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Re: Comments on BOEM's Draft Second Supplemental Environmental Impact Statement (DSSEIS) for the Chukchi Sea Planning Area, OCS Oil and Gas Lease Sale 193

Harvard Law School's Emmett Environmental Law and Policy Clinic ("EELPC") welcomes the opportunity to comment on the Bureau of Ocean Energy Management's Draft Second Supplemental Environmental Impact Statement ("DSSEIS") for the Chukchi Sea Planning Area, OCS Oil and Gas Lease Sale 193.[1] EELPC appreciates the care with which the

[1] About the Commenters: The Emmett Environmental Law and Policy Clinic works on a variety of local, national, and international projects covering the spectrum of environmental law and policy issues under the direction of Professor Wendy B. Jacobs. The Emmett Clinic has published several white papers and submitted comments to the Department of the Interior on various aspects of the regulation of offshore drilling generally and drilling in the Arctic in particular. It is the Emmett Clinic's position that rules of general applicability may not be adequately protective of the unique and sensitive Arctic marine environment. The Clinic's publications on these issues include the following: *Offshore Drilling: Coordinating and Improving Access to Information* (Dec. 2014) (attached as Exhibit A); *Suggested Indicators of Environmentally Responsible Performance of Offshore Oil and Gas Companies Proposing to Drill in the U.S. Arctic* (Dec. 2013), *available at* http://hlsenvironmentallaw.files.wordpress.com/2014/09/indicators-paper-final_1-6-14.pdf; Comments on Draft Safety Culture Policy Statement for Offshore Drilling, Docket ID. BSEE-2012-0017 (Mar. 2013), *available at* http://blogs.law.harvard.edu/environmentallawprogram/files/2013/03/ELPC_BSEE-

Bureau of Ocean Energy Management ("BOEM") has prepared the DSSEIS; given that the Chukchi Sea is a sensitive marine environment and a harsh, remote area in which to conduct oil and gas exploration, it is essential that the environmental risks associated with such exploration be properly assessed and managed.

Our comments focus on the DSSEIS's discussion of the risks associated with a very large oil spill ("VLOS") and with the potential use of dispersants to respond to a VLOS. In particular, we identify several critical flaws in the analysis contained in the DSSEIS that must be corrected to effectively address and minimize risk to this sensitive marine environment:

(1) The DSSEIS incorrectly assumes that dispersants can be an effective oil-spill response technique in "cold and ice infested waters" such as those in the Chukchi Sea. In fact, existing research shows that there is considerable uncertainty about the effectiveness of dispersants in such conditions. In addition, the studies relied upon by the DSSEIS contain multiple methodological shortcomings.

(2) Multiple scientific studies have shown that dispersants themselves can be harmful to wildlife, either directly—because of the toxicity of the chemicals in the dispersants—or indirectly—because the dispersants can increase the toxicity of the oil. The DSSEIS contains several omissions in its discussion of the potential impacts of dispersant use on wildlife, especially bowhead whales, and on the indigenous communities that depend on that wildlife.

(3) The DSSEIS assumes that a VLOS can be stopped within 74 days by the drilling of a relief well. This assumption is unreasonable for a spill that occurs near the end of the drilling season, because it does not take into account the possibility that winter conditions will delay the completion of a relief well until the next open-water season. The problems encountered by Shell during the 2012 drilling season highlight the shortcomings in this analysis.

I. The Evidence Cited in the DSSEIS Does not Support the Conclusion that "Dispersants Can Be Effective in Cold and Ice Infested Waters."

As part of its analysis regarding the environmental effects of a hypothetical VLOS, the DSSEIS properly includes a discussion on recovery and cleanup efforts. In it, BOEM recognizes

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comments-FINAL_3-20-13.pdf; and *Recommendations for Improved Oversight of Offshore Drilling Based on a Review of 40 Regulatory Regimes* (June 2012), *available at* http://blogs.law.harvard.edu/environmentallawprogram/files/2013/10/Offshore-Drilling-White-Paper-FINAL_revised-10-2-13.pdf.

the use of chemical dispersants as a "response option" in the case of a VLOS in the Chukchi Sea, even though the Unified Plan for Alaska does not have any preapproved dispersant application zones in that area.[2] The DSSEIS assumes dispersants will be effective in the cold and ice-infested waters in the Arctic in a short and superficial discussion, even though dispersant effectiveness in the Arctic Ocean is still uncertain and a recent reported commissioned by the Bureau of Safety and Environmental Enforcement ("BSEE") questions the logistical feasibility of such a treatment plan. For the reasons discussed below, we believe that there are significant omissions and inaccuracies in the DSSEIS's discussion of the effectiveness of dispersants as a response option for a VLOS in the Chukchi Sea.

A. Dispersants and Dispersant Effectiveness Testing.

Chemical dispersants are a mixture of one or more surfactants with one or more solvents. A surfactant has a chemical structure consisting of an oleophilic ("oil-loving") end and an opposing hydrophilic ("water-loving") end. In essence, what the surfactants do is orient the water with its hydrophilic end and the oil with its oleophilic end in order to reduce the oil-water interfacial tension. In addition to the surfactants, dispersant blends contain solvents that "are used as carriers for the surfactants (which are often solids or highly-viscous liquids) and allow for the surfactants to penetrate the oil and migrate it to the oil-water interface."[3]

[2] The Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases, *available at* http://dec.alaska.gov/spar/perp/plans/uc.htm (last visited December 18, 2014). Currently, the Alaska Department of Environmental Conservation, the U.S. Coast Guard and the Environmental Protection Agency are in the process of amending Appendix I (Alaska Regional Response Team Oil Dispersant Authorization Plan) and the proposed draft does not have any preauthorized dispersant application zones in the Chukchi Sea area. *See* Draft of September 25, 2013 Alaska Regional Response Team Oil Dispersant Authorization Plan (Revision I), *available at* http://dec.alaska.gov/spar/perp/docs/ARRT%20Oil%20Dispersant%20Authorization%20Plan_Draft%209-25-13.pdf.

[3] Southwest Research Institute, *Dispersant Effectiveness Literature Synthesis: Final Report*, at 2-1 (2014).

Mervin Fingas, a widely recognized authority on oil spill cleanup methods and for more than 30 years the Chief of the Emergencies Science Division of Environment Canada, has explained that there are three main motivations for the use of dispersants during an oil spill: (1) to reduce the impact of oil on shoreline, (2) to reduce the impact on birds and mammals in the water surface, and (3) to promote the biodegradation of oil in the water column.[4]

The effectiveness of a dispersant is typically understood as "the amount of oil that the dispersant puts into the water column compared to the amount of oil that remains on the surface."[5] There are many factors that influence dispersant effectiveness, including the type of oil is being treated (oil composition); sea energy; oil weathering; type, amount, and composition of the dispersant used; and the temperature and salinity of the water.

Dispersant effectiveness is typically studied in one of three ways: (1) laboratory tests; (2) tank tests; or (3) field tests. Laboratory tests can be performed at the lowest cost, but "[a] major disadvantage is . . . that it is difficult to scale the results of these tests to predict performance in the field."[6] Therefore, "[r]esults obtained from the laboratory testing should . . . be viewed as representative only and not necessarily reflecting what would take place in actual conditions."[7] Tank tests are performed in wave tanks that can hold much larger volumes than are used in laboratory tests. Although tank tests are more realistic than laboratory tests, they still have shortcomings, including that "the physical characteristics of wave tanks imply that the encounter

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[4] Merv Fingas, *Oil Spill Dispersants: A Technical Summary*, *in* OIL SPILL SCIENCE AND TECHNOLOGY: PREVENTION, RESPONSE, AND CLEANUP 435, 435-36 (Mervin Fingas ed., 2011).

[5] *Id.* at 452.

[6] *Id.* at 467.

[7] Merv Fingas, *A Review of Literature Related to Oil Spill Dispersants 2011-2014*, at 4 (June 2014), *available at* http://www.pwsrcac.net/committees/xcom/documents/PWSRCACDispersantReportFingas2014.pdf [hereinafter Fingas, *A Review of Literature*].

probability of the dispersant with the oil slick will be higher than can be achieved during a real spill response."[8] In addition, most tank tests fail to account for the skinning of the oil that occurs while weathering, making penetration of dispersants in the field more difficult.[9] Finally, field trials try to simulate real time oil spill environments. While they are the most realistic type of test, they also face several methodological challenges, including the impossibility of measuring remaining oil thickness and the need to establish a mass balance between oil in the water column and on the surface, which is difficult to achieve.[10] As a result, "it is very difficult to measure the concentration of oil in the water column over large areas and at frequent enough time periods. . . . Any field measurement at this time is best viewed as an estimate."[11]

More generally, as the National Research Council of the National Academies of Sciences has reported, dispersant effectiveness testing is subject to a series of common and systematic errors. These errors include: ignoring the evaporation of volatile compounds, the use of poor analytical methods, and incomplete recovery of floating oils.[12] All of these errors "introduce a positive bias in the estimates of dispersant effectiveness."[13]

Even with these shortcomings and positive bias, experiments have a decidedly mixed record in demonstrating dispersant effectiveness. "[V]arious tests show highly different results depending on how they are constructed and operated."[14]

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[8] Fingas, *supra* note 4, at 467.

[9] *Id.* at 467.

[10] *Id.* at 454-55.

[11] Fingas, *A Review of Literature*, *supra* note 7, at 4.

[12] NATIONAL RESEARCH COUNCIL, OIL SPILL DISPERSANTS: EFFICACY AND EFFECTS 78 (2005).

[13] Fingas, *supra* note 4, at 454.

[14] *Id.* at 563.

Moreover, if the dispersants are to do more than just move the oil around, they must also promote biodegradation.[15] In theory, dispersant application can speed up biodegradation by increasing the surface-to-volume ratio of the spilled oil, thereby making more of it available to microorganisms.[16] However, the relationship between dispersion and biodegradation is not simple. For one thing, "surfactants can interfere with the attachment of hydrophobic bacteria to oil droplets, making the process [biodegradation] very complex to understand."[17] In addition, as with dispersant effectiveness more generally, the effect of dispersants on the biodegradation of the spilled oil depends on various factors: the chemical characteristics of the dispersant; the hydrocarbons; the microbial community; nutrient concentrations; oil-water ratios; and mixing energy.[18]

Research into the effect of dispersants on the rate of the biodegradation of spilled crude oil has shown mixed results: although some studies show that biodegradation is stimulated, many others show inhibition or no effect at all.[19] Furthermore, "the most toxic components of the oil, the biodegradation of PAHs, have never been shown to be stimulated by dispersants."[20] Finally, many of the existing reports on the effect of dispersants on oil biodegradation suffer from methodological shortcomings. For example, "many experimental systems used to investigate these effects might be seen as inappropriate to represent the environment because they applied

[15] Biodegradation "is generally believed to be the dominant process that removes petroleum compounds from the environment." Kelly M. McFarlin , et al., *Biodegradation of Dispersed Oil in Arctic Seawater at -1 °C*, 9 PLOS ONE e84297, at 1 (2014).

[16] Because most compounds in crude oil are not water-soluble, any biodegradation of oil components has to occur at the surface of the oil. Roger C. Prince, et al., *The Primary Biodegradation of Dispersed Crude Oil in the Sea*, 90 CHEMOSPHERE 521, 521 (2013).

[17] Fingas, *supra* note 4, at 535.

[18] *Id.*

[19] *Id.*

[20] *Id.* at 536.

high mixing energy in an enclosed, nutrient-sufficient environment and allowed sufficient time for microbial growth."[21] By contrast, "[m]icrobial growth on open ocean slicks is likely to be nutrient limited and may be slow relative to other fate processes, many of which are resistant to biodegradation."[22]

B. The DSSEIS Incorrectly Concludes that Dispersants Have Been Demonstrated to be Effective in Arctic Conditions.

Experienced and knowledgeable research groups have concluded that the effectiveness of dispersants in Arctic conditions is little-studied and poorly understood.[23] In addition, the biodegradation process "has not been thoroughly studied in the Arctic, and questions remain as to whether biodegradation is a significant process in cold conditions."[24]

Nevertheless, the DSSEIS concludes that "[r]esearch has shown that dispersants can be effective in cold and ice infested waters when employed in a timely manner." DSSEIS at 425. In support of this conclusion, the DSSEIS relies on six reports on dispersant effectiveness, five from tank tests and one summary report that briefly discusses three field tests.[25] Notably, these

[21] *Id.* at 539.

[22] *Id.*

[23] *See, e.g.*, NATIONAL RESEARCH COUNCIL, RESPONDING TO OIL SPILLS IN THE U.S. ARCTIC MARINE ENVIRONMENT 84 (2014) ("There has been considerable debate over the effectiveness of chemical dispersants on crude oil degradation at low seawater temperatures. The main concern is that as temperature decreases, chemical processes slow down and oil viscosity increases, making it more difficul to disperse."); NUKA RESEARCH AND PLANNING GROUP, LLC & PEARSON CONSULTING, LLC, OIL SPILL PREVENTION AND RESPONSE IN THE U.S. ARCTIC OCEAN: UNEXAMINED RISKS, UNACCEPTABLE CONSEQUENCES 80 (2010) ("Many questions remain about the efficacy of dispersants in Arctic waters, the potential toxicities, and the operational feasibility of applying dispersants in ice-infested waters.") (report commissioned by the Pew Environment Group); WORLD WILDLIFE FUND, NOT SO FAST: SOME PROGRESS IN SPILL RESPONSE, BUT US STILL ILL-PREPARED FOR ARCTIC OFFSHORE DEVELOPMENT 5 (2009) ("The use of chemical dispersants as a viable response tool for arctic waters in Alaska is still many years off.").

[24] McFarlin, et al., *supra* note 15, at 1.

[25] Specifically, the SEIS cites four tank test reports by S.L. Ross Environmental Research Ltd. published in 2002, 2003, 2006 and 2007; one tank test report by Randy Belore from S.L. Ross presented in the International Oil Spill Conference Proceedings of April 2003; and a summary report on three field tests by SINTEF published in 2010. DSSEIS at 425.

reports do not support the DSSEIS's categorical statement that dispersants can be effective in such conditions because, as discussed below, they suffer from systematic experimental design errors that create a positive bias towards conclusions of effectiveness.

The most recent tank test report,[26] published in 2007, tested the effectiveness of Corexit 9500 dispersant in cold water on four Alaskan crude oils, including Alaskan North Slope crude, using the Ohmsett dispersant effectiveness test method.[27] As described by the report, the resulting dispersant effectiveness (DE) was calculated by taking the "%Dispersed/Lost"[28] estimated value for each dispersant application minus the "%Dispersed/Lost" value for the control experiment for the same oil.[29] Under this analytical methodology, the report concluded that Corexit 9500 was an effective dispersant for Alaskan North Slope oil when it is air sparged (weathered) by 15%.

There are several reasons to question this conclusion, however. First, this report was based on a wave tank experiment and, as the National Research Council has noted, "the physical characteristics of most wave tanks . . . imply that the encounter probability of the dispersant with the oil slick will be higher than can be achieved during a real spill response."[30] This positive

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[26] S.L. Ross Environmental Research, *Corexit 9500 Dispersant Effectiveness Testing in Cold Water on Four Alaskan Crude Oils* (2007). This report utilizes the same test equipment and procedures as those used in the 2006 report and compares its results with those obtained in the 2003 and 2006 reports.

[27] The Ohmsett test method consists of "laying down a uniform slick of a known quantity of oil on the surface of the Ohmsett tank, spraying the oil with dispersant at a pre-determined dose, subjecting the oil to wave action (breaking waves) for 30 min and then collecting the remaining oil on the surface at the end of the mixing period." Randy C. Belore, et al., *Large-scale Cold Water Dispersant Effectiveness Experiments with Alaskan Crude Oils and Corexit 9500 and 9527 Dispersants*, 58 MARINE POLLUTION BULL. 118, 119 (2009).

[28] "%Dispersed/Lost" estimated value is the percentage of oil not accounted for by collection or evaporation estimates.

[29] S.L. Ross Environmental Research, *supra* note 26, at 6.

[30] NATIONAL RESEARCH COUNCIL, *supra* note 12, at 90.

bias means that "wave-tank tests [provide] upper limits on operational effectiveness."[31] Second, the report did not use high-quality gas chromatography-mass spectrometry (GC-MS) techniques to measure dispersant effectiveness, instead estimating dispersant effectiveness by comparing the amount of oil spilled to that collected (or not-collected) from the surface after each experiment.[32] This analytical methodology does not account for the amount of residual oil compounds on the surface, or the potential for dispersed oil to later resurface.[33] Lastly, only half of the tests reported in the study were completed at surface water temperatures representative of Arctic conditions (between -1 and -5° C); for the other half, the water temperatures were between 3 and 9° C.[34]

The DSSEIS also relies on a report prepared by SINTEF describing field tests.[35] In these experiments, Troll B crude oil was released into water that had an ice coverage of 70-80% for approximately six hours before dispersant application, and into water with an ice coverage of 80-90% six days before dispersant application.[36] However, during both oil applications, no wave action took place and energy was added by the use of a thruster or a water jet. In situ UV Fluorescence, LISST droplet size distribution measurements, and water sampling were used to monitor the concentration of the dispersed and dissolved oil in the water column. This

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[31] *Id.*

[32] *See* Fingas, *A Review of Literature*, *supra* note 7, at 9 ("It should be made very clear that only high-quality GC/MS techniques produce a true quantitative means.").

[33] *See id.* at 4 (explaining that "dispersion is temporary and effectiveness measures should always relate this to the time after the dispersant application that the measure was taken").

[34] According to the report, midway through testing, experiments had to be postponed because the tank surface froze. Testing was resumed mid-March when air temperatures had increased considerably and a chiller was no longer available to cool the tank water. S.L. Ross Environmental Research, *supra* note 26, at 4.

[35] SINTEF, *Joint Industry Program on Oil Spill Contingency for Arctic and Ice-Covered Waters: Summary Report* (2010).

[36] *Id.* at 23-24.

experiment was more realistic than the wave tank studies, but still had notable shortcomings. First, it also failed to use GC-MS techniques. As Dr. Fingas has explained, because "[t]he composition of the oil changes with respect to aromatic content as it weathers and is dispersed, with the concentration of aromatics increasing," a "fluorometer reading will always remain a relative value and even with careful 'calibration' can only give indications that are as much as order-of-magnitude from the true value."[37] In addition, since the effectiveness values of a field test depend on establishing a mass balance between oil in the water column and on the surface, and this balance is so difficult to achieve, most results from such experiments are questionable.[38]

In addition, these studies say nothing about the biodegradation of dispersed oil. As noted above, one of the main justifications for the use of dispersants is the assertion that the chemical dispersion of oil will speed up the biological degradation of oil by marine microorganisms. If the dispersed oil is not biodegraded, then all that the application of dispersants will accomplish is the transfer of oil from one part of the ecosystem to another. To conclude that dispersants are effective at remediating an oil spill in the Chukchi Sea, it is necessary to demonstrate that the dispersed oil would be biodegraded.

Whether biodegradation will occur in Arctic waters and, if so, at what rate, has long been identified as a key uncertainty regarding dispersant effectiveness in the Arctic.[39] The composition of the planktonic community varies in different parts of the ocean; therefore, the fact that microorganisms from one location may effectively biodegrade oil does not necessarily mean that those from another location will produce similar results. In addition, biological

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[37] Fingas, *A Review of Literature*, *supra* note 7, at 9.

[38] Fingas, *supra* note 4, at 454.

[39] McFarlin, et al., *supra* note 15, at 1 ("Biodegradation is generally believed to be the dominant process that removes petroleum compounds from the environment, but the process has not been thoroughly studied in the Arctic, and questions remain as to whether biodegradation is a significant process in cold conditions.").

processes in general occur at slower rates at lower temperatures; all other things being equal, the waters of the Chukchi Sea, where temperatures typically hover around 0 to 5 degrees Celsius during the open water season,[40] should therefore exhibit slower rates of biodegradation than occur in warmer waters.

Two recent studies highlight the likelihood of different rates of biodegradation in the Chukchi Sea compared to warmer waters.[41] These studies both looked at the rate of biodegradation of dispersed crude oil at low concentrations intended to mimic the concentrations that would be found after a real spill. Both studies used Alaska North Slope crude oil, but one measured biodegradation in water collected from the New Jersey shore and maintained at 8 degrees Celsius, while the other experiment was performed in water collected in the Chukchi Sea and maintained at minus 1 degree Celsius. While biodegradation occurred in both experiments, the rate at which it occurred differed dramatically. In the experiment with New Jersey seawater at 8°C, 82% of the hydrocarbons in the crude oil had biodegraded after 41 days.[42] By contrast, in the experiment with Chukchi Sea seawater at -1°C, only 61% had biodegraded after 63 days.[43] In other words, 25% less oil was biodegraded under Chukchi Sea conditions, even after 50% more time.

Even these numbers might create a misleadingly optimistic impression. First, the detected rate of biodegradation slowed considerably over the course of the experiments; for example, in the -1°C experiment, 54% had biodegraded after 28 days, but only an additional 7%

[40] William W. Gardiner, et al., *The Acute Toxicity of Chemically and Physically Dispersed Crude Oil to Key Arctic Species under Arctic Conditions during the Open Water Season*, 32 ENVTL. TOXICOLOGY & CHEMISTRY 2284, 2284 (2013).

[41] *See* Prince, et al., *supra* note 16; McFarlin, et al., *supra* note 15, at 1.

[42] Prince, et al., *supra* note 16, at 523.

[43] McFarlin, et al., *supra* note 15, at 3.

did over the next 35 days.[44] Therefore, the time necessary for the complete biodegradation of the hydrocarbons in the oil would likely be much longer than the length of the experiment. In addition, the methods used in the experiments "indicate[] only the initiation of the biodegradation process—commonly known as primary biodegradation—not their ultimate biological oxidation to water and CO_2."[45] Finally, these studies "detect only the hydrocarbons in crude oil, and do not address the potential biodegradability of the asphaltenes and resins."[46] For all of these reasons, the effectiveness of dispersants in promoting the biodegradation of oil after a spill in the Arctic remains very much an open question.

Finally, even if dispersants were effective in Arctic waters once they had been applied to an oil slick, the extreme conditions in the Chukchi Sea could make it very difficult to apply dispersants to an oil slick in the first place. Earlier this year, the NAS recognized that the Arctic "impose[s] many challenges for oil spill response—low temperatures and extended periods of darkness in the winter, oil that is encapsulated under ice or trapped in ridges and leads, oil spreading due to sea ice drift and surface currents, reduced effectiveness of conventional containment and recovery systems in measurable ice concentrations, and issues of life and safety of responders."[47] A recently-published study commissioned by the BSEE concluded that dispersant application would be virtually impossible in Chukchi Sea winter conditions and that

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[44] *Id.*

[45] *Id.*

[46] Prince, et al., *supra* note 16, at 524.

[47] NATIONAL RESEARCH COUNCIL, RESPONDING TO OIL SPILLS IN THE U.S. ARCTIC MARINE ENVIRONMENT, *supra* note 23, at 79.

even in the summer, aerial dispersant application would be impossible approximately half of the time and vessel application would be impossible approximately 20% of the time.[48]

In summary, even though chemical dispersants have been used for decades as a response to oil spills elsewhere in the United States, there is still much to learn about their effectiveness in Arctic conditions. When chemical dispersants are used as a response to an oil spill, the immediate effect (if the dispersant is effective) will be to transport the hazardous oil, mixed with new chemical components, from the surface to the water column. From there, as the studies show, it is unclear how long it will take for the oil to biodegrade. The DSSEIS therefore should not assume that dispersants will be an effective response option should a VLOS occur.

II. The DSSEIS Contains an Inadequate Discussion of the Impacts of Dispersants on Wildlife and Therefore of the Impacts on Indigenous Communities Who Depend on that Wildlife.

Not only is it unclear that dispersants could be effectively used to disperse and promote the biodegradation of an oil spill in the Chukchi Sea, but there is a significant and growing body of evidence suggesting that the dispersants themselves can be harmful to wildlife. Although the DSSEIS discusses some of these potential harms, it also contains important omissions. As a result, its analysis of the potential impacts of dispersant use in response to a VLOS on both wildlife and on the indigenous communities that depend on that wildlife are inadequate.

The Chukchi Sea is home to a diverse array of marine species. "Chukchi Sea benthic communities are among the most abundant and diverse in Arctic regions due to the primary productivity created by phytoplankton populations." DSSEIS at 70. "The U.S. Chukchi Sea and western Beaufort Sea support at least 98 fish species representing 23 families." DSSEIS at 71. A variety of seabirds and shorebirds pass through the lease sale area. Marine mammals in the

[48] Nuka Research and Planning Group, LLC, *Estimating an Oil Spill Response Gap for the U.S. Arctic Ocean* 47-48 (Sept. 10, 2014).

planning area include the bowhead whale, fin whale, humpback whale, ringed seal, bearded seal, and polar bear, all of which are listed as endangered or threatened under the Endangered Species Act, as well as the Pacific walrus, which is a candidate species. DSSEIS at 85. Several of these species are of significant nutritional, economic, cultural, and spiritual significance to indigenous communities living along the coast of the Chukchi Sea.

A. <u>The DSSEIS Ignores Important Potential Impacts of Dispersant Use on Bowhead Whales and Other Species.</u>

It is well-established that dispersants can harm many marine species, either directly or by exacerbating the harmfulness of the dispersed oil. Early dispersant applications resulted in devastating wildlife mortality.[49] Although modern dispersants have been reformulated to reduce their toxicity, they still contain multiple compounds known to be toxic and/or carcinogenic,[50] and have been shown directly in experiments to be toxic to marine organisms.[51] In addition, aside from the direct toxicity of the dispersant chemicals, dispersants dramatically increase the number of oil droplets in the water and the bioavailability of this oil to marine organisms.[52] In addition, very little is known about the long-term effects of dispersant exposure, including

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[49] Fingas, *supra* note 4, at 519 ("[T]he use of dispersants during the *Torrey Canyon* episode in Great Britain in 1968 caused massive damage to intertidal and subtidal life.").

[50] Toxipedia Consulting Services & Earthjustice, *The Chaos of Clean-Up: Analysis of Potential Health and Environmental Impacts of Chemicals in Dispersant Products* 11 (2011) (listing ingredients of Corexit 9500 and 9527 that are confirmed animal carcinogens, known toxins, and suspected neurotoxicants); *cf.* Carl E. Brown, et al., *Environment Canada's Methods for Assessing Oil Spill Treating Agents*, *in* OIL SPILL SCIENCE AND TECHNOLOGY: PREVENTION, RESPONSE, AND CLEANUP 643, 645 (Mervin Fingas ed., 2011) ("Toxicity has been one of the primary concerns with the use of dispersants.").

[51] NATIONAL RESEARCH COUNCIL, AN ECOSYSTEM SERVICES APPROACH TO ASSESSING THE IMPACTS OF THE DEEPWATER HORIZON OIL SPILL IN THE GULF OF MEXICO 82 (2013) ("There is some evidence that chemically dispersed oil and some dispersant compounds are toxic to some marine life, especially those in early life stages.").

[52] Fingas, *A Review of Literature*, *supra* note 7, at 10.

genotoxicity and endocrine disruption, because virtually all toxicity experiments look only at acute effects.[53]

The DSSEIS greatly underestimates the impacts of dispersants on marine species present in the Chukchi Sea. For example, as to all species present in the Chukchi Sea, the DSSEIS ignores recent studies on the toxicity of dispersants and dispersed oil. With regard to bowhead whales and other cetaceans in particular, the DSSEIS ignores the potential bioaccumulation of dispersant components as well as the risk of harm from inhalation of dispersants.

1. Toxicity Studies

The DSSEIS makes a few brief references to the toxicity of dispersants and dispersed oil.[54] These statements, however, are virtually unchanged from the 2011 SEIS and therefore ignore several more recent studies that have provided new evidence of such toxicity. Because some of these studies suggest that dispersants are more hazardous to wildlife than understood in 2011, the analysis needs to be updated to reflect this new information.

Some recent studies have found that dispersants are directly toxic to mammalian cells. For example, one paper reported that dispersants caused mitochondrial malfunctions in and apoptosis of mammalian cells.[55] Another study found that Corexit 9500 and 9527 were both

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[53] Fingas, *A Review of Literature*, *supra* note 7, at 15; Mengyuan Zheng, et al., *Evaluation of Differential Cytotoxic Effects of the Oil Spill Dispersant Corexit 9500*, 95 LIFE SCIENCES 108, 116 (2014) (reporting that "although Corexit appears to be less acutely toxic [to mammalian cells in vitro than certain highly toxic compounds], its long-term toxicity is currently unknown").

[54] For example, it acknowledges that "[c]hemically dispersed oil is thought to be more toxic to water column organisms than physically dispersed oil." DSSEIS at 437. It also recognizes that "[t]he application of dispersants can cause sinking of droplets and subsequent aggregation on the benthic surface and increased exposure of small organisms to oil due to the increased surface area from small particles created by dispersants." DSSEIS at 448. The DSSEIS also mentions the increased toxicity of dispersed oil to fish (DSSEIS at 455), and the possibility of direct harms to polar bears and Pacific walrus, including "skin irritations, respiratory impacts or impacts to sensitive tissues around the eyes, nose or mouth" (DSSEIS at 514, *see* DSSEIS at 509).

[55] Zheng, et al., *supra* note 53.

cytotoxic and genotoxic to sperm whale skin cells.[56] Other research has focused on the increased toxicity of dispersed oil; one study found that chemically-dispersed oil was 35-to-300 times more toxic to trout embryos than oil that was not treated with chemical dispersants.[57] Still other researchers have examined both effects at the same time. For example, one paper found that nondispersed oil "did not induce acute toxicity," while "[d]ispersant alone . . . was shown to be acutely toxic within the range of the manufacturer's recommended application" and "dispersed oil remained more toxic than either oil or COREXIT 9500 even after 6 mo[nths] of biodegradation at low salinity."[58]

Of particular relevance, some studies found that chemically-dispersed oil is toxic to organisms that are prey for bowhead whales and other marine mammals. Thus one paper found that chemically-dispersed oil is significantly more toxic to copepods than oil alone.[59] Another found a similar effect on multiple types of microzooplankton.[60] Furthermore, the Wise study mentioned above shows that dispersants can be destructive to the skin of whales in particular. Without an analysis or even a mention of recent studies such as these, the DSSEIS lacks crucial information relating to the wellbeing of these species.

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[56] Catherine F. Wise, et al., *Chemical Dispersants Used in the Gulf of Mexico Oil Crisis are Cytotoxic and Genotoxic to Sperm Whale Skin Cells*, 152 AQUATIC TOXICOLOGY 335 (2014).

[57] Dongmei Wu, et al., *Comparative Toxicity of Four Chemically Dispersed and Undispersed Crude Oils to Rainbow Trout Embryos*, 31 ENVTL. TOXICOLOGY CHEMISTRY 754 (2012).

[58] Adam J. Kuhl, et al., *Dispersant and Salinity Effects on Weathering and Acute Toxicity of South Louisiana Crude Oil*, 32 ENVTL. TOXICOLOGY CHEMISTRY 2611, 2618-19 (2013).

[59] Rodrigo Almeda, et al., *Ingestion and Sublethal Effects of Physically and Chemically Dispersed Crude Oil on Marine Planktonic Copepods*, 23 ECOTOXICOLOGY 988 (2014). As explained in the National Marine Fisheries Service's *Biological Opinion on Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska* (2013), copepods are one of the primary prey of bowhead whales, *id.* at 69.

[60] Rodrigo Almeda, et al., *Toxicity of Dispersant Corexit 9500A and Crude Oil to Marine Microzooplankton*, 106 ECOTOXICOLOGY & ENVTL. SAFETY 76 (2014). "Concentrations of zooplankton appear necessary for bowhead whales and other baleen whales to feed efficiently to meet energy requirements." NMFS, *supra* note 59, at 69.

In addition, although the DSSEIS discusses the toxic impact of oil on bowhead whales—*see, e.g.*, DSSEIS at 495-496, it fails to take into account the impact of dispersants in these assessments. For example, the DSSEIS states that in the event of a spill:

> [i]t would be likely that surface feeding bowheads would ingest surface and near surface oil fractions with their prey, which may or may not be contaminated with oil components. Incidental ingestion of oil fractions that may be incorporated into bottom sediments can also occur during near-bottom feeding. Ingestion of oil may result in temporary and permanent damage to bowhead endocrine function and reproductive system function; and if sufficient amounts of oil are ingested mortality of individuals may also occur.

DSSEIS at 495. Even though the DSSEIS elsewhere states that "chemical oil dispersant derived compounds could be consumed by bowheads feeding on prey anywhere in contaminated water column layers to the sea floor," DSSEIS at 474, these analyses do not consider that near surface oil fractions could be combined with dispersants, or that the combination of oil and dispersants—near surface, in the water column, or at the sea floor—is potentially more toxic than oil alone.

Further, and more generally, the DSSEIS does not thoroughly address the possibility that organisms' susceptibility to toxic components within dispersants may vary depending on their lifecycle stage at the time when dispersants are applied to their habitats.[61] By contrast, the DSSEIS focuses on sensitive life cycle stages in its discussion of some other impacts. *See* DSSEIS at 415 (discussing effects of *shockwaves* on fish eggs and larvae); *id.* at 449 (discussing "articles that document the injurious and acute effects of *crude oil* on the embryology, physiology, genetics, and behavior of various fish species and fish life stages.); *id.* at 474 ("Maternal exposure to *crude oil* during pregnancy may negatively impact the birth weight of young.") (emphases added). *See also* 2007 FEIS at IV-60 (detailing effects of oil on organisms

[61] The DSSEIS does address the possibility that cleanup activities will "occur in or near lagoons or nearshore feeding areas, molting, or birthing habitats," and it states that "beluga would abandon these areas for as long as spill related activities persisted." *See* DSSEIS at 497. This section does not address the physiological or embryological effects of dispersants on whales, however.

at different stages within lifecycle, but not mentioning dispersants). Though the DSSEIS states that "[a]pplication of dispersants can cause toxic effects in fish and particularly fish eggs and larvae," it does not go on to examine the implications of that fact and whether it should affect the range of times during the year at which it would be reasonable to apply dispersants. *See* DSSEIS at 455.

2. Bioaccumulation

Although the DSSEIS recognizes that bowheads may ingest oil while feeding at the benthic surface, DSSEIS at 474, and that polycyclic aromatic compounds ("PACs") may bioaccumulate in bowhead prey, *id.* at 475, it does not discuss the role that dispersants may play in enhancing these harmful impacts. As BOEM acknowledges elsewhere in the DSSEIS, "[t]he application of dispersants can cause sinking of droplets and subsequent aggregation on the benthic surface . . . and increased exposure of small organisms to oil due to the increased surface area from small particles created by dispersants." *Id.* at 448 (citations omitted). In fact, as the aftermath of the Deepwater Horizon disaster has shown, dispersant use can lead to oil settling on the sea floor in quantities that are detectable years after the spill.[62] Bowhead whales are known to inhabit and feed in the benthic regions in which such hydrocarbon contamination can persist. DSSEIS at 279, 448 ("The application of dispersants can cause sinking of droplets and subsequent aggregation on the benthic surface . . . ."), 487. As a result of these processes, bowheads can be expected to consume more oil while feeding at the sea bottom and more oil derivatives can be expected to bioaccumulate in bowhead prey if dispersants are used in response to a VLOS. The DSSEIS does not discuss these risks associated with dispersant use.

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[62] *See* David L. Valentine, et al., *Fallout Plume of Submerged Oil from* Deepwater Horizon, 111 PROC. NAT'L ACAD. SCI. 15906, 15909 (2014) (identifying "a fallout plume of hopane from the *Deepwater Horizon* event that spans an area of 3,200 km^2 and by proxy represents 4-31% of the oil estimated to have been trapped in the deep ocean").

In addition, the fact that "[w]hales can experience several polluting events within a lifetime," DSSEIS at 476, suggests that they are particularly susceptible to the dangers posed by dispersants and the bioaccumulation of toxins that they contain. Moreover, "[m]any benthic invertebrates [on which whales feed] are filter feeders, which tend to concentrate hydrocarbons through bioaccumulation."[63] Unfortunately, however, the DSSEIS section on Cumulative Effects does not mention chemical dispersants even once in its 83 pages of analysis. *See* DSSEIS at 567-650. The failure to consider the cumulative effects of dispersants on wildlife like the bowhead whale is particularly problematic because research has demonstrated that toxic dispersant-oil mixtures can remain suspended in the water column for months and extend for many miles. Because the "the use of dispersants in the Arctic . . . is foreseeable," their adverse impacts must be analyzed in the section of the DSSEIS that addresses cumulative effects. *See* DSSEIS at 509; 2007 FEIS at IV-82 PDF page 328 ("The considerable potential longevity of the bowhead whale, coupled with its migratory use of the habitat, is important to consider in evaluating potential effects, and especially *cumulative effects*, of the Proposed Action.") (emphasis added).

3. Inhalation

Another impact of dispersants on bowhead whales that the DSSEIS ignores is the risk of harm from inhaling dispersant vapors at the surface of the water. The DSSEIS recognizes that "[t]he greatest threat to large cetaceans [from a VLOS] would be inhalation of fresh oil toxic hydrocarbon fractions." DSSEIS at 473. It also notes the danger to polar bears of "inhalation or exposure to toxic fumes from cleanup products," DSSEIS at 512, but it does not express similar concern for bowhead whales—which, in contrast to polar bears, cannot breathe from anywhere

[63] NMFS, *supra* note 59, at 343.

but the water to which dispersants would be applied. In addition, Fingas has reviewed recent publications, including some looking at cleanup workers from the Gulf oil spill, and concluded that "tests of inhalation models showed that there might be a concern over human inhalation of dispersant vapors."[64] Although he goes on to note that "the levels of exposures may not be pertinent to at sea applications,"[65] bowhead whales and other cetaceans do not have the option of retreating to the shore like humans do.

In sum, the DSSEIS ignores important new research on the toxicity of dispersants and dispersed oil. It also fails to address significant mechanisms by which dispersants can harm bowhead whales and other Chukchi Sea wildlife.

B. The DSSEIS Insufficiently Analyzes the Impacts of Dispersant Use on Indigenous Communities.

Subsistence hunting by communities along the coast of the Chukchi Sea includes harvesting of whales, seals, walruses, ocean fish, and birds. DSSEIS at 528. Marine species, including marine mammals and fish, make up approximately 60% of a coastal community's diet in this area. DSSEIS at 529. "The ocean is frequently referred to in public testimony as 'the Inupiat garden.'" *Id.* at 339. Several indigenous communities rely on bowhead whales, in particular, for subsistence.

The DSSEIS recognizes that cleanup efforts, ostensibly including dispersant use, can have "a major effect on subsistence harvests and subsistence users, who would suffer impacts on their nutritional and cultural well-being." DSSEIS at 345. A significant contribution to this impact is derived from the problem of perceived contamination, in which subsistence hunters avoid certain prey because the degree of contamination of these animals after an oil spill may be

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64 Fingas, *A Review of Literature*, *supra* note 7, at 28.

65 *Id.*

unknowable. The DSSEIS acknowledges perceived contamination, stating that "[a]n oil spill affecting *any* part of the migration route of the bowhead whale could taint this resource leaving them less desirable and possibly alter or stop the subsistence hunt." DSSEIS at 339, 529 (emphasis added). In addition, the DSSEIS recognizes that "[o]il-spill contamination of subsistence foods, actual or perceived, is a serious concern since traditional foods are the cornerstone of nutrition, culture, and social systems in [Alaskan Native] communities." DSSEIS at 555. However, BOEM does not acknowledge the significance of dispersant use, in particular, on this phenomenon.

By sinking spilled oil into the water column, dispersants increase the probability that marine mammals such as bowhead whales will come into contact with the dispersed oil and that they will consume organisms that have been exposed to chemically dispersed oil. In this way, dispersants aggravate not only the actual contamination of subsistence hunters' target species, but also the perceived contamination.

Mechanical extraction, by definition, removes oil and its harmful chemical components from the environment of aquatic organisms. Though the DSSEIS acknowledges the threat of actual or perceived tainting of indigenous resources like whale meat, it does not analyze the possibility that that the use of dispersants, as opposed to mechanical extraction, can exacerbate such actual or perceived tainting of those resources. Because mechanical extraction could limit the extent of actual or perceived contamination by comparison to dispersant use, the EIS should consider an alternative involving no dispersant use in response to a VLOS.

III. The DSSEIS's Estimated Maximum Length of Time to Drill a Relief Well, and Hence Maximum Size of a VLOS, is Unrealistically Low.

The DSSEIS's analysis of the impacts of a VLOS is premised on the assumption that a spill "would be stopped within 74 days of the initial event." DSSEIS at 421. This estimated period is "the longest of three estimated time periods for completing a relief well" as provided by BSEE's Alaska OCS Regional Office Field Operations. DSSEIS at 421.[66] In particular, this estimate is based on the conclusion that it would take only 30 days to transport a drilling rig across the Pacific Ocean, which could then drill a relief well within an additional 39 days. BOEM considers the 74-day estimate to be both reasonable and conservative given the fact that there are a number of actions that could be employed within that period that could halt the spill sooner. DSSEIS at 428-29. Even if BOEM's conservative estimate were correct, it would allow at least 2.2 million barrels of oil to spill into the pristine waters of the Chukchi Sea. DSSEIS at 420. Worse, the estimate unrealistically ignores the likelihood that a spill that occurs near the end of the drilling season would not be stopped until after the beginning of the following open-water season. The DSSEIS should therefore be revised to reflect a more realistic maximum size for the spill and, as NOAA has proposed, to include as an alternative a lease allowing a shorter drilling season.[67]

A. If a VLOS Occurs Near the End of the Drilling Season, it is Likely to Take Until the Following Open-water Season to Complete a Relief Well.

The "event" that would trigger the VLOS could occur at any time between July 15th and October 31st. If the spill occurred toward the end of this period, then relief operations would have to take place after the end of the open water season, which creates a significant risk that such operations could be delayed or rendered impossible until the following spring. For

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[66] According to the BSEE AKOCSR Field Operations estimates, the time required to drill a relief well and "kill" the discharge following a VLOS at a well is: (1) 39 days if the operator is able to use the original platform and equipment to drill the relief well; (2) 46 days if the operation has to use a second drilling platform and equipment propositioned "in-theater" (within the Chukchi Sea) to drill the relief well; and (3) 74 days if the operation has to use a second drilling platform and equipment from the Northern Hemisphere Pacific Rim to drill the relief well. DSSEIS at 421, table 4-49.

[67] *See* NOAA Comments, ID No. BOEM-2014-0078-0131 (explaining that "[i]n 2012, upon NOAA's request, BSEE required that Shell shorten its drilling season to end on September 23," and that, "[s]ince this practice has already been employed during previous Exploration Plan approval processes, it should be considered as an alternative in the leasing process").

example, if a spill occurred on October 31st, drilling of a relief well would not be expected to begin until mid-December. Weather conditions during this time of the year in the Chukchi Sea could make drilling impossible.

The DSSEIS recognizes the harsh and inhospitable conditions that prevail in the Chukchi Sea at this time of year. "Sea ice generally begins forming in late September or early October, covering most of the Leased Area by mid-November or the beginning of December." DSSEIS at 50.[68] The DSSEIS also recognizes that these conditions could make it harder to complete a relief well, stating that "an operator's ability to complete a relief well during winter months could be compromised by severe weather and cold, ice, darkness, and other factors." DSSEIS at 429.[69] Yet it does not take the next, logically necessary, step of considering what effect these conditions would have on the size of a VLOS. Instead, the scenario anticipates only four days of weather downtime in the entire relief operation. DSSEIS at 421, table 4-49.

If the weather conditions prevent the completion of a relief well, the spill will not be controlled, and the well would continue its spill until the next open water season. If a relief well could not be completed until 39 days after the next open-water season began on July 15th, then the spill would not stop until August 23rd of the following year. Extrapolating from the figures

[68] NOAA modeled the likelihood of freezeup occurring at different times in the Chukchi Sea in 2012, projecting "a 1 in 3 chance of freeze-up at the site by October 28; a 50-50 chance of freeze-up in the November 8 to 12 timeframe; and a 7 in 10 chance freeze-up by November 22." U.S. Dep't of the Interior, Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program 28 (2013). That year, freeze-up occurred on November 1st. *Id.*

[69] The DSSEIS also recognizes that "a large oil spill occurring during the Arctic winter would likely result in more severe impacts to air quality conditions when compared to summer conditions." DSSEIS at 187-88.

included in the DSSEIS, such a spill could result in the discharge of more than 5.2 million barrels of oil—larger than the Deepwater Horizon spill.[70]

B. Shell's Troubled 2012 Drilling Season Evidences the Dangers of Late-Season Operations in the Arctic.

Moreover, one need not merely hypothesize about the problems that would be encountered. Shell Oil's trouble-filled 2012 drilling season amply demonstrates how unrealistically optimistic BOEM's operating assumption is. As the Department of the Interior summarized it, Shell "experienced major problems with its 2012 program . . . . Shell's difficulties have raised serious questions regarding its ability to operate safely and responsibly in the challenging and unpredictable conditions offshore Alaska."[71]

Two incidents are particularly relevant. First, on September 9, 2012, Shell had to suspend drilling at the Burger A drilling site in the Chukchi Sea for two weeks to allow a large ice floe to pass the site.[72] As the Department of Interior review of Shell's 2012 drilling season put it, this incident "highlights the inherently unpredictable nature of working in the Arctic."[73] If ice can cause a two-week delay in drilling in September, it is plainly unreasonable to plan for only four days of weather downtime for drilling that could occur in December and January, when conditions will be much worse.

[70] This analysis assumes that the rate of decline of the oil discharge per day remains at a steady 60 barrels per day (as it is between days 73 and 74 of the model results presented in table 4-48). Given that the model shows that the rate of decline is slowing, this estimate is therefore conservative.

[71] U.S. Dep't of the Interior, Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program 1 (2013).

[72] U.S. Dep't of the Interior, Review of Shell's 2012 Alaska Offshore Oil and Gas Exploration Program 22-23 (2013).

[73] *Id.* at 23. In summing up the 2012 drilling season, Interior concluded that "[i]n submissions to DOI, Shell consistently underestimated the length of time required to complete each step of its drilling operations. The timelines provided by Shell proved to be unrealistic and did not account for complications and delays that should be budgeted for when operating in the Arctic." *Id.*

Second, one of Shell's drilling rigs, the Kulluk, ran aground in stormy seas in December 2012.[74] This incident occurred far south of the Chukchi Sea, in the Gulf of Alaska. If conditions in the Gulf of Alaska are severe enough in December for a drilling rig to break free of its tow ship and run aground, then surely it is unreasonable to base the VLOS analysis on the assumption that a drilling rig can be brought into position much farther north, in the Chukchi Sea, to begin drilling a relief well in mid-December.

C. The DSSEIS Does not Incorporate a Key Lesson of the Deepwater Horizon Disaster: that Relief Operations Can Take much Longer than Expected.

For 87 days, from April 20, 2010 until July 15, 2010, the Macondo well continuously spilled oil into the waters of the Gulf of Mexico, totaling 4.9 million barrels. As part of the response effort, the drilling of two relief wells started on May 2 and May 16 respectively. Even though two drilling rigs were already near at hand, it still took an additional 61 days from the commencement of the drilling of the relief wells for BP to able to stop oil pouring into the Gulf. Furthermore, it was not until September 19, 2010—that is 153 days after the initial triggering "event"—that the well was declared "effectively dead" posing no further threat to the Gulf. Although the DSSEIS assumes improved operations that BOEM and BSEE have mandated since the Deepwater Horizon spill, including the requirement that an operator maintain a second drilling rig nearby, it does not take into account the larger lesson: that when operating in extreme environments, unexpected impediments can—and do—arise.

BOEM's "reasonable and conservative" estimated time required to stop the uncontrolled oil discharge to the Chukchi Sea is actually unrealistic and unreasonable. The Deepwater Horizon disaster showed that real-time response for a large blowout in a well takes more time

[74] *Id.* at 29.

and effort than predicted and the DSSEIS does not consider the hostile Arctic conditions during winter season.

IV. Conclusion

The DSSEIS properly takes into account the possibility of a VLOS in the Chukchi Sea. Although it devotes considerable space to this analysis, the DSSEIS still contains significant gaps. In particular, it is based on an unrealistically low estimate of the maximum spill size, it assumes that dispersants will be an effective oil spill response tool when the evidence does not support that conclusion, and it fails to consider some of the harmful effects of dispersants on wildlife and on the indigenous communities who depend on that wildlife.

Thank you for your consideration of these comments. We welcome the opportunity to discuss this important matter with you at any time. Please direct follow up communications to Shaun Goho, 617-496-5692 (sgoho@law.harvard.edu), or Wendy Jacobs, 617-496-3368 (wjacobs@law.harvard.edu).

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