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No.	Page	Section	Technical/ Policy	Priority	Comment/Recommendation
General Comments					
Gen-1	-	2	Technical	High	The risk assessment report should include a discussion of the nature and extent of contamination at the site. Figures such as those presented in Ford and Hasselbach (2001) and Hasselbach et al. (2004) should be used to illustrate the extent of contamination along the haul road for important site-related chemicals such as cadmium, lead, and zinc. In addition, the report should compare and contrast data collected for the risk assessment by Exponent and Teck Cominco with comparable data from other recent studies of the site, including Ford and Hasselbach (2001), Hasselbach et al. (2004), and Brabets (2004). Brabets, T.P. 2004. *Occurrence and Distribution of Trace Elements in Snow, Streams, and Streambed Sediments, Cape Krusenstern National Monument, Alaska, 2002-2003.* United States Geological Survey (USGS) Scientific Investigation Report 2004-5229. Ford, J. and L. Hasselbach. 2001. *Heavy Metals in Mosses and Soil on Six Transects Along the Red Dog Mine Haul Road, Alaska.* Western Arctic National Parklands, National Parks Service, NPS/AR/NRTR-2001/38. Hasselbach, L. J.M. Ver Hoef, J. Ford, P. Neitlich, E. Crecelius, S. Berryman, B. Wolk, and T. Bohle. 2004. *Spatial Patterns of Cadmium and Lead Deposition on and Adjacent to National Park Service Lands in the Vicinity of the Red Dog Mine, Alaska*. NPS/AR/NRTR-2004-45.
Ecological Risk Assessment Comments					
Eco-1	3-33	3.6.3	Technical	Medium	Please clarify how the information from Ott and Morris (2004) is used in this assessment and provide additional information from the Ott and Morris study. What streams are still targeted for study and how do concentrations compare between Aufeis Creek, Omikviorok River and those streams still targeted for further study?
Eco-2	-	Figure 4-2	Editorial	Low	The individual panels in Figure 4-2 should be numbered 4-2a, 4-2b, etc., not 3-1, 3-2, etc. It appears this may only be a problem with the printed copy of the report. The figure in the final copy should be checked and revised accordingly.
Eco-3	-	Fig. 4-13b	Technical	Medium	This figure gives the impression that the change in metals concentrations with distance from the haul road is greater than the change in pH. However, in this figure, pH is expressed on a logarithmic scale while the metals concentrations are expressed on an arithmetic scale. A change in pH of 3 log units equates to a change in hydrogen ion concentration of 1000 times, which is greater than or equal to the concentration change observed for metals. This fact should be acknowledged in Section 4.2.1 where this

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					figure is discussed. Any implications this fact may have on interpreting the plant survey data should be described.
Eco-4	6-5	6.1.4 and Table 6-1	Technical	Medium	As agreed in the Risk Assessment Work Plan, no mammals are listed as assessment endpoints for the coastal lagoons. However, Section 6.1.6.2 indicates that muskrats have been observed in lagoons near the port. Are other mammals (e.g., moose) also likely to forage in the coastal lagoons and/or have they been sighted in this habitat type? What can be said about potential risks to mammals in the coastal lagoons based on the relative degree of contamination in the lagoons compared with other habitats where mammals were evaluated?
Eco-5	-	Table 6-4	Editorial	Medium	Please verify that the headings and/or units used for all values in this table are correct. Typically, R-square values are not expressed in units of percent.
Eco-6	6-34	6.2.3.1	Technical	Medium	The last paragraph on this page suggests that cryoturbation may be responsible in part for stressed and dead vegetation near Concentrate Storage Building 1 (CSB1) and refers to similarities in the appearance of cryoturbation features observed elsewhere (Photograph 58) and the situation near CSB1 (Photograph 57). The frost-heave formation shown in Photograph 58 is not surrounded by dead vegetation like that found near CSB1. As such, it does not appear that cryoturbation is a valid explanation for adverse effects on tundra vegetation observed near CSB1. Please revise this section accordingly.
Eco-7	6-28	6.2.2	Technical	High	Include a figure or table in this section that illustrates the comparison of metal levels in moss to critical threshold concentrations in moss.
Eco-8	6-47	6.3.3.3	Technical	Medium	The conclusion drawn at the end of this section (i.e. “there appears to be a low likelihood of adverse effects to pond vegetation from exposure to COPCs in the DMTS road corridor”) may not be entirely accurate. Overall, the assessment for pond vegetation suggests that adverse effects are possible in ponds near the road and port, based on exceedances of critical plant tissue thresholds for certain elements. Please revise the conclusion of this section accordingly. If it is Exponent’s belief that analysis of unwashed plant tissue samples overestimates “true” plant tissue concentrations, then follow-up analysis of washed samples should be considered.
Eco-9	6-49	6.3.4	Technical	High	The information presented in this section indicates the following for Anxiety Ridge Creek: (1) sediment concentrations of cadmium, lead, and zinc downstream from the haul road are elevated above reference levels; (2) levels of cadmium and lead in benthic invertebrates downstream from the haul road are elevated above reference concentrations; and (3) levels of cadmium and lead in fish downstream from the haul road are elevated compared with upstream fish. These observations suggest a road-

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					related effect. Possible adverse impacts on fish in Anxiety Ridge Creek due to the haul road require additional evaluation. Levels of cadmium and lead in fish should be compared with critical tissue concentrations for fish. The results of the comparisons should be included in this section and, if necessary, the risk characterization (Section 6.3.4.3) should be modified accordingly.
Eco-10	6-68	6.5.3.1.1 and Appendix K	Technical	High	**Willow Ptarmigan Risks.** Table K-82 shows that the lowest observed adverse effect level (LOAEL)-based hazard quotient (HQ) for this receptor is 0.99 (i.e., almost exactly 1.0) at terrestrial transect number 7 (TT7) located downwind from the mine. Because the average was used as the exposure point concentration for all media, this HQ represents the risk to the average individual. It follows then that approximately one-half of the ptarmigan population in this area would receive a greater exposure to lead and thus be at risk from lead. This is a significant finding and should be discussed in Section 6.5.3.1.1 or elsewhere in the report, as appropriate. This comment also applies to the LOAEL-based HQ of 0.93 for lead for the ptarmigan at TT5 located near the Port (see Table K-77). Because the LOAEL-based HQ is close to 1.0 for the average case, some portion of the local ptarmigan population at this location would be expected to receive a lead exposure leading to a HQ greater than 1. Again, this is a significant finding and should be discussed in Section 6.5.3.1.1 and/or elsewhere in the report, as appropriate, such as Section 6.7.1. Presentation of ptarmigan risks based only on the average exposure scenario is not acceptable. An estimate of the reasonable maximum exposure and risk must also be presented. For this receptor, either a 95 percent UCL case based on three broad assessment units (mine, road, and port) should be presented as was done for large home-rage receptors (e.g., caribou), or point-by-point risk estimates should be presented as was done for small home-range receptors (e.g., shrew).
Eco-11	6-69	6.5.3.1.4 and Appendix K	Technical	Medium	**Moose Risks.** In Tables K-83 to K-88 for the moose, are the exposure point concentrations based on mean or 95 percent UCL on the mean concentration? This point should be clearly indicated in the tables. In Table K-85 for the moose, should the footnotes refer to ST-REF-6 instead of ST-REF-5? If so, please revise the table accordingly.
Eco-12	6-75	6.5.4.1.1	Technical	High	See comment Eco-9. How is population defined in Section 6.5.4.1.1?

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Eco-13	6-76	6.5.4.1.3	Technical	Medium	In the second paragraph of this section, how is "overall tundra vole population" defined? Does it refer to all voles in Cape Krusenstern National Monument, all voles north of the haul road, or some smaller local group?
Eco-14	6-81	6.6	Technical	High	The zone of cadmium and lead contamination along the haul road reported by Hasselbach et al. (2004) is greater than that generally suggested in the draft risk assessment report (i.e., about 2 km from the haul road). The data and analyses presented in Hasselbach et al. (2004) should be discussed in this section as they relate to the adequacy of the sampling design used for the ERA, the validity of the chosen background location, and how a larger zone of contamination affects the perceived risks posed by the haul road. Hasselbach, L. J.M. Ver Hoef, J. Ford, P. Neitlich, E. Crecelius, S. Berryman, B. Wolk, and T. Bohle. 2004. *Spatial Patterns of Cadmium and Lead Deposition on and Adjacent to National Park Service Lands in the Vicinity of the Red Dog Mine, Alaska*. NPS/AR/NRTR-2004-45.
Eco-15	6-83	6.6.2.1.1	Technical	Low	Have reference areas been established for the permanent vegetation monitoring plots established in the mine area (ridge-top dwarf shrub tundra, dwarf birch and blueberry shrub, tall willow)?
Eco-16	6-87	6.6.2.3	Technical	Medium	This section seems to understate the usefulness of the current dataset for understanding reasons for the observed changes in plant communities along the haul road. Physical factors are likely to exert their greatest influence near the road where dust deposition is greatest and drainage may be locally altered. Chemical factors (elevated metals and pH) are likely to become relatively more important at greater distances but cannot be ruled out as being significant near the road. Consider modifying the discussion accordingly. When other possible explanations are offered for effects on foliage, please evaluate them as possibilities rather than just propose them. Consider for example: Is only road material alkaline, or may concentrate be contributing to high pH? Did reports on impacts from other roads show effects as far as 1000m and 2000m away from the road? Is the fine concentrate material likely to travel further than material used to construct the road? If seasonal dryness was a contributing factor, what information do you have to support it being a dry year? Why is it supposed that wildlife use was unusually high near TT6 as compared with reference areas?

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Eco-17	6-97	6.7	Technical	High	For chemicals where the HQ is greater than 1.0 in comparison with a no observed adverse effect level (NOAEL) toxicity reference value (TRV) but less than 1.0 in comparison with a LOAEL TRV, risk cannot definitively be concluded to be negligible, as suggested by the discussion in this section. The true value of the LOAEL for a chemical is not exactly known because it is based on the dose levels selected in the laboratory toxicity study used to derive it. For this reason, Alaska DEC risk assessment guidance places equal or greater emphasis on wildlife risks based on the NOAEL compared with the LOAEL. This fact should be kept in mind when discussing and interpreting the significance of the wildlife HQs in this section and other areas of the risk assessment report.
Eco-18	6-98	6.7.1	Technical	High	A discussion of possible impacts to ptarmigan from lead at terrestrial transects 5 and 7 (TT5 and TT7) should be discussed in this section (see Comment Eco-9).
Eco-19	6-99	6.7.2	Technical	High	In the first paragraph, the statement that fish monitoring studies have found " no consistent evidence of a road effect on fish metals concentrations" overlooks the fact that a road-related effect on cadmium and lead levels in fish was observed in Anxiety Ridge Creek (see comment Eco-8). This impact should be discussed in this section. In the second paragraph, the statement "Adverse effects are not predicted in tundra ponds along the DMTS road" may not be entirely accurate. Table 6-23 shows that lead and zinc in sedges from tundra pond TP4 (along the road near the mine) exceed reference sedge concentrations and phytotoxicity thresholds for plant tissues. The exceedances of the phytotoxicity thresholds are not excessive but should not be overlooked in this section. In the third paragraph, the metals responsible for possible adverse effects on plants in the vicinity of TP-0100 should be mentioned (i.e., lead and zinc; see Table 6-23). Does Photograph 4 (small tundra pond near the port facility) show TP-0100? If so, refer to the photograph in this section. Brabets (2004) found sediment concentrations of cadmium and zinc in two streams crossing the haul road (i.e., Deadman and New Heart Creeks) that were up to five times greater than sediment concentrations reported in the draft ERA report (compare Table 8 from Brabets [2004] with Table 6-24 in the draft report). The high sediment concentrations found by Brabets (2004) may be the result of concentrate spills that occurred along the haul road near these two streams. The sediment data from Brabets (2004) should be discussed as it relates to the adequacy of the stream sediment-sampling

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					program used for the ERA and the validity of the conclusions drawn for freshwater stream habitats. Brabets, T.P. 2004. *Occurrence and Distribution of Trace Elements in Snow, Streams, and Streambed Sediments, Cape Krusenstern National Monument, Alaska, 2002-2003.* USGS Scientific Investigation Report 2004-5229.
Eco-20	-	Table 6-26	Technical	Medium	The assumed diet for the green-winged teal listed in Table 6-26 (100% herbaceous plants) does not match the assumed diet listed in Table 5-2 of the approved work plan (85% herbaceous plants, 15% invertebrates). The diet listed in the work plan is more appropriate for this receptor because the teal is known to feed more on animal matter in the summer (Kaufman 1996). Please explain the reason for this change and the effect it has on the exposure and risk estimates for the teal. Kaufman, K. 1996. *Lives of North American Birds.* Houghton Mifflin.
Eco-21	6-100	6	Technical	High	A results summary should be added at the end of Section 6 listing all areas where potential risks were identified, the receptor groups affected, and the stressors (chemical and/or physical) potentially responsible for the predicted risks. For example, for tundra vegetation, the results summary should emphasize areas where vegetation parameters (e.g. moss cover, lichen cover, diversity, etc.) differ from background and/or where a road-related effect was observed, regardless of whether the effect is believed to be due to chemical stressors, physical stressors, or a combination of the two. Locations where phytotoxicity benchmarks were exceeded should be summarized. Potential site-related effects in aquatic habitats should be summarized separately for the three creeks/rivers evaluated in the ERA and for tundra ponds and coastal lagoons. For wildlife, a table should be included listing the locations and receptors where NOAEL and/or LOAEL hazard quotients exceeded 1.0 for any chemical. Information in the results summary should be incorporated into the Executive Summary of the risk assessment report and Section 8.2 (Ecological Risk Assessment Conclusions). Because many readers of the risk assessment report may only examine the Executive Summary and/or Conclusions, it is important that the ecological risks posed by the site be plainly summarized in these sections.
Eco-22	-	6	Technical	Medium	Teck Cominco (2005) presents results for lead and zinc for soil samples for seven sampling locations to the west of the ambient air boundary of the Red Dog Mine in the general vicinity of TT7. Are the soil data for TT7 used in the ERA representative for this area compared with data from Teck Cominco (2005)?

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					Teck Cominco (2005) indicates that fugitive dust emissions at the mine have been reduced but not eliminated. As such, levels of metals in soil and vegetation near the mine are likely to increase in the future. Hence, the results presented in the draft ERA for terrestrial transect number 7 (TT7) near the ambient air boundary of the mine site should be considered a snapshot of current conditions only. This point should be made in the ERA report where the results for this location are discussed. Teck Cominco. 2005. *Summary of Mine Related Fugitive Dust Studies, Red Dog Mine Site.* Prepared by Teck Cominco Alaska Incorporated, Anchorage, Alaska.
Eco-23	Table C-21	Appendix C	Technical	Low	The specific reports that the moss data were taken from should be clearly identified in Table C-21. For example, if NPS00 refers to data from Ford and Hasselbach (2001), this should be clearly indicated in a footnote to the table. This comment also pertains to other tables in Appendix C that list data from other reports. Ford, J. and L. Hasselbach. 2001. *Heavy Metals in Mosses and Soil on Six Transects Along the Red Dog Mine Haul Road, Alaska*. Western Arctic National Parklands, National Parks Service, NPS/AR/NRTR-2001/38.
Eco-24	-	Appendix E	Editorial	Low	For clarity, the page numbers for Tables E-1 and E-2 should be corrected.
Eco-25	E-13	Appendix E	Editorial	Low	Under the heading "Vegetation Tissue Collection" the first sentence in the second paragraph should refer to "stream vegetation sampling," not "aquatic invertebrate community analysis." Please revise accordingly.
Eco-26	E-15	Appendix E	Editorial	Low	Under the heading "Tundra Soil Collection" in the first paragraph, the reference to stream willow/sedge samples appears to be an error. Revise the first paragraph accordingly.
Eco-27	-	Appendix F and 6.4.1	Technical	High	Provide a copy of the sediment toxicity testing report from MEC Analytical Systems for review. A copy of MEC's report should be included in the risk assessment report, either as part of Appendix F or as a separate appendix.
Eco-28		Appendix K	Technical	High	Several EPC calculations were checked, but could not be reproduced. For example, Table K-82 lists an average EPC for lead in soil of 995 mg/kg based on PHASE2RA soil data for TT7. Table G-1 lists four lead soil concentrations for TT7: 2630, 201, 197, 111 mg/kg. The average of the values is 785 mg/kg, not 995 mg/kg as reported in Table K-82. Similar problems in reproducing EPCs were found for other receptors and analytes.

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					Example calculations should be provided in Appendix K (or in a separate appendix) clearly illustrating the data used to derive the EPCs for wildlife provided in the tables in this appendix. An example should be included for each wildlife receptor for at least one chemical for each area where the receptor was evaluated. For example, for the caribou, three example calculations should be provided–one each for the port, haul road, and mine exposure areas. It is suggested that the example calculation focus on elements predicted to pose potential wildlife risks such as aluminum, barium, and lead.
Eco-29	-	7.2 and 8.2	Technical	High	Adjust recommendations and conclusions as needed in light of above comments.

Key:
COPC = chemical of potential concern
CSB1 = Concentrate Storage Building 1
DMTS = DeLong Mountain Regional Transportation System
EPC = exposure point concentration
ERA = ecological risk assessment
HQ = hazard quotient
LOAEL = lowest observed adverse effect level
NOAEL = no observed adverse effect level
TP = tundra pond
TT = terrestrial transect
UCL = upper confidence limit (on mean concentration)