U.S. Environmental Protection Agency

Ocean Discharge Criteria Evaluation for Hilcorp Alaska, LLC - Liberty Drilling and Production Island

NPDES Permit No. AK0053805

U.S. EPA Region 10
Office of Water and Watersheds
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1. INTRODUCTION

1.1. Purpose

The U.S. Environmental Protection Agency (EPA) is issuing a National Pollutant Discharge Elimination System (NPDES) permit to Hilcorp Alaska, LLC (Hilcorp) for wastewater discharges associated with the Liberty Drilling and Production Island (LDPI), located approximately 5 miles offshore in Foggy Island Bay of the Beaufort Sea Outer Continental Shelf (Figure 1). Section 403(c) of the Clean Water Act (CWA) requires that NPDES permits for discharges into the territorial seas, the contiguous zone, and the oceans, comply with EPA's Ocean Discharge Criteria.

EPA's Ocean Discharge Criteria (Title 40 of the *Code of Federal Regulations* [CFR] Part 125, Subpart M) set forth factors the Regional Administrator must consider when determining whether the discharges will cause unreasonable degradation of the marine environment. Unreasonable degradation is defined as follows (40 CFR 125.121(e)):

- Significant adverse changes in ecosystem diversity, productivity, and stability of the biological community within the area of discharge and surrounding biological communities;
- Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms; or
- Loss of aesthetic, recreational, scientific, or economic values that are unreasonable in relation to the benefit derived from the discharge.

EPA regulations set out 10 criteria to consider when conducting an Ocean Discharge Criteria Evaluation (ODCE) (40 CFR 125.122):

1. Quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged.
2. Potential transport of such pollutants by biological, physical, or chemical processes.
3. Composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain.
4. Importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.
5. Existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs.
6. Potential impacts on human health through direct and indirect pathways.
7. Existing or potential recreational and commercial fishing, including finfishing and shellfishing.
8. Any applicable requirements of an approved Coastal Zone Management Plan.
9. Other factors relating to the effects of the discharge as may be appropriate.
10. Marine water quality criteria developed pursuant to CWA section 304(a)(1).

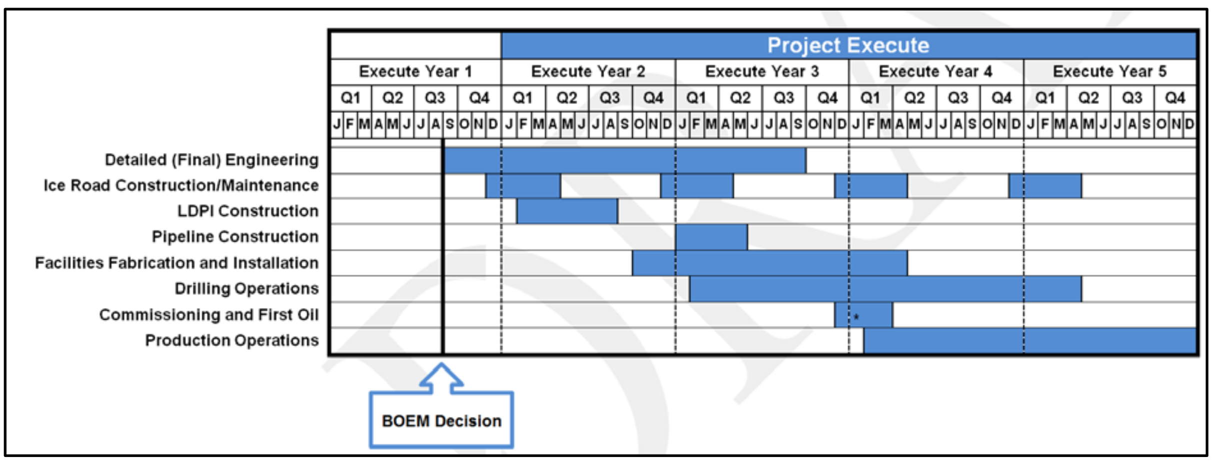
On the basis of the analysis in this ODCE, the Regional Administrator will determine whether the general permit may be issued. The Regional Administrator can make one of three findings:

1. The discharges will not cause unreasonable degradation of the marine environment and issue the permit.
2. The discharges will cause unreasonable degradation of the marine environment, and deny the permit.
3. There is insufficient information to determine, before permit issuance, that there will be no unreasonable degradation of the marine environment, and issue the permit if, on the basis of available information, that:
    - Such discharge will not cause irreparable harm[1] to the marine environment during the period in which monitoring will take place.
    - There are no reasonable alternatives to the on-site disposal of these materials.
    - The discharge will be in compliance with additional permit conditions set out under (40 CFR 125.123(d)).

This document relies extensively on information provided in the Bureau of Ocean Energy Management Draft Environmental Impact Statement for the Liberty Development Project (BOEM 2017), the National Marine Fisheries Service Final Environmental Impact Statement for the Effects of Oil and Gas Activities in the Arctic Ocean (NMFS 2016), and the ODCE for EPA's Geotechnical NPDES General Permit (USEPA 2015).

1.2. Description of the Discharges

This document evaluates the impacts of wastewater discharges associated with the LDPI. The timing of discharges discussed below are based on the following project schedule proposed by Hilcorp.



With the exception of the ongoing discharges from the seawater treatment plant during the production phase of the project, all other discharges authorized by EPA are contingency discharges. For purposes of the NPDES permit, EPA defines contingency discharge as, "an authorized discharge to navigable waters that occurs prior to construction of the waste disposal well, and/or when the well is offline or otherwise not available for injection during maintenance and/or testing activities." The contingency discharges authorized in this permit are: sanitary and domestic wastewater (Outfall 001A); potable water treatment

[1] *Irreparable harm* is defined as significant undesirable effects occurring after the date of permit issuance which will not be reversed after cessation or modification of the discharge [40 CFR 125.121(a)].

reject wastewater (Outfall 001B); construction dewatering wastewater (Outfall 003); and secondary containment dewatering wastewater (Outfall 004).

1.2.1. Sanitary and Domestic Wastewater (Outfall 001A; Contingency Discharge)

Sanitary wastes from offshore oil and gas facilities are comprised of the human body waste discharged from toilets and urinals. Domestic waste, or graywater, originates from sinks, showers, laundries, safety showers, eye-wash stations, hand-wash stations, food preparation areas, galleys, and other domestic sources that do not include wastes from toilets, urinals, hospitals, and cargo spaces.

Hilcorp intends to use a membrane bioreactor (MBR) with ultraviolet disinfection to treat the sanitary and domestic wastewater at LDPI. The MBR treatment process consists of screening, a suspended growth biological reactor (similar to conventional activated sludge systems), membrane filtration, and disinfection. MBR systems in general have higher efficiencies than a conventional secondary treatment activated sludge system. MBR removal efficiencies for biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total suspended solids (TSS) are in the 96-99% range with final effluent BODs and CODs of <2.5 milligrams per liter (mg/L) and TSS of <2 mg/L as compared to a conventional secondary treatment biological system of 85-95% removal for BOD, COD, and TSS. Final effluent quality for an MBR system also has very low turbidity (<0.2 nephelometric turbidity units) and very low fecal coliform concentrations (<2.2 coliform fecal units per 100 milliliters) without chlorination or ultraviolet disinfection. In addition to the higher efficiencies of MBR technology compared to conventional treatment, these systems have a smaller footprint. (Hilcorp 2016a)

Pollutants associated with domestic and sanitary wastewater include TSS, BOD_5, pH, fecal coliform, and oil and grease. Hilcorp estimates an average daily flow of approximately 5,000 gallons per day (*gpd*) and a maximum daily flow of 20,000 *gpd* of sanitary and domestic wastewater.

During the first two years of project construction, sanitary and domestic wastewater will be collected and hauled offsite for disposal at a permitted onshore facility. The first well Hilcorp plans to drill at the production island is a waste disposal well. The combined sanitary and domestic wastewater effluent will be injected downhole once the well is operational. As such, this discharge will only occur on a contingency basis, e.g. when the well is offline for maintenance and/or testing.

1.2.2. Potable Water Treatment Plant Reject Waste (Outfall 001B; Contingency Discharge)

Potable water treatment reject waste is the residual high-concentration brine produced during the distillation of seawater. It has a chemical composition and ratio of major ions similar to the influent seawater, but with significantly higher concentrations.

Hilcorp plans to use a vapor compression technology to generate potable water from seawater, similar to the technology used at the Northstar facility. Seawater is boiled inside a bank of enhanced surface tubes located on one side of the heat transfer surface. Maintenance chemicals will be added during the desalination process, including the use of acid or descaler to remove mineral buildup in the facility. The NPDES permit includes provisions to limit the concentrations of chemical additives used at the facility and requires toxicity testing of the discharge when chemicals are used. The excess feed water that does not evaporate (blowdown) will be discharged. Pollutants associated with potable water treatment processes may include TSS, pH, and temperature. Hilcorp estimates an average daily flow of approximately 5,000 *gpd* and a maximum daily flow of approximately 20,000 *gpd*.

During the first two years of project construction, prior to Liberty island installation, potable water will be hauled to the project location from an existing onshore source. The LDPI potable water treatment plant will be installed late in year two or early in year three of construction. Once the disposal well is available at the LDPI, Hilcorp anticipates comingling the sanitary and domestic wastewater effluent with the potable water treatment plant effluent, and discharging both waste streams into the disposal well. Hilcorp has requested this contingency discharge for those times when the disposal well is not operational due to maintenance or other issues.

1.2.3. Seawater Treatment Plant (Outfall 002)

A seawater treatment plant (STP) will be constructed to treat raw seawater withdrawn from the Beaufort Sea for use in enhanced oil recovery. The STP unit operations include a desander, coarse strainer, fine media filters, and a continuous seawater dump that allows seawater to pass through or be shunted for use in backwashing operations. The operation of the STP results in one continuous discharge through Outfall 002, which contains higher concentrations of TSS, filter backwash, and some residual chemicals used during the treatment processes at the STP. There will be an amount (yet to be determined) of sodium hypochlorite discharged directly to the receiving water during backwash of the coarse and fine filters and some residual coagulant chemicals that may be used during periods of high suspended sediment load that occur during spring break-up and during summer storm events. The use of dechlorination is being considered to reduce the amount of total residual chlorine being discharged to the marine environment. Other chemicals used during the treatment process such as biocides, oxygen scavengers, scale/corrosion inhibitors, etc. will be utilized downstream of the filter backwash processes and, therefore, will not be introduced to the marine discharge, but will be injected as part of the enhanced oil recovery process. Pollutants associated with the STP processes may include TSS, BOD_5 (depending on influent seawater), pH, temperature, and residual chemicals used for system maintenance.

The first two years of project construction will be dedicated to island construction, followed by pipeline installation. Liberty facility installation will not begin until late in second year or early in third year. No discharge of seawater treatment plant effluent will occur until that time. Once operational, the STP will be an ongoing discharge that occurs during the life of the project.

The daily maximum discharge from the STP is expected to be 1.1 million gallons per day (*MGD*) with an average daily discharge rate of 0.94 *MGD*. Discharges from the STP will occur during the production life of the project.

1.2.4. Construction Dewatering (Outfall 003; Contingency Discharge)

The majority of construction activities will be conducted during the winter months, as such, construction dewatering discharges are expected to be minimal. Construction dewatering may be required on the production island if construction activities such as land farming or facility installation occur during the spring thaw, approximately May to June. Once the waste disposal well is completed, construction dewatering effluent will be injected. Hilcorp has requested permit coverage for this waste stream; however, the discharges will be short term and temporary. No flow volume has been specified. The pollutants associated with construction dewatering discharges may include TSS.

1.2.5. Secondary Containment Dewatering (Outfall 004; Contingency Discharge)

Secondary containment dewatering will be required during the spring thaw. Hilcorp has requested authorization to discharge storm water (rainfall & snowmelt) accumulated in areas of secondary containment (i.e., diked or bermed areas) surrounding tanks, tank farms, and other areas utilizing secondary containment structures. No flow volume has been specified. The pollutants associated with secondary containment dewatering discharges may include oil and grease and TSS.

Discharge of secondary containment will occur during the first two years of construction (island and pipeline construction). Once the waste disposal well is completed in approximately Year 3 of project construction, secondary containment water generated on the island will be injected downhole into the waste disposal well.

2. PROPOSED LIBERTY PROJECT

2.1. Construction Activities

The LDPI would be located approximately 5 miles north of the Kadleroshilik River and 7.3 miles southeast of the existing Endicott Satellite Drilling Island. The LDPI would be built in approximately 19 feet of water; the elevation of the top of the island would be +15 feet above Mean Lower Low Water level. The work surface of the island would be approximately 9.3 acres (3.76 ha); the seabed footprint would be approximately 24 acres (9.71 ha). The design life of the LDPI and associated infrastructure is approximately 25 years. The proposed LDPI location is shown in Figure 1.

Island construction would commence as soon as the ice road from the mine site to the island site has been completed; Hilcorp anticipates constructing the LDPI and pipeline during the winter seasons of the first two years of the project. Additional island construction, including grading of the proposed LDPI, sheet pile installation, and island armament installation, would take place in the summer of the first two years.

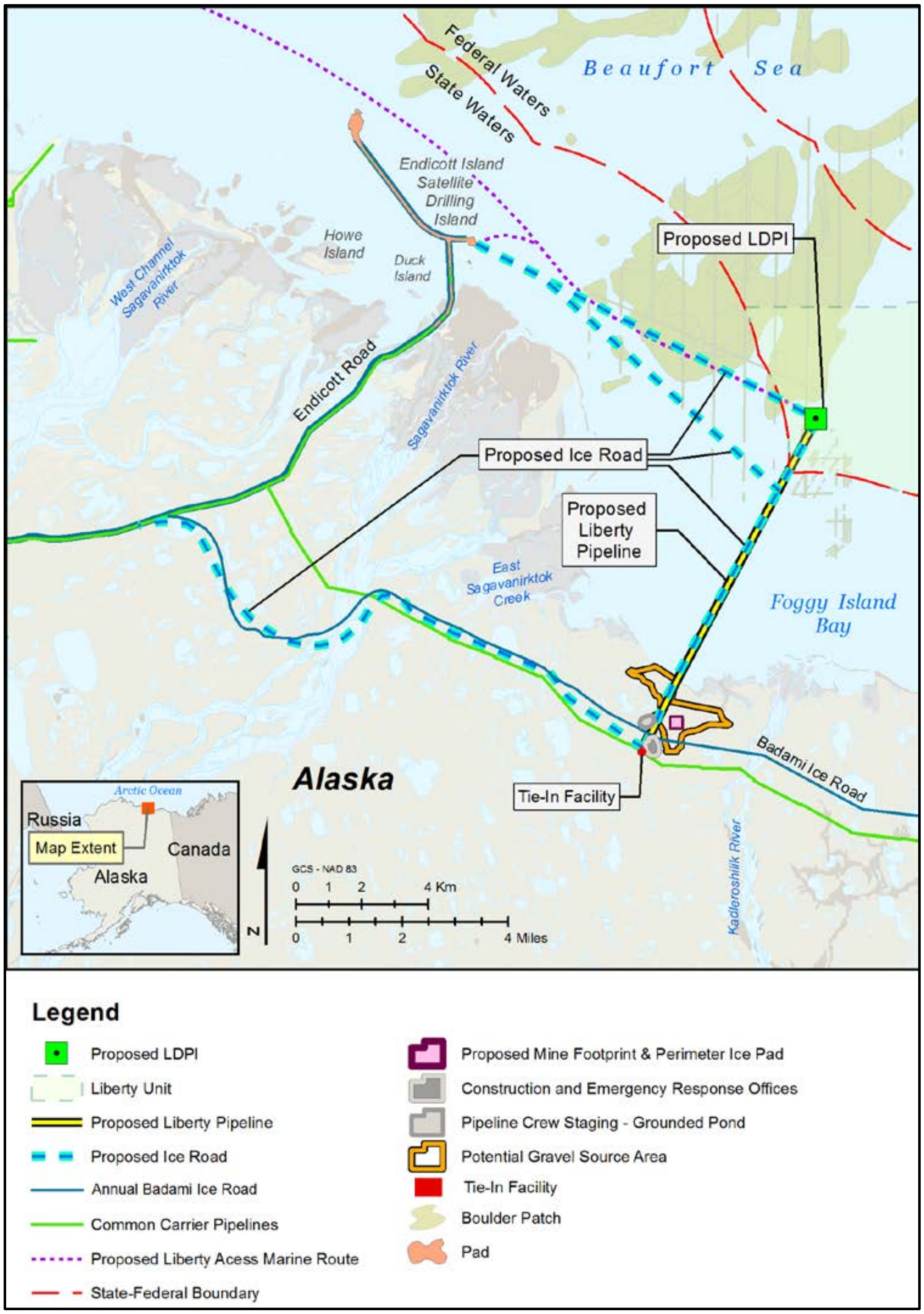


FIGURE 1. *The proposed location of the Liberty Development and Production Island.*

The LDPI layout includes areas for drilling, production, production support, utilities, a camp, camp utility area, and a relief well area. Permanent structures on the island would be supported by driven steel piles and/or slab on grade foundations. Rig mats (portable platform used to support equipment used in construction and other resource-based activities, including drilling rigs, camps, tanks, and helipad) may be used in some areas (e.g., storage containers).

The LDPI would have a helicopter landing pad and two docks to accommodate barges, hovercraft, and small boats. It would also have ramps for amphibious watercraft access. Ocean ice road transitions would occur around the LDPI bench perimeter.

The LDPI will hold a seawater treatment plant, potable water treatment plant, and a sanitary and domestic wastewater treatment plant. Sanitary and domestic wastewater would receive secondary treatment. Remaining sewage solids would be incinerated on-island at the municipal solid waste incinerator. Power for the camp and utilities during LDPI construction would be generated by two diesel-fired generators rated for a maximum power output of 1.25 megawatts each. Chemicals stored on the LDPI would include diesel fuel, methanol, and other chemicals to support drilling and production.

The LDPI production facilities and camp would be powered by fuel gas-fired turbines once the third Liberty well has been completed. The diesel-fired engines that were located on the LDPI during construction would remain on the LDPI to provide power to the facilities in the event of a power disruption from the fuel gas-fired turbines. The LDPI production facilities would include three gas-fired compressors.

Associated onshore facilities and activities to support the project would include use of permitted water sources for ice road construction, construction of gravel pads to support the pipeline tie-in location and Badami ice road crossing, ice roads and ice pad construction, hovercraft shelter, small boat dock, and development of a gravel mine site west of the Kadleroshilik River. In addition, existing North Slope infrastructure would be used to support this project.

2.2. Pipeline Construction

Hilcorp proposes a pipe-in-pipe subsea pipeline, consisting of a 12-inch diameter inner pipe and 16-inch diameter outer pipe. A 4-inch diameter continuous coiled tubing and fiber optic cable (for communication and controls) would be bundled with the subsea pipeline system. The pipeline would extend from the LDPI to a tie-in with the Badami pipeline. Once onshore, the pipeline system would transition to a single wall 12-inch pipeline supported on vertical support members.

Pipeline construction is planned for the winter following LDPI construction, which Hilcorp anticipates to be the first two quarters of year 3. The offshore and onshore pipeline segments would be installed within the same time frame, with two separate construction spreads of equipment and manpower. An onshore gravel pad, requiring up to 3,500 cubic yards of gravel and having a footprint of approximately 0.85 acres, would also be constructed to allow the annual winter ice road to cross the Liberty pipeline. The pipeline would be buried in the gravel pad at this crossing point.

Offshore, construction would progress from shallower to deeper water for the approximately 5.6-mile marine portion of the pipeline, with multiple construction spreads. Construction would involve cutting a slot through the ice, excavating a trench, placing the pipeline bundle in the trench, then backfilling the trench. The pipeline is planned to surface inshore of the shoreline, in a trench approximately 300 feet long and up to 150 feet wide at the top (approximately 1.0 acre) to accommodate the installation of thermosiphons (heat pipes which circulate fluid based on natural convection to maintain or cool ambient ground temperature). The pipeline would cross the tundra for approximately 1.5 miles, supported by approximately 150 to 170 vertical support members (that provide the pipeline a minimum 7 foot clearance above the tundra) approximately 51 feet apart. An approximately 0.6-acre gravel pad (or approximately 170 x 155 feet) would be required where the Liberty pipeline and Badami pipeline join.

2.3. Drilling Operations

Hilcorp plans to drill 5-8 producing wells, 4-6 water and/or gas injection wells, and up to two disposal wells at surface wellhead spacing of 15 feet between well slots. Sixteen additional well slots would be available as backups or for potential in-fill drilling. A conventional rotary drilling rig will be used to drill the wells, and the drilling operations are expected to occur over a period of approximately 3 years.

The first well drilled would be the cuttings re-injection and waste mud disposal well. Rock cuttings and excess drilling mud from this well would be stored on site until the disposal well is completed and the grind and inject facility is commissioned. Alternatively, cuttings and drilling muds may be transported to an onshore site for disposal. The next well drilled would be a gas injector so that produced gas could be re-injected into the reservoir, or used as fuel gas and lift gas. The third well drilled would be an oil production well.

Seawater, treated and comingled with produced water, would also be used for injection into the Liberty reservoir in a process called waterflooding that increases reservoir pressure and stimulates production. Treated seawater would also be used to create potable water and utility water used at the LDPI.

2.4. Production Operations

Hilcorp will commence production operations upon completion and commissioning of the initial facilities and the completion of the first three wells, as described above. First oil is anticipated in the 1st Quarter of Year 4. Production, drilling, and facility installation activities would occur simultaneously until all the wells are drilled and in service.

The initial production rate is expected to be in the range of 10,000 to 15,000 barrels of oil per day (BOPD). As additional wells are brought online, the production rate is expected to peak between 60,000 and 70,000 BOPD, which is anticipated to occur approximately 2 years after first oil.

The economic life of the field is estimated at approximately 15 to 20 years, and the facilities and pipeline are designed for an operational life of 25 years based on design criteria appropriate for common Arctic conditions (e.g., wave, ice, storm, seismic conditions, etc.). The facilities will be upgraded, such as replacing equipment and/or piping, if the operational life of the Liberty field exceeds 25 years.

Additional details, including descriptions of other project facilities and the proposed decommissioning activities are further discussed in BOEM’s draft EIS for the Liberty Development and Production Plan (BOEM 2017).

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

Please refer to BOEM’s EIS for the Liberty Development and Production Plan for a complete description of the physical, biological, and socioeconomic conditions of the project area (BOEM 2017).

3.1. The Receiving Water Environment

The LDPI is located in Foggy Island Bay in Stefansson Sound. Foggy Island Bay is situated between the Sagavanirktok and Shaviovik rivers, and is sheltered by offshore shoals associated with Dinkum Sands, and the McClure and Stockton barriers island complexes (Hilcorp 2014). The LDPI project area is planned for the area inside these barrier islands, approximately 4.78 nautical miles (8.85 km) offshore where water depths are between 19-23 feet (5.8 – 7.0 meters). The relatively shallow shelf depths act as a mixing zone for the clearer, generally colder and more saline ocean waters to interact with the more turbid, sediment-bearing, fresher inflows from the Sagavanirktok, Kadleroshilik and Shaviovik rivers.

The nearshore waters of the Alaskan Beaufort Sea typically remain ice-covered for about 9 months of the year. Break-up in Foggy Island Bay occurs from mid-May to mid-June and is initiated by the overflow of fresh river water onto the landfast ice. The open water period typically ranges from approximately mid-July to mid-October. The transition from freeze-up to winter ice conditions in Foggy Island Bay usually occurs in early to mid-November when the ice thickness is at least 12 inches (Hilcorp 2014).

3.1.1. Currents

Winds are predominately from an easterly direction, with westerly winds occurring more infrequently. During the open water season, easterly winds generate currents to the west, while westerly winds move water to the east. As such, the mean current direction near the LDPI is to the west (Hilcorp 2014). In Foggy Island Bay, the maximum current velocity measured during the open water season was 68 centimeters per second (cm/s), with more than 50 percent of the current measurements exceeding 15 cm/s. Current velocities during the winter are much lower as compared to those during the open water season, with the under-ice current velocities measured at 5 cm/s during the landfast ice season (Weingartner et al. 2009).

3.1.2. Salinity and Temperature

Salinities of the ambient shelf water in Stefansson Sound range from 28 parts per thousand (ppt) during open water to 34 ppt under ice formation in winter, with spring salinities of 31 to 32 ppt (Weingartner and Okkonen 2001). Salinities in the upper layer of the water column increase between early June and late July as break-up of the ice cover is followed by mixing due to wind. Bottom water salinity basically remains unchanged.

Temperatures of shelf water in Stefansson Sound range from approximately 28.4°F under ice to over 39.2°F during the summer open-water season (Weingartner et al. 2005, 2009). Coldest temperatures occur in late winter (February through early March). Warmest temperatures occur in early to mid-August, dropping off rapidly in September.

Freshwater discharge from the Sagavanirktok River influences the temperature and salinity of Stefansson Sound. Beginning in late May and continuing through August, salinity decreases and temperature increases in Stefansson Sound due to the mixing of river water throughout the water column (Weingartner and Okkonen 2001). The fresh water initially creates a brackish nearshore zone with salinities of 10 to 15 ppt. As mixing begins, salinities increase to 15 to 25 ppt with water temperatures ranging from 0°C to 9°C (32°F to 48.2°F). The nearshore waters become relatively well-mixed as the open-water season progresses, with salinities greater than 25 ppt and temperatures gradually decreasing to 32°F to 35.6°F (Hilcorp 2014).

3.1.3. Water Levels

As noted above, the proposed LDPI is located in a water depth of approximately 18 to 19 feet, mean lower low water (MLLW). The NOAA National Ocean Service reports a mean tide range of 0.51 feet, and a diurnal range of 0.70 feet for the tide station located in Prudhoe Bay (NOAA NOS 2014, as cited in Hilcorp 2014). Given the relatively small tidal range, water level fluctuations in the vicinity of the Liberty Development are governed more by meteorological effects than by astronomical tides. The Coriolis effect deflects surface waters offshore during easterly wind events and onshore during westerly wind events. As a result, westerly wind events produce positive storm surges, while easterly wind events produce negative surges.

3.1.4. River Discharge

The east channels of the Sagavanirktok River, the Kadleroshilik River, and the Shaviovik River each discharge into Foggy Island Bay. Rivers are the primary source of fresh water entering Foggy Island Bay. River water temperatures in the summer (50 to 63°F) are higher than the nearshore water temperature, and typically remain warmer until September. At certain times of the year, river discharge can affect nearshore circulation. In the spring, before the sea ice starts to deteriorate, melting snow swells the upland river channels. The bottomfast ice offshore of the river deltas forms a dam, which causes the floodwaters to pour out over the top of the sea ice during late May or early June (Hilcorp 2014).

The overflood water, which can exceed a depth of 3 feet, can spread as far as 3.7 miles offshore into Foggy Island Bay. In the floating landfast ice zone (typically in water depths greater than 6 feet), the overflood waters drain through holes and discontinuities in the ice sheet caused by tidal cracks, thermal cracks, stress cracks, and seal breathing holes forming strong hydraulic vortices or “strudels.” These powerful whirlpools can cause localized scouring of the seafloor, termed “strudel scours.” Drainage in the bottomfast ice zone (typically in water depths less than 6 feet) is limited until the ice sheet weakens and rises to the surface (Hilcorp 2014).

3.2. Stefansson Sound Boulder Patch

The nearshore Beaufort Sea seafloor is typically dominated by soft sediments. The benthic communities in those sandy, silty or muddy sediments usually contain a low diversity fauna, dominated by bivalve mollusks, polychaete worms and amphipods. Amidst these relatively low-diversity areas, there are local hotspots of abundant and diverse marine life where boulders provide rare colonisable hard substrate for macroalgae and sessile epibenthic macrofauna (MMS 2009). One of these regions is the Stefansson Sound Boulder Patch. The Boulder Patch, located behind barrier islands in Stefansson Sound, is an isolated macroalgal-dominated rocky bottom habitat characterized by a diverse arctic kelp community. First discovered in 1978, the Boulder Patch sits in about 20 feet (6 m) of water in Alaska’s Prudhoe Bay. It is characterized by having a greater than 10 percent cover of small boulders and cobblestone on the benthic surface. This hard bottom benthic surface supports the richest and most diverse biological communities known in the Beaufort Sea (BOEM 2017).

The Boulder Patch has been studied extensively, and more than 140 species of invertebrates have been identified including sponges, byrozoans, and hydrozoans with the dominant taxa being red and brown algae. The biodiversity and community structure patterns vary among different locations within the Boulder Patch, mainly due to differences in light levels and substrate type (NMFS 2011). Studies conducted in the past two decades documented that kelp biomass, growth, and productivity in the Stefansson Sound Boulder Patch are strongly regulated by light availability (MMS 2009). In the winter, availability of light limits growth of kelp when nutrient levels are high and lack of nutrients limit summer growth when light levels are high. However, even in summer light levels can be severely compromised locally because of high loads of suspended particles in the water column from river discharge or resuspension due to storm events. Detrimental effects of sedimentation for macroalgae include light reduction, smothering of small stages and abrasion of microscopic life stages important for dispersal and recolonization (MMS 2009). Kelp also has been observed shoreward in an area behind a shoal near Konganevik Point in Camden Bay; although its spatial distribution and density are not known (NMFS 2011).

The LDPI is located inshore and east of the main mapped areas of the Boulder Patch. No boulder patch was found at the proposed island site during Hilcorp's winter reconnaissance investigation in April 2014 (Hilcorp 2014).

3.3. Ocean Acidification

Over the last few decades, the absorption of atmospheric carbon dioxide (CO_2) by the ocean has resulted in an increase in the acidity of the ocean waters. The greatest degree of ocean acidification worldwide is predicted to occur in the Arctic Ocean. This amplified scenario in the Arctic is due to the effects of increased freshwater input from melting snow and ice and from increased CO_2 uptake by the sea as a result of ice retreat (NMFS 2013). Studies have shown the effects of increase atmospheric CO_2 levels is at its largest extent during late summer, including localized areas on the Canadian Archipelago and Beaufort Sea shelves (Hilcorp 2014). Experimental evidence suggests that if current trends in CO_2 continue, key marine organisms, such as corals and some plankton, will have trouble maintaining their external calcium carbonate skeletons (Orr et al. 2005).

3.4. Threatened and Endangered Species

The Endangered Species Act requires federal agencies to consult with the USFWS and NMFS if the federal agency's actions could beneficially or adversely affect any threatened and endangered species or their designated critical habitat. In this case, the federal action agency is EPA, and the federal action is the issuance of the NPDES permit to Hilcorp for discharges from the LDPI.

The action could affect listed species under the jurisdiction of both the USFWS and NMFS. This section gives an overview of the listed species (endangered, threatened, proposed, and candidate) in the project area reasons for listing.

TABLE 1. *Summary of Endangered Species Act-listed, proposed, and candidate species*

Common name	Scientific name	ESA status	Critical habitat designated within the Action Area	Reason for ESA listing
Bowhead whale	*Balaena mysticetus*	Endangered	No	Effects on population due to historic commercial whaling, habitat degradation, and ongoing whaling in other countries and other anthropogenic related disturbances
Polar bear	*Ursus maritimus*	Threatened	Yes	Global climate change and its effects on Arctic sea-ice is the primary threat to polar bear populations

Bearded seal, *Beringia DPS*	*Erignathus barbatus nauticus*	Threatened	No	Effects on bearded seal populations have included direct harvesting, indirect mortalities as a result of fisheries, mortalities resulting from marine mammal research activities, and the effects of global climate change in the Arctic environment
Ringed seal, *Arctic subspecies*	*Phoca hispida hispida*	Threatened	No	Effects on ringed seal populations have included direct harvesting, indirect mortalities as a result of fisheries, mortalities resulting from marine mammal research activities, and the effects of global climate change in the Arctic environment
Pacific walrus	*Odobenus rosmarus divergens*	Candidate	No	Effects on walrus populations have included historic commercial hunting, pollution and noise disturbances related to the oil and gas industry, and the effects of global climate change in the Arctic environment
Spectacled eider	*Somateria fischeri*	Threatened	Yes	The causes of the spectacled eider's population decline are currently unknown; however, it is likely due to loss of habitat
Steller's eider	*Polsticta stelleri*	Threatened	No	The causes of the Steller's eider population decline include increased predation, over hunting, ingestion of lead shot, habitat loss, exposure to environmental toxins, scientific exploitation, and the effects of global climate change

Ringed Seal. Ringed seals (*Phoca hispida*) are circumpolar in distribution (Angliss and Outlaw 2008). They are found in all seas of the Arctic Ocean including the northern Bering, Chukchi, and Beaufort Seas (Frost 2002). Ringed seals live on or near the ice year-round; therefore, the seasonal ice cycle has an important effect on their distribution and abundance (MMS 2008). In winter, highest densities of ringed seals occur in the stable landfast ice. On December 28, 2012, the arctic subspecies of ringed seal was listed as threatened due to concern for the long-term survival of the population because of declines in sea-ice cover and quality in the Arctic (77 FR 76705). On December 9, 2014, NMFS proposed critical habitat for the Arctic ringed seal in the northern Bering, Chukchi, and Beaufort Seas off of Alaska, an area of approximately 350,000 miles.

Bearded Seal. The majority of the bearded seal (*Erignathus barbatus*) population in Alaska is found in the Bering and Chukchi Seas with seasonal migrations into the Beaufort Sea. The species usually prefers areas of less-stable or broken sea ice, where breakup occurs early in the year (Burns 1967). They are found in nearshore areas of the central and western Beaufort Sea during summer (MMS 2008). Important feeding grounds for bearded seal include areas along ice edges, in the currents between the barrier islands and near river mouths, and in shallow areas with abundant clam beds.

Bearded seals overwinter in the Bering Sea, migrating north through Bering Strait during April and May, as the sea ice retreats. Spring surveys along the Alaska coast indicate that bearded seals are most abundant 20 to 100 miles from shore. During July through September, they follow the receding ice edge into the Chukchi and Beaufort seas, primarily inhabiting the widely fragmented edge of multiyear sea ice (Hilcorp 2014). Bearded seals were most common in the Beaufort Sea over the continental shelf during August through October. Suitable habitat for the bearded seal is more limited in the Beaufort Sea than in the Bering and Chukchi seas because the continental shelf in the Beaufort Sea is narrower and the edge of the pack ice frequently occurs seaward of the shelf, over waters too deep for bearded seals to forage (Hilcorp 2014). On December 28, 2012, the bearded seal Beringia Distinct Population Segment (DPS) was listed as threatened due to concern for the long-term survival of the population because of declines in sea ice cover and quality in the Arctic (77 FR 76739). Critical habitat was not designated for this species.

Bowhead Whale. The group of bowhead whales (*Balaena mysticetus*) that inhabit the Bering-Chukchi-Beaufort Seas is important to the viability of the species as a whole and is a species of very high importance for subsistence and to the culture of Alaskan Native peoples of the northern Bering Sea, the Chukchi Sea, and the Beaufort Sea. The best estimate of the abundance of the Western Arctic bowhead whale stock is 10,545 with a minimum population estimate of 9,472. On December 2, 1970, the bowhead whale was listed as endangered (35 FR 18319).

Bowheads are extremely long lived, slow growing, slow to mature, and currently have high survival rates. They are also unique in their ecology and their obligate use of lead systems to travel to summering grounds. This dependence on the relatively restrictive area comprising of the spring leads, described further below, combined with calving and feeding that occurs during the spring northward migration, further heightens their vulnerability to disturbance and exposure to pollutants in some areas (MMS 2006 and 2006a).

Each spring (mid-March through mid-June, approximately), the bowhead western Arctic stock travel northward through breaks in the sea ice, migrating from their winter grounds in the Bering Sea to their summer grounds in the Canadian Beaufort Sea (Braham et al. 1980). These breaks in the ice, or leads, form when winds blow the moving pack ice away from landfast ice, creating a flaw zone of open water and broken ice generally parallel to the shore (Carroll and Smithhisler 1980). Bowhead whales depend primarily on the lead system as a migratory pathway between wintering and summering grounds (MMS 2006). In spring, ice obstructs feeding opportunities; therefore, bowhead migratory movements are generally predictable and consistent between the Bering Strait and Amundsen Gulf along the lead system (Quakenbush et al. 2010 as cited in BOEM 2012). The breaks in the ice also provide critical opportunities for the bowhead whales surfacing to breathe, as discussed further below. The lead system is therefore considered an obligate pathway for this population to transit to summering grounds (MMS 2006 and 2006a).

Calving occurs from March to early August, with the peak probably occurring during the spring migration between early April and the end of May (MMS 2003). Available information indicates that most or much of the total calving of the bowheads, which comprise most of the bowhead whales in the world, occurs during the spring migration within, and adjacent to, the spring lead system, especially in the eastern Chukchi Sea (MMS 2006 and NMFS 2011). Most calving occurs in the Chukchi Sea during the spring migration from March through June from winter breeding areas in the northern Bering Sea (BOEM 2012). Females give birth to a single calf every 3 to 4 years (MMS 2008b as cited in BOEM 2012). Small calves generally stay close to their mothers' sides and are difficult to see particularly if they are on the offshore side of the mother. On two occasions, very small calves were seen riding their mothers' backs, apparently grasping the mothers with their flippers (Carroll and Smithhisler 1980).

Whales are seen in Barrow in early- to mid-April. The early pulse is dominated by juveniles. The size/age composition of the whales entering the Beaufort Sea gradually switches so that by mid-May to June, large whales and cow/calf pairs are seen. As the whales approach Point Barrow, the nearshore lead narrows and the movement of most whales is correspondingly constricted. After passing Barrow from April through mid-June, the bowhead whales move easterly through or near offshore leads. East of Point Barrow, the lead systems divide into many branches that vary in location and extent from year to year. The spring migration route is far offshore of the barrier islands in the central Alaskan Beaufort Sea. Bowheads arrive on their summer feeding grounds in the Canadian Beaufort in Amundsen Gulf and around Banks Island until late August or early September (MMS 2003). Restriction of ice near Point Barrow and development of offshore leads northeast of the Point provide the migration pathway, a result of converging water masses from the Chukchi and Beaufort Seas and shifting winds, generally from the east and northeast. It is probably advantageous for whales to use these recurring leads, as opposed to those in the southern Beaufort Sea where there is less ice movement and where the availability of open water is less predictable (Carroll and Smithhisler 1980).

During a five-year period (2006-2010), researchers from the Alaska Department of Fish and Game worked with Native whalers from Alaska and marine mammal hunters from Canada to attach 46 satellite transmitters to bowhead whales to document the migratory routes that connect their summering and wintering areas (ADF&G 2010). After passing Point Barrow in spring, bowhead whales migrated through ice that was quantified as 100 percent cover by satellite images. Once past Point Barrow, all tagged whales traveled northeast before turning east and traveling100-200 km offshore of the Beaufort Sea coast. All whales stayed between 71 and 72°N latitude. All tagged whales traveled relatively directly to the Amundsen Gulf polynya, arriving there by May 26, 2006 and by May 3, 2008. Amundsen Gulf is used by bowhead whales from May until mid-September (ADF&G 2010).

Based on duration of migration for seven individual whales, migration between the Bering Sea and the Canadian Beaufort required an average of 19 days (range of 17-24 days) (ADF&G 2010). During the spring migration, tagged whales generally did not stop between the Bering Strait and Amundsen Gulf, suggesting limited feeding opportunities or obstructions caused by ice. The spring migratory corridor between the Bering Strait and Amundsen Gulf is consistent between years. In some years, parts of the spring lead system in the Chukchi Sea west, northwest, and southwest of Barrow are used as feeding areas over extended periods of time during the spring migration, but this use is inconsistent (MMS 2007). However, several researchers have reported that the region west of Point Barrow seems to be of particular importance for feeding in some years but the whales may feed opportunistically at other locations in the lead system where oceanographic conditions produce locally abundant food (Caroll et al. 1987 as cited in MMS 2006, Moore and Reeves 1993, Moore 2000, Moore et al. 2000a as cited in Mocklin et al. 2012).

Researchers investigated the olfactory anatomy of bowhead whales and found that these whales have a cribriform plate and small, but histologically complex olfactory bulb. The olfactory bulb makes up approximately 0.13 percent of brain weight, unlike odontocetes where this structure is absent. The relative size of the olfactory bulb in apes (0.06 percent) and humans (0.008 percent) is much smaller than in bowheads. The researchers also determined that 51 percent of olfactory receptor genes were intact, unlike odontocetes, where this number is less than 25 percent. This suggests that bowheads have a sense of smell, and the researchers speculate that the whales may use this to find aggregations of krill on which they feed (ADF&G 2010). This is consistent with traditional knowledge input EPA received from subsistence hunters, who have raised concerns that bowhead whales could be deflected from their migratory pathways by anthropogenic smells associated with the discharges.

The rate of whale travel speed ranges from 1 to 11 km/hour during spring migration. Nearly all the whales traveled northeastwardly. Fewer than 1 percent traveled in the opposite direction. When they traveled southwest, it was usually because of closed leads stopping their progress to the northeast (Carroll and Smithhisler 1980). Of 2,406 bowheads that were observed over 4 years in the 1970s, 1,815 (75.4 percent) were traveling singly; 470 (19.5 percent) were in pairs; 105 (4.4 percent) were in groups of three, and 16 (0.7 percent) traveled in groups of four animals (Carroll and Smithhisler 1980). In the fall, bowheads were presumed to return along a similar general route from the Canadian Beaufort Sea where they spend much of the summer (Allen and Angliss 2011 as cited in BOEM 2012). The return route is closer to shore, in water depths ranging from 15 to 44 m (49.2 to 144.4 ft), across the Beaufort Sea, to the Bering Sea to overwinter in polynyas and along edges of the pack ice (Braham et al. 1980; Moore and Reeves 1993 as cited in BOEM 2012). The first whales to begin the fall migration are typically the larger ones, which establish the migration route in the Beaufort Sea. Migration through the eastern Alaskan portion of the Beaufort Sea continues through September and into October (Huntington and Quakenbush 2009 as cited in BOEM 2012). See Figure 2.

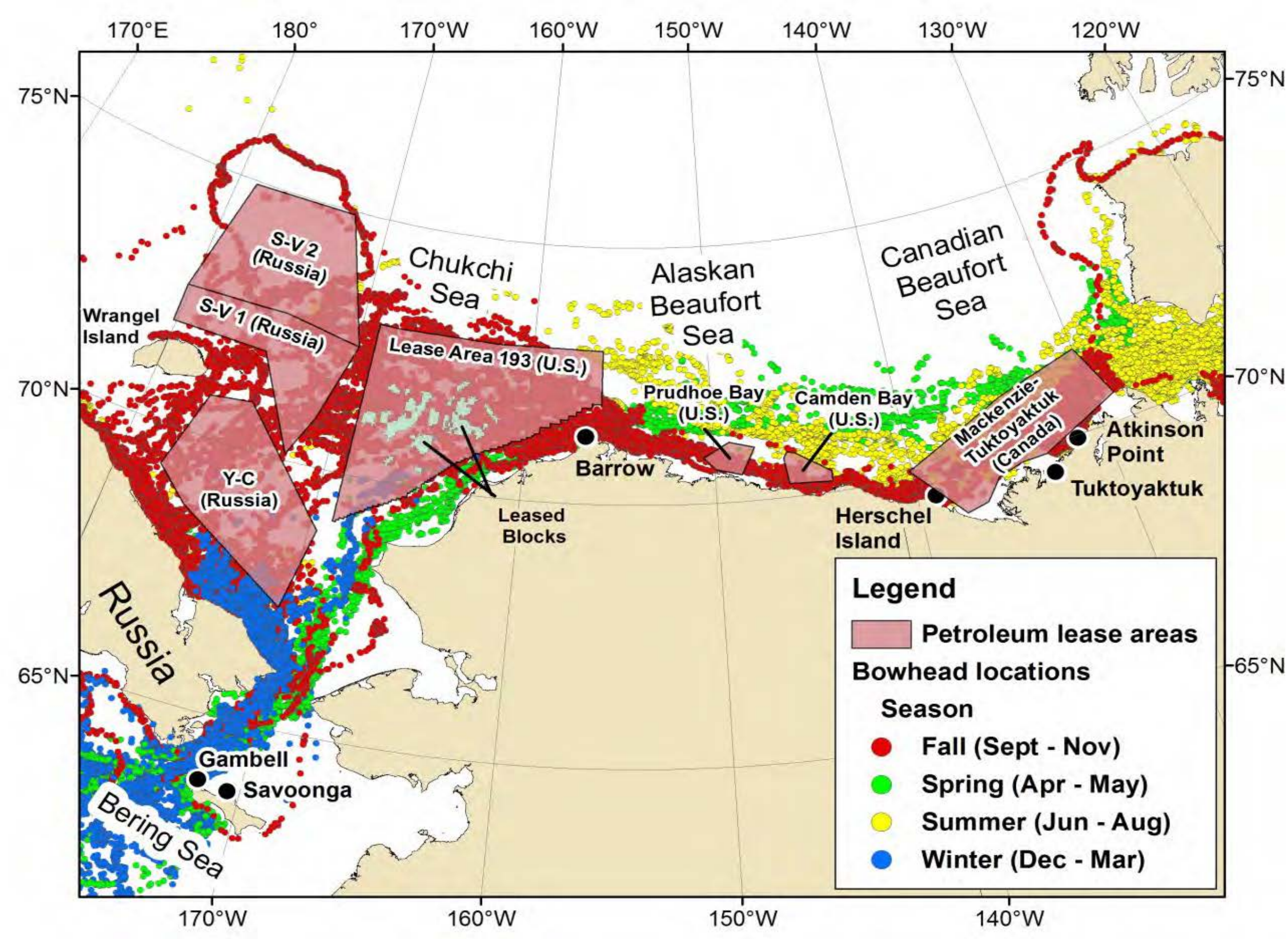


FIGURE 2. *Tracks of tagged bowhead whales between July and December, 2006–2012, relative to active and proposed petroleum areas (BOEM 2013).*

Polar Bear. Polar bears (*Ursus maritimus*) are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year. Ringed seals are polar bear's primary food source, and areas near ice edges, leads, or polynyas where ocean depth is minimal are the most productive hunting grounds. While polar bears primarily hunt seals for food, they may occasionally consume other marine mammals, including via scavenging on their carcasses (USFWS 2009). Although they are classified as marine mammals and are strong swimmers, polar bears rely principally on sea ice to provide a substrate on which to roam, hunt, breed, den, and rest. They also use islands and coastal mainland habitats. Preferred habitats include both the active seasonal ice zone that overlies the continental shelf and associated islands and areas of heavy offshore pack ice (Hilcorp 2014). During the winter and spring, polar bears tend to concentrate in areas of ice with pressure ridges, at floe edges, and on drifting seasonal ice at least 8 inches thick (Schliebe et al. 2006). In the winter, the use of shallow-water areas is greatest in areas of active ice with shear zones and leads (Durner et al. 2004).

Two polar bear stocks are thought to exist in Alaska, the Southern Beaufort Sea and the Chukchi/Bering Seas. Polar bears typically occur at low densities throughout their circumpolar range. Population estimates have wide confidence intervals and a reliable estimate does not currently exist (USFWS 2009).

All stocks of polar bears occurring in U.S. waters were listed as threatened under the ESA on May 15, 2008 (73 FR 28212). Critical habitat for polar bears was designated in December 2010 (75 FR 76086). Although this designation was vacated by the courts in January 2013 as a result of legal challenges brought forward by several groups, the action was recently reversed by the courts and the original designation has been reinstated.

Eiders. Spectacled eiders (*Somateria fischeri*) make use of the spring lead system when they migrate north from the wintering area into the Chukchi Sea in May and June (BOEMRE 2011). After breeding, male eiders fly to nearshore marine waters in late June where they undergo a complete molt of their flight feathers. In Arctic Alaska, the primary molting area is Ledyard Bay (NMFS 2011). The spring lead system includes the Ledyard Bay Critical Habitat Unit and represents the only open-water area along their migratory path (BOEMRE 2011). Like other eiders, the Spectacled eiders use the spring lead system for feeding and resting. Similarly, the Steller's eiders (*Polsticta stelleri*) return to the Arctic as spring thaw allows, migrating north in May and June (NMFS 2011). Along open coastline, Steller's eiders usually remain within about 400 m (1,312 ft) offshore in water less than 10 m (33 ft) deep but they can also be found in waters well offshore in shallow bays and lagoons or near reefs (USFWS 2000a as cited in NMFS 2011). Spectacled eiders were petitioned for listing under the ESA in December 1990, after breeding populations underwent a severe decline in abundance, particularly on the Yukon–Kuskokwim Delta in western Alaska (Stehn et al. 1993). In May 1993, spectacled eiders were listed as threatened (58 FR 27474).

EPA is coordinating a joint ESA consultation process with the Bureau of Ocean Energy Management through the development of a Biological Assessment to satisfy our regulatory requirements under Section 7(a)(2) of the Endangered Species Act. The Biological Assessment includes an evaluation of the potential impacts from the Liberty Development Project will be submitted to the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to initiate ESA consultation. Consultation will be concluded prior to EPA issuing a final agency action for the proposed NPDES permit.

3.5. Essential Fish Habitat

EFH is the waters and substrate (sediments, and the like) necessary for fish to spawn, breed, feed, or grow to maturity, as defined by NMFS for specific fish species. In the project area, EFH has been established for snow crabs, Arctic cod, saffron cod, and Pacific salmon (chinook, coho, pink, sockeye, and chum). Juvenile and adult life stages of each EFH species are present within the project area. The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires EPA to consult with NMFS when a proposed discharge has the potential to adversely affect EFH. Table 2 lists the EFH species potentially present in the project area.

TABLE 2. *EFH species potentially present in the project area.*

Common name	Scientific name
Pacific salmon- chinook, coho, pink, sockeye, chum	*Oncorhynchus tshawytscha, O. kisutch, O. gorbuscha, O. nerka, O. keta*
Arctic cod	*Boreogadus saida*
Saffron cod	*Eleginus gracilis*
Opilio snow crab	*Chionoecetes opilio*

3.6. Subsistence Activities and Environmental Justice Considerations

Environmental justice (EJ) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, and the accompanying Presidential memorandum, directs each federal agency to consider EJ as part of its mission and to develop strategies to achieve environmental protection for all communities to the greatest extent practicable and permitted by law.

EPA's tribal trust responsibilities and government-to-government consultation requirements are covered under a separate Executive Order and agency policies. However, the issues and concerns shared with EPA by tribal governments are also considered in this EJ analysis because of related issues and concerns among all Arctic communities regarding safety of subsistence foods and cultural impacts, including the continuation of the subsistence way of life. The North Slope, Northwest Arctic and Bering Sea communities are predominantly Alaska Native. EPA is taking the approach that if the permit action is protective of subsistence resources, then it will be protective of all residents of the communities. EPA developed an EJ analysis in support of the Beaufort and Chukchi Exploration NPDES General Permits (AKG282100 and AKG2881000, respectively) (USEPA 2012c). As the EJ analysis evaluated and considered the potential impacts to the same communities from similar discharges, EPA believes the EJ analysis is also relevant for this permit action. Please refer to the EJ Analysis for additional details.

While there are many subsistence resources harvested in the vicinity of the facility, there is one particular traditional cultural activity that is a key component of Inupiat culture and way of life. The bowhead whale hunt involves most of the community in some part of the hunt, and the proceeds are shared and enjoyed in feasts and celebrations. Where in many aspects of Inupiat life cultural changes have taken place at the expense of tradition, the whale hunt remains "key to the survival of [Inupiat] culture" (Brower et. al 1998 as cited in NMFS 2013).

The Western Arctic bowhead whales (*Balaena mysticetus*) migrate annually from wintering areas in the northern Bering Sea, through the Chukchi Sea in the spring, and into the Canadian Beaufort Sea where they spend the summer. In the autumn they return to the Bering Sea to overwinter. Eleven Alaskan coastal communities along this migratory route participate in traditional subsistence hunts of these whales: Gambell, Savoonga, Little Diomede, and Wales (on the Bering Sea coast); Kivalina, Point Lay, Point Hope, Wainwright, and Barrow (on the coast of the Chukchi Sea); and Nuiqsut and Kaktovik (on the coast of the Beaufort Sea). The bowhead whale hunt constitutes an important subsistence activity for these communities, providing substantial quantities of food, as well as reinforcing the traditional skills and social structure.

The spring hunt occurs as whales migrate northeast through the spring lead system along the northwestern coast of Alaska, typically from early April to early June. The fall hunt occurs in open water as whales migrate west along the Beaufort Sea or southwest along northeastern Chukchi Sea coasts of northern Alaska. The fall hunt usually occurs from August through October.

Nuiqsut. Nuiqsut whalers only conduct bowhead whaling during the fall. Nuiqsut whalers search for whales on areas north and east of Cross Island, usually in water depths greater than 66 feet. These whalers primarily use Cross Island as their base while they are hunting bowhead whales. Nuiqsut whalers usually land 3 or 4 whales per year. Currently, beluga whales are not a prevailing subsistence resource in Nuiqsut. Spotted seals are typically hunted in the nearshore waters off the Colville River Delta in the summer months. Bearded seals are generally hunted during July, with some hunting occurring also in August and September. Ringed seals are primarily hunted in the winter or spring. Other subsistence activities include fishing, waterfowl and seaduck harvests, and hunting for walrus, polar bears, caribou, and moose (NMFS 2013a).

Kaktovik. Kaktovik whalers conduct bowhead whaling during the fall. Kaktovik whalers hunt for whales east, north, and occasionally west of Kaktovik. Beluga whales are not a prevailing subsistence resource; Kaktovik hunters may harvest one beluga whale in conjunction with the annual bowhead hunt. It appears that most Kaktovik residents obtain beluga through exchanges with other communities. Bearded seals are generally hunted during July, with some hunting also occurring in August and September. Ringed seals are primarily hunted in the winter or spring. Other subsistence activities include fishing, waterfowl and seaduck harvests, and hunting for walrus, polar bears, caribou, and moose (NMFS 2013a).

Barrow. Spring bowhead whale hunting generally occurs from April to June. Barrow whalers hunt from ice leads from Point Barrow southwestward along the Chukchi Sea coast to the Skull Cliff area. Fall bowhead whale hunting occurs in August to October from approximately 10 miles west of Point Barrow to the east side of Dease Inlet. The northern boundary of the fall whaling area is 30 miles north of Point Barrow and extends southeastward to a point approximately 30 miles off Cooper Island. Beluga whaling occurs from April to June in the spring leads between Point Barrow and Skull Cliff; later in the season, belugas are hunted in open water around the barrier islands off Elson Lagoon. Walrus are harvested from June to September from west of Barrow southwestward to Peard Bay. Polar bears are hunted from October to June generally in the same vicinity used to hunt walrus. Seal hunting occurs mostly in winter, but some open-water sealing is done from the Chukchi coastline east as far as Dease Inlet and Admiralty Bay in the Beaufort Sea (MMS 2007).

3.6.1. Importance of Subsistence

The Inupiat consider subsistence to be more than just a “way of life,” and for the people who live along the Beaufort Sea and Chukchi Sea coasts, subsistence is their life (Maclean 1998). Subsistence defines the essence of who they are, and it provides a connection between their history, culture, and spiritual beliefs. An essential component of Inupiat values is the sharing of subsistence resources among families, friends, elders, and those in need. “[V]irtually all Inupiat households depend on subsistence resources to some degree” (NSB 2004, NMFS 2013).

Subsistence activities are assigned the highest cultural value by the Inupiat and provide a sense of identity in addition to the substantial economic and nutritional contributions. Many species are important for the role they play in the annual cycle of subsistence resource harvests, and each subsistence food resource plays an important role. Loss of access to any subsistence food resource could have serious effects. When a subsistence resource is unavailable for any reason, families will adapt and redirect harvest effort towards other species, but the contribution of some resources to the annual food budget would be very difficult to replace. Besides their dietary benefits, subsistence resources provide materials for family use and for the sharing patterns that help maintain traditional Inupiat family organization. Relationships between generations, among families, and within and between communities are honored and renewed through sharing, trading, and bartering subsistence foods. The bonds of reciprocity extend widely beyond the permit areas of coverage and help to maintain ties with family members elsewhere in Alaska. Subsistence resources provide special foods for religious and ceremonial occasions; the most important ceremony, Nalukataq, celebrates the bowhead whale harvest (NMFS 2008 and 2013).

The use of traditional food in the subsistence way of life provides important benefits to users. Subsistence foods are often preferable as they are rich in many nutrients, lower in fat, and healthier than purchased foods. Subsistence foods consist of a wide range of fish and wildlife and vegetable products that have substantial nutritional benefits. According to the state Division of Subsistence, about 38.3 million pounds of wild foods are taken annually by residents of rural Alaska, or about 316 pounds per person per year. This compares to 23 pounds per year harvested by Alaska's urban residents. Fish comprise 55 percent of subsistence foods taken annually. Ninety-two to one-hundred percent of rural households consume subsistence-caught fish, according to the state (ADF&G 2010).

Subsistence harvesting of traditional foods, including preparation, eating, and sharing of resources contributes to the social, cultural, and spiritual well-being of users and their communities (NMFS 2013). Communities express and reproduce their unique identities based on the enduring connections between current residents, those who used harvest areas in the past, and the wild resources of the land. Elders’ conferences, spirit camps, and other information exchange and gathering events serve to solidify these cultural connections between generations and between the people and the land and its resources (NMFS 2013).

Participation in the harvesting and sharing of subsistence foods goes beyond the family and the community. There is an extensive network of exchange that occurs between communities of the Beaufort and Chukchi Seas and further to relatives residing in larger towns such as Anchorage and Fairbanks. For instance, the shares of bowhead whale that each crew member receives after whaling are involved in secondary redistribution among local relatives and those in other communities. Social and cultural identity is strengthened by serving subsistence foods at home and at feasts and sharing subsistence foods, particularly with elders. The foods that are exchanged strengthen family and regional ties (NMFS 2013).

3.6.2. Subsistence Participation and Diet

Diets include both traditional, or subsistence foods, and non-traditional, or store foods. Traditional diets are associated with numerous health benefits and reduced risk of many chronic diseases including diabetes, high blood pressure, high cholesterol, heart disease, stroke, arthritis, depression, and some cancers (Reynolds et al. 2006; Murphy et al. 1995; Adler et al. 1996; Ebbesson et al. 1999, Bjerregaard et al. 2005). Data from the 2003 North Slope Borough census show that virtually all Iñupiat households report relying on subsistence resources to some extent, and that subsistence foods make up a large proportion of healthy meals (Circumpolar Research Associates 2010, NMFS 2013). The North Slope Borough also has among the highest per capita harvests of subsistence food in Alaska (McAninch 2010).

Residents have expressed concerns about environmental contamination, particularly as it relates to contamination of subsistence food sources. In a recent survey, 44 percent of Inupiat village residents reported concern that fish and animals may be unsafe to eat (Poppel et al. 2007, NMFS 2013). Environmental contaminants have the potential to affect human health in a number of ways. First exposure to contaminants via inhalation, ingestion, or absorption may induce adverse health effects, depending on a number of factors, including the nature of the contaminant, the amount of exposure, and the sensitivity of the person who comes in contact with the contaminant.

Aside from actual exposure to environmental contamination, the perception of exposure to contamination is also linked to known health consequences. Perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources (CEAA 2010, Joyce 2008, Loring et al. 2010), with potential changes in nutrition-related diseases as a result. It is important to note that these health results arise regardless of whether or not there is any real contamination at a level that could induce toxicological effects in humans; the effects are linked to the perception of contamination, rather than to measured levels (NMFS 2013).

4. DETERMINATION OF UNREASONABLE DEGRADATION

This section presents a discussion of EPA's evaluation of the 10 ocean discharge criteria and determination that the discharges authorized by the permit will not cause unreasonable degradation of the marine environment. EPA's ocean discharge criteria evaluations, related findings and determinations are discussed in this section.

4.1. CRITERION 1

The quantities, composition, and potential for bioaccumulation or persistence of the pollutants to be discharged.

The pollutants expected to exist in the discharge are discussed in Section 1.2, above. With the exception of the ongoing discharges from the STP during the life of the project, all other authorized discharges will be temporary, short-term, and would produce negligible impacts. The conventional pollutants designated under Section 304(a)(4) of the CWA are BOD, TSS, pH, fecal coliform, and oil and grease. Additionally, EPA has identified 65 pollutants and classes of pollutants as "toxic pollutants," of which 126 specific substances have been designated "priority" toxic pollutants. (See https://www.epa.gov/eg/toxic-and-priority-pollutants-under-clean-water-act)

All other pollutants are considered to be "nonconventional," which are the pollutants that are not included in the list of conventional or toxic pollutants. Nonconventional pollutants include COD, total organic carbon (TOC), ammonia, nitrogen, and phosphorus.

The primary discharges of concern associated with the Liberty project primarily consist of conventional pollutants and are not expected to bioaccumulate or persist in the environment.

4.1.1. Sedimentation

The Sagavanirktok River is the major river carrying suspended sediments into Stefansson Sound, with an estimated annual sediment load of about 330,000 metric tons. The maximum concentrations of TSS for the Sagavanirktok River during the spring floods range from 244 mg/L to 609 mg/L (Hilcorp 2014; Trefry et al. 2009). The depositional area for this sediment in the coastal Beaufort Sea is about 1,000 square kilometers (km^2), yielding an estimated deposition rate of about 0.04 cm per year. Naturally occurring sedimentation in the vicinity of the Liberty project is negligible (Hilcorp 2014).

Low suspended sediment concentrations typically occur during the summer. TSS concentrations during the open-water period are variable and directly related to wind conditions. Concentrations of TSS in Stefansson Sound average less than 15 mg/L during the open-water season. The highest concentration of suspended sediments in the coastal Beaufort Sea occurs during the spring runoff, when river plumes flow under landfast ice (Hilcorp 2014; Dunton et al. 2009).

The STP effluent is an ongoing discharge that will increase the concentrations of TSS in the vicinity of the outfall. The deposited materials may be mixed with natural sediments by physical resuspension processes and by biological reworking of sediments by benthic organisms or marine mammals. Ice gouging could also mix deposited materials into seafloor sediments.

4.1.2. Benthic Communities

The benthos of Stefansson Sound, like most of the Alaskan Beaufort Sea, with the notable exception of the Boulder Patch, is predominantly composed of unconsolidated sediments of fine silt, sand, and clay. Although isolated patches of marine life occur in areas where rocks cover is between 10 to 25% of the benthos, the Boulder Patch benthos covered by > 25% boulders, cobbles, and/or pebbles provides a solid substrate for settlement and growth of the most diverse biological community of the Beaufort Sea, including extensive kelp beds. The benthic communities associated with the Stefansson Sound seabed include the bacterial and diatomaceous microphytobenthos, and infaunal (living within the sediments) and epifaunal (living on the surface of sediments) invertebrate communities (Hilcorp 2014; Barnes and Reimnitz 1974).

The effects on benthic communities from the ongoing STP discharges are expected to be limited to physical smothering in the vicinity of the outfall.

4.1.3. Control and Treatment

EPA has incorporated the new source performance standards required by the Oil and Gas Effluent Limitations Guidelines in 40 CFR Part 435, Subpart A. Additionally, EPA has applied best professional judgment to establish the effluent limitations, including secondary treatment standards (40 CFR Part 133) for the discharges of sanitary and domestic wastewater. The regulations cover wastewater discharges from field exploration, drilling, production, well treatment and well completion activities. Please refer to EPA's Fact Sheet for the NPDES permit for a summary of the technical rationale of the effluent limitations associated with each discharge.

Based on the discussions above and the provisions included in the NPDES permit, it is not expected that the discharges would result in discharges of pollutants in quantities or composition that would bioaccumulate or persist in the marine environment.

4.2. CRITERION 2

> **The potential transport of such pollutants by biological, physical, or chemical processes.**

Pollutant transfer can occur through biological, physical, or chemical processes. Biological transport processes include bioaccumulation in soft or hard tissues, biomagnification, ingestion and excretion in fecal pellets, and physical reworking to mix solids into the sediment (bioturbation). Physical transport processes include currents, mixing and diffusion in the water column, particle flocculation, and discharged material settling to the seafloor. Finally, chemical processes related to the discharges are the dissolution of substances in seawater, complexing of compounds that might remove them from the water column, redox/ionic changes, and adsorption of dissolved pollutants on solids.

With the exception of the potable water reject and discharges from the STP, all other discharges will be temporary and short term in nature. The primary pollutant of concern associated with the STP discharge is TSS, which occurs naturally in the water column and sediment within the project area. Additionally, EPA has established effluent limits and monitoring requirements for all of the discharges. For these reasons, the transfer of pollutants is not expected to cause unreasonable degradation of the marine environment.

4.3. CRITERION 3

> **The composition and vulnerability of the biological communities that might be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the ecosystem, such as those important for the food chain.**

No unreasonable degradation or adverse impacts to marine resources are expected to occur. EPA is coordinating a joint ESA consultation process with the Bureau of Ocean Energy Management through the development of a Biological Assessment to satisfy our regulatory requirements under Section 7(a)(2) of the Endangered Species Act. The Biological Assessment includes an evaluation of the potential impacts from the Liberty Development Project will be submitted to the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to initiate ESA consultation. Consultation will be concluded prior to EPA issuing a final agency action for the proposed NPDES permit**.**

The potential effects on the species include behavioral changes resulting from noise during construction and operation of the LDPI, vessel activity, and limited exposure to contaminants. The BA developed in support of the permit addresses the potential impacts associated with the discharges. As discussed under Criterion 1, bioaccumulation is not expected to be an exposure pathway to the species or their prey. On the basis of the transient use of the area by the species, the limited areal extent of the potential impacts, and the overall mobility of the species, impacts from the authorized discharges from the LDPI will not cause unreasonable degradation of the marine environment.

4.4. CRITERION 4

The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

The Beaufort Sea provides foraging habitat for a number of species including marine mammals and birds. Bowhead whale migrations occur near the area of discharge from the facility with whales following open water leads from the Chukchi Sea to the Beaufort Sea in the spring. A number of other habitats and biological communities exist in the shallow and protected waters near the coast. Polar bear dens are found near shorefast ice and pack ice. The discharges authorized by the NPDES permit would be limited in extent and duration, combined with the end-of-pipe limits established in the permit, would prevent unreasonable degradation of those resources.

4.5. CRITERION 5

The existence of special aquatic sites including, but not limited to, marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas, and coral reefs.

No marine sanctuaries or other special aquatic sites, as defined by 40 CFR 125.122, are in or adjacent to the Liberty project area.

4.6. CRITERION 6

The potential impacts on human health through direct and indirect pathways.

Human health within the North Slope Borough is directly related to the subsistence activities in and along the Beaufort Sea. In addition to providing a food source, subsistence activities serve important cultural and social functions for Alaska Natives. Since the waste streams consist of conventional (non-toxic) pollutants, and the permit applies stringent end-of-pipe limits to the discharges, including requiring whole effluent toxicity testing if chemicals are used, the potential impacts to human health, either from direct or indirect exposure, are not expected to occur.

4.7. CRITERION 7

Existing or potential recreational and commercial fishing, including finfishing and shellfishing.

The Arctic Management Area, as it pertains to fisheries management, covers the Beaufort and Chukchi Seas from the Bering Strait north and east to the Canadian border (NPFMC 2009). The Northwest Pacific Fishery Management Council developed a fisheries management plan (FMP) for fish resources in the Arctic Management Area in 2009. The FMP governs all commercial fishing including finfish, shellfish, and other marine resources with the exception of Pacific salmon and Pacific halibut (NPFMC 2009). The policy prohibits commercial fishing in the area until sufficient information is available to enable a sustainable commercial fishery to proceed (74 FR 56734). The FMPs applicable to salmon and Pacific halibut fisheries likewise prohibit the harvest of those species within the Arctic Management Area.

Amendment 29 of the Bering Sea/Aleutian Islands King and Tanner Crabs FMP prohibits the harvest of crabs in the area as well (74 FR 56734). Because commercial fishing is not permitted in the area, that aspect of Criterion 7 would not be affected by the discharges authorized under the permit.

The Magnuson-Stevens Fishery Conservation and Management Act (January 21, 1999) requires EPA to consult with the NMFS when a proposed discharge has the potential to adversely affect (reduce quality or quantity or both of) EFH. EPA has determined, based on the EFH assessment, that the discharges will not adversely affect EFH.

Subsistence fishing, defined as, "noncommercial, long-term, customary and traditional use necessary to maintain the life of the taker or those who depend upon the taker to provide them with such subsistence," is not affected by the FMP (50 CFR Part 216). The most recent subsistence data (ADF&G Subsistence Community Profile Database) for North Slope Borough communities indicate that subsistence fishing occurred in the past (and might be ongoing) with the harvest of salmon species, flounder, cod, and smelt. Considering that the discharges would meet federal water quality along with the findings presented for Criteria 1 through 4, EPA does not anticipate significant adverse direct or indirect effects resulting from the authorized discharges on subsistence fishing.

4.8. CRITERION 8

Any applicable requirements of an approved Coastal Zone Management Plan.

The Alaska Coastal Management Program expired on June 30, 2011. As of July 1, 2011, there is no longer a CZMA program in Alaska. Because a federally approved CZMA program must be administered by a state, the National Oceanic and Atmospheric Administration withdrew the Alaska Coastal Management Program from the National Coastal Management Program. See 76 FR 39,857 (July 7, 2011). As a result, the CZMA consistency provisions at 16 U.S.C. 1456(c)(3) and 15 CFR Part 930 no longer apply in Alaska. Accordingly, federal agencies are no longer required to provide Alaska with CZMA consistency determinations.

4.9. CRITERION 9

Such other factors relating to the effects of the discharge as may be appropriate.

Environmental Justice

EPA has determined that the discharges authorized by the NPDES permit will not have a disproportionately high or adverse human health or environmental effects on minority or low-income populations living on the North Slope. In making that determination, EPA considered the potential effects of the discharges on the communities, including subsistence areas, and the marine environment. EPA's determination is based on the Environmental Justice analysis for the Beaufort and Chukchi Exploration NPDES General Permits (October 2012). EPA's evaluation and determinations are discussed in more detail in the EJ Analysis for the Beaufort and Chukchi Exploration NPDES General Permits.

Executive Order 12898 titled, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations states,* in part, that "each Federal agency shall make achieving environmental justices part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations...." The order also provides that federal agencies are required to implement the order consistent with and to the extent permitted by existing law.

In addition, EPA Region 10 adopted its *North Slope Communications Protocol: Communications Guidelines to Support Meaningful Involvement of the North Slope Communities in EPA Decision-Making* in May 2009. Consistent with the order and agency policies, EPA has taken efforts to provide tribal entities and North Slope with information about the permit process and to seek input into the EPA evaluations.

This ODCE evaluates the potential for bioaccumulation, pollutant transport, and significant adverse changes in ecosystem diversity, productivity and stability of biological communities in the project area. The ODCE also evaluates environmentally significant or sensitive areas that are necessary for critical stages of marine organisms, the roles of these areas in the larger biological community and the vulnerability of these areas to the discharges. The ODCE further evaluates the potential for loss of esthetic, recreational, scientific and economic values, and impacts to recreational and commercial fishing. Each of these criteria relate directly to concerns raised regarding availability of subsistence resources, potential bioaccumulation and food tainting, human health, and overall species impacts. Overall, based on the analysis in the ODCE, the discharges authorized will not result in adverse impacts under each of these criteria, as defined by the CWA.

The ODCE also evaluates the threat to human health through the direct physical exposure to discharged pollutants and indirect threats through consumption of aquatic organisms exposed to pollutants discharged under the permit. Human health is directly related to the subsistence practices of native communities. Subsistence areas and related subsistence activities provide food and support cultural and social connections. EPA has included provisions, requirements, and restrictions in the permit to ensure impacts would not occur through direct or indirect pathways. Additionally, under the CWA, EPA has the authority to make modifications or revoke permit coverage if it identifies a basis to conclude that discharges will cause an unreasonable degradation of the marine environment.

In summary, EPA carefully considered the potential environmental justice impacts related to the authorized discharges, especially the potential for disproportionate effects on communities and residents that engage in subsistence activities. Based on EPA's analysis and the conditions established by the permit, EPA has determined that the discharges authorized will not cause unreasonable degradation of the marine environment, as defined by the CWA. For similar reasons, EPA concludes that that there will be no disproportionately high and adverse human health or environmental effects on minority or low-income populations residing on the North Slope.

4.10. CRITERION 10

Marine water quality criteria developed pursuant to CWA section 304(a)(1)

Parameters of concern for effects on water quality in discharges from the LDPI include oil and grease, chlorine, and TSS. EPA has promulgated recommended marine criteria (objectives) pursuant to CWA section 304(a)(1). Current criteria are summarized in tabular form at http://water.epa.gov/scitech/swguidance/waterquality/standards/current/index.cfm and summarized in Table 3, below.

TABLE 3. *Marine water quality criteria developed pursuant to CWA section 304(a)(1).*

Pollutant[1]	Saltwater Aquatic Life CMC[2] (Acute) µg/L	Saltwater Aquatic Life CCC[3] (Chronic) µg/L	Human Health Consumption (Organisms Only) µg/L

Chlorine	13	7.5	--
Oil and Grease	Narrative[4]		--
pH	6.5 – 8.5[5]		--
TSS	Narrative[6]		--
Temperature	Species Dependent[7]		--

1 Source: http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

2 Criterion maximum concentration

3 Criterion continuous concentration

4 For aquatic life: (a) 0.01 of the lowest continuous flow 96-hour LC50 to several important freshwater and marine species, each having demonstrated high susceptibility to oils and petrochemicals; (b) levels of oils or petrochemicals in the sediment which cause deleterious effects to the biota; (3) surface waters shall be virtually free from floating nonpetroleum oils of vegetable or animal origin, as well as petroleum-derived oils (USEPA 1986).

5 For the discharge of sanitary and domestic wastewater, the secondary treatment standards for pH of 6.0 – 9.0 standard units apply. EPA is applying the federal standard of 6.5 – 8.5 standard units to discharges of potable reject water (001b) and the STP (002).

6 The depth of light penetration not be reduced by more than 10 percent (USEPA 1986).

7 (a) The maximum acceptable increase in the weekly average temperature resulting from artificial sources is 1ºC (1.8ºF) during all seasons of the year, providing the summer maxima are not exceeded; and (b) daily temperature cycles characteristic of the water body segment should not be altered in either amplitude or frequency (USEPA 1986).

4.10.1. pH

The permit established pH limits of 6.0 – 9.0 standard units for sanitary and domestic wastewater (Discharge 001a). The pH limits for potable water reject waste (Discharge 001b) and the seawater treatment plant wastewater (Discharge 002) are 6.5 – 8.5 standard units.

4.10.2. Chlorine

Chlorine is a parameter of concern because it is proposed to be used to reduce biofouling in the seawater treatment process in the STP. To ensure that the STP discharge would not result in an unreasonable degradation of the marine environment, EPA has developed a maximum daily limit and average monthly limit of 204 µg/L and 142 µg/L, respectively, for total residual chlorine. Additionally, since Hilcorp plans to utilize the ultraviolet irradiation technology for disinfection of the sanitary and domestic wastewater, EPA has not authorized the discharge of TRC for this discharge.

4.10.3. TSS

Discharges from the STP, and to a lesser extent the sanitary and domestic wastewater effluent, are expected to contain settleable solids and TSS, which contribute to turbidity. The permit applies the maximum daily and average monthly effluent limitations for TSS according to secondary treatment standards for discharges of sanitary and domestic wastewater effluent (40 CFR Part 133). The permit also requires weekly TSS monitoring for the potable water reject waste (Discharge 001B) and seawater treatment plant wastewater (Discharge 002). EPA is requiring monitoring to collect discharge information to inform future permitting decisions and to ensure TSS levels would not result in an unreasonable degradation of the marine environment.

4.10.4. Temperature

The desalination treatment processes may result in elevated temperatures in the effluent. As such, the permit requires monitoring of influent and effluent temperatures during periods of discharge of potable water reject waste (Discharge 001b). Similarly, the seawater treatment plant may also discharge wastewater at higher temperatures than ambient conditions. To ensure the discharge would not result in an unreasonable degradation of the marine environment, the permit requires weekly monitoring of influent and effluent temperatures for the STP discharge (Discharge 002).

4.11. Determinations and Conclusions

When conducting an ocean discharge criteria evaluation, EPA may presume that discharges in compliance with Clean Water Act section 301(g), 301(h), or 316(a) variance requirements, or with State water quality standards, do not cause unreasonable degradation to the marine environment pursuant to 40 CFR § 125.122(b). With the exception of the ongoing discharge from the STP, all other discharges authorized by the NPDES permit will be on a contingency basis (i.e. when the disposal well is not available). In addition, Hilcorp has not sought authorization for, and the permit does not authorize, the discharge of produced water, drilling fluids and/or drilling cuttings. Based on the ODCE analysis, EPA concludes that there will not be unreasonable degradation of the marine environment.

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