EXECUTIVE SUMMARY

Offshore oil and gas exploration, development and operations as well as other marine activities are significantly affected by the environmental and climate conditions. With an accurate description of the operating environment, drilling rigs, ships, production platforms, and other marine structures can operate safely in these areas of interest. For offshore exploration and development, an environmental baseline is needed as well as extensive engineering data. These projects require vast multi-dimensional, geospatial, and long temporal data coverage with easy access by interested parties.

In 2013, Nalcor announced the mapping of three newly defined sedimentary basins off the Labrador coast (the Henley, Chidley, and Holton Basins) as well as the extension of the previously defined Hawke Basin. This mapping was based on the regional 2D seismic surveys conducted by Nalcor, Petroleum Geo-services (PGS) and TGS Geophysical in 2011 and 2012. These newly defined sedimentary basins are located primarily in deep water in the Labrador Sea, off the east coast of Newfoundland and Labrador, Canada. To date, there has been no regional study of the metocean conditions offshore Newfoundland and Labrador. As part of Nalcor's exploration strategy, a metocean study would be considered a crucial piece of information in an area of frontier exploration. Nalcor commissioned C-CORE to provide the most comprehensive and accurate meteorological and oceanographic data set to characterize the metocean environment, covering topics such as winds, waves, currents, vessel icing, visibility (fog), pack ice, icebergs and ice islands, changes in conditions expected due to climatic change, and comparisons with other frontier regions. Various data sources were reviewed, evaluated, and verified for their suitability, coverage (spatial and temporal), accuracy and reliability. Only the most suitable data sets have been selected in this study.

The study area extends from 45.5^{o} N to 63^{o} N latitude, and from 42^{o} W to 65^{o} W longitude, covering the entire Labrador Sea and Northern Grand Banks, Flemish Pass, and Flemish Cap areas. The study area is divided into 391 grid cells, mostly one degree longitude by half degree latitude blocks, with each cell covering an average area of 3,760 square kilometres. Data summaries for metocean parameters are available for each cell and for the region.

There is a significant amount of data associated with each of the metocean parameters covered in this study. To facilitate the use of such vast data sets, Nalcor developed a web-based, interactive Database Management and Geographic Information System (DBM&GIS), called NESS (Nalcor Exploration Strategy System), which includes the above referenced metocean data as well as other geographic and geophysical information of the Newfoundland and Labrador offshore. The NESS program allows scientists, engineers, managers, and operators easy access to, and use of, the geospatial data for exploration, planning, design, production, and operations of offshore oil and gas resources with reduced risk and uncertainties.

Detailed description of the metocean data sources, data process and analyses, and statistical summaries are provided Volume 1. This report (Volume 2) provides regional metocean climatological summaries and trends for the entire Nalcor study area, as well as comparisons with other frontier exploration regions of similar characteristics. More details and statistical summaries for each of the 391 cells are provided in separate cell reports. These reports are also available in NESS as PDF files, which can be viewed or downloaded from NESS as needed.

This report presents comprehensive metocean data that, to a large extent, will provide sufficient information to assess the associated risks for exploration and development of the sedimentary basins offshore Newfoundland and Labrador.

Overall, metocean conditions in the region of the deepwater sedimentary basins in Labrador Sea are more favourable than the Grand Banks or Flemish Pass, with notably less extreme wind and wave events, as well as less fog. However, icing conditions are more severe, but this is primarily limited to the winter season and therefore will have limited influence on exploration activities.

While the pack ice and iceberg regimes are challenging along the Labrador coast, conditions improve substantially further offshore in deeper water. An analysis of pack ice data over a 30-year period shows a decreasing pack ice presence, both in terms of time and concentration when present. Analysis of output from various climate models indicates that this process will continue.

The regional characterization of iceberg frequency was challenging due to limited data, as most surveillance effort has been focused on and immediately north of the northeast Grand Banks in support of existing operations in the Jeanne d'Arc Basin. The characterization of icebergs was achieved through analysis of archived Envisat satellite data to characterize iceberg frequency in the deepwater basins. For the majority of the area covered by the deepwater basins, the iceberg frequency is similar to, or lower, than the Grand Banks. Similarly, pack ice presence in the deepwater basins is minimal. The quantification of sea ice and iceberg presence provided for these areas shows that the ice risk is significantly less than that off Greenland and near-shore Labrador.

The degree of environmental harshness to marine offshore activities such as exploration, transportation, or operations, depends on several parameters, including geographic location and prevailing metocean conditions in these areas. A *Harshness Index* was developed in this study to provide a single parameter (or index) to be used as a benchmark that represents the degree of harshness or severity a location may pose on offshore users, and to assess the risk as well as to provide a comparison with other similar regions of interest to oil and gas industry. In comparison with other analogous regions, the Harshness Index in most of the Nalcor study area, particularly in Labrador Sea, is lower than those in East and West Greenland, Canadian Beaufort Sea, Chukchi Sea, and Kara Sea.