# Pacific NorthWest LNG Project
# Marine Mammal Program Interim Report

Prepared for:
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June 30, 2015

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# Abbreviations

| | |
|---|---|
| CDS | Conventional Distance Sampling |
| CEAA | *Canadian Environmental Assessment Act, 2012* |
| COSEWIC | Committee on the Status of Endangered Wildlife in Canada |
| DFO | Fisheries and Oceans |
| DSM | Density Surface Modelling |
| EIS | Environmental Impact Statement |
| GAM | Generalized Additive Model |
| GAMM | Generalized Additive Mixed Model |
| LNG | liquefied natural gas |
| MCDS | Multicovariate Distance Sampling |
| MMMPP | Marine Mammal Monitoring and Protection Plan |
| MMO | Marine Mammal Observer |
| PDA | Project Development Area |
| PNW LNG | Pacific NorthWest LNG Limited Partnership |
| PRPA | Prince Rupert Port Authority |
| SARA | *Species at Risk Act* |

# 1.0 INTRODUCTION

Pacific NorthWest LNG Limited Partnership (PNW LNG) is proposing to construct and operate a liquefied natural gas (LNG) facility (the Project) on Lelu Island within the District of Port Edward, British Columbia. The Project would be located primarily on federal lands and waters under the jurisdiction of the Prince Rupert Port Authority (PRPA). A marine mammal monitoring and protection plan (MMMPP) has been developed to meet the pre-construction requirements for a follow-up program under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012), and addresses information requests from Section 13 of the Environmental Impact Statement (EIS) for the Project.

The MMMPP includes a marine mammal field program that is composed of a series of vessel-based line transect surveys. These surveys will provide pre-construction information on the monthly spatial distribution of marine mammals in Chatham Sound. More specifically, the objectives of the MMMPP are to:

- Identify which species of marine mammals are present in the survey areas
- Identify whether there are certain times of year that species may be more or less prevalent (monthly variation in species density, relative abundance, and spatial distribution with the survey areas)
- Estimate the abundance of marine mammal species within the survey areas
- Estimate the spatial distributions of marine mammal species within the survey areas
- Whenever possible, describe behaviours to help inform how mammals may use the study areas (e.g., for feeding, traveling, breeding, or rearing)

Several species of marine mammals have been recorded by this program to date in Chatham Sound waters. These species include humpback whale (*Megaptera novaeangliae*), northern resident and Bigg's (transient) killer whale (*Orcinus orca*), harbour porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Steller sea lion (*Eumetopias jubatus spp. monteriensis*)[1] and harbour seal (*Phoca vitulina richardsi*). The humpback whale, northern resident and Bigg's killer whales are listed as *threatened* under SARA, while both Steller sea lion and harbour porpoise are listed as *special concern* under SARA (Government of Canada 2012).

[1] 'Steller sea lion' will be used in this report in reference to the subspecies Loughlin's Northern Sea Lion (*Eumetopias jubatus spp. monteriensis*)

## 1.1 SUMMARY OF EFFORT AND FUTURE SCHEDULE

Stantec began monthly marine mammal surveys for PNW LNG in November 2014. Vessel-based surveys were conducted in two study areas, referred to as Chatham Sound Survey Area A (for marine transportation) and Chatham Sound Survey Area B (for marine construction) (see Section 2). This interim report includes data from the twelve surveys completed since that time up to June 11 2015. Table 1 summarizes the dates of each survey. Additional surveys are planned for the end of June 2015 until November 2015 (Table 2).

## Table 1 Completed Marine Mammal Surveys and Participants

| Survey Area | Survey Date | First Nation Participation | Vessel |
|---|---|---|---|
| Chatham Sound Survey Area A (Marine Transportation) | November 16 – 20, 2014 | Gitxaala First Nation, Kitselas First Nation, and Metlakatla First Nation | *MV* Ocean Royal |
| | January 27 – 31, 2015 | Gitxaala First Nation and Kitsumkalum First Nation | Lax Kw'alaams vessel: *MV* Freeport |
| | February 24 – 27, 2015 | Kitsumkalum First Nation and Gitxaala First Nation | Lax Kw'alaams vessel: *MV* Freeport |
| | March 24 – 27, 2015 | Metlakatla First Nation and Kitsumkalum First Nation | Lax Kw'alaams vessel: *MV* Freeport |
| | April 27 – May 1, 2015 | Kitselas First Nation and Kitsumkalum First Nation | Lax Kw'alaams vessel: *MV* Freeport |
| | May 24 – 27, 2015 | Gitxaala First Nation | Lax Kw'alaams vessel: *MV* Freeport |
| Chatham Sound Survey Area B (Marine Construction) | January 22 – 24, 2015 | Gitxaala First Nation and Kitsumkalum First Nation | *MV* Ocean Star |
| | February 12 – 13, 2015 | Kitsumkalum First Nation | Lax Kw'alaams vessel: *MV* Freeport |
| | March 11 – 12, 2015 | Gitxaala First Nation and Kitselas First Nation | *MV* Ocean Royal |
| | April 5 – 6, 2015 | Gitxaala First Nation | *MV* Ocean Royal |
| | May 10 – 11, 2015 | Kitsumkalum First Nation and Kitselas First Nation | *MV* Ocean Royal |
| | June 10 –11, 2015 | Kitsumkalum First Nation, Gitxaala First Nation, and Kitselas First Nation | *MV* Ocean Royal |

NOTE: No surveys were carried out in December 2014 because the original survey program was seasonal, rather than monthly. Regular monthly surveys began in January 2015.

**Table 2 Scheduled Marine Mammal Surveys**

| Chatham Sound Survey Area A (Marine Transportation) | Chatham Sound Survey Area B (Marine Construction) |
|---|---|
| June 30 – July 3, 2015 | – |
| July 21 – 24, 2015 | July 8 – 9, 2015 |
| August 27 – 30, 2015 | August 5 – 6, 2015 |
| September 17 – 20, 2015 | September 2 – 3, 2015 |
| October 20 – 23, 2015 | October 7 – 8, 2015 |
| November 17 – 20, 2015 | November 4 – 5, 2015 |

NOTE: Area A was surveyed mid to end of the month, while Area B was surveyed at the beginning of each month. Specific dates within those targeted times were based on vessel availability. The June survey in survey Area B has been completed and included in this report.

## 1.2 INTERIM REPORT OBJECTIVES

The objectives of this Marine Mammal Program Interim Report are to:

- Describe survey methods and data analyses approach to be included in the final report
- Summarize sampling effort to date
- Summarize preliminary observations of marine mammals in Chatham Sound between November 2014 and June 2015.

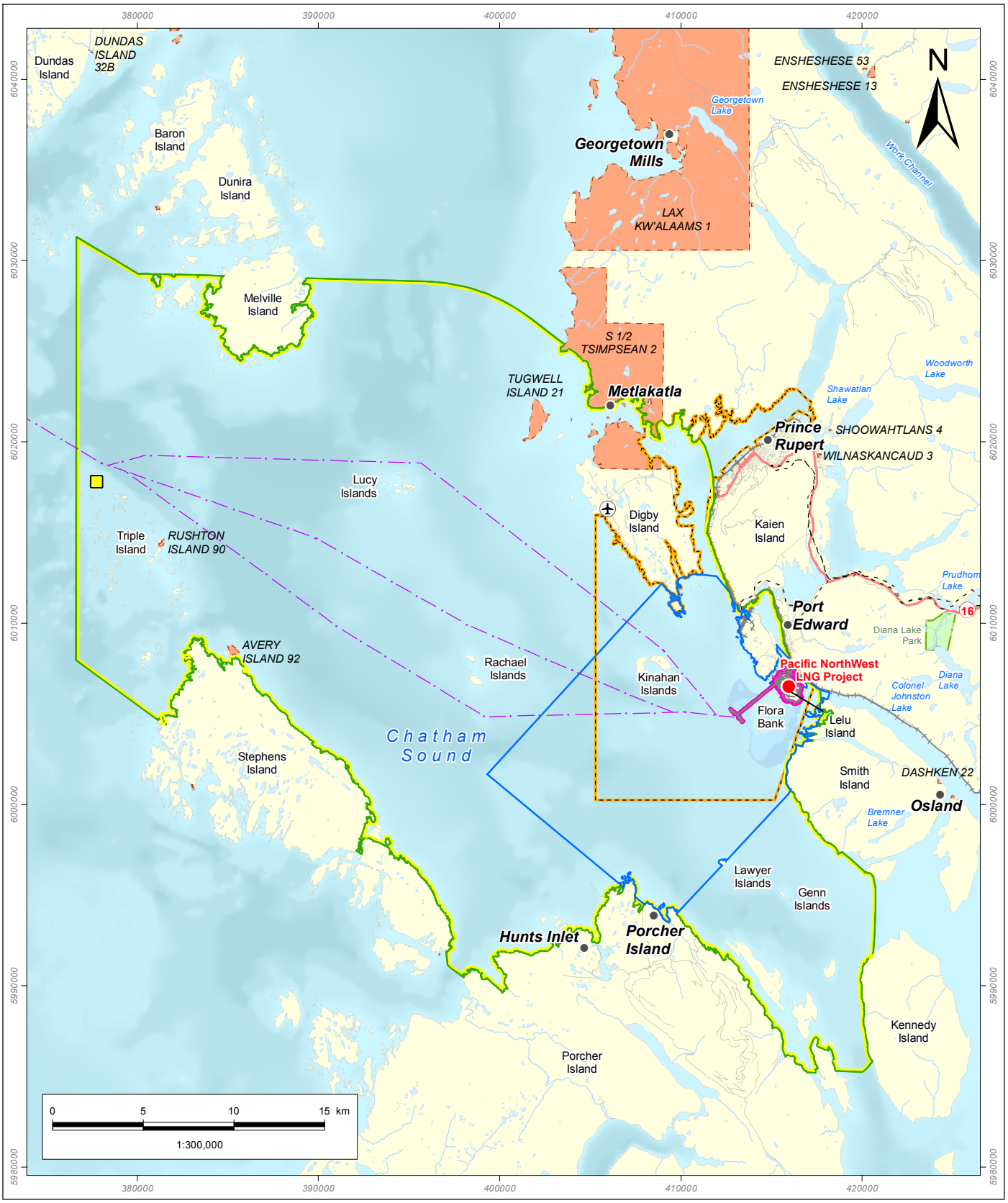
This report does not provide in-depth analyses, model results, or discussion and interpretation of data collected to date as the program is not yet complete. A comprehensive analysis will be completed as a component of the final report; analytical methods to be used at that time are described in Section 4.0.

# 2.0 STUDY AREA

The marine mammal program included monthly, vessel-based surveys at two spatial scales to capture marine mammal presence and distribution in areas of potential effects related to marine transportation (Chatham Sound Survey Area A) and marine construction (Chatham Sound Survey Area B). These study areas will be referred to as Area A and Area B for the remainder of this report.

The boundaries of Area A were the same as the Marine Resources Local and Regional Assessment Areas (Stantec Consulting Ltd. 2014a) (Figure 1). This area was determined in the EIS as the area over which project effects on marine resources are expected to occur. The area includes the PDA (Project Development Area), three potential shipping routes (between the terminal and the Triple Island Pilot Boarding Station), and an approximate 10 km buffer on either side of the potential shipping routes but extending further south into Arthur Pass to assess potential effects from underwater noise (which was based on acoustic modeling). Area A uses this spatial boundary to support the objectives listed in Section 1.0.

Area B is located within the boundaries of Area A. The boundaries of Area B were chosen based on the PDA which outlines Lelu Island and the area adjacent to proposed marine infrastructure. Area B was selected based on a square area around the PDA to facilitate the grid pattern of the survey design. The size of Area B is considered conservative in relation to the PDA (i.e., it is much larger) in order to capture the distribution and abundance of marine mammals within approximately 15 km of the Project infrastructure.




Project Location
Project Component
Potential Shipping Route
Project Development Area
Chatham Sound Survey Area A
Chatham Sound Survey Area B
Marine Resources Local and Regional Assessment Area

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

**Marine Mammal Program**
**Survey Area**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: 1

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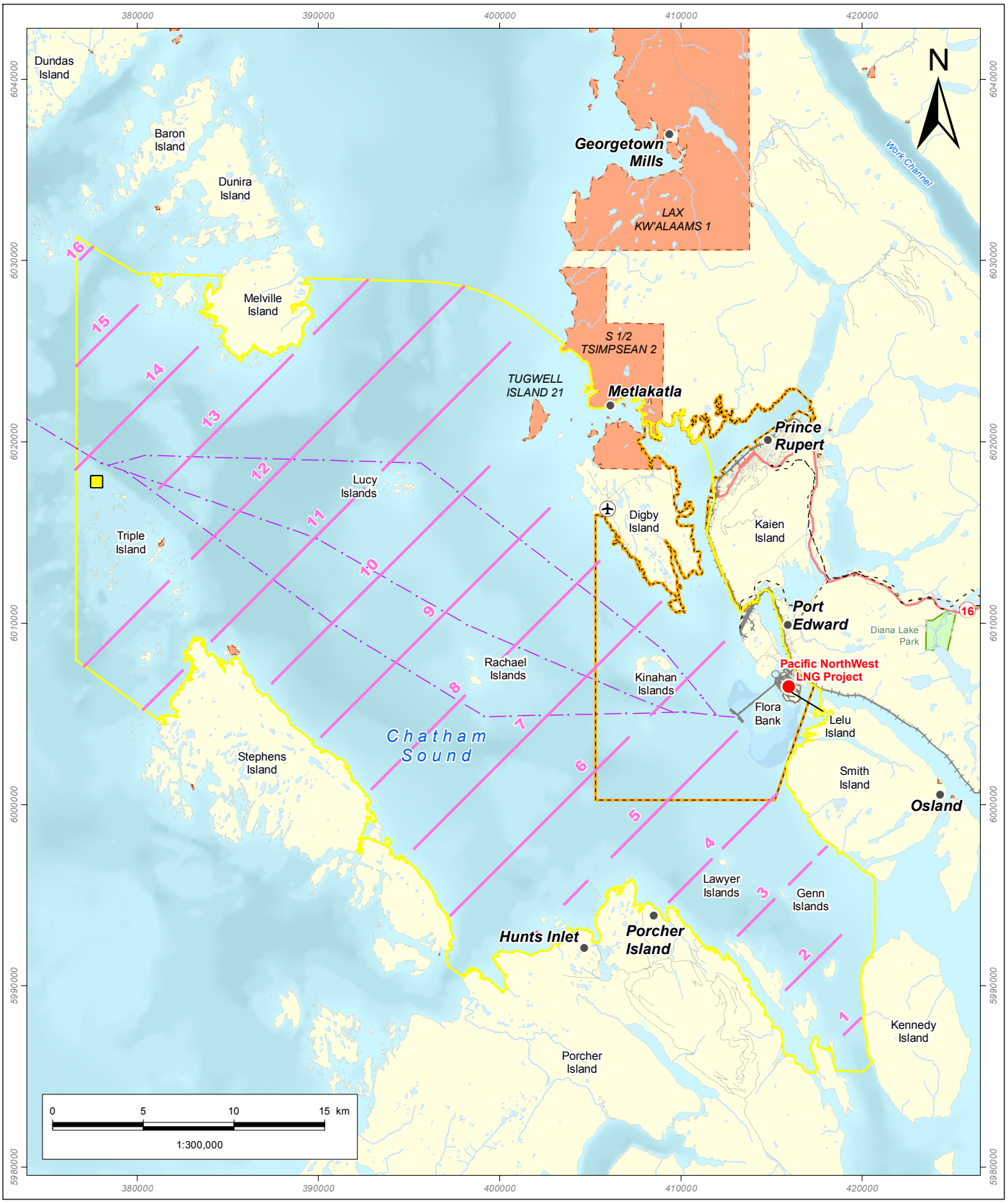
# 3.0 METHODS

Distance sampling methods (Buckland et al. 2001) were used as the analytical framework for designing the marine mammal program field surveys. Monthly, vessel-based surveys have been and will continue to be used to assess monthly variations in species distribution and density from November 2014 to November 2015 (23 surveys in total). A 4-day survey throughout Area A (which includes Area B), is planned toward the end of each month. In addition, a 2-day survey, focused on Area B, is scheduled early to mid-month. As a result, the marine construction area (Area B) will be surveyed twice each month (excluding November and December 2014).

Distance sampling methods (Buckland et al. 2001) represent a suite of statistical methods that estimates average density (number of individuals per unit of area) and relative abundance (total number of individuals within an area) of animals in a study area at the time of a survey. These methods can include point, strip or line transects (Buckland et al. 2001); however, line transects are best applied when surveying for highly mobile species such as marine mammals.

Area A includes a total of 16 transect lines that are spaced 4 km apart (Figure 2). Area B includes a total of 14 transect lines that are spaced 1 km apart (Figure 3). All transects were planned to provide uniform coverage of the survey area, as well as a "good survey design", as defined by Thomas et al. (2007) (which suggests the use of approximately 15 transect lines or more in each study area). Vessel-based marine mammal surveys have and will continue to be conducted once per month (roughly 30 days apart) in each of the survey areas.

Vessel-based line transect surveys were completed during daylight hours when weather conditions were conducive to sighting marine mammals (i.e., Beaufort sea state less than 4). If visibility was reduced by fog to less than 3 km, or if sea states were Beaufort 4 (small chop, defined direction, numerous whitecaps) or greater, the survey was paused until conditions improved.




Project Location
Project Component
Potential Shipping Route
Marine Mammal Survey Transect
Chatham Sound Survey Area A

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

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**Chatham Sound Survey Area A Transects**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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FIGURE NO: **2**

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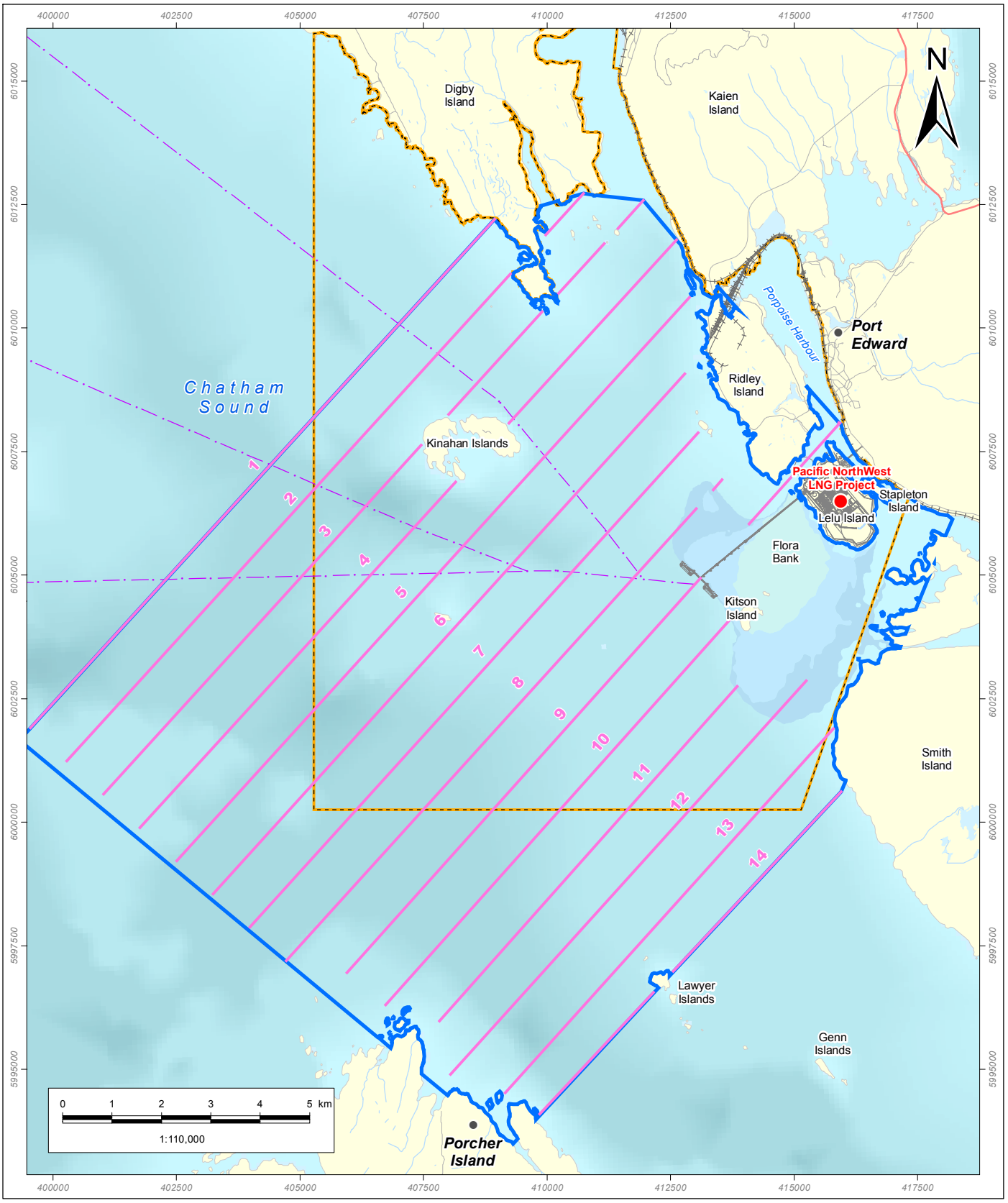


Marine Mammal Survey Transect
Project Component
Potential Shipping Route
Chatham Sound Survey Area B
City or Town
Highway
Railway
Secondary Road
Watercourse
Prince Rupert Port Authority Boundary
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
**Bathymetry (m)**
High : 1
Low : -300

***Pacific NorthWest LNG***

**Chatham Sound Survey Area B Transects**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **3**

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The survey vessel travelled at 8 to 9 knots along each transect to establish a standardized survey effort to detect marine mammals throughout all of the surveys. This vessel speed is also considered to be fast enough to avoid double counting of marine mammals, and ensure sufficient time for observers to sight the marine mammals present (Dawson et al. 2008). Marine mammal observer (MMO) training sessions (Stantec Consulting Ltd. 2014b) were conducted before surveys and reviewed on board the vessel to refresh crew of survey protocol and methods.

On each survey, there was a minimum crew of four MMOs, including at least two Stantec biologists. The MMOs rotated through positions on deck for a maximum of 80 minutes, followed by a minimum 20 minute break. The rotation was intended to reduce eye strain and fatigue for the MMOs. There were two observers and one data recorder on deck at all times; this allowed the two observers to keep their eyes on the survey area and communicate the data verbally to the single data recorder. The fourth person on break rotation was available in the event of simultaneous or multiple sightings. Vessel surveys were conducted from a suitable area on the bow for observing, with an unobstructed 180 degree view of both sides of the vessel. One of the survey vessel used, *MV* Freeport, is shown in Photograph 1.


**Photograph 1 *MV* Freeport Survey Vessel**

The observers were assigned to either the port (left) or starboard (right) side of the bow. Observers scanned -10 degrees (i.e., across the center of the bow) to 90 degrees on their side of the vessel, spending approximately twice as much time in the area from -10 degrees to 45 degrees as in the remaining 45 degrees (Dawson et al. 2008). Figure 4 provides a visual representation of the scanning effort. Observers used a combination of the naked eye and 7x50 reticle binoculars to continually scan varying distances close to and far from the vessel.

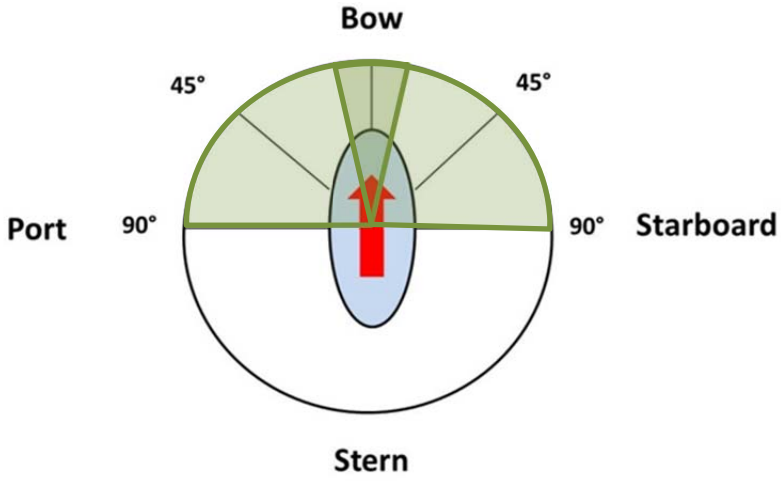



**Figure 4 Port and Starboard Observation**

Observers were on watch for marine mammals at all times when the vessel was operating, both on transect and during travel between transects. Marine mammals recorded while the vessel was on a line transect were recorded as "on transect" sightings. Sightings that occurred while the vessel was traveling between transects were recorded in the same manner but labelled as "off transect."

Data recorders kept a record of marine mammal sightings, behavioural data and environmental data with a handheld georeferenced data logger using Project specific, Stantec designed forms for ArcPad and ArcGIS. When a marine mammal was sighted, the following information was recorded:

- GPS location, date and time stamp
- Species identification
- Estimated number of individuals
- Marine mammal behaviour
- Observer estimated distance to the sighting and distance using reticle binoculars
- Angle to the sighting (using a pelorus)
- Potential of a repeat sighting

When several animals were observed near each other, a "group sighting" was recorded. The number of individuals in a group was counted or estimated, and the distance was measured to the geographic centre of the group. An observation of a group of individuals was considered as one sighting.

Behavioral data were recorded at the time of each sighting and opportunistically, using the behavioral categories described in Appendix A.

High quality digital photographs of marine mammal sightings were taken whenever possible using a Canon dSLR camera.

Status and changes in environmental variables need to be documented, as they may affect the detectability (i.e., the likelihood of observing an animal if it is present at the surface in relation to environmental conditions) of different marine mammal species. Environmental conditions (as defined in Appendix A) were characterized by the data recorder at the beginning and end of each transect. If transects took longer than half an hour to complete, an additional recording of environmental conditions was taken approximately every half an hour.

# 4.0 ANALYSIS

In the final report, Stantec will use distance sampling analysis methods (Buckland et al. 2001; Buckland et al. 2010), recognized as an effective method to estimate average relative abundance of multiple species simultaneously during single surveys. For the purpose of this program, we will derive monthly density and relative abundance estimates of species from these analyses.

## 4.1.1 Survey Data

Digital photographs were taken and can be used, if required, for confirmation and or/photo identification of the marine mammal species. Numbers of individuals can also be verified using high quality photographs (e.g., pinniped haulout size). Killer whale ecotypes (i.e., residents, Bigg's, or offshore) will be identified, where possible, for the final report by analyzing available high quality photographs taken in the field and comparing to Fisheries and Oceans' (DFO) killer whale photo identification catalogues.

Estimated distances to sightings will be corrected for bias by applying a correction factor derived from a linear mixed effects model, used to calculate the relationship between observer estimates to objects at known distances (applied using R package nlme).

## 4.1.2 Statistical Modeling

Marine mammal sightings data will be analyzed for the final report using distance sampling methods, applying the software packages Distance 6.0 (Thomas et al. 2010) and/or R 3.2.1 (R Core Team 2015).

Distance sampling analysis includes two potential methods; conventional distance sampling (CDS) and multicovariate distance sampling (MCDS). CDS uses sighting distance from the transect line to estimate animals that may not have been observed. This is then applied to estimate the density and relative abundance of marine mammals present. MCDS uses the same method but also incorporates other variables (or covariates), such as sea state or other environmental conditions, to determine if they affect the detection of a species and potentially provide a better estimate of marine mammals present in the study area. For both CDS and MCDS, a detection function will be fit for each marine mammal species that has a minimum of approximately 40 sightings (Buckland et al. 2001) across all surveys combined. To determine if covariates (e.g., sea state) should be included when fitting the detection function, an exploratory analysis of the data will be conducted for each species (e.g., Miller et al. 2013). The model fit of the detection function is assessed by examining the quantile-quantile plot of actual distances versus modelled distances, chi-square tests and Akaike's Information Criteria (Buckland et al. 2010).

To estimate marine mammal distributions in the study area, the use of Density Surface Modelling (DSM; Miller et al. 2013) will be explored. Detection functions fit from the initial density sampling analysis will be incorporated into the DSM methods (Miller et al. 2013).

The relationship between the locations of sightings and explanatory environmental variables will be used together with the detection functions to estimate a spatial distribution of species densities using generalized additive models (GAM) or generalized additive mixed models (GAMMs) (Buckland et al. 2010; Miller et al. 2013). The explanatory environmental variables used in DSM are variables that can influence species distributions, and can include water depth, slope and distance to shore. Environmental variables included in the spatial models will be selected based on fit and parsimony and will then be used to estimate the density of marine mammals for the entire study area.

The use of information on sea surface temperature and chlorophyll-*a* derived from monthly satellite imagery (for 2004 – 2014) will be explored for inclusion in the DSM. Environmental variables, such as sea surface temperature and chlorophyll-*a*, can point to areas of entrainment that may be linked to marine mammal presence (e.g., Dalla Rosa et al. 2012).

Estimates of study area wide marine mammal distribution will be completed by using the relationships modeled between estimated abundance and the environmental variables. To do this, the transect lines will be divided into segments and the sightings (or counts) are corrected by using the previously modeled detection functions to account for the proportion of animals missed. The spatial models are then used to estimate the density of marine mammals, by species, for the entire study area based on the environmental variables. The result will be a modelled surface of density values which will be summed to estimate the relative abundance of a species within the study area. GAM theory will be used to estimate the variance of the modelled density surfaces (Miller et al. 2013).

To calculate species specific distribution, density and relative abundance estimates for each month in the survey year, a minimum of three sightings per month are needed to avoid extrapolating into areas with minimal data. To date, all seven species sighted to date have the minimum number of sightings in at least one month and one survey area. Depending on the data at the time of completion of all surveys, it might not be possible to model these parameters for all species in all months (for example, killer whales were only sighted once in February, which is insufficient data for modelling February distribution and abundance).

These planned analyses will use all survey data from November 2014 to November 2015. CDS, MCDS or DSM methods have not yet been applied for the purpose of this interim report. Analyzing all data at the end of the program will provide the most accurate and comprehensive models and estimates for the species present.

### 4.1.3 Quality Control Process

Measures to collect high quality data during the marine mammal surveys include:

**1. Field Protocol**

- Training for all marine mammal observers and data recorders with the technical lead. Technical training programs have been developed by Stantec marine mammal technical leads and are based on published literature and best practice methods. Training helps promote consistent use of field surveying techniques by all observers. This contributes to promoting accurate and consistent distance measurements and survey effort across all surveys
- Distances to sightings were measured using both reticle binoculars and observer estimates to provide a comparison between the two measurements
- Photographs were taken to confirm species identification as necessary, and confirm counts of individuals within groups.

**2. Field Data Checks**

- Data were checked for quality and accuracy after each survey day in the field. The data were also reviewed in the office after the field survey by the marine mammal lead (or a marine mammal specialist) prior to analysis.

**3. Data Analysis**

- Initial exploratory analysis included mapping of data as a further check of information on sightings and group sizes
- Distance sampling analysis methods will include removing outliers to increase model fit, as per published guidelines (Buckland et al. 2001)
- Analysis methods and results will be quality reviewed by appropriate technical staff to confirm methods and output.

**4. Report Preparation and Review**

- All Stantec prepared documentation is subject to a rigorous quality control review process that includes a Quality (Technical) Review and Independent Review by qualified employees to confirm that study design and data interpretation are correct and defensible.

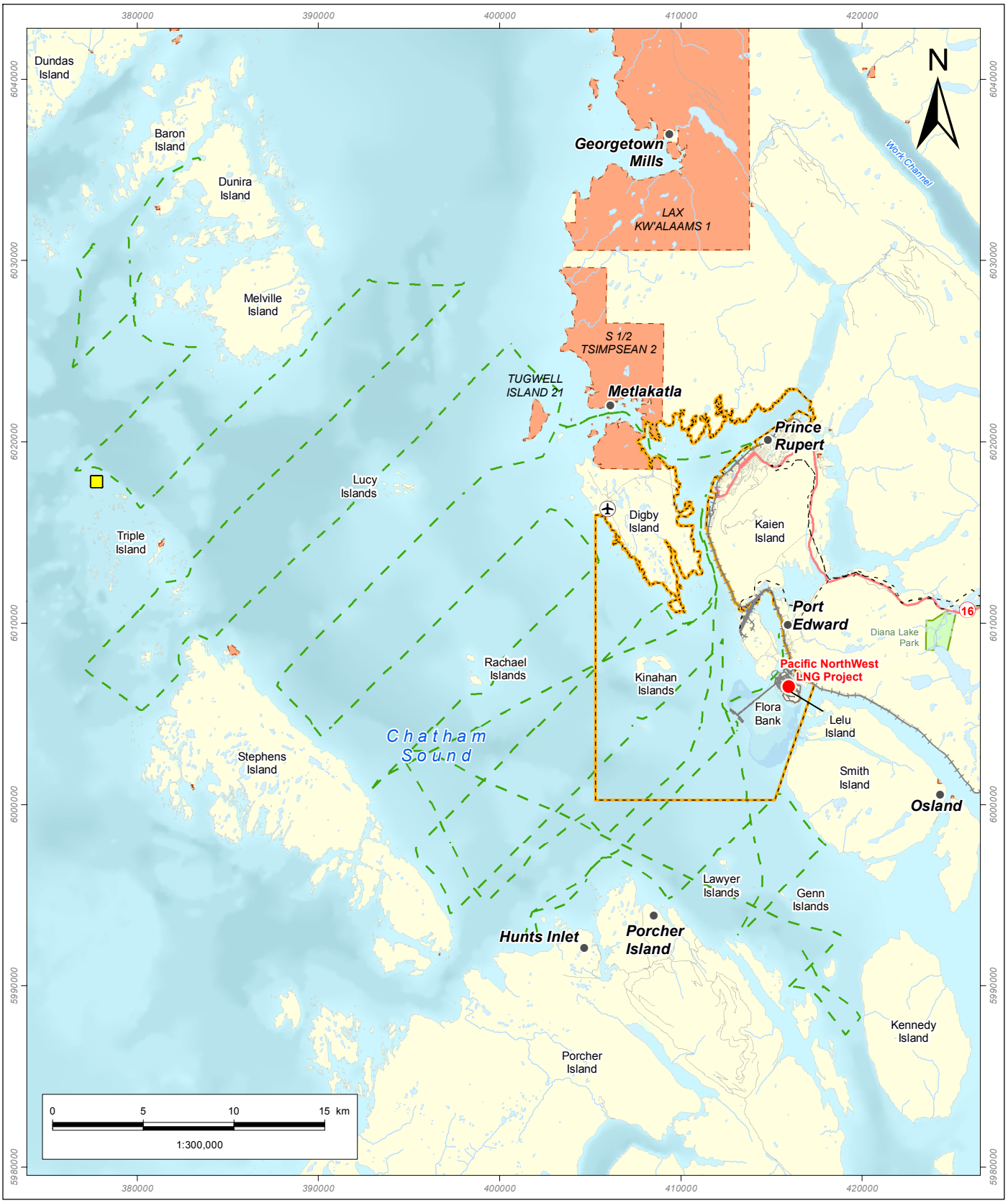
# 5.0 RESULTS

Two marine mammal surveys were conducted each month, beginning in January 2015 through to the present; one in Chatham Sound Survey Area A (16 transects) and one in the Chatham Sound Survey Area B (14 transects). November 2014 only had one survey for Area A. June 2015 only includes the Area B.

A summary of all completed surveys to date is provided in Table 3. The total distance travelled each month (vessel tracks; Figure 5 to Figure 11) and total 'on transect' distance travelled each month have been calculated. Differences in 'on transect' distance travelled between surveys can be a result of weather conditions which may result in some transect lines being cut slightly shorter. This does not affect data analysis in a substantial fashion.

**Table 3 Survey Summary**

| Survey Dates | Number of Weather Days | Vessel | Number of Completed Transects | On Transect Distance Travelled (km) | Total Distance Travelled (km) |
|---|---|---|---|---|---|
| November 16 – 20, 2014 | 0.5 | *MV* Ocean Star | 16 | 218.14 | 452.70 |
| January 22 – 24, 2015 | 2.75 | *MV* Freeport | 14 | 128.50 | 188.70 |
| January 27 – 31, 2015 | 1 | *MV* Ocean Royal | 16 | 194.17 | 467.34 |
| February 12 – 13, 2015 | 0 | *MV* Ocean Royal | 14 | 160.16 | 213.19 |
| February 24 – 27, 2015 | 0.5 | *MV* Ocean Royal | 16 | 207.49 | 411.84 |
| March 11 – 12, 2015 | 0.25 | *MV* Ocean Royal | 14 | 122.63 | 198.56 |
| March 24 – 27, 2015 | 0.75 | *MV* Ocean Royal | 16 | 213.45 | 423.29 |
| April 5 – 6, 2015 | 0 | *MV* Freeport | 14 | 168.11 | 269.55 |
| April 27 – May 1, 2015 | 1.25 | *MV* Freeport | 16 | 219.11 | 506.16 |
| May 10 – 11, 2015 | 0 | *MV* Freeport | 14 | 170.25 | 244.84 |
| May 24 – 27, 2015 | 0 | *MV* Freeport | 16 | 196.62 | 458.87 |
| June 10 – 11, 2015 | 0 | *MV* Freeport | 14 | 171.72 | 238.77 |
| **Total** | **7** | **–** | **180** | **2170.35** | **4073.81** |




Project Location
Project Component
Chatham Sound Survey Area A: Vessel Track (November 16-20, 2015)

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

**November 2014: Vessel Tracks**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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| | |
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| FIGURE ID: 123110537 | DATUM: NAD 83 |
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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **5**

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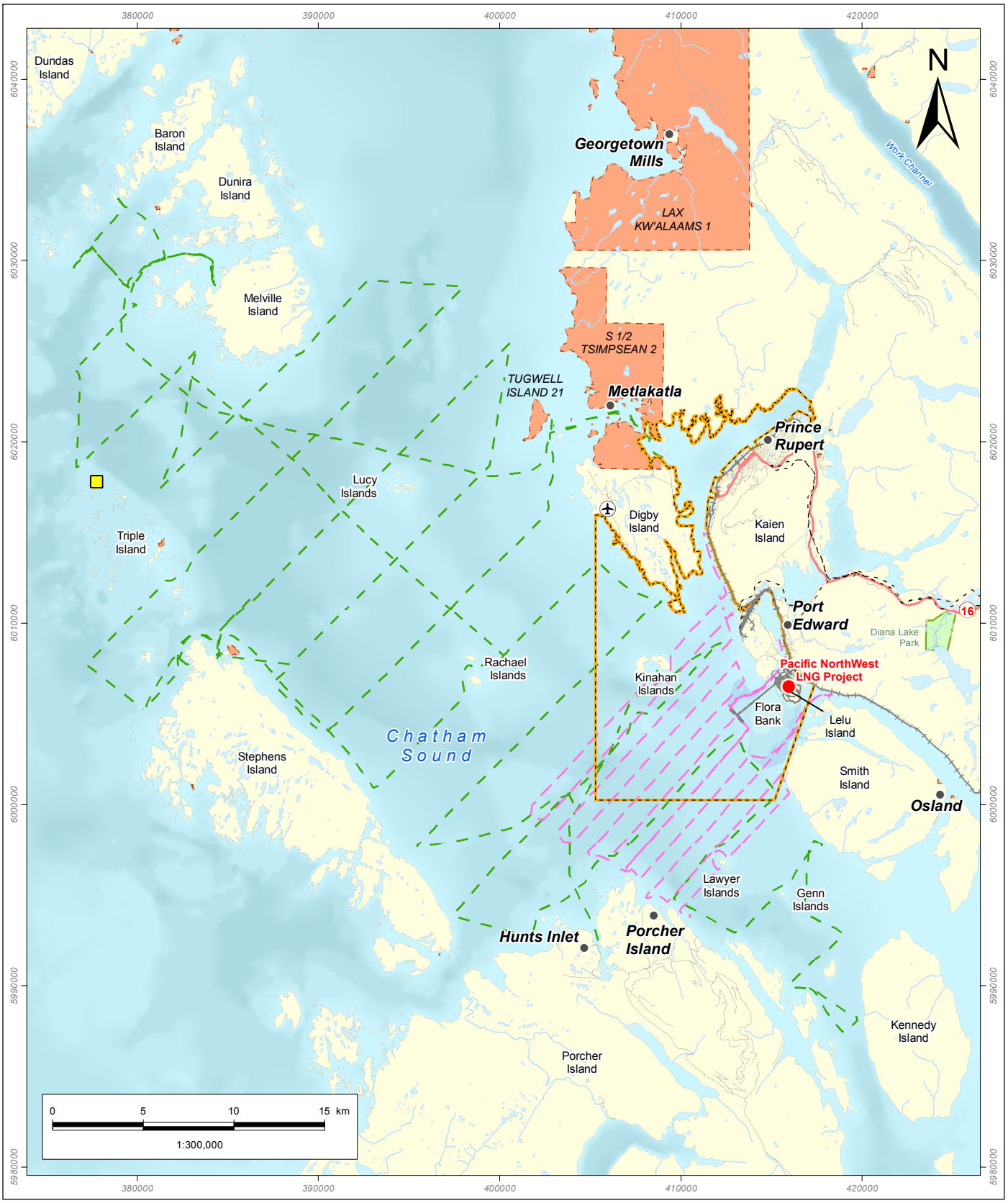


Project Location
Project Component
Chatham Sound Survey Area A: Vessel Track (January 27-31, 2015)
Chatham Sound Survey Area B: Vessel Track (January 22-24, 2015)

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

**January 2015: Vessel Tracks**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

DATE: 26-JUN-15
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PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: 6

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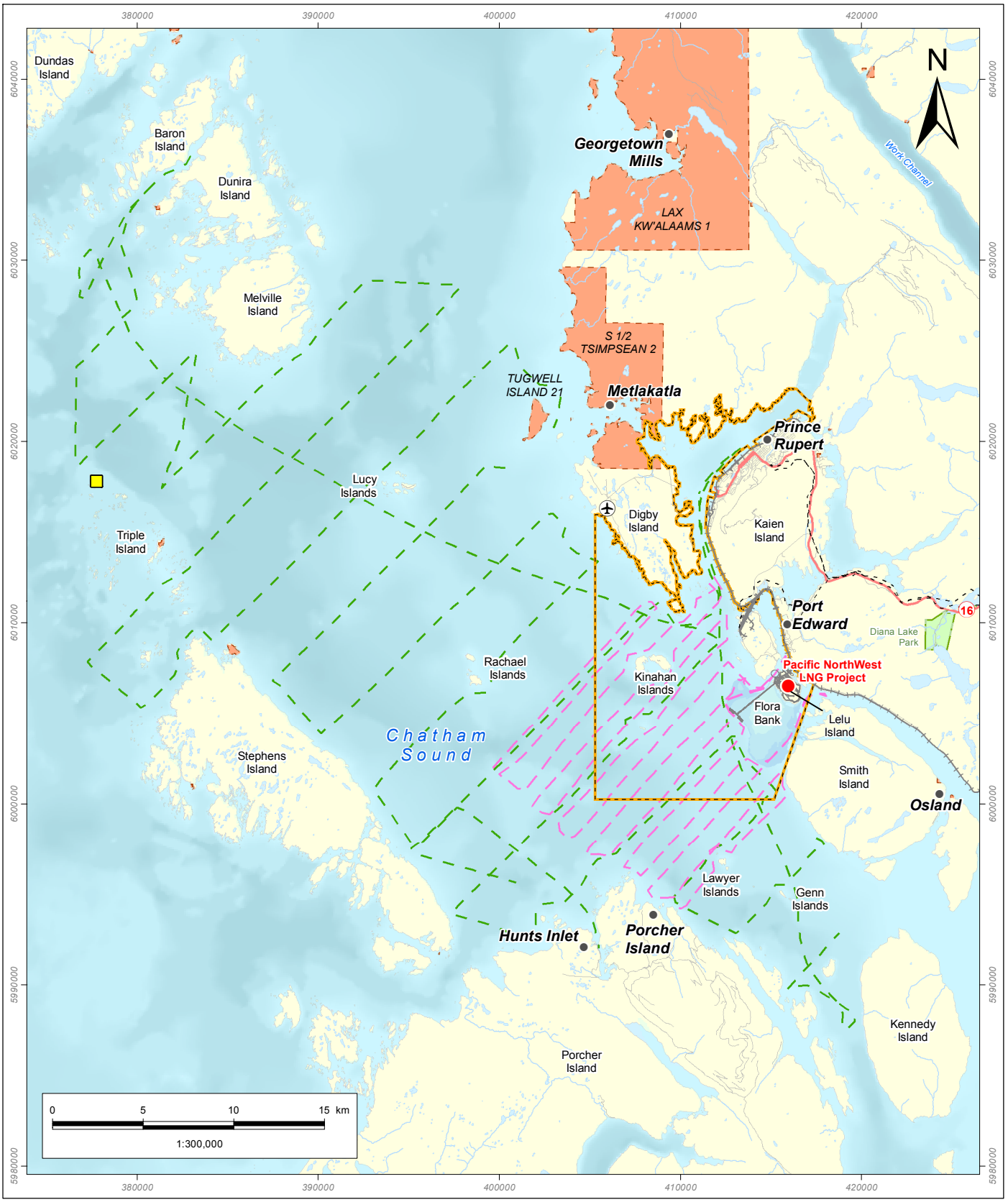


Project Location
Project Component
Chatham Sound Survey Area A: Vessel Track (February 23-27, 2015)
Chatham Sound Survey Area B: Vessel Route (February 12-13, 2015)

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m depth Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

**February 2015: Vessel Tracks**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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DATE: 26-JUN-15
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DATUM: NAD 83
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PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: 7

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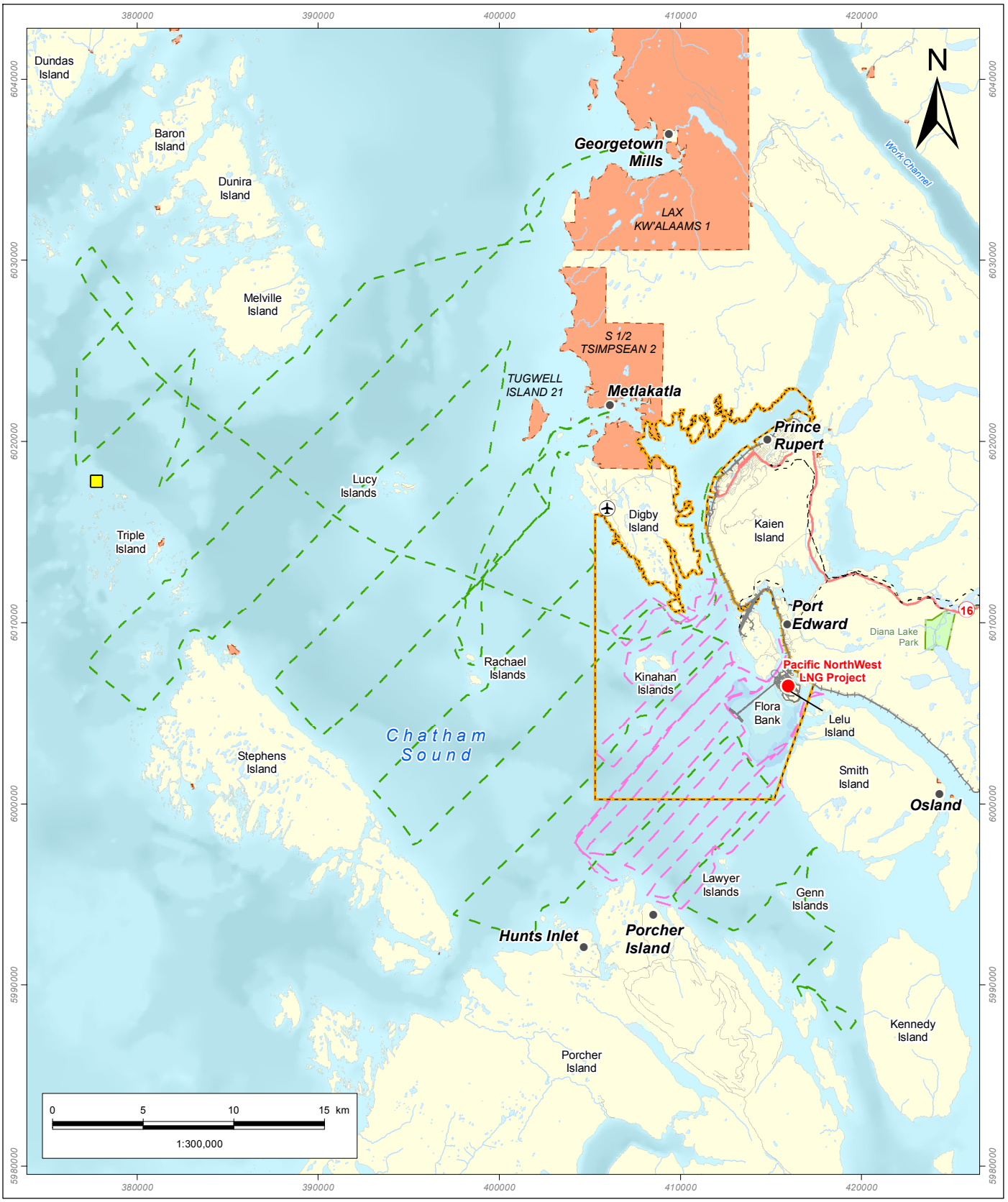


Project Location
Project Component
Chatham Sound Survey Area A: Vessel Track (March 24-27, 2015)
Chatham Sound Survey Area B: Vessel Track (March 11-12, 2015)

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

**March 2015: Vessel Tracks**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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| FIGURE ID: 123110537 | DATUM: NAD 83 |
| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **8**

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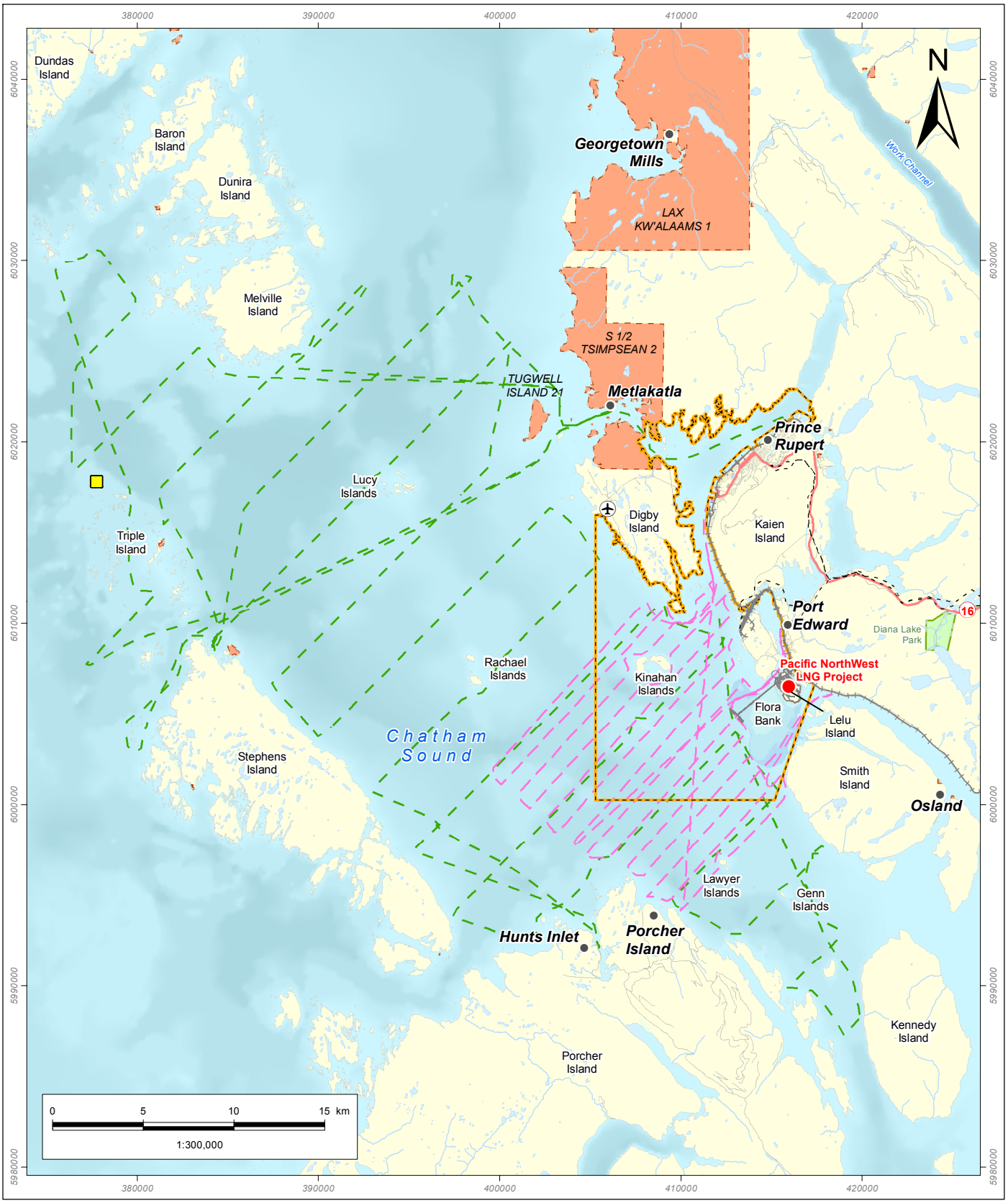


Project Location
Project Component
Chatham Sound Survey Area A: Vessel Track (April 27-May 1, 2015)
Chatham Sound Survey Area B: Vessel Track (April 5-6, 2015)

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

**April 2015: Vessel Tracks**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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DATE: 26-JUN-15
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PROJECTION: UTM - ZONE 9
DATUM: NAD 83
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PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: 9

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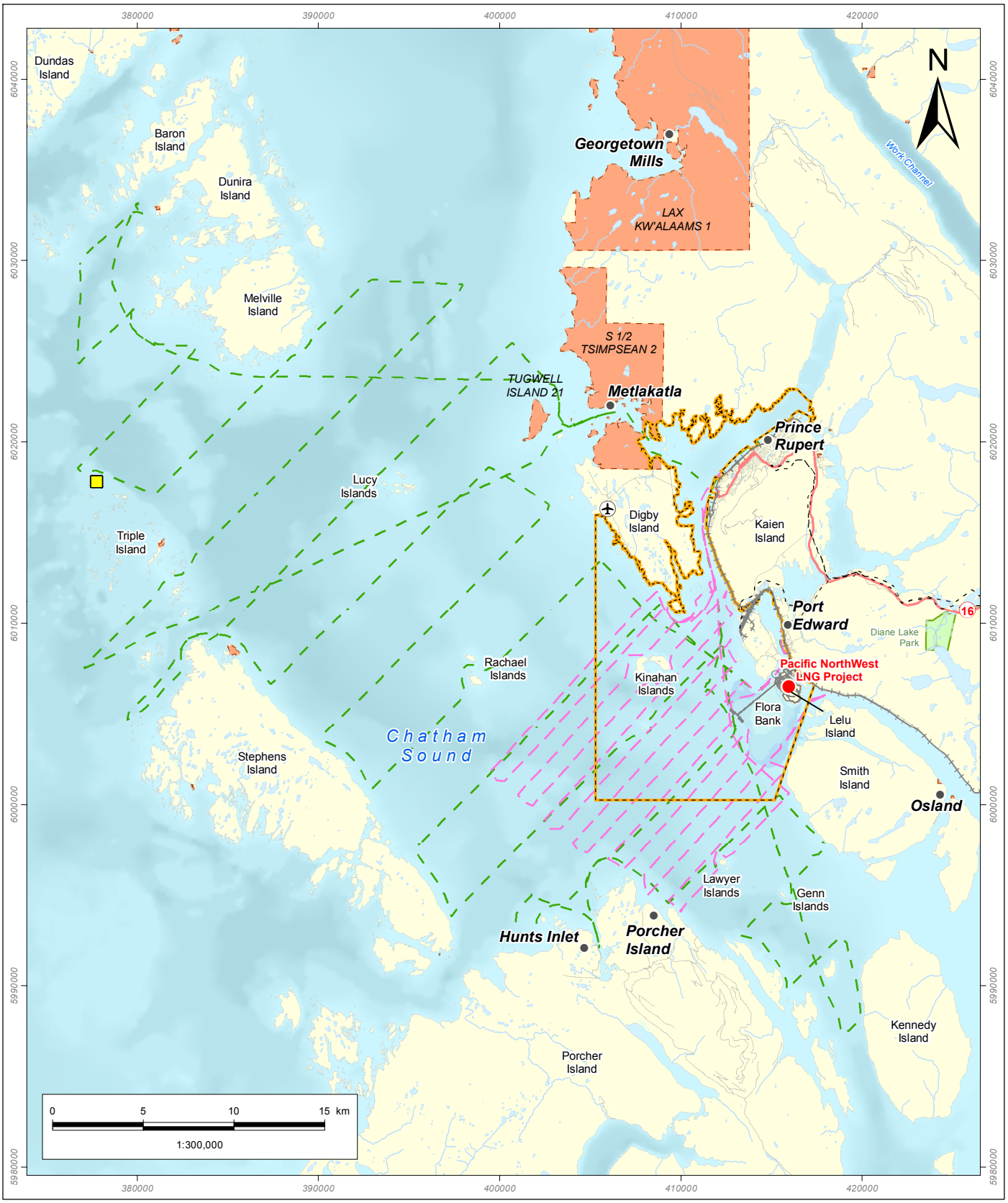


Project Location
Project Component
Chatham Sound Survey Area A: Vessel Track (May 23-May 26, 2015)
Chatham Sound Survey Area B: Vessel Track (May 10-11, 2015)

Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse

Indian Reserve
Prince Rupert Port Authority Boundary
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

**May 2015: Vessel Tracks**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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FIGURE ID: 123110537
DRAWN BY: A. BOONE
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: R. LIM

PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: 10

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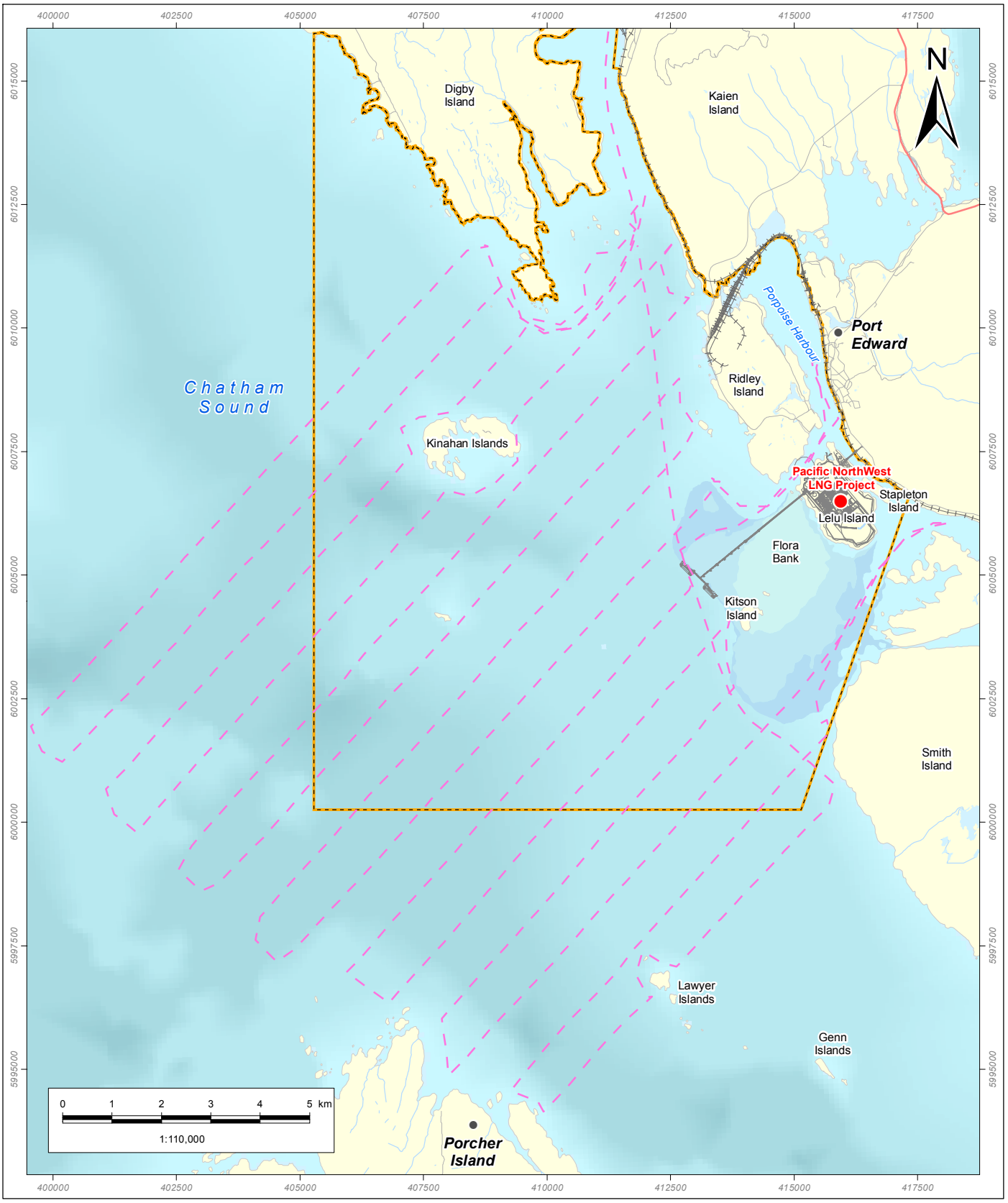


Project Location

Chatham Sound Survey Area B: Vessel Track (June 10-11, 2015)

Project Component

City or Town

Highway

Railway

Secondary Road

Watercourse

Prince Rupert Port Authority Boundary

Waterbody

Flora Bank

0 - 5 m Deep Shoal

5 - 10 m Deep Shoal

**Bathymetry (m)**

High : 1

Low : -300

***Pacific NorthWest LNG***

## June 2015: Vessel Tracks

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| FIGURE ID: 123110537 | DATUM: NAD 83 |
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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **11**

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## 5.1 CHATHAM SOUND SURVEY AREA A

Surveys in Area A began in November 2014 and recurred monthly to May 2015 (excluding December 2014). Table 4 and Figure 12 present a summary of all marine mammal species observed from Area A.

Marine mammals observed in Area A included one species of *mysticetes* (baleen whale) and four species of *odontocetes* (toothed whale). Species included humpback whale, killer whale, Dall's porpoise, harbour porpoise, and Pacific white-sided dolphin. Two species of pinnipeds were also present in all Area A surveys, the harbour seal and Steller sea lion. Unidentified baleen whale sightings were also detected in the area. Marine mammal sightings are further discussed in Sections 5.3.

## Table 4 Chatham Sound Survey Area A: Marine Mammal Sighting Summary

| Survey Dates | Humpback Whale | | Killer Whale | | Dall's Porpoise | | Harbour Porpoise | | Pacific White-sided Dolphin | | Harbour Seal | | Steller Sea Lion | | Unidentified Baleen Whale[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | I | S | I | S | I | S | I | S | I | S | I | S | I | S | I |
| November 16 – 19, 2014 | 56 | 94 | 5 | 12 | ND | ND | 3 | 6 | ND | ND | 2 | 4 | 3 | 105 | 2 | 7 |
| January 27 – 31, 2015 | 20 | 28 | ND | ND | 2 | 4 | 1 | 1 | ND | ND | 8 | 30 | 5 | 18 | 4 | 4 |
| February 24 – 27, 2015 | 4 | 4 | 1 | 6 | 4 | 18 | 7 | 19 | 1 | 6 | 1 | 1 | 3 | 37 | - | - |
| March 24 – 27, 2015 | 7 | 14 | 2 | 8 | 4 | 60 | 4 | 12 | ND | ND | 6 | 26 | 4 | 181 | - | - |
| April 27 – May1, 2015 | 2 | 3 | ND | ND | 1 | 4 | 5 | 7 | ND | ND | 3 | 27 | 4 | 191 | - | - |
| May 23 – 26, 2015 | ND | ND | 2 | 6 | ND | ND | 2 | 3 | ND | ND | 19 | 77 | ND | ND | - | - |
| **Total** | **89** | **143** | **10** | **32** | **11** | **86** | **22** | **48** | **1** | **6** | **39** | **165** | **19** | **532** | **6** | **11** |

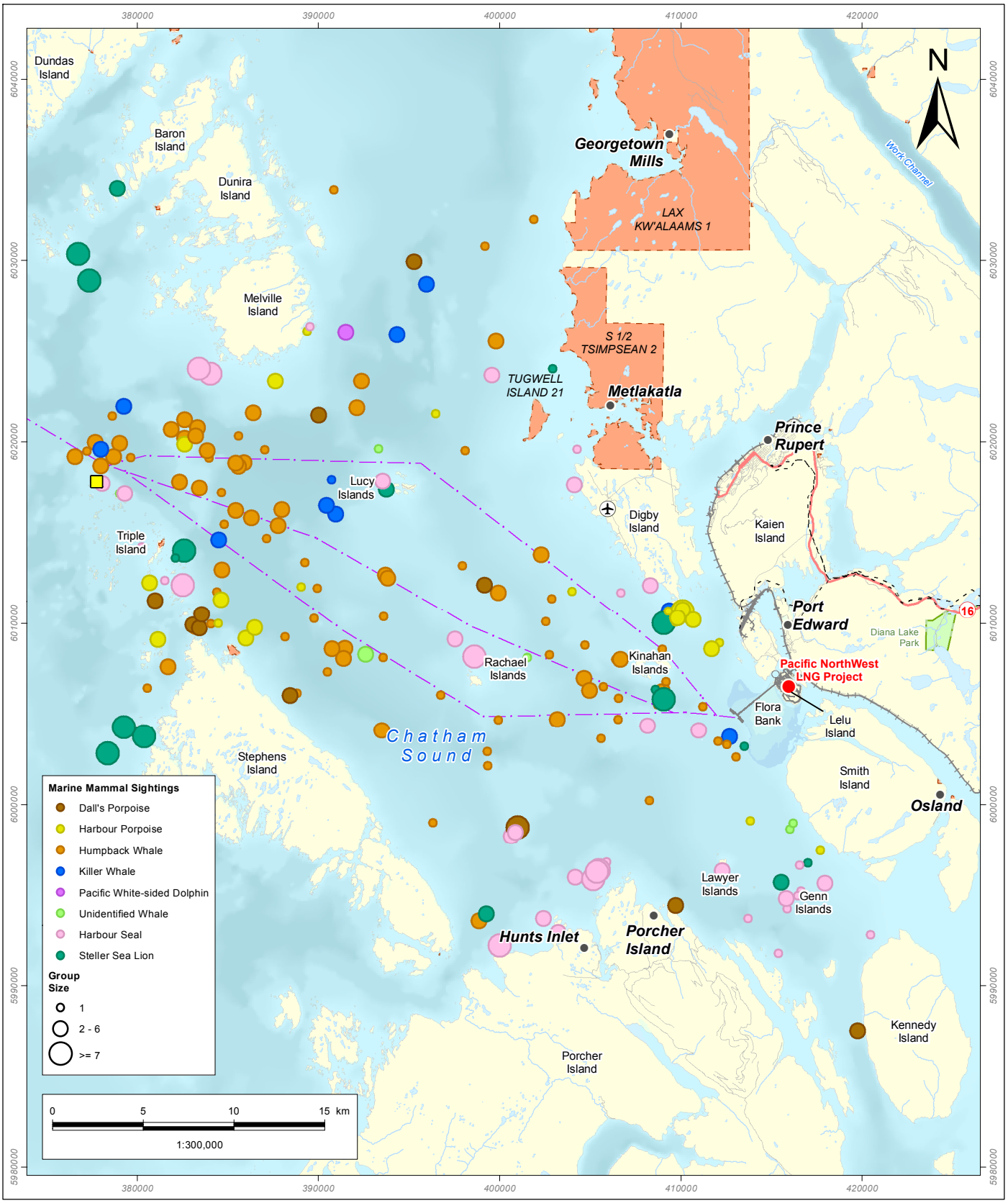
S – sighting

I – individuals

ND – not detected

Multiple sightings of pinnipeds at the same haulout were considered one sighting. The number of individuals (I) indicated was the highest number of animals recorded during one of the sightings.

[1]Baleen whale species not identified




Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

## Chatham Sound Survey Area A Marine Mammal Sightings

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| FIGURE ID: 123110537 | DATUM: NAD 83 |
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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **12**

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## 5.2 CHATHAM SOUND SURVEY AREA B

Surveys in Area B began in January 2015 and recurred monthly to June 2015. Table 5 and Figure 13 present summaries of all marine mammal species observed from the Area B.

Marine mammals observed Area B included one species of *mysticetes* (baleen whale) and four species of *odontocetes* (toothed whale). Species included humpback whale, killer whale, Dall's porpoise, harbour porpoise, and Pacific white-sided dolphin. Two species of pinnipeds were also present in all Area B surveys, the harbour seal and Steller sea lion. Marine mammal monthly sightings are further discussed in Section 5.3.

## Table 5 Chatham Sound Survey Area B Marine Mammal Sighting Summary

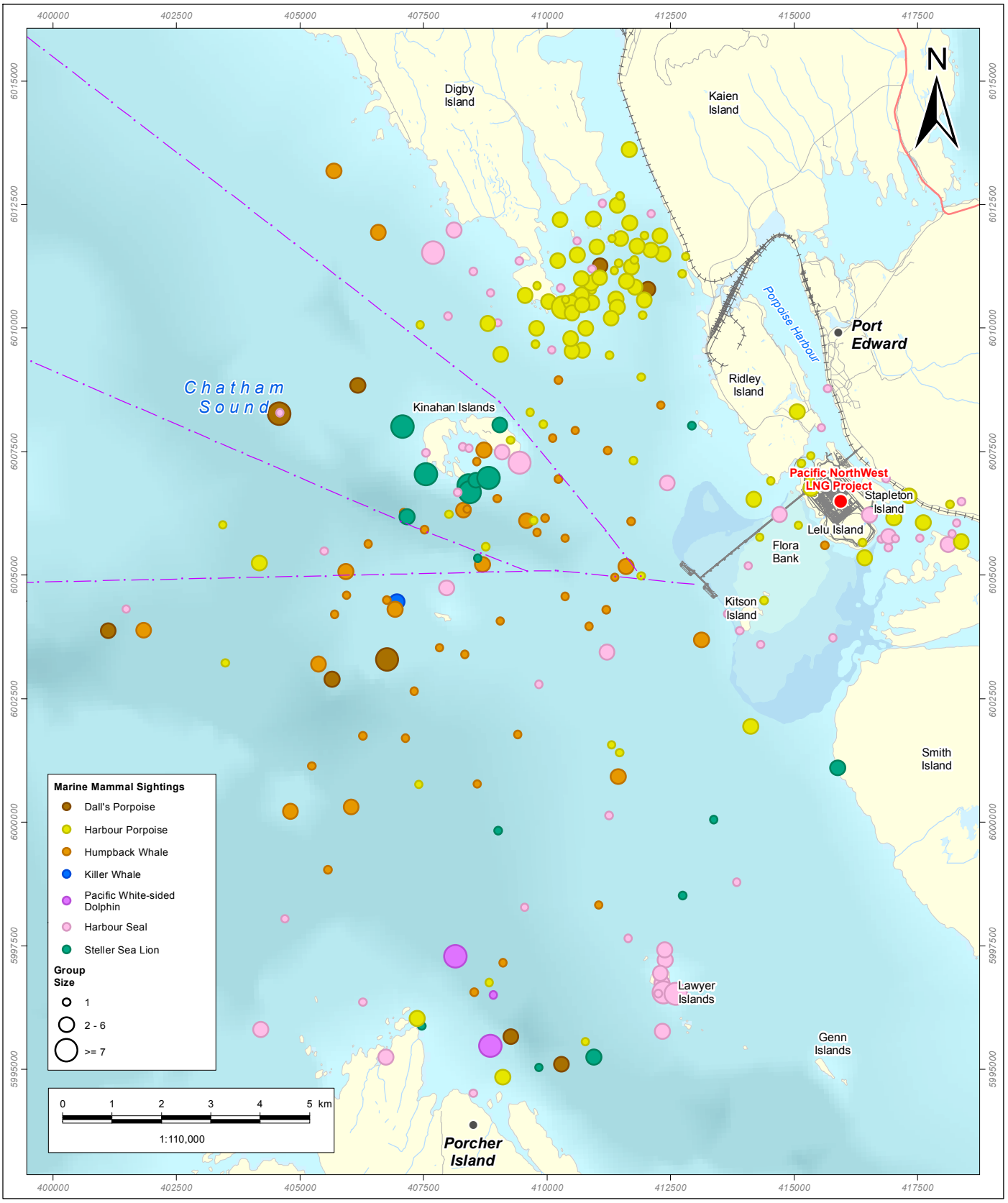
| Survey Dates | Humpback Whale | | Killer Whale | | Dall's Porpoise | | Harbour Porpoise | | Pacific White-sided Dolphin | | Harbour Seal | | Steller Sea Lion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S | I | S | I | S | I | S | I | S | I | S | I | S | I |
| January 22 – 24, 2015 | 44 | 64 | 1 | 3 | 4 | 13 | 11 | 23 | ND | ND | 9 | 12 | 6 | 48 |
| February 12 –13, 2015 | 3 | 7 | ND | ND | 6 | 37 | 13 | 32 | ND | ND | 4 | 6 | 4 | 16 |
| March 11 – 12, 2015 | 2 | 2 | ND | ND | ND | ND | 12 | 39 | ND | ND | 5 | 8 | 3 | 11 |
| April 5 – 6, 2015 | 3 | 3 | ND | ND | 1 | 3 | 21 | 48 | 3 | 111 | 15 | 37 | 1 | 3 |
| May 10 –11, 2015 | ND | ND | ND | ND | ND | ND | 22 | 45 | ND | ND | 9 | 27 | 2 | 2 |
| June 10 – 11, 2015 | ND | ND | ND | ND | ND | ND | 18 | 21 | ND | ND | 22 | 44 | 1 | 1 |
| **Total** | **52** | **76** | **1** | **3** | **11** | **53** | **97** | **208** | **3** | **111** | **64** | **134** | **17** | **81** |

S – sighting

I – individuals

ND – not detected

Multiple sightings of pinnipeds at the same haulout were considered one sighting. The number of individuals (I) indicated was the highest number of animals recorded during one of the sightings.




Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

*Pacific NorthWest LNG*

**Chatham Sound Survey Area B**
**Marine Mammal Sightings**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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FIGURE NO: 13

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## 5.3 MONTHLY SIGHTINGS

Marine mammal sightings from Areas A and B have been mapped (Figure 14 to Figure 25) and monthly summaries of marine mammal species that were present are provided below.

### 5.3.1 November, 2014

Area A was surveyed from November 16 – 20, 2014. Marine mammal sightings from the survey can be seen in Figure 14. Humpback whales had the highest number of sightings, with 56 sightings and 94 individuals. An unidentified whale blow, recorded as a likely humpback whale, was also recorded during transit. Killer whales were observed (5 sightings, 12 individuals) southwest of Lucy Islands, south of Digby Island and near Flora Bank. Photograph 2 shows the dorsal fin of the killer whale sighting south of Digby Island. Harbour porpoises were sighted 3 times (6 individuals). Two species of pinnipeds, harbour seals (2 sightings, 4 individuals) and Steller sea lions (3 sightings, 105 individuals) were observed during the November survey. Both the harbour seal sightings were near Genn Islands. One Steller sea lion sighting recorded approximately 100 individuals hauled out near Triple Island.

**Photograph 2 November 2014: Killer Whale Observation**

### 5.3.2 January, 2015

Area A and Area B were surveyed from and January 27–31, 2015 and January 22–24, respectively (Figure 15 and Figure 16). Humpback whales had a combined maximum total of 64 sightings and 92 individuals. Photograph 3 shows the tail of a humpback whale. One killer whale sighting recorded 3 individuals (one adult male, adult female and juvenile, Photograph 4). Harbour porpoises were recorded a combined maximum of 12 sightings, 24 individuals. Dall's porpoises were recorded a combined maximum of 6 sightings, 17 individuals. Harbour seals and Steller sea lions were recorded with combined maximums of 17 sightings (42 individuals) and 11 sightings (66 individuals), respectively.

**Photograph 3 January 2015: Humpback Whale Observation**

**Photograph 4 January 2015: Killer Whale Observation**

### 5.3.3 February, 2015

Area A (February 24 – 27, 2015) and Area B (February 12 – 13, 2015) sightings are shown in Figure 17 and Figure 18. Harbour porpoise were sighted the most during February (combined maximum of 20 sightings, 51 individuals), followed be Dall's porpoise (combined maximum of 10 sightings, 55 individuals, Photograph 5). Humpback whales were sighted a combination of seven times (11 individuals). One sighting of six killer whales was recorded north of Chatham Sound (Photograph 6). A sighting of six Pacific white-sided dolphins was recorded southeast of Melville Island. Harbour seal (combined maximum of 5 sightings, 7 individuals) and Steller sea lion (combined maximum of 7 sightings, 53 individuals) sightings within Area B were also recorded.

**Photograph 5 February 2015: Dall's Porpoise Observation**

**Photograph 6 February 2015: Killer Whale Observation**

### 5.3.4 March, 2015

Area A and Area B were surveyed March 24 – 27, 2015 and March 11 – 12, 2015 (Figure 19 and Figure 20). Multiple sightings of harbour porpoises were recorded (combined maximum of 16 sightings, 51 individuals). Humpback whales were sighted a combined nine times (16 individuals). Killer whales were sighted on two occasions with a group size of 6 individuals and 2 individuals. Steller sea lions (combined maximum of 7 sightings, 192 individuals) Dall's porpoise (combined maximum of 4 sightings, 60 individuals; Photograph 7) and harbour seals (combined maximum of 11 sightings, 34 individuals) were also recorded during the March surveys.

**Photograph 7 March 2015: Dall's Porpoise Observation**

### 5.3.5 April, 2015

Area A (April 27 – May 1, 2015) and Area B (April 5 – 6, 2015) sightings are shown in Figure 21 and Figure 22. Harbour porpoise (combined maximum of 26 sightings, 55 individuals) were sighted. Humpback whales (combined maximum of 5 sightings, 6 individuals). Dall's porpoise (combined maximum of 2 sightings, 7 individuals) and Pacific white-sided dolphins (3 sightings, 111 individuals) were also recorded in April. The Pacific white-sided dolphins were seen north of Porcher Island, porpoising and traveling in a large gregarious group (Photograph 8). Harbour seals (combined maximum of 18 sightings, 64 individuals) were sighted south of Digby Island. All Steller sea lions were observed hauled out during the April survey with a large group of approximately 150 individuals photographed hauled out west of Stephens Island (Photograph 9).

**Photograph 8 April 2015: Pacific White-sided Dolphin Observation**

**Photograph 9 April 2015: Steller Sea Lion Observation**

### 5.3.6 May, 2015

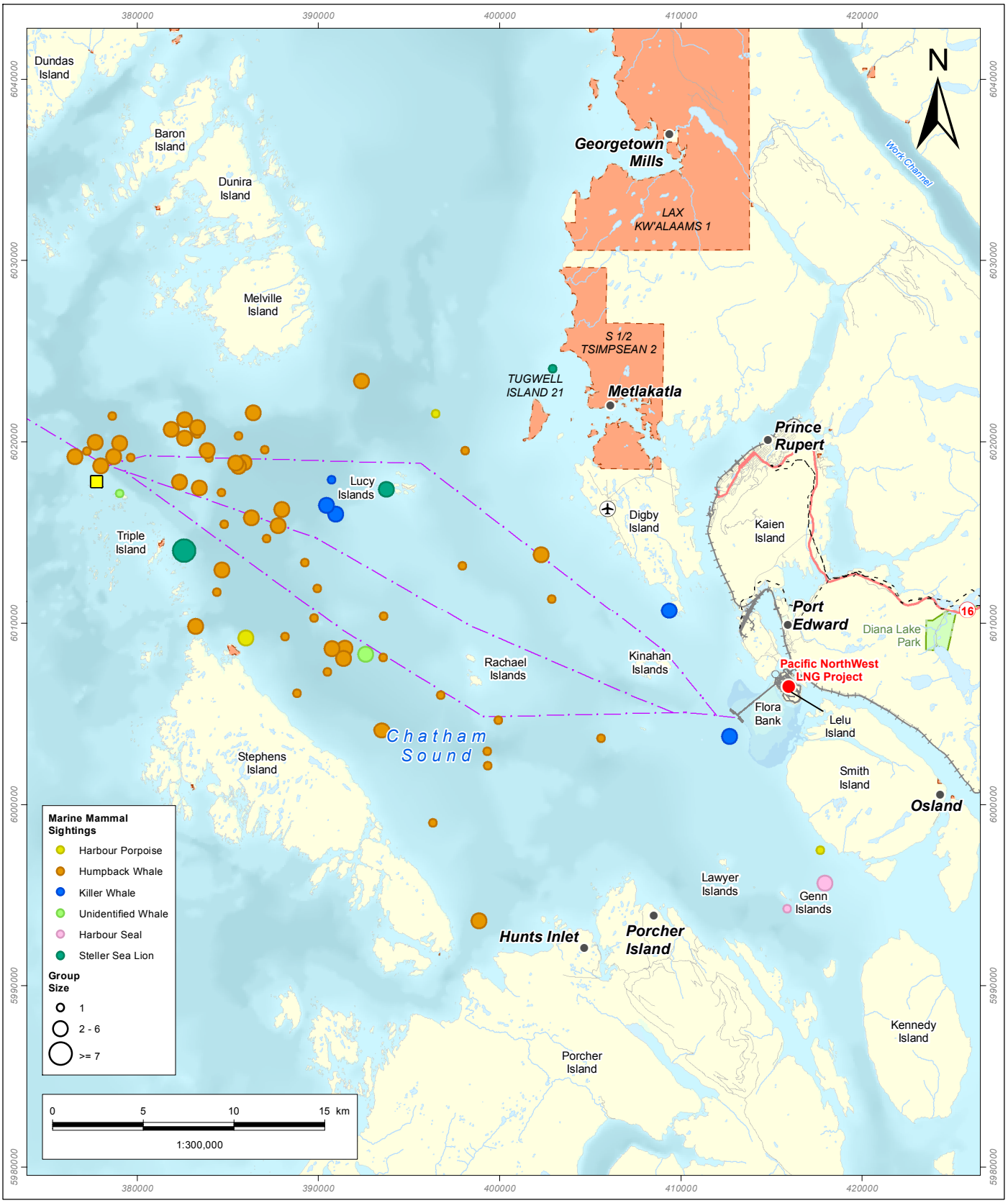
Area A (May 24 – 27, 2015) and Area B (May 10 – 11, 2015) sightings are included in Figure 23 and Figure 24. The species observed most frequently during May included harbour seals (combined maximum of 28 sightings, 104 individuals; Photograph 10) and harbour porpoises (combined maximum of 24 sightings, 48 individuals). Two killer whale sightings near Triple Island were recorded during the Area A and identified as potential repeat sightings (i.e., both sightings had the same group size of 3 individuals with similar dorsal fins). Three sightings of Steller sea lions (4 individuals) were also recorded during the May survey.

**Photograph 10 May 2015: Harbour Seal Observation**

### 5.3.7 June, 2015

No surveys were conducted in Area A in June. Area B (June 10 – 11, 2015) sightings are shown in Figure 25. Harbour seal was the most sighted species, (22 sightings, 44 individuals; Photograph 11), followed by harbour porpoise (18 sightings, 21 individuals). One sighting of a single Steller sea lion was also observed feeding with its head above the water holding a fish in its mouth.

**Photograph 11 June 2015: Harbour Seal Observation**




Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

# Chatham Sound Survey Area A: Marine Mammal Sightings (November 2014)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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PREPARED BY: Stantec

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FIGURE NO: **14**

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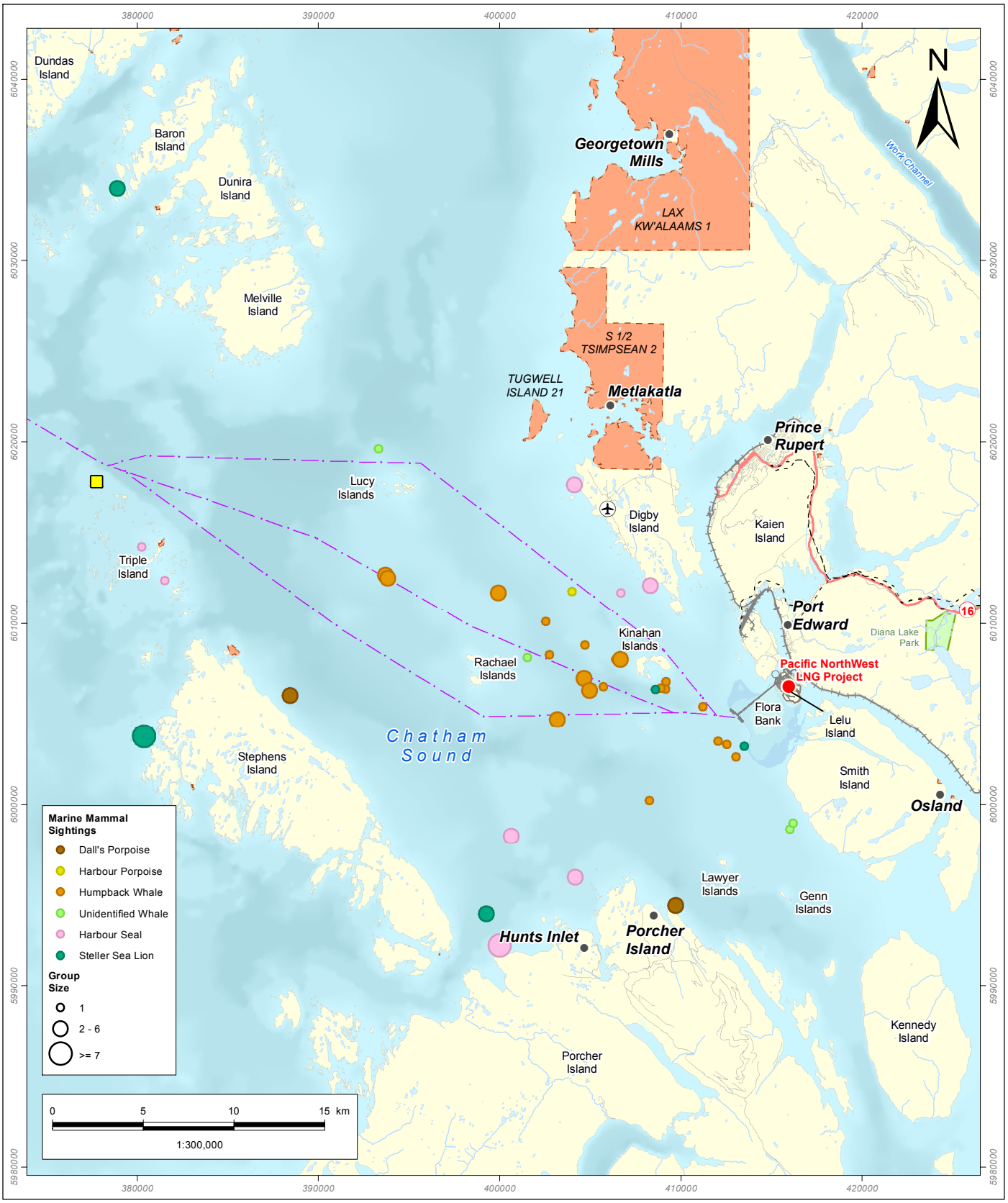


Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

# Chatham Sound Survey Area A: Marine Mammal Sightings (January 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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FIGURE NO: **15**

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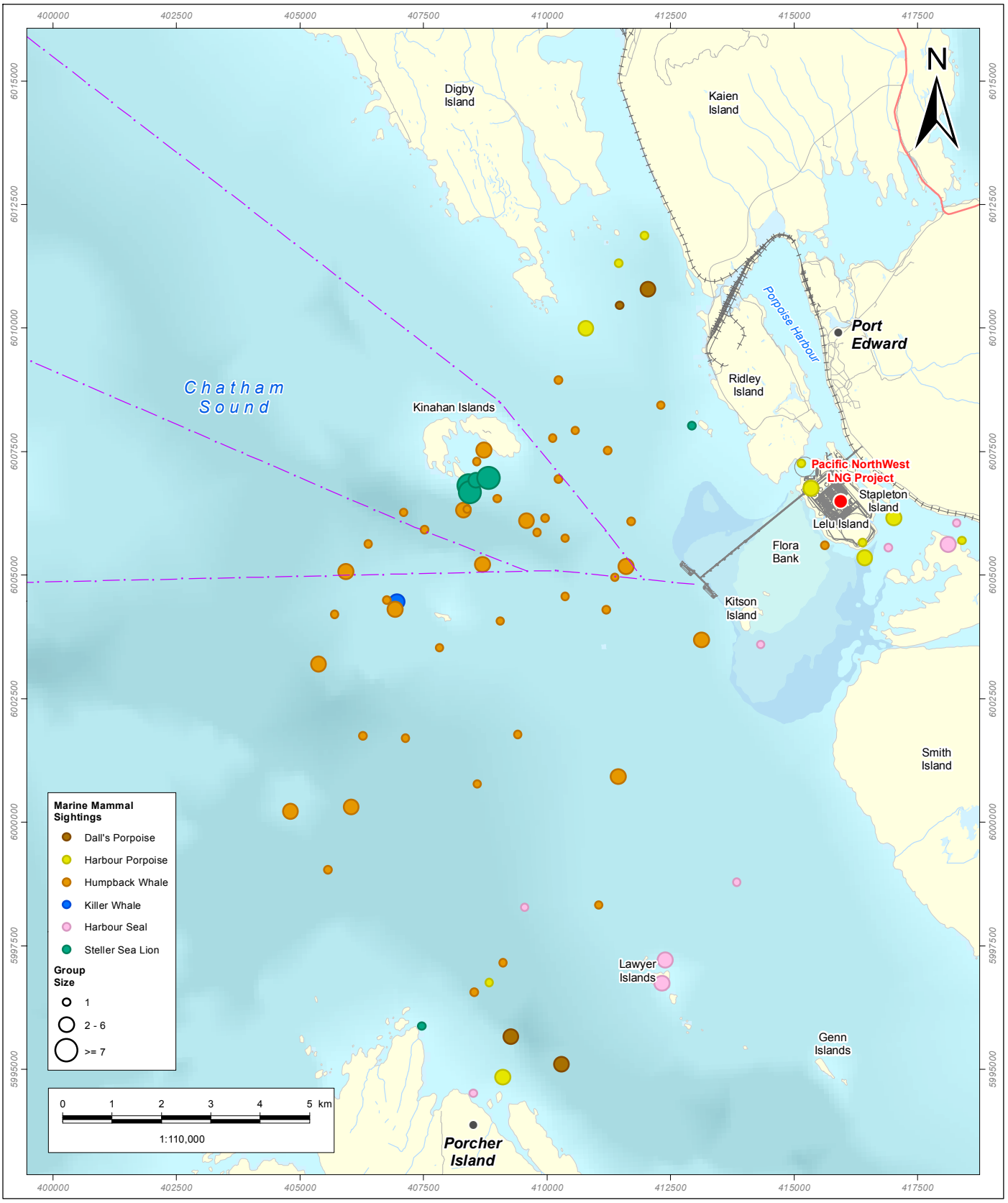


Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

*Pacific NorthWest LNG*

**Chatham Sound Survey Area B: Marine Mammal Sightings (January 2015)**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

DATE: 26-JUN-15
FIGURE ID: 123110537
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PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: R. LIM

PREPARED BY: Stantec
PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: 16

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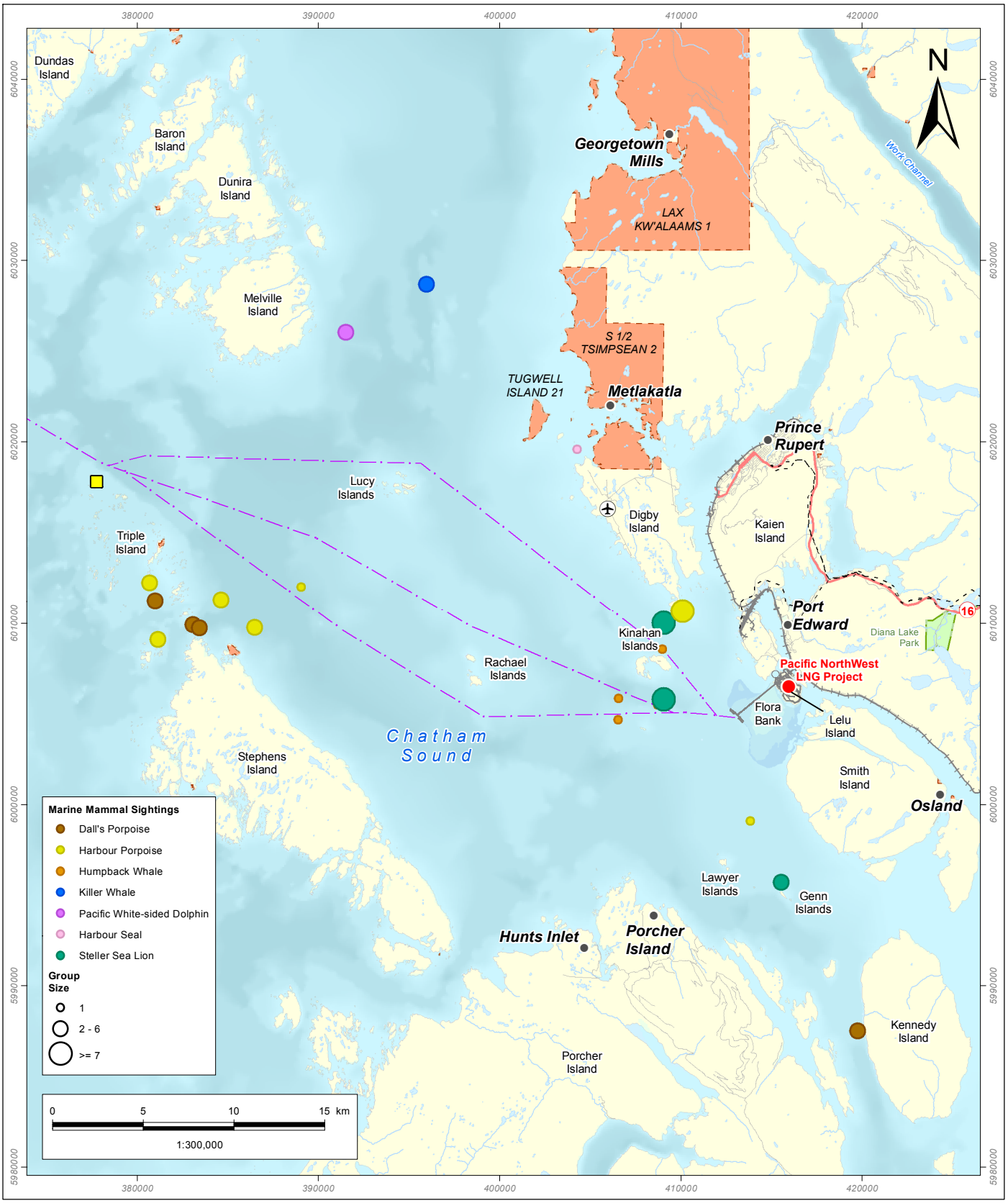


Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

## Chatham Sound Survey Area A: Marine Mammal Sightings (February 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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| FIGURE ID: 123110537 | DATUM: NAD 83 |
| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

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PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **17**

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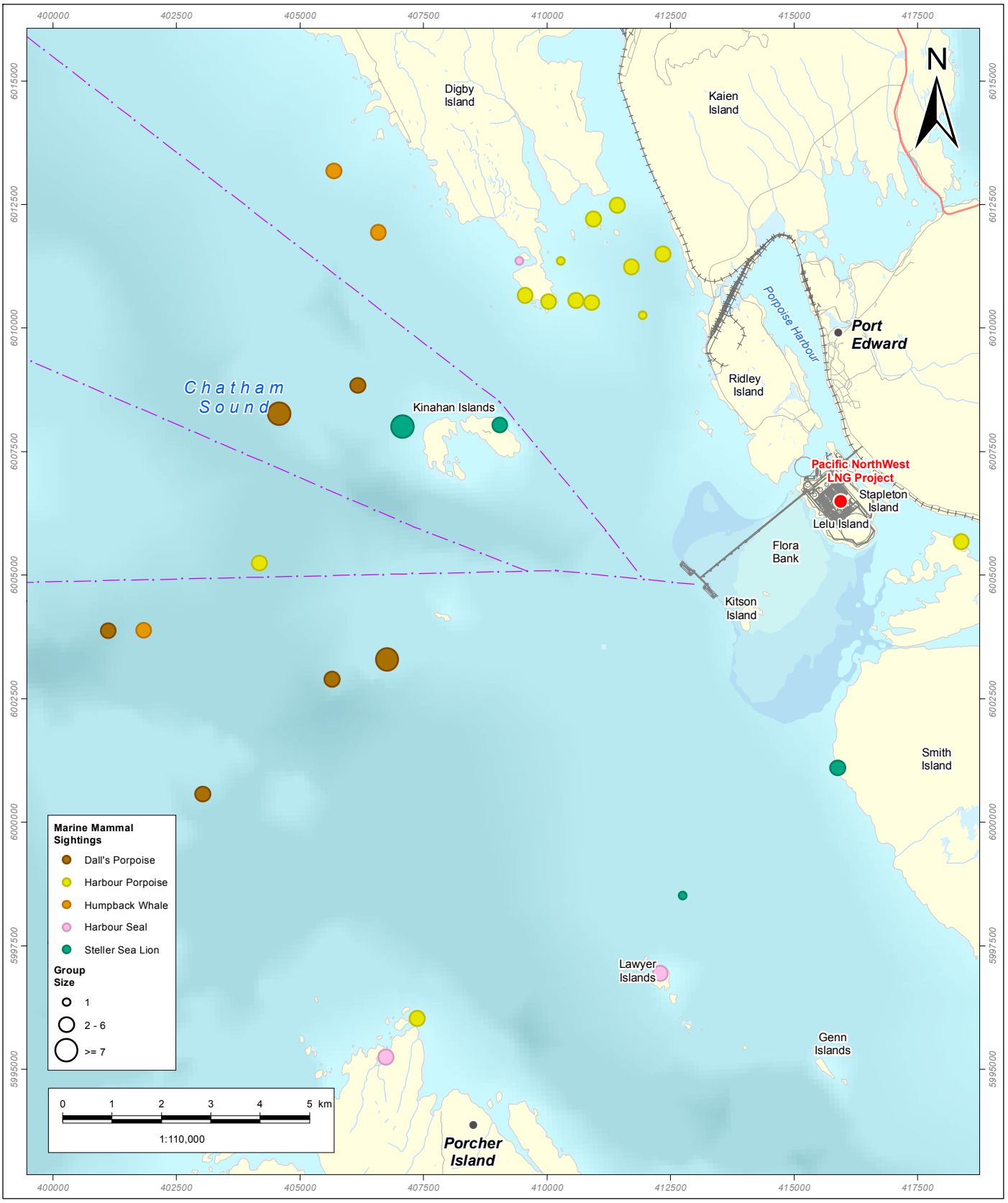


Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

**Chatham Sound Survey Area B: Marine Mammal Sightings (February 2015)**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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FIGURE ID: 123110537
DRAWN BY: A. BOONE
PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: R. LIM

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PREPARED FOR: Pacific NorthWest LNG
FIGURE NO: **19**

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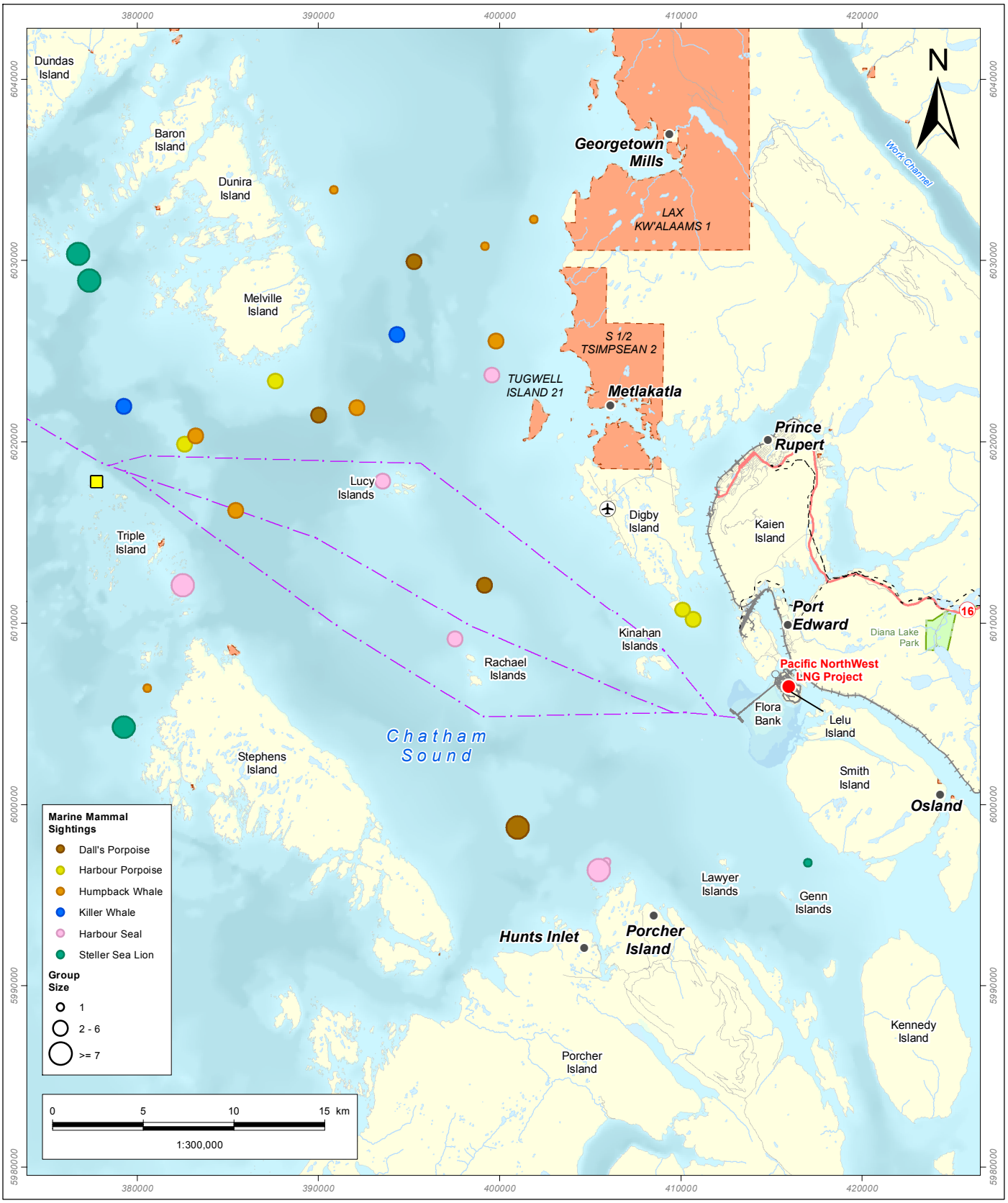


Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

# Chatham Sound Survey Area A: Marine Mammal Sightings (March 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| FIGURE ID: 123110537 | DATUM: NAD 83 |
| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **19**

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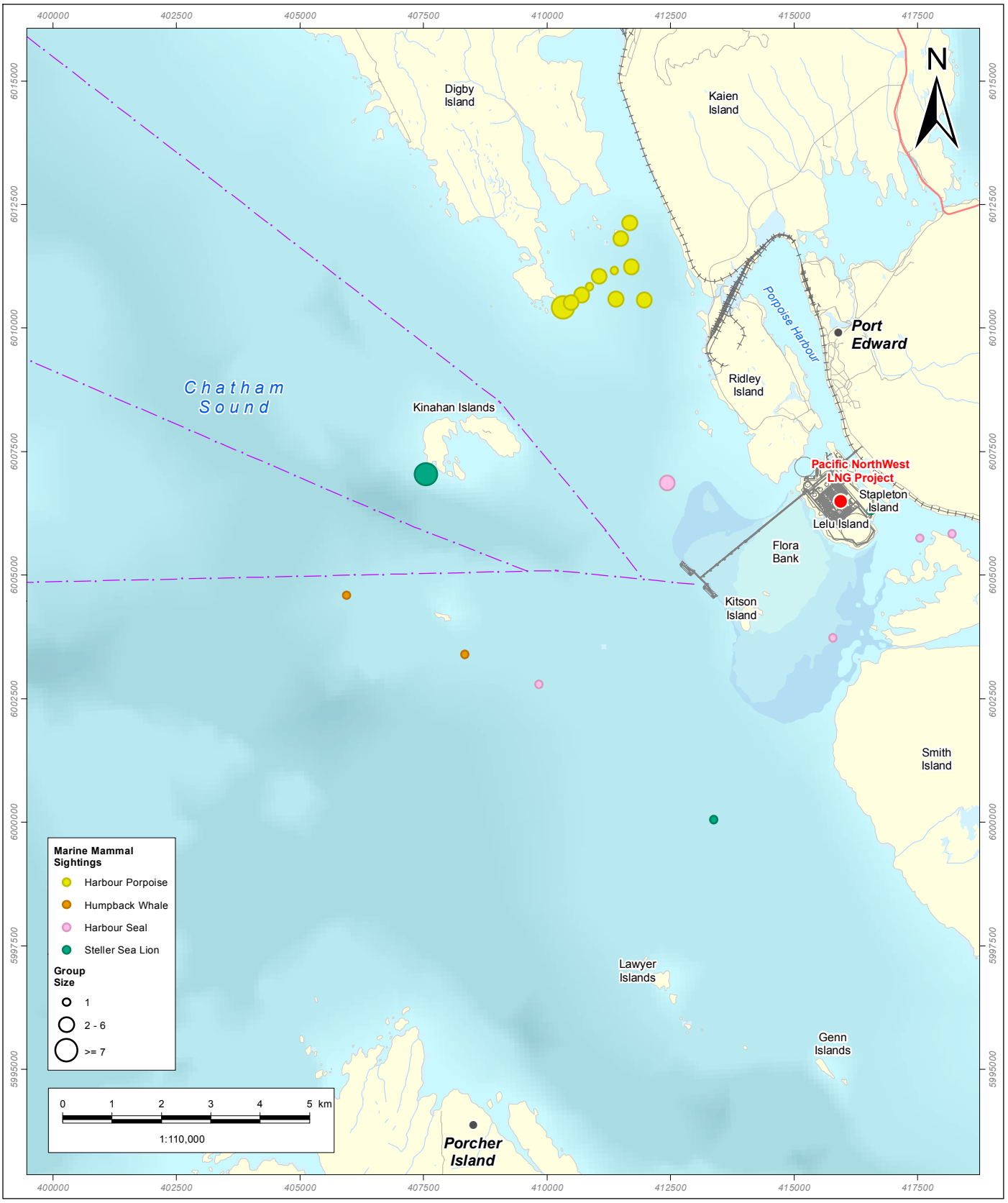


Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

## Chatham Sound Survey Area B: Marine Mammal Sightings (March 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| DATE: 26-JUN-15 | PROJECTION: UTM - ZONE 9 |
| FIGURE ID: 123110537 | DATUM: NAD 83 |
| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **20**

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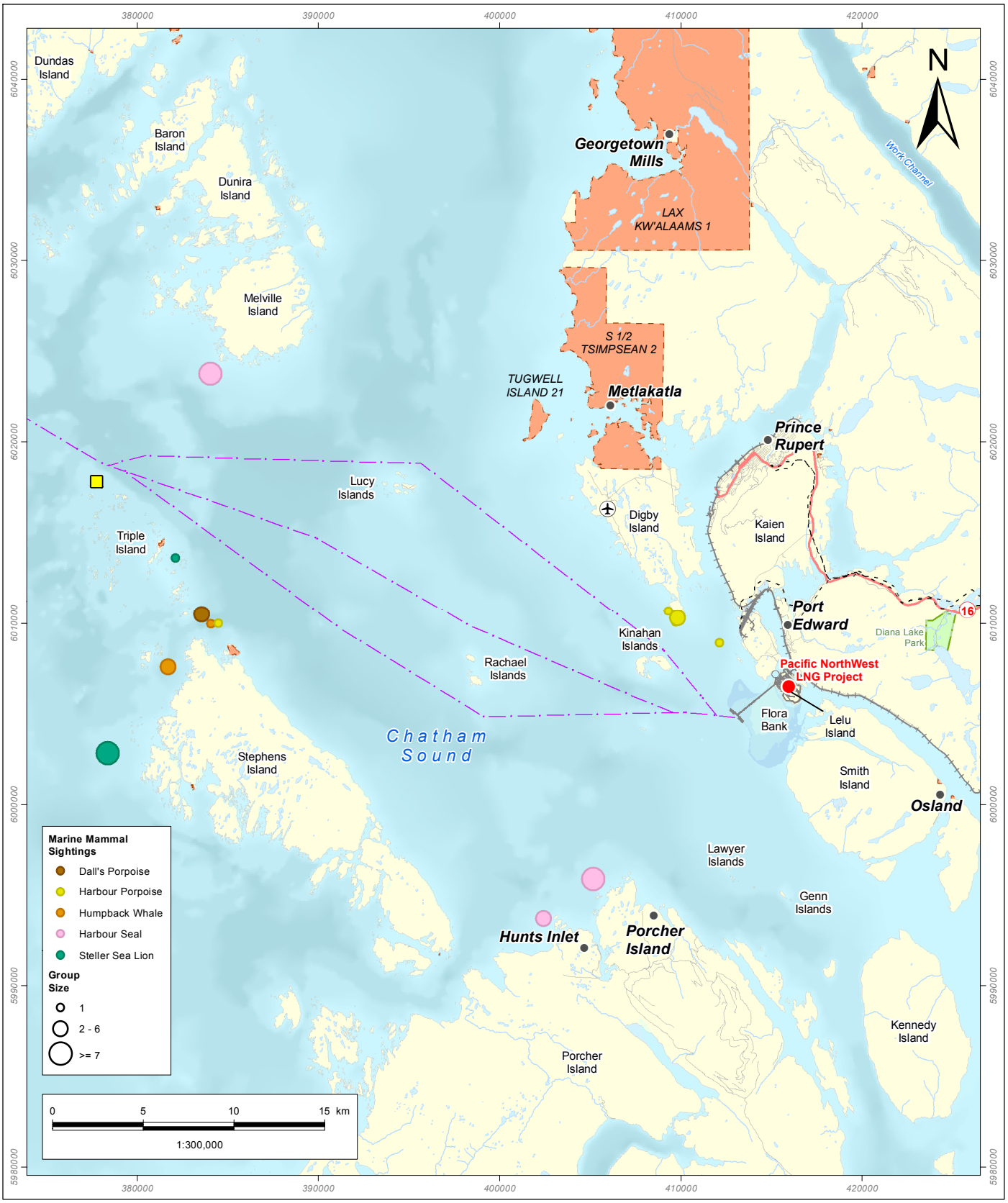


Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

## Chatham Sound Survey Area A: Marine Mammal Sightings (April 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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| DATE: 26-JUN-15 | PROJECTION: UTM - ZONE 9 |
| FIGURE ID: 123110537 | DATUM: NAD 83 |
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PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **21**

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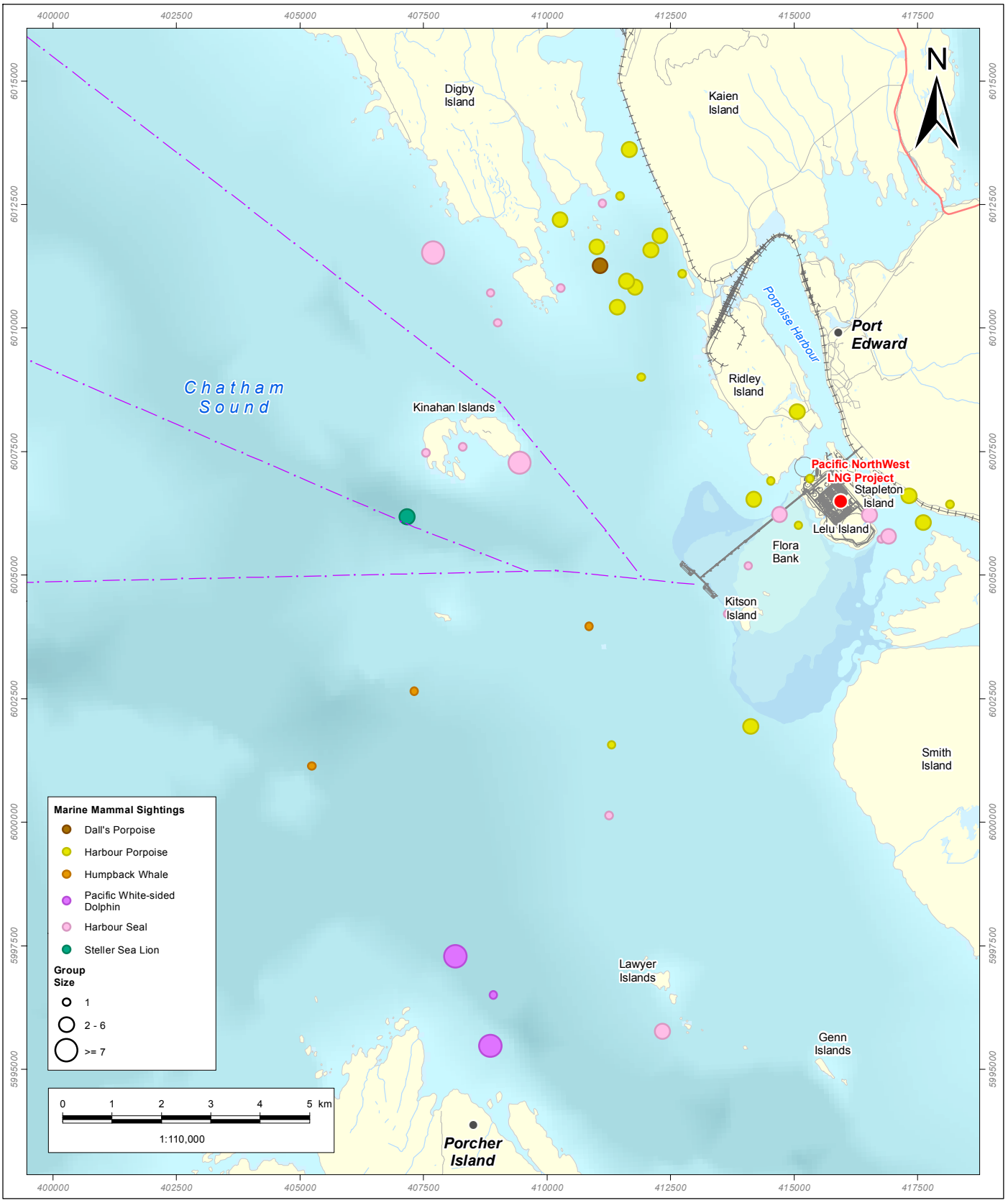


Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

*Pacific NorthWest LNG*

**Chatham Sound Survey Area B: Marine Mammal Sightings (April 2015)**

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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DRAWN BY: A. BOONE

PROJECTION: UTM - ZONE 9
DATUM: NAD 83
CHECKED BY: R. LIM

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **22**

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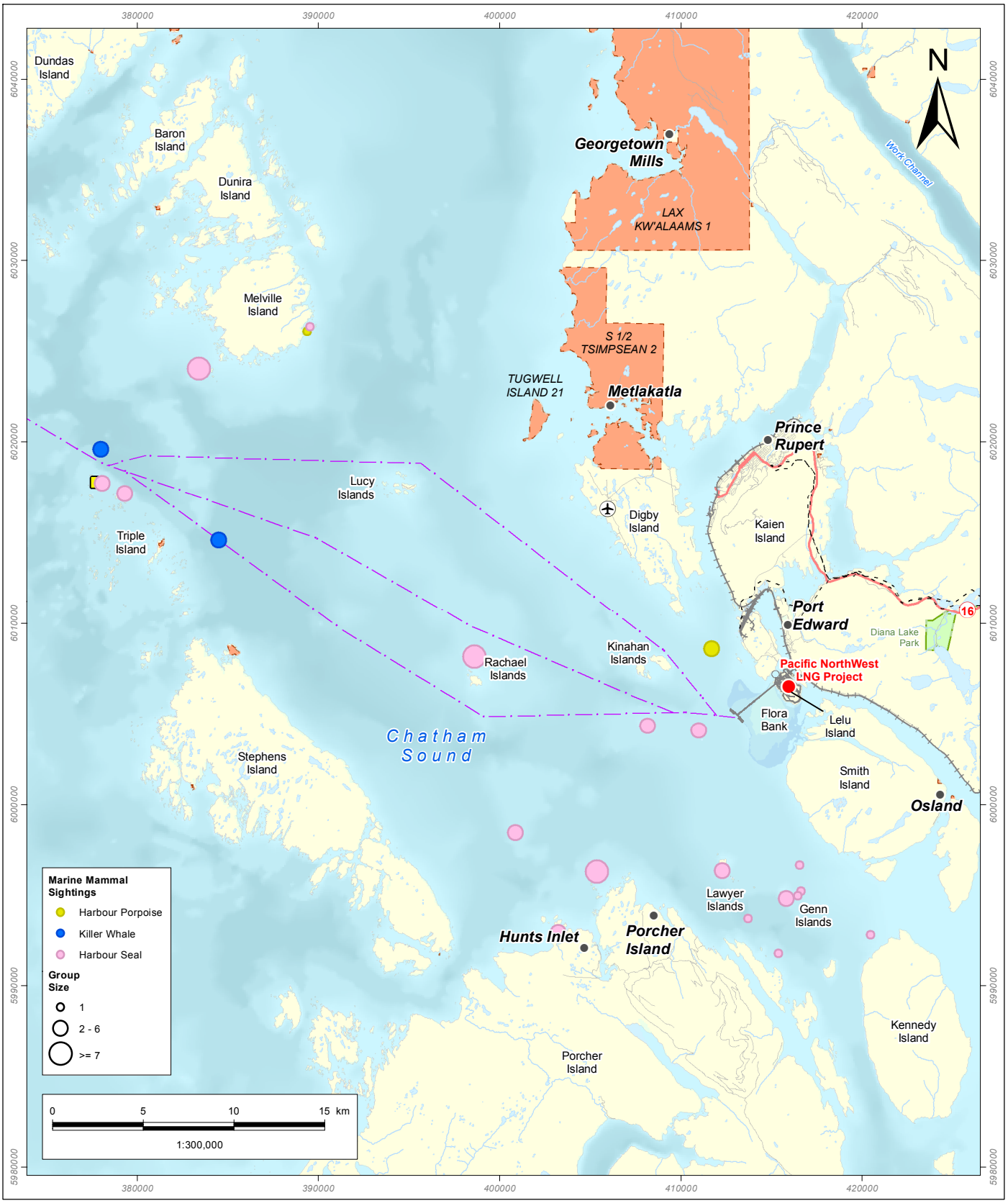


Project Location
Project Component
Potential Shipping Route
Airport
City or Town
Pilotage Station
Electrical Power Transmission Line
Highway
Railway
Secondary Road
Watercourse
Indian Reserve
Protected Area
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

**Pacific NorthWest LNG**

# Chatham Sound Survey Area A: Marine Mammal Sightings (May 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

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| FIGURE ID: 123110537 | DATUM: NAD 83 |
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PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **23**

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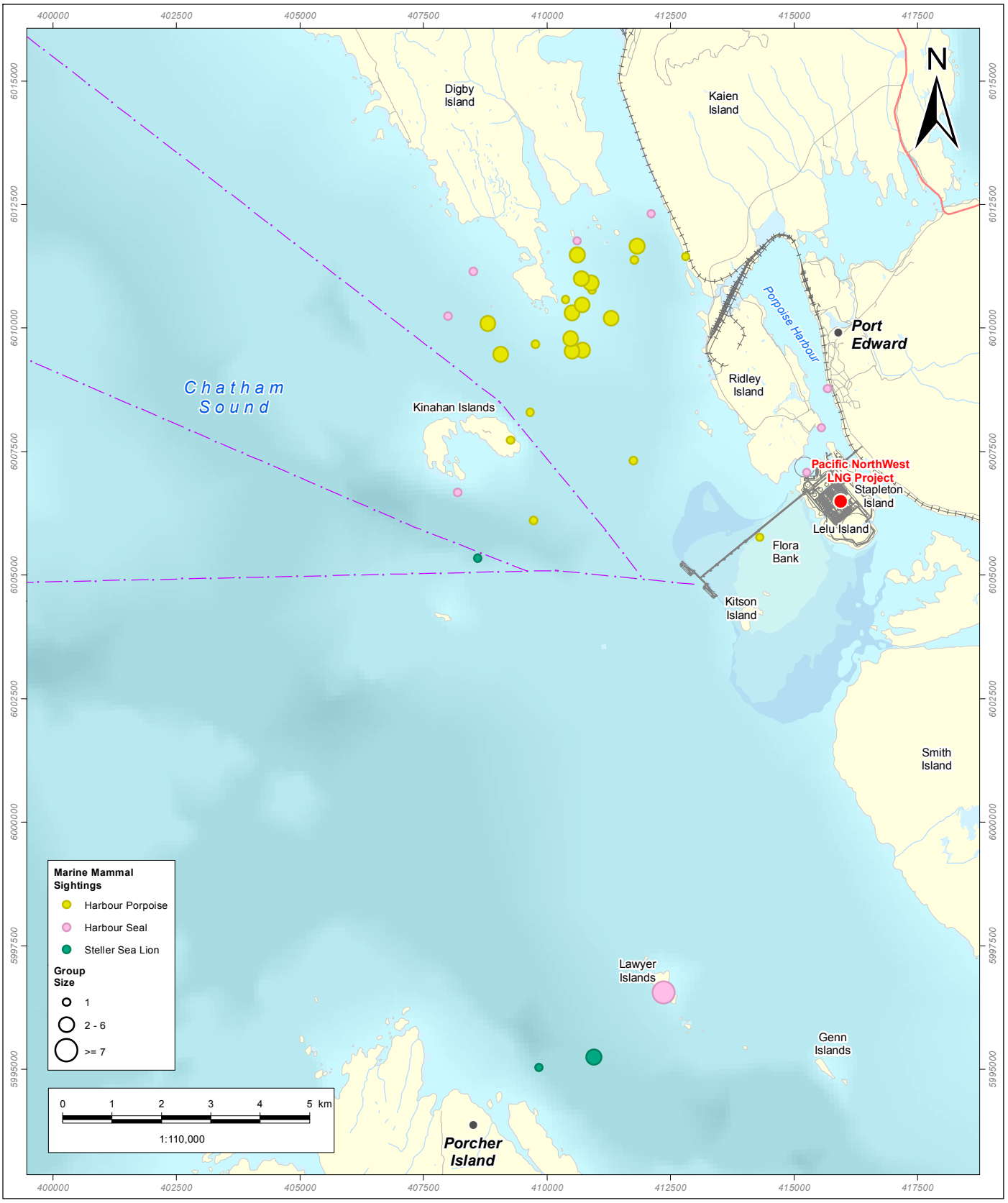


Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

## Chatham Sound Survey Area B: Marine Mammal Sightings (May 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| DATE: 26-JUN-15 | PROJECTION: UTM - ZONE 9 |
| FIGURE ID: 123110537 | DATUM: NAD 83 |
| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **24**

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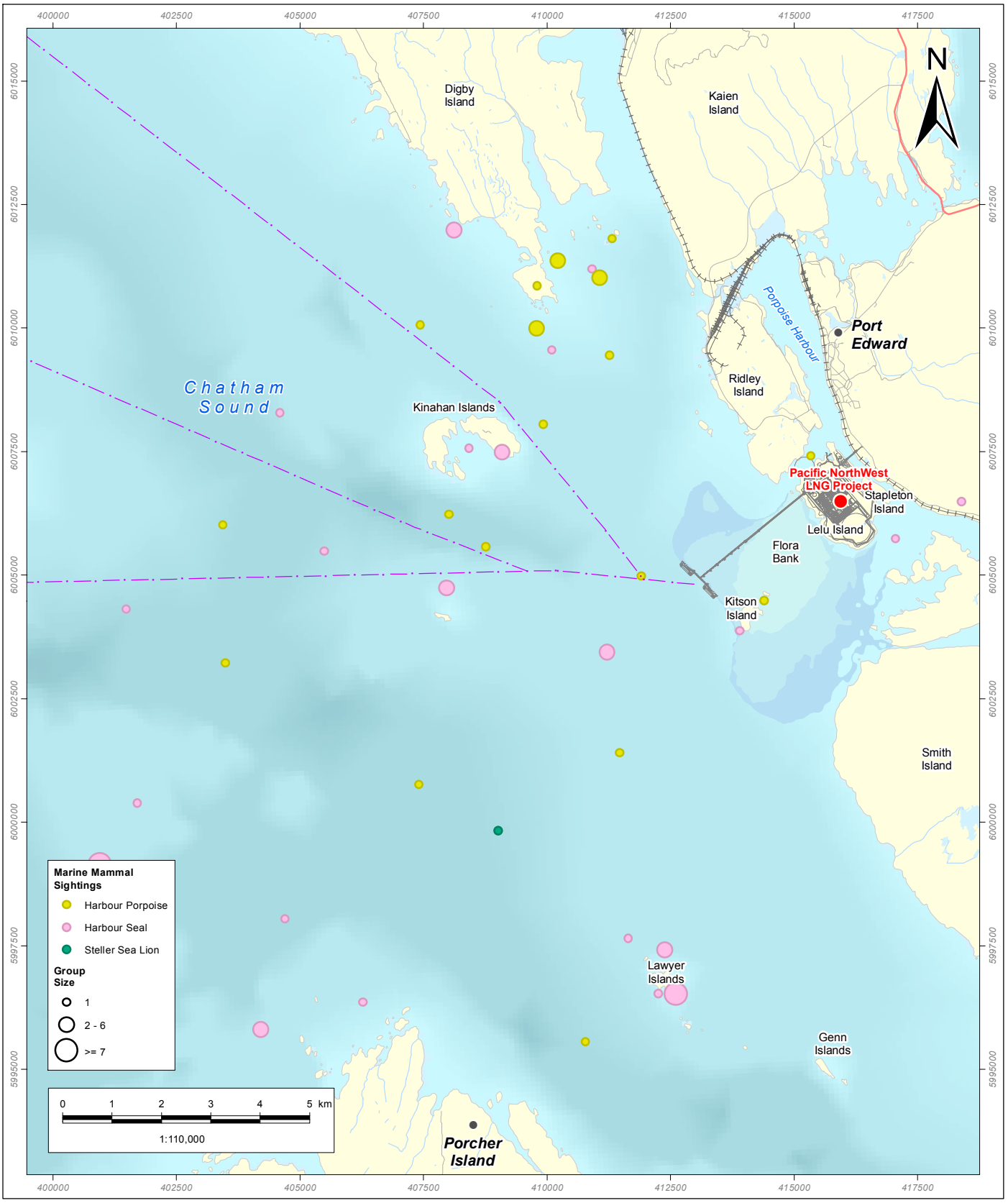


Project Location
Project Component
Potential Shipping Route
City or Town
Highway
Railway
Secondary Road
Watercourse
Waterbody
Flora Bank
0 - 5 m Deep Shoal
5 - 10 m Deep Shoal
Bathymetry (m)
High : 1
Low : -300

***Pacific NorthWest LNG***

## Chatham Sound Survey Area B: Marine Mammal Sightings (June 2015)

*Sources: Government of British Columbia; Prince Rupert Port Authority; Government of Canada, Natural Resources Canada, Centre for Topographic Information; Progress Energy Canada Ltd.*

*Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.*

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| DATE: 26-JUN-15 | PROJECTION: UTM - ZONE 9 |
| FIGURE ID: 123110537 | DATUM: NAD 83 |
| DRAWN BY: A. BOONE | CHECKED BY: R. LIM |

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PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **25**

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## 5.4 INCIDENTAL BEHAVIOURAL OBSERVATIONS

Behavioural data was collected opportunistically based on surface observations of marine mammals at the time of first sighting. Behaviours were recorded according to the categories outlined in Appendix A. Figure 26 shows the behaviours by species for all the survey data combined from November 2014 to May 2015. All behavioural data are considered incidental because the primary survey objective was to determine abundance and distribution and survey design for this is not conducive to conducting focal animal sampling (i.e., the vessel would have to stop the transect survey to monitor a single animal's behaviour for a period of time). As a result, the data shown below are only indicative of the general types of behaviours that can occur in the study area. The information presented is neither a complete tally of all possible behaviours, nor an indication of the time spent engaged in each behaviour.

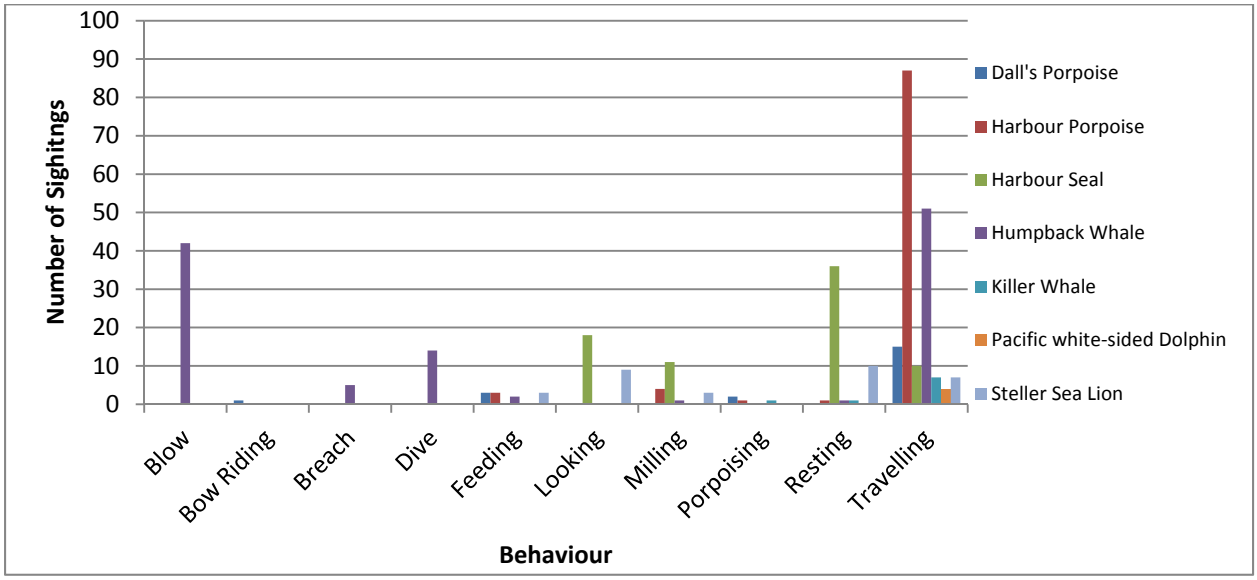


**Figure 26 Marine Mammal Behaviour Observed by Species In Areas A and B combined (Nov 2014 – June 2015)**

# 6.0 SUMMARY

Surveys from November 2014 to June 2015 recorded seven species of marine mammals present in the Areas A and B.

Humpback whales were the most frequently observed marine mammal species, with a combined maximum total of 141 sightings (219 individuals). Humpback whales were the only species of baleen whales recorded during each survey.

Four species of toothed whale (odontocetes) were observed, including killer whale, Dall's porpoises, harbour porpoises and Pacific white-sided dolphins. Killer whales were sighted in every month except for April, 2015 (combined total of 11 sightings and 36 individuals). Dall's porpoises were observed from January to April, with a combined maximum of 22 sightings and 139 recorded individuals. Harbour porpoises were observed in every month of the survey program (combined total of 119 sightings, 256 individuals). Pacific white-sided dolphins were observed in February and April.

Two species of pinnipeds were identified in all survey months. Harbour seals were recorded with a combined total of 103 sightings and 299 individuals. Steller sea lions were recorded with a total of 36 sightings and 615 individuals

This interim report covered monthly periods from November 2014 through the beginning of June 2015 (excluding December). End of June through November 2015 will be surveyed in the ongoing program with the same protocol as the previous surveys and all data will be combined for analysis in the final report. Based on observations to date (number of species and individuals) we expect to be able to fulfil the objectives outlined at the beginning of this document, and produce a robust analysis and interpretation.

# 7.0 REFERENCES

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# APPENDIX A
# BEHAVIOUR AND ENVIRONMENTAL CATEGORIES AND DEFINITIONS

# Appendix A BEHAVIOURAL AND ENVIRONMENTAL CATEGORIES AND DEFINITIONS

## Table A.1 Marine Mammal Behaviours

| Behaviour | Description |
|---|---|
| Breach | When a whale leaps out of the water and slams its body on the surface of the water |
| Fin slap/ Lobtailing | When a marine mammal slaps its pectoral fin or fluke (tail) against the surface of the water |
| Spyhop | When a marine mammal raises its head vertically out of the water |
| Resting | When a marine mammal is at the surface of the water and not traveling |
| Milling | When a marine mammal swims in no particular direction in a limited area |
| Looking | When a marine mammal looks at the vessel with its head out of the water |
| Rafting | When a group of marine mammal are in a horizontal position at the surface of the water |
| Porpoising | When a marine mammal leaps near the surface of the water as it travels |
| Bow riding | When a marine mammal swims in front of the bow of a vessel |
| Wake riding | When a marine mammal swims in the wake created by a vessel |
| Feeding | When a marine mammal is feeding |

## Table A.2 Environmental Variables

| Environmental Variable | Description Options |
|---|---|
| Weather | Clear, Partly Cloudy, Overcast, Fog, Mist, Light Rain, Moderate Rain, Heavy Rain, Snow |
| Wind direction | The direction the wind is coming from |
| Beaufort wind speed | Wind speed in knots |
| Beaufort sea state | 0 to 12. These numbers are a ranking of the sea state based on a modified Beaufort Scale (see Table A.3) |
| Visibility | Zero; < 500 m (very low visibility); 500 – 1,000 m (low visibility); 1,000 – 2,500 m (moderate visibility); 2,500 – 5,000 m (high visibility); 5,000 – 10,000 m (very high visibility); > 10,000 m (excellent visibility) |
| Sun glare (descriptive) | No Glare, Weak Glare, Strong Glare or Variable |
| Sun glare angle FROM (clock face) | Indicates the direction and portion of MMO field of view affected by glare (if any) |
| Sun glare angle TO (clock face) | Indicate where glare stops using the clock face as above |
| Sightability | The current sightability: Nil, Poor, Medium, High, Very high. This is a qualitative measure of how well the MMO can spot marine mammals based on the current visibility, weather, sea state and sun glare. |

## Table A.3 Beaufort Sea State and Wind Speed

| Beaufort Sea State | Wind Speed (knots) | Descriptive Term | Effects Observed at Sea |
|---|---|---|---|
| 0 | < 1 | Calm | Sea surface like a mirror, but not necessarily flat. |
| 1 | 1 – 3 | Light air | Ripples with the appearance of scales are formed, but without foam crests. |
| 2 | 4 – 6 | Light breeze | Small wavelets, still short but more pronounced. Crests do not break. When visibility good, horizon line always very clear. |
| 3 | 7 – 10 | Gentle breeze | Large wavelets. Crests begin to break. Foam of glassy appearance. Perhaps scattered whitecaps. |
| 4 | 11 – 16 | Moderate breeze | Small waves, becoming longer. Fairly frequent whitecaps. |
| 5 | 17 – 21 | Fresh breeze | Moderate waves, taking a more pronounced long form. Many whitecaps are formed. Chance of some spray. |
| 6 | 22 – 27 | Strong breeze | Large waves begin to form. The white foam crests are more extensive everywhere. Probably some spray. |
| 7 | 28 – 33 | Near gale | Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind. |
| 8 | 34 – 40 | Gale | Moderately high waves of greater length. Edges of crests begin to break into the spindrift. The foam is blown in well-marked streaks along the direction of the wind. |
| 9 | 41 – 47 | Strong gale | High waves. Dense streaks of foam along the direction of the wind. Crests of waves begin to topple, tumble and roll over. Spray may affect visibility. |
| 10 | 48 – 55 | Storm | Very high waves with long overhanging crests. Dense white streaks of foam. Surface of the sea takes a white appearance. The tumbling of the sea becomes heavy and shock-like. Visibility affected. |
| 11 | 56 – 63 | Violent storm | Exceptionally high waves. Sea completely covered with long white patches of foam. Visibility affected. |
| 12 | 64 – 71 | Hurricane | Air filled with foam and spray. Sea entirely white with foam. Visibility seriously impaired. |