Comments on the Eco-risk Sections of the Draft DeLong Mountain Transport System (DMTS) Fugitive Dust Risk Assessment Work Plan, Red Dog Mine, Alaska (Exponent, Feb. 2004)					
	General	General	General	High	Comments made regarding the human health portion screening procedure are applicable to the ecological screening procedure, which includes frequency of detection/exceedance are not being acceptable as screening methods.
Eco-1	General	General	General	High	The issues described in the specific comments should be addressed in all areas of the report where they occur, not only where they are called out in the comments that follow. Typically, the specific comments identify the first occurrence of a problem or the section where it is discussed at length. The draft report should be revised and reissued consistent with the specific comments below so ADEC and other stakeholders can verify that the deficiencies have been addressed.
Eco-2	3-1	3.1	Technical	High	Sulfur was inappropriately eliminated as a chemical of potential concern (COPC). Section 1.1 (*Site Overview*) indicates that the Red Dog deposit is a zinc and lead sulfide ore body. As shown in Table 2-1, total sulfur is a significant component of the ore concentrates. Because only a small fraction of total sulfur in the ore concentrates is sulfate (see Table 2-1), one must assume that sulfide is the primary form of sulfur in the concentrates. Sulfide minerals can be oxidized when exposed to air and water to yield sulfuric acid. Sulfur should not be eliminated as a COPC until it is shown that habitats that received inputs of ore dust do not exhibit depressed pH compared with background. Depressed pH can adversely affect many types of ecological receptors. Has pH been measured in any of the surface water bodies (e.g. creeks, tundra ponds, lagoons) that were sampled thus far? If so, the data should be made available to DEC. If not, pH measurements should be made during the 2004 field season.
Eco-3	3-4	3.2.3.2	Technical	Moderate	It is unclear from this section where the reference inorganic soil samples were collected. Were they collected from the terrestrial reference area or somewhere else?
Eco-4	3-8	3.2.8	Technical	High	We recommend that the "site" be divided into three operable units for the eco risk assessment when making comparisons to background, as follows: (1) port site versus background, (2) DMTS road versus background, and (3) DMTS road near mine versus background. In general, the level of contamination in sediment, soil, and water is much greater near the port than along the DMTS road (except near the mine). The smoothing effect has been discussed in the comments on the HHRA.

					For example, Table 3-8 indicates that lead is not elevated in tundra pond sediment compared with background. However, a review of the data in Tables C-9 and C-10 shows that lead in tundra pond sediment near the port (average= 1805 mg/kg) is 100 times greater than background (average = 11.6 mg/kg). To correctly identify contamination above background, it will be necessary to separate the site into operable units. If doing so results in too few samples to conduct statistical testing, then a non-statistical method should be used to judge whether contamination is present above background (see ADEC 2003), or additional samples should be collected in the 2004 field season. **References** Alaska Department of Environmental Conservation (ADEC). 2003. Determining Background Concentrations in Soil (www.state.ak.us/local/akpages/ENV.CONSERV/dspar/csites/guidance). United States Environmental Protection Agency (USEPA). 1989. *Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference*, USEPA Environmental Research Laboratory, Corvalis, OR, EPA/60/3-89-013. United States Environmental Protection Agency (USEPA). 1992. *Final Guidance for Data Usability in Risk Assessment.* USEPA Office of Solid Waste and Emergency Response, Washington, D.C., publication 9285.7-09A/FS.
Eco-5	Tables 3-5 to 3-12	3.2.8	Technical	High	The *p* value for each site-to-reference comparison should be provided in the tables. Alpha = 0.1 should be used as a cutoff for statistical significance. The tables should indicate which comparisons are based on Wilcoxon's test (a nonparametric procedure) and which are based on parametric statistical procedures.
Eco-6	Table 3-23	3.5.3.2	Technical	Moderate	For lead, this table indicates that 4 of 5 site samples exceeded the freshwater Criteria Continuous Concentration (CCC) of 3.2 ug/L. However, the lead concentration in all five samples was less than 3.2 ug/L. This apparent discrepancy appears to be related to the low hardness of the pond samples and the fact that the hardness-adjusted lead criterion was much less than 3.2 ug/L. Table 3-23 should list a range for those criteria that are hardness dependent (Cd, Cu, Pb, Ni, Ag, Zn) instead of a single value based on a hardness of 100 mg/L as calcium carbonate.
Eco-7	Tables 3-33 to	3.5.6.3	Technical	High	The screening-level assessment for the snipe and plover used a biota-sediment accumulation factor (BSAF) of unity for all metals. This is not adequately

	3-35				conservative for all metals. Instead, the recommendation from Bechtel Jacobs (1998) should be used to estimate concentrations of metals in aquatic-invertebrate prey of the snipe and plover. According to Bechtel Jacobs (1998, page 29), the 90th percentile BASFs or 95% upper prediction limits (UPLs) should be used as a preliminary screening tool. This recommendation will result in BSAFs greater than unity for several metals. A BSAF of 1 is appropriate for metals not addressed by Bechtel Jacobs (1998). **Reference** Bechtel Jacobs Company LLC. 1998. *Biota-Sediment Accumulation Factors for Invertebrates: Review and Recommendations for the Oak Ridge Reservation.* Bechtel Jacobs Company LLC. Oak Ridge, TN. BJC/OR-112.
Eco-8	3-19	3.5.2.1	Technical	High	The No Effect Concentrations (NECs) developed by Ingersoll et al. (1996) for freshwater sediments are not sufficiently conservative for use in a screening-level ecological risk assessment. The NECs are analogous to apparent effects thresholds (AETs) and thus have a high false-negative rate compared with other sediment benchmarks. Hence, the NECs should not be used to eliminate chemicals from further consideration in Section 3. **Reference** Ingersol, C.G. and eight others. 1996. Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the midge *Chironomus riparius. J. Great Lakes Res.* 22:602-623.
Eco-9	3-20	3.5.3.1	Technical	High	See comment Eco-8 on Section 3.5.2.1 regarding the NECs.
Eco-10	3-21	3.5.4.1	Technical	High	The Washington State Sediment Management Standards (SQSs) are not sufficiently conservative for use in a screening-level ecological risk assessment. The SQSs were developed using the AET approach and thus have a high false-negative rate compared with other sediment benchmarks. Hence, the SQSs should not be used to eliminate chemicals from further consideration in Section 3. Generally speaking the RAPM advocates a conservative screening approach, so NOAA screening values are preferable.
Eco-11	3-22	3.5.5.1	Technical	High	See comment Eco-10 on Section 3.5.4.1 regarding the SQSs.

Eco-12	3-31	3.6.2.3	Technical	High	Lead should be included as a COPC in pond water near the port. The data in Tables C-11 and C-12 show that lead levels in pond water near the port are 2 to 10 times higher than in the reference ponds. In addition, the surface-water lead concentration in one pond near the port exceeds the hardness-adjusted chronic water quality criterion by a factor of five. It appears that lead was not identified as a COPC in pond water because samples near the site were combined with samples from along the haul road and then compared with background. As described above (see comment Eco-4 on Section 3.2.8), to correctly identify contamination above background, it will be necessary to separate the site into operable units. If doing so results in too few samples to conduct statistical testing, then a non-statistical method should be used to judge whether contamination is present above background (see ADEC 2003), or additional samples should be collected in the 2004 field season. **Reference** Alaska Department of Environmental Conservation (ADEC). 2003. Determining Background Concentrations in Soil (www.state.ak.us/local/akpages/ENV.CONSERV/dspar/csites/guidance).
Eco-13	3-32	3.6.2.4	Technical	High	It is not clear from the information presented in the February 2004 work plan how repeated measurements at the lagoon sediment stations were handled when conducting statistical analyses. Tables C-13 and C-14 show that many lagoon sediment stations were sampled multiple times on different dates. Were the repeated measurements averaged into a single value for each station or treated individually during statistical analyses? Based on an independent analysis of the lagoon sediment data, lead, cadmium, and zinc were found to be significantly greater ($p=0.057$ for Cd, $p=0.003$ for Pb, $p=0.003$ for Zn) in sediment from Port Lagoon North compared with background (Mann Whitney U test). In addition, zinc was significantly greater in sediment from the North Lagoon compared with background ($p=0.040$, Mann Whitney U test). To avoid pseudo-replication (Hurlbert 1984), stations with repeated measurements from different dates were averaged into single station value for the analysis. Based on this analysis, it is recommended that lead and cadmium be considered COPCs in coastal lagoon sediment. In addition, Figures 3-9 to 3-11 show that Port Lagoon North, and to a lesser extent

					the North Lagoon and north arm of Port Lagoon South, have received inputs of fugitive dust. Sediment concentrations of cadmium, nickel, and zinc often exceed the ERL, and at some locations exceed the ERM. Sediment toxicity may be necessary to determine if these elevated sediment metal concentrations are associated with toxicity. The samples should be collected along a gradient in contamination near the port and also from uncontaminated background lagoons. The resulting data could be presented in the baseline risk assessment to provide a more definitive assessment of risk to benthic life in the coastal lagoons. **Reference** Hurlbert. S.H. 1984. Pseudoreplication and the design of ecological field experiments. Ecological Monographs 54:187-211.
Eco-14	3-32	3.6.2.4	Technical	Moderate	Two of five unfiltered water samples from the North Lagoon had a zinc concentration from 2 to 4 times greater than the maximum background concentration, and one sample from the North Lagoon exceeded the salt-water chronic water quality criterion for zinc. Based on these data, zinc should be considered a COPC in water in the North Lagoon. The lagoon surface-water data presented in the work plan is for unfiltered samples only. Consequently, it is possible that the elevated concentrations observed in the North Lagoon could be due to suspended solids. DEC recommends that any future surface-water sampling include collection of both filtered and unfiltered samples.
Eco-15	3-33	3.6.3	Technical	High	This section states that screening could not be performed for terrestrial carnivores due to lack of data on COPC levels in prey. Why were the small-mammal uptake models presented in Sample et al. (1998) not used? This section states that the screening results for freshwater piscivores are assumed to be protective of marine piscivores. This assumption does not consider the fact that the concentrations of cadmium, lead, zinc, and other metals in sediment from the coastal lagoons near the port are considerably greater than in the streams and creeks along the haul road. Potential risks to piscivorous wildlife that utilize the coastal lagoons should be evaluated. If necessary, collection and analysis of fish from the coastal lagoons near the port should be undertaken. Also, a better description of the ecology of coastal lagoons would be extremely helpful (i.e. what fish species are found in the lagoons, what wildlife species use the lagoons for feeding or other activities, etc.).

					See comment Eco-16 regarding Table 3-28. See comment Eco-23 regarding allometric scaling. COPC selection for wildlife will need to be modified based on these comments. Sample, B.E., J.J. Beauchamp, R.A. Efroymson, and G.W. Suter. 1998. *Development and Validation of Bioaccumulation Models for Small Mammals.* Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-219.
Eco-16	Table 3-28	3.5.6	Technical	High	**General Comment on Table 3-28:** The TRVs proposed for the following COPCs are acceptable: aluminum, barium, cadmium, copper, fluoride, manganese, mercury (except the avian NOAEL), molybdenum, nickel, selenium, tin, and vanadium. **Arsenic:** Please make available for review your derivation of the avian NOAEL and LOAEL from the study of Stanley et al. (1994). For mammals, DEC recommends that the NOAEL and LOAEL be based on Nemec et al. (1998) rather than Schroeder and Mitchener (1971). The Nemec et al. (1998) study is preferable because it is more recent and the NOAEL can be derived directly from one of the test treatments without use of an uncertainty factor. The following NOAEL and LOAEL derivation is based on Nemec et al. (1998): Compound: Arsenic Form: Arsenate (H_3AsO_4) Reference: Nemec et al. (1998) Test Species: Rabbit Body wt: 4.396 kg Exposure Duration: Days 6-18 of gestation (critical stage = chronic) Endpoint: Reproduction Exposure Route: Oral Gavage Dosage: 4 dose levels (concentrations as H_3AsO_4) H_3AsO_4 is 52.78% As by weight 0, 0.19, 0.75, and 3 mg/kg-d as H_3AsO_4 0, 0.1, 0.396, and 1.58 mg/kg-d as As Comments: Reproductive and maternal effects were observed only at the highest dose level, which resulted in mortality for 7 of 20 does. No maternal

					mortality was observed at any other dose level. Number of fetuses/litter decreased and fetal resorptions increased at the highest dose level, but the differences were not statistically significant. Because the study considered exposure during a critical life stage, the 1.58 mg/kg-d dose was considered to be a chronic LOAEL. Final NOAEL: 0.396 mg/kg-d Final LOAEL: 1.58 mg/kg-d **Cobalt:** Please provide a copy of Nation et al. (1983). **Chromium:** The avian and mammalian TRVs for chromium are based on studies with hexavalent chromium. This is appropriate for the screening-level assessment. However, for the baseline assessment, the chromium TRVs should be based on the actual form of chromium present at the site. Has hexavalent chromium been analyzed or is it presumed present in environmental media at the site? If hexavalent chromium has not been sampled for and is not likely on site a limited number of water, soil, and sediment samples should be analyzed for both hexavalent and total chromium in 2004. If no hexavalent chromium is detected or known not to exist at the site, then the TRVs for the baseline assessment should be based on studies with trivalent chromium. However if you elect not to pursue the above suggestion, given that treating total chromium as hexavalent is the conservative approach, it will be accepted in the risk assessment. **Lead:** For mammals, Table 3-28 lists a NOAEL and LOAEL of 11 and 90 mg/kg-day, respectively, based on the study of Azar et al. (1973). Sample et al. (1996) used the same study to derive a NOAEL and LOAEL of 8 and 80 mg/kg-day, respectively. Please use the TRVs from Sample et al. (1996) or explain the discrepancy. **Mercury (as methylmercury):** Please make available for review your derivation of the avian NOAEL of 0.032 mg/kg-day from the work of Heinz. Sample et al. (1996) derived an avian NOAEL of 0.0064 mg/kg-day from the study of Heinz (1979). Please use this NOAEL or defend the use of the greater NOAEL (0.032 mg/kg-day) given in Table 3-28.

					Has methylmercury been analyzed for in environmental media at the site? If not, a limited number of water, soil, and sediment samples should be analyzed for both total and methylmerury in 2004. The results of the baseline assessment will be more informative if the actual form of mercury present at the site is known and used in the exposure and risk calculations. **Silver:** Please consult Walker (1971) for mammalian toxicity data for silver. **Thallium:** For mammals, Table 3-28 lists a NOAEL and LOAEL of 0.074 and 0.74 mg/kg-day, respectively, based on the study of Formigli et al (1986). Sample et al. (1996) used the same study to derive a NOAEL and LOAEL of 0.0074 and 0.074 mg/kg-day, respectively. The NOAEL and LOAEL from Sample et al. (1996) should be used. **Zinc:** For birds, Table 3-28 lists a NOAEL of 130 mg/kg-day based on the study of Stahl et al. (1990). Sample et al. (1996) used the same study to derive a NOAEL of 13 mg/kg-day. The NOAEL from Sample et al. (1996) should be used. **References** Azar et al. 1973. Review of lead studies in animals carried out at Haskel laboratory-two-year feeding study and response to hemorrhage study. Pp. 199-210 In: *Environmental Health Aspects of Lead,* D. Barth, A. Berlin, R. Engel, et al. (Eds.). Commission of the European Communities, Luxembourg. Formigli, L., R. Scelsi, P. Poggi, C. Gregotti, A. DiNucci, E. Sabbioni, L. Gottardi, and L. Manzo. 1986. Thallium-induced testicular toxicity in the rat. *Environ. Res.* 40: 531-539. Heinz, G. H. 1979. Methyl mercury: reproductive and behavioral effects on three generations of mallard ducks. *J. Wildl. Mgmt.* 43: 394-401. Nation et al. 1983. The effects of chronic cobalt exposure on behavior and metallothionein levels in the adult rat. *Neurobehav. Toxicol. Teratol.* 5:9-15. Nemec, M.D., J.F. Holson, C.F. Farr, and R.D. Hood. 1998. Developmental toxicity assessment of arsenic in mice and rabbits. *Reprod. Toxicol.* 12: 647-658.

					Sample, B., D. Opresko, and G. Suter. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. Risk Assessment Program, Health Sciences Research Division, Oak Ridge National Laboratory. ES/ER/TM-86/R3. Schroeder, H. A and M. Mitchener. 1971. Toxic effects of trace elements on the reproduction of mice and rats. *Arch. Environ. Health* 23: 102-106. Stahl, J. L., J. L. Greger, and M. E. Cook. 1990. Breeding-hen and progeny performance when hens are fed excessive dietary zinc. *Poult. Sci*. 69: 259-263. Stanley et al. 1994. Main and interactive effects of arsenic and selenium on mallard reproduction and duckling growth and survival. *Arch. Environ. Contam. Toxicol.* 26:444-451. Walker, F. 1971. Experimental argyria: A model for basement membrane studies. *Brit. Exptl. Path*. 52: 589-593.
Eco-17	5-3	5.1.2.4	Technical	High	In addition to being exposed to chemicals in surface water, fish can be exposed to sediment contamination, especially fish that feed on benthic invertebrates. This exposure pathway should be considered and evaluated. The level of sediment contamination in the coastal lagoons is much greater than in streams and creeks along the haul road. Consequently, the screening results for freshwater piscivores cannot be assumed to be protective of piscivores that use the coastal lagoons. Potential risks to piscivorous wildlife that use the coastal lagoons should be evaluated.
Eco-18	5-4	5.1.2.5	Technical	High	Figures 3-9 to 3-11 indicate that cadmium, lead, and zinc are highly elevated in sediment at the end of the shiploader. The concentrations at this location are high enough to result in adverse impacts to benthic life. What controls are being implemented to ensure that the zone of impact does not expand? What future monitoring activities are planned for this location to confirm that the controls are effective? Table C-17 shows that nearly all the exceedances of the ERL for cadmium are due to samples collected in August 2000. The August 2000 samples have a ten-fold higher cadmium concentration than offshore sediment samples collected on other

					dates. Did the data from August 2000 undergo the same level of QA/QC applied to data from other sampling trips? Please check to see that a factor-of-ten error was not made when calculating the sample concentration from the laboratory instrument output for the August 2000 samples. If the data are sound, then it appears that cadmium contamination in sediment exists well offshore from the shiploader.
Eco-20	5-12	5.4.1	Technical	High	The third full paragraph in this section begins by stating that "mean" COPC concentrations in biota, water, sediment, and soil will be used to calculate dietary exposure in the baseline ERA. The 95% upper confidence limit (UCL) on the mean concentration should be used, as described in USEPA (2002). **Reference** United States Environmental Protection Agency (USEPA). 2002. *Calculating Exposure Point Concentrations at Hazardous Waste Sites, Draft.* Office of Emergency and Remedial Response, Washington, D.C. OSWER 9285.6-10.
Eco-21	5-12, 5-14, 5-16	5.4.1, 5.4.2, 5.5	Technical	High	The baseline assessment should use both NOAEL-based and LOAEL-based TRVs when assessing wildlife risks, not only LOAEL-based TRVs.
Eco-22	5-14	5.4.2	Technical	High	Probabilistic modeling is not acceptable for ecological risk assessment. ADEC RAPM specifies that it may only be used for human health risk assessment.
Eco-23	5-16	5.5	Technical	High	There is a large difference in body weight between several of the wildlife receptors being evaluated (e.g., moose) compared with the test animals (e.g., mouse) used to develop the TRVs in Table 3-28. Consequently, allometric scaling of TRVs should be performed for both the screening-level and baseline ERA. Despite the limitations mentioned by Sample and Arenal (1999), allometric scaling is still recommended by these authors and is standard practice in the field of ecological risk assessment (e.g. Sample and Suter 2002). **References** Sample, B.E. and C.A. Arenal. 1999. Allometric models for interspecies extrapolation of wildlife toxicity data. *Bull. Environ. Contam. Toxicol*. 62:653-663. Sample, B.E. and G.W. Suter. 2002. Screening evaluation of the ecological risks to terrestrial wildlife associated with a coal ash disposal site. *Human and Ecological Risk Assessment* 8:637-656.

Eco-24	7-1	7	Technical	High	In addition to the sampling recommended in the February 2004 work plan, the following sampling should be undertaken: 1. A limited number of water, soil, and sediment samples should be analyzed for both total and methylmercury to development an understanding of mercury speciation at the site. This information is needed to select the appropriate TRV for the baseline risk assessment for wildlife. 2. pH should be measured in surface-water bodies impacted by ore concentrate to determine if oxidation of sulfides in the ore concentrate is impacting surface-water pH. 3. Site-specific data on trace-metal bioavailability in sediment would be useful. In 2004, sediment toxicity tests may need to be conducted with sediment from coastal lagoons near the port, specifically Port Lagoon North, and reference lagoons. 4. Collection and analysis of sediment and water from additional tundra ponds near the port and along the haul road should be conducted. Currently, data are available only for two ponds near the port and two along the haul road. This number of sampling locations will be inadequate to support the statistical approach described in the work plan if the site is partitioned into operable units. 5. Any future surface water sampling should include collection of both filtered and unfiltered samples so the effect of suspended solids can be evaluated. 6. Fish may need to be collected from coastal lagoons near the port so potential risks to piscivorous wildlife that feed in this habitat can be evaluated. A reference lagoon should also be sampled in this case.