2008 Annual Report
Offshore Environmental Effects Monitoring Program
ExxonMobil Canada Properties - Sable Offshore Energy Project

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EXECUTIVE SUMMARY

AMEC Earth & Environmental (AMEC), on behalf of Accent Engineering Consultants Inc., carried out the 2008 Sable Offshore Energy Project (SOEP) Environmental Effects Monitoring (EEM) program for ExxonMobil Canada Properties. AMEC was assisted by specialists contracted to carry out specific assignments related to their area of expertise. Conestoga- Rovers & Associates was contracted to assist with the preparation of the annual report and with planning for subsequent EEM programs.

The SOEP offshore EEM program was designed principally to verify predictions made during the SOEP Environmental Assessment (EA) process. Overall, the EA process concluded that any residual effects of routine project activities (after mitigation) on Valued Ecosystem Components (VECs) in the marine environment would be minor or insignificant and would be restricted to within the 500 m-radius safety zones around offshore platforms.

Since surveys began in 1998, EEM results have validated these predictions as the underlying assumptions of the EA were purposefully conservative. In addition, several mitigative measures beyond those identified in the EA were undertaken by SOEP and EMC during the project to further reduce the likelihood of environmental impacts.

The 2008 offshore EEM program was developed by building on the results and lessons learned to date and following recommendations made by the CNSOPB EEM Review Committee which includes representation of Fisheries and Oceans Canada, Environment Canada, and the Canadian Environmental Assessment Agency. Since the SOEP offshore EEM is intended to be adaptive, efficient and meaningful, the monitoring plan is adjusted annually by removing or adding monitoring components or sampling sites with the prior approval of the CNSOPB EEM Review Committee based on the latest monitoring results and scientific information, or to address new Project activities.

Key findings of the 2008 program were:

Benthic Habitat and Fish Density (Section 2)

- There were no marine species-at-risk observed near any of the pipelines or platforms.

- The pipeline does provide a suitable substrate for colonizing marine epifauna and epiflora. A food web has established along this linear route. Grazer species were numerous, including several crab species, sea urchins, sea stars and shrimp. Fish find

refuge and feeding opportunities as well. Rich colonization by filter feeders such as anemones, sea cucumbers, sponges, tunicates and basket stars suggests the elevation above the seafloor on the pipeline facilitates particle entrapment in their tentacles.

Produced Water Chemistry and Toxicity (Section 3)

- Produced water at Thebaud, Venture and Alma are very high in some metals and each platform is relatively consistent in chemical signature from year to year.

- The total petroleum hydrocarbon concentrations in the various samples of produced water at Thebaud, Venture and Alma were well below the OWTG limits of 30 mg/L (30 days) and 60 mg/L (24-hour) for oil in water.

- The results of the 96 hour LC_{50} and IC_{50} tests indicate that produced water from Thebaud, Venture, South Venture and Alma is toxic. It is surmised that the cause of the toxicity may be due to petroleum hydrocarbons. Given the hydrodynamic marine environment near Sable Island, the chemical constituents of produced water will be diluted to non-toxic levels within a few metres of the mouth of the discharge caisson.

Air Quality (Section 4)

- The monitoring program and current observations of various emission producing activities on and around the island do not yet allow for confirmation as to whether the effects of offshore oil and gas activities can be measured on the island. In particular, the cause of H_2S and SO_2 peaks in the data set is especially hard to attribute to any particular source based upon the current information.

Seabird Monitoring (Section 5)

- The Greater Shearwater (*Puffinus gravis*) was the most common species observed during supply vessel surveys (45.7 %) and was the second most common species observed during reference surveys (15.0 %). Conversely, the Dovekie (*Alle alle*) was the most common species observed during reference surveys (26.5 %) and was the second most common species observed during supply vessel surveys (9.7 %).

- Statistical analysis indicated there was a significantly greater relative number of Dovekies observed during reference vessel surveys and the greater relative number of Greater Shearwaters observed during supply vessel surveys. Aside from the increase

in Dovekies and Murres in 2008, Greater Shearwaters showed the greatest change in the number of observations from 2005 through 2008 along supply vessel transects.

- None of the nine most commonly observed species showed an avoidance of the supply vessel route or an attraction to the SOEP platform area.

Beached Bird Surveys (Section 6)

- During 2008, the corpses of 378 beached gannets, tubenoses, gulls, and alcids were collected on Sable Island. Alcids comprised 46.6% of total birds recovered.

- For all species combined, the oiling rate for birds was 2.6 %. The highest rate for a seabird group was observed in Northern Gannets (8.3 %). The oiling rate for alcids was 5.9 %. The oiling rate observed in 2008 was the lowest recorded since 2000.

- The total number of discharge events in 2008 was within one (1) standard deviation (or within the average) of the total number of discharge events from 2000 to 2007.

- None of the eight (8) samples contained light or mid-range distillate fuels, or condensates that would be typical of oils produced on offshore gas facilities such as the SOEP processing platforms off Sable Island.

Mussel Body Burden (Section 7)

- Seven years of monitoring the uptake of hydrocarbons in mussels has shown that the presence of aliphatic hydrocarbons is attributable primarily to biogenic hydrocarbons generated by phytoplankton.

- Higher concentration of biogenic hydrocarbons in filter feeding mussels indicates that the platforms promote phytoplankton growth.(local nutrient enrichment due to PW?)

- Sensory evaluations conducted up until 2001 showed that any odour and taste difference was attributable to the condition of the Control mussel samples.

1 INTRODUCTION

Courtesy of ExxonMobil Canada

1.1 Overview

AMEC Earth & Environmental (AMEC) and Conestoga-Rovers & Associates Ltd. (CRA), on behalf of Accent Engineering Consultants Inc., submit the results of the 2008 Environmental Effects Monitoring (EEM) program for the Sable Offshore Energy Project (SOEP) to ExxonMobil Canada Properties (EMCP). Figure 1-1 shows the location of the platforms and pipelines. AMEC was assisted by a team of specialists contracted to carry out specific assignments related to their area of expertise: Environment Canada provided the seabird monitoring data and Sable Island air quality data; Zoe Lucas provided the beached bird survey data; and Dominion Diving Limited provided the pipeline survey videos. CRA was contracted to assist with the preparation of this annual report and with planning for subsequent EEM programs.

The SOEP offshore EEM program focused on the effects of drilling and production activities at Tier 1 sites (*i.e*., Venture, Thebaud, and North Triumph) since 1997. With the majority of the development drilling completed and the start-up of operations at Tier 1 sites by 2000, EEM surveys undertaken from 2001 to 2003 focused on the effects on sediments and bottom fauna of exposure to intermittent discharges of muds/cuttings during drilling and continuous produced water discharges during operations.

The 2005 program addressed start-up activities at Tier 2 sites (Alma in 2003 and South Venture in 2004) whilst considering lessons learned from the Tier I EEM Program and the recommendations from the 2003 Offshore Environmental Effects Monitoring Workshop held at the Bedford Institute of Oceanography. Following review of 2005 results, sediment chemistry and toxicity; scallop taint and body burden; and fish health components were dropped from the 2006 program.

The 2006, 2007 and 2008 offshore EEM programs were built on the results and lessons learned to date, in particular from the previous year's EEM program, and were developed from recommendations made by the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) EEM Review Committee which includes representatives of Fisheries and Oceans Canada, Environment Canada (EC), and the Canadian Environmental Assessment Agency (CEAA).

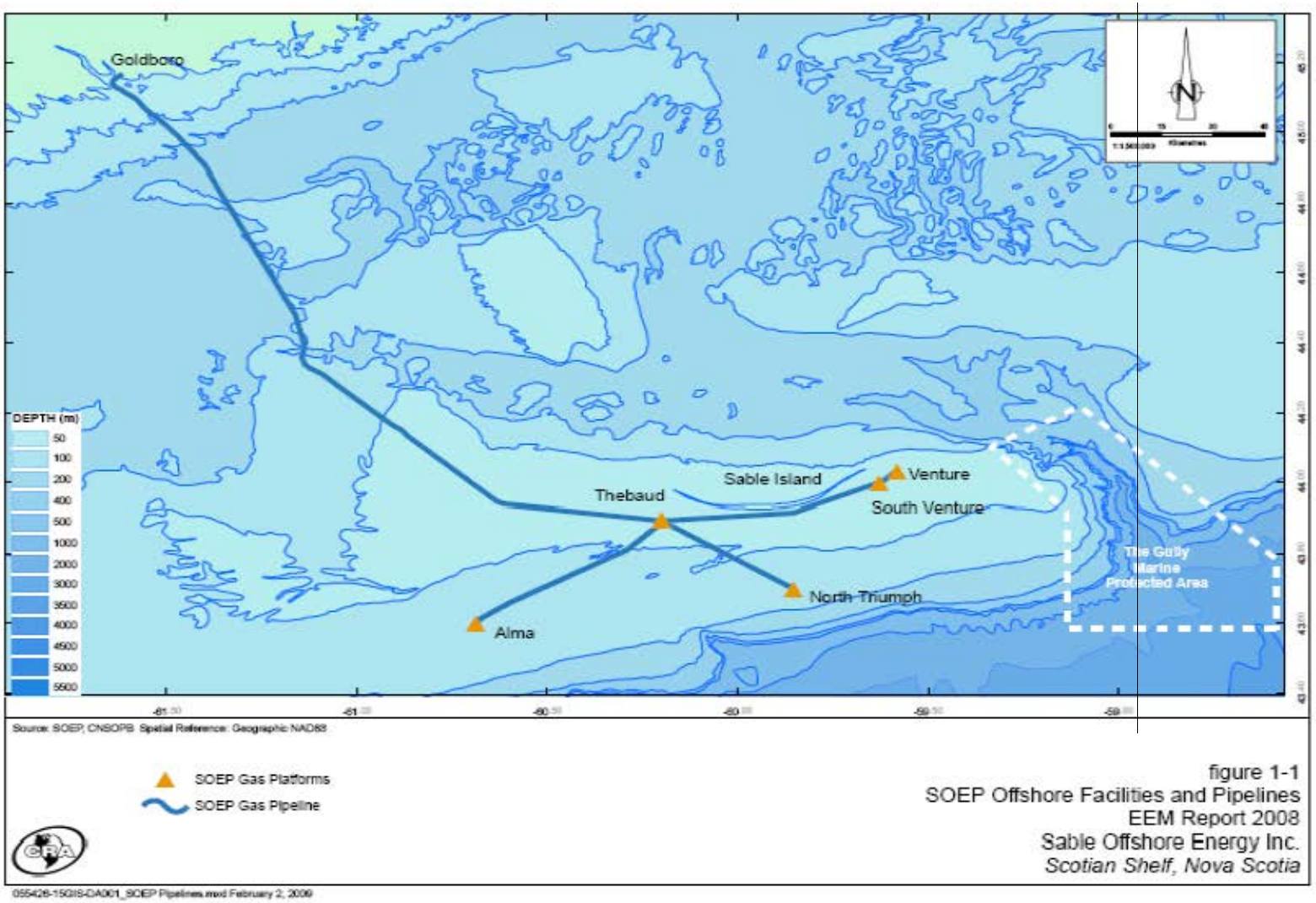


figure 1-1
SOEP Offshore Facilities and Pipelines
EEM Report 2008
Sable Offshore Energy Inc.
Scotian Shelf, Nova Scotia

1.2 Background

The purpose of the EEM program is to test whether the effects of facility presence and production emissions into the marine and atmospheric environments occur within the zones of influence predicted by the Environmental Impact Statement (EIS) (Table 1.1). Environmental measurements are concentrated where meaningful changes are expected to occur and where the point source discharge is located. The 2008 offshore EEM program was designed to address relevant predictions made during the SOE environmental assessment process.

Table 1.1: EA Predictions Relevant to 2008 EEM Program

EIS Prediction [1]	Valued Ecosystem Component [2]	2008 EEM Component
"Impacts of effluent discharges (e.g. produced water) were considered to have no significant impacts on the marine environment."	• Fish • Shellfish	• Produced Water Chemistry and Toxicity • Mussel Health/Body Burden
"Air emissions were considered to have no significant impacts on the marine environment."	• Sable Island	• Air Quality
"Lights [from work lights and gas flares] may attract migrant bird species, especially in fog and/or low cloud and rain."[3]	• Seabirds	• Seabird Monitoring
"Because of the importance of Sable Island and the Gully, special attention will be paid to these areas in the development of monitoring."[4]	• Seabirds • Sable Island	• Air Quality • Beached Seabird Surveys

[1] Unless otherwise noted, the predictions apply only to routine construction and operations activities (i.e., not accidental events) as stated in the Executive Summary of the SOEP – EIS Vol. 3.
[2] Only offshore-related VECs assessed under the marine environment were considered
[3] As stated in Section 5.2.1.9 of the SOEP – EIS Vol. 3.
[4] As stated in Section 7.4 of the SOEP – EIS Vol. 3.

The EEM components were based on valued ecosystem components (VECs) identified during the EA process and components identified by Sable Offshore Environmental Effects Monitoring Advisory Group (SEEMAG) and the EEM study team. The SOEP offshore EEM is intended to be adaptive, efficient and meaningful; therefore, the monitoring plan is adjusted annually by dropping or adding monitoring components or sampling sites with the prior approval of the CNSOPB EEM Review Committee based on the latest monitoring results and scientific information, or to address new Project activities.

1.3 Goals

The overall goal of the EEM program is to mitigate adverse environmental impacts of the SOEP and assist decision–making by providing feedback to ExxonMobil, CNSOPB, stakeholders, and the public.

1.4 Objectives

This EEM program involves the collection of repeated measurements of environmental variables to detect changes directly or indirectly attributable to drill and production discharges. The EEM program is undertaken with the following primary objectives:

- to verify whether the effects of discharging drill and production wastes into the marine environment occur within the zones of influence predicted by the EA report;
- to evaluate the effectiveness of mitigation and identify the need for improved or altered mitigation; and
- to provide an early warning of undesirable change in the environment.

1.5 Scope

This report focuses on the EEM program of the Tier I and Tier II development and includes the natural gas well fields at Venture, South Venture, Thebaud, Alma. Potential effects of Project activities evaluated in the 2008 EEM program included the platform structures and pipelines; produced water; and air emissions on the selected environmental components of benthic habitat and biota; water quality; air quality; and seabirds (Table 1.2).

Table 1.2: 2008 EEM Program

Location	Environmental Component	Type of Monitoring/Analysis	Plan for 2008
Thebaud	Benthic & Fish Habitat	Fish Density (ROV videotape analysis)	• Examine video from scour survey • Estimate average fish density of commercial fish species. • Comparative analysis with previous observations where feasible. [Note: If Atlantic cod, compare with 2006 observations]
		Cuttings Pile Analysis (ROV videotape analysis)	• Examine video from scour survey at wellhead platform to confirm previous finding that cuttings pile is no longer present.
	Sediment	Toxicity (amphipod only) at 250, 500, & 1000m from platform along predominant current axis	• Discontinue
		Chemistry (barium, TPH, strontium, ammonia, and sulphides) at 250, 500, & 1000m from platform along predominant current axis	• Discontinue
	Shellfish	Taint and body burden for mussels (jacket scraping) {Reference samples for each species to be sourced from commercial seafood outlets}	• Analyze body burden only: consistent with previous programs. • Ensure jacket leg selected for scraping is situated 'downstream' of PW discharge caisson.
	Seabirds	Observations recorded on supply vessel transects from shorebase to platform (&between platforms) and along selected reference transects.	• Continue supply vessel transect surveys. • If feasible, station seabird specialist aboard Standby vessel at Thebaud to make day/night observations of possible seabird mortality due to flare. • Continue to consult with CWS regarding Alma platform/bird interactions.
	Air Quality	Visual observations of the Flare Plume from platform.	• Record flare plume status (using EC supplied smoke chart) along with concurrent weather conditions on the platform.
Main Subsea Pipeline to shore	Fish Habitat	Fish Density (ROV videotape analysis along exposed sections of pipeline)	• Entire subsea pipeline from Thebaud to shore planned to be surveyed in 2008. • Examine pipeline inspection videos from same sections of the pipeline

Table 1.2: 2008 EEM Program

Location	Environmental Component	Type of Monitoring/Analysis	Plan for 2008
			as analyzed in 2005 and 2006 to enable comparison of snow crab densities. • Identify general sediment type from video imagery.
Gully MPA Boundary	Sediment	Toxicity (amphipod only)	• Discontinue
		Chemistry (barium, TPH, strontium, ammonia, and sulphides)	• Discontinue
Sable Island	Air Quality	Analysis of continuous monitoring data which includes nitrogen oxides, sulphur dioxide, particulate matter (total and fine) polyaromatic hydrocarbons, and volatile organic compounds.	• Summarize data analyzed in conjunction with Environment Canada • Compare air quality measurements on Sable Island with systematic flare plume measurements at Thebaud to assess potential interactions.
	Seabirds	Monthly Oiled Bird Surveys (summarization of monthly surveys-collected over a 2-3 day period - and inclusion in annual EEM report).	• Coordinate with Zoe Lucas, independent biologist and resident of Sable Island. • Use CWS methodology for determining oiling rate.
Thebaud	Fish Health	MFO, gross pathology and histopathology for fish (at platform).	• Collaborate with DFO COOGER to characterize PW plume using chemical and microbial tracers.
Thebaud, Venture, South Venture and Alma	Produced Water	Toxicity analysis as per OWTG (2002)	• OWTG expectation • Continue use of same bioassay species
		Chemistry analysis as per OWTG (2002)	• OWTG expectation

Until 2002, the assessment of produced water was delayed until the produced water volume was of sufficient quantity to study. The surveys undertaken in 2008 continued to investigate potential effects of the development on:

- habitat compensation of the marine benthos from the presence of the pipeline;
- water quality of the receiving environment with respect to toxicity and chemical characterization;
- air quality from flaring at Thebaud and on Sable Island relative to the satellite platforms; and

- the presence of the platforms on seabird populations at sea and on Sable Island.

1.6 Report Organization

This report consists of an assemblage of component study reports relating to specific EEM requirements. Each component study report was prepared using a concise and standard format to facilitate information summarization and readability. To the extent possible, references were provided for detailed methodological or analytical procedures. Detailed results are appended in each section.

2 BENTHIC HABITAT AND FISH DENSITY

2.1 Rationale

Underwater video surveys are undertaken to evaluate the integrity of the Projects subsea assets such as pipelines and other subsea infrastructure relative to spanning, corrosion and general condition. The inspection videos are opportunistically reviewed to evaluate the EA condition that there would be no net loss of habitat from construction and operation of the marine pipelines and production platforms.

From the central processing facility at Thebaud, natural gas and condensate are transported 197 km to landfall near Goldboro in a 26 inch (66 cm) concrete-coated pipeline. This pipeline is buried in the nearshore area, and for most of its length on Sable Bank. In between these two areas (KP 8 to KP 110), the pipeline is fully or partially exposed.

Twin 8 inch (20 cm) pipelines (*i.e.*, SOEP natural gas lateral and Maritimes & Northeast Pipeline Pt. Tupper gas lateral) were bottom laid across the Strait of Canso and rock-covered for protection.

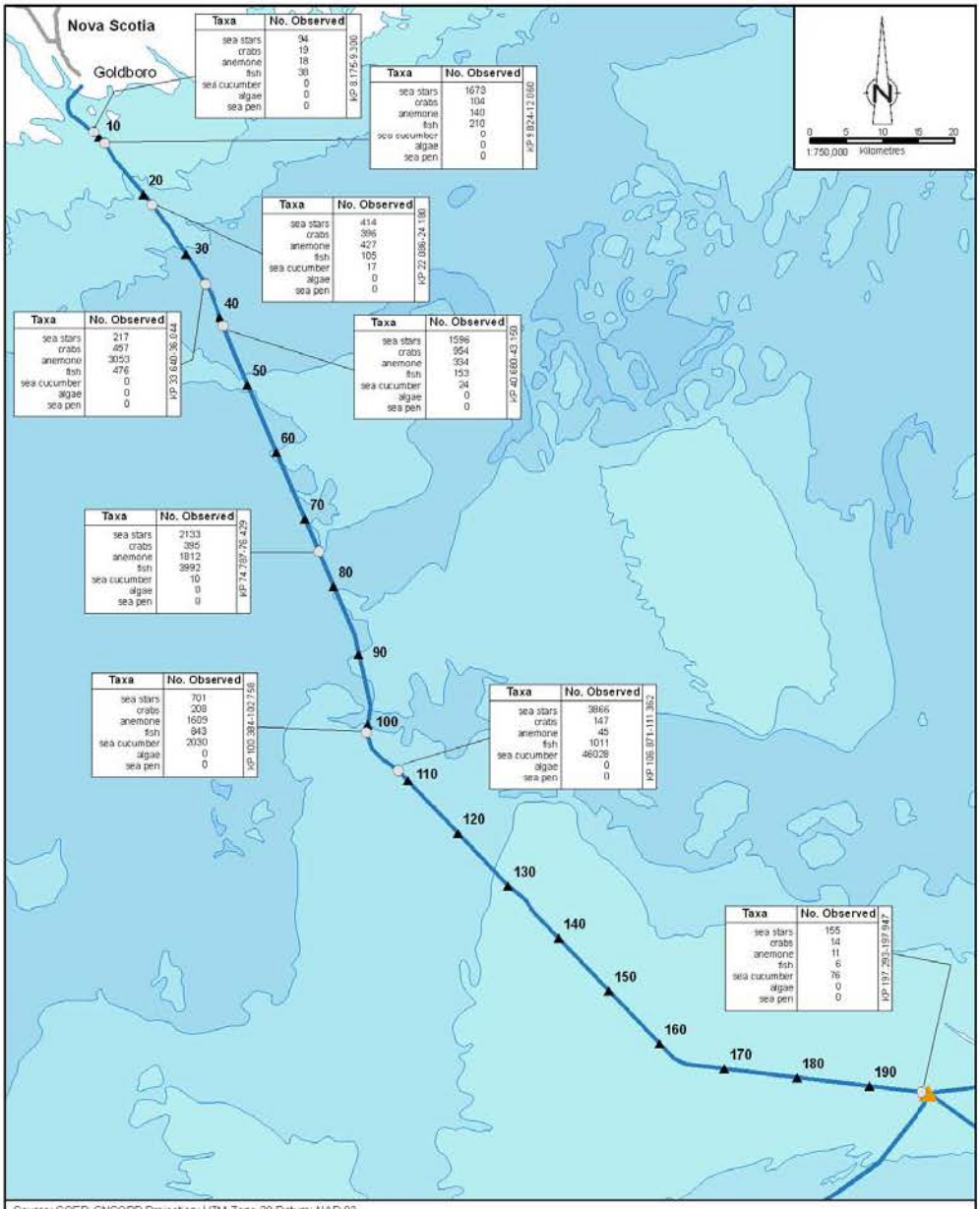
The offshore platforms and exposed pipelines offer considerable hard structure to the marine ecosystem which serves as habitat for a variety of fish and invertebrate species. Exposed sections of pipeline and protective mattresses may be important refuge for juvenile and diminutive fish species. Underwater videos of the platforms were not reviewed in 2008.

2.2 Goals

Monitoring marine growth on exposed sections of the pipeline and production platforms evaluates if the structures result in net loss of habitat. No net loss of habitat was predicted in the *Evaluation of No Net Loss of Fish Habitat* report submitted to Fisheries and Oceans Canada (JWEL and CEF 1997).

2.3 Objectives

The main ecological objective of the pipeline survey is to provide information on the distribution of fish and shellfish, particularly commercial species and the extent of marine growth along exposed sections of the 26 inch subsea pipeline and along the rock-covered twin 8 inch pipelines across the Strait of Canso. A list of selected sites observed on the video is provided in the Appendix.


Nova Scotia
Goldboro
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
Taxa
No. Observed
sea stars
crabs
anemone
fish
sea cucumber
algae
sea pen
1:750,000
Kilometres
Source: SOEP; CNSOPB Projection: UTM Zone 20 Datum: NAD 83;
figure 2-1
Dominant Organisms Observed
along the Main Pipeline
EEM Report 2008
Sable Offshore Energy Inc.
Scotian Shelf
CRA
055426-10 GIS-DA001_Organisms.mxd Feb 19, 2009

2.4 Methodology

Dominion Diving Limited conducted the ROV inspection of the main pipeline (Table 2.1)

Table 2.1: ROV survey method for the pipeline inspection

Survey Date:	Pipelines: July, August and September 2008 Platforms: not completed
Survey Vessel:	M/V Panuke Sea
Type of Sample:	VHS video recordings during pipeline inspection surveys
Test Sample Locations:	Continuous videocamera observations along selected sections of the 26 inch subsea pipeline and deeper portion of the twin 8 inch rock-covered pipelines across Strait of Canso
Reference Sample Locations:	Alongside top, port and starboard sides of the 26 inch pipeline
Number of Samples/Station:	26 inch pipeline: Videotapes from the following pipeline sections: KP 9.824-12.060; KP 100.384-102.758; KP 197.293-197.947 Twin 8inch pipelines: Water depths 11-40 m. Continuous observations were made while viewing videotape using centre-camera view supplemented by port/starboard camera views as required
Equipment:	Underwater ROV video camera

2.5 Analysis

The analysis entails a qualitative description and relative distribution of marine epilithic growth and species on the pipeline. The remotely-operated vehicle provided three camera angles, each side and top of the pipelines. Several species are noted as "unidentified" as the ROV camera resolution is for general commercial diving inspection purposes and not for high quality photographic purposes.

Only segments of the pipeline, where spanning occurred, were video inspected in 2008. Comparison with 2005 and 2006 marine growth surveys included the following segments:
Segment 1 – KP 8.175 to 9.3 (1.125 km)
Segment 2 – KP 9.824 to 12.060 (2.236 km)
Segment 3 – KP 22.086 to 24.180 (2.094 km)
Segment 4 – KP 33.640 to 36.044 (2.404 km)

Segment 5 – KP 40.680 to 43.150 (2.47 km)
Segment 6 – KP 74.787 to 76.429 (1.642 km)
Segment 7 – KP 100.384 to 102.758 (2.374 km)
Segment 8 – KP 111.362 to 106.871 (4.491 km)
Segment 9 – KP 197.293 to 197.947 (0.654 km)
Segment 10 – KP 58.095 to 59.035 (0.94 km)

2.6 Results

2.6.1 Pipelines

Table 2.2 provides a summary of the counts of observed marine life by major taxa associated with the pipelines during the 2008 ROV inspection. The enumeration provided in the Appendix includes both sides and top views of the pipelines. The segment reference and kilometre postage commences at the shore end.

Table 2.2: Number of major taxa observed on the pipelines in each survey segment

Taxon	1	2	3	4	5	6	7	8	9	10
Echinoids	3	4	6	6	6	5	5	5	2	1
Cnidarian/Sponges/Tunicates	3	3	2	4	2	6	8	7	1	3
Fish	4	6	6	9	9	8	9	10	2	2
Crustaceans	3	6	4	6	6	6	8	8	2	3
Mollusks		1				1	2	3		
Total	13	20	18	25	23	26	32	32	7	9
2005 Snowcrab Count	0	ND	272	180	148	75	ND	0	ND	ND
2008 Snowcrab Count	0	0	378	350	819	87	34	33	0	0

ND= no data

Consistent with descriptions from the 2005 and 2006 surveys, 2008 results were described in qualitative terms (eg. occasional, common species). The enumeration in 2008 indicates much higher colonization density and diversity over time. There was a much higher diversity and density in all pipeline segments except along Segment 9, which was completely buried, and Segment 10 which were similar to previous surveys.

The number of snowcrab appears to have increased when comparing 2005 and 2008 numbers; however, based on a single survey in a year, it is premature to make any statements

on the positive effect of the pipeline presence on snowcrab distribution or population as they are very mobile crustaceans.

Fourteen adult Atlantic lobsters were noticed alongside the export pipeline between KP 9 and 12, similar location to the previous surveys, but in higher numbers in 2008. One lobster was seen between KP 8 and 9. Again, statements on the effects of the main pipeline upon lobster populations and distributions cannot be made on such limited observations.

Of interest is the possible occurrence of soft coral (Alcyonacea) along a short section between KP 133 to 135. A cluster of 59 of the organisms were seen between KP 34.770 and 35.100 in a water depth of 134 m. Camera quality and angle were not adequate to confirm this observation; however, the video reviewers have seen similar features and soft corals were noted in the Photographic Atlas of the Eastern Canadian Continental Shelf (Maritime Testing Ltd. nd).

The abundance of marine organisms has increased considerably since the ROV pipeline inspection conducted in July 2001.

2.7 Conclusions

There were no marine species-at-risk observed near any of the pipelines.

The pipeline does provide a suitable substrate for colonizing by marine epifauna and epiflora. Colonization and the number of organisms associated with the pipeline has increased since 2001. A food web has established along this linear route. Numerous grazer species were observed including several crab species, sea urchins, sea stars and shrimp. Fish find refuge and feeding opportunities as well. Rich colonization by filter feeders such anemones, sea cucumbers, sponges, tunicates and basket stars suggests the elevation above the seafloor on the pipeline facilitates particle entrapment in their tentacles.

2.8 References

Jacques Whitford Environment Limited and CEF Consultants Limited. 1997. Evaluation of no net loss of fish habitat. Report to Sable Offshore Energy Project. December 1997.

Maritime Testing (1985) Ltd. nd. A photographic atlas of the eastern Canadian continental shelf: Scotian Shelf and Grand Banks of Newfoundland.

Section 2 Appendix

Distribution of marine life on the main and Strait of Canso pipelines

Pipeline Section Viewed (KP)[1]	Depth (m)	Fauna/Flora	Number of Individuals[2]	Snow Crabs	Comments
26 Inch Thebaud to Goldboro Pipeline					
8.175-9.300 2005 ROV Inspection Section Segment 1	30-32	sea star sea urchin unid fish northern red anemone rock crab hermit crab cod sculpin anemone sun star frilled anemone pollock lobster	90 25 23 12 10 9 8 6 4 4 2 1 1	0	Buried segments of pipeline section (KP): 8.323-8.361 8.477-8.498 8.641-8.758 8.761-8.878 8.915-9.158 Marine growth (% coverage on top of pipe): 8.185-8.274 0-25% 8.247-8.287 <5% 8.287-8.317 0-25% 8.317-8.371 <5% 8.371-8.409 0-25% 8.409-8.455 <5% 8.455-9.300 0-25%
9.824-12.060 2006 ROV inspection section Segment 2	28-39	sea urchin sea star brittle star anemone gadoid sculpin hermit crab sun star sponge lobster rock crab frilled anemone unid. fish unid. crab Jonah crab cod flounder lumpfish spider crab sea scallop	7890 1438 165 129 118 78 77 70 20 14 14 11 7 6 6 3 2 2 1 1	0	Last 60 m (KP 12.000-12.060) not found in videos Marine growth (% coverage on top of pipe): 9.824-9.848 75-100% 9.848-9.853 50-75% 9.853-9.966 75-100% 9.966-9.975 50-75% 9.975-9.980 25-50% 9.980-10.029 0-25% 10.029-10.035 25-50% 10.035-10.045 75-100% 10.045-10.050 50-75% 10.050-10.055 25-50% 10.055-10.063 0-25% 10.063-10.067 50-75% 10.067-10.080 25-50% 10.080-10.581 0-25% 10.581-12.000 <5%
22.086-24.180 2005 ROV Inspection	82-84	sea urchin anemone basket star sun star northern red anemone	3427 314 212 180 113	378	

Distribution of marine life on the main and Strait of Canso pipelines

Pipeline Section Viewed (KP)[1]	Depth (m)	Fauna/Flora	Number of Individuals[2]	Snow Crabs	Comments
Section Segment 3		sculpin redfish sea cucumber slender sea star sea star toad crab hermit crab unid. fish cod Atlantic herring unid. crab rock crab pollock	62 30 17 12 10 10 5 4 4 4 2 1 1		
33.640- 36.044 2005 ROV Inspection Section Segment 4	133- 135	anemone shrimp redfish tunicate/sponge sea star hermit crab pollock Atlantic tomcod sun star slender sea star cod horse star Hydroid/soft coral gadoid unid. crab northern red anemone rock crab hake wolf eel sculpin basket star unid. fish sea urchin spider crab Jonah crab	3043 875 300 160 125 86 70 45 36 30 24 22 59 14 12 10 7 7 7 5 4 4 2 1 1	350	
40.680- 43.150 2005 ROV Inspection Section Segment 5	141- 143	shrimp basket star anemone sun star redfish horse star sea star hermit crab unid. crab toad crab Atlantic tomcod	4175 382 333 265 93 85 66 66 33 31 31	819	

Distribution of marine life on the main and Strait of Canso pipelines

Pipeline Section Viewed (KP)[1]	Depth (m)	Fauna/Flora	Number of Individuals[2]	Snow Crabs	Comments
		sea urchin sea cucumber cod hake flounder unid. fish rock crab winter flounder pollock gadoid Jonah crab northern red anemone	22 21 7 6 5 4 4 4 2 1 1 1		
74.787-76.429 2005 ROV Inspection Section Segment 6	101-102	tunicate redfish sea star northern red anemone anemone hermit crab sea cucumber gadoid horse star sun star frilled anemone cod fish whelk sponge tunicate/sponge rock crab Atlantic tomcod unid. crab shrimp hake sculpin brittle star toad crab spiny crab flounder	6853 3773 1957 1199 557 274 101 97 88 85 56 52 41 40 38 25 20 18 9 6 5 4 3 3 2 2	87	
100.384-102.758 2006 ROV Inspection Section Segment 7	81-87	tunicate sea cucumber redfish tunicate/sponge northern red anemone tube dwelling anemone sea star horse star sponge anemone	6096 2034 1750 1727 1026 481 406 282 130 112	34	

Distribution of marine life on the main and Strait of Canso pipelines

Pipeline Section Viewed (KP)[1]	Depth (m)	Fauna/Flora	Number of Individuals[2]	Snow Crabs	Comments
		hermit crab	103		
		rock crab	60		
		gadoid	38		
		comb jelly	29		
		whelk	22		
		flounder	15		
		common sand dollar	15		
		sun star	13		
		stalked tunicate	13		
		American eel	12		
		spiny crab	8		
		unid. fish	8		
		sculpin	8		
		cod	7		
		sea scallop	3		
		sand shrimp	2		
		lumpfish	2		
		monkfish	2		
		Jonah crab	1		
		toad crab	1		
		unid. crab	1		
		hake	1		
		finger sponge	1		
		shrimp	5+		
106.871-111.362 2005 ROV Inspection Section Segment 8	61-62	sea cucumber	46028	33	Buried segments of pipeline section (KP): 109.144-109.180 109.189-109.265 109.280-109.361 109.370-110.604 110.682-110.689 111.175-111.283 111.308-111.345
		sea star	3632		
		gadoid	455		
		cod	317		
		tunicate/sponge	275		
		whelk	209		
		sun star	131		
		comb jelly	128		
		horse star	102		
		haddock	92		
		hermit crab	74		
		Atlantic tomcod	51		
		rock crab	31		
		common sand dollar	30		
		tunicate	40		
		lumpfish	27		
		northern red anemone	24		
		flounder	23		
		sea scallop	16		
		anemone	17		
		sculpin	14		
		redfish	11		
		sponge	10		
		unid. fish	9		
		American eel	7		

Distribution of marine life on the main and Strait of Canso pipelines

Pipeline Section Viewed (KP)[1]	Depth (m)	Fauna/Flora	Number of Individuals[2]	Snow Crabs	Comments
		hake frilled anemone toad crab skate egg case spiny crab toad crab Jonah crab unid. crab stalked tunicate brittle star shrimp	5 4 4 3 2 1 1 1 1 1 20+		
197.293-197.947 2006 ROV Inspect9ion Section Segment 9	22-29	sea stars sea cucumber anemone hermit crab unid. crab cod sculpin	155 76 11 8 6 5 1	0	First 182 m (197.293-197-475) not found in videos Camera moving sporadically – unable to follow movement or exposure of pipe
8 Inch Twin Pipeline in Strait of Canso					
58.095-59.035 2006 ROV Inspection Section Segment 10	11-40	sea star northern red anemone sand shrimp anemone unid. fish rock crab sponge green crab sculpin	143 13 10 4 4 2 1 1 1	0	Difficult to see rock cover due to poor visibility. Sea stars abundant on rock cover when it is visible.

(1) All observations are based on the quality of the video, i.e., ability to see the pipeline and camera movement. Every effort was made to obtain accurate data.
(2) Where fauna/flora were too numerous or individuals could not be distinguished, estimates were taken.

3 PRODUCED WATER CHEMISTRY AND TOXICITY

Photo Courtesy of Aquatox Testing & Consulting Ltd.

3.1 Rationale

The Offshore Waste Treatment Guidelines (OWTG) (NEB, *et al*. 2002) specify that the composition and toxicity of produced water from each production installation be analyzed and the results submitted to the Chief Conservation Officer on an approved schedule. Analysis of produced water composition is to be carried out for the following parameters:

- Metals - aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, magnesium, mercury, molybdenum, nickel, phosphorus, selenium, silver, strontium, thorium, tin, uranium, vanadium, and zinc.
- Nutrient- ammonia nitrogen
- Mineral - sulphur
- Hydrocarbon - total petroleum hydrocarbons

The suite of parameters was expanded to include benzene, toluene, ethylbenzene, xylene (BTEX), phosphorus, and total Kjehdahl nitrogen.

Annual aquatic toxicity testing is to include the echinoid (*Lytechinus pictus,* painted sea urchin) fertilization test and at least two other bioassay tests (*e.g.*, early life stage of fish, bacteria, algal species, etc.) satisfactory to the Chief Conservation Officer. The tests should be conducted contemporaneously with one of the chemical characterization tests. Besides the echinoid fertilization test, K. Doe of the Environment Canada Toxicology Laboratory in Moncton, New Brunswick recommended the three-spine stickleback (*Gasterosteus aculeatus*) test as an indicator of fish toxicity and the Microtox test as an indicator of toxicity at the cellular level.

For 2008, produced water samples were collected from the Thebaud production platform and three satellite platforms: Venture, South Venture and Alma.

Three-spine Stickleback Test

The acute lethality test with seawater-acclimated three-spine stickleback *(Gastreostreus acculeatus)* has been used by Environment Canada and several Canadian laboratories concerned with evaluating the potential toxic effects of effluents discharged into estuarine or marine environments (Environment Canada 1990).

Microtox Test

The Microtox test is based upon the use of luminescent bacteria, specifically the strain *Vibrio fisheri* NRRL B-11177, to measure toxicity from environmental samples (Environment Canada 1992a). Luminescent bacteria produce light as a byproduct of their cellular respiration. Cell respiration is fundamental to cellular metabolism and all associated life processes. Bacterial bioluminescence is tied directly to cell respiration, and any inhibition of cellular activity (*e.g.*, toxicity) results in a decreased rate of respiration and a corresponding decrease in the rate of luminescence. The more toxic the sample, the greater the percent light loss from the test suspension of luminescent bacteria. Bacterial bioluminescence has proved to be a convenient measure of cellular metabolism and consequently, a reliable sensor for measuring the presence of toxic chemicals in aquatic samples. Strain 11177 was originally chosen for the acute and chronic tests because it displayed a high sensitivity to a broad range of chemicals.

Echinoid Fertilization Test

The echinoid fertilization test, using sea urchins or sand dollars, is a common marine bioassay used for routine environmental monitoring, investigative evaluations, and/or regulatory testing of effluents and sediment pore waters (Environment Canada 1992b).

3.2 Goals

The goal of this program is to ensure that produced water from the Thebaud and three satellite platforms meets the OWTG.

3.3 Objectives

There are three objectives of the produced water investigation:

- to analyze produced water collected at the Thebaud and three satellite platform locations for aquatic LC_{50} and IC_{50} toxicity testing and chemical composition;
- to compare results with monitoring data at the same locations; and
- to utilize data in developing a strategy for future monitoring.

3.4 Methodology

The produced water samples were supplied by ExxonMobil staff on the platforms. The methodology employed for field sampling of produced water is provided in Table 3.1.

Table 3.1: Field Method for Produced Water Samples

Parameter	Sampling Methodology
Collection Date(s):	November 21, 2008 (South Venture) September 28, 2008 (Alma) October 11, 2008 (Venture) November 24, 2008; January 13, 2009 (Thebaud)
Platform(s):	Thebaud, South Venture, Venture, Alma
Type of Sample:	Produced water
Test Sample Locations:	Taken directly from the discharge caisson (prior to going overboard).
Reference Sample Locations:	None
Sample Preparation:	Toxicity testing samples were placed in the HDPE container. Instructions, sample bottles and sample preservation provided by Maxxam Analytics for chemistry analyses.

QA/QC Procedures

The samples were shipped to shore by helicopter following sample collection. Subsamples of those water samples were extracted from each, and then shipped to Harris Industrial Testing Service Ltd. (three-spine stickleback for Thebaud, Venture and South Venture platforms) and Aquatox Testing & Consulting Inc. for the echinoid fertilization and Microtox tests.

The sampling protocols from Maxxam Analytics Inc. are appended to this section. Water samples for chemical characterization were stored in a sealed cooler with a frozen gel pak to keep samples cool. They were shipped to shore by helicopter following sample collection. The samples from Thebaud, Venture and Alma were then delivered to Maxxam Analytics Inc. lab in Bedford, NS for chemical testing. Chemical characterization for South Venture was not undertaken as the sample was lost in shipping.

3.5 Analyses

Table 3.2 summarizes the analytical procedures for the produced water samples.

Table 3.2: Analytical Methods

Parameters	Analysis Methodology
Bioassays	
Cellular metabolism	Microtox Test (Environment Canada 1990)
Acute fish toxicity	Three-spine Stickleback Test (Environment Canada 1992a)
Egg fertilization	Echinoid Fertilization Test (Environment Canada 1992b)
Chemistry	
BTEX/TPH (BTEX =benzene, toluene, ethylbenzene, xylenes TPH = total petroleum hydrocarbons)	VPH (Volatile petroleum hydrocarbons) by Combi-Pal and TEH (total extractable hydrocarbons) by gas chromatography-flame ionization detector (GC-FID)
Metals	Inductively Coupled Plasma Mass Spectrometry (ICP-MS) Dilute and Shoot - This follows standard metals analysis procedure but the seawater samples are diluted prior to analysis as chloride and bromine typically found in these types of samples interferes with the analysis. Chelation and co-precipitation procedure for seawaters which reduces the interference by high metals.
Sulphur and Magnesium	Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)
Mercury	Cold Vapour Atomic Absorption
Ammonia-N	Colorimetric Test
Phosphorous	Colorimetric Test
Nitrogen	Total Kjeldahl Nitrogen Test

Maxxam Analytics reportable detection limits (RDLs) are calculated on a sample by sample basis. There are several reasons why RDLs may be raised:

- If target analytes are outside of the calibration range, the sample may be diluted and the RDLs raised accordingly.
- For some analyses, the sample matrix may cause interference that mask the signal for a particular analyte. In this case the RDL would be raised to a level above the interference.
- If limited sample is available for analysis (less than the usual amount tested), the RDLs are raised to account for the smaller sample being tested.

3.6 Results

3.6.1 Produced Water Chemistry

Table 3.3 summarizes the results of the chemical analysis of the produced water samples for the Thebaud (two sample events), Alma and Venture platforms. The metal values are reported as total concentrations.

Table 3.3: Chemical Composition of Produced Water

Sampling Date	Units	RDL	Nov 24 2008	RDL	Jan 14 2009	RDL	Oct 01 2008	RDL	Oct 25 2008	CCME MALG**
Chemical Parameters			Thebaud		Thebaud		Alma		Venture	
Thorium	µg/L	10	<10	100	<100	1	<1	200	<200	
Mercury	µg/L	0.01	**0.07**	0.1	**0.2**	0.01	**0.06**	0.01	**<0.01**	0.016
Aluminum	µg/L	1000	<1000	1000	<1000	100	<100	10000	<10000	
Antimony	µg/L	200	<200	200	<200	20	<20	2000	<2000	
Arsenic*	µg/L	0.1	<0.1	0.1	0.2	0.1	<0.1	0.1	1.4	12.5
Barium	µg/L	500	110000	500	540000	50	8500	5000	1200000	
Boron	µg/L	500	3100	500	14000	50	2300	5000	35000	
Cadmium*	µg/L	0.1	<0.1	0.1	**0.4**	0.1	<0.1	0.1	0.9	0.12
Chromium*	µg/L	0.5	1.2	0.5	2.6	0.5	1.9	0.5	<0.5	
Cobalt	µg/L	0.1	0.3	0.1	<0.1	0.1	2.0	0.1	0.1	
Copper*	µg/L	0.1	0.3	0.1	1.1	0.1	1.0	0.1	0.7	
Iron*	µg/L	5000	28000	5000	76000	5000	18000	5000	160000	

Table 3.3: Chemical Composition of Produced Water

Sampling Date	Units	RDL	Nov 24 2008	RDL	Jan 14 2009	RDL	Oct 01 2008	RDL	Oct 25 2008	CCME MALG**
Chemical Parameters			Thebaud		Thebaud		Alma		Venture	
Lead*	µg/L	0.1	1.5	0.1	7.0	0.1	0.7	0.1	8.1	
Magnesium	µg/L			0.01	0.62					
Manganese*	µg/L	200	3090	200	6900	100	180	200	30300	
Molybdenum	µg/L	200	<200	200	<200	20	<20	2000	<2000	
Nickel*	µg/L	0.5	9.9	0.5	14.8	0.5	9.7	0.5	<0.5	
Selenium	µg/L	500	<500	500	<500	50	<50	5000	<5000	
Strontium	µg/L	500	190000	500	840000	50	26000	5000	2700000	
Sulphur	µg/L		missing	0.05	<0.05	0.5	<0.5	5	69	
Tin	µg/L	200	<200	200	<200	20	<20	2000	<2000	
Uranium	µg/L	10	<10	10	<10	1	<1	100	<100	
Vanadium	µg/L	200	<200	200	<200	20	<20	2000	<2000	
Zinc*	µg/L	1	67	100	1100	1	2	500	3820	
TPH	mg/L	3	15	3	4	3	6	0.5	2.7	
Benzene	mg/L	0.3	8.1	0.3	9.3	0.3	8.1	0.05	3.9	0.1
Toluene	mg/L	0.3	13	0.3	12	0.3	13	0.05	3.0	0.2
Ethylbenzene	mg/L	0.3	0.7	0.3	0.5	0.3	0.5	0.05	0.10	0.025
Xylene	mg/L	0.5	7.9	0.5	5.7	0.5	5.9	0.1	0.9	
Phosphorus	mg/L	0.05	<0.05	0.02	<0.02	0.02	<0.02	0.02	<0.02	
Ammonia-N	mg/L	3	27	3	92	1	17	30	250	
Total Nitrogen	mg/L			2	102					3600 (NO_3)
Total Kjeldahl Nitrogen	mg/L	1	23	3	100	0.5	15	3	75	

* Metals that were analysed using chelation treatment

** CCME MALG = Canadian Council of Ministers of the Environment Marine Aquatic Life Guidelines

Values for most parameters were low or non-detectable; however, some detection limits are extremely high due to interference with high metal content of the produced water.

The highest values recorded at each platform were for barium, boron, iron, strontium and zinc. Of these metals, the Venture platform discharged the highest concentrations for the day it was tested and in comparison with the sample events at the other platforms. Note that the

Thebaud platform values for those parameters on two different days are different, showing the potential variability in snap shot water sampling. Mercury is present in produced water at levels marginally above the CCME for marine water aquatic life guideline at all the tested platforms, with the exception of Venture. Cadmium at one sample from Thebaud exceeded the CCME guideline. Sulphur is present in produced water at the Alma platform.

The total petroleum hydrocarbon (TPH) concentrations for all samples ranged from 2.7 to 15 mg/L and well below the OWTG limits of 30 mg/L (30 days) and 60 mg/L (24-hour) for oil in water.

Benzene concentration ranged from 3.9 to 9.3 mg/L, the lowest is from the Venture platform. Toluene concentrations ranged from 3.0 to 13 mg/L, the lowest is from the Venture platform. Ethylbenezene concentrations ranged from 1.0 to 0.5 mg/L, the lowest was from the Venture platform. Xylene concentrations ranged from 0.9 to 7.9 mg/L.

In comparison with previous years, metal concentrations in produced water from the Venture platform are consistently higher than the Thebaud platform which is higher than the Alma platform. Plots of barium, boron, iron, lead, strontium, and zinc are provided in the appendix. The same trend occurs for ammonia concentration in the sampled produced water. The concentration of TPH is highest in produced water from the Thebaud platform and similar levels were observed at Alma and Venture platforms. Plots of these parameters are also provided in the appendix.

3.6.2 Produced Water Toxicity

Table 3.4 summarizes the concentration of produced water sampled in 2008, as a percentage, to invoke a lethal response upon 50% of the test organisms (LC_{50}) or half maximal inhibitory concentration (IC_{50}) over a 96 hour period. Detailed laboratory reports are included in the appendix.

Table 3.4: Bioassay Results of Produced Water

Bioassay	96 Hour LC_{50} and IC_{50} Value (% Effluent)			
	Thebaud	Venture	S Venture	Alma
Three-spine Stickleback	7.70	5.66	7.69	30.80
Microtox	1.99	15.70	18.00	2.32
Sea Urchin Fertlization	3.00	0.57	0.50	1.06

The results of the 96 hour LC_{50} tests with three-spine stickleback using produced water from the four platforms ranged from 5.66 to 30.8%. The OWTG do not have a pass/fail criteria; however, most effluent discharge regulations stipulate that if an effluent has greater than 50% mortality at 100% concentration, it fails. Results of the three bioassays indicate that all the produced water samples collected on those dates at those platforms were toxic. The causative agent of the toxicity is assumed to be due to petroleum hydrocarbons. As discussed above, TPH ranged from 2.7 to 15 mg/L.

In comparison of annual results since 2005, the LC_{50} values for the fish bioassay at Thebaud decreased by half from 2005 to remain relatively stable average of about 9% produced water Figure 3-1). Microtox results appear relatively stable (Figure 3-2) as well at about 2% produced water, and the echinoid test results also decreased since 2005 results, fluctuating around about 3% or less (Figure 3-3).

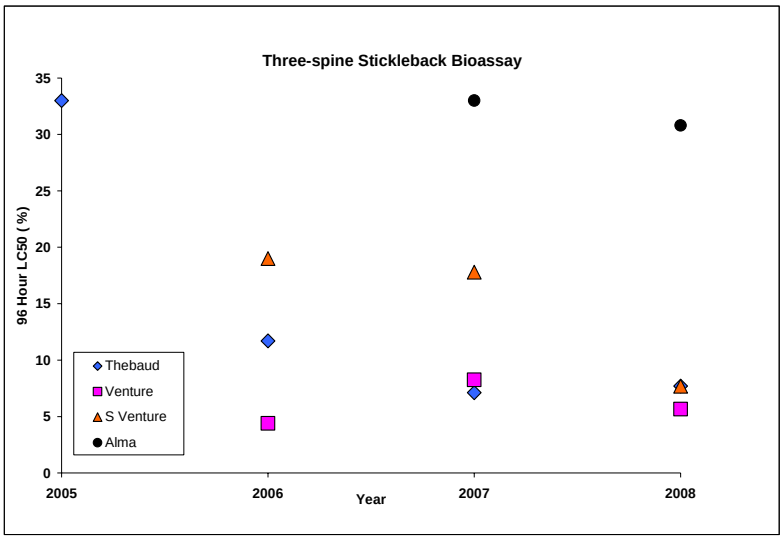


Figure 3-1 Three-spine stickleback growth test results from 2005 to 2008

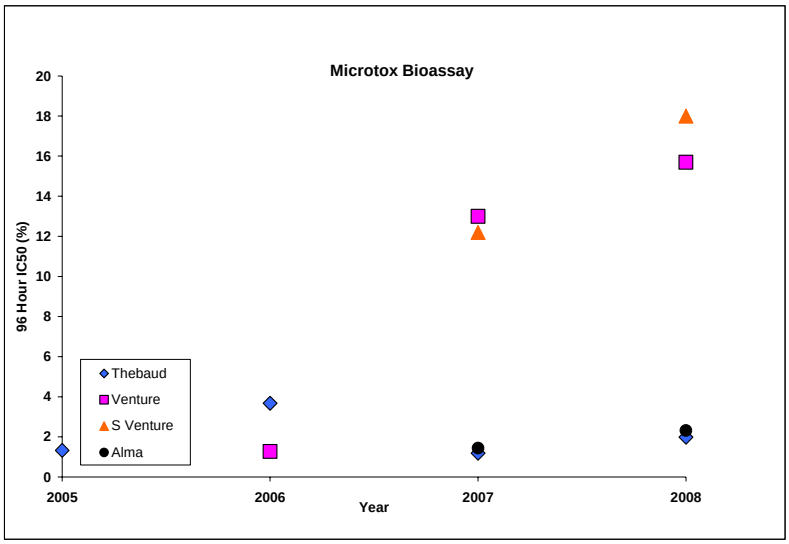


Figure 3-2 Microtox results from 2005 to 2008

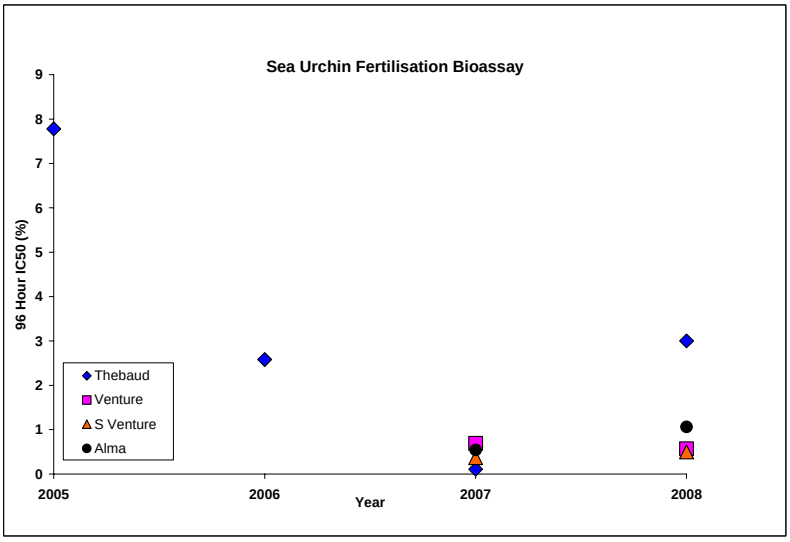


Figure 3-3 Sea urchin fertilization test results from 2005 to 2008

Produced water from the Venture platform has a relatively consistent toxicity in the fish bioassay at average of about 6% since 2006. The Microtox response shows an increasing trend of reduced toxicity from 1.2 to 15.7%. The echinoid bioassay was consistent in results between 2007 an 2008 at average of about 0.6% produced water.

Produced water from the South Venture platform shows an increased toxicity in the fish bioassay in 2008 compared with consistency in 2006 and 2007. Microtox results, conducted only in 2007 and 2008, show a decrease in toxicity. The echinoid bioassay show consistent results with an average of 0.4% produced water.

The Alma platform was only sampled in 2007 and 2008. For all three bioassays, the results are within a similar range between the two years.

3.7 Conclusions

Produced water from each platform has a unique chemical signature and produced water contains very high concentrations of specific metals. Mercury levels at all platforms except Alma marginally exceeded the CCME guideline for marine aquatic life. Cadmium levels exceeded the CCME guidelines once at Thebaud.

The total petroleum concentration of all produced water sampled is well below the OWTG.

The produced water from Thebaud, Venture, South Venture and Alma is toxic in three bioassays. Since 2005, the Alma platform produced water is least toxic to three-spine stickleback. Venture and South Venture platforms produced water is least toxic in the Microtox bioassay. Produced water from all three platforms have similar toxic effects to echinoid bioassay.

Given the energetic hydrodynamics of the marine environment near Sable Island, the chemical constituents of produced water will be diluted to non-toxic levels within a few metres of the mouth of the discharge caisson.

3.8 References

Environment Canada 1990. Biological Test Method: Acute Lethality Test using Three-spine Stickleback. EPS/1/RM/10 Environmental Protection, Ottawa, ON

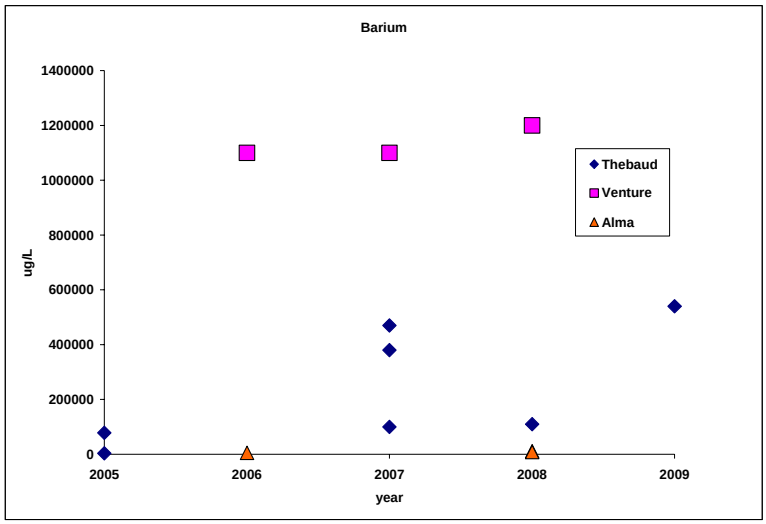
Environment Canada 1992a. Biological Test Method: Toxicity Test using Luminescent Bacteria (*Photobacterium phosphoreum*), EPS/1/RM/24 Environmental Protection, Ottawa, ON. 83 pp.

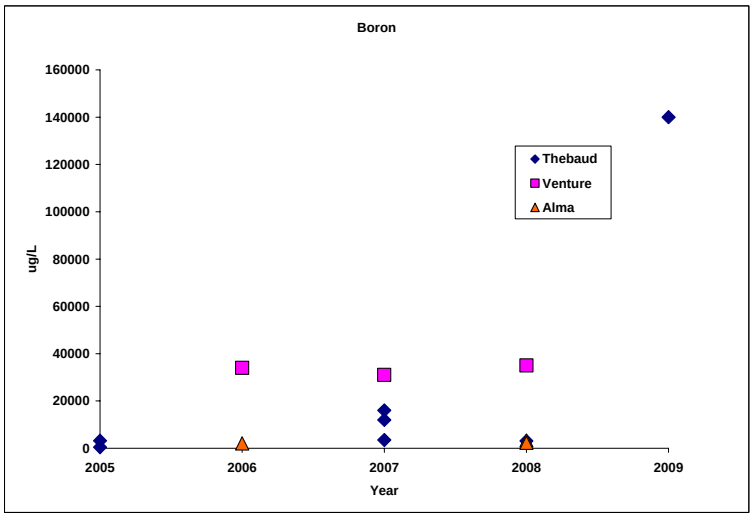
Environment Canada 1992b (with Nov 1997 amendments). Biological Test Method: Fertilization *Assay* using Echinoids (Sea Urchins and Sand Dollars) EPS/1/RM/27. Environmental Protection, Ottawa, ON. 97 pp.

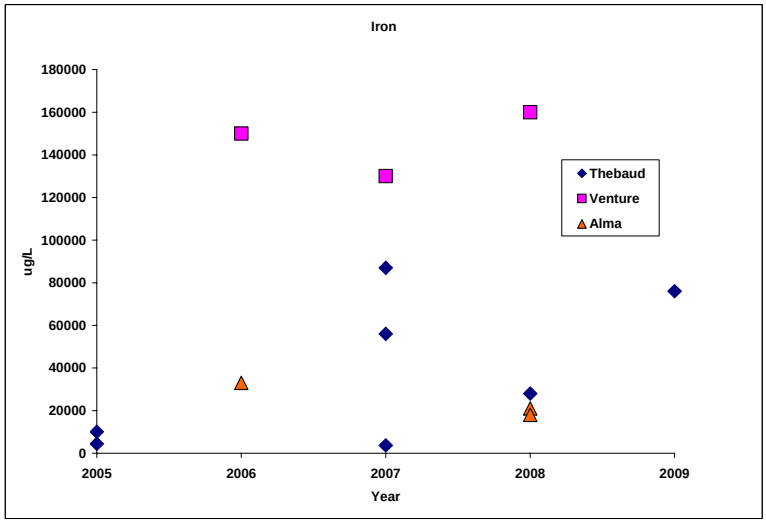
National Energy Board, Canada-Newfoundland Offshore Petroleum Board, Canada-Nova Scotia Offshore Petroleum Board. 2002. Offshore Waste Treatment Guidelines.

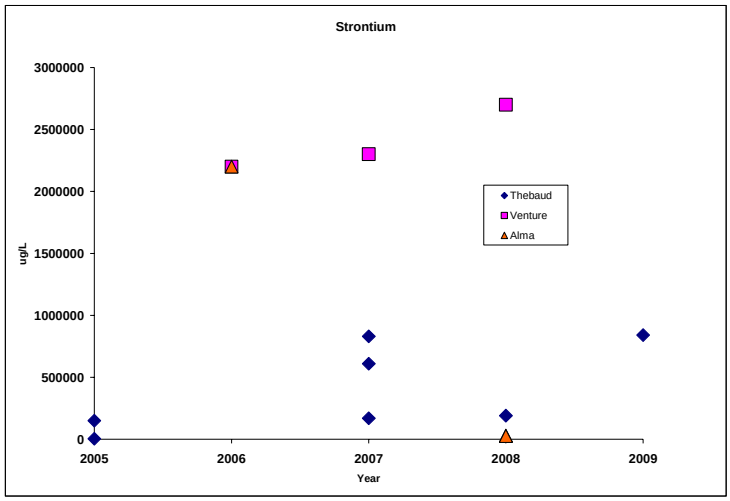
Section 3 Appendices

Historical Comparison of Selected Parameters in Produced Water Samples








Strontium
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1500000
1000000
500000
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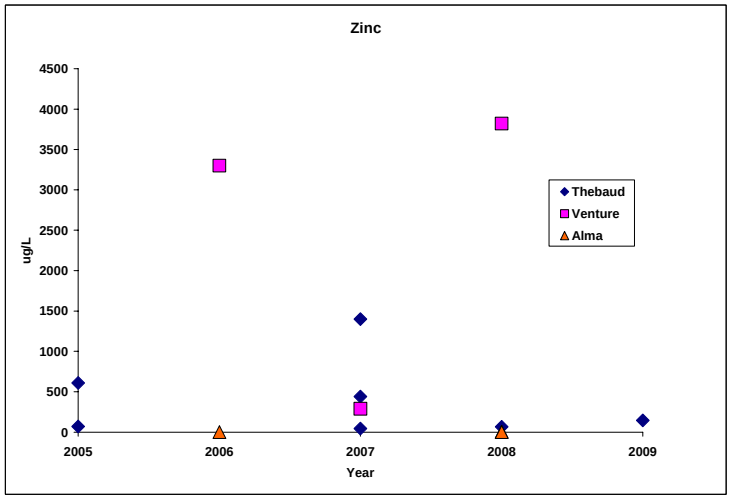
2005
2006
2007
2008
2009
Year
Thebaud
Venture
Alma


Zinc
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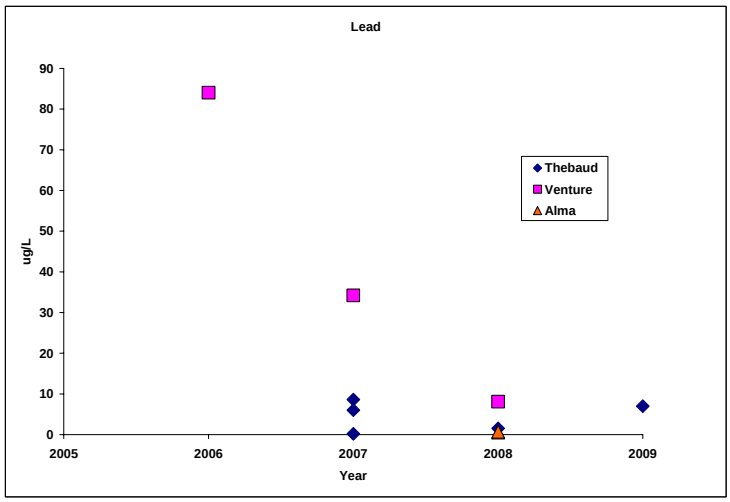
Lead
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80
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ug/L
2005
2006
2007
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Thebaud
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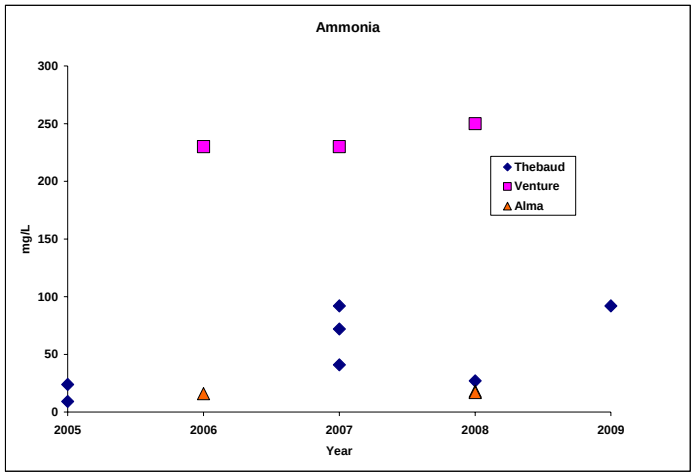
Alma


Ammonia
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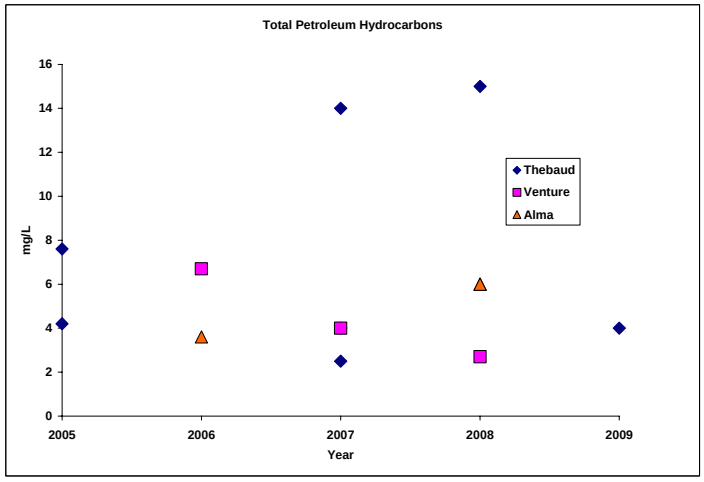
250
200
150
100
50
0
mg/L
2005
2006
2007
2008
2009
Year
Thebaud
Venture
Alma


Total Petroleum Hydrocarbons
16
14
12
10
8
6
4
2
0
mg/L
2005
2006
2007
2008
2009
Year
Thebaud
Venture
Alma

Produced Water Sampling and Analysis Procedures

Maxxam Analytics Inc.

Collection of Produced Water:

The samples that are collected directly from the discharge pipe should be sampled into the bottles supplied by the laboratory to ensure the integrity of the samples.

Nutrients

The nutrient samples that are taken for ExxonMobil are to be analysed for Ammonia and Total Phosphorous and should be sampled in 100 ml amber glass bottles that contain a sulphuric acid preservative supplied by Maxxam Analytics. Fill the bottle but not to overflowing and keep cold until shipping to the lab (not frozen).

TKN – 100 ml amber bottle preserved with sulphuric acid

Metals

The following are the bottles needed for metals analysis:

Seawater metals – 2x500ml acid washed plastic bottles. The samples are preserved at the lab, once preserved hold time is 6 months.

Dilute and Shoot Metals – 1x50ml plastic vial (field filtered if required by field protocol) preserved with nitric acid dropper (can be supplied by lab)

Thorium - 1x50ml plastic vial (field filtered if required by field protocol) preserved with nitric acid dropper (can be supplied by lab)

Mercury – 100 ml amber bottle preserved with Potassium Dichromate in 17% Nitric Acid supplied by the lab. Fill the bottle but not to overflowing and keep cold (not frozen).

Organics

The bottles required for BTEX/TPH are 2x250ml glass plus 3x40ml amber vials that contain a copper sulphate preservative. The holding time is 7 days from date sampled. The vials must be filled to the top and contain no headspace being careful not to fill to overflowing to ensure no loss of preservative.

Methods and method summaries of analysis are available upon request.

Laboratory QA/QC

Maxxam Analytics follows a very stringent QA/QC Program with the analysis of laboratory duplicates, method blanks, surrogates, spikes and certified reference materials where applicable.

Sampling Equipment Containers

The following is what the Produced Water for ExxonMobil has been analysed for in the past as well as bottles required:

Thorium – 50ml plastic with nitric acid preservative
BTEX/TPH – 3 x 40ml amber vials preserved with copper sulphate and 2 x 250ml glass bottles
Metals (dilute and shoot) - 50ml plastic with nitric acid preservative
Metals (seawater) – 2x500ml plastic acid rinsed bottles
Mercury – 100 ml amber glass preserved with potassium dichromate in 17% nitric acid
Ammonia – 100ml amber glass with sulphuric acid preservative
Total Phosphorous – 100 ml amber glass with sulphuric acid preservative
TKN – 100ml amber glass with sulphuric acid preservative

Preservation / Holding Times

BTEX/TPH – 7 days keep cold at 4C
Metals – 6 months after they are preserved – should be to the lab within 7 days
Mercury – 28 days with preservative
Ammonia – 28 days with preservative
TP – 28 days with preservative
TKN - 28 days with preservative

Analytical Methods

BTEX/TPH – Atlantic PIRI Guidelines – we run VPH (Volatile petroleum hydrocarbons) by Combi-Pal and TEH (total extractable hydrocarbons) by GC-FID and then the Modified TPH is calculated.
Metals – ICP-MS
Mercury – Cold Vapour Atomic Absorption
Ammonia – Konelab
Total Phosphorous – Colorimetric
TKN – subcontracted to Maxxam Mississauga

Toxicity Testing Results

HARRIS INDUSTRIAL TESTING SERVICE LTD.
1320 Ashdale Rd. Site 13 Box 8 RR #1 Mt. Uniacke
Nova Scotia B0N 1Z0
Phone: 902 757-0232 Fax: 902 757-0973
E-mail: hits@ns.sympatico.ca

Megan Tuttle
Exxon Mobil
1701 Hollis St.
Halifax NS
B3J 3M8

Nov. 19 2008

Dear Megan:

I have received the results from the Echinoid Fertilization and the final report for the Microtox tests. The following is a discussion of all of the results. The sample from the Alma platform was taken on Sept. 28 2008 and was received Sept. 29 2008.

The results of the three tests: Threespine stickleback (TSS), Microtox and Echinoid fertilization, indicate that the Alma produced water is toxic.

As noted in the individual reports, the produced water was pale yellow in colour with a salinity of 4.5 ppt and a petroleum odour.

The TSS test resulted in an LC_{50} value of 30.8%. A previous sample of Alma produced water resulted in an LC50 value of 33.8%. (Jan. 08). The salinity for that sample was 6 ppt.

"The Offshore Waste Treatment Guidelines" August 2002 do not have a pass/fail criteria however most effluent discharge regulations stipulate that if an effluent has greater than 50% mortality at 100% concentration, it fails.

The Microtox test gave an IC_{50} of 2.32% (2.22 – 2.42). The Guidelines do not stipulate a pass/fail number. The Jan. 08 test resulted in an IC_{50} of 1.44% (1.27 – 1.64).

The Echinoid fertiliazation test gave an IC_{25} result of 1.06% (0.19 – 1.54). The Jan. 08 test resulted in an IC_{25} of 0.54% (0.38 – 0.70). There is no pass/fail criteria available.

The results of these three tests indicate that the Alma produced water sampled in Sept. 2008 is toxic. The cause of the toxicity is most likely high petroleum levels. Chemical analysis, if performed on the sample, would probably indicate this to be the case.

Best regards,
Gary Harris
President

FISH TOXICITY REPORT (LC_{50})

Client:	Exxon Mobil Canada	Test Facility:	Harris Industrial Testing Service Ltd.
Address:	Founders Square	Location:	1320 Ashdale Rd. Site 13 Box 8 South Rawdon
	Halifax, N.S.		RR #1 Mt.Uniacke Nova Scotia Canada B0N 1Z0
Contact:	Megan Tuttle		Ph : 902 757-0232 Fax: 902 757-0973 hits@ns.sympatico.ca

SAMPLE DATA

Sample/Location:	Alma Platform Produced Water	Lab ID. #	8-432
Sampling Method:	Grab Sample Homogenized: No	Sampler:	Brent Boudreau
Date/Time Collected:	Sept. 28 2008 1000 Hrs	Received:	Sept. 29 2008
Date/Time Started:	Sept. 30 2008 1500 Hrs	Completed:	Oct. 04 2008 1500 Hrs
Sample Description:	Pale yellow and clear with petroleum odour.		

TEST INFORMATION and PRE-TEST PARAMETERS (100%)

Reference. Method:
EPS EPS 1/RM/10 July 1990
Type: LC_{50} Tox 9B
Test Organism: Threespine stickleback

Pre-test Temperature: 16.0 °C
Pre-test D.O.: 7.1 mg/L
Pre-test pH: 5.8 Adjusted: No

Conductivity of Sample: 8190 µS/cm
Salinity of Sample: *4.5 ppt
Salinity of Control #1: 29 ppt
Control #2: 4.5 ppt

Mandatory 30 minute pre-aeration:
Rate: 6.5 ± 1 ml/min/L
Time: 1430 hrs D.O.: 8.3 mg/L
Continued:___ min. @ _____ hrs
Cont'd throughout test by airstone

TEST CONDITIONS

TSS Batch #: 20
Mortality: 0 % over 7 days prior to test

Test Volume: 10 L Depth: 17.7 cm
Replicate solutions: No
Number of fish per vessel: 10

TEST CONDITIONS (Continued)

Loading Density: 0.29 g/L

Mean wet weight:
0.29 g ± 0.05 g SD
Range: 0.22 g - 0.41 g

Mean fork length:
32.6 mm ± 1.71 mm SD
Range: 31 mm - 37 mm

Photoperiod: 16L/8D Lux: 100 - 500
Static Test - Duration: 96 hours
Control/Dilution Water: Seawater
Temperature: 15 ± 1°C

TEST PARAMETERS / RESULTS

	Initial (0 Hrs)				Final (96 Hrs)			RESULTS		
Conc %	Temp °C	D.O mg/L	pH	Salin. ppt	Temp °C	D.O mg/L	pH	**Number Dead**	**Number Stressed**	Comments
100	14.5	8.3	5.9	4.5	14.5	9.1	6.4	**10/10**		All dead @ 18.5 hrs.
50	14.0	7.7	6.6	17.5	16.0	8.2	7.0	**10/10**		9 dead, 1 equil. loss @ 18.5 hrs. All dead @ 42.5 hrs.
25	15.0	7.6	6.9	23.3	14.5	7.8	7.5	**2/10**		2 dead @ 42.5 hrs.
12.5	14.5	7.1	7.2	26.4	14.5	7.7	7.7	**0/10**		
6.25	14.5	7.5	7.7	27.8	14.5	7.8	7.8	**0/10**		
Ctl. #1	14.5	7.4	7.9	29	14.5	7.8	7.9	**0/10**		
Ctl. #2	15.0	8.4	8.1	4.5	14.5	7.9	8.2	**0/10**		

96 HOUR LC_{50} RESULTS

LC_{50} Value: 30.8 %
95% Confidence Limits: 25.8 % - 36.7 %
Statistical Method: Toxstats – Spearman Karber

REFERENCE TOXICANT DATA: Batch: 20

Reference Substance: Phenol
95% C.L.: 13.0 – 17.9 mg/L
Test Date: Sept. 17 – 21 2008
Historical Phenol Mean: 17.1 mg/L
96 Hour LC_{50} for Phenol: 15.2 mg/L
Warning Limits ± 2 SD: 13.0 – 22.0 mg/L

Comments: * Deviation from protocol: Salinity of sample was 4.5 ppt. Gary Harris confirmed with Env. Canada Moncton, that it was acceptable to run the TSS test using two controls; one full strength sea water and a second control at 4.5 ppt. Test concentrations below 100% turned orange within the first 18.5 hrs.

Analyst(s): A. Huybers & G. Harris Verified by: C. Harris _____ Date: Oct. 06 2008

Accredited by the Canadian Association for Laboratory Accreditation (CALA).
The test included in this report is within the scope of this accreditation. The results reported apply only to the sapmle tested.

Form No. 5B Version No. 3 Revised: July 21 2008

AQUATOX
AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

MICROTOX® ACUTE TOXICITY TEST REPORT

Work Order : 213988
Sample Number : 22758

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.	Time Collected :	Not given
Location :	South Rawden NS	Date Collected :	2008-09-28
Substance :	Alma Platform Produced Water	Date Received :	2008-10-02
Sampling Method :	Grab	Date Tested :	2008-10-02
Sampled By :	B. Boudreau	Temp. on arrival :	14.0°C
Sample Description:	Clear, colourless, mild odour.		

Test Method : Toxicity Test Using Luminescent Bacteria, Protocol EPS 1/RM/24, Environment Canada, 1992.

TEST RESULTS

Test Endpoint	Value	95% Confidence Limits	Calculation Method
15 minute IC50	2.32%	2.22-2.42	Least Square Regression

The results reported relate only to the sample tested.

REFERENCE TOXICANT DATA

Reagent Batch :	8A1007A	15 minute IC50 :	1.38 mg/L
Expiry Date :	01/2010	95% Confidence Limits :	1.26-1.52 mg/L
Date Tested (yyyy-mm-dd) :	2008-10-02	Historical Mean IC50 :	1.49 mg/L
Reference Substance :	Zinc (as zinc sulphate)	Warning Limits (± 2SD) :	0.62-2.49 mg/L
Statistical Method :	Least Square Regression	Analyst(s):	SM

CONDITIONS OF ACUTE MICROTOX TEST

Test Organism :	*Vibrio fischeri*	Test Initiation Time :	15:20
Reagent Batch :	8A1007A	Observation Time(s) :	15 minutes
Date Reagent Received :	2008-04-17	Sample Pre-aeration/Aeration :	None
Reagent Holding Temperature :	-21 °C	Sample pH :	5.7
Analyzer Model Number :	M500	pH Adjustment :	None
Test Well Temperature :	15.0 ± 0.3 °C	Salinity Adjustment :	2% NaCl
Highest Concentration Tested :	50 %	Dilution Water :	SDI Diluent
Number of Controls :	2	Sample Storage :	4±2 °C
Number of Concentrations Tested :	8	Colour Correction :	None
Number of Replicates :	2	Analyst(s):	SM

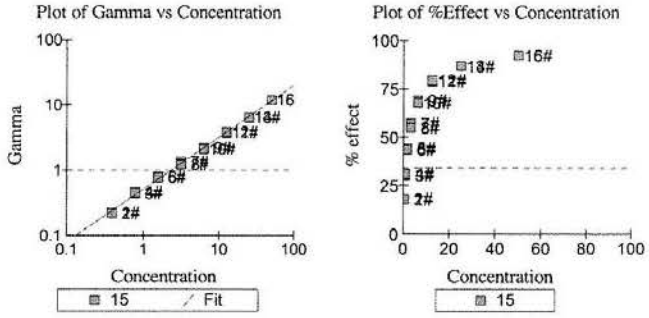
Date: 2008-10-10 (yyyy-mm-dd)

Approved by: _____ Project Manager

Accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL)

AQUATOX

Work Order: 213988
Sample Number: 22758



15 Mins Data:

Sample	Conc	Io	It	Gamma	% effect
Control	0.000	95.62	70.30	0.7352 #	
Control	0.000	98.53	71.56	0.7263 #	
Control	0.000	89.29	66.16	0.7410 #	
Control	0.000	90.01	70.69	0.7854 *	
1	0.3906	90.04	54.13	0.2212 #	18.11%
2	0.3906	91.43	55.05	0.2193 #	17.99%
3	0.7813	89.08	45.57	0.4351 #	30.32%
4	0.7813	88.58	44.69	0.4551 #	31.28%
5	1.563	90.56	36.99	0.7974 #	44.36%
6	1.563	86.85	36.01	0.7706 #	43.52%
7	3.125	89.00	27.92	1.340 #	57.27%
8	3.125	89.24	29.48	1.222 #	55.00%
9	6.250	89.01	20.24	2.229 #	69.03%
10	6.250	90.93	21.50	2.105 #	67.79%
11	12.50	87.76	13.58	3.744 #	78.92%
12	12.50	95.12	14.36	3.863 #	79.44%
13	25.00	90.24	8.85	6.486 #	86.64%
14	25.00	91.21	8.91	6.515 #	86.69%
15	50.00	87.58	4.96	11.96 #	92.29%
16	50.00	93.16	5.28	11.95 #	92.28%

- used in calculation; * - invalid data; D - deleted from calcs.

Calculations on 15 Mins data:
IC50 Concentration:2.318% (95% confidence range: 2.224 to 2.415)
95% Confidence Factor: 1.042
Estimating Equation:LOG C =1.246 x LOG G +0.3651
Coeff. of Determination (R^2):0.9982
Slope: 0.8009
Correction Factor: 0.7341

Signature: Stephanie Malko

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Sea Urchin Test Report
Fertilization Inhibition

Work Order : 213988
Sample Number : 22758

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.		
Location :	South Rawden NS	Date Collected :	2008-09-28
Substance :	Alma Platform Produced Water	Time Collected :	Not given
Sampling Method :	Grab	Date Received :	2008-10-02
Sampled By :	B. Boudreau	Time Received :	11:20
Temp. on arrival :	14.0°C	Date Tested :	2008-10-02
Sample Description:	Clear, colourless, mild odour.		

Test Method : Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars). Environment Canada, Conservation and Protection. Ottawa, Ontario. EPS 1/RM/27, December 1992 (as amended November 1997), with deviation(s) as noted below.

TEST RESULTS

Effect	Value	95% Confidence Limits	Statistical Method
IC25 (Fertilization)	1.06%	0.19-1.54	Linear Interpolation (CETIS) a

The results reported relate only to the sample tested.

COPPER (AS COPPER SULPHATE) REFERENCE TOXICANT DATA

Date Tested :	2008-10-02	Statistical Method :	Linear Interpolation (CETIS)[a]
Gamete Batch :	Ur08-10-01	Historical Mean IC25 :	120.0 µg/L
Test Duration :	20 minutes	Warning Limits (± 2SD) :	47.4 - 317.7 µg/L
IC25 Fertilization :	50.9 µg/L	Analyst(s) :	AS/RD
95% Confidence Limits :	40.0 - 57.8 µg/L		

TEST CONDITIONS

Test Vessel :	20 mL glass scintillation vial	Sperm Exposure Time [e]:	20 min
Volume per Replicate :	10 mL	Egg Exposure Time :	10 min
Number of Replicates :	4 per treatment	Total Duration of Test :	20 min
Depth of Test Solution :	Approx. 3 cm	pH Adjustment :	None
Sperm Density :	40000000 per vessel	Sample Filtration :	None
Sperm : Egg Ratio :	20000 : 1	Test Aeration :	None
Control/Dilution Water :	Artificial Sea Water[d]	Test Method Deviation(s) :	Yes (see 'Comments')

[d] no additional chemicals added
[e] 10 min exposure, continued for an additional 10 min after addition of eggs

COMMENTS

Noted Deviation(s) : At the time of arrival of the sample at the laboratory, the maximum sample holding time of 3 days had been exceeded.

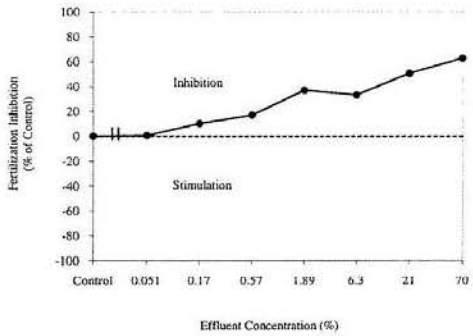
•All test validity criteria as specified in the test method cited above were satisfied.
•No organisms or gametes exhibiting unusual appearance, behaviour, or undergoing unusual treatment were used in the test.

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
2 of 4

Work Order : 213988
Sample Number : 22758

Sea Urchin Fertilization Inhibition



TEST ORGANISM

Adult Test Organism :	*Lytechinus pictus*	Holding Salinity :	30 ± 2 ‰
Adult Organism Source :	Marinus Scientific	Holding Vessel :	Glass aquaria
Source Location :	Garden Grove CA USA	Adult Mortality Rate :	0% (previous 7 days)
Date Received :	2008-10-01	Life Stage Tested :	Gamete (sperm/egg)
Holding Water :	Artificial Sea Water[a]	Gamete Batch Tested :	Ur08-10-01
Holding Temperature :	12 - 15 °C		

Reference : Recommended Procedure for the Importation of Test Organisms for Sublethal Toxicity Testing. Environment Canada, September 1999.

REFERENCES

[a] CETIS, © 2001-2007. Comprehensive Environmental Toxicity Information System. Tidepool Scientific Software, McKinleyville, Calif. 95519 [Program on disk and printed User's Guide].

[b] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[c] Environment Canada. 2001. Revised Procedures for Adjusting Salinity of Effluent Samples for Marine Sublethal Toxicity Testing Conducted under Environmental Effects Monitoring (EEM) Programs. Method Development and Applications Section, Environmental Technology Centre, December 2001.

Date : 2008-11-05
yyyy-mm-dd

Approved By : *Project Manager*

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
3 of 4

Work Order : 213988
Sample Number : 22758

FERTILIZATION DATA

Test Performed By : AS/RD
Enumerated By : EJ

Concentration (%)	Replicate	Fertilized	Unfertilized	% Fertilized	Treatment Mean
Control	A	79	21	79	**83.75**
	B	81	19	81	
	C	85	15	85	
	D	90	10	90	
Blank	A	9	91	9	**9.5**
	B	10	90	10	
	C	8	92	8	
	D	11	89	11	
0.015	A	–	–	–	**–**
	B	–	–	–	
	C	–	–	–	
	D	–	–	–	
0.051	A	74	26	74	**83.25**
	B	90	10	90	
	C	88	12	88	
	D	81	19	81	
0.17	A	66	34	66	**75.25**
	B	83	17	83	
	C	76	24	76	
	D	76	24	76	
0.57	A	59	41	59	**69.5**
	B	71	29	71	
	C	73	27	73	
	D	75	25	75	
1.89	A	51	49	51	**52.75**
	B	57	43	57	
	C	54	46	54	
	D	49	51	49	
6.3	A	49	51	49	**56**
	B	57	43	57	
	C	61	39	61	
	D	57	43	57	
21	A	33	67	33	**41.5**
	B	47	53	47	
	C	45	55	45	
	D	41	59	41	
70	A	37	63	37	**31.25**
	B	33	67	33	
	C	26	74	26	
	D	29	71	29	

NOTES : 2008-10-16: Fertilization membrane in most tested concentrations (excluding control and 0.051%) are not fully extended (i.e. very close to egg) (EJ).

"–" = not counted/not required

Data Reviewed By : JC
Date : 2008-11-04

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
4 of 4

Work Order : 213988
Sample Number : 22758

INITIAL WATER CHEMISTRY (100% EFFLUENT)

	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)	Pre-aeration Time (h)
Initial Chemistry:	21.0	5.6	7.8	102	4	–
Chemistry after Salinity Adjustment [1]:	22.0	6.5	7.0	100	32	–
Chemistry after Pre-Aeration [1,2]:	–	–	–	–	–	0:00

SALINITY ADJUSTMENT OF 100% EFFLUENT

Method :	Hypersaline Brine Addition	Volume Adjusted :	500 mL
Brine Added :	90‰ prepared with Instant Ocean™	Amount of Brine Added :	165 mL
Date Adjusted :	2008-10-02	Aging Time :	Not applicable
Aging Conditions :	Not applicable	Aging Temperature :	Not applicable

Reference : Salinity Adjustment Guidance Document. Environment Canada, revised December 2001.[c]

EXPOSURE CONCENTRATIONS WATER CHEMISTRY

Concentration (%)	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)
Control	20.0	8.2	7.3	100	32
Blank	20.0	8.2	7.3	100	32
0.015	20.0	8.2	7.3	100	32
0.051	–	–	–	–	–
0.17	–	–	–	–	–
0.57	–	–	–	–	–
1.89	20.0	8.2	7.3	100	32
6.3	–	–	–	–	–
21	20.0	7.1	7.1	97	32
70	20.0	6.8	7.2	98	32

* % saturation, adjusted for temperature and barometric pressure
"–" not required/not measured
[1] if required
[2] at <100 bubbles/min

Data Reviewed By : JE
Date : 2008-11-04

HARRIS INDUSTRIAL TESTING SERVICE LTD.
1320 Ashdale Rd. Site 13 Box 8 RR #1 Mt. Uniacke
Nova Scotia B0N 1Z0
Phone: 902 757-0232 Fax: 902 757-0973
E-mail: hits@ns.sympatico.ca

Megan Tuttle
Exxon Mobil
1701 Hollis St.
Halifax NS
B3J 3M8

Dec. 16 2008

Dear Megan:

I have received the final results from the Echinoid Fertilization and Microtox tests. The following is a discussion of all of the results. The South Venture platform was sampled on Nov. 21 2008 and it was received Nov. 21 2008.

The results of the three tests: Threespine stickleback (TSS), Microtox and Echinoid fertilization, indicate that the South Venture produced water is toxic.

As noted in the individual reports, the produced water was orange in colour and cloudy with a salinity of 135 ppt and a petroleum odour.

The TSS test gave the LC_{50} value of 7.69%. High salinity is likely a major cause of toxicity as mortalities were low at normal salinities although there was still 20% mortality at a salinity of 34 ppt. indicating some toxicity due to hydrocarbons.

"The Offshore Waste Treatment Guidelines" August 2002 do not have a pass/fail criteria however most effluent discharge regulations stipulate that if an effluent has greater than 50% mortality at 100% concentration, it fails.

The Microtox test gave IC_{50} results of 18.0% (16.3 – 20.0). The Guidelines do not stipulate a pass/fail number.

The Echinoid fertiliazation test gave IC_{25} results of 0.50% (0.42 – 0.59). There is no pass/fail criteria available.

The results of these three tests indicate that the South Venture produced water sampled in Nov. 2008 is toxic. The cause of the toxicity is most likely high petroleum levels. Chemical analysis, if performed on the sample, would probably indicate this to be the case.

Best regards,

Gary Harris
President

FISH TOXICITY REPORT (LC_{50})

Client:	Exxon Mobil Canada	Test Facility:	Harris Industrial Testing Service Ltd.
Address:	Founders Square	Location:	1320 Ashdale Rd. Site 13 Box 8 South Rawdon
	Halifax, N.S.		RR #1 Mt.Uniacke Nova Scotia Canada B0N 1Z0
Contact:	Megan Tuttle		Ph : 902 757-0232 Fax: 902 757-0973 hits@ns.sympatico.ca

SAMPLE DATA

Sample/Location:	South venture Produced Water	Lab ID. #	8-528
Sampling Method:	Grab Sample Homogenized: No	Sampler:	Not supplied
Date/Time Collected:	Nov. 21 2008 1130 Hrs	Received:	Nov. 21 2008
Date/Time Started:	Nov. 23 2008 1330 Hrs	Completed:	Nov. 27 2008 1330 Hrs
Sample Description:	Orange in colour, cloudy with a petroleum odour. The salinity of the sample was 135 ppt. This is lethal to TSS. Test concentrations were therefore started at 50%.		

TEST INFORMATION and PRE-TEST PARAMETERS (100%)

Reference. Method:
EPS EPS 1/RM/10 July 1990
Type: LC_{50} Tox 9B
Test Organism: Threespine stickleback

Pre-test Temperature: 14.0 °C
Pre-test D.O.: 7.2 mg/L
Pre-test pH: 6.4 Adjusted: No

Conductivity of Sample: -- µS/cm
Salinity of Sample: 85 ppt
Salinity of Control: 30 ppt

Mandatory 30 minute pre-aeration:
Rate: 6.5 ± 1 ml/min/L
Time: 1300 hrs D.O.: 7.5 mg/L
Continued:___ min. @ _____ hrs
Cont'd throughout test by airstone

TEST CONDITIONS

TSS Batch #: 20
Mortality: 0.7 % over 7 days prior to test

Test Volume: 10 L Depth: 17.7 cm
Replicate solutions: No
Number of fish per vessel: 10

TEST CONDITIONS (Continued)

Loading Density: 0.38 g/L

Mean wet weight:
0.38 g ± 0.09 g SD
Range: 0.24 g - 0.54 g

Mean fork length:
36.3 mm ± 2.71 mm SD
Range: 34 mm - 42 mm

Photoperiod: 16L/8D Lux: 100 - 500
Static Test - Duration: 96 hours
Control/Dilution Water: Seawater
Temperature: 15 ± 1°C

TEST PARAMETERS / RESULTS

Conc %	Initial (0 Hrs) Temp °C	D.O mg/L	pH	Salin. ppt	Final (96 Hrs) Temp °C	D.O mg/L	pH	Number Dead	Number Stressed	Comments
50	14.0	*7.5	6.5	85	14.0	*7.8	6.8	**10/10**		All dead @ 2 hrs.
25	14.0	*7.8	7.0	60	14.0	*8.2	7.3	**10/10**		All stressed @ 2 hrs. All dead @ ~20 hrs.
12.5	14.0	*8.0	7.3	46	14.0	*8.0	7.6	**10/10**		All dead @ ~ 20 hrs.
6.25	14.0	8.2	7.6	34	15.5	7.8	7.8	**2/10**		1 dead @ ~70.5 hrs. 2 dead @ ~ 96 hrs.
3.12	14.0	8.3	7.7	30	15.0	8.1	7.8	**0/10**		
Ctl.	14.0	8.4	7.8	30	15.0	8.0	7.9	**1/10**		1 dead @ ~70.5 hrs.

96 HOUR LC_{50} RESULTS

LC_{50} Value: 7.69 %
95% Confidence Limits: 6.45 % - 9.17 %
Statistical Method: Spearman Karber - Toxstats

REFERENCE TOXICANT DATA: Batch: 20

Reference Substance: Phenol
95% C.L.: 10.1 – 18.2 mg/L
Test Date: Nov. 26 – 30 2008
Historical Phenol Mean: 16.9 mg/L
96 Hour LC_{50} for Phenol: 13.6 mg/L
Warning Limits ± 2 SD: 13.1 – 12.8 mg/L

Comments: * The D.O. meter was set to the **maximum** salinity setting of 40 ppt. As salinity increases, D.O. measurements decrease. Reported measurements are higher than the true measurements. We were unable to measure actual D.O.s due to the limitations of the instrument.

Analyst(s): G. Harris & A. Huybers Verified by: C. Harris _____ Date: Dec. 01 2008

Accredited by the Canadian Association for Laboratory Accreditation (CALA).
The test included in this report is within the scope of this accreditation. The results reported apply only to the sapmle tested.

Form No. 5B Version No. 3 Revised: July 21 2008

AquaTox Testing & Consulting Inc.
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Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

MICROTOX® ACUTE TOXICITY TEST REPORT

Work Order : 214282
Sample Number : 23281

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.	Time Collected :	Not given
Location :	South Rawden NS	Date Collected :	2008-11-21
Substance :	Produced H2O	Date Received :	2008-11-25
Sampling Method :	Grab	Date Tested :	2008-11-26
Sampled By :	Not given	Temp. on arrival :	11.0°C
Sample Description:	Cloudy, orange, moderate odour.		

Test Method : Toxicity Test Using Luminescent Bacteria, Protocol EPS 1/RM/24, Environment Canada, 1992, with deviation(s) as noted below.

TEST RESULTS

Test Endpoint	Value	95% Confidence Limits	Calculation Method
15 minute IC50	18.0%	16.3-20.0	Least Square Regression

The results reported relate only to the sample tested.

REFERENCE TOXICANT DATA

Reagent Batch :	8A1007A	15 minute IC50 :	0.95 mg/L
Expiry Date :	01/2010	95% Confidence Limits :	0.78-1.17 mg/L
Date Tested (yyyy-mm-dd) :	2008-11-06	Historical Mean IC50 :	1.49 mg/L
Reference Substance :	Zinc (as zinc sulphate)	Warning Limits (± 2SD) :	0.62-2.49 mg/L
Statistical Method :	Least Square Regression	Analyst(s):	SM

CONDITIONS OF ACUTE MICROTOX TEST

Test Organism :	*Vibrio fischeri*	Test Initiation Time :	14:11
Reagent Batch :	8A1007A	Observation Time(s) :	15 minutes
Date Reagent Received :	2008-04-17	Sample Pre-aeration/Aeration :	None
Reagent Holding Temperature :	-22 °C	Sample pH :	5.8
Analyzer Model Number :	M500	pH Adjustment :	None
Test Well Temperature :	15.0 ± 0.3 °C	Salinity Adjustment :	None
Highest Concentration Tested :	50 %	Dilution Water :	SDI Diluent
Number of Controls :	2	Sample Storage :	4±2 °C
Number of Concentrations Tested :	8	Colour Correction :	None
Number of Replicates :	2	Analyst(s):	SM

Noted Deviation(s): The maximum 3 day sample holding time as specified by the test method was exceeded at the time the sample was received at the laboratory.

Date: 2008-12-12 (yyyy-mm-dd)

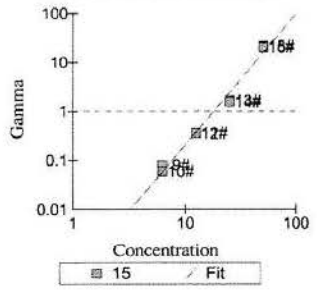
Approved by: _____ (Project Manager)

Accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA)

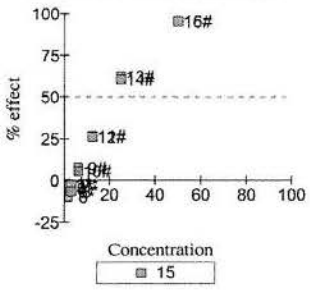
AQUATOX

Work Order: 214282
Sample Number: 23281

Plot of Gamma vs Concentration



Plot of %Effect vs Concentration



15 Mins Data:

Sample	Conc	Io	It	Gamma	% effect
Control	0.000	94.54	72.68	0.7688 #	
Control	0.000	76.58	58.67	0.7661 #	
Control	0.000	75.69	57.45	0.7590 #	
Control	0.000	78.82	60.05	0.7619 #	
1	0.3906	79.19	61.43	-0.0151 *	-1.542%
2	0.3906	80.37	63.32	-0.0303 *	-3.130%
3	0.7813	81.78	65.41	-0.0448 *	-4.697%
4	0.7813	75.18	58.88	-0.0245 *	-2.519%
5	1.563	76.94	62.78	-0.0637 *	-6.809%
6	1.563	78.38	65.84	-0.0905 *	-9.957%
7	3.125	83.47	65.34	-0.0240 *	-2.468%
8	3.125	75.69	61.61	-0.0614 *	-6.549%
9	6.250	81.93	57.99	0.0793 #	7.349%
10	6.250	75.76	54.68	0.0584 #	5.523%
11	12.50	83.61	46.93	0.3610 #	26.53%
12	12.50	85.49	48.33	0.3513 #	26.00%
13	25.00	73.39	21.15	1.651 #	62.28%
14	25.00	80.94	24.43	1.531 #	60.49%
15	50.00	76.34	2.58	21.60 #	95.58%
16	50.00	83.63	3.02	20.16 #	95.27%

- used in calculation; * - invalid data; D - deleted from calcs.

Calculations on 15 Mins data:
IC50 Concentration:18.03% (95% confidence range: 16.27 to 19.99)
95% Confidence Factor: 1.109
Estimating Equation:LOG C =0.3647 x LOG G +1.256
Coeff. of Determination (R^2):0.9823
Slope: 2.694
Correction Factor: 0.7639

Signature: Stephanie Malka

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
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Guelph ON N1H 6H9
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Sea Urchin Test Report
Fertilization Inhibition

Work Order : 214282
Sample Number : 23281

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.		
Location :	South Rawden NS	Date Collected :	2008-11-21
Substance :	Produced H2O	Time Collected :	Not given
Sampling Method :	Grab	Date Received :	2008-11-25
Sampled By :	Not given	Time Received :	13:50
Temp. on arrival :	11.0°C	Date Tested :	2008-11-26
Sample Description:	Cloudy, orange, moderate odour.		

Test Method : Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars). Environment Canada, Conservation and Protection. Ottawa, Ontario. EPS 1/RM/27, December 1992 (as amended November 1997), with deviation(s) as noted below.

TEST RESULTS

Effect	Value	95% Confidence Limits	Statistical Method
IC25 (Fertilization)	0.50%	0.42-0.59	Linear Interpolation (CETIS) a

The results reported relate only to the sample tested.

COPPER (AS COPPER SULPHATE) REFERENCE TOXICANT DATA

Date Tested :	2008-11-26	Statistical Method :	Linear Interpolation (CETIS)[a]
Gamete Batch :	Ur08-11-02	Historical Mean IC25 :	113.6 µg/L
Test Duration :	20 minutes	Warning Limits (± 2SD) :	39.6 - 346.8 µg/L
IC25 Fertilization :	120.0 µg/L	Analyst(s) :	EJ
95% Confidence Limits :	115.0 - 129.0 µg/L		

The reference toxicant test was performed under the same experimental conditions as those used with the test sample.

TEST CONDITIONS

Test Vessel :	20 mL glass scintillation vial	Sperm Exposure Time [e]:	20 min
Volume per Replicate :	10 mL	Egg Exposure Time :	10 min
Number of Replicates :	4 per treatment	Total Duration of Test :	20 min
Depth of Test Solution :	Approx. 3 cm	pH Adjustment :	None
Sperm Density :	40000000 per vessel	Sample Filtration :	None
Sperm : Egg Ratio :	20000 : 1	Test Aeration :	None
Control/Dilution Water :	Artificial Sea Water[d]	Test Method Deviation(s) :	Yes (see 'Comments')

[d] no additional chemicals added
[e] 10 min exposure, continued for an additional 10 min after addition of eggs

COMMENTS

Noted Deviation(s):

•Salinity of the all exposure concentrations ≥ 2.7% exceeded the maximum of 32‰ allowed by the test method cited above, since the salinity of the 100% effluent as submitted was 138‰. There were no other unusual conditions or deviations from the test method.

•The maximum 3 day sample holding time as specified by the test method was exceeded at the time the sample was received at the laboratory.

•All test validity criteria as specified in the test method cited above were satisfied.

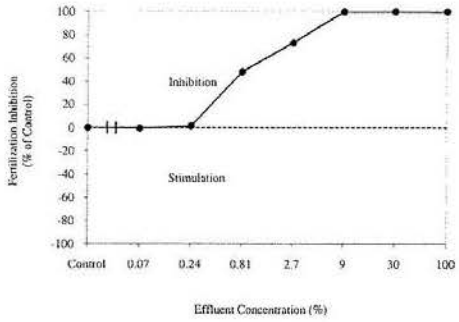
Accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA)

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
2 of 4

Work Order : 214282
Sample Number : 23281

Sea Urchin Fertilization Inhibition



TEST ORGANISM

Adult Test Organism :	*Lytechinus pictus*	Holding Salinity :	30 ± 2 ‰
Adult Organism Source :	Marinus Scientific	Holding Vessel :	Glass aquaria
Source Location :	Garden Grove CA USA	Adult Mortality Rate :	0% (previous 7 days)
Date Received :	2008-10-01	Life Stage Tested :	Gamete (sperm/egg)
Holding Water :	Artificial Sea Water[a]	Gamete Batch Tested :	Ur08-11-02
Holding Temperature :	12 - 15 °C		

Reference : Recommended Procedure for the Importation of Test Organisms for Sublethal Toxicity Testing. Environment Canada, September 1999.

REFERENCES

[a] CETIS, © 2001-2007. Comprehensive Environmental Toxicity Information System. Tidepool Scientific Software, McKinleyville, Calif. 95519 [Program on disk and printed User's Guide].

[b] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[c] Environment Canada. 2001. Revised Procedures for Adjusting Salinity of Effluent Samples for Marine Sublethal Toxicity Testing Conducted under Environmental Effects Monitoring (EEM) Programs. Method Development and Applications Section, Environmental Technology Centre, December 2001.

Date : 2008-12-10
yyyy-mm-dd

Approved By : *Project Manager*

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
3 of 4

Work Order : 214282
Sample Number : 23281

FERTILIZATION DATA

Test Performed By : EJ
Enumerated By : EJ

Concentration (%)	Replicate	Fertilized	Unfertilized	% Fertilized	Treatment Mean
Control	A	86	14	86	**89.75**
	B	92	8	92	
	C	90	10	90	
	D	91	9	91	
Blank	A	1	99	1	**1**
	B	2	98	2	
	C	0	100	0	
	D	1	99	1	
0.02	A	–	–	–	–
	B	–	–	–	
	C	–	–	–	
	D	–	–	–	
0.07	A	92	8	92	**90.25**
	B	90	10	90	
	C	88	12	88	
	D	91	9	91	
0.24	A	91	9	91	**88.5**
	B	89	11	89	
	C	90	10	90	
	D	84	16	84	
0.81	A	46	54	46	**46.5**
	B	54	46	54	
	C	50	50	50	
	D	36	64	36	
2.7	A	43	57	43	**24.25**
	B	13	87	13	
	C	22	78	22	
	D	19	81	19	
9	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
30	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
100	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	

NOTES : 2008-11-28: At higher test concentratons (i.e. 100%, 30%) eggs appear shrivelled and distorted (probably due to high salinity) (EJ).

"–" = not counted/not required

Data Reviewed By : J
Date : 2008-12-10

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
4 of 4

Work Order : 214282
Sample Number : 23281

INITIAL WATER CHEMISTRY (100% EFFLUENT)

	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)	Pre-aeration Time (h)
Initial Chemistry:	21.0	5.9	7.0	94	138	-
Chemistry after Salinity Adjustment [1]:	-	-	-	-	-	-
Chemistry after Pre-Aeration [1,2]:	-	-	-	-	-	0:00

SALINITY ADJUSTMENT OF 100% EFFLUENT

Note: The 100% effluent did not require salinity adjustment since the initial sample salinity was 138 ‰. Therefore, the effluent was tested as received.

Reference : Salinity Adjustment Guidance Document. Environment Canada, revised December 2001.[c]

EXPOSURE CONCENTRATIONS WATER CHEMISTRY

Concentration (%)	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)
Control	20.0	8.4	7.1	97	32
Blank	20.0	8.4	7.1	97	32
0.02	20.0	8.4	7.1	97	32
0.07	20.0	8.4	7.1	97	32
0.24	20.0	8.3	7.1	97	32
0.81	20.0	8.3	7.0	96	32
2.7	20.0	8.2	7.0	96	36
9	20.0	7.8	6.6	92	44
30	20.0	7.1	6.5	91	65
100	20.0	6.0	6.2	86	138

* % saturation, adjusted for temperature and barometric pressure
"-" not required/not measured
[1] if required
[2] at <100 bubbles/min

Data Reviewed By : KEH
Date : 2008-12-09

FISH TOXICITY REPORT (LC_{50})

Client:	Amec Earth & Environmental	Test Facility:	Harris Industrial Testing Service Ltd.
Address:	32 Troop Ave. Unit 301	Location:	1320 Ashdale Rd. Site 13 Box 8 South Rawdon
	Dartmouth, N.S. B3B 1Z1		RR #1 Mt.Uniacke Nova Scotia Canada B0N 1Z0
Contact:	Aubrey Beaver		Ph : 902 757-0232 Fax: 902 757-0973 hits@ns.sympatico.ca

SAMPLE DATA

Sample/Location:	Thebaud Produced Water	Lab ID. #	8-542
Sampling Method:	Grab Sample Homogenized: No	Sampler:	C. Burchell
Date/Time Collected:	Nov. 24 2008 1030 Hrs	Received:	Nov. 28 2008
Date/Time Started:	Nov. 29 2008 1030 Hrs	Completed:	Dec. 3 2008 1030 Hrs
Sample Description:	Clear, clean sample with a slight petroleum odour.		

TEST INFORMATION and PRE-TEST PARAMETERS (100%)

Reference. Method:
EPS EPS 1/RM/10 July 1990
Type: LC_{50} Tox 9B
Test Organism: Threespine stickleback

Pre-test Temperature: 15.5 °C
Pre-test D.O.: 6.4 mg/L
Pre-test pH: 5.9 Adjusted: No

Conductivity of Sample: -- µS/cm
Salinity of Sample: 38 ppt
Salinity of Control: 30 ppt

Mandatory 30 minute pre-aeration:
Rate: 6.5 ± 1 ml/min/L
Time: 1000 hrs D.O.: 6.7 mg/L
Continued: ___ min. @ _____ hrs
Cont'd throughout test by airstone

TEST CONDITIONS

TSS Batch #: 20
Mortality: 1 % over 7 days prior to test

Test Volume: 10 L Depth: 17.7 cm
Replicate solutions: No
Number of fish per vessel: 10

TEST CONDITIONS (Continued)

Loading Density: 0.43 g/L

Mean wet weight:
0.43 g ± 0.14 g SD
Range: 0.29 g - 0.68 g

Mean fork length:
35.8 mm ± 3.55 mm SD
Range: 33 mm - 44 mm

Photoperiod: 16L/8D Lux: 100 - 500
Static Test - Duration: 96 hours
Control/Dilution Water: Seawater
Temperature: 15 ± 1°C

TEST PARAMETERS / RESULTS

	Initial (0 Hrs)				Final (96 Hrs)					
Conc %	Temp °C	D.O mg/L	pH	Salin. ppt	Temp °C	D.O mg/L	pH	**Number Dead**	**Number Stressed**	Comments
100	15.0	6.7	6.0	38	15.0	7.2	6.6	**10/10**		All dead @ ~24 hrs.
50	15.0	7.6	6.5	34	15.0	7.7	6.9	**10/10**		All dead @ ~24 hrs.
25	15.0	8.0	6.8	30	15.0	7.6	7.1	**10/10**		All dead @ ~24 hrs.
12.5	15.0	8.1	7.2	30	15.0	7.8	7.4	**10/10**		All dead @ ~24 hrs.
6.25	15.0	8.1	7.3	30	15.0	6.8	7.5	**2/10**		1 dead @ ~24 hrs. 2 dead @ ~ 96 hrs.
Ctl.	15.0	8.0	7.3	30	15.0	8.0	7.8	**0/10**		

96 HOUR LC_{50} RESULTS

LC_{50} Value: 7.7 %
95% Confidence Limits: 6.46 % - 9.17 %
Statistical Method: Spearman Karber

REFERENCE TOXICANT DATA: Batch: 20

Reference Substance: Phenol
95% C.L.: 10.1 – 18.2 mg/L
Test Date: Nov. 26 – 30 2008
Historical Phenol Mean: 16.9 mg/L
96 Hour LC_{50} for Phenol: 13.6 mg/L
Warning Limits ± 2 SD: 13.1 – 21.8 mg/L

Comments: All concentraitons changed colour to reddish-brown with what looks like iron precipiatate during the first 24 hrs.

Analyst(s): G. Harris & A. Huybers Verified by: C. Harris _____ Date: Dec. 4 2008

Accredited by the Canadian Association for Laboratory Accreditation (CALA).
The test included in this report is within the scope of this accreditation. The results reported apply only to the sapmle tested.

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
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Tel: (519) 763-4412 Fax: (519) 763-4419

MICROTOX® ACUTE TOXICITY TEST REPORT

Work Order : 214316
Sample Number : 23335

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.	Time Collected :	10:30
Location :	South Rawden NS	Date Collected :	2008-11-24
Substance :	Thebaud Platform Produced Water	Date Received :	2008-12-02
Sampling Method :	Grab	Date Tested :	2008-12-02
Sampled By :	D. Burchell	Temp. on arrival :	11.0°C
Sample Description:	Clear, orange, mild odour.		

Test Method : Toxicity Test Using Luminescent Bacteria, Protocol EPS 1/RM/24, Environment Canada, 1992, with deviation(s) as noted below.

TEST RESULTS

Test Endpoint	Value	95% Confidence Limits	Calculation Method
15 minute IC50	1.99%	1.88-2.10	Least Square Regression

The results reported relate only to the sample tested.

REFERENCE TOXICANT DATA

Reagent Batch :	8A1007A	15 minute IC50 :	1.05 mg/L
Expiry Date :	01/2010	95% Confidence Limits :	0.85-1.30 mg/L
Date Tested (yyyy-mm-dd) :	2008-12-02	Historical Mean IC50 :	1.49 mg/L
Reference Substance :	Zinc (as zinc sulphate)	Warning Limits (± 2SD) :	0.61-2.49 mg/L
Statistical Method :	Least Square Regression	Analyst(s):	SSH

CONDITIONS OF ACUTE MICROTOX TEST

Test Organism :	*Vibrio fischeri*	Test Initiation Time :	15:50
Reagent Batch :	8A1007A	Observation Time(s) :	15 minutes
Date Reagent Received :	2008-04-17	Sample Pre-aeration/Aeration :	None
Reagent Holding Temperature :	-21 °C	Sample pH :	6.1
Analyzer Model Number :	M500	pH Adjustment :	None
Test Well Temperature :	15.0 ± 0.3 °C	Salinity Adjustment :	2% NaCl
Highest Concentration Tested :	50 %	Dilution Water :	SDI Diluent
Number of Controls :	2	Sample Storage :	4±2 °C
Number of Concentrations Tested :	8	Colour Correction :	None
Number of Replicates :	2	Analyst(s):	SSH

Noted Deviation(s): The maximum 3 day sample holding time as specified by the test method was exceeded at the time the sample was received at the laboratory.

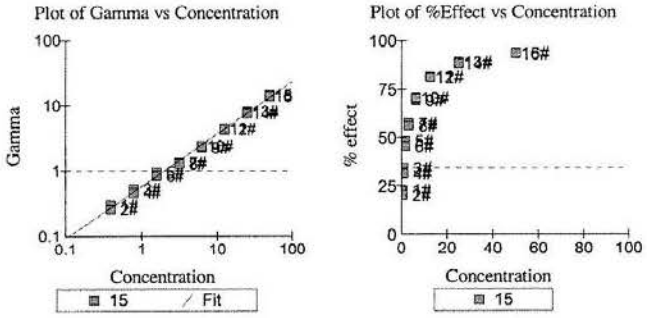
Date: 2008-12-23 (yyyy-mm-dd)

Approved by: R. Rhodes (Project Manager)

Accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA)

AQUATOX

Work Order: 214316
Sample Number: 23335



15 Mins Data:

Sample	Conc	Io	It	Gamma	% effect
Control	0.000	93.95	67.94	0.7232 #	
Control	0.000	94.99	66.81	0.7033 #	
Control	0.000	96.33	69.03	0.7166 #	
Control	0.000	96.06	68.59	0.7140 #	
1	0.3906	85.71	47.22	0.2965 #	22.87%
2	0.3906	84.66	48.17	0.2554 #	20.34%
3	0.7813	86.15	40.40	0.5231 #	34.35%
4	0.7813	85.05	41.63	0.4593 #	31.47%
5	1.563	90.26	33.31	0.9355 #	48.33%
6	1.563	87.58	34.11	0.8340 #	45.47%
7	3.125	93.27	28.40	1.346 #	57.37%
8	3.125	92.97	29.18	1.276 #	56.06%
9	6.250	82.46	18.10	2.254 #	69.27%
10	6.250	96.57	20.39	2.383 #	70.44%
11	12.50	87.00	11.57	4.371 #	81.38%
12	12.50	86.64	11.60	4.335 #	81.26%
13	25.00	92.77	7.37	7.991 #	88.88%
14	25.00	81.47	6.81	7.545 #	88.30%
15	50.00	90.91	4.16	14.61 #	93.59%
16	50.00	88.03	4.25	13.79 #	93.24%

- used in calculation; * - invalid data; D - deleted from calcs.

Calculations on 15 Mins data:
IC50 Concentration:1.986% (95% confidence range: 1.875 to 2.104)
95% Confidence Factor: 1.059
Estimating Equation:LOG C =1.241 x LOG G +0.2980
Coeff. of Determination (R^2):0.9968
Slope: 0.8033
Correction Factor: 0.7143

Signature:

AquaTox Testing & Consulting Inc.
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Tel: (519) 763-4412 Fax: (519) 763-4419

Sea Urchin Test Report
Fertilization Inhibition

Work Order : 214316
Sample Number : 23335

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.		
Location :	South Rawden NS	Date Collected :	2008-11-24
Substance :	Thebaud Platform Produced Water	Time Collected :	10:30
Sampling Method :	Grab	Date Received :	2008-12-02
Sampled By :	D. Burchell	Time Received :	11:15
Temp. on arrival :	11.0°C	Date Tested :	2008-12-02
Sample Description:	Clear, orange, mild odour.		

Test Method : Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars). Environment Canada, Conservation and Protection. Ottawa, Ontario. EPS 1/RM/27, December 1992 (as amended November 1997), with deviation(s) as noted below.

TEST RESULTS

Effect	Value	95% Confidence Limits	Statistical Method
IC25 (Fertilization)	3.0%	1.1-5.0	Linear Interpolation (CETIS) a

The results reported relate only to the sample tested.

COPPER (AS COPPER SULPHATE) REFERENCE TOXICANT DATA

Date Tested :	2008-12-02	Statistical Method :	Linear Interpolation (CE
Gamete Batch :	Ur08-12-01	Historical Mean IC25 :	110.5 µg/L
Test Duration :	20 minutes	Warning Limits (± 2SD) :	39.8 - 325.1 µg/L
IC25 Fertilization :	118.0 µg/L	Analyst(s) :	EJ
95% Confidence Limits :	108.0 - 126.0 µg/L		

The reference toxicant test was performed under the same experimental conditions as those used with the test sample.

TEST CONDITIONS

Test Vessel :	20 mL glass scintillation vial	Sperm Exposure Time [e]:	20 min
Volume per Replicate :	10 mL	Egg Exposure Time :	10 min
Number of Replicates :	4 per treatment	Total Duration of Test :	20 min
Depth of Test Solution :	Approx. 3 cm	pH Adjustment :	None
Sperm Density :	40000000 per vessel	Sample Filtration :	None
Sperm : Egg Ratio :	20000 : 1	Test Aeration :	None
Control/Dilution Water :	Artificial Sea Water[d]	Test Method Deviation(s) :	Yes (see 'Comments')

[d] no additional chemicals added
[e] 10 min exposure, continued for an additional 10 min after addition of eggs

COMMENTS

Noted Deviation(s) :
- Salinity of the all exposure concentrations ≥ 9% exceeded the maximum of 32‰ allowed by the test method cited above, since the salinity of the 100% effluent as submitted was 39‰.
- The maximum 3 day sample holding time as specified by the test method was exceeded at the time the sample was received at the laboratory.

There were no other unusual conditions or deviations from the test method.

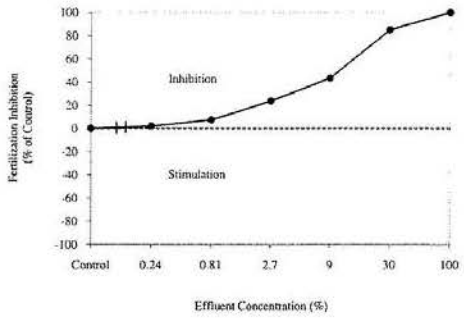
- All test validity criteria as specified in the test method cited above were satisfied.
- No organisms or gametes exhibiting unusual appearance, behaviour, or undergoing unusual treatment were used in the test.

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
2 of 4

Work Order : 214316
Sample Number : 23335

Sea Urchin Fertilization Inhibition



TEST ORGANISM

Adult Test Organism :	*Lytechinus pictus*	Holding Salinity :	30 ± 2 ‰
Adult Organism Source :	Marinus Scientific	Holding Vessel :	Glass aquaria
Source Location :	Garden Grove CA USA	Adult Mortality Rate :	0% (previous 7 days)
Date Received :	2008-10-01	Life Stage Tested :	Gamete (sperm/egg)
Holding Water :	Artificial Sea Water[a]	Gamete Batch Tested :	Ur08-12-01
Holding Temperature :	12 - 15 °C		

Reference : Recommended Procedure for the Importation of Test Organisms for Sublethal Toxicity Testing. Environment Canada, September 1999.

REFERENCES

[a] CETIS, © 2001-2007. Comprehensive Environmental Toxicity Information System. Tidepool Scientific Software, McKinleyville, Calif. 95519 [Program on disk and printed User's Guide].

[b] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[c] Environment Canada. 2001. Revised Procedures for Adjusting Salinity of Effluent Samples for Marine Sublethal Toxicity Testing Conducted under Environmental Effects Monitoring (EEM) Programs. Method Development and Applications Section, Environmental Technology Centre, December 2001.

Date : 2008-12-23
yyyy-mm-dd

Approved By : *Project Manager*

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
3 of 4

Work Order : 214316
Sample Number : 23335

FERTILIZATION DATA

Test Performed By : EJ
Enumerated By : EJ

Concentration (%)	Replicate	Fertilized	Unfertilized	% Fertilized	Treatment Mean
Control	A	79	21	79	**78.75**
	B	72	28	72	
	C	85	15	85	
	D	79	21	79	
Blank	A	1	99	1	**0.75**
	B	0	100	0	
	C	0	100	0	
	D	2	98	2	
0.24	A	73	27	73	**77.25**
	B	80	20	80	
	C	79	21	79	
	D	77	23	77	
0.81	A	67	33	67	**73**
	B	76	24	76	
	C	74	26	74	
	D	75	25	75	
2.7	A	67	33	67	**60.25**
	B	61	39	61	
	C	48	52	48	
	D	65	35	65	
9	A	41	59	41	**44.5**
	B	46	54	46	
	C	50	50	50	
	D	41	59	41	
30	A	13	87	13	**11.75**
	B	11	89	11	
	C	13	87	13	
	D	10	90	10	
100	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	

"–" = not counted/not required

Data Reviewed By : KEH
Date : 2008-12-11

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
4 of 4

Work Order : 214316
Sample Number : 23335

INITIAL WATER CHEMISTRY (100% EFFLUENT)

	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)	Pre-aeration Time (h)
Initial Chemistry:	20.0	6.3	7.3	96	39	–
Chemistry after Salinity Adjustment [1]:	–	–	–	–	–	–
Chemistry after Pre-Aeration [1,2]:	–	–	–	–	–	0:00

SALINITY ADJUSTMENT OF 100% EFFLUENT

Note: The 100% effluent did not require salinity adjustment since the initial sample salinity was 39 ‰. Therefore, the effluent was tested as received.

Reference : Salinity Adjustment Guidance Document. Environment Canada, revised December 2001.[c]

EXPOSURE CONCENTRATIONS WATER CHEMISTRY

Concentration (%)	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)
Control	20.0	8.2	7.4	100	32
Blank	20.0	8.2	7.4	100	32
0.24	–	–	–	–	–
0.81	–	–	–	–	–
2.7	20.0	8.2	7.4	99	32
9	20.0	8.1	7.3	98	34
30	20.0	7.7	6.9	92	36
100	20.0	6.4	7.1	95	39

* % saturation, adjusted for temperature and barometric pressure
"–" not required/not measured
[1] if required
[2] at <100 bubbles/min

Data Reviewed By : KH
Date : 2008-12-11

HARRIS INDUSTRIAL TESTING SERVICE LTD.
1320 Ashdale Rd. Site 13 Box 8 RR #1 Mt. Uniacke
Nova Scotia B0N 1Z0
Phone: 902 757-0232 Fax: 902 757-0973
E-mail: hits@ns.sympatico.ca

Megan Tuttle
Exxon Mobil
1701 Hollis St.
Halifax NS
B3J 3M8

Nov. 19 2008

Dear Megan:

I have received the results from the Echinoid Fertilization and the final report for the Microtox tests. The following is a discussion of all of the results. The Venture platform was sampled on Oct. 11 2008 and we received it Oct. 13 2008.

The results of the three tests: Threespine stickleback (TSS), Microtox and Echinoid fertilization, indicate that the Venture produced water is toxic.

As noted in the individual reports, the produced water was pale orange in colour with a salinity of 240 ppt and a petroleum odour.

The TSS test gave an LC_{50} value of 5.66%. Previous samples of Venture produced water resulted in an LC50 value of 4.4%. (Nov. 06) and 8.25% (Oct. 07). All samples had very high salinities, however in the Nov. 06 sample, test salinity was not the cause of toxicity as the sample was still lethal at normal salinities. Nov. 07 and this Venture sample (08) were not toxic once normal salinity values were reached through dilution.

"The Offshore Waste Treatment Guidelines" August 2002 do not have a pass/fail criteria however most effluent discharge regulations stipulate that if an effluent has greater than 50% mortality at 100% concentration, it fails.

The Microtox test gave an IC_{50} of 15.70% (15.18 – 16.24). The Guidelines do not stipulate a pass/fail number. The Oct. 07 test resulted in an IC_{50} of 13% (12.8 – 13.1).

The Echinoid fertiliazation test gave an IC_{25} result of 0.57% (0.38 – 0.99). The Oct 07 test resulted in an IC_{25} of 0.69% (0.47 – 1.00). There is no pass/fail criteria available.

The results of these three tests indicate that the Venture produced water sampled in Oct. 2008 is toxic. The cause of the toxicity is most likely high petroleum levels. Chemical analysis, if performed on the sample, would probably indicate this to be the case.

Best regards,

Gary Harris
President

FISH TOXICITY REPORT (LC_{50})

Client:	Exxon Mobil Canada	Test Facility:	Harris Industrial Testing Service Ltd.
Address:	Founders Square	Location:	1320 Ashdale Rd. Site 13 Box 8 South Rawdon
	Halifax, N.S.		RR #1 Mt.Uniacke Nova Scotia Canada B0N 1Z0
Contact:	Megan Tuttle		Ph : 902 757-0232 Fax: 902 757-0973 hits@ns.sympatico.ca

SAMPLE DATA

Sample/Location:	Venture Platform			Lab ID. #	8-459
Sampling Method:	Overboard Water	Sample Homogenized:	No	Sampler:	Brent Boudreau - Maxxam
Date/Time Collected:	Oct. 11 2008 Hrs			Received:	Oct. 13 2008
Date/Time Started:	Oct. 14 2008 1445 Hrs			Completed:	Oct. 18 2008 1445 Hrs
Sample Description:	Beige-orange in colour and translucent with a petroleum odour.				

TEST INFORMATION and PRE-TEST PARAMETERS (100%)

Reference. Method:
EPS EPS 1/RM/10 July 1990
Type: LC_{50} Tox 9B
Test Organism: Threespine stickleback

Pre-test Temperature: 16.0 °C
Pre-test D.O.: *5.6 mg/L
Pre-test pH: 5.6 Adjusted: No

Conductivity of Sample: -- µS/cm
Salinity of Sample: 240 ppt
Salinity of Control: 31 ppt

Mandatory 30 minute pre-aeration:
Rate: 6.5 ± 1 ml/min/L
Time: 1415 hrs D.O.: *5.5 mg/L
Continued:____ min. @ _____ hrs
Cont'd throughout test by airstone

TEST CONDITIONS

TSS Batch #: 20
Mortality: 0 % over 7 days prior to test

Test Volume: 10 L Depth: 17.7 cm
Replicate solutions: No
Number of fish per vessel: 10

TEST CONDITIONS (Continued)

Loading Density: 0.37 g/L

Mean wet weight:
0.37 g ± 0.12 g SD
Range: 0.20 g - 0.56 g

Mean fork length:
35.5 mm ± 4.40 mm SD
Range: 29 mm - 42 mm

Photoperiod: 16L/8D Lux: 100 - 500
Static Test - Duration: 96 hours
Control/Dilution Water: Seawater
Temperature: 15 ± 1°C

TEST PARAMETERS / RESULTS

Conc %	Initial (0 Hrs) Temp °C	D.O mg/L	pH	Salin. ppt	Final (96 Hrs) Temp °C	D.O mg/L	pH	Number Dead	Number Stressed	Comments
100	15.5	*5.5	5.6	240	15.0	*6.1	6.1	**10/10**		All on sides gasping initially. All dead @ 19 hrs.
32	16.0	*6.7	6.7	86	14.5	*7.0	6.9	**10/10**		All dead @ 19 hrs.
10	16.0	*6.6	7.1	48	15.0	*6.6	7.6	**10/10**		All dead @ 19 hrs.
3.2	16.0	6.7	7.3	40	15.5	6.7	7.9	**0/10**		
1.0	16.0	7.0	7.6	34	15.5	7.0	8.0	**0/10**		
Ctl.	16.0	7.4	7.9	31	15.5	7.4	8.0	**1/10**		1 dead @ 43 hrs.

96 HOUR LC_{50} RESULTS

LC_{50} Value: 5.66 %
95% Confidence Limits: 3.2 % - 10.0 %
Statistical Method: Binomial Test – Stephan's

REFERENCE TOXICANT DATA: Batch: 20

Reference Substance: Phenol	Test Date: Sept. 17 – Sept. 21 2008	96 Hour LC_{50} for Phenol: 15.2 mg/L
95% C.L.: 13.0 – 17.9 mg/L	Historical Phenol Mean: 17.1 mg/L	Warning Limits ± 2 SD: 13.0 – 22.0 mg/L

Comments: * The D.O. meter was set to the **maximum** salinity setting of 40 ppt. As salinity increases, D.O. measurements decrease. Reported measurements are higher than the true measurements. We were unable to measure actual D.O.s due to the limitations of the instrument.
Analyst(s): A. Huybers & G. Harris Verified by: C. Harris _____ Date: Oct. 21 2008

Aaccredited by the Canadian Association for Laboratory Accreditation (CALA).
The test included in this report is within the scope of this accreditation. The results reported apply only to the sapmle tested.

Form No. 5B Version No. 3 Revised: July 21 2008

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

MICROTOX® ACUTE TOXICITY TEST REPORT

Work Order : 214062
Sample Number : 22925

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.	Time Collected :	09:30
Location :	South Rawden NS	Date Collected :	2008-10-11
Substance :	Venture Platform	Date Received :	2008-10-15
Sampling Method :	Grab	Date Tested :	2008-10-15
Sampled By :	B. Boudreau	Temp. on arrival :	15.5°C
Sample Description:	Clear, orange, odourless.		

Test Method : Toxicity Test Using Luminescent Bacteria, Protocol EPS 1/RM/24, Environment Canada, 1992, with deviation(s) as noted below.

TEST RESULTS

Test Endpoint	Value	95% Confidence Limits	Calculation Method
15 minute IC50	15.7%	15.2-16.2	Least Square Regression

The results reported relate only to the sample tested.

REFERENCE TOXICANT DATA

Reagent Batch :	8A1007A	15 minute IC50 :	1.38 mg/L
Expiry Date :	01/2010	95% Confidence Limits :	1.26-1.52 mg/L
Date Tested (yyyy-mm-dd) :	2008-10-02	Historical Mean IC50 :	1.49 mg/L
Reference Substance :	Zinc (as zinc sulphate)	Warning Limits (± 2SD) :	0.62-2.49 mg/L
Statistical Method :	Least Square Regression	Analyst(s):	SM

CONDITIONS OF ACUTE MICROTOX TEST

Test Organism :	*Vibrio fischeri*	Test Initiation Time :	14:04
Reagent Batch :	8A1007A	Observation Time(s) :	15 minutes
Date Reagent Received :	2008-04-17	Sample Pre-aeration/Aeration :	None
Reagent Holding Temperature :	-21 °C	Sample pH :	5.5
Analyzer Model Number :	M500	pH Adjustment :	None
Test Well Temperature :	15.0 ± 0.3 °C	Salinity Adjustment :	None
Highest Concentration Tested :	50 %	Dilution Water :	SDI Diluent
Number of Controls :	2	Sample Storage :	4±2 °C
Number of Concentrations Tested :	8	Colour Correction :	None
Number of Replicates :	2	Analyst(s):	SM

Noted Deviation(s): The maximum 72 hour sample holding time as specified by the test method was exceeded. Testing proceeded as per client's request.

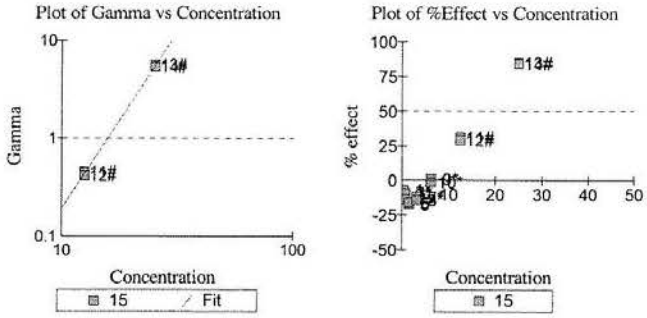
Date: 2008-10-22 (yyyy-mm-dd)

Approved by: (Project Manager)

Accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL)

AQUATOX

Work Order: 214062
Sample Number: 22925



15 Mins Data:

Sample	Conc	Io	It	Gamma	% effect
Control	0.000	95.00	69.99	0.7367 #	
Control	0.000	91.25	68.41	0.7497 #	
Control	0.000	88.17	63.68	0.7222 #	
Control	0.000	92.85	67.15	0.7232 #	
1	0.3906	91.73	71.86	-0.0643 *	-6.878%
2	0.3906	85.72	69.24	-0.0925 *	-10.20%
3	0.7813	90.46	72.29	-0.0828 *	-9.027%
4	0.7813	87.34	72.71	-0.1195 *	-13.58%
5	1.563	86.75	74.48	-0.1463 *	-17.13%
6	1.563	88.35	75.13	-0.1381 *	-16.02%
7	3.125	89.16	73.29	-0.1083 *	-12.15%
8	3.125	89.53	74.91	-0.1240 *	-14.15%
9	6.250	93.60	67.92	0.0101 *	1.000%
10	6.250	92.45	68.66	-0.0130 *	-1.323%
11	12.50	90.13	45.43	0.4542 #	31.23%
12	12.50	91.98	47.70	0.4134 #	29.25%
13	25.00	90.42	9.95	5.661 #	84.99%
14	25.00	90.74	10.45	5.365 #	84.29%
15	50.00	85.96	0.19	330.6 *	99.70%
16	50.00	87.85	0.21	305.6 *	99.67%

- used in calculation; * - invalid data; D - deleted from calcs.

Calculations on 15 Mins data:
IC50 Concentration:15.70% (95% confidence range: 15.18 to 16.24)
95% Confidence Factor: 1.034
Estimating Equation:LOG C =0.2723 x LOG G +1.196
Coeff. of Determination (R^2):0.9991
Slope: 3.669
Correction Factor: 0.7330

Signature: Stephanie Malko

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

Sea Urchin Test Report
Fertilization Inhibition

Work Order : 214062
Sample Number : 22925

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.		
Location :	South Rawden NS	Date Collected :	2008-10-11
Substance :	Venture Platform	Time Collected :	09:30
Sampling Method :	Grab	Date Received :	2008-10-15
Sampled By :	B. Boudreau	Time Received :	11:30
Temp. on arrival :	15.5°C	Date Tested :	2008-10-15
Sample Description:	Clear, orange, odourless.		

Test Method : Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars). Environment Canada, Conservation and Protection. Ottawa, Ontario. EPS 1/RM/27, December 1992 (as amended November 1997), with deviation(s) as noted below.

TEST RESULTS

Effect	Value	95% Confidence Limits	Statistical Method
IC25 (Fertilization)	0.57%	0.38-0.99	Linear Interpolation (CETIS) a

The results reported relate only to the sample tested.

COPPER (AS COPPER SULPHATE) REFERENCE TOXICANT DATA

Date Tested :	2008-10-02	Statistical Method :	Linear Interpolation (CETIS)[a]
Gamete Batch :	Ur08-10-01	Historical Mean IC25 :	120.0 µg/L
Test Duration :	20 minutes	Warning Limits (± 2SD) :	47.4 - 317.7 µg/L
IC25 Fertilization :	50.9 µg/L	Analyst(s) :	AS/RD
95% Confidence Limits :	40.0 - 57.8 µg/L		

The reference toxicant test was performed under the same experimental conditions as those used with the test sample.

TEST CONDITIONS

Test Vessel :	20 mL glass scintillation vial	Sperm Exposure Time [e] :	20 min
Volume per Replicate :	10 mL	Egg Exposure Time :	10 min
Number of Replicates :	4 per treatment	Total Duration of Test :	20 min
Depth of Test Solution :	Approx. 3 cm	pH Adjustment :	None
Sperm Density :	40000000 per vessel	Sample Filtration :	None
Sperm : Egg Ratio :	20000 : 1	Test Aeration :	None
Control/Dilution Water :	Artificial Sea Water[d]	Test Method Deviation(s) :	Yes (see 'Comments')

[d] no additional chemicals added
[e] 10 min exposure, continued for an additional 10 min after addition of eggs

COMMENTS

Noted Deviation(s):
- The maximum 3-day sample holding time as specified by the test method was exceeded. Testing proceeded as per client's request.
- Salinity of the all exposure concentrations ≥ 0.81% exceeded the maximum of 32‰ allowed by the test method cited above, since the salinity of the 100% effluent as submitted was 240‰. There were no other unusual conditions or deviations from the test method.

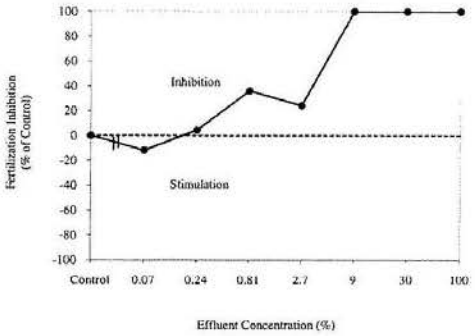
- All test validity criteria as specified in the test method cited above were satisfied.
- No organisms or gametes exhibiting unusual appearance, behaviour, or undergoing unusual treatment were used in the test.

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
2 of 4

Work Order : 214062
Sample Number : 22925

Sea Urchin Fertilization Inhibition



TEST ORGANISM

Adult Test Organism :	*Lytechinus pictus*	Holding Salinity :	30 ± 2 ‰
Adult Organism Source :	Marinus Scientific	Holding Vessel :	Glass aquaria
Source Location :	Garden Grove CA USA	Adult Mortality Rate :	7.7% (previous 7 days)
Date Received :	2008-10-01	Life Stage Tested :	Gamete (sperm/egg)
Holding Water :	Artificial Sea Water[a]	Gamete Batch Tested :	Ur08-10-01
Holding Temperature :	12 - 15 °C		

Reference : Recommended Procedure for the Importation of Test Organisms for Sublethal Toxicity Testing. Environment Canada, September 1999.

REFERENCES

[a] CETIS, © 2001-2007. Comprehensive Environmental Toxicity Information System. Tidepool Scientific Software, McKinleyville, Calif. 95519 [Program on disk and printed User's Guide].

[b] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[c] Environment Canada. 2001. Revised Procedures for Adjusting Salinity of Effluent Samples for Marine Sublethal Toxicity Testing Conducted under Environmental Effects Monitoring (EEM) Programs. Method Development and Applications Section, Environmental Technology Centre, December 2001.

Date : 2008-11-05
yyyy-mm-dd

Approved By : *Project Manager*

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
3 of 4

Work Order : 214062
Sample Number : 22925

FERTILIZATION DATA

Test Performed By : EJ
Enumerated By : AS

Concentration (%)	Replicate	Fertilized	Unfertilized	% Fertilized	Treatment Mean
Control	A	79	21	79	**86.75**
	B	81	19	81	
	C	92	8	92	
	D	95	5	95	
Blank	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
0.02	A	99	1	99	**–**
	B	–	–	–	
	C	–	–	–	
	D	–	–	–	
0.07	A	95	5	95	**97**
	B	99	1	99	
	C	96	4	96	
	D	98	2	98	
0.24	A	86	14	86	**83**
	B	82	18	82	
	C	81	19	81	
	D	83	17	83	
0.81	A	49	51	49	**55.5**
	B	37	63	37	
	C	69	31	69	
	D	67	33	67	
2.7	A	62	38	62	**65.75**
	B	63	37	63	
	C	70	30	70	
	D	68	32	68	
9	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
30	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
100	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	

"–" = not counted/not required

Data Reviewed By : JE
Date : 2008-11-04

AquaTox Testing & Consulting Inc.
11B Nicholas Beaver Rd.
RR 3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419

Sea Urchin Test Report
Fertilization Inhibition

Work Order : 214062
Sample Number : 22925

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.		
Location :	South Rawden NS	Date Collected :	2008-10-11
Substance :	Venture Platform	Time Collected :	09:30
Sampling Method :	Grab	Date Received :	2008-10-15
Sampled By :	B. Boudreau	Time Received :	11:30
Temp. on arrival :	15.5°C	Date Tested :	2008-10-15
Sample Description:	Clear, orange, odourless.		

Test Method : Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars). Environment Canada, Conservation and Protection. Ottawa, Ontario. EPS 1/RM/27, December 1992 (as amended November 1997), with deviation(s) as noted below.

TEST RESULTS

Effect	Value	95% Confidence Limits	Statistical Method
IC25 (Fertilization)	0.57%	0.38-0.99	Linear Interpolation (CETIS) a

The results reported relate only to the sample tested.

COPPER (AS COPPER SULPHATE) REFERENCE TOXICANT DATA

Date Tested :	2008-10-02	Statistical Method :	Linear Interpolation (CETIS)[a]
Gamete Batch :	Ur08-10-01	Historical Mean IC25 :	120.0 µg/L
Test Duration :	20 minutes	Warning Limits (± 2SD) :	47.4 - 317.7 µg/L
IC25 Fertilization :	50.9 µg/L	Analyst(s) :	AS/RD
95% Confidence Limits :	40.0 - 57.8 µg/L		

The reference toxicant test was performed under the same experimental conditions as those used with the test sample.

TEST CONDITIONS

Test Vessel :	20 mL glass scintillation vial	Sperm Exposure Time [e] :	20 min
Volume per Replicate :	10 mL	Egg Exposure Time :	10 min
Number of Replicates :	4 per treatment	Total Duration of Test :	20 min
Depth of Test Solution :	Approx. 3 cm	pH Adjustment :	None
Sperm Density :	40000000 per vessel	Sample Filtration :	None
Sperm : Egg Ratio :	20000 : 1	Test Aeration :	None
Control/Dilution Water :	Artificial Sea Water[d]	Test Method Deviation(s) :	Yes (see 'Comments')

[d] no additional chemicals added
[e] 10 min exposure, continued for an additional 10 min after addition of eggs

COMMENTS

Noted Deviation(s):
- The maximum 3-day sample holding time as specified by the test method was exceeded. Testing proceeded as per client's request.
- Salinity of the all exposure concentrations ≥ 0.81% exceeded the maximum of 32‰ allowed by the test method cited above, since the salinity of the 100% effluent as submitted was 240‰. There were no other unusual conditions or deviations from the test method.

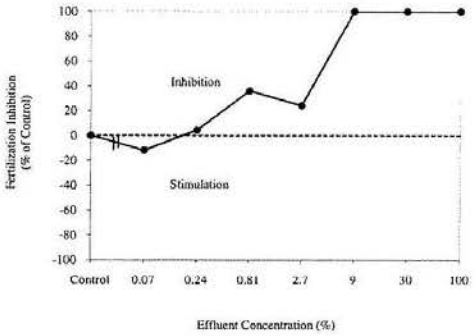
- All test validity criteria as specified in the test method cited above were satisfied.
- No organisms or gametes exhibiting unusual appearance, behaviour, or undergoing unusual treatment were used in the test.

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
2 of 4

Work Order : 214062
Sample Number : 22925

Sea Urchin Fertilization Inhibition



TEST ORGANISM

Adult Test Organism :	*Lytechinus pictus*	Holding Salinity :	30 ± 2 ‰
Adult Organism Source :	Marinus Scientific	Holding Vessel :	Glass aquaria
Source Location :	Garden Grove CA USA	Adult Mortality Rate :	7.7% (previous 7 days)
Date Received :	2008-10-01	Life Stage Tested :	Gamete (sperm/egg)
Holding Water :	Artificial Sea Water[a]	Gamete Batch Tested :	Ur08-10-01
Holding Temperature :	12 - 15 °C		

Reference : Recommended Procedure for the Importation of Test Organisms for Sublethal Toxicity Testing. Environment Canada, September 1999.

REFERENCES

[a] CETIS, © 2001-2007. Comprehensive Environmental Toxicity Information System. Tidepool Scientific Software, McKinleyville, Calif. 95519 [Program on disk and printed User's Guide].

[b] West, Inc. and D. Gulley. 1996. Toxstat Release 3.5. Western Ecosystems Technology. Cheyenne, WY, U.S.A.

[c] Environment Canada. 2001. Revised Procedures for Adjusting Salinity of Effluent Samples for Marine Sublethal Toxicity Testing Conducted under Environmental Effects Monitoring (EEM) Programs. Method Development and Applications Section, Environmental Technology Centre, December 2001.

Date : 2008-11-05
yyyy-mm-dd

Approved By : *Project Manager*

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
3 of 4

Work Order : 214062
Sample Number : 22925

FERTILIZATION DATA

Test Performed By : EJ
Enumerated By : AS

Concentration (%)	Replicate	Fertilized	Unfertilized	% Fertilized	Treatment Mean
Control	A	79	21	79	**86.75**
	B	81	19	81	
	C	92	8	92	
	D	95	5	95	
Blank	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
0.02	A	99	1	99	**–**
	B	–	–	–	
	C	–	–	–	
	D	–	–	–	
0.07	A	95	5	95	**97**
	B	99	1	99	
	C	96	4	96	
	D	98	2	98	
0.24	A	86	14	86	**83**
	B	82	18	82	
	C	81	19	81	
	D	83	17	83	
0.81	A	49	51	49	**55.5**
	B	37	63	37	
	C	69	31	69	
	D	67	33	67	
2.7	A	62	38	62	**65.75**
	B	63	37	63	
	C	70	30	70	
	D	68	32	68	
9	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
30	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	
100	A	0	100	0	**0**
	B	0	100	0	
	C	0	100	0	
	D	0	100	0	

"–" = not counted/not required

Data Reviewed By : JE
Date : 2008-11-04

AQUATOX

Sea Urchin Test Report
Fertilization Inhibition
4 of 4

Work Order : 214062
Sample Number : 22925

INITIAL WATER CHEMISTRY (100% EFFLUENT)

	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)	Pre-aeration Time (h)
Initial Chemistry:	19.5	5.6	6.3	87	240	–
Chemistry after Salinity Adjustment [1]:	–	–	–	–	–	–
Chemistry after Pre-Aeration[1,2]:	–	–	–	–	–	0:00

SALINITY ADJUSTMENT OF 100% EFFLUENT

Note: The 100% effluent did not require salinity adjustment since the initial sample salinity was 240 ‰. Therefore, the effluent was tested as received.

Reference : Salinity Adjustment Guidance Document. Environment Canada, revised December 2001.[c]

EXPOSURE CONCENTRATIONS WATER CHEMISTRY

Concentration (%)	Temp.(°C)	pH	Dissolved O_2 (mg/L)	O_2 Sat. (%)*	Salinity (‰)
Control	20.0	8.2	7.4	100	32
Blank	20.0	8.2	7.4	100	32
0.02	20.0	8.2	7.4	100	32
0.07	–	–	–	–	–
0.24	–	–	–	–	–
0.81	20.0	8.1	7.4	100	34
2.7	20.0	7.8	7.4	100	40
9	20.0	7.2	7.4	100	49
30	20.0	6.7	6.8	97	–
100	20.0	5.7	6.4	88	240

* % saturation, adjusted for temperature and barometric pressure
"–" not required/not measured
[1] if required
[2] at <100 bubbles/min

Data Reviewed By : JL
Date : 2008-11-04

4 AIR QUALITY

Photo courtesy of ExxonMobil Canada

Courtesy of Green Horse Society

4.1 Rationale

During facility start up and initial production, Sable Offshore Energy Incorporated contracted Seatech Ltd in 1999 to conduct a study of flare emissions from offshore operations at the Venture field and other fields. During start up, well contents, primarily gas, but also some condensate, water and drilling fluids are managed by flaring at the test well. Due to this mixture, soot, Volatile Organic Compounds (VOCs), and nitrogen dioxide (NO_2 among other NO_x) could be released. Passive monitoring systems (NO_2 passive samplers, VOC dosimeters, and particle deposition collectors) were installed on Sable Island during the start-up period. This component of the monitoring program was discontinued after 2001.

The rationale for the current monitoring project that commenced in 2003 came after personnel on Sable Island were exposed to a plume from a flare at the Thebaud Production Platform. The follow-up investigation resulted in a consensus that there was a need for better understanding of both ambient air concentrations in the Sable area and any possible effects from offshore operations. Further discussions led to agreement that a multi-stakeholder approach to this work was appropriate, and a proposal for the Sable Island Monitoring Station was made to the Environmental Studies Research Fund (ESRF).

The ESRF project supports the monitoring of those pollutants that could be associated with offshore oil and gas activity: nitrogen oxides (NO_x), sulphur dioxide (SO_2), fine particulate matter ($PM_{2.5}$) and hydrogen sulphide (H_2S). Taking advantage of infrastructure needed for this project and an opportunity to share costs (communication, utilities) a broader monitoring program (funded separately) was also incorporated. Offshore oil platforms and drilling activities can be a source of various air contaminants, including criteria air contaminants (NO_x, SO_2, VOCs, PM), reduced sulphur compounds, and greenhouse gases (CO_2, CH_4). Other sources of emissions in the area include transportation emissions associated with the shipment of personnel and supplies to offshore facilities via helicopter or ship. Passing marine traffic can also be a source of emissions. Some localized emission sources on Sable Island itself include air traffic to and from the island, diesel electric supply, and waste incineration at the research station. This section acknowledges the ESRF report and refers to it heavily to summarize the air quality aspects of the SOEP EEM.

4.2 Goals

The goal of the air quality monitoring component of the EEM program was to collect information on potential effects originating from the offshore platforms that may affect Sable Island or that can be monitored from the island. Sable Island provides a unique platform upon which to augment the offshore EEM program.

4.3 Objectives

There are two objectives with respect to air quality monitoring associated with the SOEP. The focus of the Sable Island Air Monitoring Program was to:

- provide baseline information on the ambient air quality on Sable Island; and
- to monitor trends in air quality as development of the Nova Scotia offshore oil and gas exploration expanded.

4.4 Methodology

4.4.1 Sable Island Air Monitoring Program

The study areas for flare emissions are located on the Thebaud Platform which are monitored by EMC staff, and at the Atmospheric Environment Service station by EC staff on the western portion of Sable Island.

Monitoring equipment consists of O_3, CH_4, CO, CO_2, NO_x, $PM_{2.5}$, and SO_2/H_2S monitors and ancillary equipment (satellite communications, data-loggers, and computers). In June of 2003, the equipment was temporarily set up in an existing building in order to begin data collection. The monitoring technologist for Nova Scotia Environment carries out most of the maintenance for the project and schedules two regular visits annually, of about four days each, to the island. Each of the visits includes standard cleaning, inspection, tuning and calibrations, as well as any required repairs. The spring visit also includes a preventative maintenance overhaul and the change-out of various instrument components. Up until now, visits have occurred in June and December, but they will be changed to April and October to try and take advantage of better weather. Further support is provided by personnel who staff Sable Island on a permanent basis. The monitoring station is visited by staff on a twice-daily basis to verify proper instrument operation and to change filters as needed.

The monitoring instruments are connected to two Campbell Scientific data-loggers. Information from the data-loggers is automatically recovered by the GGML. The data logger clocks are all set to Greenwich Mean Time (GMT) and are kept in sync with National Research Council (NRC) via a host computer. Data is retrieved from Sable by servers in Downsview via file transfer control (FTP). The data are collected in GMT. The data are provided to both Meteorological Service of Canada (MSC) Atlantic (www.atl.ec.gc.ca) and

Nova Scotia Environment (www.gov.ns.ca) each hour. Downsview reformats the data for each group. Some internal processing is also done by Downsview (*i.e.*, GMT).

Table 4.1: Measurement Instruments for Pollutants in the Sable Island Air Monitoring Program

Pollutant	Measurement Instrument	Measurement Frequency	Units	Comments
Fine Particulate ($PM_{2.5}$)	MetOne® Beta Attenuation Monitor (BAM)	Set to "Early Cycle," to accommodate external re-setting of the clock, data for the previous hour (50-minute sample) are output to the data-logger during the last 5-minutes of the hour.	$\mu g/m^3$	The monitor was purchased for the project. An external data-logger is used to store the BAM data and to synchronize the BAM's clock. A comprehensive data file is also downloaded from the internal data-logger during visits by the technologist.
Sulphur Dioxide/Hydrogen Sulphide (SO_2/H_2S)	Teledyne® Advanced Pollution Instrumentation (API) Model 101A	Continuous measurements are read and stored every five minutes at the data logger. One-hour averages are reported.	ppbv	The monitor was purchased for this project. The analyzer switches between measuring SO_2 on even-hours to measuring H_2S on odd-hours. The instrument often does not switch at exactly the top of the hour so that the hourly averages will be somewhat biased.
Nitrogen Oxides (NO_x)	Teledyne® Advanced Pollution Instrumentation (API) Model 200A	Continuous measurements are read and stored every five minutes at the data logger. One-hour averages are reported.	ppbv	The monitor was purchased for this project. A feasible method of direct measurements of NO_2 does not exist for ambient monitors. Therefore, the NO_x analyzer measures the chemiluminescence emitted

Pollutant	Measurement Instrument	Measurement Frequency	Units	Comments
				from the NO and ozone (O_3) reaction as a surrogate.
Ozone (O_3)	Thermo Electron Corporation Environmental Instruments (TEI) Model 49C analyzer	Continuous measurements are read and stored every five minutes at the data logger. One-hour averages are reported.	ppbv	This instrument is provided by the Meteorological Service of Canada (MSC), Atlantic, and was in service in Newfoundland where it had ingested water. A substantial number of repairs were performed by Nova Scotia Environment to bring the instrument to usable condition, so this instrument was not installed until later in 2003.

Source: McPherson, 2005

Technical problems and delays in station set-up resulted in data being available for only a portion of each reporting year. The periods for which data are available for each year are shown in Table 4.2.

Table 4.2: Data Completeness for the 2003-2006 Reporting Years

Pollutant	Available Data	Percentage
2003		
$PM_{2.5}$	May 28 – September 7 October 20 – December 31	45
Ozone	May 30 – June 14 November 27 – December 31	13
H_2S*	November 30 – December 31	9
SO_2*	November 30 – December 31	8
NO_X	May 30 – August 26 October 29 – December 31	40
2004		
$PM_{2.5}$	January 1 – December 31	92
Ozone	January 1 – December 31	100

Table 4.2: Data Completeness for the 2003-2006 Reporting Years

Pollutant	Available Data	Percentage
H_2S*	January 1 – December 31	91
SO_2*	January 1 – December 31	99
NO_X	January 1 – December 31	85
2005		
$PM_{2.5}$	January 1 – July 27 August 21 – October 3	65
Ozone	January 1 – July 27 August 21 – December 31	93
H_2S*	January 1 – July 27 August 21 – December 31	84
SO_2*	January 1 – July 27 August 21 – December 31	92
NO_X	January 1 – February 5, April 17 – July 26, August 20 – December 31	67
2006		
$PM_{2.5}$	March 3 – December 26	76
Ozone	January 1 – December 31	98
H_2S*	January 1 – May 31	38
SO_2*	January 1 –May 31	41
NO_X	January 1 – December 31	96

** SO_2 and H_2S measurements are recorded every other hour, other pollutants are recorded hourly.*

QA/QC Procedure

Following QA/QC procedures, Sable Island NO_x, $PM_{2.5}$ and ozone data are reported to the National Air Pollution Surveillance (NAPS) network on an annual basis by Nova Scotia Environment. MSC Atlantic provides near real time ozone and $PM_{2.5}$ data to the AIRNow program to be included in its real time mapping program. The NAPS network consists of numerous ambient air monitoring sites across the country and is managed cooperatively between Environment Canada and the provinces/territories. The objectives of the NAPS network are:

- to determine the nature and extent of air pollutants;
- to provide data for research including the effects of air pollution on health;
- to determine trends and predict emerging issues;

- to verify estimates of emissions and provide a basis for issue management legislation and international agreements; and
- to assess the effect of pollutants from local industry and mobile sources on nearby communities.

Data from the monitors are retrieved from Sable Island by Environment Canada labs in Downsview and sent to the technologist responsible for the program at Nova Scotia Environment.

In addition to the data files, QA/QC charts are prepared. This file is reviewed for any anomalous readings that may indicate an instrument malfunction. A sample plot is provided in Figure 4-1.

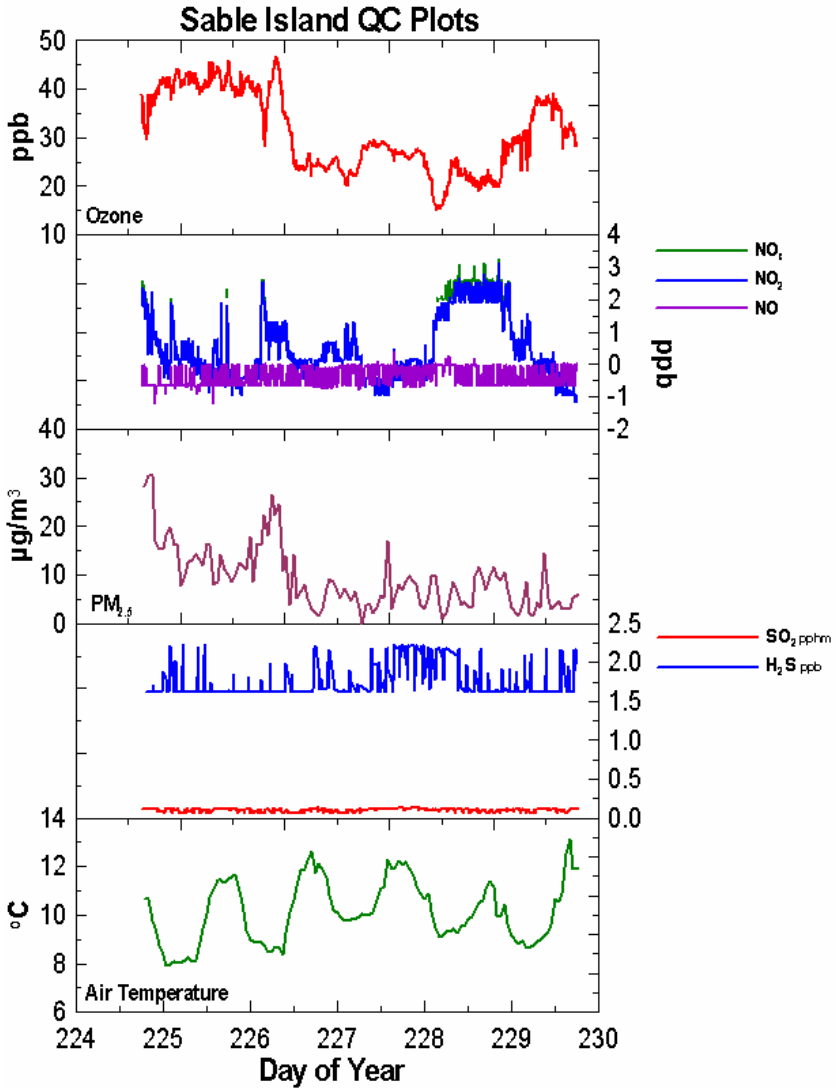


Figure 4-1: Sample QA/QC plot for Sable Island Air Monitoring Program data
(Source: Environment Canada, 2004)

It should be noted that the analyzers are programmed to send alarms if any of many possible malfunctions occur. In addition, the gas analyzers perform a weekly self-test of response against a known concentration of gas. The Nova Scotia Environment technologist does not have access to data on the alarms or the result of these self-tests. This is a limitation that prevents immediate recognition of problems, but the records of these results are useful for interpretation of the data.

4.4.2 Thebaud Flare Observations

Table 4.3 provides field methodology for the flare observations at the Thebaud platform as undertaken by ExxonMobil staff on the facility.

Table 4.3: Thebaud Flare Observation

Parameter	Sample Methodology
Survey Frequency	Twice daily
Sample Location	Thebaud Platform
Type of Sample	Flare Plume Observations
Equipment	NSE Smoke Chart

QA/QC Procedure

Occasional simultaneous (duplicate) observations by an independent observer.

4.5 Analyses

The field assessment method for determination of flare presence and flare colour is a colour chart of smoke that is numerically graded (Table 4.4 and Figure 4-2).

Table 4.4 Field Method for Flare Analysis

Parameter	Analysis Methodology
Flare plume colour	Matching shade of smoke from the flare with nearest shade on the chart

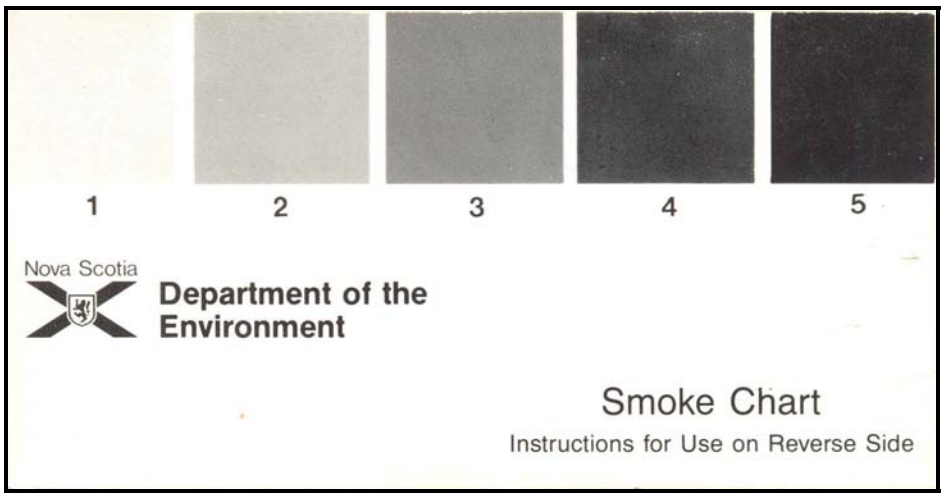


Figure 4-2 NSEL Smoke Chart

4.6 Results

4.6.1 $PM_{2.5}$ Results

The annual averages, maximum 1-hour concentrations and maximum daily averages for $PM_{2.5}$ from 2003 to 2006 are shown in Table 4.5. Exceedance numbers for the Canada Wide Standard (CWS) and World Health Organization (WHO) metrics in each year are also listed.

Table 4.5: $PM_{2.5}$ Results for 2003 to 2006 – Annual Averages, Daily and Hourly Maximums per year and Exceedances of the Canada Wide Standard (CWS) and World Health Organization (WHO) metrics

Year	Annual Average** µg/m^3	Hourly Measurements			24-hour Average		
		Annual High µg/m^3	Hours Above CWS	Hours Above WHO 24-hour Guideline	Annual High µg/m^3	Days Above CWS	Days Above WHO 24-hour Guideline
2003*	10.7	68	19	225	46	4	9
2004	7.7	85	20	96	28	0	1
2005	9.8	48	16	88	29	0	1
2006	9.0	219	36	172	41	2	3

* Measurements from June to December.

**Average of Hourly Measurements

In 2003 (period June-December), four daily averages exceeded the Canada-wide Standard (CWS) metric for $PM_{2.5}$ of 30 µg/ m^3. Nineteen daily maximums exceeded 30 µg/m^3. In 2004 and 2005, there were no 24-hour averages that exceeded the CWS metric, while twenty and sixteen daily maximum concentrations were above 30 µg/m^3, respectively. In 2006, there were two 24-hour exceedances of the CWS metric, with 36 exceedances for the daily maximums. There were several high hourly measurements in 2006, including the annual high of 219 µg/m^3.

Concentrations at Sable Island were well below the 24-hour and annual concentrations for Total Suspended Particulate established by NAAQO and the Nova Scotia Air Quality Regulations. The World Health Organization annual average for $PM_{2.5}$ was exceeded in 2003 and values were close to this annual average for both 2005 and 2006.

The highest $PM_{2.5}$ concentrations were recorded in the southwest direction (250 degrees), which coincides with the location of the Thebaud offshore platform. However, this is also the prevailing wind direction for the site and so the elevated levels recorded could also be due to other influences, including those associated with the transboundary flow of pollutants from onshore areas.

4.6.2 NOx and NO_2 Results

At the current time, there is no Canada-wide Standard for NOx. The concentrations of NOx and NO_2 on Sable Island were compared to the National Ambient Air Quality Objectives (NAAQO) for nitrogen dioxide. The focus of the NAAQO is on urban areas, however, not remote marine environments, so this comparison is somewhat arbitrary. Nova Scotia's Air Quality Regulations set permissible levels of NO_2 equivalent to the NAAQO. Concentrations were also compared to the World Health Organization's Ambient Air Quality Guidelines for nitrogen dioxide. A list of these objectives is shown in Table 4.6.

Table 4.6: Current ambient air quality objectives for nitrogen dioxide (NO_2)

Standard/Objective	1-hour (ppb)	24-hour (ppb)	Annual Average (ppb)
National Ambient Air Quality Objectives	213 (acceptable)	106 (acceptable)	32 (desirable) 53 (acceptable)
Nova Scotia Air Quality Regulations	213	--	53
World Health Organization Ambient Air Quality Guidelines	105	--	21

The maximum concentrations and maximum daily averages for NOx and NO_2 in each year are shown in Table 4.7. The maximum values fall well below both the NAAQO and WHO objectives. There were no daily measurements of NOx or NO_2 that exceeded either the 24-hour or the 1-hour maximum levels. No annual averages exceeded any of the annual average objectives. In fact, the concentrations were significantly below any of these levels. Based on this information, NOx and NO_2 do not appear to be a concern in the Sable area at the current time.

Table 4.7: NOx and NO2 hourly and daily maxima and annual average results for 2003 to 2006

Year	Maximum Hourly (ppbv)		Maximum Daily Average (ppbv)		Annual Average (ppbv)	
	NOx	NO_2	NOx	NO_2	NOx	NO_2
2003*	51	43	7	5	1.7	1.5
2004	30	16	8	7	2.4	1.7
2005	29	13	9	7	4.9	2.6
2006	47	24	10	5	1.9	0.3

*Approximately five (5) months of measurements.

In correlating predominant wind direction, the highest NOx concentrations were recorded in the direction of 70 to 90 degrees, which coincides with the location of the diesel generator on Sable Island.

4.6.3 H_2S Results

There is only one monitor for both H_2S and SOx. The monitor alternates between the two pollutants and as a result H_2S is reported every other hour. In 2006, there appears to have been an error with the instrument that resulted in a stepwise increase in the measurements beginning in the month of June. For the purposes of this report, data examination for 2006 will examine only measurements from January to the end of May, before this error appears.

There are no Canada-wide Standards or National Ambient Air Quality Objectives for H_2S in Canada. Concentrations of H_2S were compared to the levels established under the NS Air Quality Regulations listed in Table 4.8. The Ontario and Alberta provincial standards are also listed for informational purposes only.

Table 4.8: Current ambient air quality objectives for hydrogen sulphide (H_2S)

Standard/Objective	24 hour (ppb)	1 hour (ppb)
Nova Scotia Air Quality Regulations	6	30
Ontario Ambient Air Quality Standards	5	--
Alberta Ambient Air Quality Standards	3	10

The maximum concentrations and maximum daily averages for H_2S in each year are shown in Table 4.9, along with annual averages. The maximum values fall well below the NS permissible standards, although there were some daily averages that approached or exceeded the Alberta 24-hour standard.

Table 4.9: H_2S hourly and daily maxima and annual average results for 2003 to 2006

Year	Maximum Concentration (ppb)	Maximum Daily Average (ppb)	Annual Average (ppb)
2003*	2	2.0	0.13
2004	3	2.5	0.76
2005	6	3.9	1.19
2006**	4	2.9	0.96

* 2003 – approximately one month of measurements
**2006 – January 1 to May 31.

4.6.4 SO_2 Results

As with H_2S data, SO_2 results are reported every second hour and were subject to the same issues of instrument drift in the latter part of 2006. Again, only a portion of that year's data was used in the following analysis.

There are currently no Canada Wide Standards for ambient levels of SO_2. The concentrations of SO_2 on Sable Island were compared to the National Ambient Air Quality Objectives (NAAQO) for SO_2. As mentioned earlier, these standards are intended for urban areas, not the remote marine environment on Sable Island. Nova Scotia's Air Quality Regulations set permissible levels of SO_2 equivalent to the acceptable levels of the NAAQO. Concentrations were also compared to the World Health Organization's Ambient Air Quality Guidelines for SO_2. A list of these objectives is shown in Table 4.10.

Table 4.10: Current ambient air quality objectives for sulphur dioxide (SO_2)

Standard/Objective	1-hour (ppb)	24-hour (ppb)	Annual Average (ppb)
National Ambient Air Quality Objectives	172 (desirable) 334 (acceptable)	57 (desirable) 115 (acceptable)	11 (desirable) 23 (acceptable)
Nova Scotia Air Quality Regulations	--	112	22
World Health Organization Ambient Air Quality Guidelines	--	7.5	--

There were no exceedances of any of these objectives over the measurement period. The 1 hour and 24 hour concentrations were well below these levels. The annual averages also fall well below the levels established by either the NAAQO or Nova Scotia. The maximum daily and hourly measurements and the annual averages for SO_2 measurements are provided in Table 4.11.

Table 4.11: SO_2 hourly and daily maxima and annual average results for 2003 to 2006

Year	Maximum Hourly (ppb)	Maximum Daily Average (ppb)	Annual Average (ppb)
2003*	1.8	1.0	0.6
2004	2.8	2.6	0.8
2005	5.3	4.2	1.3
2006**	3.4	2.8	1.1

* 2003- approximately one month of measurements.
**2006: January 1-May 31

4.6.5 Elevated Pollution Events

Based upon the monitoring data, various episodes containing elevated pollutant values were identified and are listed in Tables 4.12 to 4.15, along with possible causes for the event. Several of these episodes (highlighted) were selected for further analysis in order to determine an underlying cause for the high values recorded (*i.e.*, transboundary flows, local effects, or natural influences).

Table 4.12: Elevated pollutant events in 2003

Date	Pollutant(s)	Possible Causes
June 29-30	Fine particulate ($PM_{2.5}$)	Long-range transport
July 6-7	Fine particulate ($PM_{2.5}$)	Long-range transport
July 27-28	Fine particulate ($PM_{2.5}$)	Long-range transport
August 27-28	Fine particulate ($PM_{2.5}$)	Possible long-range transport [1]

[1] A lack of available data makes it difficult to determine the exact cause of this event

Table 4.13: Elevated pollutant events in 2004

Date	Pollutant(s)	Possible Causes
February 19	Fine particulate ($PM_{2.5}$)	Sea-salt aerosol loading (winter storm)
June 9-10	Fine particulate ($PM_{2.5}$)	Long-range transport
November 5-7	Hydrogen Sulphide	Possible local or natural influences
December 2	Nitrogen Oxides	Diesel generator on Thebaud platform
December 12-16	Sulphur Dioxide	Possible local or natural influences

Table 4.14: Elevated pollutant events in 2005

Date	Pollutant(s)	Possible Causes
January 24	Fine particulate ($PM_{2.5}$)	Sea-salt aerosol loading (winter storm)
March 9	Fine particulate ($PM_{2.5}$)	Sea-salt aerosol loading (winter storm)
April 20-21	Fine particulate ($PM_{2.5}$) Hydrogen Sulphide	Long –range transport with possible local or natural influences
May 29	Nitrogen Oxides	Diesel generator on Sable Island
June 26	Fine particulate ($PM_{2.5}$)	Long-range transport
October 13	Nitrogen Oxides	Diesel generator on Sable Island
October 25-26	Hydrogen Sulphide Sulphur Dioxide	Possible local or natural influences

Table 4.15: Elevated pollutant events in 2006

Date	Pollutant(s)	Possible Causes
February 23	Nitrogen Oxides	Diesel generator on Sable Island
March 27	Fine particulate ($PM_{2.5}$)	Sea-salt aerosol loading (winter storm)
July 2-3	Fine particulate ($PM_{2.5}$)	Long-range transport with local contributions from Thebaud platform
September 13	Fine particulate ($PM_{2.5}$)	Sea-salt aerosol loading (Tropical Storm Florence)

High pollutant values recorded at the Sable Island monitors can result from a number of factors, including long-range transport of pollutants, emissions from local sources (e.g. offshore oil and gas activities; diesel generation; waste incineration at the research station) or natural sources (lightning; stratospheric ozone intrusions; sea-salt spray.)

There is some evidence of local source influences in the NOx data. These infrequent NOx spikes occur mainly during the overnight period with light winds from the east to northeast and appear to be mainly associated with sources at the Sable Island station, including the diesel electricity generator, emissions from forced air furnaces, vehicles, etc. There is also some evidence of levels recorded from the direction of the Thebaud diesel generator.

Smoke observation data from the Thebaud offshore platform has been provided for periods in 2003, 2004 and 2005 and all of 2006 and provides some indication of the potential influence from this source on $PM_{2.5}$ concentrations when used in combination with the wind direction and air quality data recorded.

As with local sources, it is not currently possible to reach strong conclusions regarding the influence of natural sources on Sable Island air quality.

4.7 Conclusions

Overall, the EC Sable Island Air Monitoring Program has produced some useful results in its first four years. Data from Sable Island is also being used to improve air quality modeling scenarios and to validate air quality models.

Sable Island can be affected by the long range transport of air pollution from the continental mainland. There is also some evidence of natural influences on $PM_{2.5}$ concentrations from sea-salt aerosol loading during storms with high wave action.

The monitoring program and current observations of various emission producing activities on and around the island do not yet allow for confirmation as to whether the effects of offshore oil and gas activities can be measured on the island. In particular, the cause of H_2S and SO_2 peaks in the data set is especially hard to attribute to any particular source based upon the current information.

Section 4 Appendices

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - January 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JAN 01-2008	1200 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
JAN 01-2008	17:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
JAN 02-2008	13:00 HRS	CLEAR	NORMAL	GALE FORCE SE WINDS
JAN 02-2008	17:00 HRS	CLEAR	NORMAL	STORM FORCE SE WINDS
JAN 03-2008	12:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SE WINDS DIMINISHING
JAN 03-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WNW WINDS
JAN 04-2008	12:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT NW WINDS
JAN 04-2008	17:00 HRS	CLEAR	NORMAL	LIGHT WNW WINDS
JAN 05-2008	13:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
JAN 05-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE WSW WINDS
JAN 06-2008	13:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WSW WINDS
JAN 06-2008	17:00 HRS	CLEAR	NORMAL	LIGHT WSW WINDS
JAN 07-2008	13:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT SW WINDS
JAN 07-2008	17:00 HRS	NO1 FROM SMOKE	NORMAL	LIGHT SW WINDS
JAN 08-2008	13:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG, LOW VISIBILITY
JAN 08-2008	17:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
JAN 09-2008	12:00 HRS	OBSCURED	OBSCURED	MODERATE SW WINDS
JAN 10-2008	13:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
JAN 10-2008	17:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
JAN 11-2008	12:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT SW WINDS
JAN 11-2008	16:00 HRS	NO1 FROM CHART	NORMAL	WINDS LIGHT AND VARIABLE

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - January 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JAN 12-2008	13:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JAN 12-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JAN 13-2008	13:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE WSW WINDS
JAN 13-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JAN 14-2008	13:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE EASTERLY WINDS
JAN 14-2008	17:00 HRS	OBSCURED	OBSCURED	E'LY GALES WITH ICE PELLETS AND FREEZING RAIN
JAN 15-2008	13:00 HRS	CLEAR	NORMAL	GALE FORCE WESTERLY WINDS
JAN 16-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	STRONG NW WINDS
JAN 16-2008	16:00 HRS	CLEAR	OBSCURED	STRONG NW WINDS
JAN 17-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE SW WINDS
JAN 17-2008	16:00 HRS	CLEAR	OBSCURED	MODERATE WSW WINDS
JAN 18-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE EASTERLY WINDS
JAN 18-2008	16:00 HRS	CLEAR	OBSCURED	GALE FORCE SE WINDS
JAN 19-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	GALE FORCE SE WINDS
JAN 19-2008	16:00 HRS	CLEAR	OBSCURED	GALE FORCE SE WINDS
JAN 20-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	GALE FORCE SE WINDS
JAN 20-2008	16:00 HRS	OBSCURED	OBSCURED	GALE FORCE SE WINDS WET SNOW
JAN 21-2008	1000 HRS	OBSCURED	OBSCURED	GALE FORCE WESTERLY WINDS HEAVY SNOW SQUALLS
JAN 21-2008	1600 HRS	OBSCURED	OBSCURED	GALE FORCE WESTERLY WINDS HEAVY SNOW SQUALLS
JAN 22-2008	1000 HRS	CLEAR	NORMAL	MODERATE W WINDS
JAN 22-2008	1600 HRS	CLEAR	NORMAL	MODERATE W WINDS
JAN 23-2008	1000 HRS	CLEAR	NORMAL	MODERATE SW WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - January 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JAN 23-2008	1600 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JAN 24-2008	1000 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
JAN 23-2008	1600 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
JAN 30-2008	1600 HRS	CLEAR	NORMAL	MODERATE NW WINDS
JAN 31-2008	11:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
JAN 31-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE WESTERLY WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - February 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
FEB 01-2008	11:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT WESTERLY WINDS
FEB 01-2008	17:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT WESTERLY WINDS
FEB 02-2008	11:00 HRS	OBSCURED	OBSCURED	LOW VISIBILITY IN FOG THIS AM
FEB 02-2008	17:00 HRS	CLEAR	NORMAL	STRONG SW WINDS
FEB 03-2008	11:00 HRS	CLEAR	NORMAL	MODERATE WSW WINDS
FEB 03-2008	16:00 HRS	CLEAR	NORMAL	MODERATE WSW WINDS
FEB 04-2008	11:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE NW WINDS
FEB 04-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE NW WINDS
FEB 05-2008	11:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
FEB 05-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SE WINDS
FEB 06-2008	11:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
FEB 06-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
FEB 07-2008	11:00 HRS	OBSCURED	OBSCURED	SNOW AT TIMES HEAVY REDUCED VISISBILITY
FEB 07-2008	17:00 HRS	CLEAR	NORMAL	MODERATE ENE WINDS
FEB 08-	11:00 HRS	CLEAR	NORMAL	MODERATE EASTERLY WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - February 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
2008				
FEB 08-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VARIABLE WINDS
FEB 09-2008	11:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WINDS
FEB 09-2008	17:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT SW WINDS
FEB 10-2008	11:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE EASTERLY WINDS
FEB 10-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT EASTERLY WINDS
FEB 11-2008	11:00 HRS	CLEAR	NORMAL	STORM FORCE WSW WINDS, SNOW SHOWERS
FEB 11-2008	16:00 HRS	CLEAR	NORMAL	STORM FORCE WESTERLY WINDS, SNOW SHOWERS
FEB 12-2008	11:00 HRS	CLEAR	NORMAL	STRONG NW WINDS, OCCASIONAL SNOW SHOWERS
FEB 13-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	STORM FORCE NWESTERLY WINDS, SNOW SHOWERS
FEB 13-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	STORM FORCE WESTERLY WINDS, SNOW SHOWERS
FEB 14-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	STORM FORCE NWESTERLY WINDS, SNOW SHOWERS
FEB 14-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	STORM FORCE NWESTERLY WINDS, SNOW SHOWERS
FEB 15-2008	10:00 HRS	OBSCURED	MEDIUM	MODERATE NW WINDS
FEB 15-2008	16:00 HRS	OBSCURED	MEDIUM	MODERATE NW WINDS
FEB 16-2008	10:00 HRS	NUMBER 5 FROM CHART	LARGE	MODERATE NW WINDS
FEB 16-2008	16:00 HRS	NUMBER 5 FROM CHART	LARGE	MODERATE NW WINDS
FEB 17-2008	10:00 HRS	NO1 FROM CHART	NORMAL	LIGHT TO MODERATE SW WINDS
FEB 17-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT TO MODERATE SW WINDS
FEB 18-2008	10:00 HRS	NO1 FROM CHART	NORMAL	STRONG SW WINDS
FEB 18-2008	16:00 HRS	NO1 FROM CHART	NORMAL	STRONG SW WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - February 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
FEB 19-2008	10:00 HRS	NO1 FROM CHART	NORMAL	STRONG SW WINDS
FEB 19-2008	16:00 HRS	NO1 FROM CHART	NORMAL	STRONG SW WINDS
FEB 20-2008	10:00 HRS	NO1 FROM CHART	NORMAL	STRONG SW WINDS
FEB 20-2008	16:00 HRS	NO1 FROM CHART	NORMAL	STRONG SW WINDS
FEB 21-2008	10:00 HRS	OBSCURED	OBSCURED	OBSCURED IN SNOW
FEB 21-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN SNOW
FEB 22-2008	10:00 HRS	NO1 FROM CHART	NORMAL	STRONG W WINDS
FEB 22-2008	16:00 HRS	NO1 FROM CHART	NORMAL	STRONG NW WINDS
FEB 23-2008	12:00 HRS	CLEAR	NORMAL	STRONG NE WINDS, LIGHT FREEZING RAIN
FEB 23-2008	17:00 HRS	CLEAR	NORMAL	STRONG NNE WINDS
FEB 24-2008	10:00 HRS	CLEAR	NORMAL	LIGHT NW WINDS
FEB 24-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT TO MODERATE WNW WINDS
FEB 25-2008	11:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
FEB 25-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
FEB 26-2008	11:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT SW WINDS
FEB 26-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT SW WINDS
FEB 27-2008	11:00 HRS	CLEAR	NORMAL	STRONG SE WINDS, RAIN AND MIST DEVELOPING
FEB 27-2008	17:00 HRS	OBSCURED	OBSCURED	GALE FORCE SW WINDS, DENSE FOG
FEB 28-2008	11:00 HRS	CLEAR	NORMAL	GALE FORCE SW WINDS, RAIN AND MIST
FEB 28-2008	17:00 HRS	CLEAR	NORMAL	STRONG TO GALE FORCE SW WINDS
FEB 29-	11:00 HRS	CLEAR	NORMAL	N'LY WINDS 20-25 KNOTS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - February 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
2008				
FEB 29-2008	17:00 HRS	NO1 FROM CHART	NORMAL	W'LY WINDS 30-35 KNOTS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - March 2008

TIME	FLUME COLOR	SIZE	COMMENTS
12:00 HRS	CLEAR	NORMAL	MODERATE ESE WINDS, TEMPERATURE M7C
17:00 HRS	NO1 FROM CHART	NORMAL	STRONG ESE WINDS, LOWERING VISIBILITY IN FOG / MIST
11:00 HRS	CLEAR	NORMAL	GALE FORCE SW WINDS
17:00 HRS	CLEAR	NORMAL	STORM FORCE SW WINDS
12:00 HRS	CLEAR	NORMAL	GALE TO STORM FORCE NW WINDS
17:00 HRS	CLEAR	NORMAL	STRONG NW WINDS, DIMINISHING
12:00 HRS	CLEAR	NORMAL	STRONG WSW WINDS
10:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
16:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
10:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
16:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
10:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
16:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
10:00 HRS	OBSURED	OBSURED	STRONG SE WINDS, LOWERING VISIBILITY IN FOG / MIST
16:00 HRS	OBSURED	OBSURED	STRONG SE WINDS, LOWERING VISIBILITY IN FOG / MIST
10:00 HRS	CLEAR	NORMAL	GALE TO STORM FORCE NW WINDS
16:00 HRS	CLEAR	NORMAL	GALE TO STORM FORCE NW WINDS
10:00 HRS	CLEAR	NORMAL	STRONG NW WINDS, DIMINISHING
16:00 HRS	CLEAR	NORMAL	STRONG NW WINDS, DIMINISHING
10:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
16:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
10:00 HRS	CLEAR	NORMAL	STRONG SW WINDS
16:00 HRS	CLEAR	NORMAL	STRONG SW WINDS
10:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
16:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
10:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
16:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
10:00 HRS	CLEAR	NORMAL	STRONG E WINDS
16:00 HRS	CLEAR	NORMAL	STRONG E WINDS
10:00 HRS	CLEAR	NORMAL	STORM FORCE N WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - March 2008

TIME	FLUME COLOR	SIZE	COMMENTS
16:00 HRS	CLEAR	NORMAL	STORM FORCE N WINDS
10:00 HRS	CLEAR	NORMAL	STORM FORCE N WINDS
16:00 HRS	CLEAR	NORMAL	STORM FORCE N WINDS
10:00 HRS	CLEAR	NORMAL	STORM FORCE N WINDS
16:00 HRS	CLEAR	NORMAL	STORM FORCE N WINDS
13:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
17:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
12:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT-MODERATE SE WINDS
17:00 HRS	CLEAR	NORMAL	STRONG SE WINDS
12:00 HRS	CLEAR	NORMAL	GALE FORCE SW WINDS
17:00 HRS	CLEAR	NORMAL	GALE FORCE SW WINDS
12:00 HRS	CLEAR	NORMAL	STRONG TO GALE FORCE WNW WINDS
17:00 HRS	CLEAR	NORMAL	GALE FORCE WESTERLY WINDS
11:00 HRS	CLEAR	NORMAL	STRONG WESTERLY WINDS
17:00 HRS	CLEAR	NORMAL	GALE FORCE WSW WINDS
11:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT NW WINDS
17:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE NW WINDS, SKY CLEAR
11:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS INCREASING THIS AM
16:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NE WINDS, LIGHT SNOW
11:00 HRS	NO1 FROM CHART	NORMAL	LIGHT WINDS
17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NE WINDS
11:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
17:00 HRS	CLEAR	NORMAL	MODERATE WNW WINDS
11:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE WNW WINDS
17:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS, LIGHT SNOW
12:00 HRS	CLEAR	NORMAL	MODERATE NNE WINDS, LIGHT RAIN AND SNOW MIXED
17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NE WINDS, LIGHT SNOW
11:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT N'LY WINDS, OCCASIONAL LIGHT SNOW
16:00 HRS	CLEAR	NORMAL	MODERATE NW'LY WINDS
11:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
16:00 HRS	CLEAR	NORMAL	STRONG NW WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - April 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
APR 01-2008	10:00 HRS	OBSCURED	OBSCURED	SNOW OBSCURED FLARE THIS AM
APR 01-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST, LOW CEILING
APR 02-2008	10:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST
APR 02-2008	15:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST, LIGHT RAIN
APR 03-2008	10:00 HRS	CLEAR	NORMAL	GALE FORCE W WINDS
APR 03-2008	17:00 HRS	CLEAR	NORMAL	GALE FORCE W WINDS
APR 04-2008	10:00 HRS	CLEAR	NORMAL	GALE FORCE W WINDS
APR 04-2008	17:00 HRS	CLEAR	NORMAL	GALE FORCE W WINDS DIMINISHING
APR 05-2008	10:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
APR 05-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
APR 06-2008	10:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
APR 06-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
APR 07-2008	10:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
APR 07-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
APR 08-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
APR 08-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
APR 09-2008	10:00 HRS	OBSCURED	OBSCURED	STRONG E WINDS OBSCURED IN FOG
APR 09-2008	17:00 HRS	OBSCURED	OBSCURED	STRONG E WINDS OBSCURED IN FOG
APR 10-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG AND MIST, LIGHT RAIN
APR 10-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG AND MIST, LIGHT RAIN
APR 11-2008	10:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
APR 11-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
APR 12-2008	10:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
APR 12-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
APR 13-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT SW WINDS OBSCURED IN FOG AND MIST
APR 13-2008	17:00 HRS	OBSCURED	OBSCURED	LIGHT SW WINDS OBSCURED IN FOG AND MIST
APR 14-2008	10:00 HRS	CLEAR	NORMAL	LIGHT W WINDS
APR 14-2008	17:00 HRS	CLEAR	NORMAL	LIGHT W WINDS
APR 15-2008	13:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WINDS
APR 15-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
APR 16-2008	12:00 HRS	NO1 FROM CHART	NORMAL	WINDS LIGHT AND VARIABLE
APR 16-2008	15:00 HRS	NO1 FROM CHART	NORMAL	WINDS LIGHT AND VARIABLE
APR 17-2008	11:00 HRS	CLEAR	NORMAL	LIGHT SOUTHERLY WINDS, GOOD VISIBILITY
APR 17-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SOUTHERLY WINDS, GOOD VISIBILITY
APR 18-2008	12:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG
APR 18-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG
APR 19-2008	10:00 HRS	CLEAR	NORMAL	NNE 20-25 KNOTS, VIS 3 NM IN FOG AND MIST
APR 19-2008	17:00 HRS	CLEAR	NORMAL	NE 20 KNOTS IMPROVED VISIBILITY
APR 20-2008	11:00 HRS	NO1 FROM CHART	NORMAL	LIGHT WESTERLY WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - April 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
APR 20-2008	17:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS
APR 21-2008	11:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS VIS. 15+NM
APR 21-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS VIS. 15+NM
APR 22-2008	11:00 HRS	CLEAR	NORMAL	LIGHT NW WINDS GOOD VIS. 15+NM
APR 22-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NW WINDS GOOD VIS. 15+NM
APR 23-2008	11:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS
APR 23-2008	15:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
APR 24-2008	12:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
APR 24-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SE WINDS
APR 25-2008	12:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG, MODERATE NE WINDS
APR 25-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG, MODERATE ENE WINDS
APR 26-2008	12:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG, MODERATE TO STRONG NE WINDS
APR 26-2008	17:00 HRS	CLEAR	NORMAL	STRONG EASTERLY WINDS
APR 27-2008	11:00 HRS	CLEAR	NORMAL	STRONG NE WINDS
APR 27-2008	17:00 HRS	CLEAR	NORMAL	GALE FORCE NNE WINDS, MIST AND LIGHT RAIN AT TIMES
APR 28-2008	11:00 HRS	CLEAR	NORMAL	MODERATE NORTHERLY WINDS DIMINISHING

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - May 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
MAY 01-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 01-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 02-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 02-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 03-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 03-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 04-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 04-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 05-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 05-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 06-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 06-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE E WINDS OBSCURED IN FOG
MAY 07-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE N WINDS OBSCURED IN FOG
MAY 07-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE N WINDS OBSCURED IN FOG
MAY 08-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE N WINDS OBSCURED IN FOG
MAY 08-2008	17:00 HRS	CLEAR	NORMAL	MODERATE W WINDS FOG CLEARED
MAY 09-2008	10:00 HRS	CLEAR	NORMAL	LIGHT W WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - May 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
MAY 09-2008	17:00 HRS	CLEAR	NORMAL	LIGHT W WINDS
MAY 10-2008	10:00 HRS	CLEAR	NORMAL	STRONG SE WINDS
MAY 10-2008	17:00 HRS	PARTIALLY OBSCURED	NORMAL	STRONG SE WINDS FOG & RAIN
MAY 11-2008	10:00 HRS	PARTIALLY OBSCURED	NORMAL	STRONG SE WINDS FOG & RAIN
MAY 11-2008	17:00 HRS	PARTIALLY OBSCURED	NORMAL	STRONG SE WINDS FOG & RAIN
MAY 13-2008	14:00 HRS	CLEAR	NORMAL	STRONG NNE WINDS
MAY 13-2008	18:00 HRS	CLEAR	NORMAL	STRONG TO GALE FORCE NNE WINDS
MAY 14-2008	12:00 HRS	CLEAR	NORMAL	GALE FORCE NE WINDS, FOG, RAIN AND MIST
MAY 14-2008	17:00 HRS	CLEAR	NORMAL	GALE FORCE NE WINDS, FOG AND MIST
MAY 15-2008	12:00 HRS	CLEAR	NORMAL	STRONG NE WINDS, FOG AND MIST
MAY 15-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG
MAY 16-2008	12:00 HRS	OBSCURED	OBSCURED	OBSCURED IN DENSE FOG
MAY 16-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
MAY 17-2008	11:00 HRS	CLEAR	NORMAL	WINDS CALM
MAY 17-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE TO STRONG WINDS, FOG, MIST AND OCC. RAIN
MAY 18-2008	11:00 HRS	CLEAR	NORMAL	STRONG WESTERLY WINDS THIS AM
MAY 18-2008	17:00 HRS	CLEAR	NORMAL	STRONG WESTERLY WINDS TODAY
MAY 19-2008	11:00 HRS	OBSCURED	OBSCURED	THICK FOG THIS AM OBSCURED THE FLARE
MAY 19-2008	17:00 HRS	OBSCURED	OBSCURED	LOW CEILING IN FOG, FLARE WAS OBSCURED
MAY 20-2008	11:00 HRS	CLEAR	CLEAR	MODERATE SW WINDS TODAY
MAY 20-2008	18:00 HRS	CLEAR	CLEAR	MODERATE SW WINDS , FLARE IS BURNING CLEAN
MAY 21-2008	10:00 HRS	OBSCURED	OBSCURED	LOW CEILING IN FOG AND MODERATE RAIN THIS AM
MAY 21-2008	16:00 HRS	CLEAR	NORMAL	STRONG SOUTHERLY WINDS
MAY 22-2008	12;00 HRS	CLEAR	NORMAL	MODERATE SW WINDS, GOOD VISIBILITY TODAY
MAY 22-2008	18:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WINDS
MAY 23-2008	11:00 HRS	OBSCURED	OBSCURED	MODERATE SW WINDS, LOW CEILING IN FOG
MAY 23-2008	17:00 HRS	OBSCURED	OBSCURED	DENSE FOG
MAY 24-2008	10:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
MAY 24-2008	17:00 HRS	CLEAR	NORMAL	LIGHT NW WINDS
MAY 25-2008	09:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NNW WINDS
MAY 25-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NW WINDS
MAY 26-2008	10:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE SW WINDS
MAY 26-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SW WINDS
MAY 27-2008	11:00 hrs	clear	normal	STRONG SSW WINDS
MAY 28-2008	11:00 HRS	NO1 FROM CHART	NORMAL	LIGHT TO MODERATE SW WINDS
MAY 28-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT TO MODERATE SW

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - May 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
				WINDS
MAY 29-2008	11:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
MAY 29-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
MAY 30-2008	11:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
MAY 30-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
MAY 31-2008	11:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
MAY 31-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - June 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JUNE01-2008	17:00 HRS	OBSCURED	OBSCURED	DENSE FOG
JUNE01-2008	10:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
JUNE02-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
JUNE02-2008	10:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SW WINDS
JUNE03-2008	17:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE03-2008	10:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE04-2008	17:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE04-2008	10:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE05-2008	17:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE05-2008	10:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE06-2008	17:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE06-2008	10:00 HRS	NO FLARE	N/A	PLATFORM SHUT IN
JUNE07-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE S WINDS
JUNE07-2008	10:00 HRS	NO1 FROM CHART	NORMAL	MODERATE S WINDS
JUNE08-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE S WINDS
JUNE08-2008	10:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
JUNE 10-2008	14:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
JUNE 10-2008	18:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
JUNE 11-2008	10:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VRBL. SOUTHERLY WINDS
JUNE 11-2008	16:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SOUTHERLY WINDS
JUNE 12-2008	11:00 HRS	CLEAR	NORMAL	MODERATE WSW WINDS, HAZY CONDITIONS AT SEA LEVEL
JUNE 12-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
JUNE 13-2008	10:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
JUNE 13-2008	17:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS
JUNE 14-2008	10:00 HRS	NO1 FROM CHART	NORMAL	MODERATE TO STRONG NORTHERLY WINDS
JUNE 14-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NORTHERLY WINDS
JUNE 15-2008	11:00 HRS	OBSCURED	OBSCURED	LIGHT NORTHERLY WINDS
JUNE 15-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NORTHERLY WINDS
JUNE 16-2008	11:00 HRS	OBSCURED	OBSCURED	LIGHT WESTERLY WINDS, LOW CEILING IN FOG
JUNE 16-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT WESTERLY WINDS
JUNE 17-2008	08:00 HRS	CLEAR	NORMAL	LIGHT SW WINDS, FOG AND MIST

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - June 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JUNE 17-2008	15:00 HRS	CLEAR	NORMAL	LIGHT SW WINDS
JUNE 18-2008	08:00 HRS	CLEAR	NORMAL	LIGHT SW WINDS
JUNE 18-2008	16:00 HRS	CLEAR	NORMAL	LIGHT SW WINDS
JUNE 19-2008	09:00 HRS	OBSCURED	OBSCURED	MODERATE SOUTHERLY WINDS, OBSCURED IN DENSE FOG
JUNE 19-2008	17:00 HRS	OBSCURED	OBSCURED	MODERATE SOUTHERLY WINDS, OBSCURED IN DENSE FOG
JUNE 20-2008	07:00 HRS	NO1 FROM CHART	NORMAL	WINDS LIGHT AND VRBL. NE 5 KNOTS
JUNE 20-2008	16:00 HRS	OBSCURED	OBSCURED	WINDS LIGHT AND VRBL. NE 5 KNOTS
JUNE 21-2008	09:00 HRS	OBSCURED	OBSCURED	WINDS LIGHT AND VRBL. WSW 5 KNOTS
JUNE 21-2008	17:00 HRS	OBSCURED	OBSCURED	WINDS LIGHT AND VRBL.
JUNE 22-2008	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WINDS
JUNE 22-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JUNE 23-2008	10:00 HRS	OBSCURED	OBSCURED	MODERATE SW WINDS
JUNE 23-2008	18:00 HRS	CLEAR	NORMAL	MODERATE SSW WINDS
JUNE 24-2008	08:00 HRS	OBSCURED	OBSCURED	LIGHT TO MODERATE SOUTHERLY WINDS
JUNE 25-2008	10:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WINDS
JUNE 25-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JUNE 26-2008	10:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WINDS
JUNE 26-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JUNE 27-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 27-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 28-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 28-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 29-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 29-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 30-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JUNE 30-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - July 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JULY 01-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 01-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 02-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 02-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 03-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 03-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 04-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 04-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - July 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
JULY 05-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 05-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 06-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 06-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 07-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 07-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 08-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 08-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	S-SW WINDS LIGHT
JULY 09-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	MODERATE SSW WINDS
JULY 10-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	MODERATE SSW WINDS
JULY 10-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	MODERATE TO STRONG SSW WINDS
JULY 11-2008	09:00 HRS	OBSCURED	OBSCURED IN FOG	LIGHT TO MODERATE SSW WINDS
JULY 11-2008	17:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS
JULY 12-2008	09:00 HRS	NO1 FROM SMOKE CHART	NORMAL	LIGHT VRBL. WINDS EAST 5 KNOTS
JULY 12-2008	17:00 HRS	CLEAR	NORMAL	LIGHT NW WINDS 5-10 KNOTS
JULY 13-2008	09:00 HRS	NO1 FROM SMOKE CHART	NORMAL	LIGHT VRBL. WINDS, VIS. 15+ NM
JULY 13-2008	17:00 HRS	CLEAR	NORMAL	LIGHT VRBL. WINDS, SOUTH WEST 10 KNOTS VIS 15+NM
JULY 14-2008	10:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WINDS
JULY 14-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SOUTHERLY WINDS, VIS. LOWERING
JULY 15-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	DENSE FOG THIS MORNING
JULY 15-2008	17:00 HRS	OBSCURED	OBSCURED IN FOG	MODERATE SW WINDS, LOW VISIBILITY IN FOG
JULY 16-2008	10:00 HRS	OBSCURED	OBSCURED IN FOG	LIGHT SW WINDS, FOGGY
JULY 16-2008	16:00 HRS	NO 1 FROM SMOKE CHART	NORMAL	FOG JUST ABOVE FLARE TIP BUT

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - July 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
				SLIGHT SMOKE NOTED
JULY 17-2008	10:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SSE WINDS, VIS VRBL 1-4 NM
JULY 17-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SSE WINDS, VIS LOWERING TO 1/2 NM
JULY 18-2008	10:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WINDS
JULY 18-2008	17:00 HRS	OBSCURED	OBSCURED	FOG, MODERATE SOUTH WESTERLY WINDS
JULY 19-2008	10:00 HRS	OBSCURED	OBSCURED	FOGGY CONDITIONS
JULY 19-2008	17:00 HRS	NO 1 FROM SMOKE CHART	NORMAL	LIGHT TO MODERATE SW WINDS
JULY 20-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT SE WINDS, DENSE FOG
JULY 20-2008	17:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WINDS
JULY 21-2008	10:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
JULY 21-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SW WINDS
JULY 22-2008	10:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
JULY 22-2008	17:00 HRS	CLEAR	NORMAL	STRONG SW WINDS, GOOD VISIBILITY
JULY 23-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT WESTERLY WINDS,
JULY 23-2008	16:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS
JULY 24-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT TO MODERATE SW WINDS
JULY 24-2008	16:00 HRS	OBSCURED	OBSCURED	LIGHT TO MODERATE SW WINDS
JULY 25-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT TO MODERATE SW WINDS
JULY 25-2008	16:00 HRS	OBSCURED	OBSCURED	LIGHT TO MODERATE SW WINDS
JULY 26-2008	10:00 HRS	CLEAR	NORMAL	LIGHT S WINDS
JULY 26-2008	16:00 HRS	CLEAR	NORMAL	LIGHT S WINDS, GOOD

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - July 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
				VISIBILITY
JULY 27-2008	10:00 HRS	CLEAR	NORMAL	LIGHT S WINDS
JULY 27-2008	16:00 HRS	CLEAR	NORMAL	LIGHT S WINDS, GOOD VISIBILITY
JULY 28-2008	10:00 HRS	CLEAR	NORMAL	LIGHT S WINDS
JULY 28-2008	16:00 HRS	CLEAR	NORMAL	LIGHT S WINDS, GOOD VISIBILITY
JULY 29-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG
JULY 29-2008	16:00 HRS	CLEAR	NORMAL	LIGHT S WINDS, GOOD VISIBILITY
JULY 30-2008	10:00 HRS	CLEAR	NORMAL	LIGHT S WINDS, GOOD VISIBILITY
JULY 30-2008	16:00 HRS	CLEAR	NORMAL	LIGHT S WINDS, GOOD VISIBILITY
JULY 31-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG
JULY 31-2008	16:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - August 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
AUGUST 01-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG
AUGUST 01-2008	16:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG
AUGUST 02-2008	10:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG
AUGUST 02-2008	16:00 HRS	OBSCURED	OBSCURED	LIGHT S WINDS FOG
AUGUST 03-2008	10:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
AUGUST 03-2008	16:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
AUGUST 04-2008	10:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
AUGUST 04-2008	16:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
AUGUST 05-2008	11:00 HRS	N/A	N/A	PLATFORM WAS SHUT IN DUE TO PSD, NO FLARE
AUGUST 05-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST
AUGUST 06-2008	10:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
AUGUST 06-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
AUGUST 07-2008	09:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VRBL. WINDS
AUGUST 07-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VRBL. WINDS
AUGUST 08-2008	08:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
AUGUST 08-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
AUGUST 09-2008	08:00 HRS	NO1 FROM CHART	NORMAL	LIGHT SW WINDS, VISIBILITY LOWERING
AUGUST 09-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST
AUGUST 10-2008	09:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VRBL WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - August 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
AUGUST 10-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VRBL. WINDS, SMOKE ABOVE FLARE
AUGUST 11-2008	09:00 HRS	CLEAR	NORMAL	FOG BELOW HELIDECK, LIGHT NE WINDS
AUGUST 11-2008	17:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
AUGUST 12-2008	09:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND LIGHT RAIN AND MIST
AUGUST 12-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WIND
AUGUST 13-2008	09:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND LIGHT RAIN AND MIST
AUGUST 13-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SW WIND
AUGUST 14-2008	09:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SE WIND
AUGUST 14-2008	17:00 HRS	CLEAR	NORMAL	MODERATE STRONG NW WINDS
AUGUST 15-2008	09:00 HRS	SHUT DOWN	SHUT DOWN	MODERATE STRONG NW WINDS
AUGUST 15-2008	17:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT TO MODERATE NW WIND
AUGUST 16-2008	09:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WINDS, VISIBILITY LOWERING
AUGUST 16-2008	17:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WINDS, VISIBILITY LOWERING
AUGUST 17-2008	09:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT NW WIND GOOD VISIBILITY
AUGUST 17-2008	17:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT NW WIND GOOD VISIBILITY
AUGUST 18-2008	09:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WIND GOOD VISIBILITY
AUGUST 18-2008	17:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WIND GOOD VISIBILITY
AUGUST 19-2008	09:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WIND GOOD VISIBILITY
AUGUST 19-2008	17:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WIND GOOD VISIBILITY
AUGUST 20-2008	09:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WIND GOOD VISIBILITY
AUGUST 20-2008	17:00 HRS	SHUT DOWN	SHUT DOWN	LIGHT SW WIND GOOD VISIBILITY
AUGUST 21-2008	09:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 21-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 22-2008	09:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 22-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 23-2008	09:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 23-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 24-2008	09:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 24-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 25-2008	09:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 25-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 26-2008	09:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - August 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
AUGUST 26-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND MIST
AUGUST 27-2008	09:00 HRS	CLEAR	NORMAL	LIGHT NW WIND GOOD VISIBILITY
AUGUST 27-2008	17:00 HRS	CLEAR	NORMAL	LIGHT NW WIND GOOD VISIBILITY
AUGUST 28-2008	09:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND RAIN
AUGUST 28-2008	17:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG AND RAIN
AUGUST 29-2008	09:00 HRS	CLEAR	NORMAL	STRONG E WIND
AUGUST 29-2008	17:00 HRS	CLEAR	NORMAL	STRONG E WIND
AUGUST 30-2008	09:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 30-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WIND GOOD VISIBILITY
AUGUST 31-2008	09:00 HRS	CLEAR	NORMAL	MODERATE W WIND GOOD VISIBILITY
AUGUST 31-2008	17:00 HRS	CLEAR	NORMAL	MODERATE W WIND GOOD VISIBILITY

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - September 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
2-Sep-08	11:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SOUTH EAST WINDS
2-Sep-08	16:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SOUTH EAST WINDS
3-Sep-08	08:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
3-Sep-08	17:00 HRS	CLEAR	NORMAL	MODERATE SOUTH SOUTH EAST WINDS
4-Sep-08	07:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WINDS
4-Sep-08	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SOUTH WEST WINDS
5-Sep-08	08:00 HRS	OBSCURED	OBSCURED	LIGHT TO MODERATE WESTERLY WINDS
5-Sep-08	16:00 HRS	CLEAR	NORMAL	LIGHT NORTHWEST WINDS, GOOD VISIBILITY
6-Sep-08	08:00 HRS	OBSCURED	OBSCURED	DENSE FOG, LIGHT WESTERLY WINDS
6-Sep-08	17:00 HRS	CLEAR	NORMAL	MODERATE WSW WINDS
7-Sep-08	11:00 HRS	OBSCURED	OBSCURED	MODERATE TO STRONG SW WINDS, FOG AND MIST
7-Sep-08	16:00 HRS	CLEAR	NORMAL	T.S. HANNA, STORM FORCE SW WINDSDEVELOPED THIS PM
8-Sep-08	07:00 HRS	OBSCURED	OBSCURED	MODERATE WESTERLY WINDS, FOG AND MIST THIS AM
8-Sep-08	17:00 HRS	CLEAR	NORMAL	MODERATE NORTHWESTERLY WINDS
9-Sep-08	08:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT, VARIABLE WINDS FROM SSW
9-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SOUTH WESTERLY WINDS
10-Sep-08	08:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG SSW WINDS
10-Sep-08	16:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
11-Sep-08	08:00 HRS	CLEAR	NORMAL	LIGHT NW WINDS, GOOD VISIBILITY
11-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT NN WINDS, GOOD VISIBILITY
12-Sep-08	07:00 HRS	NO1 FROM CHART`	NORMAL	LIGHT VRBL. WINDS, GOOD VISIBILITY

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - September 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
12-Sep-08	16:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS, GOOD VIS.
13-Sep-08	07:00 HRS	NO1 FROM CHART`	NORMAL	LIGHT TO MODERATE SW WINDS
13-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHR TO MODERATE SW WINDS
14-Sep-08	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SE WINDS, GOOD VIS.
14-Sep-08	16:00 HRS	CLEAR	NORMAL	MODERATE SE WINDS, GOOD VIS.
15-Sep-08	08:00 HRS	CLEAR	NORMAL	MODERATE TO STROND SOUTHERLY WINDS, IKE PASSING
15-Sep-08	17:00 HRS	CLEAR	NORMAL	STRONG SOUTHERLY WINDS, IKE PASSING OVER GULF
16-Sep-08	07:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS, GOOD VIS.
17-Sep-08	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
17-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
18-Sep-08	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
18-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
19-Sep-08	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
19-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
20-Sep-08	08:00 HRS	CLEAR	NORMAL	MODERATE E WINDS
20-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
21-Sep-08	08:00 HRS	OBSCURED	OBSCURED	MODERATE NE WINDS, FOG AND MIST
21-Sep-08	17:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
22-Sep-08	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
22-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WINDS
23-Sep-08	08:00 HRS	# 2 FROM CHART	NORMAL	LIGHT TO MODERATE N WINDS
23-Sep-08	17:00 HRS	# 2 FROM CHART	NORMAL	LIGHT TO MODERATE N WINDS
24-Sep-08	08:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE N WINDS
24-Sep-08	17:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE N WINDS
25-Sep-08	08:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE N WINDS
25-Sep-08	17:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE N WINDS
26-Sep-08	08:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE NNW WINDS
26-Sep-08	17:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE NNW WINDS
27-Sep-08	08:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE SE WINDS
27-Sep-08	17:00 HRS	# 1 FROM CHART	NORMAL	LIGHT TO MODERATE SE WINDS
28-Sep-08	08:00 HRS	# 1 FROM CHART	NORMAL	MODERATE SE WINDS
28-Sep-08	17:00 HRS	# 1 FROM CHART	NORMAL	MODERATE TO STRONG SE WINDS
29-Sep-08	08:00 HRS	# 1 FROM CHART	NORMAL	MODERATE SE WINDS
29-Sep-08	17:00 HRS	# 1 FROM CHART	NORMAL	MODERATE TO STRONG SE WINDS
30-Sep-08	11;00 HRS	CLEAR	NORMAL	LIGHT NE WINDS
30-Sep-08	17:00 HRS	CLEAR	NORMAL	LIGHT NE WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - October 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
Oct 01-2008	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
Oct 01-2008	17:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NORTH WEST WINDS
Oct 02-2008	08:00 HRS	NO1 FROM CHART	NORMAL	LIGHT EASTERLY WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - October 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
Oct 02-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
Oct 03-2008	08:00HRS	CLEAR	NORMAL	LIGHT SW WINDS
Oct 03-2008	17:00 HRS	CLEAR	NORMAL	LIGHT SW WINDS
Oct 04-2008	08:00 HRS	CLEAR	NORMAL	STRONG WESTERLY WINDS
Oct 04-2008	17:00 HRS	CLEAR	NORMAL	STRONG WESTERLY WINDS
Oct 05-2008	08:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS, NUMEROUS LAND BIRDS IN EARLY AM
Oct 05-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
Oct 06-2008	09:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
Oct 06-2008	17:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
Oct 07-2008	08:00 HRS	NO1 FROM CHART	NORMAL	MOD.WESTERLY WINDS HUNDREDS OF LAND BIRDS AROUND FLARE IN EARLY AM
Oct 07-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
Oct 08-2008	08:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NORTH WESTERLY WINDS
Oct 08-2008	17:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
Oct 09-2008	08:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
Oct 09-2008	17:00 HRS	NO1 FROM CHART	NORMAL	MODERATE WESTERLY WINDS
Oct 10-2008	08:00 HRS	CLEAR	NORMAL	MODERATE SW IN AM
Oct 10-2008	17:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY AFTER 12:00 HRS
Oct 11-2008	08:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
Oct 11-2008	16:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
Oct 12-2008	08:00 HRS	CLEAR	NORMAL	LIGHT NE WINDS
Oct 12-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NE WINDS
Oct 13-2008	07:00 HRS	NO1 FROM CHART	NORMAL	LIGHT SW WINDS
Oct 13-2008	16:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NE WINDS, GOOD VISIBILITY
Oct 15-2008	08:00 HRS	NO1 FROM CHART	NORMAL	LIGHT W WINDS
Oct 15-2008	16:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE W WINDS, GOOD VISIBILITY
Oct 16-2008	08:00 HRS	NO1 FROM CHART	NORMAL	LIGHT SE WINDS
Oct 16-2008	16:00 HRS	CLEAR	NORMAL	LIGHT SE WINDS, GOOD VISIBILITY
Oct 17-2008	08:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
Oct 17-2008	16:00 HRS	CLEAR	NORMAL	MOCERATE NW WINDS
Oct 18-2008	08:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
Oct 18-2008	16:00 HRS	CLEAR	NORMAL	MOCERATE NW WINDS
Oct 19-2008	08:00	NO1 FROM CHART	NORMAL	MODERATE W WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - October 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
	HRS			
Oct 1882008	16:00 HRS	NO1 FROM CHART	NORMAL	MOCERATE W WINDS
Oct 20-2008	08:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
Oct 20-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
Oct 21-2008	08:00 HRS	NO1 FROM CHART	NORMAL	GALE FORCE NE WIMDS
Oct 21-2008	16:00 HRS	NO1 FROM CHART	NORMAL	GALE FORCE NE WIMDS
Oct 22-2008	08:00 HRS	NO1 FROM CHART	NORMAL	GALE FORCE NE WIMDS
Oct 22-2008	16:00 HRS	NO1 FROM CHART	NORMAL	GALE FORCE NE WIMDS
Oct 23-2008	08:00 HRS	NO1 FROM CHART	NORMAL	GALE FORCE NE WIMDS
Oct 23-2008	16:00 HRS	NO1 FROM CHART	NORMAL	GALE FORCE NE WIMDS
Oct 24-2008	08:00 HRS	NO1 FROM CHART	NORMAL	MODERATE NNE WIND
Oct 24-2008	16:00 HRS	NO1 FROM CHART	NORMAL	MODERATE NNE WIND
Oct 25-2008	08:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VARIABLE WINDS
Oct 25-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT VARIABLE WINDS
Oct 26-2008	08:00 HRS	NO1 FROM CHART	NORMAL	VARIABLE SE WINDS
Oct 26-2008	16:00 HRS	NO1 FROM CHART	NORMAL	VARIABLE SE WINDS
Oct 27-2008	08:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SE WINDS
Oct 27-2008	16:00 HRS	NO1 FROM CHART	NORMAL	MODERATE SE WINDS
Oct 28-2008	17:00 HRS	CLEAR	NORMAL	STRONG SOUTH EASTERLY WINDS
Oct 28-2008	18:00 HRS	CLEAR	NORMAL	STRONG SOUTH EASTERLY WINDS
Oct 29-2008	08:00 HRS	CLEAR	NORMAL	LIGHT RAIN, MODERATE TO STRONG SW WINDS
Oct 29-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
Oct 30-2008	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE SSW WINDS
Oct 30-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT NW WINDS
Oct 31-2008	08:00 HRS	CLEAR	NORMAL	STRONG NORTH WESTERLY WINDS, LIGHT RAIN
Oct 31-2008	17:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - November 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
NOV-01-2008	09:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
NOV-01-2008	15:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
NOV-02-2008	08:00 HRS	CLEAR	NORMAL	NW 20-25 KNOTS
NOV-02-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN SNOW SHOWERS, GALE FORCE WNW WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - November 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
NOV-03-2008	09:00 HRS	CLEAR	NORMAL	MODERATE NNW WINDS
NOV-03-2008	16:00 HRS	CLEAR	NORMAL	MODERATE NNW WINDS, GOOD VISIBILITY
NOV-04-2008	08:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
NOV-04-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT WESTERLY WINDS, GOOD VISIBILITY
NOV 05-2008	09:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
NOV 05-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
NOV 06-2008	09:00 HRS	NO 1 FROM CHART	MODERATE	COMPRESSION PSD THIS AM, FLARE LARGER THAN USUAL
NOV 06-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SSW WINDS
NOV 07-2008	09:00 HRS	CLEAR	NORMAL	MODERATE SSW WINDS, GOOD VISIBILITY
NOV 07-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SSE WINDS, GOOD VISIBILITY
NOV 08-2008	08:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WIND, LIGHT RAIN, MIST AND FOG REDUCING VISIBILITY
NOV 08-2008	13:00 HRS	CLEAR	NORMAL	MODERATE SOUTHERLY WIND, LIGHT RAIN, MIST AND FOG REDUCING VISIBILITY
NOV 09-2008	08:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
NOV 09-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
NOV 10-2008	09:00 HRS	CLEAR	NORMAL	MODERATE SSW WINDS, GOOD VISIBILITY
NOV 10-2008	16:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
NOV 11-2008	09:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
NOV 11-2008	16:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
NOV 12-2008	09:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
NOV 12-2008	16:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
NOV 13-2008	09:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
NOV 13-2008	16:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
NOV 14-2008	09:00 HRS	CLEAR	NORMAL	MODERATE ESE WINDS
NOV 14-2008	16:00 HRS	CLEAR	NORMAL	MODERATE ESE WINDS
NOV 15-2008	08:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
NOV 15-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
NOV 16-2008	08:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
NOV 16-2008	16:00 HRS	OBSCURED	OBSCURED	OBSCURED IN FOG
NOV 17-2008	08:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
NOV 17-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
NOV 18-2008	08:00 HRS	CLEAR	NORMAL	STRONG NE WINDS

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - November 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
NOV 18-2008	16:00 HRS	CLEAR	NORMAL	STRONG NE WINDS
NOV 19-2008	08:00 HRS	CLEAR	NORMAL	STRONG NE WINDS
NOV 19-2008	16:00 HRS	CLEAR	NORMAL	STRONG NE WINDS
NOV 20-2008	08:00 HRS	CLEAR	NORMAL	STRONG NW WINDS Light rain
NOV 20-2008	16:00 HRS	CLEAR	NORMAL	STRONG WNW WINDS
NOV 21-2008	08:00 HRS	CLEAR	NORMAL	STRONG W WINDS Occasional Ice pellets
NOV 21-2008	16:00 HRS	CLEAR	NORMAL	STRONG W WINDS Occasional Ice pellets
NOV 22-2008	08:00 HRS	CLEAR	NORMAL	GALE FORCE E WINDS Occasional RAIN
NOV 22-2008	16:00 HRS	CLEAR	NORMAL	GALE FORCE E WINDS Occasional RAIN
NOV 23-2008	08:00 HRS	CLEAR	NORMAL	STRONG W WINDS Occasional Ice pellets
NOV 23-2008	16:00 HRS	CLEAR	NORMAL	STRONG W WINDS Occasional Ice pellets
NOV 24-2008	08:00 HRS	# 3 CHART	NORMAL	MODERATE W WINDS
NOV 24-2008	16:00 HRS	# 3 CHART	NORMAL	MODERATE W WINDS
NOV 25-2008	08:00 HRS	# 3 CHART	NORMAL	MODERATE SE WINDS
NOV 25-2008	16:00 HRS	# 3 CHART	NORMAL	MODERATE SE WINDS
NOV 27-2008	15:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE NW WINDS
NOV 27-2008	17:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT NW WINDS
NOV 28-2008	08:00 HRS	CLEAR	NORMAL	LIGHT NW WINDS
NOV 28-2008	16:00 HRS	CLEAR	NORMAL	MODERATE NE WINDS
NOV 29-2008	09:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG WESTERLY WINDS
NOV 29-2008	16:00 HRS	CLEAR	NORMAL	STRONG WESTERLY WINDS
NOV 30-2008	09:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS, GOOD VISIBILITY
NOV 30-2008	16:00 HRS	NO1 FROM CHART	NORMAL	LIGHT SW WINDS, GOOD VISIBILITY

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - December 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
DEC 01-2008	09:00 HRS	OBSCURED	OBSCURED	GALE FORCE SE WINDS, FOG AND RAIN
DEC 01-2008	16:00 HRS	OBSCURED	OBSCURED	GALE FORCE SE WINDS, FOG AND RAIN
DEC 02-2008	09:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS IN LIGHT RAIN SHOWERS
DEC 02-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 03-2008	09:00 HRS	CLEAR	NORMAL	MODERATE EASTERLY WINDS, RAIN
DEC 03-2008	16:00 HRS	CLEAR	NORMAL	STRONG NW WINDS, LIGHT RAIN
DEC 04-2008	09:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS, GOOD VISIBILITY

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - December 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
DEC 04-2008	14:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS
DEC 05-2008	09:00 HRS	CLEAR	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
DEC 05-2008	14:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
DEC 06-2008	09:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT TO MODERATE WESTERLY WINDS
DEC 06-2008	14:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE WESTERLY WINDS
DEC 07-2008	08:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NE'LY WINDS, LIGHT RAIN
DEC 07-2008	14:00 HRS	OBSCURED	OBSCURED	STRONG EASTERLY WINDS, VIS LOW IN FOG AND MIST
DEC 08-2008	09:00 HRS	CLEAR	NORMAL	STORM FORCE SW WINDS
DEC 08-2008	15:00 HRS	CLEAR	NORMAL	STORM FORCE WSW WINDS, OCC. SNOW SHOWERS
DEC 09-2008	08:00 HRS	CLEAR	NORMAL	STRONG WNW WINDS
DEC 09-2008	16:00 HRS	NO 1 FROM CHART	NORMAL	MODERATE WSW WINDS
DEC 10-2008	08:00 HRS	CLEAR	NORMAL	GALE FORCE SSW WINDS
DEC 10-2008	16:00 HRS	CLEAR	NORMAL	GALE FORCE SSW WINDS
DEC 11-2008	08:00 HRS	CLEAR	NORMAL	STRONG SW WINDS, LIGHT RAIN SHOWERS, MIST AND FOG
DEC 11-2008	14:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 12-2008	07:00 HRS	OBSCURED	OBSCURED	LOW VISIBILITY IN FOG AND MIST, STRONG SOUTH WINDS
DEC 12-2008	15:00 HRS	CLEAR	NORMAL	GALE FORCE SW WINDS, FOG IN PATCHES
DEC 13-2008	07:00 HRS	OBSCURED	OBSCURED	MODERATE WSW WINDS, FOG, RAIN AND MIST
DEC 13-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 14-2008	07:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
DEC 14-2008	16:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
DEC 15-2008	07:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 15-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 16-2008	07:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 16-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS
DEC 17-2008	07:00 HRS	OBSCURED	OBSCURED	MODERATE NE WINDS & HEAVY SNOW
DEC 17-2008	16:00 HRS	OBSCURED	OBSCURED	MODERATE NE WINDS & RAIN
DEC 18-2008	07:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
DEC 18-2008	16:00 HRS	CLEAR	NORMAL	MODERATE W WINDS
DEC 19-2008	07:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS SNOW SQUALLS
DEC 19-2008	15:00 HRS	CLEAR	NORMAL	GALE FORCE NW WINDS SNOW SQUALLS
DEC 20-2008	07:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS DEMINISHING
DEC 20-2008	15:00 HRS	CLEAR	NORMAL	MODERATE WESTERLY WINDS, GOOD VISIBILITY
DEC 21-2008	07:00 HRS	CLEAR	NORMAL	LIGHT WESTERLY WINDS, GOOD VISIBILITY
DEC 21-2008	15:00 HRS	CLEAR	NORMAL	WIND SHIFT MODERATE ESE WINDS STORM APPROACHING
DEC 22-2008	07:00 HRS	OBSCURED	OBSCURED	STORM FORCE SW WINDS
DEC 22-2008	15:00 HRS	OBSCURED	OBSCURED	STORM FORCE SW WINDS
DEC 23-2008	11:00 HRS	CLEAR	NORMAL	STRONG NW WINDS
DEC 23-2008	16:00 HRS	CLEAR	NORMAL	MODERATE TO STRONG NW

Flare Descriptions at Thebaud Platform as Provided by ExxonMobil Canada - December 2008

DATE	TIME	FLUME COLOR	SIZE	COMMENTS
				WINDS
DEC 24-2008	08:00 HRS	CLEAR	NORMAL	LIGHT SW WINDS
DEC 24-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS, VISIBILITY LOWERING IN PM
DEC 25-2008	08:00 HRS	CLEAR	NORMAL	GALE FORCE SSW WINDS, FOG AND MIST
DEC 25-2008	14:00 HRS	CLEAR	NORMAL	GALE FORCE SW WINDS, LIGHT RAIN, FOG AND MIST
DEC 26-2008	08:00 HRS	CLEAR	NORMAL	STRONG NNW WINDS, GOOD VISIBILITY
DEC 26-2008	15:00 HRS	CLEAR	NORMAL	MODERATE NNW WINDS
DEC 27-2008	09:00 HRS	NO1 FROM CHART	NORMAL	LIGHT NW WINDS
DEC 27-2008	16:00 HRS	CLEAR	NORMAL	LIGHT AND VRBL. WINDS THIS PM
DEC 28-2008	09:00 HRS	OBSCURED	OBSCURED	LIGHT RAIN, FOG AND MIST, STRONG SE WINDS
DEC 28-2008	15:00 HRS	OBSCURED	OBSCURED	LOW VISIBILITY IN FOG THIS AFTERNOON
DEC 29-2008	09:00 HRS	CLEAR	NORMAL	MODERATE WNW WINDS THIS AM, GOOD VISIBILITY
DEC 30-2008	09:00 HRS	NO 1 FROM CHART	NORMAL	LIGHT NORTHERLY WINDS, GOOD VISIBILITY
DEC 30-2008	15:00 HRS	CLEAR	NORMAL	MODERATE NW WINDS
DEC 31-2008	08:00 HRS	CLEAR	NORMAL	MODERATE NNW WINDS
DEC 31-2008	16:00 HRS	CLEAR	NORMAL	MODERATE SW WINDS

5 SEABIRD MONITORING

5.1 Rationale

Seabird monitoring observations have been conducted on a relatively continuous basis at the Thebaud production (gas) platform from 1999 until 2004 by independent observers supplied by Offshore Oil and Gas Observer Group Ltd. (OGOP). The OGOP received periodic training in seabird identification from various experts including Canadian Wildlife Service (CWS) biologists. While CWS believes that these observations provided a general appreciation of seabird/platform interactions, the observations were unable to fully assess the relative distribution of seabirds around the platform since they were restricted to a single location and limited field of view. As an alternative to earlier observations at a single location (*i.e.*, a platform) by OGOP observers, a transect gradient approach was adopted in 2005 and 2006 involving systematic observations of seabirds by CWS biologists along supply vessel transits to and from offshore platforms. The transect gradient approach offered the possibility of detecting changes in density of seabirds in relation to distance from SOEP offshore manned and unmanned gas platforms off Nova Scotia. The latter approach was continued in 2007 and 2008, but was supplemented for purposes of comparison with observations taken in other areas of the Scotian Shelf (*i.e.*, not along regular supply vessel tracks to and from SOEP platforms) by CWS observers aboard 'vessels-of-opportunity' as part a multi-year monitoring program to document the distribution and abundance of seabirds in offshore areas of Atlantic Canada.

5.2 Goals

The goal of the seabird monitoring is to evaluate if seabird abundance and activity is affected by the presence of the platforms and flaring operations.

5.3 Objectives

The objective of the seabird monitoring component of the EEM program is to compare seabird observational data along platform and 'reference' transects on Sable Island Bank. This is undertaken by:

- Determining the extent of attraction of seabirds to SOEP manned and unmanned offshore gas platforms; and

- Documenting the distribution and density of seabirds around the SOEP production area.

5.4 Methodology

Observations were made by Canadian Wildlife Service (CWS) seabird biologists and seabird observers contracted by CWS, following a standardized protocol (Environment Canada 2006) summarized below. The sampling method employed in 2008 was similar to 2007 protocol except that watches were five minutes instead of ten minutes, giving finer scale positional accuracy. Table 5.1 provides a summary of the seabird monitoring surveys undertaken in 2008.

Table 5.1: Field Survey Methodology for Seabirds

Parameter	Sampling Methodology
Survey Dates	February 6-8, September 3-10, October 4-8
Survey Locations	Routine Transect: Dartmouth shorebase to platforms Supply Vessel: *Hebron Sea* - February 6-8 *Sable Sea* - September 3-10, October 4-8 Random Transit: *CCGS Hudson* and *CCGS Louis S. St. Laurent*
Type of Sample	Visual observations of seabirds in accordance with Canadian Wildlife Service protocol (Environment Canada 2006).
Sample Preparation	CWS data sheets then archived in Microsoft Access database.
Equipment	Binoculars

Surveys are conducted while looking forward from the bridge, scanning ahead to a 90° angle from either the port or starboard side, limiting observations to a transect band 300 m wide from the side of the platform. A series of five-minute observation surveys are conducted, regardless if birds are present or not, with an attempt to ensure consistent coverage throughout the day. Observations are not conducted when visibility is poor (*i.e.*, when the entire width of the 300 m transect is not visible due to rain or fog).

Transects are scanned continuously by eye, to count and identify birds present in air or on water. Binoculars are used to confirm the species identification, and other details, such as age, sex, moult and behaviour. Observed birds on the sea surface are continuously recorded throughout the ten-minute period, and their distance from the platform is estimated.

Flying birds are not recorded continuously throughout the 10-minute period, as this would overestimate bird density. Instead, flying birds are recorded using instantaneous counts, or "snapshots", at regular intervals throughout the observation period. The number of snapshots conducted depends on the speed of the vessel.

A total of 2,034 minutes of survey (Feb: 775, Sep: 526, Oct: 733) covering 625 km of ocean track (Feb: 250, Sep: 151, Oct: 224) were conducted on the Hebron Sea and Sable Sea while in transit from the Dartmouth shorebase to/from SOEP offshore platforms. Offshore supply vessel transects presented in Figure 5-1-A

A total of 10,289 minutes (during 91 days) of survey were conducted along transects carried out onboard the Canadian Coast Guard vessels CCGS Hudson and CCGS Louis S. St. Laurent while steaming at random locations on or near the Scotian Shelf. Reference transects presented in Figure 5-1-B.

QA/QC Procedure

For quality accuracy and control purposes, the observer had basic training in seabird identification, and in methods for conducting and recording standardized observations from moving platforms based on CWS protocols (Environment Canada 2006).

5.5 Analysis

Table 5.2: Data Analysis For Seabird Surveys

Parameter	Analysis Methodology
Abundance and Distribution of Seabirds	Abundance and density (birds/km^2) of the nine most frequently observed species from offshore supply vessel surveys and reference surveys Statistical analysis conducted using a hierarchical log-linear chi-square technique and based on observed birds per hour of survey time. Chi-square analysis conducted on data collected from supply vessel transects from 2005-2008 and on reference vessels from 2007-2008.

5.6 Results

The Greater Shearwater (*Puffinus gravis*) was the most common species observed during supply vessel surveys (45.7%; Table 5.3) and was the second most common species observed during reference surveys (15.0%; Table 5.4). Conversely, the Dovekie (*Alle alle*) was the most common species observed during reference surveys (26.5%; Table 5.4) and was the second most common species observed during supply vessel surveys (9.7%; Table 5.3).

Except for high numbers of Red Phalaropes (*Phalaropus fulicaria*) observed during reference surveys, both the supply vessel and reference surveys revealed the same nine (9) species, varying only in their relative percent densities (Tables 5.3, 5.4). These species include the Northern Fulmer (*Fulmarus gracialis*), Black-legged Kittiwake (*Rissa tridactyla*), Murres (Common and Thick-billed; *Uria* spp.), Northern Gannet (*Morus bassanus*), Leach's Storm-Petrel (*Oceanodroma leucorhoa*), Great Black-backed Gull (*Larus marinus*) and Herring Gull (*Larus argentatus*).

Table 5.3: Numbers Of Seabirds Observed During Supply Vessel Surveys In 2008

Common Name (English)	Total Observed	Percentage
Greater Shearwater	469	45.7
Dovekie	100	9.7
Northern Fulmar	84	8.2
Black-legged Kittiwake	82	8.0
Murres (Common and Thick-billed)	79	7.7
Northern Gannet	60	5.8
Leach's Storm-Petrel	37	3.6
Great Black-backed Gull	36	3.5
Herring Gull	31	3.0
Atlantic Puffin	17	1.7
Unspecified Tern	11	1.1
Black Scoter	6	0.6
Unspecified Gull (*Larus* sp.)	3	0.3
Unspecified Auk	3	0.3
Unspecified Loon	2	0.2
Sooty Shearwater	2	0.2
Manx Shearwater	2	0.2
Unspecified Storm-Petrel	2	0.1
Great Cormorant	1	0.1
Wilson's Storm-Petrel	1	0.1
Unspecified Phalarope	1	0.1
White-winged Scoter	1	0.1
Iceland Gull	1	0.1
Red Phalarope	1	0.1
Total	**1032**	

Table 5.4: Numbers Of Seabirds Observed During Reference Vessel Surveys In 2008

Common Name (English)	Total Observed	Percentage
Dovekie	2712	26.5
Greater Shearwater	1534	15.0
Northern Fulmar	1428	14.0
Murres	1199	11.7
Leach's Storm-Petrel	799	7.8
Black-legged Kittiwake	698	6.8
Herring Gull	340	3.3
Northern Gannet	294	2.9
Red Phalarope	222	2.2
Unspecified Storm-Petrel	173	1.7
Great Black-backed Gull	128	1.3
Atlantic Puffin	124	1.2
Wilson's Storm Petrel	64	0.6
Pomarine Jaeger	64	0.6
Sooty Shearwater	60	0.6
Unspecified Auk	54	0.5
Cory's Shearwater	51	0.5
Black Scoter	43	0.4
Glaucous Gull	38	0.4
Razorbill	27	0.3
Unspecified Phalarope	24	0.2
Double-crested Cormorant	21	0.2
Unspecified Gull	17	0.2
Black Guillemot	13	0.1
Unspecified Tern	11	0.1
Red-necked Phalarope	11	0.1
Iceland Gull	9	0.1
Long-tailed Duck	6	0.1
Parasitic Jaeger	5	<0.1
Common Loon	4	<0.1
Unspecified Shearwater	5	<0.1
Harlequin Duck	3	<0.1
Unspecified Jaeger	3	<0.1
Peregrine Falcon	3	<0.1

Table 5.4: Numbers Of Seabirds Observed During Reference Vessel Surveys In 2008

Common Name (English)	Total Observed	Percentage
Common Tern	2	<0.1
Arctic Tern	2	<0.1
Great Skua	2	<0.1
Manx Shearwater	2	<0.1
South Polar Skua	2	<0.1
Unknown Bird	2	<0.1
Ivory Gull	1	<0.1
Laughing Gull	1	<0.1
Thayer's Gull	1	<0.1
Total	**10202**	

Based on the nine (9) most commonly occurring recorded species, chi-square analysis indicated there was a significant difference in the relative number of observed seabirds between reference and supply vessel survey transects in 2008 ($\chi^2_{[8]} = 1.90$, $p = 0.016$). The result is driven by the greater relative number of Dovekies observed during reference vessel surveys and the greater relative number of Greater Shearwaters observed during supply vessel surveys (Tables 5.3 and 5.4).

From 2005 to 2008, chi-square analysis indicated a significant interaction effect between species and year ($\chi 2[24] = 13.13$, $p = 0.036$); therefore, the number of individuals observed for some species are varying in different direction across years. The result is attributable to the absence of Dovekies and Murres along supply vessel transects from 2005 to 2007. Aside from the increase in Dovekies and Murres, Greater Shearwaters showed a significant change from 2005 through 2008 along supply vessel transects. The number of Greater Shearwaters observed during supply vessel surveys was relatively low and consistent in 2005 and 2006, increased significantly in 2007 and showed a moderate significant decline in 2008.

The Greater Shearwater was widely distributed and abundant in surveyed areas on the Scotian Shelf and the Scotian Slope including the marine areas surrounding Sable Island and the SOEP platform locations (Figure 5-2). Similarly, the Dovekie was widely distributed with the greatest abundance occurring to the west of the SOEP platform locations and in the Abyssal Plain area east of Sable Island (Figure 5-3). The Northern Fulmar was distributed across the central and eastern areas of the Scotian Shelf and Abyssal Plain (Figure 5-4), whereas the Black-legged Kittiwake was more abundant in the eastern area of the Scotian Shelf (Figure 5-5). The Great Black-back Gull was as equally distributed in the reference survey areas as the Herring Gull but was more abundant than the Herring Gull in the marine

waters west of the SOEP platform locations (Figure 5-6 and 5-7). The Common/Thick-billed Murre and Northern Gannet were well distributed in the reference and supply vessel survey areas on the Scotian Shelf (Figure 5-8 and 5-9), whereas the distribution of Leach's Storm-Petrel was primarily on the central Scotian Shelf and Abyssal Plain areas (Figure 5-10).

Based on the SOEP salvage report of migratory birds, a total of 111 specimens were recorded from platforms in 2008 (Table 5.5).

Table 5.5: Numbers of birds salvaged from SOEP platforms in 2008

Common Name (English)	Number Collected	Final Disposition of Specimens Collected
Blackpoll Warbler	46	Atlantic Vet Pathology Lab, UPEI
American Goldfinch	45	Ocean (as per A. Boyne CWS)
White-throated Sparrow	4	Atlantic Vet Pathology Lab, UPEI
Unknown species	3	Atlantic Vet Pathology Lab, UPEI
Ovenbird	2	Atlantic Vet Pathology Lab, UPEI
Red-necked Phalaropes	2	Ocean (as per A. Boyne CWS)
Ovenbird	2	Ocean (as per A. Boyne CWS)
Unknown Storm-Petrel	2	Atlantic Vet Pathology Lab, UPEI
Northern Waterthrush	1	Atlantic Vet Pathology Lab, UPEI
Palm Warbler	1	Atlantic Vet Pathology Lab, UPEI
Yellow-rumped Warbler	1	Atlantic Vet Pathology Lab, UPEI
Song Sparrow (suspect)	1	Atlantic Vet Pathology Lab, UPEI
Blackpoll Warbler (suspect)	1	Atlantic Vet Pathology Lab, UPEI
Total	**111**	

The largest single report was recorded from the Thebaud platform on October 7th, 2008, in which 47 land-based birds were found dead. Reports from the UPEI Veterinary College indicate that the dead birds encountered on the Thebaud platform (46 Blackpoll Warblers; one Ovenbird) had evidence of trauma from colliding with the platform. Sixteen Blackpoll Warblers and the one Ovenbird also had burnt or singed feathers on their wings, tail and body, indicating the birds came in contact with the platform's flare prior to colliding with the structure. The land-based birds likely collided with the platform due to disorientation caused by artificial lights of the structures.

It should be noted that ExxonMobil Canada Properties did apply for and received a "Migratory Bird Damage Permit" to scare and kill Great Black-back Gulls and Herring Gulls

on the unmanned Alma platform. The gulls were creating a serious health hazard and posed extremely high risk for a possible bird strike during helicopter operations.

5.7 Conclusions

The Dovekie and Greater Shearwater combined were the most abundant bird species in the reference survey areas (41.5%) and the supply vessel survey areas (55.4%). The Dovekie is the most abundant (and smallest) alcid in the North Atlantic, occurring in low-arctic and boreal oceanographic regions, where distributions appear influenced by oceanographic currents, shelf edges, and fronts that concentrate prey and induce vertical mixing (Brown 1988). The results support the literature as high densities of Dovekies were observed east of Sable Island beyond the Scotian Shelf in areas not surveyed in 2007. The Greater Shearwater spends the austral winter in Atlantic Canada and the Gulf of Maine and migrates in the fall to its southern hemisphere breeding grounds. The variation observed in Greater Shearwaters from 2005 to 2008 is likely due to their highly transient nature during the non-breeding season, leading to low detection probabilities during any given survey period. In addition, Greater Shearwaters are often observed following vessels at sea in hopes of scavenging food discharges, thus biasing the results.

None of the nine (9) most commonly observed species listed is Section 5.6 showed an avoidance of the supply vessel route or an attraction to the SOEP platform area; however, based on the data collected in 2008, there is insufficient information to state conclusively whether the SOEP platforms attract seabirds based on analysis of transect data. Great Black-backed Gulls, and to a lesser Herring Gulls, showed some attraction to shallower waters in the vicinity if the platforms; however, interpretation of seabird observation data in the vicinity of the SOEP platforms is complicated by the nearby presence of Sable Island, which supports colonies of many bird species. It addition, Great Black-backed Gulls and Herring Gulls are known to actively follow vessels at sea, taking advantage of food discharges, the artificial upwelling created by a vessel's wake and the residual effect of disturbance of the sea surface. If the SOEP platforms provide additional foraging, refuge or attraction due to lights, seabird densities should be noticeably higher in the immediate vicinity of all the platforms. Based on the supply vessel transects, the presence of Great Black-backed Gulls and Herring Gulls was observed only at the Thebaud platform.

5.8 References

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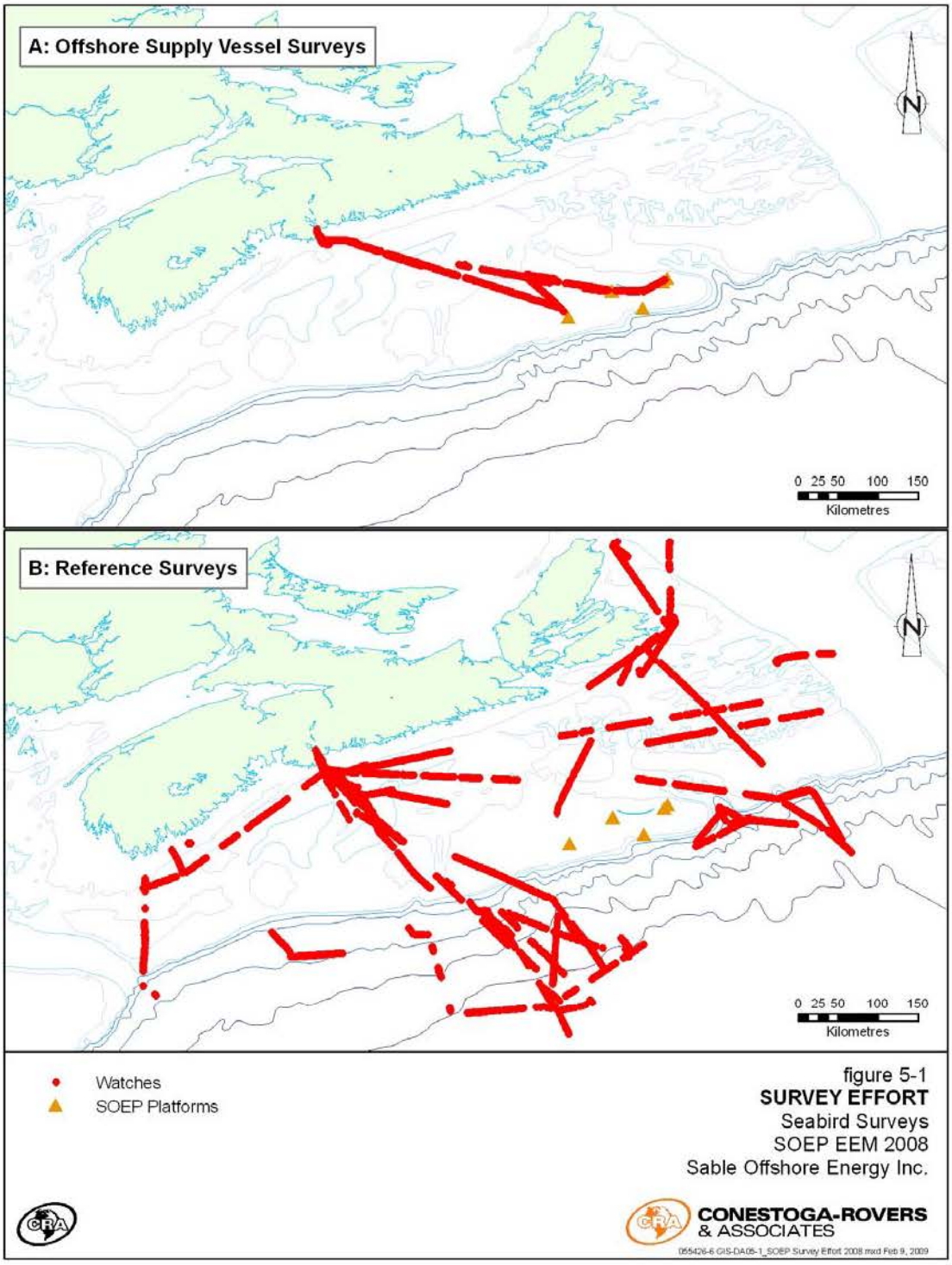
Environment Canada 2006. Standardized Protocols for Pelagic Seabird Surveys from Moving and Stationary Platforms, Version 1.2. Canadian Wildlife Service, Environment Canada – Atlantic Region, Dartmouth, Nova Scotia.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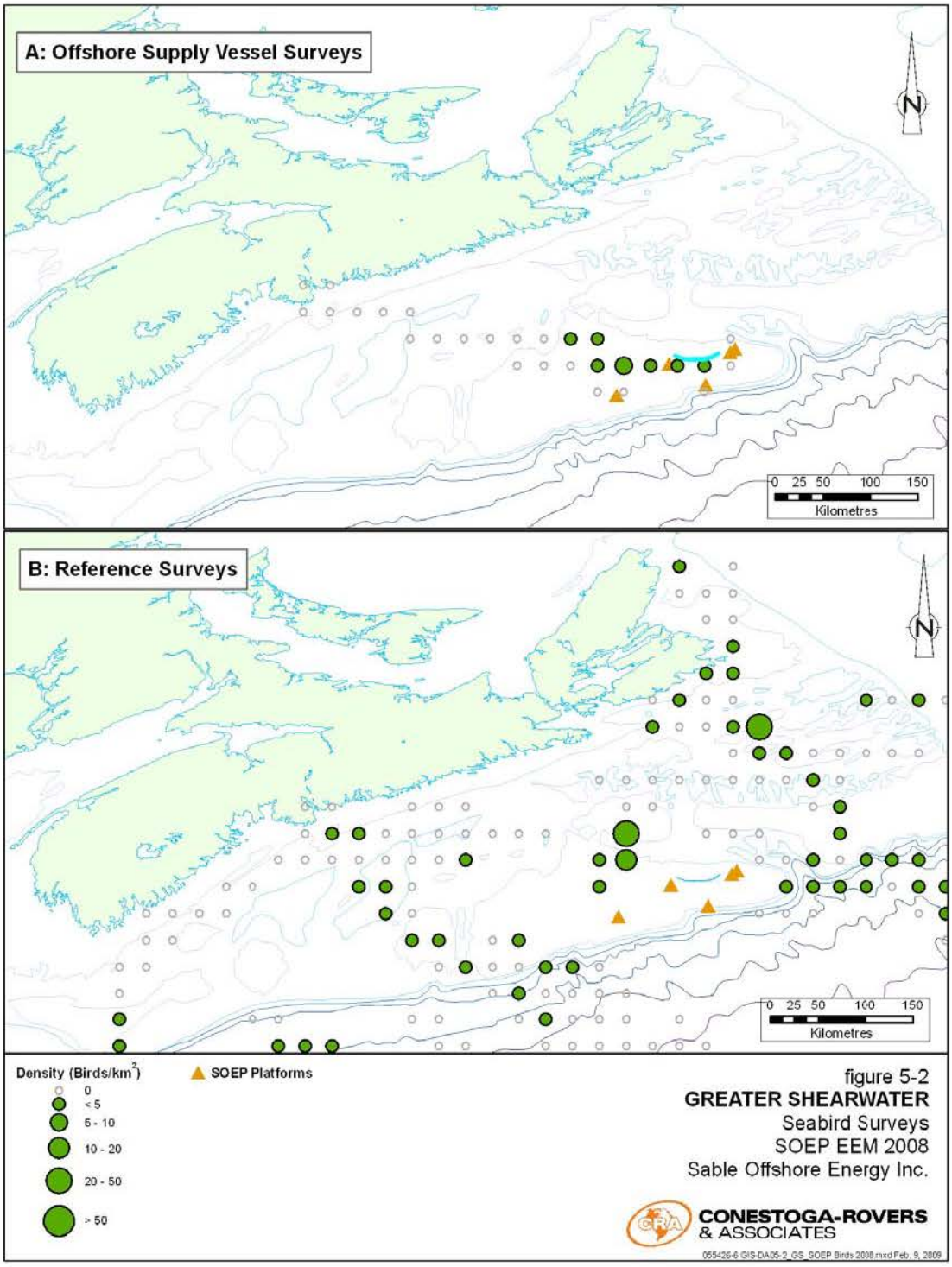
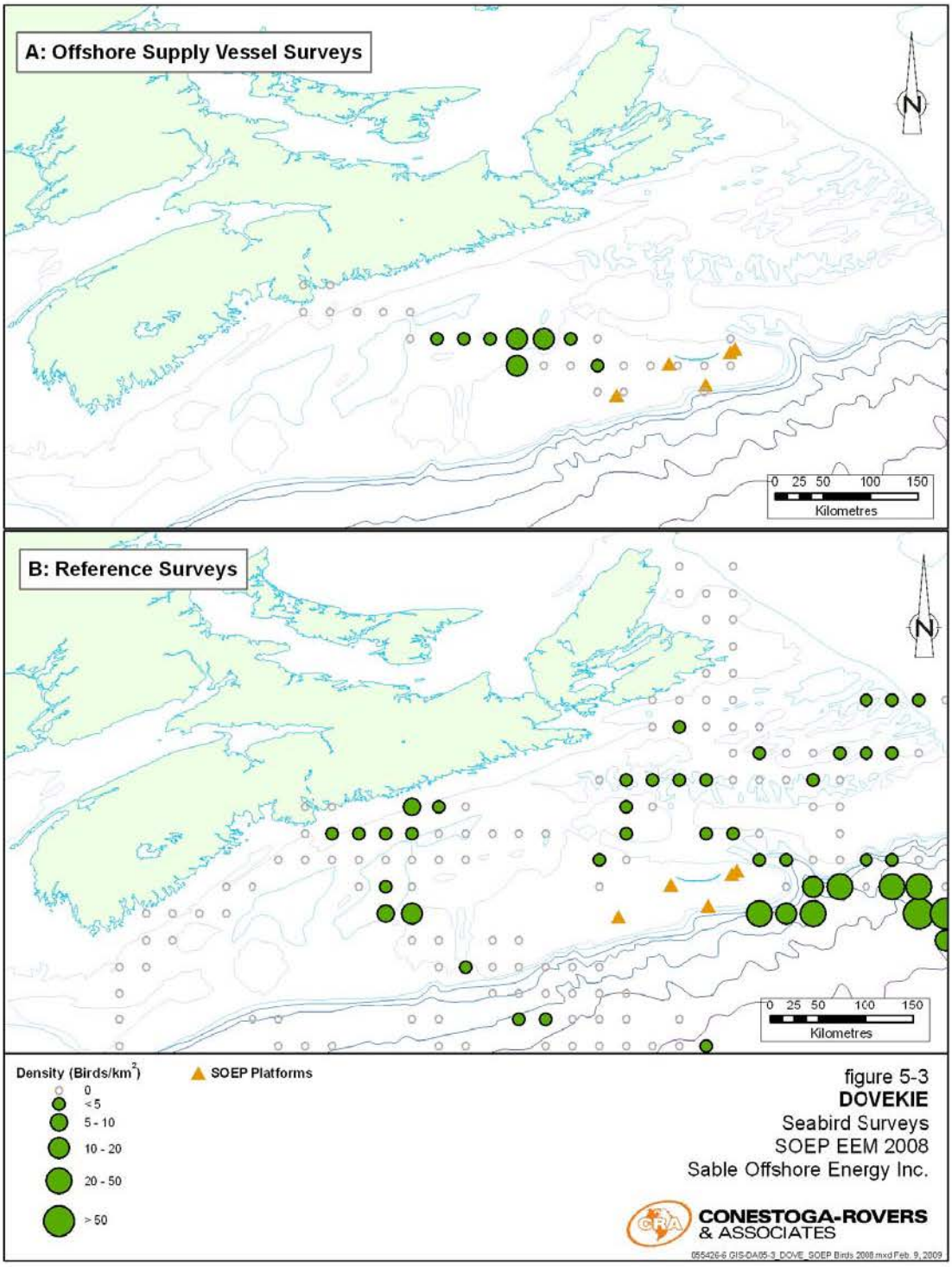
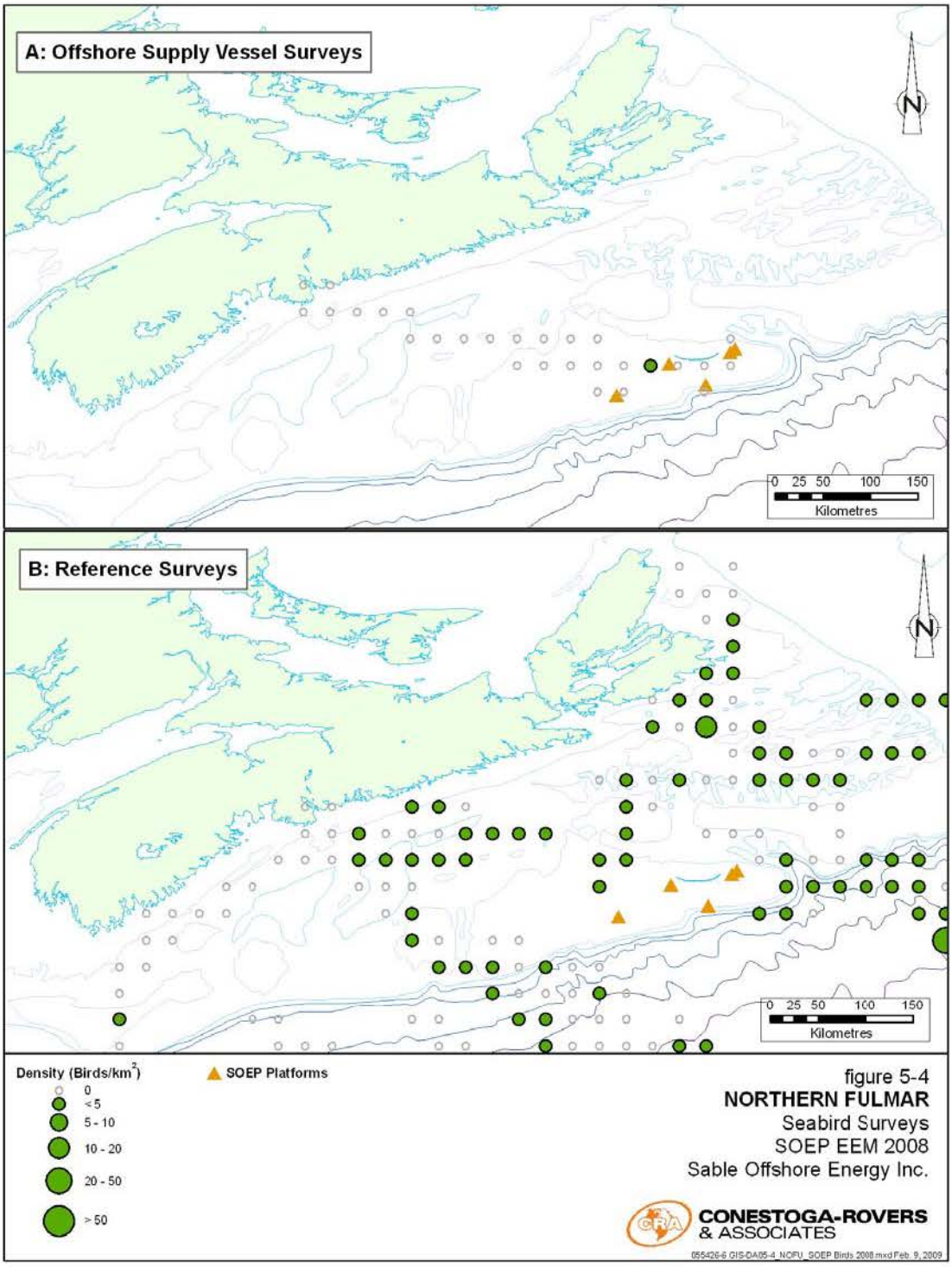
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Watches
SOEP Platforms
figure 5-1
SURVEY EFFORT
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CONESTOGA-ROVERS
& ASSOCIATES


A: Offshore Supply Vessel Surveys
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
< 5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-2
GREATER SHEARWATER
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CRA
CONESTOGA-ROVERS
& ASSOCIATES
055426-6 GIS-DA05-2_GS_SOEP Birds 2008.mxd Feb. 9, 2009


A: Offshore Supply Vessel Surveys
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
<5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-3
DOVEKIE
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CRA
CONESTOGA-ROVERS
& ASSOCIATES
055426-6 GIS-DA05-3_DOVE_SOEP Birds 2008.mxd Feb. 9, 2009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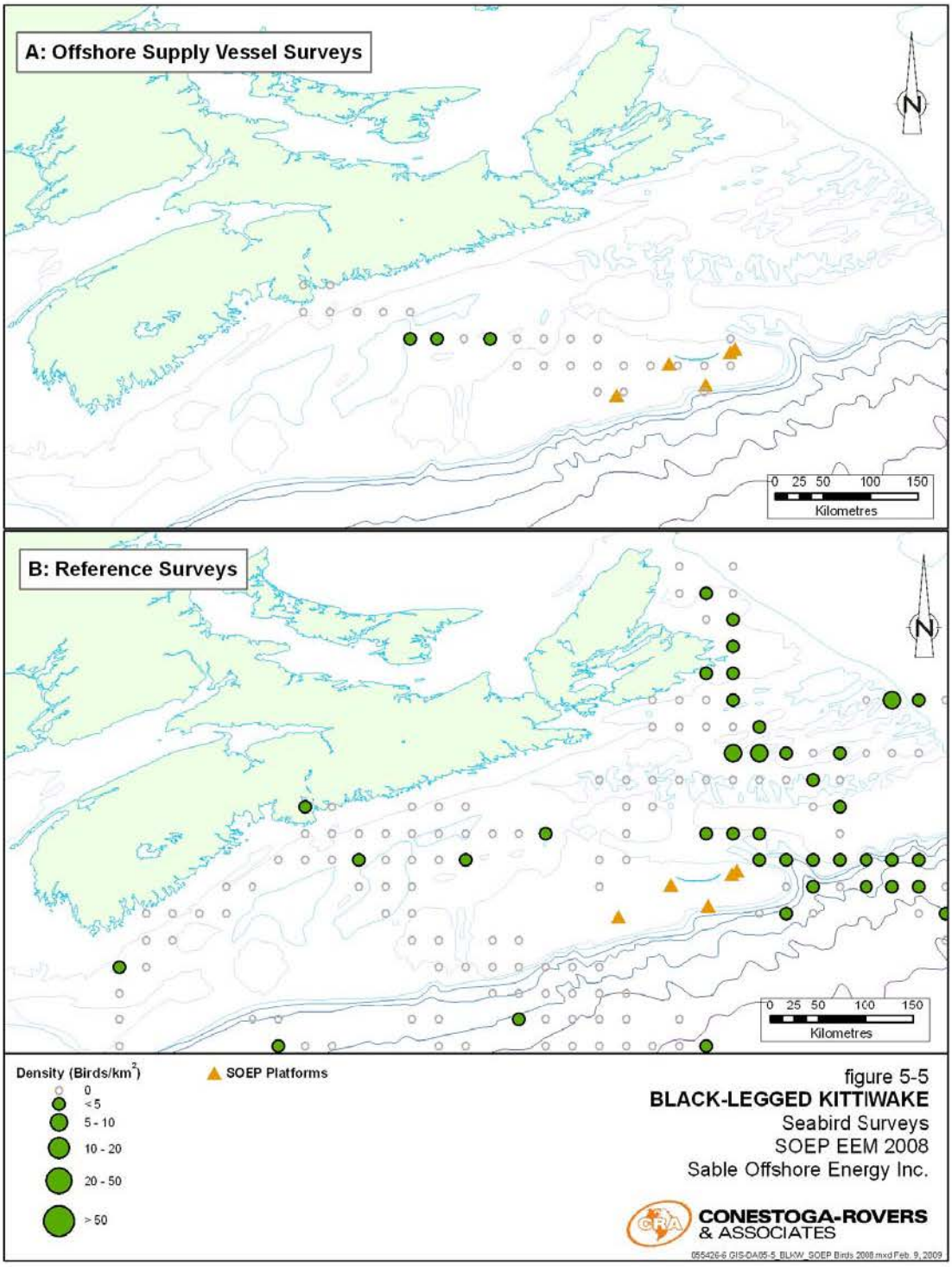
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
<5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-4
NORTHERN FULMAR
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CONESTOGA-ROVERS & ASSOCIATES
055426-6 GIS-DA05-4_NOFU_SOEP Birds 2008.mxd Feb. 9, 2009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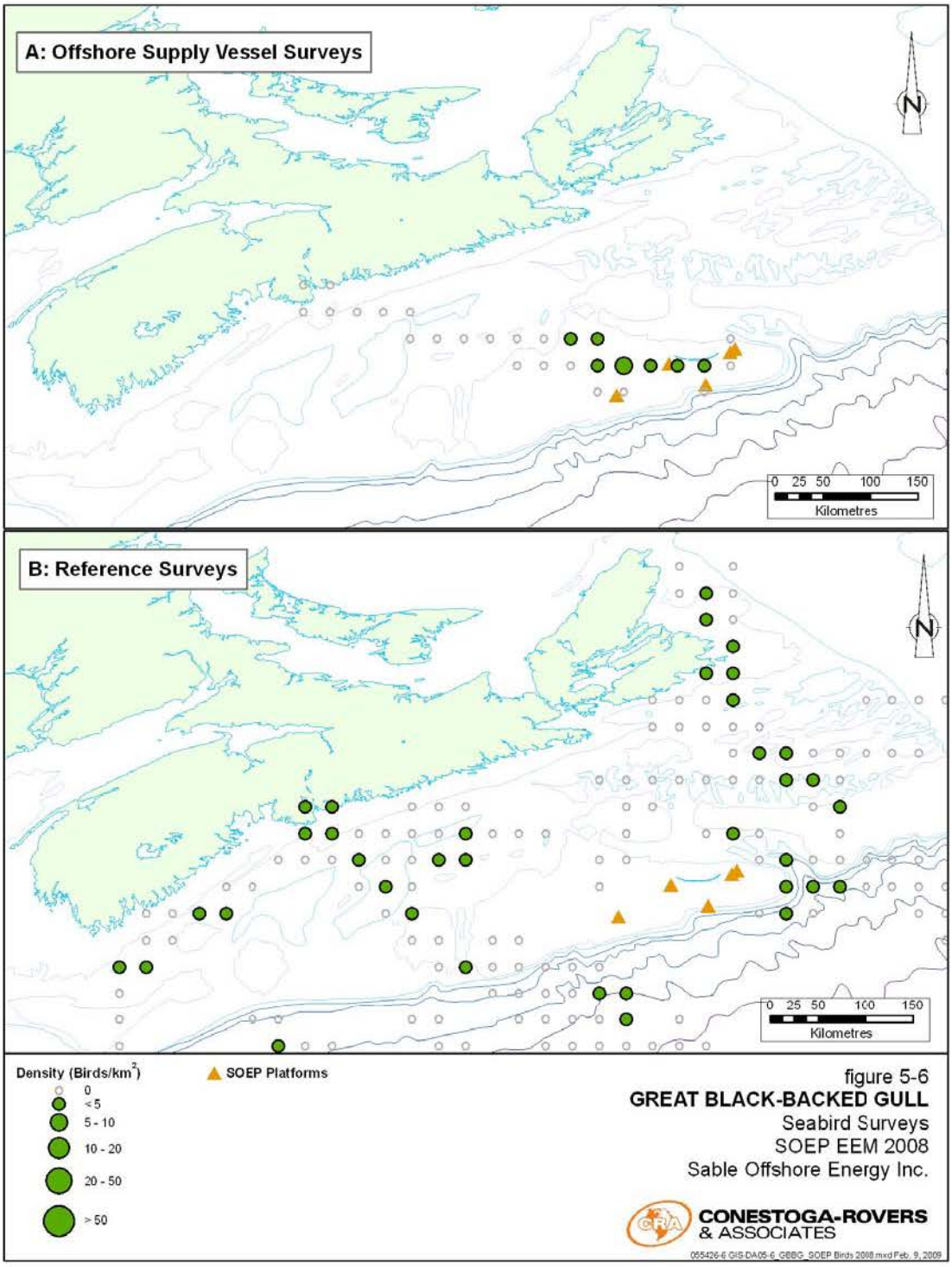
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
<5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-5
BLACK-LEGGED KITTIWAKE
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CRA
CONESTOGA-ROVERS
& ASSOCIATES
055426-6 GIS-DA05-5_BLKW_SOEP Birds 2008.mxd Feb. 9, 2009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N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
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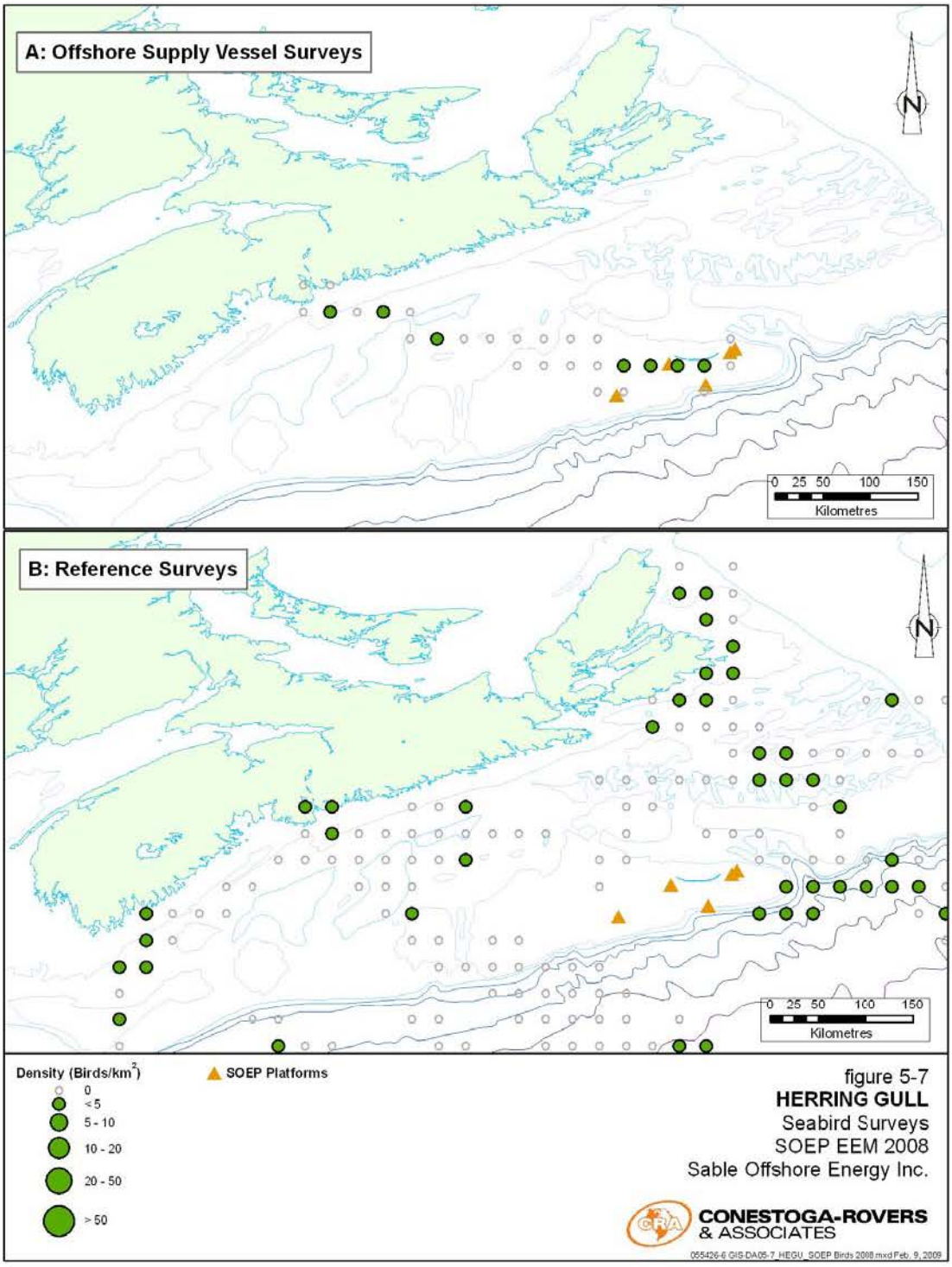
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-6
GREAT BLACK-BACKED GULL
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CONESTOGA-ROVERS & ASSOCIATES
055426-6 GIS-DA05-6_GBBG_SOEP Birds 2008.mxd Feb. 9, 2009


A: Offshore Supply Vessel Surveys
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
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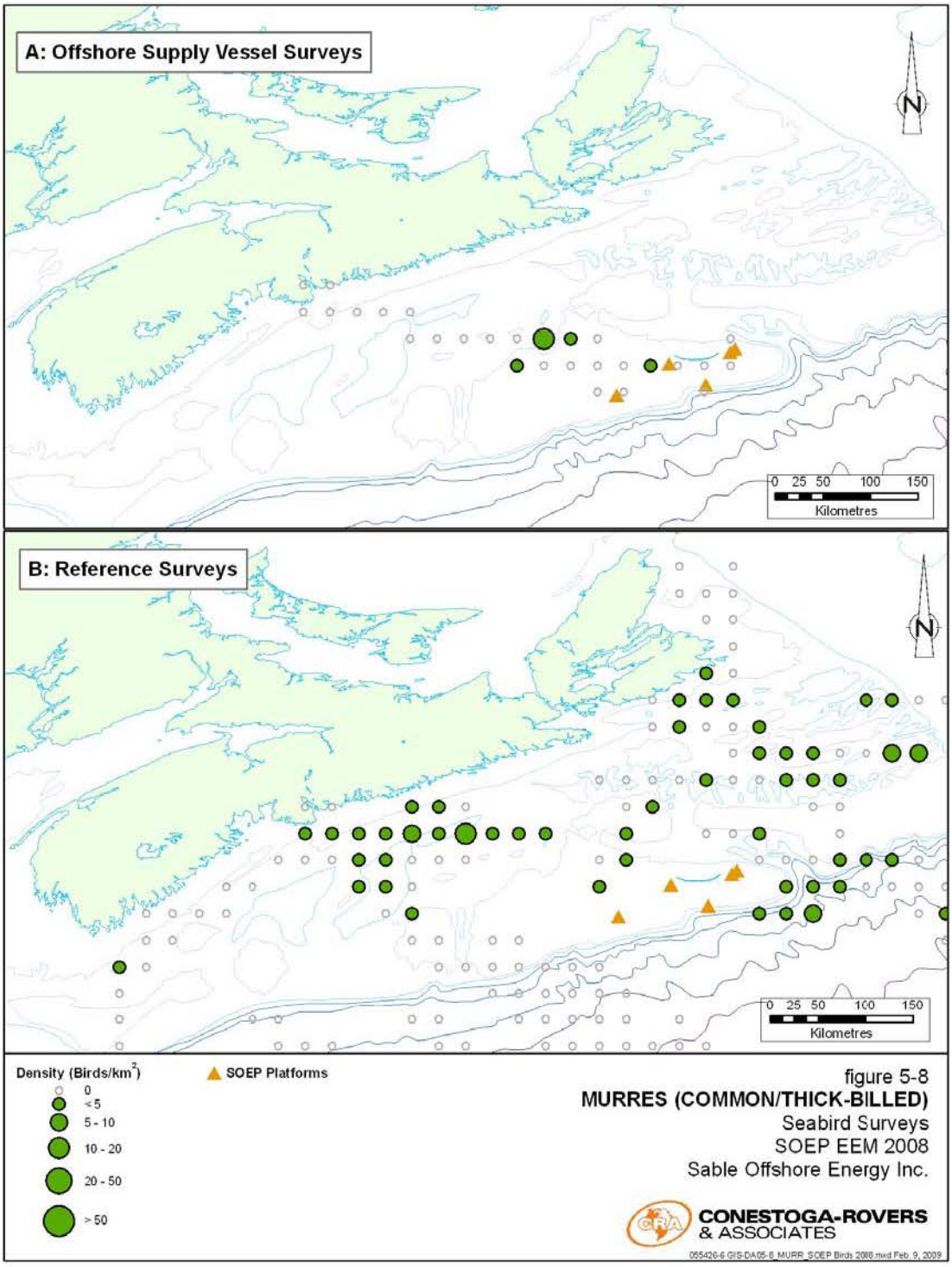
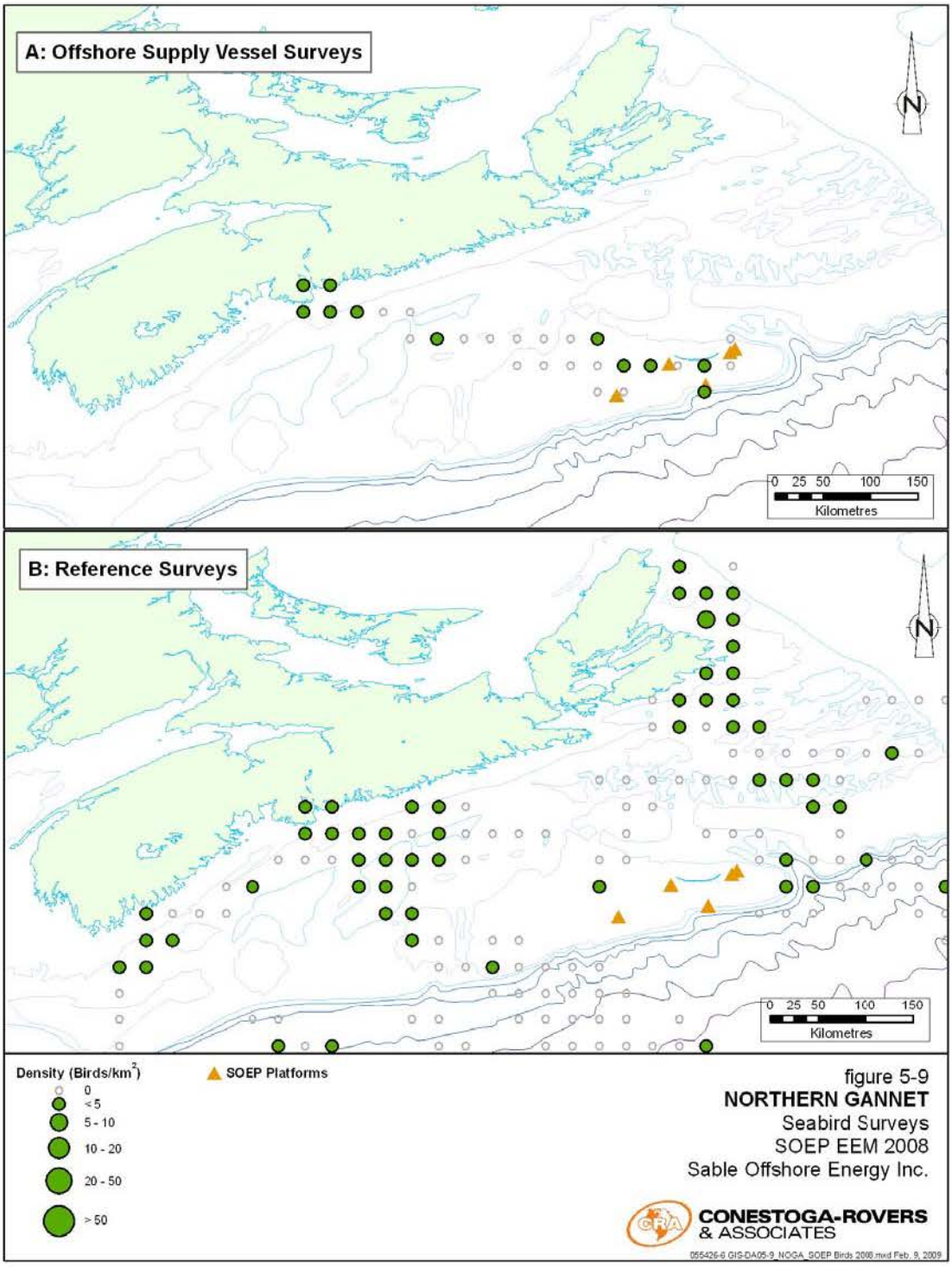
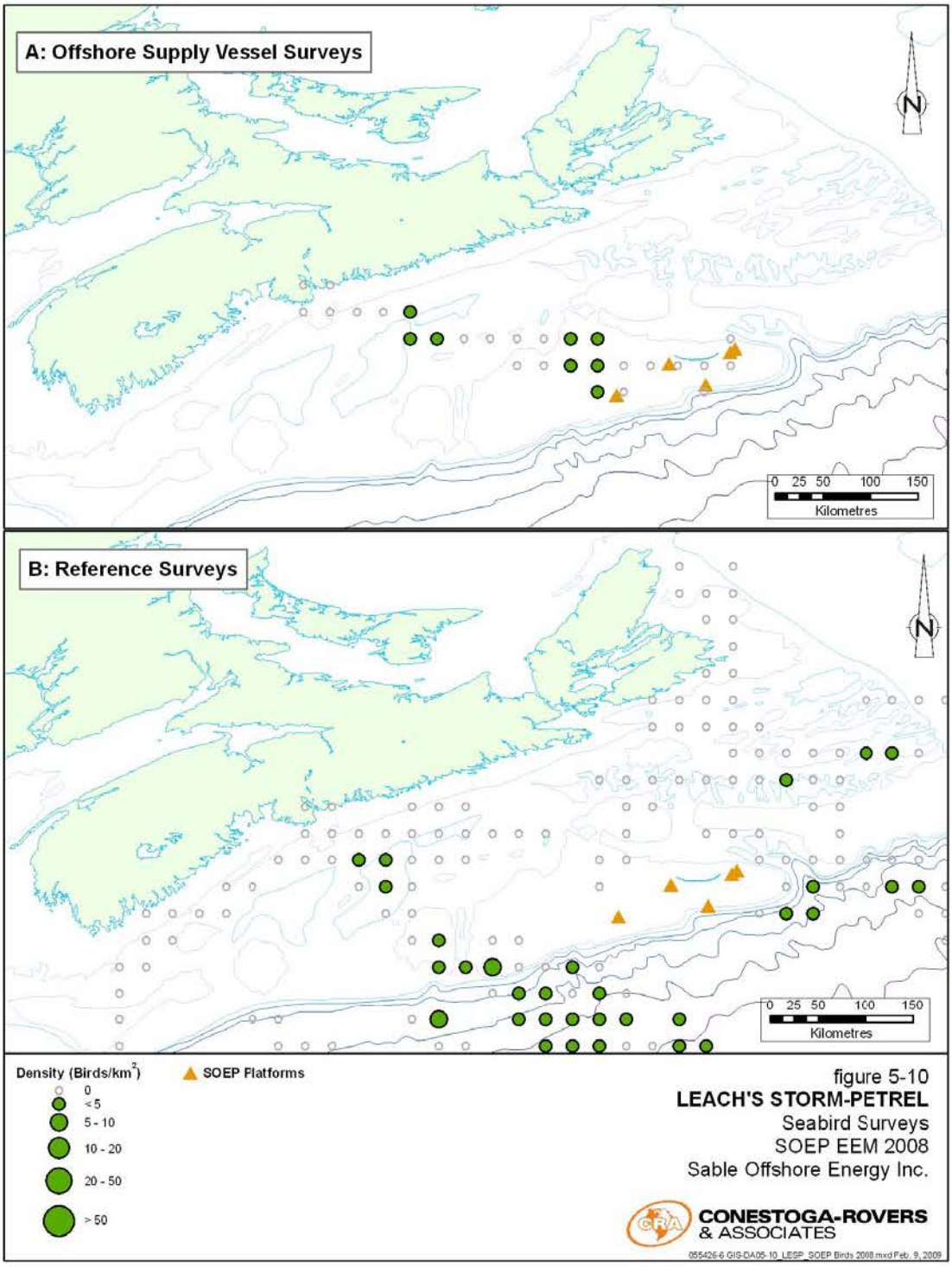
<5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-7
HERRING GULL
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CONESTOGA-ROVERS & ASSOCIATES
055426-6 GIS-DA05-7_HEGU_SOEP Birds 2008.mxd Feb. 9, 2009


A: Offshore Supply Vessel Surveys
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
<5
5 - 10
10 - 20
20 - 50
>50
SOEP Platforms
figure 5-8
MURRES (COMMON/THICK-BILLED)
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CRA
CONESTOGA-ROVERS
& ASSOCIATES
055426-6 GIS-DA05-8_MURR_SOEP Birds 2008.mxd Feb. 9, 2009


A: Offshore Supply Vessel Surveys
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
<5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-9
NORTHERN GANNET
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CONESTOGA-ROVERS
& ASSOCIATES
055426-6 GIS-DA05-9_NOGA_SOEP Birds 2008.mxd Feb. 9, 2009


A: Offshore Supply Vessel Surveys
N
0 25 50 100 150
Kilometres
B: Reference Surveys
N
0 25 50 100 150
Kilometres
Density (Birds/km²)
0
<5
5 - 10
10 - 20
20 - 50
> 50
SOEP Platforms
figure 5-10
LEACH'S STORM-PETREL
Seabird Surveys
SOEP EEM 2008
Sable Offshore Energy Inc.
CONESTOGA-ROVERS & ASSOCIATES
055426-6 GIS-DA05-10_LESP_SOEP Birds 2008.mxd Feb. 9, 2009

6 BEACHED SEABIRD SURVEYS

Photos: Sable Island Green Horse Society

6.1 Rationale

Since 1996, regular surveys for beached oiled birds have been conducted on Sable Island to monitor trends in numbers and rates of oiling in beached seabirds, and to collect specimens of contamination for gas chromatographic analysis to generically identify oil types. Results of analysis of oil samples collected from 1996 to 2005 have been reported in Lucas and MacGregor (2006).

6.2 Goal

By monitoring numbers and oiling rates in beached seabirds on Sable Island, the petroleum industry and regulators can identify and correct potential sources of oil contamination arising from offshore operations.

6.3 Objectives

There are two main objectives of the beached bird surveys:

- to monitor trends in oiling rate in beached seabird corpses; and
- to generically identify oil types found on seabird feathers and in pelagic tar.

6.4 Methodology

Zoe Lucas, biologist and long time resident of Sable Island, conducted the beach bird surveys on Sable Island. Table 6.1 provides the methodology for the beached seabird survey.

Table 6.1: Beach Seabird Field Survey Methods

Parameter	Sampling Methodology
Survey Date:	1 January through 31 December, 2008, excluding May and August
Number of Surveys	10
Type of Sample:	Species identification, corpse condition and extent of oiling were recorded for seabird specimens. When possible, the time since death was estimated based on freshness of tissues and degree of scavenging.

Table 6.1: Beach Seabird Field Survey Methods

Parameter	Sampling Methodology
	The oiling rate is the fraction of oiled birds of the total number of birds coded for oil (i.e. with > 50% of body intact) during 2008. Samples of oiled feathers, representing contamination on various seabird species, were collected.
Sample Preparation	Oil samples were packaged in aluminum foil, labeled, kept frozen for periods ranging from one week to several months, and delivered to the laboratory for gas chromatographic analysis (Maxxam Analytics). Interpretation of GC/FID results were conducted by MacGregor & Associates (Halifax) Ltd. Oil samples found on the beach and bird corpses on Sable Island were identified as representing separate discharge events on the basis of date, bird corpse condition, and oil characteristics.
Number of Samples	8
Equipment:	Collected by hand

6.5 Analysis

Maxxam Analytics Inc. conducted the analyses of eight oil samples collected from the feathers of beached seabird corpses in January, March, and April 2008.

Table 6.2: Analytical Method For Oiled Seabirds

Parameters	Analysis Method
HCR, MHCP, URM, URM/MHCP ratio	gas chromatograph (GC/FID)

Concurrently standard oils such as Bunker C, Scotian shelf crude and condensate, marine diesel, and hydrocarbon n-alkane marker standards (C6-C16 and C18-C32) were run under the same conditions. This permitted identification of the n-alkane peaks in the

chromatograms. The n-alkane peaks were not quantified; only relative concentration calculations based on peak height were undertaken.

Laboratory QA/QC

Maxxam Analytics is a CAEL facility (Canadian Associates of Environmental Laboratories).

6.6 Results

During 2008, the corpses of 378 beached Northern Gannets, tubenoses, gulls, and alcids were collected on Sable Island (Table 6.3). Alcids comprised the greatest number of birds recovered (46.6%) followed by tubenoses (33.6%).

Table 6.3: Beached Seabird Corpses Collected On Sable Island During 2008

Species	Jan	Feb	Mar	Apr	Jun	Jul	Aug	Oct	Nov	Dec	Total birds found	Total coded for oil	Oiling rate %
Northern Gannet	2	0	2	0	3	0	0	2	7	0	16	12	8.3
Tubenoses	0	1	2	1	16	88	9	7	3	0	127	92	0
Gulls	5	4	10	9	10	0	0	8	4	9	59	42	0
Alcids	23	11	15	55	3	7	0	0	16	46	176	85	5.9
Total	**30**	**16**	**29**	**65**	**32**	**95**	**9**	**17**	**30**	**55**	**378**	**231**	**2.6**

Note: Monthly numbers and annual oiling rate for birds coded (i.e. with > 50% of body intact)

For all species combined, the oiling rate for birds coded for oil (i.e., with >50% of body intact) was 2.6 %. The highest rate for a seabird group (8.3 %) was observed in gannets (1 of 12 intact corpses was oiled). The oiling rate for alcids was 5.9 %. The oiling rate observed in 2008 was the lowest recorded since 2000 (Figure 6-1).

Figure 6-1: The oiling rate for 2008 is a percentage of birds coded for oil (i.e., with > 50% of body intact, CWS beached seabird survey protocol). Red = all birds combined; green = alcids

The results of generic identification of oils from the eight samples indicate a higher proportion of bilge oils than reported from samples collected during 2000 to 2007 (Table 6.4 and 6.5).

Table 6.4: Five discharge events identified in eight oil samples collected from bird feathers on Sable Island during 2008

Date	Number of Samples	Matrix	Generic Identification of Oil
January 23	2	Alcid	Fuel oil with lube, typical of bilge oils
March 10	1	Alcid	Fuel oil
April 15	1	Alcid	Fuel oil with lube, typical of bilge oils
April 15	1	Alcid	Bunker C with lube, typical of bilge oils
April 15	3	Alcid	Crude

Table 6.5: Discharge events identified by generic oil source of samples collected on Sable Island during 2000-2008

Year	Crude Oil	Fuel Oil	Bilge Oil	Total
2000	6	1	1	8
2001	12	2	2	16
2002	5	3	2	10
2003	6	2	-	8
2004	6	-	-	6
2005	9	-	-	9
2006	5	1	-	6
2007	2	1	-	3
2008	3	1	4	8
Total	**54**	**11**	**9**	**74**

6.7 Conclusions

Northern Gannets experienced the highest percent oiling rate; however, alcids appear to be the Family of birds most impacted by oil discharge based on numbers of beached birds. In fact, the Thick-billed Murre and Dovekie experience the highest rates of oiling in eastern Canada (Montevecchi *et al*. 2002). Nonetheless, the relatively steady decrease in percent oiling rate of seabird species from 2000 to 2008 suggests measures to reduce illegal oil discharges from vessels has resulted in a reduction in the seabird oiling events in the Sable Island area.

None of the eight samples contained light or mid-range distillate fuels, or condensates that would be typical of oils produced on offshore gas facilities such as the SOEP processing platforms off Sable Island. The contamination source for the five samples containing fuel oil and bilge oils could have been one of any offshore operations in the region, including fishing and military vessels; freighters and container ships; and offshore energy vessels and facilities.

Although bilge oil was higher in 2008 than from 2000 through 2007, the total number of discharge events in 2008 was within one standard deviation of the total number of discharge events from 2000 to 2007.

6.8 References

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Montevecchi, William A. and Iain J. Stenhouse. 2002. Dovekie (Alle alle), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu.bnaproxy.birds.cornell.edu/bna/species/701doi:10.2173/bna.701

7 MUSSEL HEALTH AND BODY BURDEN

7.1 Rationale

Thebaud, the main processing platform, has been in production since December 1999. As part of the on-going EEM program, shellfish have been collected and analyzed at the site to determine hydrocarbon tainting as a result of activities in each area.

Mussel collection occurred at Thebaud from 1999 to 2002, 2005 and 2007. For the first two years of monitoring, moorings were set at 250m, 500m, 1000m, 2000m, 4000m, 10km, and 15km from the platform. The original intent was to set and collect samples on a quarterly basis. Due to increased drilling activity in 2001, and potential risk of damage to the mussel moorings, mussel collection was modified to scraping them from the rig legs at the waterline. Most of the current energy at Thebaud (about 70%) is due to elliptical tidal flow. In this average sense all jacket legs are 'downstream' of the produced water (PW) plume. The envelope defined by average tidal excursion is about 2-3 times the mean flow (i.e. prevailing current). Thus, each leg will be exposed to the PW discharge plume twice per day for some period. For sampling purposes, all jacket legs are the same. The argument to be 'downstream' of the platform is stronger when related to far-field monitoring sites.

In 2003, mussels were unavailable for sampling because of natural sloughing in wave action, which sometimes occurs when mussels reach their maximum size and density. Mussels could not be obtained in 2008 due to logistical problems.

7.2 Goal

This program component is intended to establish levels of tissue chemical contaminants testing on blue mussels to determine if sublethal effects occur and if there are demonstrable deleterious effects to marketability of fishery resources from platform produced water.

7.3 Objectives

The primary objective of the mussel health and body burden component of the EEM report is to characterization of hydrocarbon profiles relative to previously analyzed reference condensate samples

7.4 Historical Review

Table 7.1 shows the body burden concentration of hydrocarbons in mussels growing on the Thebaud Production Platform jacket legs from 1999 to 2007. During 1999 to 2000, the original intent was to assess mussel body burden and tainting on a quarterly basis. Although that goal was never achieved, several analyses were undertaken in a year.

Table 7.1: Aliphatic Hydrocarbon Concentration (C_{10}-C_{24}) In Blue Mussel Tissues at Thebaud (ppm, dry weight)

Location	Nov 99-Feb 00	Feb 00-May 00	June 00-Nov 00	July 2001	July 2002	Oct 2005	Sept 2007
Platform				31.65	44.54	20.04	14.28
Wellhead				20.09			
250 m			32.39				
500 m			32.39				
1000 m t		27.99					
1000 m b		34.22					
2000 m t	17.62	24.15					
2000 m b		14.87					
4000 m t	6.63	16.78					
4000 m b		33.24					
Control t	12.59	17.53					
Control b	13.94	14.62					
Grocery store				11.40		6.61	3.35

Table 7.2 Data Interpretation Of Mussel Body Burden And Sensory Evaluation

Sample Dates	Data Interpretation
November 1999-February 2000 (multiple collections)	• Survival of mussel moorings close to the Thebaud platform was low. • Aliphatic hydrocarbon concentration at 2000 m is similar to the Control, yet at 4000 m it is lower than the Control. • No tainting from hydrocarbons

Table 7.2 Data Interpretation Of Mussel Body Burden And Sensory Evaluation

Sample Dates	Data Interpretation
February 2000 – May 2000 (multiple collections)	• Aliphatic hydrocarbons in mussels at 1000 to 4000m • Controls were objectionable on odour and taste • No tainting from hydrocarbons
June 2000 – November 2000	• Aliphatic hydrocarbons from platform in mussels at 500m • No tainting from hydrocarbons
July 2001	• Aliphatic hydrocarbons from platform in mussels at 500m • No tainting from hydrocarbons
July 2002	• Aliphatic hydrocarbons from platform in mussels at 500m
July 2003	• No mussels at surface of platform legs
October 2005	• Aliphatic hydrocarbons from platform in mussels • Source is primarily biogenic (phytoplankton)
September 2007	• Aliphatic hydrocarbons from platform in mussels • Source is primarily biogenic (phytoplankton)

Pristane is a constituent in most petroleum deposits; however, it is suspected that the pristane in mussel tissues arose from the ingestion of phytoplankton. The C-21:6 represents an unsaturated hydrocarbon found in red, and green brown algae; diatoms; and phytoplankton.

Table 7.3: Aliphatic Hydrocarbons of Importance (ppm, dry tissue basis) in Mussels

Sample Site Location	Notable Hydrocarbons	
	Pristane (ppm)	**21:6[a] (ppm)**
May 2000 top cages- avg	0.79	1.41
May 2000 bottom cages – avg	1.40	1.44
June 2000 250-500m avg	0.25	3.18
June 2000 Control	0.12	2.16
July 2001 Platform	1.21	ND
July 2001 Control	0.40	ND
July 2002 duplicate Platform	0.32	ND
July 2002 duplicate	0.24	ND
2005 Platform	0.56	ND
2005 Control	0.48	ND
2007 Platform	0.20	ND
2007Control	TR	ND

[a] n-heneicosa-3,6,9,12,15,18-hexaene, a hydrocarbon derived from algae.
ND = not detected; TR = present at trace levels

7.5 Conclusions

Seven years of monitoring the potential for uptake of hydrocarbons in mussels has shown that the presence of aliphatic hydrocarbons is attributable primarily to biogenic hydrocarbons generated by phytoplankton.

Higher concentration of biogenic hydrocarbons in filter feeding mussels indicates that the platforms may promote phytoplankton growth due to local nutrient enrichment from PW plume.

Sensory evaluations conducted up until 2001 showed that any odour and taste difference was attributable to the condition of the Control mussel samples.