2011 ANNUAL MARINE MAMMAL MONITORING REPORT

Construction and Scientific Marine Mammal Monitoring Associated with the Port of Anchorage Intermodal Expansion Project, Marine Terminal Redevelopment

In Accordance with the Letter of Authorization Issued by the National Marine Fisheries Service for July 15, 2011 through July 14, 2012.

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Cover: Anchorage Public Boat Dock Station. View facing west, overlooking Knik Arm and Mt. Susitna. Scientific Marine Mammal Observer facing north, October 2011.

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Scientific Marine Mammal Monitoring Program 2011 Annual Report:
Distribution, Habitat Use and Behavior of Cook Inlet Beluga Whales and Other Marine Mammals at the Port of Anchorage Marine Terminal Redevelopment Project June-November 2011

1.0 INTRODUCTION AND PURPOSE

Located within the Municipality of Anchorage on the Knik Arm of Cook Inlet (Figure 1), the Port of Anchorage (Port) handles 90 percent of all consumer goods and cargo for 85 percent of the population of the state of Alaska. The Port is currently operating at or above sustainable practical capacity for the majority of the cargo types handled. Existing facilities and structures are substantially beyond reasonable design life and degraded to levels of marginal operation safety; many are functionally obsolete. The US Department of Transportation, Maritime Administration (Maritime Administration) under a Memorandum of Agreement with the Municipality of Anchorage, owner and operator of the Port of Anchorage (POA) administration, is overseeing the expansion effort, the Port of Anchorage Intermodal Expansion Project (PIEP) Marine Terminal Redevelopment (MTR Project). Integrated Concepts and Research Corporation (ICRC), prime contractor for the Maritime Administration, is managing the MTR Project construction, design, and permitting process. Port construction activities were authorized under the US Army Corps of Engineers (USACE) 404/10 Permit *POA-2003-502 issued* in August 2007.

The pile-driving equipment used for construction of the wharf generates sound waves within the water, which have the potential to present a disturbance hazard to marine mammals. The Marine Mammal Protection Act (MMPA) defines this type of hazard as *Level B Harassment*, “an act that has the potential to disturb a marine mammal stock in the wild by causing disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.”

In July 2009, the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) published a *Biological Opinion* as a result of a formal Section 7 Consultation under the Endangered Species Act. The Biological Opinion was based, in part, on the *Biological Assessment of the Beluga Whale Delphinapterus leucas in Cook Inlet for USACE Dredging and Marine Terminal Redevelopment Project at the Port of Anchorage, Alaska,* submitted to NOAA/NMFS March 2009 by the Maritime Administration, the POA, and the USACE. In-water construction activities for the MTR Project are conducted according to the conditions of the Biological Opinion.

Prior to the 2011 MTR construction season, in compliance with the MMPA, the POA and the Maritime Administration applied for and received an annual Letter of Authorization (LOA), from NOAA/NMFS for the period 15 July 2011 through 14 July 2012. The 2011-2012 LOA allows

Level B "takes" of marine mammals during in-water construction activities associated with the MTR Project. The regulations governing the issuance of an LOA are codified in 50 Code of Federal Regulations (CFR) Part 217, Subpart U. Where applicable, the stipulations of the 2011-2012 LOA supersede those of Special Condition (SC) IV of the 2007 USACE 404/10 Permit.

1.1 Annual Reporting for USACE and NMFS Permits

The POA and the Maritime Administration have implemented NMFS-approved marine mammal monitoring programs that collect information on marine mammal behavior in the vicinity of the Port. The monitoring programs were designed to comply with the conditions of the 404/10 Permit, the Biological Opinion, and the LOA. Details of these programs are described in the Marine Mammal Monthly Reports for July through November 2011. The 2011 Annual Marine Mammal Monitoring Report meets the reporting requirements of the NMFS LOA and the USACE 404/10 Permit, SC-IV(1)E; there are no reporting requirements associated with the Biological Opinion.

2.0 MTR CONSTRUCTION: WET BARGE BIRTH - NORTH EXTENSION BULKHEAD

Construction activities during 2011 were conducted at the Wet Barge Berth and North Extension Bulkhead from May through December; in-water construction was conducted intermittently between 17 July and 27 September. The following activities took place at the construction site:

- Placement of fill material
- Removal of steel sheet pile
- Dredging (Figure 2)
- Quality assurance inspection activities

3.0 SAFETY AND HARASSMENT ZONES

As required by the 404/10 Permit, the LOA, and the Biological Opinion, the POA and the Maritime Administration established safety and harassment zones at the MTR Project construction site. The presence of marine mammals was monitored before and during in-water work activities. If the applicable safety and harassment zones were not visible because of fog, poor light, darkness, sea state, or any other reason, in-water construction activities were safely shut down until the area was once again visible.

3.1 Safety Zones

The LOA established conservative *safety zones* to prevent in-water construction activities from physically harming marine mammals. When marine mammals are sighted either approaching the safety zones or surfacing within the safety zones, all in-water construction activities must be suspended until the marine mammal has moved to a safe distance or had not been sighted within the safety zones for at least 15 minutes. The enforced safety zones are:

- 50 meters (m) from in-water construction activities that do not involve vibratory or impact pile driving, such as dredging and fill placement
- 200 m from either vibratory or impact pile driving

3.2 Harassment Zones

The LOA also established conservative *harassment zones* for in-water construction. The following harassment zones and protocols were in effect during the 2011 construction season:

- 350 m from impact pile driving
- 1300 m from vibratory pile driving

Suspension of in-water pile driving when marine mammals approach or are sighted within these zones is encouraged, but not mandatory, *with the following exceptions*:

- No Level B takes of beluga whale calves are allowed when a beluga calf or calves are sighted approaching the harassment zones or are sighted within the harassment zones.
- To limit the number of takes and avoid exceeding the authorized take limit, when a group of five or more beluga whales is sighted approaching the harassment zones, in-water pile driving is suspended.

Under the preceding conditions, which were in effect during the 2011 construction season and will be in effect for the upcoming 2012 construction season, in-water pile driving activities are suspended until the marine mammal(s) are sighted 1) outside of, and moving away from, the harassment zones or 2) have not been sighted within a harassment zone for at least 15 minutes. In addition, for compliance with the conditions of the 404/10 Permit, the Biological Opinion, and the LOA, no in-water impact pile driving is conducted within two hours of published low tide occurrence.

3.3 Take Count

A take occurs when a marine mammal(s) is sighted within the safety and harassment zones while in-water construction activities are being conducted. The LOA permits the POA and the

Maritime Administration to *take by Level B harassment*: 34 beluga whales *(Delphinapterus leucas)*, 20 harbor porpoises (*Phocoena phocoena)*, 20 harbor seals *(Phoca vitulina)*, and 5 killer whales *(Orcinus orca)* annually during MTR Project construction activities. Construction marine mammal observers are contractually required to keep an accurate take count of marine mammals sighted within the safety and harassment zones and report the take(s) on an NMFS-approved sighting form. Once the allowable number of takes for a marine mammal species has been reached, the harassment zones are treated as mandatory shutdown zones.

4.0 MARINE MAMMAL MONITORING LOCATIONS

At the beginning of the 2011 construction season, ICRC relocated two existing marine mammal monitoring stations from observation locations on Joint Base Elmendorf-Richardson (JBER) (Figure 3). One station was moved to the north end of the MTR Project Site (NE Station) and the other to the Anchorage Public Boat Dock (APBD Station). The decision to relocate the connexes was based on compliance with LOA monitoring conditions, as well as marine mammal observer (MMO) access and safety considerations.

The connexes were both constructed with roof platforms with overhead protection and railings. These additions provide the MMOs some protection from the harsh weather conditions and allow access from the inside of the connex to the platform on the roof.

4.1 Anchorage Public Boat Dock Station

The marine mammal monitoring station located at the APBD near Ship Creek (Figure 4) provides an unobstructed view of Knik Arm to the south, west and north. The station is convenient to access, since no passes or permits are required. This station was staffed by the Scientific MMOs from July through mid-November 2011.

4.2 North End Station

The NE Station also provides optimal views of Knik Arm to the south, west, and north (Figure 5). This station was staffed by the Scientific MMOs June through mid-November 2011, and by the Construction MMOs as in-water work required.

5.0 MARINE MAMMAL MONITORING PROGRAMS

The Maritime Administration is responsible for implementing both the Scientific Program and the Construction Program. The marine mammal monitoring area includes all waters within the Knik Arm of Upper Cook Inlet visible from the site of the in-water construction activities located near

and offshore of the Port. During marine mammal monitoring and data collection activities in 2011, particular emphasis was placed on documenting marine mammal abundance, frequency, and response to construction activities within the area of Knik Arm near the MTR Project.

5.1 Construction Marine Mammal Monitoring Program

The Construction Program requires that Construction MMOs be present at all times during in-water construction activities and also 30 minutes prior to commencement of in-water pile driving. In 2011, the firm 61 North, under contract to West Construction Company, ICRC's construction subcontractor, provided qualified Construction MMOs who were stationed at the best vantage points practicable to monitor in-water construction and the waters of Knik Arm.

5.1.1 Construction Marine Mammal Sighting Form

The Construction MMOs documented marine mammal sightings on the NMFS-approved Construction Marine Mammal Sighting Form (Figure 6). The marine mammal species, number, location, behaviors, and movements were recorded on the sighting forms. All sightings are verified for information (e.g., accuracy for the number of animals per sighting; the number of adults, juveniles, and calves; and if shutdowns or delays occurred). In addition to documenting marine mammal sighting information on the form, the Construction MMOs recorded the type of construction work ongoing at the time of the sighting (e.g., dredging, vibratory hammer operation, or no construction activity when applicable).

When a marine mammal was sighted, a Construction MMO immediately notified the construction Project Manager and the equipment operators of the marine mammal's distance and direction of travel to expedite a decision on equipment shutdown. For quality control purposes, the Construction MMO Supervisor was required to submit a *No Sightings* form for the days when Construction MMOs were on duty but no marine mammals were observed.

The individual sighting forms completed by the Construction MMOs were provided in the monthly reports submitted to USACE and NMFS. Before the beginning of the 2011 construction season, ICRC revised the 2010 marine mammal sighting form to provide the most current, up-to-date maps for the MMOs. ICRC provided the updated form to NMFS.

Each Construction MMO was equipped with high-powered binoculars and trained in distance estimation, as well as the detection and identification of marine mammals. The Construction MMOs had no other construction-related task and were required to be fully engaged in monitoring. Prior to the start of the 2011 construction season, ICRC reviewed the

comprehensive Construction Marine Mammal Monitoring Plan submitted by the Construction Subcontractor to verify that it met the contractual requirements of the POA, the Maritime Administration, and ICRC, and that it met the conditions of the 404/10 Permit, the Biological Opinion, and the LOA.

5.2 Scientific Marine Mammal Monitoring Program

The Alaska Pacific University (APU) Environmental Science Program, Marine Biology Department, implemented the 2011 Scientific Program. Scientific MMOs documented the abundance and frequency at which beluga whales and/or other marine mammals were within or adjacent to the MTR Project footprint. They also recorded habitat use, behavior, direction of travel, and group composition, as well as the animals' reactions or changes in behavior in response to in-water construction activities or other in-water Port activities taking place at the time of the observation (Figure 7).

In June 2011, the Scientific MMOs began scheduled marine mammal observation from the NE Station and began using the APBD Station in July. Both stations provided the Scientific MMOs with a better view of Knik Arm and the Port (Figure 8) than the marine mammal monitoring station formerly located at Cairn Point. The Scientific MMOs utilized high-powered binoculars and a surveyor's theodolite to see marine mammals and track their movements The Scientific MMOs worked in collaboration with the Construction MMOs to immediately communicate information about beluga whales or other marine mammals that were approaching the Port area.

Monitoring was conducted an average of 32 hours per week, in 4- to 6-hour shifts. A weekly report that documented the days that the MMOs staffed the observation stations the previous week, and the number of marine mammals they observed, was submitted to ICRC each Monday. A weekly summary of sightings was provided to the USACE and NMFS.

5.2.1 Scientific Marine Mammal Observation Log

In addition to documenting the location, behaviors, and estimated age of beluga whales, the Scientific MMOs also recorded visibility, weather, and sea-state information. The data form used to record this information is provided in the Scientific Marine Mammal Monitoring Program 2011 Annual Report: *Distribution, Habitat Use and Behavior of Cook Inlet Beluga Whales and Other Marine Mammals at the Port of Anchorage Marine Terminal Redevelopment Project June-November 2011,* located in the appendix.

6.0 CONSTRUCTION ACTIVITIES

The focus of construction at the start of 2011 was removal of the sheet pile tailwalls of the Wet Barge Berth bulkhead (out of water work). Activities then transitioned to fill excavation and backfill behind the existing bulkhead to support inspections of the tailwalls of the North Extension bulkhead. The final construction season activity consisted of out-of-water vibracompaction of the fill material at the North Extension.

6.1 In-Water Work

In water work during the 2011 construction season consisted of 14 days of dredging and intermittent use of the vibratory hammer over two days, as shown on (Table 1). The last day of in-water work and Construction Marine Mammal Monitoring was 27 September.

6.1.1 Delay and Shutdowns of Construction Activities

In compliance with the conditions of the 404/10 Permit, the Biological Opinion, and the LOA, construction activities were delayed once and shut down twice on 18 September in response to marine mammals approaching the harassment zones.

7.0 *MARINE MAMMAL MONITORING DATA*

The following sections summarize the data collected in 2011 by the Construction and Scientific MMOs. Figure 9 presents the grid system used by both programs to generally report the locations of marine mammal sighted. Figure 9 also presents the different terminology used by each program to refer to animal sightings in relation to the MTR Project. The data collected for each marine mammal monitoring program are not easily comparable because observations were performed with significant variances between the programs; such as the number of hours per day when observation was performed, duration of the observation period, the type of construction ongoing during observation, and the locations of the MMOs. A brief summary of the two 2011 monitoring programs is provided in Table 2.

7.1 Construction Program Marine Mammal Monitoring Data

The Construction MMOs observed a total of 50 animals during 7 separate sightings, all recorded during 3 days of observation in September (Table 1). Forty-eight of the animals were beluga whales (16 white; 24 gray; and 8 dark gray) and two were harbor seals. No unusual behavioral events were reported as a response to construction activities. No marine mammals were

observed by the Construction MMOs during four days of observation in July, three days of observation in August, and six of the nine days of observation in September.

7.1.1 Marine Mammal Takes

Four incidental, Level-B beluga whale takes occurred during one day of the 2011 construction season; on 18 September. The Construction Program for 2012 will include measures to maintain, and not exceed, the remaining allowable marine mammal takes through 14 July 2011. The current status of marine mammal takes under the 2011-2012 LOA is as follows:

Construction Takes: 15 July – 15 November 2011

- 4 beluga whale
- 0 harbor seal
- 0 harbor porpoise
- 0 killer whale

Remaining Allowable Takes through 14 July 2012

- 30 beluga whale
- 20 harbor seal
- 20 harbor porpoise
- 5 killer whale

7.1.2 Comparison of Data Collected by the Construction MMOs in 2011 with the Data Collected in 2010, 2009, and 2008

Information on beluga whale behavior and abundance in the Knik Arm of Upper Cook Inlet has been collected for the PIEP since 2005, one year before construction began at the MTR Project site. Placement of fill material began in 2006, and in-water pile driving in 2008.

However, the marine mammal data gathered by the Construction MMOs during the 2011 MTR Construction Season is not typical of the data gathered during the previous 2010, 2009, and 2008 MTR construction seasons. The focus of the 2011 Construction Season, as explained in Section 6.0, was inspection of the sheet pile installed during previous construction seasons, removal of selected sheet pile tailwalls, and dredging. Most of this work was accomplished out of water and required relatively few days of in-water work. For this reason, the Construction MMOs were on site for only 16 days during 2011, as compared to 106 days in 2010, 231 days in 2009, and 108 days in 2008 (Table 3). Since pile driving began in 2008, the MTR Project construction activities have varied in type and duration. Activities included fill placement, dredging, and extensive or limited sheet pile driving/removal. Due to these variations, the only clear trend identified is that the number of marine mammals reported has varied with the number of days of monitoring during in-water construction.

7.2 Scientific Program Marine Mammal Monitoring Data

Beginning 28 June and continuing through 15 November, the Scientific MMOs conducted approximately 1202 hours of marine mammal observation over a 104-day period. The last day of Scientific Program monitoring was 15 November 2011, when ice conditions inhibited observation (Figure 10). The MMOs observed a total of 62 beluga whale groups, a total of 290 beluga whales (164 white; 122 gray; 4 dark gray), 57 harbor seals, and 6 harbor porpoises. Data collected by the Scientific Program were provided to USACE and NMFS as part of the PIEP monthly marine mammal monitoring reports.

7.2.1 Summary of Scientific Program Data

The Scientific MMOs reported 62 beluga whale groups within approximately 1,202 hours of observation; resulting in an overall sighting rate of 0.05 groups per hour of effort. Only three groups sighted contained calves. The highest sighting rate occurred between 1600 hours and 1700 hours in the day, and nearly half of the sightings occurred during low slack tide. Beluga whales were primarily observed moving south through the study area during mid-to-late summer and traveling north during the early fall. Traveling, diving, suspected feeding, and milling behaviors were recorded, with no confirmed feeding events. Three unusual behavioral events were reported (abrupt directional change, abrupt swim speed changes, dispersal) during dredging operations with no other in-water construction ongoing.

The Scientific Marine Mammal Monitoring Program 2011 Annual Report provided in the appendix provides greater detail regarding the 2011 observations. It also provides interannual comparisons for observations from 2007 through 2011.

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TABLES

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Table 1. Cumulative Summary: Marine Mammal Sightings by the Construction Marine Mammal Observers and Hours/Days of In-Water Work, 2011

Day/Month	Number of Marine Mammal Sightings	Number of Marine Mammals Observed	Marine Mammal Species, Number, and Group Composition[1]	Animals in Safety Zones[2]	Animals in Harassment Zones[3]	Shutdowns and Delays[4]	Takes[5]	In-Water Work: Dredging (days)	In-water Work: Pile Driving[6] with Vibratory Hammer (hours)	In-water Work: Pile Driving with Vibratory Hammer (days)	In-water Work: Pile Driving with Impact Hammer (days)	In-water Work: Stabbing with Vibratory Hammer (days)
17 July	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
18 July	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
19 July	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
20 July	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
9 August	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
10 August	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
11 August	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
17 September	0	N/A	N/A	N/A	N/A	N/A	N/A	0	2.50	1	0	0
18 September	4	1st Sighting: 9 2nd Sighting: 1 3rd Sighting: 9 4th Sighting: 1	1st Sighting: beluga whales (0 white; 7 gray; 2 dark gray) 2nd Sighting: harbor seal 3rd Sighting: beluga whales (0 white; 7 gray; 2 dark gray) 4th Sighting: harbor seal	1st Sighting: 0 2nd Sighting: 0 3rd Sighting: 9 4th Sighting: 0	1st Sighting: 9 2nd Sighting: 0 3rd Sighting: 0 4th Sighting: 0	1st Sighting: *1 delay* 2nd Sighting: *No delays or shutdowns* 3rd Sighting: *2 shutdowns* 4th Sighting: *No delays or shutdowns*	3rd Sighting: 4 beluga whale takes	0	5.25	1	0	0
21 September	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
22 September	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
23 September	2	1st Sighting: 3 2nd Sighting: 3	1st Sighting: beluga whale (2 white; 1 gray; 0 dark gray) 2nd Sighting: beluga whale (2 white; 0 gray; 1 dark gray)	1st Sighting: 0 2nd Sighting: 0	1st Sighting: 0 2nd Sighting: 0	No delays or shutdowns	0	1	0	0	0	0
24 September	1	24	beluga whales (12 white; 9 gray; 3 dark gray)	0	0	No delays or shutdowns	0	1	0	0	0	0
25 September	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
26 September	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
27 September	0	N/A	N/A	N/A	N/A	N/A	N/A	1	0	0	0	0
	7	50	48 beluga whale (16 white; 24 gray; 8 dark gray) 2 harbor seal	9	18	1 delay; 2 shutdowns	4 beluga whales	14	7.75	2	0	0

Notes

1. Distribution of white, gray, and dark gray beluga whales.
2. Safety zones under the National Marine Fisheries Service Letter of Authorization (LOA): 200 meters (m) from either vibratory or impact pile driving; 50 m from other in-water project activities. Animals that entered the Safety zones also entered the Harassment zones
3. Harassment zones under the LOA: 350 m from impact pile driving; 1,300 m from vibratory pile driving. Some of the animals that entered the Harassment zones also entered the Safety zones.
4. In-water construction activities were shut down or delayed until marine mammal(s) left the harassment zones.
5. The LOA for 15 July 2011 through 14 July 2012 allows 34 beluga whale takes, 20 harbor seal takes, 20 harbor porpoise takes, and 5 killer whale takes.
6. The vibratory hammer is used for both driving and pulling (removing) sheet pile.

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Table 2. Summary of Marine Mammal Monitoring Programs, 2011

Key Elements	Construction Program	Scientific Program
Mission	Monitor marine mammal movements to assist the construction contractor in complying with the conditions of the USACE 404/10 Permit, Letter of Authorization (LOA) and Biological Opinion. Enforce safety and harassment start up and shut down requirements.	Collect scientific data on marine mammals to characterize abundance and habitat use; document behavioral changes in response to in-water construction.
Location of Monitoring Stations	Two locations: the north end of the MTR Project site and the Anchorage Public Boat Dock.	Two locations: the north end of the MTR Project site and the Anchorage Public Boat Dock.
Number of Marine Mammal Observers (MMOs)	One MMO: at the dredge site Three MMOs: one at each of the two monitoring stations and one near the vibratory hammer when used.	Two MMOs: one at each of the two monitoring stations.
Days Worked On Site by MMOs	16 days.	104 days.
Monitoring Duration	17 July through 20 July; 9 August through 11 August; and 17 September through 27 September.	28 June through 15 November.

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Table 3. Number of Marine Mammals Reported by the Construction Marine Mammal Observers: 2008-2011

Year	Harbor Seal	Harbor Porpoise	Beluga Whale	Total Number of Marine Mammals Reported by the Construction Marine Mammal Observers	Number of Marine Mammal Observation Days	Comments
2008	1	0	231	431	108	*In-water construction: fill placement and begin pile driving*
2009	34	20	1221	1281 (includes 3 Steller sea lion)	231	*In-water construction: pile driving double shifts*
2010	13	2	731	746	106	*In-water construction: pile driving*
2011	2	0	48	50	16	*Limited in-water construction: fill placement and dredging*

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FIGURES

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Figure 1. Project Location

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Figure 2. Manson dredge barge. White anchor buoy to left of crane cable.

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Port of Anchorage Intermodal Expansion Project

Figure 3: Marine Mammal Monitoring Stations

Photo Date:
June 21, 2010

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Figure 4. Anchorage Public Boat Dock Marine Mammal Monitoring Station. Scientific Marine Mammal Observer and theodolite facing west. July 2011.

Figure 5. North End Marine Mammal Monitoring Station, Marine Terminal Redevelopment Project Site. View facing south, Scientific Marine Mammal Observer facing west toward Knik Arm. August 2011.

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Marine Mammal Sighting Form – Construction Marine Mammal Monitoring Program
Port of Anchorage Marine Terminal Redevelopment Project

Date of Observation: _____ Observer Name & Affiliation: _____

Observer Location: _____ Total marine mammals sighted: _____ *TAKE COUNT this sighting:* _____

Sighting #: _____ *(1st sighting of the day is Sighting #1)* *If Take occurs, report immediately.*

Time of First Sighting ↓	Time of Last Sighting ↓	Weather Conditions (circle) ↓	Species (circle) ↓	Number of Marine Mammals Sighted ↓	↓	↓	Number of Marine Mammals in Each Classification ↓	Initial Heading (circle) ↓	Final Heading (circle) ↓
		sunny sun/clouds overcast light rain rain light snow snow fog	beluga whale harbor seal harbor porpoise killer whale Other:	Outside Harassment Zones:	Inside Harassment Zones:	Inside Safety Zones:	*Use these color classifications for beluga whales:* White _____ Gray _____ Dark Gray (Calf): ___ ********** *Use these classifications for other marine mammals:* Adults _____ Juveniles _____ Calves /Pups ____ Unknown age ____ Unidentified sex ____ Male ____ Female ____	N NE NW W S SE SW E	N NE NW W S SE SW E

Distances & map coordinates of marine mammal(s) from in-water noise source (meters):
(If no in-water work in progress, record distance to nearest crane/hammer.)

1. Initial Distance = _____ 2. Closest Distance = _____ 3. Final Distance = _____

Grid Map coordinates _____ Grid Map coordinates _____ Grid Map coordinates _____

Tidal Stage at time of sighting (circle): *low slack* *low ebb* *low flood* *high slack* *high ebb* *high flood*

Beaufort Sea State (circle) *0* *1* *2* *3* *4* *5*

In-Water Project Activities at time of sighting (check box that applies) ☐ *NO in-water activity*

☐ *Dredging* ☐ *Stabbing (no hammer)* ☐ Stabbing with hammer ☐ *Vibratory hammer* ☐ *Impact hammer*

ICRC 15 April 2011 Rev 10

Figure 6. Construction Marine Mammal Monitoring Form

Sighting # _____ / Date _____

☐ *Project activities were (circle one) SHUT DOWN or DELAYED from _____ to _____ (time).*

☐ *Project activities WERE NOT shut down. Explanation Required:*

Behavior of Marine Mammal: *(mark X to indicate all marine mammal behaviors observed)*

( ) traveling	( ) diving	( ) resting	( ) milling
( ) swimming	( ) swimming toward construction	( ) swimming away from construction	( ) fleeing
( ) feeding observed	( ) feeding suspected	( ) mating	( ) other

Describe initial group cohesion (orientation & how far apart): _____

Describe final group cohesion: _____

Change in behavior ? ☐ *NO* ☐ *YES* → *Time: _____*

If YES, circle one: in response to Project construction? in response to other Port activities?

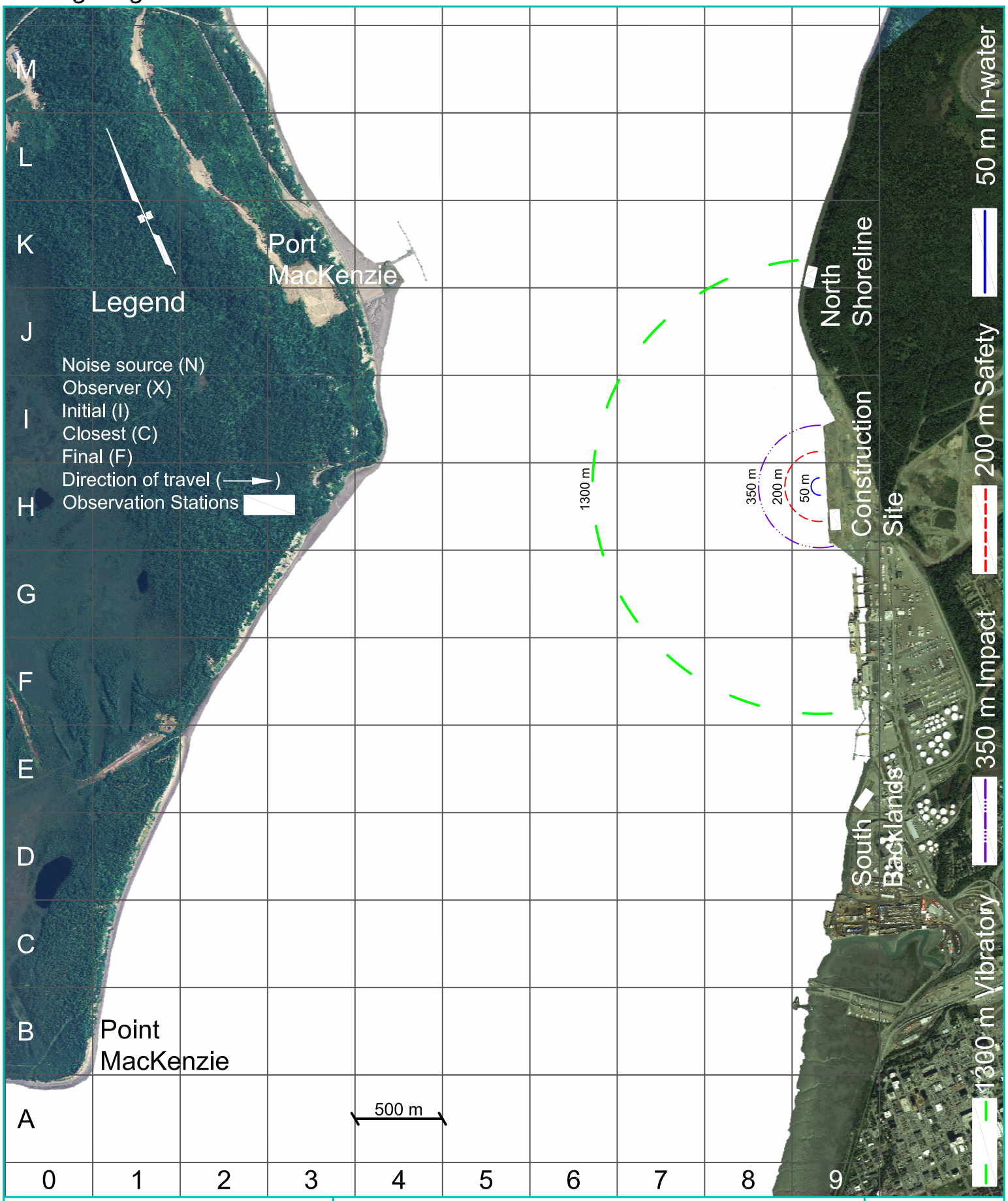
Describe behavioral change:

Describe construction or other port activity at time of behavioral change:

Additional Information: *(describe additional marine mammal behaviors and/or patterns observed)*

Pages 3 and 4 of this form are grid maps. Use these maps to mark the location of the marine mammals, the noise source, and the marine mammal observer. The page 3 grid map (3/4 inch = 500 meters) shows the project area and Knik Arm. The page 4 grid map (1/4 inch = 500 meters) shows the project area and an extended view of Knik Arm. Use the page 4 map when the marine mammal's location is beyond the borders of the page 3 map.

Sighting #: Date:



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Sighting Form

Construction Marine Mammal Monitoring

Sighting #: Date:

Figure 7. Two beluga whales swimming in Knik Arm.

Figure 8. Anchorage Public Boat Dock Station. View to the north of Knik Arm, Port of Anchorage, and Marine Terminal Redevelopment Project site. 1 July 2011.

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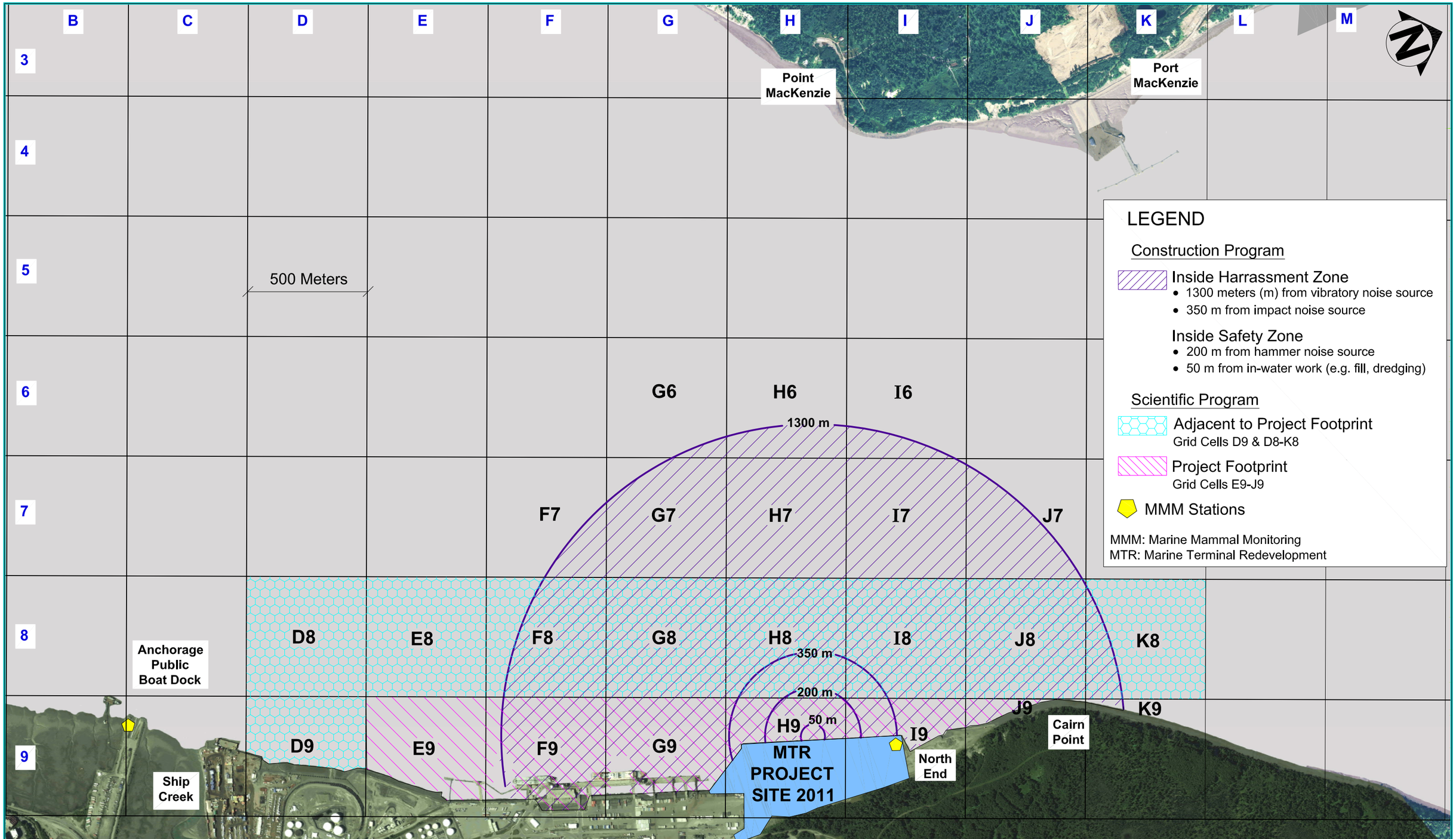

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Figure 9: Marine Mammal Monitoring Area

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12-19-11

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Figure 10. Scientific Marine Mammal Observer at Anchorage Public Boat Dock Station. View to the north. Last day of observation, 15 November 2011.

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APPENDIX

Scientific Marine Mammal Monitoring Program
2011 Annual Report

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Distribution, Habitat Use and Behavior of Cook Inlet Beluga Whales and Other Marine Mammals at the Port of Anchorage Marine Terminal Redevelopment Project
June – November 2011

Scientific Marine Mammal Monitoring Program
2011 Annual Report

Prepared for

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1.0 Executive Summary

This report summarizes the 2011 activities of the Scientific Marine Mammal Monitoring Program (Scientific Program). The Scientific Program was conducted for the US Department of Transportation, Maritime Administration (Maritime Administration), the Port of Anchorage (POA), and Integrated Concepts and Research Corporation (ICRC), in conjunction with the Port of Anchorage Intermodal Expansion Project (PIEP), Marine Terminal Redevelopment (MTR), as required by the 2011-2012 Letter of Authorization (LOA) issued to the POA and the Maritime Administration in June 2011 by the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS).

The Scientific Program was designed to meet the scientific monitoring objectives set forth by the NMFS, within the project scope agreed upon by the Maritime Administration, the lead federal agency for the MTR Project, the POA, and ICRC. The Scientific Program was conducted by trained graduate and undergraduate Marine Mammal Observers (MMOs) from the Alaska Pacific University (APU) Marine Biology program. *The Scientific Marine Mammal Monitoring Program 2011 Annual Report* presents information required by the LOA on Cook Inlet beluga whale (*Delphinapterus leucas*) and other marine mammal presence, habitat use and behavior within and near the Port of Anchorage (Port) in the Knik Arm of Cook Inlet, Alaska.

In addition to marine mammal monitoring and data collection efforts, Scientific MMOs provided real-time information (e.g., marine mammal sightings, proximity of animals to the construction site) to Construction MMOs working with the MTR construction crew at the Port. During APU's monitoring and data collection activities, particular emphasis was placed on documenting the presence of beluga whales within and near the MTR Project footprint and evaluating, as practicable, the potential responses of beluga whales to construction activities. This information was communicated between the Scientific and Construction MMOs.

A total of ~1202 hours of observational effort was completed across 104 days from 28 June 2011 through 15 November 2011. Overall sighting conditions during the entire study period were moderate. A total of 290 beluga whales (164 white, 122 gray, 4 dark

gray calves) in 62 groups was observed during the monitoring period, resulting in an overall sighting rate of 0.05 groups sighted per hour of effort. Mean group size was 4.7 ± .60 individuals. Only three groups contained identified calves, two of which were sighted within or adjacent to the MTR Project footprint. The overall sighting rate was lower in 2011 despite doubled observational effort, although the total number of whales observed was greater. The total number of calves observed has been reduced by over 80% from 2009 – 2011 compared to 2007 – 2008.

There were three unusual behavioral events (abrupt directional change, abrupt swim speed change, dispersal) during the study period. Dredging was occurring during all three of these events, but no other in-water construction activity.

2.0 Program Objectives

The Scientific Program addresses the following objectives:

1. Estimate the frequency at which beluga whales and other marine mammals are present within and adjacent to the MTR Project footprint;
2. Characterize habitat use and behavior of beluga whales near the MTR Project footprint during ice-free months in the Knik Arm of Upper Cook Inlet; and
3. Observe, analyze and document potential changes in beluga whale and other marine mammal habitat use and behavior in response to in-water construction.

APU provided Scientific MMOs, under the supervision of Associate Professor Dr. Leslie Cornick, Environmental Science Department, to staff two observation stations located at the North End of the MTR Project (NE Station) and at the Anchorage Public Boat Dock (APBD Station). When both programs' MMOs are observing, the Scientific MMOs communicate regularly with the Construction MMOs in order to exchange information about the presence of beluga whales and other marine mammals. Scientific MMOs are not responsible for construction shutdown decisions.

3.0 Methods

Under the supervision of Dr. Leslie Cornick, the Scientific MMOs received training in marine mammal identification and behavior, shore-based observational methodologies, and ICRC, POA, and APU safety and security protocols. Schedules and training were coordinated by two post-graduate supervisors.

3.1 Study Area and Observation Stations

The study area included all waters of the Knik Arm of Upper Cook Inlet visible from the NE and APBD Stations (Figure 3.1). Waters between the two stations could be observed by both MMOs simultaneously, effectively doubling the probability of observing marine mammals if they were in the area.

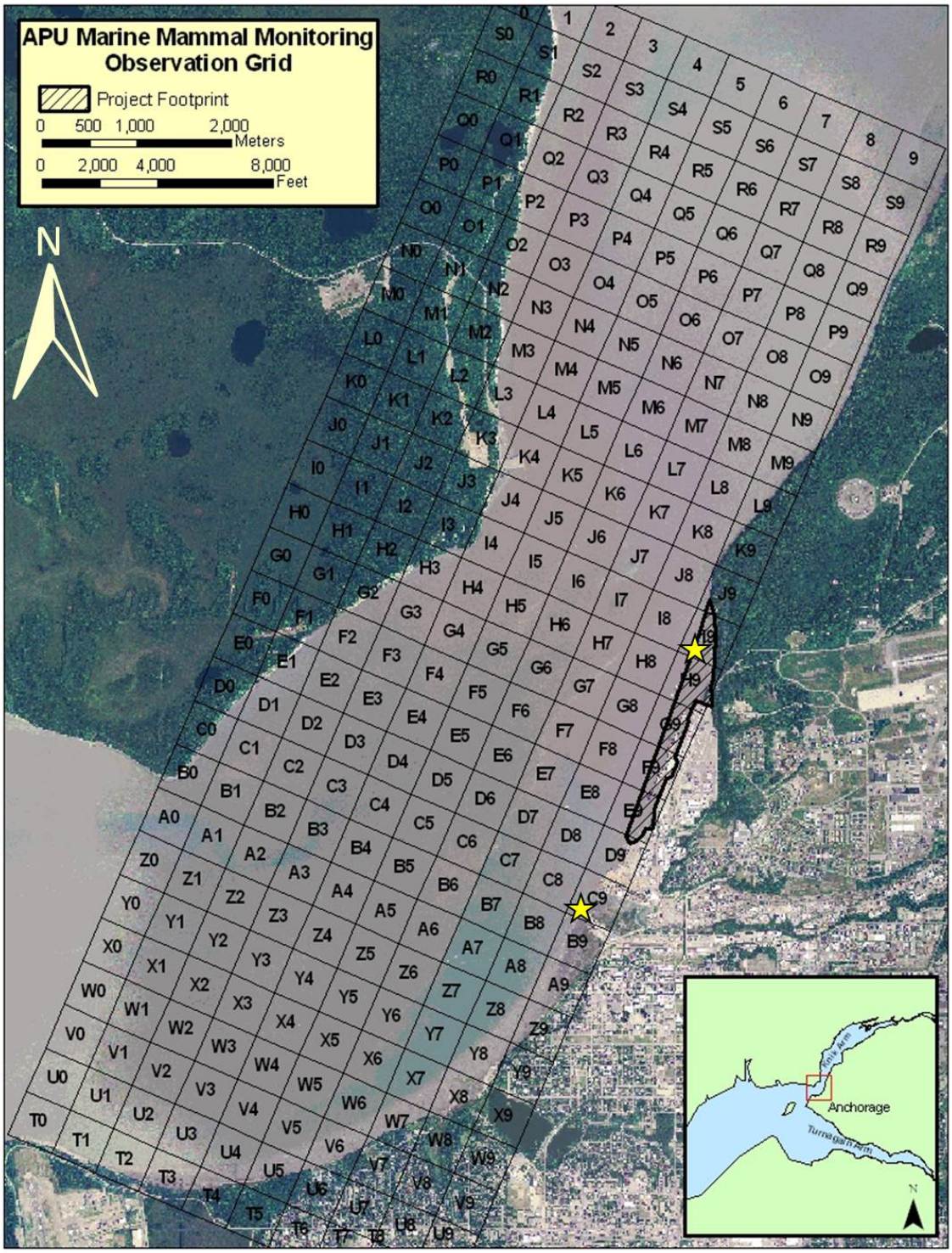

Figure 3.1. Map of the study area with 500 x 500 m grid overlay. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the Anchorage Public Boat Dock (grid cell C9) and North End (grid cell I9) are indicated by yellow stars.

3.2 Sampling Effort

Marine mammal monitoring was conducted up to 7 days per week in 4 to 6 hour shifts up to 32 hours per week, covering the full range of tidal cycles as practicable during daylight hours. Monitoring days were scheduled to provide a sample of beluga whale habitat use and behavior under varying conditions (e.g., noise, vessel traffic, environmental conditions), while accommodating the logistical, safety and security concerns of the POA, ICRC and APU.

3.3 Sampling Protocols

The following sections describe APU's data collection, analysis and reporting protocols for conducting the Scientific Program. Data sheets were reviewed for accuracy prior to data entry, and electronic databases were spot checked with data sheets randomly by Dr. Cornick or a supervisor for quality assurance and control.

3.3.1 Environmental Conditions

Environmental data pertaining to sighting conditions were logged hourly during observation sessions. These conditions included air temperature (^{o}C), wind speed (kilometers per hour; km/hr), sea state (Beaufort scale[1]), swell height (m), glare (presence/absence), percent cloud cover, percent ice cover and precipitation.

3.3.2 Port of Anchorage Activities

The number and type of vessels at the Port were documented during monitoring sessions throughout the observation period. MTR Project activities, including dredging and in-water construction activities, were recorded as part of each 10-minute scan sample during all observation periods in order to facilitate examination of beluga whale occurrence and behavior with respect to these activities. The duration of all in-water construction activities was also recorded.

3.3.3 Beluga Whale and Other Marine Mammal Observations

Each observation station (NE, APBD) was staffed by a single MMO equipped with binoculars (Bushnell 7x50 with internal compass and range-finding reticle or Nikon Monarch ATB 10x42) and a surveyor's theodolite (see Section 3.3.4) MMOs at both

[1] The Beaufort sea state scale is defined as: 0 = mirror-like; 1 = ripples without foam crest; 2 = small wavelets, crests do not break; 3 = large wavelets, scattered white caps; 4 = small waves, fairly frequent white caps.

stations conducted beluga whale observations using 10-minute scan samples. Detailed observation protocols can be found in the *Scientific Marine Mammal Monitoring Plan*.

Beluga whales were classified by color (white, gray, dark gray). White beluga whales are typically adults and gray beluga whales are typically juveniles; however there is considerable variation in the age at which beluga whales acquire their full white color. Therefore, color cannot be used reliably to determine maturity. Dark gray beluga whales were classified as calves.

Scans were recorded on standardized Scientific Marine Mammal Observation Logs (Appendix). When beluga whales were observed, the following information was recorded: date, time, number of whales sighted, color classification (white, gray, dark gray), heading and direction of travel, behavior, location and group swimming formation. Detailed data were also collected as feasible and practicable regarding the locations, movements and behavior of beluga whales near the MTR Project footprint. Locations were initially classified according to a grid-cell mapping system using bearings obtained from sighting binoculars and distances estimated by eye (Figure 3.1). Focal group sampling was used to document the behavior of whales (Mann 2000). Whales were tracked and behaviors were recorded until the whales were no longer in view, and the standard 10-minute scanning protocols were resumed.

If other marine mammal species were observed, the same protocols were followed as described above. Only location and species data were collected for other marine mammals, as these observations have never been long enough in duration to record behaviors.

3.3.4 Theodolite Tracking

A tripod-mounted surveyor's theodolite (Topcon D-200) connected to a laptop computer was used to track beluga whale movement patterns (Prevel Ramos *et al*. 2006). Horizontal (azimuth) and vertical (declination) readings from the theodolite were used to calculate the position of whales. Accurate assessment of whale group locations was facilitated by precise measurement of height and location of both observation stations and input of tide tables to account for tidal variation during the sample. Beluga whale group location data were estimated for tidal variation during the sampling period using J-

Tides tide prediction website (http://www.arachnoid.com/JTides/) and corrected using final recorded tide height data from NOAA Tides and Currents (www.tidesandcurrents.noaa.gov).

Theodolite tracking data were used to record the location of whales relative to the MTR Project footprint and construction activities, and to detail whale movement patterns and habitat use with the highest level of precision for shore-based observations. Time stamping of horizontal and vertical angle-fix information, input of other observations (e.g., group size, behavior, and environmental parameters) and rapid, real-time longitude-latitude position and movement pattern calculations were recorded using *Pythagorus* (http://www.tamug.edu/mmrp/Software/pythagoras/Index.html). GIS-compatible whale tracks were calculated to record the position of whales relative to shore and record movements of beluga whale groups.

3.3.5 500m x 500m Grid

In order to maintain sighting consistency and allow for simplified display of spatial data with respect to the MTR Project footprint, APU also continued to employ a grid system (500m x 500m grids) to monitor the locations and movements of beluga whales and other marine mammals in Knik Arm (Funk *et al*. 2005). MMOs used a combination of compass bearings taken from binoculars and landmarks to place the locations of marine mammals in grid cells during each sampling interval. Grid cell locations were updated as animals were tracked through the study area. The MTR Project footprint is located within cells D9 to J9 of the grid (Figure 3.1). The grid cell system was also used to communicate beluga whale position information with the Construction MMOs during in-water construction activities.

3.3.6 Group Size, Composition and Behavioral Sampling

When beluga whales were sighted during scan samples, detailed focal group behavior was recorded continuously until whales were out of view (Martin and Bateson 1986, Mann 2000). Behavioral state (Table 3.1), swimming formation, inter-individual distance/group spread and noteworthy behavioral events (e.g., spy hopping, vocalizations, rapid chases) were documented for each group.

Table 3.1. Beluga Whale Behaviors.

Beluga Whale Behavior Classifications[1]	
Traveling/Moving	Startled effect
Diving	Approaches then leaves
Motionless on surface	Change in swimming speed
Spyhopping	Abrupt change in direction
Breaching	Abrupt dives
Feeding Observed	Disperse
Feeding Suspected	Other
Milling	

1. Behaviors may be classified as either primary or secondary.

3.4 Data Entry and Analysis

All observations including marine mammal activity, environmental conditions and vessel activity were documented on Scientific Marine Mammal Observation Logs (Appendix). Data were then checked for accuracy and entered into SPSS v. 18 for Windows for storage and analysis. Sampling intervals were classified into their observational hour by the start time of the interval. Observational hours are defined as each hour on the hour from 0800 – 1900 in order to encompass the entire range of effort. Alpha levels were set at $p < .05$. All values are reported as mean ± 1 standard error unless otherwise noted.

3.4.1 Environmental Conditions

Environmental conditions were summarized for each season (spring, summer, fall) in order to characterize the predominant viewing conditions.

3.4.2 Sighting Rates and Temporal Distribution

Beluga whale sightings were summarized for monthly reporting purposes by overall sighting rate (beluga whale groups per hour of effort) and sighting rates for each observation station, time of day and tidal stage. Data for the complete 2011 reporting period are summarized by overall sighting rate, sightings across time of day, tidal stage, and season. Seasons are defined in the database as spring (May – June), summer (July – September) and fall (October – November), and are based broadly on the solstice (summer) and equinox (spring, fall). One-way analysis of variance (ANOVA) was used to examine differences in sighting duration across time of day for 2011 and interannual differences in mean sighting rates. Sighting rate comparisons between the previously utilized Cairn Point Station and the currently utilized APBD and NE Stations will be analyzed in a separate *Sighting Rates Report.*

Daily tidal heights were classified into six stages, each two hours long and defined as hours before (-) or after (+) low tide (Figure 3.2). Tidal stages initially derived from J-Tides were corrected prior to data analysis based on the NOAA Tides and Currents, Anchorage (Knik Arm) reporting station located at the Port (station ID 9455920).

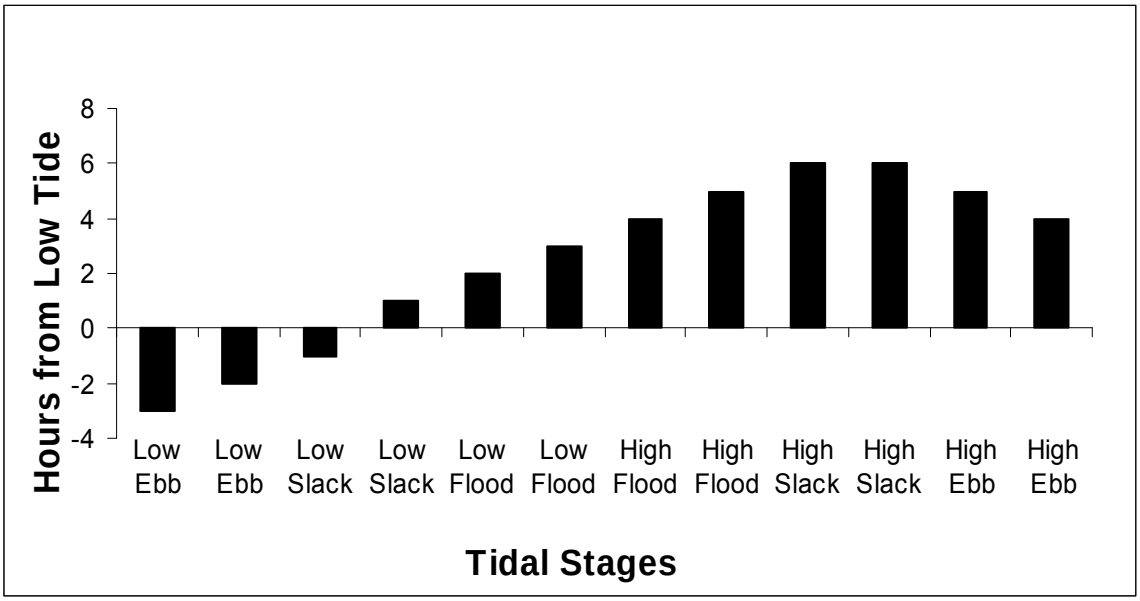

Figure 3.2. Classification of daily tidal cycles into six stages of two hours each. The stages are defined as hours before (-) or after (+) low tide. Repeats for each stage illustrate gradual transition from one stage to the next.

3.4.3 Spatial Distribution

Sightings were summed for all grid cell locations where beluga whales and other marine mammals were sighted during the observation period. Beluga whale sightings were classified according to whether the whales were observed outside, adjacent to or within the MTR Project footprint. Habitat use of whales in each location was calculated as total number of beluga whale groups sighted, total number of whales sighted and total observation time.

Habitat use and movement were mapped using ArcGIS ArcInfo 9.3 to display whale track lines obtained from theodolite fixes and translated in *Pythagoras*. Habitat use was determined by overlapping track lines with grid cells and summing the total number of beluga whale groups sighted within each grid cell. Beluga sightings during tidal stages were determined by overlapping track lines with grid cells and matching the time of day whales were observed with the correct tidal stage. A chi-squared test was used to examine differences in the number of beluga whale groups sighted by tidal stage.

3.4.4 Group Size, Structure and Behavior

Mean group size and structure were analyzed for all beluga whale sightings. Behavioral states were summarized for all whale groups observed and unusual behaviors noted, if observed. One-way analysis of variance (ANOVA) was used to examine interannual differences in mean group size and composition.

4.0 Results

A total of 1202.4 hours of observation was completed from 28 June – 15 November 2011, with the majority of effort taking place during the summer (July – September; Table 4.1). Monitoring shifts ranged from 0800 to1900, with shifts scheduled as either morning (~0800 to 1200) or afternoon (1200 – 1600 or 1400 – 1900). Effort hours were largely evenly distributed across this time range, with some tapering of the earliest morning and latest afternoon hours in October and November as light levels decreased.

Table 4.1. Observational effort by season and observation station.

	APBD		NE	
Season	**Days**	**Hours**	**Days**	**Hours**
Spring (June)	0	0	3	21
Summer (Jul-Sep)	63	403.8	63	400.1
Fall (Oct-Nov)	38	193	38	184.5
Total	101	596.8	104	605.6

4.1 Environmental Conditions

Environmental data are summarized in Table 4.2. Overall sighting conditions during the entire study period were moderate. Glare sufficient to obstruct sightings was present during 52 days of observations during the summer and fall.

Table 4.2. Environmental conditions by season.

Season	Overall conditions	Primary sea state	Wind speed (km/hr)	Temperature (°C)	Visibility (km)	Cloud cover (%)
Spring (June)	Moderate	2	8.0	15.0	10.0	69
Summer (Jul-Sep)	Moderate	2	6.2	13.6	9.9	70
Fall (Oct-Nov)	Moderate	2	8.6	1.8	9.5	71

Overall conditions and primary sea state are reported as most frequently observed.

Wind speed, temperature, visibility, and % cloud cover are reported as means.

4.2 Beluga Whales

A total of 290 beluga whales (164 white, 122 gray, 4 dark gray calves) in 62 groups was observed during the period 28 June – 15 November 2011 (Tables 4.3-4.4). This resulted in an overall sighting rate of 0.05 groups sighted per hour of effort. The following sections describe temporal and spatial distribution, group size and structure, and behavior of beluga whales across time of day, tidal stage and season during 2011.

Table 4.3. Beluga whale sighting summary for the APBD Station.

Anchorage Public Boat Dock Station									
						Group Composition			
Date	Sample Time	Sighting Duration (min)	Grid Cell	Within Footprint	Seen by Both Stations	White (#)	Light gray (#)	Dark gray (#)	Total
6-Aug-11	10:14:00	8	Y9, Z8, C9	Yes	No	1	1	0	2
6-Aug-11	10:20:00	1	D8	No	No	0	4	0	4
6-Aug-11	10:44:00	1	H9	Yes	No	1	1	0	2
9-Aug-11	12:42:00	53	H3, G2, D1, H4, K4, M3, O2, P2	No	Yes	7	1	1	9
16-Aug-11	15:40:00	75	G9, H9, J8, E9, D9, C9	Yes	No	12	2	0	14
16-Aug-11	16:18:00	3	D9, C9	Yes	No	2	4	0	6
16-Aug-11	16:26:00	34	C9, D9, F9, H9, H8	Yes	No	5	5	0	10
17-Aug-11	11:40:00	20	C9, D9	Yes	No	1	0	0	1
17-Aug-11	13:46:00	1	C9	Yes	Yes	1	0	0	1
17-Aug-11	13:50:00	1	D8	No	Yes	1	0	0	1
17-Aug-11	14:57:00	11	D8, F7, H7	No	Yes	1	0	0	1
18-Aug-11	16:14:00	126	D9, G9, J8, C9, B9, B8, A8, A9, Z8, Y6, B8, Z7, X7, W6, D8, E8, F9, G8, H8, I7	Yes	Yes	5	3	0	8
18-Aug-11	16:50:00	8	C9	Yes	No	4	0	0	4
21-Aug-11	14:00:00	16	G9, E9, D8	Yes	No	3	2	0	5
26-Aug-11	17:00:00	4	I5	No	No	1	0	0	1
27-Aug-11	13:30:00	90	C8, D9, E9, F9, H9, I9, A8, Z7, B8	Yes	No	6	4	0	10
29-Aug-11	14:27:00	5	C8, D8	No	No	1	0	0	1
29-Aug-11	14:36:00	12	D8, B8, Z7	No	No	1	1	0	2
29-Aug-11	14:45:00	1	F8	No	No	4	0	0	4
29-Aug-11	14:50:00	1	C8	No	No	1	0	0	1
29-Aug-11	15:04:00	31	D9, C9, B8, A8, Z7, X6, W5	Yes	No	5	3	0	8
29-Aug-11	15:02:00	1	Y7	No	No	1	0	0	1
29-Aug-11	16:26:00	1	C6	No	No	1	0	0	1
31-Aug-11	17:40:00	1	C9	Yes	No	2	0	0	2
1-Sep-11	18:36:00	1	H9	Yes	Yes	1	0	0	1
2-Sep-11	12:40:00	12	D9, C9, A9	Yes	No	4	0	0	4
18-Sep-11	10:10:00	1	H9	Yes	Yes	0	2	0	2
18-Sep-11	10:50:00	40	E9, B9, C9, A8	Yes	No	1	4	0	5
23-Sep-11	11:10:00	1	B8	No	Yes	1	0	0	1
19-Oct-11	9:20:00	35	A8, D8, E9, H9	Yes	Yes	2	0	0	2
27-Oct-11	15:35:00	25	W6	No	No	0	15	0	15
27-Oct-11	16:22:00	18	E8, F9, G9, I9, J8	Yes	No	7	7	0	14
2-Nov-11	10:15:00	1	B6	No	No	1	0	0	1
						84	59	1	144

Table 4.4. Beluga whale sighting summary for the NE Station.

North End Station									
						Group Composition			
Date	Sample Time	Sighting Duration (min)	Grid Cell	Within Footprint	Seen by Both Stations	White (#)	Light gray (#)	Dark gray (#)	Total
6-Aug-11	11:00:00	1	K8	No	No	1	1	0	2
9-Aug-11	13:04:00	57	J4, I4, H3, G2, F2, E1, D1, L3, M3, N2, O2, P2, R1, S1	No	Yes	7	1	1	9
16-Aug-11	15:10:00	1	H9	Yes	No	3	0	0	3
16-Aug-11	15:30:00	56	F8, H9, J8, E9, D9, C9	Yes	No	12	4	0	16
16-Aug-11	16:27:00	7	D9, C8	Yes	No	5	2	0	7
16-Aug-11	16:30:00	11	D9	Yes	No	4	3	0	7
16-Aug-11	16:50:00	25	G9, H9	Yes	No	3	5	0	8
16-Aug-11	16:57:00	18	G9, H6, J6, K7, L8, M8	Yes	No	11	5	0	16
17-Aug-11	11:10:00	8	K8, G8	No	No	1	0	0	1
17-Aug-11	13:57:00	1	D8	No	Yes	1	0	0	1
17-Aug-11	15:00:00	8	C8, F7	No	Yes	1	0	0	1
18-Aug-11	15:50:00	144	H9, I9, J8, G9, D9, C8, B8, A8, Z7, D8, H8, J7, K8, L8	Yes	Yes	5	3	0	8
21-Aug-11	13:39:00	6	K8, L8, I8, H9	Yes	No	2	2	0	4
27-Aug-11	12:50:00	90	G9, H9, I9, G8, F9, E8	Yes	No	5	3	0	8
29-Aug-11	14:26:00	64	H9, I9, L8, K8, F9, E9, B9, C8	Yes	No	7	7	0	14
29-Aug-11	14:18:00	24	K7, I9	Yes	No	2	1	0	3
29-Aug-11	14:30:00	2	H9	Yes	No	5	0	2	7
29-Aug-11	14:39:00	1	G7, E8	No	No	0	13	0	13
29-Aug-11	16:11:00	1	K7	No	No	1	0	0	1
1-Sep-11	18:40:00	1	H9	Yes	Yes	1	0	0	1
2-Sep-11	12:05:00	1	H9	Yes	No	2	0	0	2
11-Sep-11	13:03:00	1	I4	No	No	2	0	0	2
12-Sep-11	17:46:00	1	J8	No	No	0	1	0	1
18-Sep-11	10:00:00	1	G8	No	Yes	0	2	0	2
18-Sep-11	10:05:00	1	I7	No	No	0	3	0	3
18-Sep-11	10:40:00	1	J7	No	No	0	2	0	2
18-Sep-11	10:55:00	1	G7	No	No	0	3	0	3
23-Sep-11	11:13:00	1	B8	No	Yes	1	0	0	1
19-Oct-11	9:41:00	11	H9, I9, J9	Yes	Yes	2	0	0	2
27-Oct-11	16:30:00	28	E9, H8, I8, J8, K8	Yes	No	7	8	1	16
29-Oct-11	12:46:00	15	I7, J7	No	No	1	0	0	1
29-Oct-11	12:51:00	1	L5	No	No	1	0	0	1
29-Oct-11	15:18:00	3	K4, J4	No	No	1	0	0	1
29-Oct-11	15:55:00	3	P4, O4	No	No	1	0	0	1
29-Oct-11	16:15:00	3	N3, M3	No	No	1	0	0	1
29-Oct-11	16:45:00	1	N3	No	No	1	0	0	1
29-Oct-11	16:55:00	1	N3	No	No	1	0	0	1
						98	69	4	171

4.2.1 Sightings by time of day

Beluga whale sightings occurred from mid-morning through the evening (Figure 4.1). The highest sighting rate (0.40 groups per hour of effort) occurred between 1600 and 1700. The mean duration of sightings was 16.4 ± 3.5 min. There were no significant differences in the mean duration of sightings across time of day.

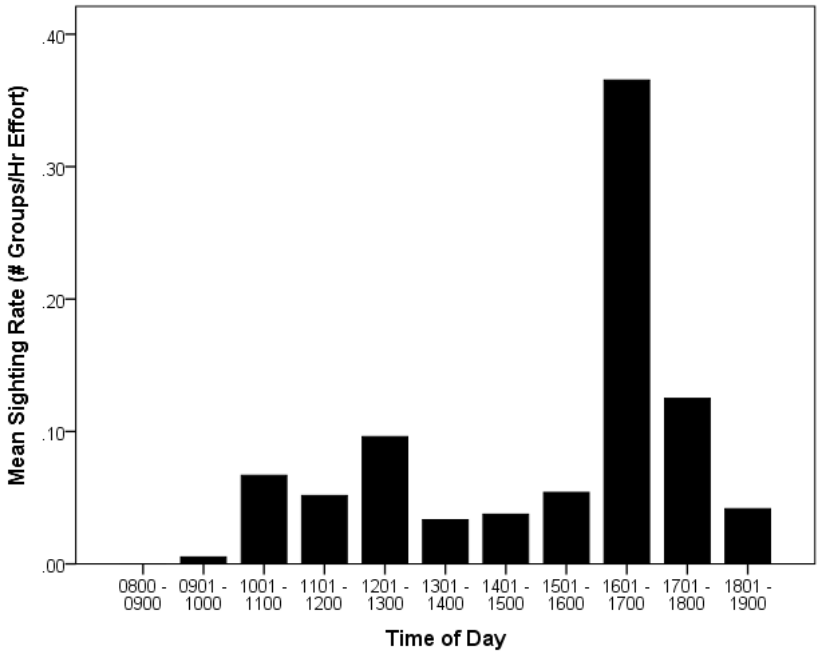

Figure 4.1. Beluga whale sighting rate (number of beluga whale groups sighted per hour of effort) by time of day. Sightings are classified into the hour in which they began.

4.2.2 Sightings by tidal stage

Beluga whales were sighted during all six tidal stages (Figure 4.2). Nearly half of the sightings (30 of 62) occurred during the low slack tide, which was significantly greater than expected (chi-squared test, $\chi^2 = 54.2$, df = 5, $P < 0.01$). Smaller peaks were observed during low and high flood tides. The fewest number of sightings occurred during the high slack tide.

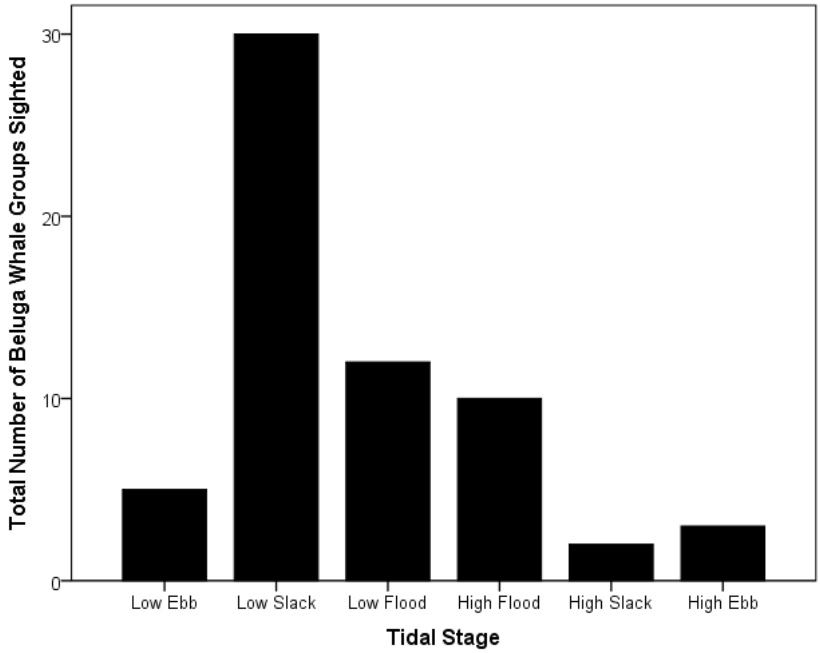

Figure 4.2. Beluga whale sightings by tidal stage. The stages are defined as hours before (-) or after (+) low tide; each stage is two hours in duration.

4.2.3 Sightings by season

Sighting rates were highest (0.06 groups sighted per hour of effort) in the summer (Jul – Sep). Sighting rates dropped by 50% (0.03 groups sighted per hour of effort) in the fall (Oct – Nov), and no beluga whales were sighted during the spring (May – Jun) or during the month of July (Figure 4.3). During 2011, as in 2010, observations did not begin until late June.

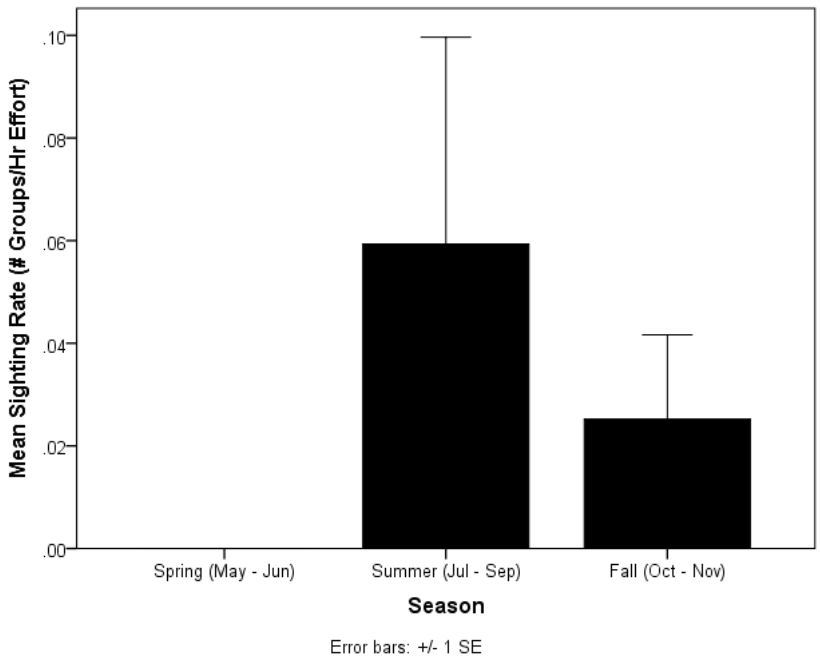

Figure 4.3. Beluga whale sighting rate (number of beluga whale groups sighted per hour of effort) by season.

4.2.4 Spatial distribution relative to the MTR Project footprint

Beluga whales were sighted throughout the study area (Figure 4.4). Seventeen of the sightings, approximately 27% of the total sightings (n = 62), occurred within the MTR Project footprint, including 2 of the 3 groups with calves. Seventeen additional sightings occurred adjacent to the MTR Project footprint, including a group with a single calf. Beluga whales spent 56% of the total time in view within the MTR Project footprint, and another 20% adjacent to the MTR Project footprint.

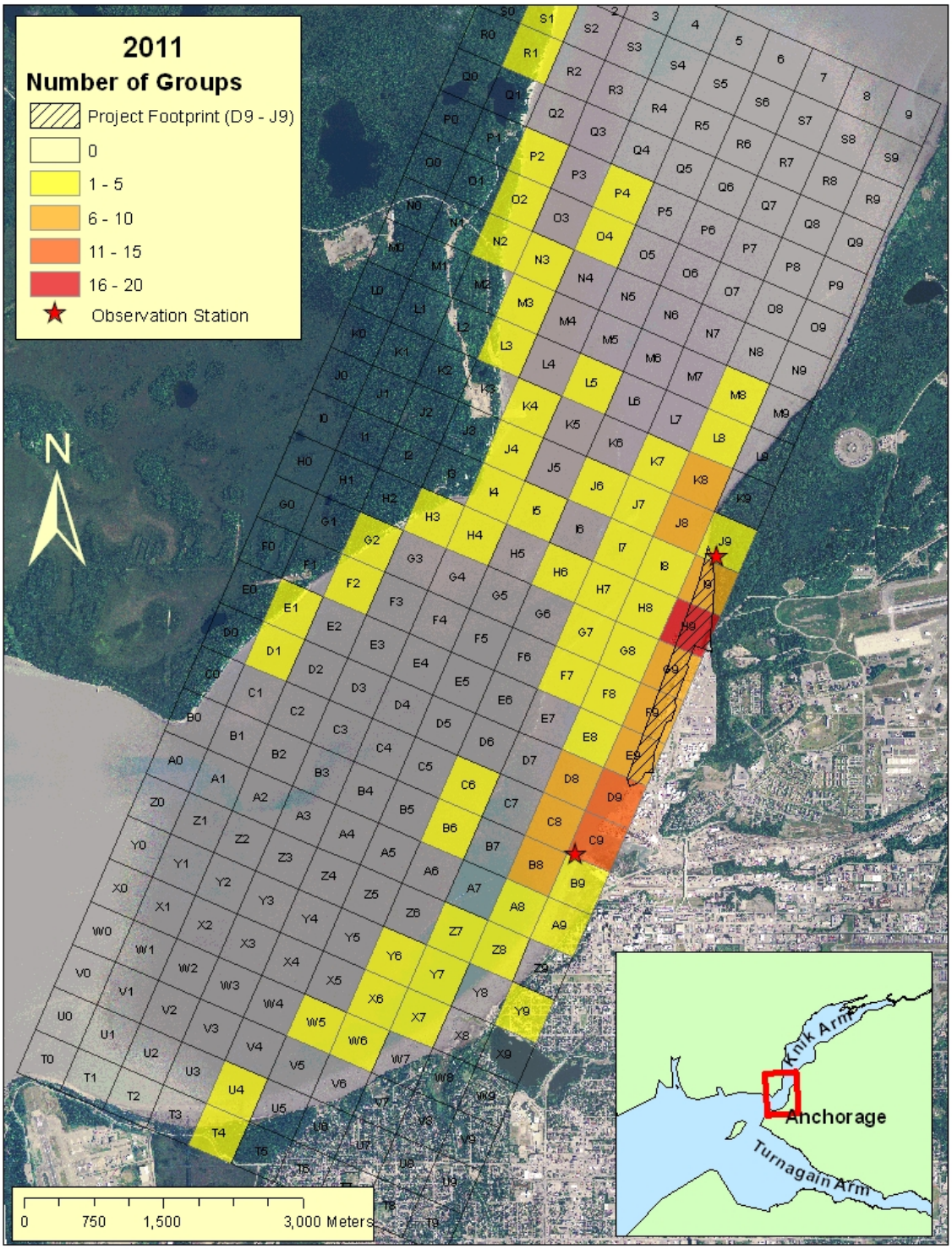

Figure 4.4. Spatial distribution of beluga whales observed from both the APBD and NE Stations during the period 28 June – 15 November 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

4.2.5 Spatial distribution by tidal stage

Spatial distribution by tidal cycle was primarily along the shoreline (Figures 4.5 – 4.10). During low ebb (Figure 4.5) and high slack (Figure 4.9) tides, beluga whales were observed only along the eastern shoreline. During low flood tides, beluga whales were observed along both shorelines, but absent from the mid-water area of the narrows (Figure 4.7). Whales were observed fairly evenly distributed across the study area during low slack tides (Figure 4.6). Very few beluga whales were observed during high tides (15 of 62 groups) and were concentrated primarily around the area of the MTR Project footprint (Figures 4.8 – 4.10).

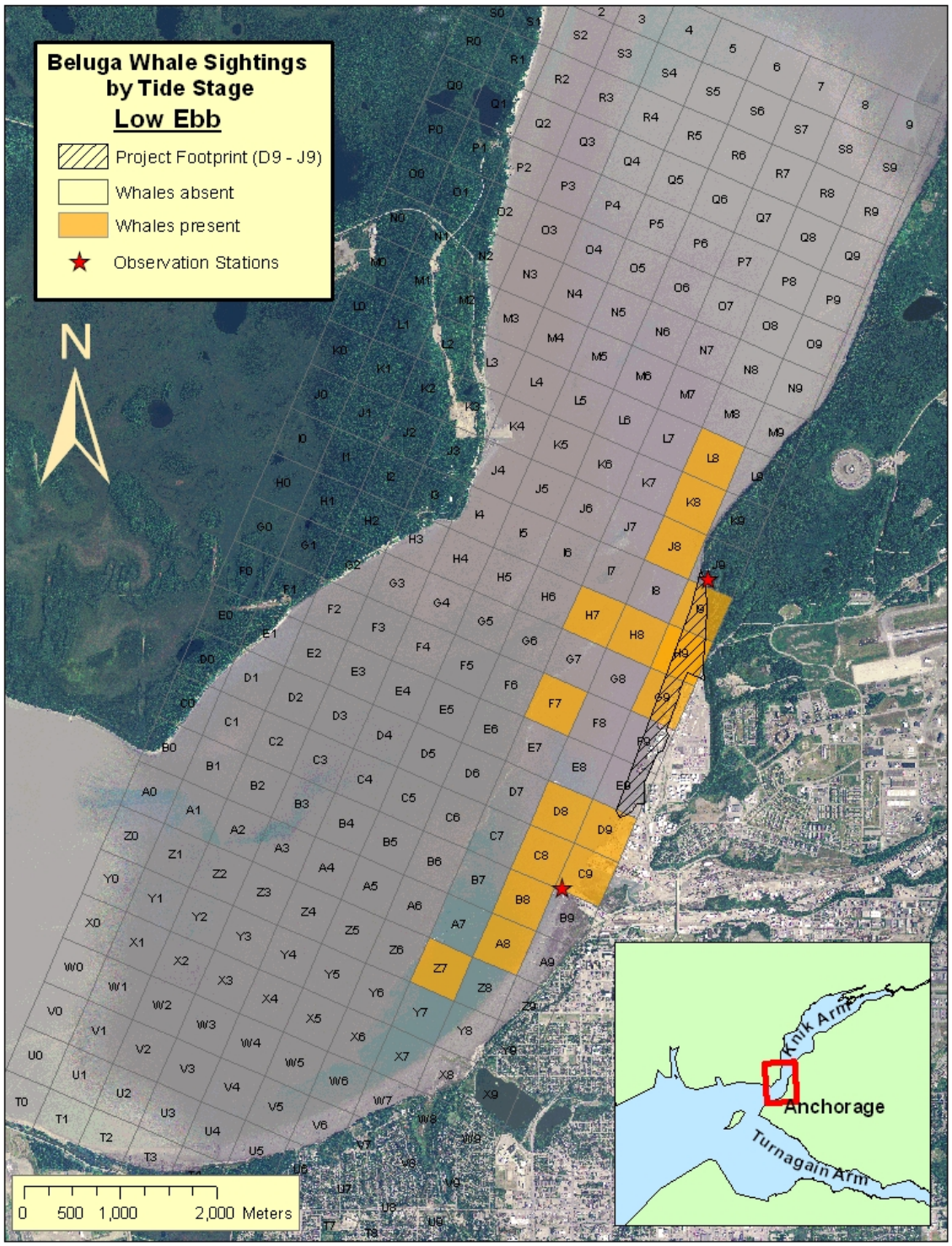

Figure 4.5. Spatial distribution of beluga whale sightings during low ebb tides during the period 28 June – 15 November, 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

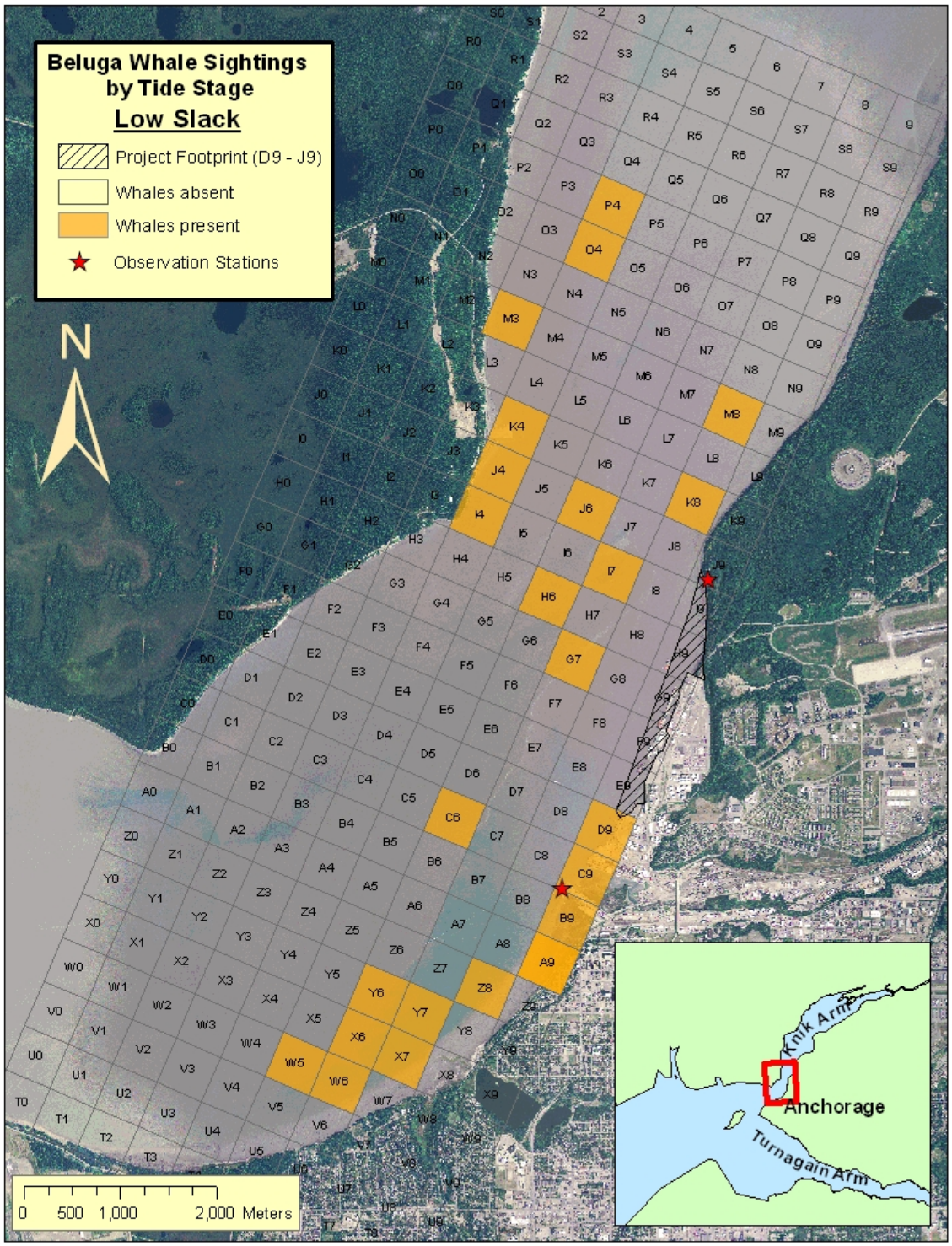

Figure 4.6. Spatial distribution of beluga whale sightings during low slack tides during the period 28 June – 15 November, 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

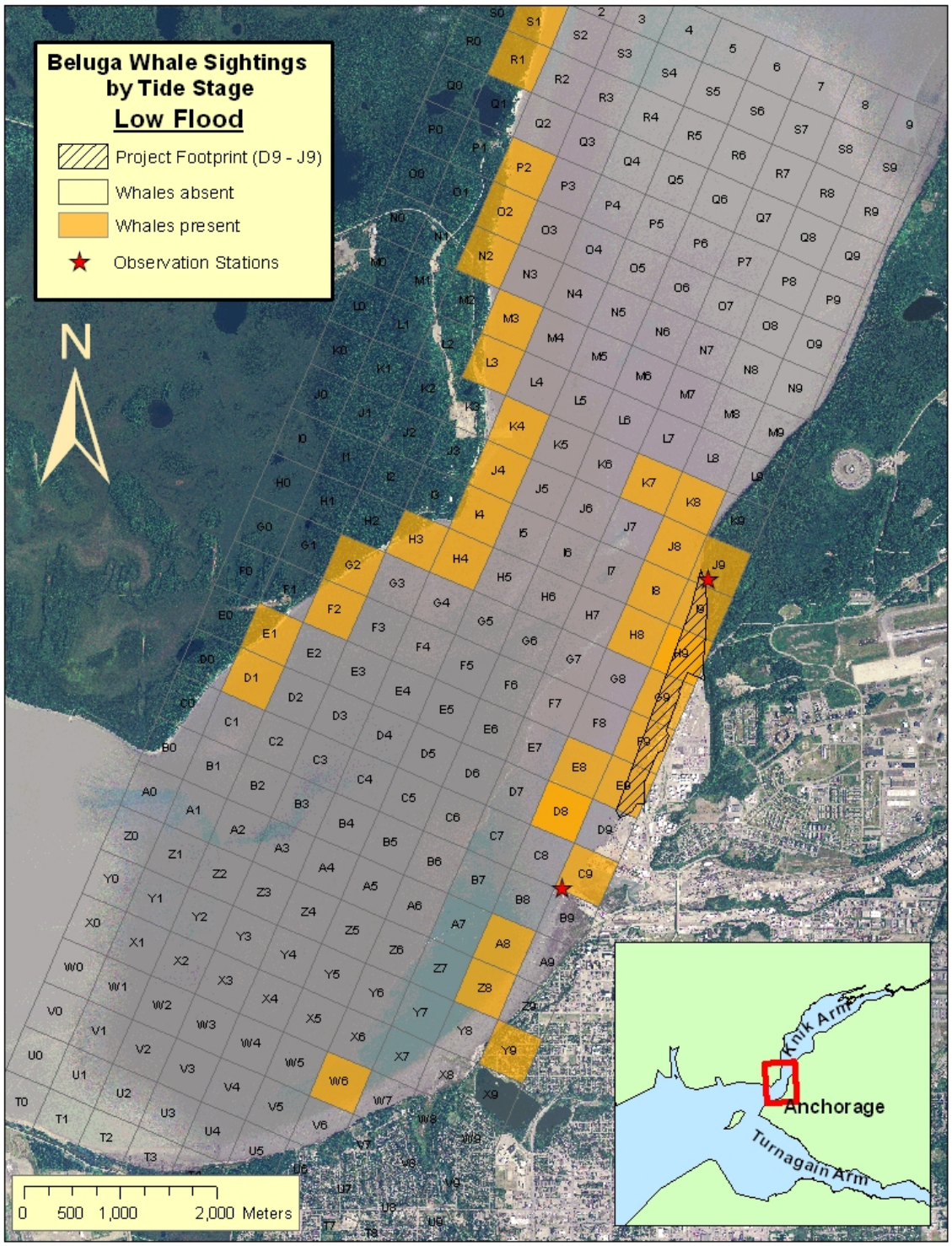

Figure 4.7. Spatial distribution of beluga whale sightings during low flood tides during the period 28 June – 15 November, 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

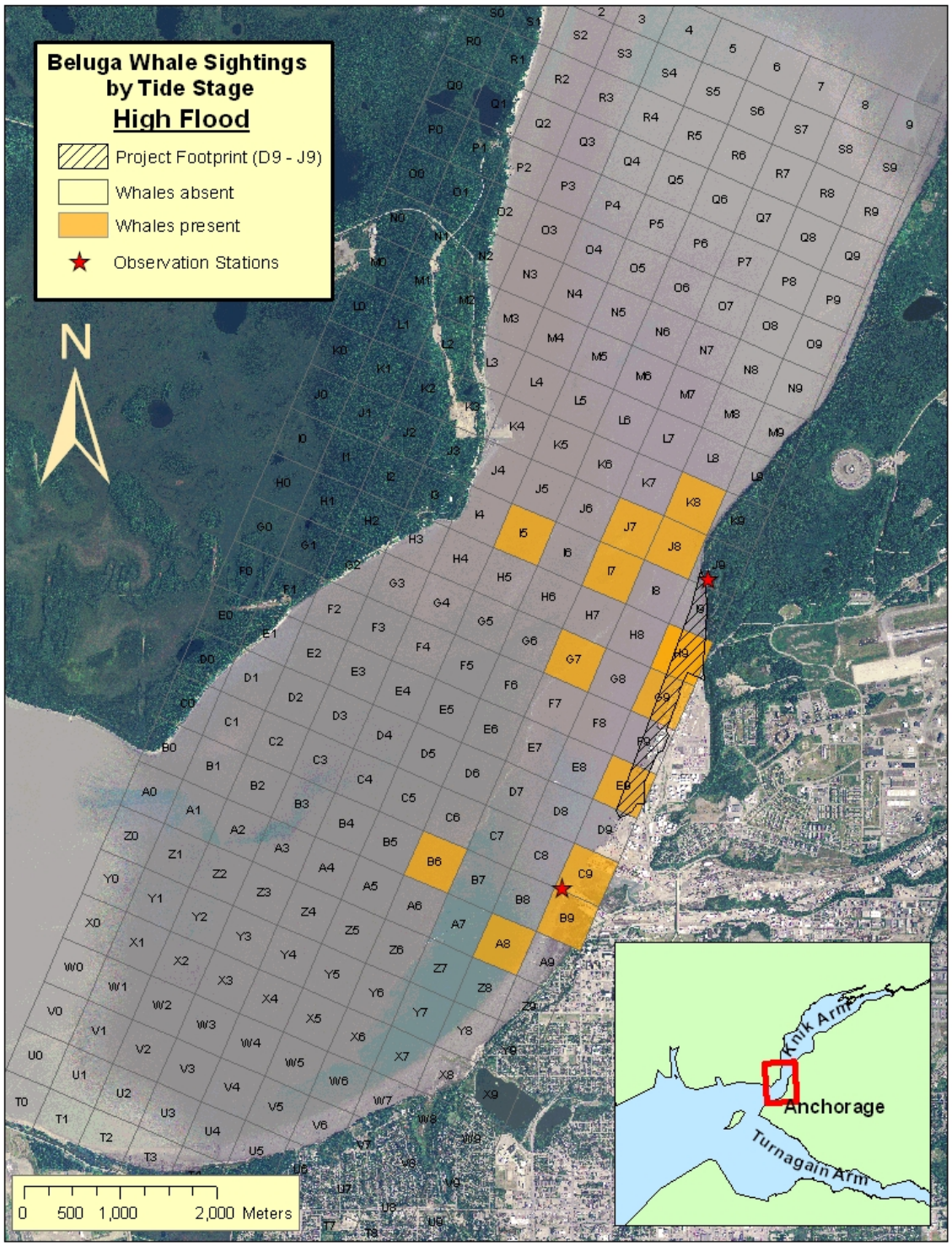

Figure 4.8. Spatial distribution of beluga whale sightings during high flood tides during the period 28 June – 15 November, 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

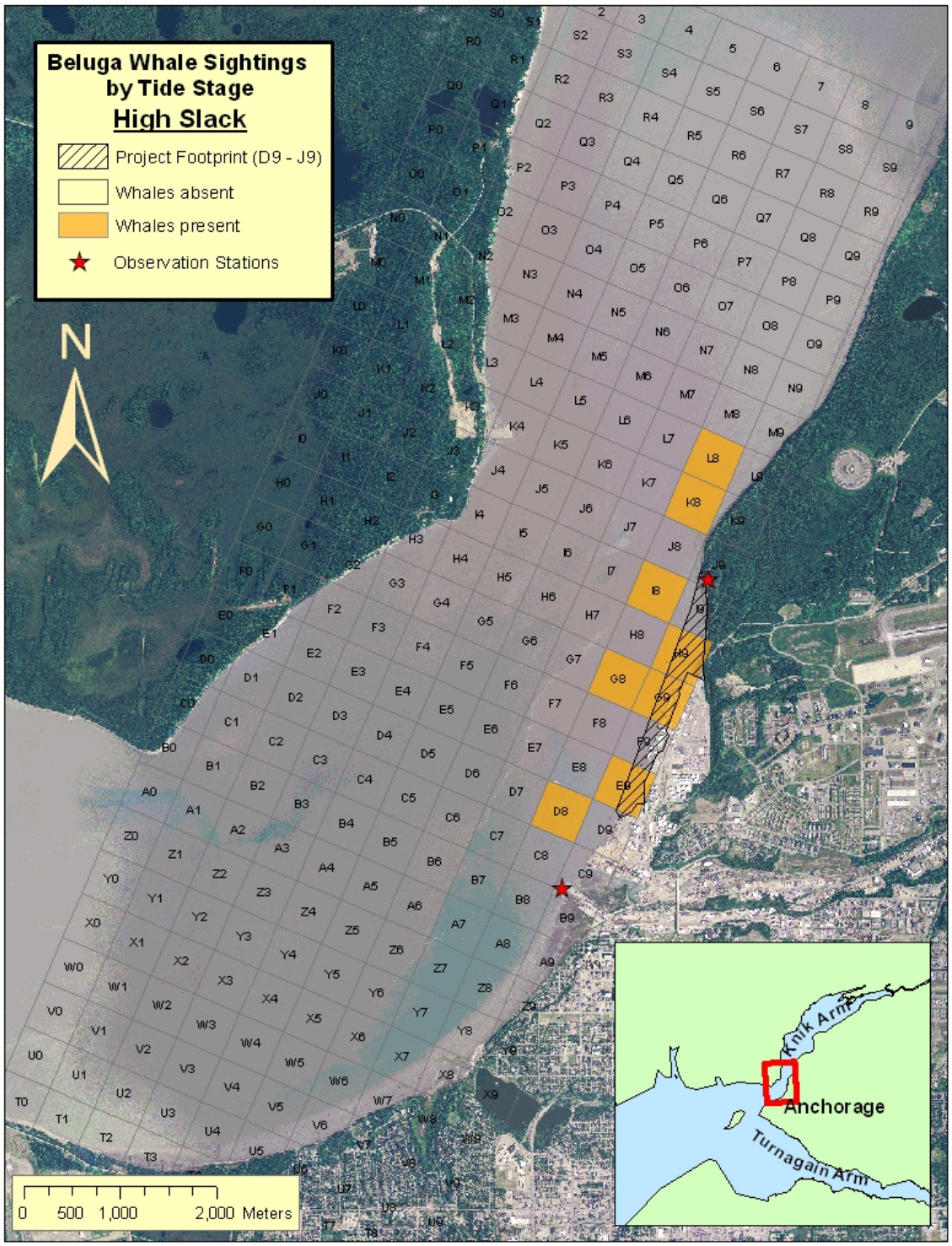

Figure 4.9. Spatial distribution of beluga whale sightings during high slack tides during the period 28 June – 15 November, 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

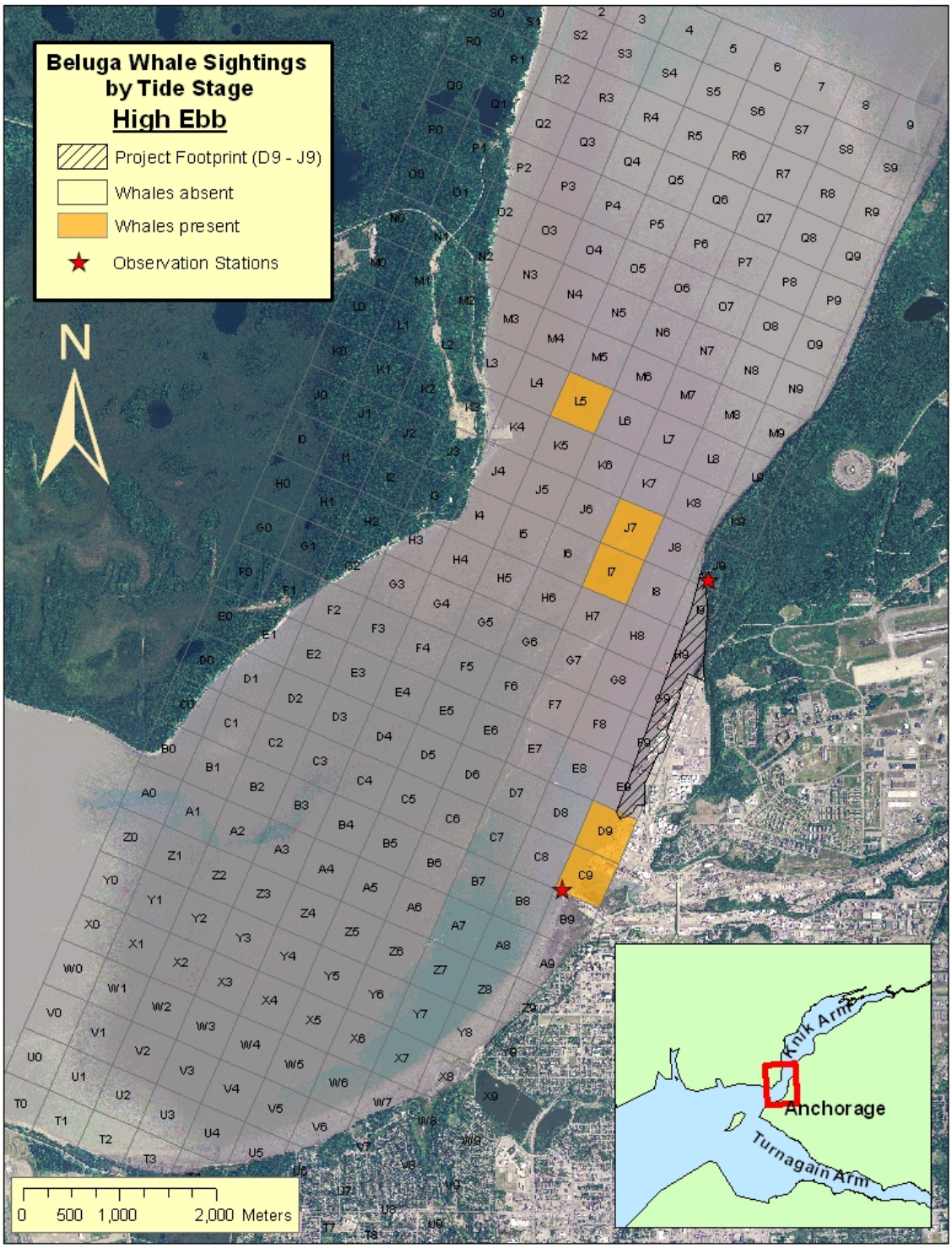

Figure 4.10. Spatial distribution of beluga whale sightings during high ebb tides during the period 28 June – 15 November, 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

4.2.6 Group Size and Structure

Mean overall group size was 4.7 ± 0.6 individuals. Only 3 groups contained identified calves, and groups with calves were larger on average (10.7 ± 2.7 individuals) than those without (4.4 ± 0.6). Two of the 3 groups containing calves were sighted within the MTR Project footprint, the third was sighted adjacent to the MTR Project footprint.

Thirty of the 40 groups with more than one individual were densely packed and moving in a unified pattern (either aligned or abreast). The remaining ten groups were traveling or milling in dispersed groups. All of the groups with calves were traveling in densely packed groups.

4.2.7 Movements and Behavior

Whales were primarily observed moving south through the study area during the mid- to late-summer (Aug-Sep), and traveling north during the early fall (Oct). Traveling, diving, suspected feeding, and milling behaviors were recorded during the study period, with no confirmed feeding events.

4.2.8 Responses to In-water Construction

There were three unusual behavioral events (abrupt directional change, abrupt swim speed change, dispersal) during the study period (Figure 4.11). Dredging was occurring during all three of these events, but no other in-water construction activity.

4.2.9 Other Marine Mammals

A total of 63 other marine mammals (57 harbor seals, 6 harbor porpoise) were observed during the study period (Table 4.5). Forty-nine harbor seals and one harbor porpoise were observed within or adjacent to the MTR Project footprint (Figure 4.12).

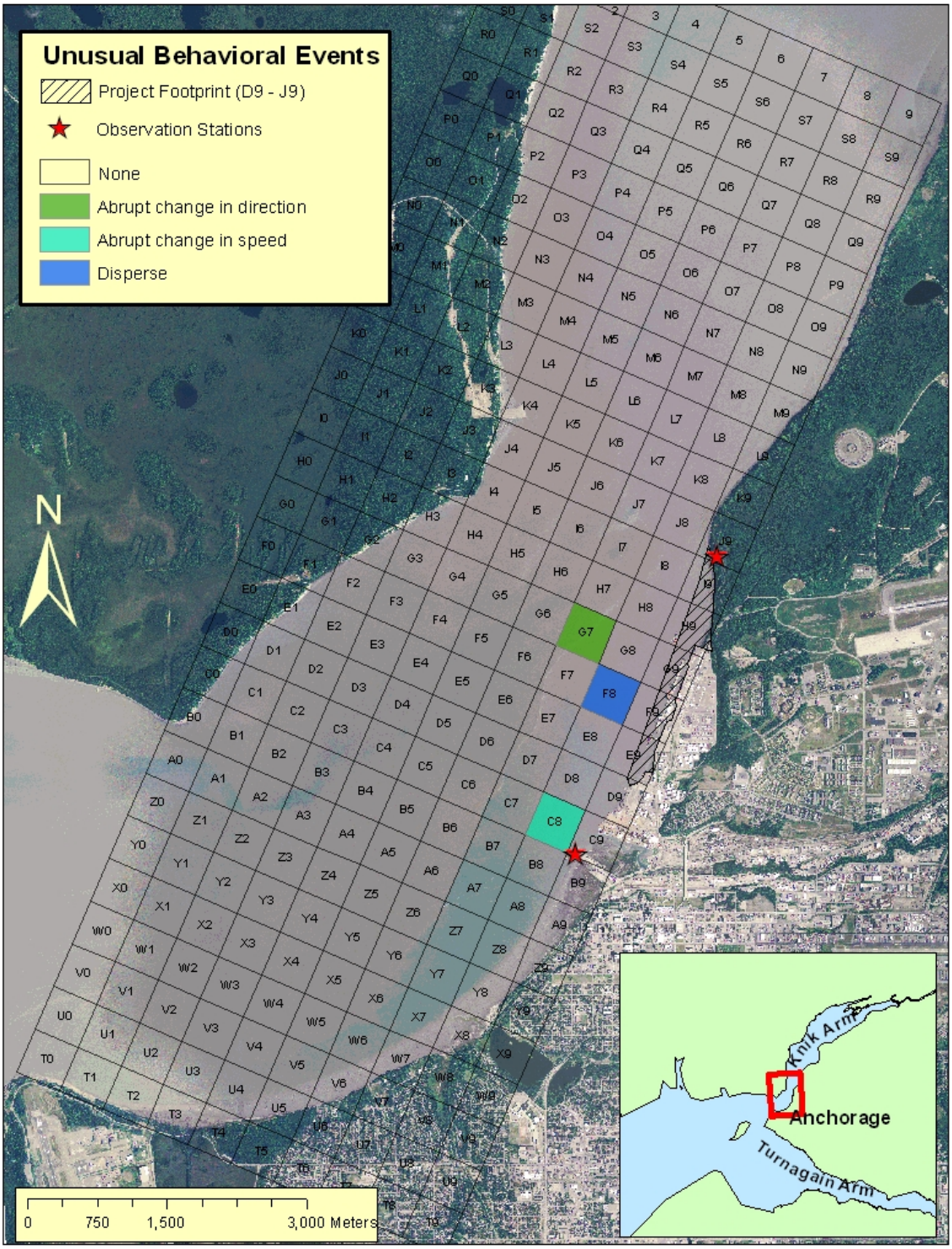

Figure 4.11. Distribution of unusual behavioral events. Dredging, but no other construction activity, was occurring during all three events. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

Table 4.5. Other marine mammal sighting summary from both APBD and NE Stations.

Other Marine Mammal Sightings				
Date	**Grid Cell[1]**	**Time(s)**	**Number**	**Species[2]**
6-Jul-11	C8	14:10	1	hs
7-Jul-11	D8, C9	10:34, 13:20	2	hs
12-Jul-11	C8	15:50, 17:49	2	hs
16-Jul-11	C9	15:40	1	hs
19-Jul-11	D8	10:40	1	hs
2-Aug-11	C9	12:30, 13:44, 15:10	3	hs
4-Aug-11	H9	10:56	1	hp
6-Aug-11	C9	09:45	1	hs
9-Aug-11	H4	18:54	1	hp
11-Aug-11	E9	18:50	1	hs
24-Aug-11	C8	15:50	1	hs
31-Aug-11	C8, C9	16:30, 16:50	2	hs
2-Sep-11	D7, C9	15:30, 16:40, 17:50	3	hs
3-Sep-11	C8	10:30, 12:50	2	hs
4-Sep-11	C9	11:10	1	hs
6-Sep-11	B9, D6, K7	16:10, 16:30, 17:20	3	hs
7-Sep-11	C9	14:15	1	hs
8-Sep-11	C9	18:00	1	hs
9-Sep-11	C9	18:00	1	hs
10-Sep-11	C9	12:00	1	hs
19-Sep-11	C9	11:30	1	hs
20-Sep-11	C9	17:50	1	hs
23-Sep-11	C8, C9	11:19, 11:40	2	hs
24-Sep-11	E9	17:00	1	hs
26-Sep-11	C9	11:10	1	hs
27-Sep-11	C9	14:00	1	hs
1-Oct-11	B8, C9	14:00, 15:08, 15:47, 16:18	4	hs
1-Oct-11	B7	17:02	2	hp
4-Oct-11	C8	13:30	1	hs
5-Oct-11	C9	11:30	1	hs
6-Oct-11	C9	14:55	1	hs
8-Oct-11	C8, B8, A8	14:00, 14:10, 14:50, 15:10, 15:40	7	hs
13-Oct-11	C9	14:10, 14:30, 15:40, 16:40	4	hs
16-Oct-11	C9	16:00, 16:30, 17:20	3	hs
23-Oct-11	I6	16:30	1	hp
5-Nov-11	B9	15:40	1	hp
6-Nov-11	C9	9:10	1	hs
Total hs			*57*	
Total hp			*6*	
Total Other Marine Mammals			**63**	

[1]MTR Project Footprint Grid Cells D9-J9

[2]Species Codes

hs = harbor seal kw = killer whale

hp = harbor porpoise up = unidentified pinniped

ssl = Steller sea lion uc = unidentified cetacean

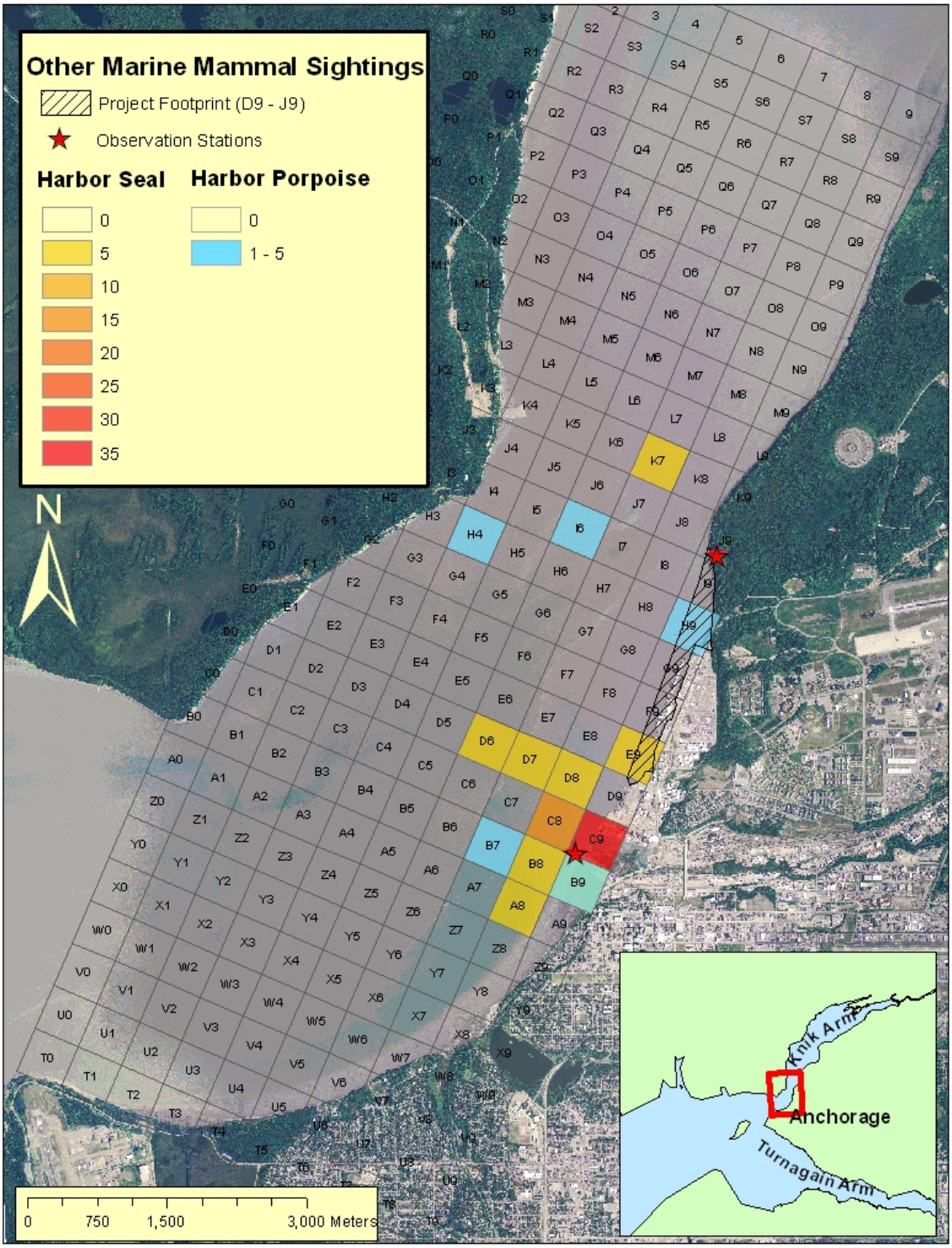

Figure 4.12. Spatial distribution of other marine mammals observed from both the APBD and NE Stations during the period 28 June through 15 November 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars. Grid cell B9 represents combined sightings of harbor seals and harbor porpoise.

4.3 Interannual Comparisons

The following sections examine differences in beluga whale sighting rates, spatial distribution and behavior from 2007 – 2011. During 2007, observations were conducted only during October and November, so comparisons including 2007 are limited to overall sighting rates, mean group size, and broad patterns of habitat use and behavior. Spring observations were limited to 2 days during 2010 and 3 days during 2011, so seasonal comparisons are focused on summer and fall from 2008 – 2011, which also corresponds to the period when beluga whales are at their highest concentration in Knik Arm.

4.3.1 Interannual differences in beluga whale sightings

Beluga whale sighting rates have continued to decline (Figure 4.13). Mean sighting rates (calculated as the average of monthly sighting rates within each year) were not significantly different between years; however sampling effort was doubled in 2011 compared to previous years. Mean group size in 2011 was larger than in all previous years; however this difference was not statistically significant (Figure 4.14). Mean group size for groups with calves also increased in 2011, but this increase was not statistically significant (Figure 4.15).

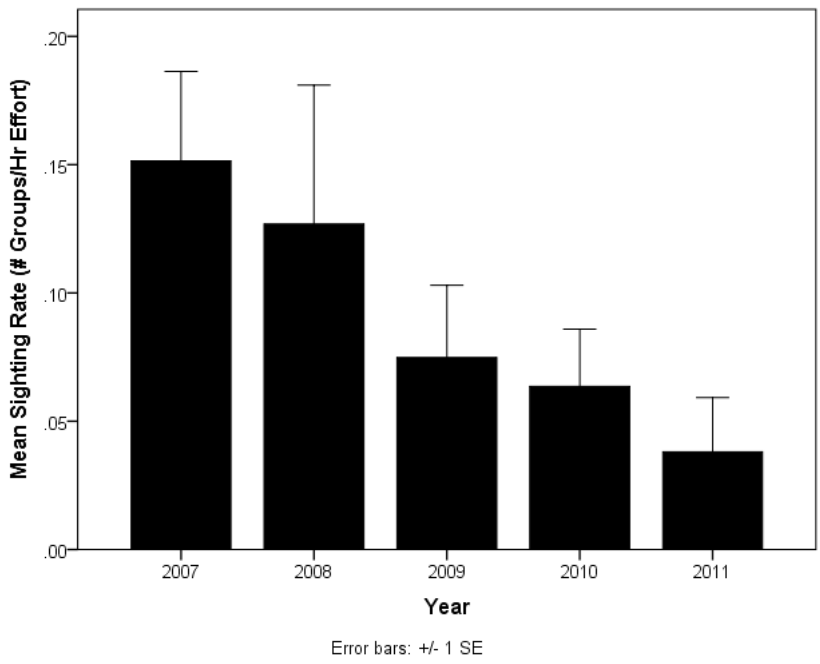

Figure 4.13. Mean sighting rates of beluga whales each year from 2007 – 2011. Error bars represent one stand error of the mean. Differences in sighting rates across years were not statistically significant.

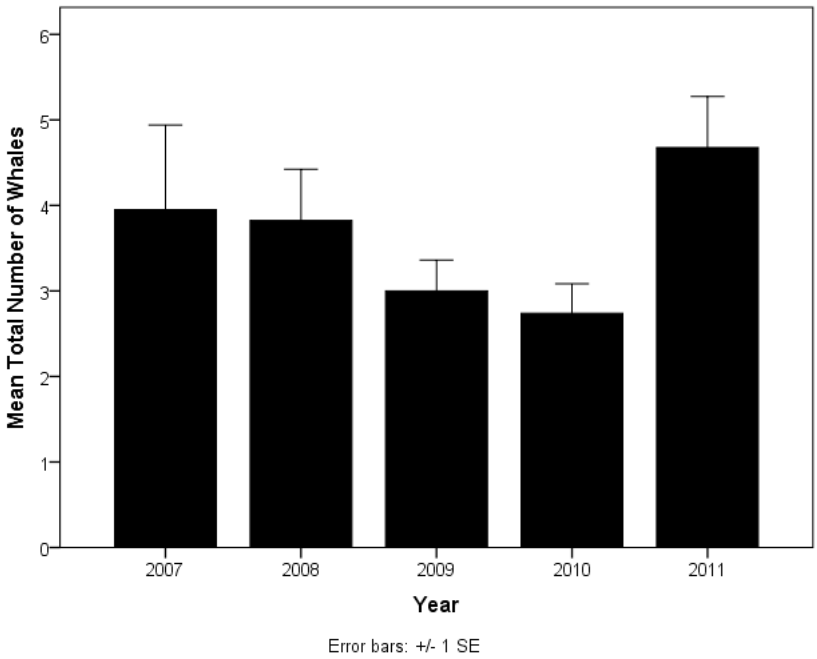

Figure 4.14. Mean group size for all groups each year from 2007 – 2011. Error bars represent one stand error of the mean. Differences in group size across years were not statistically significant.

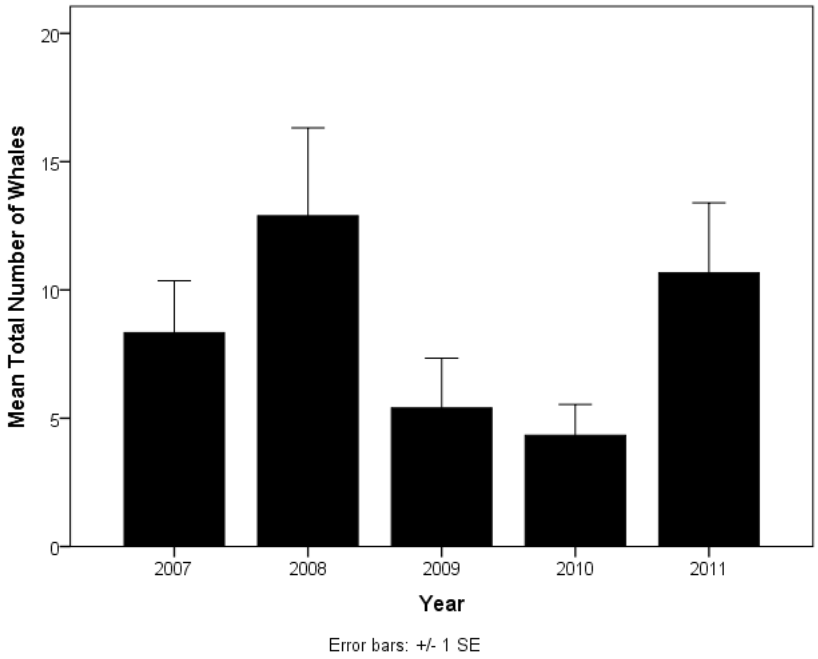

Figure 4.15. Mean group size for groups with calves each year from 2007 – 2011. Error bars represent one stand error of the mean. Differences in group size across years were not statistically significant.

4.3.2 Interannual Differences in Spatial Distribution

Whales were distributed throughout the survey area in all years (Figures 4.16 – 4.20) except 2007, when observations were limited to the fall (Oct – Nov). There was a reduced concentration of groups within the MTR Project footprint in 2010 (Figure 4.19) relative to 2008 (Figure 4.17) and 2009 (Figure 4.17), which is consistent with the reduced proportion of sightings in those areas from 2008 – 2010. Whales were sighted in greater concentrations around the MTR Project footprint again during 2011 (Figure 4.20).

Beluga whales were distributed throughout the study area in both summer (Figure 4.21; 2008 – 2011) and fall (Figure 4.22; 2007 – 2011). However, during the fall, beluga whales were more concentrated in the narrows and along the shoreline. They were distributed very heavily along the western shoreline during fall 2010 (Cornick *et al*. 2010), which is consistent with the reduced proportion of sightings within and adjacent to the MTR Project footprint in 2010.

Beluga whales were observed during all 6 tidal stages (Figures 4.23 – 4.28) but were most often sighted during low tides (Figures 4.23 – 4.25) across all years combined (~60% of all sightings). Approximately 71% of sightings across all years combined occurred during ebb and slack tides.

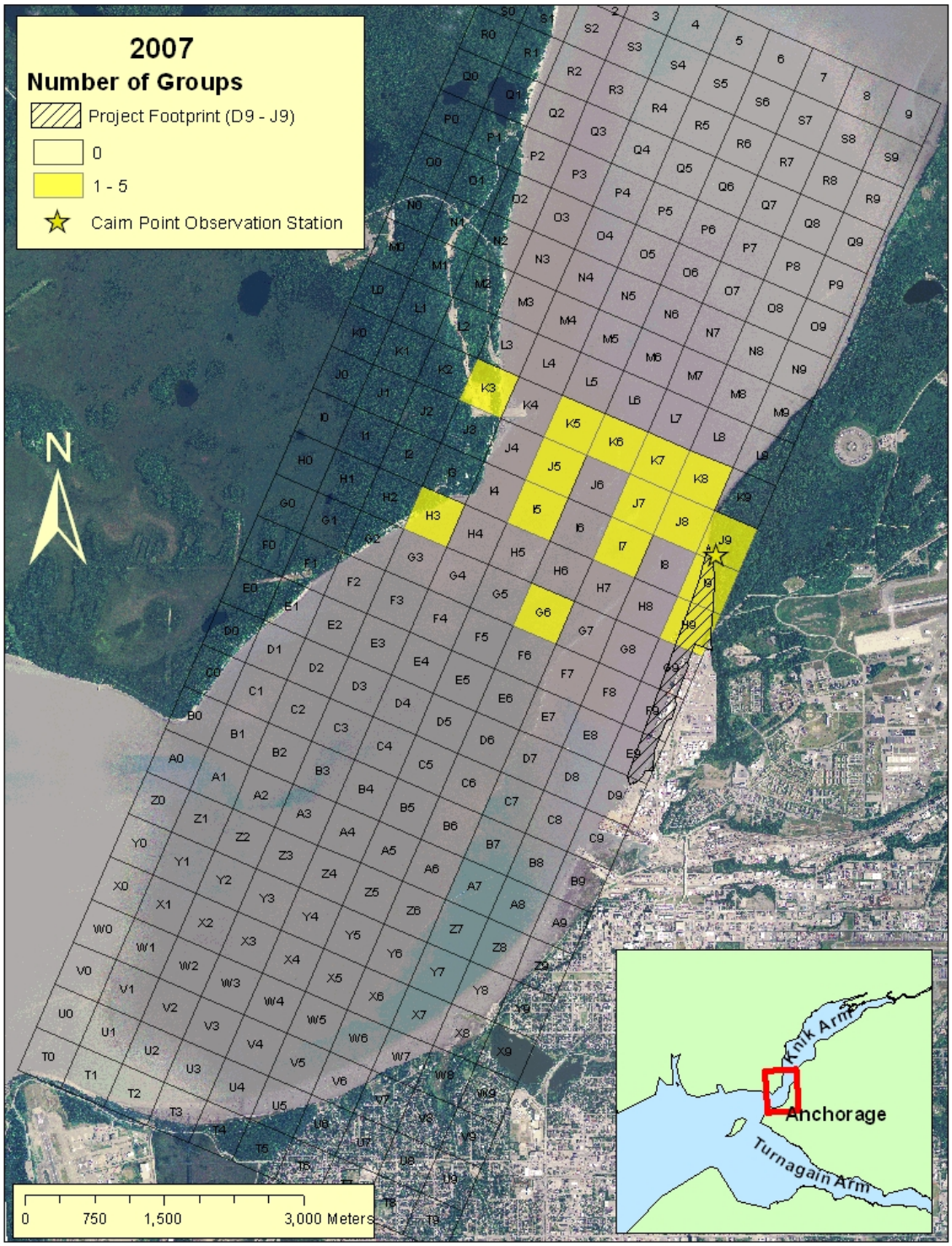

Figure 4.16. Spatial distribution of beluga whale sightings during 2007. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation station at Cairn Point (grid cell J9) is indicated by yellow star (2007 – 2010).

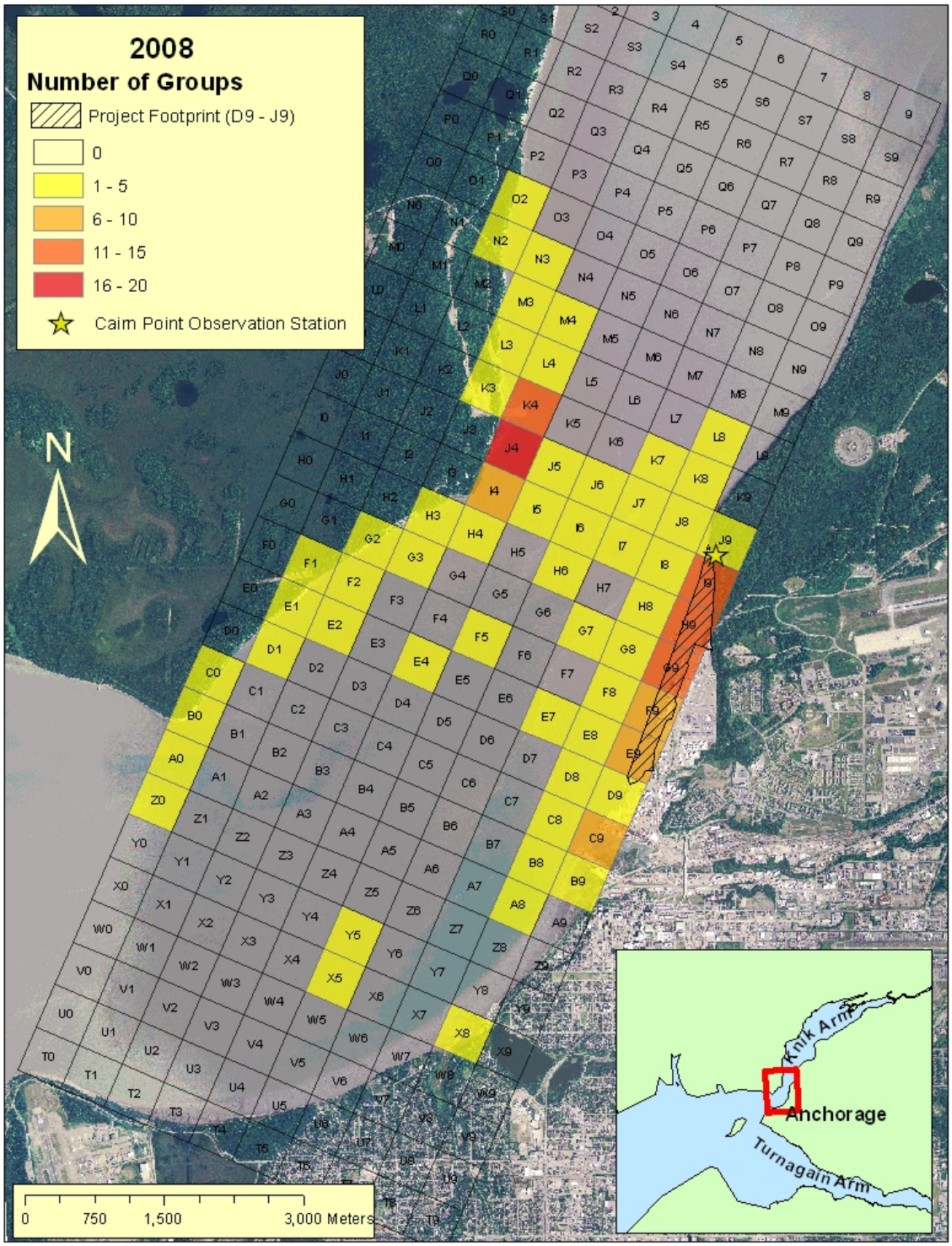

Figure 4.17. Spatial distribution of beluga whale sightings during 2008. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation station at Cairn Point (grid cell J9) is indicated by yellow star (2007 – 2010).

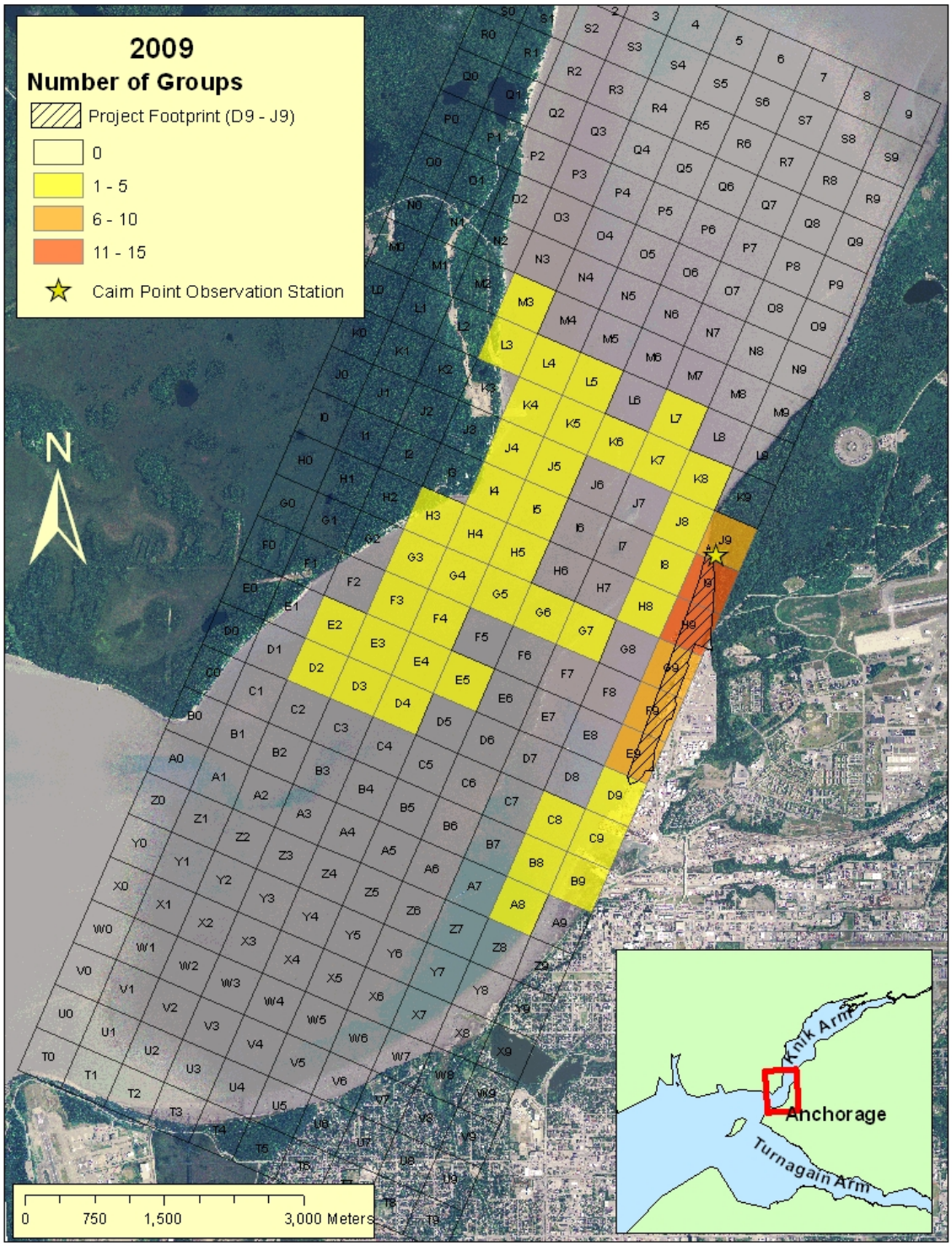

Figure 4.18. Spatial distribution of beluga whale sightings during 2009. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation station at Cairn Point (grid cell J9) is indicated by yellow star (2007 – 2010).

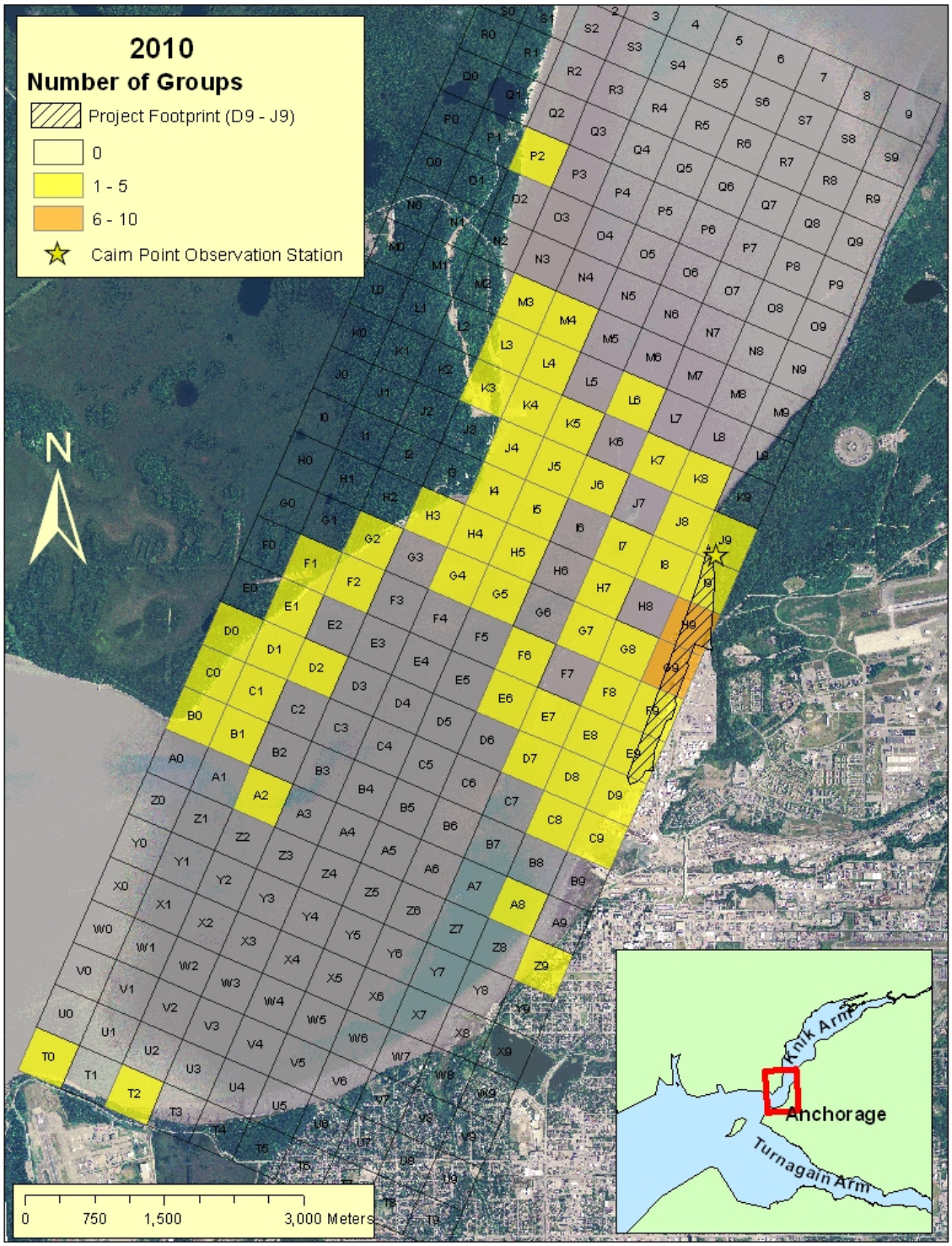

Figure 4.19. Spatial distribution of beluga whale sightings during 2010. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation station at Cairn Point (grid cell J9) is indicated by yellow star (2007 – 2010).

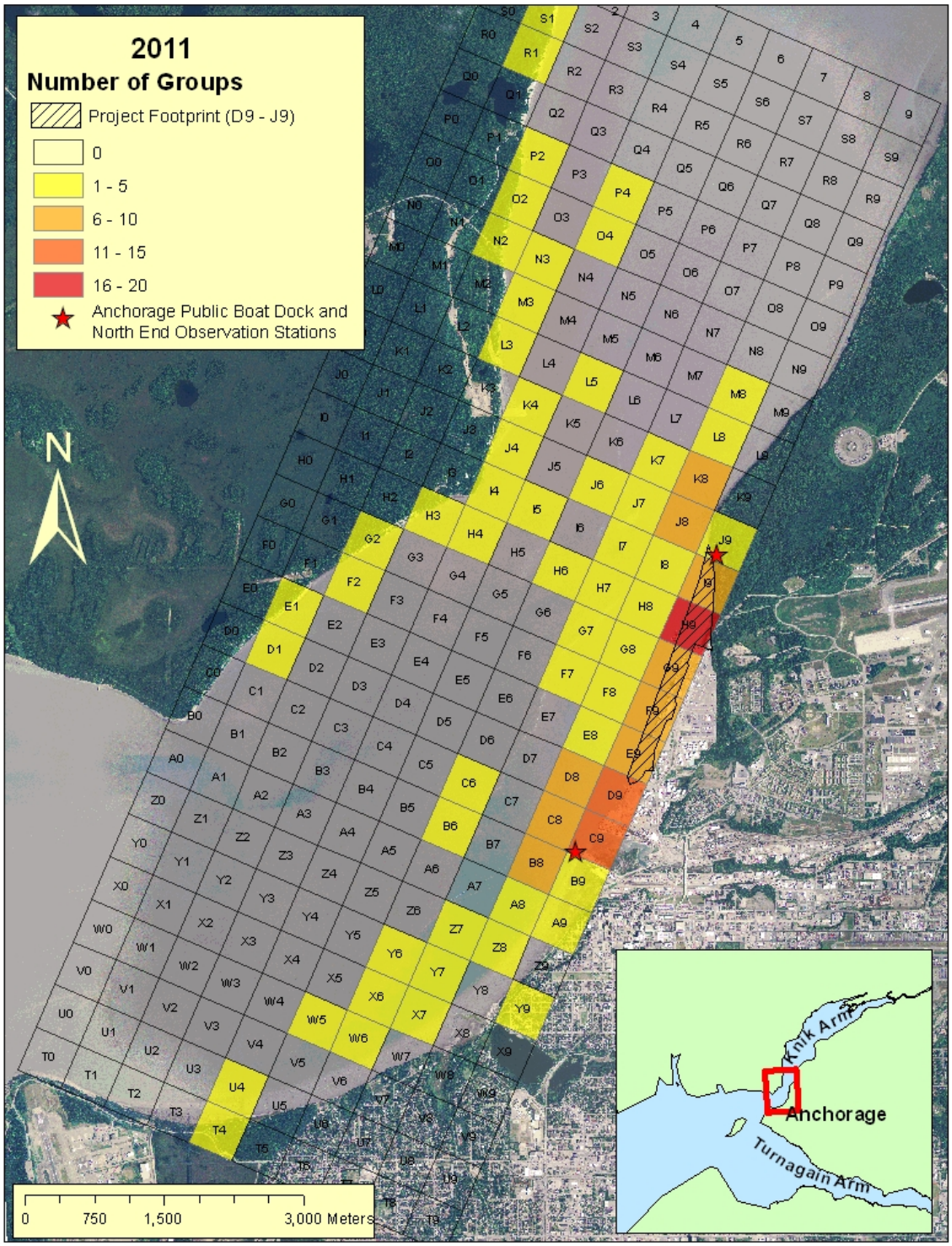

Figure 4.20. Spatial distribution of beluga whale sightings during 2011. MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

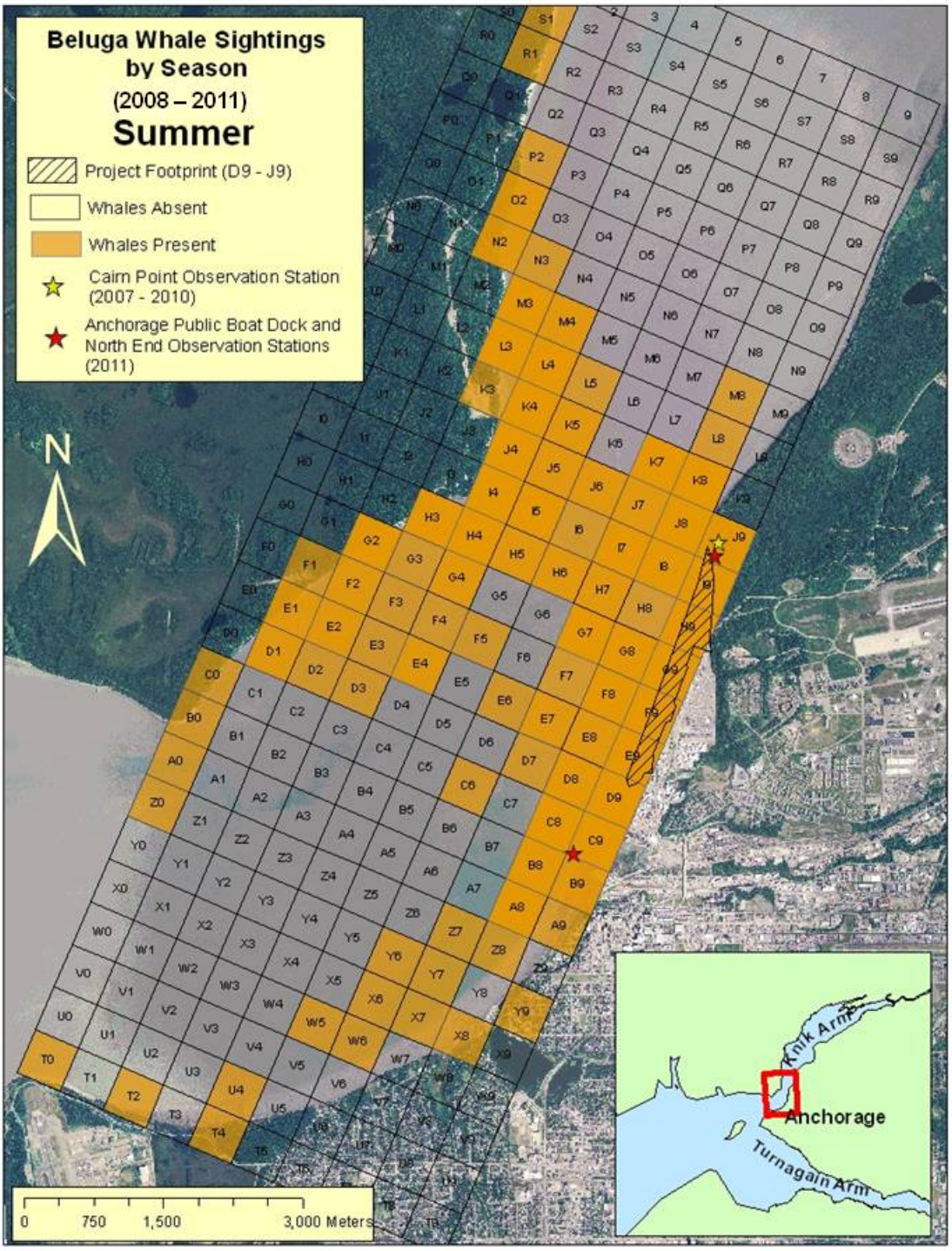

Figure 4.21. Spatial distribution of beluga whale sightings during the summer (Jul – Sep) for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation station at Cairn Point (grid cell J9) is indicated by yellow star (2007 – 2010). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars (2011).

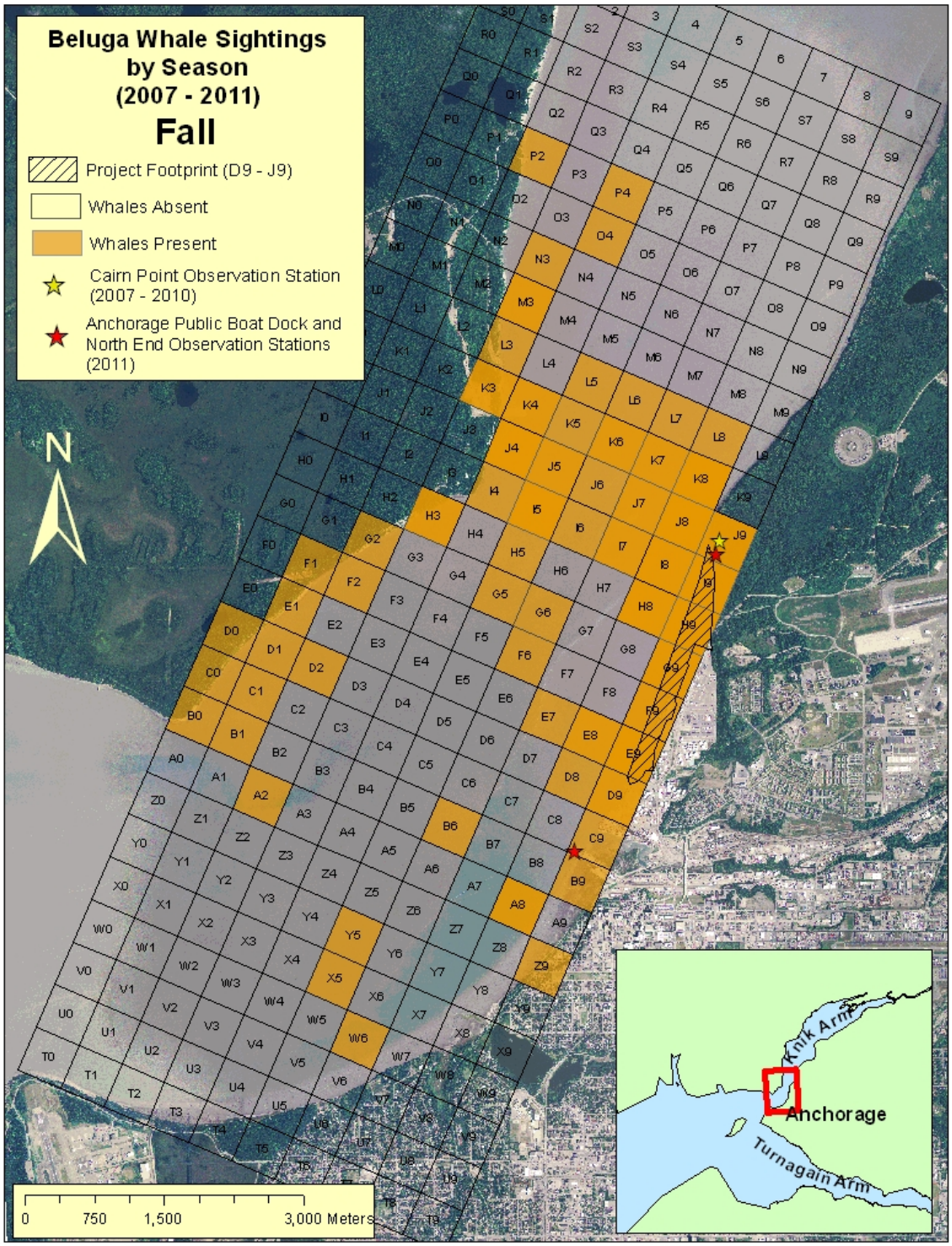

Figure 4.22. Spatial distribution of beluga whale sightings during the fall (Oct – Nov) for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation station at Cairn Point (grid cell J9) is indicated by yellow star (2007 – 2010). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars (2011).

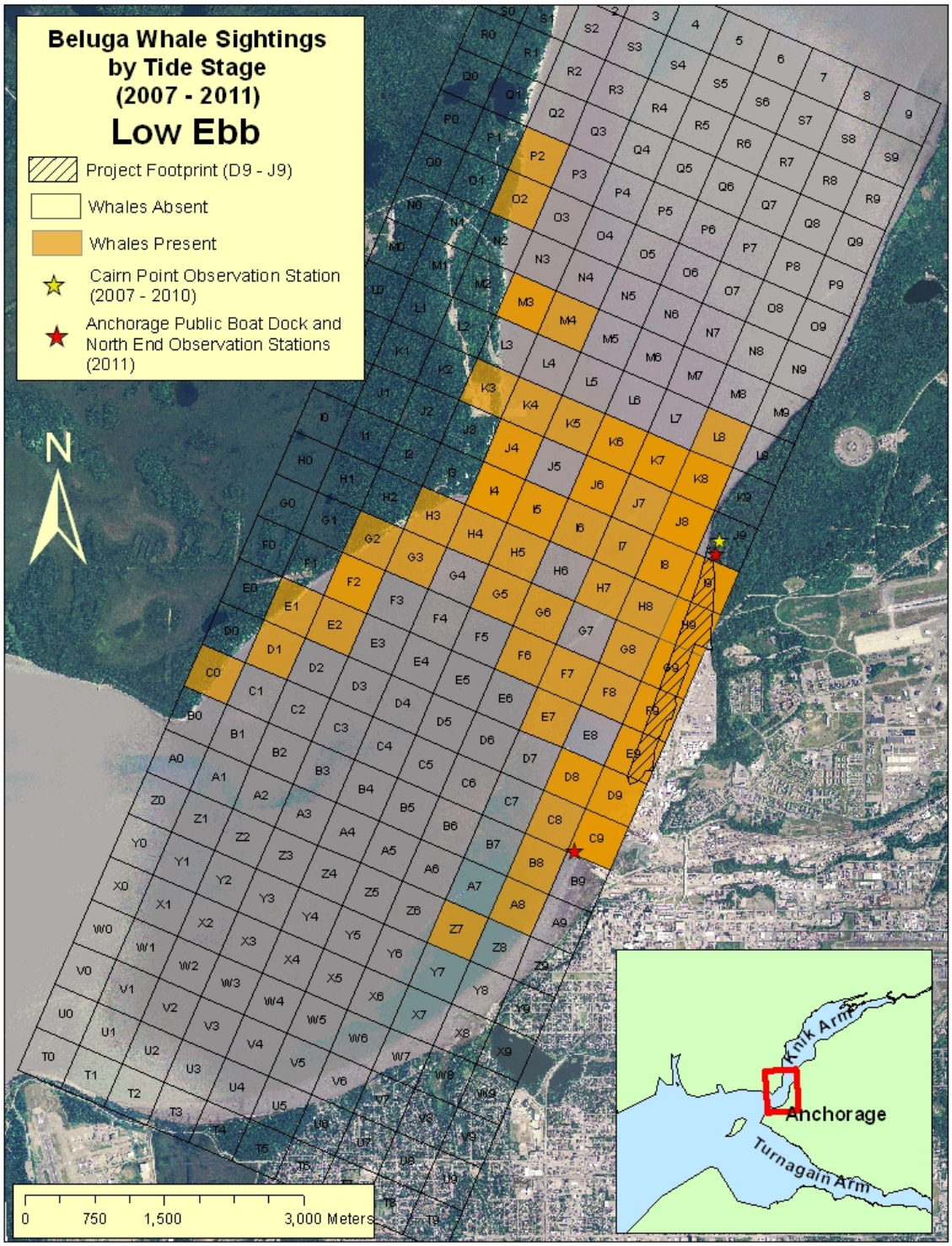

Figure 4.23. Spatial distribution of beluga whale sightings during low ebb tides for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

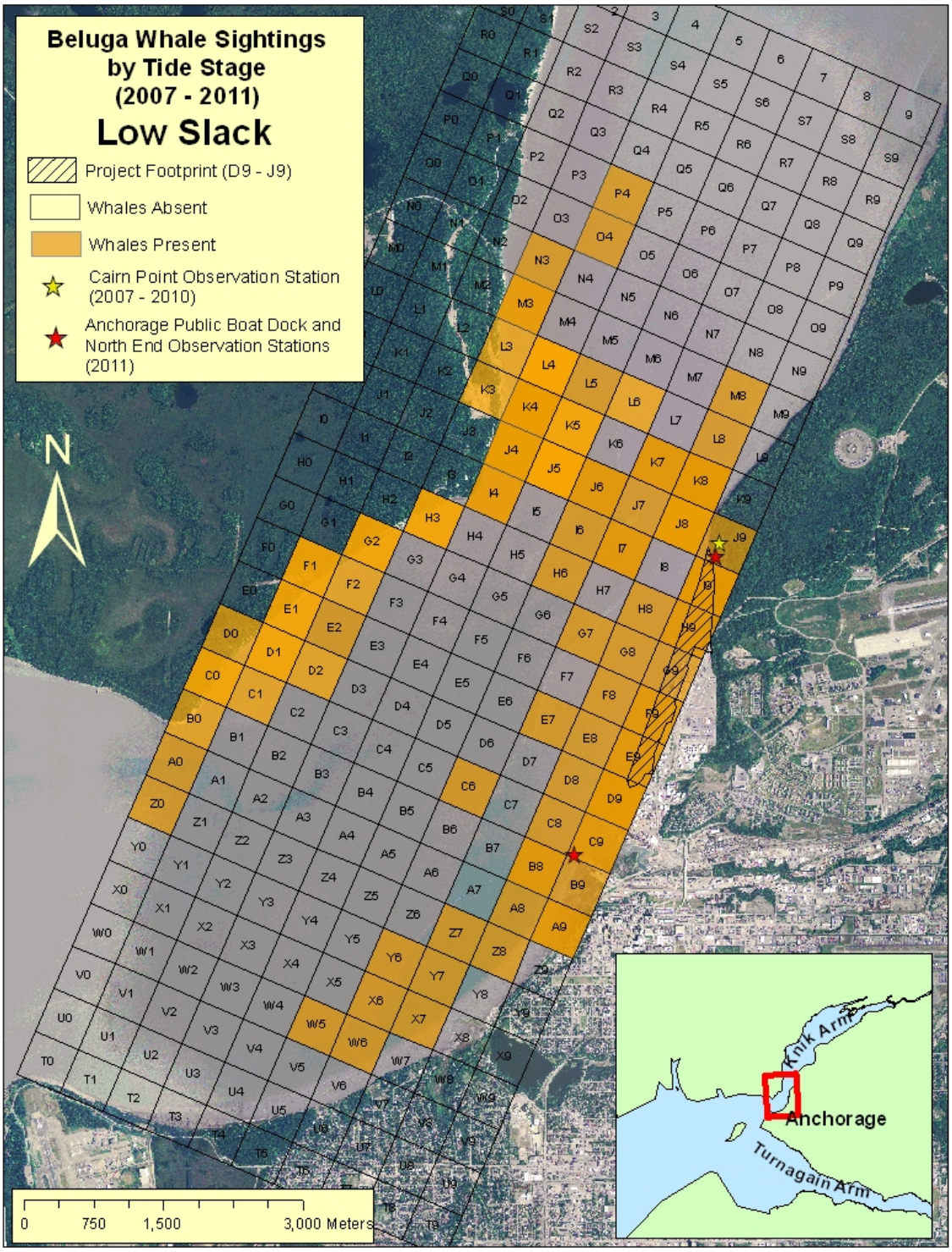

Figure 4.24. Spatial distribution of beluga whale sightings during low slack tides for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

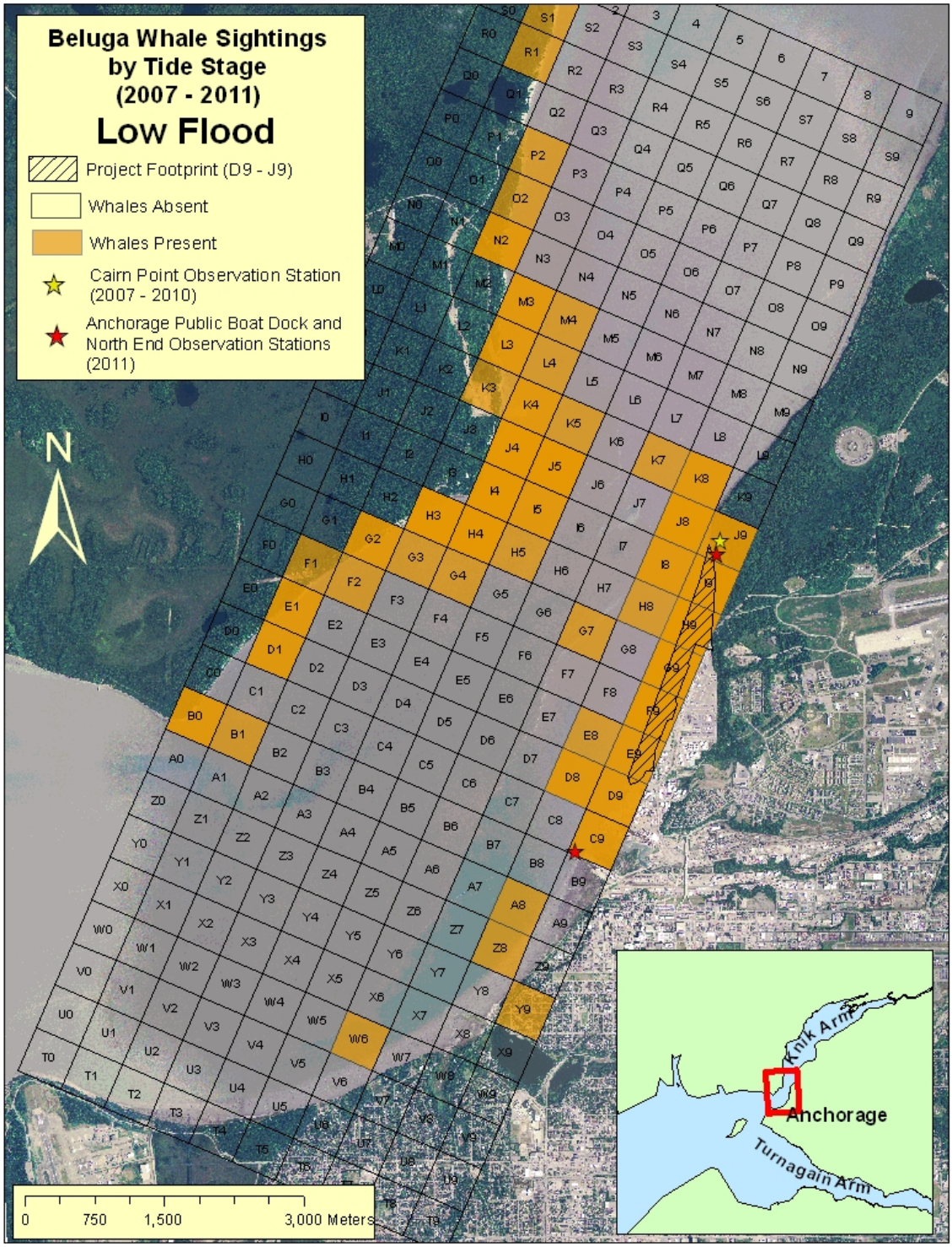

Figure 4.25. Spatial distribution of beluga whale sightings during low flood tides for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

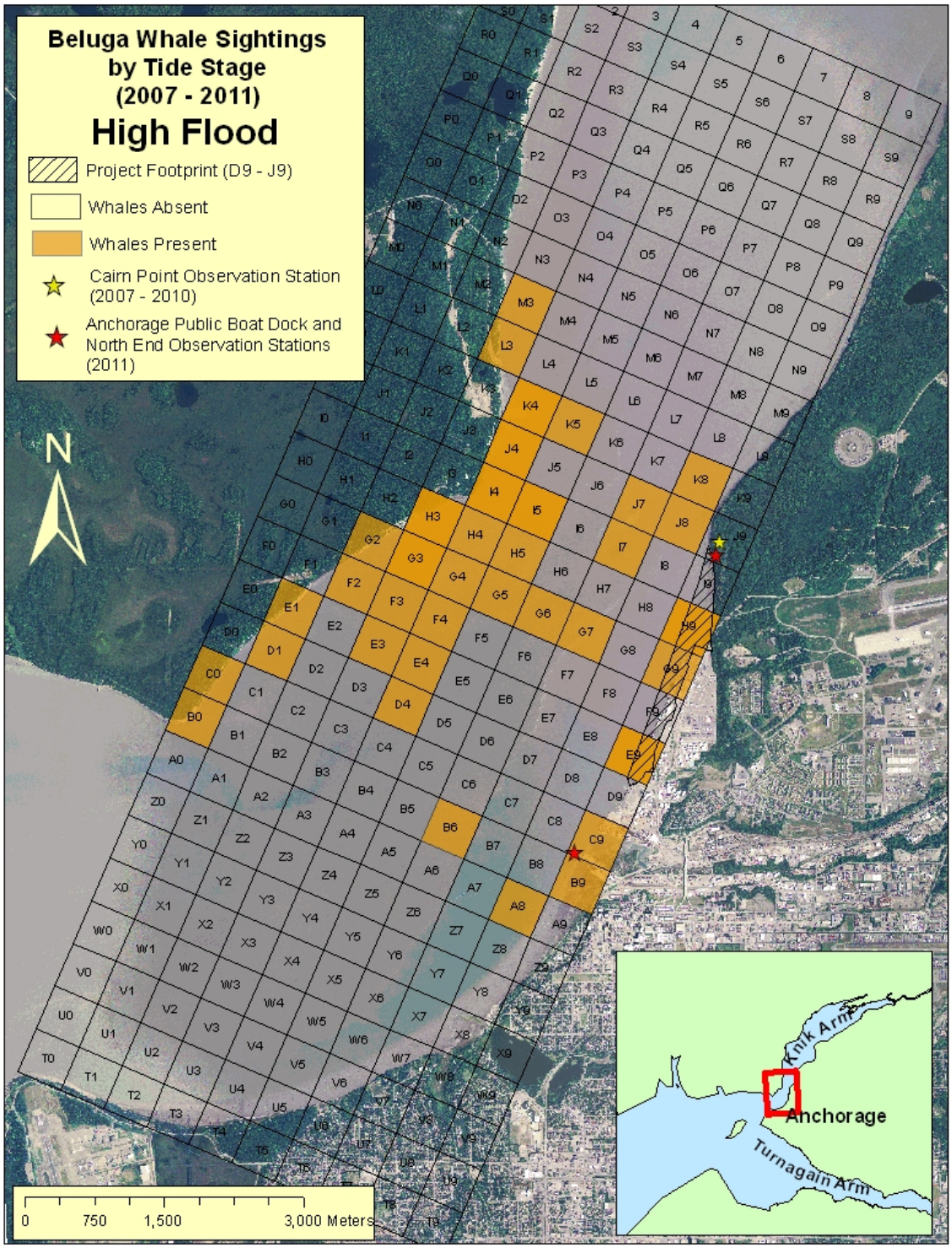

Figure 4.26. Spatial distribution of beluga whale sightings during high flood tides for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

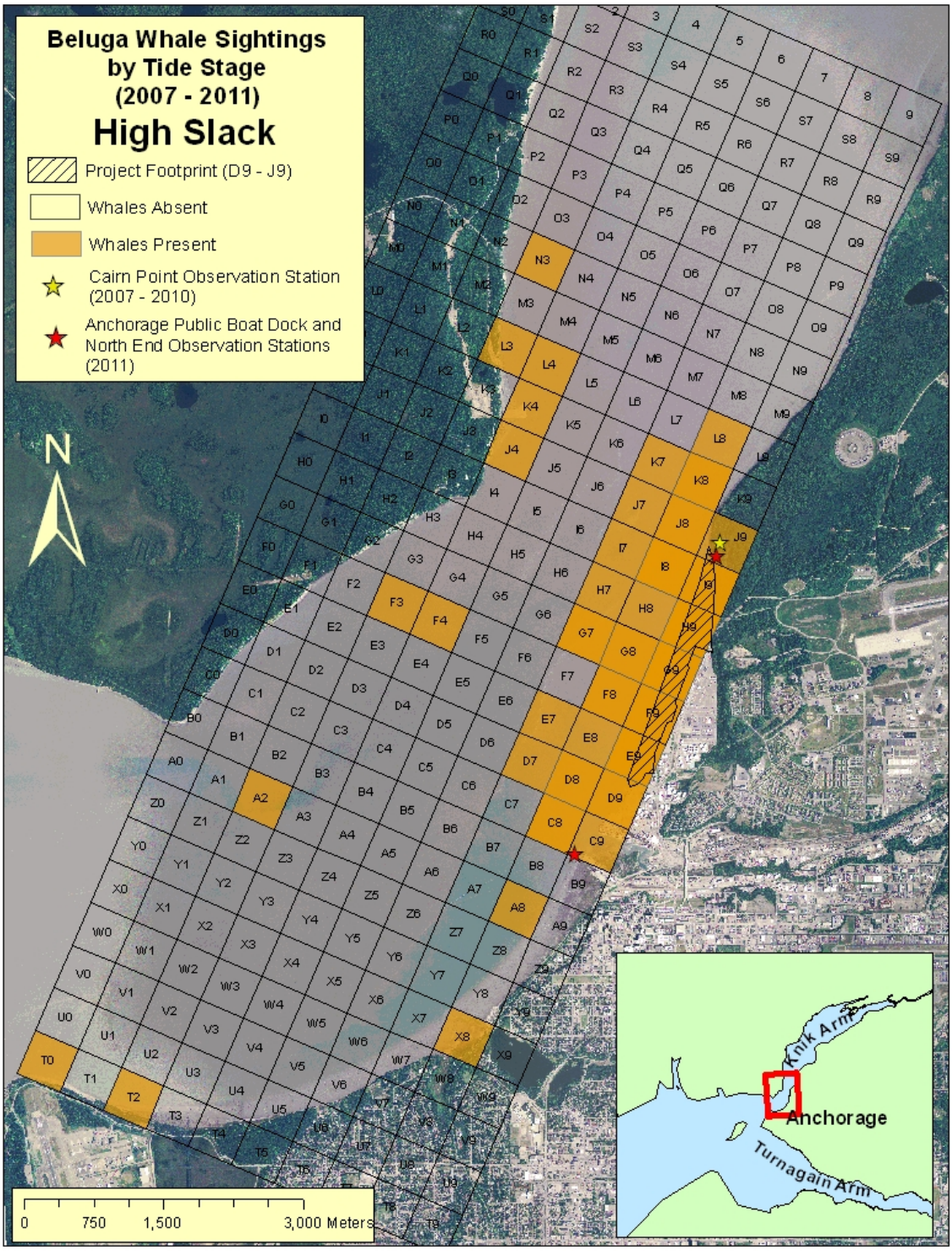

Figure 4.27. Spatial distribution of beluga whale sightings during high slack tides for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

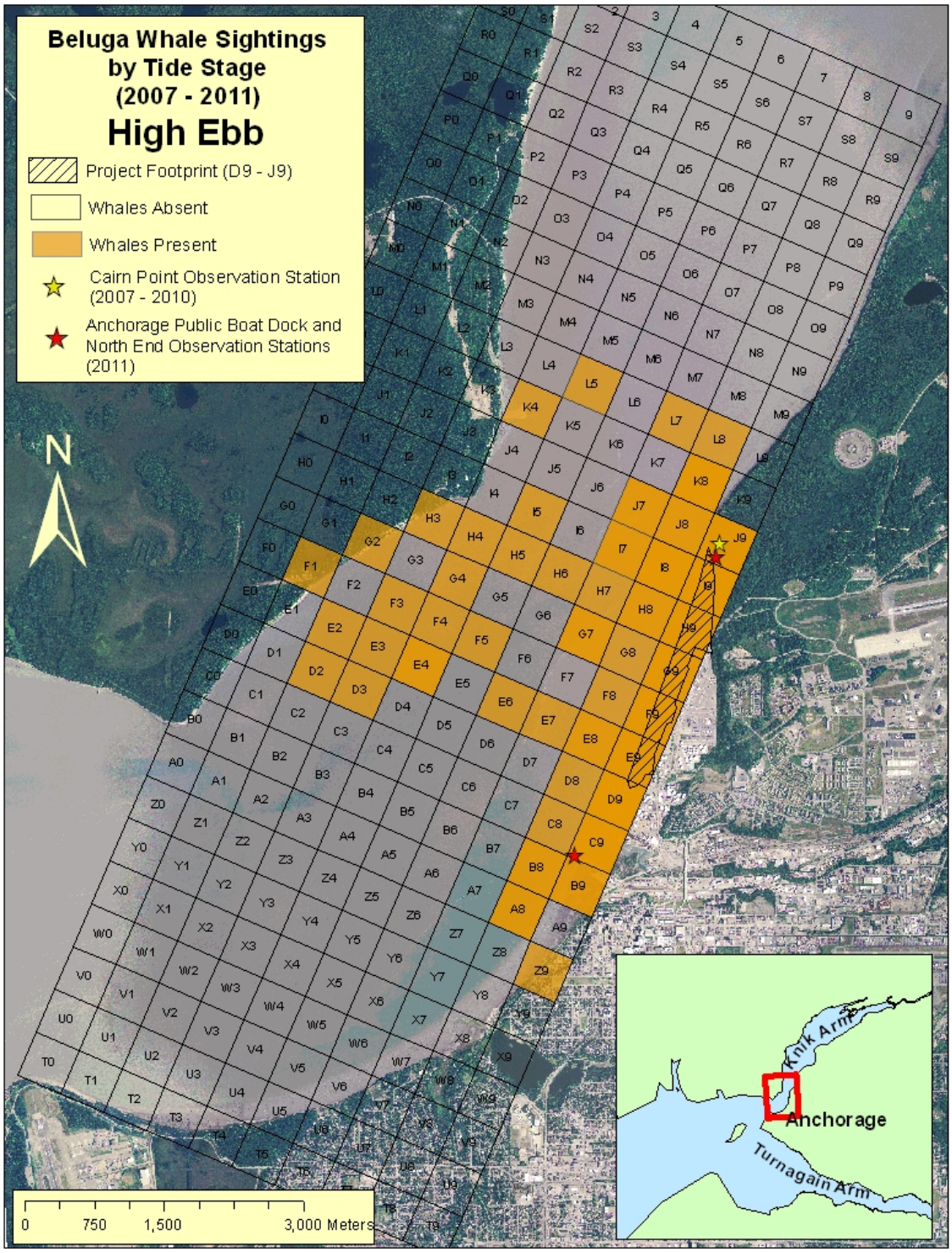

Figure 4.28. Spatial distribution of beluga whale sightings during high ebb tides for all years (2007 – 2011). MTR Project footprint is outlined and cross hatched (enclosed within grid cells D9 – I9). Observation stations at the APBD (grid cell C9) and NE (grid cell I9) are indicated by red stars.

5.0 Discussion

This section synthesizes the results of marine mammal monitoring performed by the Scientific Program during 2011, as well as the interannual comparisons from 2007 – 2011 presented in Section 4.3. All interpretations and conclusions are derived from data collected solely for the MTR Project during 2007 – 2011. References to current trends in the overall population status of Cook Inlet beluga whales are based on published survey data collected by the NMFS.

5.1 Sighting Rates

Sighting rates continue to decline each year despite doubling observational effort in 2011 (Figure 4.13). The decline in sighting rates is likely reflective of a continued ~1.1% annual decline in the Cook Inlet beluga whale population (Allen and Angliss 2010). Prior to 2011 there was a three-year decline in the proportion of sightings within and adjacent to the MTR Project footprint (64% in 2008, 46% in 2009, 21% in 2010). This trend was reversed in 2011, with 54% of sightings occurring within or adjacent to the MTR Project footprint. This may suggest that beluga whales have resumed utilizing the entire available habitat in the study area, as there was minimal in-water construction, and reduced occurrence of pile driving, during 2011.

5.2 Temporal Distribution

Beluga whale sightings continue to peak in the late summer (Figure 4.21) and early fall (Figure 4.22) as beluga whales move into Knik Arm in response to movements of their primary prey. During 2011 there was only 1 beluga whale sighted in November, which also differs from the trend over the previous four years of consistent sightings during November; however weather conditions during November 2011 were severe, and may have reduced the probability of sighting whales if they were in the area. Continued later use of the upper reaches of Knik Arm by beluga whales is consistent with recent survey data that indicate a significant range contraction of Cook Inlet belugas into the furthest reaches of the upper inlet (Hobbs *et al*. 2008). This pattern is expected to persist as long as ice-free conditions are adequate for movement of whales.

5.3 Spatial Distribution

During 2011 beluga whales were more evenly distributed across the study area than in the previous three years (Figure 4.4). This also supports the hypothesis that in the

absence of in-water construction beluga whales use the entire available habitat in Knik Arm. While the relocation of observation stations during 2011 closer to water level may have increased the probability of sighting whales to some degree, this is not likely an explanation for the change in spatial distribution in 2011, as whales were previously successfully sighted throughout the study area prior to the relocation of observation stations, and overall sighting rates have continued to decline.

Beluga whales have been observed during all tidal stages, with the exception of flood tides during 2007. However, this is likely an artifact of reduced sampling effort, as observations during that year were only conducted for six weeks (October – November). Observations continue to remain highest during low tides (~60% of all sightings) and during ebb and slack tides (~71% of all sightings) across years, although there is some interannual variability that is likely related to interannual variability in the distribution and abundance of prey.

5.4 Group Size, Structure and Behavior

Mean group size nearly doubled in 2011 compared to 2009 and 2010 to sizes more comparable to 2007 and 2008 (Figure 4.14), and the mean size of groups with calves more than doubled (Figure 4.15). Group structure during 2011 was comparable to previous years, with the majority of groups of two or more animals being densely packed.

Observed beluga whale behavior in 2011 was also consistent with previous years, with whales primarily traveling through the study area on the incoming and outgoing tides to and from foraging areas further up Knik Arm (e.g., Fish Creek, Eagle River, Eklutna). Diving and suspected feeding are occasionally observed; however no confirmed feeding events have been documented since 2007.

5.5 Responses to in-water construction

There were three unusual behavioral events (abrupt directional change, abrupt swim speed change, dispersal) during the study period (Figure 4.11). Dredging was occurring during all three of these events, but no other in-water construction activity. It is unlikely that the dredging activity caused these events, as dredging is a common activity in the study area, and has not been previously associated with abrupt changes in beluga whale

behavior. Other possible mechanisms for these behaviors include predator avoidance, intraspecific aggression or opportunistic pursuit of prey.

6.0 Conclusions

During 2011 beluga whales in the study area appear to have returned to similar habitat use, behavior and group structure patterns that were in place prior to 2010, which may be related to the reduced occurrence of pile driving and other in-water construction activities. Additional data during years with and without pile-driving or other in-water construction are necessary in order to obtain a more clear understanding of any changes in behavior and habitat use that may result from coastal zone development within Cook Inlet beluga whale critical habitat.

7.0 Acknowledgements

We would like to acknowledge the contributions of several people to the successful completion of the Scientific Marine Mammal Monitoring Program. The environmental program staff at ICRC provided APU with excellent logistical support. The safety program staff ensured the continued safety and security of our team. Nine APU students worked as MMOs during 2011 and also assisted with data entry. The opportunity provided by ICRC and the Maritime Administration is a significant enhancement to their training in the APU Marine Biology Program.

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APPENDIX

Scientific Marine Mammal Observation Logs

- **Marine Mammal Log**
- **Environmental Data Log**

POA Land-Based Surveys of Marine Mammals: Beluga whales (*Delphinapterus leucas*) **Alaska Pacific University**

Station:	Date (dd/mm/yy):	Observer (s):	Pg __ of __
Shift Start Time (hh:mm):		Shift End Time (hh:mm):	Optic:

Verified_____
Entered by_____
Sheet#_____

Sampling Round	Best Sample ?	Time (hh:mm)	Beluga Count			Harbor Seal	Harbor Porpoise	Steller Sea Lion	Killer Whale	Other	Magnetic Compass Bearing 001-360°	Grid Cell	Group #	Group Code	Activity		Direction	In-water Construction Activity		Start/End/Arrive/Leave		Comments - Write additional comments on the reverse side of this sheet. Be sure to identify which record additional comments are associated with.	Comments on the Reverse ?
			White	Gray	Dk. Gray (Calf)										1	2		1	2	CON 1	CON 2		
	?																						
	?																						
	?																						
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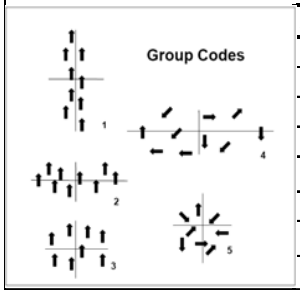
Note the time at the first and last sighting of each whale/group. Identify EACH grid cell the whales move through and note the time they enter each cell!!

Continue to count whales throughout the time the whales are in the area, until you get an accurate count (Best Sample)



Activity Code		Activity Code		In-water Construction Activities			
1	Traveling/Moving	9	Startled effect	0	No construction	6	Dredging
2	Diving	10	Approaches then leaves	1	Soft-start	7	In-water fill
3	Motionless on surface	11	Change in swimming speed	2	Impact sheet PD	8	Impact + Vibratory PD
4	Spyhopping	12	Abrupt change in direction	3	Vibratory sheet PD	9	Dredge + Impact PD
5	Breaching	13	Abrupt dives	4	Impact pipe PD	10	Dredge + Vibratory PD
6	Feeding Observed	14	Disperse	5	Vibratory pipe PD	11	Dredge + Impact + Vibratory
7	Feeding Suspected	99	Other			99	Other
8	Milling						

POA Land-Based Surveys of Marine Mammals: Environmental Conditions **Alaska Pacific University**

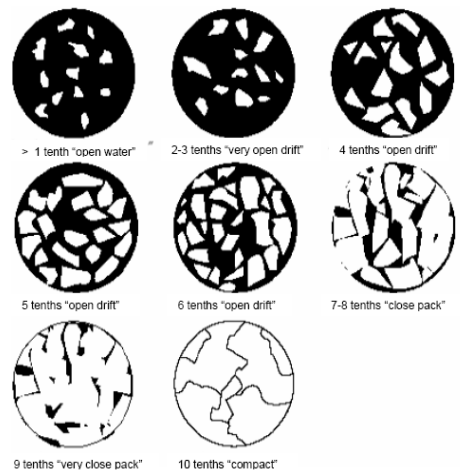
Station:	Date (dd/mm/yy):	Observer(s):	Pg___of___

Verified_____
Entered by_____
Sheet #_____

Time (hh:mm)	Air Temp. (°C)	Precip Code 00-none 01-fog 02-rain 03-snow	Wind Dir. (99 if null)	Wind Speed (km/hr, nearest whole number)	Cloud Cover (%)	Vis. Dis. (km)	See Far Shore	Glare	Central Glare Bearing 001-360°	Swell (ht in m)	Sea State (Beaufort)	White Caps	Sea Ice Concentration	Overall Conditions	# of vessels (hourly)	Comments	Comments on Reverse

Sea State	Description
0	Sea like mirror
1	Ripples but without foam crests
2	Small wavelets
3	Large wavelets, perhaps scattered white horses
4	Small wavelets, fairly frequent white horses

Sea Ice Concentration (tenths 00-10)



Types of Vessels	
Ship	Skiff
Tug boat	Dredge
Barge	Coast Guard
Tug & barge	Other

Overall Conditions	
1	Poor
2	Moderate
3	Excellent