



Beaufort Sea 3D-Seismic Survey

Offshore Seismic Survey
Plan of Operations 2017

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Table of Contents

1. INTRODUCTION	1
2. PURPOSE	1
3. LOCATION	2
4. SCHEDULE	4
5. OVERVIEW OF ACTIVITY	4
6. PROJECT DETAILS	6
6.1 Mobilization and Access	6
6.2 Land Based Activities	6
6.3 Housing and Logistics.....	6
7. SEISMIC SURVEY DETAILS.....	6
7.1 Details.....	6
7.2 Equipment and Vessels	7
7.3 Recorder Deployment and Retrieval.....	8
7.4 Sound Source Vessels.....	8
7.5 Housing Vessels	8
7.6 Receiver Deployment and Retrieval	8
7.7 Recording	9
7.8 Source Vessel Operations.....	9
7.9 Navigation and Data Management.....	10
8. ENVIRONMENTAL PLANS.....	11
8.1 Responsibility	11
8.1 Waste Management.....	11
8.2 Fueling Operations.....	11
8.3 Wildlife Interaction Plan and Marine Mammal Monitoring Program	11

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9. PERMITS AND AUTHORIZATIONS	12
10. COMMUNITY RELATIONS	13

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1. INTRODUCTION

SAExploration, Inc. (SAE), in partnership with Kuukpik Corporation (Kuukpik), plans to conduct three-dimensional (3D) nodal or ocean-bottom node (OBN) seismic surveys in state and federal waters in the Beaufort Sea during the 2017 open water season. The survey will be conducted over a period of approximately 70 days within the time period of Mid-July to late October, 2017. This time period includes all activities: mobilization, marine layout activities, marine data acquisition and demobilization of equipment and crews. Project operations will include state and federal waters, including shallow waters.

The proposed seismic operation will use marine ocean bottom recorders. Unlike the ocean bottom cable systems (OBC), the marine ocean bottom node technology has recording nodes/geophones that do not require cables. The survey involves deploying a marine node from a vessel for placement on the ocean bottom. Autonomous recording nodes lack cables but will be tethered together using a thin rope for ease of retrieval. The source energy will be a submerged compressed air source (air gun) towed by a vessel. After sufficient data have been recorded to allow accurate mapping of the strata, the marine nodes will be lifted onto the deck of the vessels, moved to a new location, data will be downloaded and nodes placed onto the seabed again. By repeating the process, the volume of subsurface area can be acoustically imaged. Because the new technology will allow SAE to use fewer vessels, equipment and personnel, it will likely have less of an environmental impact than past OBC surveys.

2. PURPOSE

The purpose of the proposed survey is to replace and augment existing datasets by providing better quality, higher resolution seismic data by using autonomous nodal seismic recording equipment

This data will improve operators' understanding of the geology and potential targets for existing production and future lease sales. Previous old technology surveys collected 3D and 2D data which can often be distorted, leading to inaccurate interpretations of the data. A 3D seismic survey using new technology provides more accurate images due to the multiple points of observation, resulting in greater accuracy to base business and geologic decisions.

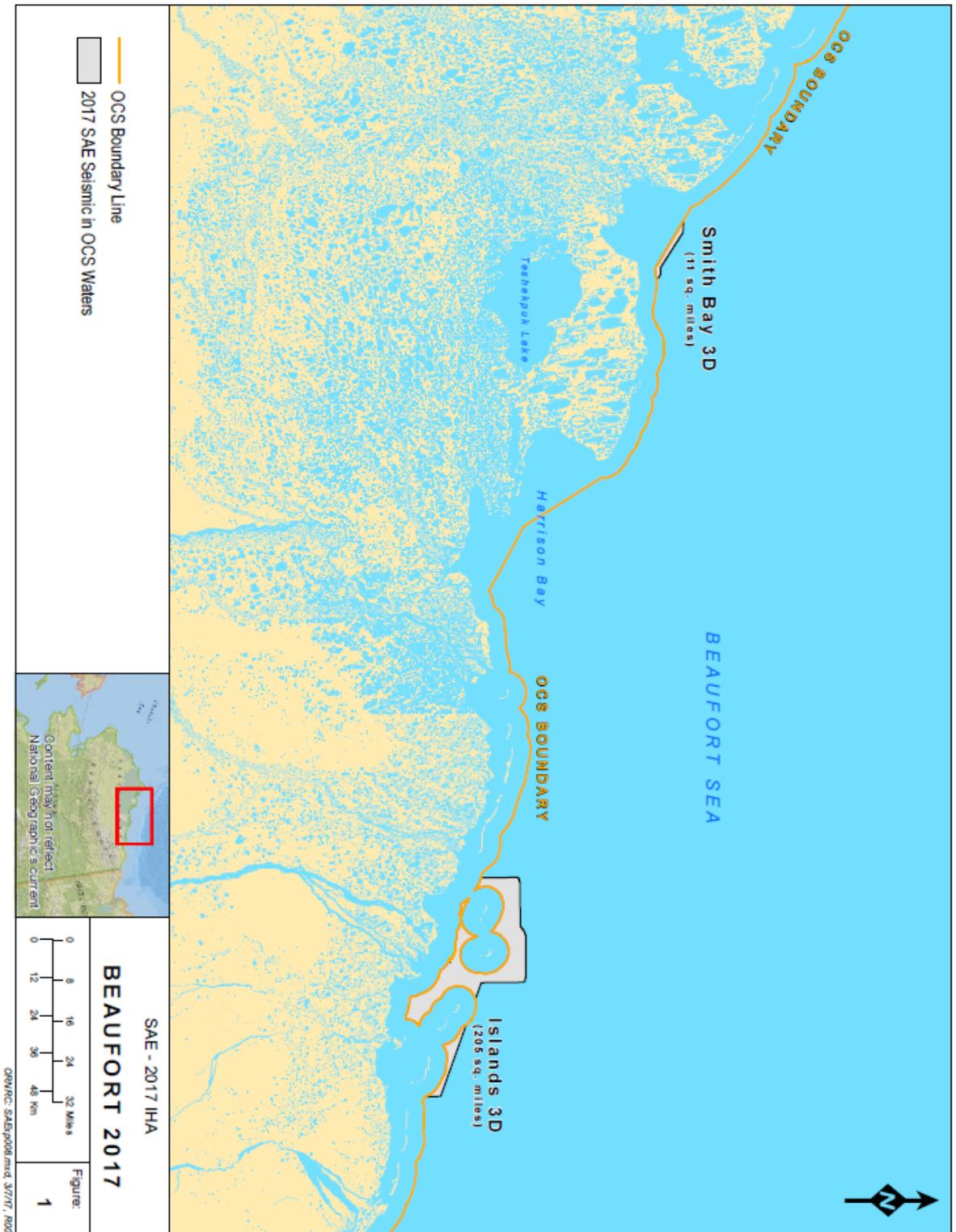
3. LOCATION

Separating the project into two different units will allow the project to work around the environmental and subsistence hunting times. The survey would occur in the waters of the Beaufort Sea in the area of Smith Bay, and the area just east of the Jones Islands and west of Maguire islands. The two project areas where SAE would potentially work would be in the areas shown in figure one and would be totally offshore. Collectively, these units total approximately 682 square miles. Smith Bay project area is approximately 89 square miles and Islands 3D is approximately 593 square miles. SAE expects that a maximum area of 500 square miles could be shot in 2017, as broken down by unit in Table 1-1.

TABLE 1-1. AREA OF THE TWO POTENTIAL UNITS SAE THAT COULD BE COLLECTED IN 2017.

Unit	Total Area (mi²)	State Waters(mi²)	Federal Waters(mi²)
Smith Bay	89	78	11
Islands 3D	593	389	205

Figure 1



4. SCHEDULE

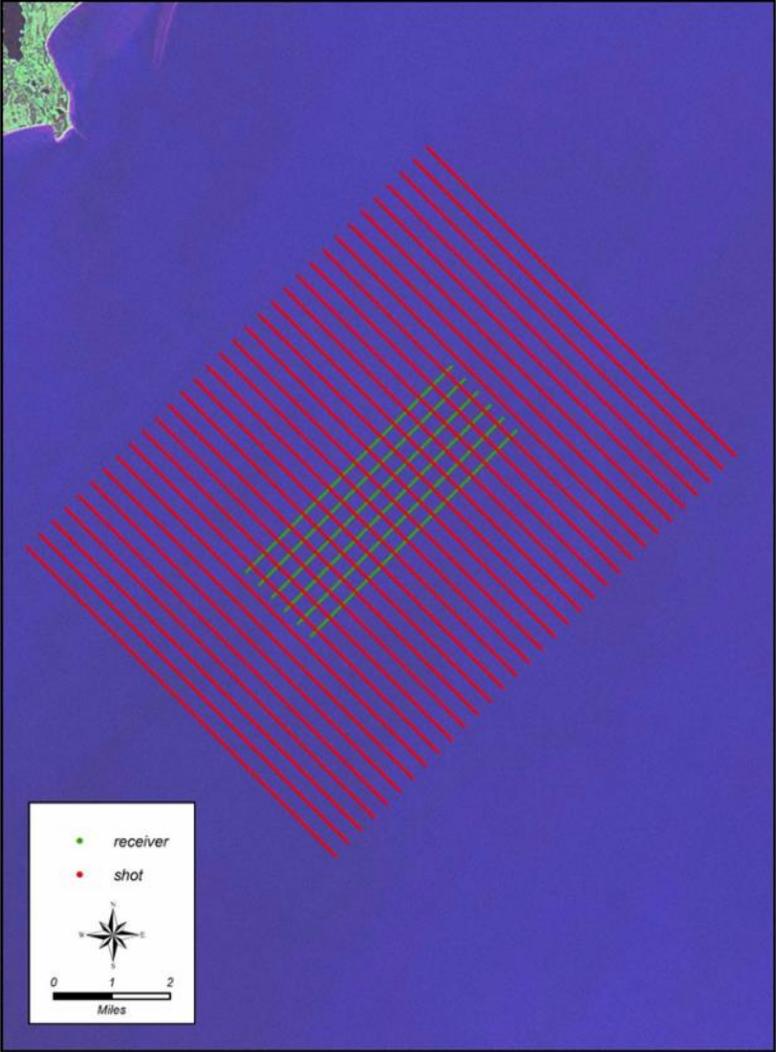
The timing of the survey is dependent upon sea ice conditions. Mobilization is planned to occur in mid to late July. Vessels may be mobilized from Oliktok Dock and or West Dock, and may motor or sail to the survey area. The larger vessels will transit from Anchorage to the site when sea ice conditions allow. Seismic data acquisition is planned to commence as soon as the 2017 open water season is free of ice (July 15th to October 30th) and will be completed in October of 2017. All associated activities, including mobilization, surveying and demobilization of survey and support crews would occur inclusive of the above dates. The actual data acquisition is expected to take approximately 70 days. Based on past similar seismic shoots in the Beaufort Sea, it is expected that effective shooting would occur over about 70 percent of the 70 days (or about 49 days). If required in the Conflict Avoidance Agreement (CAA), surveys will temporarily cease during the fall bowhead whale hunt to avoid acoustical interference with the Cross Island, Kaktovik, or Barrow based hunts. The seismic surveys will take place inside the boxes shown in figure one. Given the uncertainties of ice conditions and other factors that can influence the survey, there is a contingency plan to obtain data in September/October after the whaling season. The survey would be completed by the end of October.

5. OVERVIEW OF ACTIVITY

Prior to the start of water operations, the source and receiver grids are mapped. Hazard mapping is included in the design to ensure buffer zones, structure, pipelines, cultural resources, ect are marked as exclusion zones.

Marine operations are based on a recording patch approach (Figure 2). Positioning of the vessels is through the use of GPS and antennas attached to the air guns. The rapid discharge of compressed air through the airgun ports generate air bubbles which collapse when the pressure inside the bubble is less than the water pressure outside the bubble. A pulse is released into the surrounding water, once the survey line or patch is completed the nodes are picked up and laid again along another patch.

Figure 2. Example of patch layout



6. PROJECT DETAILS

6.1 Mobilization and Access

Smaller vessels will be transported overland to SAE operated staging areas in Prudhoe Bay. These locations will require letters of non-objections from land/lessee owners. Vessels could be launched from the West Dock facility and/or Oliktok when these areas are ice free, typically in early July. The larger vessels will be sailed to project location.

6.2 Land Based Activities

All staging will occur on privately owned property and/or existing private facilities in the Prudhoe Bay area. Land based support activities, such as small vessel mobilization/demobilization and vessel re-supply are planned to occur at West Dock and or Oliktok Point. Transportation to staging areas and docks will be conducted with light duty trucks and buses on existing roads. If helicopters are used they will be based at existing facilities at Deadhorse, Kuparuk, or Alpine. Helicopters may be used to transport survey equipment and crew members. Vehicles will remain on existing roads.

6.3 Housing and Logistics

Seismic data acquisition will occur over a 24-hour per day schedule. Approximately 100 personnel will be employed in the marine portion of the operation and possibly 35 land based personnel at staging areas. Staffing will include seismic crew, vessel management, marine mammal observers, support personnel, pilots, mechanics, and overall project management.

Marine based personnel will be housed on the vessels provided in Table 2.0 with berths and food service. All land based staff will be housed in existing facilities at Deadhorse, or similar.

For protection from weather, vessels may anchor near the islands or other near shore area locations. Personnel transfers may also occur at land locations during survey activities. Surveyors will deploy navigation positioning base stations on land and may mark receiver locations in advance of the lay-out crews.

7. SEISMIC SURVEY DETAILS

7.1 Details

Marine operations are based on a recording patch approach (Figure 2). A series of receiver lines, referred to as a "stoke," are laid on the sea floor in a defined grid of source lines to be fired and recorded. Positioning of the vessels is through the use of GPS and antennas attached to

the air gun array.

Data will be acquired using the stroke technique--multiple patches with 6 receiver lines per patch. Source lines will be acquired perpendicular to the receiver lines for each patch.

Typically, approximately 6 receiver lines oriented in a North - South direction will be deployed on the ocean bottom with a minimum spacing of 660ft and up to 880 between lines. The source vessel will travel perpendicular over the offshore receivers along lines oriented in an East-West direction (parallel to the coastline) with a minimum spacing of 990ft and up to 1100 between lines. Receiver placement will be adjusted for wildlife and geographic features as necessary.

7.2 Equipment and Vessels

Several offshore vessels will be required to support recording, shooting, and housing in the marine and transition zone environments. Table 2 identifies planned vessels for the survey. In the event a specific vessel is not available for the survey, a vessel with similar parameters would be used. All vessels meet or exceed EPA tier two requirements and during operations horse power are at approximately 50%. Any substitution will be in accordance with the Incidental Harassment Authorization (IHA) requirements.

Table 2 Summary of Number/Type of Vessels Involved in Proposed Project

Vessel	Operation	Size (feet)	Gross Tonnage	No. of Berths	Main Activity/Frequency	Source Levels* (dB)
Peregrine Falcon(or similar)	Source Vessel	120 x 25	100-250	10-20	Seismic data acquisition 24 hour operation/ 1200hp	179.0
TBD	Source Vessel	80 x 25	100-250	10-20	Seismic data acquisition 24 hour operation	165.7
Miss Diane I(or similar)	Node equipment deployment and retrieval	80 x 20	50	16	Deploying and retrieving nodes 24 hour operation/600 hp	165.3

Mark Stevens (or similar)	Node equipment deployment and retrieval	80 x 20	50	16	Deploying and retrieving nodes 24 hour operation/750 hp	165.3
TBD	Mitigation/Housing Vessel	90 x 20	100	20-30	House crew 24 hour operation	200.1
TBD	Crew Transport Vessel	30 x 20	20-30	3	Transport crew intermittent 8 hours	191.8
Sleep Robber	Bow Picker	32 x 14	20-30	3	Deploying and retrieving nodes Intermittent operation/860 hp	171.8
Maxine	Bow Picker	30 x 20	20-30	3	Deploying and retrieving nodes Intermittent operation/900 hp	171.8

**Sound source levels from Aerts et al. (2008) based on empirical measurements of the same vessels expected to be used during this survey.*

7.3 Recorder Deployment and Retrieval

Jet driven shallow draft vessels and bow pickers can be used for the deployment and retrieval of the offshore recording equipment. These vessels can be rigged with hydraulically driven deployment, retrieval squirter and crab blocks allowing for automated deployment from the stern and retrieval from the bow of the vessel. Some of these vessels will carry the nodes on hydraulically driven conveyors to allow the nodes to be picked from the bow and moved to the rear for deployment, while the smaller vessels carry the recording equipment on the deck in fish totes.

7.4 Sound Source Vessels

Multi-purpose shallow draft landing crafts will be used for source vessels. Source vessels have the ability to deploy two arrays off the stern using large A-frames and winches and can operate in ultra-shallow waters due to 2-6' draft. On the source vessels, the airgun arrays (mounted in a cage) are typically carried on the stern deck with an umbilical that allow the arrays to be deployed and towed approximately 50' to 75' off the stern. The larger forward deck allows for sufficient space for source compressors and additional airgun equipment to be stored.

7.5 Housing Vessels

Housing vessel(s) will be sufficient berthing to house crews and management. The housing vessel will have ample office and bridge space to facilitate its role as the mother ship and central operations.

7.6 Receiver Deployment and Retrieval

Floating vessels will be used for the deployment and retrieval of nodes at predetermined locations for receivers. Each node is a multicomponent system containing three velocity sensors and a hydrophone. These nodes will be deployed with small rope connected to each node. Each

receiver/node line will vary in length depending on size of patch, and are spaced approximately 660 ft. apart (although wider spacing is possible). As the vessel lay the node on the bottom of the sea floor, surface buoys are attached at each end of the seismic line for retrieval purposes.

In the surf zone, jet driven shallow draft vessels and bow pickers will be used for the deployment and retrieval of the offshore recording equipment. These vessels can be rigged with hydraulically driven deployment and retrieval squirts crab block, allowing for automated deployment and retrieval from the bow or stern of the vessel. These nodes will not affect any marine traffic.

Example of marine node



7.7 Recording

Once the receivers for a stroke have been deployed, they will autonomously and continually record data. Data from these OBN units are retrieved only after the stroke has been successfully completed. The information is then downloaded and nodes are redeployed.

7.8 Source Vessel Operations

One or two seismic source vessels will be used during the proposed survey. The sources will be arrays of airguns. The primary seismic source for offshore recording consists of a 2 x 880-in³ array for a total of 1,760-in³ for waters greater than 5 m deep and a 4 x 220-in³ array (880 in³ total) for waters less than 5 m. The arrays of the main source vessels will be towed at a distance

of approximately 50 to 75 ft from the stern at 9 to 12 ft, which is remotely adjustable if needed. The source vessels will travel along pre-determined lines with a speed varying from approximately 1 to 5 knots, mainly depending on the water depth. To limit the duration of the total survey, the source vessels will be operating simultaneously, with the operating source vessels alternating shots; this means that one vessel discharges airguns when the other vessel is recharging. Shot intervals are expected to be about 16 seconds for each array resulting in an overall shot interval of 8 seconds considering the two alternating arrays. Operations are expected to occur 24 hours a day, with actual daily shooting to total about 12 hours. The exact shot intervals will depend on the compressor capacity, which determines the time needed for the airguns to be recharged.

7.9 Navigation and Data Management

Navigation will be accomplished with the use of a Differential Global Positioning System (DGPS). This navigation system remotely links the operating systems located on each vessel to a land based known point as a reference. Two DGPS base stations may be maintained along the coast, on land, to provide corrections to the rover units aboard both the source and layout vessels offshore and the land based survey. This gives all systems a common known error in their data to correct them back to match real world coordinates. All vessels will transmit their location back to a central monitoring system that can display where everyone is in real time.

Each system will display known obstructions, islands, and identified areas of sensitivity along with pre-plotted source and receiver lines. These obstacles and line positions will be expanded and updated as the survey progresses. The centralized server will update and display the positions of each vessel in the survey area every few seconds. This will provide the crew a quick way to reference each vessel's position progress and how it's relates to the various displayed items.

The position of each receiver deployed in the surf zone will be determined using a corrected GPS position from a survey grade navigation unit. Determining positions of receivers once deployed under water may require more than one technique due to the variable bathymetry of the survey area. A combination of Ocean Bottom Node location, GPS and acoustic pingers will be used. For Ocean Bottom Node locations, the source vessel fires a small precisely positioned single energy source (10cui. gun) multiple times along both sides of the receiver lines to achieve a triangulated position for each node. In addition, acoustical pingers will be located at predetermined intervals on the receiver lines and transmit a signal to a transponder mounted on a vessel. This allows for known position at each transponder and we can interpolate the other receiver's locations between the acoustical pingers. This can also serve as a verification of the

Ocean Bottom Node Locations or production positioning methods. Because the Ocean Bottom Node Locations method is not accurate in shallow water (< 15ft), the receiver locations at these depths will be recorded as "as laid" positions, which is the GPS location where the receivers are deployed. A tide gauge may also be installed in the operation area so we can adjust both the source and receiver water depths back to sea level.

8. ENVIRONMENTAL PLANS

8.1 Responsibility

SAE will conduct the proposed seismic operation in full compliance with all federal, state, and local regulations. SAE will have an HSE Plan, inclusive of an Interface Plan, Emergency Response Plan to guide the conduct of work. All employees and subcontractors will be trained at a minimum to the applicable standards set forth by the North Slope Training Cooperative. Additionally, all personnel will participate in specific project related training programs, which include vessel and overall operational safety, marine mammals, and other wildlife interaction.

The Captain on each vessel and HSE Advisors from SAE are charged with the responsibility of ensuring compliance with permits and regulations and the HSE Plan. SAE Management and HSE staff will provide oversight and assurance. Protective Species Observers (PSOs) will be on board source vessels to monitor for marine mammals in accordance with the requirements in with the National Marine Fisheries Service (NMFS) and U.S. Fish & Wildlife Service (USFWS) in accordance with the Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) regarding marine mammals occurring the project area.

8.1 Waste Management

A waste management plan will be developed and implemented for each operating area, vessel operations, and staging sites. Wastes will be stored and hauled to Prudhoe Bay for treatment, or disposal in existing approved facilities. Staging areas will have waste accumulation areas where wastes generated by working crews will be transferred. Vessels will have USCG approved marine sanitation devices for handling sewage. Vessel fluids will be managed in accordance with applicable governmental regulations. Solid wastes from vessels will be transferred to shore for handling at existing facilities.

8.2 Fueling Operations

Refueling of vessels at sea will be conducted with approved US Coast Guard procedures. Refuel of the vessels will take place at West Dock or by delivery from an approved vessel. All fuel will be stored at existing permitted facilities.

8.3 Wildlife Interaction Plan and Marine Mammal Monitoring Program

SAE has submitted a polar bear/wildlife interaction plan with a request for a Letter of

Authorization for incidental take from US Fish and Wildlife Service. A marine mammal monitoring and mitigation plan was submitted with a request for an Incidental Harassment Authorization to the National Marine Fisheries Service. The proposed monitoring program includes PSOs on each source vessel, ramp up procedures, and avoidance protocols.

9. PERMITS AND AUTHORIZATIONS

Federal, state and local permits and authorizations will be required for the proposed activity. These are summarized in Table 3. No field archeological and cultural resource reconnaissance will be conducted within the project area due to all activities are offshore. If there are archaeological sites identified within the area of activity from past surveys, these areas will be noted along the shoreline for avoidance.

Letters of notification will be sent to affected leaseholders, Unit Operators and Operators of Rights-of-Way within the survey area. If private parcels are necessary for project operations, SAE will request short term Revocable Use Permits from private land owners as necessary.

Table 3 Regulatory Requirements and Agreements

PERMIT/APPROVAL	AGENCY
<i>FEDERAL</i>	
Incidental Harassment Authorization (IHA) for Marine Mammals	National Marine Fisheries Service
Letters of Authorization (LOA) for Incidental Take of Polar Bears and Pacific Walrus	U.S. Fish and Wildlife Service
Geological and Geophysical Explorations or Scientific Research on the Outer Continental Shelf	Bureau of Ocean Energy Management
<i>STATE</i>	
Miscellaneous Land Use Permit (Geophysical Exploration}	Alaska Department of Natural Resources, Division of Oil and Gas
Cultural Resources Clearance	Alaska Department of Natural Resources, State Historical Preservation Office
<i>LOCAL</i>	
Development Approval	North Slope Borough
Inupiat History, Language, and Culture Traditional Land Use Inventory Clearance Certificate (NSB}	North Slope Borough
Conflict Avoidance Agreement (CAA) / Plan of Cooperation	Alaska Eskimo Whaling Commission and North Slope Communities Whaling Captains' Associations
<i>OTHER</i>	
Letters of Notification	Oil and Gas Unit Operators

Private surface use Agreements	No private land or Native allotments will be crossed, no private agreements required.
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10. COMMUNITY RELATIONS

The proposed seismic survey will take place between July and October. Potential impact from the planned activities is expected mainly from sounds generated by the vessels and during active airgun deployment. As a joint venture partner with Kuukpik, SAE will be working closely with the whaling commission and the communities on the North Slope to plan operations that will include measures that are environmentally suitable and that do not impact local subsistence use. SAE will participate in the Conflict Avoidance Agreement. A schedule of meetings in the villages and or affected communities will be developed and meetings attended. SAE has attended the AEWC meetings in December 2016 and February 2017.