
From: Hayes, Miriam (Nicole) <mnhayes@blm.gov>
Sent: Thursday, March 14, 2019 8:47 AM
To: Sean Cottle; coastalplainAR
Subject: Fwd: [EXTERNAL] Submission of Comments on the Draft EIS for Oil Leasing in the 1002 Area of the Arctic Refuge
Attachments: 2019.03.13_ArcticRefuge EIS comments_GretaBurkartPhD.docx
Follow Up Flag: Follow up
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----- Forwarded message -----

From: **Greta Burkart** <greta.burkart@gmail.com>
Date: Wed, Mar 13, 2019 at 8:49 PM
Subject: [EXTERNAL] Submission of Comments on the Draft EIS for Oil Leasing in the 1002 Area of the Arctic Refuge
To: <mnhayes@blm.gov>

Hi Nicole,

Please accept my comments (attached) to the BLM on the Draft EIS for Oil Leasing in the 1002 Area of the Arctic Refuge. I will also submit the same document via the BLM E-Planning website.

Thank you!

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As a former arctic aquatic ecologist for the Arctic National Wildlife Refuge who has a PhD and 18 years of experience in Arctic research, I find it very disturbing that this Environmental Impact Statement has so many errors and such an inadequate analysis. The 20-plus pages of comments I have submitted only contain a small portion of the errors in the Water Resources section. The EIS was very difficult to review due to all of the mistakes and the large gaps of information. The analysis section was so vague that I finished reading the entire section and associated appendix without realizing that what I had read was supposed to be the analysis.

The primary purposes of the Arctic Refuge include protecting fish, other aquatic species, and water quality and quantity. The purpose of an EIS is to disclose how resources will be impacted by proposed activities and to provide a scientifically credible analysis that allows for an informed decision to be made. The draft EIS for oil leasing in the Arctic Refuge does not accurately disclose how resources will be impacted by the proposed activities and does not allow for decision makers to make an informed decision when choosing between alternatives. Because there is a lack of accuracy and scientific integrity, the draft EIS does not meet regulations required by the Council for Environmental Quality. The analysis contains numerous mistakes and misinterpretations of existing studies, references sources that have not been peer-reviewed, and draws erroneous conclusions that are unsupported by scientific evidence.

The Council for Environment Quality (1502.24) requires agencies to ensure professional and scientific integrity of the discussions and analyses and the agencies must identify methodologies used and must make explicit references to the scientific and other sources relied upon. The water resources section makes erroneous and unreferenced statements, provides incorrect references, lacks a science-based analysis, and fails to raise information critical to describing the existing baseline and data about impact stressors upon which to assess environmental consequences under each alternative. The EIS authors lack of specific expertise about the unique features of Arctic Refuge 1002 Area has resulted in inadequate and inaccurate description of its water resources and how these ecosystems function. Without this basic understanding, they have not been able to create a scientifically credible account of the existing condition of water resources or an analysis of the impacts of oil activities and infrastructure on the condition of these resources.

Examples of errors and serious omissions:

- The following sentence is on page 3-53: "By the end of the winter season, the volume of liquid water in these lakes has been estimated to be reduced by 98 percent (Craig 1989)." This statement is incorrect. Craig 1989 estimates a 95% reduction in the volume of liquid water in streams not a 98% reduction for lakes. See the following excerpt from Craig 1989: "winter freezing reduces stream habitat available to fish by 95 percent." For a discussion of winter water availability in the largest lakes in the 1002 Area, reference Trawicki et 1991 or Lyons and Trawicki 1994. These reports document the most comprehensive studies of overwintering water availability in the 1002 Area of the Refuge.
- The following sentence references Jorgenson et al 2008: "...usable groundwater is limited to distinct and unconnected shallow zones in the thaw bulbs of rivers and lakes, due to the presence of permafrost, which is continuous across the North Slope (Jorgenson et al. 2008)." This sentence implies that Jorgenson et al 2008 states that groundwater is limited to distinct and unconnected shallow zones in the thaw bulbs of rivers and lakes; however, this statement cannot be attributed to Jorgenson et al 2008.
- The latter part of the same paragraph states that "shallow groundwater zones do exist, they are typically very small and are likely to have similar water quality as the rivers and lakes nearby (BLM 2004, Section 3.2.2.1)." This statement is not supported by the information in BLM 2004, Section 3.2.2.1.
- Fecal contamination from wildlife -- Excerpt from Affected Environment Water Resources/ Water Quality "Most freshwater systems in the program area are pristine; however, fecal contamination above State of Alaska water quality standards may occur in areas with dense avian, caribou, and lemming populations. Cold water temperatures tend to prolong the viability of fecal coliform." If these sentences are going to be in the EIS they need a reference. I am not aware of any fecal contaminant monitoring that has taken

place in the Arctic Refuge 1002 Area, so I am not sure what the reference for these sentences would be. Additionally, I am not sure why they have even been included in the EIS for oil leasing in the Arctic Refuge 1002 Area, especially since there is much more relevant information that has been excluded from the water resources section. I am pretty sure these sentences were just copied from another EIS or report. Including them here is kind of strange given that caribou have been using the 1002 Area as the sacred calving ground for AT LEAST 12,000 years – I would hardly call their poop contamination. If anything, it is probably an important part of the microbial food web in the area.

- The following statement is in the EIS but is unreferenced and incorrect: “Most freshwater bodies in the program area have low turbidity and dissolved oxygen near saturation”. I am not sure where this reference is from, but during winter, dissolved oxygen tends to be far below saturation. It is obvious that a thorough review of Refuge literature was not performed for the EIS. The EIS should reference some of the water quality work that has been conducted in the Refuge. The EIS authors should be given time to review the available reports and data so they are not limited to copying and pasting sentences from EIS’s written for areas hundreds of miles away in the NPRA. See Snyder Conn and Lubinski 1999 for summer water quality data for 35 lakes in the 1002 Area. Other studies in the 1002 Area indicate that winter dissolved oxygen is not near saturation during winter in the Refuge.
- The following statement about winter water quality is in the EIS but cannot be attributed to the reference or the 1002 Area: “Lakes in the program area generally have lower pH and alkalinity values that slowly increase in the winter; this reflects the ice exclusion process, which occurs during freeze-up (Trawicki et al. 1991)”. Trawicki et al. 1991 does not measure or even mention alkalinity and pH, but does reference others with regard to winter water quality of arctic lakes: “Clough et al.(1987), Sloan {1987), and Wilson et al. (1977) reported that as ice thickness increases, there is an increase in the concentrations of dissolved ions and organic matter, and that dissolved oxygen concentrations are depressed due to the lack of aeration and limited photosynthesis during winter months.”
- The entire third paragraph on flooding of North Slope Rivers (page 3-52), has no references and suggests that snowmelt and summer precipitation are the only causes of flooding. Again, the Arctic Refuge 1002 Area is very different than areas in the NPR-A and other North Slope areas. Compared to the developed areas in the NPRA, the 1002 Area is very close to the highest peaks in the Brooks Range (and Sadlerochit mountains), the terrain is steeper, groundwater springs and aufeis are very important hydrologic features, glaciers are an important source of river flow, and rivers a flow a relatively short distance to the coast. These factors play a very important role in flooding in the 1002 Area. The incredibly wide extent, magnitude, and natural variability in aufeis-caused flooding is evident in satellite imagery and USGS hydrology data. The importance of glacier-related flooding is evident in USGS datasets, Nolan et al 2011, etc... These unique qualities of the Arctic Refuge will have an important influence on how the 1002 Area is impacted by oil and gas activity, whether required operating procedures in the NPRA will be effective at protecting the primary purposes of the Refuge, and how impacts may vary between different alternatives.
- Page 3-54 states the salinity of lagoons, but no units are given, so the numbers are meaningless. There is no reference for this statement, so it is not possible to know where the information came from. This same sentence mentions the amplitude of the tides, but the authors should also note the wind-driven changes in lagoon water level, which tend to be far more important than changes in tide and will have a much greater influence on oil spill dispersion into the environment and the difficulty of cleaning up oil spills in nearshore marine areas frequented by polar bears and millions of birds.
- The analysis of impacts to water resources in the Arctic Refuge does not use ANY of the water resources data collected in the 1002 Area of the Refuge (see U.S. Fish and Wildlife Service reports by Trawicki et 1991, Lyons and Trawicki 1994, and dozens of other reports by the USFWS and others). Not only does the

analysis not include water resource data from the 1002 Area, it does not include ANY data what so ever from anywhere. The analysis section is a vague compilation of disorganized and mostly unreferenced statements that don't even come close to providing a coherent qualitative analysis before the authors assume impacts to the 1002 Area of the Arctic refuge will be no different than those described in the existing Environmental Impact Statements for areas in the National Petroleum Reserve- Alaska (2004, 2012, 2018). See below for multiple problems with the approach to the analysis in the EIS for the 1002 Area of the Arctic Refuge:

- Not using any data at all (not even the readily available national hydrography dataset), does not provide adequate information to evaluate impacts of the various alternatives B – D, other minimal leasing alternatives (e.g., a maximum of two 400,000-acre leases), or management practices (e.g. Required Operating Procedures (ROPs) and stipulations) that may avoid or reduce impacts to water resources. The resulting analysis section does not allow us to make an informed choice between the alternatives. It does not account for realistic estimates of water use for these alternatives or the estimates of the hydrologic impacts expected under different alternatives. There are no analyses of the differences in the means of obtaining water even though it is obvious that the means will have to vary for different alternatives due to the highly uneven distribution of water in areas considered for leasing and surface occupancy under each alternative. There is no accounting for the overall impacts under each alternative given the vulnerability of water resources in the different areas considered for leasing and surface occupancy.
- The existing EIS's for the National Petroleum Reserve have not been peer-reviewed and studies referenced in them lack any statistical analyses, lack statistical inference to other waterbodies, have not assessed impacts to aquatic invertebrates and birds (as requested by the NRC 2003), contain misinterpreted data and have almost no ability to detect change due to small sample sizes and high variability. For example, studies on the impacts of water pumping were conducted on man-made gravel pits and deep lakes that were chosen as studies sites for their usefulness as water pumping sources (see NPRA EIS 2004 which states the following regarding selection of lakes for water withdrawal studies: "selected as study lakes for the Alpine Lakes Recharge Study because they are typical of lakes suitable for water supply lakes in the Alpine Development Project Area..."). These studies cannot be applied to the mostly small shallow and typically isolated lakes in the Arctic Refuge. To assess the applicability of these studies to the Arctic Refuge, the authors of the current EIS would have to understand the differences between waterbodies in the NPRA and the 1002 Area of the Arctic Refuge and they would need to adequately review these mostly oil-company funded NPRA studies and assess the statistical ability to detect change, statistical area of inference, etc. This has not been done and will require extensive knowledge of rationale for site selection, an advanced understanding of characteristics of aquatic ecosystems in the Arctic Refuge and a firm grasp on statistical inference, change detection and scientific integrity.
- The water resources analysis section of the EIS for the 1002 Area of the Arctic refuge states that there is "potential to reclaim gravel mines into water reservoirs suitable to support fish and wildlife habitats and potential water resources for further water use needs, if the gravel mines are near waterways (BLM 2004)". They fail to mention the watershed-scale impacts that river-connected gravel mining pits will likely have on the natural diversity of fish populations, the outcome of competition between species, and the naturally occurring nutrient, thermal, and flooding regimes that support naturally occurring populations of fish and wildlife. These impacts are not considered in the water resources or fisheries section of this EIS but would be significant at a watershed scale and last for hundreds of years beyond oil development.
- The water resources analysis refers to ROPs and in some cases assumes they will fully mitigate for impacts when scientific evidence of this is lacking. The effectiveness of proposed stipulations and required operating procedures to protect water resources in the Arctic Refuge are based on ROPs in place in the NPR-A. The effectiveness of these stipulations has

never been tested with scientifically-sound studies in the NPRA. There is even less known about how effective these ROPs would be in the Arctic Refuge 1002 Area.

- The draft EIS notes that estimates of water use have been presented in the literature (e.g. See NRC 2003 estimates of water use by Conoco to be ¼ of a billion gallons per year), but the EIS does not present any projected water use estimates in the EIS. It is only noted that “project-specific” estimates would be more accurate. By not including these published estimates of total estimated water use, it is even more difficult for the public to grasp the magnitude and severity of water withdrawal impacts in the 1002 Area of the Arctic Refuge. Also, not included in the analysis are the best available data for estimating winter water availability in the Arctic Refuge 1002 Area (See Trawicki reports from the 1990s).
- The analysis of impacts to water availability in the Arctic Refuge does not take into account data indicating that water availability in the 1002 Area of the Refuge is less than 10% of that in the NPR-A. According to the National Research Council, one oil company alone uses a ¼ of a billion gallons of water per year to support oil production in the NPR-A. Studies in the Arctic Refuge indicate the entire volume of water available during winter may only be a billion gallons. Thus, the scarcity of water in the Arctic Refuge’s 1002 Area will likely lead to much greater impacts on the limited water resources as oil companies extract large volumes of water to meet their needs in an area where water is so scarce. The draft EIS analysis section only mentions impacts of a small portion of the water withdrawals (those related to ice-road infrastructure) and states that “under all action alternatives, no potential long-term impacts on lakes and ponds are anticipated...”. This statement is unsupported and will not likely be the case for the following reasons:
 - The proportion of water removed in the Arctic Refuge will likely be ten times higher than the proportion currently removed in the NPRA where only a small fraction of the permitted volume is used.
 - Compared to lakes in the NPRA, lakes in the 1002 Area of the Refuge tend to be shallower. Lake depth is a major factor determining late winter dissolved oxygen concentrations (Leppi et al 2017) indicating lakes in the Arctic Refuge 1002 Area will be more sensitive to water pumping.
 - Isolated lakes may not recharge following snowmelt after pumping.
 - It cannot be assumed that water will be recharged during snowmelt because of stipulations in place. Adequate recharge depends on several factors including connectivity, watershed area and snow water equivalent. Many isolated lakes in small watersheds have very limited recharge capacity and may not be fully recharged during snowmelt after water withdrawal, especially during low snow years. For more information on “recharge vulnerable” lakes in the NPRA see figure 6 in Jones et al 2017 (A lake-centric geospatial database to guide research and inform management decisions in an Arctic watershed in northern Alaska experiencing climate and land-use changes. *Ambio*. Volume 46). More than 50% of the lakes presented in this study are considered recharge vulnerable. An even greater proportion of the lakes in the 1002 Area of the Arctic Refuge are likely recharge vulnerable.
 - Compared to withdrawals in the NPRA, in the 1002 Area of the Arctic Refuge it can be expected that repeated withdrawals at much greater withdrawal proportions on a much greater proportion of the lakes in the area will occur. Because lakes in this area likely have marginal dissolved oxygen concentrations due to their relatively shallow depths, we expect greater impacts to physical, chemical, and biological properties of these lakes. These lakes may be more isolated and sensitive to pumping when compared to NPRA lakes. Repeated changes in lake levels that don’t recharge at snowmelt could lead to long-term changes in littoral zones, biota, chemistry, etc. Due to the uneven distribution of lakes across the 1002 Area, there will be differences in the overall impacts under different scenarios. Furthermore,

the rarity of lakes in some areas may warrant special protections to ensure that not every lake in a watershed is not impacted.

- According to the Council for Environmental Quality, agencies shall make it clear when information is incomplete or unavailable or obtain this information when feasible (i.e., the means to obtain it are known and the costs of obtaining it are not exorbitant) and considered necessary for evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement. Simply tiering off to the NPRA EIS's analysis of oil impacts on an area hundreds of miles from the 1002 Area is not acceptable. In February of 2018, the USFWS, USGS, BLM staff and others created Resource Assessments for Water Resources and other resources in the 1002 Area of the Refuge. These assessments were written and reviewed by subject matter experts and include regulatory management decisions that may need to be made, knowledge gaps, and recommended studies or actions to fill knowledge gaps or improve the best available science that will be necessary to inform NEPA processes, etc. These assessments indicate that tiering off to existing NPRA EIS's is not appropriate. The data gaps noted in these assessments should be filled to provide information necessary to complete a credible scientific analysis of the impacts of each alternative in the EIS for the 1002 Area. None of this information was presented in the EIS for the 1002 Area.

Based on the major errors and omissions, the major impacts to water resources likely to result from all the action alternatives and the lack of scientifically credible analysis, I urge you to obtain necessary information and start over with a new draft EIS and have a new public review. Please see my additional comments on the Draft EIS for the 1002 Area of the Arctic Refuge below. These comments include additional errors, recommendations for changes, and a list of some of the studies necessary to conduct an adequate analysis of impacts.

Sincerely,

Greta Burkart PhD

Please see additional comments below:

Page	Section/Description	Comments
Cover	Photo and associate text on the next page	The cover photo should also show polar bears, caribou or other iconic wildlife that will be impacted by oil leasing. Furthermore, the text describing this photo is inaccurate. There are no oil seeps in the photo, but I do see vegetation that has been scoured by aufeis, iron rich sediment, and a typical tannic colored tributary flowing into the spring-fed Sadlerochit River, a spring-fed river that hosts an endemic population of Dolly Varden and is ranked highest for the importance of its cultural resources. Perhaps the tannic tributary has been mistaken for an oil seep. If the seeps are along the coast they are most certainly not in the photo. If this photo is used be sure to mention the importance of this special spring-fed river and the phenomenal wildlife that it supports and the cultural significance that it has. For more information see the Wild River review in the Arctic Refuge Comprehensive Conservation Plan (2015, USFWS)
	Water Resources Section	The following must be understood before developing a plan to tier off to the BLM NPRA EIS's and use of their stipulations: <ul style="list-style-type: none"> ● The Alaska National Interest Lands Conservation Act (ANILCA) explicitly directs the U.S. Fish and Wildlife Service to ensure water quality and quantity for the conservation of the natural diversity of fish, wildlife and their habitats: <ul style="list-style-type: none"> (i) <i>to conserve fish and wildlife populations and habitats in their natural diversity.....</i> (iv) <i>to ensure, to the maximum extent practicable and in a manner consistent with the purposes set forth in paragraph (i), water quality and necessary water quantity within the refuge.</i>

		<ul style="list-style-type: none"> There must be adequate data for an evaluation of the efficacy, applicability and transferability of BMPs, permit stipulations and mitigation measures used in the NPR-A for use on the coastal plain, 1002 area (per National Research Council (NRC) 2003) for all phases of industrial activity (seismic, exploration, development, restoration). This evaluation must recognize and understand the implications of the stark hydrologic, soil, and topographic differences between the coastal plain, 1002 area and areas in the NPRA with ongoing development: <ul style="list-style-type: none"> Water covers 20.2% of the developed area in NPR-A, but only 1.6% of the coastal plain, 1002 area where large expanses of land are nearly devoid of lakes (figure 1). Most lakes in the coastal plain, 1002 area are isolated from major drainages with limited recharge and may be more vulnerable to water withdrawals. Most flowing waters in the coastal plain, 1002 area are alluvial mountain streams. Groundwater-fed springs are unique to the coastal plain, 1002 area and provide critical habitat for extraordinarily high concentrations of invertebrates and overwintering fish. The relatively steep terrain and lack of water in the coastal plain, 1002 area will make it necessary to employ alternative untested practices. Differences in vegetation, soil and permafrost in the 1002 Area may make the 1002 Area more sensitive to water quality impacts compared to developed areas in the NPRA.
	General comment on entire document	<p>Government workers who interact with the oil companies say that unless it is included as a stipulation in the EIS it is not going to happen. That is why it scares me that the BLM and others have repeatedly called the EIS for the Arctic Refuge 1002 Area a "paper exercise". What is needed is long-term planning that will protect threatened and endangered species and Refuge purposes. This long-term planning effort needs to be based on sound science to allow input from a well-informed public. This Environmental Impact Statement is a mess and clearly lacks credible science. The mistakes and tiered-off references to documents that also lack scientific credibility show how little effort has been put forward into a rushed environmental impact statement that will determine the fate of one of the World's most precious ecosystems. If this is just a paper exercise, the BLM needs to give the public some idea of how likely it is that additional stipulations or other protections will be added later as part of an adaptive management plan. If there is to be an adaptive management plan, it should be specified what actual statistically relevant monitoring will occur and what</p>

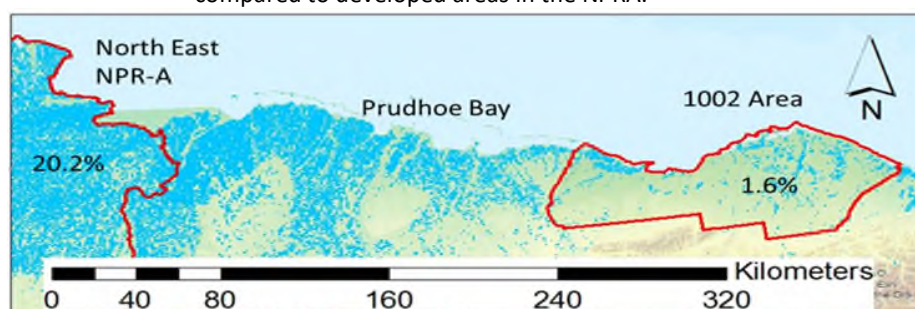


Figure 1. Surface water extent in the coastal plain, 1002 area and north eastern NPR-A planning area.

		level of impact will monitoring be able to detect because without this information adaptive management is not really possible.
	General comment on entire document, including alternatives, appendix B and water resources section	An alternative that considers a maximum of two 400,000-acre leases should be considered.
	General comment on entire document, including alternatives, appendix B and water resources section	Assuming the maximum allowable surface disturbance in the tax act will be the surface disturbance is not logical if there are efforts to minimize impacts. It does not make sense that 200,000 acres of disturbed area (plus of 305 +/- 5 acres of disturbed areas due to gravel mining) would occur in all action alternatives. While congress may have made this a maximum level of surface disturbance, it was not defined as minimum level of disturbance. If there is a responsible attempt to reduce impacts, it does not make sense 200,000 acres of surface disturbance would occur under all alternatives. For example, it does not make sense that 200,000 acres of disturbance would be necessary when the area available for leasing is not as sprawling as it is in other options. To minimize unnecessary impacts due to unnecessary surface disturbance, an analysis should be conducted to determine what acreage of surface disturbance is actually necessary under each action alternatives.
	General comment on entire document, including alternatives, appendix B and water Resources section	Transportation infrastructure and material requirements will vary between alternatives if there really are efforts to minimize surface disturbance in each action alternative. It does not make sense to assume that the same level of surface disturbance (200,000 acres of surface disturbance plus 308-315 acres of gravel mining-related surface disturbance) will occur under each alternative. For example, one alternative involves no surface occupancy and no leasing in a substantial area and another alternative involves surface occupancy and leasing across a much broader sprawling area which would require more roads and material sources. The comparison of alternatives should attempt to include an accurate estimate of surface disturbance and infrastructure acreage as they will both have substantial long-term impacts to hydrology and water quality, vegetation, soils, etc. Appendix B and analyses of resources impacted by surface disturbance and infrastructure should use these estimates when assessing impacts.
	Water Resources (and relationship to permafrost and soils sections)	In the Arctic water quality and quantity are tightly linked to soil type, vegetation and the presence of permafrost/ice. A lack of adequate mapping and analysis of surficial geology and permafrost/ice makes it impossible to adequately evaluate how impacts on water resources will vary among alternatives. An adequate analysis must include the sensitivity of the landscape to the development throughout the 1002 Area. This information must be coupled with more accurate estimates of development using the best available data on where development will most likely occur based on the best available data on probability of oil yields.
	Water Resources and Fisheries Sections	The water resources and fisheries sections totally underplay the potential impacts of ice roads and ice bridges on flooding and fish migration. These flooding events could have major impacts on fish populations, recharge of river flood plains and infrastructure and could increase the probability of hazardous spills. The cause of the major 2015 flooding event along the Sagavanirktok was likely caused by ice road activity associated with seismic work (Shur et al. 2016). This massive flooding event occurred despite industry efforts to remove ice bridges. Furthermore, in 2018 BLM staff working in the NPRA stated that stipulations for removal of ice bridges may not be effective in the Arctic Refuge and that site-specific surveys were necessary. Yet, the

		draft EIS for the 1002 Area has the same NPRA stipulation for removal of ice bridges and does not include requirements for site-specific analyses or follow-up monitoring.
3-50 (and other pages that use or propose estimates of gravel material needs)	Sand and Gravel Resources Appendix B Vegetation Water Resources Soils	Realistic forecasting of gravel material needs and a cap on gravel removal and surface area disturbance is necessary to fully understand the potential impacts to vegetation, soils, water, fish, recreation, etc under different alternatives. The analysis presented in appendix B is unreasonably crude and does not provide adequate information.
	Contaminants section Water Resources Section All other sections that refer to oil spills (or hazardous waste spills) as improbable, having little impact, easily dealt with at a local scale, and/or short-term.	<p>The section on hazardous spills really downplays spills as if just because a 10,000-gallon spill does not occur every day, they are nothing to worry about. There HAVE been North Slope oil spills that are greater than 10,000 gallons and they HAVE occurred with the new advanced technology. They may not happen every day, but they do happen. The Arctic Refuge 1002 Area is a sensitive environment that supports millions of migratory birds, endangered polar bears, important cultural activities, and subsistence resources. There is no guarantee that these resources and activities will not be seriously impacted in the long-term because 10,000-gallon spills are not occurring on a daily basis. Oil spills are not easy to clean up and some spills are much more difficult to clean up than others. There is no guarantee that there will be money to clean up spills. The water resources section indicates that spills in near-shore marine areas will only be local and short-term. Unless the spill is on soil and you can extract and remove it all from the Refuge, spills are not easy to clean up and are not short-term. The Exxon Valdez was a spill that had a low probability of occurring, yet it's severe long-term impacts on fish, wildlife, and humans is still evident today.</p> <p>The potential severity and any probability of occurrence is great enough that we need far better information on sensitive areas and species and a far better idea of the extent of impacts than what we have now. I have spent the day walking on a beautiful glacier-fed river delta that feeds into a lagoon protected by the barrier islands of the 1002 Area – I was surrounded by thousands of birds and saw at least a dozen polar bears. These bears swim across the lagoon regularly. A spill in an area like this would be tragic. The 1002 Area of the Arctic Refuge's 1002 Area is full of amazing and fragile habitats like this. It is hard to define areas like these without studies and there has not been time or money to do a systematic assessment of sensitive or unique habitats in the Arctic Refuge's 1002 Area.</p>
3-50 (and other pages that use or propose estimates of gravel material needs)	Sand and Gravel Resources Appendix B Vegetation Water Resources Soils	To properly evaluate alternatives and consider the need for stipulations and ROPs, a much more rigorous analysis of gravel material needs, and potential source locations is required. The currently analysis stems from Appendix B, which involves an extremely crude analysis that one might think was done in five minutes on the back of an envelope. More accurate estimates are also critical for evaluating impacts of gravel mining to water resources, vegetation, soils, fish, recreation, etc under all alternatives. Given the widespread importance and implications, a much more meaningful analysis should be conducted. Also, make a map of potential gravel mining sites under all alternatives. This is particularly important to illustrate that the current No Surface Occupancy stipulations allow for gravel removal which is likely one of the most destructive and irreparable oil-development related activities.
	Water Resources, fisheries, and all the other sections	A picture really can be worth a thousand words. I know there are space and time limitations that make it difficult to read, synthesize, and convey information on such a complex document, but it really is important to be accurate and present a relevant

	that are not adequately conveying information and lack scientific integrity	<p>analysis. The 1002 Area of the Arctic National Wildlife Refuge is a special place home to amazing wildlife and is treasured at local, national, and global scales. Please, start using diagrams and pictures so that readers can better grasp topics.</p> <p>Also check for references – are they there, accurate and specific enough for someone to unravel what needs to be said for an adequate view of the status of resources and an impact analysis of the alternatives or will they leave people scratching their heads wondering what if that was actually the analysis? I know getting references correct is a basic scientific integrity thing – I am not trying to be condescending, but I do need to point out the gross degree to which scientific integrity is lacking because there is something very wrong with this process and it needs to be fixed because this Environmental Impact Statement should not be taken so lightly. I know that these authors would do a much better job given adequate time and guidance from subject matter experts with experience working in the 1002 Area.</p>
	Water Resources Section (and any other sections with analyses that are so vague you are not even sure what the outcome of the analysis is or how it came about)	In the analyses, be specific. For most of the direct and indirect analyses in the water resources section, I can't tell what the analysis is, what it is supported by and/or what the magnitude and duration of the effects are for each impact indicator. I am extremely knowledgeable, but I am really having a hard time figuring what the analysis was and what the reported outcome is.
	Water Resources Section	GMT SEIS provided readers with proposed plans for bridges and pipeline access road routes. The EIS for oil leasing in the Arctic Refuge does not have similar information that would allow readers to better assess potential impacts of development. Omissions such as this make it impossible to adequately evaluate impacts and effectiveness of mitigation strategies in a landscape that is very different from those in the NPRA.
	Water Resources Section (reference to NPRA EIS')	Residual risk after application of mitigation strategies must be clarified -- > To properly assess residual risk, there is a need verify that mitigation strategies are effective. Verification of the effectiveness of mitigation strategies is largely absent for the stipulations that the GMT2 SEIS claims will "largely" mitigate for all impacts to marine and freshwater fishes. There is no evidence from statistically valid studies that documents the effectiveness of these studies, so tiering-off to these NPRA documents really does not provide with an adequate impact analysis for the Arctic Refuge 1002 Area.
	Water Resources Section	<p>The purpose of tiering is to "tier off their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review" (CEQ, 40 CFR 1500-1508 Subsection 1502.20). Tiering is not appropriate when tiered discussions are not relevant and a new analysis is warranted. In many cases tiering is inappropriate due to the differences between the Arctic refuge 1002 Area and the NPRA. In other cases tiering is not appropriate because the analyses or in the tiered-to documents are flawed and have not been peer-reviewed by subject matter experts. In many cases of tiering, it is not at all clear what part of which document is even be tiered to.</p> <p>The analysis of effects simply tiers to NPRA EIS' and does not consider or even present the best available datasets that could be useful for analysis of the impacts in the Arctic Refuge 1002 Area. These datasets include Trawicki et al 1991 and 1994, which provide the most comprehensive water quantity dataset and include water quantity estimates</p>

		<p>for almost the entire surface area of lakes and covers the vast majority of major river miles.</p> <p>The only potential changes to groundwater considered in the analysis is the impact expected to occur to shallow suprapermafrost groundwater related to gravel mining. Gravel mining is not the only activity expected to impact groundwater and shallow suprapermafrost groundwater is not the only type of groundwater that may be impacted. Every aspect of infrastructure associated with oil and gas activities is expected to influence shallow suprapermafrost groundwater in the vicinity of infrastructure. Oil exploration, drilling, and injection of hazardous wastes into the ground has great potential for contamination of the deep groundwater flowpaths that support the springs that are so important to the unique aquatic and terrestrial communities in the Refuge's 1002 Area and the associated subsistence activities. These springs are not prevalent in the NPRA and there are no supporting data to indicate groundwater in the NPRA has not been contaminated; thus, tiering off to an NPRA EIS for this analysis is not appropriate.</p>
	Water Resources Section continued	<p>In the "Groundwater Springs and Aufeis" section of the Affected Water Resources Environment Environment Section (paragraph 3 of page 3-53), the importance and uniqueness of springs in the Arctic Refuge are mentioned. This section, however, does not mention that these perennial springs are freshwater and are fed by deep groundwater sources. These attributes of deep groundwater springs are particularly noteworthy given that in the NPRA EIS's it is assumed that deep subsurface injections of hazardous wastes will not impact any deep freshwater resources because deep water aquifers in the NPRA are thought to be highly saline and do not emerge at the surface to create perennial freshwater springs. In the Arctic Refuge Coastal Plain, however, there is much greater potential to contaminate. Yet the potential for contamination is not mentioned in the analysis here or elsewhere.</p> <p>Second paragraph in the groundwater section in the ARCP EIS that states that suprapermafrost groundwater zones "have similar water quality to lakes and streams nearby (BLM 2004, Section 3.2.2.1)." This statement is not supported by the information in BLM 2004, Section 3.2.2.1. Furthermore, ongoing suprapermafrost groundwater studies in the 1002 Area indicate the chemical composition of suprapermafrost groundwater in some areas is very different than that of nearby surface water bodies.</p> <p>More than 60% of the second paragraph of the groundwater section has been copied directly from NPR-A 2004 EIS (BLM 2004) and should be updated to information that is more current that reflects the importance of groundwater in the Arctic Refuge Coastal Plain.</p> <p>The Environmental Impact Statement for Drilling in the Arctic Refuge's 1002 Area should be taken more seriously. The contractors pulling information together for the public to review should be given adequate time to provide the public with the best available information that is relevant to the Arctic Refuge. Copying 60% of the material from an Environmental Impact Statement written for oil leasing on a different landscape that is hundreds of miles away from the Arctic Refuge's 1002 Area is unacceptable and shows disregard for the Arctic Refuge 1002 Area and the American Public who have fought tirelessly for decades to protect the amazing habitat and wildlife found in the 1002 Area.</p>
	Entire Document and the section	<p>Can it really be said that this document was prepared in cooperation with the US Fish and Wildlife Service when USFWS employees are shocked by the lack of scientific</p>

	that lists cooperators.	integrity in this document? Neither USGS or USFWS were on the interdisciplinary planning team and neither were involved in writing this document. At the very least the public should know that the USFWS and USGS were not involved in writing this document – this should be clearly stated in the section that lists cooperators.
	<p>Stipulations</p> <p>AND</p> <p>Appendix B</p>	<p>Currently the BLM does not consider gravel mining sites and other major disturbances associated with oil development and production to be part of the cap on development in the 1002 Area. These areas should be considered in the development cap and the overall footprint of oil development and any subsequent analyses.</p> <p>Rehabilitation standards must be written into the leasing stipulations, especially pertaining to all gravel sources used on a lease, and also for all infrastructure used to support oil and gas activities. The rehabilitation should be to restore to the original condition, including natural diversity of plant species and populations, water quality, etc.</p> <p>The lack of adequate restoration plans and adequate bonds to cover reclamation of areas impacted by oil and gas development on the North Slope is a major problem (2003 NRC report, Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)).</p> <p>According to the NRC (2003, page 158): “...only about 1% of the habitat affected by gravel fill on the North Slope has been restored. Other than for well plugging and abandonment procedures, state, federal, and local agencies have largely deferred decisions about the nature and extent of restoration. The lack of clear performance criteria, standards, and monitoring methods at the state and federal level to govern the extent and timing of restoration has hampered progress in restoring disturbed sites. If restoration would make potential future use of a site more expensive or perhaps impossible, restoration is likely to be deferred.”</p> <p>The NRC (2003, page 150) states the following: “Because the obligation to restore abandoned sites is unclear and the financial resources to do so are so uncertain, the committee judges it likely that, absent a change in those constraints, most of the disturbed North Slope habitat will never be rehabilitated or restored.”</p> <p>Appendix B of the draft EIS states that after rehabilitation of areas, these areas will no longer be considered as part of the cap on infrastructure. If the area is not restored to the original condition, including natural diversity of plant species and populations, water quality, etc, it should not be released from the cap. Currently there are no stipulations requiring what level of restoration will be required for an area to be released from the cap.</p> <p>To disclose impacts accurately and to help ensure protection of the purposes of the Arctic NWR, restoration standards must be included set in stipulations in the draft EIS for oil leasing in the 1002 Area. The EIS must clearly state what level of restoration will be required before land is no longer considered part of the infrastructure development cap. To avoid the issues noted by NRC (2003) and protect Refuge purposes, a restoration plan that include details on the level of restoration required and the expected cost of the restoration must be required and reviewed prior to issuing a lease in the 1002 Area. The oil companies must pay bonds consistent with restoration cost estimates prior to permitting.</p>

	Stipulations	A major problem with oil development on the North Slope has been the lack of data to assess what the cumulative impacts of oil and gas development are (see National Research Council Report, Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)). Standards for effectiveness monitoring need to be defined in stipulations or there needs to be a stipulation that includes development of an effectiveness monitoring plan (and centralized publicly accessible database) that would be prepared in consultation with the USFWS and implemented by lessee/operator/contractor. At a minimum the following requirement should be met for all effectiveness monitoring programs: statistically valid sampling designs with clearly defined levels of inference and change detection capabilities. Without a properly designed long-term effectiveness monitoring program and publicly accessible database, there is no way to detect impacts and employ adaptive management techniques. When pre-development monitoring will not occur, general methods for selecting control sites using a statistically valid approach is necessary. Requirements for a research and monitoring program need to be clearly defined in this EIS.
	Stipulations that include No surface Occupancy to protect water resources	No surface occupancy needs to pertain to gravel mining, drilling, reinjection of hazardous wastes as well. Gravel mines impact physical, chemical, and biological properties of water resources in perpetuity. Drilling and reinjection of hazardous wastes endanger aquatic ecosystems, especially groundwater ecosystems and should not be permitted in NSO areas because of the special resources in these areas.
2-4	Lease Stipulation I	The objectives for alternative B and C should be the same as that for alternative D (e.g. include recreation and hunting) and should include wilderness and scenic values important for recreation. Maintaining recreational value supports the National Wildlife Refuge Improvement Act.
2-4	Lease Stipulation I	To meet the objective and protect Refuge purposes, gravel mining sites cannot be in the NSO. Gravel mining disturbs flow paths, water quality, and can alter the natural diversity of fisheries by altering competitive balance and predator prey relationships. It would not be possible to meet his objective if gravel mining is allowed in the NSO areas.
2-4	Lease Stipulation 1	<p>River setbacks are not adequate to allow for continuation of the primary purposes of the Refuge. The following are exceptional rivers with exceptional fisheries, recreation, subsistence, cultural, or other values:</p> <ul style="list-style-type: none"> • The Hulahula should have a 4-mile setback under all alternatives to protect its values and purposes. It provides the most important winter subsistence fishery in the 1002 Area. It is also an important recreational river and recommended Wild River (Arctic Refuge CCP 2015). • The Canning River should have a 3-mile setback to protect the important fisheries, recreation and cultural values of this eligible Wild River. For more information see Arctic Refuge CCP 2015. • The Aichillik River, which flows along the Wilderness boundary, should have at least a 3-mile setback under all alternatives to protect its important Wilderness and recreational value. For more information see Arctic Refuge CCP 2015. • The Sadlerochit River and Itkilyariak Creek Spring -complex should have a 3-mile setback in all alternatives due to its cultural significance and unique terrestrial and aquatic communities. The Sadlerochit River and Itkilyariak Creek Spring -complex has a unique endemic population of dwarf Dolly Varden and is also an important subsistence use area. For more information see Arctic Refuge CCP 2015.

		<ul style="list-style-type: none"> The Jago and Okpilak Rivers should have 2-mile setbacks in alternative B and C and 3-mile setbacks in Alternatives D to protect their outstanding resource values. For more information see Arctic Refuge CCP 2015. Spring-fed rivers are the most unique and productive habitats in the Refuge. In alternatives B and C, they should have a minimum setback of 1-mile. In alternative D they should have a minimum setback distance of 2-miles.
2-5	Lease Stipulation 2 (alternatives B and C)	Alternative B and C (Lease stipulation 2) should require setback distances for the Canning Area lakes because of their special values and to help meet the objective of Stipulation 2.
2-6	Lease Stipulation 3, Alternative B and C	Spring-fed river systems are the most important, productive and unique aquatic habitats in the Refuge. In addition, they provide benefits to terrestrial wildlife and subsistence users. Alternatives B, and C should have the same requirements as Alternative D.
2-6	Lease Stipulation 3, Alternative B/C/D	The standard requiring studies prior to drilling should “ensure drilling or injection of wastes will not alter the natural flow or impair the water quality of perennial springs”
2-6	Lease Stipulation 3, Alternative B/C/D	The perennial springs that feed Itkilyariak Creek are part of the Sadlerochit Spring system. All alternatives should include protection of the entire Itkilyariak-Sadlerochit spring system.
2-6	Lease Stipulation 3, Alternative B/C/D	No surface occupancy needs to prohibit gravel extraction. Gravel mining would alter ground and surface water flow and impact the natural fish diversity.
2-6	Lease Stipulation 3, Alternative B/C/D	In areas where no leasing is allowed, the following should be prohibited as well: gravel mining, roads, infrastructure and other disturbances that support development.
2-4	Addition to Lease Stipulations	To meet water quality purposes of the Arctic Refuge, a lease stipulation to protect lakes in the 1002 area should be included. This is especially important since lakes are relatively rare. Include the following stipulation for all alternatives: “Generally, permanent oil and gas facilities, including gravel pads, roads, airstrips, gravel mines, and pipelines, are prohibited on the lake or lakebed and within 0.25 mile of the ordinary high watermark of any lake that may have fish.”
2-	Lease Stipulation 4, Alternative B/C/D	Are Sewage treatment plants and sewage lagoons allowable under all of the alternatives?
2-7, 2-8	Lease Stipulation 4, Alternative B/C/D	At a minimum, stipulations in alternative D should be applicable under alternative B and C as well.
2-17	ROP 3	The scarcity and purposes of the Arctic Refuge warrant greater setback distances for fueling stations and fueling activities. 2,000 feet should be a minimum distance in alternative D1. In alternative B and C the minimum setback distance should 1,000.
2-17	ROP 3	<p>To minimize the potential for impacts of contaminant spills, there must be required operating procedures for containment under all alternatives. Include the following in ROP 3 for all alternatives: 1) containment of fuel over 200 gallons should be bear-proof, 2) spill containment systems for all fuel storage should be capable of containing 150% of the stored volume 3) “Except during overland moves, fuel, other petroleum products, and other liquid chemicals designated by the authorized officer that in total exceed 210 gallons shall be stored within an impermeable lined and diked area or within approved bear-proof alternate storage containers” and 4) All temporary and permanent fueling Stations shall be lined or have impermeable protection to prevent fuel migration to the environment from overfills and spills.</p> <p>Note – NPR-A EIS 2012 ensures containment is considered</p>

2-19	ROP 8, Standard	Change the ROP to the following: “Withdrawal of unfrozen water or ice aggregates from rivers, streams, and springs during winter is prohibited. If it has been shown that no impacts to hydrology (including hydrologic flow paths) at breakup, channel morphology, and/or impacts to fish and invertebrates and their habitat will occur, withdrawal of up to 20% of ice aggregate from a grounded area ≤4-feet deep may be authorized on a site-specific basis if it is determined that such removal will not impact natural hydrologic regimes or habitats. This will be determined by the BLM authorizing officer in collaboration with the USFWS. Monitoring of hydrology and channel morphology prior to and after removal may be required. The design of the monitoring effort must be peer-reviewed to ensure the ability to detect changes in hydrology, substrate, and morphology.”
2-19	ROP 9	<p>Rationale for different withdraw volumes compared to NPR-A EIS: 1) impacts on species and habitat are unquantified (NRC 2003), especially impacts of removal of entire permitted volume; 2) lakes are relatively rare in the Arctic Refuge thus a much larger proportion of lakes will be impacted by water withdraw which would have more significant impacts to fish and wildlife in the area; 3) because lakes are rare, companies would be more likely to withdraw fully permitted volume; 4) the original and primary ANILCA purpose of the Refuge is to maintain adequate water quality and quantity to support fish and wildlife and their habitat. Furthermore, impacts of water withdrawal on soils, shorebird habitat (wet meadow zones, and invertebrates in the NPR-A have never been assessed. The few studies of the impacts of water withdrawal on hydrology and chemistry did not have a statistical design that allowed for change detection or inference to other lakes, especially lakes in regions as far away as the Arctic Refuge. During these studies, only a small fraction of the permitted water/ice was withdrawn, allowing no assessment of the impacts when the permitted volume is withdrawn. Even when only a small fraction of the permitted volume of water was removed, one of the few lakes studied did not fully recharge at snow melt. Other studies indicate that dissolved oxygen in untapped lakes is typically close to dissolved oxygen thresholds that, if crossed, would have severe impacts on fish and wildlife habitat. These findings suggest that additional declines in oxygen due to water withdrawal could have a severe negative impact on fish and wildlife habitat. Based on these studies and the Refuge’s primary purpose to maintain adequate water quality and quantity, more conservative guidelines need to be in place.</p> <p>Change requirements a-d TO THE FOLLOWING FOR ALL ALTERNATIVES: “a. Lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 10% of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are ≤7-feet deep. b. Lakes with only non-sensitive fish (i.e., ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 20% of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are ≤7-feet deep. c. Lakes with no fish present, regardless of depth: water available for use is limited to 20% of total lake volume. d. In lakes where unfrozen water and ice aggregate are both removed, the total use shall not exceed the respective 10%, 20%, or 20% volume calculations.</p>
2-19	ROP 9	There are no requirements for determining fish presence prior to activities that could impact fish. Add the following requirement: Sensitive and nonsensitive fish species will be assumed to be present until surveys with 95% detection probability have been conducted during the appropriate seasons.
2-19	ROP 9	The following should be included for all alternatives. Additional modeling and monitoring of lake recharge shall be required to ensure natural hydrologic regime, water quality, and aquatic habitat for migratory birds and macroinvertebrates is

		maintained. Data from these efforts shall be stored in a geodatabase with appropriate metadata and be accessible to the USFWS and the general public.
2-19	ROP 9	Because water withdrawal from ice-covered lakes can have severe negative impacts on a wide range of species and habitats there is a need for a BMP that puts a cap on the percentage of lakes in each area that can be impacted by water withdrawals. Add the following requirement for all alternatives: a) Up to 20% of lakes in each class (1. deep isolated, 2. deep connected, 3. shallow isolated, and 4. shallow connected) in each major ecoregion and watershed (HUC8) can be tapped annually, b) Up to 30% of lakes in each class in major ecoregion and watershed (HUC8) can ever be tapped unless statistically valid studies with the appropriate level of inference indicate there will be no impacts to hydrology, fish and wildlife, and their habitat.
2-19	ROP 9	Under all alternatives, there is a need for stronger protections for isolated lakes. These isolated lakes are important for shorebirds and may harbor particularly dense and unique macroinvertebrate populations. Water quantity and quality in these habitats is important to protecting fish and wildlife diversity and habitats in the Refuge. Add the following to all alternatives: e) In isolated lakes with limited recharge capabilities, water available for use is limited to guidelines established in ROP 10 or 30% of the estimated snowmelt recharge volume, whichever is lesser.
2-22	ROP 11	Requirement/standard (a) for alternative D should be changed to the following to help ensure protection: "Snow depth and density and vegetation data should be collected where ground operations will actually be occurring. There is a great deal of evidence that shows how variable these conditions are even within the same watershed. The exact dates should be determined by the BLM authorized officer in coordination with the USFWS." For all Requirements/Standards that need to be approved by the BLM authorized official, the decision on approval should be made in coordination with USFWS subject matter experts familiar with the area. Winter ground operations are known to have negative impacts on the tundra. These impacts have cascading effects on water quantity, water flow paths, and habitat quality for fish and wildlife. To protect Refuge resources, the standards for ROP 11, Alternative D should also be applied to B and C.
2-24	ROP 12	There should be a requirement to monitor effectiveness of breaching at crossings to ensure impacts to fish and hydrology do not occur. The rationale for this is that there is only limited information about the effectiveness of this ROP in the NPR-A and the effectiveness of this ROP has not been assessed in the 1002 Area, which has very different terrain and hydrology compared to NPRA.
2-24	ROP 15	Permitting should occur in consultation with the USFWS subject matter experts who are familiar with polar bear denning habitats and snow and hydrologic modeling. Distribution of denning habitat, snow and hydrologic monitoring should be considered in an analysis of the potential impacts of snow fencing.
2-24	ROP 16	Non-fish bearing systems provide important habitat that supports invertebrates, migratory birds and other wildlife. Change requirement to the following for all alternatives to help ensure protection of fish, invertebrates, riparian vegetation and water resources: Exploratory drilling is prohibited upon or within 100-year flood plain of streams and rivers, on or within 2,000 feet of the ordinary high water mark of potential fish-bearing lakes, and 1,000 feet as measured from the ordinary high watermark of non-

		<p>fish-bearing waterbodies unless further setbacks are stipulated under Lease Stipulations.</p> <p>Any consideration of exploratory drilling within these areas should be assessed in consultation with USFWS subject matter experts with knowledge of aquatic resources in the 1002 Area.</p>
2-25	ROP 19	The scarcity and purposes of the Arctic Refuge warrant greater setback distances for protection of fish and wildlife. The importance of fishless lakes in supporting unique invertebrate communities and migratory bird populations warrant protections for fishless lakes. Permanent facilities should be at least 2,000 feet from the ordinary high-water mark of fish-bearing lakes and 1,000 from ordinary high water in other lakes.
2-21	ROP 10	To protect fisheries and other wildlife requirements in alternative D must be applied to all alternatives.
2-26	ROP 22	<p>Add the following to requirements: d) 5 years of data on stream flow, seasonal patterns in lake connectivity, and sheet flow shall be collected prior to planning bridges and culverts. These data will be stored in a centralized database and available to the general public.</p> <p>Standard "C" should ensure crossing structures are designed for ice-dam flooding as well.</p>
2-27	ROP 24	The impacts and severity of gravel mining on water resources in active floodplains will be severe and long-lasting. Creating deep water habitats that are connected to rivers could alter the outcome of competitive interactions between species and predator-prey relationships that are important for maintaining naturally occurring fish populations. Prior to these activities extensive studies should be undertaken. In all alternatives the following standards should apply: no mining sites in the 100-year floodplain of rivers with anadromous, freshwater, or endemic fisheries (e.g., Canning, Sadlerochit, Tamayariak, Itkilyariak, Aichilik, Hulahula).
2-27	ROP 24	Requirement/Standard (e) should apply to alternatives to help ensure the protection of water resources.
2-27	ROP 24	There is a need for mining restoration plans (see 2003 NRC report, Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)). Add the following requirement to each alternative: Each proposed mine site shall have a USFWS-approved restoration plan and effectiveness monitoring plan prior to site approval and construction. Restoration effectiveness monitoring shall continue for ten years following completion of restoration.
2-29	ROP 28	The requirement should include cooperation with the USFWS to assess the information necessary for a plan.
2-32	ROP 35	The lack of adequate restoration plans and adequate bonds to cover reclamation of areas impacted by oil and gas development on the North Slope is a major problem (2003 NRC report, Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)). Restoration standards need to be set in stipulations in this EIS. It should also be clearly stated what level of restoration will be required before land is no longer considered part of the infrastructure development cap. Restoration plans should be required and reviewed prior to issuing a lease and should be approved by the BLM and USFWS. All alternatives should include requirement for plans to include ecosystem restoration to restore pre-development stability, visual, hydrologic, vegetation, wilderness, and habitat conditions and Wild and Scenic River eligibility conditions.
F-18	F.4.10 Water Resources	The types of impacts under drilling and operation should include reinjection of waste/hazardous waste. Impact indicators should include ground water quality.

F-18	F.4.10 Water Resources	The types of impacts under barge docks and seawater treatment plant construction and operation should include alterations of water temperature salinity, currents, and sediment deposition. Will there be wastes disposed of STP as well? If so, alteration of nutrient cycles and introduction of contaminants should also be considered potential impacts.
F-18	F.4.10 Water Resources	Snow roads can impact vegetation, lead to thermokarst, and alter water quality. Impacts to water quality should be listed under type of impact. Impact indicators should include change to surface water quality
F-17	F.4.10 Water Resources	Construction and maintenance of gravel pads, roads and air access facilities can alter wetland area and extent / lead to inundation and starvation of tundra. These impacts should be listed under impact indicators.
F-22	F.4.10 Water Resources	“Water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses” should be changed to “Water withdrawal from lakes for ice roads, water supply, dust suppression, and other uses”. Withdraw from streams is not permitted and has been shown to have more severe impacts during winter.
F-22	F.4.10 Water Resources	Fish mortality should be included in the list of impacts that could occur due to loss of aquatic habitat. See Cott et al 2008 studies of lakes in the Canadian Arctic. The withdrawal volumes in these studies were similar to the withdrawal volumes proposed in the ROPs. There are studies in the NPRA; however, the volume of water removed was only a small fraction of the permitted volume and many of the studies were conducted in deep water gravel pits that are not representative of lakes in the 1002 Area.
F-23	F.4.10 Water Resources	Impacts of gravel mining associated with the creation of deep water habitats in river floodplains include changes in the outcome of competition between species in nearby natural occurring habitats and changes in predator-prey relationships, that could impact the natural diversity of invertebrate and fish communities. There could be negative impacts to important subsistence species that rear and spawn in nearby rivers. These deep-water habitats would also change thermal regime, flooding regime, and ice phenology in nearby rivers. These impacts should be listed under type of impact and should at least be qualitatively discussed as impact indicators in the analysis.
F-18	F.4.11 Solid and Hazardous Waste	<p>Actions affecting the resource should include injection of hazardous fluids. National Research Council 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Washington, DC: The National Academies Press. https://doi.org/10.17226/10639.</p> <p>Note – the 1002 area of the Arctic Refuge has freshwater reservoirs that feed deep groundwater springs that support the most productive freshwater communities in the area. These deep freshwater reservoirs and spring-fed habitats are rare or absent in the developed areas in the NPR-A. In the developed areas of the NPRA most deep-water reservoirs are considered too saline to be considered drinking water and potential for contamination of these sources by injection of hazardous waste is not considered a potential impact even though it does occur.</p>
F-18	F.4.10 Water Resources, Analysis Assumptions	In the scientific field it is widely accepted that climate change is ongoing and has widespread impacts across the North Slope of Alaska. There are numerous scientific reports on the impacts of climate change. These reports include current impacts and future projections. Climate change must be considered as a cumulative stressor if analyses are to be considered scientifically credible.
F-18	F.4.10 Water Resources, Analysis Assumptions	It cannot be assumed that impacts would be similar to those described in Greater Moose's Tooth 2 and other North Slope EIS'. The 1002 area of the Arctic Refuge is very different than developed areas of the NPR-A where the extent and volume of water is much greater and the terrain is not as steep. If the Arctic Refuge were to have the

		same stipulations and the NPR-A, it is expected that water withdraw would have a much greater impact as the proportion of sources tapped would be much higher in the Refuge and oil companies would use the fully permitted volume (In the NPR-A oil companies only tend to use a small fraction of the permitted volume).
F-18	F.4.10 Water Resources, Impacts and Indicators	Injection of hazardous wastes should be listed as an action impacting water resources. The type of impact would be potential contamination of ground and surface waters. The impact indicators would be surface water quality/contamination and groundwater quality/contamination. When conducting the analysis, consider that the potential for impacts to groundwater would be reduced under alternatives with stipulations that provide a protective buffer around major spring-fed rivers.
F-18	F.4.10 Water Resources, Impacts and Indicators	Since the development scenarios for the alternatives did not address a range of development/infrastructure needs at the level necessary to assess impacts on water resources (e.g. water withdrawal needs, ice road length, gravel mine locations and type), it is not possible to conduct an analysis that considers these factors when assessing impacts and comparing alternatives. More information is necessary to complete an adequate analysis. This information should include water needs, ice road lengths, etc. When there are a range of possibilities for a given scenario, the range should be given. This type of analysis needs to happen so that document authors can adequately assess impacts for water resources, vegetation, etc.
	F.4.10 Water Resources, Impacts and Indicators	For impact indicators, consider comparing the total volume of water needed for development (250 million gallons?) to the estimated volume of liquid water available in in lakes and rivers at the end of the winter season in the 1002 area (about 1 billion gallons, Trawicki et al 1991 or Lyons and Trawicki 1994).
	F.4.13 Fish and aquatic species	Since the development scenarios for the alternatives did not address a range of development/infrastructure needs at the level necessary to assess impacts on fish and aquatic species (e.g. water withdrawal needs, ice road length, gravel mine locations and type), it is not possible to conduct an analysis that considers these factors when assessing impacts and comparing alternatives. More information is necessary to complete an adequate analysis. This information should include water needs, ice road lengths, etc. When there are a range of possibilities for a given scenario, the range should be given. This type of analysis needs to happen so that document authors can adequately assess impacts for water resources, vegetation, etc. Until this information is available, an adequate analysis cannot be done.
	F.4.13 Fish and aquatic species	For impact indicators, consider comparing the total volume of water needed for development in each region (e.g. 250 million gallons) to the estimated volume of liquid water available in in lakes and rivers at the end of the winter season in the 1002 area (about 1 billion gallons, Trawicki et al 1991 or Lyons and Trawicki 1994). This should also be mentioned in the impacts analysis discussion because it highlights some of the differences between the NPR-A and 1002 Area that will affect the impact analysis.
F-24	F.4.13 Fish and Aquatic Species	Actions for “ice roads and snow management” should include ice bridges since they are much thicker than ice roads and can have a much greater impact on flow.
	3.2.10 Water Resources	Tiering the impacts on water resources to BLM’s documents (NPR-A 2013, NPRA 2004a, BLM 2018) is inappropriate in many cases as impacts in the Arctic Refuge 1002 Area will be different due to the many differences between the 1002 Area and the developed areas in the NPR-A. For example, in the Arctic Refuge 1002 Area, water is relatively scarce, the terrain is steeper, and major groundwater-fed springs are extremely important.
3-58	3.2.10 Water Resources	Reference to BLM 2012 4.5.4.2 is – not relevant to the 1002 area. Furthermore, 4.5.4.2 does not present an analysis or discussion, it only states that impacts are not long-term and does not provide a reference to support this. Even in the NPR-A, the long-

		term impacts of water withdrawal are unknown, especially for isolated lakes that may not fully recharge at snowmelt.
3-58 (last paragraph)	3.2.10 Water Resources	It should be noted that erosion and thermokarst related to development activities will have long-term impacts on surface water quality.
3-59	3.2.10 Water Resources	It cannot be assumed that water will be recharged during snowmelt because of stipulations in place. Adequate recharge depends on several factors including connectivity, watershed area and snow water equivalent. Many isolated lakes in small watersheds have very limited recharge capacity and may not be fully recharged during snowmelt after water withdrawal, especially during low snow years. For more information on “recharge vulnerable” lakes in the NPRA see figure 6 in Jones et al 2017 (A lake-centric geospatial database to guide research and inform management decisions in an Arctic watershed in northern Alaska experiencing climate and land-use changes. Ambio. Volume 46). More than 50% of the lakes presented in this study are considered recharge vulnerable. An even greater proportion of the lakes in the 1002 Area of the Arctic Refuge are likely recharge vulnerable.
3-59	3.2.10 Water Resources	<p>In the impacts analysis section, the discussion on impacts to groundwater is limited to gravel mining impacts to subsurface flows. The potential impacts to deep groundwater flowpaths that support perennial springs are not mentioned. Deep groundwater sources and perennial springs are very important in the 1002 Area. Perennial springs have very different chemistry, thermal regimes, and ice phenology compared to other waterbodies in the Refuge (See the Arctic Refuge Comprehensive Conservation Plan 2015 or papers by Alex Huryn for more information).</p> <p>Infrastructure and operations are also expected to lead to permanent irreversible impacts to shallow groundwater flowpaths with changes in permafrost thaw and thermokarst.</p>
	3.2.10 Water Resources (changes to groundwater)	<p>In the impacts analysis section it is important to note that contamination related to injection of hazardous wastes in subsurface areas and fracking could have major irreversible impacts to the ground and surface water quantity and quality and could impact major spring-fed systems that are important for wildlife and subsistence users.</p> <p>Note – the 1002 area of the Arctic Refuge has freshwater reservoirs that feed deep groundwater springs that support the most productive freshwater communities in the area. These deep freshwater reservoirs and spring-fed habitats are rare or absent in the developed areas in the NPR-A. In the developed areas of the NPRA most deep-water reservoirs are considered too saline to be considered drinking water and potential for contamination of these sources by injection of hazardous waste is not considered a potential impact even though it does occur. These impacts should be considered in the impact analysis sections for water resources and fisheries.</p> <p>More information on injection of hazardous fluids can be found in National Research Council 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Washington, DC: The National Academies Press. https://doi.org/10.17226/10639.</p> <p>In the NPRA EIS’ the BLM noted that in the NPR-A groundwater contamination during injection of hazardous materials is not a concern unless it results in drinking water contamination.</p> <p>A groundwater expert who can spend a substantial portion of time working on this EIS should conduct the impacts analysis for groundwater.</p>

	3.3.2 Fisheries Impacts Analysis Section	<p>It is important to note that contamination related to injection of hazardous wastes in subsurface areas and fracking could have major irreversible impacts to the water quantity and quality and fisheries in major spring-fed systems that are important for wildlife and subsistence users.</p> <p>Note – the 1002 area of the Arctic Refuge has freshwater reservoirs that feed deep groundwater springs that support the most productive freshwater communities in the area. These deep freshwater reservoirs and spring-fed habitats are rare or absent in the developed areas in the NPR-A. In the developed areas of the NPRA most deep-water reservoirs are considered too saline to be considered drinking water and potential for contamination of these sources by injection of hazardous waste is not considered a potential impact even though it does occur. These impacts should be considered in the impact analysis sections for water resources and fisheries.</p> <p>More information on injection of hazardous fluids can be found in National Research Council 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Washington, DC: The National Academies Press. https://doi.org/10.17226/10639.</p> <p>In the NPRA EIS' the BLM noted that in the NPR-A groundwater contamination during injection of hazardous materials is not a concern unless it results in drinking water contamination. In the 1002 Area injection of hazardous waste has much more potential to impact fresh water reservoirs that support perennial springs and associated fish and invertebrate populations.</p>
	General	<p>It is important to note that contamination related to injection of hazardous wastes in subsurface areas and fracking could have major irreversible impacts to the water quantity and quality and fisheries in major spring-fed systems that are important for wildlife and subsistence users.</p> <p>A groundwater expert who can spend a substantial portion of time working on this EIS should conduct the impacts analysis for groundwater.</p>
	Appendix B	General comment: It is misleading to call the 2,000-acre cap a surface disturbance cap if the BLM interpretation is that the cap does not include all types of surface disturbance related oil development. Use more appropriate terminology that is not misleading.
	Appendix B	Be explicit about what offshore actions are planned so that these can be considered in the range of effects. Otherwise, these analyses are grossly incomplete.
	Appendix B	There is a need for a more rigorous analyses of potential development scenarios that include a much better assessment of the feasibility of using freshwater resources versus using groundwater versus using an STP. This information is necessary to develop an appropriate analysis of the impacts of development on water resources, fish, other aquatic species, etc. Without this information, the analyses cannot adequately address impacts under different alternatives.
	Appendix B	Total projected water use should be presented under development scenarios. It is expected that water use could increase greatly under alternative B. It is not possible to adequately conduct analyses of the impacts of development on water resources, fish, other aquatic species, and birds without detailed projections of water use under any of the alternatives.
	Appendix B	Total projected ice road use should be presented under development scenarios. It is expected that ice road use could increase greatly under alternative B. Without assessments of ice road use under all alternatives, it is not possible to adequately

		conduct analyses of the impacts of development on vegetation, fish, other aquatic species, birds, soils, and water.
	Appendix B	The lack of adequate restoration plans and adequate bonds to cover reclamation of areas impacted by oil and gas development on the North Slope is a major problem (2003 NRC report, Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (2003)). Restoration standards need to be set in stipulations in this EIS. It should also be clearly stated what level of restoration will be required before land is no longer considered part of the infrastructure development cap.
	Water Resources Section	<p>These are key information gaps that need to be addressed for an adequate NEPA process that adequately addresses alternatives. These information gaps were identified by several subject matter experts from agencies including the BLM, USFWS, and USGS. Please follow CEQ and other guidance to ensure these information gaps are filled prior to the EIS or indicate why they cannot be filled due to resource limitations:</p> <ul style="list-style-type: none"> • How effective are existing BMPs and mitigation measures used in the NPR-A at ensuring protection of habitat? Will they ensure protection of habitat in the coastal plain, 1002 area? According to the NRC (2003), these questions have not been answered. • What habitats or areas need additional protection due to their vulnerability and/or high-value to fish, waterbirds, other wildlife, recreation, and subsistence? • What is the status and natural variability in water quality and quantity of rivers and lakes? This information is necessary to allow for impact assessments and adaptive management practices. • What BMPs, mitigation measures, and restoration standards will ensure protection of habitat from impacts of development in the coastal plain, 1002 area where there are considerable differences in hydrology, terrain, and management purposes compared to the NPR-A?
	Water Resources Section	<p>These are some of the studies that need to be conducted to fill key information gaps described above. These studies were identified by several subject matter experts from agencies including the BLM, USFWS, and USGS. Please follow CEQ and other guidance to ensure these studies are conducted to fill critical information gaps or indicate why they cannot be filled due to resource limitations:</p> <ul style="list-style-type: none"> • Characterize seasonality in water quantity and quality to allow for science-informed NEPA processes and development of BMPs and permitting stipulations that ensure protection of fish and wildlife habitat and account for cumulative impacts of climate change. Conduct continuous water quality and quantity monitoring on the Hulahula, Tamayariak, and Canning rivers to evaluate the current status and natural variability in late fall and spring surface water quality and quantity in relation to the timing of fish use and industrial activity. • Identify the extent and value of groundwater to delineate special areas and support science-informed NEPA processes, BMPs, and decisions regarding hazardous waste disposal that ensure protection of fish and wildlife and habitat: <ul style="list-style-type: none"> ○ Evaluate groundwater flow paths and recharge -- Develop a conceptual groundwater model informed by isotopic studies to delineate and age flow paths. Quantify river recharge rates to inform water withdrawal permits in areas that are primarily recharged from groundwater. ○ Identify open-water areas and aufeis-associated fish habitat and evaluate terrestrial mammal use of aufeis, aufeis contributions to

		<p>late summer flows, and the importance of aufeis and ice-dam flooding in recharging fish and wildlife habitat in the Canning, Hulahula, Itkilyariak, Katakturak, and Sadlerochit river drainages.</p> <ul style="list-style-type: none"> ● Evaluate efficacy of current practices and applicability to the coastal plain, 1002 area to support science-informed NEPA processes, BMPs, and restoration plans that ensure protection of fish and wildlife. Considerations must include effects on sheet flow, ice-dam flooding, and recharge of floodplains and differences between the coastal plain, 1002 area and the NPR-A. <ul style="list-style-type: none"> ○ Identify and conduct studies to minimize impacts of gravel extraction and infrastructure ○ Identify and conduct studies to ensure adequate restoration ● Identify high-value and/or vulnerable lakes and characterize seasonality in water quantity and quality to allow for science-informed NEPA processes and development of BMPs and effectiveness monitoring protocols that ensure protection of fish and wildlife habitat with a known level of confidence. <ul style="list-style-type: none"> ○ Fish surveys have only been conducted in 2.3% of lakes in the 1002 area and most surveys were brief reconnaissance surveys only targeting nine spine stickleback. Fish distribution models and sample collection protocols have been developed for other areas on the North Slope, but their applicability to the 1002 area is unknown. Macroinvertebrate diversity is an indicator of ecosystem health and has never been assessed in 1002 area. Baseline contaminants surveys of fish have only been conducted at a small handful of sites. To identify high-value aquatic habitats, inform planning, and provide baseline samples there is a need to document fish presence; test the applicability of existing fish survey protocols and distribution models, and collect baseline macroinvertebrate, fish e-DNA, and fish tissue samples to archive for future analysis (for more information, see resource assessment for contaminants). Results would include the following: traditional fish surveys in up to 60 lakes, validation of protocols and fish distribution models for applicability in the 1002 area, baseline macroinvertebrate and fish contaminant samples collected in up to 60 high-priority lakes, and e-DNA samples available to test for fish presence in up to 200 lakes. ○ Develop geospatial inventory of hydrologic connectivity, watershed areas and relative snowpack to assess lake vulnerability/recharge potential. ○ Continuous water level and winter water quality monitoring on representative lakes to evaluate current status and natural variability relative to timing of potential impacts of industrial activities and use by fish and wildlife. ● Evaluate efficacy of current practices and applicability to coastal plain, 1002 area to support science-informed NEPA processes and BMPs that ensure protection of fish and wildlife. <ul style="list-style-type: none"> ○ Assessments of the adverse impacts of water withdrawal on lake biota in the NPR-A are necessary to assess the efficacy of existing BMPs (per National Research Council 2003). Comparing aquatic macroinvertebrate diversity in the NPR-A on 6 untapped lakes and 6 lakes where the entire permitted volume has been withdrawn and the vulnerability is similar to a range of lake types in the coastal plain 1002 area will help assess the efficacy of existing BMPs.
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	Water Resources and Fisheries Section	<p>This is a conceptual diagram of some of the effects of water withdrawal on lakes. Be sure the concepts are adequately covered in the EIS and note where information is lacking or necessary to make informed decisions.</p>
	Entire document and this NEPA process	<p>It is obvious that there was not adequate time for the contracted authors who are just learning about Arctic Refuge ecosystems to fully understand aquatic ecosystems in the Arctic Refuge at a level that would allow them to conduct an adequate analysis. I feel sorry for the people are being forced to write this document in such a short period of time without the input of USFWS experts who have been working in the Refuge for several years. I also feel sorry for those who are spending their free time to try to review this draft EIS. I can't even imagine how difficult it must be for someone without a scientific background focused on Arctic Science to write and/or review this document. It is a shame to spread so much misinformation to the public. I also feel very badly for the fish and wildlife in the Arctic Refuge, the Native communities, and the American Public who may be forced to live with the outcome of an error-ridden Environmental Impact Statement that lacks scientific credibility and tiers-off to irrelevant documents that have not been peer-reviewed.</p>

REFERENCES

NRC 2003 -- National Research Council 2003. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope. Washington, DC: The National Academies Press.
<https://doi.org/10.17226/10639>