

2006 Annual Report
Offshore Environmental Effects Monitoring Program
ExxonMobil Canada Properties - Sable Offshore Energy Project

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EXECUTIVE SUMMARY

AMEC Earth & Environmental (AMEC) and Hurley Environment Ltd (Hurley), on behalf of Accent Engineering Consultants Inc., carried out the 2006 Sable Offshore Energy Project (SOEP) Environmental Effects Monitoring (EEM) program for ExxonMobil Canada Properties. AMEC and Hurley were assisted by a team of specialists contracted to carry out specific assignments related to their area of expertise.

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

Since surveys began in 1998, EEM results have validated these predictions. This is not entirely surprising 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 during the project to further reduce the likelihood of environmental impacts. These include the use of low toxicity SBM drilling mud, skipping SBM muds/cuttings to shore, the use of produced water polishing technology, the use of air hammer strikes (instead of underwater strikes) to reduce underwater noise emissions during pile driving, etc.

The 2006 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 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. Following review of the 2005 results, sediment chemistry and toxicity, scallop taint and body burden, fish health components were dropped for the 2006 program

The EEM contractor team made two field survey trips aboard ExxonMobil platforms: on a heavy-lift vessel in May 2006 to observe marine mammals during installation of the compression platform at Thebaud; and on a supply vessel in September 2006 to observe seabird distributions along vessel transects between shorebase and Thebaud.

ExxonMobil provided videotapes for analyses of sections of the 26" export pipeline from Thebaud to shore to investigate the status of pipeline spans, the twin 8" pipelines across the Strait of Canso to confirm complete rock coverage of the bottom-laid pipelines and in the immediate proximity of the Thebaud platform complex to monitor scour around jacket legs. Beached bird surveys and air quality monitoring were carried out on Sable Island.

Key findings of the 2006 program were:

Benthic Habitat and Fish Density (Section 2)

- There were no marine species-at-risk observed near any of the pipelines or platforms.
- A few adult Atlantic lobsters were noticed alongside the export pipeline between KP 10 and 11.
- A few spiny crabs were observed on the export pipeline between KP 100 and KP 102.
- Numerous small redfish and Jonah crab were most abundant near suspended lengths of the export pipeline (i.e., spans) where they could presumably find shelter from predators on the underside of the pipeline between KP100 and KP102.
- Marine growth on the pipeline closest to Thebaud (KP 197- 198) was heavy - dominated by sea anemones and sea stars whilst marine growth on other sections of the pipeline was variable.
- The Thebaud production platform jacket legs and cross-members were generally covered with marine growth, consisting mostly of sea anemones, sea stars, and blue mussels. Large mats of mussels and starfish were observed on the seafloor alongside the platform – likely dislodged from the surface of the jacket by storm events and weakening of mussel attachment by the predatory starfish. In contrast, little marine growth is evident on the Thebaud compression platform prior to the 2006 3rd quarter scour survey.
- Schools of cunners (non-commercial species) and Atlantic cod (commercial species) were observed in the immediate vicinity of the Thebaud platform complex.

Produced Water Chemistry and Toxicity (Section 3)

- The Total Petroleum Hydrocarbon concentrations in the various samples used for chemical characterization and aquatic toxicity of produced water at the three platforms were well below the OWTG limits [8] of 30 mg/L (30 days) and 60 mg/L (24-hour) for oil in water.
- The results of the 96 hour LC50 tests with Threespine Stickleback using produced water from the three platform locations ranged from 4.4 to 19.0 %. In comparison, the LC50 values for previous samples taken at Thebaud were 1.33% (2005) and 17.6-64.0 % (2000) [7]. While there is no pass/fail concentration stipulated by the OWTG (2002) [8], Dr. J. Sprague of the University of Guelph [9], a recognized expert in fish toxicology, classifies as "practically non-toxic" any value above 10,000 mg/L or 1 percent for fish. Given the hydrodynamic marine environment near Sable Island, the

chemical constituents of produced water will likely be diluted to background levels within a few metres of the mouth of the discharge caisson.

- The results for Microtox and Sea Urchin Fertilization are difficult to interpret. The IC50 results for Microtox were 3.68% at Thebaud and 1.27% at Venture and 2.58% for the Sea Urchin Fertilization assay at Thebaud. These results are similar to that of most produced water samples that have been tested in Environment Canada's Toxicology Laboratory (Moncton, NB) and observed mortality was most likely caused by aromatic hydrocarbons or phenols (K. Doe [6], and P. Jackman [4], Environment Canada, pers. comm.) even though measured Total Petroleum Hydrocarbon levels (Section 3.6) were well below the regulatory limits. High salinity levels in the produced water (e.g., >150 ppt in the undiluted sample) may also have been a contributing factor (G. Harris, Harris Industrial Testing, pers. comm. [5]).

Underwater Noise and Marine Mammals (Section 4)

- No marine mammal or sea turtle species-at-risk were sighted by an independent trained marine mammal observer during pile-driving operations for the Thebaud compression platform. This was not entirely unexpected, given the short duration of pile driving (less than 2 weeks), the 30-minute 'ramp up' period prior to commencing 'active' pile-driving operations, and the fact that Thebaud is not located in an area of particular importance for marine mammals and sea turtles.

Air Quality (Section 5)

TO BE COMPLETED WHEN DATA AVAILABLE FROM ENVIRONMENT CANADA

Seabird Monitoring (Section 6)

- The most common species observed along the tracks, particularly at the survey locations closest to Sable Island and the Thebaud platform, was the Greater Shearwater. This species is recognized as having been in transit (to more southerly breeding grounds) at the time of the survey and was perhaps attracted to the survey vessel for scavenging purposes.
- Based on analysis of a limited number of 10 minute surveys taken on two vessel tracks carried out between September 16 and 18, 2006, there is no evidence that seabirds were attracted to the SOEP offshore platform (Thebaud).
- The distribution of seabirds along these two tracks also appeared to be independent of proximity to Sable Island.

Beached Bird Surveys (Section 7)

- During 2006, the corpses of 379 beached gannets, tubenoses, gulls and alcids were collected on Sable Island. Alcids comprised 26.9% of total birds recovered.
- For all species combined, the oiling rate was 11.8%. The highest rate for a seabird group, 42.2%, was observed in alcids.
- The oiling rate observed in 2006 was similar to the six-year average for 2000-2005 (Figure 7-1).
- No recently oiled corpses were recovered during June-November 2006, and therefore no samples were collected for that period.
- Of the 22 oil samples collected from the beach and from the feathers of bird corpses in 2006, the results for 14 are available. Of the 14 samples analysed, 13 contained no light or mid-range distillate fuels, or condensates that would be typical of oils produced on offshore gas facilities such as SOEP processing platforms off Sable Island. The contamination source for the single sample containing fuel oil 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. [Note: There were no spills from SOEP offshore facilities for several months prior to the discovery of the specimen containing fuel.]
- Generic identification of oil samples collected in 2006 indicated that, as in 2000 to 2005, crude oil discharges were likely responsible for a large proportion of pelagic tar and oiled seabirds observed on Sable Island.

1 INTRODUCTION



1.1 Overview

AMEC Earth & Environmental and Hurley Environment Ltd., on behalf of Accent Engineering Consultants Inc., are submitting the results of the 2006 Environmental Effects Monitoring (EEM) program for the Sable Offshore Energy Project (SOEP) to ExxonMobil Canada Properties (EMCP).

The SOEP offshore EEM program has focused on the effects of drilling and production activities at Tier 1 sites (i.e. Venture, Thebaud, 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 in 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 which called for greater emphasis on monitoring fish health effects.

The 2006 offshore EEM program was also developed by building on the results and lessons learned to date and recommendations made by the CNSOPB EEM Review Committee which includes representatives of Fisheries and Oceans Canada, Environment Canada, and the Canadian Environmental Assessment Agency. Following review of 2005 results, sediment chemistry and toxicity, scallop taint and body burden, fish health components were dropped for the 2006 program.

1.2 Background

The 2006 offshore EEM program was designed to address relevant predictions made during the SOEA Environmental Assessment (EA) process (refer to Table 1-1). 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. In 2006, the following EEM components were monitored: benthic habitat and fish density, produced water chemistry and toxicity, underwater noise and marine mammals, air quality, seabird monitoring and beach seabird surveys (Table 1-2).

1.3 Objectives and Goals

The SOEP EEM program is undertaken with the following primary objectives:

- To verify predictions made during the EA process;
- To evaluate the effectiveness of mitigation and identify the need for improved or altered mitigation;
- To provide an early warning of undesirable change in the environment; and
- To inform the CNSOPB, other key regulatory authorities, and stakeholders.

1.4 The EEM Team

Figure 1-1 shows the organization of the offshore EEM Team led by AMEC Earth & Environmental and Hurley Environment Ltd. Several firms were contracted to carry out specific assignments related to their specific area of expertise. In addition, Environment Canada offered considerable assistance in the areas of air quality, seabird distributions, and produced water toxicity.

1.5 Field Trips

Supply vessels were used to carry seabird and marine mammal observers between the shorebase and offshore facilities. On May 12, 2006, the MV Panuke Sea was used to transport the OGOP observer to the Thebaud platform complex. He was then transferred to the Saipem S7000 heavy-lift vessel for carrying out marine mammal observations during pile driving operations for installation of the compression platform. Transit of the observer from the platform back to Halifax International Airport was by helicopter on May 24, 2006. From September 16-18, 2006, a CWS biologist made observations of seabirds along vessel survey transects between the ExxonMobil shorebase in Woodside, NS and the Thebaud processing platform aboard the supply vessel Hebron Sea.

1.6 Reference Map

A Reference Map which shows the locations of the SOEP offshore facilities and pipelines is located at Figure 1-2.

1.7 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 were generally attached at the back of the respective component study report.

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Table 1-1 EA Predictions Relevant to 2006 EEM Program

EA Prediction¹	Valued Ecosystem Component (VEC)²	2006 EEM Component
<i>"Underwater noise from construction activities or from platform operations will not be above ambient noise levels in the Gully."</i>	– Marine Mammals – Gully MPA	– Underwater Noise and Marine Mammals
<i>"Due to the localized occurrence of fouling, the overall impact on the communities in the vicinity of production structures is not expected to be significant."³</i>	– Fish – Shellfish	– Benthic Habitat and Fish Density
<i>"Impacts of effluent discharges (e.g. produced water) were considered to have no significant impacts on the marine environment."</i>	– Fish – Shellfish	– Produced Water Chemistry and Toxicity
<i>"Air emissions were considered to have no significant impacts on the marine environment."</i>	– Sable Island	– Air Quality
<i>"Lights [from work lights and gas flares] may attract migrant bird species, especially in fog and/or low cloud and rain."⁴</i>	– Seabirds	– Seabird Monitoring
<i>"Because of the importance of Sable Island and the Gully, special attention will be paid to these areas in the development of monitoring."⁵</i>	– Seabirds – Gully MPA – Sable Island	– Air Quality – Beached seabird surveys – Underwater Noise and Marine Mammals

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 5.2.1.6 of the SOEP – EIS Vol. 3.

⁴ As stated in Section 5.2.1.9 of the SOEP – EIS Vol. 3.

⁵ As stated in Section 7.4 of the SOEP – EIS Vol. 3.

Table 1-2 Sampling Details

Environmental Component	Location(s)	Type of Monitoring	Sample Acquisition/ Equipment	Analytical Procedures	QA/QC Procedures
Benthic Habitat and Fish Density	Thebaud, Pipeline	Benthic habitat and fish density near Thebaud platform complex and along selected sections of 26" export pipeline to shore and twin 8" pipelines across Strait of Canso	Client-supplied UW videotape acquired by ROV camera	Analysis of videotape to identify distribution of associated marine life with focus on commercial and species-at-risk	Species verifications by fisheries expert
Produced Water Chemistry and Toxicity	Thebaud	Produced water chemistry and toxicity testing: Twice yearly analysis of trace metal composition and HC concentration and annual toxicity testing of approved species, as required by OWTG (2002).	Client-supplied PW grab samples from platform	Trace metal suite as per EPA method 200.10 & 245.1; TPH via gas chromatography-mass spectrometry; LC50 toxicity testing: Sea urchin fertilization test (as per EPS 1/RM/27) plus Microtox and Threespine Stickleback bioassay tests.	Replicate short-term bioassay samples at various concentrations of PW under controlled laboratory conditions

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Environmental Component	Location(s)	Type of Monitoring	Sample Acquisition/ Equipment	Analytical Procedures	QA/QC Procedures
Underwater Noise and Marine Mammals	Thebaud during the installation of the compression platform in May 2006.	Marine mammal observations during pile-driving	Record observations with high-power binoculars using standardized protocols/forms	Continuous observations during pile-driving operations with particular attention to species-at-risk marine mammals and sea turtles	Reference to field guides approved by CWS
Air Quality	Thebaud	Twice daily flare monitoring by EM personnel	Visual observations	Recording scale readings	Replicate readings
Air Quality	Sable Island	Summarize EC monitoring data for NO _x , SO ₂ /H ₂ S, O ₃ , PM _{2.5}	Real-time continuous monitoring using a variety of air quality parameter samplers	As per equipment manufacturers maintenance and calibration procedures	Standard EC QA/QC procedures for continuous air quality monitoring; Investigation of 'anomalies' in relation to Thebaud flare plume observations
Seabird distribution	Shorebase to Thebaud	Systematic observations of seabirds during supply vessel transects between shorebase and Thebaud platform.	Record observations with high-power binoculars using standardized CWS protocols/forms	As per CWS-approved protocol for offshore seabird observations from a moving platform	Observations by independent trained observer and CWS seabird biologist

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Environmental Component	Location(s)	Type of Monitoring	Sample Acquisition/ Equipment	Analytical Procedures	QA/QC Procedures
Beached Seabirds	Sable Island	Monthly beached seabird surveys by Zoe Lucas	1-2 day beach surveys using ATV (weather/sea conditions permitting)	Counts, photo records, sample collection	Representative oiled seabird feather samples sent to shore for HC 'chemoprinting'. Comparison with chromatographs of standards of various oil types

Figure 1-1 The EEM Team

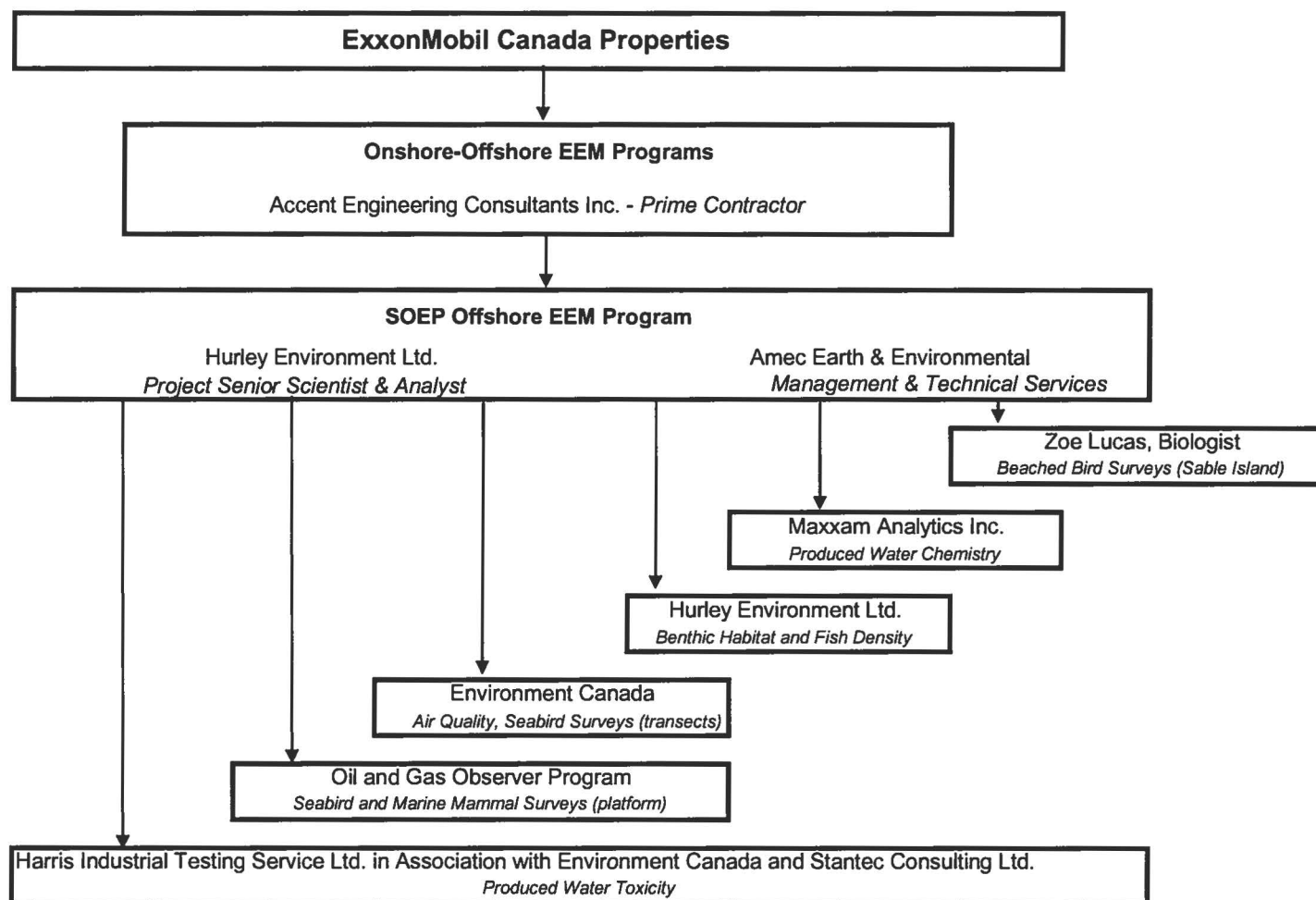


Figure 1-2 SOEP Offshore Facilities and Pipelines Reference Map

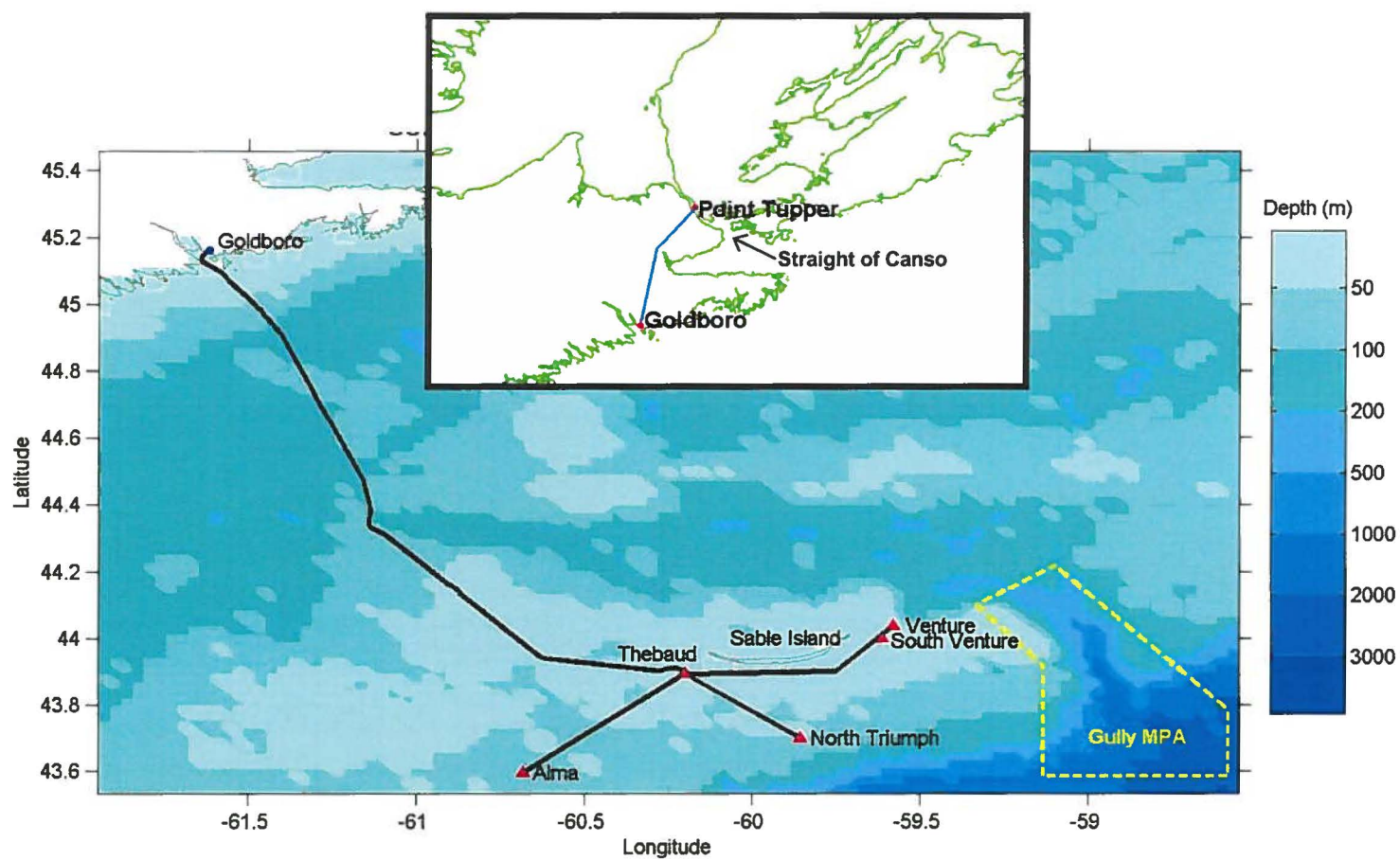


Figure 1-3 Sable Island

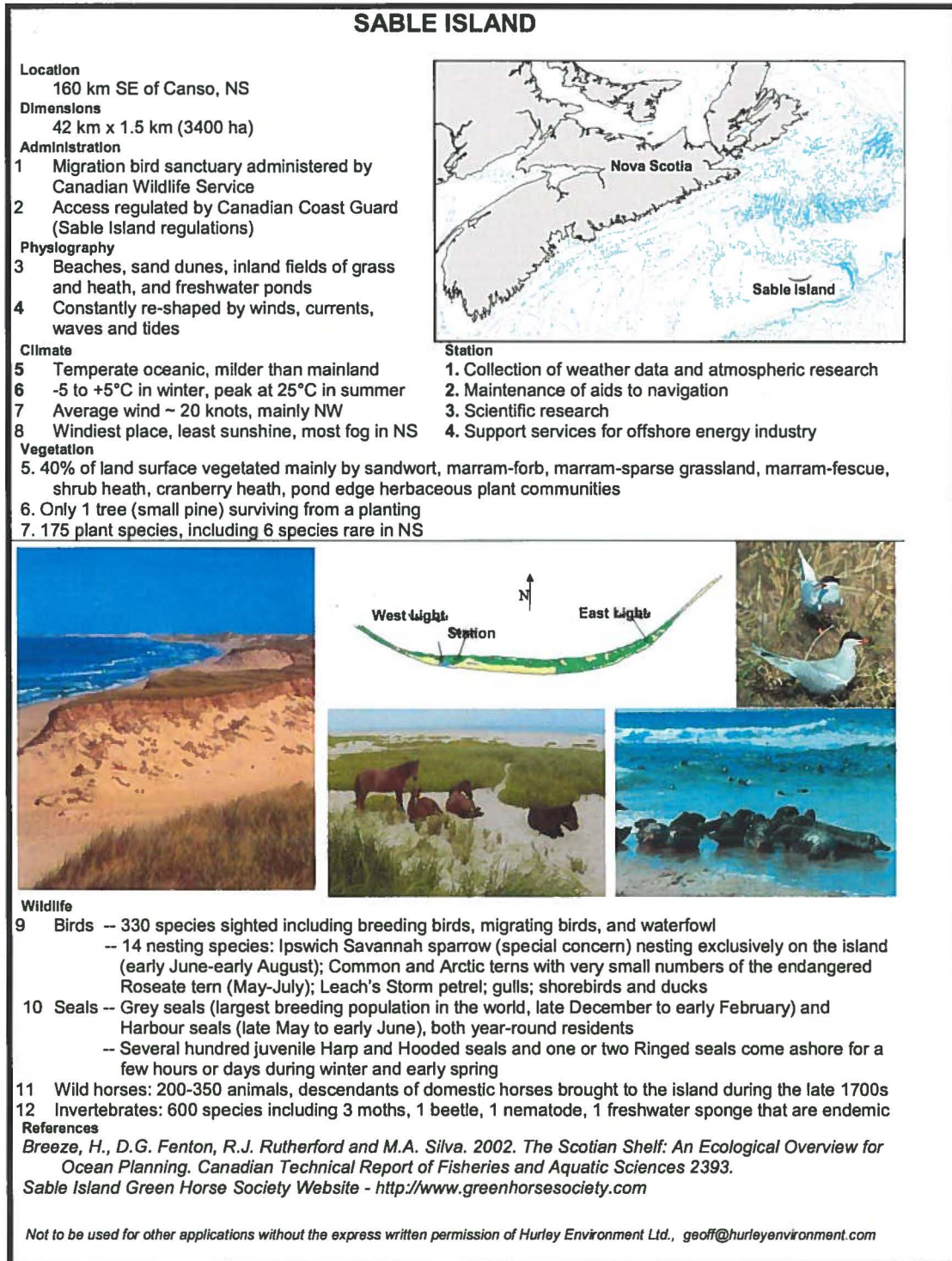
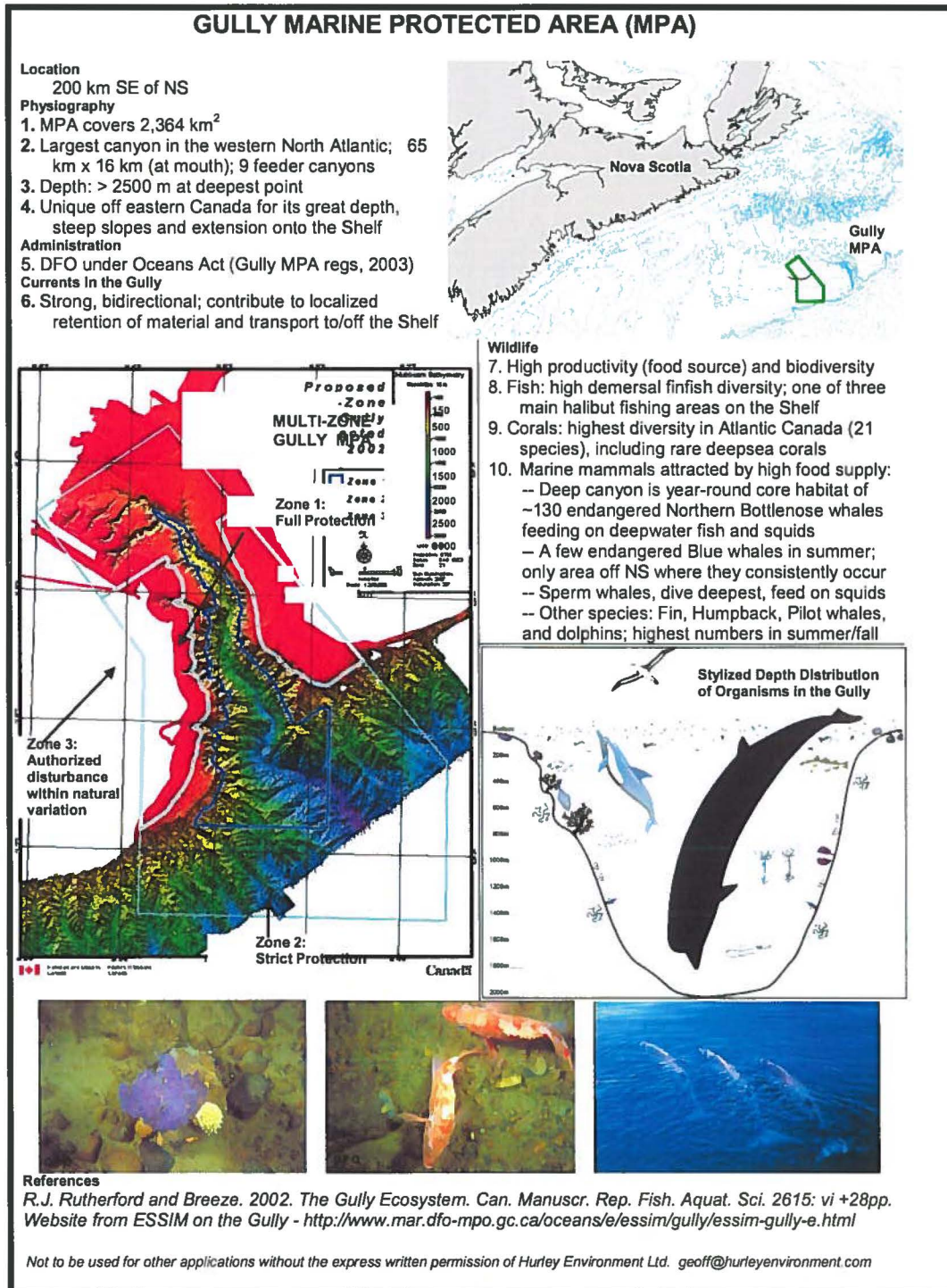


Figure 1-4 Gully Marine Protected Area (MPA)



2 BENTHIC HABITAT AND FISH DENSITY



2.1 Background

From the central processing facility at Thebaud, natural gas and condensate are transported 197 km to landfall near Goldboro, NS in a 26" 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 (Figure 2-1, A). Some of the exposed sections of this pipeline are known to have spanning issues.

Twin 8" pipelines (i.e., SOEP NGL & M&NP Pt. Tupper gas lateral) were bottom laid across the Strait of Canso and rock-covered for protection (Figure 2-1, B).

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 ([1], [2]). Exposed sections of pipeline and protective mattresses may be important to juvenile and diminutive fish species and therefore may have regional significance as nursery grounds particularly for exploited species [3].

2.2 Goal

Evaluate the extent of marine growth and colonization along sections of the 26" subsea pipeline from Thebaud to landfall known to have spanning issues, near the Thebaud platform complex and along the rock-covered twin 8" pipelines across the Strait of Canso.

2.3 Objective

Observe the distribution of fish and shellfish, particularly commercial species and species-at-risk (if any), and the extent of marine growth along sections of the 26" subsea pipeline where spanning occurs, and along sections which are covered with protective mattresses; at the Thebaud production and compression platforms; and along the rock-covered twin 8" pipelines across the Strait of Canso.

2.4 2006 Sampling

Reporting Organization: Hurley Environment Ltd.

Contractor: Oceanengineering Canada Ltd. / Fugro Jacques Geosurveys on behalf of ExxonMobil

Survey Date:	<u>Pipelines:</u> July, 2006; <u>Platforms:</u> Thebaud production platform (November, 2006); Thebaud compression platform (August, 2006)
Survey Vessel:	M/V Panuke Sea
Type of Sample:	VHS video recordings during pipeline inspection surveys and during regular (3 rd quarter) and post-storm (November, 2006) platform scour surveys
Test Sample Locations:	a) Continuous videocamera observations along selected sections of the 26" subsea pipeline and deeper portion of the twin 8" rock-covered pipelines across SOC b) At base of platform jacket legs
Reference Sample Locations:	a) Alongside port and starboard sides of the 26" pipeline b) Opportunistic video views away from the platforms such as over protective mattresses and at valve locations
Number of Samples/Station:	<u>26" pipeline:</u> Videotapes from the following pipeline sections: KP 9.824-12.060; KP 100.384-102.758; KP 197.293-197.947 <u>Twin 8" pipelines:</u> water depths 11-40 m. Continuous observations were made while viewing videotape using centre-camera view supplemented by port/starboard camera views as required <u>Thebaud production platform:</u> base of six jacket legs and protective mattresses covering associated pipelines <u>Thebaud compression platform:</u> base of eight jacket legs
Sample Preparation:	Still photos of representative observations taken from video
Equipment:	Underwater ROV video camera (s) [Note: Three cameras were used simultaneously during pipeline surveys: centre, port and starboard cameras; visibility enhanced with artificial lighting]
Sampling QA/QC:	Entire videotape pipeline segment examined using centre camera view; examination of underside of 26" pipeline using video from port and starboard cameras as required particularly in areas of spanning.

2.5 Analysis

2.5.1 Parameters Analyzed

Parameters	Analysis Method
Relative distribution of marine growth on pipeline and associated protective mattresses and occurrence of commercial fish and shellfish species. [Note: Estimates provided of maximum observed densities of redfish and Jonah crab].	Videotape examination

2.5.2 QA/QC

Re-viewing of videotapes as required using up to three camera angles

2.6 Results

2.6.1 Pipelines

Refer to Table 2-1.

2.6.2 Thebaud Platform Complex

- The production platform jacket legs and cross-members were generally 100% covered in marine growth- mostly sea anemones, sea stars and blue mussels (*Mytilus edulis*).
- Large mats of blue mussels and starfish were noticed on the seafloor in the immediate vicinity of the production platform.
- There was little marine growth observed on the recently installed compression platform jacket.
- Schools of cunners (*Tautoglabrus adspersus*) and Atlantic cod (*Gadus morhua*) were observed near the platform.

Table 2-1 Distribution of marine life near pipeline

Videotape Pipeline Section (KP)	Depth (m)	Comments
26" export pipeline		
9.824 – 12.060	28-39	Marine growth variable – up to 100% in depths < 30 m; occasional rock crab, starfish, sea anemone, sea urchin on pipeline and Atlantic lobster alongside pipeline; generally featureless sand bottom
100.384 – 102.758	81-87	Very little marine growth (<10 %) on pipeline; pipeline in and out of suspension; many small redfish (up to 15-20/m) and Jonah crabs (one every 50-100 m) along underside of suspended sections of pipeline (i.e., spans); occasional codfish, starfish, sea anemones, rock crabs, spider crabs, sea slugs on pipeline; shell debris common alongside pipeline
197.293 – 197.947	22-29	Pipeline varying from fully buried to fully-exposed; featureless sandy bottom; pipeline near Thebaud platform overlain with protective concrete mattresses (up to 100% covered with marine growth – mostly sea anemones, sea stars); schools of Atlantic cod and cunners were observed near the Thebaud production platform.
8" Twin Lines across Strait of Canso		
58.095- 59.035	11-40	Rock-covered pipelines not visible; marine growth on rock cover variable with depth: < 5% (25-40 m); 5-10% (20-25 m); 10-25% (15-25 m); 100% mostly kelp (<15m); occasional green crab, starfish, sea anemone on rock cover

2.7 Summary and Conclusions

- There were no marine species-at-risk observed near any of the pipelines or platforms.
- A few adult Atlantic lobsters were noticed alongside the export pipeline between KP 10 and 11.
- A few spiny crabs were observed on the export pipeline between KP 100 and KP 102.
- Numerous small redfish and Jonah crab were most abundant near suspended lengths of the export pipeline (i.e., spans) where they could presumably find shelter from predators on the underside of the pipeline between KP100 and KP102.
- Marine growth on the pipeline closest to Thebaud (KP 197- 198) was heavy - dominated by sea anemones and sea stars whilst marine growth on other sections of the pipeline was variable.
- The Thebaud production platform jacket legs and cross-members were generally covered with marine growth, consisting mostly of sea anemones, sea stars, and blue mussels. Large mats of mussels and starfish were observed on the seafloor alongside the platform – likely dislodged from the surface of the jacket by storm events and weakening of mussel attachment by the predatory starfish. In contrast, little marine growth is evident on the Thebaud compression platform prior to the 2006 3rd quarter scour survey.
- Schools of cunners (non-commercial species) and Atlantic cod (commercial species) were observed in the immediate vicinity of the Thebaud platform complex.

2.8 References

- [1] Love, M.S., J. Caselle, and L. Snook, 1999a. Fish assemblages around seven oil platforms in the Santa Barbara Channel area. *Fish. Bull.* 98: 96-117.
- [2] Love, M.S., J. Caselle, and L. Snook, 1999b. Fish assemblages on mussel mounds surrounding seven oil platforms in the Santa Barbara Channel and Santa Maria Basin. *Bull. Mar. Sci.* 65: 497-513.
- [3] Love, M.S. and A. York, 2005. A comparison of the fish assemblages associated with an oil/gas pipeline and adjacent seafloor in the Santa Barbara Channel, Southern California Bight. *Bull. Mar. Sci.* 77(1): 101-117.
- [4] Scott, W.B. and M.G. Scott, 1988. Atlantic Fishes of Canada, *Can. Bull. Fish. Aquat. Sci.* 219: 731 p.

Figure 2-1 SOEP Pipelines Reference Map

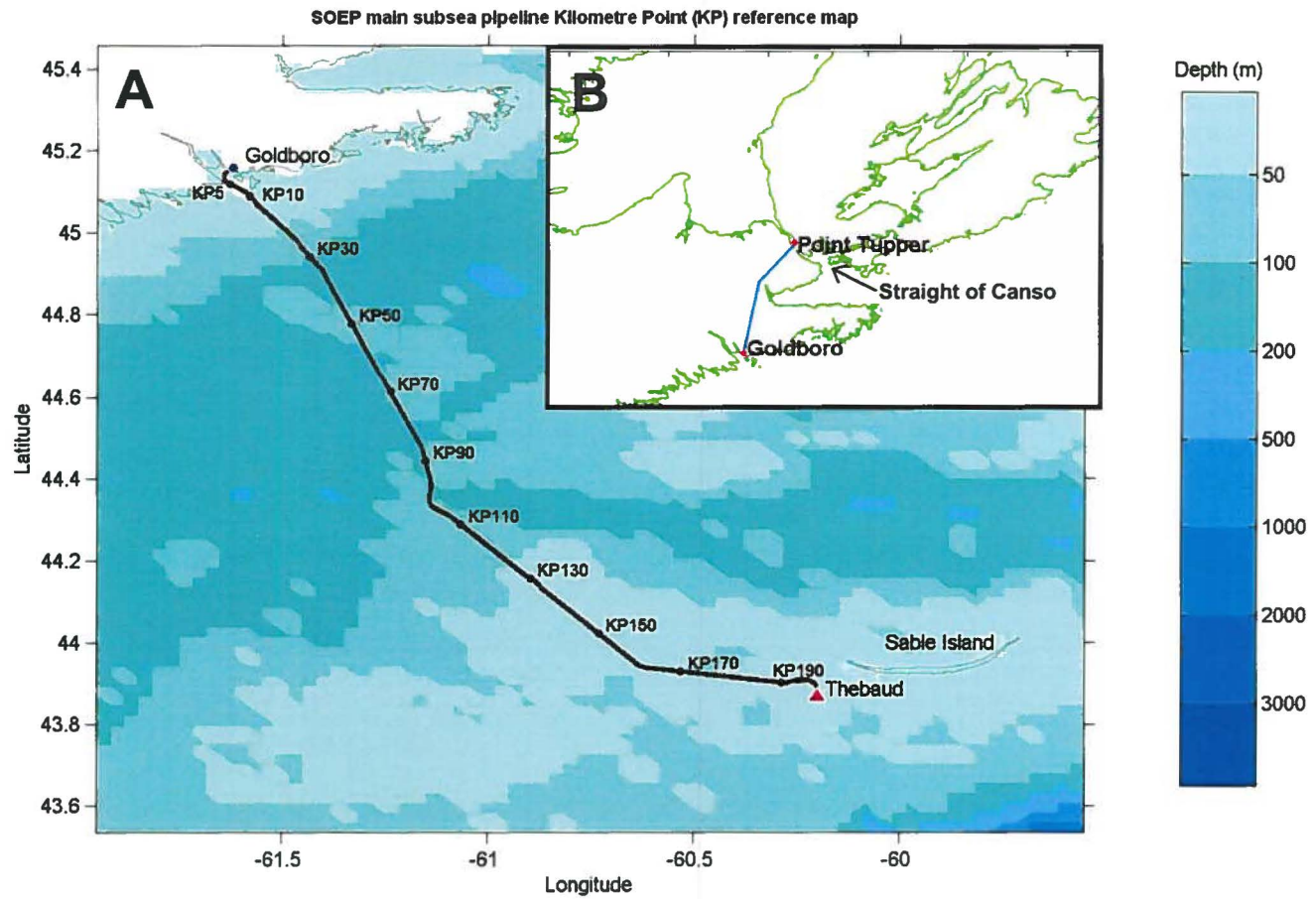


Figure 2-2 Lobster (circled) alongside export pipeline



Figure 2-3 Sea anemone and shell debris near field joint # 861 on export pipeline



Figure 2-4 Spiny crabs embracing on export pipeline

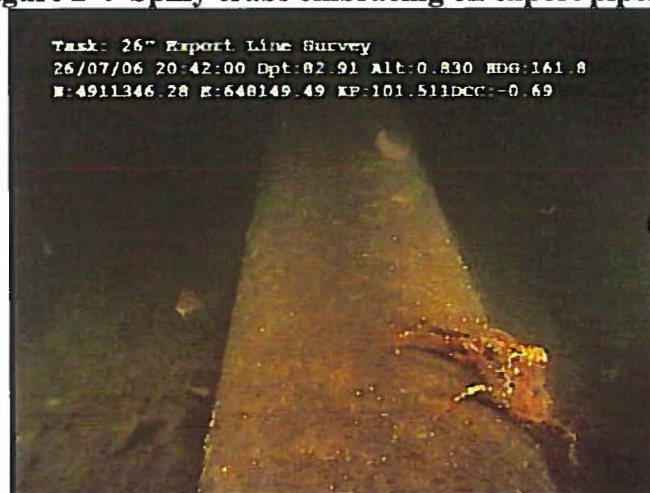


Figure 2-5 Small redfish near suspended export pipeline



Figure 2-6 Export pipeline with associated protective mattress (arrow) near Thebaud production platform



Figure 2-7 Marine growth on rock-covered twin pipelines across Strait of Canso

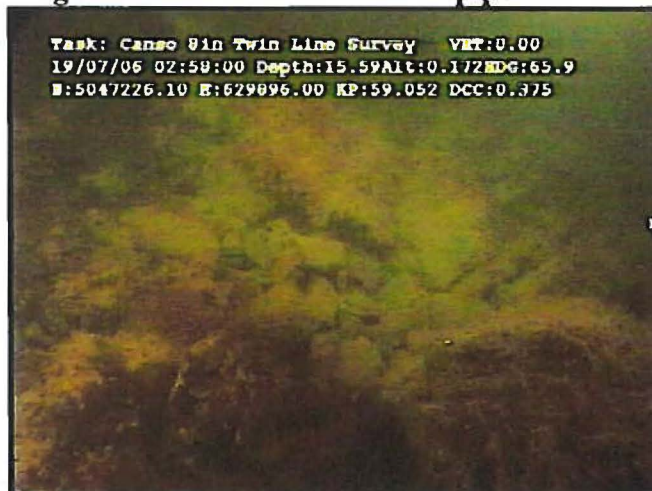


Figure 2-8 Fish around base of Thebaud compression platform



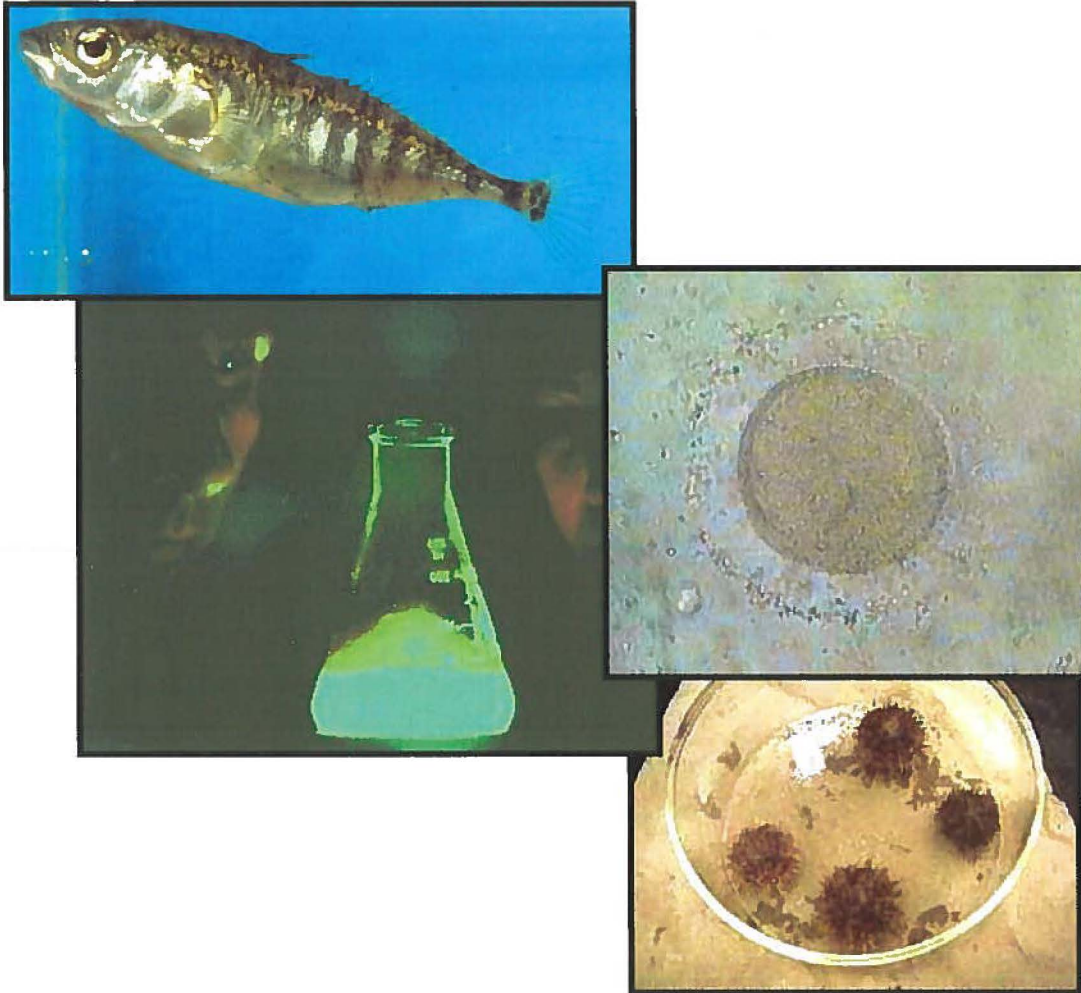
Figure 2-9 School of Atlantic cod near Thebaud production platform



Figure 2-10 Atlantic cod, sea stars and blue mussels near base of Thebaud production platform



3 PRODUCED WATER CHEMISTRY AND TOXICITY



3.1 Background

The Offshore Waste Treatment Guidelines (OWTG 2002) [8] 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 twice yearly for the following parameters: Aluminium, Antimony, Arsenic, Barium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Molybdenum, Nickel, Phosphorus, Selenium, Silver, Strontium, Thorium, Tin, Uranium, Vanadium, Zinc, Mercury, Ammonia Nitrogen, Sulphur, and Total Petroleum Hydrocarbons.

Annual aquatic toxicity testing is to include the 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 twice-yearly chemical characterization tests. Besides the Sea Urchin Fertilization test, Dr. Ken Doe of the Environment Canada Toxicology Laboratory in Moncton, NB has also recommended the Threespine Stickleback test as an indicator of fish toxicity and the Microtox test as an indicator of toxicity at the cellular level.

For 2006, produced water samples were collected from the Thebaud production platform and two satellite platforms, South Venture and Venture. For logistical reasons, it was not possible to collect more than one sample and to obtain sufficient volumes of produced water from the unmanned satellite platforms to carry out the full set of Microtox and Sea Urchin Fertilization tests.

[Note: The two most recent produced water samples from Thebaud were collected on January 11, 2007 and December, 27, 2005 (results reported in 2005 EEM report) – just over 12 months between sampling].

Background on Threespine Stickleback test

The acute lethality test with seawater-acclimated Threespine Stickleback (*Gasterosteus 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 [3].

Background on Microtox test

The basic technology of the Microtox Test System is based upon the use of luminescent bacteria, specifically the strain *Vibrio fischeri* NRRL B-11177, to measure toxicity from environmental samples. When properly grown, 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 (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.

Background on Sea Urchin Fertilization test

The Sea Urchin Fertilization test is a common marine bioassay used for routine environmental monitoring, investigative evaluations, and/or regulatory testing of effluents and sediment pore waters.

3.2 Goal

To examine the potential aquatic toxicity of produced water from the Thebaud and two satellite platforms using indicator species and to perform chemical characterization tests as per the Offshore Waste Treatment Guidelines (OWTG 2002) [8].

3.3 Objectives

- Analyze produced water collected at the Thebaud and two satellite platform locations for aquatic LC50 toxicity testing and chemical composition.
- Compare results with monitoring data at the same locations.
- Utilize data in developing a strategy for future monitoring.

3.4 2006 Sampling

Note: Produced water samples, which were supplied by ExxonMobil, were collected and analysed following procedures supplied by Maxxam Analytics Inc. as outlined in Attachment 3-1.

Collection Date(s):	July 7, 2006 (South Venture) July 27, 2006 (Alma) November 1, 2006 (Venture) January 11, 2007 (Thebaud)
Platform(s):	Thebaud, South Venture, Venture, Alma
Type of Sample::	Produced water chemistry and toxicity
Test Sample Locations:	Taken directly from the discharge caisson (prior to going overboard).
Reference Sample Locations:	None
Sample Preparation:	Sample Bottles were provided by Maxxam Analytics Ltd. as follows (see Attachment 3-1): • 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 • Nitrogen – 100ml amber glass with sulphuric acid preservative AMEC E&E supplied an HDPE container for the Harris Industrial Testing Service Ltd. sample.
Sampling QA/QC:	Each bottle (supplied by the Maxxam laboratory to ensure the integrity of the samples) was filled to the top but not to overflowing (i.e., no headspace) to ensure no loss of preservative and kept cold until shipping to the lab (not frozen). Samples 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 were then delivered to Maxxam Analytics Inc. for chemical testing. For toxicity testing, the samples were placed in the HDPE container on the Thebaud Platform. The samples were shipped to shore by helicopter following sample collection. They were collected by Harris Industrial Testing from the heliport. Subsamples were extracted from each, and then shipped to Stantec Consulting Ltd. for the Sea Urchin Fertilization and Microtox tests (for Thebaud platform), or Environment Canada for the Microtox test (for Venture platform).

3.5 Analyses

Contractors:

1. Harris Industrial Testing Service Ltd. (Threespine Stickleback for Thebaud, Venture and South Venture platforms)
2. Environment Canada's Toxicology Laboratory (Microtox for Venture platform)
3. Stantec (Microtox and Sea Urchin Fertilization for Thebaud platform)
4. Maxxam Analytics Inc. (Chemical Parameters for Thebaud, Venture, South Venture, and Alma platforms)

3.5.1 Parameters Analyzed

Parameters	Analysis Method
Cellular metabolism	Microtox Test [2]
Egg fertilization	Sea Urchin Fertilization Test [1]
Acute fish toxicity	Threespine Stickleback (TSS) [3]
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)
Chemical Characterization	Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
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

3.5.2 QA/QC

The QA/QC procedures for the each laboratory involved with the various testing included the use of duplicates, method blanks, surrogates, spikes and certified reference materials where applicable. For further details on QA/QC procedures refer to Attachment 3-1.

3.6 Results

Table 3-1 summarizes the results of the chemical analysis of the produced water samples for the various platforms. Values for most parameters were low or non-detectable. Highest values at each site were recorded for Barium, Boron, Iron and Strontium. The Total Petroleum Hydrocarbon concentrations for all samples ranged from 3.6 to 6.7mg/L.

Table 3-2 summarizes the results of toxicity testing of the most recent samples of produced water collected from the three platforms. Detailed laboratory reports are included as Attachments 3-3, 3-4 and 3-5 for the Fish Toxicity, Microtox, and Sea Urchin Fertilization tests respectively. There were insufficient volumes of produced water available to enable

testing of Sea Urchin Fertilization at Venture and South Venture and Microtox at South Venture.

3.7 Summary and Conclusions

- The Total Petroleum Hydrocarbon concentrations in the various samples used for chemical characterization and aquatic toxicity of produced water at the three platforms were well below the OWTG limits [8] of 30 mg/L (30 days) and 60 mg/L (24-hour) for oil in water.
- The results of the 96 hour LC50 tests with Threespine Stickleback using produced water from the three platform locations ranged from 4.4 to 19.0 %. In comparison, the LC50 values for previous samples taken at Thebaud were 1.33% (2005) and 17.6-64.0 % (2000) [7]. While there is no pass/fail concentration stipulated by the OWTG (2002) [8], Dr. J. Sprague of the University of Guelph [9], a recognized expert in fish toxicology, classifies as "practically non-toxic" any value above 10,000 mg/L or 1 percent for fish. Given the hydrodynamic marine environment near Sable Island, the chemical constituents of produced water will likely be diluted to background levels within a few metres of the mouth of the discharge caisson.
- The results for Microtox and Sea Urchin Fertilization are difficult to interpret. The IC50 results for Microtox were 3.68% at Thebaud and 1.27% at Venture and 2.58% for the Sea Urchin Fertilization assay at Thebaud. These results are similar to that of most produced water samples that have been tested in Environment Canada's Toxicology Laboratory (Moncton, NB) and observed mortality was most likely caused by aromatic hydrocarbons or phenols (K. Doe [6], and P. Jackman [4], Environment Canada, pers. comm.) even though measured Total Petroleum Hydrocarbon levels (Section 3.6) were well below the regulatory limits. High salinity levels in the produced water (e.g., >150 ppt in the undiluted sample) may also have been a contributing factor (G. Harris, Harris Industrial Testing, pers. comm. [5]).

[Notes: The sample of produced water from Thebaud was received and analyzed by the laboratory three days after the maximum holding time specified by the tests [5]. There are no pass/fail criteria for either Sea Urchin Fertilization or Microtox tests]

3.8 References

- [1] Environment Canada, Dec. 1992 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.
- [2] Environment Canada, 1992. Biological Test Method: Toxicity Test using Luminescent Bacteria (*Photobacterium phosphoreum*), EPS/1/RM/24 Environmental Protection, Ottawa, ON. 83 pp.
- [3] Environment Canada, 1990. Biological Test Method: Acute Lethality Test using Threespine Stickleback. EPS/1/RM/10 Environmental Protection, Ottawa, ON
- [4] Environment Canada, Jackman, Paula, 2005. Email Communication.
- [5] Harris, Gary, 2007. Personal communication.
- [6] Harris, Gary, 2007. In conversation with Ken Doe of Environment Canada
- [7] Harris, Gary, 2006. Letter RE: Produced Water Toxicity Tests in Attachment 3-2 of this report.
- [8] National Energy Board, Canada-Newfoundland Offshore Petroleum Board, Canada-Nova Scotia Offshore Petroleum Board, August 2002. Offshore Waste Treatment Guidelines.
- [9] Sprague, J.B., 1973. The ABC's of Pollutant Bioassay Using Fish, Biological Methods for the Assessment of Water Quality, ASTM STP 528, American Society for Testing and Materials, pp 6 – 30.

Table 3-1 Chemical Composition of Produced Water

Sampling Date		11 January, 2007	7 July, 2006	27 July, 2006	10 Aug, 2006
Chemical Parameters as per OWTG (2002)	Units	THEBAUD	SOUTH VENTURE	ALMA	VENTURE
Thorium	ug/L	ND	ND	ND	ND
Mercury	ug/L	0.01	0.05	ND	ND
Aluminum	ug/L	ND	ND	ND	ND
Antimony	ug/L	ND	ND	ND	ND
Arsenic	ug/L	ND	ND	0.1	0.1
Barium	ug/L	100000	320000	5600	1100000
Boron	ug/L	3500	3700	2100	34000
Cadmium	ug/L	ND	ND	ND	7
Chromium	ug/L	ND	3.1	ND	1.6
Cobalt	ug/L	1.7	1.1	2.8	2
Copper	ug/L	0.3	0.4	0.5	2
Iron	ug/L	3660	25600	33000	150000
Lead	ug/L	0.2	2.7	ND	84
Molybdenum	ug/L	ND	ND	ND	ND
Nickel	ug/L	13.5	10.5	10.4	10
Selenium	ug/L	ND	ND	ND	ND
Strontium	ug/L	170000	390000	17000	2200000
Sulphur	mg/L	missing	13	ND	91
Tin	ug/L	ND	ND	ND	ND
Uranium	ug/L	ND	ND	ND	ND
Vanadium	ug/L	ND	ND	ND	ND
Zinc	ug/L	44	23	2	3300
Total Petroleum Hydrocarbons	mg/L	4	5	3.6	6.7
Ammonia-N [4]	mg/L	41	9.1	16	230
Phosphorus	mg/L	0.02	0.05	0.04	0.13

ND = Not detected

[4] Ammonia is reported as ammonia-N. This is done so that all nitrogen sources are reported as concentration of N and are then additive to compare to total N. Therefore ammonia-N should always be less than total nitrogen-N.

Table 3-2 Toxicity of Produced Water

Toxicity Test	96 Hour LC50/IC50 Value (95% confidence limits in brackets)		
	Thebaud	Venture	S. Venture
Threespine Stickleback Fish Toxicity	11.7% (9.41-14.5%)	4.4% (3.3-5.9%)	19.0% (15.3-23.6%)
Microtox	3.68% (3.61-3.76%)	1.27% (1.02-1.58%)	--
Sea Urchin Fertilization	2.58% (2.09-3.32%)	--	--

[Note: LC50 is the medial lethal concentration, i.e., the concentration of material in the water that is estimated to be lethal to 50% of the test organisms.]

Attachments

Attachment 3-1 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.

Produced Water / Filtration of Produced Water / Sub-Sampling Procedures / Salinity, pH, Oxygen

N/A to laboratory

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

Inorganics (SPM)

N/A to laboratory

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.

Quality Control

Blank samples can be supplied by the client to run as samples within the laboratory. They will be treated the same as all other samples.

Field and Trip blanks can be supplied to the client upon request and can be run as actual samples.

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

General Info on Sampling / Preparing to go to the field / Locating Site Stations / Field Notes / Observations

N/A to laboratory

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

Sampling Collection Methods

N/A to laboratory

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

Other Considerations

N/A to laboratory

Attachment 3-2 Letter from Harris Industrial Testing Service



HARRIS INDUSTRIAL TESTING SERVICE LTD.

1320 Ashdale Rd. RR #1 Mt. Uniacke

Nova Scotia B0N 1Z0

Phone: 902 757-0232 Fax: 902 757-0973

E-mail: hits@ns.sympatico.ca

Jan. 10 2006

Geoff Hurley
Hurley Environment Ltd.

Re : Produce Water Toxicity Tests

Dear Geoff:

As you are aware, there is no Pass/Fail criteria for these tests. I do not know which well was sampled for the produce water as the sample information sheet we supplied was not submitted.

In 2000, I tested Venture, Thebaud and North Triumph using Threespine Stickleback (TSS) and Echinoid Fertilization. The results follow:

	Echinoid Fertilization	TSS
Venture	IC50: 35.6%	LC50: 64%
North Triumph	IC50: 5.3%	LC50: 17.6%
Thebaud	IC50: 19.3%	LC50: 39%

These results are comparable to the TSS (33%) and Echinoid Fertilization (7.8%) achieved with the 2005 tests. I have no historical data for the Microtox test, however with an IC50 of 1.33%, it would be considered to be toxic.

I have no idea of the correlation between these tests as there is little data to compare.

Please contact me if you require further information.

Regards,

Gary Harris

Attachment 3-3 Fish Toxicity Report – Thebaud Jan. 11, 2007

Client: Amec Earth & Environmental	Test Facility: Harris Industrial Testing Service Ltd.
Address: 32 Troop Ave. Unit 301 Dartmouth, N.S. B3B 1Z1	Location: 1320 Ashdale Rd., South Rawdon, RR#1 Mt. Uniacke Nova Scotia, Canada B0N 1Z0 Tel: 902 757-0232
Contact: Aubrey Beaver	Fax: 902 757-0973 E-mail: HITS@ns.sympatico.ca
This laboratory is accredited by the Canadian Association for Environmental Analytical Laboratories. The test included in this report is within the scope of this accreditation.	

Sample Data

Sample/Location	Thebaud Platform Produced Water TN00796-1	Lab ID. #	7-20
Sampling Method	Not supplied by client	Sampler	Not supplied by client
Date/Time Collected	Jan. 11 2007 -- Hrs	Received	Jan. 15 2007
Date/Time Started	Jan. 15 2007 1445 Hrs	Completed	Jan. 19 2007 1445 Hrs

Test Conditions

Based on Method: EPS 1/RM/10 July 1990	Volume: 13 L	Number of fish:
LC50 Lab Method ID: Tox 9B	Depth: 23.0 cm	Control: 10 Test: 10
Test Organism: Threespine stickleback	Mean wet weight:	Mean fork length:
Batch #: 15	0.80 g $\pm$ 0.17 g SD	38.6 mm $\pm$ 1.99 mm SD
Stock Tank Mortality: 0 % 1-5 days prior to test	Range: 0.49 g - 0.99 g	Range: 35 mm - 41 mm
Dilution Water: Seawater	Loading Density: * 0.61 g/L	Sample Homogenized: Yes
Aeration: Continuous by Airstone	Conductivity: -- μ S/cm	Mandatory 30 minute pre-aeration:
Rate: 6.5 $\pm$ 1 ml/min/L	Salinity of Sample: 30 ppt	Time: 1415 hrs D.O.: 6.9 mg/L
Test Duration: 96 hours	Control: 28 ppt	Continued: min. @ hrs
Test Temperature: 15 $\pm$ 1 °C	Pre-test Temperature: 12.5 °C	Primary Analyst(s):
Temperature of sample upon receipt: 30.0 °C	Pre-test D.O.: 6.2 mg/L	G. Harris & A. Huybers
	Pre-test pH: 6.0 Adj: No	

Test Parameters

Initial					Final			Test Results	
Conc. %	Temp. °C	D.O. mg/L	pH	Sal. ppt	Temp. °C	D.O. mg/L	pH	Dead #	Comments
100	14.0	6.9	6.2	30	14.5	7.6	6.5	10/10	All dead @ 19.15 hrs.
50	14.0	8.4	6.6	29	14.5	7.8	6.9	10/10	All dead @ 19.15 hrs.
25	14.0	8.7	6.9	29	14.5	7.9	7.4	10/10	All dead @ 19.15 hrs.
12.5	14.0	8.8	7.3	28	15.0	8.2	7.7	6/10	2 dead @ 19.15 hrs. 6 dead @ 43.15 hrs.
6.25	14.0	8.8	7.5	28	15.0	8.1	7.8	0/10	
Ctl	14.0	8.9	7.6	28	15.0	8.5	7.8	0/10	

96 Hour LC₅₀ Value = **11.7%** 95% Confidence Limits: 9.41 % - 14.5 % Statistical Method: Spearman Karber – Toxstats

Reference Toxicant on Phenol Batch 15	96 Hour LC ₅₀ for Phenol: 21.6 mg/L	95% Conf. Limits: 17.0 – 27.3 mg/L
Historical Phenol Mean: 16.8 mg/L	Warning Limits $\pm$ 2 SD: 12.8 – 22.0 mg/L	Date: Jan. 16 – 20 2007

Comments: Sample description: Clear and clean with a strong hydrocarbon odour. Colour change to orange in all concentrations overnight. Non-conformance: Loading density exceeded by 0.11 g/L due to volume of effluent supplied and size of fish. Report on file.

Transcribed by: C. Harris x A. Huybers G. Harris

Authorized by: G. Harris x A. Huybers Date: Jan. 22 2007

2006 Annual Report - Offshore Environmental Effects Monitoring Program
Section 3 Produced Water Chemistry and Toxicity

Fish Toxicity Report – South Venture July 7, 2006

Client: ExxonMobil Canada	Test Facility: Harris Industrial Testing Service Ltd.
Address: Founders Square Halifax, N.S.	Location: 1320 Ashdale Rd., South Rawdon, RR#1 Mt. Uniacke Nova Scotia, Canada B0N 1Z0 Tel: 902 757-0232
Contact: Megan Tuttle	Fax: 902 757-0973 E-mail: HITS@ms.sympatico.ca
This laboratory is accredited by the Canadian Association for Environmental Analytical Laboratories The test included in this report is within the scope of this accreditation.	

Sample Data

Sample/Location	South Venture Platform Produced Water	Lab ID. #	6-301
Sampling Method	Grab	Sampler	Scott Stirling
Date/Time Prepared	July 07 2006 1400 Hrs	Received	July 07 2006
Date/Time Started	July 09 2006 1345 Hrs	Completed	July 13 2006 1345 Hrs

Test Conditions

Based on Method: EPS 1/RM/10 July 1990	Volume: 10 L	Number of fish:
LC50 Lab Method ID: Tox 9B	Depth: 17.7 cm	Control: 10 Test: 10
Test Organism: Threespine stickleback	Mean wet weight:	Mean fork length:
Batch #: 12	0.36 g $\pm$ 0.09 g SD	34.4 mm $\pm$ 3.57 mm SD
Stock Tank Mortality: 0 % 1-5 days prior to test	Range: 0.20 g - 0.45 g	Range: 28 mm - 38 mm
Dilution Water: Seawater	Loading Density: 0.36 g/L	Sample Homogenized: No
Aeration: Continuous by Airstone	Conductivity: 73.2 ms/cm	Mandatory 30 minute pre-aeration:
Rate: 6.5 $\pm$ 1 ml/min/L	Salinity of Sample: 46 ppt	Time: 1315 hrs D.O.: 5.6 mg/L
Test Duration: 96 hours	Control: 30 ppt	Continued: ___ min. @ ___ hrs
Test Temperature: 15 $\pm$ 1 °C	Pre-test Temperature: 20.0 °C	Primary Analyst(s):
Temperature of sample upon receipt: 30.0 °C	Pre-test D.O.: 4.3 mg/L	G. Harris & A. Huybers
	Pre-test pH: 5.6 Adj: No	

Test Parameters

Initial					Final			Test Results	
Conc. %	Temp. °C	D.O mg/L	pH	Sal. ppt	Temp. °C	D.O mg/L	pH	Dead #	Comments
100	14.0	6.8	5.8	46	14.0	7.0	6.1	10/10	All dead @ 4 hrs.
50	14.0	7.5	6.7	38	16.0	6.3	7.0	10/10	All stressed @ 4 hrs. All dead @18 hrs.
25	14.5	7.7	7.1	34	16.0	6.9	7.4	8/10	All stressed @ 4 hrs. 4 dead @18 hrs. 6 dead @ 44 hrs. 7 dead @ 69 hrs. 8 dead @ 96 hrs.
12.5	14.5	7.7	7.4	32	16.0	8.3	7.9	1/10	1 dead @ 69 hrs.
6.25	15.0	7.8	7.7	31	15.5	8.2	8.1	0/10	
Ctl	15.0	7.8	8.0	30	15.5	8.2	8.1	1/10	1 dead @ 69 hrs.

96 Hour LC₅₀ Value = 19.0 % 95% Confidence Limits: 15.3 % - 23.6 % Statistical Method: Probit – Toxstat 3.5

Reference Toxicant on Phenol Batch <u>12</u>	96 Hour LC ₅₀ for Phenol: <u>----</u> mg/L	95% Conf. Limits: <u>----</u> - <u>----</u> mg/L
Historical Phenol Mean: <u>----</u> mg/L	Warning Limits $\pm$ 2 SD: <u>----</u> - <u>----</u> mg/L	Date: <u>-----</u>

Comments: Sample description: Clear and colourless with a strong petroleum odour. Updated Reference toxicant data to follow.

Transcribed by: C. Harris x A. Huybers _____ G. Harris _____

Authorized by: G.Harris _____ A. Huybers x Date: July 13 2006

2006 Annual Report - Offshore Environmental Effects Monitoring Program
Section 3 Produced Water Chemistry and Toxicity

Fish Toxicity Report – Venture Nov. 1, 2006

Client: ExxonMobil Canada	Test Facility: Harris Industrial Testing Service Ltd.
Address: Founders Square Halifax, N.S.	Location: 1320 Ashdale Rd., South Rawdon, RR#1 Mt. Uniacke Nova Scotia, Canada B0N 1Z0 Tel: 902 757-0232
Contact: Megan Tuttle	Fax: 902 757-0973 E-mail: HTS@ns.sympatico.ca

*This laboratory is accredited by the Canadian Association for Environmental Analytical Laboratories
The test included in this report is within the scope of this accreditation.*

Sample Data

Sample/Location	Venture Platform Produced Water Overboard	Lab ID. #	6-487
Sampling Method	Grab	Sampler	Gary Faulkner
Date/Time Prepared	Nov. 01 2006 0740 Hrs	Received	Nov. 01 2006
Date/Time Started	Nov. 02 2006 1315 Hrs	Completed	Nov. 06 2006 1315 Hrs

Test Conditions

Based on Method: EPS 1/RM/10 July 1990	Volume: 10 L	Number of fish:
LC50 Lab Method ID: Tox 9B	Depth: 17.7 cm	Control: 10 Test: 10
Test Organism: Threespine stickleback	Mean wet weight:	Mean fork length:
Batch #: 15	0.28 g $\pm$ 0.08 g SD	33.3 mm $\pm$ 2.79 mm SD
Stock Tank Mortality: 0 % 1-5 days prior to test	Range: 0.17 g - 0.38 g	Range: 29 mm - 37 mm
Dilution Water: Seawater	Loading Density: 0.28 g/L	Sample Homogenized: Yes
Aeration: Continuous by Airstone	Conductivity: 218 ms/cm	Mandatory 30 minute pre-aeration:
Rate: 6.5 $\pm$ 1 ml/min/L	Salinity of Sample: >150 ppt	Time: 1245 hrs D.O.: 6.1 mg/L
Test Duration: 96 hours	Control: 30 ppt	Continued: ___ min. @ ___ hrs
Test Temperature: 15 $\pm$ 1 °C	Pre-test Temperature: 17.0 °C	Primary Analyst(s):
Temperature of sample upon receipt: 30.0 °C	Pre-test D.O.: 6.2 mg/L	A. Huybers
	Pre-test pH: 5.9 Adj: No	

Test Parameters

Initial					Final			Test Results	
Conc. %	Temp. °C	D.O. mg/L	pH	Sal. ppt	Temp. °C	D.O. mg/L	pH	Dead #	Comments
100	16.0	6.1	5.9	>150	15.0	6.2	6.2	10/10	All dead @ 20.75 hrs.
50	16.0	7.5	6.7	116	15.0	7.2	6.6	10/10	All dead @ 20.75 hrs.
25	16.0	7.6	7.0	72	15.5	7.1	7.0	10/10	All dead @ 20.75 hrs.
12.5	15.0	7.8	7.2	50	15.0	7.3	7.4	10/10	All dead @ 20.75 hrs.
6.25	15.0	7.6	7.3	36	14.5	7.9	7.7	6/10	2 dead @ 20.75 hrs. 3 dead @ 45 hrs. 6 dead @ 92.75 hrs.
3.13	14.5	8.3	7.7	33	14.5	7.9	7.8	4/10	1 dead @ 45 hrs. 3 dead @ 68.75 hrs. 6 dead @ 92.75 hrs.
1.57	14.5	8.1	7.8	33	14.5	7.9	7.8	0/10	
Ctl	15.5	8.4	8.0	30	14.5	8.0	7.9	0/10	

96 Hour LC₅₀ Value = 4.4 % 95% Confidence Limits: 3.3 % - 5.9 % Statistical Method: Probit – Toxstat 3.5

Reference Toxicant on Phenol Batch <u>15</u>	96 Hour LC ₅₀ for Phenol: <u>16.5 mg/L</u>	95% Conf. Limits: <u>14.5 – 18.8 mg/L</u>
Historical Phenol Mean: <u>16.4 mg/L</u>	Warning Limits $\pm$ 2 SD: <u>12.8 – 21.0 mg/L</u>	Date: <u>Nov. 02 – 06 2006</u>

Comments: Sample description: Orange in colour and opaque with a petroleum odour.

Transcribed by: C. Harris x A. Huybers _____ G. Harris _____

Authorized by: G. Harris _____ A. Huybers x Date: Nov. 06 2006

Attachment 3-4

Environment Canada Toxicology Laboratory Report –Venture Nov. 1, 2006

Environment Canada, Toxicology Laboratory, Moncton, NB

Page 1 of 3
Version: June 12, 2006

Microtox Water Samples Reporting Form

Test Method: Environmental Protection Series Biological Test Method: Toxicity Test Using Luminescent Bacteria (*Photobacterium phosphoreum*) EPS/1 RM/24 November 1992

Test Organism: *Vibrio fischeri* (previously known as *Photobacterium phosphoreum*)

Client	Harris Industrial Testing Limited
Client Sample ID (location etc.)	Produce Water from EXXON/MOBIL Venture
Station Number	Information not available
Date and Time Collected	01 November 2006 @ 07:40
Sample collected By	Information not available
EQL Sample Number	2006002310
Report ID(s)	T804
Sample Matrix	Water
Sampling Method	Information not available
Sample Description (color, etc.)	Light red in colour with a petroleum odor
Temperature upon arrival in the lab (°C)	8.1

Date and Time Tested	03 November 2006 @ 11:50
Analyst	Troy Steeves
Analyser	Microtox 500
Operating Software	Microtox Omni Version 1.18
Test temperature	15 ± 0.5 °C
Test duration	15 minutes
Water Quality Measurements	T (°C) = 8.1 DO (mg/L) = 5.1 pH = 5.67 Salinity (ppt) = >150 Conductivity (µS/cm) = >200 000
Batch # of organisms	5G1062
Expiry Date of organisms	July 2007
Date organisms arrived	22 February 2006
Holding temperature	-16 to -34 °C
Test type (basic, 100%)	Basic
Salinity adjustment description	None performed
Diluent used	28ppt seawater
Color correction Performed	None performed

Reference toxicant	Zn
Date tested	03 November 2006
Organism Batch Number	5G1062
IC50 (95% confidence limits)	1.27 mg/L (1.02 – 1.58)
Historical Mean and warning limits	1.21 mg/L (0.874 – 1.67)

Results are on attached sheet.

Verified By:

[Signature]

Date:

Nov 16/06

The results reported relate only to the sample as submitted to and tested by the laboratory.

This report shall not be reproduced, except in full, without written approval of the lab.

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MicrotoxOmni Test Report

Date: -- 11/3/2006

Test Protocol: Basic-type Test

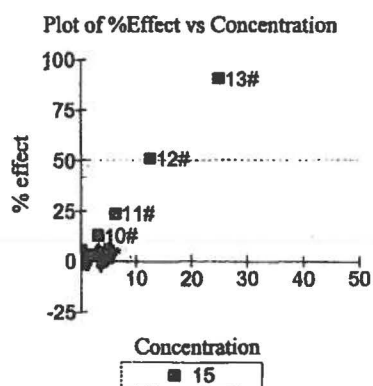
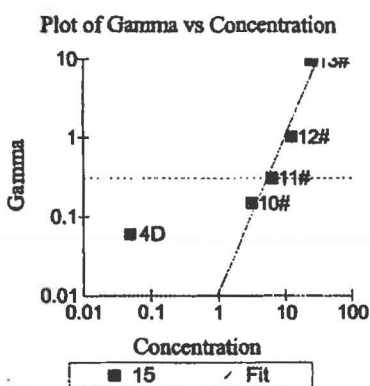
Sample: 2006002310

Toxicant:

Reagent Lot no.:

Test description: 2006002310

Data File: 2006002310.K15;



15 Mins Data:

Sample	Conc	lo	It	Gamma	% effect
Control	0.000	92.50	75.26	0.8136 #	
1	0.0061	82.13	66.10	0.0109 *	1.082%
2	0.0122	86.06	67.39	0.0390 *	3.756%
3	0.0244	85.84	66.73	0.0466 *	4.455%
4	0.0488	83.87	64.35	0.0604 D	5.698%
5	0.0976	85.70	69.74	-0.0001 *	-0.0181%
6	0.1953	80.96	65.42	0.0068 *	0.6844%
7	0.3906	84.69	69.98	-0.0153 *	-1.559%
8	0.7813	82.19	66.39	0.0072 *	0.7201%
9	1.563	86.56	67.98	0.0360 *	3.475%
10	3.125	91.29	64.75	0.1471 #	12.82% → 34 ppt
11	6.250	87.04	54.13	0.3083 #	23.56% → 40 ppt
12	12.50	85.42	34.22	1.031 #	50.76% → 50 ppt
13	25.00	84.96	6.52	9.602 #	90.57% → 72 ppt
14	50.00	89.44	0.45	160.7 *	99.38% → 115 ppt

Test solution Salinity (ppt)

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

Calculations on 15 Mins data:

EC50 Concentration: 9.722% (95% confidence range: 5.510 to 17.15)

95% Confidence Factor: 1.765

Estimating Equation: $\text{LOG C} = 0.4756 \times \text{LOG G} + 0.9877$

Coeff. of Determination (R^2): 0.9429

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Slope: 1.983
Correction Factor: 0.8136

There is no QA data available for this test.

Signature: _____



Printed: 11/3/2006 03:52 PM

Stantec Toxicology Laboratory Report -Thebaud Jan. 11, 2007

Stantec Consulting Ltd.
118 Nicholas Beaver Road RR3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419
stantec.com

MICROTOX® ACUTE TOXICITY
TEST REPORT
Page 1 of 2



Stantec

Work Order : 210804
Sample Number : 17757

SAMPLE IDENTIFICATION

Company :	Harris Industrial Testing Service Ltd.	Time Collected :	Not given
Location :	South Rawden NS	Date Collected :	2007-01-11
Substance :	Produced Water TN 00796-1	Date Received :	2007-01-17
Sampling Method :	Not given	Date Tested :	2007-01-17
Sampled By :	Not given	Temp. on arrival :	3.0°C
Sample Description:	Clear, colourless, 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	3.68%	3.61-3.76	Least Square Regression

The results reported relate only to the sample tested.

REFERENCE TOXICANT DATA

Batch # :	6A1034	15 minute IC50 :	1.12 mg/L
Expiry Date :	2008/01	95% Confidence Limits :	1.04 - 1.20 mg/L
Date Tested (yyyy-mm-dd) :	2007-01-12	Historical Mean IC50 :	1.41 mg/L
Reference Substance :	Zinc (as zinc sulphate)	Warning Limits ($\pm$ 2SD) :	0.51 - 2.45 mg/L
Statistical Method :	Least Square Regression	Analyst(s):	RD/AS

CONDITIONS OF ACUTE MICROTOX TEST

Test Organism (Batch #) :	<i>Vibrio fischeri</i> (6A1034)	Observation Times (minutes) :	15
Date Received (reagent) :	2006-11-22	Sample pH :	6.2
Reagent Holding Temp. (°C):	-20	pH Adjustment :	None
Model # of Analyser :	M500	Sample Aeration :	None
Test Well Temperature (°C) :	15.0 $\pm$ 0.3	Salinity Adjustment :	2% NaCl
Highest Concentration Tested :	50.0%	Dilution Water :	SDI Diluent
Number of Controls :	2	Sample Storage (°C) :	4 $\pm$ 2
No. of Concentrations Tested :	8	Colour Correction :	None
Number of Replicates :	2	Analyst(s):	JP

Noted Deviation(s): The sample was received by the laboratory on 2007-01-17, three days after the maximum sample holding time, as specified by the test method, was exceeded. The client was notified and testing initiated upon request of the client. There were no other unusual conditions or deviations from the test protocol.

Date: 2007-01-26

Approved by: J. Pandey
Project Manager

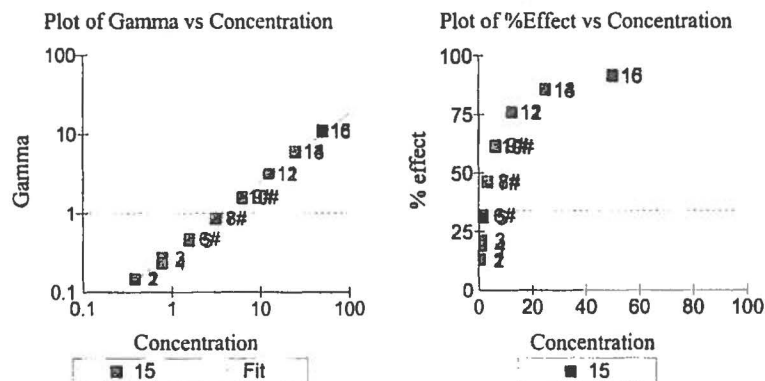
Certified by the Canadian Association of Environmental Analytical Laboratories (CAEAL)

2006 Annual Report - Offshore Environmental Effects Monitoring Program
Section 3 Produced Water Chemistry and Toxicity

Stantec

Work Order : 210804
Sample Number : 17757

Page 2 of 2



15 Mins Data:

Sample	Conc	lo	It	Gamma	% effect
Control	0.000	95.55	85.37	0.8935 #	
Control	0.000	97.56	88.35	0.9056 #	
Control	0.000	96.91	87.09	0.8987 #	
Control	0.000	93.75	87.34	0.9316 #	
1	0.3906	94.98	75.08	0.1478	12.88%
2	0.3906	94.98	75.16	0.1466	12.79%
3	0.7813	96.46	68.87	0.2708	21.31%
4	0.7813	93.62	68.86	0.2336	18.94%
5	1.563	94.53	59.11	0.4510	31.08%
6	1.563	95.50	58.90	0.4712 #	32.03%
7	3.125	97.99	48.02	0.8515 #	45.99%
8	3.125	98.25	47.74	0.8673 #	46.45%
9	6.250	94.27	32.68	1.617 #	61.79%
10	6.250	93.19	32.73	1.583 #	61.29%
11	12.50	95.26	20.69	3.178	76.06%
12	12.50	99.10	21.56	3.171	76.02%
13	25.00	93.86	12.31	5.918	85.55%
14	25.00	95.55	12.27	6.066	85.85%
15	50.00	96.09	7.17	11.16	91.78%
16	50.00	93.49	7.19	10.80	91.52%

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

Calculations on 15 Mins data:
IC50 Concentration: 3.684% (95% confidence range: 3.607 to 3.763)
95% Confidence Factor: 1.021
Estimating Equation: $\text{LOG C} = 1.130 \times \text{LOG G} + 0.5664$
Coeff. of Determination (R^2): 0.9995
Slope: 0.8842
Correction Factor: 0.9073

Signature: _____

John Pickett

Attachment 3-5

Stantec Sea Urchin Laboratory Report -Thebaud Jan. 11, 2007

Stantec Consulting Ltd.
118 Nicholas Beaver Road RR3
Guelph ON N1H 6H9
Tel: (519) 763-4412 Fax: (519) 763-4419
stantec.com

Sea Urchin Test Report
Fertilization Inhibition
1 of 3



Stantec

Work Order : 210804
Sample Number : 17757

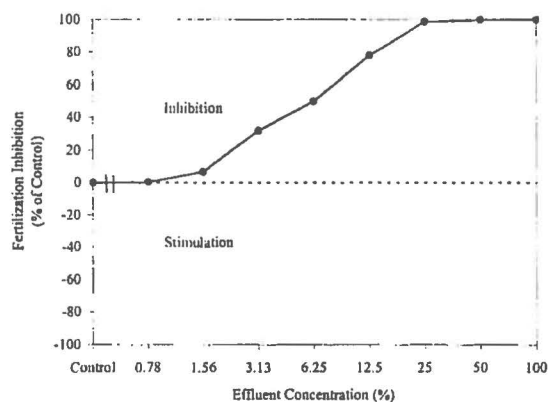
Sample Identification

Company :	Harris Industrial Testing Service Ltd.	Date Collected :	2007-01-11
Location :	South Rawden NS	Time Collected :	Not given
Substance :	Produced Water TN 00796-1	Date Received :	2007-01-17
Sampling Method :	Not given	Time Received :	13:30
Sampled By :	Not given	Date Tested :	2007-01-17
Shipped By :	Fed Ex/Rd	Lab Storage:	4±2 °C
Temp. on arrival :	3.0 °C		
Sample Description:	Clear, colourless, mild odour.		

Test Results

Effect	Value	95% Confidence Limits	Statistical Method
IC25 (Reproduction)	2.58%	2.09-3.32	Linear Interpolation (Toxstat 3.5) b

Sea Urchin Reproductive Inhibition



2006 Annual Report - Offshore Environmental Effects Monitoring Program
Section 3 Produced Water Chemistry and Toxicity

Stantec

Sea Urchin Test Report

Fertilization Inhibition

2 of 3

Work Order : 210804
Sample Number: 17757

Test Conditions

Test Organism ^a	: <i>Lytechinus pictus</i>	Test Type	: Static non-renewal
Gamete Batch	: Ur07-01-01	Test Volume (per replicate)	: 10 mL
Source	: Stantec in-house culture	Test Solution Depth	: 3 cm
Life Stage	: Gamete (sperm / egg)	Test Vessel	: 20 mL scintillation vial
Mean Organism Mortality	: 0% (previous 7 days)	Exposure Time (Sperm)	: 10 minutes
Salinity Adjustment ^c	: None	Exposure Time (Eggs)	: 10 minutes
pH Adjustment	: None	# Replicates	: 4
Sample Filtration	: None	Volume sperm suspension	: 0.1 mL per replicate
Sample Pre-aeration Time	: None	Volume of egg suspension	: 1 mL per replicate
Test Aeration	: None	Eggs per replicate	: 2000
Light Intensity	: Ambient lighting (~400 lux)	Sperm per replicate	: 4.0×10^7
Test Temperature	: 20.0 ± 1 °C	Test Initiation Time	: 14:50h
Control/Dilution Water ^d	: Artificial seawater	Analyst(s)	: AS/RD/KJ

^a Test Organism: Adult sea urchins (*Lytechinus pictus*) were obtained from Marinus Scientific (Garden Grove CA USA) following the Environment Canada procedures for the importation of test organisms (September 1999). They were received by the laboratory on November 15, 2006 in good condition. Sea urchins were placed in glass aquaria containing artificial seawater (salinity 30‰ and temperature 12-14°C), and are continually held under these conditions. The organisms were held at the laboratory for a minimum of two weeks prior to collection of the gametes for testing purposes. No organisms exhibiting unusual appearance, behaviour, or undergoing unusual treatment were used as a source of gametes for testing.

^c Salinity Adjustment: The salinity of the effluent sample was adjusted (if applicable) following Environment Canada's Salinity Adjustment Guidance Document (revised December 2001), using the Direct Salt Addition procedure. Prior to test initiation, Instant Ocean[®] Sea Salt was added to the undiluted effluent sample. The dry salt (~30g/L) was added during the stirring of the effluent sample, to achieve a final salinity of 30 ± 2 g/kg. After salinity adjustment, the sample was stored in a closed container with minimal head space at 4 ± 2 °C in darkness. The salinity adjusted sample was held for 16-24 hours before use in toxicity testing.

^d Control/Dilution Water: Artificial seawater was prepared in advance over the course of 3 or 4 days by adding Instant Ocean[®] salts to reverse osmosis water at a rate of 6.8 kg per day. The water was then left to age for a period of two weeks, after which it was filtered prior to use. During the entire process, the water was continuously aerated.

Test Protocol: Biological Test Method: Fertilization Assay Using Echinoids (Sea Urchins and Sand Dollars).
Environment Canada Report EPS 1/RM/27, December 1992 (with November 1997 amendments) with deviation(s) as noted below.

Comments/Deviations

The sample was received by the laboratory on 2007-01-17, three days after the maximum sample holding time, as specified by the test method, was exceeded. The client was notified and testing initiated upon request of the client. There were no other unusual conditions or deviations from the test protocol.

Reference Toxicant Data

Substance	: Copper (as Copper Sulphate)	Historical Mean IC25	: 145.5 µg/L
Test Date	: 2007-01-17	Historical Warning Limits (±2SD)	: 57.7-382.9
Test Duration	: 20 minutes	Statistical Method	: Linear Interpolation ^b
IC25 Fertilization	: 119.9 µg/L	Gamete Batch	: Ur07-01-01
95% Confidence Limits	: 115.4-122.3	Analyst(s)	: A. Sobaszek/R. Dorosz

The reference toxicant test was conducted under conditions identical to the test.

References

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

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

Date: 2007-01-26

Approved By: 
Project Manager

2006 Annual Report - Offshore Environmental Effects Monitoring Program
Section 3 Produced Water Chemistry and Toxicity

Stantec

Sea Urchin Test Report
Fertilization Inhibition
3 of 3

Work Order : 210804
Sample Number : 17757

FERTILIZATION (%)

Concentration (%)	Replicate				Average	Standard Deviation	CV (%)
	A	B	C	D			
Control	84	93	86	90	88.3	4.0	4.6
Blank	0	0	0	0	0.0	0.0	-
0.39	nc	nc	nc	nc	-	-	-
0.78	91	85	89	87	88.0	2.6	2.9
1.56	76	81	81	91	82.3	6.3	7.6
3.13	60	57	55	68	60.0	5.7	9.5
6.25	39	42	55	41	44.3	7.3	16.4
12.5	21	19	21	17	19.5	1.9	9.8
25	1	0	1	3	1.3	1.3	100.7
50	0	0	0	1	0.3	0.5	200.0
100	0	0	0	0	0.0	0.0	-

nc = not counted

Initial Water Chemistry (100% Effluent)

	Temp. (°C)	pH	Dissolved O ₂ (mg/L)	O ₂ Sat. (%)*	Salinity (‰)	Pre-aeration Time (h) ^{1,2}
Initial Chemistry:	20.0	6.0	7.3	100	30	-
Chemistry after Salinity Adjustment ¹ :	-	-	-	-	-	-
Chemistry after Pre-Aeration ^{1,2} :	-	-	-	-	-	-

Exposure Concentrations Water Chemistry

Concentration (%)	Temp. (°C)	pH	Dissolved O ₂ (mg/L)	O ₂ Sat. (%)*	Salinity (‰)
100	20.0	6.6	7.2	93	30
50	-	-	-	-	-
25	-	-	-	-	-
12.5	-	-	-	-	-
6.25	20.0	8.0	7.1	93	32
3.13	-	-	-	-	-
1.56	-	-	-	-	-
0.78	-	-	-	-	-
0.39	20.0	8.1	7.1	95	32
Blank	-	-	-	-	-
Control	-	-	-	-	-

* % saturation, adjusted for barometric pressure

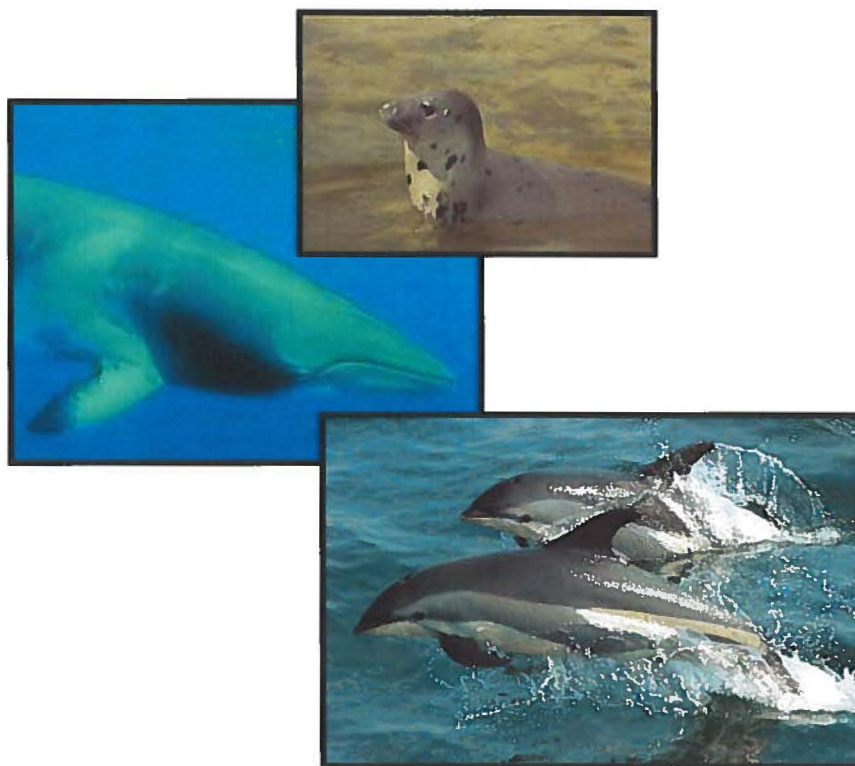
"-" not measured

¹ if applicable

² @ <100 bubbles/min

Data Reviewed By : JS
Date : 2007-01-25

4 UNDERWATER NOISE AND MARINE MAMMALS



4.1 Background

A representative of the Offshore Oil and Gas Program (OGOP) Ltd., trained in marine mammal identification was contracted by ExxonMobil make observations marine mammals and sea turtles during the pile-driving activities related to installation of the compression platform by the Saipem S7000 at the Thebaud site over the period May 11 to 24, 2006. Observations were to be made using a protocol approved by the CNSOPB (refer to Section 4.4).

Underwater noise from piledriving for the compression platform may attract or repel marine mammals and sea turtles. Noise monitoring during pile driving at the SOEP Venture site, with hammer impacts occurring in air, was recorded at 170-175 dB @ 1.5 and 1.9 km (respectively) broadband (45-7070 Hz) during installation of the Venture platform [1].

Since pile-driving technology and methods for installation of the compression platform will be similar to those used at Venture, noise levels that may cause hearing damage (> 180 dB) or some temporary behavioural changes (>170 dB) in marine mammals [2] should be restricted to within a 500-m safety zone and visual range of the observer located on the Saipem 7000.

4.2 Goal

To carry out observations for marine mammals and sea turtles during pile-driving activities for the installation of the compression platform by the Saipem S7000 at the Thebaud site.

4.3 Objective

Record marine mammal sightings prior to the start-up of pile driving operations, during pile driving operations, and prior to any re-starts.

4.4 2006 Sampling

Contractor: Oil and Gas Observer Program Canada Ltd. (OGOP)

Collection Date(s):	May 11 to 24, 2006
Platform:	Saipem S7000 at Thebaud platform
Type of Sample:	Visual observations of marine mammals and seabirds.
Test Sample Locations:	A safety zone of 500 m around the S7000 to be monitored for 30 min before pile driving start-up and re-starts; with starting delayed if a sea turtle or whale, other than a dolphin or porpoise, is seen within the safety zone, until the sea turtle or whale has not been observed within the safety zone for at least 30 minutes. If a designated endangered or threatened whale or sea turtle (i.e. Blue whale, Northern Bottlenose whale, Atlantic Right whale, or Leatherback turtle) is observed within the 500-m safety zone, immediate shut down of the pile driving operations would occur.
Reference Sample Locations:	NA
Sample Preparation:	Completion of data observation sheets
Equipment:	Binoculars
Sampling QA/QC:	Observer attended a familiarization meeting with a biologist at the Bedford Institute of Oceanography (Fisheries and Oceans Canada) in advance of deployment to discuss marine mammal observation protocols.

4.5 Parameters Analyzed

Parameters	Analysis Method
Count and classification of marine mammals	A safety zone was to be monitored for 30 min before pile driving start-up and re-starts.

4.6 Results

- The Observer did not sight any marine mammals in the project area prior to or during any pile driving operations, which were completed from 0600 on May 19 until around 11 hrs on May 21, 2006.

- There were three separate observations of marine mammals reported outside the time of pile driving operations. A summary of the three recorded observations is:
 Grey Seals 2 (May 16)
 Minke Whale 1 (May 14)
 Minke Whale 1 (May 18)
- The observer also noted five Minke Whales chasing bait fish at an approximate distance of 700 metres from the S7000, just prior to boarding the helicopter for his return transit home.
- An ROV launched on the seafloor on May 16 by the S7000 revealed two hermit crabs, two other crabs and numerous shrimp.
- On May 19 during pile driving operations an individual on the Thebaud platform adjacent to the S7000 noticed two fish floating in the water that appeared to be dead. The observer, located on the S7000, performed an additional sweep of the pile driving area, but saw no evidence of dead fish or other unusual sights.

The trip report compiled by OGOP Ltd. is attached (Appendix 4-1).

4.7 Summary and Conclusions

Few marine mammals, and no sea turtles, were sighted at Thebaud platform. This was not entirely unexpected, given the presence of trained marine mammal observers during pile-driving operations, the short duration of pile driving (less than 2 weeks), the 30-minute 'ramp up' period prior to commencing 'active' pile-driving operations, and the fact that Thebaud is not located in an area of particular importance for marine mammals and sea turtles.

4.8 References

- [1] Greeneridge Sciences & LGL Ltd. 1999. Piledriving and Vessel Sound Measurements During Installation of a Gas Production Platform Near Sable Island, Nova Scotia, Durin March and April, 1998.
- [2] NMFS. 1998. National Marine Fisheries Service (Office of Protected Resources) Workshop on Acoustic Criteria, Silver Spring, MD, Sept 9-12, 1998.

Attachment 4-1 Final OGOP Report S7000 May 11-24, 2006

ExxonMobil Canada Compression Platform Installation – Pile Driving

S7000, May 11 – 24, 2006

Final OGOP Report

1. Deployment

An OGOP Fisheries Observer was hired to perform observations during the installation of the compression platform pile driving by the Saipem S7000 at the Thebaud site over the period May 11 to 24, 2006. The Observer was involved in this program at the request of Chris Coles, ExxonMobil Canada, as part of a requirement for marine mammal observation during pile driving operations.

The OGOP Observer Wayne Slauenwhite was deployed on this program. Wayne has recently observed other ExxonMobil Tier 2 operations. During the S7000 pile driving operation Wayne conducted routine sea bird and marine mammal observations. He conducted dedicated marine mammal observations during the start-up phase and throughout the pile driving operation period.

Wayne Slauenwhite attended familiarization meetings in advance of deployment to discuss sea bird and marine mammals expectations and observation recordings. These meetings on May 11 involved a sea bird biologist at the Canadian Wildlife Service (of Environment Canada) and a marine mammal biologist at the Bedford Oceanographic Institute (of Fisheries and Oceans Canada). These sessions were organized by Geoff Hurley at the request of ExxonMobil.

Wayne Slauenwhite also participated in mobilization meetings with ExxonMobil personnel and contractors involved in the pile driving operation on May 11 and in the morning of May 12, 2006.

Wayne joined the MV Panuke Sea in Halifax on May 12, 2006 around 1300 hrs and departed for the Thebaud site around 1800 hrs. The vessel arrived at the Sable project on May 13, 2006 around 1200 hrs. He was transferred to the Saipem S7000 at 1500 hrs. He attended a briefing on the S7000 later on the 13th.

The platform was lowered into place by the S7000 on May 16, 2006. Pile driving operations took place from 0600 on May 19 until around 11 hrs on May 21, 2006.

Wayne left the S7000 on May 24, 2006 following completion of the pile driving operation. His transit to Halifax was provided by helicopter, arriving at the heliport around 1600 hrs.

The total work period was 14 days.

2. Fishing Activity

One commercial fishing vessel was observed during the observation period for two days. It was outside the field of operations around 8 miles, at its closest range, to the south east of the S7000. The fishing vessel did not respond to hail attempts.

3. Observation Schedule

The observer was asked to conduct seabird observations during vessel transits and while on the S7000 in accordance with a draft Canadian Wildlife Service (CWS) observation protocol. Marine mammal observations were also to be recorded when sightings were made on a continuous watch basis. Extra marine mammal observations were made prior to the start-up of pile driving operations and re-starts.

Sea Bird Observations:

Individual sea bird observation reports during vessel transits are conducted over three periods each day: daylight, mid-day and sunset, weather permitting. If the vessel is moving less than 4 knots, sea bird observations are made in accordance with the stationary platform protocol which calls for one "snapshot" observation every hour possible during daylight, again weather permitting. The latter is the protocol the Observer following during his days on the S7000.

All seabird observation reports are recorded on paper and then transferred to an electronic summary spreadsheet file developed by CWS. A copy of the spreadsheet containing all sea bird observations during the trip accompanies this report.

There were 84 separate 10 minute snapshot observations made during this deployment using the stationary protocol and 6 observations made during vessel transits. The totals of each sea bird by type observed are as follows, in order of diminishing quantity.

Herring Gulls	92
Great black backed Gull	49
Terns	45
Greater shearwater	30
Northern Gannets	19
Wilson's Storm Petrel	6
Leach's Storm Petrel	2
Manx Shearwater	2
Northern Fulmar	1
Thick Billed Murre	1
Unknown	14

The Observer also made note of land birds that were observed using the S7000 as a resting place. A separate report is included with detailed information. The 5 land birds observed over the May 16 to May 21 period were a Black and White Warbler, a Rose Breasted Grosbeak, a Blackburnian Warbler, a Savannah Sparrow and a Barn Swallow.

Marine Mammal Observations:

Marine mammal observations were conducted from sunrise to sundown on an opportunistic basis during the Observer's normal observation period on the bridge and elsewhere on the vessel. Specific periods of observations for pile driving operations were also established in accordance with the environmental program established for the project in which the Observer followed a protocol approved by the CNSOPB. The protocol involved:

A safety zone of 500 m around the S7000 to be monitored for 30 min before pile driving start-up and re-starts; with starting delayed if a sea turtle or whale, other than a dolphin or porpoise, is seen within the safety zone, until the sea turtle or whale has not been observed within the safety zone for at least 30 minutes.

If a designated endangered or threatened whale or sea turtle (i.e. Blue whale, Northern Bottlenose whale, Atlantic Right whale, or Leatherback turtle) is observed within the 500-m safety zone, immediate shut down of the pile driving operations would occur.

Discussions during mobilization covered the expected type of marine mammals to be observed in the area at the time, given the season and knowledge of the area.

The Observer did not sight any marine mammals in the project area prior to or during any pile driving operations, which were completed from 0600 on May 19 until around 11 hrs on May 21, 2006.

The Observer was assisted in his observations by crew members would check for marine mammals during normal bridge operations and inform the observer if a marine mammal was sighted. The observer spent every available daylight hour on watch.

There were three separate observations of marine mammals reported, copies of which have been submitted with this report. In addition, just prior to boarding the helicopter for his

return transit home the Observer noted five Minke Whales chasing bait fish at an approximate distance of 700 metres from the S7000. He was unable to determine any additional information to complete a report. A summary of the three recorded observations is:

Grey Seals 2 (May 16)
Minke Whale 1 (May 14)
Minke Whale 1 (May 18)

4. General

The only additional related activity carried out by the Observer occurred during the placement of the platform on the sea floor on May 16 by the S7000. When an ROV was launched the Observer watched the ROV camera to scan the bottom for any debris and to see the pipeline. There was little marine life around the area, with the exception of two hermit crabs, two other crabs and lots of shrimp.

Finally, one other minor observation is worthy of note. On May 19 during pile driving operations an individual located on the Thebaud platform adjacent to the S7000 noticed two fish floating in the water that appeared to be dead. Upon receiving this information the Observer performed an additional sweep of the pile driving area, the waters closest to the Thebaud platform and looked downstream/downwind from the S7000 but did not see any evidence of dead fish or other unusual sights. He concluded that the Thebaud platform observation was an isolated incident and was not necessarily associated with the pile driving operations.

OGOP is pleased to have been able to serve ExxonMobil's observation requirements during the Sable project Tier 2 development including the pile driving off the S7000.

Wayne Slauenwhite
May 24, 2006

Jay Lugar
May 31, 2006

5 AIR QUALITY



Photo of Sable Island Horses courtesy Sable Island Green Horse Society

TO BE COMPLETED WHEN DATA AVAILABLE FROM ENVIRONMENT CANADA

6 SEABIRD MONITORING



Photo: Sable Island Green Horse Society



Photo source: <http://www.capecodbirds.org/bbcpelagic070806/bbcpelagic070806.htm>

6.1 Background

Data on the offshore distribution and abundance of marine birds are required in order to identify and minimize the impacts of human activities at sea on birds. Data provide information for environmental assessments for offshore developments, and will help identify areas where birds are at high risk for oil pollution, and other human activities. The primary objective for the Canadian Wildlife Service monitoring program is to map the relative abundance and distribution of pelagic birds in Atlantic Canada. Ships-of-opportunity are used to transport seabird observers to offshore areas throughout the region, and prioritize areas that can be surveyed across multiple seasons and years.

Seabird monitoring observations have been made on a relatively continuous basis at the Thebaud production platform since 1999 by independent observers supplied by Offshore Oil and Gas Observer Group Ltd. (OGOP). The OGOP received training in seabird identification from various experts including CWS biologists. These observations cannot be used to assess the impact of the attraction of seabirds to the platform. In 2005, as an alternative to regular observations at a single location, a transect gradient approach was adopted - systematic observations of seabirds along vessel transits to/from offshore platforms, thus enabling investigation of the possible attraction of seabirds to a platform. Observations were taken in this manner, as well, for the 2006 EEM program aboard the supply vessel Hebron Sea in September, between Halifax Harbour and Thebaud.

NOTE: Incidental seabird observations were also made at Thebaud from May 11-24, 2006 by an OGOP Ltd observer on the Saipem S7000 while monitoring possible effects of noise on sea turtles and marine mammals during pile driving activities for the installation of the compression platform (See Attachment 4-1).

6.2 Goal

Collect data on the abundance and distribution of seabirds to determine the extent of attraction of an offshore oil and gas platform to pelagic seabirds.

6.3 Objective

Quantify seabird abundance and distribution along transects between Halifax Harbour and Thebaud processing platform.

6.4 2006 Sampling

Reporting Organization: Hurley Environment Ltd. in association with Environment Canada

Collection Date(s):	16, 17, 18, September 2006
Platform:	Hebron Sea

Type of Sample::	Visual observations of seabirds in accordance with Canadian Wildlife Service Protocol [1].
Test Sample Locations:	A total of 59 10-min surveys were conducted while the vessel was in transit over a 3 day period between Halifax and Thebaud platform.
Reference Sample Locations:	Observations along vessel tracks outside the immediate vicinity of the platforms
Sample Preparation:	CWS data sheets then archived in Microsoft Access Database
Equipment:	Binoculars
Sampling QA/QC:	Observations were made by Canadian Wildlife Service seabird biologist, following a standardized protocol [1]. 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 300m wide from the side of the platform. A series of ten-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 300m transect is not visible due to rain or fog). Binoculars are used to confirm the species identification, and other details, such as age, moult, carrying. Flying birds are not recorded continuously throughout the 10-minute period, as this would overestimate bird density. Instead, They are counted using instantaneous counts, or “snapshots”, at regular intervals throughout the observation period. The number of snapshots conducted depends on the speed of the platform.

6.5 Parameters Analyzed

Parameters	Analysis Method
Abundance and Distribution of Seabirds	- Data collected by the observer during the trips were entered into an MS ACCESS database designed by the Canadian Wildlife Service (CWS). - Only seabird observations made within the 300m transect to/from Thebaud were utilized in the analysis. - Survey locations where seabirds were observed were plotted (Figure 6-1). - The number and type of seabirds observed for each 10-minute survey was plotted in a histogram (Figure 6-2).

6.6 Results

The observer spent a total of three days on the supply vessel at sea and carried out 59 ten-minute sea bird observations. Of these 59 surveys, 37 of them actually included birds that were observed within the 300m transect. In total, 97 birds were counted from three families. The most abundant species observed was the Greater Shearwater (38%). These individuals have spent the austral winter in Atlantic Canada and are now migrating to breeding grounds in the southern hemisphere. This species is often observed following the vessel, as they wait to scavenge any food coming from the ship. Both species of storm-petrel (Leach's and Wilson's) were observed relatively frequently (32% of all observations). Like the Greater Shearwater, Wilson's Storm-petrels are sub-antarctic migrants, while Leach's Storm-petrels breed in small numbers on many of the islands off Atlantic Nova Scotia. Great Black-backed Gulls are typically more pelagic than Herring Gulls, which is reflected in our observations. Although not observed within the 300m transects, one Northern Gannet (*Morus bassanus*), and one Parasitic Jaeger (*Stercorarius parasiticus*) were also recorded during the trip.

Figure 6-1 shows the locations of the 59 surveys. The surveys follow along two vessel tracks - track A to B extends halfway along the route from the ExxonMobil shorebase in Dartmouth, N.S., to the Thebaud Production Platform. Track D to E extends from the Thebaud platform back to the shorebase. Point C on the figure is a single survey performed on September 17 at Venture platform, where no birds were observed, due to poor visibility. The coloured dots show locations at which observations were taken. The colour coding represents different dates as follows:

Blue	16 September, 2006
Green	17 September, 2006
Red	18 September, 2006

Figure 6-2 and Table 6-1 illustrate the total number and types of seabirds observed at each survey location along the two vessel tracks. The abbreviations used to denote seabird type are included within the table in brackets.

6.7 Summary and Conclusions

- The most common species observed along the tracks, particularly at the survey locations closest to Sable Island and the Thebaud platform, was the Greater Shearwater. This species is recognized as having been in transit (to more southerly breeding grounds) at the time of the survey and was perhaps attracted to the survey vessel for scavenging purposes.
- Based on analysis of a limited number of 10 minute surveys taken on two vessel tracks carried out between September 16 and 18, 2006, there is no evidence that seabirds were attracted to the SOEP offshore platform (Thebaud).
- The distribution of seabirds along these two tracks also appeared to be independent of proximity to Sable Island.

6.8 References

- [1] Environment Canada, July 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.

Table 6-1. Numbers of birds observed within the 300m-wide transect during 16-18 September 2006 survey.

Family	Species		Number observed
Procellariidae	Greater Shearwater (GRSH)	<i>Puffinus gravis</i>	37
	Cory's Shearwater (COSH)	<i>Calonectris diomedea</i>	1
	Unknown Shearwater (UNSH)		5
Hydrobatidae	Leach's Storm-petrel (LHSP)	<i>Oceanodroma leucorhoa</i>	6
	Wilson's Storm-petrel (WISP)	<i>Oceanites oceanicus</i>	16
	Unknown Storm-petrel (UNSP)	<i>Oceanodroma</i> or <i>Oceanites</i>	9
Laridae	Herring Gull (HERG)	<i>Larus argentatus</i>	5
	Great Black-backed Gull (GBBG)	<i>L. marinus</i>	17
	Unknown Gull (UNGU)	<i>L. spp.</i>	1
Total number observed within transect			97

Figure 6-1 Seabird Observation Tracks

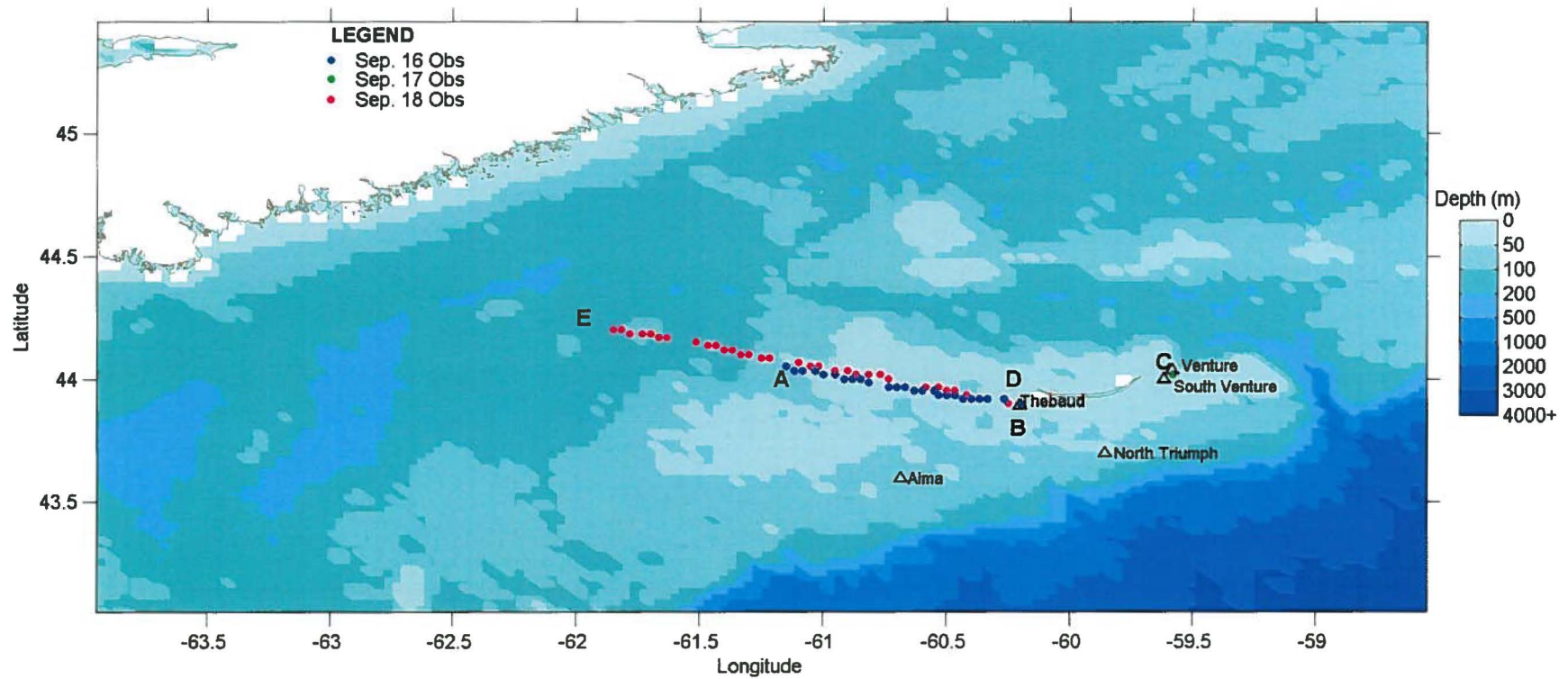
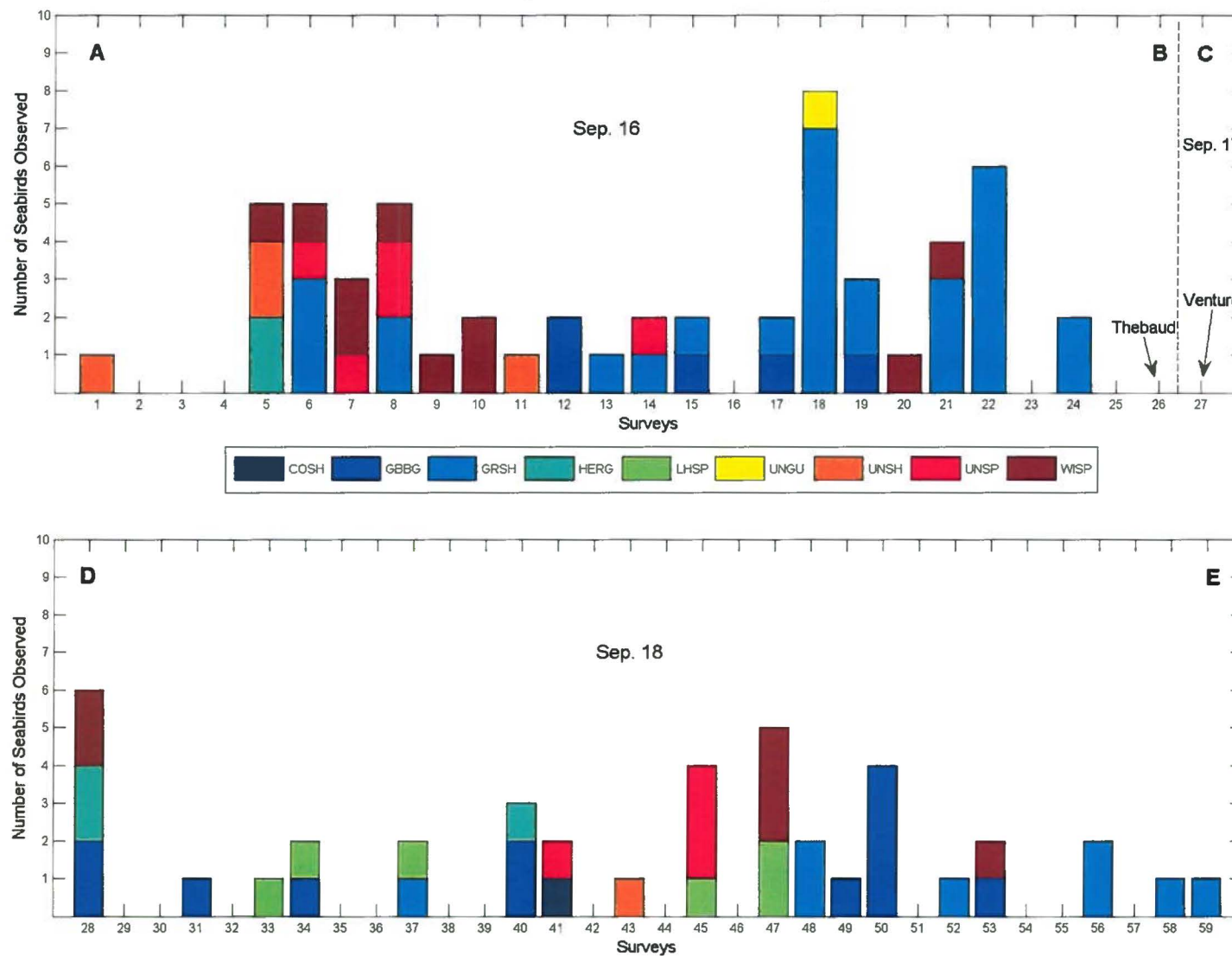
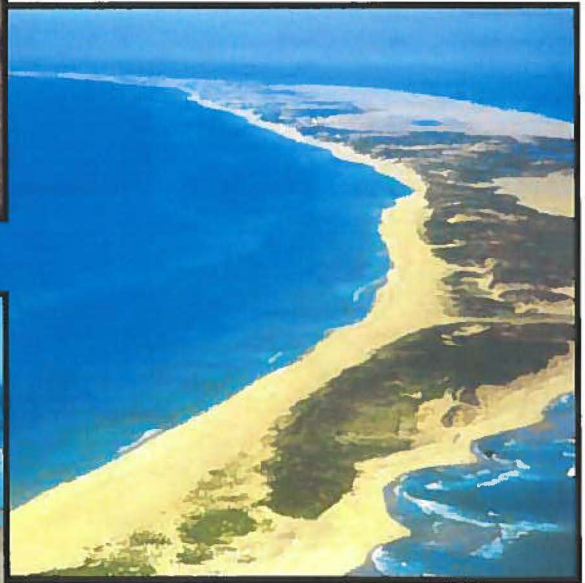


Figure 6-2 Number and Type of Seabirds Observed per 10 minute Survey



7 BEACHED SEABIRD SURVEYS



Photos: Sable Island Green Horse Society

7.1 Background

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 oil analysis of beached bird samples collected during 1996-2005 have been reported in Reference [1].

7.2 Goal

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

7.3 Objectives

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

7.4 2006 Sampling

Contractor: Zoe Lucas, Sable Island

- Between January 1 and December 31, 2006, eleven surveys for beached oil and oiled seabirds were conducted once every 30-40 days on Sable Island.
- All surveys were conducted by Zoe Lucas.
- 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.
- The oiling rate is the fraction of oiled birds of the total number of dead birds, intact and otherwise, found on the beach.
- Samples of beached pelagic tar and oiled feathers, representing contamination on various seabird species, and at various beach locations on the island, were collected.
- 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 specimens were solid samples (pelagic tar or oiled seabird feathers) and were dissolved directly in dichloromethane. This extract, filtered to remove solids, was injected on a glass capillary column (SPB-1) in an HP 5890 Gas Chromatograph with Flame Ionization Detector (GC/FID). Outputs from the GC were retrieved on HPChem station, and chromatograms were produced and assessed manually. 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. N-alkane peaks were not quantified: only relative concentration calculations based on peak height were undertaken
- 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.

Survey Date:	January –December 2006
Platform	Beach, Sable Island
Type of Sample	Pelagic tar, oiled seabird feathers
Test Sample Locations:	n/a
Reference Sample Locations:	n/a
Number of Samples	11 surveys, 22 oil samples (14 analysed ¹)
Sample Preparation	frozen
Equipment:	Collection by hand from the beach using glass or metal foil containers

¹The eight remaining samples, collected during December 2006, have been retained for a GC/FID interpretation comparison study and will be analysed at a later date.

7.5 Analysis

Analysis of 14 oil samples collected from the feathers of beached seabird corpses during March – May 2006.

7.5.1 Parameters Analyzed

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

7.5.2 QA/QC

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

7.6 Results

Results are presented in Table 7-1, Table 7-2, and Table 7-3.

7.7 Summary and Conclusions

- During 2006, the corpses of 379 beached gannets, tubenoses, gulls and alcids were collected on Sable Island. Alcids comprised 26.9% of total birds recovered.
- For all species combined, the oiling rate was 11.8%. The highest rate for a seabird group, 42.2%, was observed in alcids.
- The oiling rate observed in 2006 was similar to the six-year average for 2000-2005 (Figure 7-1).
- No recently oiled corpses were recovered during June-November 2006, and therefore no samples were collected for that period.
- Of the 22 oil samples collected from the beach and from the feathers of bird corpses in 2006, the results for 14 are available. Of the 14 samples analysed, 13 contained no light or mid-range distillate fuels, or condensates that would be typical of oils produced on offshore gas facilities such as SOEP processing platforms off Sable Island. The contamination source for the single sample containing fuel oil 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. [Note: There were no spills from SOEP offshore facilities for several months prior to the discovery of the specimen containing fuel.]
- Generic identification of oil samples collected in 2006 indicated that, as in 2000 to 2005, crude oil discharges were likely responsible for a large proportion of pelagic tar and oiled seabirds observed on Sable Island.

7.8 References

- [1] Lucas, Z. and C. MacGregor. 2006. Characterization and source of oil contamination on the beaches and seabird corpses, Sable Island, Nova Scotia, 1996-2005. *Marine Pollution Bulletin* 52: 778-789.

Table 7-1 Monthly numbers, and annual oiling rate, of beached seabird corpses collected on Sable Island during 2006

	Jan	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Oiling rate %
NG	3	0	1	1	0	0	0	0	2	4	6	17	11.8
TN	2	1	1	1	19	94	31	9	6	0	0	164	0
Gulls	5	9	3	13	6	8	8	8	21	4	11	96	0
Alcids	13	20	18	19	6	2	0	0	0	0	24	102	42.2
Total	23	30	23	34	31	104	39	17	29	8	41	379	11.9

NG (Northern Gannet), TN (tubenoses).

No survey was conducted during February.

Table 7-2 Six discharge events identified in 14 oil samples collected on Sable Island during 2006

Date	Number of Samples	Matrix	Generic Identification of Oil
Mar 4	7	Alcids	Crude. Moderate weathering.
Mar 4	1	Alcid	Fuel oil. Moderate weathering.
Apr 3	2	Alcids	Crude. Moderate weathering.
May 4	3	Alcids	Crude. Moderate weathering.
May 4	1	Gannet	Crude. Moderate weathering, but fresher than previous three samples.
May 4	1	Alcid	Crude + small amount of lighter unknown, possibly solvent.

Table 7-3 Discharge events identified by generic oil source of samples collected on Sable Island during 2000-2006

Year	crude oil	Fuel oil	bilge	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
Total	49	9	5	63

Figure 7-1 Annual oiling rates for beached seabird corpses found on Sable Island during 2000-2005.
Red = all birds combined; blue = alcids

