spilltech as a response technique for on water recovery of oil.	Granular sorbents are suitable for deck and land spills but are not recommended for on water response. Heavy oil can adhere to the sorbent and cause it to sink and not be recovered. In general, sorbents are suitable for light oiling with light to medium oils and where used on water should be contained (in a boom, 'tea-bag' or pad).	Limit use of sorbents for on-water response to suitable spills, attempt recovery of liquid oil wherever possible. Only use granular sorbents for land/deck spills.	SD3
Moderate	No boom suitable for recovering free floating oil was on-call for oil spills.	Response techniques from TNPA contractor focussed on containment with fence boom and sorbent use. No vessel towable boom was seen.	Ensure oil spill response provision within Saldanha port includes collection of free oil.	SD4
Major	No dispersant was held in Saldanha.	Dispersant is described as one of the most suitable oil response techniques in the NOSCP. Subject to the dispersant guidance conditions including depth and distance to shore (see section 1.3), dispersant would be suitable for a medium viscosity oil spill that will not disperse on its own. Such a spill could come from Saldanha operations or from a vessel incident with a passing ship in the area. No dispersant or spray equipment is available in Saldanha. A test spray should always be conducted before large scale dispersant operations.	Arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline. Arrange mobilisation plan for dispersant, spray equipment and trained operators to Saldanha if it is not one of the designated storage points. This is likely to be an inter-agency initiative.	SD5

Gap Classification	Gap	Explanation	Recommendation	Ref #
Moderate	Currently using preventative booming but not being effectively secured in place so boom can be affected by wind and currents and so not provide effective containment.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Review the use of H booms/flexible booms as an alternative, to be inserted between the ship and fuel barge and secured fore and aft to collect any spilt oil (Refer to Appendix 2 Equipment Recommendations). A way of recovering the oil (e.g. skimmer) would also be needed.	
Responders				
Major	No responders trained in dispersant use are available in Saldanha.	Dispersant is described as a primary response option in the OSCP yet there are no responders in Saldanha trained in its use.	Train staff in dispersant spraying techniques as part of organising a national capability.	SD6
Moderate	Staff experienced in offshore/ nearshore containment and recovery techniques were not on contract for port response.	OPCSA personnel were experienced in oil spill response techniques but were not on call.	Arrange official call off contract with OPCSA or alternative adequately experienced supplier to respond to port spills where containment and recovery of liquid oil is required.	SD7
Major	No trained aerial surveillance observers	It is thought that helicopters could be chartered in a spill to provide a platform for aerial surveillance but there are no agency or operator staff trained in surveillance.	Train a group of port staff in aerial surveillance. Make available in an oil spill. These could be a shared resource with Cape Town.	SD8
Moderate	Tug captains are restricted to operate within port limits or sheltered port limits only.	The certificate of competency required to operate outside port limits requires the candidate to meet criteria assessed by the maritime authority. The type of operations a port vessel conducts often does not give the crew the needed experience to achieve this certification. Some tug masters certificates are endorsed sheltered port operations only, which means they are not allowed to proceed to the outer anchorage, or sea side of the port zone. The ports authorities in South Africa only require a Port Operation Only certificate of competency for their tug crews, as a result most of their tug masters are not licensed by the maritime safety authority to proceed	Vessel masters able to respond to outer port waters to be identified. Availability to be tested during a table top exercise.	SD9

Gap Classification	Gap	Explanation	Recommendation	Ref #
		beyond the boundaries of a port that they are operating in.		
Major	Lack of appropriate training on oil spill response for operator level oil spill responders.	It was unclear who was trained to which level to fulfil each response role. There was a lack of awareness of the most appropriate techniques to use – for example an overuse of sorbents for on-water spills.	Conduct training needs analysis. Implement training program.	**SD10**
Moderate	Whilst there was evidence of IMS training at higher levels of oil spill response management, there was no IMS training of operator level oil spill responders.	The NOSCP states that all role players must be Incident Management System trained and competent to the following levels: IMS 100: every person that would be playing a role in any of the response functions, including the command- and general staff. IMS200: functional heads, deputies and heads. IMS 300 – 400: the incident commander, functional heads, deputies and heads	Review level of training required for all levels of spill response organisation. Rollout training as required.	**SD11**
Major	No evidence of oil spill exercises.	Oil spill exercises keep responders up to date with skills and allow for continuous improvement by identifying improvements that can be made.	Run oil spill exercises to identify knowledge gaps. Drills to be run every 12 months. Table top exercises to be run every 12 months. Functional exercises to be run every 24 months.	**SD12**
Moderate	Oiled wildlife response	TNPA have no on-call oiled wildlife response capability. In country organisations (including SANCCOB, uShaka Marine World, Two Oceans Aquarium and Bayworld) could support wildlife rehabilitation but are not on call to TNPA and support will be dependent on other commitments. Management authorities (including SANParks and CapeNature) would usually be responsible for search and capture.	TNPA should invest in tier 1 and tier 2 oiled wildlife preparedness and response capability through oiled wildlife preparedness and response retainer agreements with OWR organisations as well as oiled wildlife contingency planning and training.	**SD13**
Additional Support				
Moderate	No booming plan in place for Langebaan lagoon.	The current at Langebaan lagoon entrance would cause conventional boom across the lagoon entrance to fail. But deflection booming and/or oil collection by an integrated oilboom before oil reaches the lagoon entrance should be possible.	Develop a plan to stop oil entering Langebaan lagoon. Exercise and practice the techniques required with on-call team.	**SD14**

Gap Classification	Gap	Explanation	Recommendation	Ref #
Minor	Key elements of the TNPA Port of Saldanha OSCP missing.	Plan is missing: actions for each TNPA role, response techniques to be used, detailed waste management strategy, training and exercises. Limited detail on what the actions would be for each role other than the initial actions. No explanation of what response techniques would be used in the different scenarios listed.	Include the missing elements to make a more robust Contingency Plan and to ensure an effective oil spill response.	**SD15**

Cape Town

The Port of Cape Town is situated in Table Bay and is 120 nm northwest of Cape Agulhas. The port consists of two docks, the larger outer Ben Schoeman Dock in which lies the container terminal, and the older inner Duncan Dock holding the multipurpose and fruit terminals as well as a dry dock, repair quay and tanker basin. There is also an extensive yachting marina.

Figure 9 Cape Town Area Map.

Within the Port of Cape Town, the depth at the entrance channel is 15.9 m, 15.4 m at the 180 m wide entrance into Duncan Dock and 14 m at the entrance to Ben Schoeman Dock. The depth in the Duncan Dock varies between 9.9 m near the repair quay to 12.4 m at the tanker basin. Ben Schoeman Dock varies from 9 m to 13. 9 m. Dredging operations are underway in the Ben Schoeman Dock (container terminal) to provide deeper berths for new generation container shipping.

Pilotage is compulsory for all vessels with the pilot being taken on board 1.6 miles and 155° off the main breakwater. Pilot transfer is by pilot boat. Navigation is subject to VTS and tug service is provided by four tugs operated by TNPA.

The tanker terminal in Cape Town (terminal berths 1 and 2) import or export refined petroleum products - Mogas, Jet A1, Gasoil or diesel and HFO heavy fuel. Hydrocarbons are pumped to a pipework header before being transferred to three storage tanks. Storage is onsite before being distributed via pipeline to two vessel bunkering sites.

Every tanker that calls in Cape Town to work fuel cargoes at the tanker terminal is boomed off regardless of what the product is. Vegetable and chemicals discharged at terminals 1 and 2 are not boomed off. When bunker fuel is delivered to fishing vessels in the V&A Waterfront which is a tourist destination they boom off – this does not apply in the working side of the harbour.

Figure 10 Port of Cape Town Aerial Photograph.

The Port of Cape Town handles on average 2,500 vessel movements per year with total imports of approximately 3.5 M tonnes and total exports of appx. 1 M tonnes. The container terminal has six deep-sea berths. The multi-purpose terminal in Duncan Dock handles fruit, steel, paper, maize, wheat, rice, timber, coal, scrap and other general cargo, as well as passenger cruise ships.

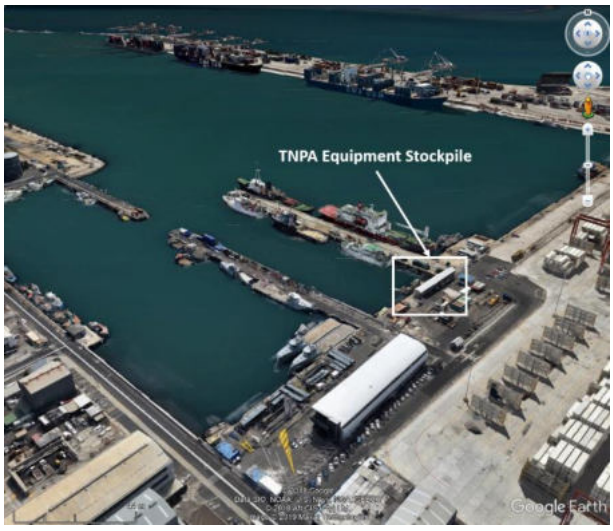


Figure 11 TNPA OSR Equipment Stockpile.

Oil Characteristics

Petroleum companies receive Marine Gas Oil (MGO), Intermediate Fuel Oil (IFO) and Heavy Fuel Oil (HFO) via pipeline from a refinery facility in Milnerton.

Table 13 Oil Inventory

Cape Town	Oil Type	Volume	Characteristics
Loading jetty	Crude oil	VLCC capacity of ~160,000 m^3	Various crudes: Specific Gravity (SG): 0.79 – 0.97 Viscosity: <0.9 cSt - >20000 cSt @ 40°C (104°F) Could contain hydrogen sulphide (H_2S)
Loading jetty	IFO or HFO	VLCC fuel tanks estimated capacity of 10,000 m^3	IFO or HFO: Characteristics vary depending on the type of oil (more information below).
Small Vessels	Diesel	Up to 100 m^3	Specific Gravity (SG): 0.84 – 0.88 Viscosity: <1.3 cSt – 4.5 cSt @ 40°C (104°F)
Vessels	Hydraulic Oil	Dependant on equipment on board. < 10 m3	API: <35 Viscosity: 100 cSt @ 30oC
Vessels	Lube oil	< 1 m3	API: 29 Viscosity: 79-86 cSt @ 20oC

Marine Gas Oil

MGO describes marine fuels that consist exclusively of distillates. Distillates are all those components of crude oil that evaporate in fractional distillation and are then condensed from the gas phase into liquid fractions. MGO usually consists of a blend of various distillates. It has a boiling point > 170 °C, flash point of > 60 °C, boiling point of <-7 °C, upper explosion limit of 7% and lower explosion limit of 0.6%. Its density at 20 °C is 0.8900 kg/m^3 and kinematic viscosity at 40 °C is 11 mm^2/s. MGO typically evaporates and disperses into the water column readily.

Intermediate Fuel Oil

IFO can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61°C and boiling point > 204 °C. Its density at 20°C is 0.9850 g/cm^3 and kinematic viscosity of 180 mm^2/s at 50°C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Heavy Fuel Oil

HFO is a mixture of the heavy residual oil, left after the lighter components of crude oil are removed during the refining process, this is then blended with lighter oils to meet specifications for viscosity, pour point and specific gravity. HFOs can also be a blend of heavy and light oils but they generally contain more of the heavier components. In the MARPOL Marine Convention of 1973, heavy fuel oil is defined either by a density of greater than 0.9 g/cm^3 at 15°C or a kinematic viscosity of more than 180 cSt at 50°C. Heavy fuel oils have

large percentages of heavy molecules such as long-chain hydrocarbons and aromatics with long-branched side chains.

Wind and Current

Wind

A wind rose diagram is a tool which graphically displays wind speed and wind direction at a particular location over a period of time. Figure 12 Wind Rose for Port of Cape Town shows the predominant wind speeds and directions annually for Cape Town taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10m above the sea surface.

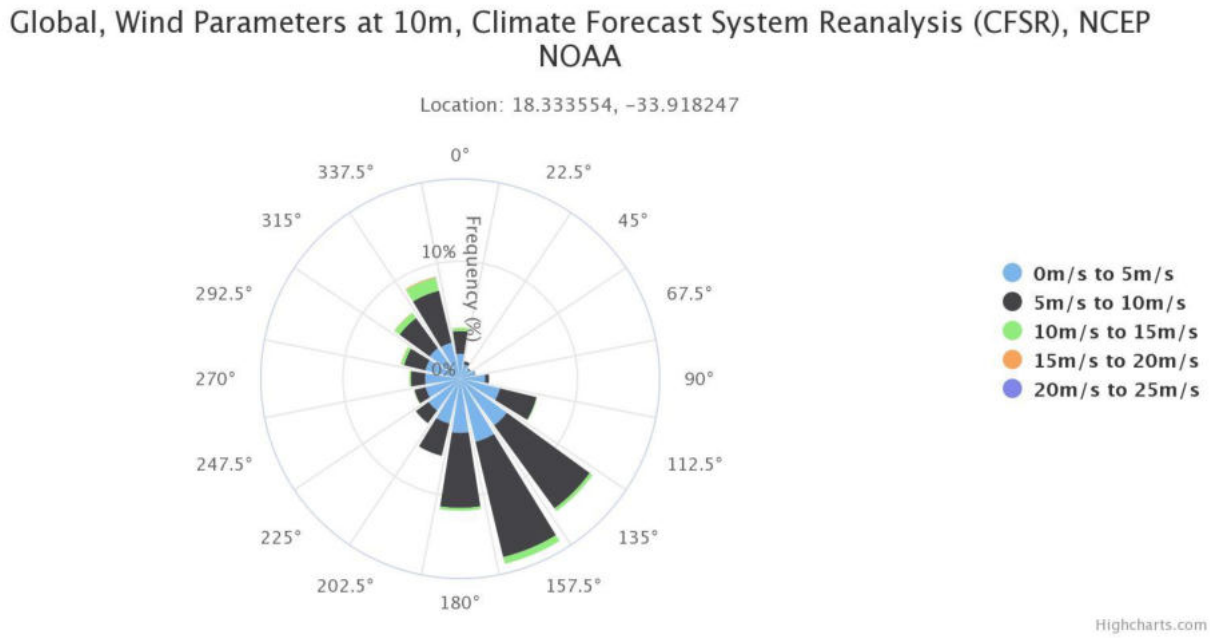


Figure 12 Wind Rose for Port of Cape Town.

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant winds in the Cape Town area are from the northwest in summer and south to southeast in Winter.

Based on the yearly dominant wind direction (south-southeast) 16% of the total time the wind blows less than 10 m/s and 0.6% of the year the wind blows above 10 m/s. 96% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Based on this differing guidance it suggests that dispersant application and containment and recovery are feasible response techniques for oil spills in Cape Town and should be attempted if safe and practical to do so.

Current

Marine currents in close proximity to the port of Cape Town travel from the southeast towards the northwest.

Environmental and Socioeconomic Sensitivities

This area of the coastline is at high-risk of oil pollution. The Cape is a focal point for all ships trading between the Indian and Atlantic Ocean ports and represents a hazardous area for allisions and collisions.

The main sensitivities as identified within the Cape Zone Coastal Oil Spill Contingency Plan are:

- Robben Island and Boulders Penguin Colonies, which are breeding sites for endangered and threatened species such as penguins, gannets, cormorants and other sea birds;
- A number of estuaries and lagoons which are important for fish, water birds and recreational amenities;
- Marine reserves and sanctuaries;
- Spawning areas for species such as anchovy and sole;
- False Bay is a calving area for the southern right whales, and otters are common along certain parts of the coast. False Bay, which is a spawning ground for various fish and squid. Squid in particular are highly sensitive;
- Recreational amenities such as popular beaches, tidal pools, surfing and sailing areas; and
- Commercial considerations such as shellfish and seaweed collection, rock lobster catches, demersal and line fish landings.

The Table Mountain National Park (TMNP) is located on the Cape Peninsula and is managed by SANParks for all activities, species and land within the boundaries of the Park, in terms of the National Environmental Management: Protected Areas Act (57/2003) and Biodiversity Act (10/2004). Should oil wash ashore within the boundaries of the Park, the Park is responsible for cleaning, or arranging for the cleaning of the affected area. SANParks has a co-management agreement with DEA (O&C) for the TMNP Marine Protected Area (MPA).

The whole peninsula area from Green Point to Muizenberg falls within the Table Mountain National Park Marine Protected Area (MPA). The MPA is important for commercial fisheries- such as the West Coast rock lobster industry, components of which are based in the MPA – as well as recreational and subsistence fishers. The TMNP MPA has six restricted areas (No Take Zones) where no fishing or harvesting of marine resources is permitted within its boundaries (Karbonkelberg, Cape of Good Hope, Paulsberg, Castle Rock, Boulders and Kalk Bay) along with three harbours (Simons Town, Kalk Bay and Hout Bay).

Due to its proximity to Cape Town, there are high levels of tourism, recreational activities as well as research and education in the MPA. Internationally renowned tourist attractions within the MPA include Cape Point and the Boulders African penguin colony. Threatened and protected species supported within the MPA include white sharks, abalone, African penguins and several over-exploited line fish species, such as poenskop and red steenbras.

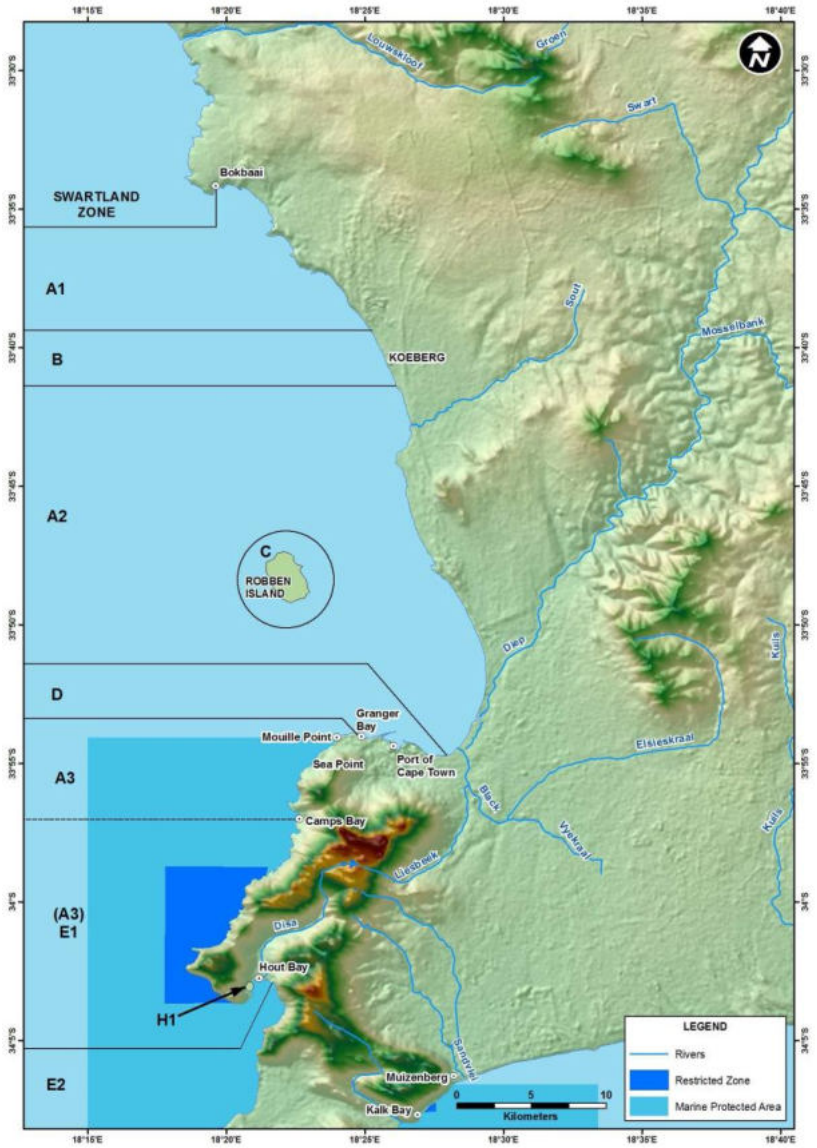


Figure 13 Map of the Cape Zone.

Source: Coastal Oil Spill Contingency Plan No.3: Cape Zone.

The main protection priorities for Cape Town are listed in Table 14.

Table 14 Protection Priorities Cape Town

Type of Sensitivity	Name (s)	Details
Estuaries	Milnerton Lagoon	A tidal lagoon with strong current flow at the mouth and permanently open to the sea due to the treated effluent from the Potsdam Waste Water Treatment Works as well as from the storm water drainage infrastructure in Milnerton.
Seabirds	Robben Island Boulders Penguin Colony Noordhoek Tidal Lagoon	Penguins and other sea birds found at Robben Island. Boulders Beach is a popular tourist site due to the Penguin Colony.

Type of Sensitivity	Name (s)	Details
Harbours	Port of Cape Town / Victoria & Alfred (V&A) Waterfront Oceana Boat Club Granger Bay Harbour Kalk Bay Harbour Simonstown Harbour Royal Cape Yacht Club Hout Bay Yacht Club Cape Marlin and Tuna Club False Bay Yacht Club Gordons Bay Harbour, Yacht Club, Aquatic Club Harbour Island Marina Murrays Bay (Robben Island)	V&A is a popular tourist destination. Many harbours with yacht moorings and fishing boats.
Intakes	Koeberg Power Station	Intake basin for cooling water. Beaches on either side of intake basin.

Resources Available to Cape Town

Equipment

Due to the size and importance of Cape Town as a port in South Africa there are various equipment stockpiles located in the area that could be drawn upon and therefore considered as Tier 1 resources. Some of these resources are private stockpiles owned by commercial companies and some are central government owned. Below is a list of the various equipment stockpiles available in Cape Town:

- TNPA
- DEFF
- Spilltech

TNPA

The TNPA equipment stockpile is stored within the port area in the SE corner of the port shown in Figure 11 TNPA OSR Equipment Stockpile. The stockpile is based on a harbour containment and recovery package supported by two work boats. The containment boom is fence boom and there are two recovery devices, a weir type, Desmi Termite skimmer and a rope mop. A variety of equipment ancillaries included spate pumps and air blowers. Temporary storage of waste oil is achieved with the use of metal skips. Much of the equipment inspected did not appear to be in a response ready state and many items needed for a safe and effective work site were missing or incomplete. A list of the TNPA equipment inspected with photos can be found in Appendix 1.

DEFF

The DEFF OSR equipment stockpile is in Paarden Eiland, Cape Town. The stockpile is made up of a large amount of nearshore, containment and recovery equipment including; inflation chamber boom, weir skimmers, vacuum systems, rope mops, disk skimmers and some associate ancillaries (eg. Hoses and pumps). There is also a large amount of sorbent boom sections. Temporary storage of waste oil is achieved with two Fastank 2000s. The status of the equipment observed was not response ready and vital ancillaries were missing. A small amount of new equipment was seen at a new storage location closer to the port. It appeared that this equipment was yet to be commissioned. Two RIB work boats were found within the stockpile although these were also not response ready. A list of the DEFF equipment inspected with photos can be found in Appendix 1.

Spilltech

Spilltech have a small amount of fence boom and sorbent material housed in a 40ft shipping container within the Port of Cape Town, this is shown in Figure 11. This equipment is used for encirclement booming of tankers while loading / unloading takes place within the port. Offsite, Spilltech have a large warehouse facility which is used to store a large amount of sorbent material, absorbent pads, detergents, skips and hand tools. All the equipment stored onsite and offsite appeared to be in good condition and response ready.

Drizit

Drizit have a small warehouse of equipment in Cape Town. The equipment is based on a harbour containment and recovery package and includes fence boom, sorbent material, detergents and absorbent

rolls. Although showing some signs of wear and tear the equipment predominantly looked to be in good condition and response ready. A list of the Drizit equipment inspected with photos can be found in Appendix 1.

Personnel

There is a mix of terminal operators and Tier 1 responders that are available to respond to a spill. These staff have not received any IMO accredited spill response training or client tailored training for the equipment they may be requested to operate during a spill. Although Tier 1 operators would probably respond promptly if requested by TNPA, there is no call off contract in place.

TNPA staff in the Port of Cape Town have not completed any table top exercises or practical deployment exercises in the last 24 months. The Spilltech team do deploy encirclement boom around tankers during loading and unloading on the quayside.

Supporting Information: Emergency Response Documents

Robust Contingency Plan and Emergency Plans are essential plans to respond to an oil spill effectively. These documents need to include robust systems and procedures, which allow for a good oil spill response.

TNPA Port of Cape Town Oil Spill Contingency Plan covers all oil spills within their jurisdiction to respond to spills from ships and offshore installations. It states to cover the following sources of risk; seawater intakes to various fish processing industries in Alfred and Victoria Basins, seawater intake to aquarium in Alfred Basin, commercial fishing boats operating from Port of Cape Town and the Royal Cape Yacht Club situated in the Elliot Basin and the small craft basin of Duncan Dock. It references that the National Oil Spill Contingency Plan would be used in conjunction with this plan if the spill spreads beyond the jurisdiction (Tier 1) of TNPA. The plan includes: responsibilities for various authority's users of the port including TNPA, DEAT, SAMSA and shipping agents, initial response actions, prevention strategies, TNPA equipment and contacts directory. It also includes some reference information such as liabilities, claims and compensation and South African legislation.

Gaps identified for this region are described in the Gap Analysis.

Risk Assessment

Risk Register

Table 15 Oil Spill Risk Scenarios – Port of Cape Town

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[8]
1	Mechanical equipment on vessel or jetty	Small operational spill	Various (including lube oil, diesel, hydraulic oil).	< 10 litres	Minimal – sheen on water surface	5	1	L	• Monitoring, contain on deck/land where possible, assisted natural dispersion.
2	Vessel	Bilge pumping	Various (including lube oil, diesel, hydraulic oil).	< 500 litres	Sheen and oiling around pumping location and surrounding area	4	2	M	• Monitoring and assisted natural dispersion.
3	Loading/ offloading at berths 1 or 2	Loading arms minor failure	Various (including jet A1, gasoil, diesel, HFO, vegetable oils).	1 m^3	Sheen and oiling around jetty and surrounding area. All oil should be contained within the protection boom (hence being assigned a severity of 1).	3	1	L	• Monitoring and assisted natural dispersion of lighter products. • Limited containment and recovery possible for heavier products- all oil except vegetable oil should be contained within the protection boom (hence being assigned a severity of 1) so skimming to recover oil should be possible – skimmer type will depend on oil viscosity.

[8] For more information on these techniques refer to Appendix 2

SCENARIOS

#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[8]
4	Loading/ offloading at berths 1 and 2	Loading arms major failure	Various (including jet A1, gasoil, diesel, HFO, vegetable oils).	267 m^3 based on an estimated pumping rate of 8 000 m^3 / hour x 2 mins to shut down.	Affecting port operations and possible spread outside Cape Town harbour. Likely to affect tourism and could affect bird populations at Robben Island.	2	3	M	• Monitoring and surveillance to predict spill spread. • Containment and recovery of oil on water surface for heavier oils. Assisted natural dispersion (whilst gas monitoring) for lighter oils. • Protection of sensitive resources. • Shoreline clean-up.
5	Tanker at loading/ offloading jetty	Leaking seals/valves	Various (including jet A1, gasoil, diesel, HFO).	<1 m^3	Sheen and oiling around jetty and closely surrounding area. All oil should be contained within the protection boom (hence being assigned a severity of 1).	4	1	L	• Containment and recovery - all oil should be contained within the protection boom so limited skimming to recover oil should be possible – skimmer type will depend on crude viscosity. • Monitoring and assisted natural dispersion.
6	Pipeline from berths 1 and 2	Pipeline failure with partial loss of line volume	Various (including jet A1, gasoil, diesel, HFO, vegetable oils).	2.5 m^3	Sheen and oiling around jetty and closely surrounding area.	3	2	L	• Monitoring and assisted natural dispersion. • Limit volume of oil that reaches the water.
7	Loading/ offloading jetty	Vessel collision with jetty – loss of	Crude oil	162 m^3 based on a 20” line	Shoreline oiling within Cape Town area. Possible impact to Robin Island.	2	3	M	• Monitoring and surveillance to predict spill spread.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[8]
		pipeline volume		and 200m length					• Containment and recovery of oil on water surface. • Protection of sensitive resources. • Shoreline clean-up.
8	Vessel – shore to ship refuelling	Fuel transfer spill: leaking valve whilst refuelling vessel	IFO or HFO	< 1 m^3	Oiling around jetty and immediate surroundings.	3	2	L	• Assisted natural dispersion if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for HFO.
9	Vessel – shore to ship refuelling	Fuel transfer spill: split hose whilst refuelling vessel.	IFO or HFO	25 m^3	Could overwhelm harbour protection to cause oiling within wider port area.	2	2	L	• Assisted natural dispersion if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for HFO. • Potential shoreline clean-up.

10	Vessel – ship to ship refuelling	Fuel transfer spill: leaking valve whilst refuelling vessel	IFO or HFO	< 1 m^3	Oiling around bunkering site and immediate surroundings.	3	1	L	• Lighter fuel oils (MGO, MDO):
									  • assisted natural dispersion
									  • attempt to recover with an oleophilic skimmer if enough volume
									• Heavier fuel oils (IFO/HFO):
									  • recover by mechanical skimmer.

11	Vessel – ship to ship refuelling	Fuel transfer spill: split hose whilst refuelling vessel	IFO or HFO	25 m^3	Could overwhelm harbour protection to cause oiling within wider port area.	2	2	L	• Lighter fuel oils (MGO, MDO):
									  • assisted natural dispersion
									  • recovery with oleophilic skimmer
									• Heavier fuel oils (IFO/HFO):
									  • recovery by mechanical skimmer.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[8]
12	Storage Tank	Loss of primary containment	IFO or HFO	5 000 m^3. Assuming a spill of 25 000 m^3, with 20% loss to sea.	Major impact in and around spill location and surrounding sites.	1	3	L	• Monitoring and surveillance to determine spill spread. • Assisted natural dispersion and/or sorbent boon sweeps if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for HFO. • Potential shoreline clean-up.
13	Vessel - cruise ship or container ship	Grounding/ collision with loss of oil from fuel storage tank(s).	IFO or HFO	500 m^3	Spread from accident site to wider port area. Severity dependant on spill location and spread.	2	3	M	• Monitor and evaluate (aerial surveillance, trajectory modelling to predict spill spread and visualisation). • Assisted natural dispersion and/or sorbent boon sweeps if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for HFO. • Potential shoreline clean-up.
14	Tanker – inside port	Grounding / collision inside port areas with loss of oil from storage tanks.	IFO or HFO	100 000 m^3	Major impact in and around spill location and surrounding sites. Potential for oil to travel great distance.	2	4	M	• Monitor and evaluate (aerial surveillance to predict spill spread and visualisation). • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
15	Tanker – outside port	Grounding / collision outside port areas with loss of oil from storage tanks.	IFO or HFO	100 000 m^3	Major impact in and around spill location and surrounding sites. Could affect marine park/endangered bird species nesting and feeding sites. Potential for	2	5	H	• Monitor and evaluate (aerial surveillance, trajectory modelling to predict spill spread and visualisation). • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[8]
					oil to travel great distance. Will affect tourism.				
16	Tanker – place of refuge	Place of refuge for damaged tanker, with loss of oil from storage tanks.	IFO or HFO	100 000 m^3	Major impact in and around spill location and surrounding sites. Could affect marine park/endangered bird species nesting and feeding sites. Potential for oil to travel great distance. Will affect tourism.	1	5	H	• Monitor and evaluate (aerial surveillance, trajectory modelling to predict spill spread and visualisation). • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
17	Fishing vessel	Fire / collision / grounding / sinking inside harbour	Diesel	10 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
18	Fishing vessel	Fire / collision / grounding / sinking outside harbour	Diesel	10 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.
19	Recreational Yachting	Fire / collision / grounding / sinking inside harbour	Diesel	5 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
20	Recreational Yachting	Fire / collision / grounding /	Diesel	5 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[8]
		sinking outside harbour							

Risk Assessment Summary

The Risk Assessment Matrix demonstrates that TNPAs highest risk in the port of Cape Town comes from a tanker collision or grounding with major loss of product. Cape Town's greatest environmental sensitivities lie outside the main port activity area, but its proximity to sensitive areas mean that an incident near the harbour breakwater could spread to sensitive areas. Port operations and tourism would be affected in a large spill.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium or low risk.

Table 16 Risk Matrix for Cape Town Scenarios

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**			3, 10, 17, 19	5	1
	2		9, 11	6, 8, 18, 20	2	
	3	12	4, 7, 13			
	4		14			
	5	16	15			

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

Table 17 Gaps Identified in the Port of Cape Town

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	Gas monitors not present in response equipment stockpile.	In addition to onboard gas monitors on vessels, response personnel should conduct gas monitoring at any oil spill work site. Gas monitors should test for CO, O_2, H_2S, LEL, UEL and benzene.	Identify potential spill sites that are away from fixed gas monitor. Include portable gas monitors into the response equipment package.	**CT1**
Major	TNPA had no written procedures on how to operate equipment.	Standard operating procedures and work instructions reduce the risk of an accident when carrying out tasks.	Oil spill equipment owners should arrange work instructions for any mechanical equipment they hold.	**CT2**
Major	TNPA lack of equipment maintenance was a safety risk.	Whilst the TNPA termite skimmer looked in good condition and had a maintenance schedule, other equipment observed was in various states of decay. There was no schedule for replacement seen. Hydraulic oil can burn skin and be injected into the body if a hydraulic hose fails.	Ensure regular maintenance of equipment, including replacement of hydraulic hoses where appropriate.	**CT3**
Equipment				
Moderate	Granular sorbents in stock at TNPA in Cape Town are considered a standard response technique for on water recovery of oil.	Granular sorbents are suitable for deck and land spills but are not recommended for on water response. Heavy oil can adhere to the sorbent and cause it to sink and not be recovered. In general, sorbents are suitable for light oiling with light to medium oils and where used on water should be contained (in a boom, 'tea-bag' or pad).	Limit use of sorbents for on-water response to suitable spills, attempt recovery of liquid oil wherever possible. Only use granular sorbents for land/deck spills. Carry out staff training for oil spill responders.	**CT4**
Moderate	No booms suitable for recovering free-floating oil were available.	Response techniques within the port focussed on containment with fence boom and sorbent use. No vessel towable boom was seen. As a backup containment boom there should be access to a boom that is more suitable for use in heavier wave and winds. This gap could be filled by having a towable boom. This boom could be used to recover oil with the termite skimmer held by TNPA or alternative skimmer suitable for medium / light oils (see next gap).	Arrange access to curtain boom (air or solid floatation boom). Identify who should be responsible for containment and recovery within the Cape Town area. Arrange suitable equipment.	**CT5**
Moderate	A termite skimmer was held at TNPA facilities but there were not any other	The termite skimmer appeared well maintained and is suitable for heavier oils as it has a strong pump that can pump oils that other skimmers cannot. But it is not suitable for lighter oils such as MGO.	Arrange oleophilic skimmer for large light to medium oil spill (mop, disk or brush).	**CT6**

	response ready skimmers.			
Major	No dispersant was held at Cape Town.	Dispersant is described as one of the most suitable oil response techniques in the NOSCP. Subject to the dispersant guidance conditions including depth and distance to shore (see Table 4), dispersant would be suitable for a medium viscosity oil spill that will not disperse on its own. Such a spill could come from Cape Town operations or from a vessel incident with a passing ship in the area. No dispersant or spray equipment is available at Cape Town. A test spray should always be conducted before large scale dispersant operations.	Arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline. The sensitivities surrounding Cape Town would justify it being one of the strategic points.	**CT7**
Moderate	Equipment seen at TNPA was not response ready.	Some equipment viewed appeared response ready, but some skimmers and some boom seen at TNPA were not. Staff should regularly be deploying equipment in exercises which familiarises all staff with equipment as well as proves use in different conditions.	Perform regular and documented maintenance. Conduct regular deploying exercises to familiarise responders with equipment.	**CT8**
Moderate	No protective booming is in place during bunkering operations.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Reduce bunkering risk by using a H booms/flexible booms inserted between the ship and fuel barge fore and aft to collect any spilt oil (Refer to Appendix 2 Equipment Recommendations). A way of recovering the oil (e.g. skimmer) would also be needed.	
Responders				
Major	No responders trained in dispersant use are available in Cape Town.	Dispersant is described as a primary response option in the NOSCP yet there are no responders in the Cape Town area trained in its use. (Refer to Appendix 2 Response Techniques)	Train staff in dispersant spraying techniques as part of organising a national capability. This should be an inter-agency initiative and may be led by an agency other than TNPA.	**CT9**
Moderate	No responders trained in how to recover free-floating oil within or outside the harbour area.	Response techniques from TNPA contractor focussed on containment with fence boom and sorbent use. No personnel experienced in vessel towable boom were on call.	Identify who should be responsible for oil spill containment and recovery within the Cape Town area. Train on call staff in the use of these techniques.	**CT10**
Moderate	Tug captains are restricted to operate within port limits or	The certificate of competency required to operate outside port limits requires the candidate to meet criteria assessed by the maritime authority. The type of	Vessel masters able to respond to outer port waters to be identified. Availability to be	**CT11**

	sheltered port limits only.	operations a port vessel conducts often does not give the crew the needed experience to achieve this certification. Some tug masters' certificates are endorsed sheltered port operations only, which means they are not allowed to proceed to the outer anchorage, or sea side of the port zone. The port authorities in South Africa only require a Port Operation Only certificate of competency for their tug crews, as a result most of their tug masters are not licensed by the maritime safety authority to proceed beyond the boundaries of a port that they are operating in.	tested during a table top exercise.	
Major	No trained aerial surveillance observers.	It is thought that helicopters could be chartered in a spill to provide a platform for aerial surveillance but there are no agency or operator staff trained in surveillance. And no call off contract or process	Train a group of port and /or operator staff in aerial surveillance. Make available in an oil spill.	**CT12**
Moderate	Whilst there was evidence of IMS training at higher levels of oil spill response management, there was no IMS training of operator level oil spill responders.	The NOSCP states that all role players must be Incident Management System trained and competent to the following levels: IMS 100: every person that would be playing a role in any of the response functions, including the command- and general staff. IMS 200: functional heads, deputies and heads. IMS 300 – 400: the incident commander, functional heads, deputies and heads	Review level of training required for all levels of spill response organisation. Rollout training as required.	**CT13**
Major	Lack of appropriate training on oil spill response for operator level oil spill responders.	It was unclear who was trained to which level to fulfil each response role. There was a lack of awareness of the most appropriate techniques to use- for example an overuse of sorbents for on-water spills.	Conduct training needs analysis. Implement training programme.	**CT14**
Major	No evidence of oil spill exercises.	Oil spill exercises keep responders up to date with skills and allow for continuous improvement by identifying improvements that can be made.	Run oil spill exercises to identify knowledge gaps. Drills to be run every 12 months. Review table top exercises to be run every 12 months. Functional exercises to be run every 24 months.	**CT15**
Moderate	Oiled wildlife response	TNPA have no on-call oiled wildlife response capability. In country organisations (including SANCCOB, uShaka Marine World, Two Oceans Aquarium and Bayworld) could support wildlife rehabilitation but are not on call to TNPA	TNPA should invest in tier 1 and tier 2 oiled wildlife preparedness and response capability through oiled wildlife	**CT16**

		and support will be dependent on other commitments. Management authorities (including SANParks and CapeNature) would usually be responsible for search and capture.	preparedness and response retainer agreements with OWR organisations as well as oiled wildlife contingency planning and training.	
Additional Support				
Minor	No TRPs/SRPs	In coastal plan there are all different sites listed, with protection priorities. These provide some information on possible booming sites and suitable response techniques but have some limitations (e.g. not user friendly to response team leader; lack site access information)	Add detail to these initial site-specific response plans in the coastal contingency plans.	**CT17**
Minor	Key elements of the TNPA Cape Town OSCP missing.	Plan is missing: a clear area of jurisdiction defined, specific actions for each TNPA role, details on response techniques that would be used to respond to an oil spill, detailed waste management strategy, details of type of training / and exercises conducted and their frequency, no detail of the types of oil spills encountered in the port or the risks from them.	Include missing elements.	**CT18**
Minor	Spilltech Oil Spill Response Plan Port of Cape Town- Tanker Basin	Tiers listed are not in line with the National Oil Spill Contingency Plan (stated by volume spilt). Plan states recovery of free-floating oil by skimming but no skimming devices listed in the equipment list. No evidence of waste storage onsite.	This document would be better structured as a tactical response plan.	**CT19**
Other				
Major	Lack of understanding of jurisdictional boundary and commitment to outside of operational area.	In conversations with TNPA, they saw their area of responsibility to respond to an oil spill to be limited to the immediate port area – to the harbour breakwater. This is different to other TNPA regions visited who saw their area of responsibility to be the wider port area. TNPA staff said they would work within	Clarify who is responsible for response within wider port area. This should be consistent for all port areas throughout South Africa. Exercise roles and responsibilities between TNPA / SAMSA and DEFF.	**CT20**

Mossel Bay

Mossel Bay is 345km East of Cape Town at Longitude 22º 08' E and Latitude 34º 08' S. It is the smallest of the commercial South African harbours. The harbour is the only port with two offshore mooring buoys inside port limits, of which one is a marine tanker terminal single point mooring buoy used by feeder vessels from Durban and Cape Town.

Figure 14 Mossel Bay Area Map.

The Mossel Bay harbour is used mainly by fishing and service craft for the local oil industry and handles little other commercial cargo, and therefore has basic infrastructure. The fishing industry provides an important contribution to the economy of the Southern Cape and local community.

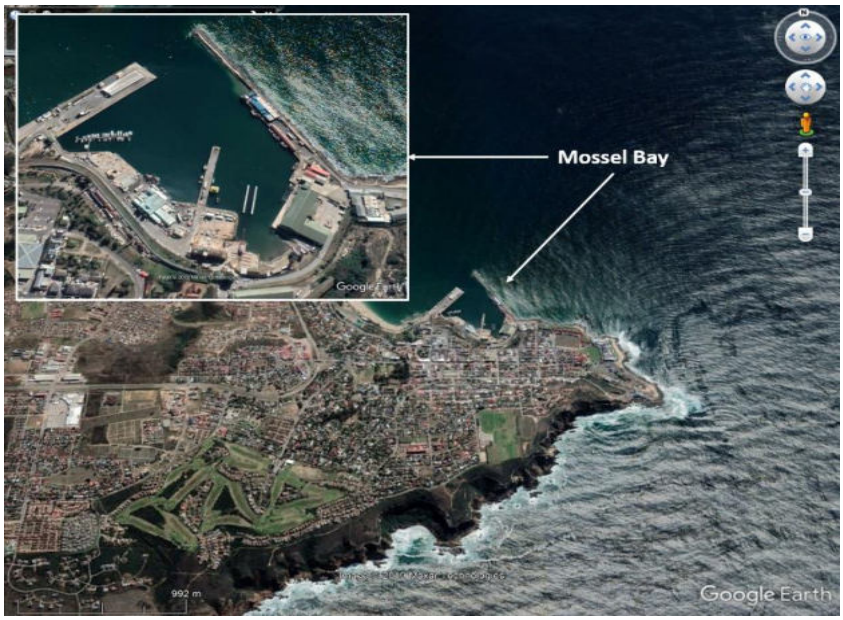


Figure 15 Port of Mossel Bay Aerial Photograph.

The harbour is draft restricted to 6.5 m and can take vessels up to 130 m.

Oil company operations

There are various oil company operations outside the Mossel Bay harbour but within the wider port area. PetroSA has oil production and drilling operations in the Mossel Bay area.

- The Single Point Mooring (SPM) was built in 1992 and is 3 nautical miles east of Voorbaai tank farm in a 20m water depth (see Figure 16).
- The Conventional Buoy Mooring (CBM) was built in in 1959 and is 1 km inshore of the SPM. The CBM is used for chemical loading and offloading which is outside the scope of this capability review.

The SPM and CBM are within the wider port area.

A 36" carrier pipeline runs from the SPM to Voorbaai tank farm. The pipeline is 3.4 km long, of which 2.0 km is subsea. This carrier pipeline contains three smaller pipelines.

- 1 x 8" – was used for ballast water but is no longer in use and is blanked off.
- 1 x 12" – used for petrol export and reformate or condensate import.
- 1 x 14" – used for diesel export and condensate import.

The pipelines can be shut off at the pipeline end manifold. The SPM floating hose is 8" wide and 180-200m long. The pumping rate is 750 m^3/hour for petrol and 650 m^3/hour for diesel. The exported petrol and diesel are shipped to other South African ports, particularly Port Elizabeth and East London.

The two Mossel Bay offshore moorings are managed and maintained by Africa Marine Solutions (AMSOL) on behalf of PetroSA. AMSOL would be the first responders to an incident at the SPM. Each SPM operation has an AMSOL loading master and three divers, who stay on board the tanker until all cargo operations are completed. There are wind restrictions on when loading/unloading can take place at the SPM. The condensate and petroleum products are pumped between the tank farm at Voorbaai and the PetroSA refinery.

Figure 16 Port of Mossel Bay Aerial Photograph.

There are 25 tanks at the Voorbaai tank farm, each with a storage capacity of 2 000 to 17 200 m^3. There are four 17 200 m^3 tanks which all store condensate.

Oil Characteristics

A variety of crude oils are handled in Mossel Bay.

Table 18 Oil Inventory

Mossel Bay	Oil Type	Volume	Characteristics
Voorbaai tank farm/produced from FA platform	Condensate	4 x 17200 m^3 storage tanks at Voorbaai. 51000 m^3 max and 20 000 m^3 is stored at Voorbaai. Produced at 3 to 5 m^3/hour from FA platform.	API°>40 Specific gravity: 0.5 to 0.8
Voorbaai tank farm	Petrol	17 200 m^3 max and 6000 m^3 average stored at Voorbaai.	Specific density 0.72 to 0.76 g/m^3 Kinematic viscosity <1 at 30°C Flash point -30°C
Voorbaai tank farm	Diesel	20 000 m^3 max and 6000 m^3 average stored at Voorbaai.	Density of 0.82 g/cm^3 Viscosity of 2.87 sCt, Boiling point of 369.8 °C.
Voorbaai tank farm	Kerosene	3 800 m^3 max is stored at Voorbaai, but these tanks are usually empty.	Density of 0.76 to 0.81 g/cm^3 Viscosity of 1 to 1.9 sCt at 40°C Boiling point of 200 to 260 °C
Voorbaai tank farm	Reformate	10 000 m^3	Specific gravity of 0.79 at 68F Flash point of -120°C Relative density 0.5-0.7
Small Vessels	Diesel	Up to 100 m^3	Specific Gravity (SG): 0.84 – 0.88 Viscosity: <1.3 cSt – 4.5 cSt @ 40°C (104°F)

Condensate

Condensate is a hydrocarbon oil consisting primarily of gas oil and naphtha, which is a liquid at ambient temperature and pressure, flows freely and has an API of greater than 40. Condensates are composed mainly of alkanes and are low in polycyclic aromatic hydrocarbons (typical in crude oils), they have low solubility in water and are highly volatile. When spilled in water, condensates generally evaporate quickly and are classified as non-persistent; they typically break up naturally in wind and waves.

Petrol

Petrol or gasoline is a complex mixture of many volatile, flammable and liquid hydrocarbons derived from petroleum and used as fuel for internal combustion engines. Gasoline is a mixture of paraffins, oleofins and cycloalkanes; this blend is adjusted to altitude and season. It has a specific density between 0.72 to 0.76g/m^3, kinematic viscosity <1 at 30 °C and a flash point of -30°C.

In a warm climate, gasoline will evaporate on water within one day and in about two days in cold circumstances, also it will disperse naturally to a large degree in turbulent waters.

Diesel

Diesel is the common term for the petroleum distillate fuel oil for use in motor vehicles that use the compression ignition engine. It is obtained from fractions of crude oil that are less volatile than the fractions

used in gasoline; the Diesel produced at the GTL refinery has a sulphur content of 50 ppm (low sulphur diesel). Diesel has a density of 0.82 g/cm^3, viscosity of 2.87 sCt, boiling point of 369.8 ^{o}C. Diesel will evaporate to the extend of 60% in about 3 days on warm water and in 6 days in very cold water.

Kerosene

Kerosene also known as paraffin is a combustible hydrocarbon widely used to power jet engines and as cooking and lighting fuel. It has a density of 0.76 to 0.81 g/cm^3, a viscosity of 1 to 1.9 cSt at 40^{o}C and a boiling point of 200 to 260 ^{o}C. When spilled, kerosene spread rapidly into thin sheens and as diesel it will rapidly evaporate and naturally disperse.

Reformate

Premium blending stock for high-octane gasoline formed by catalytic reforming, which is a chemical process used to convert petroleum refinery naphthas, they are distilled from crude oil into high-octane liquid products. It has a specific gravity of 0.79 at 68F and a flash point of -120^{o}C.

Intermediate Fuel Oil

Intermediate Fuel Oil (IFO) can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61^{o}C and boiling point > 204 °C. Its density at 20^{o}C is 0.9850 g/cm^3 and kinematic viscosity of 180 mm^2/s at 50^{o}C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Heavy Fuel Oil

Heavy Fuel Oil (HFO) is a mixture of the heavy residual oil, left after the lighter components of crude oil are removed during the refining process, this is then blended with lighter oils to meet specifications for viscosity, pour point and specific gravity. HFOs can also be a blend of heavy and light oils but they generally contain more of the heavier components. In the MARPOL Marine Convention of 1973, heavy fuel oil is defined either by a density of greater than 0.9 g/cm³ at 15°C or a kinematic viscosity of more than 180 cSt at 50°C. Heavy fuel oils have large percentages of heavy molecules such as long-chain hydrocarbons and aromatics with long-branched side chains.

Wind and current

A wind rose diagram is a tool which graphically displays wind speed and wind direction at a particular location over a period of time. Figure 17 shows the predominant wind speeds and directions annually for Mossel Bay taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10 m above the sea surface.

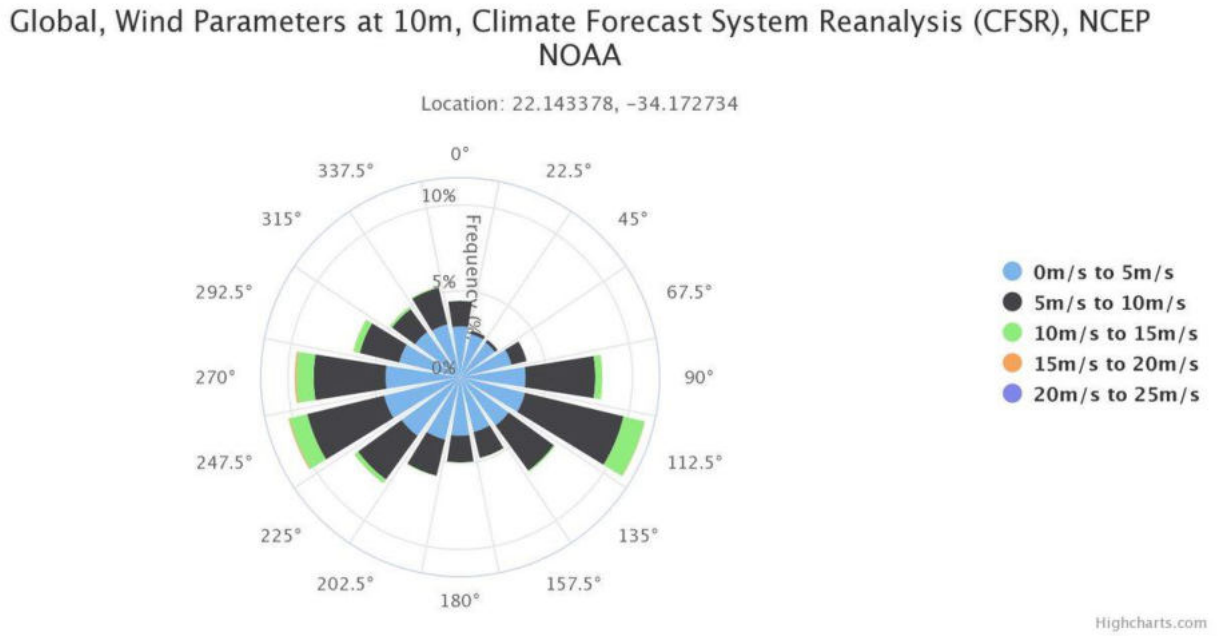


Figure 17 Wind Rose for Mossel Bay.

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant winds in the Mossel Bay area are from the north-northwest and the west in summer and east -southeast in winter.

Based on the yearly average wind data, 95% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Based on this differing guidance it suggests that dispersant application and containment and recovery are feasible response techniques for oil spills in Mossel Bay and should be attempted if safe and practical to do so.

Current

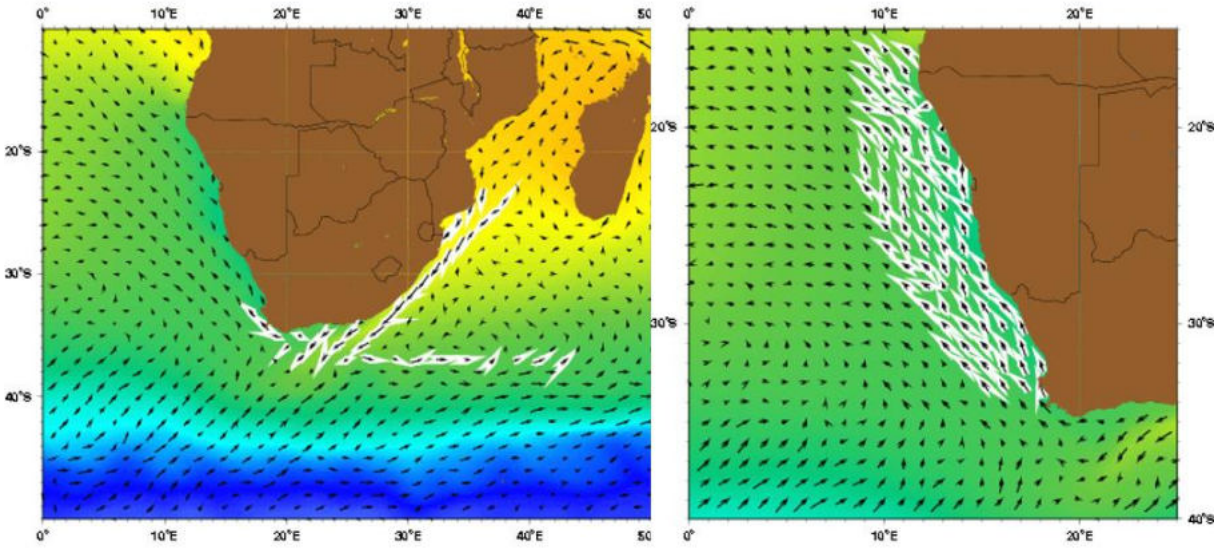


Figure 18 The Agulhas Current and the Benguela Current Yearly Average Direction.
Source: www.oceancurrents.rsmas.miami.edu

The Agulhas Current flows down the east coast of Africa from 27°S to 40°S. Like other western boundary currents, the Agulhas Current is quite fast. At the surface, it can reach maximum speeds of 3.8Kts. As one of the major currents in the Southern Hemisphere, the Agulhas Current system transports large volumes of water. As the Agulhas Current reaches the southern tip of the continental shelf of Africa, it begins to turn toward the west. Marine currents near Mossel Bay travel from the North East towards the South West.

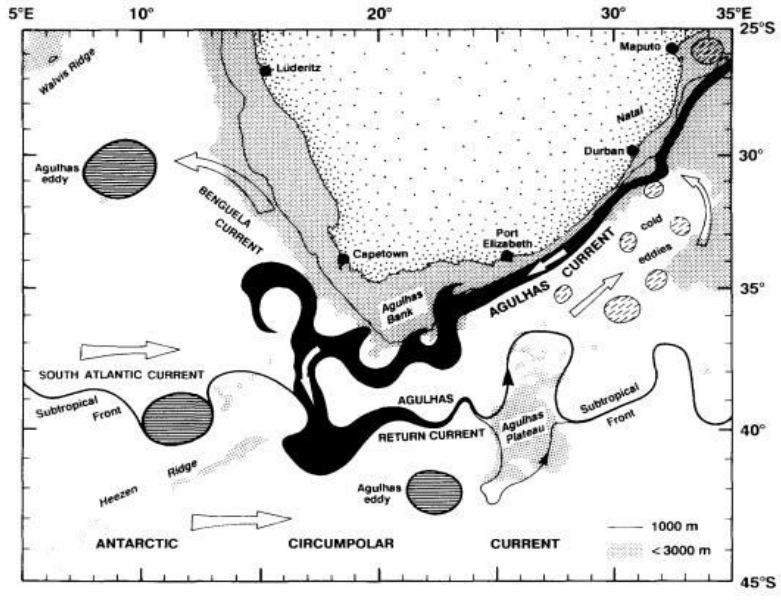


FIG. 8. Schematic representation of the Agulhas Current system (adapted from LUTJEHARMS and VAN BALLEGOOYEN, 1988 and LUTJEHARMS, 1989). Open arrows indicate the general direction of the surface geostrophic currents.

Figure 19. The Agulhas and Benguela Currents.
Source: Lutjeharms, J.R.E., and R.C. van Ballegooyen, (1988).
The Retroflection of the Agulhas Current, Journal of Physical Oceanography, 18, 1570-1583.

The Benguela Current is the eastern boundary current of the South Atlantic subtropical gyre. It begins as a northward flow off the Cape of Good Hope, where it skirts the western African coast equatorward until around 24°S-30°S. The Benguela Current has a well-defined mean flow that is mostly confined near the continent and a more variable transient flow on its western side. The transient flow is dominated by large eddies shed from the Agulhas Retroflection. High resolution nearshore current data is sparse for the South Africa coastline close to Mossel Bay. Planning assumptions have been made based on the current directions of the Agulhas and Benguela currents.

Environmental and Socioeconomic Sensitivities

According to the Environmental Impact Assessment[9], two key potential environmental effects of an offshore oil spill are on marine ecology and commercial fisheries. For a near shore spill the key potential effect is on the recreational use of beaches, desalination plant and amenities within Mossel Bay.

Marine Ecology

The biological communities of the Mossel Bay area consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). Beyond the surf-zone, marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments, rocky reefs and the water column.

Surface waters are characterized by generally low phytoplankton biomass, although phytoplankton concentrations increase due to shelf-edge and coastal upwelling. The inshore areas are an important nursery ground for many line fish species.

The fish most numerous on the shelf, beyond the shelf break and in the offshore waters, are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the IUCN, primarily due to overfishing.

The great white shark is a significant apex predator in the Mossel Bay area, particularly in the vicinity of the seal colony at Seal Island. Great white sharks were legislatively protected in South Africa in 1991 and are classed as vulnerable by the IUCN. Great white sharks migrate along the entire South African coast along the Western Cape coast and are typically present at seal colonies during the winter months, moving nearshore during summer.

The shallower inshore areas (<100 m) along the south coast comprise a varied habitat of rocky reefs and soft-bottom substrates, which support a high diversity of endemic teleost species (Smale et al. 1994), some of which move into inshore protected bays, such as Mossel Bay, to spawn (Buxton 1990). Spawning of the majority of species endemic to the area occurs in spring and summer.

60 bird species are thought to occur, along the south coast of South Africa. Fifteen species breed within the South Coast region, including Cape Gannets, African Penguins, Cape Cormorants, Whitebreasted Cormorant, Roseate Tern, Damara Tern, Swift Term and Kelp Gulls.

[9] Marine Specialist Assessment undertaken by Andrea Pulfrich for Environmental Impact Assessment for Proposed Well Stimulation in the F-O field, 2014 and Risk Assessment of Wellhead Snagging in Block 9 by Capricorn Marine Environmental, 2015.

Three species of turtle occur along the South Coast; the leatherback, the loggerhead and occasionally the green turtle. Sixty species of seabirds are known along the South Coast, of which 15 breed within the region. There are 28 to 38 species of cetaceans (whales and dolphins) and one seal species, the Cape fur seal.

Beaches and recreational activities

Mossel Bay has 4 out of the 23 Blue Flag beaches in the Western Cape: Santos Beach (Madiba Beach), De Bakke Beach, Hartenbos Beach and Kleinbrak Beach. Diaz beach in the close vicinity of the SPM and CBM is another popular beach. The beaches are used for surfing, swimming and walking throughout the year and particularly during the school holiday periods.

Mossel Bay also hosts shark cage diving, whale watching and other boat-based tourist activities. Recreational sailing and shore and boat based recreational fishing targeting the inshore pelagic fishery is also popular in the bay.

Protection Priorities

The protection priorities identified in the Draft Coastal Oil Spill Contingency Plan (OSCP) for the Mossel Bay Zone are the rich marine life, the estuaries and amenity beaches. At a more regional scale the protection priorities are:

1. Protected areas: Goukamma marine reserve, Garden Route National Park, De Hoop, Still Bay, Robberg and Tsitsikamma.
2. Desalination plant inlets- Mossel bay, Sedgefield, Knysna and Plettenberg Bay.

Clean up priorities identified in the Draft Coastal OSCP are:

1. Protection priorities according to the section above (should the protection measures have failed).
2. Sea birds, marine protected species and wildlife in general.
3. Amenity beaches.

The Draft Coastal OSCP identifies protection and clean-up priorities. The main protection and clean up priorities within 20 miles of the Voorbaai tanks farm and the SPM are listed in Table 19.

Table 19 Protection and Clean up Priorities Mossel Bay

Type of Sensitivity	Name (s)- Description	Protection	Clean Up
Aquaculture	Mossel Bay zone- oyster collection: highest annual yield is from this area.	Implement Wildlife Contingency Plan	
Amenity beaches	Boggomsbaai, Visbaai, Vlessbaai, Kanonstrand		Amenity beaches to be cleaned prior to and during holiday season and otherwise if there is a heavy deposit of oil.
Amenity beaches	Bothastrand and Glentana.		Amenity beach to be cleaned all year round.
Pebble beaches	Between Gouritzmond and Vleesbaai	Deploy stray bales on pebble beaches (conservance)	Remove oiled straw bales where necessary.
Amenity beaches with wave cut rocky platforms	Mossel Bay municipality	TNPA to cover the area	Amenity beach to be cleaned all year round.
Desalination plant	Voorbaai	Shut down desalination plant	
River mouths	Blinde river, Twee-Kuilen, Pansy Stream, Hartenbos river, Little Brak river, Groot Brak River. River mouths support bait organisms, sea birds and are breeding sites.	Mouths to be closed	Should oil enter the river, the DEEF on- scene coordinator should be advised immediately, and clean-up should only be undertaken under super-vision of the DEFF Shore Controller.
Harbour	Mossel Bay harbour	Implement harbour contingency plan.	Oil to be contained and removed using skimmers and sorbent materials.

Resources Available to Mossel Bay

Equipment

TNPA hold the following equipment at the harbour:

- Small venter trailer with 13 x 200 mm yellow inflatable boom (fast current boom)
- 2 x Spillsorb bags x 2
- Bags of sorbent granules
- 100+ empty bags for clean-up
- 200m total of 300 mm fence boom (4 lots of 5 x 10m)
- Magnetic connector to side of ship
- 1x rope mop skimmer with rope
- 1x Fastank 1500
- 1x spill kit drum (with brooms and spill socks)

The equipment at TNPA was generally in reasonable condition but was not deployed to check this. The rope mop had not been started in many months.

Personnel

TNPA have a team of 5 staff per shift. They are not a dedicated spill response service but if there was a spill the harbour master would attempt to release all 5 staff for spill response efforts. They have a monthly emergency response exercise (usually for a fire or other emergency). They undertake table top exercises and have undertaken exercises with AMSOL and PetroSA, though no exercise report was viewed. There are no regularly scheduled oil spill response exercises.

Risk Assessment

Risk Register

This risk assessment includes the oil spill risk in Mossel Bay and does not include spill scenarios from production or drilling operations.

Table 20 Oil Spill Risk Scenarios – Mossel Bay

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[10]**
1	Vessel coming onto SPM	Bilge pumping	Various	< 500 litres	Sheen and oiling around pumping location and surrounding area.	4	1	L	• Monitor and evaluate. • Natural dispersion, assisted by prop washing and surf washing.
2	Loading / offloading vessels through SPM	Hose rupture	Petrol, diesel, kerosene, condensate, reformate	23.5 m^3 Loss of hose volume (6.5 m^3) + average pumping rate 680 m^3/hr x 90 second shut down time (17 m^3)	Sheen and oiling around pumping location and surrounding area.	2	2	L	• Monitor and evaluate. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Shoreline clean-up.
3	Loading / unloading	Collision with mooring buoy causing	Petrol, diesel, kerosene,	186 m^3	Oiling several sandy amenity beaches (Pansy beach, Diaz Beach,	1	3	L	• Monitor and evaluate.

[10] For more information on these techniques refer to Appendix 2.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[10]
	vessels through SPM	subsea damage to mooring at pipeline join and pipeline rupture	condensate, reformate	Assume 50% loss of 14" pipeline volume, = 169 m^3 + pumping rate 680 m^3/hr * 90 second time shut down = 17 m^3	Diasstrand, Baydunes, Hartenbos Beach, Ronin Erasmus Beach), wavecut rocky platforms and breeding sites (Hartenverbos river mouth and Brak river mouth). Sea birds, desalination plant (Voorbaai)				• Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Shoreline clean-up.
4	Tanker en-route to SPM incident with another vessel.	Grounding/ collision with total loss of oil from oil cargo storage tank(s)	Petrol, diesel, kerosene, condensate, reformate	50 000 m^3	Spread from accident site to surrounding area. Severity dependant on spill location and spread. Energy of environment likely to cause natural dispersion.	1	4	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Attempt to recover with an oleophilic skimmer if enough volume. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Shoreline clean-up.
5	Tanker en-route to SPM incident with another vessel.	Grounding/ collision with partial loss of oil from oil cargo storage tank(s)	Petrol, diesel, kerosene, condensate, reformate	20 000 m^3	Spread from accident site to surrounding area. Severity dependant on spill location and spread. Energy of environment likely to cause natural dispersion.	2	4	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Attempt to recover with an oleophilic skimmer if enough volume. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Shoreline clean-up.

SCENARIOS

#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[10]
6	Vessel	Grounding/ collision with loss of oil from fuel storage tank(s)	IFO or HFO	500 m^3	Spread from accident site to surrounding area. Severity dependant on spill location and spread. Energy of environment likely to emulsify oil.	2	3	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Containment and recovery of oil on water surface for gross contamination. • Lighter fuel oils (MGO, MDO) attempt to recover with an oleophilic skimmer if enough volume. • Heavier fuel oils (IFO/HFO): • recover by mechanical skimmer. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Shoreline clean-up.
7		Small operational spill	Various – lube oil, diesel, hydraulic oil	< 10 litres	Minimal – sheen on water surface	5	1	L	• Monitor and evaluate. • Recover using sorbents and absorbent rolls.
8	Tanker at loading/ offloading SPM	Leaking seals/valves	Petrol, diesel, kerosene, condensate, reformate	<1 m^3	Sheen and oiling around SPM and closely surrounding area. All oil should be contained within the protection boom (hence being assigned a severity of 1).	4	1	L	• Monitor and evaluate. • Recover using sorbents and absorbent rolls. • Natural dispersion, assisted by prop washing and surf washing.
9	Fishing Vessel	Fire / collision / grounding / sinking inside harbour	Diesel	10 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[10]**
10	Fishing Vessel	Fire / collision / grounding / sinking outside harbour	Diesel	10 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.

Risk Assessment Summary

The Risk Assessment Matrix shows that TNPA's highest risk coastal spills are:

- Vessel incident (grounding/ collision) with loss of either the vessel fuel and/or the cargo carried.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium or low risk, and outlines that TNPA in Mossel Bay has no oil spill risks classed as high risk.

Table 21 Risk Matrix for Mossel Bay Scenarios

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**		2	9	1, 8	7
	2			10		
	3	3	6			
	4	4	5			
	5					

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

The identified gaps in oil spill response specific to Mossel Bay are described in Table 22.

Table 22 Gaps Identified to Mossel Bay

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	Gas monitors were not seen in any response equipment stockpile.	Offloading tankers will have gas monitors on board as standard, which would warn personnel in the vicinity of noxious or flammable gasses above safe limits. But response personnel could be exposed to vapours above safe limits if working away from these areas.	Evaluate potential oil spill working areas that are away from fixed gas monitor areas. Have appropriate gas monitors for response teams.	**MB1**
Equipment				
Major	TNPA Equipment stockpile	The TNPA equipment stockpile was a small amount of response equipment for the spill risk in Mossel Bay.	Increase TNPA equipment stockpile in line with the equipment recommendations set put in Appendix 2.	**MB2**
Moderate	No protective booming is in place during bunkering operations.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Reduce bunkering risk by using a H booms/flexible booms inserted between the ship and fuel barge fore and aft to collect any spilt oil (Refer to Appendix 2 Equipment Recommendations). A way of recovering the oil (e.g. skimmer) would also be needed.	
Responders				
Major	No oil spill response training plan was provided. No spill exercise program is in place.	No oil spill response training plan was provided for review. Personnel are trained in emergency response in case of fire but require oil spill training. There is not a spill exercise program as part of the OSCP.	Develop a training program. Recommend IMS 100, 200 and 300 and IMO 200 and 300 for the IMT and shoreline operations training (SCAT training) for personnel who would assist in a shoreline response. Implement a series of oil spill drills, looking at different scenarios and table top exercises. An ideal deployment exercise would involve protection of sensitive resources. Any lessons learned and improvements made should	**MB3**

Gap Classification	Gap	Explanation	Recommendation	Ref #
			be recorded, where appropriate.	
Major	No trained aerial surveillance observers	The OSCP states that helicopters could be used in a spill to provide a platform for aerial surveillance but there are no agency or operator staff trained in surveillance.	Train a group of operator staff in aerial surveillance. Make available in an oil spill.	**MB4**
Moderate	No trained SCAT responders	No trained SCAT responders for TNPA, or in South Africa.	SCAT responders should be available in a spill where shoreline oiling is possible.	**MB5**
Moderate	Oiled wildlife response	TNPA have no on-call oiled wildlife response capability. In country organisations (including SANCCOB, uShaka Marine World, Two Oceans Aquarium and Bayworld) could support wildlife rehabilitation but are not on call to TNPA and support will be dependent on other commitments. Management authorities (including SANParks and CapeNature) would usually be responsible for search and capture.	TNPA should invest in tier 1 and tier 2 oiled wildlife preparedness and response capability through oiled wildlife preparedness and response retainer agreements with OWR organisations as well as oiled wildlife contingency planning and training.	**MB6**
Additional Support				
Major	No TNPA OSCP reviewed for Mossel Bay	It is recognised as industry best practice to have an OSCP for any activity where a spill risk exists.	TNPA should create an OSCP for Mossel Bay.	**MB7**

Port Elizabeth and Ngqura (Coega)

The Port of Port Elizabeth is a multi-cargo port situated in Algoa Bay, on the south-eastern coast of Africa. The port handles dry bulk, bulk liquid, general cargo and container cargo. Passenger ships use one of the fruit terminal berths when calling at Port Elizabeth. A total of up to 1 000 vessels a year use the port facilities.

The container terminal has three berths with a storage area of 22 hectares. The bulk terminal has six berths and a tanker berth, there are also tug, fishery and trawler jetties.

Figure 20 Area Map showing Port Elizabeth and Coega port areas.

Products handled within the port include: manganese ore, petroleum products and vehicles for the motor industry. The fishing industry also makes use of the port. There are no major ship repair facilities although a slipway is available for small vessel use. In the future some of the port's present commercial activity may be lost to the new, nearby port of Ngqura (Coega).

There are two white refined petroleum products that come ashore at the Dom Pedro Terminal. It has a 56 000 t storage capacity and is usually at 50% operating volume. Usually 2 to 3 vessels per month offload product at the terminal (usually part loads), and this offloaded volume can fluctuate throughout the year. Astron Energy is the housekeeper for all terminal activities taking place at Port Elizabeth. Partners are Engen, BP, Total and Shell. Astron Energy are responsible for all operations and maintenance of equipment and pipelines at Port Elizabeth. There are two 250 mm pipelines running 1.3 km from the marine terminal to the storage tanks. The maximum permissible cargo discharge rate for white oils is 550 m^3 per hour.

In July 2016 the first offshore bunkering service in South African waters started in Algoa Bay. Aegean Marine Petroleum Network operate their bunkering vessel MT LEFKAS from Port Elizabeth supplying IFO380 and MGO.

The entrance channel is maintained at a depth of 14.5 m and has a width of 310 m. Vessels using the port are constrained to 11 m draught for passenger and dry cargo vessels, 11.2 m for container ships, 12.1 m for ore carriers and 9.6 m for tankers. Vessels can anchor outside the port in Algoa Bay as long as the approaches to the entrance channel are kept clear.

TNPA's equipment stockpile for Port Elizabeth is shown in Figure 21. For further details on the TNPA equipment see Equipment Section (P.88) and Appendix 1 Equipment on Site (P.156).

Figure 21 Port of Port Elizabeth Aerial Photograph showing the TNPA Stockpile location.

Ngqura (Coega)

The port of Ngqura (Coega) is South Africa's most modern and recent port (Figure 22). It is situated at the mouth of the Coega river, 20km north-east of Port Elizabeth. The port has six berths: three for containers, two for dry bulks and one for liquid bulks. A fourth berth for containers has already been contructed to allow Ngqura extra capacity in the future. Future long-term enlargement of the port will involve additional berth development up the Coega River and along Algoa Bay. It is believed to be one of the fastest growing ports in the world.

Ngqura port was developed as a deepwater container ship transhipment hub and therefore it is capable of handling the largest container ships. The port received 453 cargo vessels in 2017/2018, handling 13.830 million tonnes of cargo and is forecast in the next 30 years to handle 110 million tonnes per year. The port is expected to handle exports of manganese and magnetite ore and other minerals in the near future.

It has two anchorage areas shared with the Port of Elizabeth. Offshore vessel bunkering and ship-to-ship bunkering takes place within the port. There are seven bunker barges in Ngqura .

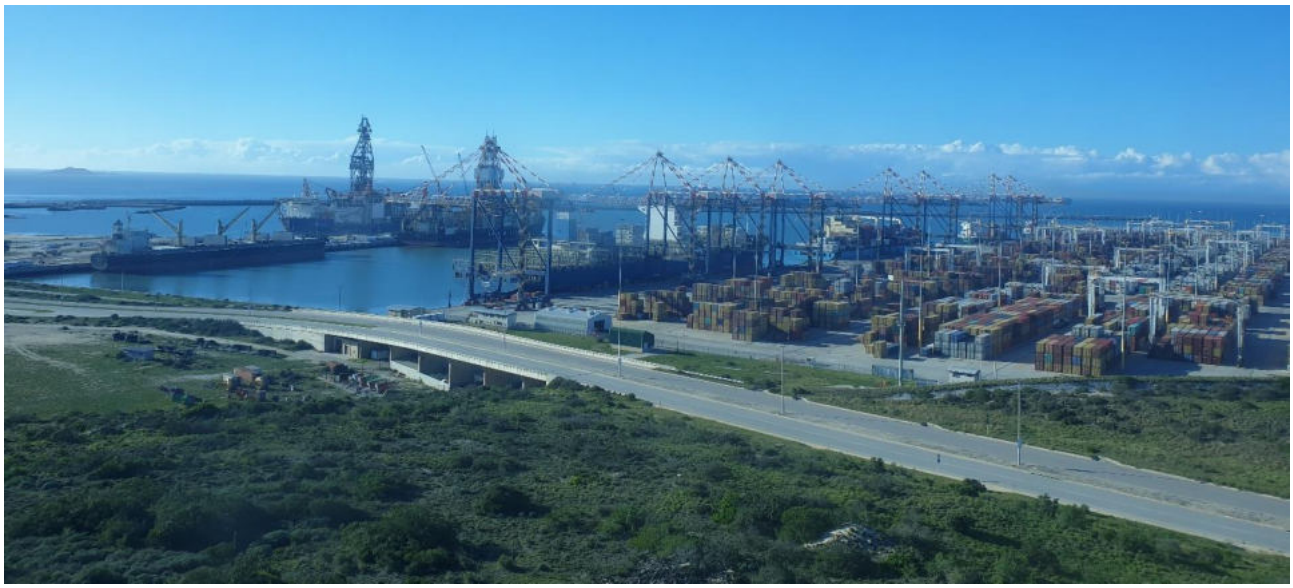


Figure 22 Ngqura Terminal.

TNPA's equipment stockpile for Port Elizabeth is shown in Figure 21. For further details on the TNPA equipment see Equipment Section (P.88) and Appendix 1 Equipment on Site (P.156).

Figure 23 Port of Ngqura Aerial Photograph showing the TNPA Stockpile location.

Oil Characteristics

Table 23 lists the Port Elizabeth oils used or handled.

Table 23 Port Elizabeth Oil Inventory

Location	Oil Type	Volume	Characteristics
Dom Pedro Terminal			
Tank 1	Petrol	56,000 m³	Specific Gravity: 0.720 – 0.770 Viscosity: No data available
Tank 2	Diesel		Specific Gravity: 0.802 - 0.844 Viscosity: 2.2 cSt – 5.3 cSt @ 40°C (104°F)
Various	Hydraulic oil	Dependant on equipment on board. < 5 m3	°API: <35 Viscosity: 100 cSt @ 30oC
Aegean Marine Petroleum – Algoa Bay			
Fuel 1	MGO	Unknown	Specific Gravity: <0.89 Viscosity: 1.5-6 cSt at 40°C

Fuel 2	IFO 380	Unknown	Specific Gravity: 0.985 Viscosity: 180 cSt at 50 °C

Petrol

Petrol is composed of mainly low-weight components and is highly volatile. Petrol will evaporate and dissolve readily and leave little or no residue. However, many of these low-weight components are toxic and potentially flammable. If inhaled cab be of concern for human health and safety. Petrol is categorised as Group 1 under the ITOPF oil classification.

Diesel

Diesel is a low viscosity distillate fuel and contains a significant proportion of light-ends. This means that evaporation will be an important process contributing to a reduction in mass balance. The specific gravity of diesel is typically in the range of 0.802 – 0.844 (API 35 – 45), viscosity 4 cst/50°C and pour point -36°C. Classified as a Group 2 oil under the ITOPF classification, diesel will spread rapidly on water and should evaporate within a few days after release. Evaporation is enhanced by higher wind speeds, higher air and sea temperatures. A small percentage may also dissolve in water. This readiness to evaporate brings about additional concerns regarding explosive risks in the event of an accidental release.

Marine Gas Oil

Marine Gas Oil (MGO) describes marine fuels that consist exclusively of distillates. Distillates are all those components of crude oil that evaporate in fractional distillation and are then condensed from the gas phase into liquid fractions. MGO usually consists of a blend of various distillates. It has a boiling point > 170 °C, flash point of > 60 °C, boiling point of <-7 °C, upper explosion limit of 7% and lower explosion limit of 0.6%. Its density at 20 °C is 0.8900 kg/m^3 and kinematic viscosity at 40 °C is 11 mm^2/s. MGO typically evaporates and disperses into the water column readily.

Intermediate Fuel Oil

Intermediate Fuel Oil (IFO) can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61°C and boiling point > 204 °C. Its density at 20°C is 0.9850 g/cm^3 and kinematic viscosity of 180 mm^2/s at 50°C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Hydraulic oil

Hydraulic oil (specific gravity 0.88 g/cm3, °API < 35, viscosity 100 cSt @ 30°C, pour point < 0°C, flash point >60°C) is a relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Hydraulic oil has a low volatility and moderate flash point, so there is no major safety issue when dealing with this oil. However, this oil is fairly persistent in the environment. Expect limited spread and minimal loss

through evaporation and natural dispersion. The action of mixing energy on hydraulic oil is likely to produce a frothy emulsion.

Wind and Current

Wind

A wind rose diagram is a tool which graphically displays wind speed and wind direction at a particular location over a period of time. Figure 24 Wind Rose for Port of Elizabeth shows the predominant wind speeds and directions annually for port Elizabeth taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10m above the sea surface.

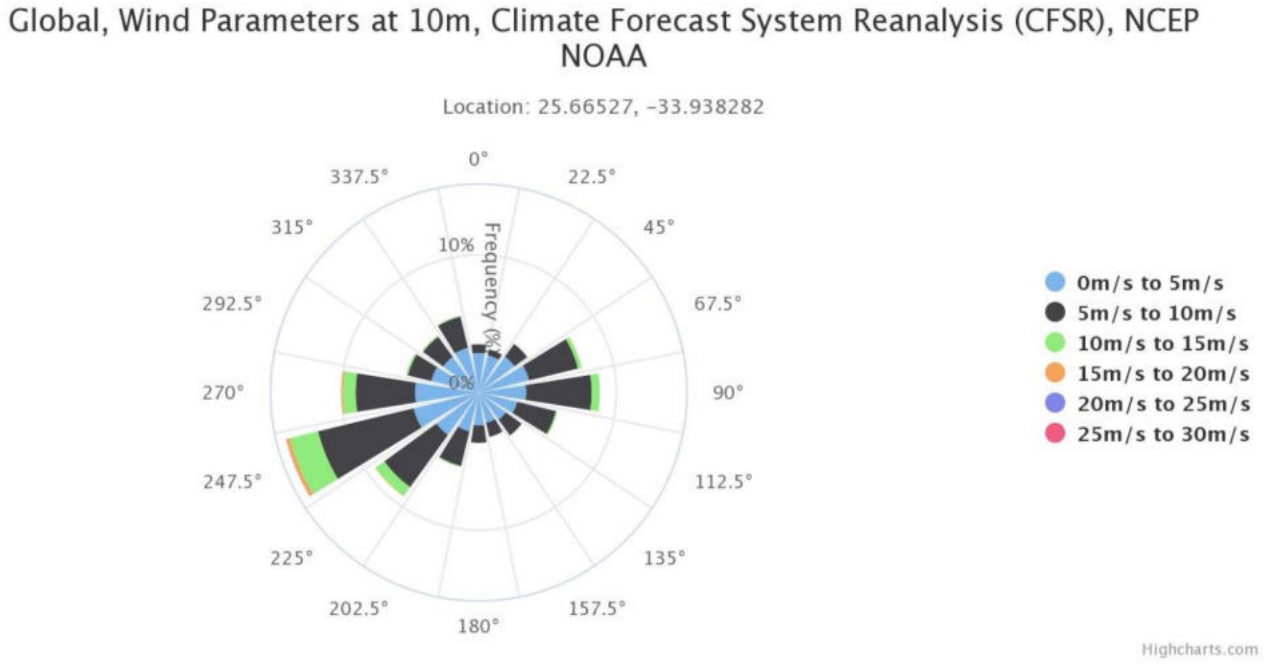


Figure 24 Wind Rose for Port of Elizabeth.

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant strongest winds in the Port of Elizabeth area are from west, west-southwest and northwest in summer and southwest, west-southwest and east in Winter.

For the predominate wind direction for the average year (west-southwest), 12% of the total time the wind blows less than 10 m/s and 2% of the year the wind blows above 10 m/s. 94% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Based on this differing guidance it suggests that dispersant application and containment and recovery are feasible response techniques for oil spills in Port Elizabeth and should be attempted if safe and practical to do so.

Current

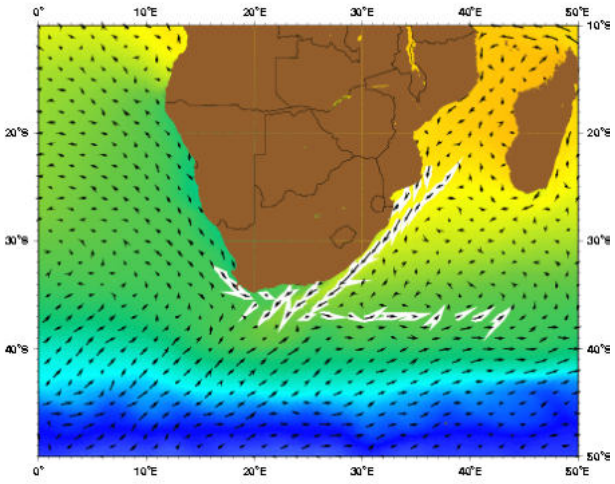


Figure 25 The Agulhas Current.
Source: www.oceancurrents.rsmas.miami.edu

The Agulhas Current flows down the east coast of Africa from 27°S to 40°S. Like other western boundary currents, the Agulhas Current is quite fast. At the surface, it can reach maximum speeds of 3.8Kts. As one of the major currents in the Southern Hemisphere, the Agulhas Current system transports large volumes of water. As the Agulhas Current reaches the southern tip of the continental shelf of Africa, it begins to turn toward the west.

Marine currents near Port Elizabeth travel from the North East towards the South West.

Environmental and Socioeconomic Sensitivities

The main sensitivities as identified within the Dias Zone Coastal Oil Spill Contingency Plan are as follows:

- Offshore Islands, such as St Croix and Bird Island, which are breeding sites for endangered and threatened species such as penguins, gannets, cormorants and other sea birds
- Estuaries and lagoons and associated navigable rivers which are important for bait organisms, fish, water birds and recreational amenities
- Marine reserves and sanctuaries
- Spawning areas for species such as anchovy and sole
- Algoa Bay is a calving area for the southern right whales, and otters are common along the coast
- Recreational amenities such as popular beaches, tidal pools, surfing and sailing areas.
- Commercial considerations such as oyster and seaweed collection, rock lobster catches, demersal and linefish landings.

The main protection priorities for Port Elizabeth are listed in Table 24.

Table 24 Protection Priorities Port Elizabeth

Type of Sensitivity	Name (s)	Details
Estuaries	Gamtoos, Swartkops, Great Fish, Sundays, Bushman's, Kariega, Kowie, Boknes, Riet Kleinemonde	Gamtoos, Bushmans river: Estuary support numerous fish, bird and bait organisms. Salt mashes Swartkops river: Cultivated oysters, large number of waders, recreational area. Intake for salt works. Sundays River: coastal area Damara Tern breeding sites.
Seabirds	St Croix and Bird Island; Brenton Jahleel	Nature reserves with large seabird populations: penguins, gannets cormorants etc.)

Resources Available to Site

Equipment

OSR equipment is held by TNPA and Spilltech (on behalf of Astron Energy) in Port Elizabeth. TNPA equipment is stored in two locations, Port Elizabeth and Ngqura, see Figure 23 and Figure 22. TNPA have a contract for Tier 1 response with Extreme Projects. Spilltech equipment is stored offsite in a large warehouse approx. 5 km from the port.

The TNPA stockpiles are based on a harbour containment and recovery package with the addition of a small work boat. The containment boom is air inflation chamber boom and the recovery device is a weir type, Foilex TDS 200 Sea Skimmer and a Fasttank was available to be used for waste oil storage. Many ancillary items were missing and would be required to set up a safe and effective work site. A list of the TNPA equipment inspected with photos can be found in Appendix 1.

Extreme Projects have a small stockpile of harbour response equipment at Port Elizabeth and Ngqura .

Spilltech have a medium sized warehouse in Port Elizabeth which is used to store a sorbent material, absorbent pads, detergents, skips and hand tools. A shipping container was also loaded with 4 reels of inflation chamber boom and associated ancillaries. A fast response trailer was loaded with sorbent material and PPE. All of the equipment appeared to be in good condition and response ready.

Personnel

There are a mix of terminal operators and Tier 1 responders (from Spilltech) that are available to respond to a spill. These staff have not received any IMO accredited spill response training or client tailored training for the equipment they may be requested to use during a spill.

TNPA staff in Port Elizabeth have not completed any table top exercises or practical deployment exercises in the last 24 months.

Supporting Information: Emergency Response Documents

Robust Contingency Plan and Emergency Plans are essential plans to respond to an oil spill effectively. These documents need to include robust systems and procedures, which allow for a good oil spill response.

The TNPA Port Oil Spill Contingency Plan covers the preparatory activities required prior to an incident and the response actions to be initiated after an oil spill has occurred in the Port of Port Elizabeth. The plan includes: Initial actions, callout and contacts, stages of spill clean-up, equipment available, areas of high risk, role specific actions, tactical response to oil spills at the various berths, and clean up procedures in different situations: on land, at sea etc.

Gaps identified for this section are described in the Gap Analysis.

Risk Assessment

Risk Register

Table 25 Oil Spill Risk Scenarios – Port Elizabeth

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[11]**
1	Mechanical equipment on vessel or jetty	Small operational spill	Petrol or Diesel	< 10 litres	Minimal – sheen on water surface	5	1	L	• Monitoring, contain on deck/land where possible, assisted natural dispersion.
2	Vessel	Bilge pumping	Petrol or Diesel	< 500 litres	Sheen and oiling around pumping location and surrounding area	4	2	M	• Monitoring and assisted natural dispersion.
3	Loading/ Offloading	Loading arms minor failure	Petrol or Diesel	1 m^3	Sheen and oiling around jetty and surrounding area.	3	2	L	• Monitoring and assisted natural dispersion of light products.
4	Loading/ Offloading	Loading arms major failure	Petrol or Diesel	19 m^3 based on an estimated pumping rate of 550 m^3 / hour x 2 mins to shut down.	Affecting port operations and possible spread outside port Elizabeth.	2	2	L	• Monitoring and trajectory analysis to predict spill spread. • Assisted natural dispersion (whilst gas monitoring).

[11] For more information on these techniques refer to Appendix 2

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[11]
5	Pipeline from jetty to storage tank	Pipeline failure with full loss of line volume	Petrol or Diesel	255 m^3 based on 250 mm pipeline of 1300 m length	Sheen and oiling around jetty and closely surrounding area.	2	2	L	• Monitoring and assisted natural dispersion. • Limit volume of oil that reaches the water.
6	Vessel – shore to ship refuelling	Fuel transfer spill: leaking valve whilst refuelling vessel	MGO or IFO 380	< 1 m^3	Oiling around jetty and immediate surroundings.	3	2	L	• Assisted natural dispersion if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for IFO.
7	Vessel – shore to ship refuelling	Fuel transfer spill: split hose whilst refuelling vessel	MGO or IFO 380	25 m^3	Could cause oiling within wider port area.	2	2	L	• Assisted natural dispersion if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for IFO. • Potential shoreline clean-up.
8	Vessel – offshore ship to ship refuelling	Fuel transfer spill: leaking valve whilst refuelling vessel	MGO or IFO 380	< 1 m^3	Oiling around spill location and immediate surroundings of Algoa Bay.	3	2	L	• Assisted natural dispersion if MGO. • Unlikely to be able to contain in time for containment and recovery. • Potential shoreline clean-up.
9	Vessel – offshore ship to ship refuelling	Fuel transfer spill: split hose whilst refuelling vessel	MGO or IFO 380	25 m^3	Spread from bunkering site to Algoa Bay and wider Port Elizabeth area.	2	2	L	• Assisted natural dispersion if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for IFO. • Potential shoreline clean-up.
10	Container ship / cargo vessel	Grounding/ collision with loss of fuel	MGO or IFO 380	500 m^3	Spread from accident site to wider port area.	3	3	M	• Monitoring and surveillance to determine spill spread.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[11]
		from storage tank(s)			Severity dependant on spill location and spread.				• Assisted natural dispersion if MGO. • Containment and recovery with mechanical recovery or vacuum trucks for MFO. • Potential shoreline clean-up.
11	Bunkering tanker MT Lefkas in Algoa Bay	Grounding / collision in Algoa Bay with loss of oil from storage tanks.	MGO or IFO 380	6 644 m^3	Major impact in and around spill location and surrounding area. Could affect marine reserves/ endangered bird species nesting and feeding sites. Potential for oil to travel significant distance. Will affect tourism.	2	4	M	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
12	Tanker – in port	Grounding / collision with loss of oil from storage tanks.	Diesel or petrol	100 000 m^3	Major impact in and around spill location and surrounding area. Potential for oil to travel great distance. Will affect tourism.	2	4	M	• Monitoring and surveillance to determine spill spread. • Containment and recovery with oleophilic skimmer. • Sorbent boom sweeps. • Potential port clean-up.
13	Tanker - outside port	Grounding / collision with loss of oil from storage tanks.	Diesel or petrol	100 000 m^3	Major impact in and around spill location and surrounding area. Could affect endangered bird species nesting and feeding sites but less likely to than a heavier	2	4	M	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[11]
					oil as should disperse readily. Potential for oil to travel great distance. Will affect tourism.				
14	Tanker – place of refuge	Place of refuge for damaged tanker, with loss of oil from storage tanks.	MGO or IFO 380	100 000 m^3	Major impact in and around spill location and surrounding sites. Could affect marine reserves/endangered bird species nesting and feeding sites. Potential for oil to travel great distance. Will affect tourism.	1	5	H	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
15	Fishing Vessel	Fire / collision / grounding / sinking inside harbour	Diesel	10 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
16	Fishing Vessel	Fire / collision / grounding / sinking outside harbour	Diesel	10 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.
17	Recreational Yachting	Fire / collision / grounding /	Diesel	5 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[11]
		sinking inside harbour							
18	Recreational Yachting	Fire / collision / grounding / sinking outside harbour	Diesel	5 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.

Risk Assessment Summary

The Risk Assessment Matrix shows that TNPAs highest risk in Port Elizabeth comes from a VLCC tanker collision or grounding with major loss of product outside the port area. Port Elizabeth's greatest environmental sensitivities lie outside the main port area on the offshore Islands of St Croix and Bird Island, an incident near the harbour breakwater could spread to sensitive areas. Port operations and tourism would be affected in a large spill.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium or low risk.

Table 26 Risk Matrix for Port Elizabeth scenarios

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**			15, 17		1
	2		4, 5, 7, 9	3, 6, 8, 16, 18	2	
	3			10		
	4		12, 13, 11			
	5	14				

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

Table 27 Gaps Identified in Port Elizabeth

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	Gas monitors were not seen in any response equipment stockpile.	Tankers will have gas monitors on board as standard, which would warn personnel in the vicinity of noxious or flammable gasses above safe limits. However, response personnel could be exposed to vapours above safe limits if working away from these areas.	Evaluate potential oil spill working areas that are away from fixed gas monitor areas. Have suitable portable gas monitors for response teams.	**PE1**
Major	TNPA have no written procedures on how to operate equipment.	Standard operating procedures and work instructions reduce the risk of an accident when carrying out tasks.	Oil spill equipment owners should arrange work instructions for any mechanical equipment they hold.	**PE2**
Equipment				
Moderate	Granular sorbents in stock at Spilltech were described as a response technique for on water recovery of oil.	Granular sorbents are suitable for deck and land spills but are not recommended for on water response. Heavy oil can adhere to the sorbent and cause it to sink and not be recovered. In general, sorbents are suitable for light oiling with light to medium oils and where used on water should be contained (in a boom, 'tea-bag' or pad).	Limit use of sorbents for on-water response to suitable spills, attempt recovery of liquid oil wherever possible. Only use granular sorbents for land/deck spills. Carry out staff training for oil spill responders.	**PE3**
Moderate	No equipment available for the collection and recovery of free floating mobile oil.	Response techniques from TNPA contractor focussed on containment with fence boom and sorbent use. No vessel towable boom was seen.	Ensure oil spill response provision within Port Elizabeth includes collection of free oil by skimmers.	**PE4**
Moderate	A Foilex weir skimmer was held at TNPA facilities but there were not any other response ready skimmers.	The Foilex skimmer appeared well maintained (no maintenance records were presented) and is suitable for heavier oils as it has a strong pump that can pump oils that other skimmers cannot. But it is not suitable for lighter oils such as MGO, petrol or diesel.	Arrange oleophilic skimmer for large light to medium oil spill (mop, disk or brush).	**PE5**
Moderate	Lack of suitable equipment held by TNPA.	The equipment stockpile held by TNPA in Port Elizabeth and Ngqura is not sufficient to respond to a spill any greater than 25m³.	Enlarge the equipment stockpile held at Port Elizabeth and broaden the type of equipment held.	**PE6**

Gap Classification	Gap	Explanation	Recommendation	Ref #
			Suitable ancillaries should also be held ready to be deployed in the event of a spill.	
Moderate	No dispersant was held at Port Elizabeth.	Dispersant is described as one of the most suitable oil response techniques in the NOSCP. Subject to the dispersant guidance conditions including depth and distance to shore (see Table 4), dispersant would be suitable for a medium viscosity oil spill that will not disperse on its own. Such a spill could come from Port Elizabeth or Algoa Bay operations or from a vessel incident with a passing ship in the area. No dispersant or spray equipment is available at Port Elizabeth. A test spray should always be conducted before large scale dispersant operations.	Arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline. The sensitivities surrounding Port Elizabeth would justify it being one of the strategic points.	**PE7**
Moderate	No protective booming is in place during bunkering operations.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Reduce bunkering risk by using a H booms/flexible booms inserted between the ship and fuel barge fore and aft to collect any spilt oil (Refer to Appendix 2 Equipment Recommendations) . A way of recovering the oil (e.g. skimmer) would also be needed.	
Responders				
Moderate	No responders trained in dispersant use are available in Port Elizabeth.	Dispersant is described as a primary response option in the OSCP yet there are no responders in the Port Elizabeth area trained in its use.	Train staff in dispersant spraying techniques as part of organising a national capability.	**PE8**
Moderate	No trained responders for recovery of free floating oil within or outside the port area.	Response techniques from TNPA contractor focussed on containment with fence boom and sorbent use. No personnel experienced in vessel towable boom were on call.	Identify who should be responsible for oil spill containment and recovery within the Port Elizabeth area. Train on call staff in the use of these techniques.	**PE9**

Gap Classification	Gap	Explanation	Recommendation	Ref #
Moderate	Tug captains are restricted to operate within port limits or sheltered port limits only.	The certificate of competency required to operate outside port limits requires the candidate to meet criteria assessed by the maritime authority. The type of operations a port vessel conducts often does not give the crew the needed experience to achieve this certification. Some tug masters certificates are endorsed sheltered port operations only, which means they are not allowed to proceed to the outer anchorage, or sea side of the port zone. The ports authorities in South Africa only require a Port Operation Only certificate of competency for their tug crews, as a result most of their tug masters are not licensed by the maritime safety authority to proceed beyond the boundaries of a port that they are operating in.	Vessel masters able to respond to outer port waters to be identified. Availability to be tested during a table top exercise.	**PE10**
Major	No trained aerial surveillance observers.	It is thought that helicopters could be chartered in a spill to provide a platform for aerial surveillance but there are no agency or operator staff trained in surveillance.	Train a group of port and /or operator staff in aerial observations of oil spills. Make available in an oil spill.	**PE11**
Moderate	No evidence of IMS training of oil spill responders.	The NOSCP states that all role players must be Incident Management System trained and competent to the following levels: IMS 100: every person that would be playing a role in any of the response functions, including the command- and general staff. IMS200: functional heads, deputies and heads. IMS 300 – 400: the incident commander, functional heads, deputies and heads.	Deliver IMS training to all responders including TNPA staff.	**PE12**
Major	Lack of appropriate training on oil spill response for operator level oil spill responders.	It was unclear who was trained to which level to fulfil each response role. There was a lack of awareness of the most appropriate techniques to use- for example an overuse of sorbents for on-water spills.	Conduct training needs analysis. Implement training programme.	**PE13**
Major	No evidence of oil spill exercises.	Oil spill exercises keep responders up to date with skills and allow for continuous improvement by identifying improvements that can be made.	Run oil spill exercises to identify knowledge gaps. Drills to be run every 12 months. Table top exercises to be run every 12	**PE14**

Gap Classification	Gap	Explanation	Recommendation	Ref #
			months. Functional exercises to be run every 24 months.	
Additional Support				
Minor	TNPA Port Elizabeth Harbour Plan	Plan is missing: a clear area of jurisdiction defined, detailed waste management strategy, details of type of training / and exercises conducted and their frequency.	Include gaps to make more complete.	**PE15**
Minor	No TRP/SRPs	In coastal plan there are all different sites listed, with protection priorities. These provide some information on possible booming sites and suitable response techniques but have some limitations (eg not user friendly to response team leader; lack site access information).	Develop Tactical Response Plans for high priority sites.	**PE16**
Other				
Major	Lack of understanding of jurisdictional boundary and commitment to respond outside of operational areas.	TNPA will not respond to oil spills outside the port limits / breakwater.	DEFF / SAMSA to clarify jurisdiction and responsibility for responding to oil spills outside of port limits.	**PE17**

East London

The Port of East London is a river port situated at the mouth of the Buffalo River in the East Cape Province. On the West Bank is a car terminal capable of a throughput of 50 000 units per year due to increase to 180 000 vehicles per year. On the East Bank is a multipurpose terminal used for container ships and is capable of handling 90,000 TEU's a year. The Port of East London has a dry dock capable of handling ships of up to 200 m and a maximum beam of 24.8 m. In total there are 12 commercial berths plus a repair quay of 110 m, a pilot jetty and fishing jetty. Six of the berths lie on the West Bank. The port has a total of 2 410 m of quayside.

The entrance to the Port of East London is dredged to 14 m, 170 m width at the narrowest part and a draught alongside the berths ranging from 8.5 m to 10.4 m. The port can accommodate vessels of up to 245 m. there is an outer anchorage approximately 1 nm east of the southern breakwater, this is an exposed position.

Figure 26 East London Area Map.

The marine terminal stores and distributes refined petroleum products. The petroleum products that are stored at the terminal include petrol, diesel, illuminating paraffin, dual purpose kerosene and JET A1 fuel. All petroleum products are received from ships in the port via a pipeline to the terminal. From the marine terminal there are 4 discharging lines to petroleum company depots.

Within the port there are three hose manifolds presented to the ships, two lines for refined products (the red line and the green line) and one for black oils and HFO. The red and green lines have four, 8'' marine hoses with 9 bar maximum back pressure. And the HFO line is 7 bar maximum back pressure.

The length of the red and green line is 2 000 m, whilst the shore pipe line for the HFO leads from the berth to the HFO tank 820 m from the berth within the Port area.

Figure 27 Port of East London.

Figure 28 TNPA East London Equipment Stockpile.

Oil Characteristics

Table 28 East London Oil Inventory

Location	Oil Type	Volume	Characteristics
East London			
Product / cargo 1	Petrol	Unknown	Specific Gravity: 0.720 – 0.770 Viscosity: ~3 cSt @ 18°C
Product / cargo 2	Diesel	Unknown	Specific Gravity: 0.802 - 0.844 Viscosity: 2.2 cSt – 5.3 cSt @ 40°C (104°F)
Fuel 1	MGO	Unknown	Specific Gravity: <0.89 Viscosity: Viscosity: 1.5-6 cSt at 40°C
Fuel 2	IFO or HFO	Unknown	Specific Gravity: ~0.985 Viscosity: ~180 cSt at 50 °C

Petrol

Petrol is composed of mainly low-weight components and is highly volatile. Petrol will evaporate and dissolve readily and leave little or no residue. However, many of these low-weight components are toxic and potentially flammable. If inhaled cab be of concern for human health and safety. Petrol is categorised as Group 1 under the ITOPF oil classification.

Diesel

Diesel is a low viscosity distillate fuel and contains a significant proportion of light-ends. This means that evaporation will be an important process contributing to a reduction in mass balance. The specific gravity of diesel is typically in the range of 0.802 – 0.844 (API 35 – 45), viscosity 4 cst/50°C and pour point -36°C. Classified as a Group 2 oil under the ITOPF classification, diesel will spread rapidly on water and should evaporate within a few days after release. Evaporation is enhanced by higher wind speeds, higher air and sea temperatures. A small percentage may also dissolve in water. This readiness to evaporate brings about additional concerns regarding explosive risks in the event of an accidental release.

Marine Gas Oil

Marine Gas Oil (MGO) describes marine fuels that consist exclusively of distillates. Distillates are all those components of crude oil that evaporate in fractional distillation and are then condensed from the gas phase into liquid fractions. MGO usually consists of a blend of various distillates. It has a boiling point > 170 °C, flash point of > 60 °C, boiling point of <-7 °C, upper explosion limit of 7% and lower explosion limit of 0.6%. Its density at 20 °C is 0.8900 kg/m^3 and kinematic viscosity at 40 °C is 11 mm^2/s. MGO typically evaporates and disperses into the water column readily.

Intermediate Fuel Oil

Intermediate Fuel Oil (IFO) can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61^{o}C and boiling point > 204 °C. Its density at 20^{o}C is 0.9850 g/cm^{3} and kinematic viscosity of 180 mm^{2}/s at 50^{o}C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Heavy Fuel Oil

Heavy Fuel Oil (HFO) is a mixture of the heavy residual oil, left after the lighter components of crude oil are removed during the refining process, this is then blended with lighter oils to meet specifications for viscosity, pour point and specific gravity. HFOs can also be a blend of heavy and light oils but they generally contain more of the heavier components. In the MARPOL Marine Convention of 1973, heavy fuel oil is defined either by a density of greater than 0.9 g/cm³ at 15°C or a kinematic viscosity of more than 180 cSt at 50°C. Heavy fuel oils have large percentages of heavy molecules such as long-chain hydrocarbons and aromatics with long-branched side chains.

Wind and Current

Wind

A wind rose diagram is a tool which graphically displays wind speed and wind direction at a particular location over a period of time. Figure 29 Wind Rose for East London shows the predominant wind speeds and directions annually for East London taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10m above the sea surface.

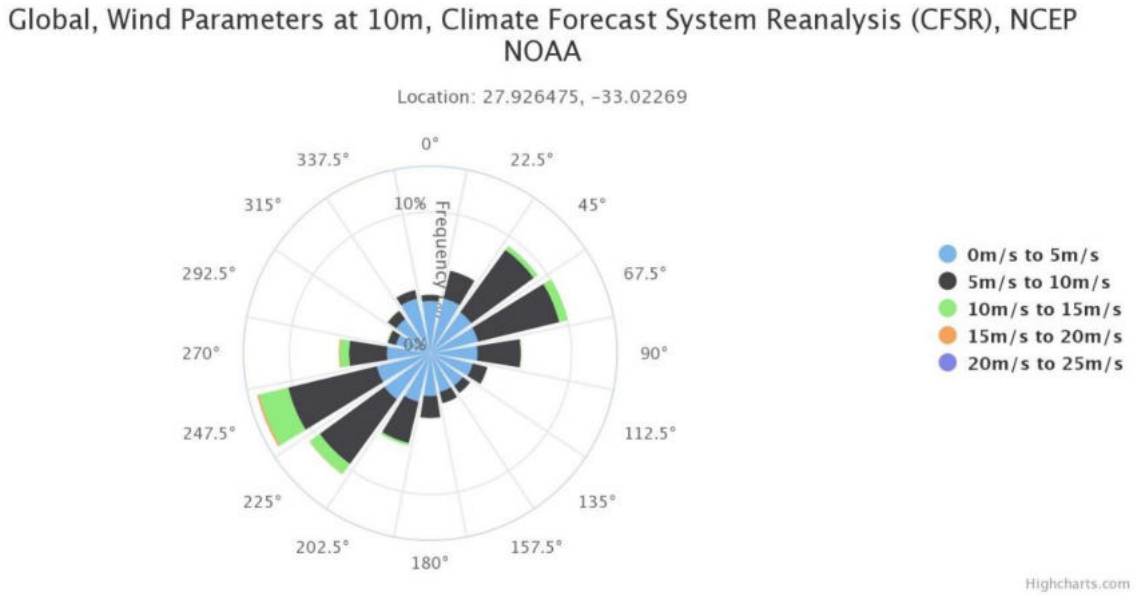


Figure 29 Wind Rose for East London

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant winds in the East London area are from the south-southwest in summer and east-northeast in Winter.

Based on the yearly dominant wind direction (south-southwest) 10% of the total time the wind blows less than 10 m/s and 2% of the year the wind blows above 10 m/s. 95% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Based on this differing guidance it suggests that dispersant application and containment and recovery are feasible response techniques for oil spills in East London and should be attempted if safe and practical to do so.

Current

Marine currents near East London travel from the North East towards the South West.

Environmental and Socioeconomic Sensitivities

The main sensitivities within the Amathole Zone Coastal Oil Spill Contingency Plan are as follows:

- Important habitats for birdlife in particular, migrant waders at the mouth of the Keiskamma River.
- Oiled penguins, which forage offshore and periodically come ashore in this zone.
- A number of estuaries and lagoons which are important for bait organisms, fish, water birds and recreational amenities.
- Coastal Forest Reserves.
- Spawning areas for species such as anchovy and sole.
- Recreational amenities such as popular beaches, tidal pools, surfing, angling and sailing areas.
- Commercial considerations such as shellfish and seaweed collection, demersal and linefish landings.
- Seawater intakes for fish farms, aquarium and City sanitation system.

The main protection priorities for East London are listed in Table 29.

Table 29 Protection Priorities East London

Type of Sensitivity	Name (s)	Details
Estuaries	Keiskamma Tyolomqa Nahoon Gqunube Kwelera Great Kei	These estuaries are the most important in this area as they are permanently open. Mangroves (Avicennia marina) occur in most of these estuaries and would be sensitive to protection measures affecting salinity levels. Keiskamma salt marsh, for example, provides a vital estuarine ecosystem for 81 species of fish and bird species. Many of the estuaries are closed but may breach after heavy rain or be overtopped during high spring tides which could create serious problems. These estuaries are also often open during the period of most vulnerability; i.e. during times of greater onshore wind / waves.
Harbours	The Port of East London on the Buffalo River.	The river mouth is stabilised by two breakwaters and kept open by dredging. The harbour is used for ocean going vessels, fishing boats and yachts.

Resources Available to Site

Equipment

OSR equipment in East London is held by TNPA, the Buffulo City Fire Dept, and Spilltech. The TNPA equipment is stored within the port on the west Bank as shown in Figure 28 TNPA East London Equipment Stockpile. Spilltech equipment is stored offsite in a small warehouse approximately 2 km from the port.

The TNPA stockpile is based on a harbour containment and recovery package with the addition of a small work boat. The containment boom is an air inflation chamber boom and the recovery device is a small weir type skimmer. Many ancillary items were missing and would be required to set up a safe and effective work site. A list of the TNPA equipment inspected with photos can be found in Appendix 1.

Spilltech have a store of sorbent material, absorbent pads, detergents and hand tools. A fast response trailer was loaded with sorbent material and PPE. All of the equipment appeared to be in good condition and response ready.

Personnel

TNPA staff have not received any IMO accredited spill response training or client tailored training for the equipment they may be requested to use during a spill. TNPA staff in East London have not completed any table top exercises or practical deployment exercises in the last 24 months.

Supporting information: Emergency Response Documents

Robust Contingency Plan and Emergency Plans are essential plans to respond to an oil spill effectively. These documents need to include robust systems and procedures, which allow for a good oil spill response.

The TNPA Port Oil Spill Contingency Plan covers the preparatory activities required prior to an incident and the response actions to be initiated after an oil spill has occurred in the Port of East London. The plan includes: reporting of oil spills, initial actions, role and responsibilities, callout and contacts, tiers of response, response actions and equipment available.

Gaps identified for this section are described in the Gap Analysis.

Risk Assessment

Risk Register

Table 30 Oil Spill Risk Scenarios – East London

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[12]**
1	Mechanical equipment on vessel or jetty	Small operational spill	Petrol or diesel	< 10 litres	Minimal – sheen on water surface	5	1	L	• Monitoring, contain on deck/land where possible, assisted natural dispersion.
2	Vessel	Bilge pumping	Petrol or diesel	< 500 litres	Sheen and oiling around pumping location and surrounding area	4	2	M	• Monitoring and assisted natural dispersion.
3	Offloading	Loading arms minor failure	Petrol or diesel	1 m^3	Sheen and oiling around jetty and surrounding area.	3	2	L	• Monitoring and assisted natural dispersion of light products.
4	Offloading	Loading arms major failure	Petrol or diesel	25 m^3	Affecting port operations and possible spread outside East London.	2	2	L	• Monitoring and trajectory analysis to predict spill spread. • Assisted natural dispersion (whilst gas monitoring).
5	Pipeline from quayside to storage tank	Pipeline failure with full loss of line volume	Petrol or diesel	250 m^3	Sheen and oiling around jetty and closely surrounding area.	2	2	L	• Monitoring and assisted natural dispersion. • Limit volume of oil that reaches the water.

[12] For more information on these techniques refer to Appendix 2

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[12]**
6	Vessel – shore to ship refuelling	Fuel transfer spill: leaking valve whilst refuelling vessel	MGO, IFO or HFO	< 1 m^3	Oiling around jetty and immediate surroundings.	3	2	L	• Monitor and attempt mechanical recovery. Oil should collect in natural collection points in port.
7	Vessel – shore to ship refuelling	Fuel transfer spill: split hose whilst refuelling vessel	MGO, IFO or HFO	25 m^3	Could cause oiling within wider port area.	2	2	L	• Monitoring to determine spill spread. • Containment and recovery with mechanical recovery or vacuum trucks. • Potential shoreline clean-up.
8	Container Ship / Cargo Vessel	Grounding/ collision with loss of fuel from storage tank(s)	MGO, IFO or HFO	500 m^3	Spread from accident site to wider port area. Severity dependant on spill location and spread.	3	3	M	• Monitoring and surveillance to determine spill spread. • Containment and recovery with mechanical recovery or vacuum trucks. • Likely shoreline clean-up.
9	Tanker – in port	Grounding / collision with loss of cargo from storage tanks.	Petrol or diesel	100 000 m^3	Major impact in and around spill location and surrounding area. Potential for oil to travel great distance.	2	4	M	• Monitoring and surveillance to determine spill spread. • Depending on oil type and weathering, attempt: o Containment and recovery with oleophilic skimmer. o Assisted natural dispersion. o Sorbent boom sweeps. • Potential port clean-up.
10	Tanker - outside port	Grounding / collision with loss of cargo	Petrol or diesel	100 000 m^3	Major impact in and around spill location and surrounding area.	2	4	M	• Monitoring and surveillance to determine spill spread. • Depending on oil type and weathering, attempt:

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[12]
		from storage tanks.			Potential for oil to travel great distance.				○ Containment and recovery with oleophilic skimmer. ○ Assisted natural dispersion. ○ Sorbent boom sweeps. • Potential shoreline clean-up.
11	Tanker – place of refuge	Place of refuge for damaged tanker, with loss of cargo from storage tanks.	Petrol or diesel	100 000 m^3	Major impact in and around spill location and surrounding sites. Could affect marine reserves/endangered bird species nesting and feeding sites. Potential for oil to travel great distance. Will affect tourism.	1	4	M	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.
12	Fishing Vessel	Fire / collision / grounding / sinking inside harbour	Diesel	10 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
13	Fishing Vessel	Fire / collision / grounding / sinking outside harbour	Diesel	10 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.
14	Recreational Yachting	Fire / collision / grounding /	Diesel	1 m^3	Sheen and oiling around pontoon and	3	1	L	• Monitoring and assisted natural dispersion.

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[12]**
		sinking inside harbour			closely surrounding area.				
15	Recreational Yachting	Fire / collision / grounding / sinking outside harbour	Diesel	1 m^3	Sheen and oiling in immediate area.	3	1	L	• Monitoring and assisted natural dispersion.

Risk Assessment Summary

The risk assessment matrix shows that TNPA's highest risk in East London comes from a vessel collision or grounding and spilling fuel oil from bunker tanks. A passing ship scenario, or an incident involving a tanker offshore and the port receiving the vessel as a port of refuge also rank as medium risk scenario.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium, or low risk.

Table 31 Risk matrix for East London scenarios

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**	1		12, 14, 15		
	2		4, 5, 7	3, 6, 13	2	
	3			8		
	4	11	9, 10			
	5					

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

Table 32 Gaps Identified in East London

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	Portable gas monitors were not seen in any response equipment stockpile.	Tankers will have gas monitors on board as standard, which would warn personnel in the vicinity of noxious or flammable gasses above safe limits. However, response personnel could be exposed to vapours above safe limits if working away from these areas.	Have suitable portable gas monitors for response teams.	**EL1**
Major	TNPA have no written procedures on how to operate equipment	Standard operating procedures and work instructions reduce the risk of an accident when carrying out tasks.	Oil spill equipment owners should arrange work instructions for any mechanical equipment they hold.	**EL2**
Equipment				
Moderate	Granular sorbents in stock at Spilltech were described as a response technique for on water recovery of oil.	Granular sorbents are suitable for deck and land spills but are not recommended for on water response. Heavy oil can adhere to the sorbent and cause it to sink and not be recovered. In general, sorbents are suitable for light oiling with light to medium oils and where used on water should be contained (in a boom, 'tea-bag' or pad).	Limit use of sorbents for on-water response to suitable spills, attempt recovery of liquid oil wherever possible. Only use granular sorbents for land/deck spills. Carry out staff training for oil spill responders.	**EL3**
Moderate	No equipment available for the collection and recovery of free floating mobile oil.	Response techniques from TNPA contractor focussed on containment with fence boom and sorbent use. No vessel towable boom was seen.	Ensure oil spill response provision within East London includes suitable equipment for the collection of free phase oil with skimmers.	**EL4**
Moderate	Lack of suitable equipment commensurate to the risk held by TNPA.	The equipment stockpile held by TNPA in East London is not sufficient to respond to a spill any greater than 25m³.	Enlarge the equipment stockpile held in East London and broaden the type of equipment held.	**EL5**

Gap Classification	Gap	Explanation	Recommendation	Ref #
Moderate	No dispersant was held in East London	Dispersant is described as one of the most suitable oil response techniques in the NOSCP. Subject to the dispersant guidance conditions including depth and distance to shore (see Table 4), dispersant would be suitable for a medium viscosity oil spill that will not disperse on its own.	Arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline.	**EL6**
Moderate	No protective booming is in place during bunkering operations.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Reduce bunkering risk by using a H booms/flexible booms inserted between the ship and fuel barge fore and aft to collect any spilt oil (Refer to Appendix 2 Equipment Recommendations). A way of recovering the oil (e.g. skimmer) would also be needed.	
Responders				
Moderate	No responders trained in dispersant use are available in East London.	TNPA staff have not received any training in dispersant application or dispersant effectiveness monitoring.	Train staff in dispersant spraying techniques as part of organising a national capability.	**EL7**
Moderate	No trained responders for recovery of free floating mobile oil within or outside the port area.	Response techniques from TNPA contractor focussed on containment with fence boom and sorbent use.	Identify who should be responsible for oil spill containment and recovery within the East London area. Train on call staff in the use of these techniques.	**EL8**
Major	No trained aerial surveillance observers	It is thought that helicopters could be chartered in a spill to provide a platform for aerial surveillance but there are no agency or operator staff trained in surveillance.	Train a group of port and /or operator staff in aerial surveillance. Make available in an oil spill.	**EL9**

Gap Classification	Gap	Explanation	Recommendation	Ref #
Moderate	No evidence of IMS training of oil spill responders	The NOSCP states that all role players must be Incident Management System trained and competent to the following levels: IMS 100: every person that would be playing a role in any of the response functions, including the command- and general staff. IMS200: functional heads, deputies and heads. IMS 300 – 400: the incident commander, functional heads, deputies and heads	Deliver IMS training to all responders including TNPA staff.	**EL10**
Moderate	Tug captains are restricted to operate within port limits or sheltered port limits only.	The certificate of competency required to operate outside port limits requires the candidate to meet criteria assessed by the maritime authority. The type of operations a port vessel conducts often does not give the crew the needed experience to achieve this certification. Some tug masters certificates are endorsed sheltered port operations only, which means they are not allowed to proceed to the outer anchorage, or sea side of the port zone. The ports authorities in South Africa only require a Port Operation Only certificate of competency for their tug crews, as a result most of their tug masters are not licensed by the maritime safety authority to proceed beyond the boundaries of a port that they are operating in.	Vessel masters able to respond to outer port waters to be identified. Availability to be tested during a table top exercise.	**EL11**
Major	Lack of appropriate training on oil spill response for operator level oil spill responders.	It was unclear who was trained to which level to fulfil each response role. There was a lack of awareness of the most appropriate techniques to use- for example an overuse of sorbents for on-water spills.	Conduct training needs analysis. Implement training programme.	**EL12**
Major	No evidence of oil spill exercises.	Oil spill exercises keep responders up to date with skills and allow for continuous improvement by identifying improvements that can be made.	Run oil spill exercises to identify knowledge gaps. Drills to be run every 12 months. table top exercises to be run every 12 months. Functional	**EL13**

Gap Classification	Gap	Explanation	Recommendation	Ref #
			exercises to be run every 24 months.	
Additional Support				
Minor	No TRP/SRPs	In the coastal plan there are different sites listed, with protection priorities. These provide some information on possible booming sites and suitable response techniques but have some limitations.	Add detail to this initial site-specific response information in the coastal contingency plans.	**EL14**
Minor	TNPA Port of East London Oil Spill Contingency Plan	Plan is missing: a clear area of jurisdiction defined, detailed waste management strategy, details of type of training / and exercises conducted and their frequency.	Include recommended actions to fill gaps identified.	**EL15**
Other				
Major	Lack of understanding of jurisdictional boundary and commitment to respond outside of operational areas.	TNPA will not respond to oil spills outside the port limits / breakwater.	DEFF / SAMSA to clarify jurisdiction and responsibility for responding to oil spills outside of port limits.	**EL16**

Durban

Port of Durban

The Port of Durban is South Africa's busiest port handling a broad range of cargoes as well as fishing vessels and ship repair. The port has 43 operational berths some of which are currently being lengthened and deepened to allow them to accommodate container ships of up to 14,000 teu capacity. These 43 berths handle 31% of all import and export containers from all the 8 main South African ports.

The port's entrance channel is 222 m wide at its narrowest point with a draft of 19 m in the outer entrance, shallowing to 16.5 m in the inner channel. Pilotage is compulsory for all vessels from 3 nautical miles north east of the port entrance, a TNPA helicopter performs most pilot transfers, backed up by pilot boat service. Navigation is subject to vessel tracking service (VTS) controlled by TNPA from the millennium tower on the Bluff, this includes all ship movements within port limits.

The port is serviced by a fleet of tugs, work boats, floating cranes, dredging vessels, pilot launches, hydrographic survey vessels, a passenger harbour boat, and a pollution vessel. The pollution vessel OSRV Udonti is currently out of service. The port operates a bunker barge.

Figure 30 Durban Area Google Earth Image.

SAPREF refinery and single buoy mooring

SAPREF is a joint venture between Shell SA Refining and BP Southern Africa. They operate a refinery and SBM located 2.5 km off Isipingo in a water depth of 50 m. The SBM receives Very Large Crude Carriers (VLCC's) (carrying approximately 2 million barrels of crude oil) and Long Range type 3 (LR3) tankers (carrying approximately 1 million barrels of crude oil). 14-15 tankers offload at the SBM every month. As the SBM is outside the Durban port area it has not been included in this assessment.

SAPREF is the largest crude oil refinery in Southern Africa with 35% of South Africa's refining capacity. The refinery processes 24 000 t crude/day and makes 10 main products in 46 different grades including 2.7 billion litres of petrol/year. The refinery is at Isipingo, approximately 19 km south of Durban harbour (outside the TNPA area of responsibility). 80% of the refinery throughput is transferred to Island View (IV) by 7 underground transfer lines.

Island View (IV)

The SAPREF IV complex has 51 tanks with a total capacity of 525 000 m^3. Products are both exported and imported at the site. There are 320-360 vessel operations a year at the site. SAPREF manage all the berths that work refined or petroleum products except IV 9 which National Crude Oil Storage (NATCOS) attend to. The petroleum products handled are aviation fuel (avgas/Jet A1), all grades of petrol, diesel, gasoil, marine fuel oil and paraffins. SAPREF attend to all BP and Shell cargoes, Engen assist SAPREF for their cargoes.

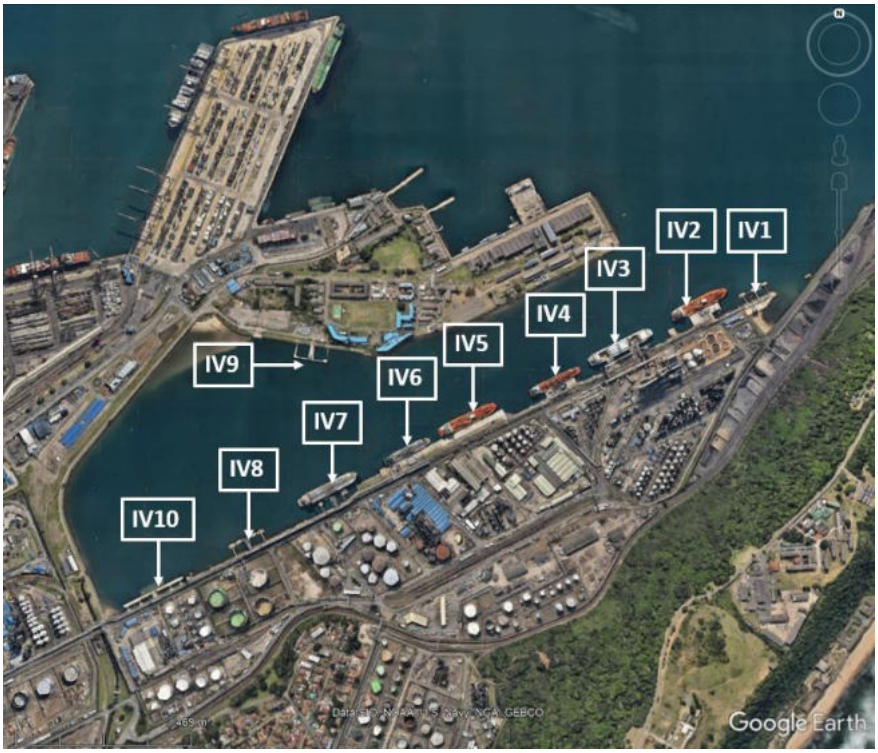


Figure 31 IV Berths.

SAPREF is responsible for all HSE related matters at the berths on IV that work refined or petroleum cargoes. Hose loading occurs at berth 10. The berth 10 hose has a 6" diameter and is 36 m long. The standards below are in place to reduce the risk of a hose incident.

- Hoses are pressure tested annually.
- Hoses have protective wrapping to prevent fraying.
- Hoses are on hose wheels to prevent fraying and abrasion.
- Hoses are inspected and any defects reported leads to the hoses being changed out.
- Operators are permanently present at the berth when hose loading occurs, if there is a failure the valves will be isolated and loading pumps stopped.

Table 33 summarises berth use at IV.

Table 33 Island View Berths

Island View Berth	Use
1	Lay by berth.
2	Chemicals and base oils. Engen import base oil for their LOPB/ZBP site.
3	Can be used for vegetable oils only but is predominantly a bulk grain loading / offloading facility for bulk carriers.
4	Chemicals, base oils and vegetable oils. Engen import of base oil for LOPB/ZBP site. Blendcor loading and unloading of oils.
5	Chemicals and base oils. Blendcor loading and unloading of oils. Currently not used.
6	Chemicals, base oils and petroleum products – predominantly used for chemical cargoes. Used by Shell, BP, Calulo and SAPREF. It has 4 loading arms on a carousel. The berth has a maximum draft of 12.4 m.
7	LPG and petroleum products. Used by Shell, BP, Engen and SAPREF. Has a maximum draught of 12.2 m.
8	Petroleum products only. Used by Shell, BP, Engen and SAPREF. Has a maximum draught of 12.2 m.
9	Can be used for crude oils and diesel only but predominantly used for lay-by. NATCOS attend to this berth.
10	IV 10 is primarily a bunker berth. Site 3 at IV 10 has 16 tanks with a total capacity of 180 000 m^3, most of which is heavy bunker fuel.

Oil Characteristics

Table 34 summarises the oils handled or used at the SBM or Island View.

Table 34 Oil Inventory

Location	Oil Type	Volume	Characteristics
Island View	Aviation fuel (avgas/Jet A1)	Stored on land. Maximum vessel cargo would be ~ 300 000 m^3	°API 45 Viscosity: 2.5 cSt @ 18°C
	Diesel	Stored on land. Maximum vessel cargo would be ~ 300 000 m^3	°API 30-37 Viscosity~ 3 cSt @ 18°C
	Petrol	Stored on land. Maximum vessel cargo would be ~ 300 000 m^3	°API 30-37 Viscosity~ 3 cSt @ 18°C
	Paraffins	Stored on land. Maximum vessel	°API 43 - 55 Viscosity of 1 to 1.9 sCt at 40°C

Location	Oil Type	Volume	Characteristics
		cargo would be ~ 300 000 m^3	
	IFO or HFO	Varies dependant on vessel. A panama plus typically has 9000 m^3 of fuel oil on board.	Will vary dependant on type of fuel oil. Typically density > 0.9 g/cm^3 and viscosity > 180 cSt at 50°C. Heavy fuel oil viscosity ~380 @ 50°C
	Hydraulic Oil	Dependant on equipment on board. < 10 m^3	°API: <35 Viscosity: 100 cSt @ 30°C
	Lube oil	< 1 m^3	°API: 29 Viscosity: 79-86 cSt @ 20°C

Aviation fuel

Jet A1 (Specific Gravity 0.8 g/cm3, °API 45) is a kerosene type aviation gas-turbine engine fuel and is categorised as Group 1 under the ITOPF oil classification. Jet A1 flows easily and spreads rapidly. They are easily dispersed and do not have any tendency to emulsify[13]. As this oil is composed of mainly the low-weight components, they are highly volatile. They will evaporate and dissolve readily and leave little or no residue. However, many of these low-weight components are toxic and potentially flammable and readily inhaled and are of concern for human health and safety.

Petrol

Petrol or gasoline is a complex mixture of many volatile, flammable and liquid hydrocarbons derived from petroleum and used as fuel for internal combustion engines. Gasoline is a mixture of paraffins, oleofins and cycloalkanes; this blend is adjusted to altitude and season. It has a specific density between 0.72 to 0.76 g/m^3, kinematic viscosity <1 at 30°C and a flash point of -30°C.

In a warm climate, gasoline will evaporate on water within one day and approximately two days in a cold climate. It will disperse naturally to a large degree in turbulent waters.

Diesel

Diesel fuel is a light petroleum distillate. Diesels vary in their properties but have a specific gravity in the range 0.84-0.88 g/cm^3 (30-37°API), with pour points of between -17°C and -30°C. As such they are generally classed as Group II oils, i.e. light persistent oils, under the ITOPF classification of oil according to their specific gravity. Diesel will evaporate to the extent of 60% in approximately 3 days on warm water and 6 days in very cold water.

Paraffin

Kerosene also known as paraffin is a combustible hydrocarbon widely used to power jet engines and as cooking and lighting fuel. It has a density of 0.76 to 0.81 g/cm^3, a viscosity of 1 to 1.9 sCt at 40°C and a boiling

[13] NOAA. 1992. Introduction to Coastal Habitats and Biological Resources for Spill Response. Oil Behaviour and Toxicity.

point of 200 to 260°C. When spilled, kerosene spread rapidly into thin sheens and as diesel it will rapidly evaporate and naturally disperse.

Hydraulic oil

Hydraulic oil (specific gravity 0.88 g/cm3, °API < 35, viscosity 100 cSt @ 30°C, pour point < 0°C, flash point >60°C) is a relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Hydraulic oil has a low volatility and moderate flash point, so there is no major safety issue when dealing with this oil. However, this oil is fairly persistent in the environment. Expect limited spread and minimal loss through evaporation and natural dispersion. The action of mixing energy on hydraulic oil is likely to produce a frothy emulsion.

Lubricating oil

Lubricating oil or 'lube oil" (specific gravity 0.87 g/cm3, API 29, viscosity = 79-86 cSt @ 20°C, pour point -35°C, flash point >60°C) is relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Lube oil flows easily and is easily dispersed if treated promptly. However, this oil tends to persist in the environment. There is a likelihood that the action of mixing energy on lube oil will produce frothy emulsions. With the low volatility and moderate flash point, there is no major safety issue when dealing with this oil.

Intermediate Fuel Oil

Intermediate Fuel Oil (IFO) can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61°C and boiling point > 204 °C. Its density at 20°C is 0.9850 g/cm^3 and kinematic viscosity of 180 mm^2/s at 50°C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Heavy Fuel Oil

Heavy Fuel Oil (HFO) is a mixture of the heavy residual oil, left after the lighter components of crude oil are removed during the refining process, this is then blended with lighter oils to meet specifications for viscosity, pour point and specific gravity. HFOs can also be a blend of heavy and light oils but they generally contain more of the heavier components. In the MARPOL Marine Convention of 1973, heavy fuel oil is defined either by a density of greater than 0.9 g/cm³ at 15°C or a kinematic viscosity of more than 180 cSt at 50°C. Heavy fuel oils have large percentages of heavy molecules such as long-chain hydrocarbons and aromatics with long-branched side chains.

Wind and current

A wind rose diagram is a tool which graphically displays wind speed and wind direction at a particular location over a period of time. Figure 32 shows the predominant wind speeds and directions annually for Durban taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10m above the sea surface.

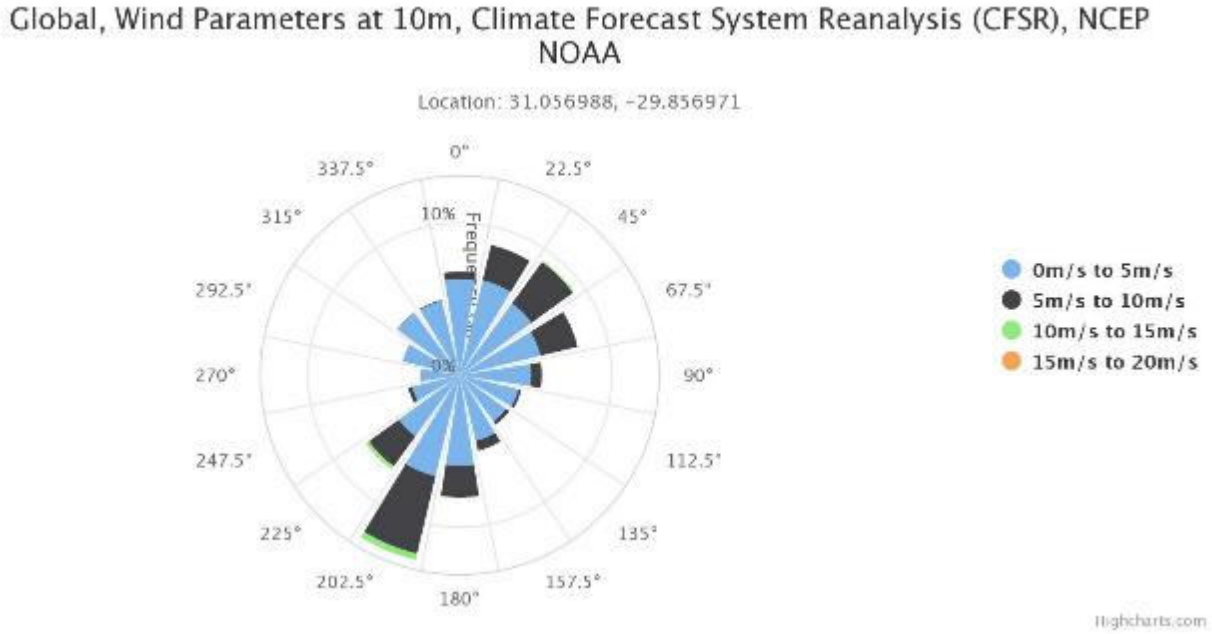


Figure 32 Wind Rose for Durban.

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant winds in the Durban area are from the north-northeast and south-southwest in the summer and south-southwest in winter. Based on the yearly average wind data, 99% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Although the guidance does not align it suggests that dispersant application and containment and recovery are feasible response techniques for oil spills in Durban and should be attempted if safe and practical to do so.

Current

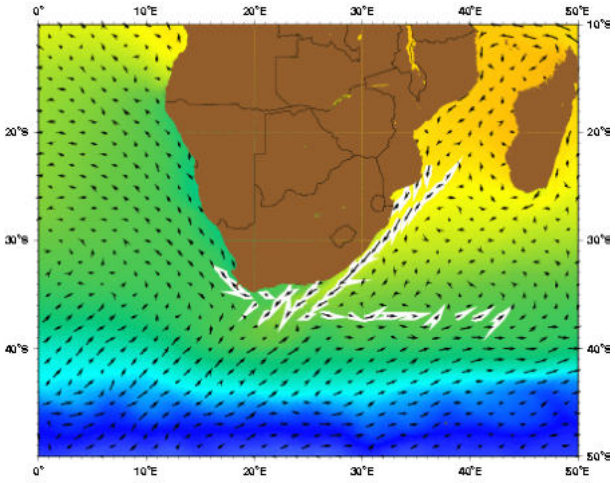


Figure 33 The Agulhas Current.
Source: www.oceancurrents.rsmas.miami.edu

The Agulhas Current flows down the east coast of Africa from 27°S to 40°S. Like other western boundary currents, the Agulhas Current is quite fast. At the surface, it can reach maximum speeds of 3.8Kts. As one of the major currents in the Southern Hemisphere, the Agulhas Current system transports large volumes of water. As the Agulhas Current reaches the southern tip of the continental shelf of Africa, it begins to turn toward the west.

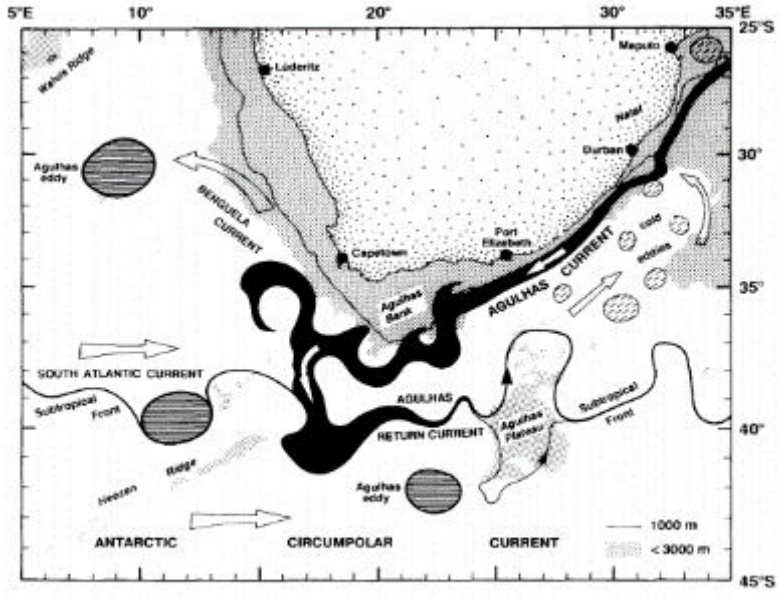


FIG. 8. Schematic representation of the Agulhas Current system (adapted from LUTJEHARMS and VAN BALLEGOOYEN, 1988 and LUTJEHARMS, 1989). Open arrows indicate the general direction of the surface geostrophic currents.

Figure 34. The Agulhas and Benguela Currents.
Source: Lutjeharms, J.R.E., and R.C. van Ballegooyen, (1988).
The Retroflection of the Agulhas Current, Journal of Physical Oceanography, 18, 1570-1583.

The Benguela Current is the eastern boundary current of the South Atlantic subtropical gyre. It begins as a northward flow off the Cape of Good Hope, where it skirts the western African coast equatorward until

around 24°S-30°S. The Benguela Current has a well-defined mean flow that is mostly confined near the continent and a more variable transient flow on its western side. The transient flow is dominated by large eddies shed from the Agulhas Retroflection.

Environmental and Socioeconomic Sensitivities

The Durban coastal zone runs from Ballito in the north to Scottburgh in the south and is made up of many estuaries and lagoons, these areas are brackish ecosystems, and some have the potential to breach into the sea following periods of heavy rain. Although diverse and abundant with native species these areas have not been mapped using an environmental sensitivity index since the coastal sensitivity atlas for Southern Africa was first published in 1984. This work highlighted multiple sensitivities in the area.

- Environments of significant importance for birdlife, especially: migrant waders, terns, gulls and pink-backed pelicans.
- The Aliwal Shoal marine protected area; this is an area rich in biodiversity including many fish species and the location of where ragged-tooth sharks gather.
- Offshore sea bird species using the area for foraging and feeding.
- Estuaries and lagoon habitats used as spawning grounds for bait organisms, fish and water birds.
- The coastal forest reserve of Maputaland.
- The recreational areas including Durban’s amenity beaches, tidal pools, surfing, angling and sailing areas.
- Commercial fisheries for shellfish, crustaceans and line caught fish.
- Commercial sea water intakes.

Protection Priorities

According to the Coastal Oil Spill Contingency Plan no 20: Durban Zone (DEA [now DEFF], January 2011), the protection priorities within the Durban coastal zone include estuaries, lagoons, amenity beaches, inshore reefs, recreational fisheries and the port of Durban.

Information on the most important protection priorities as prioritised in the coastal oil spill contingency plan is summarised in Table 35 below.

Table 35 Protection and Clean up Priorities Durban

Type of Sensitivity	Name (s)- Description	Details
Estuaries and lagoons	The most important estuaries and lagoon in this area are: • Mkomazi (Umkomaas); • Lovu; • Sipingo; • Mgeni; • Mhlanga; • Tongati; • Msimbazi; • Manzimtoti; • Mbokodweni; • Umdloti.	Mkomazi River: recreational usage with ski boat base. Lovu estuary: mangroves are on the southern bank Tongati River: mouth is usually open; degraded due to sugar mill effluent, sewage and agricultural runoff. Msimbazi Lagoon: some recreational usage. Little Manzimtoti Lagoon: mouth is usually closed and no tidal exchange. Mbokodweni Lagoon; closed but opens to the sea when heavy rainfall. Mdloti (Umdloti) Lagoon: mouth usually is closed, but overwash may occur during high spring tides. Mangroves, rich birdlife and recreational area. Umhlanga Lagoon: mouth is usually closed, but overwash may occur. Nature reserve; large number of waders.
Mangroves	Mangroves occur at Isipingo, Mgeni and Umhlanga, and are sensitive to oil pollution as well as to protection measures affecting salinity levels.	Isipingo Lagoon: mouth is usually closed, with runoff via pipeline. River is polluted, but mangrove stand has survived. Mgeni River: the mouth is usually open. River polluted but highly productive environment, with mangroves in the Beachwood tidal creek on the north bank. Important habitat for birds and popular recreational area. Umhlanga Lagoon: mouth is usually closed, but overwash may occur. Nature reserve; large number of waders.
Ports/harbours	Port of Durban, yacht club and offshore moorings.	Main harbour area with tanker terminal, container quay and extensive commercial operations.
Amenity Beaches	The most important amenity beaches in this area are: • Cave Rock; • Ocean View; • Isipingo Beach; • Merwent; • Amanzimtoti Beach; • Kingsburgh Beach; • Illovo Beach; • Umgababa Beach; • Palm Cliff; • Freeland Park; • Scottburgh.	The most common activities taking place at these locations are: • Surfing; • Fishing; • Walking; • Sailing; • Nature watching.

Resources Available to Durban

Equipment

TNPA have a stockpile of equipment in the warehouse in Island View. A full list of this equipment is in Appendix 1. It includes a trailer mounter heavy oil skimmer, fence boom, air inflation curtain boom, pumps, and clean up consumables.

TNPA have a variety of vessels that could potentially assist with emergency response operations.

- 8 X tugs.
- 2 X pilot boats.
- 5 X launches.
- 2 X pilot helicopters.
- 1 X debris collection boat.

Personnel

TNPA have a team of 7 pollution control staff. None of the team have had formal oil spill response training. One person will be on standby and in an emergency would call out a tier 1 response contractor – probably Spilltech or Drizit (no official contract is held with them, but both have been used in the past). TNPA participated in a large SAPREF run exercise though there was no evidence of TNPA organised oil spill exercises.

Supporting information: Emergency Response Documents

Robust Contingency Plan and Emergency Plans are essential plans to respond to an oil spill effectively. These documents need to include robust systems and procedures, which allow for a good oil spill response.

The TNPA Oil Spill Contingency Plan Port of Durban covers oil spills in the Port of Durban and if a spill spreads beyond the jurisdiction of TNPA (Tier 1), the plan states it will be used in conjunction with the South African Oil Spill Contingency Plan. Oil spill resulting from an incident involving a collision, grounding or hull failure of a ship while manoeuvring in the vicinity of the Port of Durban will active the Oil Spill Contingency Plan for the Port of Durban.

The plan includes: responsibilities of various stakeholders including TNPA, DEA, SAMSA, port stakeholders and also defines the roles of the various TNPA positions and other roles that would be part of a spill response. It includes initial reporting requirements and response actions to take at the three tiers, possible causes of spills, coastal sensitivities, TNPA equipment list and a contact directory. It also includes some reference information such as liabilities, claims and compensation and International and National legislation.

For waste management, this plan references the Port of Durban's Waste Management plan, however this document has not been reviewed as part of this work.

Gaps identified for this section are described in the Gap Analysis.

Risk Assessment

Risk Register

Risk assessment scenarios for the Port of Durban are shown below. They do not represent every single scenario that could occur but are representative of the range and scale of scenarios that could lead to an oil spill.

Table 36 Oil Spill Risk Scenarios – Durban

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Effect	Likelihood	Severity	Risk	Suitable Response Techniques[14]
1	Storage tank at Island View.	Loss of primary and secondary containment of multiple tanks caused by tropical cyclone.	Various – LPG, aviation fuel, petrol, diesel, gasoil, heavy fuel oil and paraffins.	Assume multiple tanks damaged with partial loss to sea: 10 000 m^3.	Oiling sandy amenity areas including: Cave Rock, Ocean View, Isipingo Beach, Merwent, Amanzimtoti Beach, Kingsburgh Beach, Illovo Beach, Umgababa Beach, Palm Cliff, Freeland Park and Scottburgh. Cyclone likely to assist natural dispersion of oil.	1	4	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Containment and recovery of oil on water surface for gross contamination if safe. Recovery with oleophilic skimmer. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Shoreline clean-up.
2	Vessel incident within Durban harbour.	Allision with IV berth or collision with another vessel whilst manoeuvring away from berth.	Various – LPG, heavy fuel oil, aviation fuel, petrol,	100 000 m^3	Spread from accident site to surrounding area. Severity dependant on oil type. Harbour boom may partially limit oil movement but will not	2	4	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Containment and recovery of oil on water surface for gross contamination.

[14] For more information on these techniques refer to Appendix 2.

		Loss of product from cargo tank(s) on one side of fully loaded VLCC.	diesel, gasoil, and paraffins.		contain this volume of oil. Potential oiling of sandy amenity areas including: Isipingo Beach, Merwent, Amanzimtoti Beach, Kingsburgh Beach, Illovo Beach, Umgababa Beach, Palm Cliff, Freeland Park and Scottburgh. Port operations affected.				• Lighter fuel oils (MGO, MDO) attempt to recover with an oleophilic skimmer if enough volume. • Heavier fuel oils (bunker fuel oil) recover with mechanical skimmer. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and, if appropriate, surf washing. • Protection of sensitive resources. • Shoreline clean-up.
3	Vessel incident within Durban harbour.	Allision with IV berth with loss of oil from fuel storage tank(s).	IFO or HFO	4500 m^3 (based on 50% loss of fuel oil of Panamax plus).	Spread from accident site to surrounding area. Severity dependant on if harbour boom is deployed rapidly enough to limit spread. Energy of area outside port likely to emulsify oil. Potential oiling sandy amenity areas including: Isipingo Beach, Merwent, Amanzimtoti Beach, Kingsburgh Beach, Illovo Beach, Umgababa Beach, Palm Cliff, Freeland Park and Scottburgh.	2	3	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Dispersant test spray and effectiveness test for heavy fuel oil (note dispersant guidance suggests dispersant should not be used on HFO). Negotiate with DEFF to use if effective. If permission granted, continue until no longer effective. • Containment and recovery of oil on water surface for gross contamination - recover by mechanical skimmer. • Protection of sensitive resources. • Shoreline clean-up.
4	Mechanical equipment on vessel or jetty.	Small operational spill.	Various – lube oil, diesel, hydraulic oil.	< 10 litres.	Sheen on water surface.	5	1	L	• Monitor and evaluate. • Recover using sorbents and absorbent rolls.
5	Tanker loading/ offloading at Island View.	Leaking seals/valves.	Various – LPG, bunker fuel oil, petrol, diesel.	< 1 m^3.	Sheen and oiling around jetty. Could be contained within IV jetty area using fence boom on jetty.	4	1	L	• Monitor and evaluate. • Recover using sorbents and absorbent rolls. • Natural dispersion, assisted by prop washing and surf washing.

6	Vessel – ship to ship refuelling.	Fuel transfer spill: leaking valve whilst refuelling vessel.	Marine Diesel / HFO.	< 1 m^3.	Oiling around spill location and immediate surroundings.	3	2	L	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Assisted natural dispersion if marine diesel. • Protection of sensitive resources. • Potential small-scale shoreline clean-up.
7	Vessel – ship to ship refuelling.	Fuel transfer spill: split hose whilst refuelling vessel.	IFO or HFO	25 m^3.	Spread from bunkering site to Durban area.	2	2	L	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Assisted natural dispersion if marine diesel. • Containment and recovery of oil on water surface for gross contamination - recover by mechanical skimmer. • Protection of sensitive resources. • Shoreline clean-up if appropriate.
8	Bunkering tanker in Durban harbour	Grounding / collision in Durban harbour with loss of oil from storage tanks.	IFO or HFO	3500 m^3.	Effect will depend on type of oil spilt. Marine diesel would have a moderate effect as it is likely to disperse naturally. A heavier oil such as HFO would persist for much longer and is likely to emulsify. Potential oiling sandy amenity areas including: Isipingo Beach, Merwent, Amanzimtoti Beach, Kingsburgh Beach, Illovo Beach, Umgababa Beach, Palm Cliff, Freeland Park and Scottburgh.	2	3	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Assisted natural dispersion if marine diesel. • Dispersant test spray and effectiveness test for heavy fuel oil. Negotiate with DEFF to use if effective. If permission granted, continue until no longer effective. • Containment and recovery of oil on water surface for gross contamination - recover by mechanical skimmer. • Protection of sensitive resources. • Shoreline clean-up if appropriate.
9	Tanker – place of refuge	Place of refuge for damaged tanker, with loss of oil from storage tanks.	IFO or HFO	100 000 m^3	Major impact in and around spill location and surrounding sites. Could affect marine park/endangered bird species nesting and feeding sites. Potential for	1	5	H	• Monitor and evaluate (aerial surveillance, trajectory modelling to predict spill spread and visualisation). • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.

					oil to travel great distance. Will affect tourism.				
10	Fishing Vessel	Fire / collision / grounding / sinking inside harbour	Diesel	10 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
11	Fishing Vessel	Fire / collision / grounding / sinking outside harbour	Diesel	10 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.
12	Recreational Yachting	Fire / collision / grounding / sinking inside harbour	Marine Diesel	5 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
13	Recreational Yachting	Fire / collision / grounding / sinking outside harbour	Marine Diesel	5 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.

Risk Assessment Summary

The risk assessment matrix in Table 37 shows that TNPA's highest risk of a coastal spill is from a tanker fire or other major vessel incident causing a total loss of cargo crude oil at the SBM. There are also has a variety of medium risk scenarios.

- Vessel incident within Durban harbour. Allision with IV berth or collision with another vessel whilst manoeuvring away from berth. Loss of product from cargo tank(s) on one side of fully loaded VLCC.
- Vessel incident within Durban harbour. Allision of large bulk carrier with IV berth with loss of oil from vessel fuel storage tank(s).
- Bunker tanker grounding / collision in Durban harbour with loss of oil from storage tanks.
- Tanker collision /grounding with moored tanker or SBM resulting in total loss of oil from tankers largest cargo tank.
- SBM floating hose rupture during discharge operations (due to parting of mooring ropes/chafe chains or slipping of chains in stoppers).
- Damage/failure with loss of contents of underground pipeline from SBM to refinery due to dropped anchor/vessel hitting into pipeline.
- Major weather event such as a tropical cyclone causing major tank incident with loss of primary and secondary containment to multiple tanks at either the IV or refinery sites.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium or low risk.

Table 37 Risk Matrix for Durban Scenarios

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**			10, 12	5	4
	2		7	6, 11, 13		
	3		3, 8, 11, 12			
	4	1, 9	2			
	5					

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

Gaps identified are specific to TNPA in Durban are described in Table 38 below.

Table 38 Gaps Identified for SAPREF Durban

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	TNPA had no written procedures on how to operate equipment.	Standard operating procedures and work instructions reduce the risk of an accident when carrying out tasks.	Oil spill equipment owners should develop and share work instructions for any mechanical equipment they hold.	**DS1**
Equipment				
Major	No dispersant is available as a tier 1 resource.	Based on the type of crude oils handled at the SBM, and previous modelling results, dispersant would probably be the best response technique for a large crude spill to avoid or reduce extensive shoreline oiling.	Arrange dispersant and spray equipment and train operators in its use. This would be best positioned on the support vessels at the SBM. Dispersant stocks should be enough for an initial response, to be supplemented by national stocks (see recommendation DS3) or Tier 3 resources. See also DS8 recommendation to obtain pre-approval for dispersant use.	**DS2**
Major	No dispersant is held nationally.	Dispersant is described as a suitable oil response technique in the NOSCP. Subject to the dispersant guidance conditions including depth and distance to shore (see section 1.3), dispersant would be suitable for a medium viscosity oil spill that will not disperse on its own.	With other operators/ authorities, arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline.	**DS3**
Moderate	No booms suitable for recovering free-floating oil are available.	No vessel towable boom was seen which is essential for at sea containment and recovery. Whilst the conditions off much of the South African coastline are too rough to be able to carry out containment and recovery effectively, a vessel towed system would be usable in sheltered bays and harbours (probably an enhanced system as a lot of the currents would undercut 'traditional' boom).	Arrange access to vessel towed boom. This could be arranged as a Tier 2 resource as there are many vessel operations within the Durban area.	**DS4**

Gap Classification	Gap	Explanation	Recommendation	Ref #
Responders				
Moderate	No trained SCAT responders	No trained SCAT responders exist for TNPA in South Africa.	SCAT responders should be available in a spill where shoreline oiling is possible. Limited SCAT responders would be available as a Tier 3 resource, but numbers would not be sufficient to mount a large-scale shoreline program commensurate to the number of sensitive shorelines at risk.	**DS5**
Moderate	No protective booming is in place during bunkering operations.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Reduce bunkering risk by using a H booms/flexible booms inserted between the ship and fuel barge fore and aft to collect any spilt oil (Refer to Appendix 2 Equipment Recommendations). A way of recovering the oil (e.g. skimmer) would also be needed.	**DS6**
Additional Support				
Minor	Roles of different companies /organizations not clearly defined in the SBM OSCP	The different roles of the companies/organizations involved the oil spill response defined in the OSCP are not well explained	To make the roles clearer, better describe the role of the different companies/ organizations involved: AMSOL, SBM Operator, SAPREF, OSEC, STASCO	**DS7**
Minor	Key elements of the TNPA Durban OSCP missing.	Plan is missing: list of actions for each TNPA role, details on response techniques that would be used to respond to an oil spill (Tier 1), details of type of training / and exercises conducted and their frequency, no risk assessment detailing potential oil spill scenarios and mitigation measures. Response tiers list volumes for each which is no longer a method of classifying tiers based on IOGP IPIECA good practice guidance.	TNPA to update OSCP to include missing elements.	**DS8**

Richards Bay

Richards Bay is South Africa's most northernmost and easterly port, it is 160 km northeast of Durban and 465 km southwest of Maputo. The Port of Richards Bay was built in 1976 and so is South Africa's most modern port. Richards Bay is situated in a large natural lagoon and is dredged to 19 m making it one of South Africa's deep-water ports. There are two main terminals, the Multi Purpose Terminal (MPT) and the Dry Bulk Terminal (DBT). The MPT can handle a variety of cargo types including; break bulk, neo-bulk and containers. The DBT handles in excess of 13 million tons of cargo each year and is can transfer multiple products over its conveyer system. The port handles 330 vessel movements a month. Richards Bay has a total of 21 operational berths ranging in length up to 350 m. Tanker operations take place at berths 208 and 209.

Figure 35 Port of Richards Bay Google Earth Image.

Pilotage is compulsory for all vessels from 3 nautical miles southeast of the south breakwater, with pilot transfer performed by pilot boat. Navigation is subject to VTS operated by TNPA from port control offices, which oversees all shipping movements inside port limits.

Figure 36 Multi-Purpose Terminal.

Richards Bay is popular for cruise ships because of the close proximity to game parks and the St Lucia World Heritage Site. Cruise ships make use of either the small craft berth or one of the normal cargo handling berths depending on the size of the ship. There is a modern marina for recreational sailing next to the tug and dredging berths in the small vessel basin. Other water sports and recreational activities are permitted within the harbour at dedicated locations. There are areas of mangroves within the harbour, including directly behind the berths at the northern end of the dry berth terminal.

Figure 37 Dry Bulk Terminal.

Joint Bunkering Services (JBS)

Engen are the operators of the Joint Bunkering Services (JBS) operations at Richards Bay. Astron Energy, BP and Shell are partners in this operation. JBS carries out bunkering of Marine Fuel Oil (MFO) and Marine Gas Oil (MGO) to vessels. JBS have the following tanks:

- 2 x 15 000 m^3 tanks of MFO;
- 1 x 9 500 m^3 tank of MFO; and
- 1 x 4 500 m^3 tank of MGO.

Figure 38 Engen JBS Terminal.

The fuel is transferred from the tanks to berth 209 via an approximate 1 km pipeline. A 24" line for HFO and a 16" line for MFO run into a 20" line. The MGO pipeline is 16" its whole length. At berth 209 the fuel is loaded onto a bunker barge, Liphoma, which refuels at the berth approximately every second day. The Liphoma refuels other vessels by ship to ship transfer. The Liphoma holds 3 800 m^3 of MFO and 800 m^3 of MGO. Refuelled vessels will take between 300 and 1 800 m^3 fuel oil. Refuelling 1 800 m^3 takes approximately 5 hours. There are gas monitors round the refinery but not currently on the berth.

There are automatic shutdown valves at the control room and a manual shut down valve at the berth. A gauge continuously monitors flow. If there was an incident then refuelling would be shut down within

5 minutes (or faster). Engen have refuelling protocols including starting refuelling at a low flow rate and increasing rate gradually.

There are plans to add an additional pipeline to berths 301 and 302 and use these to load MFO and MGO. The plans are being discussed with TNPA.

BP

BP have a separate bunker tanker, the Amber 2. It is owned by BP but AMSOL handle the logistics and scheduling. It supplies marine fuel and MGO at rates of up to 550 litres an hour, with a barge capacity of 5 700 m^3 MFO and 800 m^3 MGO.

Oil Characteristics

Table 39 Port Elizabeth Oil Inventory

Location	Oil Type	Volume	Characteristics
Engen			
Tank Farm	IFO or HFO	39 500 m^3	Density: 0.9850 kg/m^3 at 20°C. Kinematic viscosity: 180 mm^2/s at 50°C.
Tank Farm	MGO	4 500 m^3	Density: 0.8900 kg/m^3 at 20°C. Kinematic viscosity: 11 mm^2/s at 40°C
Berths			
Liphoma bunker barge	IFO or HFO	3 800 m^3	Density: 0.9850 kg/m^3 at 20°C. Kinematic viscosity: 180 mm^2/s at 50°C.
Liphoma bunker barge	MGO	800 m^3	Density: 0.8900 kg/m^3 at 20°C. Kinematic viscosity: 11 mm^2/s at 40°C.
Vessels	Hydraulic oil	Dependant on equipment on board. < 10 m^3	°API: <35 Viscosity: 100 cSt @ 30°C
Vessels	Lube oil	Dependant on vessel. < 1 m^3	°API: 29 Viscosity: 79-86 cSt @ 20°C

Marine Gas Oil

Marine Gas Oil (MGO) describes marine fuels that consist exclusively of distillates. Distillates are all those components of crude oil that evaporate in fractional distillation and are then condensed from the gas phase into liquid fractions. MGO usually consists of a blend of various distillates.

The MGO stored and loaded at Richards Bay is a dark amber liquid. It has a boiling point > 170 °C, flash point of > 60 °C, boiling point of <-7 °C, upper explosion limit of 7% and lower explosion limit of 0.6%. Its density at 20 °C is 0.8900 kg/m^3 and kinematic viscosity at 40 °C is 11 mm^2/s.

The material safety data sheet for the marine gas oil states that Engen should expect hydrogen sulphide to be present. MGO typically evaporates and disperses into the water column readily.

Intermediate Fuel Oil

Intermediate Fuel Oil (IFO) can be a mix with 180 cSt or 380 cSt. IFO 180 is a mix of 98% of residual oil and 2% of distillate oil. And IFO 380 is a mix of 88% of residual oil and 12% of distillate oil. Due to the higher content in distillate oil, IFO 380 is often more expensive than IFO 180.

IFO is a blended oil with a high proportion of heavy fuel oil blended with MGO or MDO. It is dark brown, has a flash point > 61°C and boiling point > 204 °C. Its density at 20°C is 0.9850 g/cm^3 and kinematic viscosity of 180 mm^2/s at 50°C. It tends to persist in the marine environment. Dispersant have been found to be effective on fresh intermediate fuel oil.

Heavy Fuel Oil

Heavy Fuel Oil (HFO) is a mixture of the heavy residual oil, left after the lighter components of crude oil are removed during the refining process, this is then blended with lighter oils to meet specifications for viscosity, pour point and specific gravity. HFOs can also be a blend of heavy and light oils but they generally contain more of the heavier components. In the MARPOL Marine Convention of 1973, heavy fuel oil is defined either by a density of greater than 0.9 g/cm^3 at 15°C or a kinematic viscosity of more than 180 cSt at 50°C. Heavy fuel oils have large percentages of heavy molecules such as long-chain hydrocarbons and aromatics with long-branched side chains.

Hydraulic oil

Hydraulic oil (specific gravity 0.88 g/cm3, °API < 35, viscosity 100 cSt @ 30°C, pour point < 0°C, flash point >60°C) is a relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Hydraulic oil has a low volatility and moderate flash point, so there is no major safety issue when dealing with this oil. However, this oil is fairly persistent in the environment. Expect limited spread and minimal loss through evaporation and natural dispersion. The action of mixing energy on hydraulic oil is likely to produce a frothy emulsion.

Lubricating oil

Lubricating oil or 'lube oil" (specific gravity 0.87 g/cm3, °API 29, viscosity = 79-86 cSt @ 20°C, pour point -35°C, flash point >60°C) is relatively viscous oil and is classed as Group 3 oil under the ITOPF classification of oil according to their specific density.

Lube oil flows easily and is easily dispersed if treated promptly. However, this oil tends to persist in the environment. There is a likelihood that the action of mixing energy on lube oil will produce frothy emulsions. With the low volatility and moderate flash point, there is no major safety issue when dealing with this oil.

Wind and Current

Wind

A wind rose diagram is a tool which graphically displays wind **speed** and wind **direction** at a location over a time period. Figure 39 shows the predominant wind speeds and directions annually for Richards Bay taken from averaged global high accuracy wind dataset for the period 1979 to May 2019 at 10 m above the sea surface.

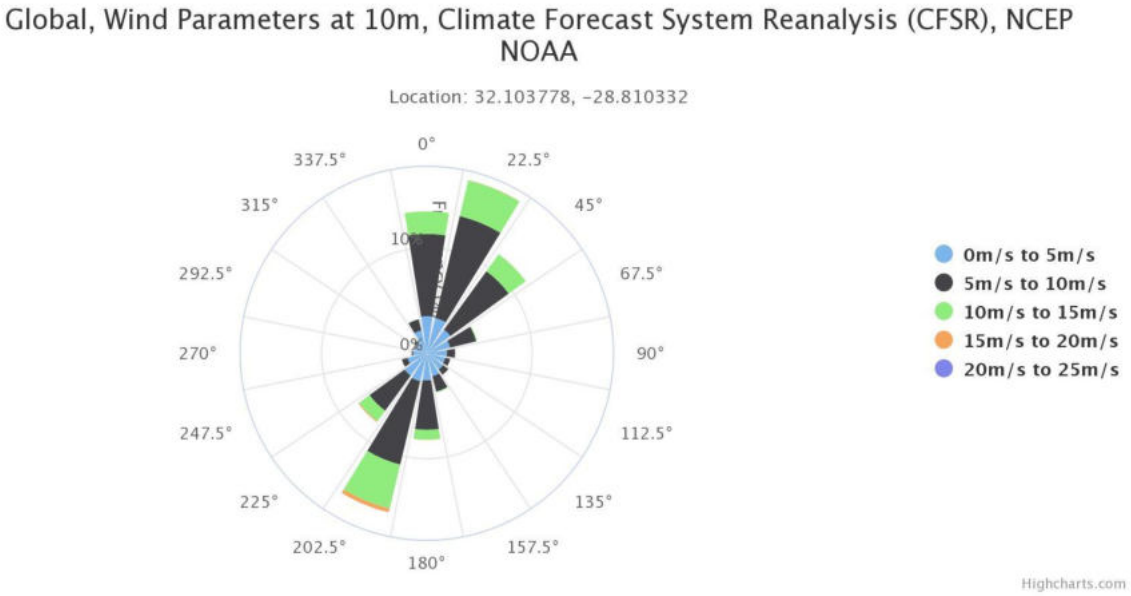


Figure 39 Wind Rose for Richards Bay.

Source: DHI Metocean Data Portal, Climate Forecast System Reanalysis (CFSR)), National Centers for Environmental Prediction (NCEP) National Oceanographic and Atmospheric Administration(NOAA)

The predominant winds in the Richards Bay area are from the north and north-northeast in the summer and north- northeast and north-east in winter.

Based on the yearly average wind data, 84% of the total time the wind blows at less than 10 m/s from any wind direction.

Based on the Oil Spill Response Effectiveness in UK Waters study (Oil & Gas UK, 2015), less than 10 m/s (20 knots) is considered feasible to conduct containment and recovery operations offshore and less than 14 m/s (27 knots) for aerial and vessel dispersant application. The Draft National Dispersant Policy for South Africa however states that dispersant application will be impossible in winds greater than Beaufort No.5 (17-21 knots). Although this guidance varies it suggests that dispersant application and containment and recovery are feasible response techniques some of the time for oil spills in Richards Bay and should be attempted if safe and practical to do so.

Current

Marine currents near Richards Bay travel from the North East towards the South West.

Environmental and Socioeconomic Sensitivities

The main sensitivities as identified in the Richards Bay Coastal Oil Spill Contingency Plan are:

- The Richards Bay Sanctuary which supports an extensive mangrove community and rich birdlife;
- A number of estuaries and lagoons which are important for bait organisms, fish, water birds and recreational amenities as well as mangrove stands;
- Spawning and juvenile recruitment areas for species such as maasbanker and roundherring, hake, pilchard and anchovy;
- Recreational amenities such as popular beaches, tidal pools, surfing and sailing areas;
- Commercial considerations such as shellfish and seaweed collection, rock lobster catches, demersal and line fish landings;
- Port of Richards Bay and Yacht Club.

The main protection priorities for Richard Bay are listed in Table 40.

Table 40 Protection Priorities Richards Bay

Type of Sensitivity	Name (s)	Details
Estuaries/Rivers	Richards Bay Sanctuary, Mlalazi, Mfolozi, Nhlabane, with special attention to mangroves	Richards Bay Sanctuary: Mlalazi: Important mangroves and estuarine bird habitat. Mfolozi Mouth: ski boat launch site. Nhlabane mouth: Provides water source for titanium mining operations along the dunes.
Seawater intakes	Alusaf and Mhltuze Water seawater intakes in Richards Bay harbour.	For industrial operations within the Port
Sea and estuarine birds:	Across the zone including in Richards Bay Sanctuary and various estuaries and lagoons.	Pratincoles, African Spoonbill, Turnstone, Little Stints, Curlew Sandpipers, Terek Sandpipers, Egrets, Herons, Pink-backed Pelicans and Black Oystercatchers.
Ports/harbours	Richards Bay Harbour	Vessels fuelling in the Harbour.
Aquaculture facilities	Various across the zone.	Important area for East Coast crustacean fisheries: prawns, crabs, langoustine and rock lobster. Important area for line fishery, with important reef species such as bream, rockcod and cob.

Resources Available to Site

Equipment

TNPA hold limited equipment that was last used in 2014. This equipment includes nearshore booms, skimmers and PPE. The equipment did not look response ready. A hydraulically driven Komara disk skimmer was seen with no hydraulic power pack. Both pneumatic and hydraulic hoses were seen – there was no evidence of recent pressure testing of the hoses.

Tugs are used as pilot boats within the port. They have fire monitors and foam. Tugs and small workboats could be made available if required to assist with spill response.

TNPA have a helicopter available 24 hours a day that is normally used to fly a pilot to ships – this helicopter could be used for aerial surveillance. TNPA have camera coverage of the berths and harbour entrance so should see any incident happening at these locations.

Personnel

TNPA see their area of responsibility to a spill be within the inner port boundary (harbour area). They see the outer port area to be the responsibility of SAMSA/DEFF. If TNPA wished to respond to a spill they would request assistance from a Tier 1 provider (probably Spilltech). Spilltech have a depot in Haulton, approximately 25 minutes away. They have 2 permanent staff and 21 contractors who work shifts. They carry out various work within the Richards Bay area but if there was a spill they could move staff of other jobs to assist.

Supporting information: Emergency Response Documents

Robust Contingency Plan and Emergency Plans are essential plans to respond to an oil spill effectively. These documents need to include robust systems and procedures, which allow for a good oil spill response.

The TNPA Port of Richards Bay pollution response contingency plan applies to all port operations that result in pollution from port operations (eg cargo handling, bunkering, storage and transportation). It also covers spillages from vessels docked in the port and outer anchorage. The plan includes response techniques to consider based on the spill conditions, protection priorities, roles and responsibilities, required notifications/ communications channels and tiers of response. Annexes are listed to include useful supporting information eg deployment of booms plan and equipment inventory, however these were not available at the time of review.

Risk Assessment

The oil spill risk assessment is an important phase of the gap analysis and is used to identify whether the tiered response capability in place is appropriate for the risks identified. Potential oil spill scenarios risks identified for the South Africa coastline and ports and harbours have been identified through documentation collected in advance of the site visits, and observation and conversations during the site visits. The resultant risk has been assessed by the project team.

Risk Assessment Methodology

To keep the capability review consistent across all SAPIA stakeholders, standard OSRL risk matrix severity/likelihood definitions have been used. The definitions of each category are provided in Table 41 and Table 42.

The resulting assessment for the current project is presented in the Risk Register in Table 43.

Table 41 Description of Severity.

Level of Severity	Description of Severity – Environmental
1 Low	Minor spill with no observable or measurable damage on habitats, species or ecosystem services.
2 Medium Low	Moderate spill within site limits or immediate proximity causing observable or measurable short-term and reversible degradation on habitats, species or ecosystem services.
3 Medium	Serious spill affecting the site vicinity or third parties causing important observable or measurable damage on habitats, species or ecosystem services.
4 High	Major pollution extending beyond the site and its vicinity causing very serious and long-term environmental damage on habitats, species or loss of ecosystem services with respect to ground state. High probability of observable or measurable permanent residual damage on ecosystem services.
5 Very High	Catastrophic and widespread pollution with irreversible environmental consequences. Observable or measurable permanent damages on habitats, species or loss of ecosystem services despite applying remediation measures.

Table 42 Description of Likelihood.

Likelihood	Description of Likelihood
1 Remote	Remote chance of happening. Very rare combination of factors.
2 Possible	May happen less than once during the facility/project lifetime/considered time period. Rare combination of factors.
3 Likely	Expected to occur in the facility/ project lifetime/ considered time period.
4 Very Likely	Expected to occur several times in the facility/ project lifetime / considered time period.
5 Almost Certain	Occurs once or more per year in the facility/ project lifetime / considered time period.

Risk Register

Table 43 Oil Spill Risk Scenarios – Richards Bay.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[15]
1	Mechanical equipment on vessel or jetty	Small operational spill	Various – lube oil, diesel, hydraulic oil	< 10 litres	Minimal – sheen on water surface	5	1	L	• Monitoring, contain on deck/land where possible, assisted natural dispersion.
2	Vessel	Bilge pumping	Various – lube oil, diesel, hydraulic oil	< 500 litres	Sheen and oiling around pumping location and surrounding area	4	2	M	• Monitoring and assisted natural dispersion.
3	Storage tank at JBS Terminal	Loss of primary and secondary containment of multiple tanks caused by tropical cyclone.	MGO, IFO or HFO.	Assume multiple tanks damaged with partial loss to sea: 5 000 m^3.	MGO could cause localised in water toxicity which could affect fish spawning and juvenile fish areas round the port. MFO would persist and could cause oiling of the mangrove areas around the port, as well as	1	4	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Containment and recovery of oil on water surface for gross contamination if safe. Recovery with oleophilic skimmer. • Natural dispersion (whilst gas monitoring) for lighter oils, assisted by prop washing and surf washing. • Protection of sensitive resources. • Low pressure water flushing to remove oil from sensitive areas. • Shoreline clean-up.

[15] For more information on these techniques refer to Appendix 2

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[15]**
					affecting port operations. Cyclone likely to assist natural dispersion of oil for MGO but cause emulsification of MFO.				
4	Vessel incident within Richards Bay	Allision with berth with loss of oil from fuel storage tank(s).	MGO, IFO or HFO.	4500 m^3 (based on 50% loss of fuel oil of Panamax plus).	Large persistent spill with significant damage. Oiling of mangrove areas within the port likely. Will affect port operations and have a potential effect on tourism.	2	3	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Dispersant test spray and effectiveness test for heavy fuel oil (note dispersant guidance suggests dispersant should not be used on HFO). Negotiate with DEFF to use if effective. If permission granted, continue until no longer effective. • Containment and recovery of oil on water surface for gross contamination - recover by mechanical skimmer. • Protection of sensitive resources. • Shoreline clean-up.
5	Vessel – ship to ship refuelling.	Fuel transfer spill: leaking valve whilst refuelling vessel.	MGO, IFO or HFO.	< 1 m^3.	Oiling around spill location and immediate surroundings.	3	2	L	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Assisted natural dispersion if marine diesel. • Protection of sensitive resources. • Potential small-scale shoreline clean-up.

SCENARIOS									
#	**Source**	**Event**	**Oil Type**	**Spill Volume**	**Potential Environmental Impact**	**Likelihood**	**Severity**	**Risk**	**Suitable Response Techniques[15]**
6	Vessel – ship to ship refuelling.	Fuel transfer spill: split hose whilst refuelling vessel.	MGO, IFO or HFO.	25 m^3	Spread from bunkering site to surrounding area.	2	2	L	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Assisted natural dispersion if marine diesel. • Containment and recovery of oil on water surface for gross contamination - recover by mechanical skimmer. • Protection of sensitive resources. • Shoreline clean-up if appropriate.
7	Bunkering vessel	Grounding / collision in Richards bay with loss of fuel oil from storage tanks.	MGO, IFO or HFO.	3800 m^3.	Large persistent spill with significant damage. Oiling of mangrove areas within the port likely. Will affect port operations and have a potential effect on tourism.	2	3	M	• Monitor and evaluate. • Aerial surveillance to predict spill spread. • Dispersant test spray and effectiveness test for heavy fuel oil. Negotiate with DEFF to use if effective. If permission granted, continue until no longer effective. • Containment and recovery of oil on water surface for gross contamination - recover by mechanical skimmer. • Protection of sensitive resources. • Shoreline clean-up.
8	Tanker – place of refuge	Place of refuge for damaged tanker, with loss of oil from storage tanks.	MGO, IFO or HFO.	100 000 m^3	Major impact in and around spill location and surrounding sites. Could affect marine reserves/endangered bird species nesting and feeding sites.	1	4	M	• Monitoring and surveillance to determine spill spread. • Dispersant in suitable areas (if oil is amenable). • Containment and recovery. • Potential shoreline clean-up.

SCENARIOS									
#	Source	Event	Oil Type	Spill Volume	Potential Environmental Impact	Likelihood	Severity	Risk	Suitable Response Techniques[15]
					Potential for oil to travel great distance. Will affect tourism.				
9	Fishing Vessel	Fire / collision / grounding / sinking inside harbour	Diesel	10 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
10	Fishing Vessel	Fire / collision / grounding / sinking outside harbour	Diesel	10 m^3	Sheen and oiling in immediate area.	3	2	L	• Monitoring and assisted natural dispersion.
11	Recreational Yachting	Fire / collision / grounding / sinking inside harbour	Diesel	1 m^3	Sheen and oiling around pontoon and closely surrounding area.	3	1	L	• Monitoring and assisted natural dispersion.
12	Recreational Yachting	Fire / collision / grounding / sinking outside harbour	Diesel	1 m^3	Sheen and oiling in immediate area.	3	1	L	• Monitoring and assisted natural dispersion.

Risk Assessment Summary

The Risk Assessment Matrix shows that TNPA's highest risk in Richards Bay comes from a vessel collision or grounding and spilling fuel oil from bunker tanks. A passing ship scenario, or an incident involving a tanker offshore and the port receiving the vessel as a port of refuge also rank as medium risk scenario.

The matrix below shows how the likelihood and severity classes have been used to rank the different scenarios as high, medium, or low risk.

Table 44 Risk Matrix for Richards Bay scenarios.

		Likelihood				
		1	**2**	**3**	**4**	**5**
Severity	**1**			9, 11, 12		1
	2		6	5, 10	2	
	3		4, 7			
	4	3, 8				
	5					

Scenario risk colour coding		
High	Medium	Low

Gap Analysis

Figure 40 Gaps Identified in Richards Bay.

Gap Classification	Gap	Explanation	Recommendation	Ref #
Safety				
Major	Portable gas monitors were not seen in any response equipment stockpile.	A large light oil spill could cause vapours at levels that are harmful to health. The MSDS for Engen MGO warns that it should be assumed hydrogen sulphide could be present. Anyone working in the area of spilt light oil should be observing safe entry protocols and gas monitoring, both for the potential hydrogen sulphide risk and for the risk of volatile and flammable vapours. Gas monitors should test for CO, O_2, H_2S, LEL, UEL and benzene.	Have suitable portable gas monitors for response teams.	**RB1**
Equipment				
Moderate	No equipment available for the collection and recovery of free-floating mobile oil.	No vessel towable boom is in the TNPA stockpile of equipment.	Ensure oil spill response provision within Richards Bay includes suitable equipment for the collection of free floating oil with boom and skimmers.	**RB2**
Moderate	Lack of suitable equipment commensurate to the risk held by TNPA.	The equipment stockpile held by TNPA in Richards Bay is not sufficient to respond to the higher risk spill scenarios identified in the risk assessment.	Enlarge the equipment stockpile held in Richards Bay and broaden the type of equipment held.	**RB3**
Minor	No dispersant was held in Richards Bay	Dispersant is described as one of the most suitable oil response techniques in the NOSCP. Dispersant has been found to be effective on fresh MFO. Due to the dispersant guidance conditions including depth and distance to shore (see Table 4), dispersant would only be suitable for a spill that originates outside the port, or spreads sufficiently far outside the port within the window of opportunity for dispersant use.	Arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline.	**RB4**
Moderate	No protective booming is in place during bunkering operations.	Bunkering operations carry a risk of oil spills. Ensuring that any oil spilt from the bunkering hose is contained would reduce this risk. Booms placed fore and aft either side of the bunkering hose would	Reduce bunkering risk by using a H booms/flexible booms inserted between the ship and fuel barge fore and aft to collect any spilt oil (Refer to	

		contain any oil spilt in the region (can be used between ship and shore or ship and fuel barge).	Appendix 2 Equipment Recommendations). A way of recovering the oil (e.g. skimmer) would also be needed.	
Responders				
Moderate	No trained responders for recovery of free floating oil within or outside the port area.	As described in the equipment heading, there is no current capability for recovery of free floating oil.	Identify who should be responsible for oil spill containment and recovery within the Richards Bay area. Train on call staff in the use of these techniques.	**RB5**
Major	No trained aerial surveillance observers	The TNPA helicopter could be used to provide oil spill aerial surveillance but there are no agency or operator staff trained in surveillance.	Train a group of port and /or operator staff in aerial surveillance. Ensure at least one of the group is available at all times to respond to an oil spill.	**RB6**
Moderate	No evidence of IMS training of oil spill responders	The NOSCP states that all role players must be Incident Management System trained and competent to the following levels: IMS 100: every person that would be playing a role in any of the response functions, including the command- and general staff. IMS 200: functional heads, deputies and heads. IMS 300 – 400: the incident commander, functional heads, deputies and heads	Deliver IMS training to TNPA responders.	**RB7**
Moderate	Tug captains are restricted to operate within port limits or sheltered port limits only.	The certificate of competency required to operate outside port limits requires the candidate to meet criteria assessed by the maritime authority. The type of operations a port vessel conducts often doesn't give the crew the needed experience to achieve this certification. Some tug masters certificates are endorsed sheltered port operations only, which means they aren't allowed to proceed to the outer anchorage, or sea side of the port zone. The ports authorities in South Africa only require a Port Operation Only certificate of competency for their tug crews, as a result most of their tug	Vessel masters able to respond to outer port waters to be identified. Availability to be tested during a table top exercise.	**RB8**

		masters are not licensed by the maritime safety authority to proceed beyond the boundaries of a port that they are operating in.		
Major	No regular exercises for TNPA responders of oil spill exercises.	Oil spill exercises keep responders up to date with skills and allow for continuous improvement by identifying improvements that can be made. A previous exercise run with Engen is a good example of collaborative improvement but should be backed up by regular smaller deployment exercises for the TNPA team.	Run exercises to identify knowledge gaps. Drills to be run every 12 months. table top exercises to be run every 12 months. Functional exercises to be run every 24 months.	**RB9**
Moderate	Lack of specialised oil spill response knowledge for Engen spill response contractor.	Oil spill response techniques cited by TNPA's spill response contractor included using granular sorbents for on-water oil spills. This is not an appropriate technique. The spill response contractor appeared to be strong in safety knowledge, response team set up and organisation, however the response capability would be improved if this were backed up by increased specialised knowledge of marine oil spills.	Engage with spill response contractor to ensure all staff supplied in a spill have on water cleanup knowledge (to the equivalent level of IMO 2 training).	**RB10**
Additional Support				
Moderate	No TRP/SRPs	In the coastal plan there are different protection priority sites listed. Neither the coastal contingency plan or the TNPA contingency plan contain detailed site plans. These should detail site access, relevant stakeholders, techniques to be used and where appropriate booming plans for these priority sites.	Add detail to this initial site-specific response information in the coastal contingency plans.	**RB11**
Moderate	TNPA Richards Bay Pollution Contingency Plan 2015 update	Plan is missing: a clear area of jurisdiction, detailed waste management strategy, details of type of training/exercises conducted and their frequency.	Include recommended actions to fill gaps identified.	**RB12**
Moderate	TNPA Richards Bay Pollution Contingency Plan 2015 update	The plan states that the TNPA environmental management team should ensure that the most sensitive areas in the harbour are prioritised.	Clearly identify the response techniques for the most sensitive sites within TNPA jurisdiction.	**RB13**

		Priorities should be preassigned to avoid any delays when a spill occurs. There should be a plan of how to protect the most sensitive sites.		
Other				
Major	Lack of understanding of jurisdictional boundary and commitment to respond outside of operational areas.	TNPA will not respond to oil spills outside the port limits / breakwater.	DEFF/SAMSA to clarify jurisdiction and responsibility for responding to oil spills outside of inner limits but within the outer port area.	**RB14**

National Resources Available

DEFF

Equipment stockpile

The DEFF OSR equipment stockpile is in Paarden Eiland, Cape Town and could be mobilised nationally.

DEFF prioritised providing shoreline rather than offshore resources as offshore containment and recovery equipment is expensive and will not be suitable in every spill due to the nature of the oil spilt and weather conditions in coastal South Africa. The DEFF stockpile is made up of a large amount of nearshore, containment and recovery equipment including; inflation chamber boom, weir skimmers, vacuum systems, rope mops, disk skimmers and some associate ancillaries (including some hoses and pumps). There is also a large amount of sorbent boom sections. Temporary storage of waste oil is achieved with two Fastank 2000s.

At the time of the visit DEFF were moving the oil spill equipment to the alternative storage location close to the port. Most equipment was stored in the old location. Ancillaries were not stored with main equipment and no equipment labels or standard operating procedures were with the equipment. A small amount of new equipment was seen at a new storage location closer to the port There was equipment in the new location that had not been commissioned. Hydraulic hoses within the stockpile required testing and/or replacement. We understand that some of the equipment was due to be disposed of but this equipment was not clearly marked.

. A list of the DEFF equipment inspected with photos can be found in Appendix 1.

Surveillance and modelling

DEFF own and operate unmanned aerial vehicles (UAV) which could be used to provide a live stream for oil spill surveillance. They are in Cape Town and could be mobilised within 24-48 hours depending on the spill location and if the UAVs had to be flown to another location. Flight clearance would have to be obtained before a UAV could be flown for surveillance, but permission is expected to be granted rapidly (~3 hours).

DEFF are developing modelling and have an oil spill model that was used and tested during a spill at Algoa Bay. It is being refined for areas outside Algoa Bay (under development). DEFF can assist with current datasets for oil spill modelling.

Patrol boats

DEFF have four patrol boats which have a dual role - they patrol the fishing grounds around South Africa and are to be used for pollution control. They are fitted with spray arms and dispersant tanks. It was unclear at the time of the visit if these tanks had dispersant in them, though the dispersant stocks in South Africa have been tested and found to have degraded so if they do contain dispersant, it will be the same stock. The four vessels comprise:

- 1 x offshore patrol boat - this is the largest patrol boat, classed an ocean patrol boat; and
- 3 x inshore patrol boats - these are small, fast patrol boats.

Navy

The navy have an oil spill warehouse at Simons Town near Cape Town. Much of the equipment is still in its original packaging so is clean and visually in good order but has not been used for exercises. Boom/plastic that remains folded in one position will degrade along a fold or crease over time. So, the condition of the equipment needs to be confirmed and it can't be assumed that all the following equipment is response ready. Some of the equipment showed signs of having been used, for example 200 meters of air inflation boom was used to contain oily residue that leaked into the sea following the sinking of an old decommissioned tug.

The equipment was supplied in the late 2000's. The stockpile is thought to consist of:

- 1000 m – near shore air inflation chamber type boom
- 1 x rope mop (still wrapped)
- 1 x weir Skimmer (still wrapped)
- 1 x decontamination unit (still wrapped)
- 2 x bubble screen systems
- 1 x compressor for bubble screen
- 4 x fast tanks (still wrapped)
- 300 m (approx) fence boom
- Bags of Drizit absorbent pads
- Bags of Drizit absorbent material
- 50 x 25ltr of Gamlin oil dispersant liquid

Wildlife

SANCCOB have facilities in Cape Town and Port Elizabeth. In Cape Town SANCCOB have a recently upgraded, purpose-built facility. It has a hospital building with two intensive care units, a surgery, laboratory, medication room and x-ray room. There is a three-part wash bay area for oiled birds and a walk-in freezer to store fish to feed birds in care. In Port Elizabeth SANCCOB have an oiled wildlife rehabilitation centre with adjoining visitor centre. The centre has the capacity to rehabilitate over one hundred birds at a time and assess their health prior to release back into the wild.

There is one pool area for resident birds and three further pools to allow birds different levels of access to water to build up swimming strength as part of their pre-release rehabilitation.

SANCCOB have 40 staff including support functions. Approximately half the staff are trained in rehabilitation. These staff are trained to a level whereby they could train volunteers or other non-skilled staff to carry out wildlife response roles in a large spill. SANCCOB have staff vets. They train approximately 150 volunteers a year in wildlife response.

Other wildlife organisations are listed in the draft National Oiled Marine Wildlife Preparedness and Response Contingency Plan. These include uShaka who were visited as part of this capability review. uShaka rehabilitate

stranded marine animals and would be willing to help rehabilitate marine mammals in a spill. They have veterinarian staff and rehabilitation facilities.

In the event of a major wildlife response DEFF assets will be mobilised to assist. The DEFF marine mammal team and coastal research team would be mobilised. The Society for the Prevention of Cruelty to Animals (SPCA) can further be requested to assist for larger marine species. The SPCA will further be required to guide the disposal or incineration of animal carcases.

National level gaps

National level gaps are shown in Table 45 below. The national gaps are not necessarily the responsibility of TNPA to fill and some will be outside the TNPA area of influence, but they listed so that TNPA are aware of areas that could affect a large TNPA response. The gaps listed below are either gaps in the national level resources that are summarised in this section, or they are gaps that were seen in every TNPA location.

Table 45 Gaps Identified Nationally

Gap Classification	Category	Gap	Explanation	Recommendation	Ref #
Major	Safety	Portable gas monitors were not seen in the TNPA response equipment stockpile	Facilities and tankers will have fixed gas monitors on board, but initial oil spill responders are often going into areas that have evaporating hydrocarbons. With no gas monitors this is a safety concern.	Have suitable portable gas monitors for all response teams who may need to respond.	**N1**
Major	Safety	TNPA and DEFF facilities had no visible written procedures on how to operate equipment.	Standard operating procedures and work instructions reduce the risk of an accident when carrying out tasks.	Oil spill equipment owners should arrange work instructions for any mechanical equipment they hold.	**N2**
Major	Safety	The DEFF equipment stockpiles contained equipment with hydraulic hoses that had exceeded their testing and/or replacement dates. This might apply to the Navy equipment too.	Lack of maintenance has resulted in equipment being in various states of decay. In some cases lack of maintenance has caused very decayed hydraulic hoses that would pose a risk to the operator of that equipment, or nearby personnel.	Equipment that is to be used should be well maintained to ensure safety. Clearly mark any equipment awaiting decommissioning so it cannot be confused with 'in-use' equipment.	**N3**

Moderate	Containment and recovery	The only equipment available for the collection and recovery of free floating mobile oil was seen in Saldanha.	Whilst containment and recovery with a towed boom is not suitable in rough conditions, it would be suitable in calmer waters/calmer conditions.	Ensure oil spill response provision includes suitable equipment for the collection of free floating oil with boom and skimmers.	**N4**
Moderate	Wildlife Response	TNPA does not have guaranteed access to any wildlife response resources.	Wildlife response organisations, exist in South Africa, but they are not an oil industry resource and will always have to balance limited competing resources.	Arrange tier 1 and tier 2 oiled wildlife preparedness and response capability through oiled wildlife preparedness and response retainer agreements with OWR organisations.	**N5**
Major	Dispersant	No dispersant, dispersant spray equipment, or trained responders are available nationally.	Dispersant is described as one of the most suitable oil response techniques in the NOSCP. Subject to the dispersant guidance conditions including depth and distance to shore (see Table 4), dispersant would be suitable for a medium viscosity oil spill that will not disperse on its own.	Arrange dispersant, spray equipment and trained operators at strategic points on the South African coastline.	**N6**
Major	Aerial surveillance	No trained aerial surveillance observers	Helicopters could be re-tasked in a spill to provide aerial surveillance but there are no agency or operator staff trained in surveillance.	At a national level, trained aerial surveillance responders should be available and on call.	**N8**
Major	Maintenance	Lack of maintenance and even commissioning of oil spill response equipment.	The Navy, DEFF and TNPA all had equipment that has never been unpacked and commissioned. This equipment is not response ready. DEFF equipment needs maintenance before it is response ready.	All oil spill providers should have response ready equipment that is maintained and exercised.	**N9**
Moderate	Responder competency	Responders seen did not, in general, have a high level of oil spill response knowledge.	Tier 1 providers had varying levels of spill response knowledge. Whilst some were trained in health and safety there was very little knowledge of	Ensure that any spill response provider to TNPA is appropriately trained (IMO level 2 or equivalent).	**N10**

			specialist oil spill response techniques.		
Moderate	Agency support	DEFF staff may not have the capacity to effectively support a large oil spill response.	Due to low staffing levels DEFF staff may not be able to support a response effectively/quickly enough.	Work with all agencies involved in oil spill response to ensure that appropriate support is available.	**N11**

List of Documents Reviewed

The documents provided are listed below:

- TNPA Port of Saldanha Oil Spill Contingency Plan
- TNPA Port of Cape Town Oil Spill Contingency Plan
- TNPA Port of Elizabeth Harbour Spill Contingency Plan & working manual
- TNPA Port of East London Oil Spill Contingency Plan
- TNPA Port of Richards Bay Pollution Response Contingency Plan

Appendix 1 Equipment on Site

Equipment at Saldanha

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph
Sorbent	Spilltech	Saldanha store	120 x 10 kg bags of oil sep/biozorb sorbent material; 50 x 10 m sorbent boom	Yes	
Fence boom	Spilltech	Saldanha store	250 m Lamor 900 mm foam filled fence boom 300 m Drizit foam filled fence boo	Yes	
Inflatable containment boom	Spilltech	Saldanha store	4 reels , each with 3 x 25 m on. (300 m total)	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph
Weir skimmers	Spilltech	Saldanha store	2 older style wier skimmers	Yes	
Response vehicles	Spilltech	Saldanha store	2 x response vehicles	Yes	
Vessel	Spilltech	Saldanha store	Alligator response craft with 75 hp motor	Yes	
Inflatable containment boom	Spilltech	Marine response	4 reels, each with 3 x 25 m	Yes	No Photo

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph
		container: jetty	on. (300 m total).		

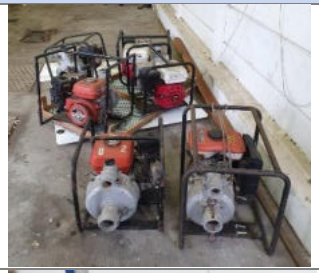
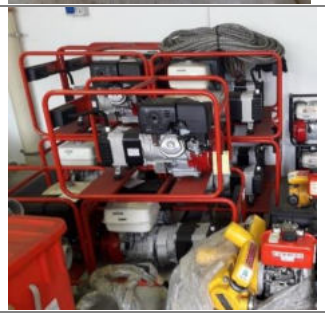
Cape Town

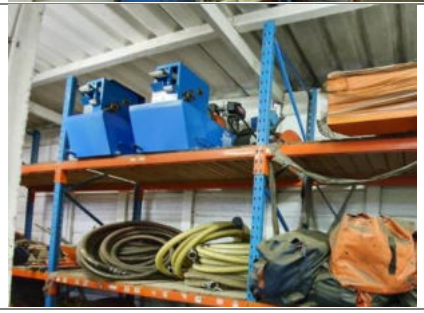
Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Pollution Clean-Up Boat Dtc 991 Samsa (Sterretjie)	TNPA	TNPA Store – Port of Cape Town	1	Unknown	
Pollution Boat - Pelican (Nautical)	TNPA	TNPA Store – Port of Cape Town	1	Unknown	
Desmi Termite Skimmer	TNPA	TNPA Store – Port of Cape Town	1	Yes	

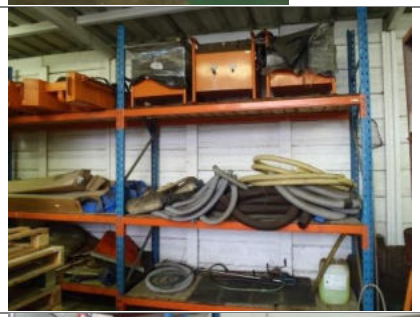
Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Desmi Power Pack	TNPA	TNPA Store – Port of Cape Town	1	Yes	
Fence Boom	TNPA	TNPA Store – Port of Cape Town	3 Reels of 60m and 4 rolls of 60m	Yes	 
Spate Pumps	TNPA	TNPA Store – Port of Cape Town	3	Unknown	

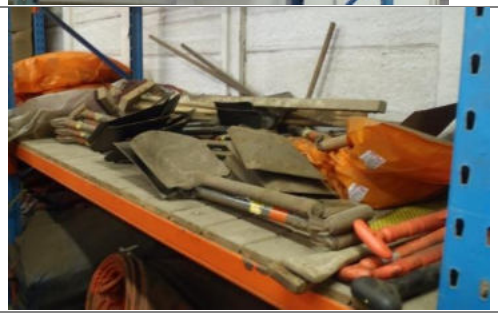
Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Air Blowers	TNPA	TNPA Store – Port of Cape Town	3	Unknown	
Rope Mops	TNPA	TNPA Store – Port of Cape Town	2	Unknown	
Ancillaries	TNPA	TNPA Store – Port of Cape Town	Various	Yes	Hoses, Rope, Fittings, Anchors, Buoys etc.
Near Shore Boom	DEFF	Paarden Eiland	35 x 20m Sections	Unknown	 

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Ancillaries	DEFF	Paarden Eiland	Various	Yes	
Spate Pump	DEFF	Paarden Eiland	4	Yes	
Honda Water Pump	DEFF	Paarden Eiland	2	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Honda Water Pump	DEFF	Paarden Eiland	6	Unknown	
Generator	DEFF	Paarden Eiland	7	Yes	
Work Boat	DEFF	Paarden Eiland	3	No	 

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
					
Disk Skimmer	DEFF	Paarden Eiland	4	No	
Rope Mop Skimmer	DEFF	Paarden Eiland	2	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Vacuum Skimmer	DEFF	Paarden Eiland	1	No	
Ancillaries	DEFF	Paarden Eiland	Various	Unknown	
Sorbent Material	DEFF	Paarden Eiland	30 Bags	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Absorbent Rolls and Pads	DEFF	Paarden Eiland	Various	Yes	
Fasttank 2000	DEFF	Paarden Eiland	2	Unknown	
Hand Tools	DEFF	Paarden Eiland	Various	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Absorbent Rolls and Pads	Spilltech	Spilltech Cape Town (Offsite)	Various	Yes	
Hand Tools	Spilltech	Spilltech Cape Town (Offsite)	Various	Yes	
Skips	Spilltech	Spilltech Cape Town (Offsite)	35+	Yes	

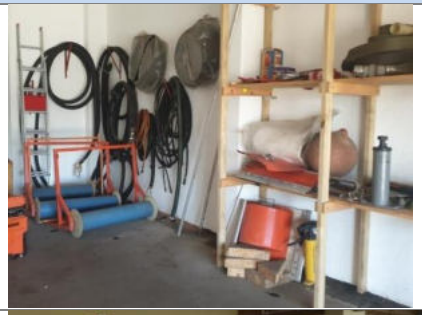
Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Inflation Boom	Spilltech	Spilltech Cape Town (Offsite)	4 Reels of 60m	Unknown	
Fence Boom	Spilltech	Spilltech Cape Town (Offsite)	100m+	Yes	
Work Boat	Spilltech	Spilltech Cape Town (Offsite)	1	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Vacuum Trucks	Spilltech	Spilltech Cape Town (Offsite)	3+	Yes	
Fence Boom	Drizit	Drizit Cape Town (Offsite)	100m+	Yes	
Work Boat	Drizit	Drizit Cape Town (Offsite)	1	Unknown	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Detergents	Drizit	Drizit Cape Town (Offsite)	Various	Yes	
Absorbent Rolls and Pads	Drizit	Drizit Cape Town (Offsite)	Various	Yes	
Sorbent Material	Drizit	Drizit Cape Town (Offsite)	Various	Yes	

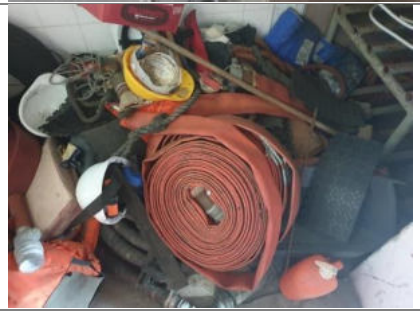
Port Elizabeth

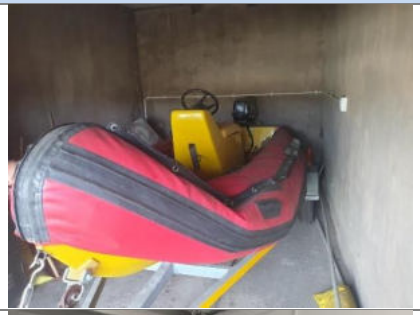
Type of Equipment	Owner / Operator	Location	Quantity	Response Ready? Y/N	Photograph (if available)
Near Shore Boom	TNPA	Port Elizabeth	150m	Unknown	
Foilex 200 Sea Skimmer	TNPA	Port Elizabeth	1	Yes	
Fasttank 2000	TNPA	Port Elizabeth	2	Unknown	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready? Y/N	Photograph (if available)
Ancillaries	TNPA	Port Elizabeth	Various	No	
Near Shore Boom	TNPA	Ngqura	400m	Unknown	
Work Boat	TNPA	Ngqura	1	Yes	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready? Y/N	Photograph (if available)
Fasttank 2000	TNPA	Ngqura	1	Unknown	
Tier 1 Response Trailer w' Fence Boom & Sorbent Material	Xtreme Projects	Ngqura	1	Yes	

East London

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Fence Boom	TNPA	East London	200m	Unknown	
Weir Skimmer	TNPA	East London	1	No	
Ancillaries	TNPA	East London	Various	No	

Type of Equipment	Owner / Operator	Location	Quantity	Response Ready?	Photograph (if available)
Work Boat	TNPA	East London	1	No	
Work Boat	Fire Dept	East London	3	Yes	  

Appendix 2 Equipment Recommendations

Harbour Equipment Package

A harbour response package is a suitable for a light oil spill risk at the port during product transfer, therefore the response equipment detailed would be suitable to contain and recover small oil spills within the port area. A harbour response package should be stored at the port and readily accessible.

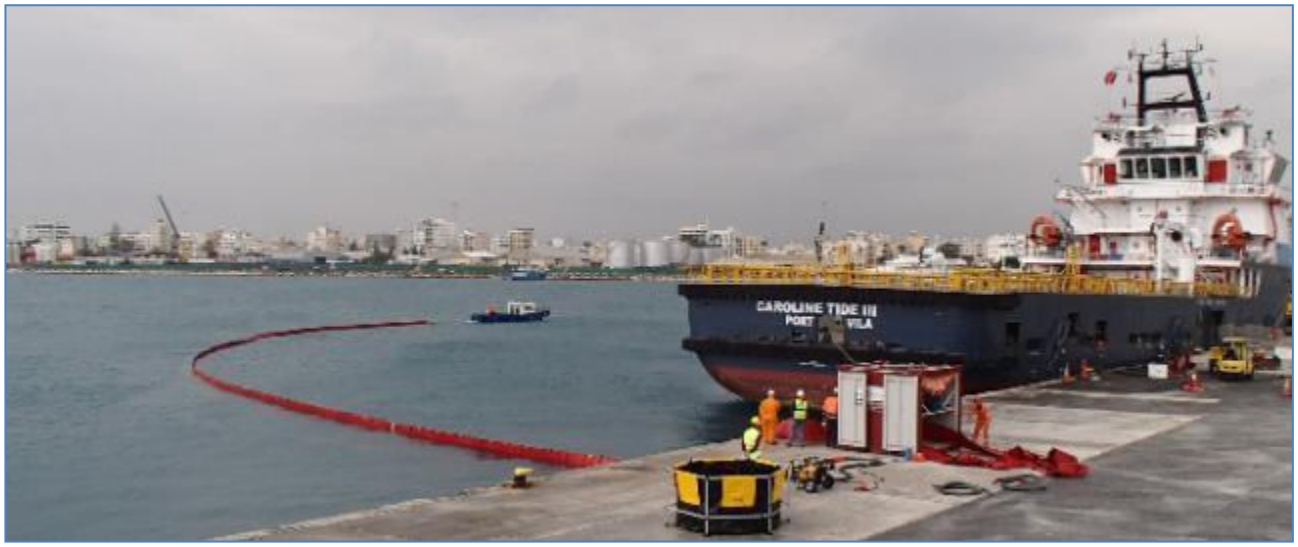


Figure 41 Harbour Response Scenario.

A harbour equipment package may consist of:

- 150m of fence boom
- A skimmer system complete with powered pump and hose set
- A Fastank 2000 temporary storage
- Ancillary equipment
- PPE sets
- 1 x 10ft ISO container

Figure 42 Fence Boom / Fastank 2000 / Skimmer System.

Fence boom is manufactured from PVC in 25m sections and is approximately 750mm (freeboard and skirt) in height. Developed using symmetrical closed cell foam floats that allow the boom to be fleet packed into a 10ft container. It is very simple to deploy from a manually operated reel and can be used without any special ancillary equipment, ideal for operations in ports and harbours.

The boom needs to be anchored so that it sits away from the side of the vessel and does not get caught under any part of the vessel to ensure any oil released would be contained. Fence boom can also be affected by wind and currents due to its poor wave-following characteristics. This can cause the boom to lie flat in the water and not contain the oil or the freeboard to sink below the surface or the skirt to ride between crests as a wave passes, allowing oil to escape.

The skimmer system is easy to transport and deploy with minimal personnel. Provided with both disk and brush cassettes, this skimmer is capable of recovering light to heavy oils. Temporary storage of recovered product is provided with the Fastank 2000's 10m^3 capacity. A harbour package will require four – six persons to manage.

Other types of boom suitable for containing any oil spilt in the port during product transfer is a type of H boom/inflatable flex boom. This could be put in place as a preventative measure prior to starting fuel transfer either inserted between two vessels (bunkering ships by fuel barge or tanker ship to ship transfers) or placed between the vessel and dockside in pairs, fore and aft of the vessel to maintain a constant seal.

Figure 43 Inflatable H booms deployed between vessel and dockside and between two vessels.

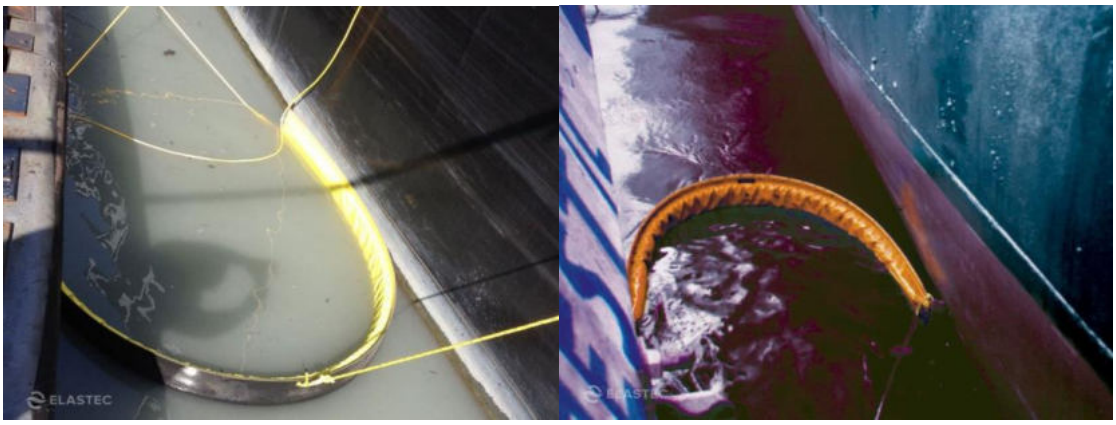


Figure 44 Flexible booms deployed between vessel and dockside and between two vessels.

The two different type of booms (inflatable or solid) are both put in place and secured using guidelines to allow deployment from the vessel deck or at dock level. These types of booms are available in a range of sizes and require very little storage space, minimal responders to deploy and eliminate the need to boom around the whole vessel.

Although these booms work well when positioned correctly, considerations must be given to the conditions they are used in. These booms only work well in calm water conditions; waves or situations which make the vessel move around a lot cause the seal between the vessel and dockside to be broken. Another issue is that the part of dockside wall that the boom will sit against needs to be smooth to prevent it from getting caught on the dockside wall and not sitting level on the water surface.

An important part of any boom deployment is trained responders. There are several lines that are attached to the boom which all need to be handled properly for the boom to get positioned correctly so frequent training must be carried out. Maintenance of the equipment is also important to make sure the lines are packed away so they can be deployed when needed and not get tangled.

Vessel Chemical Dispersant Package

The vessel based chemical dispersant spray package is suitable on fresh/amenable oil, removing surface oil to the water column, enhancing microbial degradation. The chemical dispersant will be supplied in 1000ltr intermediate bulk containers (IBC). The dispersant is pumped using Boat Spray 50 systems complete with AFEDO nozzle sets. The system is designed for the application of either concentrated (neat) or diluted dispersant. This package is delivered in one 10ft DNV container.

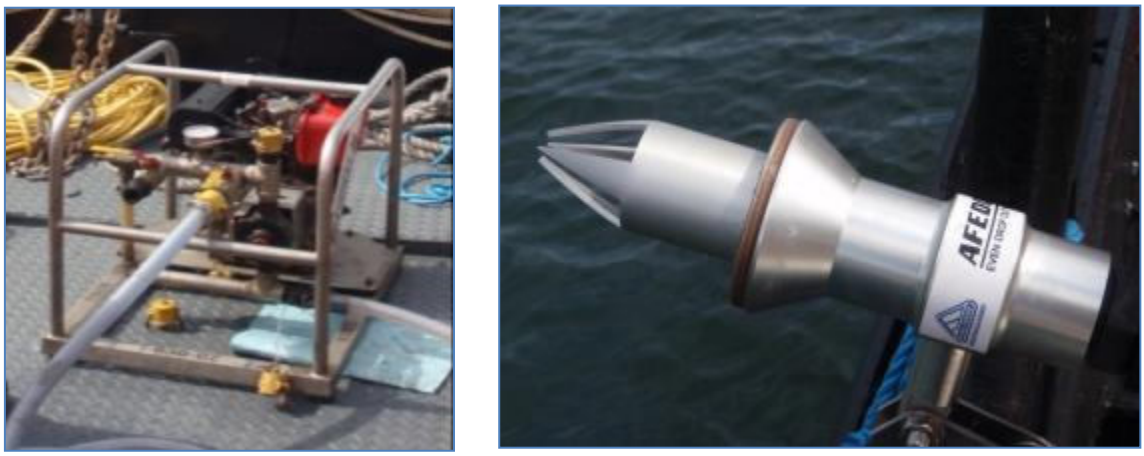


Figure 45 Vessel Chemical Dispersant System.

A chemical dispersant package consists of:

- Boat spray 50 pump unit
- Hose sets
- 2 x spray nozzles
- 4 x 1000ltrs of dispersant (with a treatment ratio of 20:1 is capable of treating an oil pollution incident of 80000ltrs)
- PPE sets
- 1 x 10ft DNV container

Sampling and monitoring equipment is also required to ensure the dispersant applied is being effective on the oil.

Conventional Offshore Containment & Recovery (C&R) Equipment Package

A conventional offshore C&R package is a two-vessel strategy, ideally in a J formation. The boom is housed on a hydraulic reel, inflated and deployed from an open or low stern vessel. For ease of deployment and manoeuvrability, OSRL recommends that the boom systems are provided in a 200m sectioned design and at least a total of 1500mm (freeboard and skirt). Larger section boom systems can be provided but would restrict the towing speed of the vessel and offer minimal advantages. The same vessel also operates the offshore skimmer unit at the apex of the boom formation, see figure below.

Figure 46 Offshore Containment and Recovery J Formation.

One conventional C&R package consists of:

- 200m of heavy-duty offshore boom housed on a hydraulically driven containerised reel
- An offshore skimmer, typically weir type with brush attachments
- A diesel power pack used for running both the skimmer system and hydraulic reel (not simultaneously)
- An offloading screw transfer pump
- A floating storage inflatable barge with a $25m^3$ capacity for temporary storage of the recovered product
- Hose sets and ancillary equipment
- Personal protection equipment (PPE) sets
- Marine tracking buoy (optional),
- 2 x 10ft DNV containers

Table 46 C&R System Statistics

System	Conventional System
Inflation design	0.5 bar
Length	200m
Containerised	10ft sea container for the reel system and 200m boom
Material	Heavy duty neoprene
Deployment and recovery time	20 minutes
Recovery	Skimmer unit located in the boom apex
Country of manufacture	Denmark/Finland/UK
Operational speed	0.75 knts
Storage	Separate inflatable barge or on board storage
Operating personnel	Approx 6
Oil type	ca. 5 – 180000cPS
Freeboard	1000mm
Front opening (swath)	50 – 100m
Operational parameters	3.5m wave height
Cost considerations	With the inclusion of a skimmer unit and associated powerpack/ancillaries, this is the least expensive system

Figure 47 Typical Offshore Recovery Device with Brush Attachment.

This conventional system has a towing limitation of under one knot, more suitable for an initial release where there is a high percentage of surface oil coverage.

The offshore skimmer system includes an adaptable weir skimmer unit with oleophilic polymer removable brush attachments allowing recovery of an expansive range of oil types including heavy oils, medium such as Campanian and Cenomanian to lighter vessel fuels and hydraulic oils.

These smaller units would be easier to transport and deploy, larger recovery units would be available under the OSRL Tier 3 membership. Each C&R package will include a spare screw type offloading pump unit.

One offshore containment and recovery system will require four - six persons to effectively manage (not including the second vessel).

Recovered oil storage is an important consideration offshore. Recovered oil may either be pumped and stored aboard the towing vessel or into a towed inflatable storage barge.

Each offshore C&R package may include two $10m^3$ or one $25m^3$ inflatable storage barges, see figure below. These barges can be towed behind the recovery vessel, containing any recovered oil. Once containing oil, the barges may either be anchored, or towed to an offloading facility ashore or at sea.

Figure 48 Inflatable Barge Design.

Appendix 3 Response Techniques

This section provides operational guidance on the following response techniques:

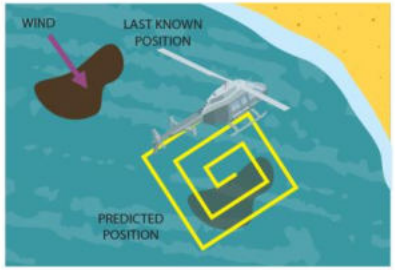
- Aerial Surveillance
- Assisted natural dispersion
- Response to minor spills using sorbents
- Dispersant operations
- Offshore containment and recovery
- Shoreline operations

Respond: Aerial Surveillance

There are four key missions that aerial support can be tasked with, these are listed below:

1. Verification of Oil Spill

Using predicted locations estimated from manual or computer calculated trajectories, aerial support can follow simple search paths (such as expanding square or ladder patterns) to ensure all oil is encountered and accounted for.



2. Quantification of Amount of Oil Spilled

To calculate the amount of oil spilled, the aircraft will need to fly both the width and length of the slick.

1. Calculate the length and width (m):

$$\frac{\text{TIME TAKEN TO FLY (seconds) X SPEED (knots)}}{\text{3600 (seconds) OR 60 (minutes)}}$$

Divide answer by 1.85 to convert to kilometres.

2. Calculate the area (km^2):

$$\text{AREA } (km^2) = \text{LENGTH (km) X WIDTH (km)}$$

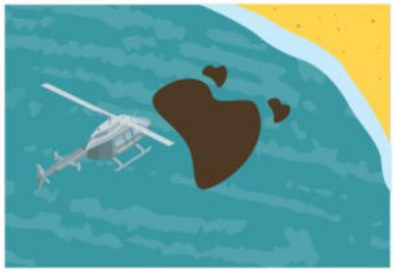
3. Calculate the volume (m^3):

$$\text{OVERALL AREA } (km^2) \text{ X MINIMUM THICKNESS (microns)}$$

NOTE: If using the Bonn Agreement Colour Code then two values will be calculated to get a maximum and minimum value.

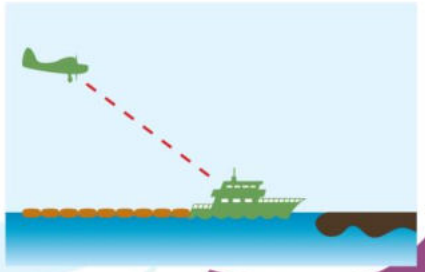
3. Monitor and Evaluate

Aircraft can be used as a surveillance tool to monitor the location of the spill and current condition, then evaluate whether the spill appears to be naturally dispersing, or if further response is necessary.



4. Supporting Operations

Aircraft may be tasked with surveillance of other aircraft and vessels conducting dispersant or recovery missions. The aircraft acts as a 'spotter' plane, identifying and directing other operational assets to the leading edge of the slick.



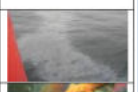
More information regarding aerial surveillance for oil spill operations can be found in the Aerial Surveillance Field Guide.

AERIAL SURVEILLANCE	Operational Information for aerial surveillance oil spill operations			
Response Objective	Minimum of two overflights (depending on size of spill) carried out early morning and late afternoon to locate, monitor and inform an effective oil spill response.			
Response Considerations	Flying authorisation, air clearances, government support and aerial infrastructure / logistics			
Safety Awareness	Emergency ditching of aircraft	Exposure to Volatile Organic Compounds (VOCs) and potentially also Hydrogen Sulphide (H_2S) from the oil being recovered.		Rotating machinery (propellers/ helicopter blades)
	Slips, trips and falls	Acute airsickness		Noise (85-90dBA)
PPE Requirements	Aviation lifejackets	Ear defenders	Grab bag	Sturdy footwear
Major Communication lines	Aircraft pilot Trained Observers (crew or pilot)	Vessels tasked with response operations		Incident Command
Response Efficiency	Aerial surveillance results dependent on flying conditions and visibility. Aerial surveillance can be used for any oil type (see the Tools below).			
Resources: Types of aerial surveillance platforms	**Fixed Wing Aircraft**		**Helicopter**	
	Advantages	*Disadvantages*	*Advantages*	*Disadvantages*
	Faster transit than helicopter	Dependent upon position in aircraft, view could be obstructed	Unobstructed visibility	Short endurance
	Longer endurance		Ability to land ‘off airport’	
	Less expensive than helicopter		More manoeuvrable than fixed wing	
	More readily available		Fly slower and able to hover	

<table>
<tr><th>AERIAL SURVEILLANCE</th><th colspan="2">Operational Information for aerial surveillance oil spill operations</th></tr>
<tr><td rowspan="2">Conducting an overflight</td><td>Predict the slick location</td><td>Use oil spill modelling or plot a trajectory where the oil will have moved on a chart based on 3% of the wind’s energy and 100% of the current.</td></tr>
<tr><td>Conduct a localised search</td><td>Expanding square/ spiral search

Ladder search</td></tr>
<tr><td>Logistics</td><td>Specific support

Trained observers</td><td>Response implementation

Suitable aircraft, refuelling</td></tr>
<tr><td>Supporting Information and Tools</td><td>Quantification codes</td><td>
<table>
<tr><th>Code</th><th>Description / Appearance</th><th>Layer Thickness Interval (Microns)</th><th>Litres per km²</th><th>Typical Appearance</th></tr>
<tr><td>1</td><td>Sheen (silver/ grey)</td><td>0.04 - 0.30</td><td>40 - 300</td><td>  </td></tr>
<tr><td>2</td><td>Rainbow</td><td>0.30 - 5.0</td><td>300 - 5000</td><td>  </td></tr>
<tr><td>3</td><td>Metallic</td><td>5.0 - 50</td><td>5000 - 50,000</td><td>  </td></tr>
<tr><td>4</td><td>Discontinuous true colour</td><td>50 - 200</td><td>50,000 - 200,000</td><td>  </td></tr>
<tr><td>5</td><td>Continuous true oil colours</td><td>>200</td><td>>200,000</td><td>  </td></tr>
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ITOPF Colour Codes
<table>
<tr><th>Oil Type</th><th>Appearance</th><th>Approximate Thickness</th><th>Approximate Volume (m/km²)</th></tr>
<tr><td>Oil Sheen</td><td>Silver</td><td>>0.0001mm</td><td>0.1</td></tr>
<tr><td>Oil Sheen</td><td>Iridescent</td><td>>0.0003mm</td><td>0.3</td></tr>
<tr><td>Crude and Fuel Oil</td><td>Brown to Black</td><td>>0.1mm</td><td>100</td></tr>
<tr><td>Water-in-oil Emulsions</td><td>Brown/ Orange</td><td>>1mm</td><td>1000</td></tr>
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Assisted natural dispersion

Select suitable option:

Enhanced agitation by water application

Spray seawater onto the surface of the oil spill using fire-fighting hoses to break up slick and aid dispersion.

Propeller assisted agitation

Use vessel “prop wash” to mechanically break up and disperse the oil. Direct the vessel to the thicker leading edge of the spill if safe to do so.

- Approach the slick from upwind at 90° to the direction of the current.
- Assist natural dispersion on non-boomed oil for maximum efficacy.

OFFSHORE CONTAINMENT AND RECOVERY	Operational Information for assisted natural dispersion operations
Response Objective	Disperse the oil naturally by agitating the water surface.
Response Considerations	Select the thicker parts of the oil to target with assisted agitation. Use only on low to medium viscosity oils. Approach the slick from upwind at 90° to the direction of the current.
Safety Awareness	Manual handling Exposure to Volatile Organic Compounds (VOCs) and potentially also Hydrogen Sulphide (H_2S) from the oil being recovered Man overboard Slips, trips and falls Unsecured loads / cranes Fire / collision Tides / water Heatstroke Noise (85-90dBA)
PPE Requirements	Personal Floatation Devices (PFD) or lifejackets Ear defenders, safety glasses Gloves, overalls (Tyvek) Sturdy footwear and hardhat
Major Communication lines	Between vessels (mother ship) and aerial surveillance support pilot ⟷ In-country response manager/Operations Supervisor ⟷ Incident Command
Response Efficiency	Assisted natural dispersion is suitable for low to medium viscosity oils. This technique **should not** be used with heavier oils as the slick will fragment, not disperse the spill.
Resources: Types of assisted natural dispersion	**Enhanced agitation by water application** **Propeller assisted agitation** Seawater spraying by firehose to break up the slick and aid the dispersion. Use vessel "prop wash" to mechanically break up and disperse the oil.
Logistics	**Specific support** • No specialised equipment required • Any vessel can be used for this technique
Supporting Information and Tools	Communications Plan Vessel Tracking Automatic Identification System (AIS) on all vessels

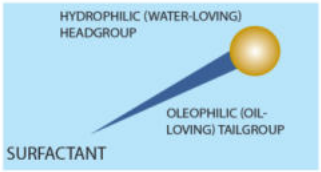
MINOR OIL SPILLS	Operational Information for response to minor oil spills			
Response Objective	To contain the spill as quickly as possible using resources on site.			
Response Considerations	Waste management of oiled products. Sorbent products include: sorbent pads, rolls, sorbent booms, pom-poms and snare booms and loose or granulated sorbent materials.			
Safety Awareness	Hazardous materials	Exposure to Volatile Organic Compounds (VOCs) and potentially also Hydrogen Sulphide (H_2S) from the oil being recovered		Slips, trips and falls
PPE Requirements	Lifejackets	Ear defenders	Overalls	Gas monitors
	Gloves	Safety glasses	Sturdy footwear	
Major Communication lines	Spill Observer	Dock Master		Incident Command
Response Efficiency	The quicker the spill is contained, the easier it will be to clean up and less likelihood of secondary contamination. Sorbent products can be used on a range of oil types.			
	Advantages		*Disadvantages*	
	Efficient at collecting up oil due to large surface area.		Can be expensive	
	Good for use in calm, slow moving waters or for backing up inflatable boom or on a ground surface to limit the spread.		Generates additional oily waste that needs to be temporarily stored and which has specific disposal requirements.	
			Not suitable for use with heavy oil types.	
			Have to be changed regularly when fully saturated with oil.	
Resources: Types of sorbents	**Mops- Pompoms** 	**Sorbent granules** 	**Booms** 	
	Rolls Also known as blankets a, are products which can be up to several metres long.		**Pads** Pads of sheets of thick, flexible products such as felts, polypropylene sheets. 	

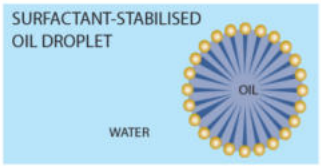
MINOR OIL SPILLS	Operational Information for response to minor oil spills
	

Respond: Dispersant Application

1. Dispersants

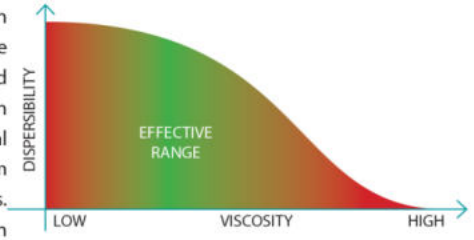
Dispersants are substances that can be applied to a spill at sea in order to break the surface tension and allow the formation of microscopic oil droplets that are then 'dispersed' in the water column. By dispersing the oil, it becomes much easier for the natural process of biodegradation to take place by greatly increasing the surface area of the oil. The dispersant is a blend of two principal components; a surfactant and a solvent. The surfactant is the active ingredient comprising a hydrophilic head and hydrophobic tail; the solvent acts as the transport medium.





2. Dispersant Operations

To ensure dispersant is an effective response option, the oil, operating conditions and the logistics of the operation must be considered. Approval may need to be sought from the appropriate authorities. The viscosity of the oil often determines dispersant effectiveness (see graph) and there will be a window of opportunity where dispersant will be effective. The duration of this window will also vary according to ambient sea and air temperatures as well as weather conditions.



3. Applying Dispersants

Dispersants can be applied in a number of ways depending on the operating conditions, availability of resources and size of the spill.

- A vessel or helicopter can target an oil spill with dispersant with more precision, however, a large aircraft can cover a greater area in a shorter period of time.
- Any dispersant operation must be directed at the thickest part (the leading edge) of the slick.
- When the spill has been located, a ladder or zigzag approach should be adopted dependent on the distribution of the oil on the surface of the sea.

4. Dispersant Monitoring

To ensure that the dispersant application is effective, the slick should be monitored with visual observations as a minimum.

- If the application rate is effective, a grey or coffee coloured plume will be Visible in the water.
- If the oil slick is underdosed with dispersant, no change will be obvious.
- If the oil slick is overdosed, or the dispersant is ineffective, cloudy white plumes will appear in the water.

A basic field test can also be used to confirm dispersant effectiveness. Using a two glass jar test, in the first jar, a sample of oil and sea water should be mixed with a sample of dispersant. The second jar should contain oil and sea water only, for comparison. Both jars should then be shaken, the oil, water and dispersant sample should form a cloudy mixture; if the water retains the cloudiness (> 1 hr) and there is less visible surface oiling, it is likely that the dispersant will be effective.

To confirm or support visual observations, fluorometry can be used to provide near real-time qualitative measurements, if the equipment and trained responders are available.

DISPERSANT APPLICATION	Operational Information for dispersant oil spill operations				
Response Objective	Reduce the amount of oil on the water surface and therefore reduce the amount of generated waste. Ensure effectiveness of dispersant is monitored and adjusted.				
Response Considerations	Window of opportunity, application method (aerial/vessel), oil type and operating conditions, approval for operations, monitoring (visual and water sampling).				
Safety Awareness	Manual handling	Man overboard / emergency crash landing	Unsecured load	Exposure to dispersant	Noise (85-90dBA)
	Slips, trips and falls	Exposure to Volatile Organic Compounds (VOCs) and potentially also Hydrogen Sulphide (H_2S) from the oil being recovered			
PPE requirements	Personal Floatation Devices (PFD) or lifejackets (dependent on proximity to water's edge)	Ear defenders (whilst machinery is running)	Oil resistant suit (Tyvex) (and gloves	Sturdy footwear, hardhat, safety goggles, breathing apparatus.	
Major Communication lines	Vessel conducting dispersant operations / aircraft conducting dispersant operations	Spray Master ⟷		Incident Command ⟷	
Dispersant Efficiency	Results are dependent upon oil type and behaviour, sea, weather and temperature conditions and the volume of oil spilt.				
Resources: Types of dispersant application platforms	**Fixed Wing Aircraft**				
	Advantages		*Disadvantages*		
	Aircraft can get 'on scene' quickly		There are limited number of systems available.		
	Large aircraft systems can hold a large volume of dispersant and treat a large area of oil in a relatively shore period of time.		Aircraft have to regularly refuel		

DISPERSANT APPLICATION	Operational Information for dispersant oil spill operations	
		Crew hours have to be considered when calculating the amount of spray runs that are possible
	Vessel	
	Advantages	*Disadvantages*
	Can stay 'on station' if a continuous oil spill release and could be effectively positioned to treat the spilt oil.	Have limited capacity to hold dispersant dependent upon the vessel deck space or internal tank capacity.
	Dispersant application vessels are easier to get than aircrafts vessels of opportunity and can be fitted with boat spray sets	Are able to cover a smaller area than an aerial system
	Helicopter	
	Advantages	*Disadvantages*
	Helicopter application can be more targeted than aircraft application so can be used to treat smaller 'break away' spills.	Helicopters have a shorted range than aircraft
		Helibuckets generally have a smaller capacity than aircraft spray systems
Suitable spray systems	 Spray arms / nozzles	Dispersant applied in a controllled manner Spray system should be mounted before the bow wave to make sure there is direct contact with the oil before mixing by the bow wave Can control the dose rate
Logistics	**Specific support**	**Response implementation**

DISPERSANT APPLICATION	Operational Information for dispersant oil spill operations	
	Fluorometry Dispersant effectiveness testing Sufficient supply of dispersant Water sampling	Suitable vessels/aircraft for dispersant spraying
Supporting Information and Tools	*Calculating Correct Dispersant Dosage*	
	Under-dosing	Applying too little dispersant – oil will remain on the surface in its normal state.
	Effective concentration	When the is effective a grey / coffee coloured plume will be visible in the water. There may also be a noticeable movement of oil from the surface into the water column.
	Over-dosing	Spraying too much dispersant or spraying on clean water will result in a cloudy plume appearing in the water.

Respond: Offshore Containment and Recovery

The containment and recovery of an oil spill uses floating barriers (booms) to contain the oil in sufficiently concentrated quantities to enable recovery devices (skimmers) to remove the oil from the surface.

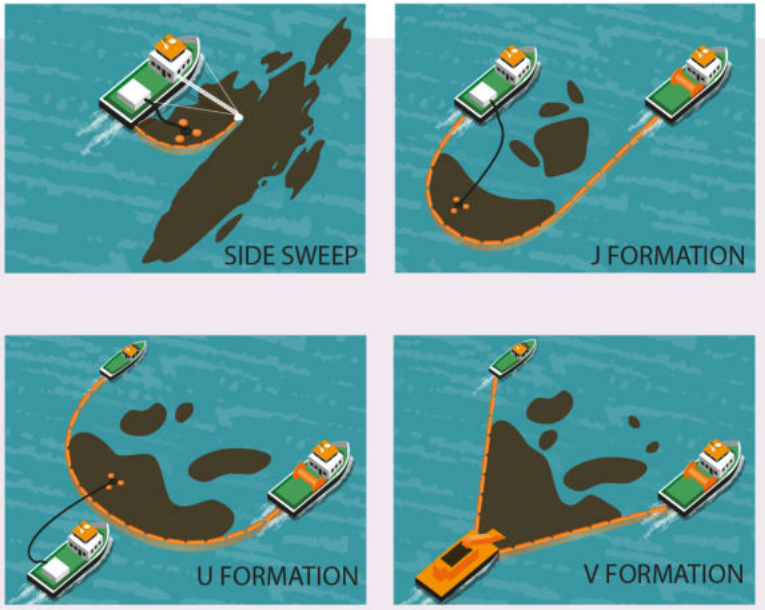
1. Identify Response Resources

Before deploying boom, the priorities of the response operation must be established such as choosing the correct boom type. Operating conditions must also be taken into account as wave height, swells and currents can cause the boom to fail. To deploy boom correctly, the following will be required:

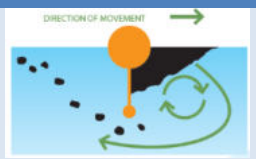
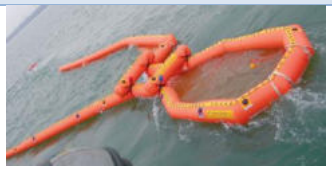
Deployment Vessel	Vessel will need adequate deck space and an open stern to load, secure and deploy the containment and recovery equipment.
Tow Vessel	Vessel will need a suitable means of securing the tow line in a safe manner.
Suitable Storage	Recovered oil will need to be stored in containers; there will need to be adequate space on board to store these containers.
Correct Boom Type	Certain booms are suitable in different environments. Booms may be joined together to increase length as necessary.
Recovery Device	The device deployed will be dependent on oil type and operating conditions.
Deployment Strategy	To ensure deployment is successful, a strategy must be agreed and communicated to all parties involved effectiveness
Spotter Aircraft	To improve operational effectiveness and ensure the system is in the thickest part of the oil.

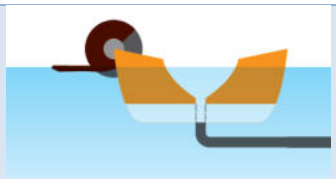
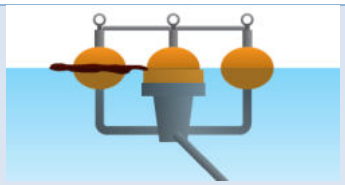
2. Choose An Appropriate Boom Configuration

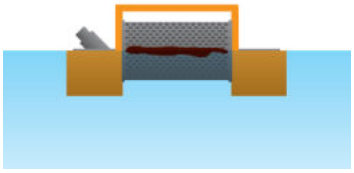
Different boom configurations can be utilised dependent upon the resources that are available for the containment and recovery operations. Whilst more vessels will allow for a wider encounter rate, operations will be harder to coordinate and a wide boom encounter will make it difficult to position the recovery device for optimum oil and minimum water recovery.



OFFSHORE CONTAINMENT AND RECOVERY	Operational Information for offshore containment and recovery oil spill operations
Response Objective	Contain oil in a boom configuration and recover oil with skimmers or pumps.
Response Considerations	Suitable selection of equipment for the oil type and weather conditions. Well-maintained boom. Deployed by trained operators. Suitable deployment/tow vessels. Effective communications. Available storage for recovered waste.
Safety Awareness	Manual handling / oil contact; Exposure to Volatile Organic Compounds (VOCs) and potentially also Hydrogen Sulphide (H_2S) from the oil being recovered; Man overboard Slips, trips and falls; Unsecured loads / cranes; Fire / collision; Tides / water; Hypothermia / heatstroke; Noise (85-90dBA)
PPE Requirements	Personal Floatation Devices (PFD) or lifejackets; Ear defenders, safety glasses; Gloves, overalls (Tyvek); Sturdy footwear and hardhat
Major Communication lines	Between vessels (mother ship) and aerial surveillance support pilot Trained Observers (crew or pilot) In-country Operations Supervisor Incident Command
Response Efficiency	Offshore containment and recovery results are dependent on weather conditions. Boom failure can be caused by undercutting, boom saturation or boom damage.
Causes of boom failure	*Boom saturation* If the boom fills with oil and a recovery device is not deployed the oil collected may overwhelm the boom and escape. 

OFFSHORE CONTAINMENT AND RECOVERY	Operational Information for offshore containment and recovery oil spill operations			
	Undercutting If the boom is towed at excessive speed or the current s running quickly then oil may nudercut the boom escape.			
	Boom Damage If a chamber is damaged during deployment or operations the remainder of the boom is able to stay afloat. There is potential for the oil to escape through the resultant gap, so the damaged chamber should be repaiered as soon as practicitably possible.			
Resources: Types of Offshore Containment Boom	**Passive Boom**		**High speed boom systems**	
	 Inflation boom is generally used for offshore activities as it has better wave-following characteristics than rigid boom. There are many different makes of offshore boom however the principles are the same.		 High speed boom systems (e.g. NOFI current buster) have the advantage of being able to be towed more quickly than traditional passive inflation booms (4-5 knots as opposed to <1 knot).	
	Advantages	*Disadvantages*	*Advantages*	*Disadvantages*
	Passive boom is relatively easy to deploy and maintain, ideally suited to spills where it may be necessary to deploy and	To complete the system you still need to source a suitable recovery system.	Can be towed quicker therefore has a higher encounter rate. Incorporates	A vessel dedicated to recovering from the boom is generally required as the apex is a considerable distance from the tow vessels. Buster booms are prone to collecting

OFFSHORE CONTAINMENT AND RECOVERY	Operational Information for offshore containment and recovery oil spill operations			
	recover the boom relatively frequently as the vessels 'chase the oil'.		a separator reducing the amount of water and maximising the amount of oil that is recovered.	debris which can interfere with the ability to recover oil.
Recover the oil	**Oleophilic skimmer**		**Weir skimmer**	
				
	An oleophilic skimmer uses discs, drums or brushes which have oleophilic ("oil loving") properties. The oleophilic surface picks up the oil which is later removed by scrapers and pumped into storage.		A weir skimmer sits on the oil/water interface, the oil flows into the hopper to be pumped into storage.	
	Advantages	*Disadvantages*	*Advantages*	*Disadvantages*
	The amount of water collected is reduced compared to other types of skimmers.	The skimmers are generally ineffective on oil that is heavily emulsified (as the high percentage of water in oil will inhibit the ability of the oil to adhere to the oleophilic surface). If dispersant has been used oil will not adhere	Skimmer is effective on oil of a higher viscosity than the oleophilic skimmer.	Weir skimmers are sensitive to weather conditions and tend to recover a relatively high proportion of water due to wave action. Their operation can also be negatively affected by the presence of debris in the water which may

OFFSHORE CONTAINMENT AND RECOVERY	Operational Information for offshore containment and recovery oil spill operations	
	to the oleophilic surface.	block the hopper and the pump.
	Mechanical skimmer	
		
	A mechanical skimmer physically removes oil from the water's surface i.e. by the use of nets, drums or crane-operated buckets.	
	Advantages Skimmer is effective on oils of a higher viscosity or weathered, emulsified oil.	*Disadvantages* There is the potential for a high percentage of water to be recovered and a thick layer of oil is required to be effective.
	Recovery rates Skimmers will have a pump rating that is based on test tank conditions and does not reflect the reality of offshore recovery operations. The rated pumping volume will seldom be achieved in field conditions.	
Range of Use	**Metocean conditions**	

WIND	WAVES	CURRENT	BOOM PERFORMANCE
0-10 knots (0-20 km/hr)	Calm, swells	0-0.5 knots (0.25 m/s)	GOOD
>20 knots	>3-4 ft (>1 m)	>1 knot (>0.5 m/s)	BAD

Logistics	**Specific support**	**Response implementation**
	Aerial Surveillance support Sourcing suitable vessels	Suitable vessels for deployment operations Suitable oil waste storage

OFFSHORE CONTAINMENT AND RECOVERY	Operational Information for offshore containment and recovery oil spill operations
Supporting Information and Tools	Communications Plan Vessel Tracking Automatic Identification System (AIS) on all vessels

Respond: Shoreline Protection

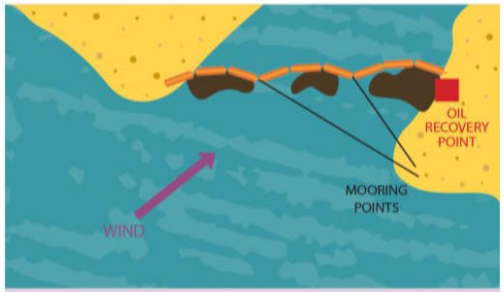
If oil is expected to impact sensitive areas, booms may be used as a barrier to protect the shoreline.

1. Prioritise Resources

Some shorelines can be considered more sensitive to oil than others due to their ecological, economic or cultural importance. These shorelines may be prioritised for protection. It is important to involve local stakeholders to prioritise sensitive areas for protection resources.

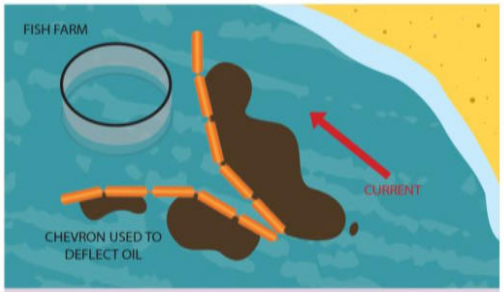
Identify the type of shoreline from the Environmental Sensitivity Index (ESI) *[Source: NOAA]*	
ESI Values	Shoreline Type
1	Exposed Rocky Shore
2	Exposed Rocky Platform
3	Fine-grained Sand Beaches
4	Coarse-grained Sand Beaches
5	Mixed Sand and Gravel Beaches
6a	Gravel Beaches
6b	Riprap Structures
7	Exposed Tidal Flats
8a	Sheltered Rocky Shores
8b	Sheltered Man-made Structures
9	Sheltered Tidal Flats
10a	Salt to Brackish Marshes
10b	Freshwater Marshes
10c	Swamps
10d	Mangroves

2. Deploy Appropriate Booming Strategy



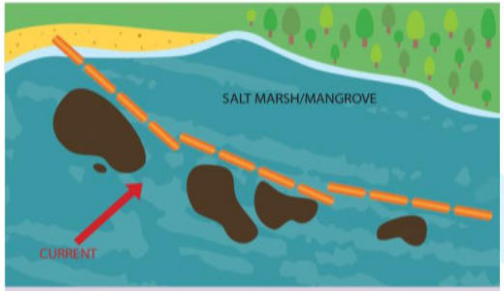
EXCLUSION BOOMING

Protects sensitive sites including small bays, inlets and harbour entrances.



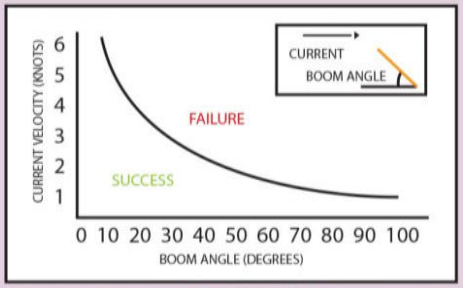
CHEVRON BOOMING

Deflects oil away from sensitive sites or resources.



CASCADE BOOMING

Deflects oil away from sensitive resources to a point of enhanced natural collection for recovery.



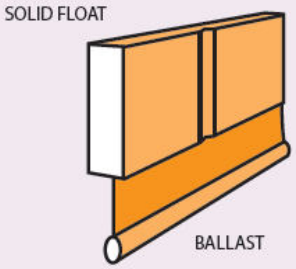
BOOM ANGLE

The angle of the boom can impact on the success of its deployment.

RIGID/FENCE BOOM

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

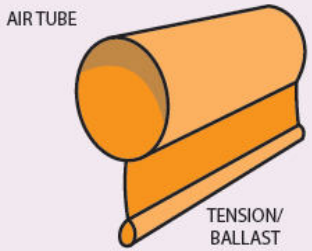
- ✓ Quick to deploy.
- ✓ Functions well in calm sea conditions.
- ✗ Requires significant storage space.
- ✗ Less effective wave-following characteristics than inflation boom.



INFLATION CURTAIN BOOM

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

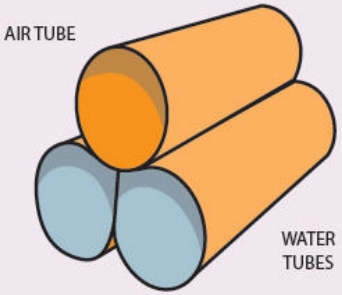
- ✓ Good wave-following characteristics.
- ✓ Are deflated for storage, therefore require less storage space.
- ✗ Ancillaries are required (air fan to fill air chamber).



SHORE SEALING BOOM

Top chamber filled with air, bottom two chambers filled with water.

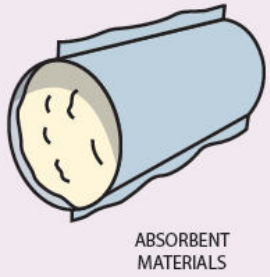
- ✓ Forms an effective barrier in intertidal areas.
- ✓ Are deflated for storage, therefore require less storage space.
- ✗ Ancillaries are required (water pump to fill water chambers, air fan to fill air chamber.



SORBENT BOOM

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

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



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

SHORELINE OPERATIONS	Operational Information for shoreline operations
Response Objective	Protect sensitive areas from oiling, contain and recover oil on the water surface and shoreline
Response Considerations	Selection of suitable recovery devices for oil type and weather conditions. Well-maintained boom deployed by trained operators. Effective communications. Pre cleaning sites and suitable storage available. Net Environmental Benefit Analysis (NEBA) (natural recovery). Shoreline Clean-up Assessment Technique (SCAT). Identifying and prioritising sensitive shorelines.
Safety Awareness	Manual handling; Exposure to Volatile Organic Compounds (VOCs) and potentially also Hydrogen Sulphide (H_2S) from the oil being recovered; Rotating machinery and hydraulic hose failure Slips, trips and falls; Tides & dangerous wildlife; Hypothermia / heatstroke; Noise (85-90dBA)
PPE Requirements	Personal Floatation Devices (PFD) or lifejackets (dependent on proximity to water's edge); Ear defenders, safety glasses; Oil resistant suit (Tyvek) and gloves; Sturdy footwear and hardhat
Major Communication lines	Operations Manager ⟷ In-country shoreline Supervisor ⟷ Incident Command
Response Efficiency	Results are dependent upon prioritising resources and selecting the most appropriate booming strategy and recovery device for the environment.
Resources: Methods of shoreline clean-up	**Natural Recovery** In some areas, eg salt marshes, it may be less environmentally damaging to allow the shoreline to recover naturally. It will have a slower recovery than doing a full clean-up operation, however, it may be the best course of action from a safety, environmental and operational perspective. 

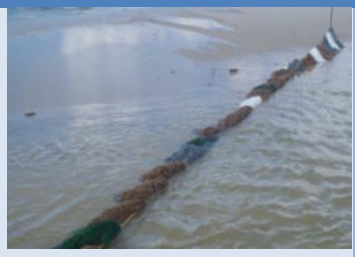
SHORELINE OPERATIONS	Operational Information for shoreline operations	
	Mechanical recovering (using skimmers and/or pumps) Oil can be recovered from shorelines/port areas using either skimmers or vacuum trucks. Oil can be contained in areas of a port or shoreline using boom and a skimmer used to recover the product. Oleophilic skimmers are more suitable for diesel spills due to their ability to recover light oil substances with minimal water collection. Vacuum equipment should not be used with light oil products due to the risk of explosion.	
Supplementary Resources	**Manual Clean up** A labour-intensive strategy involving large numbers of people collecting stranded oil by hand or by using the necessary tools. Team safety, supervision and waste management are important factors to consider when using manual clean-up. Personnel involved in the cleaning should be trained to only remove oiled sediment to minimise the amount of waste that is generated. Suitable site set-up is in place to minimise secondary contamination.	
	Low Pressure Flushing Pumps and hoses are used to wash the bulk oil from the shoreline. There should be containment boom in place to capture and recover the oily water run off to prevent it migrating to unoiled areas. When carrying out flushing, the water used should have the same characteristics as the environment it's being used in, otherwise the flushing water itself can cause further environmental damage.	
	Surf Washing Surface or buried oiled sediment (Sand, shingle, pebble and cobble shorelines) are relocated to the surf zone where it is exposed to wave energy. Here, the breaking waves clean the sediment contaminated with moderate to light levels of stranded oil. Once in the surf zone the released oil is then expected to naturally biodegrade due to the energy from the wave action.	

SHORELINE OPERATIONS	Operational Information for shoreline operations

Absorbents

Absorbents (either blanket or boom form) are made of oleophilic material which selectively absorbs oil whilst repelling water.

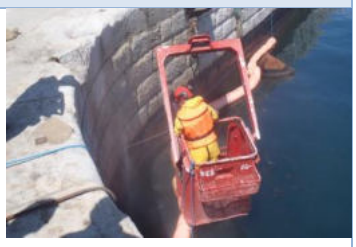
Absorbents are designed for use with lighter hydrocarbon products. Heavy oils will adhere to the outside of the absorbent rather than absorbing into the product. Absorbents should be used sparingly as they form a solid waste stream which must be disposed of appropriately.



High Pressure Washing

High pressure pumps with hoses are used to wash more persistent oil from the shoreline.

High pressure equipment can dislodge shoreline organisms unaffected by the oiling and could potentially sterilise the area. There should be containment boom in place to capture and recover the oily water wash off to prevent it migrating to unoiled areas.



Range of Use

	Natural Recovery	Mechanical (Skimmers/ Pumps)	Manual	Low Pressure Flushing	Surf Washing	Absorbents	High Pressure Washing
Manmade Structures		✓	✓	✓		✓	✓
Mixed Sand and Gravel		✓	✓	✓	✓		
Gravel Beach		✓	✓	✓	✓	✓	
RipRap Structures	✓		✓	✓			✓
Sheltered Rocky Shores		✓	✓	✓		✓	

Determining the most appropriate response strategy is important in ensuring that the shoreline is given the opportunity to recover from the environmental and socioeconomic damage caused by the spilled oil. Net Environmental Benefit Analysis (NEBA) should be considered to ensure the response options chosen are the most suitable for the shoreline type. More than one response option may be combined to produce a strategy, i.e. absorbent boom being used to contain and recover oil that has been pressure washed from a harbour wall. Response strategies can then be chosen based on producing the optimum solution for the area.

Logistics	Specific support	Response implementation
	Aerial Surveillance support	• Suitable vessels for deployment of boom

SHORELINE OPERATIONS	Operational Information for shoreline operations	
	Volunteers Post spill monitoring	• Site set up of shoreline clean-up area; zones for oil clean-up operations, decontamination and rest/food areas • Suitable oil waste storage
Supporting Information and Tools	Communications Plan Sensitivity maps of the shoreline	