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Comments on:

**Draft Feasibility Study, Northeast Cape FUDS, F10AK096903, St. Lawrence Island, Alaska**

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**Site History and Document Background**

Ancestors of the current residents of St. Lawrence likely arrived on the island from neighboring parts of Siberia many hundreds, if not thousands of years ago. The location of St. Lawrence Island is such that it had strategic importance during the Cold War and the United State's Government for nearly twenty years, from 1954-1972, operated the former military surveillance installation at Northeast Cape. During this time, numerous contaminants were used, spilt, buried, disposed of, or otherwise released into the environment. From government records, eyewitness accounts, and a variety of investigations conducted from 1994 until the present time, 33 individual sites of potential concern have been identified. This draft Feasibility Study provides information on the remedial alternatives under consideration for sites that are deemed significant enough for further action. Based on available data, 17 sites are proposed for no further action and will be left as is.

The Northeast Cape (NEC) has been used intensely by Island residents in the past for seasonal subsistence activities, although due to fear of contamination, the site is currently only sporadically visited during transit. In recognition of past abundance of fish and game, and in anticipation of the restoration of the area to its original state, the residents have designated the Northeast Cape as the next permanent community on the island.

**Site Characterization**

A series of remedial investigations mentioned above have been used to characterize the NEC sites in terms of select contaminants and environmental media. These efforts have been limited by a number of endemic factors including site history, the size and complexity of the sites, the large size of the NEC, the climate and occurrence of permafrost, the topography, the geology and hydrology, limited field seasons, the remote location of the Northeast Cape, and the amount of time that has past since military occupation. External limitations include costs, schedules, analytical and technological limitations, Corps of Engineers (COE) guidelines and operating procedures, differences between various investigations and contractors, and other factors imposed by the context of the investigation.

As a consequence, a number of serious limitations exist in the characterization of various sites at Northeast Cape. These include inadequate sample numbers, analytical protocols, limited analyte lists, elevated detection or reporting limits, inadequate sample sites or placement, biases in interpretation, and other problems noted during the review of previous remedial investigations. In particular, the characterization of landfills, the origin of petroleum in sediments and soils in the Suqi drainage, groundwater on site, and even the general geology of the sites have not been adequately investigated.

Poor site characterization will inevitably leave significant amounts of contaminants in place and the poorly characterized sites will remain sources of contamination to the local region and Bering Sea for generations

Part of the problem lies in the site based approach of the various studies. Little or no attempt has been made to understand aquifer flow or characterize the various aquifers on site, nor have meaningful hydrogeological cross-sections been constructed on a site wide basis. In many cases, landfill soil samples have come from cover materials rather than actual fill. Given these limitations, it is difficult if not impossible, to evaluate the results of draft feasibility study or proposed alternatives on the long-term status of the site and the appropriateness of remedies selected.

This, however, is not an indictment of individuals involved in the remedial process. We are convinced that everyone involved wants the same outcome, i.e. that is a cleanup that is complete as possible and protective of human health and the environment and a process that can be held up as a model of the commitment and ability of our government agencies and representatives to live up to their environmental and human responsibilities.

Our critiques predominantly question the rigidity and policies of the system followed by the COE, the inadequacies of remedial investigations at such complex and large sites, the lack of understanding of designated site interrelationships, the lack of effective and feasible options for cold climate sites, and the lack of funding for the FUDS program.

These factors combine to create a sense of defeatism given the limited funding, incomplete environmental investigations, and the inevitability that stores of contaminants will remain in the soils, sediments, surface and groundwater as a consequence of an inadequate remediation of the Northeast Cape sites..

Given these constraints, as technical advisors to the RAB, we are left with no other option than to try to guide available funding to efforts and areas that will have the greatest impact on the environmental health of the site, while still disagreeing with the limitations and choices presented in the Draft Feasibility Study.. Therefore, we present the following comments with the realization that the remediation will be severely under funded, limited in scope, and based on insufficient data.

The following comments are divided into two major categories including:

1. Generic or general topics relative of the overall series of proposed remedial options ; and 2. Site specific comments based on the limited site characterizations:

**Generic Concerns.** There are a number of potential insitu and ex-situ remedial technologies discussed in the Northeast Cape Feasibility Study that have questionable utility in Arctic/tundra regions including: Enhanced Biodegradation, Bioslurping, use of Bioreactors, Phytoremediation, Constructed Wetlands, Bioventing, Landfarming/Composting, and Air Stripping due to climatic and soil/sediment constraints.

Remedial technologies designed to utilize microbial degradation is dependent on temperature of the soil, sediments and/or groundwater. Phytoremediation, Constructed Wetlands, Bioventing, Landfarming/Composting involve microbial processes and are therefore temperature dependent and require a significant degree of maintenance to work effectively including maintaining moisture and perhaps plant harvesting and effective disposal of the vegetation if contaminants are to be prevented from recycling back to the impacted soils.

Natural Attenuation processes are also affected by site temperature and soil/sediment type. Microbes can significantly enhance the degradation of organic compounds including POL, GRO and DRO. however, local temperature, soil/sediment composition, moisture, availability of dissolved oxygen, the acidity of the soils and/or groundwater and particle size also play a major role on natural attenuation processes and are likely to be less effective in degrading the contaminants of concern in Arctic, tundra regions including sites located at the Northeast Cape.

Other suggested remedial technologies involve the transfer of soil, sediment and groundwater contaminants to the atmosphere. Transfer to the atmosphere technologies include Soil Vapor Extraction (SVE), Thermally Enhanced SVE, Thermal Desorption, Air Stripping, Air Sparging, Thermal Desorption and although not intended, Landfarming/Composting also results in the transfer of contaminants to the air.

If these technologies are not combined with some form of destructive process after the contaminants of concern are separated from the impacted solids and liquids, the contaminants will be released to the atmosphere and contribute to local and global air contamination.

**Physical Barriers**. Physical barriers include use of engineered liners, soils or constructed structures including impermeable caps commonly used on landfills to prevent contaminants from migrating offsite. Capping is a form of a physical barrier proposed as one of the remedial options for landfills used by the military at the Northeast Cape, including the Cargo Beach Landfill at Site 7 and the Housing and Operations Landfill at Site 9.

**Institutional Controls.** This form of site isolation involves establishing guidelines, constraints, including fences or walls and/or warning signs designed to keep humans and

animals away from contaminants impacting an area or site. Site isolation does not remove, degrade or immobilize the contaminants of concern to ensure the substances do not come in contact with humans and/or other animals, but physically and/or with the use of signs and publicized restrictions, isolate the sites to prevent humans and animals from coming in contact with the contaminants.

**Contaminants assessed**. There were a range of organic and inorganic contaminants identified in the NIEHS Environmental Justice sampling conducted at the NEC that are ignored in the summary data discussed in the Draft FS including mercury, mirex, Hexachlorobenzene, DDE and PCB Aroclors other than 1254 and/or 1260. Although some or portions of the above listed contaminants may have derived from global transport and deposition, the concentrations and trends with depth in sediment cores indicate these substances derived from former military occupancy at the NEC.

**Site Specific-No Further Action Recommended**

Site 5-Cargo Beach. This site is situated near the hunting/fishing camp. The shallow groundwater and surface water located in proximity to this area is likely to be utilized by visitors utilizing the camp during hunting/fishing seasons. The possible use of the Cargo Beach surface and groundwater by visitors will likely increase since they are closest to the camp and the probability of use of these resources will increase with time.

Site 12-Gasoline Tank Area. Although there was no indicated evidence of leaks at this site, it is evident there was some spillage as indicated by the presence of DRO and RRO in the analyzed soil samples. Because this site was a storage facility for leaded gasoline, there should also be an assessment and summary of the lead concentrations of the soils.

Site 16-Paint and Dope Storage Building. This site has been effected by a range of contaminants including arsenic, antimony, cadmium, lead, PCBs and TCE. Although TCE was ONLY detected in one sample, it represented 33% of the samples collected (1 of 3 representing another example of incomplete site characterization). What was the detection limit for the TCE in the 1998 sampling for TCE? Were only the averaged concentration of a compound (element) used to determine action levels? The use of averaged concentrations is specifically referenced in this document to the 1994 PCB sample results.

Although it is well recognize that suspended sediments can add to the concentration of trace metals in water samples, filtering of the samples can also reduce the dissolved phase of detected metals particularly if the pH of the sample has changed. The extrapolation of the lead data based on the elevated cadmium data attributed to the suspended sediment results is not justified since the lead was not analyzed as a filtered sample.

Site 21-Wastewater Treatment Facility. This site has been impacted by a range of contaminants including PCBs, arsenic and chromium (why is it not hexavalent chromium?). The arsenic may well be related to treated wood and perhaps the chromium is as well. It is not likely though that the 170 mg/kg is background and the elevated

concentration is likely related to the treated wood. Why is it stated that the PCB sites at this site are not readily accessible to humans and/or animals, especially if the NEC becomes a third SLI community?

Site 22-Water Wells and Water Supply Building. Because this site location is underlain by recoverable groundwater and may have the potential of serving as a source of municipal drinking water, a monitoring period of the monitoring wells should be integrated into future remedial actions.

Site 24-Receiver Building Area. Invoking biogenic origins to DRO and RRO. Was the reporting limit (10mg/kg) for antimony in water samples as well? Why do the migration to groundwater cleanup levels not apply?

Site 34-Upper Camp. Was the PCB cleanup level of 1.0 mg/kg applied to this site?. When visited, this site's building walls and immediate surrounding areas (floor) were extensively oil stained.

## Areas of Concern

**Sites 3 and 4 Combined.** Based on the groundwater and soil data collected to date, additional sampling is required to assess the effects of salinity, turbidity, detected analytes in the blank samples and cause of the low dissolved oxygen concentrations of the groundwater (likely due to stagnant and organics) in the analyzed samples. The proximity to the Native Fishing Camp will likely expose seasonal camp users to the shallow groundwater and soils. Impacts to soils and groundwater are evident at these two sites and selective source removal and disposal or treatment should be considered as part of the remedial options.

**Site 6-Cargo Beach Road Drum Field**. At this stage, it is not known whether the drum field contains only "empty" drums. Based on the collected samples of soils and groundwater, there was and likely is, at a minimum, considerable quantities of "residual" petroleum in the field of drums at Site 6. The elevated metal concentrations defined in the soils and groundwater suggests other forms of metal-contained substances were disposed at the landfill. Mercury is mentioned as an analyte although no mercury data is referenced in this report. Was mercury an analyte at Site 6 and if so, what were the detection limits and results?

The capping alternative should be eliminated for this site considering the shallow groundwater. Although effective capping could be accomplished, the cap would require long term maintenance and the surrounding areas of the site will also require long term monitoring to ensure the cap is effective in restricting off-site migration of contaminants. Capping will not prevent the drums from continuing to deteriorate releasing liquids to the drum field and downgradient regions in proximity to the field. Additionally, the shallow groundwater will introduce water to the drum field from below the field of drums due to capillary action of the fluctuating groundwater thereby introducing contaminants contained in the drum field to the downgradient environments.

Caps work more effectively at sites that have been lined with a clay/geotexture material to prevent water from migrating vertically into the mass of overlying drums and impacted fill material. Since this site is not lined, there is significant potential for the upward migration of shallow groundwater into the overlying mass of wastes.

Site 7-Cargo Beach Road Landfill. Because this site was operated as a landfill (dump) that operated for an approximate ten year period (1965-1974). little is actually known about the range and concentration of contaminants contained in the fill material although a wide range of organic and inorganic substances have been identified within the landfill and offsite soils and groundwater. Drums containing liquid waste materials have also been reported. The waste material at Site 7 has been covered with a thin cover of local soil material and although sampling of site soils has identified PCBs and a range of organic and inorganic contaminants, not all of the sampling has been conducted of the actual waste materials, but of the cover material which is not reflective of the material disposed in the landfill.

As described above (Site 6), this site was used as a waste management facility by the military and used to dispose of a range of co-mingled municipal and hazardous wastes.. The site will continue to pose a threat to the local environment as long as waste materials exist within the landfill. Because the landfill does not have a liner, wastes contained in partially filled drums and other containers and other soluble materials will be able to migrate from the mass of buried wastes to the surrounding soils and groundwater. Capping of landfills to prevent the infiltration of water can be only partially effective. Although caps are partially effective in preventing offsite migration of wastes as long as the capping material is well maintained, areas with high, fluctuating water tables are not ideal sites to minimize water infiltration since the shallow groundwater will be able to migrate upward into the waste materials providing a source of contaminated leachate that can migrate offsite to surrounding soils and groundwater.

**Site 9-Housing and Operations Landfill.** This site was used as a mixed waste landfill for the period of 1952-1965. This site contains a range of organic and inorganic contaminants including DRO, dioxins and furans and trace metals. The site is also situated upgradient of the Suqi River posing a potential source of contamination to the river and estuary. This landfill (dump) was not designed or constructed with a basal liner and the waste materials, therefore. rest directly on top and in contact with the native soils. Site 9 is located within a wetland environment and portions of the landfill have been eroded exposing wastes.

As discussed above for the landfills at Sites 6 and 7, capping of unlined landfills provides limited effect in preventing the formation and offsite migration of landfill leachate. Because Site 9 is located in a very wet environment, capping will have only limited effect in preventing the formation and migration of leachate to the surrounding environments.

**Site 8-POL Spill Site.** It appears there is not sufficient information to develop a proposed remedial action on this site. The limited sampling conducted on this site indicates

elevated DRO (19,500 mg/kg) concentrations in sediments; yet despite the elevated concentrations in the sediments, non detect of DRO in surface waters. This site also drains to the Suqi River and therefore has a potential effect on the water quality of the River and Estuary. Because there is limited understanding of the concentrations and sources of the DRO at this site, additional sampling should be conducted to gain the additional information needed to develop effective remedial options.

**Area of Concern E (AOC E); Sites 10, 11, 13, 15, 19, and 27.-Main Operations Complex.** The sites listed above are situated in areas that are significantly different from the areas downgradient and north of the Main Complex. The sites included in the AOC E area are significantly different geologically and hydrologically from the shallow groundwater and clayey soils of the downgradient areas to the north that are dominated by fine grained, organic, tundra soils.

As the higher elevations of the Main Complex area are approached from the north, the soils become coarser grained, the groundwater is more uniform and deeper and found in coarser grained sediments. If permafrost is encountered near and south of the Main Complex, it is deeper than found in the northern areas of the NEC series of military sites. Surface and groundwater drainage is to the north and the majority of the drainage north of the Main Complex will intersect the Suqi drainage, including the section of the Suqi tributary that has been classified as the Main Drainage. Spills, leaks. landfills, discharges from impacted soils and any other potential contaminant releases near or south of the Main Complex will either move into the groundwater and/or migrate toward the north and therefore likely intersect the Suqi River drainage.

Toward the south of the NEC, the elevation increases quickly above the Main Complex as the mountain is approached. The White Alice site was situated on glacial outwash material which overlies the very coarse grained, highly permeable talus deposits that flank the mountain. The tramway is built on the steep slope of the mountain on the bolder strewn talus deposits and undisturbed granitic bedrock.

Because the surface and underlying deposits of soils and sediments differ significantly from the deposits north of the Main Complex, remedial technologies designed to degrade or retain contaminants at the sites located near the Main Complex will therefore be different for the coarser grained soils and sediments found near and south of the Main Complex including the deeper, more uniform groundwater resources underlying these areas.

The transition from the tundra soils north of the Main Complex and the coarser grained soils to the south also included the use of gravel fill material by the military that was used to establish slabs for Main Complex buildings and support structures as well for road materials.

Large volume spills were reported from storage tanks including a 30,000 to180,000 gallon spill from one of the 400,000 gallon diesel fuel tanks (site 11), a 40,000 gallon spill of diesel fuel from Site 13. These spills and other unreported smaller releases

contributed to the contamination of the groundwater underlying the Main Complex as well as the soils and sediments immediately downgradient including the sediments of the Suqi drainage basin.

In addition to the petroleum based compounds, PCBs and other chlorinated compounds as well as a range of trace metals have been identified in the soils and sediments at the NEC. The shallow groundwater at the Main Complex contains elevated concentrations of arsenic, lead, benzene, toluene, ethylbenzene, DRO, GRO, and RRO. The contaminated groundwater is a continuing source of contamination of the downgradient regions of the NEC including the soils, sediments and groundwater to the north of the Main Complex.

Additionally, the presence and elevated concentrations of volatile compounds including the GRO, benzene, ethylbenzene and other volatile compounds suggests these compounds have been isolated from the surface since being spilled and further that biodegradation or natural attenuation has not been effective since these more volatile and more biodegradeable materials have persisted in the environment for more than 50 years. The natural attenuation parameters of the Main Complex groundwater is not the most conducive to active biodegradation or other forms of Natural Attenuation and may be cause for the presence of the more volatile and biodegradeable, organic compounds.

Although PCBs have been identified in the Main Complex soils, the method detection limits used by the COE contractors for soluble phase PCBs is too high to detect the presence of these compounds in water. PCB water concentrations at highly impacted sites ( Hudson River, NY; Anniston, AL) are in the range of 100-150 ng/L; more than an order of magnitude lower than the analytical protocols used by COE contracted analytical laboratories. The presence of aqueous phase PCBs within the Main Complex groundwater and downgradient surface and/or groundwater is, therefore, not known.

Chemical oxidation can be used effectively to degrade contaminants in soils. If reagents can be infused through the soils and/or sediments, chemical oxidation can be used effectively to degrade organic compounds including refractory compounds. Additionally, this technology can immobilize trace metals. Additionally, use of dilute (<10%) reagents, significantly reduces adverse effects including impacts to subsurface infrastructure (not an issue at NEC) as well as operations personnel.

The Main Complex site area is a source of contamination to the downgradient regions of the NEC. Remedial technologies must be used to degrade and immobilize the contaminants impacting the soils, sediments and groundwater of the sites within the complex as well as to the impacted areas to the north and downgradient of the large source of contaminants stored in the soils and groundwater of the Main Complex sites. In order to reduce the organic and inorganic contaminants in the soils and groundwater, a proactive remedial program is required to effectively degrade the contaminants of concern (COCs) which will likely require processes to reduce and eventually eliminate the organic and inorganic substances impacting this area. The subsurface area of the Main Complex and areas immediately to the south provide a viable source of

groundwater which could provide sufficient quantities for municipal use. In order to utilize this source of groundwater, the contaminants must be removed likely requiring a mix of technologies.

**Area of Concern F-Drainage Basin-Site 28.** Three discrete drainages flow from the Main Complex north to the Suqi River and then to the Estuary. This drainage is a tributary of the Suqi River and because this branch of the river receives its waters from areas above and within the Main Complex, the tributary has been significantly impacted by the large volume spills and release of contaminants originating from the impacted soils as well as the affected surface and groundwater. Sections of this drainage are narrow (<1') and deep (~ 2') where it is incised into the tundra soils.

Sampling within the narrow regions of the Main Drainage (Suqi Tributary) must be done carefully to avoid the sampling the incised tundra soils. The poorly consolidated tundra soils can be easily mistaken for Main Drainage and Suqi drainage sediments and because the tundra soils are likely centuries old, they will be essentially unaffected by any of the near term contaminants derived from military activities. Similarly, during dry periods or shortly after extensive river flow, the Main Complex Drainage will have little sediment accumulated in the small drainage.

Where sediments do accumulate in the Main Drainage, there is often an evident oil sheen that is released to the water column when the bottom sediments are disturbed. Because the river is narrow and deepened where its width is reduced, flooding that takes place during the spring melt and times of extensive precipitation, re-suspends the fine grained sediments and transports the material downgradient to the Suqi River and then to the Estuary where the sediments and associated contaminants accumulate.

The Main Drainage, therefore, has and currently serves as a conduit for the contaminants being released to the downgradient regions of the NEC by the Main Complex store of organic and inorganic contaminants residing in and being released by the upgradient soils and groundwater.

The reservoir of contaminants being released to the Main Drainage of the Suqi will diminish when the Main Complex area is effectively remediated. However, as long as there are contaminated soils and groundwater within the Main Complex area, the Main Drainage and the Suqi River and Estuary will continue to be impacted. This section of the Suqi River drainage needs to be effectively monitored during and after remediation of the Main Complex to ensure contaminants are no longer being released to the Main Drainage. When contaminated sediments accumulate in sections of the Main Drainage, they should be removed and disposed even though this remedial phase will damage the system's ecology.

**Area of Concern G-Suqitughneq (Suqi) River and Estuary-Site 29**. This section of the Suqi drainage was likely affected by the large spills reported from the above ground fuel storage facilities located upgradient of the river. Comments made above relative to the Main Drainage section (Site 28) of the Suqi are relevant as it relates to the

accumulation of impacted sediments during periods of low flow, scouring and transport and remobilization of the sediments during high flow. It also emphasizes the need for careful sampling to ensure sediments and not tundra soils are being sampled. The relative high variation in the DRO sampling results suggests sampling may not have been consistent and may have included tundra and not the contaminated sediments derived from impacted upgradient sources. Tundra soils will also contain large quantities of biogenic organics and low concentrations of petrogenic materials.

To ensure Site 29 sediments are not impacted, additional sampling and analysis needs to be conducted to ensure sediments are sampled and that the sediments represent material recently accumulated which would be reflective of the effects of the upgradient sources of the sampled material.

As with Site 28, designating the Suqi River (Site 29) as a suitable alternative drinking water source is based on insufficient data including detection limits of PCBs and presence of aqueous phase contaminants during various flow regimes including PAHs, DRO and trace metals. Subtle changes in pH, Eh, dissolved oxygen, water flow, organic acids and other physicochemical parameters have profound effects on contaminant solubility and mobility. Because it is known that a range of organic and inorganic contaminants exist in the Suqi River drainage and upgradient soils and groundwater, these same materials are also present in the aqueous phase within the Suqi system.

**Area of Concern H-White Alice Complex-Site 31**. The organic contaminants identified in the White Alice soils are comprised of DRO and PCBs. It is evident from the more than 50 year history of the persistence of the DRO that Natural Attenuation is not effective in degrading DRO at the NEC.

Chemical oxidation is not restricted to groundwater and has been used to degrade contaminated sediments including PCB-contaminated, relatively permeable, soils/sediments. The use of dilute oxidizing reagents can also stimulate biodegradation of the DRO compounds.

What data was used to determine the groundwater at Site 31 is not impacted? The FS should summarize this statement to complete the record.

The preferred action would be to remove all contaminated soils from the White Alice site followed by off-island disposal. Clean fill should be used to replace the removed soils.

Area of Concern I-PCB Contaminated Soils (Sites 13, 31). PCBs are highly resistant to changes in the natural environment. However, although considered highly refractory, depending which of the approximate 200+ congeners is involved, this compound can be volatile, soluble and, therefore, highly mobile. In general, the lower the chlorine content, the more soluble and volatile the congener. Land farming, composting, constructed wetlands and other remedial alternative that affect the chlorine content of the compound can have a profound effect on the mobility of this contaminant.

It is also well recognized that PCBs can be partially altered by anaerobic, microbial degradation. This involves the selective loss of chlorines on the biphenyl ring creating PCBs that are less chlorinated than the parent compound and are therefore more soluble and more volatile and subsequently more mobile than the parent compound.

The PCB contaminated soils can be isolated by capping and which can then partially degrade creating more mobile compounds. PCBs can also be degraded by chemical oxidation, particularly effective on coarse-grained, low organic, non-carbonate soils.

The preferred remedial option is to ensure these compounds do not become more mobile due to the partial loss of chlorine. The PCB contaminated soils should be removed off-island to be treated and disposed in approved facilities.