Executive Summary

This background document presents a compilation of available information pertaining to fugitive dust and hazardous substance releases from Red Dog operations related to transport, handling, and storage of the ore concentrate between the concentrate storage building (CSB) at the mine and the deep sea vessels off the coast. Fugitive dust is any dust or particulate matter that is emitted to the ambient air as a result of activities at a facility. At the Red Dog Mine, the associated DeLong Mountain Regional Transportation System (DMTS) road and at the DMTS port, fugitive dust may be either ore concentrate, road dust, or a combination of both.

The primary objectives of the background document are to:

- Compile and summarize information pertinent to the fugitive dust issue
- Present a preliminary conceptual site model (CSM) describing sources and transport mechanisms for fugitive dust, potential exposure pathways, and human and ecological receptors
- Identify where additional data collection is needed (data gaps)
- Outline a decision-making framework for addressing current and future fugitive dust issues.

The background document is organized into three main parts: Part A—*Introduction*, Part B—*Background Information on Fugitive Dust*, and Part C—*Regulatory Review and Data Gaps*. Parts A and C were prepared by the Alaska Department of Environmental Conservation (DEC) and its contractor. Part B was prepared by Teck Cominco Alaska Incorporated (Teck Cominco) and Exponent.

Background

The Red Dog Mine is located approximately 50 miles east of the Chukchi Sea, in the western end of the Brooks Range of Northern Alaska (Figure ES-1). Metallic mineralization has been found to occur naturally throughout much of the western Brooks Range, and strongly elevated zinc, lead, and silver concentrations have been identified in many areas.

The Red Dog Mine has been in operation since 1989. Ore is mined in an open pit, and is transferred to a nearby processing facility where it is crushed, ground, and concentrated using a flotation process. At the mine site, the concentrates are temporarily stored in a CSB. Trucks are used to transport the concentrates from the mine CSB over the DMTS road, which connects the mine to the coastal port site. At the port site, the trucks empty the concentrates into a hopper, which feeds the concentrates into a fully enclosed conveying system that carries them to one of the two CSBs. The storage capacity allows mine operations to proceed year-round, between shipping seasons. The concentrates from the storage buildings are loaded into a fully enclosed conveyor system and transferred to the shiploader, and then into barges. The barges have a built-in and enclosed conveyor that is used to transfer the concentrates to deepwater ships.

Red Dog operations are governed by a number of major permits and other authorizations issued by various federal, state, and local regulatory agencies. While some of the dust control measures have been taken in anticipation and response to enforcement actions, many engineering and operational improvements have been voluntarily implemented by Teck Cominco, both in the past and at present, to control fugitive dust emissions. The ambient air boundaries for the port and mine are illustrated in Figure ES-2. The ambient air boundary for the road is located 300 ft on either side of the road centerline.

Many environmental studies and monitoring programs have been conducted since Red Dog mining operations began. These programs have been designed to evaluate baseline conditions, monitor environmental impacts from the operations, and measure the effectiveness of emission control measures. A summary of these programs is provided in Table ES-1.

Nature and Extent of Fugitive Dust

Metals concentrations in soil at the port site are elevated in several areas near operational parts of the facility, but concentrations decline rapidly with distance away from the concentrate storage and handling areas. Soil sampling conducted in 2001 along the DMTS road indicated that the soils making up the road base are not a significant source of metals. This sampling showed that elevated metals concentrations occurred on the road surface and road shoulder. Soil samples collected on transects in 1991 and 1992 showed that concentrations decrease rapidly with distance from the road.

Surface water samples recently collected from five creeks at locations along the DMTS road had no exceedances of water quality criteria in 4 months of data collection (July, August, September, and October 2001). Surface water data from those creeks show little if any impact from the DMTS road. Most of the samples had concentrations below analytical detection limits and none of the concentrations exceeded DEC's surface water criteria.

At the port site, patterns observed based on dustfall collector sampling, snow sampling, and high-volume air sampling indicated that the primary sources of fugitive dust were at the ends of the CSBs, the roadway where trucks exit from the truck unloading building, and the surge bin (at the dock area) that evens out concentrate flow on the conveyors at the dock area. Along the DMTS road, dustfall collector results from September 2001 indicated that the total dustfall rate was greatest near the port site and relatively consistent along the rest of the road.

Alaska Department of Fish and Game (ADFG) sampled juvenile Dolly Varden tissues from two streams (Aufeis Creek and Omikviorok River) in the vicinity of the DMTS road in 2001. Juvenile Dolly Varden was chosen because it is a species and age class that can rapidly reflect the environmental metals concentrations in its tissues, and therefore is a good indicator of metals contamination. The results did not show a relationship of fugitive dust to the metals concentrations in juvenile Dolly Varden samples.

The National Park Service (NPS) performed a preliminary study in Cape Krusenstern National Monument in June–July 2000 to determine whether there were elevated lead, zinc, and cadmium levels in moss near the road. The NPS transect sampling showed that metals concentrations decreased rapidly with distance from the road. However, concentrations were still somewhat elevated at transect endpoints 1,000 and 1,600 m from the road. As part of Teck Cominco's fugitive dust study in 2001, Exponent collected moss, lichen, willow, and salmonberry samples on transects positioned along the DMTS road from the port facility to the mine. Metals concentrations in moss were higher in transects near either end of the road, and were lower in transects located in the middle section of road and were consistent with NPS study results. Exponent's sample results confirmed the NPS finding that concentrations typically decreased with distance away from the road. Lead, zinc, and cadmium concentrations in moss samples were highest near operational features such as the CSBs and the loop road, where trucks pull into the CSBs.

Unwashed salmonberry samples collected by both Exponent and DEC at the port had elevated mean lead, zinc, and cadmium concentrations relative to unwashed salmonberry samples collected in offsite areas.

Preliminary Conceptual Site Model

The preliminary CSM identifies potential sources, transport mechanisms, exposure media, exposure routes, and human and ecological receptors. The CSM provides an initial description of the network of relationships between chemicals released from a site and the human or ecological receptors that may be exposed to the chemicals through pathways such as ingestion of food or water. The CSM for Red Dog operations delineates hypothesized transport of metals from sources at the mine, along the DMTS road, and at the DMTS port facility into surrounding terrestrial and aquatic ecosystems, and the pathways by which human or ecological receptors may be exposed to these metals. The primary mechanisms by which metals escape from these sources are through fugitive dust and concentrate spillage. In addition, runoff from precipitation and snowmelt could also transport metals from the DMTS road, mine, and port operations into surrounding ecosystems.

Sources and Transport Mechanisms

Sources of metals from the mine include air transport of dust and surface water runoff. These sources are managed through DEC permitting processes. Air emissions from the mine have been modeled as part of the air permitting process. Air modeling demonstrates that the air permit requirements are met at the mine's ambient air boundary. All surface water from the mine area is collected behind the tailings dam and is treated prior to release to Red Dog Creek. Metals concentrations in the surface water discharge are subject to limits defined in the National Pollutant Discharge Elimination System (NPDES) discharge permit.

The primary sources and mechanisms of fugitive dust transport along the DMTS road include tracking (adhering to the tires or other surfaces of the haul trucks, and subsequently being deposited onto the road), and windblown dust from the road surface. Dust on truck surfaces may be blown from those surfaces and carried onto the road or into the surrounding environment. Surface water runoff from the road can carry metals containing dust from the surface of the road to the tundra just off the road shoulder. In the past, concentrate spillage and escapement from trucks was likely a significant factor; however, new trucks with hydraulically closed steel covers that seal tightly may have minimized or possibly eliminated this source.

In addition to those mechanisms described above for the DMTS road, other fugitive dust sources and transport mechanisms may occur at the port site. These include windblown dust from the unloading process at the truck unloading building, handling of concentrates in the CSBs, and moving the concentrates through the conveyor loading system. Concentrates are now carried by a closed conveyor from the CSBs to the barges. Before the system was enclosed, however, some spillage of concentrate from the conveyors occurred.

During barge loading, there is some potential for concentrate dust to emerge from the covered barge and be carried into the surrounding environment by the wind. There is low potential for spillage or windblown dust during transport between the shiploader and the deepwater ship. Once within the ship, there is low potential for spillage or generation of windblown fugitive dust.

Human Health

The potential for people to be exposed to metals related to the DMTS road and the port area is limited, because of the remote nature of the affected area. Worker exposure is controlled through a closely monitored industrial hygiene program. The local subsistence users that fish, hunt, and gather plants and berries may also be exposed through consumption of food items.

Potential exposure pathways may be categorized under three environments: marine, terrestrial, and freshwater. In each of these environments, there may be some potential for exposure to metals through consumption of food (e.g., plants, fish, and/or other animals) and incidental ingestion or contact with soil/sediment. In the freshwater environment, potential exposure to metals may also exist through ingestion or contact with affected water.

Metals could be transported to the marine environment through surface water runoff, fugitive dust deposition, or spillage in the barge transfer operation, and could subsequently be taken up by marine animals that are consumed by people. Local residents could be exposed to metals taken up by plants or animals downwind of the DMTS road or port site through consumption of subsistence harvest foods. Metals from the DMTS road or port facility that have been transported onto plants or tundra soils could be consumed by animals (e.g., ptarmigan and caribou) that are in turn consumed by people. People could also consume plants and berries that have taken up metals from the soil or onto which dust has been deposited. Incidental ingestion and dermal contact with soil (if it contains elevated metals concentrations) could possibly lead to human exposure as well. Inhalation of airborne particulates from soil is another potential exposure pathway, although it is likely to be limited relative to other pathways. Berry sampling conducted by DEC and Exponent suggested elevated concentrations of some metals relative to reference conditions. However, preliminary risk calculations conducted by the Alaska Department of Health and Social Services did not indicate any elevated risks associated with consumption of berries or other subsistence foods.

Although current data indicate minimal effects, surface water quality could potentially be impacted by metals from the DMTS road, port, or the mine. If surface water quality is affected, fish in the streams may accumulate metals, which could then be consumed by subsistence users. If freshwater sediments are affected by metals, exposure could theoretically occur through incidental ingestion or dermal contact with the sediments. Surface water runoff from the mine is collected behind the tailings dam, treated, and discharged to Middle Fork Red Dog Creek (subject to the permit issued under NPDES), which ultimately flows into the Wulik River. The Wulik River is a source of drinking water for Kivalina residents. Sampling of Kivalina drinking water has been conducted on an ongoing basis and has not shown elevated metals concentrations. This sampling program will continue.

Ecological

Pathways by which ecological receptors may be exposed to metals associated with Red Dog operations exist for both aquatic and terrestrial communities in the vicinity of the mine, DMTS road, and port facility. The mine is located in an area of naturally occurring mineralization and therefore naturally elevated metals concentrations. Primary exposure pathways for aquatic receptors include the ingestion or uptake of surface water, consumption of plant material or prey, incidental ingestion of sediment during foraging, and direct contact with surface water. Primary exposure pathways for terrestrial receptors include the consumption of plant material or prey and the incidental ingestion of soil. For plants, the primary pathways are the uptake of metals incorporated into soil and the uptake of metals deposited onto plant surfaces as fugitive dust. For most receptors, direct contact with affected sediment or soil would be brief, and thus constitutes only a minor exposure pathway.

Ecological receptors that may be exposed to metals from Red Dog operations occur in aquatic systems such as creeks, tundra ponds, marshes, bogs and other wetlands, coastal lagoons, and the marine ecosystem. Receptors also occur in terrestrial systems such as shrub and tussock tundra and coastal sand dunes. Receptors that would be considered for use in an ecological risk assessment would be identified in consultation with local subsistence users.

Identification of Potential Data Gaps

This section provides a preliminary list of additional information that may be needed to understand the effects of fugitive dust on the environment (referred to as data gaps). The following list of data gaps emerges from a review of the various background information and analytical data, as well as the site conceptual model reviewed and described in this document. Additional data gaps may be identified through the public review process, which would include consultation with the subsistence committee, as well as local, state, and federal agencies.

The potential data gaps listed below should be viewed as a starting point for public review, and may not be a complete list of needed information. As these potential data gaps are evaluated, and available data reviewed, some of the items may be removed from the list, if sufficient information is already available.

Additional background information that may be needed to evaluate fugitive dust transport, deposition, and effects includes:

- Current subsistence information (e.g., percentages of villagers relying on subsistence activities, most important subsistence foods, consumption rates)
- Regional metals occurrences and background concentrations of metals (in order to distinguish between naturally occurring metals concentrations and metals concentrations resulting from dust emissions from the mining and transport operations).

Data gaps related to the characterization of the nature and extent of fugitive dust deposition may include:

- Soil data to define the extent of ore concentrate deposition around operational features at the port site (e.g., conveyor storage area, P8 conveyor, etc.), and along the road
- Water from tundra ponds in the vicinity of the DMTS road
- Sediment data from nearshore areas, the deepwater ship area, and stream sediment and/or tundra pond sediment from along the DMTS road
- Aquatic biological data, possibly including aquatic organisms in tundra ponds along the DMTS road
- Terrestrial biological data needs may include:
  - Extent of metals in moss around the DMTS port and along the DMTS road (unclear where elevated numbers approach background)
  - Metals uptake into subsistence harvest plants—metals within versus on plant (potentially for addressing human health concerns)
  - Ecological impacts of fugitive dust (ecological risk screening evaluation)
  - Small animal tissue data to support ecological risk screening evaluation.

Data needs related to monitoring fugitive dust emissions and the effects of fugitive dust deposition may include:

- Periodic soil sampling (road, port)
- Periodic water sampling (lagoons, streams at road crossings)
- Periodic sediment sampling (lagoon and offshore sediment)
- Air monitoring (at ambient air boundary of road, port and mine)

- Air monitoring in villages (already planned)
- Juvenile Dolly Varden tissue (additional monitoring near road already planned)
- Periodic moss sampling
- Caribou sampling (field work completed in April 2002, analyses in progress)
- Other species (e.g., ptarmigan, receptors in risk assessment process).

Decision Making Framework (DEC)

Areas that qualify as "contaminated sites" will be addressed through the Site Cleanup Rules found in 18 Alaska Administrative Code (AAC) 75.325-390. These rules set the processes and standards to determine the necessity for and degree of cleanup required to protect human health and the environment at sites where hazardous substances are located. The general decision framework shown in Figure ES-3 will be used to make cleanup decisions at contaminated sites associated with the Red Dog Mine operations between the CSB at the mine and the deep sea vessels off the coast. Taken together, paragraphs 21, 22, 23, 49, and 115 of 18 AAC 75.990 define a contaminated site as an area containing hazardous substances at concentrations exceeding applicable cleanup levels. Cleanup levels are defined as concentrations of hazardous substances that may be present in environmental media under specified exposure conditions without posing a threat to human health, safety, or welfare, or to the environment. Environmental monitoring options to evaluate and determine dust control measures at the Red Dog Mine CSB, and the DMTS road and port facilities will be evaluated throughout the project.

Figures

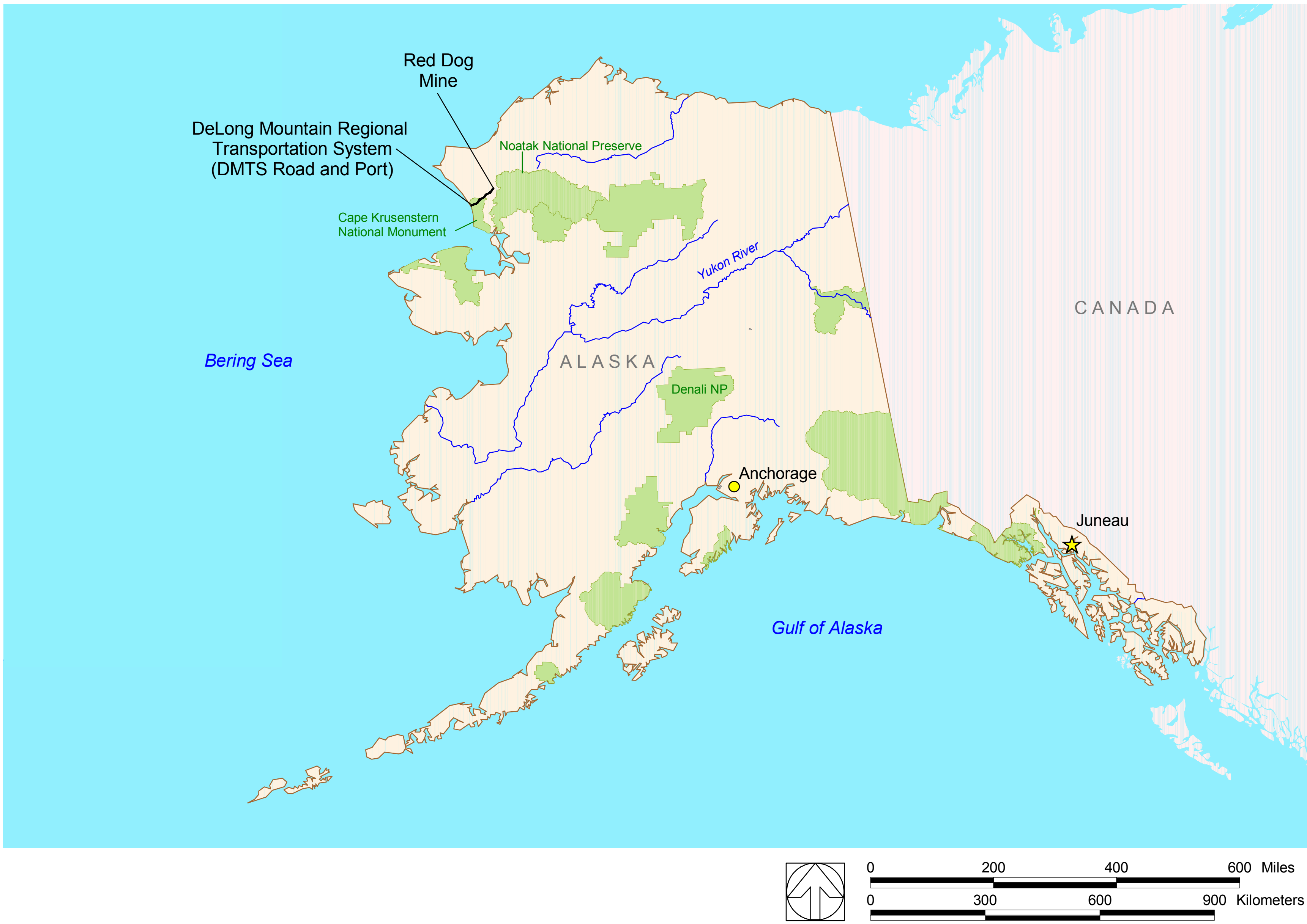

Figure ES-1. Location map

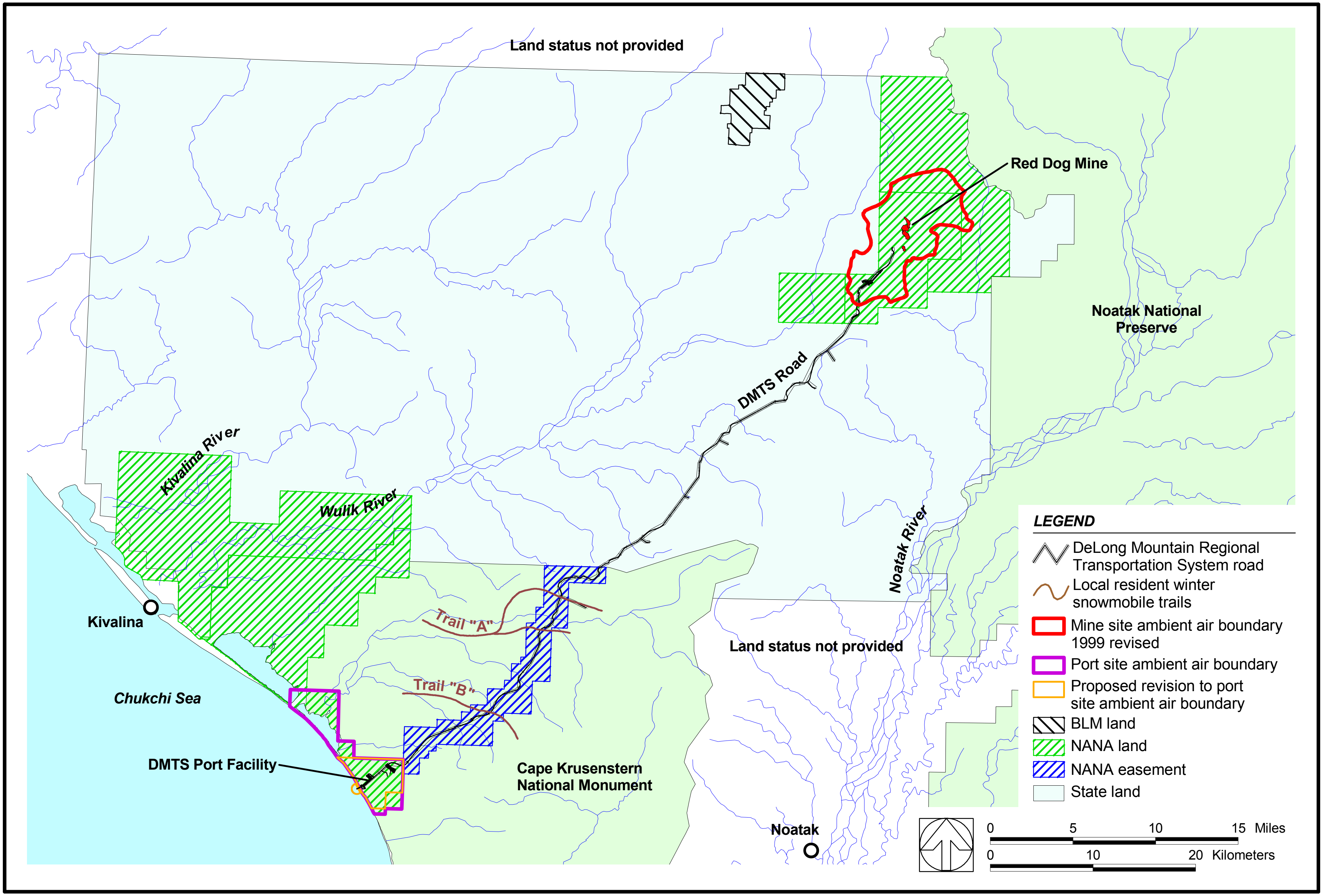

Figure ES-2. Land ownership and use map

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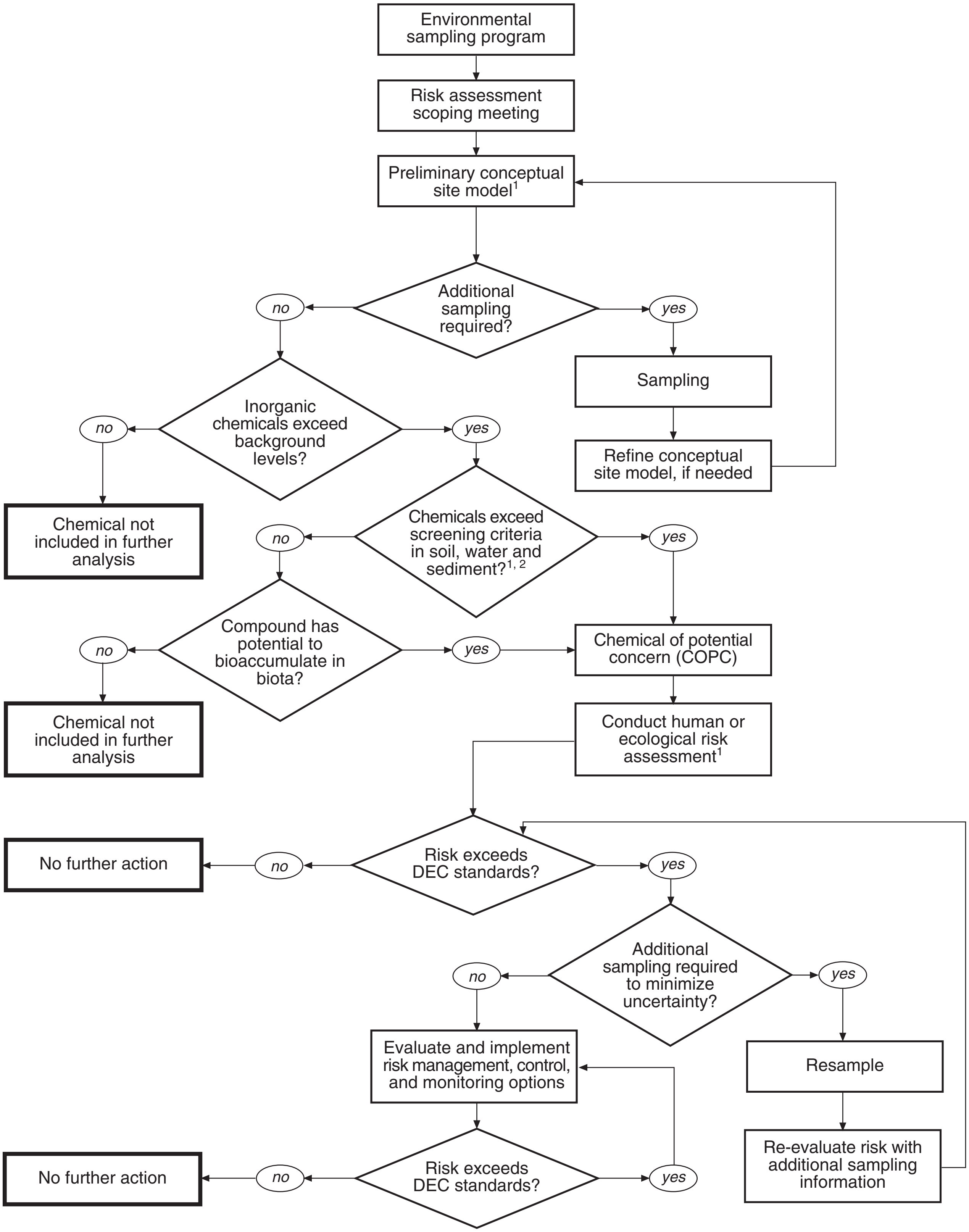
8601997.001 0302 | May 16, 2002 | Fig 1-6 Land ownership | Fig ES-2 land ownership layout | j:\red_dog\projects\bckgrnd_0202.apr



1 Human and ecological receptors will be evaluated separately

2 Water quality standards and contaminant migration will be evaluated

Figure ES-3. Decision making framework for evaluating risk to human health and ecological receptors

Tables

Table ES-1. Summary of studies by media

								Biological Media											
				Environmental Media				Plant								Animal			
Lead Organization	Study Type	Citation	Study Dates	Soil	Water	Sediment	Air	Algae	Moss	Lichen	Willow	Salmonberry	Blackberry	Sourdock	Plant Communities	Invertebrates	Fish	Caribou	Human Blood
Pre-Mine/Baseline																			
Teck Cominco	Environmental baseline study	Dames & Moore (1983)	1981–1983		A											O	A		
General Crude Oil and Minerals	Environmental baseline study	Ward and Olson (1980)	1978–1979		A												A		
Alaska Department of Environmental Conservation	Aquatic baseline study	EVS and Ott Water (1983)	1982														A		
U.S. Fish and Wildlife Service	Baseline study for Selawik NWR	Mueller et al. (1993)	1987–1988		A	A											A		
Post-Mine																			
Teck Cominco	Port site monitoring	ENSR (1990, 1991, 1993, 1996); RWJ (1997)	1990–1996	A	A	A													
	Transportation corridor monitoring	ENSR (1991)	1991–1992	A	A														
	Port site air monitoring		1997–present				A												
	Vegetation and soil monitoring	RWJ (1997)	1992, 1993, 1997	A											O				
	Fugitive dust study	Exponent (2002)	2001	A	A				A	A	A	A							
	Kivalina drinking water study	RWJ (1997); DHSS (2001)	1991–2001		A														
Alaska Industrial Development and Export Authority	Sediment quality survey	Cominco, RWJ, and PN&D (1999)	1998	A		A													
	Marine biota survey	RWJ (2001)	2000													O	O		
Alaska Department of Environmental Conservation	Subsistence foods investigation	ADEC (2001); DHSS (2001)	2001		A							A	A	A					
Alaska Department of Fish and Game	NPDES monitoring	Weber-Scannell and Ott (2001)	1991–1994														O		
	NPDES monitoring, expanded scope	Weber-Scannell and Ott (2001)	1994–2001		A			O								O	A		
	Juvenile fish tissue study	Morris and Ott (2001); DHSS (2001)	1993, 1998–2001														A		
	Caribou monitoring	Pollard (1994)	1993–1994															O	
	Caribou tissue study	DHSS (2001)	1996															A	
National Park Service	DMTS road dustfall study	Ford and Hasselbach (2001)	2000	A					A										
		Ford and Hasselbach (2002)[a]		A					A										
Kivalina Village	Kivalina drinking water sampling	DHSS (2001)	1995, 1996, 2001		A														
Alaska Department of Health and Social Services	Public health evaluation	DHSS (2001)	1992–2001																A

Note: A - analytical data available
O - other data types available

[a] Study release is pending.