Pre-Deployment Visual Monitoring for Beluga Whales in and near the Cook Inlet Tidal Energy Project Proposed Deployment Area, May-November 2010.

Final Report

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EXECUTIVE SUMMARY

South-central Alaska's Cook Inlet is home to some of the greatest tidal energy potential in the United States. It is also home to an endangered population of beluga whales (*Delphinapterus leucas*). Successful permitting and operation of a tidal power project in Cook Inlet will require a rigorous biological assessment of the potential and realized effects of the sound footprint and physical presence of tidal turbines on the distribution, relative abundance, and behavior of Cook Inlet beluga whales. In 2009 and 2010 LGL Alaska Research Associates, Inc., sponsored by ORPC, conducted a study to visually monitor beluga whale presence, relative abundance, and behavior off of the north side of Fire Island, Upper Cook Inlet, Alaska. This report presents results from 2010.

The study plan to survey for beluga whales in and near the proposed Deployment Area was developed by ORPC and reviewed by regulatory and resource agencies as part of the Federal Energy Regulatory Commission (FERC) pre-consultation process. A copy of the approved study plan is included in Appendix A. Any modifications to the original plan due to logistical constraints were made after conversations with NMFS-Alaska Region, and are discussed in this report.

The study had two primary objectives:

1. Estimate the frequency of occurrence, relative abundance, and surface behavior of beluga whales in and near the proposed Deployment Area during ice-free months of 2009 and 2010.
2. Provide information to ORPC, NMFS, and FERC on beluga whale sightings and locations relative to the Cook Inlet Tidal Energy Project.

ORPC is collaborating with the Alaska Department of Fish and Game (ADF&G) to share data from visual and passive acoustic detections of beluga whales in and around the proposed Deployment Area near Fire Island. Results of this collaboration will be presented in a separate report**.**

Methods

In May 2009, an observation site was selected on Fire Island that gave the maximum vantage of the proposed Deployment Area. NMFS personnel visited the site prior to the commencement of 2009 field operations and confirmed the viability of the site for making visual observations (with the caveat that vegetation obstructing the field of view be cleared from the site, which subsequently occurred). This site was also used in 2010. Observations in 2010 began on May 4 and continued until November 13. Observers were typically at the observation site two days per week. Observations were only conducted during daylight hours. All tidal stages were sampled.

Visual observations of the presence, abundance, and surface-behavior of beluga whales and other marine mammals were conducted by trained observers stationed on a cliff 64.5 m (212 ft) above

the mean low water line overlooking the proposed Deployment Area. Observers surveyed for belugas from land (at the observation site), as well as from the air during flights to and from Fire Island. Observations were also conducted from a research vessel used to transport observers to and from Fire Island on a few occasions.

Land-based observers used hand-held binoculars, spotting scope, a survey grade theodolite, and the naked eye to search for belugas in the proposed Deployment Area and surrounding areas as far as the Susitna River and Point MacKenzie. Beluga locations were recorded in two ways: 1) by using a 500 m x 500 m (1,640 ft x 1,640 ft) grid-cell map of the field of view and, 2) using a theodolite and software combination.

Aerial and boat-based observers used the unaided eye, clinometer, global positioning system (GPS) unit, and a grid-cell map to locate and record beluga whales during crew-transport trips between Anchorage and Fire Island. Incidental beluga sightings were obtained by observers surveying from the beach while walking to the observation site, and from interviews with pilots. During twice-daily crew-transport flights, observers asked the pilots when and where they saw belugas during their other flights and how many belugas they saw. During visual observations for belugas, observers also searched for and recorded other marine mammals in the proposed Deployment Area and field of view. Observers measured and recorded hourly environmental conditions, as well as the presence of vessels in the proposed Deployment Area and field of view and the presence of birds on the water in or near the proposed Deployment Area. Data recorded using Pythagoras™ (a marine mammal tracking program) were imported in a Geographic Information System (GIS). The locations of all belugas were mapped relative to the proposed Deployment Area and the observation site.

Results

Visual observations were conducted for a total of 47 days (310.9 hours) between May 4 and November 13, 2010, averaging 1.7 days of observation per week. Belugas were seen on 17 of the 47 observation days, for a total of 466 sightings and an average of 1.5 sightings per hour. Belugas were seen most often and in the greatest numbers in May, and were never seen in November, although observation time in November was greatly reduced relative to other months. Belugas were seen in the proposed Deployment Area on three days in 2010, and near it on two days (near was defined as ≤2 km/1.2 m from the center of the proposed Deployment Area). Belugas were most commonly seen in and around the mouth of the Little Susitna River. Belugas were seen only once during crew-transport flights in 2010, along the shore near Westchester Lagoon (in Anchorage). No belugas were observed during vessel transit. Spernak Air pilots reported seeing beluga whales in the mouths of the Beluga, Ivan, Lewis, Theodore, Susitna, and Little Susitna rivers, as well as near Port MacKenzie in Knik Arm, but not in or near the proposed Deployment Area or around Fire Island. Harbor seals were seen on only one of the 47 observation days. Apart from harbor seals (and beluga whales), no other marine mammals were seen.

Discussion

This study was a continuation of the first dedicated survey, to our knowledge, for beluga whales from Fire Island, Alaska. The primary objective of the study was to estimate the frequency of occurrence, relative abundance, and surface behavior of beluga whales in and near the ORPC proposed Deployment Area during ice-free months of 2010 and 2009. In 2010, belugas were seen on only three occasions in the proposed Deployment Area during the six and a half month observation period (May through mid-November). There were no beluga sightings in or near the proposed Deployment Area in 2009. Although whales were seen in and near the proposed Deployment Area in 2010, the majority of all sightings were located at the mouth of the Little Susitna River. This result was consistent with results from 2009 and with other studies that have repeatedly demonstrated patterns of belugas congregating in the rivers and bays of Upper Cook Inlet during the summer and fall. Belugas seen in the proposed Deployment Area were observed to be travelling between other areas.

The second objective of this study was to provide information to ORPC, NMFS, and FERC on beluga whale sightings and locations relative to the Cook Inlet Tidal Energy Project. This objective has been met with monthly progress reports from LGL to ORPC, which ORPC in turn distributes to NMFS and FERC. Copies of these reports are publically available at http://www.fakr.noaa.gov/protectedresources/whales/beluga/development.htm#orpc. This final report is a summary of the seven monthly reports for 2010.

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NMFS
Mandy Migura, Kate Savage, Susan Walker

Permit
Cook Inlet Region Inc. (CIRI); the local Native Corporation who owns the majority of Fire Island lands, granted a permit to allow for access to the island.

United States Coast Guard (USCG) License HSCG-Z71117-09-RP-054L was executed on June 8, 2009 to allow observers to utilize the observation site at the NW corner of the island, and amended in July to allow for the construction of an observation tower.

INTRODUCTION

ORPC Alaska, LLC (ORPC), a subsidiary of Ocean Renewable Power Company, LLC, is an Alaska-based, tidal energy technology and project development company. Ocean Renewable Power Company has developed proprietary OCGen™, TidGen™, and RivGen™ technology that will convert the energy in ocean, tidal, and river currents into emission-free electricity. In March 2007, ORPC was granted a Preliminary Permit (P-12679) by the Federal Energy Regulatory Commission (FERC) for its project site in Upper Cook Inlet; this permit expired in March 2010 and a second preliminary permit was applied for and issued to ORPC on October 13, 2010 (this permit expires on October 12, 2013). On March 31, 2009, ORPC submitted a draft application for a FERC Pilot Project License for its Cook Inlet Tidal Energy Project, which would allow ORPC to install a 5MW pilot project, in a phased approach beginning with an initial 1MW installation in 2012. This pilot project license would have duration of up to eight years. Pilot projects are small, short-term, removable projects that must be carefully monitored to ensure that there are no unacceptable adverse environmental effects. The projects are designed to be easily and quickly shut down and/or removed if such effects are encountered that cannot be mitigated. This pilot project will provide data necessary for a potential commercial scale expansion both in terms of technological viability and environmental sustainability of the project.

While Cook Inlet is home to some of the greatest tidal energy potential in the United States, it is also home to an endangered population of beluga whales (*Delphinapterus leucas*). Successful permitting and operation of a tidal power project in Cook Inlet will require a rigorous biological assessment of the potential and realized effects of the sound footprint and physical presence of tidal turbines on the distribution, relative abundance, and behavior of Cook Inlet beluga whales. A study plan to survey for beluga whales in and near the proposed Deployment Area was developed by ORPC and reviewed by regulatory and resource agencies as part of the FERC pre-consultation process. A copy of the approved study plan is included in Appendix A.

Beluga whales use sound for communication, navigation, predator/prey interactions, and hazard avoidance. Underwater sound associated with installation and operation of equipment during Pilot Project operations may temporarily alter beluga whale behavior and presence in the proposed Deployment Area. In addition, the physical presence and operation of the turbine in the proposed Deployment Area has the potential to affect the distribution, relative abundance, and/or behavior of beluga whales. Information is needed to evaluate the use of the proposed Deployment Area by belugas and to assess potential risks to belugas during deployment and operation of tidal energy modules.

Understanding and quantifying potential effects of ORPC's Cook Inlet Tidal Energy Project on beluga whales is critical to the success of the project. The Cook Inlet beluga whale Distinct Population Segment (DPS) was listed in October 2008 as endangered by the National Marine Fisheries Service (NMFS) under the Endangered Species Act (ESA). It is also designated as depleted under the Marine Mammal Protection Act (MMPA). Critical habitat was proposed by NMFS in December 2009, with Upper Cook Inlet, including the ORPC proposed Deployment Area, proposed as Critical Habitat Type 1 (high value/high sensitivity) for beluga whales (NMFS 2009a). FERC cannot issue a hydropower license to ORPC without a Biological Opinion from

NMFS indicating that the project will not jeopardize the Cook Inlet beluga population or its critical habitat.

Numerous visual surveys of beluga whales have been undertaken in the upper parts of Cook Inlet in conjunction with environmental studies for the Port of Anchorage, Knik Arm Bridge, and Seward Highway Projects (Funk et al. 2005, Prevel-Ramos et al. 2006, Markowitz and McGuire 2007). However, limited information is available for the ORPC module proposed Deployment Area near Fire Island (Figure 1).

This report presents results from 2010 of a study by LGL Alaska Research Associates, Inc. (LGL) sponsored by ORPC to visually monitor beluga whale presence, relative abundance, and behavior in the waters off of the north side of Fire Island, Upper Cook Inlet, Alaska. This marks the second year of the pre-deployment monitoring effort, with the first year of monitoring occurring in 2009. Information presented in this report provides data that will be used to characterize pre-deployment patterns of beluga whale presence, distribution, relative abundance, and surface behavior in and near the Cook Inlet Tidal Energy Project proposed Deployment Area. Continued studies in future years have been proposed and would consist of monitoring during and after deployment of the generating equipment to determine beluga whale interaction with the OCGen™ Module and the proposed Deployment Area. Results from the pre- and post-deployment years will be compared to determine if underwater noise and/or physical presence of the module is associated with changes in beluga distribution, relative abundance, and behavior (i.e., behavior visible at the surface).

The study had two primary objectives:

1. Estimate the frequency of occurrence, relative abundance, and surface behavior of beluga whales in and near the proposed Deployment Area during ice-free months of 2010.
2. Provide information to ORPC, NMFS, and FERC on beluga whale sightings and locations relative to the Cook Inlet Tidal Energy Project.

ORPC is collaborating with the Alaska Department of Fish and Game (ADF&G) to share data from visual and passive acoustic detections of beluga whales in and around the proposed Deployment Area near Fire Island. Passive acoustic sampling is paired with visual sampling to compare the two methods of observation and to complement the data sets of each method. Through a comparison of these data sets we will gain an understanding of how the two methods might overlap in their detections of belugas and how each might be limited. Combining visual and acoustic observations will increase our abilities to detect belugas in the Deployment Area. ADF&G uses an acoustic mooring package consisting of two types of acoustic recorders, one (the Ecological Acoustic Recorder or EAR) to record low-frequency sounds and one (the C-Pod to record high-frequency sounds). ADF&G will analyze the recorded data from the EAR/C-Pod array deployed in 2009 and 2010. LGL will analyze the visual observation data from 2009 and 2010. LGL and ADF&G will collaborate to correlate visual and acoustic data. Results of this collaboration will be presented in a separate report.

METHODS

Site Selection and Observation Schedule

A permit from Cook Inlet Region, Inc. (CIRI; the majority land owner on Fire Island) was secured on in 2009 and renewed in 2010 for observer access to Fire Island. ORPC also obtained a license from the United States Coast Guard (USCG) to use the Race Point Lighthouse Reservation lands on Fire Island (which provided a vantage of the proposed deployment site) for the observation site for investigation of beluga whale use of the area. In May 2009, an observation site was selected near Race Point that was accessible from pre-existing trails on the island, and gave the maximum vantage of the proposed Deployment Area (Figure 1). This site was confirmed as viable for the study by Kate Savage of NMFS in June 2009, and was subsequently used for the entirety of the 2009 and 2010 field seasons.

Beluga field observations in 2010 began on May 4 and continued until November 13. The 2010 observation schedule was adjusted from the 24 hour per week goal established for 2009 to a goal of two seven-hour observation days per week. This goal was reduced to one day per week during the first three weeks of August so as to allow for more observation days later in the season when, in addition to their standard monitoring effort, crews were required on site to visually monitor for belugas during the deployment of acoustic equipment in and around the proposed Deployment Area. Observations were only conducted during daylight hours, and all tidal stages were sampled over the field season.

For transportation to and from the observation site, the observation team chartered round trip aircraft service between Fire Island and Merrill Field in Anchorage, AK. Upon landing at Fire Island, the observation team hiked approximately 3 km (2 mi) through marsh, beach, meadow and woods to reach the observation site. Over the course of the season, the crew maintained two small cabins near the northeast corner of Fire Island as safety shelters in case they were stranded on the island. The crew had to remain on the island overnight once throughout the season. Observers traveled and worked in pairs due to safety concerns related to the remoteness of the observation site. The observation team traveled on a research vessel to Fire Island on one day and from Fire Island on four days because of adverse weather conditions that grounded aircraft.

Visual Observations

Visual observations of the presence, abundance, and surface-behavior of beluga whales and other marine mammals were conducted by trained observers stationed at the observation site, a bluff ~64.5 m (212 ft) above the mean low water line overlooking the proposed Deployment Area. The distance between the observation site and the center of the proposed Deployment Area was 1.25 km (0.76 mi; Figure 1). Visual observers were necessary due to the turbid water of Cook Inlet which made underwater observations (from still cameras, video cameras, or divers) unfeasible.

All 2010 beluga monitoring was conducted from a tower constructed in 2009 on an existing foundation at the site. The improved vantage for visual observations that the tower afforded was

supported by NMFS personnel. The observation tower provided observers with safety from bears and moose, shelter from winds and rain, and a higher vantage that reduced the need to continually prune vegetation in order to keep it from obstructing the view of the proposed Deployment Area. The tower was 4.5 m (14.8 ft) high which, combined with the bluff height, resulted in an observer height 69.8 m (229 ft) above mean low water, and an increased field of view (Figure 2).

Beluga Sightings

Observers surveyed for belugas from land (at the observation site) and air (during flights to and from the island). Observations were conducted from a boat when vessel transit to or from the island was required. Observers also obtained incidental beluga sighting information from crew-transport aircraft pilots. Nine observers were on the observation team; all were experienced field biologists and those observers new to the project were always paired with more-experienced team members.

Land-based Observations

Observers used hand-held binoculars (7 x 50, with built-in reticles and compass), a frame-mounted spotting scope (20 x 60), a survey grade theodolite (Sokkia DT-5), and the unaided eye to search for belugas in the proposed Deployment Area and surrounding areas from the Susitna River to Point MacKenzie (Figure 1). When a beluga whale was sighted, observers recorded the time, location, group size, whale color (i.e., white, gray, or calf, defined as <2/3 adult size, usually dark gray and swimming alongside a larger beluga), direction of travel, (i.e., N, S, E, W) and behavior. Focal group behavioral information (Mann 2000) was collected including behavioral state (traveling, milling, diving, resting, and feeding) and inter-individual distance/group spread. Predominant and secondary surface-behaviors were recorded for each group sighted. A beluga had to be seen by one or both observers in order for it to be recorded as a confirmed sighting; surface disturbances (i.e., splashes or "footprints") or sounds were recorded as possible sightings. Observers noted if a beluga was seen or near in the proposed Deployment (near was defined as ≤2 km/1.2 m from the center of the proposed Deployment Area).

Locations were recorded in two ways: 1) using a 500 m x 500 m (1,640 ft x 1,640 ft) grid-cell map of the field of view and, 2) using a theodolite and software combination. LGL has developed and employed a grid system to record the locations and movements of Cook Inlet beluga whales in Upper Cook Inlet, including Knik Arm (Funk et al. 2005), the Port of Anchorage (Markowitz and McGuire 2007) and along Turnagain Arm (Markowitz et al. 2007). This system has proven effective for documenting whale group location and movements on a coarse scale (500 m x 500 m or 1 km x 1 km grids [1,640 ft x 1,640 ft or 0.62 mi x 0.62 mi]). In applying this technique, trained observers used a combination of compass bearings taken from binoculars and landmarks to place whale groups at any given time in a grid cell.

Use of a surveyor's theodolite to monitor the location and movement patterns of whales and dolphins is a well-established technique (reviewed by Samuels and Tyack 2000), and LGL has found it to be particularly effective for monitoring beluga whales' distances from, and responses

to, human activities in Cook Inlet (Prevel-Ramos et al. 2006, Markowitz and McGuire 2007). During theodolite tracking sessions, data were entered directly into a laptop computer in a Microsoft® Access database. Using this technique, computer calculations made with Pythagoras™ (Gailey and Ortega-Ortiz 2000) whale-survey software provided accurate, real-time estimates of the distance of whales from the proposed Deployment Area. To ascertain the accuracy of the theodolite, in 2009 GPS tracks from a small boat were compared to the fixes taken of the same boat with the theodolite. A GIS analyst later compared the boat's GPS track line to the track line created by the theodolite and Pythagoras™ software. In instances when the theodolite was not working (e.g., dead batteries, high winds) the grid cell map was used as a backup to determine whale locations. The theodolite was the preferred means of spatial designation and the grid system was maintained as a back up.

Aerial and Boat-based Observations

Aerial observers used the unaided eye, clinometer (measures angle), global positioning system (GPS) receiver, and a grid-cell map to locate and record beluga whales during crew-transport flights between Anchorage and Fire Island in a Cessna 207 and a Cessna 107. Flights were usually at an altitude of 150-300 m (492-984 ft) at approximately 160 km/hr (99 mi/hr). Both observers scanned for belugas. When whales were detected, observers recorded the angle, altitude, GPS location, time and the number of belugas. Observers also recorded the belugas' estimated location on a grid cell map and later refined that location using the data recorded during the sighting. The flight path of the plane was recorded using the track function on the GPS receiver. Observers employed this same protocol for boat-based observations (although without integration of clinometer and altitude data) in determining whale location. The field of view from within the vessel's cabin was considerably smaller than those afforded by land-based or aerial surveys, although vessel transit was longer (30-90 minutes each way) than air transit (approximately five minutes within view of the water each way). The vessel routes passed directly through much of the land-based field of view, including passage directly through the proposed Deployment Area.

Incidental Observations

Incidental beluga sightings were obtained by observers surveying from the beach while walking to the observation site, and from interviews with pilots. During both inbound and outbound crew-transport flights, observers asked the pilots when and where they saw belugas during their other recent flights and how many belugas they had seen.

Other Marine Mammal Sightings

During visual observations for belugas, observers also searched for and recorded other marine mammals in the proposed Deployment Area and field of view. If a marine mammal was seen, observers recorded the time, location, group size, behavior, and travel pattern of the mammal. The theodolite and grid cell map were used to record the marine mammal's location. Marine mammal sightings were later mapped in the same manner as beluga sightings.

Environmental Conditions

Observers measured and recorded environmental data including air temperature, wind speed and direction, cloud cover, Beaufort sea state, visibility (i.e., ability to see far shore), angle of glare, and presence of whitecaps. Temperature and wind speed were measured with an anemometer/thermometer. Environmental conditions were recorded every hour, or when any significant changes occurred.

Vessel Sightings

During observations for belugas, observers also recorded the presence of vessels in the field of view. If a vessel was seen, observers recorded the time of day, vessel type, name, and general route, including any passage through or near the proposed Deployment Area. Vessel totals were tallied every hour. The theodolite was used to map and track vessels.

Bird Sightings

Observers noted the presence of birds on the water in or near (defined as closer than 2 km/1.2 m) the proposed Deployment Area. Species and number were recorded when possible. Bird sightings were not mapped.

Analysis

Data recorded using Pythagoras™ were imported into a Geographic Information System (GIS) using ESRI's ArcGIS 10.0. The locations of belugas were mapped relative to the proposed Deployment Area and the observation site. When the theodolite data were not available, data derived from the grid cell maps were used. Data derived both from the theodolite and the grid cells were recorded in point format as a static location.

As part of the mapping process, locations of belugas were then transposed over the 500 m x 500 m (1,640 ft x 1,640 ft) grid layer in the GIS. Cells that contained beluga locations were selected and exported as the graphical representation of the whales' locations. Using the cells to represent general areas was done in an attempt to better accommodate the dynamic nature of a whale in the water. Daily beluga sighting maps are found in Appendix B.

RESULTS

Visual Observations

Land-Based Observation Effort and Beluga Sightings

Visual observations were conducted on a total of 47 days (310.9 hours) from May 4 through November 13, 2010 (Table 1). The greatest number of observation days (10 days) and observation hours (69.4 hours) occurred in September. The lowest number of observation days (4 days) and hours (12.9 hours) occurred in November. Belugas were seen on 17 of the 47 observation days (Table 1). Belugas were seen most often and in the greatest numbers in May. Belugas were not seen in November, although monitoring effort in November was less than other

study months both in number of observation days and hours of observation each day (Table 1, Figure 3).

Belugas were seen in the Proposed Deployment Area on three days in 2010; one day in May and two days in October (Table 1; Figures 4 and 5; Appendix B, C, and D). The May sighting in the proposed Deployment Area consisted of a mother and calf (Appendix D). Belugas were seen near but not in the proposed Deployment Area on two days (May 18 and September 8). The mean distance between belugas and the proposed Deployment Area was 5.4 km (3.36 mi; Table 1). Belugas were most often seen in and around the mouth of the Little Susitna River and toward the Susitna River (Figures 5-12; Appendix B, C, and D). Beluga densities for all months of observation combined were greatest at the outflow of the Little Susitna River (Figure 4).

Methods of Determining Sighting Location

Two different methods (grid-cell maps and theodolite) were used to determine the location of marine mammal sightings. Little discrepancy in beluga locations was apparent for the two methods, although it appeared that mapped locations of belugas tracked with the theodolite were at a somewhat greater distance from the observation site than those locations mapped based on estimated location/distance with grid cell (i.e., observers tended to visually underestimate distance slightly; McGuire and Bourdon 2010). In 2009, comparisons were made between the GPS tracklines from a small boat and the tracked locations of the same boat from the theodolite; tracks were found to be very similar (McGuire and Bourdon 2010).

Aerial & Boat-based Surveys

Belugas were seen only once during crew-transport flights in 2010. The sighting occurred on August 26 when a group of three white belugas was seen along the shore near Westchester Lagoon in Anchorage (Figure 13). Flight paths of crew transit to and from Fire Island in 2010 are presented in Figure 14. No whales were observed during vessel transit. Belugas were not seen from the beach by observation crews during their twice-daily walks between the runway and the observation site.

Incidental Observations

Over the course of the field season, Spernak Air pilots reported seeing beluga whales in the mouths of the Beluga, Theodore, Lewis, Ivan, Susitna, and Little Susitna rivers, as well as in Knik Arm near Point MacKenzie (Figure 15). The largest groups were seen in June at the mouths of the Susitna and Little Susitna rivers, and whales were seen most frequently at the Susitna River (Table 2). Pilots did not report seeing beluga whales in or near the proposed Deployment Area or around Fire Island.

Other Marine Mammal Sightings

Harbor seals were seen from the observation tower on only one of the 47 observation days in 2010 (Table 3, Figure 16). The harbor seals were within 2 km (1.2 mi) of the proposed Deployment Area. On June 29, an unconfirmed pinniped sighting was recorded near the Kincaid

Park shoreline of Anchorage; the pinniped was believed to have been a harbor seal. Apart from harbor seals (and beluga whales), no other marine mammals were recorded.

Environmental Conditions

Sighting conditions in 2010 were rated as good on 13.5 days, fair on 31.5 days, and poor on 2 days. Poor sighting conditions in July were due to fog, and poor sighting conditions in September were due to haze and whitecaps. Observers were able to see to the far shore (the mouth of the Little Susitna River) on all observation days in 2010. Mean wind speed was 7.0 km/hr (4.4 mi/hr), and wind speed ranged from 0-37.4 km/hr (0-23.4 mi/hr). Mean Beaufort sea state was 1.2. Mean air temperature was 12.6 ^{o}C (54.7 ^{o}F), and ranged from -3.8 to 25.8 ^{o}C (25.2 to 78.4 ^{o}F). Rain was noted on 16 days, and fog on nine days; snow was not noted on any observation days (Table 4).

Vessel Sightings

Skiffs and the ORPC research vessels were the most commonly-seen vessels in 2010. The ORPC- commissioned research vessel was engaged in work in and around the proposed Deployment Area. No vessels were observed engaging in fishing activities (Table 5).

Bird Sightings

Gulls were the most common birds on the water in or near (i.e., ≤2 km/1.2 m) the proposed Deployment Area in 2010. Three mew gulls (*Larus canus*) were identified to species. Surf scoters (*Melanitta perspicillata*), pacific loons (*Gavia pacifica*), and bald eagles (*Haliaeetus leucocephalus*) were also seen in or near the proposed Deployment Area (Table 6). Birds were rarely seen on the water in or near the proposed Deployment Area during observations, and were only sighted there on three out of 47 observation days.

DISCUSSION

This 2009-2010 study is, to our knowledge, the first dedicated survey for beluga whales from north Fire Island, Alaska. The primary objective of the study was to estimate the frequency of occurrence, relative abundance, and surface behavior of beluga whales in and near the ORPC proposed Deployment Area during ice-free months of 2009 and 2010. Belugas were seen in the proposed Deployment Area on only three days during the six and a half month observation period in 2010 (May through mid-November). Belugas were not seen in the proposed Deployment Area during the 2009 field season (mid-June through mid-November). Overall sighting rates were comparable between 2009 and 2010 (1.6 and 1.5 belugas/hour, respectively).

The low frequency of occurrence of beluga whales in the proposed Deployment Area during this study was not surprising given that other studies have consistently reported patterns of beluga whale presence in the rivers and bays of Upper Cook Inlet during the summer and fall. These studies have included aerial and boat-based surveys of Upper Cook Inlet, tagging studies, and land-based observations in Knik Arm, Turnagain Arm, and near the Chuit River (Rugh et al. 2000, 2005, 2006, 2007; Funk et al. 2005; Hobbs et al. 2005; Goetz et al. 2007; Markowitz and

McGuire 2007; Markowitz et al. 2007; Nemeth et al. 2007; McGuire et al. 2008, 2009; Shelden et al. 2008a,b,c, 2009a,b). Sighting reports from Spernak pilots were also consistent with the idea that belugas aggregate at the mouths of rivers in Upper Cook Inlet during the ice-free months.

The north side of Fire Island has neither rivers nor bays, nor does it contain "estuarine areas, or shallow areas adjacent to medium and high low accumulation streams" (Goetz et al. 2007), which are considered preferred habitat features for Cook Inlet belugas as defined by NMFS (NMFS 2009a). Belugas are known to prey on a variety of fish and invertebrates, and salmon (*Onchorhynchus* spp) and eulachon (*Thaleichthys pacificus*) have been found to be important prey species (Fried et al. 1979, Hazard 1988, Huntington 2000, Moore et al. 2000). There are no documented salmon or eulachon[1] runs on Fire Island (NMFS 2009b). They are however, known to spawn in the Susitna River and other rivers in Upper Cook Inlet in May and July (Calkins 1989).

The tracks of 15 belugas instrumented with satellite tags 1999-2003 showed belugas were sometimes in the vicinity of Fire Island, although movement patterns suggest they passed the island while transiting between other areas (Hobbs et al. 2005). Tagged belugas were tracked near Fire Island in all seasons. The primary activity of all belugas seen in the proposed Deployment Area in 2010 was travel. In 2009, belugas were not observed using waters in or near the proposed Deployment Area, for travel between areas of known occurrences (e.g., the mouth of the Susitna River and Knik Arm) or otherwise.

Our observations of beluga whale presence in and near the Little Susitna River throughout the summer and fall with a peak in August (2009) and May (2010) are consistent with patterns detected from aerial surveys by NMFS (1993-2009; Rugh et al. 2000, 2005, 2006; Shelden et al. 2008a,b,c, 2009a,b). Observers during aerial surveys flown by NMFS June 2-9, 2009 reported groups of belugas in Chickaloon Bay and the Susitna Delta (defined as the near shore area between the Beluga and Little Susitna rivers; Shelden et al. 2009a). Observers during surveys flown by NMFS August 11-13, 2009 reported groups of belugas near the Ivan, Susitna, and Little Susitna Rivers, as well as in Knik Arm (Shelden et al. 2009b). In previous years, aerial surveys (conducted annually in June, and sometimes in May, July, and August) have detected belugas off of the Susitna Delta in the summer, but not around Fire Island (Rugh et al. 2000), the only exception being two belugas reported northeast of Fire Island on June 14, 2007 (Rugh et al. 2007).

Beluga whales were reported in the Susitna Delta in May, June, July, and August, but not in September or October during boat-based surveys in May through October 2006 (Nemeth et al. 2007). Belugas were not seen as the vessel transited near Fire Island during any of these months.

[1] During the site visit to the Fire Island in May 2009, observers noted many dead (spawned) eulachon on the beach on the north side of Fire Island; it was assumed these dead eulachon were carried downstream in the Susitna or Little Susitna rivers by the current and washed up on Fire Island by the tide.

Belugas were seen from the Fire Island observation station in October 2010 but not in October 2009. The absence of beluga sightings in October 2009 was notable, particularly because belugas were again seen in November of the same year at the mouth of the Little Susitna River, and was likely an artifact of the sampling schedule and not because whales do not use this area at this time. Spernak Air pilots reported seeing whales at the mouth of the Little Susitna River on six days in October 2009 and on two days in 2010. NMFS does not conduct aerial surveys for belugas in October, and aerial-survey data for this time period are not available for comparison.

The second objective of this study was to provide information to ORPC, NMFS, and FERC on beluga whale sightings and locations relative to the Cook Inlet Tidal Energy Project. This objective has been met with monthly progress reports from LGL to ORPC, which ORPC in turn distributed to NMFS and FERC. Copies of these reports are publicly available at http://www.fakr.noaa.gov/protectedresources/whales/beluga/development.htm#orpc. This report is a summary of the seven monthly reports for 2010.

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Table 1. Monthly observation effort and beluga sightings from the Fire Island Alaska observation site in 2010.

Month	# Days of Effort	# Hours of Observation	# Days Belugas Sighted	Percent Observation Days Belugas Sighted	# Beluga Groups Sighted	# Beluga Sightings	# Beluga Sightings/Hour	Belugas in Deployment Area?	Closest Distance between proposed Deployment^ Area and Belugas (km)
May	6	42.2	5	83.30%	11	326	7.7	yes	0*
June	9	61.92	2	22.20%	3	75	1.2	no	5.0
July	6	40.62	1	16.70%	1	15	0.4	no	5.8
August	5	38.93	3	60.00%	3	22	0.6	no	5.1
September	10	69.38	4	40.00%	4	25	0.4	no	0.5
October	7	44.96	2	28.60%	2	3	0.1	yes	0*
November	4	12.91	0	0.00%	0	0	0	no	NA
2010 Total	**47**	**310.92**	**17**	**36.20%**	**24**	**466**	**1.5**		
								Mean	**5.45**

** Belugas were sighted within proposed Deployment Area*
^ Measured from center of proposed Deployment Area

Table 2. Reports of incidental sightings from Spernak Air pilots, as reported to LGL observers from May 3 to November 14, 2010.

Month	Date	Location	Number of Whales	Comments
May	21MAY2010	Susitna River	Not reported	Seen at high tide
May	30MAY2010	Little Susitna River	300+	
June	05JUN2010	Susitna River	300+	
June	16JUN2010	Theodore & Lewis Rivers	100	
June	17JUN2010	Susitna River	Not reported	
June	17JUN2010	Beluga River	Not reported	
June	17JUN2010	Lewis River	Not reported	
June	17JUN2010	Theodore River	Not reported	Seen 1/4 mile up River
June	23JUN2010	Susitna River	Not reported	Seen at southwest side of river mouth
June	23JUN2010	Susitna & Beluga Rivers	Not reported	Seen along coast between the two rivers
June	24JUN2010	Susitna River	Not reported	Seen at southwest side of river mouth
June	24JUN2010	Susitna & Beluga Rivers	Not reported	Seen along coast between the two rivers
June	24JUN2010	Ivan River	Not reported	
July	01JUL2010	Beluga River	Not reported	
July	01JUL2010	Susitna River	Not reported	
July	01JUL2010	Lewis River	Not reported	
July	01JUL2010	Theodore River	Not reported	
July	06JUL2010	Beluga River	20	
July	06JUL2010	Ivan River	15	
July	06JUL2010	Lewis River	15	
July	06JUL2010	Theodore River	15	
July	07JUL2010	Lewis River	60	
July	07JUL2010	Ivan River	15	
July	22JUL2010	Susitna River	20	
July	28JUL2010	Susitna River	136	Pilot flew over ~15 times to count
August	03AUG2010	Little Susitna River	50	
August	03AUG2010	Ivan River	"Lots"	
August	25AUG2010	Little Susitna River	"Small group"	Seen at high tide
September	01SEP2010	Susitna River	Not reported	
September	01SEP2010	Ivan River	Not reported	
September	01SEP2010	Theodore River	Not reported	
September	02SEP2010	Knik Arm	Possible sighting	Something seen moving rapidly North up Knik Arm. Not confirmed as beluga
September	02SEP2010	Theodore River	Not reported	
September	03SEP2010	Little Susitna River	25	
September	09SEP2010	Susitna River	Possible sighting	Heavy V's observed under water in SW & NE channels; no surfacing - no confirmation of sighting.

September	21SEP2010	Susitna River	15	8-10 whales seen in AM, 4-5 whales seen in PM. High tide in afternoon. Observation date not certain.
September	23SEP2010	Knik Arm (near Birchwood)	Not reported	
September	28SEP2010	Ivan River	20+	Observation date not certain
October	11OCT2010	Susitna River	20+	Seen in mouth @ 0845
October	14OCT2010	Beluga River	25+	Lots of activity and apparent play
October	14OCT2010	Little Susitna River	80	
October	14OCT2010	Ivan River	40	
October	22OCT2010	Little Susitna River	40	Seen around bend of river. Observation date not certain
October	28OCT2010	Beluga River	Not reported	Observation date not certain; may be October 29 instead
November	10NOV2010	Little Susitna River	3	

Table 3. Harbor seal sightings from the Fire Island Alaska observation site in 2010.

Month	Days of Observation Effort	Hours of Observation	Days Harbor Seals Sighted	Harbor Seal Sightings	In Deployment Area?
May	6	42.2	1	2	Yes
June	9	61.92	0	0	no
July	6	40.62	0	0	no
August	5	38.93	0	0	no
September	10	69.38	0	0	no
October	7	44.96	0	0	no
November	4	12.91	0	0	no
2010 Total	**47**	**310.92**	**1**	**2**	no

Table 4. Monthly environmental conditions from the Fire Island Alaska observation site in 2010.

Month	# Days of Observation	# Days Conditions Good	# Days Conditions Fair	# Days Conditions Poor	# Days Able to See Far Shore	Mean Wind Speed (km/hr)	Range of Wind Speed (km/hr)	Mean Beufort Sea State	Mean Air Temperature (°C)	Range of Air Temperature (°C)	# Days with Rain	# Days with Fog	# Days with Snow
May	6	5	1	0	6	2.9	0.0 to 13.5	0.5	16.3	8.0 to 25.8	1	0	0
June	9	2	7	0	9	10.1	0.0 to 31.0	1.5	14.8	1.0 to 23.7	4	2	0
July	6	0	5	1	6	9.2	0.0 to 32.9	1.3	15.8	12.8 to 22.2	2	2	0
August	5	0	5	0	5	5.5	0.0 to 22.0	1.0	15.7	12.1 to 21.2	3	3	0
September	10	2	7	1	10	5.2	0.0 to 28.8	1.1	12.3	0.7 to 19.8	3	0	0
October	7	1.5	5.5	0	7	7.3	0.0 to 15.8	1.4	3.5	-3.8 to 7.9	3	2	0
November	4	3	1	0	4	16.0	3.1 to 37.4	1.9	1.4	-0.5 to 3.6	0	0	0
2010 Total	**47**	**13.5**	**31.5**	**2**	**47**	**7.0**	**0.0 to 37.4**	**1.2**	**12.6**	**-3.8 to 25.8**	**16**	**9**	**0**

Table 5. Monthly sightings of vessels seen from the Fire Island Alaska observation site in 2010. Vessel sightings are expressed in number of hours each vessel type was seen per month. DA refers to vessels seen in the proposed Deployment Area; non-DA refers to vessels seen outside of the proposed Deployment Area.

Month	# Days of Observation	ORPC survey boat		Tugs		Tug with barge		Skiff		Motorized Barge		Container Ship		Tanker		Other vessels		Leucas	
		DA	Non-DA	DA	Non-DA	DA	Non-DA	DA	Non-DA	DA	Non-DA	DA	Non-DA	DA	Non-DA	DA	Non-DA	DA	Non-DA
MAY	6	0	0	1	0	2	1	2	1	1	0	2	0	0	0	0	0	0	0
JUN	9	0	0	0	0	1	0	2	2	0	0	1	0	0	0	0	0	0	1
JUL	6	0	0	1	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0
AUG	5	6	0	2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
SEP	10	1	0	2	0	2	0	5	7	0	0	1	0	1	0	0	0	0	0
OCT	7	10	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
NOV	4	5	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Totals	**47**	**22**	**1**	**6**	**0**	**10**	**3**	**12**	**11**	**1**	**0**	**4**	**0**	**1**	**0**	**0**	**1**	**0**	**1**
	Combined Total	**23**		**6**		**13**		**23**		**1**		**4**		**1**		**2**		**2**	

Table 6. Monthly bird sightings seen from the Fire Island Alaska observation site in 2010. Bird sightings are reported for birds seen on the water in or near (≤ 2km/1.2mi) the Deployment Area.

Month	Days of Observation Effort	# Surf Scoters	# Pacific Loons	# Bald Eagles	# Mew Gulls	# Unidentified Gull Spp.
May	6	30	5	0	3	0
June	9	0	0	0	0	0
July	6	0	0	2	0	61
August	5	0	0	0	0	0
September	10	0	0	0	0	0
October	7	0	0	0	0	0
November	4	0	0	0	0	0
2010 Total	**47**	**30**	**5**	**2**	**3**	**61**

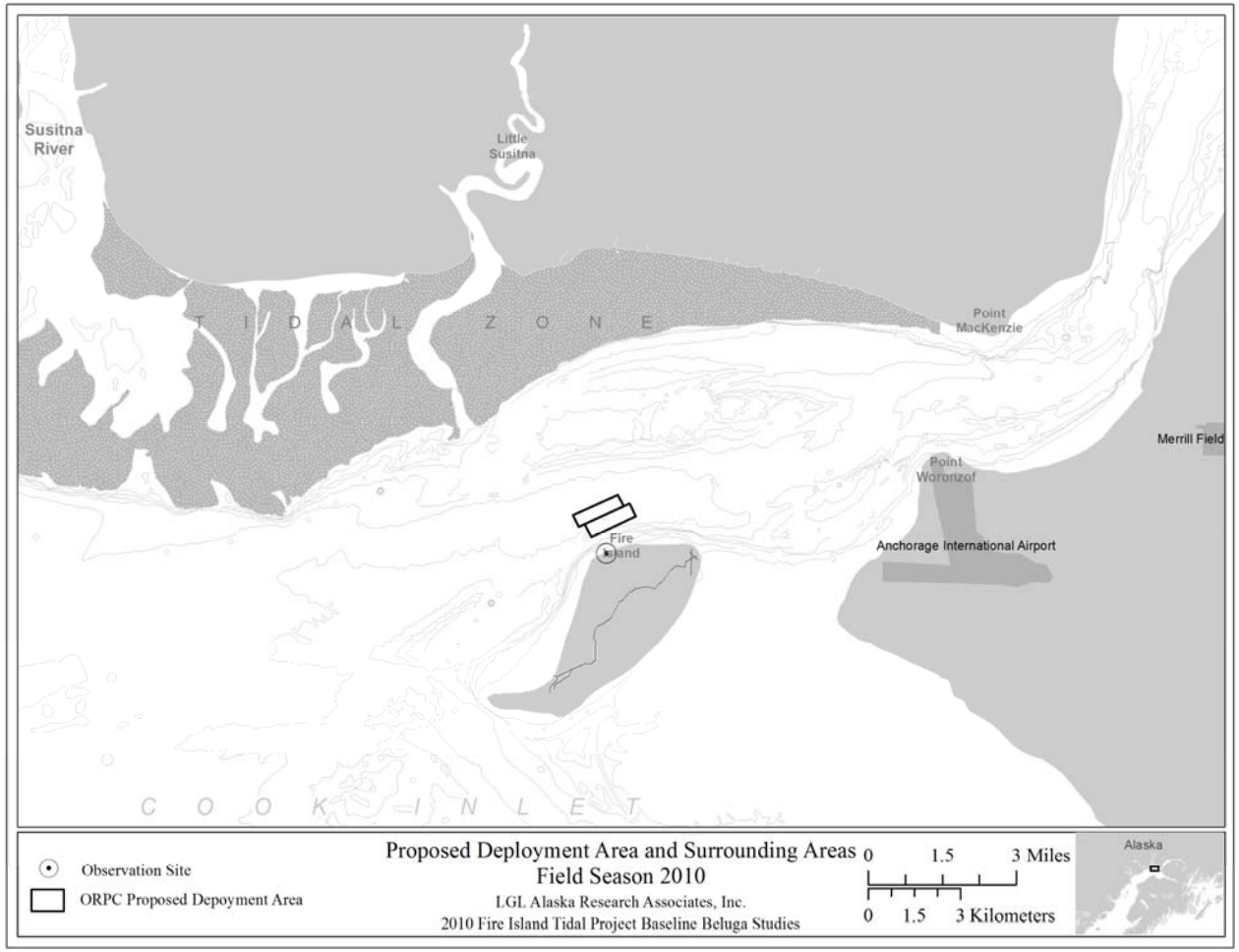

Figure 1. A map of Upper Cook Inlet showing the ORPC proposed Deployment Area, the Fire Island observation site, and major features presented in the text. Prominent areas visible from the observation site include the Susitna River to the West, the Little Susitna River to the north, and Point MacKenzie to the east.

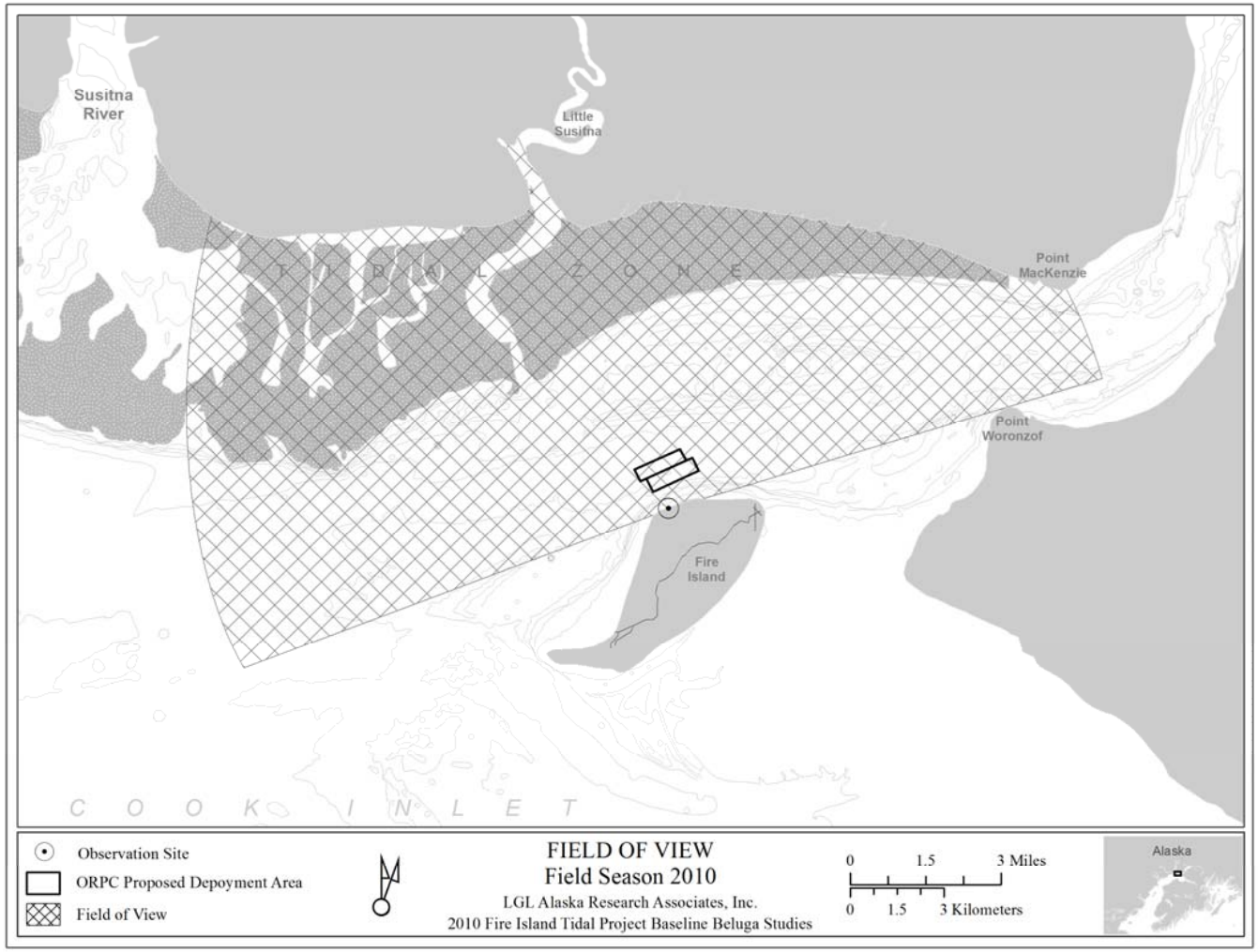

Figure 2. The maximum field of view as seen from the observation site tower and measured with the theodolite. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

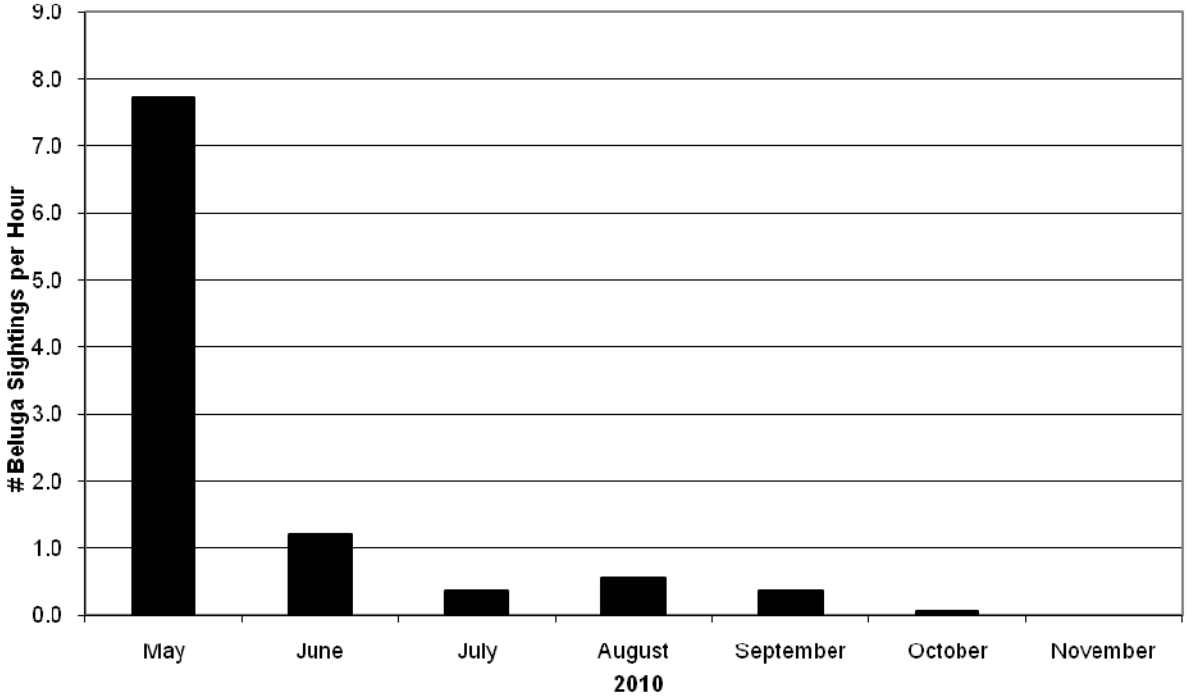

Figure 3. Number of belugas sightings per hour from the Fire Island observation site in 2010.

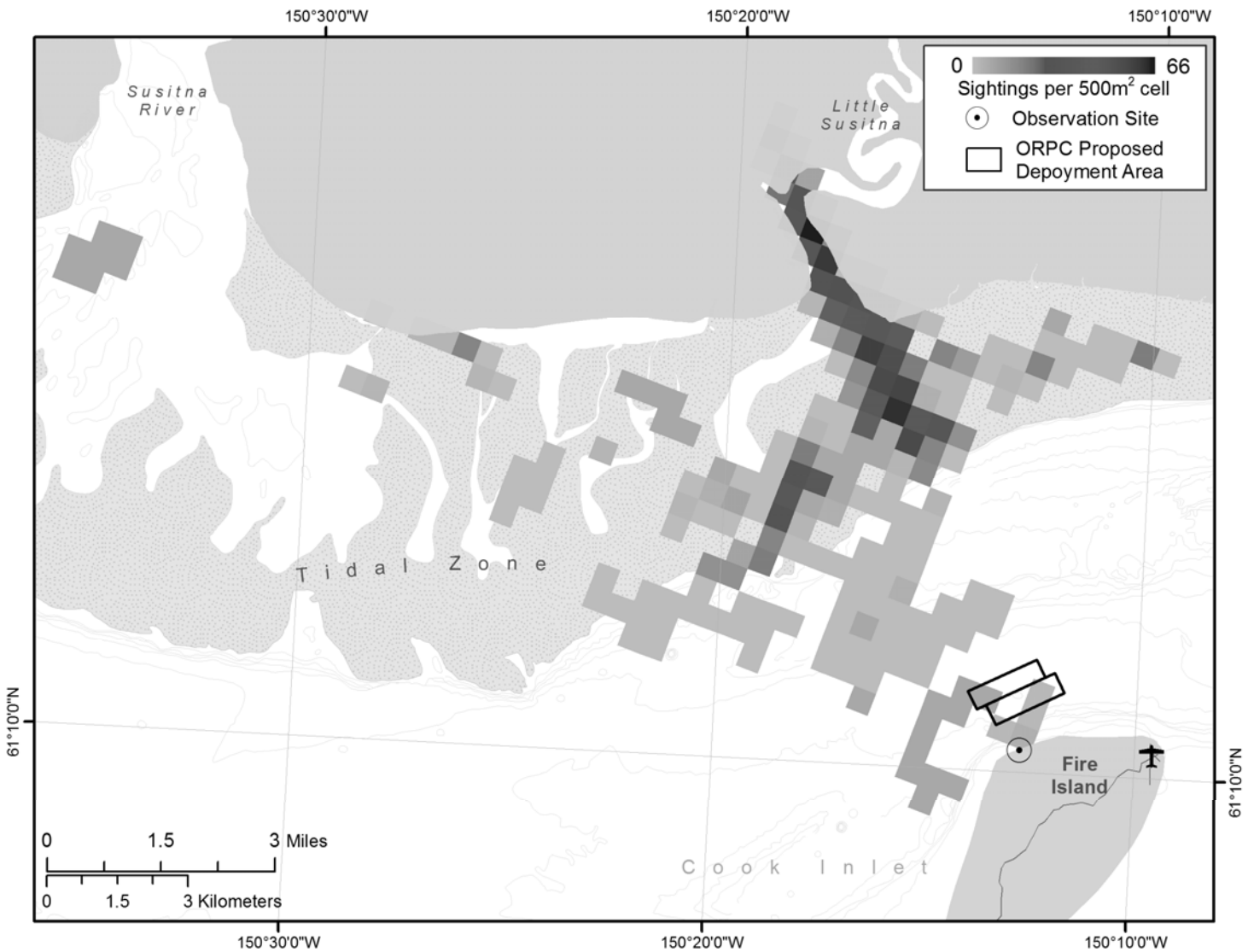

Figure 4. Density of beluga sightings between May 4 and November 13, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

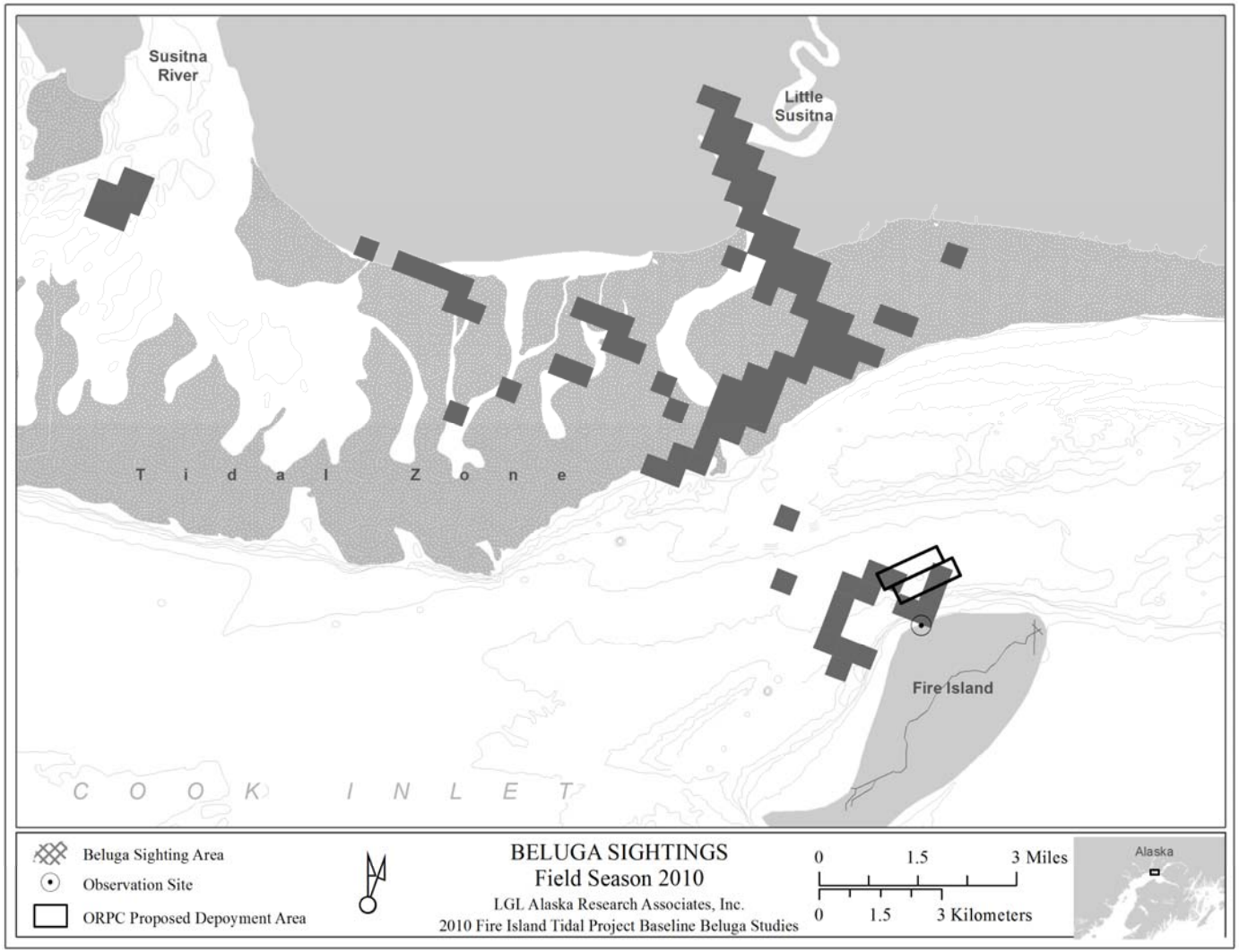

Figure 5. Locations of all beluga sightings between May 4 and November 13, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

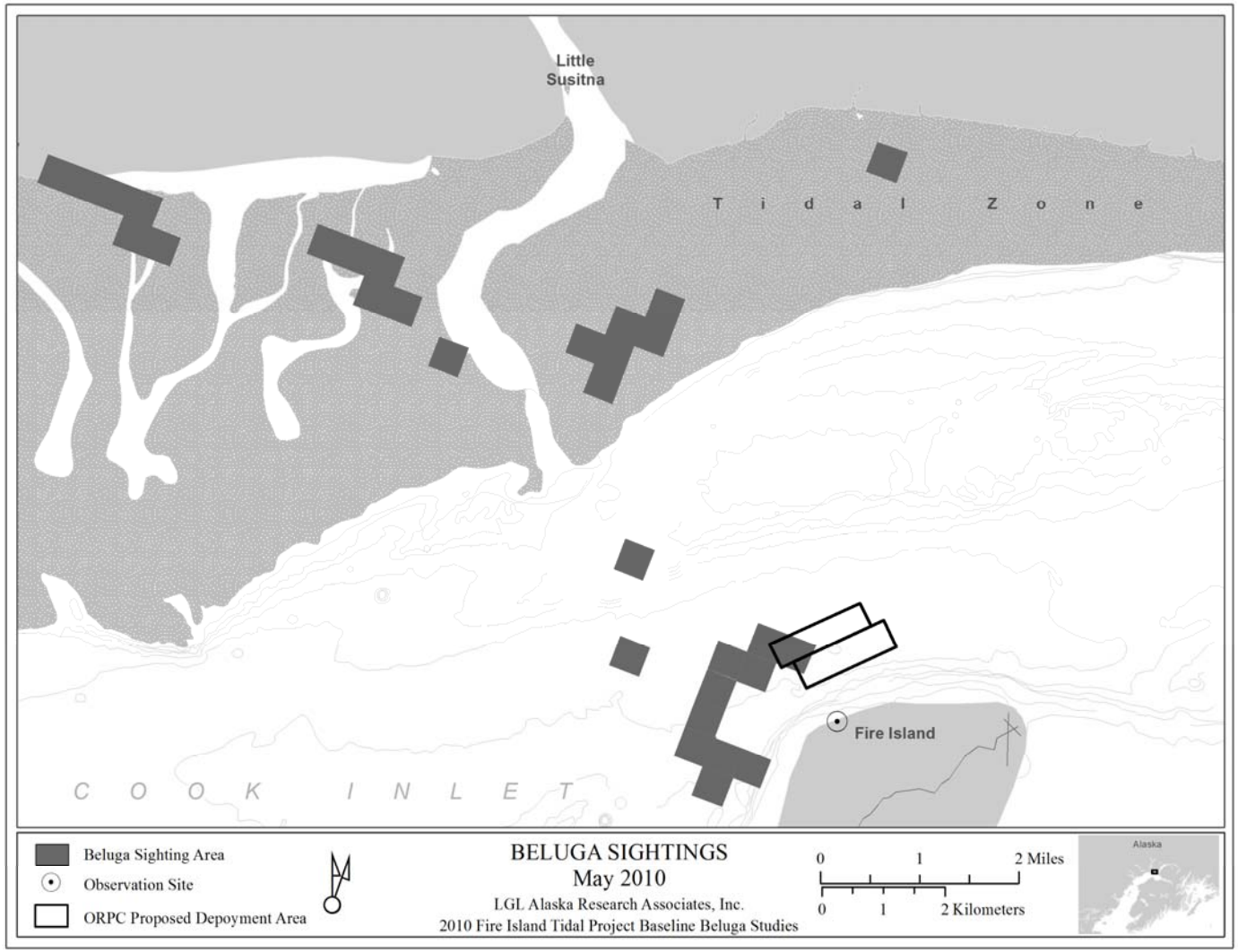

Figure 6. Locations of all beluga sightings in May 2010. Observations began on May 4. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

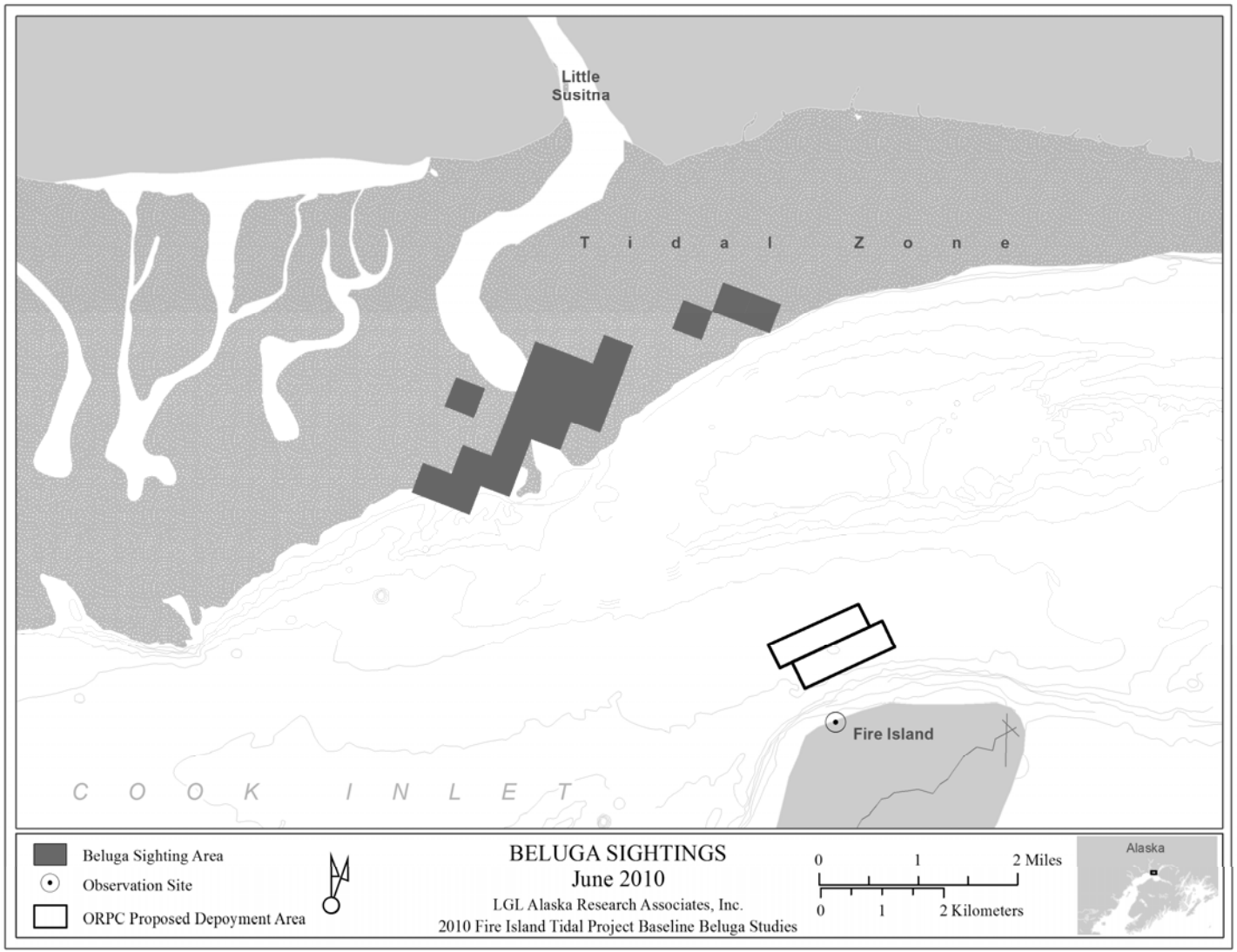

Figure 7. Locations of all beluga sightings in June 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

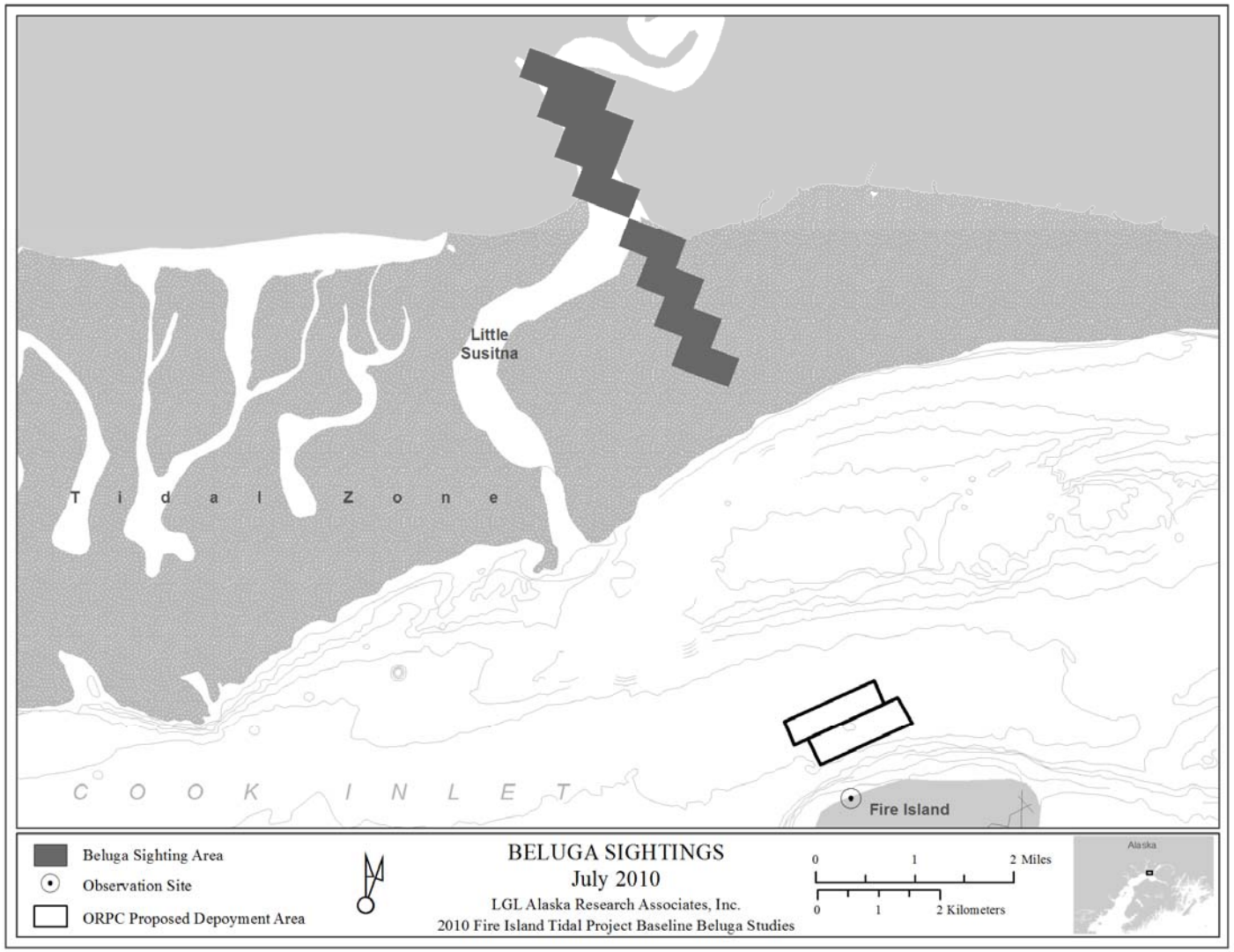

Figure 8. Locations of all beluga sightings in July 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

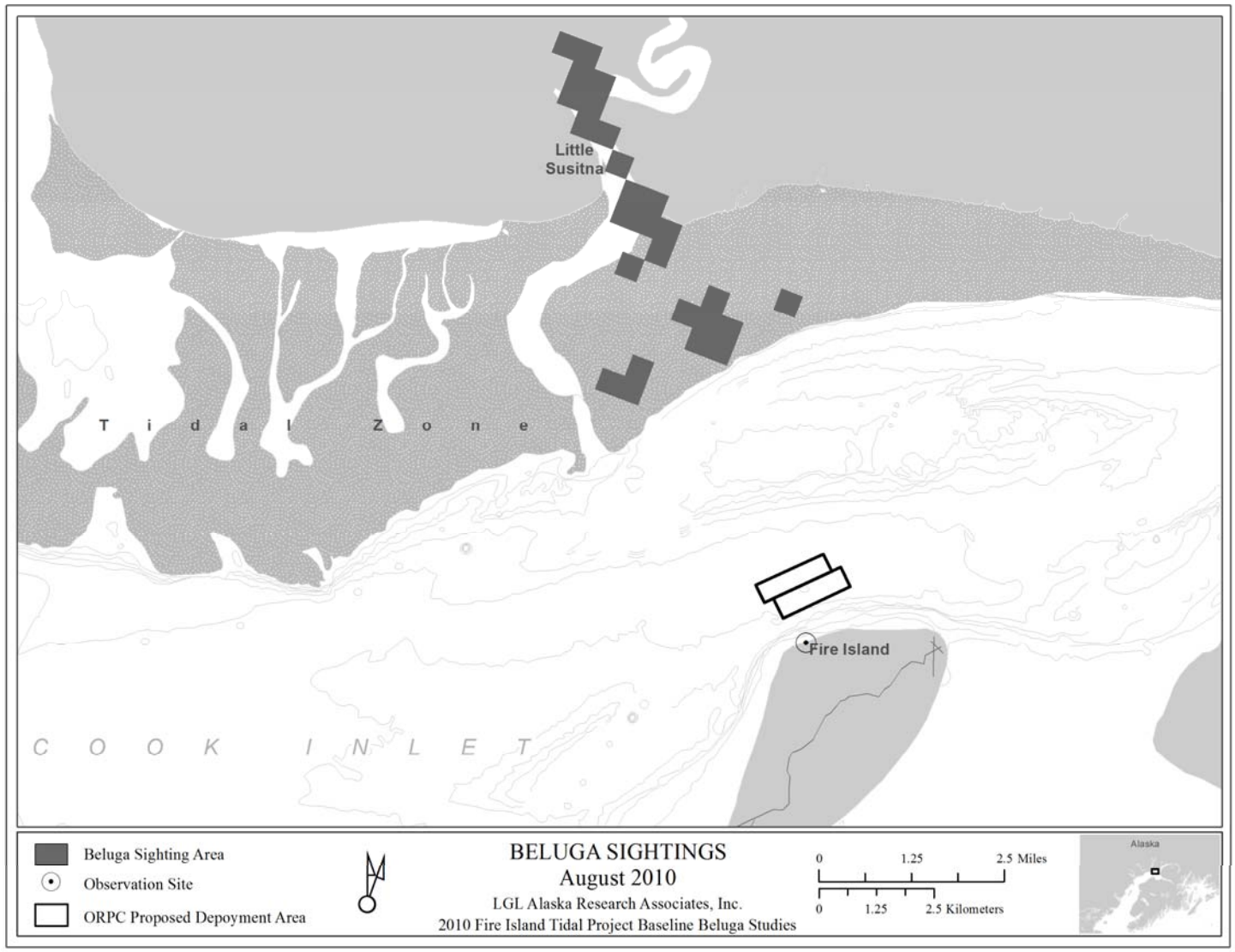

Figure 9. Locations of all beluga sightings in August 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

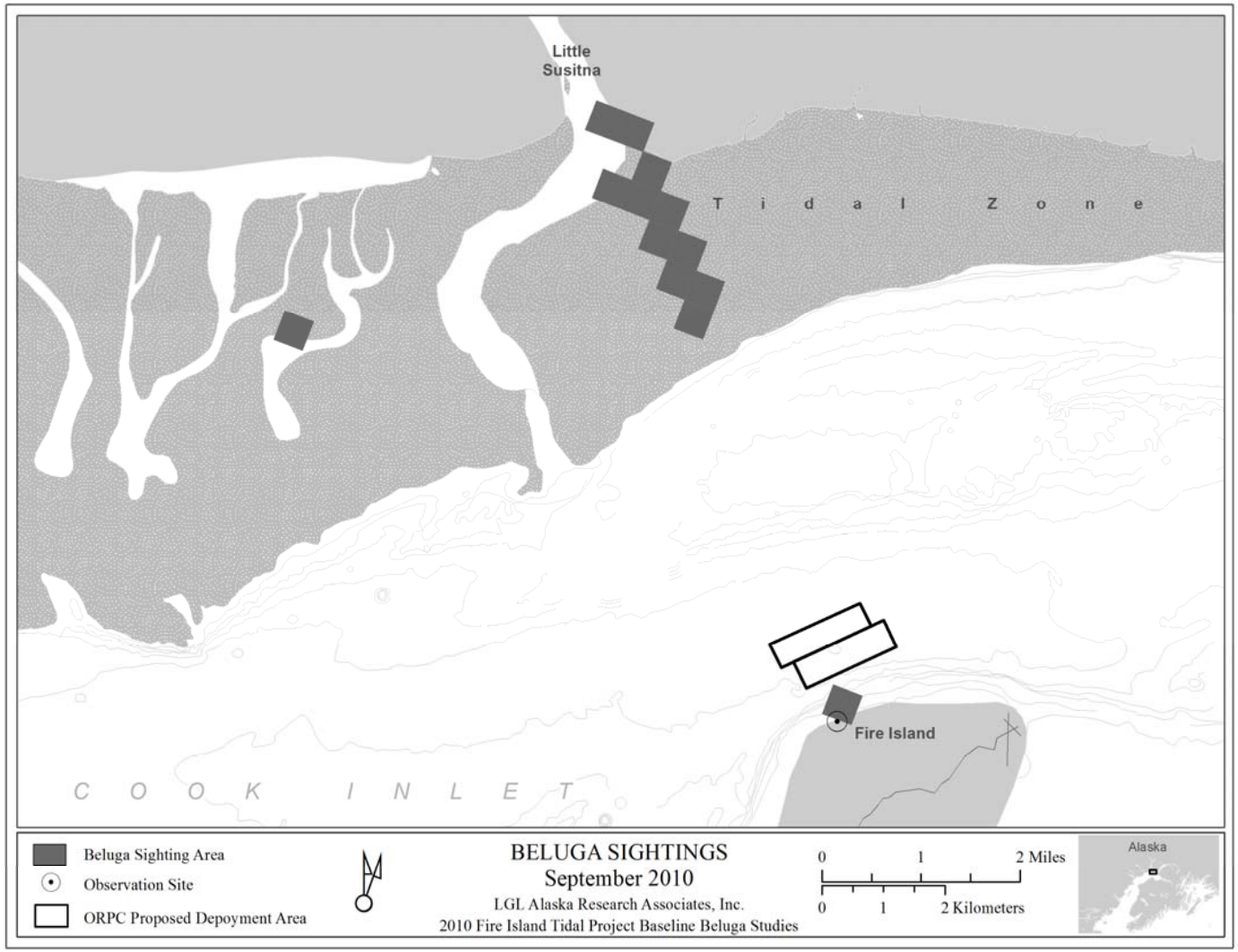

Figure 10. Locations of all beluga sightings in September 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

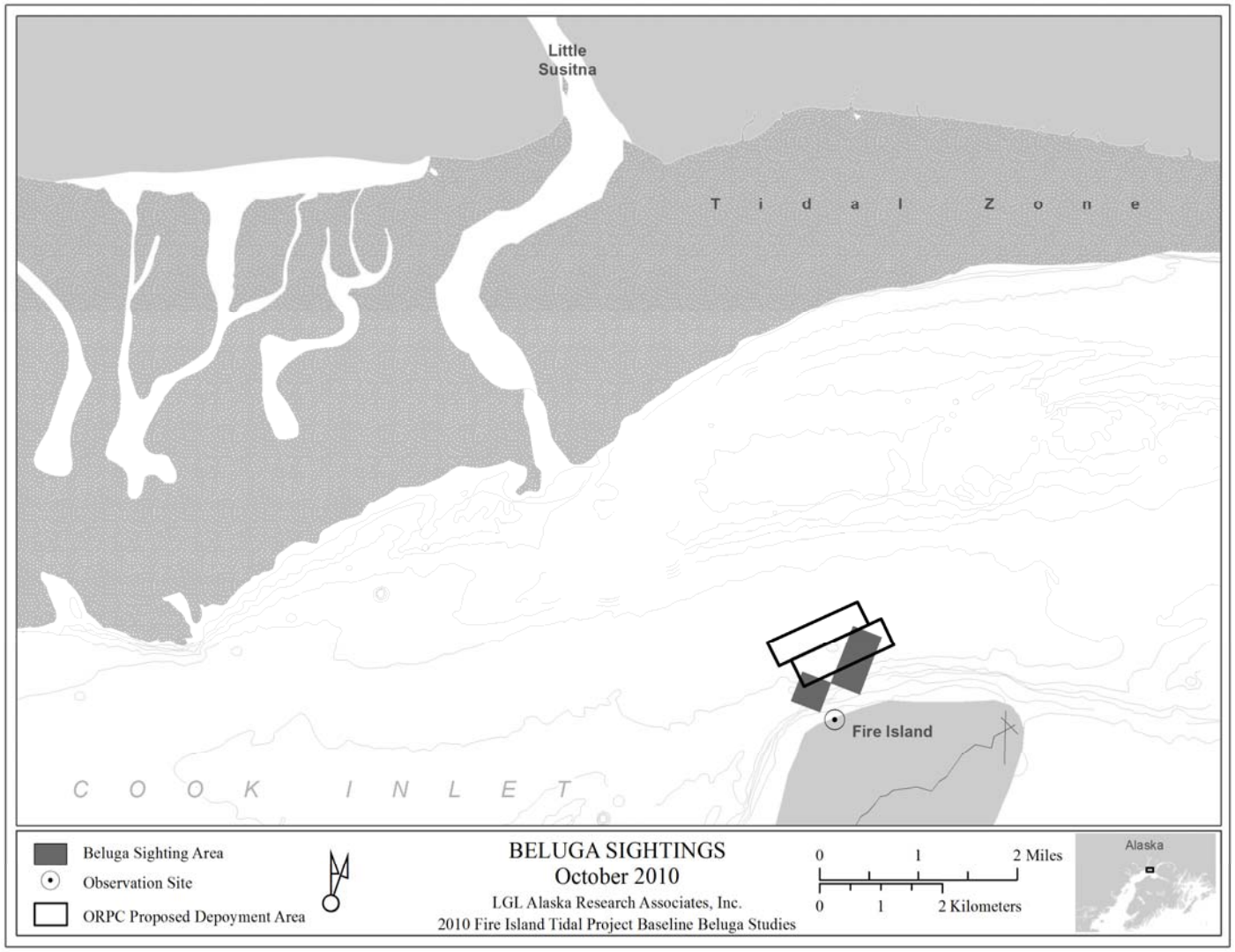

Figure 11. Locations of all beluga sightings in October 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

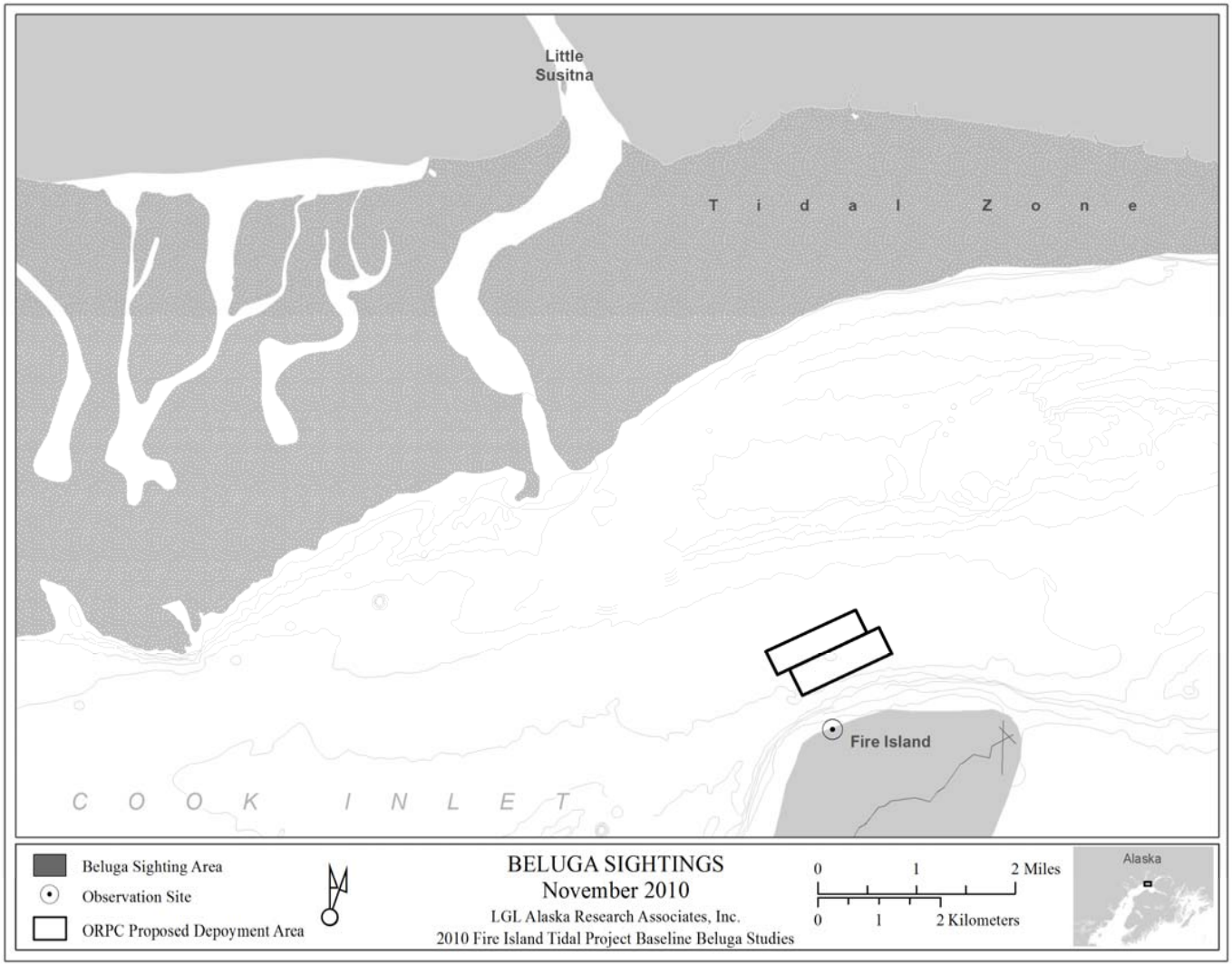

Figure 12. Locations of all beluga sightings in November 2010. Observations concluded November 13, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

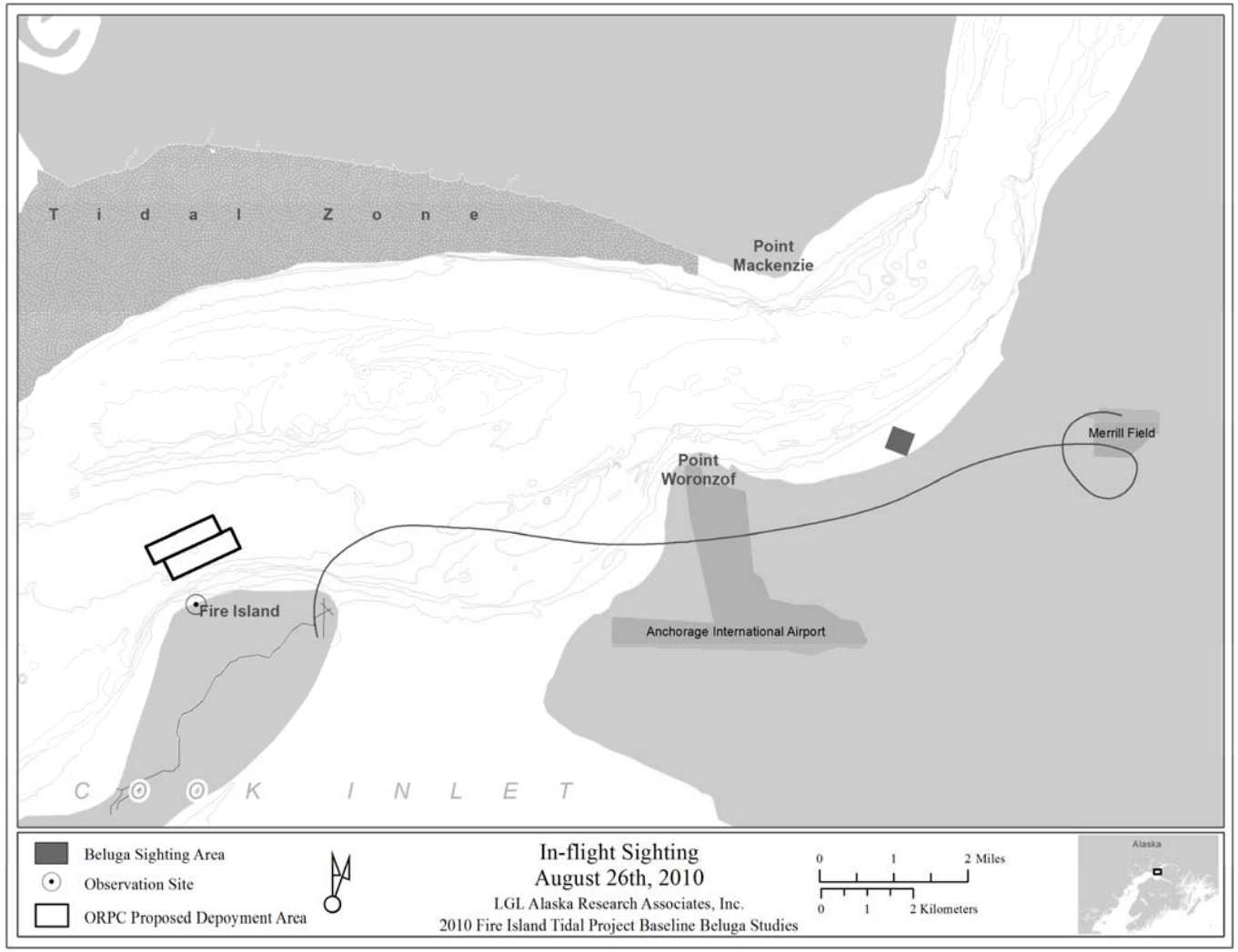

Figure 13. Location of 3 belugas sighted during a crew-transport flight on August 26, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

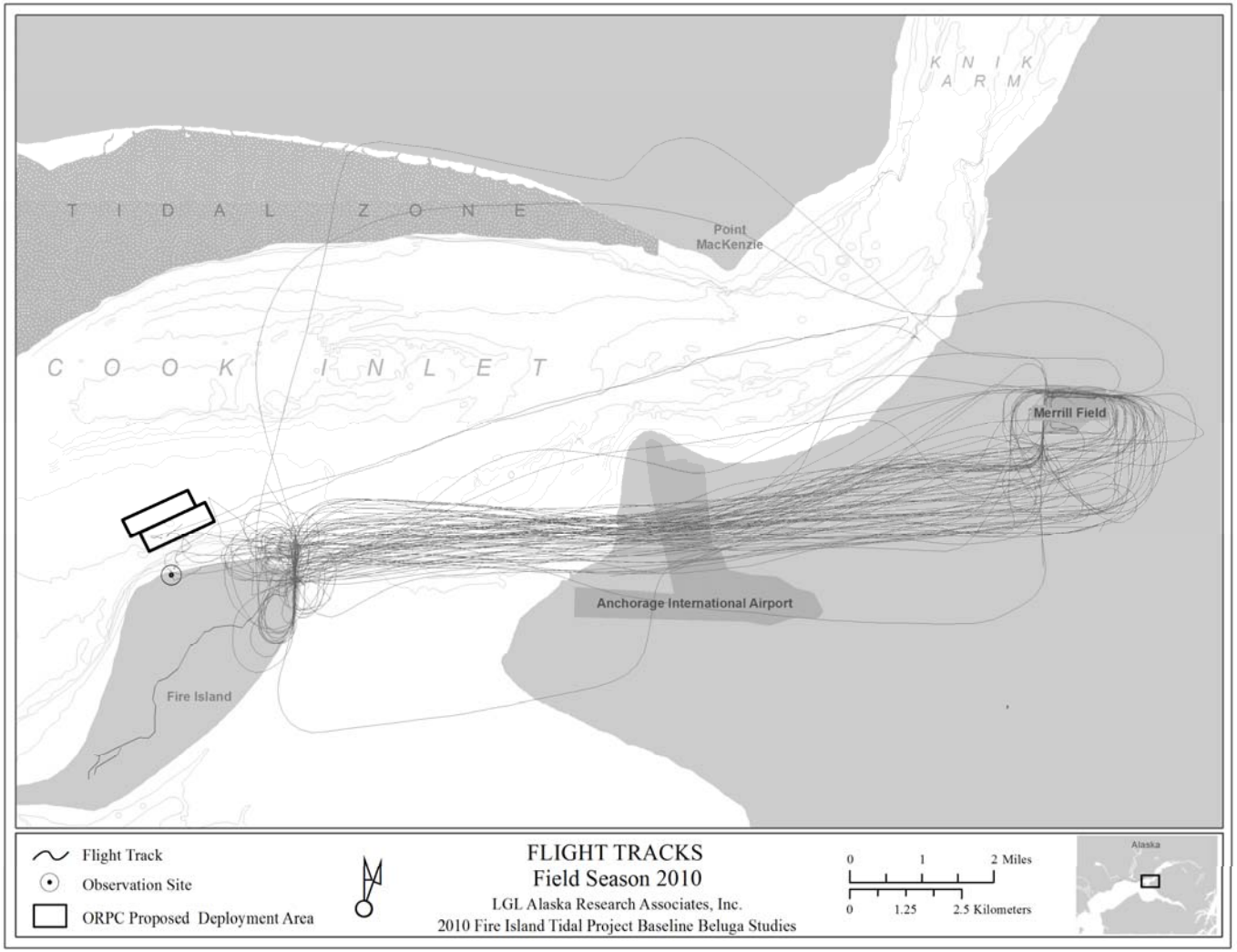

Figure 14. Tracks of crew-transport from flights and vessels, May 4, 2010 through November 13, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

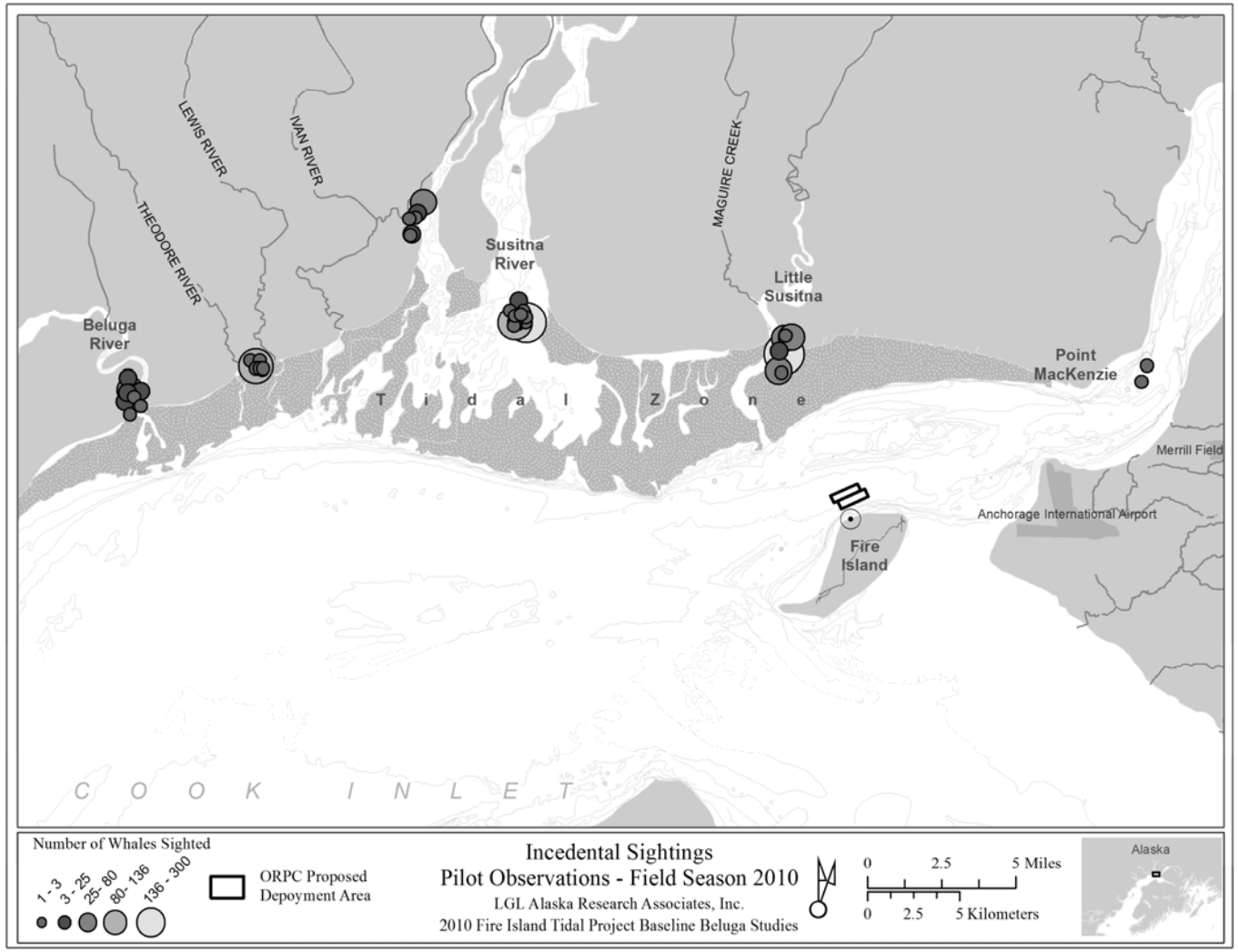

Figure 15. Location and estimated group sizes of belugas observed by Spernak Air pilots on flights other than crew transport to Fire Island, May 4 through November 13, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

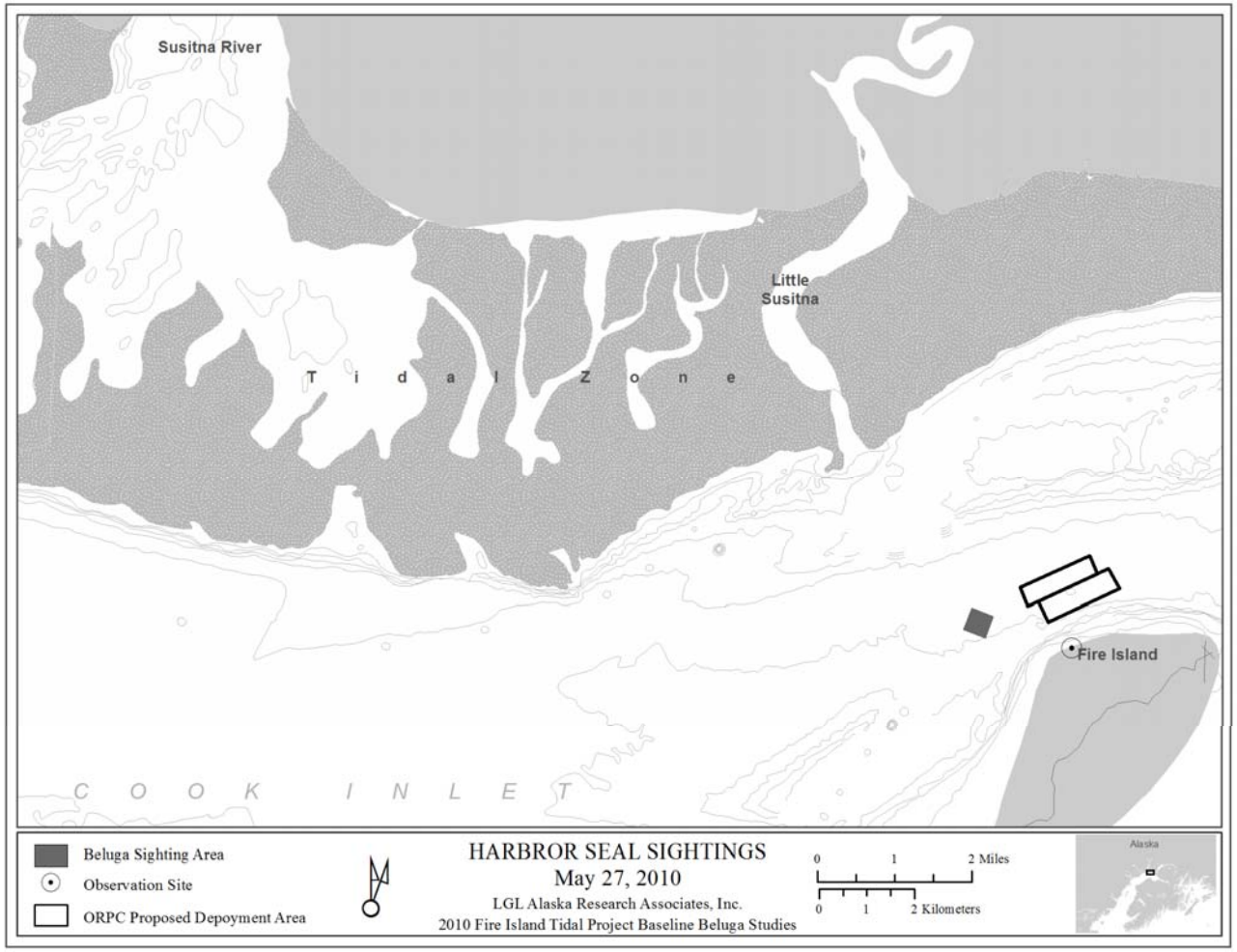

Figure 16. Locations of harbor seals sighted from May 4 to November 13, 2010. Seals were only sighted on one day (May 27). The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

APPENDIX A

ORPC ALASKA PRE-DEPLOYMENT BELUGA WHALE OBSERVATIONS STUDY PLAN – 3/23/09

1.0 DESCRIPTION OF ISSUE

ORPC Alaska, LLC (hereinafter, ORPC), a subsidiary of Ocean Renewable Power Co., is applying to the Federal Energy Regulatory Commission (FERC) for a pilot license for the Cook Inlet Tidal Energy Pilot Project, FERC Project No. 12679 (hereinafter, Pilot Project or Project). The Project will evaluate the potential for a new source of clean, renewable energy generation using tidal energy resources in Upper Cook Inlet (UCI). The purpose of the Pilot Project is to collect the engineering and environmental effects information to support the project description and environmental analysis of a larger commercial project. ORPC has developed a proprietary modular ocean current generation device, the OCGen™ Module (module). The core component of the OCGen™ technology is ORPC's proprietary turbine-generator unit (TGU), which utilizes advanced design cross-flow turbines to drive a permanent magnet generator located between the turbines and mounted on the same shaft. Multiple TGUs are combined to form one module. Each module proposed for deployment in Cook Inlet will be comprised of 4 TGUs.

The Project will consist of a phased deployment and operation of 5 modules over an expected 8 year license term. Each module has an estimated peak capacity of 1 megawatt (MW) in a 6 knot current. For the site-specific conditions in UCI, a single module will consist of two half-modules, each with 2 TGUs. The overall dimension of each half-module is approximately 91 feet (ft) (28 meter [m]) in length by 28 ft (8.5 m) high and 14 ft (4.2 m) wide. The modules will be placed approximately 42 ft (12.8 m) below the surface at Mean Lower Low Water (MLLW). ORPC plans to deploy the modules in a phased approach. During the first phase, 1 module will be deployed during May/July of 2011, pending all regulatory approvals. During the second phase, ORPC anticipates installing an additional four modules in July/August, 2012, within the designated Pilot Project Deployment Area (Deployment Area) (Figure A1).

Information on beluga whale presence, habitat use and behavior in the proposed project area is critical for evaluating potential project effects and for meeting regulatory requirements under the ESA, the Marine Mammal Protection Act (MMPA), and under FERC regulations for hydropower licensing. There have been numerous surveys of beluga whales in the upper parts of Cook Inlet as part of the environmental studies conducted for the Port of Anchorage, Knik Arm Bridge, and Seward Highway Projects (Markowitz and McGuire 2007, Ramos et al. 2006, Funk et al. 2005). However, there is limited information for the Deployment Area near Fire Island.

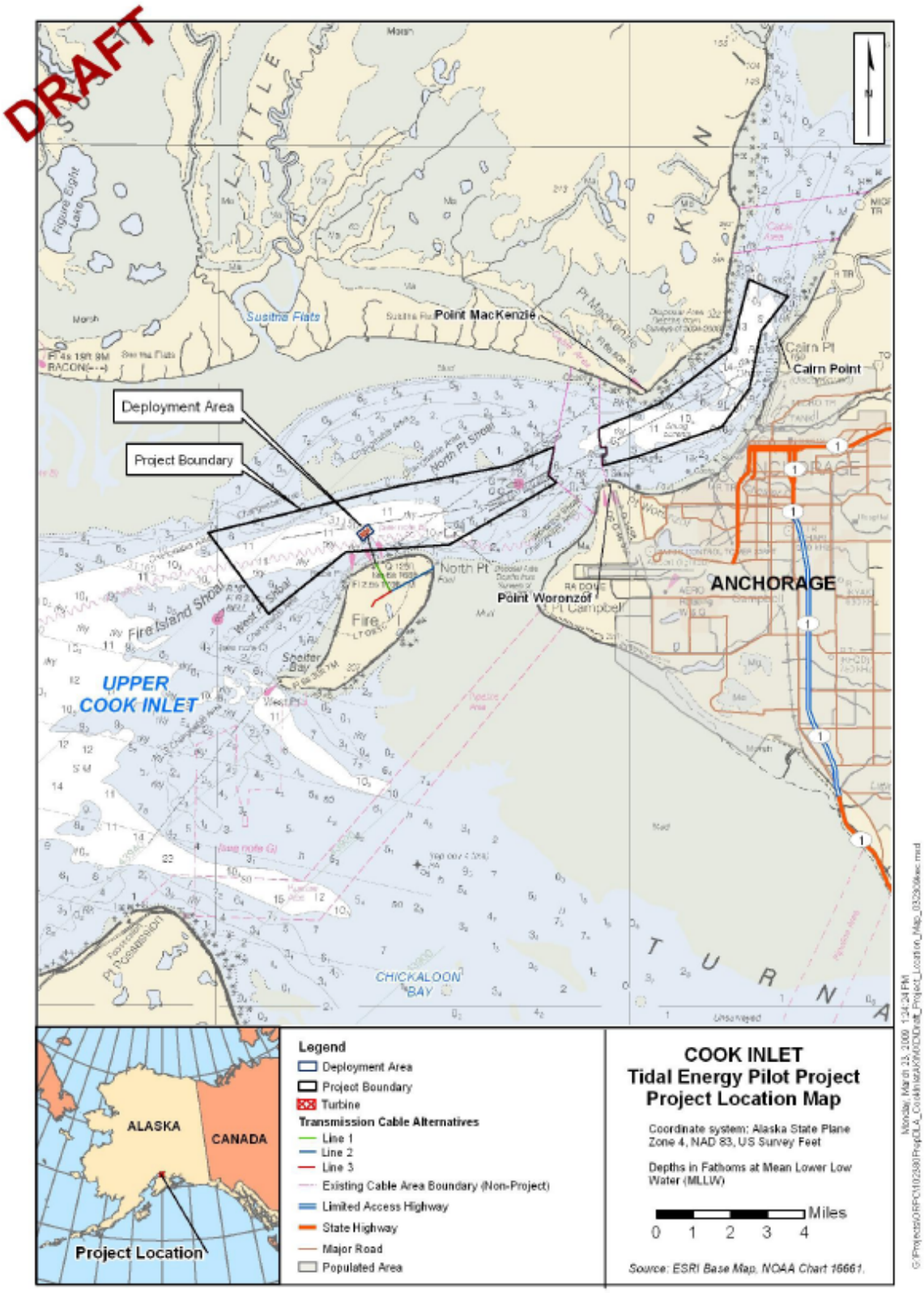

Figure A1. Project Location Map.

2.0 RELEVANT EXISTING INFORMATION

The Cook Inlet beluga whale (*Delphinapterus leucas*) Distinct Population Segment (DPS) has recently been listed as endangered by National Oceanic and Atmospheric Administration (NOAA) under the Endangered Species Act (ESA). Surveys on beluga whales in Cook Inlet documented a decline in abundance of nearly 50 percent between 1994 and 1998, from an estimate of 653 whales to 347 whales (National Marine Fisheries Service [NMFS] 2008). This decline was mostly attributed to the subsistence harvest (through 1998); however, even with the restrictions on this harvest, the population has continued to decline by 1.45 percent per year from 1998 to 2008. Annual surveys have continued since 1994, and indicate this population is not recovering (NMFS 2008).

Critical habitat has not been designated but NOAA Fisheries has designated Knik Arm as a Type 1 habitat of high value/high sensitivity for beluga whales (NMFS 2008). These areas are full of shallow tidal flats, river mouths, or estuarine areas, and are important for foraging and calving habitats. Use of this habitat varies during the year with the potential of belugas occurring within the vicinity of the Deployment Area in most months. Depending on the season, belugas can occur in both offshore and coastal waters. During the spring and summer, Cook Inlet belugas are generally concentrated near the warm, shallow waters of river mouths where prey availability is high due to seasonal fish runs. Most of the calving in Cook Inlet occurs from mid-May to mid-July in the vicinity of these warm-water river mouths (Nemeth et al. 2007). In general, belugas are more dispersed throughout the Upper and Middle Inlet during winter months rather than concentrated at river mouths. The Little Susitna River mouth and Susitna Flats, documented beluga use areas, are approximately four miles and further from the deployment area.

Beluga whales using Knik Arm and UCI are exposed to variable conditions due to the large tidal fluctuations that occur in the arm and in UCI in general. Funk et al. (2005), conducted shore-based observations of beluga whales in Knik Arm to characterize whale movement patterns and to determine important habitat locations in relation to tidal patterns. The study found that changes in water depth associated with the tidal cycle greatly influenced the habitat available, the patterns of whale movement, and the habitat used by belugas in Knik Arm (Funk et al. 2005). As the tide flooded, beluga whales typically moved into the upper reaches of Knik Arm. Whales moved south towards the Sixmile Creek/Eagle Bay area and out of the upper reaches of Knik Arm as the ebb tide began. Movements of beluga whales in Knik Arm with tides are highly predictable. Riding the tides is likely to be energetically efficient, and may decrease the chances of stranding. Prior to this there had been no published reports describing these movements or clear correlations between tidal changes and beluga distributions and habitat use in Cook Inlet (Moore et al. 2000). The influence of tides on the movement of beluga whales that reside in or use coastal estuaries in Russian waters was summarized by Kleinenberg et al. (1964). Inshore migrations by belugas occurred primarily during flood tides in areas with marked tidal fluctuations. Beluga whales were reported to migrate along the shore during high spring tides with movements into rivers driven by prey availability (Kleinenberg et al. 1964 as cited in Funk et al. 2005).

Beluga whales have been observed to feed most efficiently in summer months, possibly building up energy reserves for the winter. Belugas are reported by Native hunters to have only 2-3 inches (in) (5-7.5 centimeter [cm]) of blubber in April and May but up to 12 in (30.5 cm) in the fall (Huntington 2000). Beluga whales feed throughout the water column and on the sea floor although they appear to focus their foraging efforts at streams and rivers where fish are highly concentrated. In general, belugas usually dive for about 3-15 minutes while hunting for food. Other beluga populations inhabiting shallow coastal areas are known to make shallow dives while foraging for food (Martin et al. 2000). They can travel for about 1.5 miles during a dive and commonly dive to a depth of 66 feet (20 m) to hunt. They can dive to greater depths ranging 1,000 to 2,000 feet (305 to 610 m) at times, however greater dive depths are associated with populations that inhabit deep water and not those in relatively shallow coastal habitat (Martin et al. 2000). In the winter, Cook Inlet belugas concentrating in deeper waters in the mid Inlet (further south of the deployment area) make deep feeding dives (NMFS 2008).

3.0 NEED FOR ADDITIONAL INFORMATION

Information on the numbers, behavior, and habitat use of belugas has been collected for recent projects in UCI, north of Fire Island. A limited amount of information is available for the western reach of the proposed project area, the Deployment Area off of Fire Island. Agency staff has indicated that Cook Inlet beluga whales are known to use the habitat in the proposed Project Area (Figure A1) on a regular basis, and the vicinity of Cairn Point is an important migratory route for whales as they move into and out of Knik Arm. More localized information is needed in order to evaluate existing use of the proposed Deployment Area by belugas and assess potential risks to whales during deployment of tidal energy modules.

4.0 PRE-DEPLOYMENT STUDY PLAN

4.1 Study Plan Goals and Objectives

The primary objective of the proposed study is to assess the distribution and movement of beluga whales in the Deployment Area off the north side of Fire Island.

4.2 Study Area

The proposed study area for beluga observations is the area to the north of Fire Island, with focus on the Deployment Area (Figure A2).

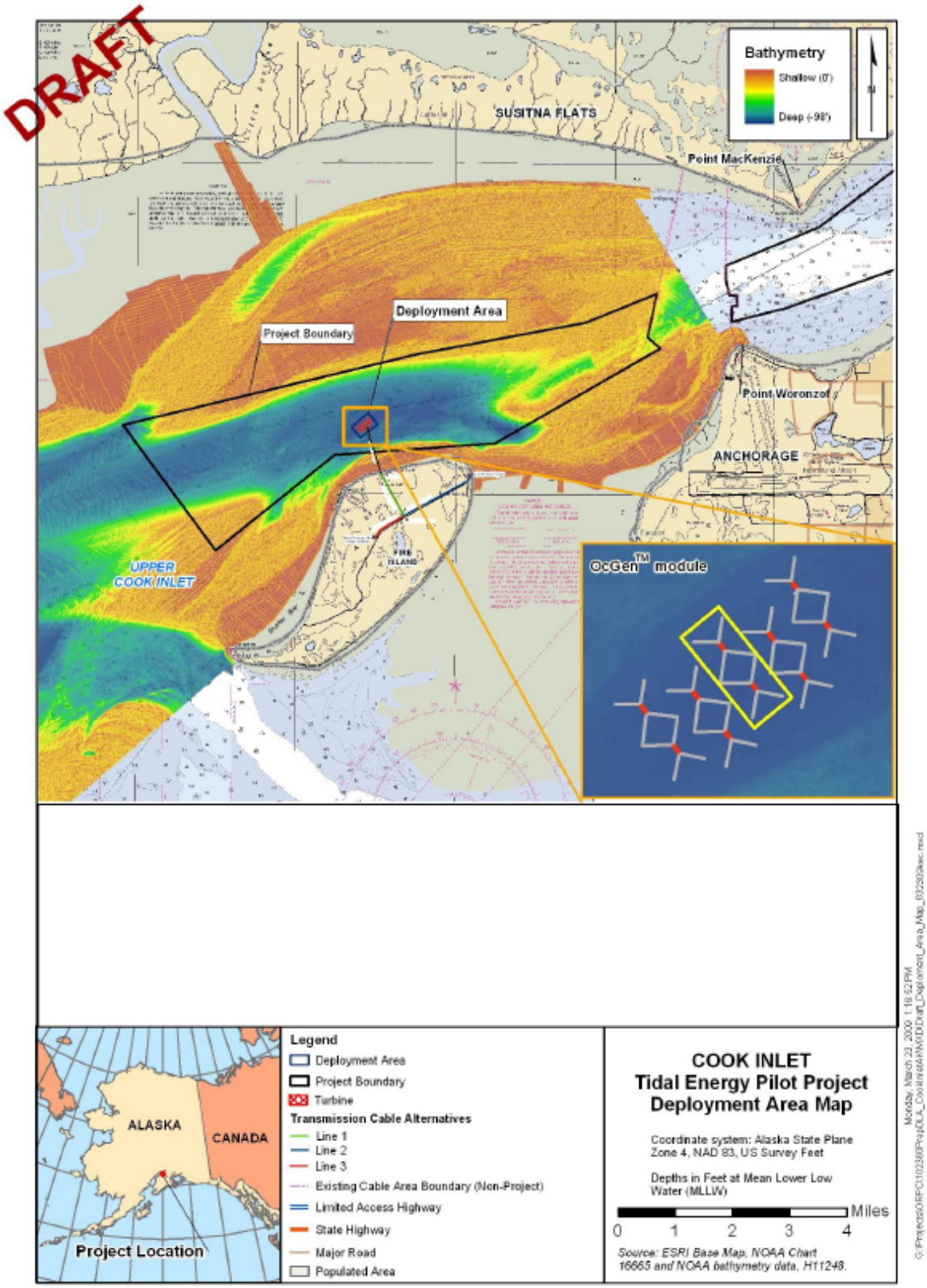

Figure A2. Deployment Area Map.

4.3 Methods

The proposed baseline monitoring study is adapted from similar shore-based visual observation studies as referenced above. The pre-deployment monitoring will take place over the course of the 2009 field season (May-November) and is expected to begin mid-late May. Given the large observation area and safety concerns on the remoteness of the area, two observers will be stationed on Fire Island.

Data collected at the monitoring stations will include: start and end time, environmental conditions (including Beaufort sea state), and beluga whale sighting information, including whale location, direction of travel, speed, group number, number and age class of whales if possible, and additional behavioral observations. Incidental observations of other marine mammals in the project area will be noted. Monitoring session frequency will coincide with habitat use patterns and will typically range from 2 to 6 days/week throughout the season (average of 4 days/week from May through November). The observer will conduct visual monitoring sessions utilizing binoculars, spotting scope, theodolite with laptop computer, and digital camera with zoom lens. Daily observations will average 6 hours with adjustments for seasonal occurrence and abundance. Photo documentation of beluga whale and other marine mammal sightings will be taken to confirm sightings. The precise location of the observation site and details of the study methodology will be refined in consultation with appropriate regulatory and resource agencies prior to initiating the survey.

4.4 Data Analysis and Reporting

Results of the beluga observations will be summarized in a draft report in December 2009. The results of the beluga observations will be incorporated into the final license application to be filed March 2010. Map figures will be created to document observation locations and photo-documentation of sightings will be provided in an appendix.

Further, the results will provide guidance to ORPC in evaluating the need for additional sites or an increased effort in development of a post-deployment beluga monitoring plan.

4.5 Schedule

The pre-deployment baseline beluga observations are expected to start mid to late May and continue through the ice-free season, possibly November, 2009. The precise location of observation sites and details of the study methodology will be refined in consultation with appropriate regulatory and resource agencies prior to initiating the survey. Results of the beluga observations will be summarized in a draft report in December 2009.

5.0 References

Funk, D.W., T.M. Markowitz, and R. Rodrigues (eds.). 2005. Baseline studies of beluga whale habitat use in Knik Arm, Upper Cook Inlet, Alaska, July 2004-July 2005. Rep. from LGL Alaska Research Associates, Inc., Anchorage, AK, in association with HDR Alaska, Inc., Anchorage, AK, for Knik Arm Bridge and Toll Authority, Anchorage, AK, Department of Transportation and Public Facilities, Anchorage, AK, and Federal Highway Administration, Juneau, AK.

Huntington, H.P. 2000. Traditional Knowledge of the ecology of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska. Marine Fisheries Review 62:134-140.

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Martin, A.R., P. Hall, and P.R. Richard. 2000. Dive Behavior of Belugas (*Delphinapterus leucas*) in the Shallow Waters of Western Hudson Bay. Aortic 54:3, pp. 276-283.

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National Marine Fisheries Service. 2008. Conservation Plan for the Cook Inlet beluga whale (*Delphinapterus leucas*). National Marine Fisheries Service, Juneau, Alaska.

Nemeth, M.J., C.C. Kaplan, A.M. Prevel-Ramos, G.D. Wade, D.M. Savarese, and C.D. Lyons. 2007. Baseline studies of marine fish and mammals in Upper Cook Inlet, April through October 2006. Final report prepared by LGL Alaska Research Associates, Inc., Anchorage, Alaska for DRven Corporation, Anchorage, Alaska.

APPENDIX B

MAPS OF DAILY BELUGA WHALE SIGHTINGS

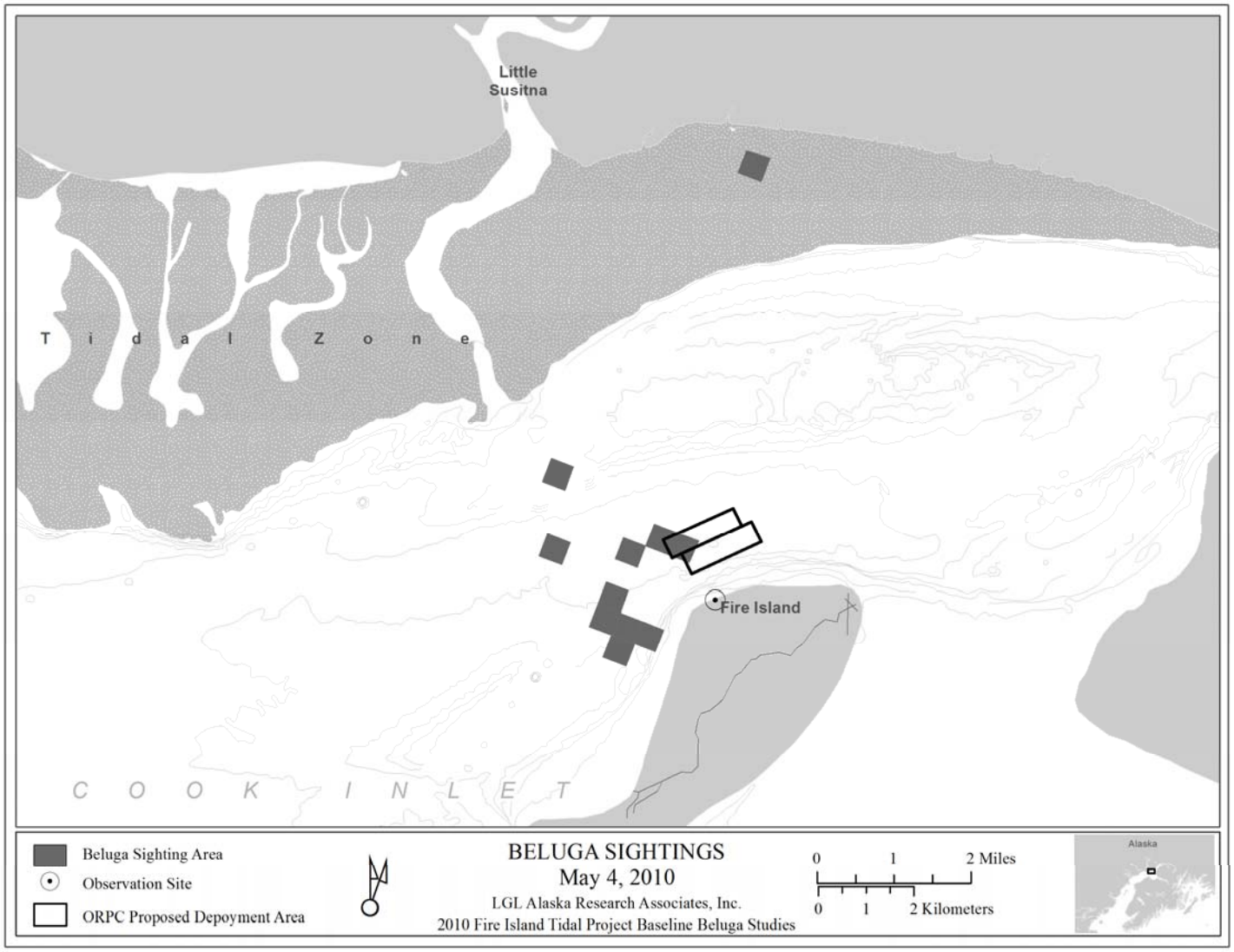

Figure B1. Locations of beluga whales sighted on May 4, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

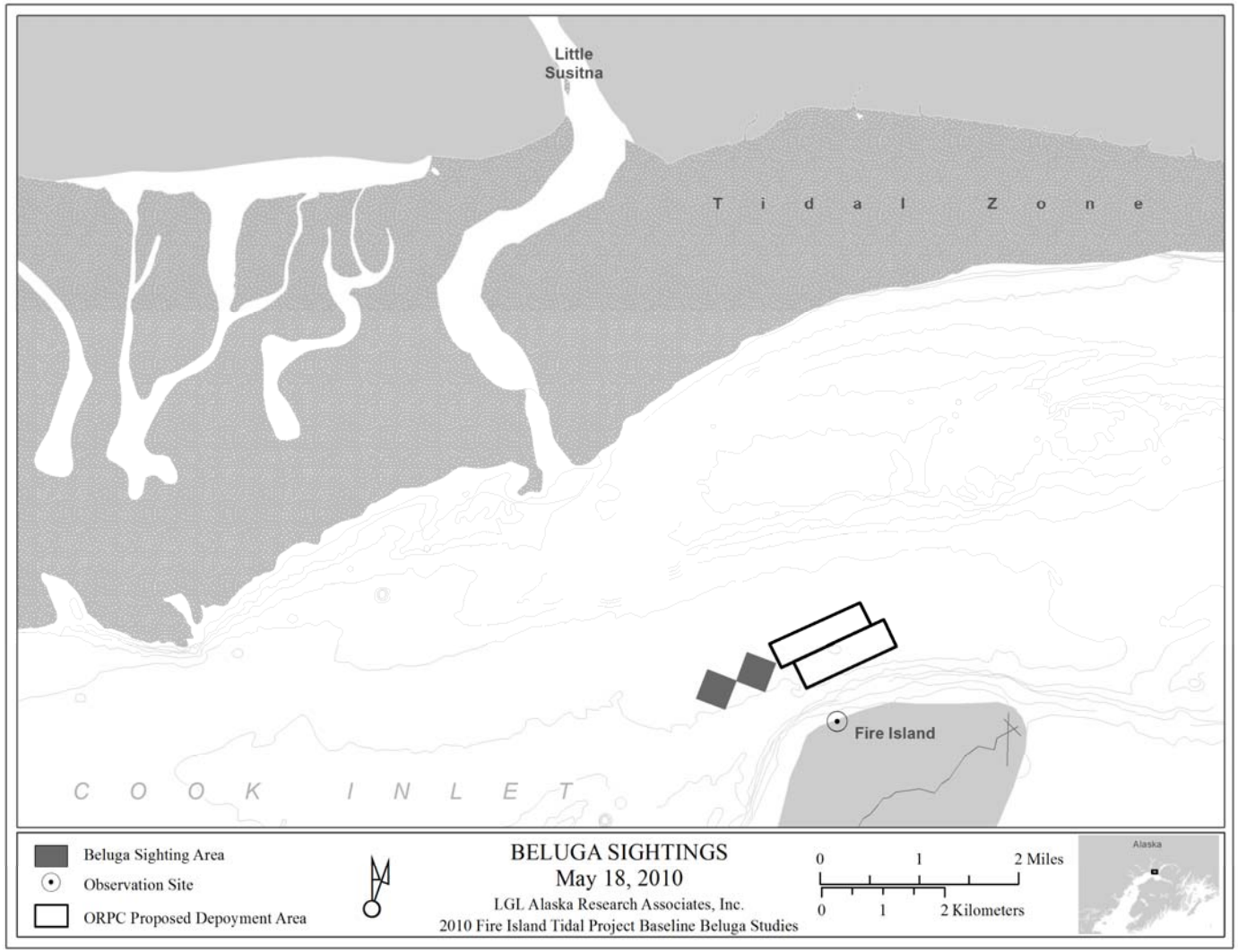

Figure B2. Locations of beluga whales sighted on May 18, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

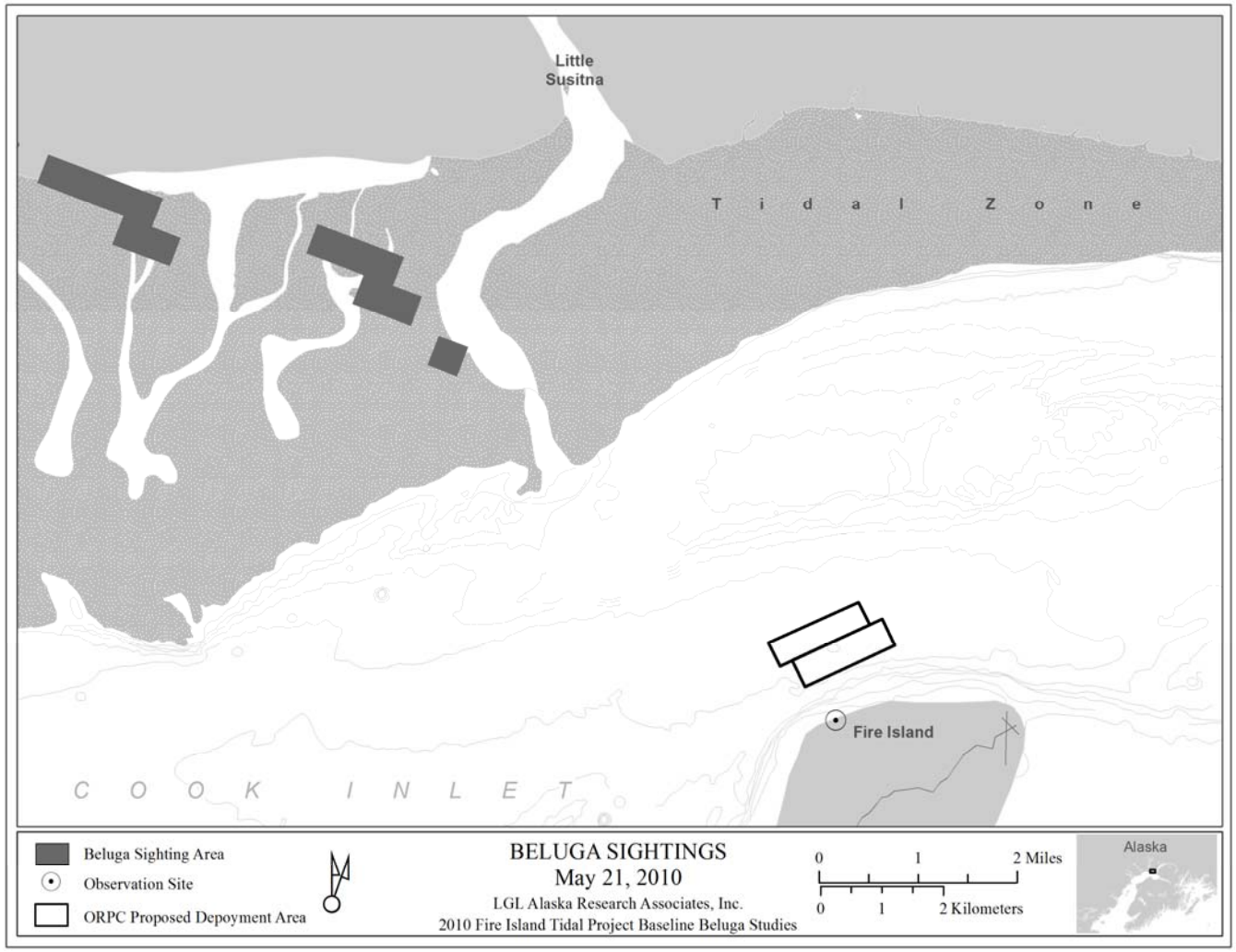

Figure B3. Locations of beluga whales sighted on May 21, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

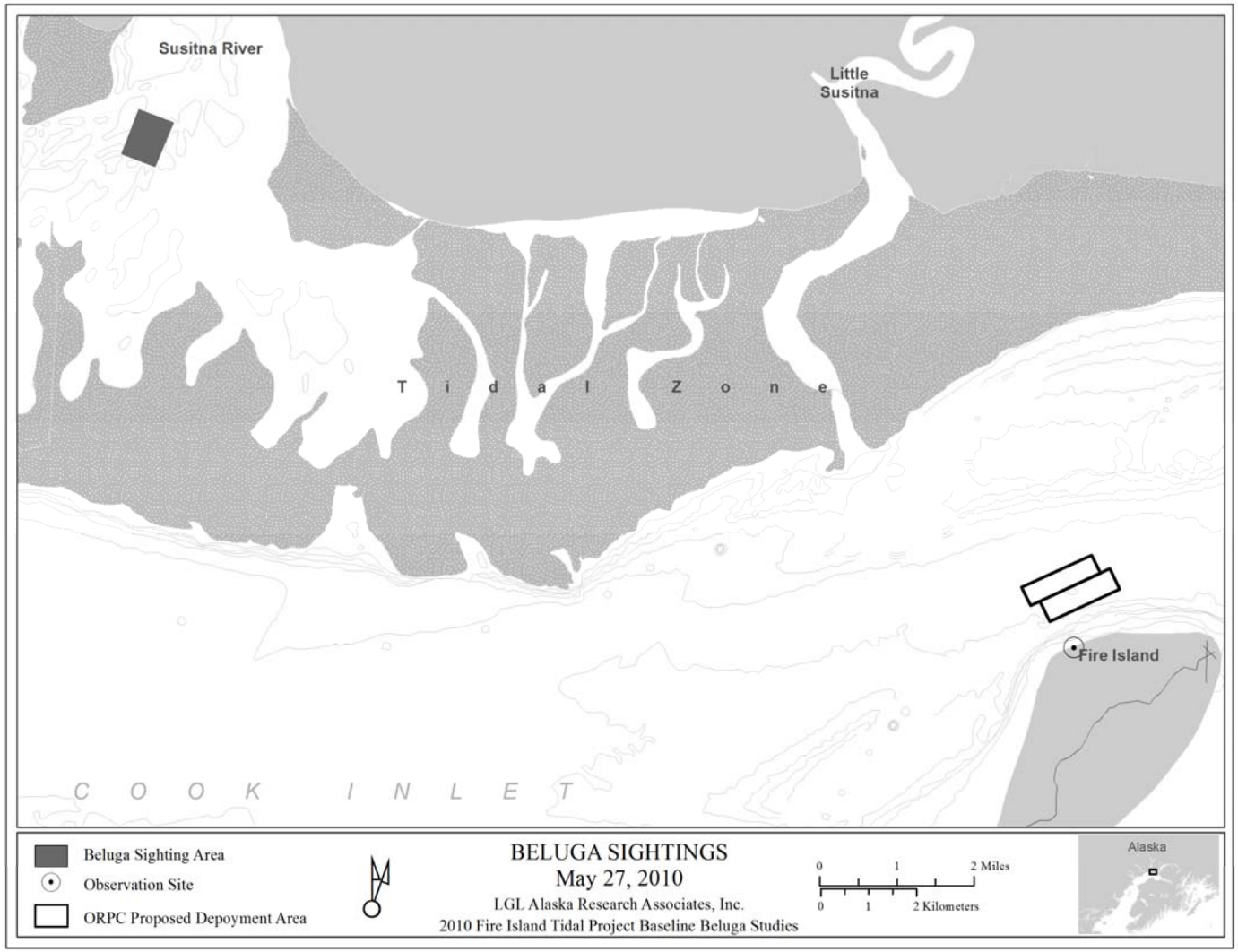

Figure B4. Locations of beluga whales sighted on May 27, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

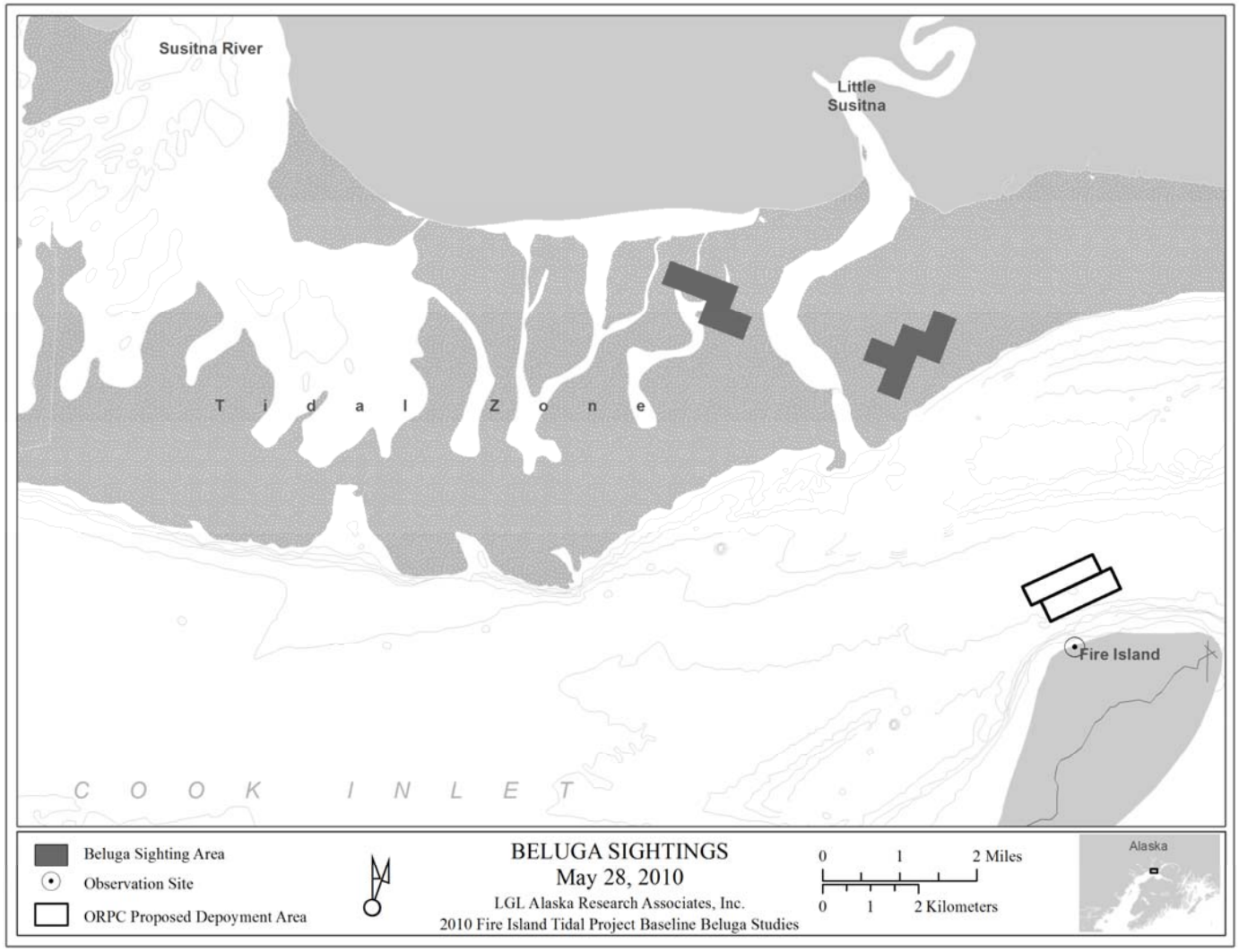

Figure B5. Locations of beluga whales sighted on May 28, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

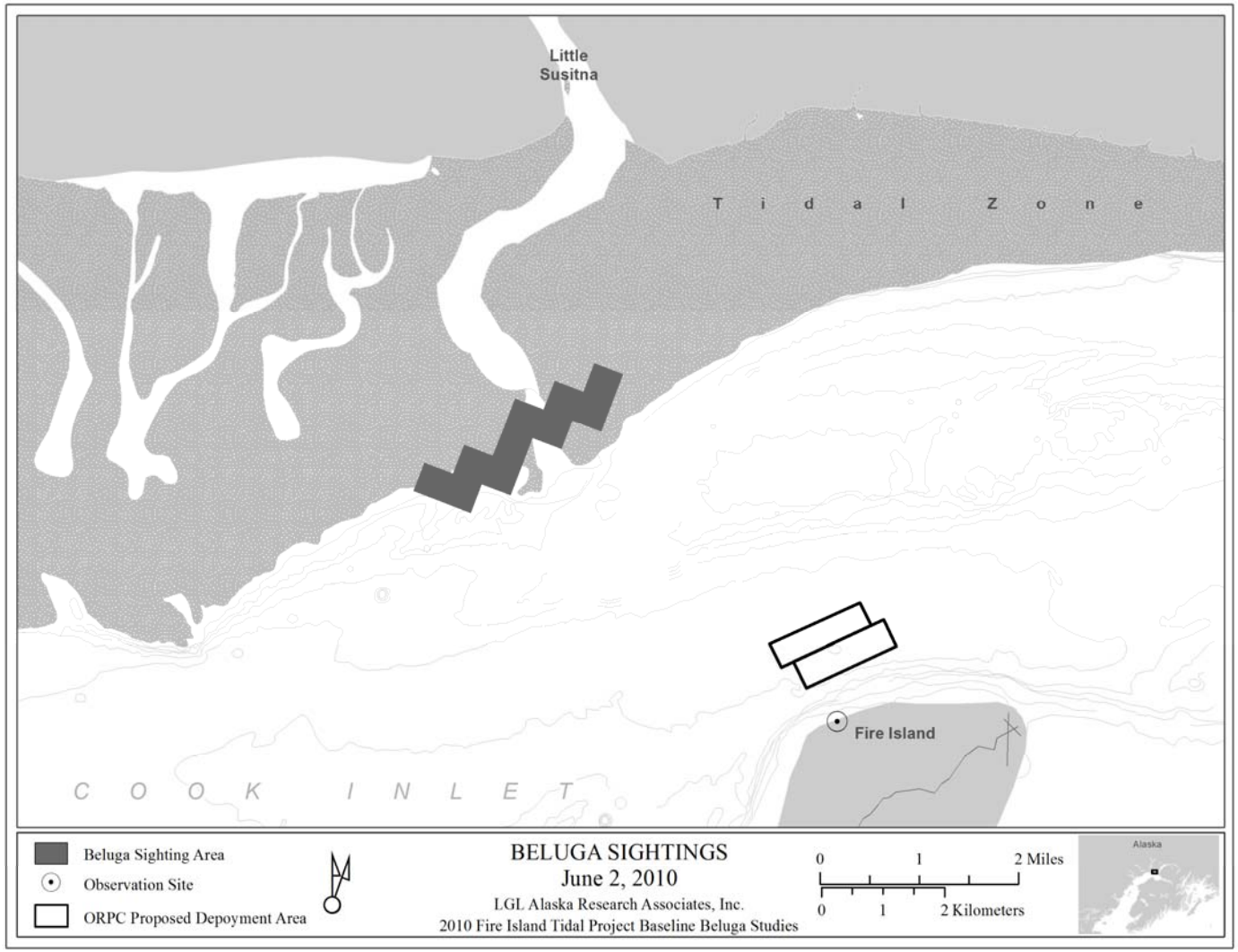

Figure B6. Locations of beluga whales sighted on June 2, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

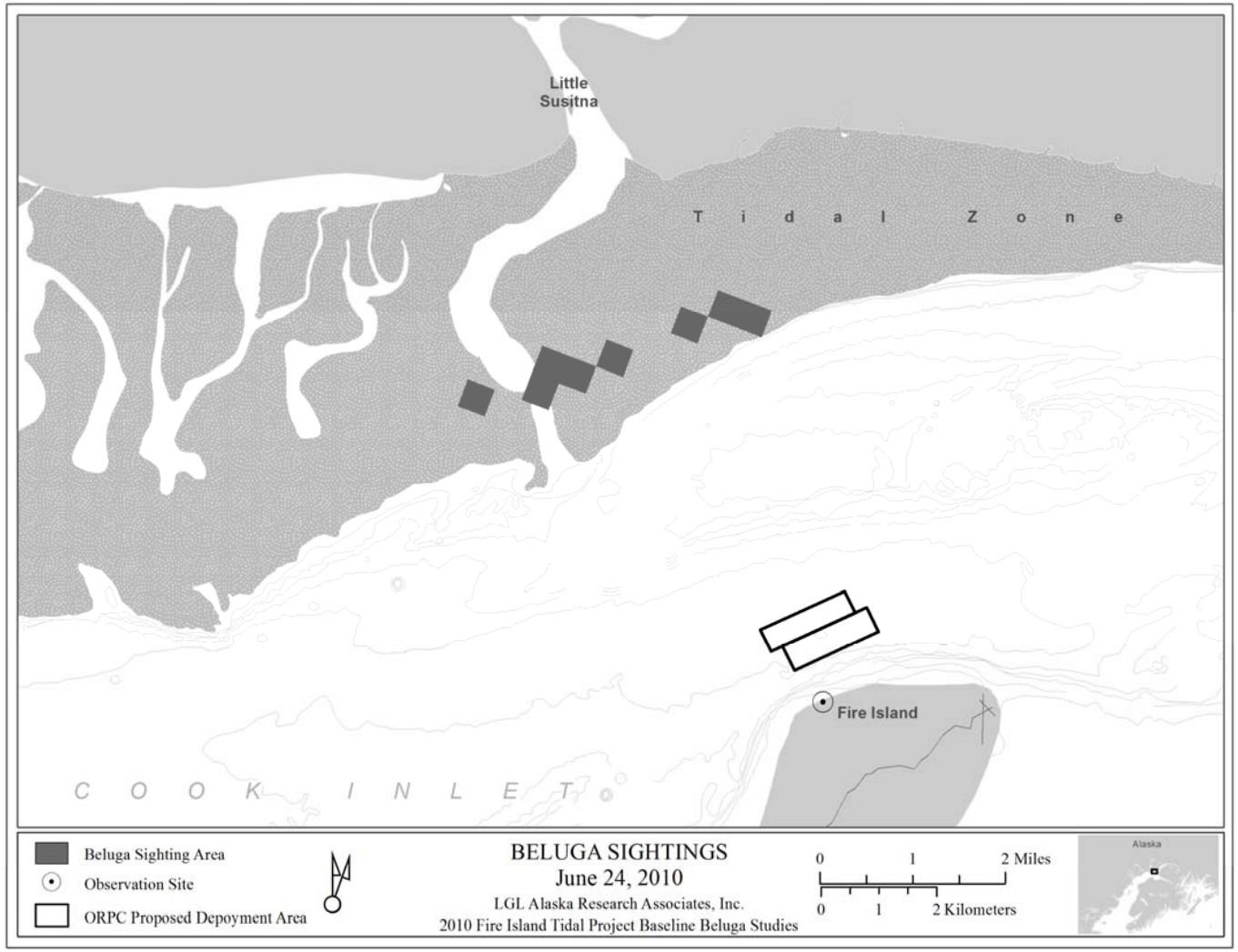

Figure B7. Locations of beluga whales sighted on June 24, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

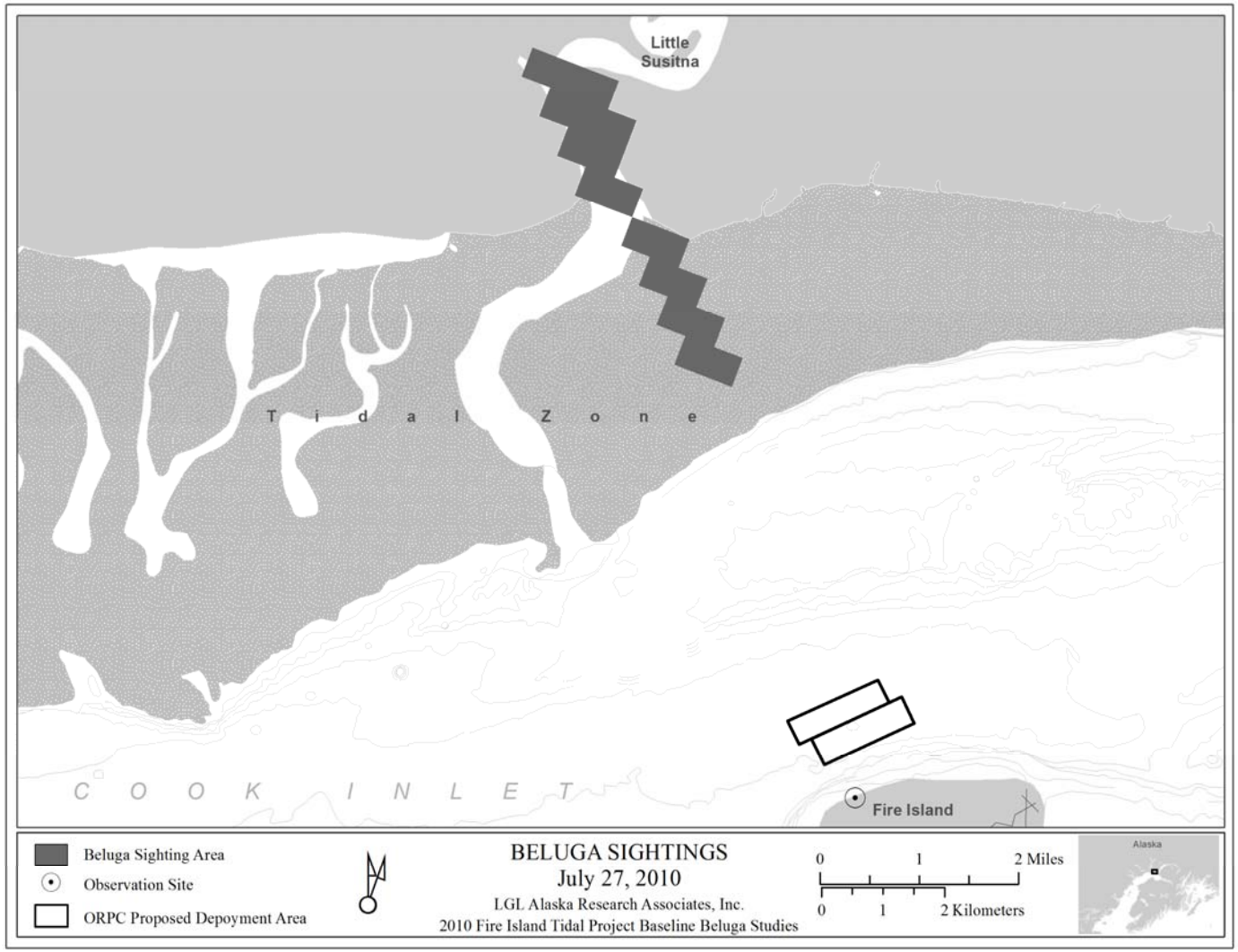

Figure B8. Locations of beluga whales sighted on July 27, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

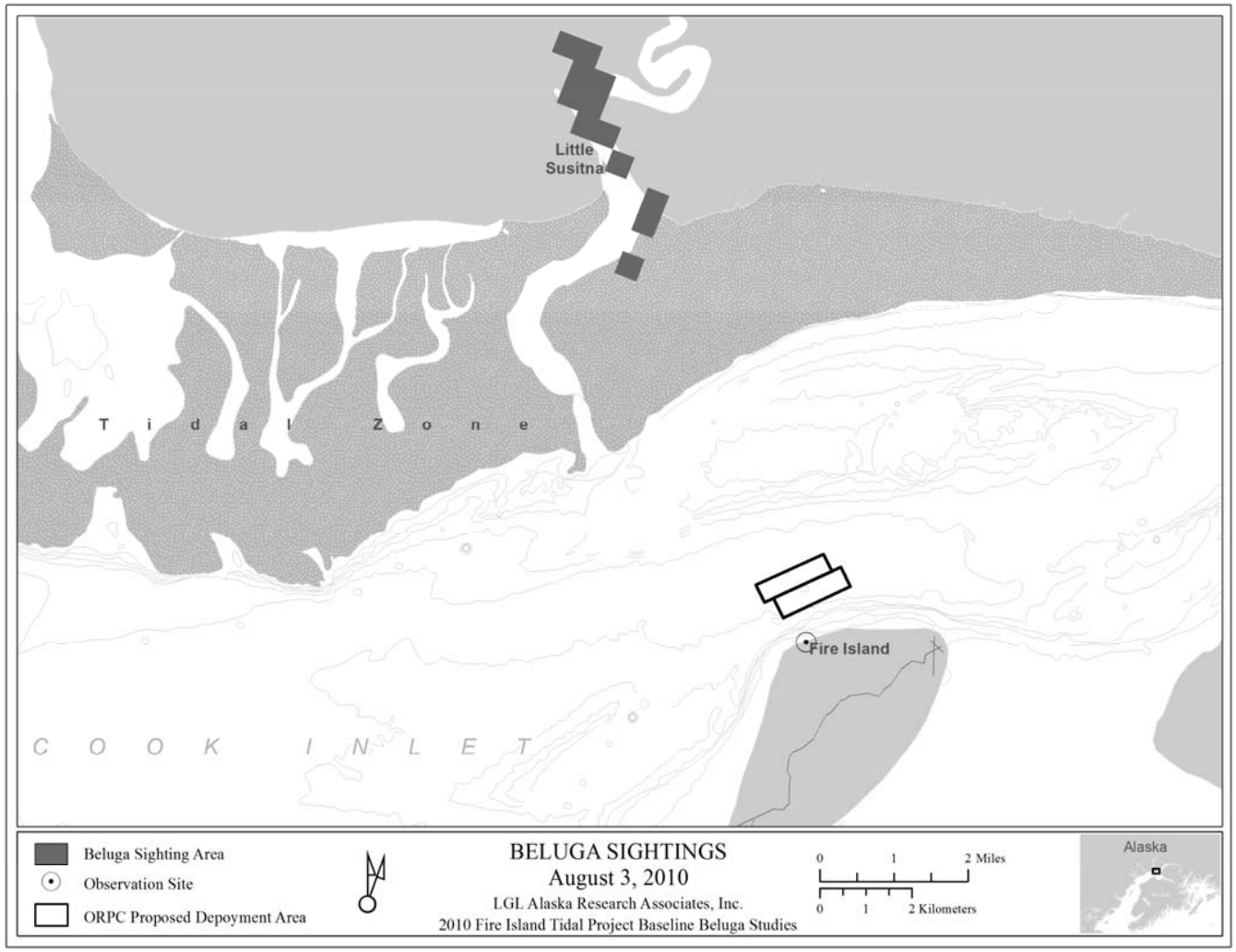

Figure B9. Locations of beluga whales sighted on August 3, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

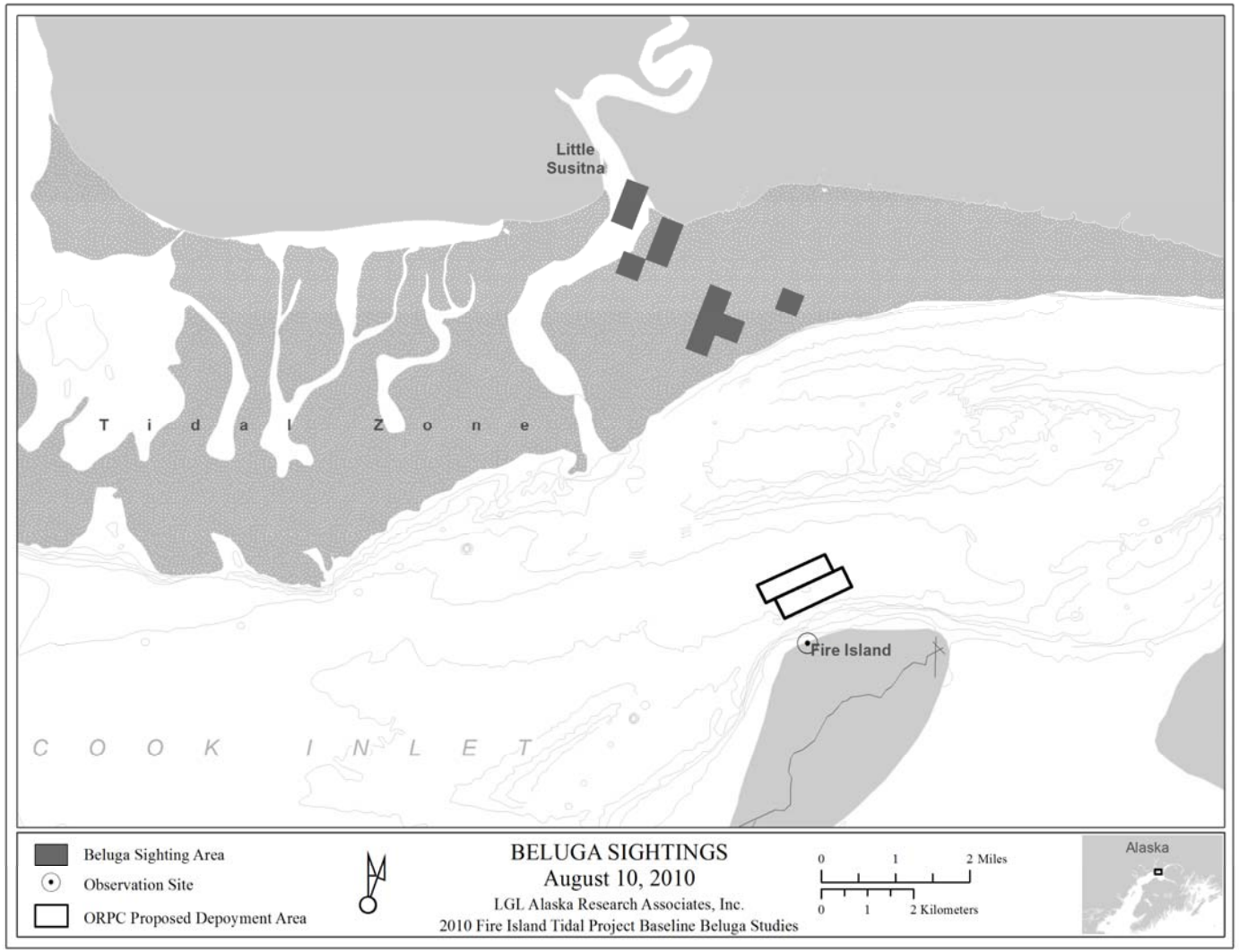

Figure B10. Locations of beluga whales sighted on August 10, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

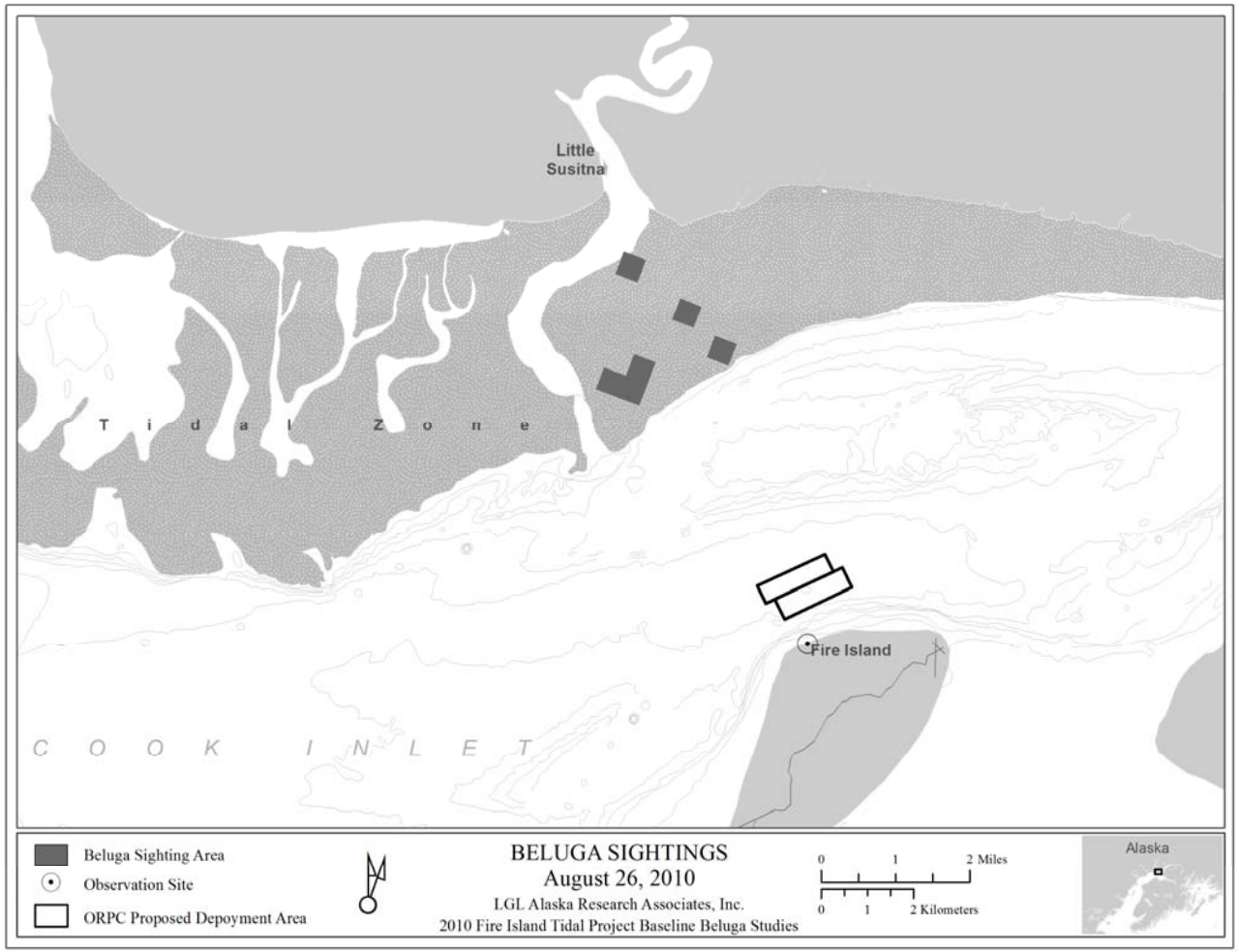

Figure B11. Locations of beluga whales sighted on August 26, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

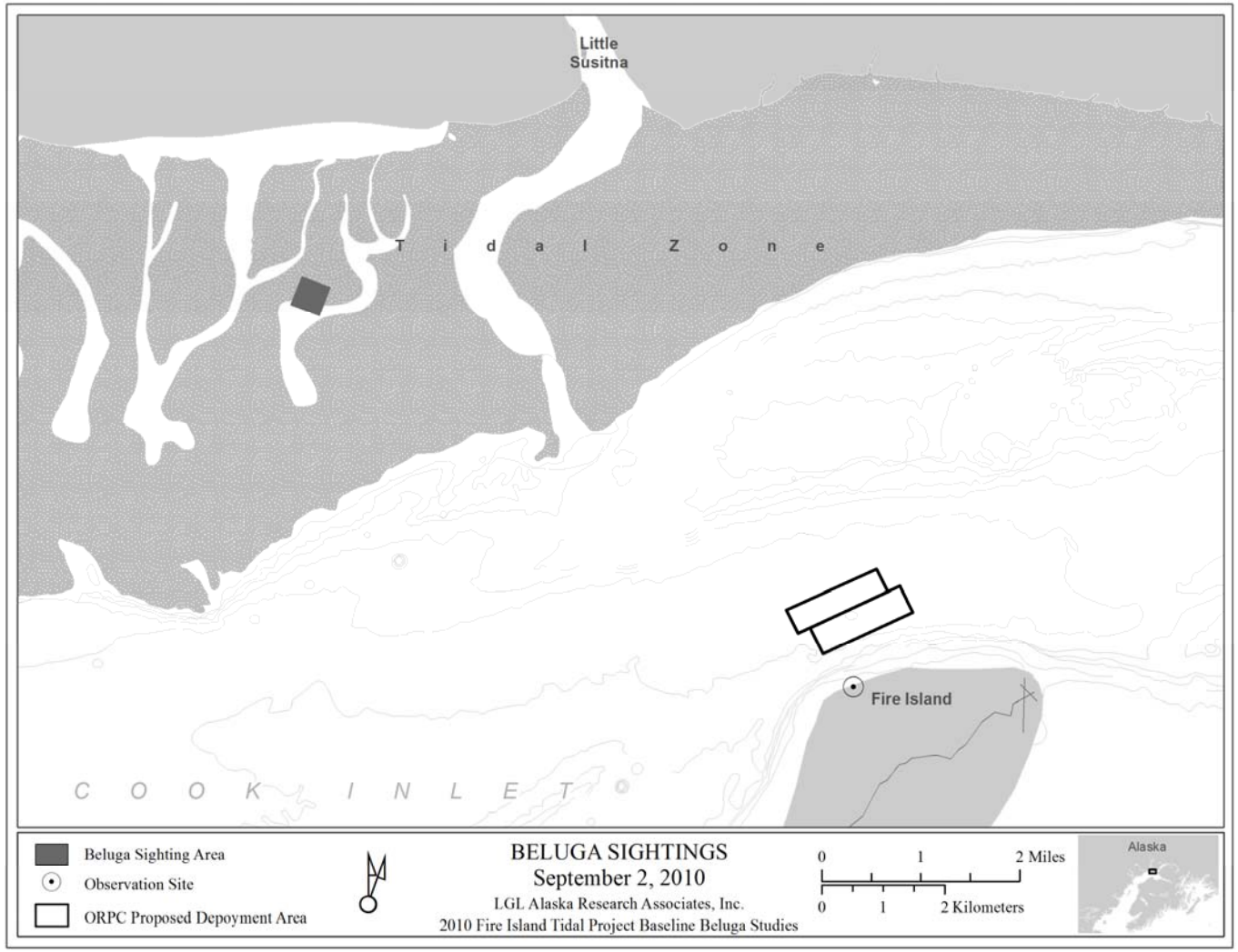

Figure B12. Locations of beluga whales sighted on September 2, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

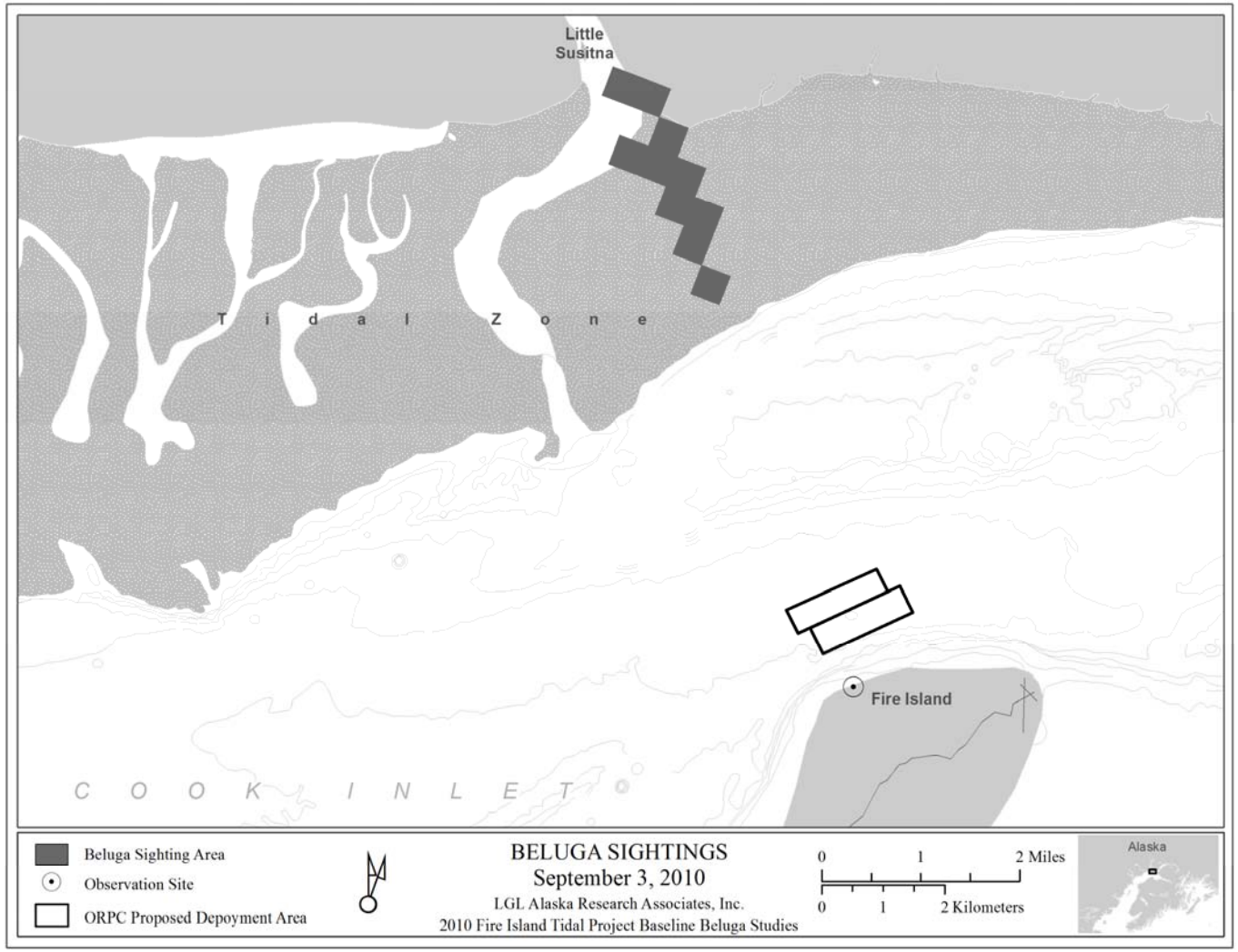

Figure B13. Locations of beluga whales sighted on September 3, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

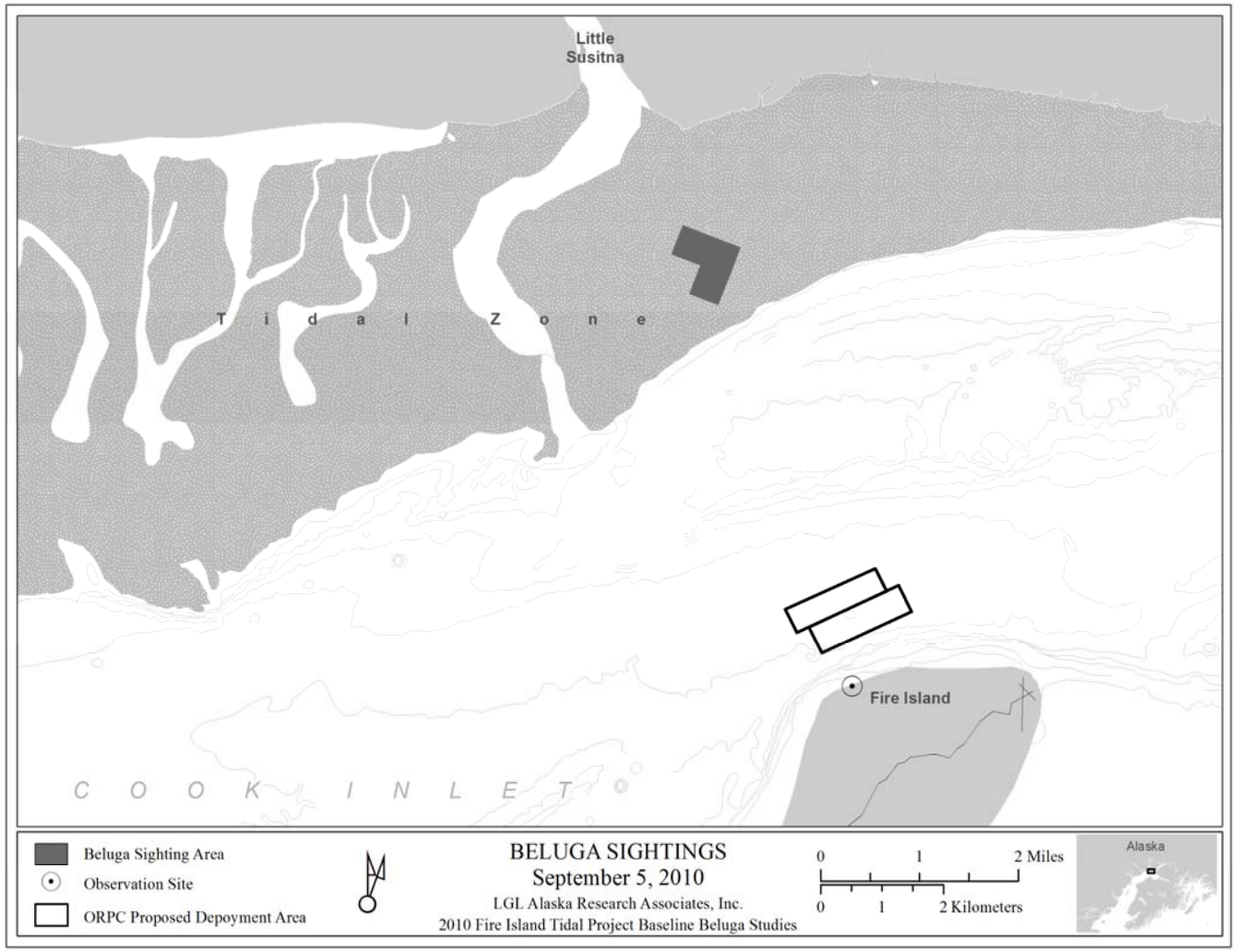

Figure B14. Locations of beluga whales sighted on September 5, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

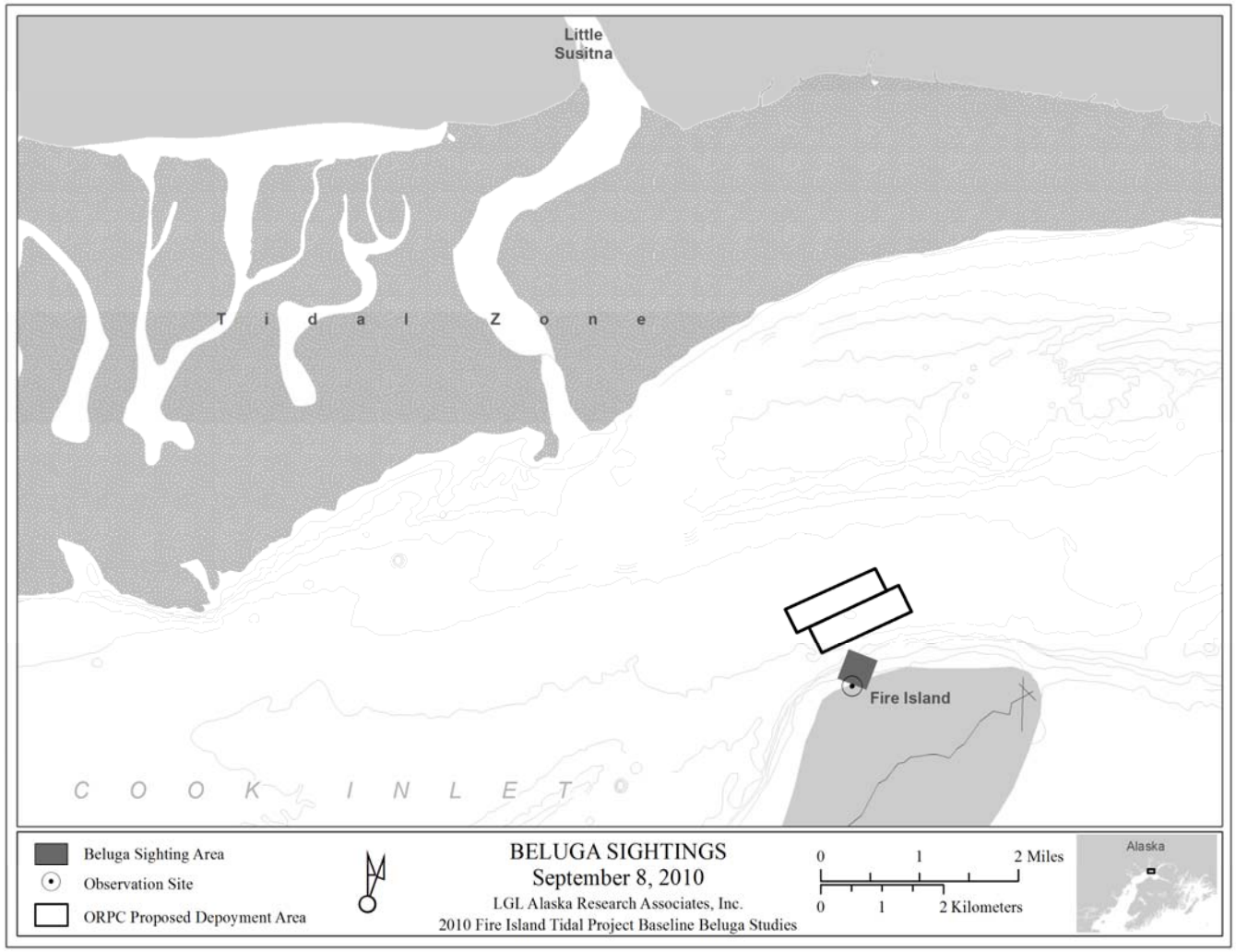

Figure B15. Locations of beluga whales sighted on September 8, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

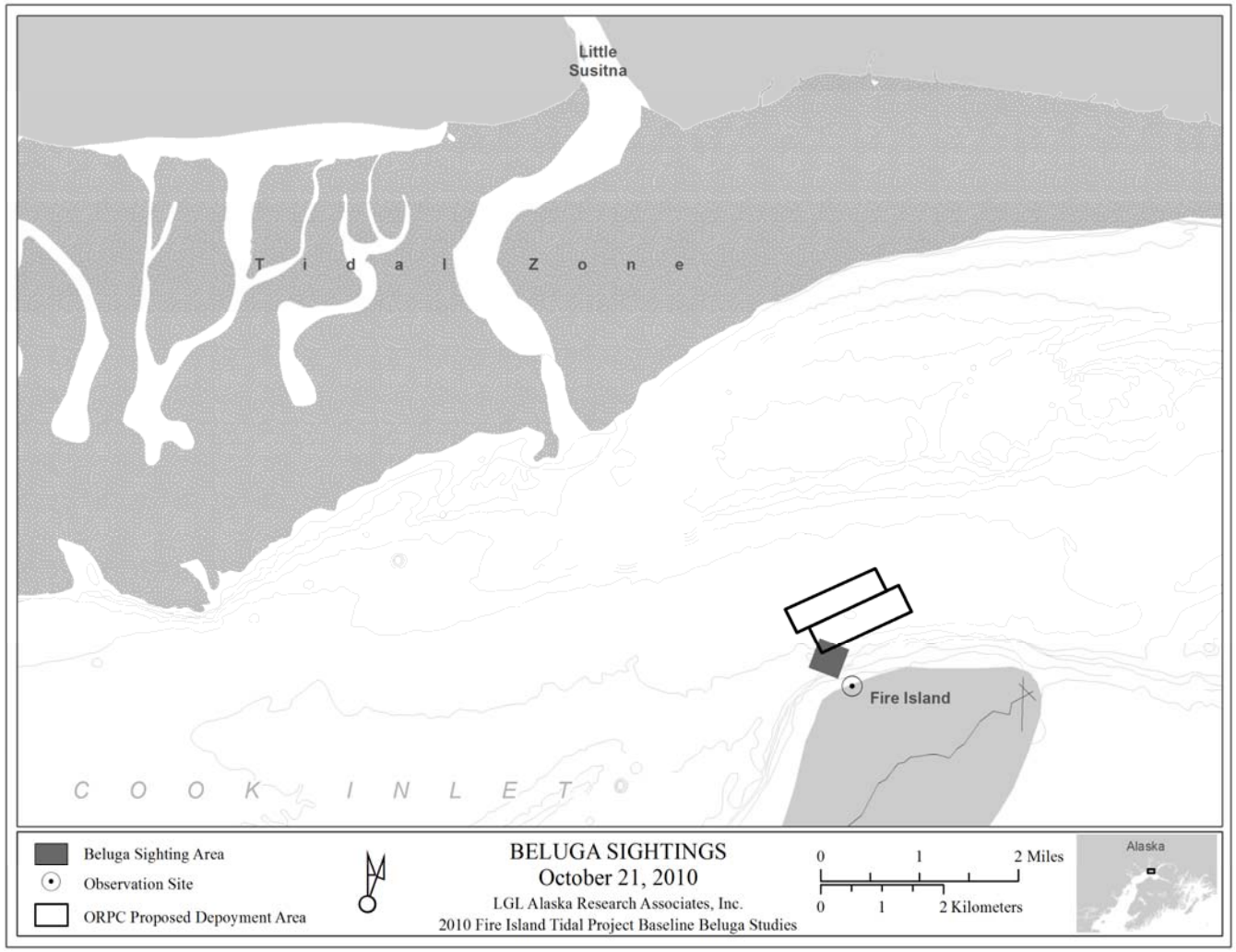

Figure B16. Locations of beluga whales sighted on October 21, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

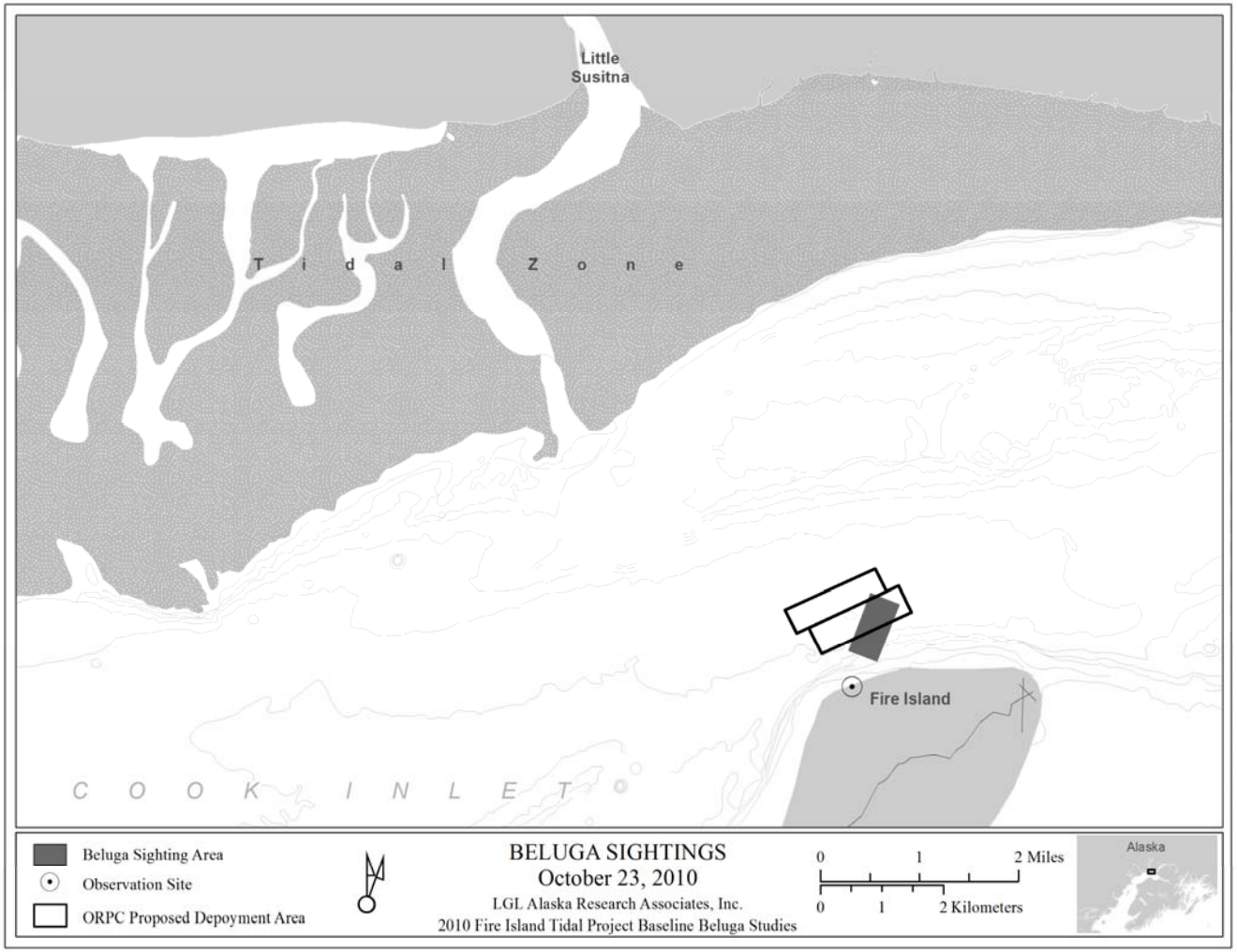

Figure B17. Locations of beluga whales sighted on October 23, 2010. The term Deployment Area refers to the proposed Deployment Area, which is subject to change upon further development of the project.

APPENDIX C

MONITORING EFFORT BY MONTH

*Table C1. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for May 2010. *Near is defined as ≤ 2km/1.2mi from the proposed Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010MAY04	9:10	16:10	7.0	5.62	3.69	5:43	22:12	Yes	Yes
2	2010MAY05	9:10	16:10	7.0	4.26	4.96	5:40	10:14	No	No
3	2010MAY18	9:13	16:13	7.0	7.68	1.48	5:06	10:48	Yes	Yes
4	2010MAY21	8:58	16:00	7.0	2.34	6.47	4:59	10:56	Yes	No
5	2010MAY27	9:10	16:20	7.2	7.81	2.61	4:46	11:10	Yes	No
6	2010MAY28	9:03	16:03	7.0	8.74	0.94	4:44	11:12	Yes	No

*Table C2. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for June 2010. *Near is defined as ≤ 2km/1.2mi from the proposed Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010JUN02	9:01	4:03	7.0	6.18	2.89	4:35	23:22	YES	NO
2	2010JUN03	8:58	4:01	7.0	4.72	4.19	4:34	23:24	NO	NO
3	2010JUN07	8:51	3:55	7.0	2.64	7.02	4:28	23:31	NO	NO
4	2010JUN08	9:03	4:05	7.0	3.37	6.95	4:27	23:32	NO	NO
5	2010JUN16	9:20	16:00	6.7	8.06	0.89	4:21	23:41	NO	NO
6	2010JUN17	9:05	15:50	6.7	6.06	2.71	4:21	23:42	NO	NO
7	2010JUN23	9:15	16:00	6.7	3.98	6.41	4:22	23:44	NO	NO
8	2010JUN24	9:15	16:10	6.9	5.64	5.04	4:22	23:44	YES	NO
9	2010JUN29	9:20	16:00	6.7	8.66	0.16	4:26	23:42	NO	NO

*Table C3. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for July 2010. *Near is defined as ≤ 2km/1.2mi from the proposed Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010JUL01	9:10	16:10	7.0	6.86	2.12	4:28	23:41	NO	NO
2	2010JUL07	9:10	16:10	7.0	2.46	7.04	4:37	23:34	NO	NO
3	2010JUL08	9:10	16:10	7.0	3.38	6.76	4:38	23:33	NO	NO
4	2010JUL13	9:30	15:30	6.0	9.9	-0.76	4:48	23:25	NO	NO
5	2010JUL19	9:05	16:02	6.9	1.14	6.89	5:01	23:13	NO	NO
6	2010JUL27	9:20	16:00	6.7	8.78	0.51	5:20	22:54	YES	NO

*Table C4. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for August 2010. *Near is defined as ≤ 2km/1.2mi from proposed the Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010AUG03	9:20	16:10	6.8	2.40	5.68	5:38	22:36	YES	NO
2	2010AUG10	9:20	16:16	7.1	9.06	1.15	5:56	22:16	YES	NO
3	2010AUG17	9:10	16:06	6.9	1.67	6.52	6:14	21:56	NO	NO
4	2010AUG26	11:07	22:20	12.2	7.17	9.09	6:37	21:28	YES	NO
5	2010AUG27	7:30	16:45	11.2	6.15	1.53	6:39	21:25	NO	NO

*Table C5. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for September 2010. *Near is defined as ≤ 2km/1.2mi from the proposed Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010SEP02	10:05	17:05	7.0	2.98	5.56	6:55	21:06	YES	NO
2	2010SEP03	9:00	16:05	7.7	1.81	6.97	6:57	21:03	YES	NO
3	2010SEP05	10:15	17:10	6.9	1.95	8.02	7:02	20:57	YES	NO
4	2010SEP06	10:16	17:15	7.0	3.22	7.93	7:05	20:54	NO	NO
5	2010SEP08	9:40	16:40	7.0	7.03	5.32	7:10	20:47	YES	YES
6	2010SEP09	10:40	17:40	7.0	6.67	6.29	7:12	20:44	NO	NO
7	2010SEP22	10:05	16:40	6.6	6.29	6.13	7:44	20:03	NO	NO
8	2010SEP23	9:36	16:30	6.9	7.32	4.99	7:47	19:59	NO	NO
9	2010SEP27	9:45	16:40	6.9	8.77	2.08	7:57	19:47	NO	NO
10	2010SEP28	9:40	16:40	7.0	8.10	2.57	7:59	19:43	NO	NO

*Table C6. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for October 2010. *Near is defined as ≤ 2km/1.2mi from the proposed Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010OCT06	9:50	16:30	6.7	4.54	8.21	8:20	19:18	NO	NO
2	2010OCT11	9:50	16:30	6.7	9.44	1.49	8:32	19:03	NO	NO
3	2010OCT15	9:40	16:30	6.8	3.63	6.07	8:43	18:50	NO	NO
4	2010OCT21	9:50	15:00	5.2	5.57	3.49	8:59	18:32	YES	YES
5	2010OCT22	9:50	17:00	7.2	6.68	6.47	9:01	18:29	NO	NO
6	2010OCT23	10:05	17:05	7.0	7.62	5.23	9:04	18:26	YES	YES
7	2010OCT25	10:33	16:00	5.4	7.81	1.95	9:09	18:20	NO	NO

*Table C7. Monitoring effort, tidal height, daylight hours, and summary of beluga sightings for November 2010. *Near is defined as ≤ 2km/1.2mi from the proposed Deployment Area.*

Day	Date	Shift Start	Shift Stop	Total Hours of Observation	Tide Height Start (m)	Tide Height Stop (m)	Sunrise (AKDT)	Sunset (AKDT)	Belugas Sighted	Belugas sighted in or near* the proposed Deployment Area?
1	2010NOV03	10:47	14:00	3.2	1.45	4.59	9:34	17:55	NO	NO
2	2010NOV11	9:41	15:00	5.3	8.36	4.1	8:56	16:34	NO	NO
3	2010NOV12	9:48	12:30	2.7	7.46	7.39	8:58	16:31	NO	NO
4	2010NOV13	11:00	12:40	1.7	7.33	7.64	9:01	16:29	NO	NO

APPENDIX D

BELUGA WHALE SIGHTINGS SUMMARIZED BY DATE

Table D1. Beluga whale sightings during May 2010 are summarized by date. Unk = unknown.

Date	Time	White	Gray	Calves	Unknown	Total	Group #	1° Activity[1]	2° Activity	Spread[2]	Direction[3]	Formation[4]	Belugas sighted within or near proposed Deployment Area?
2010MAY04	10:35-10:35	1	0	0	0	1	1	T	U	na	W	NF	No
2010MAY04	10:57-11:36	1	0	1	0	2	2	T	D	3	W	L	Yes
2010MAY04	11:26-11:26	1	0	0	0	1	3	T	U	na	W	NF	No
2010MAY04	12:13-12:13	1	0	0	0	1	4	T	U	na	SW	NF	No
2010MAY04	15:25-15:25	0	0	1	5	6	5	T	U	13	NE	NF	No
2010MAY18	10:41-10:55	2	0	2	0	4	1	T	D	3	S	U	Yes
2010MAY21	08:58-9:46	52	5	0	0	57	1	T	U	U	U	NF	No
2010MAY21	13:39-14:51	34	0	0	0	34	2	U	U	U	U	U	No
2010MAY27	11:15-11:15	100	0	0	0	100	1	U	U	U	U	U	No
2010MAY28	9:35-9:35	0	0	0	58	58	1	FS	M	>13	na	L	No
2010MAY28	13:04-16:05	0	0	0	62	62	2	T/FS	M	>13	W	L	No

[1] Activity				[2] Spreads (Body Length)		[3] Direction		[4] Formations	
Traveling	T	Resting	R	<1	1	Variable	V	Circular	C
Socialize	S	Spy Hop	SH	1-3	3	Unknown	U	Parallel	P
Dive	D	Milling	M	4-7	7	North	N	Linear	L
Feeding Observed	FO	Other	O	8-12	12	South	S	Echelon	E
Feeding Suspected	FS	Unknown	U	>13	13	East	E	No Formation	NF
				Unknown	U	West	W	Unknown	U

Table D2. Beluga whale sightings during June 2010 are summarized by date. Unk = unknown.

Date	Time	White	Gray	Calves	Unknown	Total	Group #	1° Activity[1]	2° Activity	Spread[2]	Direction[3]	Formation[4]	Belugas sighted within or near proposed Deployment Area?
2010JUN02	14:32–16:00	65	0	0	0	65	1	T	U	>13	E	L	No
2010JUN24	12:45	1	0	0	0	1	1	U	U	<1	U	NF	No
2010JUN24	13:18-14:26	9	0	0	0	9	2	T	U	7	U	U	No

[1] Activity				[2] Spreads (Body Length)		[3] Direction		[4] Formations	
Traveling	T	Resting	R	<1	1	Variable	V	Circular	C
Socialize	S	Spy Hop	SH	1-3	3	Unknown	U	Parallel	P
Dive	D	Milling	M	4-7	7	North	N	Linear	L
Feeding Observed	FO	Other	O	8-12	12	South	S	Echelon	E
Feeding Suspected	FS	Unknown	U	>13	13	East	E	No Formation	NF
				Unknown	U	West	W	Unknown	U

Table D3. Beluga whale sightings during July 2010 are summarized by date. Unk = unknown.

Date	Time	White	Gray	Calves	Unknown	Total	Group #	1° Activity[1]	2° Activity	Spread[2]	Direction[3]	Formation[4]	Belugas sighted within or near proposed Deployment Area?
2010JUL27	9:38-15:55	14	1	0	0	15	1	U	U	U	U	U	No

[1] Activity				[2] Spreads (Body Length)		[3] Direction		[4] Formations	
Traveling	**T**	Resting	**R**	<1	**1**	Variable	**V**	Circular	**C**
Socialize	**S**	Spy Hop	**SH**	1-3	**3**	Unknown	**U**	Parallel	**P**
Dive	**D**	Milling	**M**	4-7	**7**	North	**N**	Linear	**L**
Feeding Observed	**FO**	Other	**O**	8-12	**12**	South	**S**	Echelon	**E**
Feeding Suspected	**FS**	Unknown	**U**	>13	**13**	East	**E**	No Formation	**NF**
				Unknown	**U**	West	**W**	Unknown	**U**

Table D4. Beluga whale sightings during August 2010 are summarized by date. Unk = unknown.

Date	Time	White	Gray	Calves	Unknown	Total	Group #	1° Activity[1]	2° Activity	Spread[2]	Direction[3]	Formation[4]	Belugas sighted within or near proposed Deployment Area?
2010AUG03	11:20-15:30	11	0	0	0	11	1	U	U	U	U	U	No
2010AUG10	9:35-14:33	5	0	0	0	5	1	U	U	U	U	U	No
2010AUG26	15:03-16:51	6	0	0	0	6	1	U	U	U	U	U	No

[1] Activity				[2] Spreads (Body Length)		[3] Direction		[4] Formations	
Traveling	**T**	Resting	**R**	<1	**1**	Variable	**V**	Circular	**C**
Socialize	**S**	Spy Hop	**SH**	1-3	**3**	Unknown	**U**	Parallel	**P**
Dive	**D**	Milling	**M**	4-7	**7**	North	**N**	Linear	**L**
Feeding Observed	**FO**	Other	**O**	8-12	**12**	South	**S**	Echelon	**E**
Feeding Suspected	**FS**	Unknown	**U**	>13	**13**	East	**E**	No Formation	**NF**
				Unknown	**U**	West	**W**	Unknown	**U**

Table D5. Beluga whale sightings during September 2010 are summarized by date. Unk = unknown.

Date	Time	White	Gray	Calves	Unknown	Total	Group #	1° Activity[1]	2° Activity	Spread[2]	Direction[3]	Formation[4]	Belugas sighted within or near proposed Deployment Area?
2010SEP02	10:43	5	0	0	0	5	1	T	U	3	W	L	No
2010SEP03	11:56	10	1	0	0	11	1	U	U	U	U	U	No
2010SEP05	10:45-11:28	5	3	0	0	8	1	O	U	U	U	U	No
2010SEP08	13:53	1	0	0	0	1	1	T	U	N/A	E	N/A	Yes

[1] Activity				[2] Spreads (Body Length)		[3] Direction		[4] Formations	
Traveling	**T**	Resting	**R**	<1	**1**	Variable	**V**	Circular	**C**
Socialize	**S**	Spy Hop	**SH**	1-3	**3**	Unknown	**U**	Parallel	**P**
Dive	**D**	Milling	**M**	4-7	**7**	North	**N**	Linear	**L**
Feeding Observed	**FO**	Other	**O**	8-12	**12**	South	**S**	Echelon	**E**
Feeding Suspected	**FS**	Unknown	**U**	>13	**13**	East	**E**	No Formation	**NF**
				Unknown	**U**	West	**W**	Unknown	**U**

Table D6. Beluga whale sightings during October 2010 are summarized by date. Unk = unknown.

Date	Time	White	Gray	Calves	Unknown	Total	Group #	1° Activity[1]	2° Activity	Spread[2]	Direction[3]	Formation[4]	Belugas sighted within or near proposed Deployment Area?
2010OCT21	11:25	1	1	0	0	2	1	T	U	1	W	N/A	Yes
2010OCT23	14:57-15:00	1	0	0	0	1	1	T	U	N/A	NE	N/A	Yes

[1] Activity				[2] Spreads (Body Length)		[3] Direction		[4] Formations	
Traveling	**T**	Resting	**R**	<1	**1**	Variable	**V**	Circular	**C**
Socialize	**S**	Spy Hop	**SH**	1-3	**3**	Unknown	**U**	Parallel	**P**
Dive	**D**	Milling	**M**	4-7	**7**	North	**N**	Linear	**L**
Feeding Observed	**FO**	Other	**O**	8-12	**12**	South	**S**	Echelon	**E**
Feeding Suspected	**FS**	Unknown	**U**	>13	**13**	East	**E**	No Formation	**NF**
				Unknown	**U**	West	**W**	Unknown	**U**