

# APPENDIX I

## TERMS OF REFERENCE

- 1 Background
  - 1.1 Federal response
- 2 Geographic area for consideration
- 3 Public review phases
  - 3.1 Phase 1

### 1. BACKGROUND

In 1972, the Government of Canada imposed a moratorium on crude oil tanker traffic through Dixon Entrance, Hecate Strait, and Queen Charlotte Sound due to concerns over the potential environmental impacts. The moratorium subsequently extended to include oil and gas activities. This was followed by a similar prohibition by the Government of British Columbia.

In September 1983, the Governments of Canada and British Columbia established the basis for a joint federal-provincial review of the potential environmental and socio-economic effects of oil and gas exploration offshore British Columbia. A five-member environmental assessment panel was appointed and held public information meetings and public hearings throughout northern coastal British Columbia. The Public Review Panel's report contained 92 terms, conditions, and recommendations to be applied to offshore oil and gas activities. However, as a result of the Exxon Valdez oil spill in 1989, the two governments decided to continue the moratoria.

The government of British Columbia recently commissioned several studies to assess the potential impacts of offshore oil and gas activities. This was followed by a Scientific Panel review, also commissioned by B.C., which concluded that *“There is no inherent or fundamental inadequacy of science or technology, properly applied in appropriate regulatory framework, to justify a blanket moratorium on such activities”*. The Panel also concluded that: *“There would be several important things that would need to be done before there could be any expectation of investor interest, public or private, in proposals for exploration or development work in the BC offshore.”*

The government of British Columbia provided copies of the studies and the Scientific Panel review report to the Government of Canada and requested that the Government of Canada consider lifting the federal moratorium on oil and gas activities.

#### 1.1 FEDERAL RESPONSE

On March 28, 2003 the Minister of Natural Resources Canada announced that the Government of Canada will proceed with a review to:

- (a) identify science gaps related to possible oil and gas activity, offshore B.C. (Science Review);
- (b) hear the views of the public regarding whether or not the federal moratorium should be lifted for selected areas (Public Hearings); and,
- (c) consult with First Nations to ensure that issues of unique interest to First Nations are fully explored (First Nations Consultations).

All components of the review will take into account legal and regulatory safeguards that would be in place if the moratorium were lifted. Lifting the moratorium for specific areas would not result in activities until a regulatory regime is in place to assess proposed activities. A regulatory regime would respect the requirements of federal legislation and policy. Federal legislation which would apply to offshore oil and gas activities includes; the *Canada Petroleum Resources Act*, the *Canada Oil and Gas Operations Act*, the *Canadian Environmental Assessment Act*, the *Canadian Environmental Protection Act*, the *Canada Oceans Act*, the *Navigable Waters Protection Act*, the *Fisheries Act*, and the *Canada Labour Code*.

## 2. GEOGRAPHIC AREA FOR CONSIDERATION

The area recommended for review is that of highest estimated petroleum resource potential (see Figure 1 and 2 in Attachment 1).

### Figure 1: Sedimentary basins - Canada's west coast region

Figure 1 shows sedimentary basins on the Pacific margin that are identified as prospective for oil and gas. Resource estimates for these basins are documented in the 2001 Geological Survey of Canada Bulletin 564, 'Petroleum Resource Potential of Sedimentary Basins on the Pacific Margin of Canada', by P.K. Hannigan, J.R. Dietrich, P.J. Lee, and K.G. Osadetz. They estimate that the Queen Charlotte region contains three to four times the gas resource potential of either the Tofino or Georgia regions and a significant oil resource potential that is not identified for either the latter two regions. Therefore, the review will focus on the Queen Charlotte region.

### Figure 2: Resource potential and proposed exclusion zones

Within the Queen Charlotte region a qualitative evaluation of existing geoscience information permits a delineation of areas with greater prospectivity (see Figure 2). It should be emphasized that confirmation or otherwise of this delineation requires additional information.

It should also be noted that the Queen Charlotte region encompasses areas that expert departments have deemed to be particularly sensitive, as well as, recommended exclusion zones identified in the 1986 West Coast Offshore Exploration Environmental Assessment Panel Report. Some of the latter areas are identified in Figure 2 including:

1. A 20 km coastal exclusion zone which was recommended by the 1986 West Coast Offshore Exploration Environmental Assessment Panel to minimize potential impacts on marine life and sensitive near-shore environments from routine operations, or from an oil blow-out.
2. The proposed Gwaii Haanas National Marine Conservation Area (NMCA) in the southern most Queen Charlotte Islands (shown in deep yellow). Parks Canada recommends that this region be excluded from potential exploration and development activities on the basis of a first ministers' MOU (1987), a detailed federal-provincial agreement (1988) and several subsequent federal, provincial and industry actions. The pale yellow areas on the east and south east side of Queen Charlotte Sound and Hecate Strait are regions identified by Parks Canada as potential candidate sites for a central coast NMCA because they are each natural and representative for the region and are deemed to meet the criteria of a 'representative marine area' as outlined in Parks Canada Guiding Principles and Operational Policies (1994).

3. The Department of Fisheries and Oceans designates the known sponge reef complexes (purple) and a ~9 km buffer zone surrounding them as 'no fishing zones'. The department has advised that the reefs are under consideration for designation as Marine Protected Areas.

Furthermore, both the Department of Fisheries and Oceans and Environment Canada are currently considering additional exclusion zones in this region based on their understanding of fish, mammal, and bird populations. It is anticipated that the science workshops will critically evaluate the impacts of oil and gas activities on ecosystems outside of the proposed review area.

### **3. PUBLIC REVIEW PHASES**

The review will be divided into two phases. Phase 1 will include the Science Review as well as public information sessions. This will be followed by phase 2 of the review process, which will consist of Public Hearings and First Nations Consultations.

#### **3.1 Phase 1**

In consultation with his colleagues, the Minister of Natural Resources Canada shall appoint an independent Science Expert (Chair). This Science Expert will be responsible for conducting a series of science workshops, evaluating information presented therein and preparing a summary report on the findings. The evaluation will also draw upon previously conducted reviews in British Columbia and relevant experiences from other Canadian and international jurisdictions. The report will be made available to the Minister, the Public Review Panel and also to the general public in advance of the Public Hearings and First Nations Consultations. It is anticipated that the report will focus the discussion of science related matters during Phase 2 of the review. The Science Expert shall be supported by additional scientists with complementary expertise and knowledge (the Science Review Panel).

The independent Science Expert will be responsible for defining the scope of the science workshops, identifying workshop participants and facilitating workshop discussions. The science workshops will allow qualified experts drawn from governments, First Nations (to ensure that traditional knowledge is considered in the science review), industry, universities, advocacy groups, and alike to identify any science gaps which may need to be filled, with a focus on the identification of any gaps which may need to be filled before a decision is made in respect to the moratorium, but also provide a path forward on the science requirements which would precede, or be concurrent with, any exploration or development activity. They will also identify who should be responsible for the completion of identified gaps (i.e. government, industry, etc.) and carefully evaluate risks associated with not filling an identified gap.

Furthermore, the science workshops shall critically evaluate sensitive environments identified by expert departments as well as previously recommended exclusion zones within the proposed review area. Guided by the precautionary principle the science workshops may, as deemed necessary, identify additional areas requiring special management measures in the event of a decision to lift the moratorium. All such areas will be described in the summary report prepared by the Science Expert.

Notwithstanding the above, it is anticipated that the workshops will include issues such as:

1. Natural Hazards and their Potential Constraints on Exploration and Development, including:
  - Earthquakes
  - Seafloor and Sub-seafloor
  - Waves and Tsunamis
  - Weather
  - Wind factors

2. Potential Impacts of Exploration and Development on species habitat, on fish, birds and mammals, on marine protected areas and on marine ecosystems , including:
  - Seismic exploration
  - Exploration Drilling
  - Production
3. Impacts of Potentially Catastrophic Events on species habitat, on fish, birds and mammals, on marine protected areas and on marine ecosystems, including:
  - Blowouts
  - Oil Spills

### **SCIENCE WORKSHOPS: PRECAUTIONARY APPROACH**

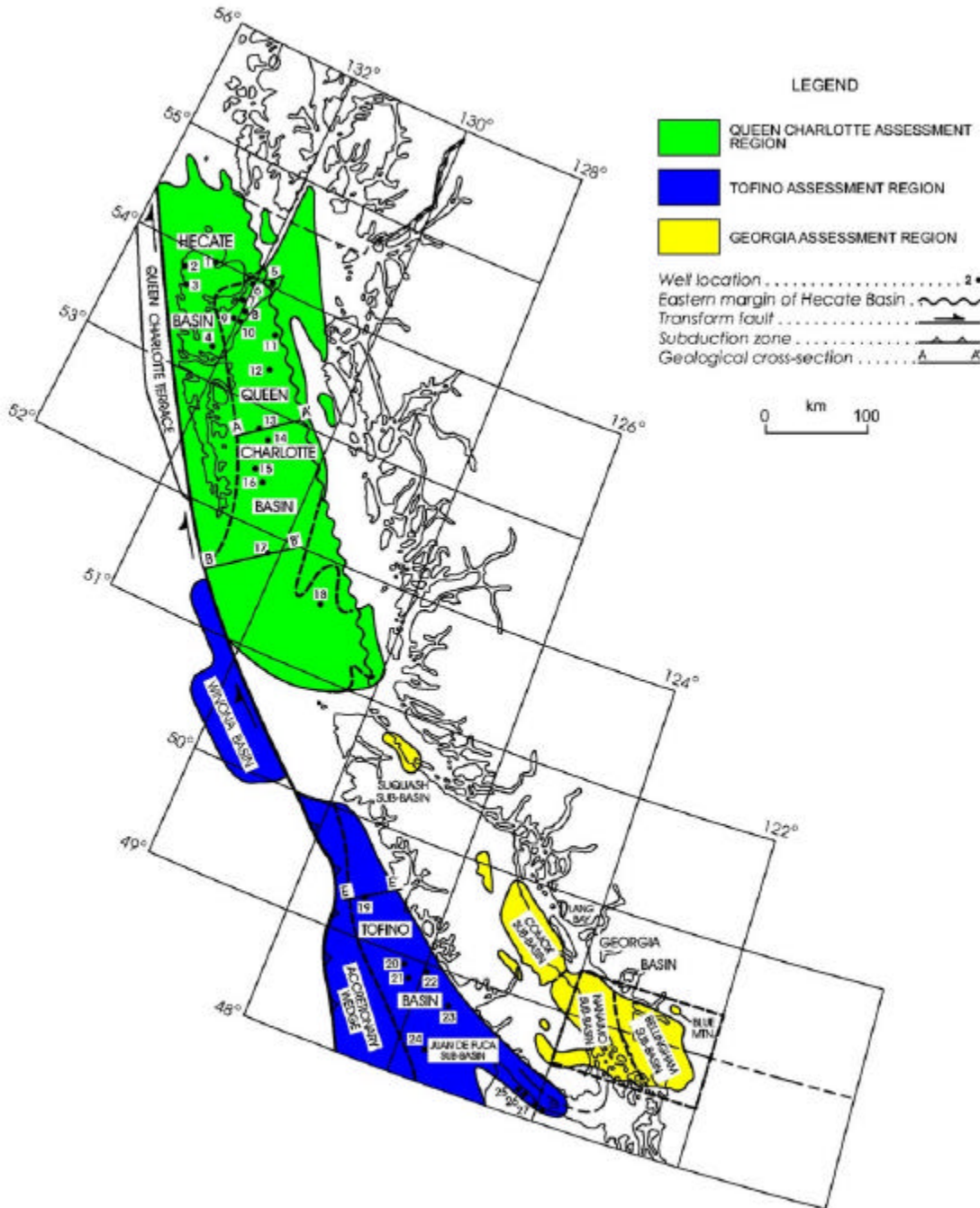
It is recognized that there are many definitions and interpretations of the precautionary approach and reasonable certainty. In order to avoid confusion, it is recommended that the participants agree to a common definition. For example, the precautionary approach as used in the federal *Oceans Act*, "in the face of scientific uncertainty, it is preferable to err on the side of caution". Further, the absence of full scientific certainty shall not be used as a reason to postpone decision-making. The following four levels of scientific assertion are included for the consideration of the workshop participants.

- There is a complete series of precise and accurate observations, consistent with theory. The margins for error are narrow and enable the statement: ***We are certain that...***
- There is an incomplete series of observations (e.g., few observations from the particular ecosystem and species of interest), supplemented by a completed model / theoretical study. The margins for error are fairly narrow and enable the statement: ***We are confident that...***
- There is an incomplete, series of observations supported by incomplete (e.g., calibrated but not validated) model / theoretical study. The margins for error are considerable. The statement can be: ***We predict that...***
- There is an incomplete series of observations and either no model exists or the models are not validated or calibrated. The margins for error are substantial, but not as large as for pure chance. The statement can be: ***It is our judgment that...***

Following the science workshops the Science Expert may, as deemed necessary, consult with workshop participants in the preparation of the summary report.

# Attachment 1

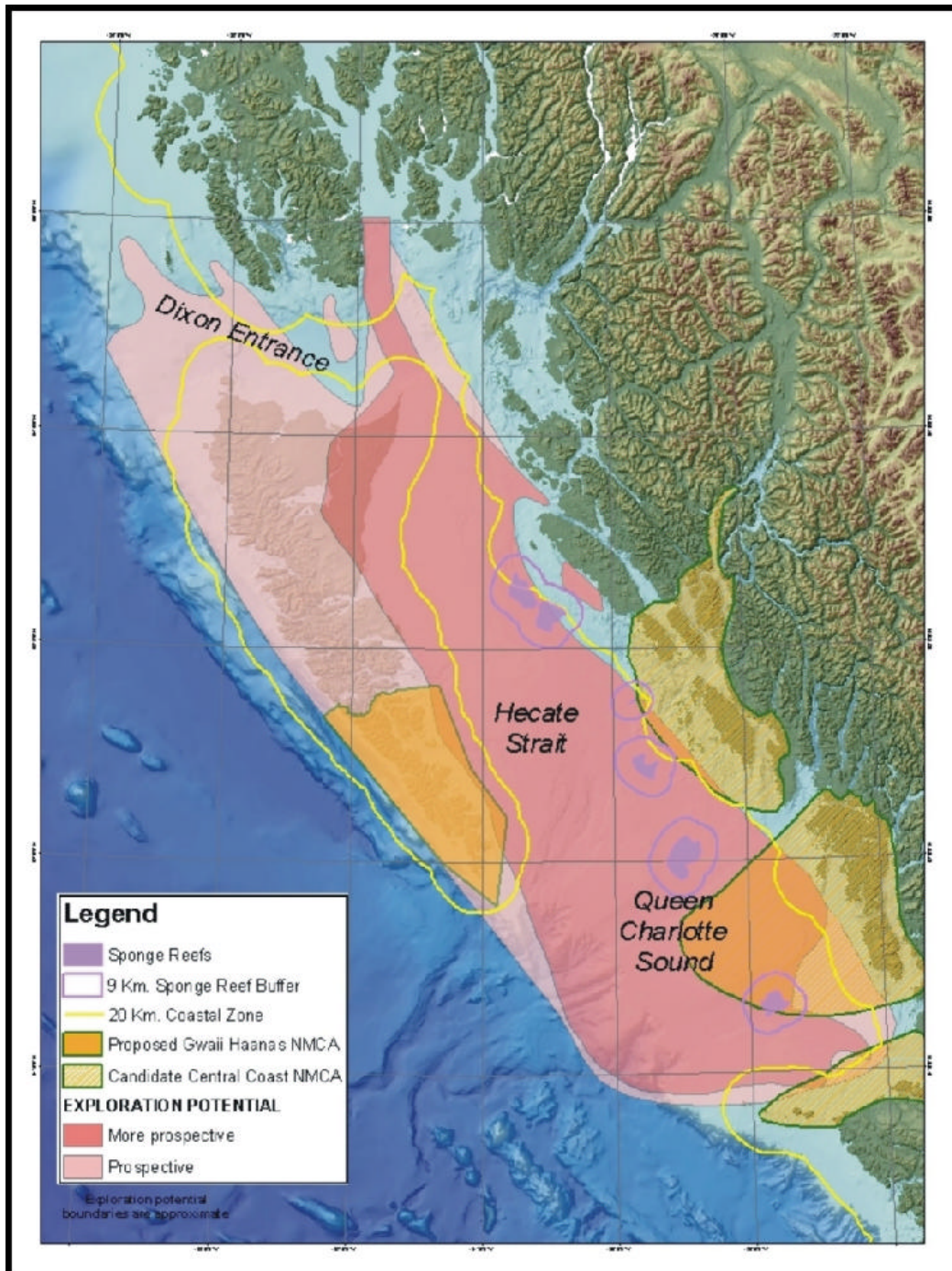
**Figure 1: Sedimentary basins - Canada's west coast region**



**Figure 1.** Regional setting and basin outlines of the west coast region of Canada. Assessment regions are shaded. Eastern edge of Hecate Basin modified from Haggart (1993).

# Attachment 1

## Figure 2: Proposed Exclusion Zones



## APPENDIX II

### WORKSHOP PROGRAMS

#### WORKSHOP I

##### **Physical Aspects of Queen Charlotte Basin, and Risk Assessment of Hazards Related to Potential Oil and Gas Activities**

Wednesday-Friday, October 15-17, 2003

Marriott Pinnacle Hotel, 1128 West Hastings Street, Vancouver

##### **Wednesday – October 15<sup>th</sup>, 2003**

###### **Introductions**

08:10 *Jeremy McNeil, Chair, Expert Panels Committee, Royal Society of Canada*

08:15 *Jeremy Hall, Chair: Process and Ground Rules*

08:25 *David Strong, University of Victoria: A brief review of the Offshore Oil and Gas situation from the perspective of the 2001 British Columbia Scientific Review Panel*

###### **1. Geological background and hydrocarbon resources**

08:40 Hydrocarbon resources of the Queen Charlotte region (*Peter K. Hannigan, J.R. Dietrich and K.G. Osadetz, Geological Survey of Canada*)

09:05 New hydrocarbon assessments for the Queen Charlotte Basin (*Michael Whitticar, University of Victoria*)

09:25 Frontier exploration and production: risks vs. rewards (*Marcel Hamonic, Shell Canada*)

09:55 Discussion

###### **2. Risk management and assessment**

10:30 Risk management for resource development (*Lorraine Goobie, Shell Canada*)

11:00 An overview of quantitative risk assessment methods (*Maher Nessim, CFER*)

11:30 Discussion

###### **3. Oil and gas activities: general description of environment, operations, technology update, and identification of associated potential hazards**

11:45 **Marine environment** (*Richard Addison, John Dower*)

Biota

Exclusion zones, marine protected areas

Rationale for zones adjacent to shore, sponge reefs

###### **Physical environment**

12:05 West coast wind, weather and climate issues (*Laurie Neil, MSC*)

12:25 Bathymetry (*Fred Stephenson, DFO*)

13:30 Oceanography and ocean currents (*Bill Crawford, DFO*)

14:00 Sea state (*Diane Masson, DFO*)

14:20 Tsunamis (*Fred Stephenson, DFO*)

14:40 An industry perspective on the metocean environment (*Cortis Cooper, ChevronTexaco*)

15:10 Discussion (*facilitated by Val Swail, MSC; contributions by Owen Hertzman, SFU, and John Marko, ASL Environmental Sciences*)

Earthquakes

15:50 Regional seismicity (*Garry Rogers, GSC*)

16:10 Seismic hazard and ground motion issues (*Gail Atkinson, Carleton University*)

16:40 Seabed character and dynamics (*Vaughn Barrie, GSC*)

17:00 Discussion

### **Thursday – October 16<sup>th</sup>, 2003**

#### **3. Oil and gas activities: general description of environment, operations, technology update, and identification of associated potential hazards (continued from Wednesday)**

- Exploration**
- 08:30 Exploration objectives and uncertainties (*Larry Stewart, ChevronTexaco*)
- 09:00 Geophysical surveys (*Kevin Williams, ChevronTexaco; Doug Bogstie and Eugene Gridnev, WesternGeco, Robert Pitt, Canning and Pitt Associates, Inc.*)
- 09:30 Exploration drilling (*DrewTaylor, ChevronTexaco*)
- 10:00 Discussion
- Production**
- Fixed and floating production facilities
- Development drilling
- Production drilling
- Seabed infrastructure, inc. subsea completion systems
- 10:40 (*Ralf Hirschfeld, Shell Canada;*
- 11:10 *John Bruce, Sandwell*)
- 11:40 Discussion
- Distribution and transport**
- 12:00 Pipelines (*Andrew Palmer, U. Cambridge*)
- 13:30 Oil transport solutions for the offshore industry (*Graham Westgarth, Teekay Shipping*)
- 14:00 Support facilities (*Norm Allyn, Westmar*)
- 14:30 **The East Coast experience** (*Don Sutherland, Husky Energy*)
- 15:00 Discussion

#### **4. Design and risk mitigation of hazards, and physical and biological consequences: data, modelling, risk quantification, regulation (Bill Maddock, Sandwell )**

- 15:40 **Design procedures**
- Standards for offshore structures
- Canadian standards
- Limit states (failure; ultimate loads; time-dependent effects e.g. fatigue and corrosion; serviceability)
- 16:10 **Design for natural hazards**
- Wind (*Barry Vickery, UWO*)
- Waves, currents and tsunamis (*Michael Isaacson, UBC*)
- Earthquakes
- 16:40 Discussion

#### **Summary Discussion**

- 17:00 **Ongoing and new science studies** (*S. Colvine, Natural Resources Canada; Laurie Neil, Environment Canada*)
- Discussion

### **Friday – October 17<sup>th</sup>, 2003**

#### **4. Design and risk mitigation of hazards, and physical and biological consequences: data, modelling, risk quantification, regulation (continued from Thursday)**

- 08:30 **Analysis and mitigation of impacts of oil and gas activities**
- Acoustic impacts on biota
- 08:40 Seismic surveys (*Rolph Davis, LGL*)

- 09:00 Discussion  
 09:40 Drilling waste: mud, cuttings, produced water, flares (*Kelly Hawboldt, MUN*)  
 10:00 Drilling waste, oil spills: an operator's perspective (*Wishart Robson, Nexen*)
- Oil spills, blow-outs
- 10:40 Statistics (*Ian Jordaan*)  
 10:50 Impacts (*Richard Greer, Golder Associates*)  
 11:10 Oil spill risk assessment and sensitivity analysis (*David Dickins, D.F. Dickins Associates*)  
 11:30 Oil spill response measures (*Norm Allyn, Westmar*)  
 11:40 Oil spills and the Queen Charlotte Basin (*Merv Fingas, Environment Canada*)  
 12:00 Discussion
- Regulatory regimes**  
 Assumptions about regime that might be set up for QCB, to guide panel re when science gaps should be filled  
 (*Kim Coady, C-NOPB;*  
*Jan-Erik Hagen, Scando;*  
*Al Hudec and Michelle Pockey, Davis & Co.)*
- 13:20  
 13:40  
 14:00  
 14:20 Discussion

## 5. Summary discussion

- 15:00 Protected areas and regional planning (*Roger Creasey, Shell Canada*)  
 15:30 Exclusion zones (*Jeff Ardron, Living Oceans Society; Michele Patterson, WWF*)  
 16:00 Discussion
- 16:30 **Gaps in knowledge** of the physical environment and generalities of impacts of oil and gas activities on biota. What gaps require filling before a decision is made on lifting moratoria, including baseline studies to provide foundations for demonstrating impacts of O&G activities? What further knowledge should be acquired after potential lifting of moratoria?

## WORKSHOP II

### Evaluating Potential Hazards and Biological Consequences of Oil and Gas Activities in the Queen Charlotte Basin

Tuesday-Thursday, October 28-30<sup>th</sup>, 2003

Marriott Pinnacle Hotel, 1128 West Hastings Street, Vancouver

#### Tuesday – October 28<sup>th</sup>

08:30 Introduction to Workshop II (*Jeremy Hall*)

#### **1. Ecosystem integrity, with specific reference to the QCB**

08:45 National Marine Conservation Areas in the QCB (*Tom Tomascik, Parks*)

09:15 Gwaii Haanas ecosystems (*Norm Sloan, Parks*)

10:00 Spatial data analysis & ecosystem modeling (*Jeff Ardron, Living Oceans Society*)

10:30 Questions and Discussion

#### **2. The air-sea interface: birds and mammals**

11:30 Marine mammals (*Linda Nichol, John Ford, DFO; Andrew Trites, UBC; Paul Spong, OrcaLab*)

2:00 Industrial noise (*Lance Barrett-Lennard, Vancouver Aquarium*)

2:30 Questions and Discussion

3:15 Seabirds and oiling (*Alan Burger, U. Vic.*)

3:45 Seabird habitats and trophic interactions: science gaps and ecosystem consequences of offshore oil and gas activities (*Doug Bertram, CWS*)

4:15 Seabirds and oil platforms (*Francis Wiese, U. Washington*)

4:45 Questions and Discussion

#### Wednesday – October 29<sup>th</sup>

#### **3. The water column (wild fish, aquaculture, plankton, etc)**

08:30 Pelagic fish and zooplankton (*Dan Ware*)

09:00 Groundfish (*Alan Sinclair, DFO*)

09:30 Questions and Discussion

10:15 Salmon (*Dave Welch, DFO*)

10:45 Aquaculture (*Bill Pennell, Malaspina*)

11:15 Questions and Discussion

#### **11:45 Summary discussion**

**Ongoing and new science studies** (*John Pringle, DFO*)

#### **4. The sediment-water interface:**

1:30 Benthic ecology (*Brenda Burd*)

2:00 Benthic invertebrates (*Glen Jamieson, DFO*)

2:30 Shellfish and other invertebrates (*Jim Boutillier, PBS*)

3:15 Questions and Discussion

#### Thursday – October 30<sup>th</sup>

#### **5. The land-sea interface:**

08:30 Nearshore biota (*Colin Levings, DFO*)

09:00 Oil spill response measures (*Craig Dougans, Burrard Clean Operations*)

#### **6. Other Issues**

- 09:30 Environmental impact assessment process (*Roger Creasey, Shell Canada*)  
10:15 Exclusion zones (*Michele Patterson, WWF*)  
10:45 Sponge reefs (*Kim Conway, NRCan*)  
11:15 Understanding and minimizing impacts of discharges from offshore drilling and production operations (*Andrew Glickman, Chevron Texaco*)  
11:45 Examples of environmental risk analysis of impacts of oil activities (*Isabel Johnson, Golder Associates*)  
12:15 Questions and Discussion

## **7. Summary discussion**

- 14:00 **Ongoing and new science studies**  
Province of British Columbia Coastal Science and Information Initiatives (*D. Howes, Ministry of Sustainable Resource Management, BC Govt.*)  
UNBC NCIRP program: the LGL component (*Bob Bocking, LGL*)  
**Other**  
Environmental assessment (*Kathy Penney, JWJ*)
- 15:15 **Gaps in knowledge**  
What gaps require filling before a decision is made on lifting moratoria, including baseline studies to provide foundations for demonstrating impacts of O&G activities? What further knowledge should be acquired after a potential lifting of moratoria?

## WORKSHOP III

### Hearing from those in the region of the Queen Charlotte Basin

Friday, October 31<sup>st</sup>, 2003  
Crest Hotel, Prince Rupert

08:30 **Welcome and introductions**

#### 1. The review process, and progress of science workshops

*(Jeremy Hall, Chair, Expert Panel)*

#### 2. Regional development

08:40 Economic and environmental issues around oil and gas development in the Queen Charlotte Basin  
*(David McGuigan, Pacific Coast Offshore Oil and Gas Association)*

09:00 Economic development around Prince Rupert: a perspective *(Robert Stromdahl, Prince Rupert Economic Development Corporation)*

09:20 Economic development around Prince Rupert: a perspective from the Port Authority *(Don Krusel, Prince Rupert Port Authority)*

09:40 POEA's Perspective on the impacts of offshore oil and gas development in BC *(Terry Knight, Pacific Offshore Energy Association)*

09:55 Regional socio-economic impacts of offshore oil and gas development *(Al Hudec, Davis & Co.)*

10:15 Modelling the economic impacts of offshore energy development on the northern coast of BC  
*(John Schofield, University of Victoria)*

10:35 Discussion

11:20 Tsimshian Nation views of potential oil and gas activities *(Bob Hill/Teresa Ryan, Tsimshian Nation)*

#### 3. Ongoing and new science studies

11:40 Northern Coastal Information and Research Program *(Norman Dale, UNBC)*

#### 4. Resources of the Queen Charlotte Basin

12:10 Shellfish *(Bruce Watkinson, Tsimshian Stewardship Committee)*

12:30 Discussion

13:30 Aboriginal fisheries issues *(Susan Anderson-Behn, BC Aboriginal Fisheries Commission)*

13:50 Impact of oil and gas activities on biota in the Queen Charlotte Basin *(Margo Hearne and Peter Hamel, Delkatla Sanctuary Society)*

14:10 Other contributions (including *Jack Miller*) and discussion

#### 4. Sensitive areas and exclusion zones

14:50 Sensitive areas *(Michele Patterson, WWF)*

15:10 Discussion

#### 5. Other contributions and general discussion

6:20 Contributions from Clifford White, Harry Mose, Bill White, Odd Eidsvik, Larry Golden, Joy Thorkelson

## APPENDIX III

### AUTHORS OF BRIEFS AND OTHER RECENT CONTRIBUTIONS ACCESSED (excluding those referenced in the text, and excluding authors who made presentations listed in the workshop programs, Appendix II)

Contact		Affiliation
First Name	Last Name	
Taylor	Bachrach	Sierra Club of Canada
Chris	Barnes	UVic
Jacqueline	Booth	Jacqueline Booth and Associates
Ian	Bruce	David Suzuki Foundation
Kenneth	Brunn	Senior Lighthouse Keeper (retired)
Rolf	Bettner	Haida Gwaii Marin Resources Group Association
Chris	Campbell	Pacific Offshore Energy Group
Hadi	Dowlatabadi	Sustainable Development Research Initiative, UBC
Lois	Epstein	Cook Inlet Keeper
Dan	Esler	Centre for Wildlife Ecology, Simon Fraser U.
Ian	Frigaard	UBC Lab for Complex and Non-Newtonian Fluid Flows
Gerald	Graham	World Ocean Consulting
L.E.	Harding	Environment Canada
Craig	Harrison	Pacific Seabird Group
Stuart	Hertzog	resident: Sidney, BC
John	Hildebrand	Scripps Institution of Oceanography
John	Hunter	J Hunter & Associates Ltd.
Vicky	Husband	Sierra Club of Canada
Jessen	Sabine	Canadian Parks and Wilderness Society
Evert	Kenk	Cooperative Ocean Information Network: Pacific
Manfred	Krautter	University of Stuttgart
Otto	Langer	David Suzuki Foundation
Dan	Lawn	Living Oceans Society
Nora	Layard	Jacqueline Booth and Associates
Paul	Leblond	Can. Parks and Wilderness Soc.(CPAWS), BC Chapter
John	Lucas	Pacific Offshore Environment Association (POEA)
Valerie	MacDonald	Biologica Environmental Services
Alex	MacGillivray	School of Earth and Ocean Sciences, Uvic
Greg	Martin	Laskeek Bay Conservation Society
Robert	McCauley	Centre for Marine Science and Tech., Curtin University
Bill	MacDonald	Sierra Club of Canada
Terence	McGauley	McGauley Consultants Limited
Oonagh	O'Connor	Living Oceans Society
Rosemary	Ommer	Coasts Under Stress, UVic
Kevin	O'Neill	Radarsat International
Ben	Parfitt	Sierra Legal Defence Fund for Living Oceans
Arthur	Popper	Dept. of Biology, U. Maryland
Jeep	Rice	NOAA
Kristin	Rohr	Rohr Consulting

Mark	Shrimpton	Jacques Whitford Environment Ltd.
Gordon	Staples	Radarsat International
Kazi	Stastna	Sierra Club of Canada
David	Weller	National Marine Fisheries Service, NOAA
Lee	Williams	?
Rob	Williams	University of St. Andrews
Jonathan	Wills	Living Oceans Society
Sarah	Wren	Canadian Nature Federation

## APPENDIX IV

### BACKGROUND TO THE PRECAUTIONARY PRINCIPLE

O’Riordan and Cameron (1994) reviewed the history of the principle and suggest that its origins lie in the German socio-legal traditions developed in the 1930’s by the democratic socialists. There are many definitions, for example the 1998 Wingspread Statement (see below). It is the basis of the Cartagena Biosafety Protocol agreed in Montreal in January 2000, as stated in Principle 15 of the Rio Declaration: “In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

Another, more detailed statement is the Wingspread statement of precautionary principle. An international group of scientists, government officials, lawyers, and labor and grass-roots environmental activists met January 23-25, 1998 at Wingspread in Racine, Wisconsin to define and discuss the precautionary principle. After meeting for two days, the group issued the following consensus statement:

#### **Wingspread Statement on the Precautionary Principle (1998)**

"The release and use of toxic substances, the exploitation of resources, and physical alterations of the environment have had substantial unintended consequences affecting human health and the environment. Some of these concerns are high rates of learning deficiencies, asthma, cancer, birth defects and species extinctions, along with global climate change, stratospheric ozone depletion and worldwide contamination with toxic substances and nuclear materials.

"We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment—the larger system of which humans are but a part.

"We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

"While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

"Therefore, it is necessary to implement the Precautionary Principle: When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context the proponent of an activity, rather than the public, should bear the burden of proof.

"The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action." [End of statement.]

## APPENDIX V

### NOTES ON SOME OFFSHORE ACCIDENTS

#### Introduction

The following notes have been compiled as background for the assessment contained in the report. The incidents listed below show some severe consequences to human life and to the environment. It is noteworthy that human factors are involved in all of them.

#### *Ixtoc 1*

This was the marine blowout resulting in the largest spill recorded, with a volume of 3 million bbl. It occurred in Campeche Sound, Gulf of Mexico, 1979-80. The accident was well summarized in WCOEEAP, (1986), which provides the basis for much of the following. The accident occurred while a semi-submersible unit was drilling an exploratory delineation well on June 5, 1979. It was only brought under final control on March 25, 1980.

The unit (SEDCO 135F) was drilling on June 3 at 3,657 m in 52 m of water with 244 mm production casing cemented at 3, 627 m. At 3615 m, the well had lost drilling mud. Drilling fluid circulation was then totally lost. It was decided to seal the well by withdrawing the drill pipe and inserting a plug. The drillstring was pulled. At the time when drill collars reached the level of the blowout preventers, mud flowed up the pipe and onto the platform. Preventers were closed around the collars, but flow increased inside the collars, which started to rise from the well. Shearing of the thick-walled collars by the preventers was not possible. The well caught fire and the crew was evacuated. The platform sank to the bottom. The blowout preventer stack remained intact on the seabed.

A large fire on the surface burned. By June 12 a slick 180 km long and 80 km wide had formed. By June 26, some success had been achieved in actuating preventer valves and a reduction in flow was accomplished. Unfortunately, fluids immediately flowed around the wellhead on the ocean floor. This might have resulted because the string of cemented production casing ruptured.

Relief well drilling began, and other methods were attempted to kill the blowing well. A reduction in flow from 30,000 to 10,000 barrels per day resulted. Since fluid had begun to flow around the wellhead, the realistic method of control was a relief well. Two were drilled, and the second relief well was successful. The Ixtoc 1 well was at last brought under control on March 17, 1980, and plugged and abandoned on March 25. The duration of the incident was a total of 281 days.

The pipe rams in the blowout preventer will not shear drill collars and could not close off flow. Reliance on bag preventers and use of other fallback equipment were insufficient to provide a seal.

An analysis of the environmental impacts of the spill can be found in Jernelov and Linden (1981).

#### *Ocean Ranger*

On the morning of February 15, 1982, the semisubmersible drilling unit, the *Ocean Ranger*, was lost whilst drilling on the Grand Banks of Newfoundland. All 84 members of the crew lost their lives. The accident occurred during a severe storm. A wave broke a porthole in the ballast control room during the evening of February 14. A bow list developed probably as a result of malfunction of the ballast control system after the porthole had been damaged and sea water entered the ballast control room. Deadlights had been left open to assist in viewing the draft marks. These should have been closed in storm conditions. Intervention by the

crew consisted of reactivation of the control panel allowing water to enter the port pontoon. Then, in an attempt to remedy the situation they actually increased the forward list since they failed to realize that one or more valves to the aft ballast tanks were open, and water was unintentionally pumped out of these aft tanks. There was a misunderstanding of the manual control system comprising rods, which were inserted in an attempt to close valves. This was a mistake. The result was the opening of up to 15 ballast tank valves, and an acceleration of the forward list.

The events surrounding the tragedy are summarized in the Royal Commission on the *Ocean Ranger* Marine Disaster (1984). Apart from the aspects regarding proper training of the crew, design weaknesses were identified, including the location and design of the ballast control room, the strength of the porthole, and the proper use of deadlights. Procedures and training in search and rescue are other issues that received attention.

## ***Piper Alpha***

Piper Alpha, an oil platform in the North Sea, caught fire and burned down on July 6, 1988. In the disaster, 167 people were killed, and the billion dollar platform was destroyed. The platform included a drilling derrick, a processing and refining area, and accommodation for persons working on the platform. It had two gas risers, and the gas was processed on the platform. The processed gas and other oil products were piped to shore. During a routine maintenance procedure, a backup pump for propane condensate had its pressure safety valve removed for checking. Since the maintenance workers did not have all the equipment needed, they were given permission to leave the pump out, and complete the work the next day.

During the same evening, the primary condensate pump failed. The personnel in the control room did not know of the maintenance of the backup pump, and decided to activate it. Gas escaped with considerable force from the hole left in the pump during maintenance. Ignition and explosion followed, blowing down a firewall. Large amounts of stored oil were ignited. The automatic deluge system had been turned off so as to protect divers in the water adjacent to the intake of the system.

The fire caused the gas risers to burst and the gas under pressure ignited causing an inferno of burning gas. At the peak, the flames were about a hundred metres in the air. The conditions for the crew became a nightmare, and only 62 were saved, many with severe burns. Lack of safety training was evident.

The subsequent enquiry was headed by Lord Cullen. His wide ranging report has had a significant effect on offshore safety and procedures. In particular, the use of goal-setting regulations, and procedures based on risk analysis were used in subsequent management of safety issues. Changes to the permit to work system were also implemented by industry.

## ***Exxon Valdez***

Details of the accident can be found on the *Exxon Valdez* Oil Spill Trustee Council website (<http://www.evostc.state.ak.us/facts/details.html>). The tanker Exxon Valdez transported North slope crude oil from the Alyeska Pipeline Terminal to Long Beach, California. She ran hard aground shortly after midnight on March 24, 1989, at Bligh Reef, rupturing eight of its 11 cargo tanks and spilling about 41,000 m<sup>3</sup> of crude oil into Prince William Sound. During the accident, no human lives were lost. Human factors relevant to the accident are discussed in the website noted above.

The major environmental consequences of the *Exxon Valdez* oil spill (summarized from Rice et al., 1996) are as follows:

1. Approx 2800 sea otters and approx. 300 harbour seals were killed; in addition, there was a possible loss of killer whales from Prince William Sd. following the spill (Laughlin et al., 1996) though this could not be specifically attributed to the spill.

2. It was estimated that approx. 250,000 seabirds were killed (though it is recognised that such estimates are only approximate, as they rely on extrapolation of much smaller numbers of carcasses actually recovered: Piatt and Ford, 1996).
3. Reduced growth was observed in early life stages of pink salmon in 1989 (but not 1990) (Geiger et al., 1996; Wertheimer and Celewycz, 1996; Willette, 1996) and this was probably not attributable to changes in prey availability (Wertheimer et al. 1996; Celewycz and Wertheimer, 1996). There was a probable reduction of about 2% in pink salmon returns in years following the spill (Willette, 1996).
4. Larval herring production probably dropped by 50% (Brown et al., 1996); it was not possible to relate this to later adult returns because of confounding factors.
5. Changes occurred in inter-tidal invertebrate communities; some invertebrate populations (algae and molluscs) were reduced while others, such as barnacles and some oligochaetes, which presumably were pollution-tolerant, were enhanced (van Tamelen and Stekoll, 1996; Hooten and Highsmith, 1996).
6. Subtidal macroalgae apparently were not affected (Dean et al., 1996a) but populations of epibenthic invertebrates showed changes which were generally correlated with the extent of oil distribution (Dean et al., 1996b)
7. Subsistence “fisheries”, particularly those based on invertebrates, were affected because of human health concerns (Bolger et al., 1996).

Damage to cultural and archaeological sites occurred as a result of increased access to the region during clean-up operations (Bittner, 1996).

Recent reports (Peterson et al., 2003; and <http://www.evostc.state.ak.us/facts/status.html>) show that response of the ecosystem can have various time scales, due to persistence of toxic subsurface oil and chronic exposure. At one end of the spectrum of responses, the common loon, three species of cormorant, the harbor seal, the harlequin duck, Pacific herring and pigeon guillemot have shown little or no clear improvement since spill injuries occurred; on the other hand, the bald eagle, black oystercatcher, common murre, pink and sockeye salmon and river otter have all met recovery objectives.

## *Nestucca*

The following summary is based on Harding and Englar (1989). On December 23, 1989, about 875 m<sup>3</sup> of Bunker C oil were spilled off Gray’s harbour, Washington. The oil reached Vancouver Island on December 31. The spill affected about 150 km of coastline with light to moderate oiling along high tide lines; about 2 km were heavily oiled. Significant concentrations were found in areas containing important seabird, fish, shellfish and marine mammal habitats. About 3,500 seabirds were found dead in B.C. and 9,000 in Washington. Some seals, sea lions and river otters were found dead but deaths attributable to oil were not confirmed. Grey whales migrated through the area during March-April “without incident”. Crabs were contaminated at the entrance to Clayoquot Sound and fishing of these was closed until June 26. Other areas were closed to bivalve, gooseneck barnacle and mussel harvesting for several weeks, as a precautionary measure. Salmon habitats were in protected bays and not in the exposed outer coastline where most oiling occurred. The historical spawning locations in Barkley Sound (as documented) were altered but it was not certain if this was related to the oil. The commercial quotas were met and there was not any evidence of tainting of herring.

## *Prestige*

On November 13, 2002, a tank in the ship burst in a storm whilst she was off Galicia in Spain. She was single-hulled, flying a Bahamas flag, and had been chartered by a Russian oil company based in Switzerland. On November 19, the ship broke into two. The Spanish government let the Prestige sink, and the wreck continued to leak oil. It was unlikely that the ship would have broken into two if it had been towed to calm waters, and the cargo transferred, as had been requested by the ship’s captain.

The leaking oil has polluted the sea bed and contaminated the Spanish coastline in a very notable ecological region. Simon Walmsley, senior policy officer for shipping for the World Wildlife Fund states that “The environmental devastation caused is at least on a par, if not worse, than the *Exxon Valdez*. The amount of oil spilled is more than the *Valdez* and the toxicity is higher, because of the higher temperatures.” Questions have also been raised regarding the condition of the vessel at the time of the accident.