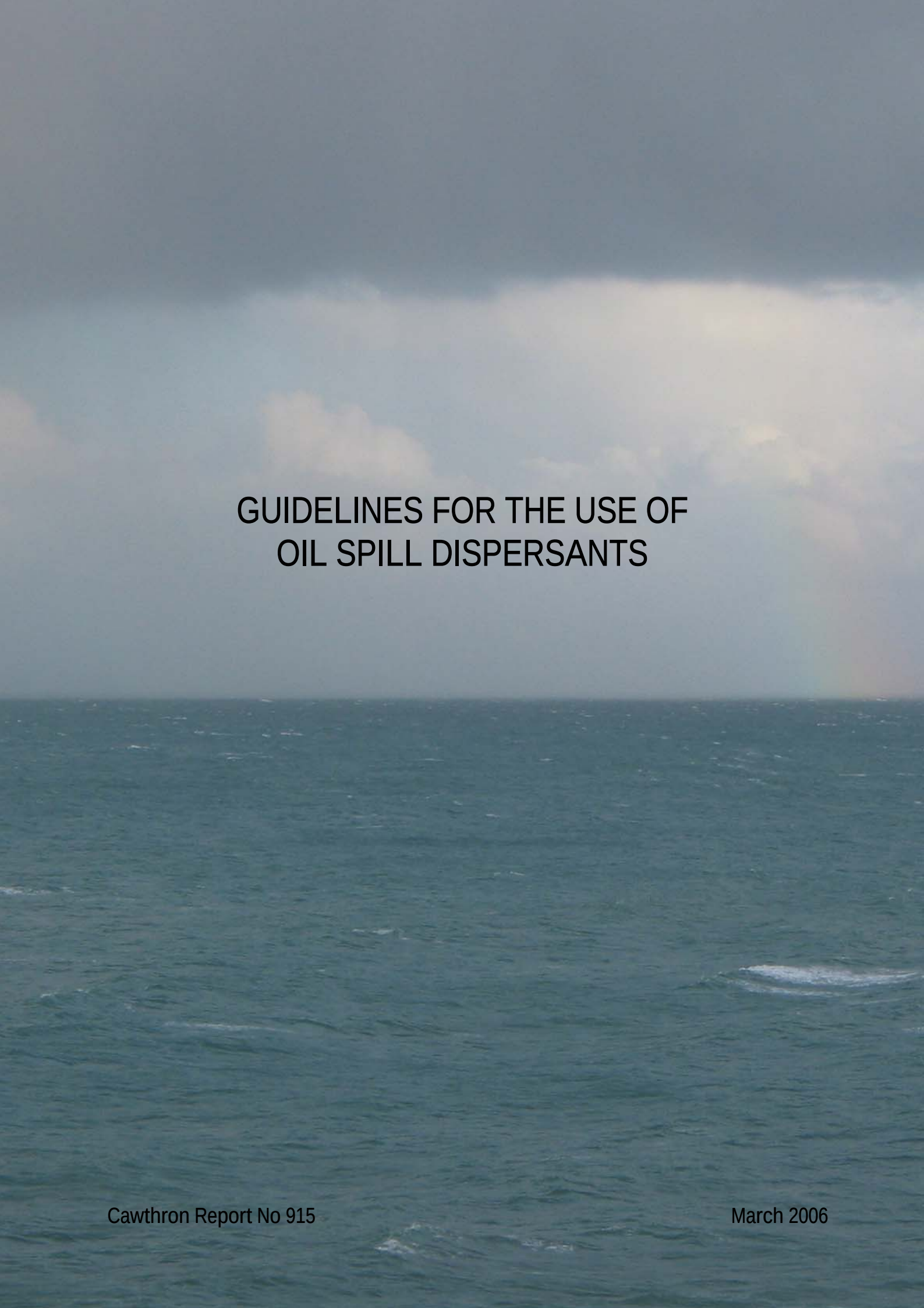


GUIDELINES FOR THE USE OF OIL SPILL DISPERSANTS

Cawthron Report No 915

March 2006

GUIDELINES FOR THE USE OF OIL SPILL DISPERSANTS

Leigh Stevens

Prepared for

Maritime New Zealand

Cawthron Institute,
98 Halifax St East, Private Bag 2,
Nelson, New Zealand.
Ph. +64 3 548 2319,
Fax +64 3 546 9464.
www.cawthron.org.nz

Reviewed by: Barrie Forrest

Approved for release by: Dr Barry Robertson

Recommended Citation:
Stevens, L.M. 2006. Guidelines for the Use of Oil Spill Dispersants. Prepared for Maritime New Zealand. *Cawthron Report No. 915.* 33p.

ACKNOWLEDGEMENTS

The Cawthron Institute is contracted by Maritime New Zealand (MNZ) to provide scientific support, training, and spill response services at a regional and national level. The current revision of the Guidelines has been completed as part of this contract.

This is the first review of the Guidelines since their completion in 2000 under contract to the New Zealand Foundation for Research, Science, and Technology. Since their release they have been formally adopted by MNZ, with several of the reporting forms becoming part of the broader National Marine Oil Spill Contingency Plan. The Guidelines have also been used during national oil spill responses and in several training exercises.

The Guidelines have also been modified and published by the Energy Institute, London (formerly the Institute of Petroleum) in February 2004 under the title *Operational Guidelines on the Use of Oil Spill Dispersants at Sea*.

Feedback since the initial release has resulted in a number of improvements being made. Please direct suggestions for further improvements to Maritime New Zealand.

AVAILABILITY OF THE GUIDELINES

OVERVIEW OF GUIDELINES FOR THE USE OF OIL SPILL DISPERSANTS

These guidelines are designed to facilitate and document rapid defensible decisions for dispersant use during an oil spill. The guide is designed as a single use document to be filled in during use. The On-Scene Commander (OSC) should retain the completed guide as evidence of the rationale for adopting a dispersant response strategy, cross referencing supporting documents as appropriate.

As every spill will be different, the guidelines do not provide hard and fast rules for dispersant use. Based on the information available and the type of values requiring protection, decision-makers are expected to judge whether a dispersant response will result in a *'net environmental benefit'*, either on its own, or in combination with other response options.

> *Net environmental benefit* is the best outcome likely after weighing up the advantages and disadvantages of all possible response outcomes, including taking no action. It accepts that some cleanup responses will cause damage that may be justifiable because of overriding benefits.

The guidelines are structured around the Dispersant Use Flowchart (page 2) which summarises the key aspects to be considered during the decision making process. The decision-maker should use the flowchart to guide dispersant use decisions.

Each numbered box in the flowchart is supported by a corresponding section to assist the decision process. It includes:

- Templates for spill reporting, assistance requests, and monitoring.
- Provides written documentation of each stage of the decision process.
- Text, checklists, or questions to assist in answering the key questions.
- Discussion notes summarising knowledge or providing rationale for decisions.
- Data summaries of key information and links to other sources of information.

It is imperative that the decision process commences as soon as possible after notification of a spill, and that response decisions are implemented quickly.

Rapid decision making is extremely important as dispersant is generally most effective when applied within 24 hours of a spill.

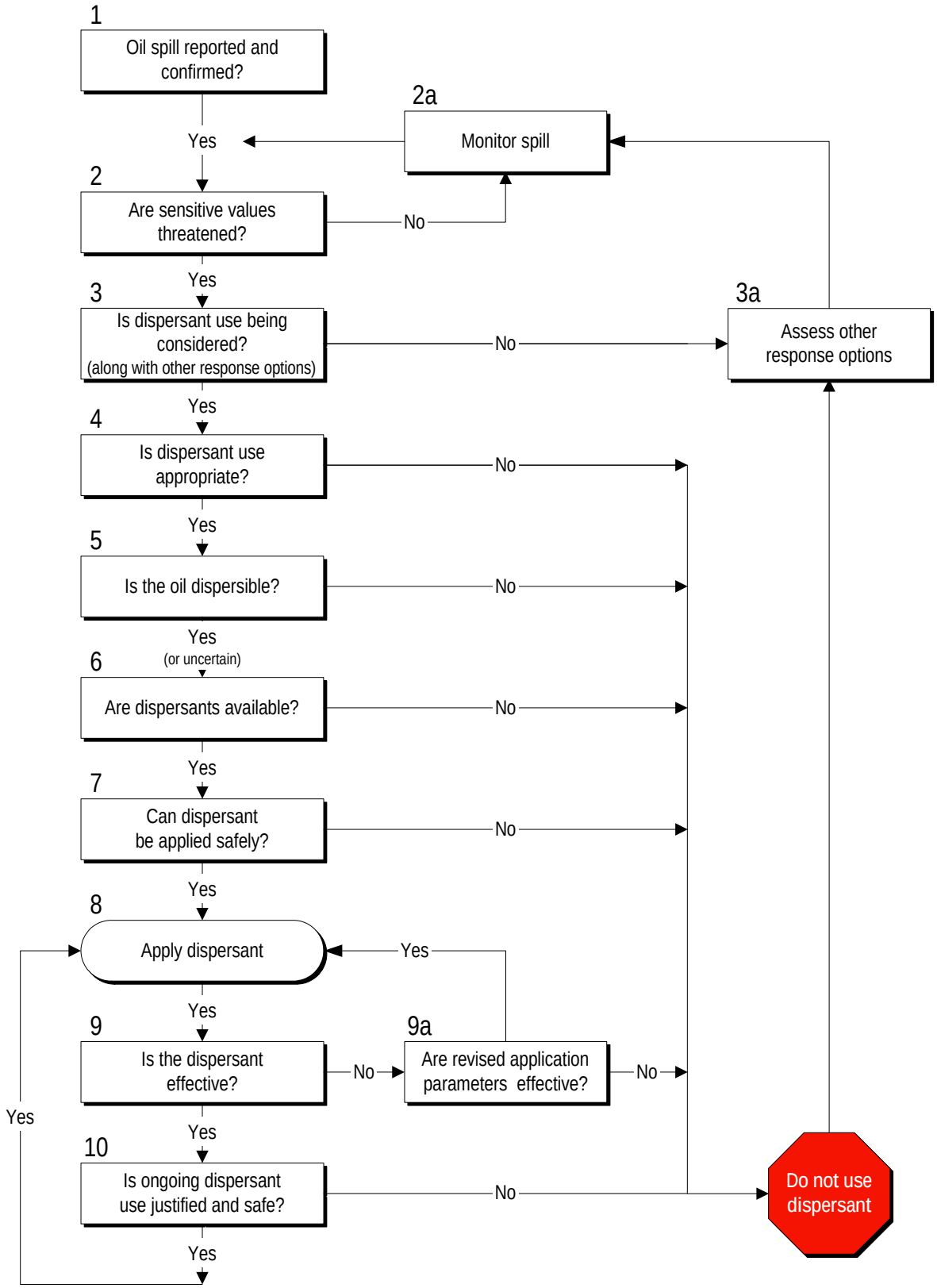
NOTE OF CAUTION: These guidelines are intended for use by trained decision-makers who:

- Are familiar with these guidelines, and relevant regional and national response plans.
- Know the range of oil spill response options available to protect sensitive values and habitats.
- Have a basic understanding of: dispersant chemistry and toxicity,
  application methods,
  monitoring requirements,
  the benefits and drawbacks of dispersant use.

If you do not have these skills, you should not use these guidelines

DISPERSANT USE FLOWCHART

The flowchart identifies sequential actions to address during the decision making process. Actions will often be undertaken in parallel, and reference to the supporting documentation will not always be necessary. For defensibility, it is vital that the dispersant decision summary on page 3 is completed.



DISPERSANT DECISION SUMMARY

Box	Issue	Decision	Approved by	Comments/Rationale
1	Spill Confirmed	Yes/No	Time: Date:	
2	Sensitive Resources Threatened	Yes/No	Time: Date:	
3	Dispersant Use Being Considered	Yes/No	Time: Date:	
4	Dispersant Use Appropriate	Yes/No	Time: Date:	
5	Oil Dispersible	Yes/No	Time: Date:	
6	Dispersants Available	Yes/No	Time: Date:	
7	Safe to Apply	Yes/No	Time: Date:	
8	Dispersant Applied	Yes/No	Time: Date:	
9	Dispersant Effective	Yes/No	Time: Date:	
10	Ongoing Use Justified	Yes/No	Time: Date:	

TABLE OF CONTENTS

BOX 1	OIL SPILL REPORTED AND CONFIRMED?		
		Date	Time
❑ Yes	Go to Box 2. Assess if sensitive values are threatened	.....	.....
❑ No	Complete reporting	.....	.....

1.1 Checklist of spill reporting requirements

1. Follow the directions given in Chapter 2 of the National Marine Oil Spill Contingency Plan (National Plan), and complete the following reporting forms as appropriate:

- Notification of a Marine Oil Spill (page 21)
- Marine Oil Spill Assessment (2 pages) (page 22)
- Regional Council Request for MNZ Assistance (page 24)

Reporting forms are included in Chapter 2 of the National Plan and appended to this document.

2. Forward verified spill details without delay to the Regional On-Scene Commander (ROSC) and/or MNZ Oil Spill Duty Officer (OSDO) for evaluation.

BOX 2 ARE SENSITIVE VALUES & HABITATS THREATENED BY THE SPILL?

			Date	Time
❑	Yes	Go to Box 3. Notify relevant wildlife/scientific advisers (see Tier 2 Plan)	.....	.....
❑	No	Go to Box 2A below. Continue monitoring spill	.....	.....

2.1 Assess the threat to sensitive values

i) Plot spill position on appropriate nautical chart.

ii) Estimate likely spill movement and speed using data from the Marine Oil Spill Assessment form.

iii) Use any of the relevant sources to identify if sensitive values are present in the spill location:

Information sources:

- ❑ MNZ GIS database
- ❑ Tier 2 Regional Plan
- ❑ Coastal Atlas
- ❑ Department of Conservation
- ❑ Ministry of Fisheries
- ❑ Regional/Local Council
- ❑ Fishing/Aquaculture Industry
- ❑ Charter boat operators
- ❑ Tourism agencies
- ❑ Port authorities
- ❑ Recreation groups – diving, boating, fishing
- ❑ Govt Institutes *e.g.* NIWA
- ❑ Maori/Iwi
- ❑ Environmental groups
- ❑ University
- ❑ Other.....
  .....

2.2 Indicate the type/s of sensitive values threatened by the spill (NOTE: not an exhaustive listing)

Environmentally important resources:

- ❑ Rare/endangered species
- ❑ Marine Reserves
- ❑ Mangroves/salt marshes/seagrass beds
- ❑ Mudflats/sandflats
- ❑ Fish spawning/nurseries
- ❑ Sea birds
- ❑ Sea mammals
- ❑ Other .....
- ❑ No environmental values threatened

Economically important resources:

- ❑ Marinas/ports/harbours
- ❑ Fishing/shellfish areas
- ❑ Fishing activity
- ❑ Aquaculture
- ❑ Water intakes
- ❑ Tourist beaches
- ❑ Recreation areas
- ❑ Other .....
- ❑ No economic values threatened

2.3 Estimate if any threat to sensitive values is significant

Base this estimate on the values identified, the location and likely movement of the spill, and if known, the spill size and oil type. Significant threats can include ecological damage, high cleanup costs, slow natural recovery, effects to large areas, long-term economic impacts.

BOX 2A IS THE SPILL BEING MONITORED?

			Date	Time
❑	Yes	Return to Box 2. Continue to assess whether sensitive values are threatened	.....	.....
❑	No	Start monitoring spill*. Return to Box 2.	.....	.....

*NOTE: Spill monitoring procedures are described in Regional and National Contingency Plans.

BOX 3 IS DISPERSANT USE BEING CONSIDERED?

			Date	Time
❑	Yes	Go to Box 4. Notify relevant dispersant advisers (contact MNZ)	.....	.....
❑	No	Go to Box 3A below. Assess other response options	.....	.....

KEY BENEFITS OF DISPERSANT USE

- Dispersant use minimises the effects of an oil spill principally by dispersing oil before it reaches shorelines or sensitive areas (*e.g.* mangroves, estuaries).
- Removing oil from the surface of the water reduces the potential for impacts to birds & marine mammals.
- Dispersants can enhance natural degradation in the water column.
- Dispersants can effectively treat large spills more quickly and cheaply than most other response methods.
- Dispersants can be effective in rough water and strong currents where mechanical responses are limited.
- Effective dispersant responses can greatly reduce the quantity of oil requiring recovery and disposal.
- Dispersant use is often the only feasible response to spills that exceed mechanical response capabilities.
- Dispersant use does not generally limit other options, except oleophilic mechanical responses.

3.1 Consideration of dispersant use

Dispersant use should be considered if:

- ❑ Oil is likely to significantly impact birds, marine mammals, or other flora and fauna at the water surface
- ❑ Oil is likely to significantly impact shorelines, structures and facilities (*e.g.* marinas, wharves)
- ❑ Oil is likely to significantly impact economically important resources (*e.g.* shellfish beds, tourist beaches)
- ❑ Natural dispersion could be enhanced
- ❑ Other response techniques are unlikely to be adequate, effective, or economical
- ❑ Sea/weather conditions preclude the use of other response techniques
- ❑ The oil could emulsify and form mousse, or tar balls
- ❑ Other:.....

BOX 3A ARE OTHER RESPONSE OPTIONS BEING ASSESSED?

			Date	Time
❑	Yes	See below. Determine and implement most appropriate response	.....	.....
❑	No	Go to Box 2A. Monitor the spill as a minimum response option	.....	.....

Consider all response options to identify which option, or combination of options, is most appropriate. The following clean up options are described in Chapter 6 of the National Plan:

- Monitor and evaluate (Natural recovery)
- Contain and recover
- Dispersant
- Protection
- Foreshore clean-up
- *In situ* burning
- Bioremediation

BOX 4 IS DISPERSANT USE APPROPRIATE?

		Date	Time
❑ Yes	Go to Box 5. Determine if the oil is dispersible	.....	.....
❑ No	Go to Box 3A. Assess other response options	.....	.....

If dispersant use is considered appropriate, mobilise staff to commence operational planning for a dispersant response.

ASSESSING THE APPROPRIATENESS OF DISPERSANT USE

- The most important question to answer is: **Will dispersant use significantly reduce the impact of spilt oil?**
- Rapid decisions on use are essential as dispersant must be applied quickly to be effective.
- Decision-makers must consider the environmental, social, economic, & cultural factors unique to each spill.
- Tradeoffs will be necessary, as no response is likely to satisfy all parties and protect all resources.
- Ecological effects will be due primarily to the spilt oil. Dispersant alone, when applied at recommended rates, is unlikely to cause significant adverse effects, even in multiple applications.
- Oil dispersed into >10m of water will quickly dilute to levels where acute toxic effects are unlikely.
- Few acute toxic effects have been reported for crude oil dispersed into less than 10m of well-flushed water.
- Small spills of light fuels seldom require dispersant use.

4.1 Will dispersant use have a Net Environmental Benefit? ❑ Yes ❑ No ❑ Neutral

Consider:
- The type and value of habitat potentially affected
- The sensitivity of affected resources to oil, and to different oil response strategies
- Natural recovery rates of affected species and habitats
- Likely oil persistence and degradation rates with and without dispersant use
- Potential oil toxicity on surface species compared to water column and/or seafloor species

4.2 Are there benefits in dispersant use for any of the following values?

SOCIAL: ❑ Yes ❑ No ❑ Neutral .....

ECONOMIC: ❑ Yes ❑ No ❑ Neutral .....

POLITICAL: ❑ Yes ❑ No ❑ Neutral .....

CULTURAL: ❑ Yes ❑ No ❑ Neutral .....

Consider:
- Recreational and/or commercial use of potentially affected areas
- Relative social and economic costs of different response options
- Public and cultural expectations and concerns

AREAS WHERE DISPERSANT USE IS GENERALLY NOT APPROPRIATE

- In shallow, nearshore areas, with limited circulation and flushing.
- Near aquaculture facilities, shellfish beds and fish spawning grounds.
- Around seawater intakes.

NOTIFICATION OF DISPERSANT USE

- Dispersant use is pre-approved in all New Zealand marine waters except for marine reserves.
- Tier 2 Regional Plans may identify preferred exclusion zones, although final decisions on use are based on net environmental benefit.
- Notification of interest groups is discretionary and should not delay any dispersant response.
- The notification of relevant interest groups is strongly recommended for any significant dispersant operation (suggested list follows).

4.3 Interest groups who may need to be notified of a significant dispersant operation

Group notified	Person notified	Date	Time
❑ Department of Conservation	.....	.....	.....
❑ Ministry of Fisheries	.....	.....	.....
❑ Environmental groups	.....	.....	.....
❑ Maori/Iwi	.....	.....	.....
❑ Health Protection Officers	.....	.....	.....
❑ Aquaculture industry	.....	.....	.....
❑ Fishing industry	.....	.....	.....
❑ Port authorities	.....	.....	.....
❑ Charter boat operators	.....	.....	.....
❑ Tourism agencies	.....	.....	.....
❑ Recreation groups	.....	.....	.....
❑ Media	.....	.....	.....
❑ Other (specify)	.....	.....	.....

The notification process is intended to inform interest groups of the response decisions made by the OSC. Interest groups should be provided with sufficient information to understand why dispersants are being used, including expected benefits and likely impacts. Where relevant, feedback on concerns raised by interest groups should be incorporated into the decision process.

BOX 5 IS THE OIL POTENTIALLY DISPERSIBLE?

			Date	Time
❑	Yes	Go to Box 6. Determine if appropriate dispersants are available.	.....	.....
❑	No	Do not use dispersant. Go to Box 3a, assess other response options.	.....	.....

Where oil type or characteristics are unknown, consider the oil potentially dispersible and go to Box 6.

OIL DISPERSIBILITY

- A key criterion for dispersant use is whether the oil is dispersible.
- The best indication of oil dispersibility is from specific oil weathering and dispersion data from field trials.
- Dispersion can be indicated by lab. weathering and dispersibility studies, but results will be **oil-specific**.
- Potential dispersibility can also be *estimated* from physical properties of oils (*e.g.* ADIOS see Table 5.3).
- Dispersant use should not be rejected exclusively on the basis of predictive models.
- **Unless certain that the oil is non-dispersible, testing dispersant on the spilt oil is recommended.**

General points:

- Dispersants do not work well on highly viscous or semi-solid oils and emulsions.
- Dispersion is unlikely if oil viscosity exceeds 10,000 $mPas^{-1}$
- Dispersion is unlikely if the sea temperature is more than $10^{o}C$ below the oil pour point.
- Dispersants are less effective in calm seas.

5.1 Determine potential oil dispersibility

Refer to the following sections to determine whether the oil is likely to be dispersible & record outcome below.

Dispersion assessment based on:		**Is the oil considered dispersible?**		
➢ **Oil properties**	(see section 5.2)	❑Yes	❑ No	❑ Not assessed
➢ **Laboratory test results**	(see section 5.3)	❑Yes	❑ No	❑ Not assessed
➢ **Test kit results**	(see section 5.4)	❑Yes	❑ No	❑ Not assessed
➢ **Field trial results**	(see section 5.5)	❑Yes	❑ No	❑ Not assessed

5.2 Oil properties

A general indication of oil dispersibility can be gained from oil properties. Assess potential dispersion using the following tables:

Table 5.1	Description of general oil characteristics based on oil type
Table 5.2	Prediction of general dispersibility based on oil characteristics
Table 5.3	ADIOS computer database (ADIOS predicts oil dispersion based on physical and chemical properties of spilt oil under specified spill conditions)

Further information can be obtained from the National Plan:
Chapter 4: Oil types/characteristics in NZ
Chapter 7: Guideline for dispersant use on selected crude oils and refined products under various sea temperatures

NOTE: Estimates based solely on oil properties are unreliable. The best way to determine if oil can be dispersed is direct assessment using either test kits or, preferably, field trials.

Table 5.1 GENERAL CHARACTERISTICS OF DIFFERENT OIL TYPES

Type	Description	Characteristics	
I	**Light distillates** Specific Gravity: <0.80 API Gravity: >45 Viscosity: 0.5-2.0 cSt @ 15°C	• Non-persistent* • Very volatile and highly flammable • High evaporation rates • Rapid spreading rates	• Highly toxic to biota • Little, if any, emulsification • High penetration of substrate
	e.g. Maui & Kapuni distillate, Gasoline blendstocks, Motor spirit (RMS/PMS), Avgas, Jet A1, Kerosene		
	DISPERSION GENERALLY UNDESIRABLE (due to high evaporation rate and toxicity of oil)		
II	**Light crudes** Specific Gravity: 0.80-0.85 API Gravity: 35-45 Viscosity: 4 cSt to solid @ 15°C (avg. 8 cSt)	• Non-persistent* • Moderate to high volatility • Low to moderate viscosity • Below pour points - behave like Group IV oil	• Moderate to high toxicity • Can form stable emulsions • Mod. to high penetration of substrates
	e.g. Automotive Gas Oil, Marine Gas Oil, Navy Gas Oil, Light crudes		
	DISPERSION GENERALLY POSSIBLE (if water temperature above oil pour point)		
III	**Medium – heavy crudes, fuel oils** Specific Gravity: 0.80-0.95 API Gravity: 17.5-35 Viscosity: 8 cSt to solid @ 15°C (avg. 275 cSt)	• Persistent** • Moderate volatility • Moderate viscosity • Below pour points - behave like Group IV oil	• Variable acute toxicity • Can form stable emulsions • Low to mod. penetration of substrates
	e.g. Light Fuel Oil, Medium – heavy crudes		
	DISPERSION GENERALLY POSSIBLE (if treated promptly & water temp. above oil pour point)		
IV	**Heavy crudes and residues** Specific Gravity: 0.95-1.00 API Gravity: 10.0-17.5 Viscosity: 1500 cSt to solid @ 15°C	• Persistent** • Low to moderate volatility • Moderate to high viscosity	• Variable acute toxicity • Can form stable emulsions • Low to mod. penetration of substrates
	e.g. Heavy Fuel Oil, Residues, Fletcher Blend, Maui F sands below pour point, Lube oils, Lube oil blendstocks		
	DISPERSION GENERALLY DIFFICULT (not feasible if water temp. >5°c below oil pour point)		
V	**Non-spreading oils** Specific Gravity: >1.00 API Gravity: <10.0 Viscosity: solid (unless heated)	• Persistent** • Very low volatility • Little, if any, evaporation • Very high viscosity	• Very low acute toxicity • Can form stable emulsions • Little, if any, penetration of substrate
	e.g. Heavy Bunker Fuel Oil, Bitumen, Very heavy fuel oil		
	DISPERSION GENERALLY NOT FEASIBLE		

* **Non-persistent:** A petroleum based oil that, at the time of shipment, consists of hydrocarbon fractions of which at least 50% by volume distill at a temperature of 340°C (645°F); and of which at least 95% by volume distill at a temperature of 370°C (700°F).

** **Persistent:** A petroleum based oil that does not meet the distillation criteria for a non-persistent oil.

Table 5.2 GENERAL DISPERSIBILITY OF OIL

Pour point				
5°C (41°F)	Probably difficult or impossible to disperse	Medium weight material Fairly persistent Probably difficult to disperse if water temperature below pour point of oil	Light weight material Relatively non-persistent Probably difficult to disperse if water temperature below pour point of oil	No need to disperse Very light-weight material Oil will dissipate rapidly
		Medium weight material Fairly persistent Easily dispersed if treated promptly	Light weight material Relatively non-persistent Easily dispersed	
API gravity	17	34.5	45	
Specific gravity	0.953	0.852	0.802	

NOTE: Dispersion estimates from this table will be conservative. If there is any doubt about oil dispersibility, dispersant should be tested directly on the spill for effectiveness.

Table 5.3 ADIOS (AUTOMATED DATA INQUIRY FOR OIL SPILLS) COMPUTER DATABASE

Copies of ADIOS are held by MNZ & Regional Councils, and can be downloaded from the NOAA website:

http://response.restoration.noaa.gov/software/adios/adios.html

ADIOS requires the following information to estimate the dispersibility of specific oils (get from the Marine Oil Spill Assessment form):

Oil/product name:	.....	Wind speed:	.....	$m.s^{-1}$ / knots
Amount spilled:	.....m^3/tonnes	Wave height:	.....	m
Type of release:	❑ Instantaneous	Water temp:	.....	^oC / ^oF
	❑ Continuous	Water salinity*:	.....	ppt

*Oceanic salinity = approximately 34 ppt

Approximate Water Temp.	Winter (Aug)	Summer (Feb)
Northland	16 ^oC	22 ^oC
Cook Strait	12 ^oC	18 ^oC
Southland	8 ^oC	14 ^oC

IMPORTANT LIMITATIONS ON THE USE OF ADIOS

ADIOS predicts dispersibility based on estimates of oil properties (including emulsification) under different conditions. As emulsification data are scarce, **predicted rates of dispersion may be different to actual rates of dispersion.**
ADIOS is intended for use with floating oils only, and does not account for currents, beaching, or containment of oil.
ADIOS is unreliable for very large or very small spills. It is also unreliable when using very high or very low wind speeds in modelling the spill.

5.3 Laboratory test results

LABORATORY TESTING OF DISPERSANT EFFECTIVENESS

- Laboratory weathering and dispersion tests can indicate the potential dispersibility of spilt oils.
- The many different internationally recognised dispersant effectiveness tests (*e.g.* WSL LR448, McKay, Exdet, Baffled flask, IFP) vary in methods and interpretation of the results. Expert judgement is required to evaluate potential dispersant effectiveness at sea based on laboratory results.

5.4 Dispersant effectiveness test kits

Each region holds a MNZ dispersant test kit containing sampling requirements and instructions for use. Test kits are intended to show the relative effectiveness of different MNZ stocked dispersants on spilt oil, but can also indicate whether the oil is amenable to dispersion. Field conditions will have a significant influence on application success so positive test kit results may not translate into successful field applications.

5.5 Field trials to assess dispersant effectiveness

FIELD TESTING DISPERSANT

- Field tests (test sprays) are the best way to determine whether spilt oil can be successfully dispersed.
- Monitoring is required to determine the effectiveness of different dispersants and application ratios.
- Field tests should not delay a dispersant response if the application has a reasonable likelihood of being successful, and there is a narrow window of opportunity, and/or weather conditions are forecast to deteriorate rapidly.

5.5.1 Assess if field applications can be undertaken

- ❑ Confirm that trained staff and application platforms are available within a suitable timeframe
- ❑ Confirm appropriate dispersant is available
- ❑ Ensure conditions at the spill site are within operational limits of the available application method/s
- ❑ Ensure effectiveness monitoring can be undertaken (see section 5.5.3)

Regularly review decisions about whether field applications are possible until a dispersant response is no longer considered feasible.

5.5.2 Select dose rate

As a general guide, **a dispersant:oil ratio of 1:20 is recommended**. However, dispersion will be affected by many factors including oil type, weathering, slick thickness, application method, and prevailing conditions. The OSC should set specific dispersant dose rates based on any relevant information available for the spilt oil *e.g.* laboratory results or past experience. Most importantly, the results of effectiveness monitoring of field applications should be used to revise the dose rate.

5.5.3 Mobilise monitoring of field applications

Field applications must be monitored to determine how effectively oil is dispersed with the selected dispersant, application ratio, and method. Monitoring intensity should reflect spill size and prevailing conditions, as well as the potential effects of the spill, and logistical and physical constraints.

Visual observation of dispersant effectiveness is the minimum acceptable level of monitoring. Termination of dispersant operations should, wherever possible, be based on real-time *in situ* water column monitoring results from at least one depth. Monitoring at multiple depths (either with real-time data or samples collected for later analysis) will provide the best information on dispersant effectiveness and the fate of the dispersed oil.

Monitoring details are described in Section 9.

BOX 6 ARE DISPERSANTS AVAILABLE?

		Date	Time
❑ Yes	Go to Box 7 to determine if dispersant can be applied safely.	.....	.....
❑ No	Do not use dispersant. Go to Box 3a, assess other response options.	.....	.....

6.1 Identify whether suitable dispersants are available

DISPERSANT SELECTION

- Only dispersants approved by MNZ can be considered for use in NZ.
- It may be necessary to test several different dispersants to find an effective product.
- Dispersant must be available within the timeframe that dispersants are likely to be effective.
- The logistics and timeframes required to mobilise dispersant to the spill site must be considered.
- Additional dispersant stocks or products may need to be manufactured or brought into the country.

6.2 Dispersants approved for use in NZ

Chapter 7 of the National Plan lists the dispersants approved for use in NZ.

6.3 Dispersants held by MNZ

Dispersants held by MNZ are detailed in Table 6.1 and in Annex 1 of the National Plan.
Details on how to obtain international dispersant stocks are presented in Annex 1 of the National Plan.
Regional supplies of non-MNZ owned dispersant are listed in Tier 2 Regional Plans.

Table 6.1 LOCATION AND QUANTITY OF MNZ DISPERSANT STOCKS (L) as at March 2006

Location		Gamlen OSD LT	Shell Disp VDC	Corexit 9500	Corexit 9527	Slickgone LTSW
Auckland	*MPRS*	10,400	3,600	29,920	960	70,400
Northland	*Marsden Pt*	4,000			9,560	
Northland	*Opua*				40	
Auckland		4,000				
Waikato	*Gordonton*	4,000				
Waikato	*Raglan*					
Waikato	*Whitianga*					
BOP	*Whakatane*	40				
BOP	*Mt Maung.*	3,960			3,200	
Taranaki		4,000			3,200	
Gisborne		4,000				
Hawkes B		4,000			3,200	
Wanganui						
Wellington		3,885			3,200	
Marlborough		4,000				
Tas/Nelson		4,000			3,200	
West Coast	*Greymouth*					
West Coast	*Westport*	4,000				
Canterbury	*Lyttleton*	2,800			3,200	
Canterbury	*Timaru*	1,200			3,200	
Otago		3,800			3,200	
Southland		4,000			3,200	
Chathams		4,000			1,600	
TOTAL		**70,085**	**3,600**	**29,920**	**40,960**	**70,400**

These stocks are available for immediate distribution to other regions in the event of a significant oil spill

BOX 7 CAN DISPERSANT BE APPLIED SAFELY?

			Date	Time
❑	Yes	Go to Box 8. Assess if field trials are possible	.....	.....
❑	No	Do not use dispersant. Go to Box 3a, assess other response options.	.....	.....

HUMAN SAFETY OVERRIDES ALL OTHER CONSIDERATIONS DURING A RESPONSE

GENERAL SAFETY ISSUES

- The OSC is responsible for ensuring Health & Safety requirements are adequately addressed during a response.
- Individuals should not engage in activities that they are not appropriately trained to perform.
- Individuals are expected to adhere to safety procedures appropriate to the conditions they are working under.
- Vessel/aircraft operators are expected to define appropriate operational limits & safety and maintenance requirements for their craft.
- Aircraft should be regularly washed with fresh water to remove any dispersant and salt water, particularly from the tail rotor assembly of helicopters, or exposed rubber components of aircraft controls.
- Material Safety Data Sheets (MSDS) for MNZ stocked dispersants are held by MNZ.

7.1 Determine if dispersant can be applied safely

- ❑ There is no significant risk to response personnel (*e.g.* ignition risk, operational hazards *etc*)
- ❑ Response personnel are appropriately trained and briefed
- ❑ Appropriate personal protective equipment is available
- ❑ Application aircraft and vessels will remain within standard operating limits

7.2 Responsibilities for the safe application of dispersant

Each person involved in a response is required to take personal responsibility for his or her safety. The OSC will appoint a Health and Safety Co-ordinator if required.

Key safety aspects to consider:

- Weather conditions (*e.g.* wind strength, fog, rain)
- Physical hazards (*e.g.* waves, tides, unstable or slippery surfaces)
- Heavy machinery and equipment
- Chemical Hazards (*e.g.* oil and dispersant exposure)
- Atmospheric hazards (*e.g.* fumes, ignition risks, noise)
- Confined spaces
- Personal Protective Equipment (PPE)
- Fatigue
- Heat/cold stress
- Wildlife (bites/stings)
- Cleanup facilities
- Medical treatment

BOX 8 APPLY DISPERSANT

Date Time

❑ Yes Go to Box 9. Monitor dispersant effectiveness ....

GENERAL APPLICATION INFORMATION

- The OSC has final responsibility for operational aspects of dispersant applications.
- Dispersant must only be applied by experienced spray applicators in accordance with manufacturers' instructions.
- The person applying dispersant is responsible for the calibration and operation of the spraying system, and the safety and maintenance of the application platform.
- Droplet size is the key variable influencing dispersant effectiveness. Undersized droplets (*e.g.* fog or mist) will be lost through drift and evaporation. Oversized droplets will punch through the oil and be lost in the water column.
- Dispersants pre-diluted in water are generally less effective than undiluted dispersant.
- Only undiluted concentrate dispersant is applied from aircraft.
- Dispersant should, where possible, be applied into the wind and parallel with the slick.
- Dispersant should be applied in a methodical and continuous manner to ensure the entire target area is treated.
- Dispersants are generally more effective, and smaller quantities are needed, on fresh oil compared to weathered oil.
- Spraying effort should concentrate on the thickest sections of oil that threaten sensitive areas.
- Thick portions of the slick may require several applications.
- Oil sheen should not be sprayed with dispersant.

8.1 Dispersant application

❑ Calculate the volume of oil to be dispersed (refer to Marine Oil Spill Assessment form on page 22)
❑ Determine the initial dispersant application ratio (usually 1:20)
❑ Calculate the volume of dispersant required

Record details on the Dispersant Application Summary form (page 25)

❑ Mobilise application team ..... Date ..... Time
❑ Mobilise monitoring team ..... Date ..... Time

A general guide is provided on the following page for each of the main application methods. The guides are intended simply to highlight key issues. The OSC is expected to co-ordinate and oversee operational aspects of dispersant applications. Dispersant applicators and equipment are listed in Tier 2 Regional contingency plans and in the Tier 3 National Plan (Annex 1).

AERIAL APPLICATION

- Aircraft application should always include pump driven spray units.
- Dispersant droplet size should be between 400 and 1000 microns.
- Commercial aircraft spraying nozzles generally range between 350 to 700 microns.
- MNZ can supply 1000 micron spray nozzles for use on viscous oils.
- Underslung buckets on helicopters should be mounted so the pilot can see the ends of the spray booms in flight.
- The altitude of the aircraft should be as low as possible, within safe operating limits.

BOAT APPLICATION

- Spray booms should be mounted as far forward as possible to prevent oil being moved aside by the bow wave before being sprayed. This then utilises the mixing energy of the bow wave to break up the oil.
- Spraying systems should be set so that the spray pattern is flat, striking the water in a line perpendicular to the direction of the boat's travel.
- The fan shaped sprays from adjacent nozzles should be set as low as possible, overlapping just above the oil/water surface, with the inboard spray striking the hull just above the water line.
- Boat speed is the main determinant of dispersant dose rate (reduce boat speed to increase the dose rate).

Undiluted dispersants

- Air blast sprayers and modified spray pumps can be used to apply undiluted concentrated dispersants and conventional dispersants.
- Application rate is usually constant and determined by nozzle size, and spray pressure.
- Calibration and use of an appropriate droplet size is critical to effective applications.

Pre-diluted dispersants

- Concentrated dispersants can be applied after pre-dilution in seawater, but will generally be less effective.
- The dispersant : water ratio should be equal to, or greater than, 10%.
- Applications through ship's fire fighting equipment are controlled by opening or closing the dispersant supply.
- Dual pump systems for dispersant and seawater supplying spray booms allow the dilution rate to be adjusted.
- MNZ Warren Spring spray equipment has a fluid pumping rate set at approximately 90 litres/minute. A 10% ratio of dispersant to seawater will be achieved with the proportioning valve open ¾ to 1 turn.

SMALL SCALE APPLICATIONS

- Dispersant can also be applied to small spills using backpack sprayers, or from land-based hose and eductor systems, although hose and eductor applications are not recommended for use in NZ.
- Efficient dispersant applications require calibrated equipment and appropriate droplet sizes.
- Controlling droplet size and dose rate for hose and eductor applications can be difficult, and care must be taken to ensure water pressure does not push the dispersant through the slick.
- Many hose and eductor systems use freshwater. Many dispersants are unsuitable for pre-dilution in freshwater.
- Effectiveness monitoring is required to maximise efficiency and prevent overdosing.

BOX 9 IS THE DISPERSANT EFFECTIVE?

			Date	Time
❑	Yes	Go to Box 10. Assess if ongoing use justified	.....	.....
❑	No	Go to 9.2. Review dispersant use	.....	.....

MONITORING DISPERSANT EFFECTIVENESS

- Dispersant applications must be monitored to confirm whether or not dispersant use is effective.
- Dispersant applications should not be delayed simply because monitoring is not in place.
- Visual observation is the minimum level of monitoring.
- There will be few instances where dispersant application is possible, but visual monitoring is not.
- *In situ* monitoring of oil dispersed in the water column should support visual monitoring where possible.
- A visible coffee-coloured cloud in the water column indicates the dispersant is working.
- Absence of a coffee-coloured cloud makes it difficult to determine if the dispersant is working.
- A milky white plume can indicate excessive dispersant application and/or that dispersion is unsuccessful.
- A difference in the appearance of treated and untreated slicks indicates dispersion is likely.
- Successful dispersion can occur with no visible indication of dispersion.
- Boat wakes may physically part oil, falsely indicating successful dispersion.

9.1 Assessing dispersant effectiveness

- ❑ Mobilise monitoring team (this should be done as early as possible in the response)
- ❑ Review dispersant monitoring results after each dispersant application
- ❑ Determine if dispersant application is effective
- ❑ Determine if chemical dispersion is significantly greater than natural dispersion
- ❑ Assess whether changing application parameters could make the application more effective

The following monitoring forms are appended to this document:

9.2 When dispersant is not effective

If monitoring shows dispersion does not appear effective, review all aspects of the application and monitoring for possible reasons why. Aspects to consider include:

- Dispersant formulations (try different types)
- Application ratios (increase or decrease oil:dispersant ratios)
- Application methods
- Monitoring methods
- Monitoring interpretation
- Oil weathering
- Weather conditions

If dispersion is not effective, and reviewed application and monitoring parameters do not alter effectiveness, dispersant operations should be terminated. Go to Box 3a and assess other response options.

BOX 10	IS ONGOING DISPERSANT USE JUSTIFIED AND SAFE?	Date	Time
❑ Yes	Go to Box 8. Apply dispersant	.....	.....
❑ No	Do not use dispersant. Go to Box 3a, assess other response options.	.....	.....

There will be a point when the use of dispersant is no longer effective.

10.1 Justification of ongoing dispersant use

All of the following must apply to justify ongoing dispersant use:

- ❑ Sensitive values are significantly threatened (refer to Box 2)
- ❑ The option of no response other than monitoring is inappropriate (refer to Box 3A)
- ❑ There is a significant 'net environmental benefit' from continued dispersion, including being more cost effective and having less adverse impact than other responses (refer to Box 3 and Box 4)
- ❑ The dispersant is effective (refer to Box 6 and Box 9)
- ❑ Chemically enhanced dispersion is significantly greater than natural dispersion (refer to Box 9)
- ❑ Dispersant can be applied safely (refer to Box 7)

10.2 Termination of dispersant use

The decision to terminate dispersant operations should be based on:

- ❑ Monitoring feedback, preferably visual monitoring confirmed by *in situ* UV fluorometry or similar, indicating that dispersants are no longer effective
- ❑ No visible change in the appearance of the slick after several hours following dispersant applications
- ❑ The oil being too scattered for the effective or efficient application of dispersant

REPORTING FORMS

marinepollutionRESPONSEservice
MARITIME NEW ZEALAND

NOTIFICATION OF A MARINE OIL SPILL

FILL IN THIS FORM WITH A BLACK PEN AND FAX TO MNZ RCCNZ

Fax to: **Rescue Co-ordination Centre of New Zealand (RCCNZ)** **Maritime New Zealand (MNZ)** **Fax: (04) 914 8388** Phone: (04) 914 8380	**URGENT** ☐ **NON-URGENT** ☐

Spill reported by:..... Organisation:.....

Date:..... Time:..... Phone:..... Fax:..... Mobile:.....

Estimated Tier of Response: **Tier 1 – Local** ☐ **Tier 2 – Regional** ☐ **Tier 3 – National** ☐

SITUATION REPORT:

Date of Spill:..... Time of Spill:..... Spill Location:.....

LAT. _____ °_____ 'S LONG. _____ °_____ 'E

Type of oil spilt: Crude ☐ HFO ☐ LFO ☐ Lube Oil ☐ Marine Diesel ☐ Hydraulic Oil ☐
Kerosene/Av.Gas ☐ Petrol/Gasoline ☐ Bilge ☐ Unknown ☐ Other ☐ .....

Estimated quantity of oil spilt: .....

Source of oil spilt: Land-Based ☐ Vessel ☐ Oil Transfer Site ☐ Offshore Installation ☐ Pipeline ☐ Unknown ☐

Vessel/Site Name: ..... MSA or MNZ# : .....

Owner:.....

Name:..... Address:.....

Activity: Vessel Loading/Unloading ☐ Refuelling ☐ Bilge Pumping ☐ Capsize ☐ Grounding ☐
Sinking ☐ Collision ☐ Unknown ☐ Other ☐ .....

Cause: Equipment/Mechanical Failure ☐ Human Error ☐ Vandalism ☐ Negligence ☐ Unknown ☐

Other ☐ .....

Environmental effects/Damage: .....

.....

.....

.....

Response/Action taken:.....

.....

.....

.....

If 'YES' to <u>any</u> of the following, notify the RCCNZ immediately by phone, and fax the RCCNZ this page.

Could spill escalate?.....YES / NO
Are response costs likely to exceed $5000? .....YES / NO
Is media interest likely? .....YES / NO
Is prosecution action likely? .....YES / NO

Then complete as much as possible of the **Marine Oil Spill Assessment Form** with currently available information and fax it. Do not delay notification while information is collected. Fax information updates when available.

If 'NO' to <u>all</u> of the above, tick non-urgent' at top of this page & fax this page to MNZ (04) 914 8388 within 3 days.

MARINE OIL SPILL ASSESSMENT (PAGE 1 OF 2)

FILL IN THIS FORM WITH A BLACK PEN AND FAX TO MNZ RCCNZ

This report made by:..... Organisation:.....

Date: ..... Time:.....Phone: ..... Fax: ..... Mobile:.....

Spill reported by: ..... Organisation:.....

Date: ..... Time:.....Phone: ..... Fax: ..... Mobile:.....

Address:.....Availability (next few hours):.....

Spill observed from: ❑ Vessel Name:..... Flag State:.....

❑ Aircraft Identification:..... Altitude:..... ft/m

❑ Land Location: .....

SOURCE OF SPILL: .....Time spill started: .....

❑ Instantaneous spill:.....litres/tonnes ❑ Continuous spill: .....litres/tonnes per hour

TYPE OF OIL SPILT ..... Specific gravity ..... at .....°C/°F

Product name..... API gravity..... at .....°C/°F

Product origin..... Kinematic viscosity..... cSt at .....°C/°F

❑ Crude oil Pour point..... °C/°F

❑ Refined product Volatility (flash point).....°C/°F

SHAPE OF SLICK ❑ Oval ❑ Circle ❑ Square ❑ Rectangle ❑ Streamers ❑ Other.....

TOTAL AREA AFFECTED BY SPILL

Length		Width		Total Spill Area
	x		=	
Km		Km		Km^2

AREA COVERED BY OIL

Total Spill Area		Percent covered by oil		Total Slick Area
	x		÷ 100 =	
Km^2		(max. =100%)		Km^2

VOLUME OF SPILL

1. If more than one type of oil is present, estimate the proportion of each oil type within the total slick area based on appearance*
2. For each oil type, multiply loading x proportion x total slick area to calculate oil volume
3. Sum the volumes of each oil type to estimate total spill volume

Oil Type (Appearance)	Thickness (mm)	Loading m^3 / Km^2		Proportion of Total Slick Area		Total Slick Area Km^3		Volume m^3
Silvery sheen	0.0001	0.1	x		x		=	
Rainbow sheen	0.0003	0.3	x		x		=	
Yellow/Brown Slick	0.01	10	x		x		=	
Black/Brown Oil	0.1	100	x		x		=	
Brown/Orange Mousse	1.0	1000	x		x		=	
TOTAL				(Must = 1)				m^3

*If uncertain, base estimate on crude/fuel oil 0.1 mm thick = 100 m^3 of oil / km^2; (= 1 tonne of oil / Ha)

MARINE OIL SPILL ASSESSMENT (PAGE 2 OF 2)

LOCATION OF SPILL .....

OR Range and bearing <u>from</u> geographical feature:

Latitude:..... South — Bearing: .....degrees true/magnetic

Longitude:..... East/West — Distance:..... nm/km

Time position fixed:..... Hours — Feature:.....

POSITION OF SOURCE.....

OR Range and bearing <u>from</u> geographical feature:

Latitude:..... South — Bearing: .....degrees true/magnetic

Longitude:..... East/West — Distance:..... nm/km

Time position fixed:..... Hours — Feature:.....

If spill source a vessel: Speed:..... knots — Approximate course: .....degrees true/magnetic

WEATHER CONDITIONS AT SPILL SITE ❑ Sunny ❑ Overcast ❑ Cloudy ❑ Rain ❑ Fog

Sea state:..... Wind speed:.....knots/km Air temperature:..... ^{o}C

Wave height:.....m Wind direction:..... degrees true/magnetic Sea temperature:..... ^{o}C

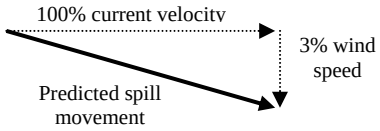
Water depth: .....m Visibility:.....nm/km Salinity:..... ppt

Weather and sea conditions expected over the next 24 hours:.....

.....

PREDICTED SPILL MOVEMENT

Plot spill movement on appropriate nautical chart.
Predict spill direction and speed using:
100% current velocity and 3% wind speed.



Note: Wind blows FROM the specified direction; currents flow TOWARDS the specified direction

Current velocity:.....knots/km — Tides: next low at.....hours, height ..... m

Current direction:..... degrees true/magnetic — next high at.....hours, height ..... m

Predicted slick speed: .....knots/km — Predicted slick direction: .....degrees true/magnetic

Estimated distance to shore/sensitive area:..... nm/km

Estimated time for spill to reach shore/sensitive area:.....

Description of coastal areas and resources likely to be affected:.....

.....

.....

.....

.....

.....

marinepollutionRESPONSEservice
MARITIME NEW ZEALAND

REGIONAL COUNCIL REQUEST FOR MNZ ASSISTANCE

FILL IN THIS FORM WITH A BLACK PEN AND FAX TO MNZ RCCNZ

Fax to: Rescue Co-ordination Centre of New Zealand (RCCNZ) **Maritime New Zealand (MNZ)** **Fax: (04) 914 8388** Phone: (04) 914 8380	**URGENT** ☐ **NON-URGENT** ☐

This report made by: .....Organisation:..... Date: ..... Time: .....

Phone:..... Fax:.....Mobile:..... Pager:.....

On-Scene Commander: .....Organisation:.....

Phone:..... Fax:.....Mobile:..... Pager:.....

THE FOLLOWING ASSISTANCE IS REQUESTED FROM MNZ

Advice on:

- ☐ Oil characteristics
- ☐ Spill movement
- ☐ Cost recovery
- ☐ Other (specify):.....
- ☐ Response options
- ☐ Oil recovery
- ☐ Prosecution
- .....
- ☐ Dispersants
- ☐ Waste disposal
- ☐ Media relations
- .....

Staff and equipment:

- ☐ Spill managers
- ☐ Equipment operators (Number required:.....)
- ☐ Equipment (list below)
- ☐ Other (specify): .....
- .....
- .....
- .....

EQUIPMENT REQUESTED: (Continue on separate page if necessary)

Type	Quantity	Priority	Type	Quantity	Priority
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....

Delivery contact:.....

Delivery address: .....

Phone:..... Fax:.....Mobile:..... Pager:.....

DISPERSANT APPLICATION SUMMARY

TO BE COMPLETED BY DISPERSANT APPLICATORS FOR AIRCRAFT AND VESSELS

This report made by:.....Organisation:..... Date: ..... Time: .....

Application Parameters

General location:.....

Size of target area: .....Ha/Km^2

Volume of oil targeted:.....Litres/Tonnes

Volume of dispersant required:.....Litres/Tonnes

Dispersant : oil ratio (DOR): .....

Dispersant being used:.....

Application Platform

Aircraft/Boat/Other: .....

Type:.....

Capacity:.....

Swath width:.....

Application speed:.....

Pump rate: .....

Application capacity

Distance to slick: ..... km

Resupply time:..... min

Applications per hour: .....

Transit time to slick (return):.....min

Spraying time per sortie: .....min

Coverage per hour: ..... Ha/Km^2

Sketch of proposed application: (include scale, north arrow, location of oil, flight path, prominent landmarks, *etc*)

POSITION LOG FOR DISPERSANT APPLICATIONS

This report made by:…….. Organisation:…… Date:…… Time:…….

Date of application:…… General location of application:…….

Pass	Waypoint ID		START POSITION OF APPLICATION			FINISH POSITION OF APPLICATION			Dispersant
No.	START	FINISH	Time	Latitude (S)	Longitude (E)	Time	Latitude (S)	Longitude (E)	Applied (L)

DISPERSANT OBSERVATION CHECKLIST

FOR DISPERSANT OBSERVERS TO COMPLETE BEFORE DEPARTURE

This report made by:.....Organisation:..... Date: ..... Time: .....

Observers name/s:..... Organisation/s:.....

Observation platform: helicopter / aircraft / boat / other (specify): .....

Application platform: helicopter / aircraft / boat / other (specify): .....

COMMUNICATIONS:	**VHF channel**	**UHF frequency**	**Other**
Air to air	.....	.....	.....
Air to vessel	.....	.....	.....
Air to ground	.....	.....	.....
Ground to vessel	.....	.....	.....
Vessel to vessel	.....	.....	.....

	Aircraft/personnel names	**Call sign**	**ETD to spill**	**ETA at spill**
Sprayer 1:	.....	.....	.....	.....
Sprayer 2:	.....	.....	.....	.....
Spotter:	.....	.....	.....	.....
Observer:	.....	.....	.....	.....
Command Centre:	.....	.....		

Name of dispersant: ..... Dispersant : oil ratio: .....

Dilution prior to application (if any): ..... Rate of application: .....litres/Ha

Dispersant application altitude: .....feet Observation altitude: ..... feet

WEATHER CONDITIONS ❑ Sunny ❑ Overcast ❑ Cloudy ❑ Rain ❑ Fog

Sea state:.....	Wind speed:.....knots	Air temperature:.....^{o}C
Wave height:.....m	Wind direction:..... degrees true/magnetic	Sea temperature:.....^{o}C
Water depth: .....m	Current speed:.....knots	Salinity:..... ppt
Visibility:..... nm/km	Current direction: ..... degrees true/magnetic	Tide:..... flood / ebb / slack

DISPERSANT OBSERVATION EQUIPMENT AND SAFETY CHECKLIST

Observation

- ❑ Basemaps/charts
- ❑ Clipboard/notebook/reporting forms/checklists
- ❑ Pens/pencils
- ❑ GPS + spare batteries
- ❑ Job aids for visual observation
- ❑ Camera + spare film
- ❑ Video camera + spare batteries
- ❑ Binoculars

Personal Safety Equipment

- ❑ Lifejacket (and exposure suit if required)
- ❑ Survival equipment (*e.g.* flares, locator beacon)

Safety Brief

- ❑ Safety brief with pilot/skipper
- ❑ Purpose of mission
- ❑ Operational constraints
- ❑ Area orientation/observation plan
- ❑ Trip duration
- ❑ Landing/mooring sites
- ❑ Radio frequencies and reporting schedule
- ❑ Safety features (*e.g.* emergency locator beacon, fire extinguishers, first aid kit, radios, *etc*.)
- ❑ Emergency exit procedures
- ❑ Gear deployment (*e.g.* current drogue, dye)

DISPERSANT OBSERVATION REPORTING FORM

FOR RECORDING DISPERSANT OBSERVATIONS FROM AIRCRAFT AND VESSELS

This report made by:.....Organisation:..... Date: ..... Time: .....

Pass	Waypoint ID		START POSITION OF APPLICATION			FINISH POSITION OF APPLICATION		
No.	START	FINISH	Time	Latitude (S)	Longitude (E)	Time	Latitude (S)	Longitude (E)

Viewing difficulties (if any): .....

VISUAL APPEARANCE OF SLICK (use MNZ standard definitions and visual guides of oil on water)

Before application:	**Immediately after** application:	**20 minutes after** application:
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
Film No:.....	Film No:.....	Film No: .....
Photo No:.....	Photo No:.....	Photo No: .....

Dispersion cloud observed: YES/NO Colour: ..... Time taken for cloud to form: .....minutes

Did oil slick reform (recoalesce)?:..... YES/NO Time taken to reform:.....minutes

% of slick treated: ..... % overspray: ..... Estimated efficiency of application:.....%

Describe any variation in effectiveness across slick:

.....

.....

.....

Describe differences between treated/untreated areas:

.....

.....

.....

Describe any biota present and any effects observed:

.....

.....

.....

General comments/problems encountered:

.....

.....

.....

Recommendations for future applications: .....

.....

.....

ABBREVIATIONS

ADIOS	Automated Data Inquiry for Oil Spills	MNZ	Maritime New Zealand
avg	Average	MSDS	Material Safety Data Sheet
cSt	Centistoke	nm	Nautical mile
DOC	Department of Conservation	NOSC	National On-Scene Commander
EEZ	Exclusive Economic Zone	NOSSC	National Oil Spill Service Centre
ETA	Estimated Time of Arrival	NZ	New Zealand
ETD	Estimated Time of Departure	OSC	On-Scene Commander
ft	Feet	OSDO	Oil Spill Duty Officer
GPS	Global Positioning System	OSH	Occupational Safety and Health
Ha	Hectare	PPE	Personal Protective Equipment
HFO	Heavy Fuel Oil	ppt	Parts per thousand (also $^{0}/_{00}$)
IFO	Intermediate Fuel Oil	ROSC	Regional On-Scene Commander
km	Kilometre	UHF	Ultra High Frequency
L	Litre	VHF	Very High Frequency
m	Metre	%	Percent
mm	Millimetre	>	Greater than
m^3	Cubic metre	<	Less than

GLOSSARY

Absolute viscosity The ratio of shear stress to shear rate. It is a fluid's internal resistance to flow. The common unit of absolute viscosity is the poise (P). Absolute viscosity divided by fluid density equals kinematic viscosity. It is occasionally referred to as dynamic viscosity.

ADIOS Automated Data Inquiry for Oil Spills. A computer database listing the characteristics of crude oils and refined products, and predicting expected characteristics and behaviour of oil spilled into the marine environment.

API gravity The universally accepted scale adopted by the American Petroleum Institute (API) for expressing the density of liquid petroleum products. API Gravity = 141.5/specific gravity at 15.5°C - 131.5.

Bioremediation The processes where living organisms (bacteria and fungi) use oil as a food source, converting it into a non-hazardous form. Nutrients are often added to speed up the rate of digestion and the rate of reproduction of naturally occurring hydrocarbon-eating microbes. Hydrocarbon-eating organisms' can also be introduced to contaminated sites.

Black oil A black or very dark brown layer of oil, sometimes with a latex texture. Generally spreads quickly to a thickness of about 1 millimetre (depending on quantity of oil spilt). Can look like kelp and other natural phenomenon

Brown oil Water-in-oil emulsion. Thickness typically 0.1 to 1.0 mm, but will vary depending on wind & current conditions. Usually has a heavy or dull sheen. Brown oil can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp.

Centistoke (cSt) A unit of measurement used in defining the kinematic viscosity of a fluid.

Chemical dispersant A chemical formulation containing solvents and surface active agents (surfactants) that lower the surface tension between oil and water, promoting the formation of oil droplets and reducing the tendency of oil to stick to other droplets or surfaces, thereby enhancing dispersion into the water column.

Clean-up Actions taken to prevent further oil releases, protect areas from oil damage, mitigate oil effects (*e.g.* through deflection, containment, collection, chemical dispersion, or bioremediation), and clean-up oil contaminated areas and wildlife where monitoring shows a net environmental benefit in doing so.

Coastal waters The Territorial Sea of New Zealand from high water mark to 12 nautical miles.

Continental waters The Territorial Sea (high water mark to 12 nautical miles) and the Exclusive Economic Zone (12 to 200 nautical miles), and all water over the continental shelf of New Zealand beyond 200 nautical miles (refer to the Territorial Sea and Exclusive Economic Zone Act 1977 for further detail).

Contingency plan An action plan prepared in anticipation of an oil spill for a site or region containing guidelines and operating instructions to facilitate efficient and effective clean-up operations, and to protect areas of biological, social and economic importance.

Convergence line A line on the water surface where floating objects and oil collect, *e.g.* the interface between two bodies of water, areas with significant depth change, tidal changes, or other common phenomena. Convergence lines are common in the marine environment.

Dispersion The breaking up of an oil slick into small droplets that are mixed into the water column by breaking waves and other sea surface turbulence.

Emulsification The formation of a water-in-oil mixture. Different oils exhibit different tendencies to emulsify, and emulsification is more likely to occur under high energy conditions (strong winds and waves). An emulsified mixture of water in oil is commonly called "mousse"; its presence indicates a spill that has been on the water for some time.

Entrainment The loss of oil from containment when it is pulled under a boom by a strong current. Entrainment typically occurs from booms deployed perpendicular to currents greater than 1 knot (0.5 meter per second).

Exclusive Economic Zone (EEZ) All marine waters between the outer edge of the New Zealand Territorial Sea (12 nautical miles) and the 200 nautical mile limit.

Flash point The lowest temperature at which a liquid gives off enough flammable vapor to ignite and produce a flame when an ignition source is present.

Hydrophilic Water loving. A strong affinity for water.

Kinematic viscosity The absolute viscosity divided by the density of the fluid. It is usually expressed in centistokes (cSt).

Maritime New Zealand (MNZ) Crown-owned body corporate established under the Maritime Transport Act 1994, responsible for cost effective and efficient marine pollution prevention and oil pollution response.

Mousse An emulsified mixture of water in oil. Mousse typically has a thick consistency compared with fresh oil, and can incorporate up to 75 percent water into the oil, increasing apparent oil volume by up to four times. Colours can range from red, orange or tan to dark brown. Mousse can be easily confused with algal scum collecting in convergence lines, algae patches, or kelp. See also emulsification.

National marine oil spill contingency plan (NMOSCP) The marine oil spill response plan produced by the Director of Maritime New Zealand for Tier 3 responses. Usually referred to as the National Plan.

Net environmental benefit The best outcome likely after weighing up the advantages and disadvantages of all possible response outcomes, including taking no action. It accepts that some cleanup responses will cause damage that may be justifiable because of overriding benefits.

Oil spill The actual or probable release, discharge, or escape of oil into waters of the New Zealand Territorial Sea or EEZ.

Oil spill response The entire process by which a marine oil spill is managed, including spill verification, response planning, set-up, clean-up, and termination.

Oil Petroleum in any form (except petrochemicals) including crude oil, fuel oil, sludge, oil wastes, and refined products.

Oleophilic Oil loving. A strong affinity for oil.

On-Scene Commander (OSC) The person responsible at a Tier 2 regional level (Regional On-Scene Commander - ROSC) or Tier 3 national level (National On-Scene Commander - NOSC) for the control and management of a marine oil spill response.

Oil Spill Duty Officer (OSDO) Maritime New Zealand staff providing a 24 hour alert for marine oil spills within the National Marine Oil Spill Contingency Plan.

Pancakes Isolated patches of mostly circular oil (size range: few cms to 100's of meters in diameter). Sheen may or may not be present.

Persistent oil Oils and petroleum products such as crude oils, fuel oils and lubrication oils that, when spilt, remain in a residual form in the environment for an appreciable period.

Pour point Lowest temperature at which an oil or distillate fuel is observed to flow, when cooled under conditions prescribed by test method ASTM D 97. The pour point is 3°C (5°F) above the temperature at which the oil in a test vessel shows no movement when the container is held horizontally for five seconds.

Recoverable oil Oil thick enough to be recovered by mechanical techniques and equipment. Generally only black or dark brown oil, mousse, and heavy (dull brown) sheens are considered thick enough to be recovered by skimmers.

Regional Councils The Regional Councils and Unitary Authorities responsible for marine oil pollution response in the Territorial Sea.

Regional marine oil spill contingency plan (RMOSCP) The marine oil spill response plan prepared by each Regional Council and approved by the Director of Maritime New Zealand for Tier 2 responses. Usually referred to as the Regional Plan.

Sheen A very thin layer of oil (less than 0.003 millimeters in thickness) floating on the water surface. Sheen is the most commonly-observed form of oil during the later stages of a spill. Depending on thickness, sheens range in color from dull brown for the thickest sheens to rainbows, grays, silvers, and near-transparency in the case of the thinnest sheens. Natural sheens can result from biological processes.

Slick Oil spilled on the water, which absorbs energy and dampens out surface waves, making the oil appear smoother (or slicker) than the surrounding water.

Specific gravity The ratio of the mass of oil to the mass of freshwater for the same volume, and at the same temperature.

Streamers A narrow line of oil, mousse, or sheen surrounded on both sides by clean water. Streamers result from the combined effects of wind, currents, and/or natural

	convergence zones. Heavier concentrations are often present in the centre, with progressively lighter sheen along the edges. Streamers are also often called "fingers", "ribbons" or "windrows".
Tar balls	Oil weathered into a pliable ball up to approximately 30 cm. Sheen may or may not be present.
Tar mats	Non-floating mats of oily debris (usually sediment and/or plant matter) found on beaches or just offshore in shallow water.
Territorial Sea	Coastal waters extending out to the 12 nautical mile limit.
Tier 1	Site level plan or first response to marine oil spills for which they are responsible. Includes most shore-side industry with oil transfer sites, offshore installations and all vessels required to have a shipboard plan.
Tier 2	Regional level plan or response for marine oil spills within the Territorial Sea (12 nautical miles) which exceed the Tier 1 response capability, or for which no responsible party can be identified.
Tier 3	National level plan or response for marine oil spills within the Territorial Sea (12 nautical miles) which are beyond the Tier 2 response capability, or which occur within the EEZ, but are outside Regional Council boundaries.
Viscosity	Measurement of a fluid's resistance to flow. Highly viscous oil will not flow easily. The common metric unit of absolute viscosity is the poise (P). Since viscosity varies inversely with temperature, its value is meaningless without knowledge of the temperature at which it is determined.
Volatility	A property of a liquid that has a low boiling point and a high vapour pressure at ordinary pressures and temperatures.
Water-in-oil emulsion	(see mousse)
Weathering	A combination of physical and environmental processes, such as evaporation, dissolution, dispersion, and emulsification, which act on spilled oil to change its physical properties and composition.
Window of opportunity	The period of time available for undertaking a particular response. For example the application of dispersant before the oil emulsifies to a stage where dispersant becomes ineffective.
Windrows	Oil or sheen oriented in lines or streaks in the direction of the wind. Windrows typically form early during a spill when the wind speed is at least 10 knots (5.1 meters per second). Sheen is the form of spilled oil that most frequently windrows.

UNIT CONVERSIONS

Convert from	Into	Multiply by	Convert from	Into	Multiply by
AREA					
Hectares (100m x 100m)	Square metres	10,000	Square metres	Hectares	0.0001
Hectares	Square kilometres	0.0100	Square kilometres	Hectares	100
Hectares	Square statute miles	0.0039	Square statute miles	Hectares	258.9990
Hectares	Square nautical miles	0.00291	Square nautical miles	Hectares	3.3489
Hectares	Acres	2.4711	Acres	Hectares	0.4047
Square nautical miles	Square kilometres	3.4345	Square kilometres	Square nautical miles	0.2912
Square nautical miles	Square statute miles	1.3261	Square statute miles	Square nautical miles	0.7541
Square nautical miles	Acres	8.2753	Acres	Square nautical miles	0.0012
Square statute miles	Square kilometres	2.5900	Square kilometres	Square statute miles	0.3861
LENGTH/DISTANCE					
Millimetres	Microns	0.001	Microns	Millimetres	1000
Inches	Centimetres	2.5400	Centimetres	Inches	0.3937
Feet	Metres	0.3048	Metres	Feet	3.2808
Yards	Metres	0.9144	Metres	Yards	1.0936
Fathoms	Metres	1.8288	Metres	Fathoms	0.5468
Statute miles	Kilometres	1.6093	Kilometres	Statute miles	0.6214
Nautical miles	Kilometres	1.8532	Kilometres	Nautical miles	0.5396
TEMPERATURE					
Centigrade	Fahrenheit	1.8 (^{o}C) + 32	Fahrenheit	Centigrade	0.5556 [(°F) - 32]
VELOCITY					
Kilometres/hour	Metres/second	0.2778	Metres/second	Kilometres/hour	3.5997
Kilometres/hour	Nautical miles/hour	0.5400	Nautical miles/hour	Kilometres/hour	1.8518
Kilometres/hour	Statute miles/hour	0.6214	Statute miles/hour	Kilometres/hour	1.6093
Nautical miles/hour	Statute miles/hour	1.1508	Statute miles/hour	Nautical miles/hour	0.8690
Nautical miles/hour	Metres/second	0.5148	Metres/second	Nautical miles/hour	1.9426
Statute miles/hour	Metres/second	0.4470	Metres/second	Statute miles/hour	2.2369
VOLUME					
Litres	Cubic metres	0.001	Cubic metres	Litres	1000
Litres	Tonnes	0.001	Tonnes	Litres	1000
Litres	US gallons	0.2642	US Gallons	Litres	3.7854
Litres	Barrels (US oil)	0.0063	Barrels (US oil)	Litres	158.9873
Cubic metres	Tonnes	1	Tonnes	Cubic metres	1
Cubic metres	US gallons	264.1721	US gallons	Cubic metres	0.0038
Cubic metres	UK gallons	219.9688	UK gallons	Cubic metres	0.0045
Cubic metres	Barrels (US oil)	6.2898	Barrels (US oil)	Tonnes	0.1590
Barrels (US oil)	US gallons	42	US gallons	Barrels (US oil)	0.0238
Imperial gallons	US gallons	1.2010	US gallons	Imperial gallons	0.8327

VOLUME FLOW RATE		per second	per minute	per hour
Cubic metre per second	Cubic cm	1,000,000	60,000,000	3,600,000,000
	Litre	1,000	60,000	3,600,000
	Cubic metre	1	60	3,600
	Cubic inch	61,023.7441	3,661,424.6456	219,685,478.7
	Cubic foot	35.3147	2,118.8800	127,132.8002
	US gallon	264.1721	15,850.3231	951,019.3885
	UK gallon	219.9688	13,198.1280	791,887.6748

A windows conversion programme can be downloaded from www.savardsoftware.com/