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15 FOLLOW-UP AND MONITORING

The follow-up and monitoring programs for this Project will be designed to meet several legislative and regulatory requirements, as well as internal corporate standards and requirements. Pursuant to the *Canadian Environmental Assessment Act* (CEAA), a follow-up program is mandatory for Projects requiring Comprehensive Studies with the purpose of “(a) *verifying the accuracy of the environmental assessment of a project, and (b) determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project.*” Follow-up programs serve as the primary means to determine and quantify change from routine operations on the receiving environment. While the Responsible Authority is responsible for the Follow-Up Program, it may also delegate any part of its design and delegation.

The Canada-Newfoundland and Labrador Offshore Petroleum Board’s (C-NLOPB) Development Plan Guidelines (C-NLOPB 2006) also requires an environmental assessment to include a follow-up monitoring program which it says “*may include, but not be limited to, implementation monitoring, environmental effects monitoring, compliance monitoring, and any monitoring of identified species at risk (Species at Risk) that may be required pursuant to the Species at Risk Act.*” The Development Plan Guidelines (C-NLOPB 2006) also include the requirements for the following monitoring programs to be addressed: Biological Observation Requirements, Physical Environmental Observation Program and Forecasting Programs.

There are a number of other federal and provincial regulations and guidelines are applicable to this Project including that may require monitoring to verify compliance. In addition, ExxonMobil Canada Properties (EMCP) has committed to undertake observational and monitoring programs associated with certain Project activities.

The following sections address all of the above requirements.

15.1 Environmental Effects Monitoring

A key component of monitoring the construction and operations of a project is the Environmental Effects Monitoring (EEM) program. EEM programs take repetitive measurements of environmental variables over time to detect changes caused by external influences directly or indirectly attributable to a specific anthropogenic activity or development (Duinker 1985). Ultimately, EEM programs are an assessment tool to help determine the sustainability of human activities on ecosystem health. EEM programs verify environmental effects predictions and the effectiveness of mitigative measures, as well as facilitate the identification of any unforeseen environmental problems that may arise, thereby allowing them to be addressed in a timely and effective manner.

EEM programs are designed using an iterative process that allows for opportunities to review the EEM design over the life of a project and address project changes, as well as changing priorities in environmental management policies and practices while allowing for the incorporation of new and/or improved technologies and methodologies.

15.1.1 Proposed Offshore Environmental Effects Monitoring Program

The development and design of EEM programs in the Newfoundland and Labrador offshore oil and gas industry has built upon the considerable knowledge and experience gained from industry monitoring in the North Sea and the Gulf of Mexico. Each of the subsequent Canadian EEM programs (*i.e.*, Cohasset-Panuke, Hibernia, Sable Gas, Terra Nova and White Rose) has sought input from the regional, national and international scientific community, regulatory agencies and other stakeholders to further define expectations and goals of their EEM programs. The following describes the process that has been used to date in the development of EEM programs in the Newfoundland and Labrador offshore oil and gas industry. EMCP is proposing to use a similar process in the development of the EEM for this Project.

The initiation of the EEM process has typically consisted of the identification of the parameters to be measured, data gaps to be addressed and the overall goals and purpose of the EEM program. This step typically includes a literature and data review and identification of marine resources of interest as well as the establishment of boundaries and scale for the monitoring program. A conceptual model may also be developed at this stage, which describes the underlying cause-and-effect links of the project that may be used to generate environmental effects predications to be tested in the EEM program.

During this initial stage of the EEM process, input from the scientific community, regulatory agencies and key stakeholders groups is solicited through a series of formal and informal meetings and/or consultations. These meetings and consultations assist in developing a focused monitoring strategy by:

- ◆ Defining the purpose of the EEM Program
- ◆ Defining interactions from project discharges
- ◆ Determining the appropriate parameters to be monitored and the rationale for their inclusion / exclusion for the program
- ◆ Determining the means by which to measure environmental effects predictions
- ◆ Determining the requirement for new or additional site specific baseline data
- ◆ Determining the spatial design and statistical methodologies to be used for the various EEM components
- ◆ Reporting and incorporating information into the overall Environmental Protection Plan (EPP) to facilitate decision-making

Where an EEM program identifies unanticipated environmental effects, or where mitigation is found to be ineffective, EMCP will work with the applicable regulatory authorities to amend the EEM program and/or mitigation strategies to ensure that the Project does not result in significant adverse environmental effects. EMCP will include the EEM program as a part of the overall Management System outlined for the Project in Chapter 16 of this Comprehensive Study Report (CSR).

As stated above, under CEAA, the Responsible Authority has overall responsibility for ensuring necessary mitigation and that a Follow-Up Program is designed and implemented in accordance with CEAA. EMCP, in consultation with the C-NLOPB, will engage the other regulatory agencies to ensure the results of the EEM program are communicated in a manner that facilitates the obligations of Responsible Authorities to report on the EEM program. Where EEM requirements are identified through the permitting stage (*i.e.*, authorizations under the *Canadian Environmental Protection Act*), these programs will be incorporated into the overall EEM program framework.

In addition to the operational EEM program, EMCP is committed to a fish habitat compensation monitoring program. The details regarding fish habitat compensation monitoring will be determined in consultation with DFO. A fish habitat compensation monitoring survey is conducted following completion of the compensation works to verify the amount and productivity of habitat created.

In addition, should an accidental release of oil occur from a spill or blow-out, a spill EEM program will be instituted.

15.1.2 Existing Offshore Environmental Effects Monitoring Programs

The three EEM programs currently approved for the Newfoundland and Labrador offshore oil and gas industry have core similarities with some differences that make each program unique (Petro-Canada 2007; HMDC 2005; Husky Energy 2007). The core components of the EEM programs are sediment, water and commercial fish analyses (Figure 15-1).

The EEM programs conducted to date offshore Newfoundland and Labrador have typically adopted a radial gradient sampling design for sediment quality monitoring; parameters are measured at increasing distances along transect radii from the drill site(s). Gradient designs have been found to provide the greatest statistical power to detect changes associated with production and drilling activities, and to provide information on the scale of disturbance effects (Ellis and Schneider 1997; Green 2003). The sediment quality monitoring program is primarily designed to detect and monitor changes associated with the release of solid discharges from the operating platforms.

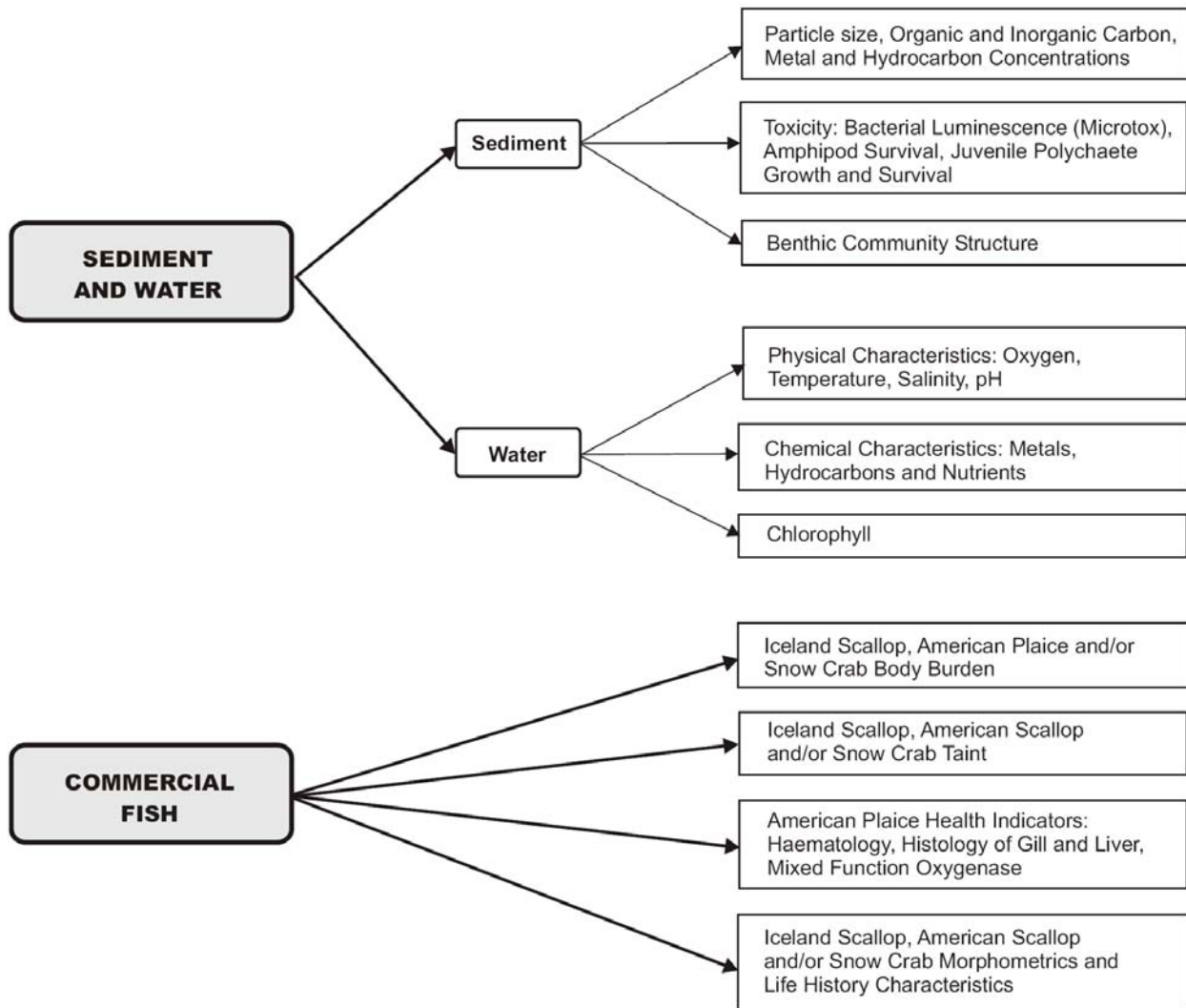


Figure 15-1 Environmental Effects Monitoring Program Components

Commercial fish parameters in Newfoundland and Labrador EEM programs have been typically examined in a control-impact design, where samples collected and parameters measured are examined from both study and control areas. The commercial fish programs are used to detect changes associated with both solid and liquid discharges.

Water sampling EEM programs have, for the most part in Newfoundland and Labrador, been based on a control-impact design or a modification of the control-impact design. These programs are designed to detect and monitor changes related to the release of liquid discharges, primarily produced water from the operating platforms.

All current EEM programs in Newfoundland and Labrador use more than one far-field reference station and have both baseline and operational EEM programs. The actual type(s) of EEM sampling design ultimately used for the Hebron Project will be chosen during the EEM design process. This process may be similar to that described above, and will build upon knowledge and data gained from existing Jeanne d’Arc Basin EEM programs. Upon

completion of a draft EEM design for the Hebron Project, the design will be formally submitted to the C-NLOPB for review and comment. Upon receipt of regulatory and other stakeholder comments, the Hebron EEM program will be finalized and implemented. Subsequent EEM programs will be reviewed and refined as necessary during the life of the project in order to ensure continual improvement.

15.1.3 Nearshore Environmental Effects Monitoring Program

EMCP will implement a nearshore EEM program to verify impact predictions in the marine environment in Bull Arm. The details of the nearshore EEM program will be developed in consultation with regulatory agencies and key stakeholders.

In addition, should an accidental release of oil occur from a spill, a spill EEM program will be determined based on criteria established with EMCP's Offshore Oil Spill Response Plan.

15.2 Environmental Compliance Monitoring

Environmental compliance monitoring (ECM) programs refers to activities used to ensure compliance with all regulatory and self-imposed environmental requirements. ECM assures regulators and the public that environmental regulations and standards are followed.

EMCP will implement a comprehensive Environmental Protection Plan (EPP) for the Nearshore Project Area and the Bull Arm Site. In addition, pursuant to the *Drilling and Production Regulations*, an EPP will be implemented for the offshore drilling and production operations.

15.2.1 Nearshore Environmental Compliance Monitoring

During construction activities at the Nearshore Project Area, as required by regulation, or as may be prescribed in the EPP and consistent with ExxonMobil standards, EMCP will implement an audit and compliance monitoring program. This program will incorporate compliance reporting requirements for applicable federal and provincial regulations governing activities at the Bull Arm Site. These regulatory instruments include, but are not limited to:

- ◆ Section 36 of the federal *Fisheries Act*, which prohibits the discharge of deleterious substances into any type of water frequented by fish
- ◆ Section 32 of the federal *Fisheries Act*, which prohibits the destruction of fish by any means other than fishing
- ◆ Section 35 of the *Migratory Birds Convention Act, 1994*, which prohibits the deposit of oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds
- ◆ *Oil Pollution Prevention Regulations* of the *Canada Shipping Act*, which details how fuel transfers between ship and shore or between ships are conducted

- ◆ The *Hazardous Products Act*, which is the basis for Workplace Hazardous Materials Information System (WHMIS), which promotes proper labelling of controlled products and requires workers to receive education and training safe storage, use and handling of controlled products
- ◆ The Authorization for Works or Undertakings Affecting Fish Habitat, issued by Fisheries and Oceans Canada (DFO) under the *Fisheries Act*, and the Permit to Alter a Body of Water under the *Water Resources Act*, which details how infilling will be conducted
- ◆ Ocean disposal requirements under the *Canadian Environmental Protection Act*
- ◆ Newfoundland and Labrador Department of Environment and Conservation (NLDEC) Guidance Documents *Dredge Spoils Disposal* GD-PPD-028-1 and *Leachable Toxic Waste, Testing and Disposal* GD-PPD-026-1, which details the testing and disposal requirements of dredged materials from marine construction activities. The removal and disposal of dredge spoils from within the marine/freshwater environment requires testing as per GD-PPD-026-1 and approval from the Government Service Centre
- ◆ *Garbage Pollution Prevention Regulations, Pollutant Substance Regulations, Pollutant Discharge Reporting Regulations* and *Oil Pollution Prevention Regulations* as required by the CSA, which will govern all vessel activities
- ◆ The NLDEC *Water and Sewer Regulations* for waste water discharge, which requires testing of the water from any on-land settling ponds prior to discharge

15.2.2 Offshore Environmental Compliance Monitoring

The ECM program requirements for the offshore oil and gas industry are detailed in the *Offshore Waste Treatment Guidelines* (OWTG) (National Energy Board (NEB) *et al.* 2010). The OWTG (NEB *et al.* 2010) outline the recommended practices and standards for the treatment and disposal of wastes and the sampling and analysis of waste streams. All operations will adhere to the most recent version of the guidelines.

The OWTG (NEB *et al.* 2010) provide minimum standards for the treatment and disposal of specific waste streams, including air emissions, produced water, drilling muds, drilling solids, storage displacement water, bilge and ballast water, deck drainage, produced sand, well treatment fluids, cooling water, desalination brine, sewage and food wastes, water for testing fire control systems, monoethylene glycol, naturally-occurring radioactive material and other substances, wastes and residues. For further information with respect to the standards for the treatment, disposal and monitoring of waste streams listed above, the reader is referred to the OWTG (NEB *et al.* 2010).

An Authorization for Works or Undertakings Affecting Fish Habitat will also be issued under the *Fisheries Act* for Project components occurring at the Offshore Project Area.

EMCP will adhere to ocean disposal requirements under the *Canadian Environmental Protection Act* for disposal of dredge spoil from any potential future excavated drill centres.

15.3 Other Required Programs

EMCP has committed to undertaking monitoring and reporting of various VECs during certain activities associated with the Hebron Project. In addition, pursuant to C-NLOPB guidelines and regulatory requirements, EMCP may have to undertake monitoring programs associated with the issuance of permits / authorizations. These may include, but are not limited to:

- ◆ Collection of data on marine mammals, sea turtles and marine birds during blasting programs at Bull Arm
- ◆ Collection of data on marine mammals and marine birds during geophysical programs. Marine mammal and sea turtle monitoring and observation protocols will be consistent with the *Geophysical, Geological, Environmental and Geotechnical Program Guidelines* (C-NLOPB 2011). Marine bird observations will be undertaken, where applicable, as per the pelagic marine bird monitoring protocol developed by the Canadian Wildlife Service
- ◆
- ◆ Compliance monitoring to ensure that the *Navigable Waters Protection Act* Conditions of Approval are implemented as outlined by Navigable Waters Protection Program of Transport Canada
- ◆ Collection and reporting of physical environmental data
- ◆ Project activities affecting fish habitat evaluated as part of the fish habitat compensation program. All fish habitat compensation measures will be monitored to ensure no net loss of productive capacity in fish habitat. A fish habitat compensation monitoring survey is conducted following completion of the compensation works to verify the amount and productivity of habitat created. In addition, compensation monitoring to determine the continued functioning of the habitat will be conducted for a period of time and at intervals agreed upon by DFO and EMCP. The timelines for monitoring will be included in the Fish Habitat Compensation Plan, which will be provided as a condition of Section 35(2) of the *Fisheries Act*

15.4 Environmental Assessment Validation

Various program activities during the life of the Hebron Project will require authorization under the Atlantic Accord Acts (*e.g.*, drilling, dredging, geotechnical, geohazard and seismic surveys). Authorizations may be valid for one to five years at the discretion of the C-NLOPB. The schedule of Project activities outlined in this environmental assessment is based on the best available knowledge at this time. EMCP recognizes the requirement to ensure that the environmental assessment is kept current and valid to support the renewal of any applicable authorizations and/or any important changes in

environment or resource use in the Project Areas during that time. Therefore, during the life of the Project, as authorizations are renewed or new ones are required, EMCP will submit documentation to the C-NLOPB and federal regulatory authorities to confirm that:

- ◆ The scope and nature of activities planned and addressed under this environmental assessment have not changed
- ◆ The nature of the species at risk in the Project and Study Areas have been validated and have not changed (including review of Recovery Strategies and Management Plans)
- ◆ The nature and extent of the fishing activities in the Project Area have been validated and have not changed
- ◆ The mitigation measures defined and committed to in the environmental assessment are still valid

As part of its continuous improvement and stakeholder engagement, EMCP will consult with stakeholders, including fishers, regarding ongoing operations, as necessary.

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16 ENVIRONMENTAL MANAGEMENT

Environmental leadership and performance for the Hebron Project will be managed by taking a sound science, risk-based, life cycle approach. Environmental management is an evergreen process that is continuously monitored and enhanced throughout Project life.

ExxonMobil Canada Properties (EMCP) recognizes that important environmental-related decisions are often made during initial planning and concept selection. In many cases, these early decisions can effectively reduce environmental effects without measurably affecting a project's cost or schedule. Early identification of potential environmental effects can help narrow the scope of concept alternatives, develop appropriate environmental mitigation approaches and optimize a project's environmental footprint by addressing energy needs, water usage, land use, air emissions, effects on sensitive environments and effects on local communities.

For the Hebron Project, EMCP will use an established ExxonMobil Corporation (ExxonMobil) Environmental Management Process that covers the complete life cycle of a new development (facility design, construction, operation and decommissioning). A number of planning and decision-making tools and processes are used to address identified environmental challenges and to ensure that the desired level of environmental performance is achieved. Environmental risk assessments, alternatives analyses and adherence to internal environmental standards will guide the Project throughout this planning and construction process.

This Comprehensive Study Report (CSR), as well as the Socio-economic Impact Statement (SEIS), was prepared after the concept was selected and approved. An Environmental Management Plan (EMP) or Environmental Protection Plan (EPP) (as required by Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) for operations) will also be prepared to document environmental impact avoidance and/or mitigation measures. This EMP will include a description of the roles and responsibilities of Project-associated personnel, environmental-related regulatory requirements and environmental performance expectations.

During the operations stage, Project personnel will track environmental measurements to ensure that the required level of environmental performance is obtained. Facilities will be dismantled and reclaimed at the end of the Project's life per C-NLOPB requirements. A life cycle approach, from initial project concept to final decommissioning, will ensure the proper stewardship of the environmental aspects for the Hebron Project.

Environmental management for the Hebron Project will be guided by ExxonMobil's Environment Policy, expectations from the "Protect Tomorrow. Today." initiative and management systems. These systems provide a systematic, structured and disciplined approach to environmental management.

16.1 ExxonMobil Corporation Environment Policy

The Board of Directors of ExxonMobil have adopted and oversee the administration of ExxonMobil's Standards of Business Conduct, which include the foundation policies of ExxonMobil. ExxonMobil's approach to environmental protection is guided by the ExxonMobil's Environment Policy, as shown in Figure 16-1.

It is ExxonMobil Corporation's policy to conduct its business in a manner that is compatible with the balanced environmental and economic needs of the communities in which it operates. The Corporation is committed to continuous efforts to improve environmental performance throughout its operations.

Accordingly, the Corporation's policy is to:

- comply with all applicable environmental laws and regulations and apply responsible standards where laws and regulations do not exist;
- encourage concern and respect for the environment, emphasize every employee's responsibility in environmental performance, and foster appropriate operating practices and training;
- work with government and industry groups to foster timely development of effective environmental laws and regulations based on sound science and considering risks, costs, and benefits, including effects on energy and product supply;
- manage its business with the goal of preventing incidents and of controlling emissions and wastes to below harmful levels; design, operate, and maintain facilities to this end;
- respond quickly and effectively to incidents resulting from its operations, in cooperation with industry organizations and authorized government agencies;
- conduct and support research to improve understanding of the impact of its business on the environment, to improve methods of environmental protection and to enhance its capability to make operations and products compatible with the environment;
- communicate with the public on environmental matters and share its experience with others to facilitate improvements in industry performance;
- undertake appropriate reviews and evaluations of its operations to measure progress and to foster compliance with this policy.

Figure 16-1 ExxonMobil Corporation Environment Policy

16.2 Corporate Environmental Initiative

ExxonMobil senior management has reinforced environmental performance expectations to all ExxonMobil's business lines in order to achieve superior performance. This leadership-driven initiative is called "Protect Tomorrow. Today." (Figure 16-2).

ExxonMobil seeks to deliver superior environmental performance, and in this spirit, an Environmental Management Process has been developed, which is integrated with project design and operations processes and procedures and has been deployed consistently around the world. This process allows ExxonMobil to conduct its business in a manner that is compatible with the balanced environmental and economic needs of the communities in which it operates. ExxonMobil is committed to continuous efforts to improve environmental performance.

- "Protect Tomorrow. Today."***
- Deliver superior environmental performance, leading to competitive advantage.
 - Drive environmental incidents with real impact to zero, through a process of continuous improvement.
 - Achieve industry leadership in key environmental areas relevant to each business.

Figure 16-2 "Protect Tomorrow. Today." Principles

16.3 Management Systems

Long-term sustainable performance will be established through use of the ExxonMobil management systems, including operations integrity, controls integrity, reliability and capital projects management. The Environmental Management Process is integrated into two of these management systems: the Operations Integrity Management System (OIMS) and the ExxonMobil Capital Projects Management System (EMCAPS).

16.3.1 Operations Integrity Management System

ExxonMobil's OIMS Framework establishes common worldwide expectations for addressing risks inherent in its business. The term "operations integrity" is used by ExxonMobil to address all aspects of its business that can affect personnel and process safety, security, health and environmental performance at ExxonMobil facilities worldwide.

OIMS is a framework of management systems designed to identify hazards and manage the associated risks. It provides a systematic, structured and disciplined approach across businesses and facilities worldwide and enables ExxonMobil to measure progress and ensure management accountability in these areas. OIMS also ensures that ExxonMobil appropriately engages with the communities in which it operates. Business-line managers are expected to adhere to all OIMS requirements, from project inception to ongoing operations, and conduct OIMS assessments on a frequent basis.

OIMS is embedded into ExxonMobil's day-to-day work processes to establish common worldwide expectations that every operating unit must fulfill to proactively manage risk globally. Over time, it has become a part of ExxonMobil's culture and the way it does business, improving operations reliability, and reducing safety, security, health and environmental risks and effects.

The overall effectiveness of OIMS is reviewed every five years and the system is adjusted accordingly. As a result, OIMS has been continuously

improved to include behaviour-based safety, security, environmental matters and enhanced community involvement.

In 2007, Lloyd's Register Quality Assurance, Inc. (LRQA) attested that OIMS meets the requirements of the ISO 14001 standard for environmental management systems. Furthermore, LRQA recognized that OIMS also meets all the requirements of the Occupational Health and Safety Assessment Series for health and safety management systems (OHSAS 18001).

EMCP is establishing the management systems, including the Environmental Management System, to address the requirements and expectations of the OIMS framework. These systems incorporate five essential characteristics:

- ◆ **Scope and Objectives:** scope defines the system's boundaries and interfaces with other systems, organizations and facilities. Objectives clearly define the system's purpose and expected results
- ◆ **Processes and Procedures:** processes address the steps that describe what the system does and how it functions. Procedures address the key tasks within a process
- ◆ **Responsible and Accountable Resources:** the approval authority, experience and training necessary for specific roles and responsibilities in implementation and execution of the system are specified
- ◆ **Verification and Measurement:** a system must be checked to see whether it is functioning as designed and is achieving its stated purpose
- ◆ **Feedback and Improvement Mechanisms:** these mechanisms help ensure actions are taken to continuously improve a system's suitability, capability and effectiveness

The OIMS framework has 11 elements (Figure 16-3), each with clearly defined expectations that every operation must fulfill. Environmental aspects are integrated throughout OIMS. The specific basis for the Environmental Management System is within Element 6, Operations and Maintenance.

16.3.2 ExxonMobil Capital Projects Management System

The EMCAPS provides a framework for guiding project development and execution. This system requires several deliverables to be completed by specific decision points in the life of a project. Two key EMCAPS deliverables related to the Environmental Management Process are the EMP and the Regulatory Compliance Plan.

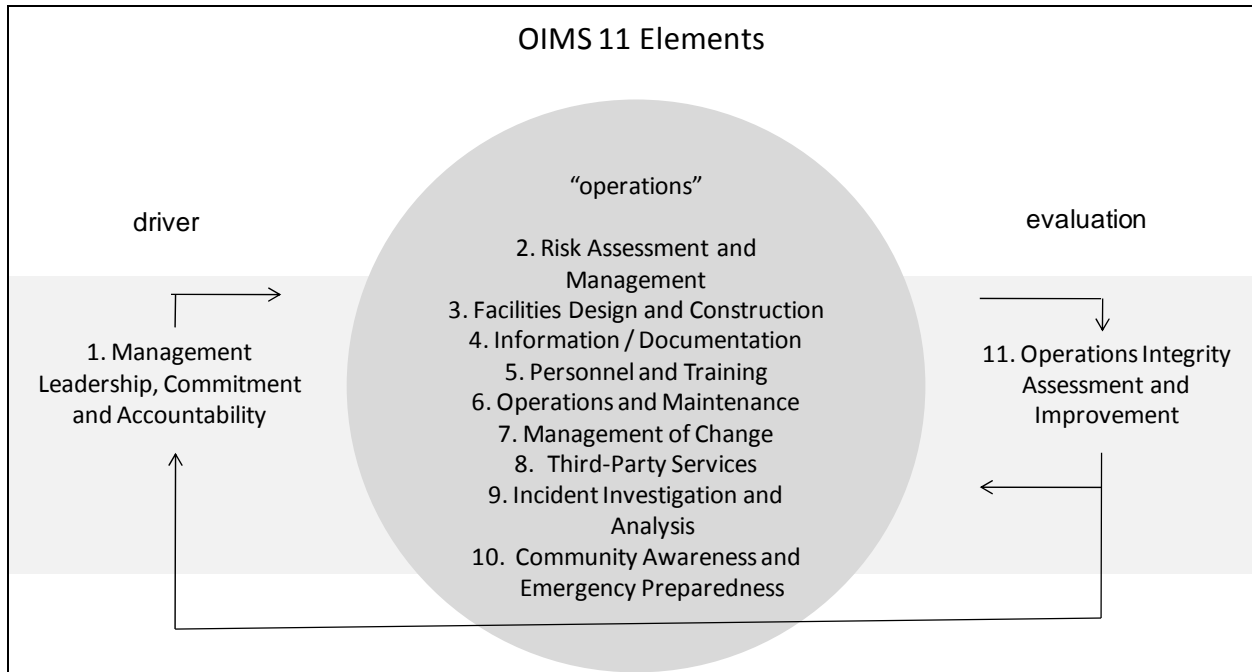


Figure 16-3 OIMS 11 Elements

16.4 Environmental Management Process

ExxonMobil’s structured Environmental Management Process ensures that a variety of tools, plans and processes are in place to safeguard the environment - its biodiversity, cultural heritage and value. These features are a priority in business planning throughout a project’s life cycle. The Environmental Management Process requires an early engagement approach to identifying environmental issues and alternatives, even before the project concept is determined. In the project’s early stages, alternatives analyses guide project concepts and decisions as more knowledge about site characteristics and facility designs become known. Decisions early in a Project’s life can lead to an overall reduced environmental footprint.

The Environmental Management Process for the Hebron Project has been broken down into five stages of activity that follow the timeline for developing and operating a project (Figure 16-4).

Implementation of a structured Environmental Management Process with organized and well-defined associated systems, tools and processes is the key to managing the environmental, socio-economic and health challenges of the Hebron Project.

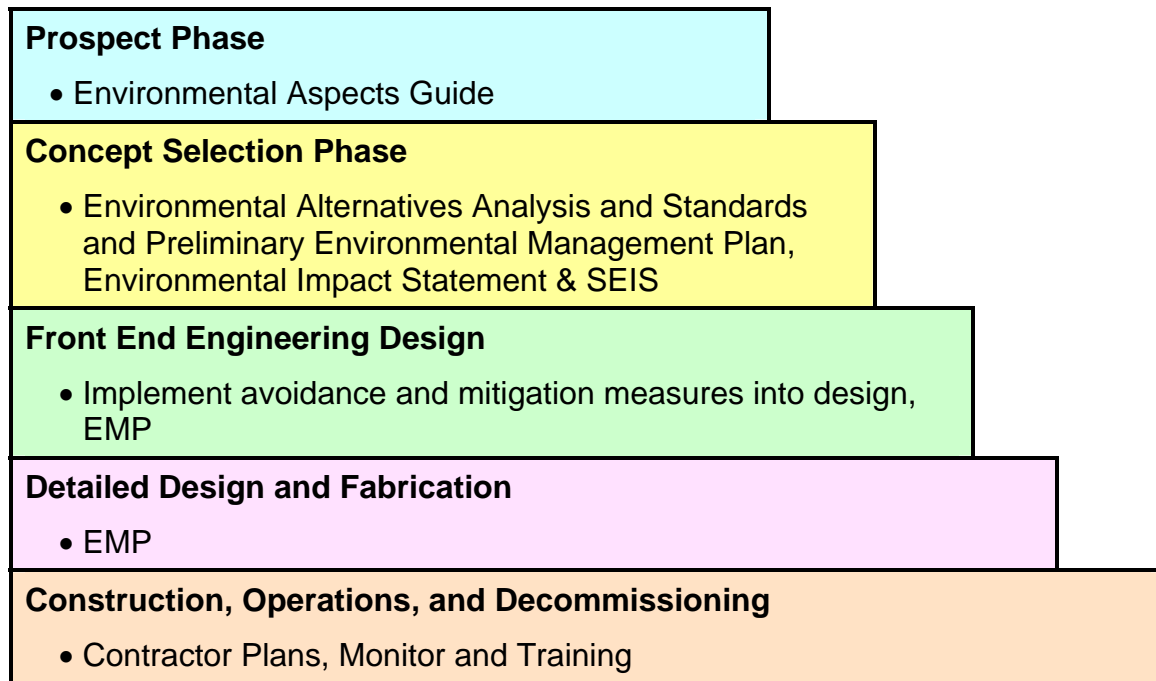


Figure 16-4 The Five Project Stages and Related Environmental Tools and Processes

16.4.1 Prospect Phase

The tool developed to guide this process and ensure that a wide range of potential environmental sensitivities are considered is the ExxonMobil Environmental Aspects Guide. This Guide provides a comprehensive list of environmental sensitivities for consideration and a systematic process for the initial assessment of activities, products and services that interact with the environment. The Guide promotes early engagement with the applicable engineering, geoscience and management teams and straightforward high-level mitigation approaches in order to reduce environmental effects. This Guide was used to steer Hebron Project environmental and regulatory planning, as well as development of the environmental assessment and Preliminary Environmental Management Plans (PEMP).

This phase of the Environmental Management Process usually involves the environmental and regulatory evaluation of various Project alternatives or concepts. The environmental risks associated with the alternative modes of development for the Hebron Project were evaluated and a preferred concept was selected prior to ExxonMobil becoming the operator (as described in Section 2.4).

From the earliest stages of the Project, the management team has actively promoted a safety, security, health and environment (SSH&E) culture, to both those working on the Project and to the public. EMCP is committed to working with the provincial government, the Workplace Health, Safety and Compensation Commission, the Building Trades Council and others toward improved safety in the province. EMCP hosted an initial contractor SSH&E Forum in June 2009 and has carried its message of safety ("Nobody Gets

Hurt."), security ("Security is everybody's business.") and environment ("Protect Tomorrow. Today.") to the public through presentations at Open Houses, in schools and at conferences. The Open Houses in the fall of 2009 were one means of bringing the information about the Project and the environmental assessment to the interested public.

16.4.2 Concept Selection Phase

In the normal process, once a new hydrocarbon resource has been determined to represent a viable development opportunity, several concepts for developing the resource are contemplated. For each of these concepts, a more detailed level of environmental alternative analysis is conducted. These analyses consider the various environmental impacts associated with each of the different design concepts and technologies being considered.

16.4.2.1 Alternatives Analyses

During the concept selection phase, the tool that is used to manage environmental reviews is the Early Project Environmental Alternatives Analysis. This tool focuses on select environmental aspects that can be reasonably evaluated at an early stage, allowing for practical decisions to be made. Another tool, developed to enhance early project decisions, is a series of ExxonMobil Environmental Standards that address aspects related to air, water, land and local communities.

16.4.2.2 Environmental Standards

EMCP is committed to meeting provincial and federal regulations for environmental performance and, where no local regulations exist, to operate to standards that are protective of the environment. These standards were developed by ExxonMobil and are based on sound science and comprehensive risk assessments. They provide an additional layer of environmental protection assurance, especially in regions where environmental requirements are not comprehensive. The existing environmental standards include nitrogen oxides emissions, offshore drill cutting discharges, flare and venting reduction, water management, waste management, land use, energy efficiency and greenhouse gases, socio-economic management, air emissions and marine geophysical operations. These standards assist in identifying environmental improvement opportunities early in project planning when they can be implemented most effectively.

16.4.2.3 Environmental and Socioeconomic Impact Statements

An Environmental Impact Statement (EIS) is required by Canadian and Newfoundland and Labrador legislation. Pursuant to the *Canadian Environmental Assessment Act*, the EIS is a CSR. Per these requirements, the scope and detail of the CSR and SEIS for the Hebron Project are based on the conceptual level of engineering design, the Project environment's sensitivity, existing socio-economic conditions, the scope of the Project and

the nature of anticipated environmental issues / effects. These tools are valuable to many Project team members, since decisions made by Project personnel will be influenced by its findings and recommendations.

The CSR and SEIS processes are detailed and rigorous, and ensure that a project is appropriately designed, constructed and operated in an environmentally responsible manner. The results of these assessments lead to the development of environmental effects avoidance and mitigation plans. These avoidance and mitigation measures, as well as specific monitoring and measuring procedures, are documented in subsequent project documents and plans, starting with the PEMP.

16.4.2.4 Preliminary Environmental Management Plan

During this phase, a PEMP was prepared to describe the process for managing its associated environmental-related issues in view of the Project schedule and other needs. This plan identified and organized the key issues and processes necessary for managing the Project's environmental aspects, including applicable environmental-related regulatory requirements, external financing-related environmental requirements (if applicable), roles and responsibilities of specific project personnel and environmental-related requirements for Project engineering and construction contracts and contractors. The PEMP provides a roadmap of environmental-related expectations as the details of the Project design and construction plans continue to be defined.

16.4.3 Front End Engineering Design

The results of the CSR, SEIS and PEMP prepared during the Concept Selection Stage, including recommended environmental issues / effects avoidance, mitigation and monitoring measures, will be integrated into the Project design during FEED. The appropriate environmental standards will be used to evaluate design changes as necessary. As design progresses during this stage, the PEMP will be updated and results documented as an EMP.

16.4.3.1 Environmental Management Plan

The EMP for the Hebron Project will integrate the environmental and socio-economic issues / effects avoidance, mitigation and monitoring measures, identified in the CSR and SEIS, into the Project's activities and operations. This includes integrating them into the overall Project schedule and in the supporting engineering and contractor plans and contracts. Deviations from agreed-upon strategies require a stringent, documented review and approval process. Any approved changes are incorporated into the Project schedule and documentation. The EMP includes plans for public consultation, environmental training of project personnel, waste management and other specific plans as appropriate. Depending on the environmental, socio-economic and health challenges associated with each Project phase, other specific plans may be needed to support the EMP.

The Hebron Project EMP will provide the basis for the EPP that will be submitted to the C-NLOPB for approval.

16.4.4 Detailed Design and Fabrication

When the Project's designs become finalized and fabrication begins, the EMP will help guide Project activities at various contractor sites. Prior to beginning significant onsite construction and installation activities, the environmental advisors will conduct a series of assessments with each major segment of the Project, such as the installation, logistics, procurement coordinators and production operations personnel to review the Project's environmental-related requirements and commitments. These assessments are documented and reviewed for endorsement by key Project managers. During this stage, the EMP will continue to be updated as the Project matures.

16.4.5 Construction, Operations and Decommissioning

The above-mentioned systems, tools and standards are primarily used for Project geophysical, planning, engineering, fabrication, construction and drilling activities. A plan will be developed to transition the EMP to the production operations group several months prior to anticipated "start-up". The plan includes the identification and documentation of key activities and responsibilities. During this commissioning process, it is optimal for construction and operations EMP implementation and compliance monitoring personnel to overlap in order to ensure a smooth transition. The development phase tools, plans and standards continue to be applicable during the production phase. At the end of Project life the Project facilities will be decommissioned.

16.4.5.1 Environmental Effects Monitoring

Throughout the construction and operations phases, the work is monitored in view of the applicable environmental and regulatory obligations and requirements. Tools such as a proprietary menu-driven database are used by ExxonMobil to track the completion of these obligations and requirements. This database is available continuously and globally so that all project team members have access to it when needed. Since it is a "live" database, updates and changes made are viewable at all times.

Regulatory Compliance Assessments are also conducted to review the various aspects of the project, including its environmental requirements, and highlights areas for improvement. Follow-up actions are monitored to ensure closure.

16.4.5.2 Contractor Requirements

Contractual requirements for each of the Project contractors will require them to develop their own EMP and Regulatory Compliance Plan specific to their scope of work. These plans are reviewed and endorsed by the Project team to ensure that the contractor will meet ExxonMobil's environmental and regulatory expectations and requirements. Project team members are

assigned to each contractor to monitor their work throughout the construction phase.

16.4.5.3 Management of Change Process

The systems and processes used to develop and construct a project include a Management of Change (MOC) Process. The MOC Process provides a means to ensure that changes are reviewed and endorsed regarding their health, safety, environmental, regulatory, security and operational implications, and any other requirements before they are endorsed.

16.5 Capacity Building

16.5.1 Training

In order to ensure that the Environmental Management Process is consistently implemented, ExxonMobil has developed a training curriculum for its environmental advisors (Figure 16-5). These sessions are taught by experts and are designed to build technical capacity and share information on ExxonMobil's environmental, socio-economic and health management philosophy and approach. Project studies are shared and problems are worked in groups to provide instruction regarding how to approach the types of decisions and issues related to environmental matters arise when undertaking major projects



Figure 16-5 Example Training Sessions

16.5.2 Environmental Management Process Workshops

In addition to project host-country employment and business use opportunities, ExxonMobil provides workshops to explain its Environmental Management Process, how it works and ExxonMobil's overall environmental expectations and requirements. Recent workshops have included a wide range of audience, including Project teams, contractors and key government agency representatives.

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17 SUMMARY AND CONCLUSIONS

17.1 Summary of Proposed Activities

The Hebron Project is a proposed oil and gas development located offshore Newfoundland, approximately 340 km east of St. John's. Forecasted cumulative oil recovery for the initial development phase after 30 years of producing life ranges from 87 Mm³ (548 MBO) to 140 Mm³ (883 MBO) from an anticipated 41 wells. The Ben Nevis Pool within the Hebron Field is the core of the Hebron Project, and is anticipated to produce approximately 80 percent of the Hebron Project's crude oil.

The intent is to develop the Hebron oil field using a concrete Gravity Base Structure (GBS) with an integrated Topsides facility. The GBS will be a reinforced concrete structure designed to withstand impacts from sea ice and icebergs and the meteorological and oceanographic conditions at the Hebron Field. It will accommodate up to 52 well slots with J-tubes connected to the base of the GBS for potential expansion opportunities. An Offshore Loading System (OLS) will be installed to off-load crude oil from the platform to tankers.

Potential expansion opportunities may include subsea tieback to the Hebron Platform from excavated drill centres.

The scope of the Hebron Project includes GBS construction activities at the Nalcor Energy-Bull Arm Fabrication site in Trinity Bay, Newfoundland, which are scheduled to begin in 2011, and the installation, operation and future decommissioning activities of the Project offshore, with first oil targeted for 2017. The environmental assessment is therefore focused on activities in both the Nearshore and Offshore Project Areas.

17.2 Summary of Assessment Findings

Under the *Canadian Environmental Assessment Act* (CEAA), the Hebron Project requires environmental assessment at a comprehensive study-level of assessment. The Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) and other federal Responsible Authorities (RAs) have set out the required scope of this environmental assessment in a Scoping Document (C-NLOPB 2009). This Comprehensive Study Report (CSR) meets these requirements, as well as meeting the requirements of the C-NLOPB *Development Plan Guidelines* (C-NLOPB 2006).

The potential environmental effects of each Project phase have been evaluated for each of the selected Valued Ecosystem Components (VECs) (*i.e.*, those components of the environment that are valued socially, economically, culturally and/or scientifically and are of interest when considering the potential environmental effects of the Project). The VECs selected for this environmental assessment reflect the issues raised by stakeholders and include Air Quality (air quality and greenhouse gas (GHG)

emissions), Marine Fish and Fish Habitat, Commercial Fisheries, Marine Birds, Marine Mammals and Sea Turtles, Marine Species at Risk (SAR) (marine fish species SAR, marine mammal and sea turtle SAR and bird SAR) and Sensitive or Special Areas.

17.2.1 Summary of Residual Effects

A summary of the residual environmental effects assessment for each of the identified VECs is provided in Table 17-1. The only potential for significant residual adverse environmental effects as a result of the Hebron Project is in association with an accidental event. In such an unlikely event, significant adverse environmental effects have been predicted for Marine Birds, bird SAR and the Sensitive or Special Areas located in the Nearshore Project Area, however, the likelihood of this occurring is considered very low. Emphasis on both pollution prevention and effective response planning will further reduce the potential for these unlikely significant environmental effects to occur.

Table 17-1 Significant and Not Significant Residual Environmental Effects on Valued Ecosystem Components

VEC	Significance of Residual Environmental Effect					
	Construction / Installation	Operation and Maintenance	Decommissioning and Abandonment	Accidents, Malfunctions and Unplanned Events	Project Overall	Cumulative Environmental Effects
Air Quality	NS	NS	NS	NS	NS	NS
Fish and Fish Habitat	NS	NS	NS	NS	NS	NS
Commercial Fisheries	NS	NS	NS	NS	NS	NS
Marine Birds	NS	NS	NS	S	NS	NS
Marine Mammals and Sea Turtles	NS	NS	NS	NS	NS	NS
Species at Risk: Marine Fish	NS	NS	NS	NS	NS	NS
Species at Risk: Marine Mammals and Sea Turtles	NS	NS	NS	NS	NS	NS
Species at Risk: Birds	NS	NS	NS	S	NS	NS
Sensitive or Special Areas	NS	NS	NS	S	NS	NS
S = Significant residual environmental effects NS = Not significant residual environmental effect						

17.2.2 Summary of Proposed Mitigation Measures

The proposed mitigation measures identified in association with each of the VECs is outlined in Table 17-2 for the following phases: nearshore construction activities, offshore construction and installation, potential expansion opportunities, offshore operations and maintenance, potential expansion opportunities, decommissioning and abandonment and accidental events.

Table 17-2 Proposed Mitigation by Project Phase and Valued Ecosystem Component

Applicable VECs	Mitigation
Nearshore Construction	
<ul style="list-style-type: none"> • Air Quality and GHG Emissions 	<ul style="list-style-type: none"> • Limited periods when vessels are idling • Vessel maintenance and inspection
<ul style="list-style-type: none"> • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles and Birds) 	<ul style="list-style-type: none"> • During blasting use of bubble curtains, if required • Harmful alteration, disruption or destruction (HADD) authorization and compensation • Use of sediment control measures • Adherence to the <i>Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters</i> (Wright and Hopky 1998) • During blasting, monitor appropriate safety zone for diving birds, marine mammals and sea turtles • Compliance with terms of Section 32 <i>Fisheries Act</i> Authorization (if required) • Washwater from the cleaning of mixers, mixer trucks and concrete delivery systems directed to a settling basin • Proper release of stranded birds per Canadian Wildlife Service (CWS) protocol • For deepwater site moorings, restrict disturbance to mooring sites • Vessels to maintain steady course and speed and to avoid concentrations of marine birds and marine mammals • Vessels to deviate course to avoid concentrations of marine mammals • Use of best practices, continuous improvement programs and best available technology
<ul style="list-style-type: none"> • Commercial Fisheries 	<ul style="list-style-type: none"> • Fisheries liaison committee • Safety zone • Timing • Vessel traffic management plan • Fisheries compensation plan • Notification and communication • Fisheries Liaison Officer (FLO) • Single point of contact (SPOC)
Offshore Construction and Installation	
<ul style="list-style-type: none"> • Air Quality and GHG Emissions 	<ul style="list-style-type: none"> • Ensure the use of properly maintained and functioning equipment • Limited periods when vessels and helicopters are idling • Vessel and helicopter maintenance
<ul style="list-style-type: none"> • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles and Birds) 	<ul style="list-style-type: none"> • Use of best practices, continuous improvement programs and best available technology • Survey vessels and equipment will only use the power required to attain the data, thereby minimizing noise • Proper release of stranded birds per CWS protocol • Helicopters to avoid active marine bird colonies, including Witless Bay Ecological Reserve, and to avoid flying at low altitudes, where possible • Vessels to maintain minimum distance of 2 km from active marine bird colonies, maintain steady course and speed and avoid concentrations of marine birds or marine mammals • Vessels to deviate course to avoid concentrations of marine mammals • Adherence to the <i>Geophysical, Geological, Environmental and Geotechnical Program Guidelines</i> (C-NLOPB 2011) • Adherence the Section 35(2) <i>Fisheries Act</i> Authorization and completion of associated fish habitat compensation and related monitoring
<ul style="list-style-type: none"> • Commercial Fisheries 	<ul style="list-style-type: none"> • Notification and communication • FLO • SPOC • Safety Zone • Operational Protocols

Applicable VECs	Mitigation
	<ul style="list-style-type: none"> • Fishing Gear Compensation Program • Compliance with <i>Navigable Waters Protection Act</i> – Conditions of Approval
Potential Expansion Opportunities	
<ul style="list-style-type: none"> • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish and Marine Mammals and Sea Turtles) 	<ul style="list-style-type: none"> • Fish habitat compensation • Efficient Installation with minimal seabed disturbance • Use of best practices, continuous improvement programs and best available technology • Proper release of stranded birds per CWS protocol • Adherence the Section 35(2) <i>Fisheries Act</i> Authorization and completion of associated fish habitat compensation and related monitoring
<ul style="list-style-type: none"> • Commercial Fisheries 	<ul style="list-style-type: none"> • Notification and communication • SPOC • Safety Zone • Operational Protocols • Fishing Gear Compensation Program
Offshore Operations and Maintenance	
<ul style="list-style-type: none"> • Air Quality and GHG Emissions 	<ul style="list-style-type: none"> • Investigate the use of efficient / reduced emission technology, where appropriate, and where technologically sound and economically justifiable incorporate into the design • Monitor the number of flaring events • Develop and implement standard operating procedures (SOPs) for all chemical handling operations • Vessel and helicopter maintenance
<ul style="list-style-type: none"> • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles and Marine Birds) 	<ul style="list-style-type: none"> • Use of best practices, continuous improvement programs and best available technology • Synthetic-based mud (SBM) reinjection • Adherence to the <i>Geophysical, Geological, Environmental and Geotechnical Program Guidelines</i> (C-NLOPB 2011) • Subsurface discharge of wastewater and water-based mud (WBM) cuttings • Proper release of stranded birds per CWS protocol • Helicopters to avoid active marine bird colonies, including Witless Bay Ecological Reserve, and to avoid flying at low altitudes, where possible • Vessels to maintain minimum distance of 2 km from active marine bird colonies, maintain steady course and speed and avoid concentrations of marine birds • Vessels to deviate course to avoid concentrations of marine mammals
<ul style="list-style-type: none"> • Commercial Fisheries 	<ul style="list-style-type: none"> • Notification and communication • FLO • SPOC • Safety Zone • Operational Protocols • Fishing Gear Compensation Program
Potential Expansion Opportunities	
<ul style="list-style-type: none"> • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles and Marine Birds) 	<ul style="list-style-type: none"> • Use of best practices, continuous improvement programs and best available technology • Adherence to the <i>Geophysical, Geological, Environmental and Geotechnical Program Guidelines</i> (C-NLOPB 2011) • Plan surveys to avoid concentrations of members of Alcidae • Proper release of stranded birds per CWS protocol • Subsurface discharge of WBM and SBM cuttings • Temporal avoidance of marine mammals • For seismic surveys minimize sound levels
<ul style="list-style-type: none"> • Commercial Fisheries 	<ul style="list-style-type: none"> • Notification and communication • FLO • SPOC

Applicable VECs	Mitigation
	<ul style="list-style-type: none"> • Safety Zone • Operational Protocols • Fishing Gear Compensation Program
Decommissioning and Abandonment	
<ul style="list-style-type: none"> • Air Quality and GHG Emissions 	<ul style="list-style-type: none"> • Vessel and helicopter maintenance
<ul style="list-style-type: none"> • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles and Marine Birds) 	<ul style="list-style-type: none"> • Use of best practices, continuous improvement programs and best available technology • Proper release of stranded birds per CWS protocol • Helicopters to avoid active marine bird colonies, including Witless Bay Ecological Reserve, and to avoid flying at low altitudes, where possible • Vessels to maintain minimum distance of 2 km from active marine bird colonies, maintain steady course and speed and avoid concentrations of marine birds • Helicopters to avoid low overflights when possible • Vessels to avoid animal concentrations when possible and deviate course to avoid animals • Vessels to maintain steady speed and course • Adherence to the <i>Geophysical, Geological, Environmental and Geotechnical Program Guidelines</i> (C-NLOPB 2011)
<ul style="list-style-type: none"> • Commercial Fisheries 	<ul style="list-style-type: none"> • Notification and communication • FLO • SPOC • Safety Zone • Operational Protocols • Fishing Gear Compensation Program
Accidents, Malfunctions and Unplanned Events	
<ul style="list-style-type: none"> • Air Quality and GHG Emissions • Fish and Fish Habitat • Marine Birds • Marine Mammals and Sea Turtles • Species at Risk (Marine Fish, Marine Mammals and Sea Turtles and Birds) • Sensitive or Special Areas • Commercial Fisheries 	<ul style="list-style-type: none"> • Train staff in spill prevention and awareness • Spill response equipment • Blowout prevention design • Alert / Emergency Response Contingency Plan • SOPs for oil handling operations • SOPs for chemical handling and storage • Prevention through design standards and maintenance • Oil Spill Response Plan • Adherence with all standard navigation procedures, Transport Canada requirements, Coast Guard requirements and navigation systems • Risk awareness and training, preparation, equipment inventory, prevention, and emergency response drills • Fisheries Compensation Plan • Control and containment of debris

A Project-specific Environmental Management Plan will be developed for the Hebron Project for the Nearshore and Offshore phases.

During construction, ExxonMobil Canada Properties (EMCP) will implement an Environmental Protection Plan (EPP) for all activities at the Bull Arm Site. This EPP will be developed in consultation with regulators and area residents, in particular the commercial fish harvesters.

For offshore drilling and production operations, EMCP will comply with all regulatory requirements respecting environmental protection in accordance with the *Drilling and Production Regulations*, Operations will adhere to C-NLOPB guidance (e.g., *Offshore Waste Treatment Guidelines* (National Energy Board (NEB) *et al.* 2010), *Offshore Chemical Selection Drilling and*

Production Guidelines (C-NLOPB and CNSOPB 2011), *Environmental Protection Plan Guidelines* (NEB et al. 2011), *Offshore Physical Environmental Guidelines* (NEB et al. 2008),).

Prior to commencement of Project activities, EMCP will develop contingency plans that will serve as the guidelines for EMCP's response to an emergency at the Hebron Project. EMCP's emergency response philosophy is to minimize the effect of an emergency on people, environment and the corporation.

Throughout all phases of the Project, EMCP will actively engage stakeholders and community representatives regarding Hebron Project activities.

17.3 Summary of Monitoring and Follow-Up

EMCP will develop and implement environmental effects monitoring (EEM) programs for Nearshore and Offshore activities. These EEM programs will build on the previous Bull Arm (Hibernia) EEM program and the experience of the other three existing offshore production EEM programs. The programs for both nearshore and offshore Project activities will be developed in discussion with federal and provincial regulators, as well as the area fish harvesters, and will be closely linked to the EPP.

EMCP will undertake a fish habitat compensation monitoring program for habitat compensation works offshore and nearshore.

EMCP will use environmental observers to collect data on marine mammals, and possibly marine bird occurrences, as well as to record weather and ice conditions and oversee mitigations such as proper marine bird handling procedures and documentation. An oceanographic monitoring program will also be conducted.

17.4 Conclusions

The Project will benefit from the experience of the existing production projects offshore Newfoundland and Labrador, with respect to many key items, including reducing resource conflicts with commercial fishers, development of effective monitoring programs and effective emergency response planning.

Ecological processes will not be disturbed outside natural variability, and ecosystem structure and function will not be critically affected by the Hebron Project. Most environmental effects are reversible, and of limited duration, magnitude and geographic extent. While significant adverse environmental effects have been predicted for Marine Birds, bird SAR and Sensitive or Special Areas (those located in the nearshore only) in the case of an accidental event, the likelihood of this occurring is considered very low. EMCP will have pollution prevention measures and emergency response procedures in place.

The various routine components and activities associated with the proposed Project are predicted to result in not significant residual adverse environmental effects on Air Quality, Fish and Fish Habitat, Commercial

Fisheries, Marine Birds, Marine Mammals and Sea Turtles, Marine SAR and Sensitive or Special Areas.

EMCP acknowledges that the scope of the Project being assessed in this CSR extends over several decades, during which time the regulatory and biophysical environment may change from that assessed in this report. EMCP recognizes the requirement to ensure that the environmental assessment is kept current and valid to support the renewal of any applicable authorizations and/or any important changes in environment or resource use in the Project Areas during that time. During the life of the Project, as authorizations are renewed or new ones are required, EMCP will submit documentation to the C-NLOPB and federal regulatory authorities to confirm that proposed activities are captured within the scope of the Project and that environmental assessment predictions remain valid, including those for Species at Risk.

EMCP is committed to maintaining open communication with regulators and stakeholders and to an adaptive management approach with respect to environmental management of the Hebron Project.

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19 GLOSSARY, ACRONYMS AND ABBREVIATIONS

19.1 Glossary

Word	Definition
Abandonment	The decommissioning of facilities, including the plugging of wells and removal of offshore structures following production of reserves
Abiotic	Non-biological; a process not mediated or resulting from the activity of organisms. Ocean currents and weather are examples of abiotic processes
Advection	The process of, or referring to the transport of one fluid mass (air, water) by the movement of another
Aerobic	A process requiring the presence of air or oxygen
Alcids	A group of shorebirds, predominantly of northern coasts, including auks, puffins, murre and guillemots
Anomaly	A geological feature, especially in the subsurface, distinguished by geological, geophysical or geochemical means, that is different from the general surroundings and is often of potential economic value, (e.g., a magnetic anomaly)
Anoxic	Deficient in oxygen
Anthropogenic	Derived or resulting from human activity
Artificial Reef	An underwater artificial structure that provides habitat similar to that provided by a natural reef
Artificial Reef Effect	The effect generated by the placement of an undersea structure in an area where previously there were no similar habitats. Benthic organisms colonize the structure and, subsequently, fish and other organisms are attracted to it in search of food
Astronomical Tides	The alternate rise and fall of the surface of oceans, seas and the bays, rivers, connected with them, caused by the gravitational attraction of the sun and moon
Baleen	Comb-like semi-rigid plates with frayed edges that hang from the roof of a baleen whale's mouth; used when feeding to filter prey from the water
Ballast	(a) A relatively heavy material, such as lead, iron or water, placed in a ship to ensure stability or to maintain the proper draft or trim; (b) To pump seawater into empty fuel tanks of a ship to ensure its stability or suitable draft and trim for seaworthiness
Ballast Water	Water carried in tanks on a vessel (e.g., tanker) to maintain sea-going stability
Barite	A mineral (barium sulphate); used as a weighting material for drilling because of its high specific gravity
Bathymetry	The measurement of depths of water in oceans, seas and lakes; also the information derived from such measurements
Bedrock	A general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material
Benthos	Marine plants and animals that live on, in, or attached to the ocean

Word	Definition
	bottom
Bentonite	A clay formed from volcanic ash decomposition
Bergy Bit	A piece of floating glacier having a sail greater than 1.5 m but less than 5 m and a water plane area greater than 20 m ² but less than 300 m ² . Size approximates that of a small house and mass is between 120 and 5,400 t
Bilge	The nearly horizontal part of a ship's bottom
Biocide	A chemical agent that destroys bacteria
Biofouling	The encrustation of submerged structures by barnacles and molluscs , seaweeds and other marine life; also known as marine fouling
Biomass	The amount of living matter of a specified type given as a concentration per unit area or volume
Biota	The flora and fauna of a region
Bioturbation	The churning and stirring of a sediment by organisms
Bloom	Rapid growth of a population of planktonic organisms
Blowout	A change in the gas or oil pressure of the well, that cannot be handled by the well's control system, resulting in uncontrolled flow
Blowout Preventer (BOP)	A stack or an assembly of heavy duty valves attached to the top of the casing to control well pressure
Borehole	The hole in the earth made by the drill; the uncased drill hole from the surface to the bottom of the well
By-catch	Organisms that are caught commercially but are not the target species, (e.g., haddock is often a by-catch of the cod fishery)
Caisson	A large-diameter pipe that houses a submudline wellhead
Chlorophyll	A green pigment found in all algae and higher plants. Responsible for light capture in photosynthesis
Climax	A community that has reached a steady-state under a particular set of environmental conditions
Cobble	A rounded rock fragment between 64 and 256 mm in diameter
Comprehensive Study Report (CSR)	A level of environmental assessment required pursuant to CEAA Sections 16(1)(2)
Continental Shelf	Gently sloping, shallowly submerged marginal zone of the continents extending from the shore to an abrupt increase in bottom inclination; greatest average depth less than 183 m, slope generally less than 1 to 1,000, local relief less than 18.3 m, width ranging from very narrow to more than 320 km
Crude Oil	Unrefined petroleum
Delineation Wells	Wells drilled after the initial exploration well to give a better understanding of the extent and performance of the reservoir
Demersal	Referring to animals, usually fish, associated with, but not living on, the sea bottom

Word	Definition
Detrital	Particles occurring in sedimentary rocks that were derived from pre-existing igneous, sedimentary or metamorphic rocks, or other pre-existing material
Detritus	Dead or decaying organic matter, and associated microorganisms that are responsible for its decomposition
Development Application	The official title of all the documentation submitted in support of the development of Hebron Project
Diatoms	Microscopic algae characterized by "pill-box like" cell walls containing silica
Dinoflagellate	A chiefly marine one-celled organism with resemblances to both plants and animals. Hard parts preserved as microfossils are important for dating and correlating Mesozoic and Cenozoic deposits
Drilling Mud	A special mixture of clay, water and chemical additives pumped down the wellbore through the drill pipe and drill bit to cool the rapidly rotating bit, lubricate the drill pipe as it turns in the wellbore, and carry rock cuttings to the surface; may have a water base or a synthetic oil base fluid
Ecosystem	The complex of a community and its environment functioning as an ecological unit in nature
Endangered	Descriptive of a species that is in danger of extinction within all or part of its range (the region to which it is native)
Environmental Impact Statement (EIS)	A document that attempts to predict the environmental effects a major development might have on the human and natural environments of a given geographic area. An EIS is prepared to enable industry, government and the public to consider the environmental and socio-economic costs and benefits of a development project. Based on the information in the EIS, decisions can be made on whether to proceed with the development project
Epifauna	Benthic animals living attached to or crawling over the bottom
Fault	A fracture or fracture zone along which there has been displacement of the sides relative to each other parallel to the fracture. The displacement may be a few millimetres or many kilometres
Fecundity	Potential reproductive capacity of an organism or population. In fish, fecundity is measured by the number of eggs
Flare	An arrangement of piping and burners used to burn combustible vapours - a part of emergency pressure relief system
Flaring	Disposal of surplus combustible vapours by burning at the discharge of the flare tower
Flatfish	Fish with a flattened body and both eyes on one side of the head. Includes plaice, flounder and halibut
Flowline	(a) A pipeline that takes fluids from a single well or a series of wells to a gathering centre. (b) Seabed piping that connects field components such as wells, manifolds and riser bases
Formation Water	See produced water
Geology	The study of the structure, origin, history and development of the Earth
Geostrophic	Pertaining to deflecting force resulting from the Earth's rotation
Grain	A general term for sedimentary particles of all sizes (from clay to

Word	Definition
	boulders), as used in the expressions “grain size”, “fine-grained” and “coarse-grained”
Gravity Base Structure (GBS)	The base of an offshore drilling and production platform, usually made of concrete, and of such weight that it is held securely on the ocean bottom without the need for piling or anchors
Grey Water	Water that has been used for washing, showers, laundry, or in the galley and contains no hydrocarbons or high concentrations of chemicals
Groundfish	Species of fish that are collected by bottom gear trawls (e.g., cod, haddock and flounder)
Growler	The smallest category of iceberg size, with a sail extending less than 1.5 m above sea level and a water plane area of approximately 20 m ² . Comparable in size to a car and having a mass of less than 120 t
Gyre	Circular movement of water masses
Habitat	The place where an animal or plant lives, often characterized by some physical condition (e.g., stream habitat)
HADD	Harmful alteration, disruption or destruction (of fish habitat)
Hebron Unit	Comprises the four Hebron Significant Discovery Licences (SDL 1006, SDL 1007, SDL 1009 and SDL 1010)
Hertz (Hz)	Unit of sound frequency equal to one cycle per second
Heterotrophs	Organisms that receive nourishment by ingesting and breaking down organic matter from the surrounding water
Hurricane	A tropical cyclone with sustained wind speeds over 118 km/h, usually accompanied by rain, thunder and lightning
Hydroids	Typical colonial polyps with variously branched bushy or feathery growths. Each polyp has a crown of tentacles around the mouth
Ichthyoplankton	Collective term for fish eggs and larvae when planktonic
ICOADS	International Comprehensive Ocean-Atmosphere Data Set
Inhibitor	A substance that is capable of stopping or retarding a chemical reaction
Injection Water	Water pumped into the formation to maintain reservoir pressure (secondary recovery technique); offshore, injection water is filtered seawater treated with biocides , an oxygen scavenger and scale inhibitor
Interannual	Year-to-year
Isobath	A line on a map or chart connecting points of equal water depth
Isopods	A group of crustaceans
Juvenile	Fish past the larval stage of development, but not yet large enough to be caught in the commercial fishery (e.g., cod remains juvenile for approximately four years)
Larvae	The first immature phases of many animals after hatching of eggs and before assuming the adult form and habit
Manifolds	A piece of equipment where the fluids from several wells are received and combined

Word	Definition
Megaripple	A large, gentle, ripple-like feature composed of sand in subaqueous environments having a wavelength greater than 1 m or a ripple height greater than 10 cm. Wavelengths reach 100 m and amplitude approximately 0.5 m; may be formed by tidal currents
Mitigation	A procedure designed to reduce or negate the possible harmful effects of a substance or process on a species, habitat or environment
Mollusc	An animal possessing an external or vestigial calcium carbonate shell; including clams, snails and squid
Nursery Area	An area that supports fish during their first year of life
Operations Phase	The period following First Oil until cessation of all oil production from the Hebron Field, includes post-First Oil development drilling, offshore installation activities, production, operations, maintenance, well abandonment , decommissioning and removal from the Hebron Field of all facilities, equipment and vessels used in the production system
Operator	When capitalized in this document, refers to ExxonMobil Canada Properties (EMCP)
Pack Ice	Any area of sea ice, except fast ice, composed of a heterogeneous mixture of ice of varying ages and sizes and formed by the packing together of pieces of floating ice
Pebbles	Smooth rounded stones ranging in diameter from 2 to 64 mm
Pelagic Species	Animals which live or feed within the water column
Petroleum	Oil and natural gas
Photosynthesis	The use of the sun by plants to combine water and carbon dioxide into simple sugars
Phytoplankton	Planktonic (<i>i.e.</i> , floating or swimming) photosynthesizing organisms that are mostly single-celled, although some are colonial; some are capable of swimming, while others are incapable of independent motion
Plankton	Plant (phytoplankton) and animal (invertebrate (zooplankton) and fish eggs and larvae (ichthyoplankton)) organisms that drift with ocean currents
Platform	A large structure used during the development and production phases to support such facilities as the drilling rigs, living quarters, production equipment and helipads
Plume	a column of one fluid or gas moving through another
Polychaete	A marine worm with true body segments and hard spines
Pool	A unique accumulation of petroleum whose limits are established by subsurface geologic factors
Porosity	The volume of the pore space expressed as a percentage of the total volume of the rock mass
Primary Production	Carbon fixation during photosynthesis by plants including phytoplankton
Produced Water	Water brought up from hydrocarbon bearing strata during the extraction of oil and/or gas and can include formation water, injection water , small volumes of condensed water and trace amounts of treatment chemicals

Word	Definition
Production Platform	An offshore structure equipped to receive oil or gas from offshore wells where primary processing, compression and pumping are carried out before transportation of the oil or gas to shore
Productivity	(a) Production rate of oil, gas or water per unit differential pressure; (b) The rate of production of new biomass by populations of organisms
Recruitment	The addition of individuals to a population through reproduction and immigration
Reserves	That part of an identified resource from which a usable mineral or energy commodity can be economically and legally extracted at the time of determination
Reservoir	A subsurface rock body in which gas or oil has accumulated; most reservoir rocks are porous and permeable, usually limestones, sandstones or dolomites (or a combination)
Residual Environmental Effect	Those environmental effects remaining after enhancement and mitigation measures have been applied
Resource	An initial volume of oil and gas that is estimated to be contained in a reservoir
Rig	Refers to the combination of equipment used to drill wells
Riser	A section of pipe involving vertical or near-vertical flow
Satellite	In this document, satellite refers to a remote facility or installation that cannot operate entirely independently of a central facility
Scour	(a) Seafloor trench caused by the ploughing motion of an iceberg grounding on the ocean floor. (b) Seafloor erosion caused by strong currents, resulting in the redeployment of bottom sediments and formation of holes and channels
Sea Ice	Any ice floating in the sea
Sediment	Solid material, both mineral and organic, that is being or has been transported from its site of origin by air, water or ice, and has come to rest on the Earth's surface either above or below sea level
Seismic	Pertaining to, characteristic of or produced by earthquakes or Earth's vibration
Seismicity	The phenomenon of Earth's movements; seismic activity
Sessile	Organisms that are fixed to substrate
Shuttle Tanker	A ship with large tanks in the hull for carrying oil or water back and forth over a short route
Significant Discovery License (SDL)	The document of title by which lands are held within a Significant Discovery Area. Ownership of a Significant Discovery License must be homogeneous; therefore, there may be several Significant Discovery Licenses comprising a Significant Discovery Area if ownership of the Significant Discovery Area is multi-partied
Silt	A detrital particle smaller than a very fine sand grain and larger than coarse clay, having a diameter in the range of 0.004 to 0.0625 mm

Word	Definition
Stock	A species, group or population that maintains and sustains itself over time in a definable area. A stock is characterized by constancy of the genetic information in the gene pool, and constancy of expression of particular characters controlled either genetically or environmentally. Examples include maintenance of colour variations or particular growth rates
Storm Surge	A rise above normal water level due to the action of wind on the water surface and the rise in level because of atmospheric pressure reduction
Stratification	Division of the water column into layers, or strata, because of differences in water density, structure or temperature
Surficial	Characteristic of, pertaining to, formed on, situated at, or occurring on the Earth's surface; especially, consisting of unconsolidated residual, alluvial or glacial deposits lying on the bedrock
Tectonic	Of, or relating to the deformation of the Earth's crust; the forces involved in or producing such deformation, and the resulting forms
Template	Template in this context refers to the subsea structure designed to support a collection of wells
Thermocline	A temperature gradient as in a layer of sea water, in which the temperature decrease with depth is greater than that of the overlying and underlying water
Threatened Species	In Canada, an indigenous species that is likely to become endangered if the factors affecting its vulnerability are not reversed
Topside Facilities	All the oil and gas separation, treatment and production equipment and related equipment such as compressors, flares and accommodations located on top of an offshore facility
Transshipment Facility	An intermediate onshore facility that receives and stores crude oil from oilfield shuttle tankers and subsequently transfers the oil to market via tanker
Tree	a) An arrangement of valves placed on top of a well to control flow from the well b) An arrangement of valves and fittings attached to the tubing head to control flow and provide access to the tubing string (also referred to as a Christmas tree)
Trophic Level	The position an organism occupies in the food web, determined by the number of energy transfer steps needed to get to that point
Tropical Storm	A tropical cyclone with sustained wind speeds from 61 to 118 km/h
Tsunami	A long-period sea wave produced by a submarine earthquake, also known as a seismic sea wave. It may travel for thousands of kilometres
Upwelling	Light surface water transported away from a coast (by action of winds parallel to it) and replaced near the coast by heavier subsurface water
Viscosity	The measure of the resistance of a fluid to flow; the lower the viscosity number, the more readily the fluid will flow
Water-based Mud (WBM)	A drilling mud in which the continuous phase is water
Water Column	The vertical dimension of a body of water (<i>i.e.</i> , the water between a reference point or area on the surface and one located directly below it on the bottom)
Wave Hindcasting	Prediction of waves based on past meteorological conditions

Word	Definition
Well Completion	The final sealing-off of a drilled well from the borehole with valving and safety and flow-control devices, following final cementing and perforation of the casing at the production zone and removal of the drilling apparatus from the borehole
Wellhead	The equipment installed at the top of the wellbore used to support the casing strings and upon which the tree is installed; it controls the rate of flow of liquid and gas from the well
Zooplankton	The animal component of those organisms drifting or weakly swimming in the ocean, largely at the mercy of prevailing currents

Note: Bolded words within a definition are themselves defined

19.2 Acronyms

Acronym	Definition
ACAP	Atlantic Coastal Action Program
API	American Petroleum Institute
asl	Above sea level
BIO	Bedford Institute of Oceanography
BOEMRE	US Bureau of Ocean Energy Management, Regulation and Enforcement
BTEX	Benzene, toluene, ethylbenzene, xylene
CAC	Criteria air contaminants
CAPP	Canadian Association of Petroleum Producers
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CEAA	<i>Canadian Environmental Assessment Act</i>
CEA Agency	Canadian Environmental Assessment Agency
CFU	Compact Flotation Unit
CH ₄	Methane
CHS	Canadian Hydrographic Service
CIS	Canadian Ice Service
C-NLOPB	Canada-Newfoundland and Labrador Offshore Petroleum Board
CO	Carbon monoxide
CO ₂	Carbon dioxide
CO ₂ eq	Carbon dioxide equivalents
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPA	Closest Point of Approach
CPAWS	Canadian Parks and Wilderness Society
CSA	<i>Canada Shipping Act</i>
CWS	Canadian Wildlife Society
DFO	Fisheries and Oceans Canada

Acronym	Definition
DSM	Drilling Support Module
EBSA	Ecologically and Biological Significant Area
ECM	Environmental Compliance Monitoring
ECRC	Eastern Canada Response Corporation
EEM	Environmental Effects Monitoring
EEZ	Exclusive Economic Zone
EL	Exploration Licence
ENGO	Environmental Non-Governmental Organization
EOC	Emergency Operations Centre
EPP	Environmental Protection Plan
FEED	Front-end Engineering and Design
FFAW	Fish, Food and Allied Workers Union
FGCP	Fishing Gear Compensation Program
FLO	Fisheries Liaison Officer (on-board)
FPSO	Floating Production, Storage and Offloading (facility)
FRCC	Fisheries Resources Conservation Council
GHGs	Greenhouse gases
GLC	Ground-level concentration
H ₂ S	Hydrogen sulphide
H _{max}	Maximum individual wave height
H _s	Significant Wave Height
HSE	Hibernia South Extension
HUC	Hookup and Commissioning
IBA	Important Bird Area
ICOADS	International Comprehensive Ocean-Atmosphere Data Set
ICS	Incident Command System
IIP	International Ice Patrol
IPCC	Intergovernmental Panel on Climate Change
MANMAR	Manual of Marine Observations
MCP	Marine Code of Practice
MMS	US Minerals Management Service
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
MP / HP	Medium pressure / high pressure
MSL	Mean Sea Level
N ₂ O	Nitrous oxide
N&C	Notification and Communications
NAAQ	National Ambient Air Quality
NAF	Non-Aqueous Fluid used for drilling (e.g., SBM)

Acronym	Definition
NAFO	Northwest Atlantic Fisheries Organization
NAO	North Atlantic Oscillation
NARRT	North American Regional Response Team
NEB	National Energy Board
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NMCA	National Marine Conservation Area
NMFS	US National Marine Fisheries Service
NO ₂	Nitrogen dioxide
NO _x	Nitrogen oxides
NOAA	US National Oceanic and Atmospheric Administration
NPRI	National Pollutant Release Inventory
OIM	Offshore Installation Manager
OLS	Offshore Loading System
OSC	On-Scene Commander
OSP	Oil Spill Response
OSRP	Oil Spill Response Plan
OWTG	Offshore Waste Treatment Guidelines
PAH	Polycyclic Aromatic Hydrocarbon
PAL	Provincial Aerospace Ltd.
PBGB LOMA	Placentia Bay-Grand Banks (PBGB) Large Ocean Management Area (LOMA)
PM	Particulate Matter
PTS	Permanent Threshold Shift
PWRI	Produced water re-injection
RA	Responsible Authority
REET	Regional Environmental Emergency Team
ROV	Remote Operated Vehicle
RV	Research Vessel
SAR	Species at Risk
SARA	<i>Species at Risk Act</i>
SBM	Synthetic-based mud
SO ₂	Sulphur dioxide
SOP	Standard Operating Procedure
SPOC	Single Point of Contact
SSH&E	Safety, Security, Health and Environment
THmax	Wave period associated with Hmax
Tp	Peak wave period
TPH	Total Petroleum Hydrocarbons
TPM	Total Particulate Matter

Acronym	Definition
TSP	Total Suspended Particulate
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
UPM	Utilities and Processing Module (Integrated Deck)
VDS	Volatile Deposited Solids
VEC	Valued Ecosystem Component
VFA	Volatile Fatty Acid
VME	Vulnerable Marine Ecosystem
VOC	Volatile Organic Compound
VSP	Vertical Seismic Profile
VTMP	Vessel Traffic Management Plan
WHGBS	Wellhead Gravity-base Structure
WHMIS	Workplace Hazardous Management Information System

19.3 Abbreviations (units of measure)

Abbreviation	Definition
bbl	Barrel (approximately 159 L)
BF	Beaufort Force
cm	centimetre
dB	Decibel
h	Hour
Hz	Hertz
kbd	Thousand barrels per day
kHz	Kilohertz
km	Kilometre
km ²	Square kilometre
km ³	Cubic kilometre
L	Litre
m	Metre
m ³	Cubic metre
m ³ /day	Cubic metre per day
Mbbl	Thousand barrels
MBO	Million barrels of oil
mg	Milligram
mg/L	Milligram per Litre
mm	Millimetre
MSCFD	Thousand Standard Cubic Feet Per Day
MW	Megawatt

Abbreviation	Definition
nm	nautical mile
ppb	Parts per billion
ppm	Parts per million
s	Second
t	Metric tonne
µg	Microgram
µm	Micrometre