Appendix E

Summary of Phase II Sampling Program for the DMTS Fugitive Dust Risk Assessment

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Introduction

The Phase II field study for the DeLong Mountain Regional Transportation System (DMTS) fugitive dust risk assessment consisted of five major elements that provided additional information to assess possible risk to the environment and human health from the DMTS. These elements were a terrestrial assessment, a freshwater aquatic (i.e., streams and tundra ponds) assessment, a coastal lagoon assessment, a marine assessment, and a supplemental subsistence foods assessment for the human health risk assessment. The Phase II assessment was primarily focused on addressing data gaps by evaluating concentrations of chemicals of potential concern (CoPCs) in biota in each environment: small mammals, ptarmigan, soil and aquatic invertebrates, lagoon fishes, vegetation, salmonberries, and sourdock, as well as in tundra soil and sediment. Vegetation community analyses were also performed. Information on the study design and objectives is provided in Exponent (2004a,b).

The Phase II field study included four sampling events. The first sampling event was conducted in June 2004, during which marine sediment samples were collected at the port site prior to shipping activities. The second sampling event was conducted in June and July 2004, during which selected biota in each environment and tundra soil and sediment were collected. The third sampling event was a supplemental program added in late July/early August 2004 to obtain additional subsistence foods data for salmonberries and sourdock (Exponent 2004c). The fourth sampling event was conducted in September 2004, during which marine sediment samples were collected at the port site during the shipping season. The following subsections describe the sampling and any modifications relative to the field sampling plan (Exponent 2004a). A summary of the data collected during the Phase II field study is presented in Table E-1. Further detail is provided in Table E-2.

All sampling equipment was decontaminated prior to sampling according to the procedures described in the Phase II field sampling and analysis plan (Exponent 2004a). The samples were placed into appropriate chemically cleaned containers and were either held at 4°C or frozen (depending on the holding requirements for each respective sample type) during shipment and at the laboratory prior to analysis. Field duplicates and replicates were collected at a frequency of 1 per 20 samples. The samples were sent to Columbia Analytical Services, Inc. (Kelso, Washington) for chemical analysis and to MEC-Weston, Inc. (Carlsbad, California) for toxicity testing.

June 2004 Sampling Event

Marine Assessment

Surface sediment samples were collected at the port site in June 2004 prior to the seasonal start of shipping activities at the facility, and 1 year after major shiploader and lightering barge improvements were made to further control fugitive concentrate dust. Sediment samples were located at the same stations that were sampled in 2003. The marine assessment evaluated the concentrations of CoPCs in surface sediments at stations in the Chukchi Sea in the vicinity of the shiploader. The station locations were selected primarily on the basis of historical evaluations (RWJ 1997; Exponent 2003a, 2004b) and offshore current patterns (prevailing current is northward) and were designed to allow evaluation of possible gradients of CoPC concentrations in relation to potential sources, as well as potential temporal changes in CoPC concentrations (i.e., by resampling stations from previous studies).

Undisturbed surface sediment was collected from the upper 0–2 cm interval using a modified Ponar grab sampler. Twenty-nine stations were sampled for surface sediment during the June 2004 sampling event (Figure E-1): 26 site stations and 3 reference area stations. The site stations were located on a grid that had been sampled historically in the vicinity of the port site (RWJ 1997; Exponent 2003a,b, 2004a,b). The reference area stations were located upwind and upcurrent of the port facility. Metals and conventional analytes listed in Table E-2 were analyzed at 7 of the 26 site stations and at all of the reference area stations (locations shown on Figure E-1). The subset of seven locations (NMD, NMGZ, NML, NMM, NMN, NMO, and NMAA) included the 4 stations where these chemicals exceeded benchmarks in 2003 (i.e., NMD, NMGZ, NML, and NMM), and also represented a range of concentrations observed historically, at different distances and orientations relative to the shiploader, including locations beneath and downcurrent (north) of the shiploader that were expected to have the highest concentrations, based on data collected previously (RWJ 1997; Exponent 2003d, 2004b). Lead, zinc, and cadmium analyses were conducted at all of the remaining site grid stations (Figure E-1). Extra sediment volume was also collected at these locations for possible toxicity testing.

The following modifications were made to the Phase II sampling strategy for the June 2004 marine assessment described in the field sampling and analysis plan (Exponent 2004a):

- A modified Ponar grab sampler was used to collect the sediment samples rather than the stainless-steel Ekman grab sampler, modified petite-Ponar grab sampler, or a drive rod check valve (DRCV) corer suggested in Exponent (2004a). The modified Ponar grab sampler provides the same quality of sediment sample, but the grab sampler is slightly larger than the petite version and therefore provides more sediment per grab.

- The location of Station NM-REF-1 was adjusted slightly to allow for the movement of beach material that occurred during the 2003–2004 winter

storms. Station NM-REF-1 was placed as close as possible to the beach and the previously sampled station coordinate.

The quality and usability of the data generated from this field event were not affected by these modifications.

June/July 2004 Sampling Event

Terrestrial Assessment

The terrestrial assessment focused on addressing data gaps by evaluating concentrations of CoPCs in terrestrial biota: small mammals, ptarmigan, soil invertebrates, and vegetation, as well as tundra soil. Vegetation community analyses were also conducted to assess the general health and vitality of vegetation, and species richness and diversity. The stations where sampling and community analyses were performed were located along the length of the DMTS road between the port and mine on transects that extended to the downwind (northwest) side of the DMTS road and mine ambient air boundary (Figures E-2 and E-3).

Reference site samples of small mammals, ptarmigan, soil invertebrates, vegetation, and tundra soil were also collected. Reference sample stations were located in the terrestrial reference area shown in Figure E-2. The reference area was selected because it is near the DMTS, but far enough away in the prevailing upwind direction (southeast of the DMTS) that it is expected to be unaffected by fugitive dust. In addition, the geology and topography prevalent at the reference area were similar to the study area.

Small Mammal Collection

Small mammals (different species depending on availability; see Table E-2 for specific species collected at each station) were collected for chemical analysis of tissue. Small mammal species targeted for collection were either the tundra vole (*Microtus oeconomus*) or the brown lemming (*Lemmus trimucronatus*), depending on availability. Small mammals were also collected from one station at the terrestrial reference area to evaluate background risk to terrestrial carnivores.

The small mammal traps were placed in close proximity to the tundra soil stations (see Figures E-4 and E-5). Chemical analyses were conducted on whole body tissue to evaluate potential ecological risks to terrestrial receptors. Each individual small mammal was analyzed as a single, whole body sample.

The following modifications were made to the Phase II sampling strategy for small mammal collection as described in the field sampling and analysis plan (Exponent 2004a):

- Small mammal traps were placed at 14 of the 16 stations specified in the field sampling plan (Exponent 2004a). Traps were placed at an additional two stations in an attempt to supplement the samples obtained on the planned stations. Due to poor habitat conditions, small mammal traps could not be set on transect stations TT6-0020 or on TT7 transect stations (too open; no habitat cover). Small mammals were captured at 7 of the 15 stations. Information on the level of small mammal trapping activities during the June/July 2004 sampling event is presented in Table E-3.

- The sampling plan called for the collection of five individual small mammal samples at each station on each terrestrial transect and five individual small mammal samples from the reference area. However, the number of small mammals collected at each site station varied, and four individual small mammals were collected at the reference area (Table E-2).

- Northern red backed voles (*Clethrionomys rutilus*) and masked shrews (*Sorex cinereus*) were added in the field to the small mammal target species list. Northern red backed voles were collected at four site stations and masked shrews were collected at four site stations (see Table E-2 for specific stations where northern red backed voles and masked shrews were collected). Both species were collected at the terrestrial reference area.

- Oats were used in the Sherman live traps instead of an oat/peanut butter mixture to prevent unwanted disruption of the traps by larger mammals that may be attracted to the peanut butter smell.

- Snap traps were not found effective as compared with the live traps, and were not used after June 17, 2004.

- Sherman live traps were placed in the sampling grid at 10-ft intervals instead of the 20-ft intervals specified in Exponent (2004a).

Because the substituted methods are similar to the methods specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by any of the modifications.

Ptarmigan Collection

Ptarmigan were collected using steel shot. Five ptarmigan were collected near the DMTS road and three ptarmigan were collected in the terrestrial reference area. Ptarmigan were collected for chemical analysis of tissue. Each ptarmigan sample consisted of one individual adult bird. Breast muscle tissue (including the skin), liver, and kidneys from each bird were analyzed separately.

The following modifications were made to the Phase II sampling strategy for ptarmigan collection as described in the field sampling and analysis plan (Exponent 2004a):

- The samples were collected by a member of the field team, rather than being collected by local hunters. Local hunters do not specifically seek out ptarmigan, but rather will sometimes shoot them when they happen to find them. A similar approach was used by the field team member, shooting them when they were found in the areas where collection was planned and permitted.

- Ptarmigan collection was very difficult, as their numbers were apparently very low compared to other years. Many days of effort were applied to

collect ptarmigan. Anecdotal evidence from a Teck Cominco employee who lives in one of the villages indicated that it was a hard winter for ptarmigan. He stated that high winds formed a wind crust on the snow that prevented the ptarmigan from finding shelter beneath the snow, resulting in a large winter die-off. This information was seemingly corroborated by some field observations of dead ptarmigan. It was anticipated that five ptarmigan would be collected in the terrestrial reference area. However, only three ptarmigan were collected in the reference area.

- Due to the limited number of ptarmigan available in the originally specified terrestrial reference area, the hunting area for ptarmigan collection was increased to include the valleys to the southwest of the originally specified terrestrial reference area (see Figure E-2), but still but far enough away in the prevailing upwind direction (south of the DMTS) that it was expected to be unaffected by fugitive dust. In addition, the geology and topography prevalent at the extended reference area were similar to the study area and the original terrestrial reference area.

Because the requirements for an appropriate reference area are similar to those specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by this change.

Soil Invertebrate Collection

Soil invertebrates (different species depending on availability; see Table E-2 for species collected at each station) were collected for chemical analysis of tissue. Soil invertebrates were also collected from one station at the terrestrial reference area to evaluate background risk to terrestrial avian and mammalian insectivores.

The soil invertebrates were collected at seven tundra soil stations near the port facility and DMTS road (four on transect TT5 and three on transect TT2). Soil invertebrates were also collected from one station at the terrestrial reference area. The soil invertebrates were collected in close proximity to the tundra soil stations (see Figures E-4 and E-5). Chemical analyses were conducted on whole body tissue. All soil invertebrates collected at a given station were combined into a single tissue sample and weighed (wet weight). Soil invertebrates in the samples were identified to the lowest possible taxonomic level in the field and the weights of each taxonomic group within the sample were measured.

The following modifications were made to the Phase II sampling strategy for soil invertebrate collection as described in the field sampling and analysis plan (Exponent 2004a):

- Soil invertebrates were collected at six additional stations (three stations on transect T3 and three stations on transect TT6; see Table E-2).
- Thirty-six pitfall traps were placed at each station instead of the originally specified 15 traps per station. Due to the narrow distance between tundra tussocks, pan traps were not used to collect the soil invertebrates.

- Surfactant (soapy water) was placed in the bottom of each pitfall trap instead of using a moist paper towel.
- A barrier was not used to "herd" the invertebrates into the pitfall traps.
- Due to limited observations of predation from avian predators, the pitfall traps were not covered.
- The pitfall traps were checked daily (in most cases) instead of being left in place for 2 days before removal of any soil invertebrates that had been captured.
- In a few cases, to reach the desired sample weight for analysis of the CoPCs, the pitfall traps were left in place at a given station for longer than the 4 days stipulated in the field sampling plan (Exponent 2004a).

The addition of stations from those proposed in the study design will increase the quality and usability of the data. Because the substituted methods are similar to the methods specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by any of the modifications.

Vegetation Tissue Collection

Vegetation samples were collected to provide tissue data for use in food web models to evaluate risks to terrestrial avian and mammalian herbivores. Vegetation samples for chemical analysis were collected at 20 stations near the DMTS road or mine and also at three stations at the terrestrial reference area. A summary of vegetation tissue samples is included in Table E-2. The vegetation samples were collected in close proximity to the tundra soil stations (see Figures E-4 and E-5). Young willow leaves and new growth shoots, whole lichens, and sedge plants (blades only; no root material) were sampled to represent the aboveground plant material that herbivores would eat while grazing or browsing in the tundra.

The following modifications were made to the Phase II sampling strategy for vegetation collection as described in the field sampling and analysis plan (Exponent 2004a):

- Both willow and birch leaves were collected as “bridge data” at the 100 m station on transect TT3 and at the 1,000 m station on transect TT5.
- Despite walking the grid pattern specified in the field sampling and analysis plan (Exponent 2004a), field staff located no willow trees at the 1,000 m station on transect TT3 or at the 2,000 m station on transect TT5. Therefore, no willow leaves were collected at either of these stations. Birch leaves were collected at both stations instead (alternate species as stipulated in Exponent [2004a]).
- Reindeer lichen (*Cladina spp.*), a preferred food item for caribou (*Rangifer tarandus*), was added to the terrestrial vegetation sampling scope.

- Cottongrass (*Eriophorum vaginatum*) was found to be very common in tussock tundra habitats. Therefore, cottongrass rather than *Carex* sedge was collected as the representative herbaceous plant at most terrestrial stations. *Carex spp*. was collected at stations located at higher elevations near the mine, where cottongrass was less abundant or absent. Bridge data for *Eriophorum* and *Carex* sedges were collected at the 100 m station on transect TT6 and at station TS-REF-5.

- Sedge seeds were not collected opportunistically at terrestrial stations as stated in the field sampling and analysis plan (Exponent 2004a), but were sampled opportunistically at freshwater aquatic and coastal lagoon stations (described below), where avian receptors such as the green-winged teal and the brant might feed.

- Willow and birch leaf samples were collected from at least three shrubs at each station rather than exactly three shrubs, as specified in the field sampling and analysis plan (Exponent 2004a). In some instances, it was necessary to collect leaves from more than three plants in order to accumulate enough tissue mass for analysis without completely defoliating the shrubs.

- Cottongrass blades were collected from multiple tussocks to obtain a sedge sample representative of the station, not necessarily from plants at 15-cm intervals, as specified in the field sampling and analysis plan (Exponent 2004a).

- Terrestrial station locations were documented with GPS, and vegetation sampling locations within each station were described in the field notebook. Sampling locations were typically described in relation to the small mammal grid or the vegetation plot line (Figures E-4 and E-5).

- In general, lichens were not abundant near the DMTS road. Consequently, lichen samples could not be collected at some stations located 10 m from the road, including stations TT2-0010, TT5-0010, and TT8-0010. Instead, lichens were identified farther away from the road, and samples of these were collected at approximately 40-45 m along transect TT2, 60-70 m along transect TT5, and 35 m along transect TT8.

Because the substituted methods are similar to the methods specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by any of the modifications. The collection of bridge data between species at several stations improved the quality and usability of the data.

Vegetation Community Analysis

The general health and vitality of vegetation and species richness and diversity was assessed at 32 stations on 4 terrestrial transects, at 2 site and 2 reference coastal lagoon stations, and at 4 terrestrial reference stations (3 in the terrestrial reference area, and 1 on the coastal plain). On

one of the transects (Transect TT8), the community structure of vegetation was assessed at 17 additional microplots at incremental distances from the DMTS road to better document any possible gradient in plant community structure versus distance from the road. A listing of stations where vegetation community analysis plots were placed is included in Table E-2. The station locations are shown on Figures E-2 and E-3.

The general health and vitality of vegetation was assessed qualitatively through field observations and photographs. Field team members documented the overall appearance of plants, estimated the amount of foliage cover on shrubs, noted whether species were flowering or senescing, and recorded any signs of disease, infestation, or herbivory. Plant richness, dominance, and distribution were assessed quantitatively by identifying each plant species (to the lowest possible taxon), estimating its canopy coverage, and calculating the frequency with which each species occurred within the vegetation microplots.

The following modifications were made to the Phase II sampling strategy for vegetation community analysis as described in the field sampling and analysis plan (Exponent 2004a):

- At each station, 10 microplots were spaced every 30 ft along a 300-ft line oriented parallel to the road, rather than placed within a 10-m square as originally stipulated in Exponent (2004a). The microplots were placed along the north side of the line at the stations on road transects. Also, when a shrub habitat was present at a station, the point-intercept method was used along the 300-ft line to assess the shrub stratum for comparison with the results from the microplots. These modifications to the field sampling plan were made for the following reasons: 1) for the stations in close proximity to the road, the microplots along a line were all more or less equidistant from the road, whereas in a square layout, they would not have been equidistant from the road; 2) the line-intercept method was conducted along the 300-ft line, which was equidistant from the road, whereas the original plan had four shorter transects from the corners of the 10-m-square plot, which would not have been equidistant from the road; and 3) placing the microplots along a 300-ft line was expected to provide more complete coverage of the range of vegetation types and conditions present at a station, in comparison to a 10-m-square orientation of microplots.

- Because topography was more consistent with distance from the road at transect TT8, discretionary stations to assess plant community structure versus distance from the DMTS road were added at transect TT8 rather than at transect TT3, as originally planned. This change was made because the topography was more consistent over the length of transect TT8 than it was at TT3. At TT8, plant community analysis was conducted at the 10 m, 100 m, and 1,000 m stations by the method described above, with 10 microplots along a 300-ft line at each station. Sixteen additional single microplots were added between these stations (perpendicular to the road) to provide regular coverage from the road to 1,000 m. The additional microplots were located at distances of 50, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650,

700, 750, 800, and 900 m from the road, to supplement the 10, 100, and 1,000 m stations.

- A reference location (TS-REF-12) was added in the coastal plain to match conditions observed at the onsite transect TT5 and to supplement the three reference stations in the terrestrial reference area (Figure E-2).
- The location of reference station TS-REF-11 was slightly modified to better match the vegetation community found at the site stations.
- GPS coordinates were taken from the center point and at the ends of the vegetation plot line.

The modifications are expected to improve the quality and usability of the data generated from the plant community analyses.

Tundra Soil Collection

Tundra soil was collected from 43 stations for chemical analysis. Tundra soil, as defined and sampled historically, is the decayed or decaying peaty organic material just beneath the live tundra mat. Tundra soil samples (0–2 cm from beneath the live tundra mat, which is approximately 5 to 15 cm [2–6 in.] thick depending on location) was collected from five transects that extended to the north/west of the DMTS road and from one transect that extended to the north/west of the mine's ambient air/solid waste permit boundary. Five of the transects were located on the prevailing downwind side of the DMTS road and the sixth transect was located downwind of the mine's permit boundary. All of the transects were oriented in the general downwind direction, and generally perpendicular to the road or solid waste permit boundary at each respective location. The exact station placement was determined in the field based on the location of target plant species collected in the immediate area of the transect. On one transect (TT8), tundra soil was collected at an additional 17 locations in conjunction with vegetation community analysis (i.e., at each additional vegetation community microplot). A listing of stations where tundra soil samples were collected is included in Table E-2. The station locations are shown on Figures E-2 and E-3.

The following modifications were made to the Phase II sampling strategy for tundra soil collection as described in the field sampling and analysis plan (Exponent 2004a):

- It was anticipated that plant community structure versus distance from the DMTS road would be determined on transect TT3. However, based on field observations and the location of the transects between the port facility and the mine, it was decided that transect TT8 was a better choice for this analysis. Therefore, an additional 17 tundra soil samples were collected in conjunction with the vegetation microplots on transect TT8.
- As mentioned above, it was anticipated that the community structure of vegetation would be documented at three stations in the terrestrial reference area. However, this number was increased to four reference area stations

(Station TS-REF-12 was added to the vegetation community analysis) to better match vegetation conditions found at the site stations. An additional tundra soil sample was collected at Station TS-REF-12.

- The location of reference station TS-REF-11 was slightly modified to better match the vegetation community found at the site stations on transect TT6. The tundra soil sample was taken in proximity to the modified vegetation station location.

Because the substituted methods are similar to the methods specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by any of the modifications. In addition, the relocation of stations from those proposed in the study design will benefit the quality and usability of the data.

Freshwater Aquatic Assessment

The structure of the aquatic invertebrate community in freshwater streams along the DMTS between the port and the mine and the CoPC concentrations in willows and sedges near these streams were evaluated for the freshwater aquatic assessment. In addition, samples of tundra soil and surface sediment were also collected. Water quality parameters were measured in streams and tundra ponds. A schematic of the typical stream station sampling layout is provided in Figure E-6. The freshwater aquatic assessment also evaluated CoPC concentrations in sedges and tundra soil at the edges of tundra ponds located between the port and the mine.

Streams

Aquatic invertebrates, willow leaves and new growth shoots, sedges, and tundra soil were collected from or near three streams that cross the DMTS (Aufeis Creek, Omikviorok River, and Anxiety Ridge Creek), as shown in Figure E-7. These three streams were selected to represent varying conditions over the length of the road, and to match Phase II sampling stations with stations where sampling has been previously conducted (Exponent 2002a, 2004b; Morris and Ott 2001). Aufeis Creek is nearest to the port, Omikviorok River represents conditions in the middle portion of the road, and Anxiety Ridge Creek represents conditions nearer to the mine. Stations coincided with stations at which Teck Cominco regularly collects water samples (Exponent 2002a) and where surface sediment samples were collected during the Phase I sampling event. A listing of samples collected at stream stations is provided in Table E-2.

Aquatic Invertebrate Tissue Collection

Aquatic invertebrate samples were collected to provide tissue data for use in food web models to evaluate risks to aquatic ecological receptors. The aquatic invertebrates were collected using a kick net and were collected after aquatic invertebrates in the stream had been collected for community analysis. One multi-species composite of aquatic invertebrates was collected from each of the three stations on streams that cross the DMTS (Aufeis Creek, Omikviorok River, and Anxiety Ridge Creek; Figure E-7). In addition, one multi-species composite of aquatic

invertebrates was collected from each of two streams in the freshwater aquatic reference area (ST-REF-3 and ST-REF-6).

The following modifications were made to the Phase II sampling strategy described in the field sampling and analysis plan (Exponent 2004a):

- Based on field observations, it was determined that aquatic invertebrates of sufficient mass to meet sample analysis and detection limit requirements could be collected from the freshwater streams that were specified for aquatic invertebrate community analysis in Exponent (2004a). Therefore, five new aquatic tissue samples were added to the study design.

The collection of aquatic invertebrates for chemical analysis of their tissue at each freshwater stream station enhanced the study design and improved the quality and usability of the data.

Aquatic Invertebrate Community Analysis

To determine the characteristics of aquatic invertebrate communities in the freshwater streams near the DMTS road, five replicate samples of aquatic invertebrates were collected from each of the following six locations: Aufeis Creek, Omikviorok River, Anxiety Ridge Creek, and three reference area streams (Figure E-7).

The following modifications were made to the Phase II sampling strategy for aquatic invertebrate community analysis as described in the field sampling and analysis plan (Exponent 2004a):

- Aquatic invertebrates for community analysis were collected at two additional reference area streams not specified in Exponent (2004a). Therefore, data on two new aquatic invertebrate communities in the reference area were added to the study design.

- Modifications to the specific steps in the freshwater invertebrate collection procedures stipulated in Exponent (2004a) were made in the field:

    1. Rather than washing the collected material from the driftnet into a No. 30 sieve (which has 600 μm mesh), the collection cup (which had 363 μm mesh) attached to the driftnet was used as the sieve.

    2. After the collection time was complete and the stakes pulled from the net, the net was first gently moved around in the streamflow (with the net opening out of the water), so as to dislodge material from the sides of the net and wash it into the cup at the bottom of the net.

    3. The net was then raised out of the water, and a clean scoop was used to collect stream water and run it down the outsides of the net, to move any remaining material within the net down into the cup.

4. The collection cup was then removed from the net and inverted into a sample jar to transfer the bulk of the sample volume. A limited amount of stream water was then used to help rinse and transfer the remaining sample material from the collection cup to the sample jar. The collection cup was checked to ensure all of the sample material had been transferred.

5. The formalin was then added to the sample jar immediately, prior to departing the sampling station (as stipulated in Exponent 2004a).

- Prior to implementing the above modifications, the very first samples (ST0001A through ST0001E) were transferred from the driftnet collection cup into a double Ziploc bag, excess air was removed, and then the samples were transported to the field lab where they were then sieved using a No. 60 sieve (which has 250 μm mesh), transferred to sample jars, and then preserved with formalin.

The quality and usability of the data generated from this field event were improved by these modifications to the sample collection procedures. In addition, the addition of stations from those proposed in the study design improved the quality and usability of the data.

Vegetation Tissue Collection

Young willow leaves and new growth shoots were collected at three stations near streams crossing the DMTS road and at three reference area stream stations. Sedge plants (rinsed roots [i.e., no sediment] and unwashed blades) were collected at two stations near streams crossing the DMTS road and at three reference area stream stations (Figure E-7).

The following modification was made to the Phase II sampling strategy for stream vegetation sampling as described in the field sampling and analysis plan (Exponent 2004a):

- Despite walking the grid pattern specified in the field sampling and analysis plan (Exponent 2004a), field staff located no sedge plants near Aufeis Creek. Therefore, no sedge plants were collected at this station.

- Sedge seeds were sampled opportunistically at freshwater aquatic stations where avian receptors such as the green-winged teal and the brant might feed.

- Willow leaves were collected from at least five shrubs per stream station, rather than three shrubs, as specified in the field sampling and analysis plan (Exponent 2004a). The shrubs coincided approximately with the five drift net locations along the sampling reach.

- When possible, sedge plants and sedge seeds were collected from multiple locations along the sampling reach in order to form composite samples representative of the station, rather than at 15-cm intervals as specified in the field sampling and analysis plan (Exponent 2004a).

- Dead tissue was removed from whole sedge samples using gloves or decontaminated stainless steel scissors. Sedge roots were dabbed dry with clean paper towels after the site water rinse to minimize the potential for tissues to rot.

The usability and quality of the data generated from this field event were not affected by these changes.

Tundra Soil Collection

To provide plant and media CoPC data near the stream stations, tundra soil samples (0–2 cm from beneath the live tundra mat, which is approximately 5 to 15 cm [2–6 in.] thick depending on location) were collected adjacent to the immediate area of the streams where willow and sedge samples were collected, at all stream stations (Figure E-7). There were no modifications relative to the field sampling and analysis plan (Exponent 2004a).

Stream Sediment Collection

Sediments were collected from each of the three streams that cross the DMTS (Aufeis Creek, Omikviorok River, and Anxiety Ridge Creek; Figure E-7). In addition, one surface sediment sample was collected from each of two streams in the freshwater aquatic reference area (ST-REF-3 and ST-REF-6). Undisturbed surface sediment was collected from the upper 0–2 cm interval using an Ekman grab sampler.

The following modification was made to the Phase II sampling strategy for surface sediment collection as described in the field sampling and analysis plan (Exponent 2004a):

- Because it was determined that there were aquatic invertebrates of sufficient mass to meet sample analysis and detection limit requirements in the freshwater streams, surface sediment samples (the primary media that the aquatic invertebrates come in contact with) were also collected. Therefore, five new sediment samples were added to the study design, collocated with the benthic invertebrate composite tissue samples.

The collection of surface sediment for chemical analysis from these freshwater streams, when paired with the benthic invertebrate composite tissue samples, enhanced the study design and improved the quality and usability of the data.

Water Quality Parameter Measurements

Water quality parameters (i.e., pH, dissolved oxygen, temperature, conductivity, and salinity) were measured at each stream station. There were no modifications relative to the field sampling and analysis plan (Exponent 2004a).

Tundra Ponds

Sedges and tundra soil from the edges of four tundra ponds at varying distances between the mine and the port site (i.e., near the mine, middle of the road, and toward the port) were sampled during the Phase II field event to evaluate gradients of CoPC concentrations in relation to sources. Two of the four tundra pond stations were located at the tundra ponds that were sampled during the Phase I sampling event (i.e., TP1-0100 and TP1-1000; see Figure E-7). Those two ponds were located within the port facility boundary, and the other two ponds were located on the downwind (north/west) side of the road. In addition, sedges and tundra soil were also collected from two stations at the freshwater aquatic reference area (see Figure E-7). The reference area stations coincided with stations sampled during the Phase II sampling event.

Vegetation Tissue Collection

Sedge samples were collected at the edges of tundra ponds to evaluate risks to freshwater avian and mammalian herbivores. Sedge samples were collected in close proximity to the tundra soil stations. Sedge samples were collected from four tundra ponds near the port facility and along the DMTS road and from three stations near the reference area tundra ponds (Figure E-7). The whole sedge plant (rinsed roots and unwashed blades) was collected to include the above- and below-ground plant material that herbivorous receptors might eat.

The following modifications were made to the Phase II sampling strategy for vegetation tissue near tundra ponds as described in the field sampling and analysis plan (Exponent 2004a):

- After extensive searching, field staff located only two tundra ponds (rather than the planned three) near the middle of the road and toward the mine that were within the desired 100–500 m from the road. Therefore, sedge plants were collected at only four tundra ponds near the DMTS road and port.
- Dead tissue was removed from whole sedge samples using gloves or decontaminated stainless steel scissors. Sedge roots were dabbed dry with clean paper towels after the site water rinse to minimize the potential for tissues to rot.

The usability of the data generated from this field event was not affected by this change.

Tundra Soil Collection

To provide plant and media CoPC data near the tundra pond stations, tundra soil samples (0–2 cm from beneath the live tundra mat, which is approximately 5 to 15 cm [2–6 in.] thick depending on location) were collected adjacent to the immediate area of the ponds where willow and sedge samples were collected, at all pond stations.

The following modification was made to the Phase II sampling strategy for tundra soil near a tundra pond as described in the field sampling and analysis plan (Exponent 2004a):

- As mentioned above, only two tundra ponds (rather than the planned three) were found near the middle of the road and toward the mine that were within the desired 100–500 m from the road. Therefore, tundra soil (in conjunction with the vegetation tissue samples) was collected at only four tundra ponds near the DMTS road and port.

The usability of the data generated from this field event was not affected by this change.

Water Quality Parameter Measurements

Water quality parameters (i.e., pH, dissolved oxygen, temperature, conductivity, and salinity) were measured at each tundra pond station.

The following modification was made to the Phase II sampling strategy for tundra soil near a tundra pond as described in the field sampling and analysis plan (Exponent 2004a):

- As mentioned above, only two tundra ponds (rather than the planned three) were found near the middle of the road and toward the mine that were within the desired 100–500 m from the road. Therefore, water quality measurements (in conjunction with the vegetation tissue samples) were collected at only four tundra ponds near the DMTS road.

The usability of the data generated from this field event was not affected by this change.

Coastal Lagoon Assessment

The coastal lagoon assessment evaluated the CoPC concentrations in aquatic invertebrates, fishes, sedges, surface sediments, and tundra soil at stations in or adjacent to the coastal lagoons to the north and west (prevailing downwind) of the port facilities. The station locations (see Figure E-8) were selected to allow evaluation of risk in locations with the highest measured CoPC concentrations in lagoon media, as well as to provide a gradient of concentrations away from port site facilities. The stations have all been sampled historically as part of periodic monitoring conducted at the port site (RWJ 1997; Exponent 2003b) and were sampled in Phase I of the fugitive dust risk assessment sampling program.

Aquatic Invertebrate Tissue Collection

To evaluate risks to avian invertevores, representative samples of aquatic macroinvertebrates (multiple species and multiple individuals in each sample) were collected for chemical analysis of tissue at each of the three stations in the coastal lagoons near the DMTS port facility and at two stations in reference lagoons southeast of the DMTS port facility. Chemical analyses were conducted on whole body tissue. All aquatic macroinvertebrates collected at a given station were combined into a single tissue sample and weighed (wet weight). Aquatic

macroinvertebrates in the samples were documented to the lowest possible taxonomic level in the field and the weights of each taxonomic group within the sample were measured.

The following modification was made to the Phase II sampling strategy for aquatic invertebrate tissue collection as described in the field sampling and analysis plan (Exponent 2004a):

- Because it was determined that there were aquatic invertebrates of sufficient mass to meet sample analysis and detection limit requirements in an additional reference lagoon, an additional aquatic invertebrate tissue sample was collected. Therefore, one new aquatic invertebrate tissue sample from a coastal lagoon was added to the study design.

The collection of an additional aquatic invertebrate tissue sample for chemical analysis from an additional reference lagoon enhanced the study design and improved the quality and usability of the data.

Aquatic Invertebrate Community

To evaluate community structure, aquatic invertebrate samples were collected at three stations in the coastal lagoons near the DMTS port facility spanning a CoPC gradient in sediment, and at three stations in reference lagoons southeast of the DMTS port facility (Figure E-8). The aquatic invertebrates were collected in close proximity to the sediment stations. Undisturbed surface sediment was collected using an Ekman grab sampler. Five replicate samples were collected at each station for community analysis (i.e., based on taxonomic composition). There were no modifications from the field sampling and analysis plan (Exponent 2004a).

Fish Collection

Fish were to be collected from the coastal lagoons to evaluate risks to coastal avian piscivores. Individual fish were to be collected from two coastal lagoons near the port facility (i.e., Port Lagoon North and North Lagoon) and from one reference lagoon southeast of the DMTS port facility. No fish were collected during the Phase II sampling event.

The following modification was made to the Phase II sampling strategy for fish collection as described in the field sampling and analysis plan (Exponent 2004a):

- After thoroughly seining each of the three coastal lagoons from one end to the other, field staff determined that there were no fish present in the coastal lagoons. In addition, no visual observations of fish were made by the sampling team during collection of other media at the coastal lagoons. No fish were collected from coastal lagoons during the Phase II sampling event.

Vegetation Tissue Collection

Sedge samples were collected at the edges of the coastal lagoons to evaluate risks to avian herbivores. Sedge samples were collected in close proximity to the sediment stations (Figure E-8). Sedge samples were collected from two stations in the coastal lagoons near the DMTS port facility and at two stations in reference lagoons southeast of the DMTS port facility (see Table E-2). The whole sedge plant (blades and roots) was collected to include above- and below-ground material that a brant or other avian herbivore might pull from the sediment and eat.

The following modification was made to the Phase II sampling strategy for vegetation collection as described in the field sampling and analysis plan (Exponent 2004a):

- As a result of the sand dune and coarse gravel environment on the seaward side of all of the coastal lagoons, the habitat was determined to be inhospitable to sedge plants. Sedges were not present at site lagoon station NLF (on the seaward shore). Therefore, sedge plants were only collected at four of the six coastal lagoon stations (see Table E-2). Tufted hairgrass (*Deschampsia sp.*) was collected as a representative herbaceous plants at this station using the same method described for sedge collection in the field sampling and analysis plan (Exponent 2004a). Tufted hairgrass was also collected at reference lagoon station CL-REF-3b for comparison with that collected at site station NLF.

- Sedge seeds were sampled opportunistically at coastal lagoon stations where avian receptors such as the green-winged teal and the brant might feed.

- Samples of two sedge species (*Carex aquatilis* and *Eriophorum angustifolium*) were collected at coastal lagoon stations PLNL and CL-REF-1 rather than one sample per station.

- Sourdock (*Rumex arcticus*) leaf and stem samples were collected at stations PLNL, NLK, and CL-REF-3b. These samples were archived at the analytical laboratory.

- Dead tissue was removed from whole sedge samples using gloves or decontaminated stainless steel scissors. Sedge roots were dabbed dry with clean paper towels after the site water rinse to minimize the potential for tissues to rot.

- Coastal lagoon station locations were documented with GPS. Vegetation sampling locations within each station (e.g., relative to the vegetation community assessment transect) were described in the field notes.

Because the substituted methods are similar to the methods specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by any of the modifications.

Vegetation Community Analysis

The community structure of the vegetation fringing the lagoons was evaluated near two site lagoon stations and near two reference area lagoon stations. The exact location of these community surveys was determined in the field based on slope and distance from the lagoons (which vary in size seasonally), and vegetation present at a given station.

The following modification was made to the Phase II sampling strategy for vegetation community analysis as described in the field sampling and analysis plan (Exponent 2004a):

- Due to the sand dune and coarse gravel environment on the seaward side of all of the coastal lagoons, the habitat was determined to be inhospitable to tundra plants. Therefore, community analysis data was only collected at four of the six coastal lagoon stations (see Table E-2).
- At each station, the microplots were originally planned to be placed within a 10-m square as described in Exponent (2004a). Instead, at the lagoon stations, the 10 microplots were placed along a 300-ft vegetation plot line (as for the community analyses in the terrestrial environment, described above). The lagoon vegetation survey line was generally oriented north-south (parallel with the lagoon shoreline), and the microplots were placed along the west side of the line.

The modifications are expected to improve the quality and usability of the data generated from the plant community analyses.

Tundra Soil Collection

Tundra soil samples (0–2 cm from beneath the live tundra mat, which is approximately 5 to 15 cm [2–6 in.] thick depending on location) were collected at the three site and three reference lagoon stations. There were no modifications from the field sampling and analysis plan (Exponent 2004a).

Lagoon Sediment Collection

A sample of the 0–2 cm sediment interval was collected from three stations in the coastal lagoons near the DMTS port facility and from three stations in reference area lagoons southeast of the DMTS port facility (Figure E-8). Stations corresponded with locations where samples were collected for aquatic invertebrate community analysis.

Field sampling observations indicated that benthic macroinvertebrates may be scarce or absent in the coastal lagoons, so additional surface sediment (0–2 cm) was collected for toxicity testing at three stations in the coastal lagoons near the DMTS port facility and at three stations at the reference lagoons southeast of the DMTS port facility (Figure E-7). Sediment samples collected for toxicity testing were collected from the same sediment sample volume from which sediment was collected for chemical analysis.

The following modification was made to the Phase II sampling strategy for sediment analysis as described in the field sampling and analysis plan (Exponent 2004a):

- Interstitial water quality tests prior to test initiation determined that the amphipod *Hyalella azteca* was a more appropriate test species than the estuarine amphipod *Leptocheirus plumulosus.* Therefore, the toxicity tests were performed using *H. azteca*.

Because the substituted species is similar to the test species specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by any of the substitutions, but rather enhanced by switching to a more appropriate test species for the conditions encountered in the field.

Water Quality Parameter Measurements

Water quality parameters (i.e., pH, dissolved oxygen, temperature, conductivity, and salinity) were measured at each lagoon station. There were no modifications from the field sampling and analysis plan (Exponent 2004a).

July/August 2004 Sampling Event

Additional subsistence food sampling for the DMTS fugitive dust risk assessment was conducted during July and August 2004. This supplemental sampling program had two purposes: 1) to assess current conditions 3 years after the 2001 sampling event and following the implementation of various fugitive dust controls, and 2) to obtain data for additional analytes in subsistence foods to meet a data need for the human health risk assessment. A supplemental field sampling and analysis plan was prepared for this subsistence food sampling (Exponent 2004c). Salmonberries and sourdock were collected and analyzed for CoPCs.

Salmonberry and Sourdock Tissue Collection

Salmonberry and sourdock samples were collected to provide tissue data for use in the human health risk assessment. Five samples of washed and unwashed salmonberries and five samples of washed and unwashed sourdock were collected in each of the three sampling areas (see Figure E-2); each of these sampling areas represent food collection sites. The location of sampling sites B and C were chosen in the field by members of the Subsistence Committee and the Tribal Council.

The following modifications were made to the Phase II sampling strategy for salmonberry and sourdock collection as described in the draft supplemental field sampling and analysis plan (Exponent 2004c):

- Due to a request from the members of the Subsistence Committee and the Tribal Council that were assisting with the sample collection, the salmonberry and sourdock samples were not collected in the order specified in Exponent (2004c).
- Sourdock at Site B was collected along the edge of a pond approximately 3 miles south of Kivalina (Station KIVSS) and the berries were collected further to the south along the a small berm or old beach berm that extended from the coast inland approximately a mile and half (Station KIVSB). The berm provided higher ground, which was more suitable habitat for the berries, but which did not have the lower wetter conditions that the sourdock seems to prefer.
- Sourdock at Site C was collected to the southwest of the mouth of New Heart Creek (Station IPLS) and salmonberries were collected to the northeast of the mouth of New Heart Creek (Station IPLB) (i.e., the sourdock was collected seaward and the salmonberries were located from the mouth of New Heart Creek toward Ipiavik Lagoon).

Because the modified sampling locations are close to the sampling locations specified in the field sampling plan (Exponent 2004a), the quality and usability of the data generated from this field event were not affected by the changes.

September 2004 Sampling Event

Marine Assessment

Surface sediment samples were collected at the port site in September 2004 during shipping activities at the facility, and more than 1 year after major shiploader and lightering barge improvements were made to further control fugitive concentrate dust. Sediment samples were located at the same stations that were sampled in 2003 and in June 2004. The marine assessment evaluated the concentrations of CoPCs in surface sediments at stations in the Chukchi Sea in the vicinity of the shiploader. The station locations were selected primarily on the basis of historical evaluations (RWJ 1997; Exponent 2003b, 2004b) and offshore current patterns (prevailing current is northward) and were designed to allow evaluation of possible gradients of CoPC concentrations in relation to potential sources, as well as potential temporal changes in CoPC concentrations (i.e., by resampling stations from previous studies).

Undisturbed surface sediment was collected from the upper 0–2 cm interval using a modified Ponar grab sampler. Twenty-nine stations were sampled for surface sediment during the September 2004 sampling event (Figure E-1): 26 site stations and 3 reference area stations. The site stations were located on a grid that had been sampled historically in the vicinity of the port site (RWJ 1997; Exponent 2003a,b, 2004a,b). The reference area stations were located upwind and upcurrent of the port facility. Metals and conventional analytes listed in Table E-2 were analyzed at 7 of the 26 site stations and at all of the reference area stations (locations shown on Figure E-1). The subset of seven locations (NMD, NMGZ, NML, NMM, NMN, NMO, and NMAA) includes the four stations where these chemicals exceeded benchmarks in 2003 (i.e., NMD, NMGZ, NML, and NMM), and also represents a range of concentrations observed historically, at different distances and orientations relative to the shiploader, including locations beneath and downcurrent (north) of the shiploader that were expected to have the highest concentrations, based on data collected previously (RWJ 1997; Exponent 2003b, 2004b). Lead, zinc, and cadmium analyses were conducted at all of the remaining site grid stations (Figure E-1). Extra sediment volume was also collected at these locations for possible toxicity testing.

The following modifications were made to the Phase II sampling strategy for the June 2004 marine assessment described in the field sampling and analysis plan (Exponent 2004a):

- A modified Ponar grab sampler was used to collect the sediment samples rather than the stainless-steel Ekman grab sampler, modified petite-Ponar grab sampler, or a DRCV corer suggested in Exponent (2004a). The modified Ponar grab sampler provides the same quality of sediment sample, but the grab sampler is slightly larger than the petite version and therefore provides more sediment per grab.

- The location of Station NM-REF-1was adjusted slightly to match the station coordinate sampled during the 2003 and June 2004 sampling events. Station

NM-REF-1 was placed as close as possible to the beach and the previously sampled station coordinate.

The quality and usability of the data generated from this field event were not affected by these modifications.

References

Exponent. 2003a. Port site characterization data report. Prepared for Teck Cominco Alaska Inc., Anchorage, AK. Exponent, Bellevue, WA.

Exponent. 2003b. Current and historical metals concentrations in marine sediment samples from the DMTS port site. Memorandum to Teck Cominco, April 2, 2003. Exponent, Bellevue, WA.

Exponent. 2004a. Phase II field sampling and analysis plan for the DMTS fugitive dust risk assessment. Prepared for Teck Cominco Alaska Inc., Anchorage, AK. Exponent, Bellevue, WA.

Exponent. 2004b. Draft DMTS fugitive dust risk assessment work plan. Prepared for Teck Cominco Alaska Inc., Anchorage, AK. Exponent, Bellevue, WA.

Exponent. 2004c. Draft field sampling and analysis plan for supplemental salmonberry and vegetation assessment. Prepared for Teck Cominco Alaska Inc., Anchorage, AK. Exponent, Bellevue, WA.

Morris, W.A., and A.G. Ott. 2001. Metals concentrations in juvenile Dolly Varden (*Salvelinus malma*) sampled at two streams along the DeLong Mountain Regional Transportation System, Red Dog Mine. Alaska Department of Fish and Game.

RWJ. 1997. Red Dog port site monitoring program. Prepared for Cominco Alaska, Inc., Anchorage, AK. RWJ Consulting, Chugiak, AK.

Figures

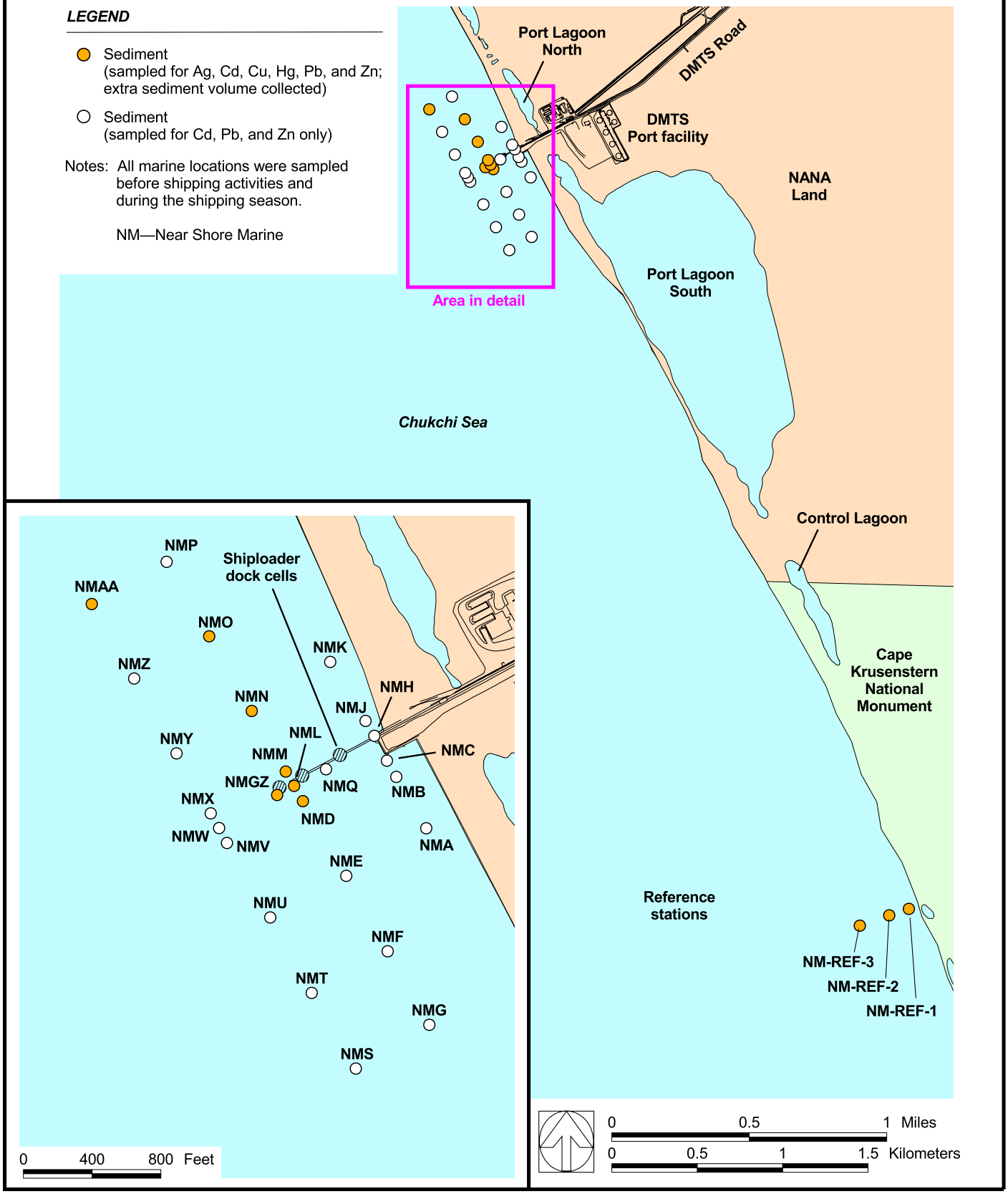

Figure E-1. Locations of marine sediment sample stations

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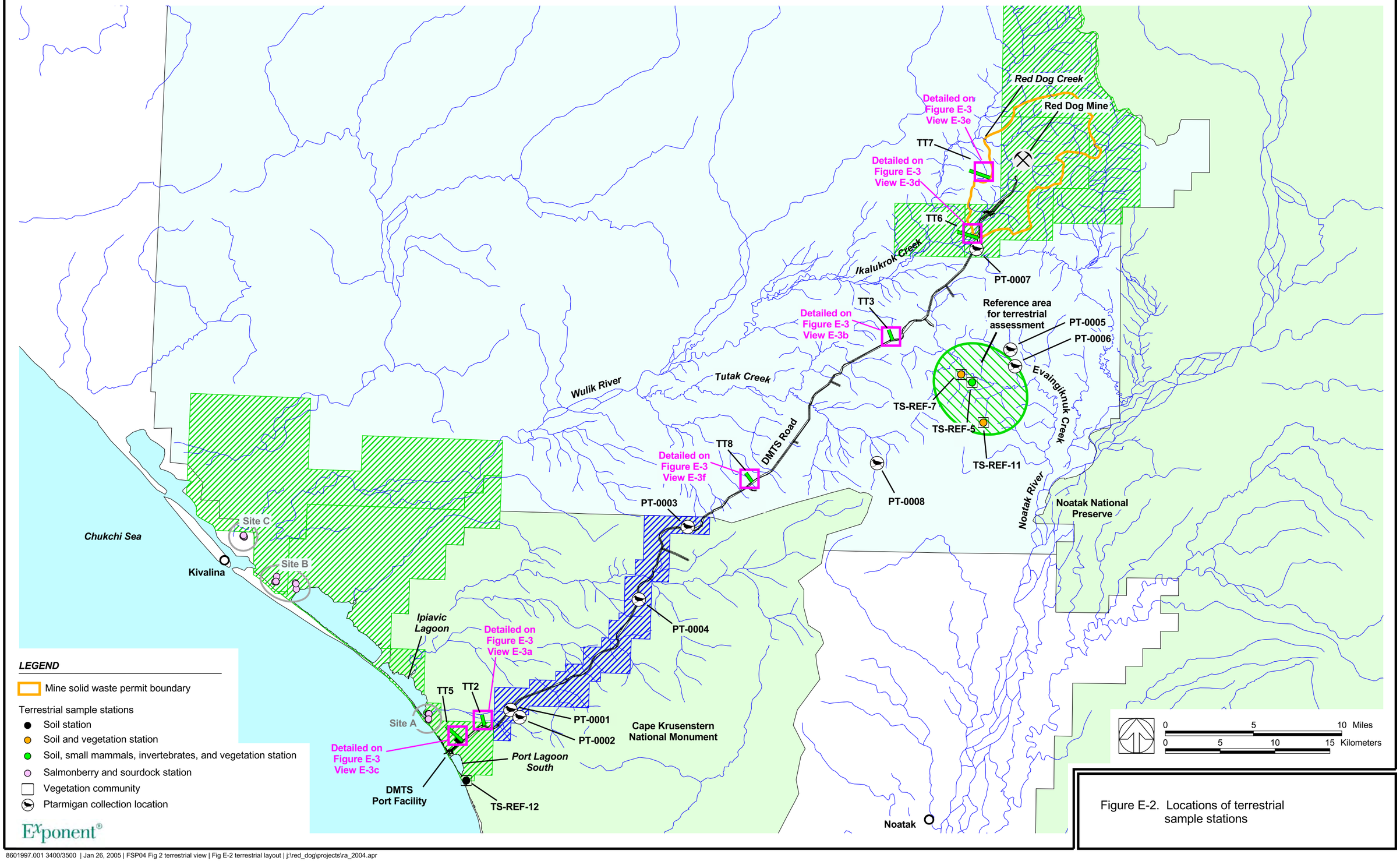
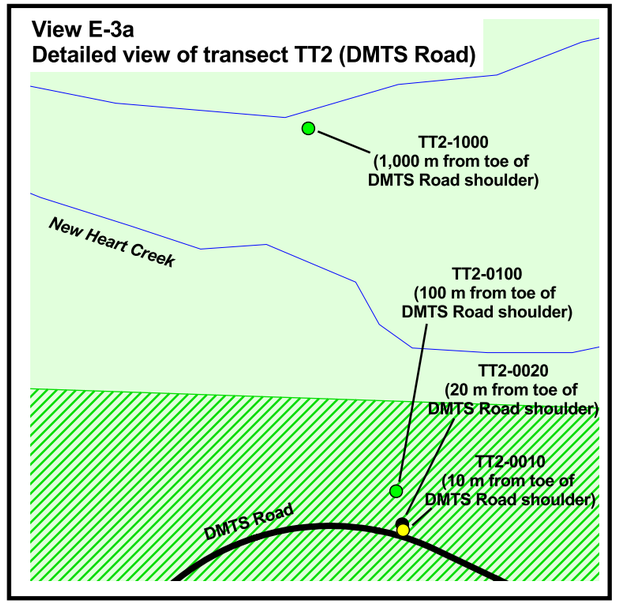
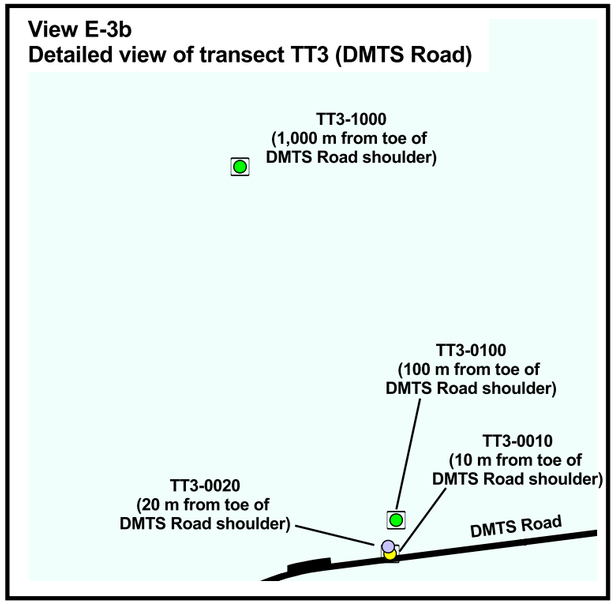
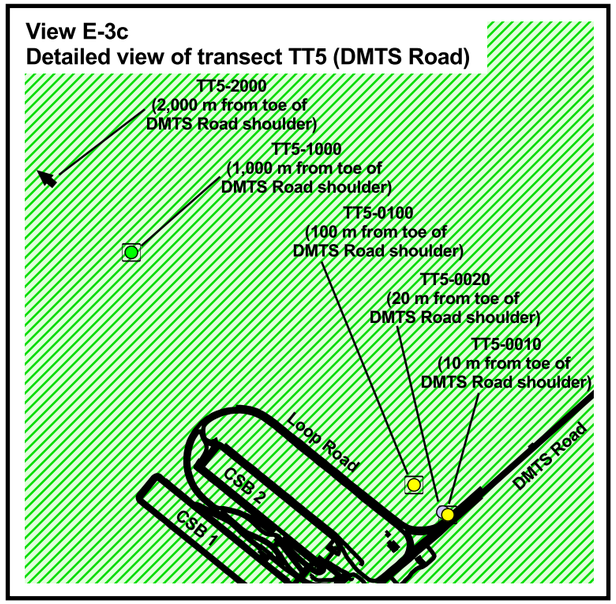
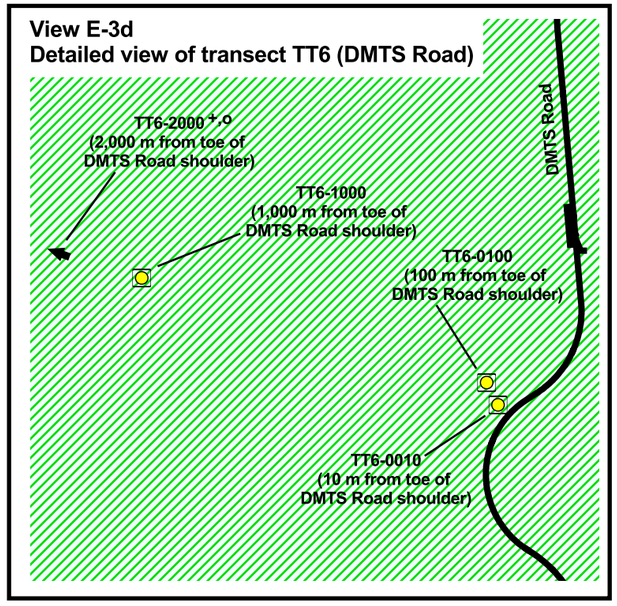


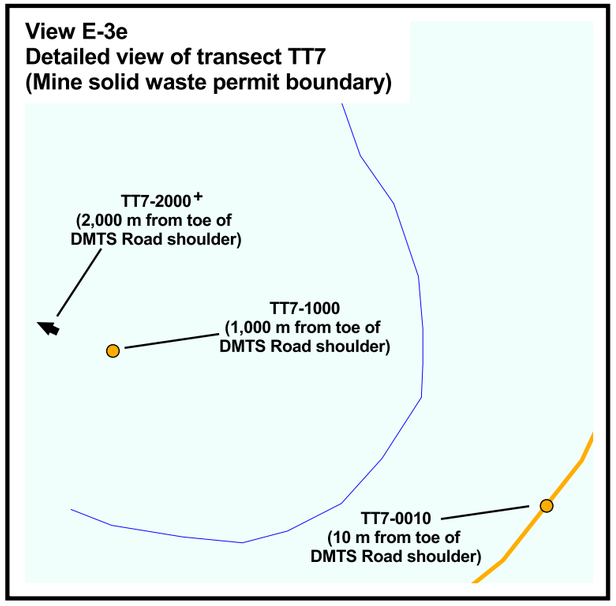
Figure E-2. Locations of terrestrial sample stations

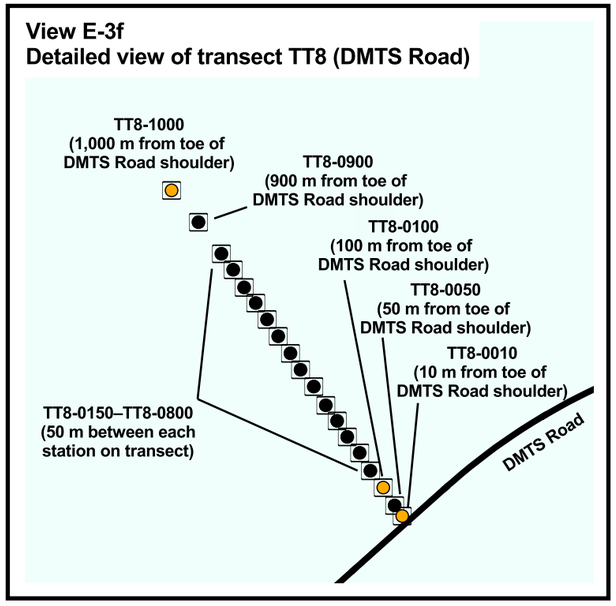












LEGEND

Mine solid waste permit boundary

Terrestrial sample stations

- Soil station
- Soil and vegetation station
- Soil, invertebrates, and vegetation station
- Soil, small mammals, invertebrates, and vegetation station
- Soil and small mammals
- Vegetation community

Notes: + No small mammals or invertebrates collected at this station
o No vegetation community analysis at this station

0 1000 2000 3000 Feet
0 500 1000 Meters

Figure E-3. Detailed views of locations of terrestrial sample stations

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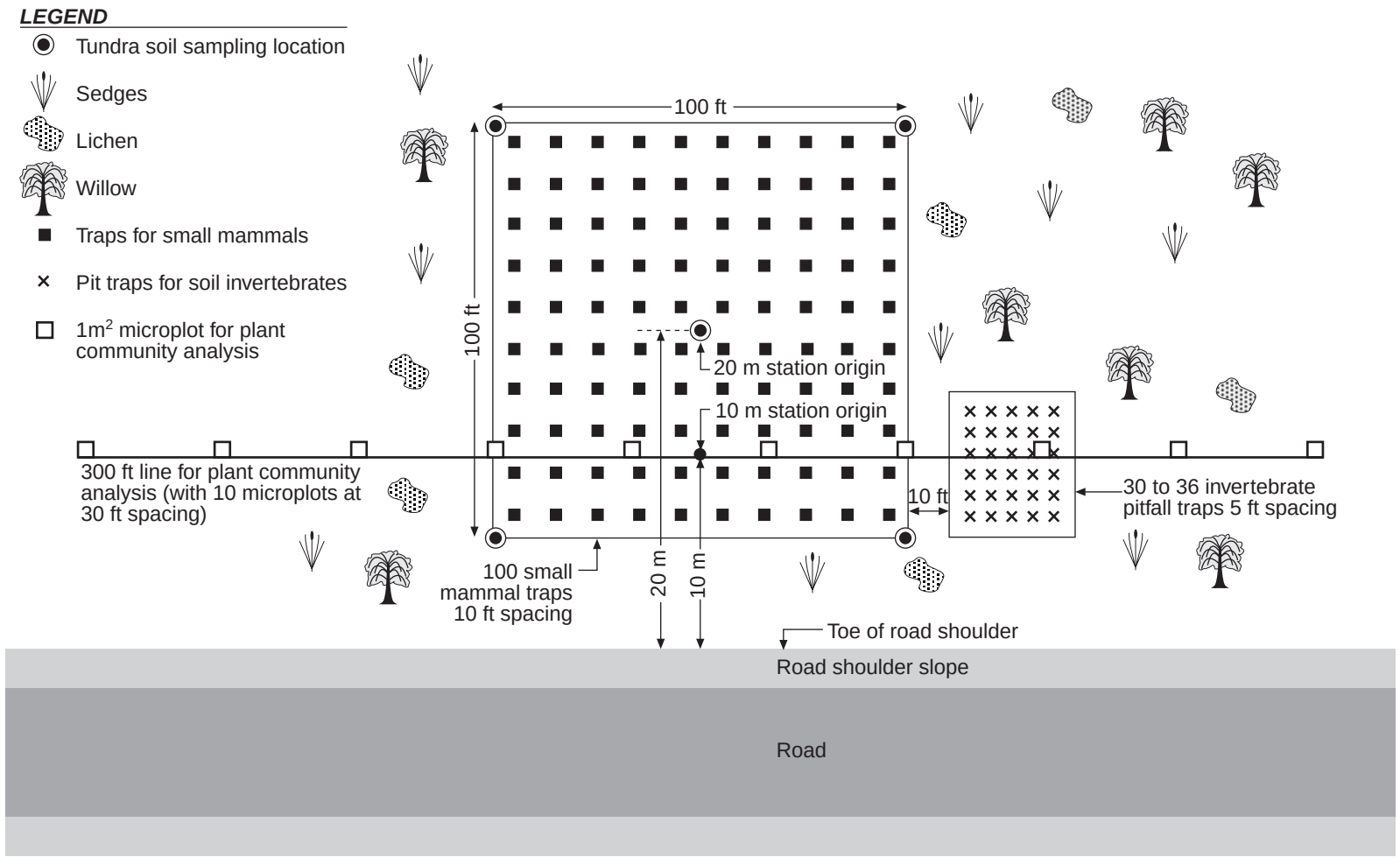


Figure E-4. Schematic layout of typical 10 m and 20 m terrestrial transect station

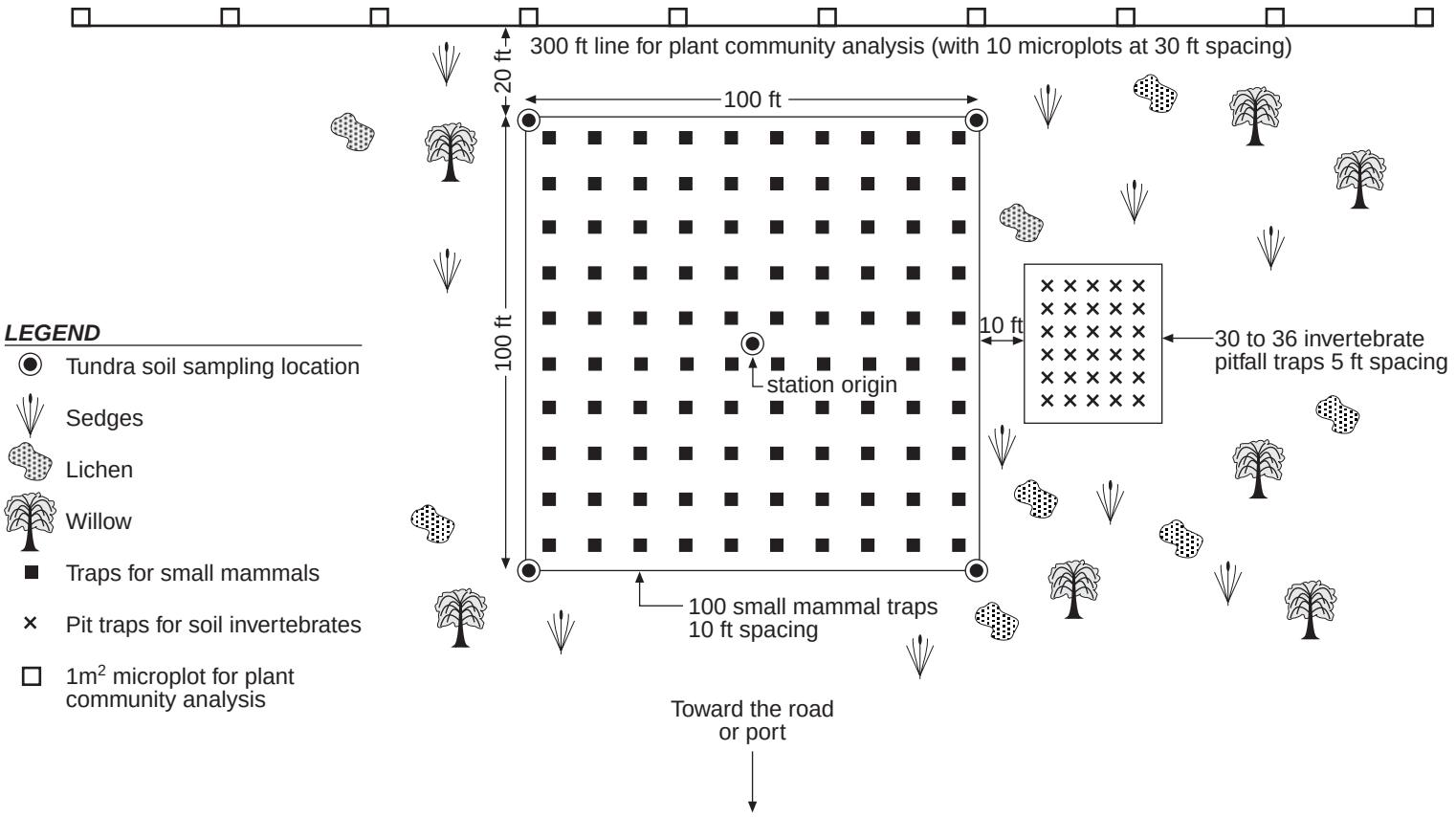
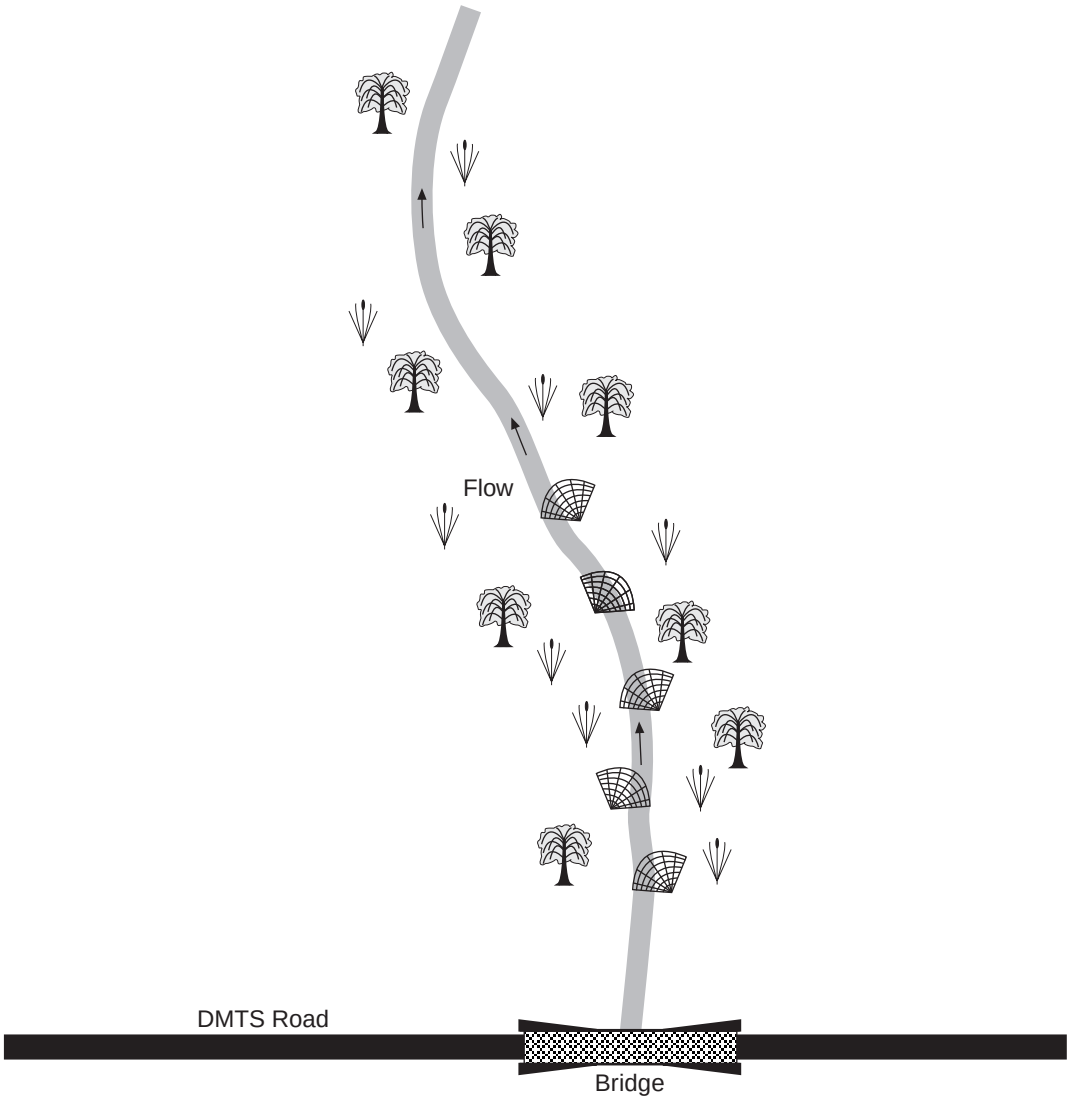


Figure E-5. Schematic layout of typical 100 m, 1,000 m, and 2,000 m terrestrial transect station



LEGEND

Drift nets

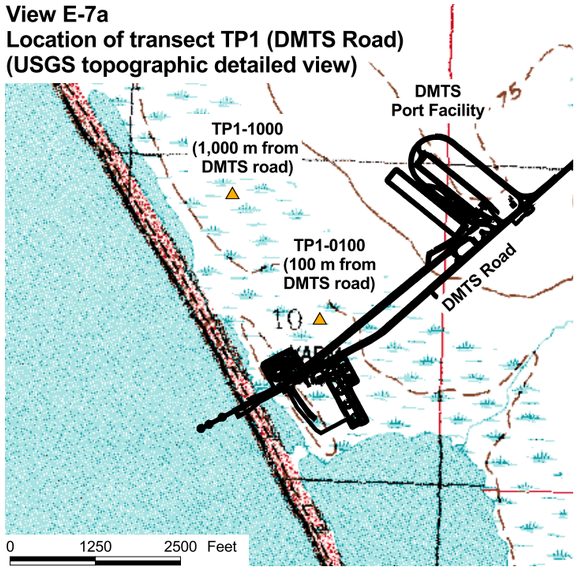
Sedges

Willow

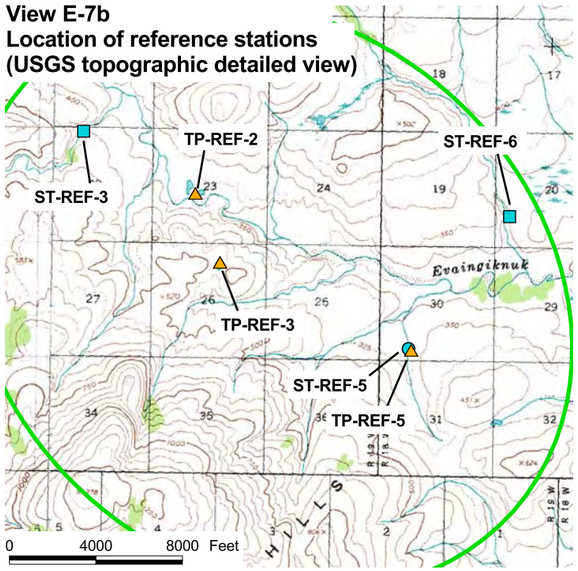
Note: The typical range of stream reach length between the road edge and the last net is 150–300 ft.

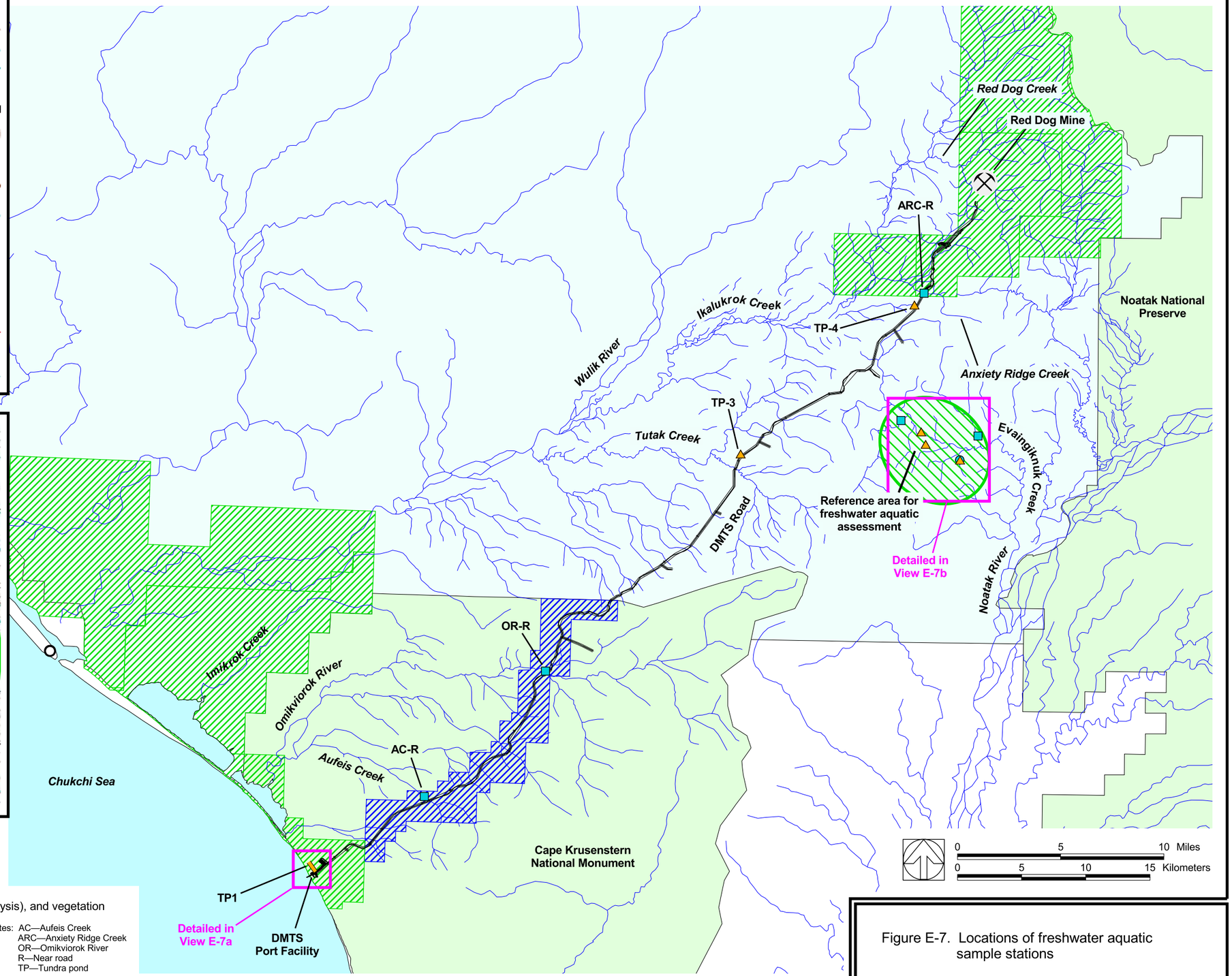
Figure E-6. Schematic layout of typical stream station

View E-7a
Location of transect TP1 (DMTS Road)
(USGS topographic detailed view)



View E-7b
Location of reference stations
(USGS topographic detailed view)





LEGEND

Stream station
- Aquatic invertebrates (community analysis), and vegetation
- Sediment, aquatic invertebrates (tissue chemistry and community analysis), and vegetation

Tundra pond station
- Tundra soil and vegetation

Notes: AC—Aufeis Creek
ARC—Anxiety Ridge Creek
OR—Omikviorok River
R—Near road
TP—Tundra pond

Figure E-7. Locations of freshwater aquatic sample stations

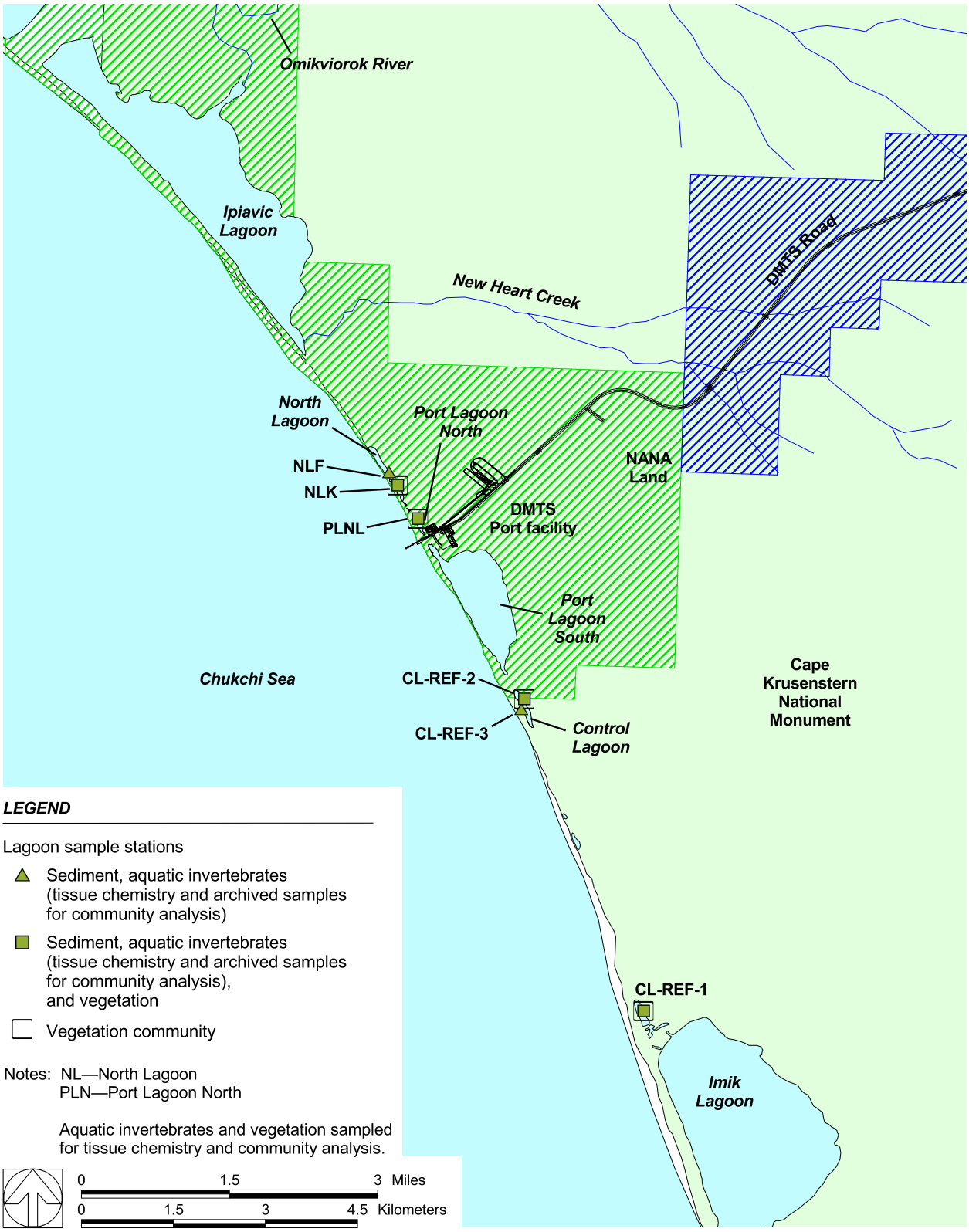


Figure E-8. Locations of coastal lagoon sample stations

Tables

Table E-1. Overview of Phase II data

Assessment Endpoint	Station/ Transect	Distance (m)	Small Mammals	Ptarmigan	Terrestrial Invertebrate Tissue	Vegetation									Aquatic Invertebrates		Sediment		Water Quality Parameters
						Willow	Birch	Sedge	Lichen		Salmon-berries	Sour-dock	Vegetation Plots	Tundra Soil	Tissue	Community Analysis	Chemistry	Toxicity Test	
									Peltigera	Cladina									
Terrestrial																			
	TT5	10			X	X		X	X				X	X					
		20	X											X					
		100	[a]		X	X		X	X				X	X					
		1,000	X		X	X	X	X	X				X	X					
		2,000	X		X		X	X		X			X	X					
	TT2	10			X	X		X	X					X					
		20	[a]											X					
		100	X		X	X		X	X					X					
		1,000	X		X	X		X	X					X					
	TT8	10				X		X	X				X	X					
		20	[a]																
		50											[b]	X					
		100	[a]			X		X	X				X	X					
		150											[b]	X					
		200											[b]	X					
		250											[b]	X					
		300											[b]	X					
		350											[b]	X					
		400											[b]	X					
		450											[b]	X					
		500											[b]	X					
		550											[b]	X					
		600											[b]	X					
		650											[b]	X					
		700											[b]	X					
		750											[b]	X					
		800											[b]	X					
		900											[b]	X					
		1,000				X		X	X	X			X	X					
	TT3	10			X	X		X	X				X	X					
		20	X											X					
		100	X		X	X	X	X	X				X	X					
		1,000	X		X		X	X	X	X			X	X					
	TT6	10			X	X		X	X	X			X	X					
		20	[c]																
		100			X	X		X	X	X			X	X					
		1,000			X	X		X	X	X			X	X					
		2,000				X		X	X	X				X					
	TT7	10				X		X		X				X					
		1,000				X		X		X				X					
		2,000				X		X		X				X					

Table E-1. (cont.)

Assessment Endpoint	Station/ Transect	Distance (m)	Small Mammals	Ptarmigan	Terrestrial Invertebrate Tissue	Vegetation									Aquatic Invertebrates		Sediment		Water Quality Parameters
									Lichen										
						Willow	Birch	Sedge	Peltigera	Cladina	Salmon-berries	Sour-dock	Vegetation Plots	Tundra Soil	Tissue	Community Analysis	Chemistry	Toxicity Test	
	TS-REF-5		X		X	X		X	X	X			X	X					
	TS-REF-7					X	X	X	X	X			X	X					
	TS-REF-11					X	X	X	X	X			X	X					
	TS-REF-12												X	X					
	Near the DMTS road			X															
	Terrestrial reference area			X															
	Site A										X[a]	X[a]							
	Site B										X[d]	X[d]							
	Site C										X[d]	X[d]							
Streams																			
	AC-R					X								X	X	X	X		X
	OR-R					X		X						X	X	X	X		X
	ARC-R					X		X						X	X	X	X		X
	ST-REF-3					X		X						X	X	X	X		X
	ST-REF-5					X		X						X		X			X
	ST-REF-6					X		X						X	X	X	X		X
Tundra Ponds																			
	TP1	100						X						X					X
		1,000						X						X					X
	TP3							X						X					X
	TP4							X						X					X
	TP-REF-2							X						X					X
	TP-REF-3							X						X					X
	TP-REF-5							X						X					X
Coastal Lagoons																			
	PLNL							X					X	X	X	X[e]	X	X	X
	NLK							X					X	X	X	X[e]	X	X	X
	NLF													X	X	X[e]	X	X	X
	CL-REF-1							X					X	X	X	X[e]	X	X	X
	CL-REF-2							X					X	X	X[f]	X[e]	X	X	X
	CL-REF-3													X		X[e]	X	X	X
Marine (Pre-shipping - June 2004)																			
	NMA																X		
	NMB																X		
	NMC																X		
	NMD																X		
	NME																X		
	NMF																X		
	NMG																X		
	NMH																X		
	NMJ																X		

Table E-1. (cont.)

Assessment Endpoint	Station/ Transect	Distance (m)	Small Mammals	Ptarmigan	Terrestrial Invertebrate Tissue	Vegetation					Salmon-berries	Sour-dock	Vegetation Plots	Tundra Soil	Aquatic Invertebrates		Sediment		Water Quality Parameters
									Lichen						Tissue	Community Analysis	Chemistry	Toxicity Test	
						Willow	Birch	Sedge	Peltigera	Cladina									
	NMK																X		
	NML																X		
	NMM																X		
	NMN																X		
	NMO																X		
	NMP																X		
	NMQ																X		
	NMS																X		
	NMT																X		
	NMU																X		
	NMV																X		
	NMW																X		
	NMX																X		
	NMY																X		
	NMZ																X		
	NMAA																X		
	NMGZ																X		
	NM-REF-1																X		
	NM-REF-2																X		
	NM-REF-3																X		

[a] Grid set; no small mammals collected.

[b] Single microplot for vegetation community.

[c] No small mammal grid set; not correct habitat (too open).

[d] Five washed and five unwashed samples were collected at each site.

[e] Samples archived.

[f] Aquatic invertebrate tissue sample collected from area encompassed by both Stations CL-REF-2 and CL-REF-3.

Table E-2. Phase II data collection matrix

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
Terrestrial							
Small Mammals (presented in ascending order from port facility to mine along the DMTS)					Tissue chemistry; whole body; each individual mammal equals one sample	List 1[a]	
TT5	-- Port transect	4	3				
	20 m north of road			5; 2 brown lemmings and 3 tundra voles			
	100 m north of road			None			Grid set; no small mammals were collected
	1,000 m north of road			3 northern red backed voles			
	2,000 m north of road			1 masked shrew			
TT2	-- DMTS road transect	3	2				
	20 m north of road			None			Grid set; no small mammals were collected
	100 m north of road			3 northern red backed voles			
	1,000 m north of road			1 northern red backed vole			
TT8	-- DMTS road transect	0	0				Stations were added in the field.
	20 m north of road			None			Grid set; no small mammals were collected
	100 m north of road			None			Grid set; no small mammals were collected
TT3	-- DMTS road transect	3	3				
	20 m north of road			1 masked shrew			
	100 m north of road			2; 1 masked shrew and 1 tundra shrew			
	1,000 m north of road			3; 2 northern red backed voles and 1 masked shrew			
TT6	-- DMTS road transect	3	0				
	20 m north of road			None			No grid set; not correct habitat (too open)
	100 m north of road			None			Grid set; no small mammals were collected
	1,000 m north of road			None			Grid set; no small mammals were collected
TT7	-- Solid waste permit boundary transect	2	0				
	10 m downwind of boundary			None			No grid set; not correct habitat (rock face)
	1,000 m downwind of mine			None			No grid set; not correct habitat (rock face)
TS-REF-5	-- Terrestrial reference area	1	1	4; 3 masked shrews and 1 northern red backed vole			
Ptarmigan	Near the DMTS road	NA	NA	5 individual birds	Tissue chemistry; breast muscle tissue (skin on), liver, and kidneys from each bird analyzed separately	List 2: Antimony, barium, cadmium, lead, thallium, and zinc	
	Terrestrial reference area	NA	NA	3 individual birds			
Soil Invertebrate Tissue (presented in ascending order from port facility to mine along the DMTS)					Tissue chemistry; whole body; composite tissue sample of all soil invertebrates collected at a given station	List 1[a]	
TT5	-- Port transect	4	4				
	10 m north of road			1 spiders-only composite and 1 multi-species composite			
	100 m north of road			1 crane flies-only composite and 1 multi-species composite			
	1,000 m north of road			2 spiders-only composites and 1multi-species composite			
	2,000 m north of road			1 multi-species composite			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
TT2	-- DMTS road transect	3	3				
	10 m north of road			1 multi-species composite			
	100 m north of road			1 multi-species composite			
	1,000 m north of road			1 multi-species composite			
TT3	-- DMTS road transect	0	3				Stations were added in the field.
	10 m north of road			1 multi-species composite			
	100 m north of road			1 multi-species composite			
	1,000 m north of road			1 multi-species composite			
TT6	-- DMTS road transect	0	3				Stations were added in the field.
	10 m north of road			1 multi-species composite			
	100 m north of road			1 multi-species composite			
	1,000 m north of road			1 multi-species composite			
TS-REF-5	-- Terrestrial reference area	1	1	1 multi-species composite			
Vegetation Tissue (presented in ascending order from port facility to mine along the DMTS)							
TT5	-- Port transect	4	4		Tissue chemistry; unwashed willow or birch leaves (debris removed in field), unwashed sedge blades (minimum 3 plants per station), unwashed lichen (debris removed in field with minimum 3 plants per station)	List 1[a]	
	10 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	100 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	1,000 m north of road			4; willow, birch, sedge, and lichen (Peltigera) (1 composite sample per species)			Willow and birch leaves were collected at this station.
	2,000 m north of road			3; birch, sedge, and lichen (Cladina) (1 composite sample per species)			No willow leaves were collected at this station. Birch leaves were collected at this station.
TT2	-- DMTS road transect	3	3				
	10 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	1,000 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	1 km north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
TT8	-- DMTS road transect	3	3				
	10 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	100 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	1,000 m north of road			4; willow, sedge, and lichen (both Peltigera and Cladina) (1 composite sample per species)			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
TT3	-- DMTS road transect	3	3				
	10 m north of road			3; willow, sedge, and lichen (Peltigera) (1 composite sample per species)			
	100 m north of road			4; willow, birch, sedge, and lichen (Peltigera) (1 composite sample per species)			Willow and birch leaves were collected at this station.
	1,000 m north of road			4; birch, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			No willow leaves were collected at this station. Birch leaves were collected at this station.
TT6	-- Port transect	4	4				
	10 m north of road			4; willow, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			
	100 m north of road			4; willow, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			
	1,000 m north of road			4; willow, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			
	2,000 m north of road			4; willow, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			
TT7	-- Solid waste permit boundary transect	3	3				
	10 m downwind of boundary			3; willow, sedge, and lichen (Cladina) (1 composite sample per species)			
	1,000 m downwind of mine			3; willow, sedge, and lichen (Cladina) (1 composite sample per species)			
	2,000 m downwind of mine			3; willow, sedge, and lichen (Cladina) (1 composite sample per species)			
TS-REF-5	-- Terrestrial reference area	1	1	4; willow, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			
TS-REF-7	-- Terrestrial reference area	1	1	5; willow, birch, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			Willow and birch leaves were collected at this station.
TS-REF-11	-- Terrestrial reference area	1	1	5; willow, birch, sedge, and lichen (Peltigera and Cladina) (1 composite sample per species)			Willow and birch leaves were collected at this station.
Berries							
Site A	-- just north of the port ambient air boundary at Ipiavik Lagoon	1	1	10; 5 washed and 5 unwashed salmonberry samples	Tissue chemistry; for all washed samples any debris was removed in field	Antimony, barium, cadmium, lead, thallium, and zinc	
Site B	-- north of the port facility but closer to Kivalina	1	1	10; 5 washed and 5 unwashed salmonberry samples			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
Site C	-- reference area north of Kivalina	1	1	10; 5 washed and 5 unwashed salmonberry samples			
Site D	-- south of Site A on Ipiavik Lagoon but closer to the port facility	0	1	10; 5 washed and 5 unwashed salmonberry samples			
Sourdock					Tissue chemistry; for all washed samples any debris was removed in field; minimum 3 sourdock plants per station	Antimony, barium, cadmium, lead, thallium, and zinc	
Site A	-- just north of the port ambient air boundary at Ipiavik Lagoon	1	1	10; 5 washed and 5 unwashed sourdock samples			
Site B	-- north of the port facility but closer to Kivalina	1	1	10; 5 washed and 5 unwashed sourdock samples			
Site C	-- reference area north of Kivalina	1	1	10; 5 washed and 5 unwashed sourdock samples			
Site D	-- south of Site A on Ipiavik Lagoon but closer to the port facility	0	1	10; 5 washed and 5 unwashed sourdock samples			
Vegetation Plots (presented in ascending order from port facility to mine along the DMTS)					Community analysis	--	
TT5	-- Port transect	4	4				
	10 m north of road			--			
	100 m north of road			--			
	1,000 m north of road			--			
	2,000 m north of road			--			
TT8	-- DMTS road transect	3	19				
	10 m north of road			--			Station was added in the field.
	50 m north of road			--			Single microplot; station was added in the field.
	100 m north of road			--			
	150 m north of road			--			Single microplot; station was added in the field.
	200 m north of road			--			Single microplot; station was added in the field.
	250 m north of road			--			Single microplot; station was added in the field.
	300 m north of road			--			Single microplot; station was added in the field.
	350 m north of road			--			Single microplot; station was added in the field.
	400 m north of road			--			Single microplot; station was added in the field.
	450 m north of road			--			Single microplot; station was added in the field.
	500 m north of road			--			Single microplot; station was added in the field.
	550 m north of road			--			Single microplot; station was added in the field.
	600 m north of road			--			Single microplot; station was added in the field.
	650 m north of road			--			Single microplot; station was added in the field.
	700 m north of road			--			Single microplot; station was added in the field.
	750 m north of road			--			Single microplot; station was added in the field.
	800 m north of road			--			Single microplot; station was added in the field.
	900 m north of road			--			Single microplot; station was added in the field.
	1,000 m north of road			--			
TT3	-- DMTS road transect	3	3				
	10 m north of road			--			
	100 m north of road			--			
	1,000 m north of road			--			
TT6	-- Port transect	3	3				
	10 m north of road			--			
	100 m north of road			--			
	1,000 m north of road			--			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
TS-REF-5	-- Terrestrial reference area	1	1	--			
TS-REF-7	-- Terrestrial reference area	1	1	--			
TS-REF-11	-- Terrestrial reference area	1	1	--			Reference area station location was modified to better match vegetation community at site stations.
TS-REF-12	-- Terrestrial reference area	0	1	--			Station was added in the field.
Tundra Soil (presented in ascending order from port facility to mine along the DMTS)					Chemistry; 0–2 cm	List 3[b] and pH	
TT5	-- Port transect	5	5				
	10 m north of road			1			
	20 m north of road			1			
	100 m north of road			1			
	1,000 m north of road			1			
	2,000 m north of road			1			
TT2	-- DMTS road transect	4	4				
	10 m north of road			1			
	20 m north of road			1			
	100 m north of road			1			
	1,000 m north of road			1			
TT8	-- DMTS road transect	3	19				
	10 m north of road			1			
	50 m north of road			1			Station was added in the field.
	100 m north of road			1			
	150 m north of road			1			Station was added in the field.
	200 m north of road			1			Station was added in the field.
	250 m north of road			1			Station was added in the field.
	300 m north of road			1			Station was added in the field.
	350 m north of road			1			Station was added in the field.
	400 m north of road			1			Station was added in the field.
	450 m north of road			1			Station was added in the field.
	500 m north of road			1			Station was added in the field.
	550 m north of road			1			Station was added in the field.
	600 m north of road			1			Station was added in the field.
	650 m north of road			1			Station was added in the field.
	700 m north of road			1			Station was added in the field.
	750 m north of road			1			Station was added in the field.
	800 m north of road			1			Station was added in the field.
	900 m north of road			1			Station was added in the field.
	1,000 m north of road			1			
TT3	-- DMTS road transect	6	4				Vegetation transition points at 50 m and 250 m were moved from TT3 to TT8.
	10 m north of road			1			
	20 m north of road			1			
	100 m north of road			1			
	1,000 m north of road			1			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
TT6	-- Port transect	5	4				
	10 m north of road			1			
	20 m north of road			0			No tundra soil sample was collected at 20 m.
	100 m north of road			1			
	1,000 m north of road			1			
	2,000 m north of road			1			
TT7	-- Solid waste permit boundary transect	3	3				
	10 m downwind of boundary			1			
	1,000 m downwind of mine			1			
	2,000 m downwind of mine			1			
TS-REF-5	-- Terrestrial reference area	1	1	1			
TS-REF-7	-- Terrestrial reference area	1	1	1			
TS-REF-11	-- Terrestrial reference area	1	1	1			Reference area station location was modified to better match vegetation community at site stations.
TS-REF-12	-- Terrestrial reference area	0	1	1			Station was added in the field.
Streams							
Aquatic Invertebrate Tissue (presented in ascending order from port facility to mine along the DMTS)					Tissue chemistry	Cadmium, lead, mercury, and zinc	Stations were added in the field.
AC-R	Aufeis Creek	0	1	1 multi-species composite			
OR-R	Omikviorok River	0	1	1 multi-species composite			
ARC-R	Anxiety Ridge Creek	0	1	1 multi-species composite			
ST-REF-3	-- Freshwater aquatic reference area	0	1	1 multi-species composite			
ST-REF-6	-- Freshwater aquatic reference area	0	1	1 multi-species composite			
Aquatic Invertebrate Community (presented in ascending order from port facility to mine along the DMTS)					Community analysis	--	
AC-R	Aufeis Creek	1	1	5 replicates per station			
OR-R	Omikviorok River	1	1	5 replicates per station			
ARC-R	Anxiety Ridge Creek	1	1	5 replicates per station			
ST-REF-3	-- Freshwater aquatic reference area	1	1	5 replicates per station			
ST-REF-5	-- Freshwater aquatic reference area	0	1	5 replicates per station			
ST-REF-6	-- Freshwater aquatic reference area	0	1	5 replicates per station			
Vegetation Tissue (presented in ascending order from port facility to mine along the DMTS)					Tissue chemistry; unwashed willow leaves (debris removed in field), sedge plant (rinsed roots [no sediment] and unwashed blades with minimum 3 plants per station)	List 1[a]	
AC-R	Aufeis Creek	1	1	1; willow (1 composite sample)			Sedge was not collected at this station.
OR-R	Omikviorok River	1	1	2; willow and sedge (1 composite sample per species)			
ARC-R	Anxiety Ridge Creek	1	1	2; willow and sedge (1 composite sample per species)			
ST-REF-3	-- Freshwater aquatic reference area	1	1	2; willow and sedge (1 composite sample per species)			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
ST-REF-5	-- Freshwater aquatic reference area	1	1	2; willow and sedge (1 composite sample per species)			
ST-REF-6	-- Freshwater aquatic reference area	1	1	2; willow and sedge (1 composite sample per species)			
Tundra Soil (presented in ascending order from port facility to mine along the DMTS)					Chemistry; 0–2 cm	List 3[b] and pH	
AC-R	Aufeis Creek	1	1	1			
OR-R	Omikviorok River	1	1	1			
ARC-R	Anxiety Ridge Creek	1	1	1			
ST-REF-3	-- Freshwater aquatic reference area	1	1	1			
ST-REF-5	-- Freshwater aquatic reference area	1	1	1			
ST-REF-6	-- Freshwater aquatic reference area	1	1	1			
Stream Sediment (presented in ascending order from port facility to mine along the DMTS)					Chemistry; 0–2 cm	List 3[b] and pH	Stations were added in the field (associated with the stream aquatic invertebrate tissue samples).
AC-R	Aufeis Creek	0	1	1			
OR-R	Omikviorok River	0	1	1			
ARC-R	Anxiety Ridge Creek	0	1	1			
ST-REF-3	-- Freshwater aquatic reference area	0	1	1			
ST-REF-6	-- Freshwater aquatic reference area	0	1	1			
Stream Water (presented in ascending order from port facility to mine along the DMTS)					Field measurements	Water quality parameters[c]	
AC-R	Aufeis Creek	1	1	1			
OR-R	Omikviorok River	1	1	1			
ARC-R	Anxiety Ridge Creek	1	1	1			
ST-REF-3	-- Freshwater aquatic reference area	1	1	1			
ST-REF-5	-- Freshwater aquatic reference area	1	1	1			
ST-REF-6	-- Freshwater aquatic reference area	1	1	1			
Tundra Ponds							
Vegetation Tissue (presented in ascending order from port facility to mine along the DMTS)					Tissue chemistry; sedge plant (rinsed roots [no sediment] and unwashed blades with minimum 3 plants per station); entire plant will be sampled	List 1[a]	
TP1	-- Port transect						
	100 m north of road	1	1	1			
	1 km north of road	1	1	1			
	--DMTS road						2 ponds at 100-500 m north of road - near mine and middle of road; a suitable third pond was not identified
	TP3	1	1	1			
	TP4	1	1	1			
TP-REF-2	-- Freshwater aquatic reference area	1	1	1			
TP-REF-3	-- Freshwater aquatic reference area	1	1	1			
TP-REF-5	-- Freshwater aquatic reference area	1	1	1			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
Tundra Soil (presented in ascending order from port facility to mine along the DMTS)					Chemistry; 0–2 cm	List 3[b]	
TP1	-- Port transect						
	100 m north of road	1	1	1			
	1 km north of road	1	1	1			
	--DMTS road						
	TP3	1	1	1			
	TP4	1	1	1			
TP-REF-2	-- Freshwater aquatic reference area	1	1	1			
TP-REF-3	-- Freshwater aquatic reference area	1	1	1			
TP-REF-5	-- Freshwater aquatic reference area	1	1	1			
Tundra Pond Water (presented in ascending order from port facility to mine along the DMTS)					Field measurements	Water quality parameters[c]	
TP1	-- Port transect						
	100 m north of road	1	1	1			
	1 km north of road	1	1	1			
	--DMTS road						2 ponds at 100-500 m north of road - near mine and middle of road; a suitable third pond was not identified
	TP3	1	1	1			
	TP4	1	1	1			
TP-REF-2	-- Freshwater aquatic reference area	1	1	1			
TP-REF-3	-- Freshwater aquatic reference area	1	1	1			
TP-REF-5	-- Freshwater aquatic reference area	1	1	1			
Coastal Lagoons							
Aquatic Invertebrate Tissue (presented in ascending order from port facility to the north))					Tissue chemistry; composite sample of all invertebrates collected at a station	List 4: Cadmium, lead, and zinc	
PLNL	Port Lagoon North (inland shore)	1	1	1 multi-species composite			
NLK	North Lagoon (inland shore)	1	1	1 multi-species composite			
NLF	North Lagoon (seaward shore)	1	1	1 multi-species composite			
CL-REF-1	-- Reference lagoon	1	1	1 multi-species composite			
CL-REF-2/3	-- Control lagoon	0	1	1 multi-species composite			Station was added in the field.
Aquatic Invertebrate Community (presented in ascending order from port facility to the north)					Community analysis	--	
PLNL	Port Lagoon North (inland shore)	1	1	5 replicates per station			
NLK	North Lagoon (inland shore)	1	1	5 replicates per station			
NLF	North Lagoon (seaward shore)	1	1	5 replicates per station			
CL-REF-1	-- Reference lagoon	1	1	5 replicates per station			
CL-REF-2	-- Control lagoon (inland shore)	1	1	5 replicates per station			
CL-REF-3	-- Control lagoon (seaward shore)	1	1	5 replicates per station			
Fish							
	2 site lagoons	2	0	0			All 3 coastal lagoons were seined and trapped; no fish were collected.
	Reference lagoon TBD	1	0	0			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
Vegetation Tissue (presented in ascending order from port facility to the north)					Tissue chemistry; sedge plant (rinsed roots [no sediment] and unwashed blades with minimum 3 plants per station); entire plant will be sampled	List 1[a]	
PLNL	Port Lagoon North (inland shore)	1	1	1			
NLK	North Lagoon (inland shore)	1	1	1			
NLF	North Lagoon (seaward shore)	1	0	0			No sedge was present at Station NLF.
CL-REF-1	-- Reference lagoon	1	1				
CL-REF-2	-- Control lagoon (inland shore)	1	1	1			
CL-REF-3	-- Control lagoon (northern shore)	1	0	0			
Vegetation Plots (presented in ascending order from port facility to the north)					Community analysis	--	
PLNL	Port Lagoon North (inland shore)	1	1	--			
NLK	North Lagoon (inland shore)	1	1	--			
NLF	North Lagoon (seaward shore)	1	0	--			No vegetation plots were surveyed at Station NLF; sand dune environment
CL-REF-1	-- Reference lagoon	1	1	--			
CL-REF-2	-- Control lagoon (inland shore)	1	1	--			
CL-REF-3	-- Control lagoon (northern shore)	1	0	--			No vegetation plots were surveyed at Station CL-REF-3
Tundra Soil (presented in ascending order from port facility to the north)					Chemistry; 0–2 cm	List 3[b] and pH	
PLNL	Port Lagoon North (inland shore)	1	1	1			
NLK	North Lagoon (inland shore)	1	1	1			
NLF	North Lagoon (seaward shore)	1	1	1			
CL-REF-1	-- Reference lagoon	1	1	1			
CL-REF-2	-- Control lagoon (inland shore)	1	1	1			
CL-REF-3	-- Control lagoon (northern shore)	1	1	1			
Lagoon Sediment (presented in ascending order from port facility to mine along the DMTS)					Chemistry and toxicity test; 0–2 cm	List 5: Arsenic, cadmium, lead, zinc; List 6: Grain size and total solids; *Hyalella* survival and growth	
PLNL	Port Lagoon North (inland shore)	1	1	1			
NLK	North Lagoon (inland shore)	1	1	1			
NLF	North Lagoon (seaward shore)	1	1	1			
CL-REF-1	-- Reference lagoon	1	1	1			
CL-REF-2	-- Control lagoon (inland shore)	1	1	1			
CL-REF-3	-- Control lagoon (seaward shore)	1	1	1			
Lagoon Water (presented in ascending order from port facility to the north)					Field measurements	Water quality parameters[c]	
PLNL	Port Lagoon North (inland shore)	1	1	1			
NLK	North Lagoon (inland shore)	1	1	1			
NLF	North Lagoon (seaward shore)	1	1	1			
CL-REF-1	-- Reference lagoon	1	1	1			
CL-REF-2	-- Control lagoon (inland shore)	1	1	1			
CL-REF-3	-- Control lagoon (seaward shore)	1	1	1			

Table E-2. (cont.)

Sample Type	Description	No. of Proposed Stations	No. of Stations Sampled	No. of Field Samples	Kind of Sample	Analytes	Comments
Marine							
Surface sediment	19 stations around the port	19	19	38 (two events)[d]	Chemistry and toxicity test; 0–2 cm	List 4: Cadmium, lead, zinc	
Surface sediment	7 port stations - NMD, NMGZ, NML, NMM, NMN, NMO, NMAA	7	7	14 (two events)[d]		List 7: Cadmium, copper, lead, mercury, silver, zinc; List 6: Grain size, total solids; *Hyalella* survival and growth[e]	
Surface sediment	3 reference stations to the southeast	3	3	6 (two events)[d]			

Note: DMTS - DeLong Mountain Regional Transportation System
NA - not applicable
TBD - to be determined

[a] List 1: Aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, lead, mercury, molybdenum, selenium, thallium, vanadium, and zinc.

[b] List 3: Antimony, arsenic, barium, cadmium, cobalt, copper, lead, manganese, mercury, molybdenum, selenium, silver, thallium, vanadium, and zinc.

[c] Water quality measurements were taken in the field (i.e., pH, dissolved oxygen, temperature, conductivity, and salinity).

[d] Marine sediment sampling events conducted in June and September 2004.

[e] The criteria described in the sampling and analysis plan (Exponent 2004b) were not met, so no sediment toxicity testing was conducted on marine sediments.

Table E-3. Information on level of small mammal trapping activities during the June/July 2004 sampling event

Station	Date Set	Date Picked Up	Nights Set	Number of Traps	Trap Nights	Number of Mammals	Incidental Take	Notes
TT5-0010	06/12/04	06/16/04	4	150	600	5	None	100 live traps, 50 snap traps
TT5-0100	06/16/04	06/19/04	3	100	300	0	None	100 live traps
TT5-1000	06/13/04	06/16/04	3	150	450	3	None	100 live traps, 50 snap traps
TT5-2000	06/11/04	06/15/04	4	118	472	0	1 masked shrew caught in pitfall trap	80 live traps, 38 snap traps
TT2-0010	06/18/04	06/21/04	3	100	300	0	None	100 live traps
TT2-0100	06/16/04	06/19/04	3	100	300	3	None	100 live traps
TT2-1000	06/15/04	06/18/04	3	150	450	1	None	100 live traps, 50 snap traps
TT8-0010	06/25/04	07/05/04	10	100	1,000	0	None	100 live traps
TT8-0100	06/26/04	07/05/04	9	100	900	0	None	100 live traps
TT3-0010	06/19/04	06/22/04	3	100	300	0	1 masked shrew caught in pitfall trap	100 live traps
TT3-0100	06/19/04	06/22/04	3	100	300	1	1 masked shrew caught in pitfall trap	100 live traps
TT3-1000	06/21/04	06/24/04	3	100	300	1	2 - 1 masked shrew and 1 northern red backed vole caught in pitfall trap	100 live traps
TT6-0100	06/25/04	06/29/04	4	100	400	0	None	100 live traps
TT6-1000	06/22/04	06/25/04	3	100	300	0	None	100 live traps
TS-REF-5	07/01/04	07/05/04	4	100	400	1	3 masked shrews caught in pitfall traps	100 live traps
					6,772	15		1 capture per 451.5 nights

Attachment E-1

Sediment Toxicity Testing Report
MEC Analytical Systems

MEC ANALYTICAL SYSTEMS WESTON SOLUTIONS
152 Sunset View Lane, Sequim, WA 98382 / (360) 582-1758 / (360) 582-1679 FAX

August 12, 2004

Scott Shock
Exponent
15375 SE 30th Place, Ste. 250
Bellevue, Washington 98007

Dear Scott:

We are pleased to provide you with the survival and growth results and ancillary data in support of the Red Dog Mine Phase II sediment evaluation. This report includes a brief description of the test methods, test acceptability assessment, and a summary of test results.

Sediment toxicity was evaluated using the 10-day, benthic acute test with *Hyalella azteca*. Sediment treatments SD0001, SD0002, SD0003, SD0004, SD0005, and SD0007 were received on July 7, 2004 in good condition and were stored in the dark at 4°C. *Hyalella azteca* were supplied by Aquatic Biosystems of Boulder Colorado and delivered directly to the Carlsbad Laboratory. Test organisms were reared in the laboratory in native sediments. Native sediment was also provided for control sediment treatments.

The 10-d acute toxicity tests with *Hyalella azteca* were initiated on July 17, 2004. To prepare the test exposures, all jars of sediment were homogenized and approximately 200 mL of sediment were placed in clean, acid and solvent-rinsed 1-L glass jars, which were then filled to 950 mL with deionized water. Eight replicate chambers were prepared for each test treatment and the native sediment control treatment. Test chambers were then placed in randomly assigned positions in a temperature-controlled room at 20°C and allowed to equilibrate overnight. Trickle-flow aeration was provided only if dissolved oxygen concentrations dropped below acceptable levels. The test was initiated by randomly allocating ten 7-day-old *Hyalella* into each test chamber, ensuring that each of the amphipods successfully buried into the sediment. Amphipods that did not bury within approximately 2 hours were replaced with healthy amphipods. Dissolved oxygen, temperature, pH, and salinity were monitored in each replicate at initiation and termination, and in one replicate per treatment on test days 1 through 9.

Target test parameters were as follows:

Dissolved Oxygen:	≥3.4 mg/L
pH:	7.00 ±1.0 units
Temperature:	23°C ±2°C
Conductivity:	<50% variation

The 10-day test was conducted as a static-renewal test, with exchanges of 400 mL of water occurring daily. *Hyalella* were fed daily with 1.0 mL of YCT stock solution (1800 mg YCT/L). At test termination, sediment from each test chamber was sieved through a 0.5-mm screen and all recovered amphipods transferred into a Petri dish. The number of surviving and dead amphipods was then determined under a dissecting microscope, with 10% of the counts being confirmed by a second observer. All surviving amphipods were then transferred to pre-weighed, aluminum foil weigh boats, and then dried in a drying oven at 60°C for approximately 24 hours. Each weigh boat was removed, cooled in a dessication jar, then weighed on a microbalance to 0.01 mg. A water-only, 4-day reference-toxicant test with cadmium chloride was conducted concurrently with the sediment tests.

Results:

A summary of *Hyalella* survival and biomass is presented in Table 1 and a summary of water quality observations is presented in Table 2. Raw data sheets are presented in Appendix A. The *Hyalella* test was validated by greater than 80% survival in the controls and measurable growth in all control replicates. The LC50 for the copper reference-toxicant test was 0.31 mg Cu/L, which is within the control chart limits (0.0 to 0.41 mg Cu/L), indicating that the test organisms used in this study were of similar sensitivity of those previously tested at Carlsbad.

Temperature remained within acceptable limits throughout the test. Dissolved oxygen in treatments SD0001 and SD0004 dropped to 2.2 mg/L and 3.3 mg/L, respectively on Day 1. Trickle-flow aeration was initiated on all test chambers on Day 1 and continued throughout the remainder of the test. In all test treatments, pH was slightly above acceptable limits; however pH for all treatments were within 0.3 pH units of the acceptable limits. Conductivity in the test treatments decreased throughout the test. This was due to acclimation of test sediments to the conductivity of the lab water (0.19 mS/cm). The deviations in water quality did not appear to have an affect on test results as all test treatments exceeded the controls for both survival and growth.

Mean percent survival in the controls was 90.0% for *H. azteca* and mean individual growth, based on the number at initiation, was 0.1 mg/individual. Mean percent survival in the test treatments ranged from 91.3% in SD0003 to 98.8% in SD0001, SD0002, and SD0005. Growth in the test treatments ranged from 0.19 mg/individual in SD0005 and SD0007 to 0.28 mg/individual in SD0002. Survival and growth in each of the test treatments was greater than that of the controls, indicating that there was no biologically significant toxicity in any of the test treatments.

Please call me if there are any questions.

Sincerely,

William Gardiner

Senior Scientist
MEC-Weston Solutions, Inc

Table 1. 10-Day Solid-Phase Test with Hyalella azteca, Red Dog Mine Phase II, Exponent

Sample	Rep	Number Initiated	Number Surviving	% Survival	Mean % Survival	Total Biomass	Growth[a]	Mean Growth	SD
Control	1	10	7	70.0		0.83	0.08		
Control	2	10	9	90.0		1.00	0.10		
Control	3	10	8	80.0		0.96	0.10		
Control	4	10	8	80.0		0.80	0.08		
Control	5	10	10	100.0		1.12	0.11		
Control	6	10	10	100.0		1.23	0.12		
Control	7	10	10	100.0		1.11	0.11		
Control	8	10	10	100.0	**90.0**	1.23	0.12	**0.10**	**0.01**
1	1	10	9	90.0		2.23	0.22		
1	2	10	10	100.0		2.71	0.27		
1	3	10	10	100.0		2.66	0.27		
1	4	10	10	100.0		2.45	0.25		
1	5	10	10	100.0		2.92	0.29		
1	6	10	10	100.0		2.40	0.24		
1	7	10	10	100.0		2.82	0.28		
1	8	10	10	100.0	**98.8**	3.06	0.31	**0.27**	**0.03**
2	1	10	10	100.0		2.66	0.27		
2	2	10	10	100.0		2.74	0.27		
2	3	10	10	100.0		3.10	0.31		
2	4	10	9	90.0		2.25	0.23		
2	5	10	10	100.0		3.16	0.32		
2	6	10	10	100.0		3.10	0.31		
2	7	10	10	100.0		2.62	0.26		
2	8	10	10	100.0	**98.8**	2.82	0.28	**0.28**	**0.03**
3	1	10	7	70.0		0.98	0.10		
3	2	10	10	100.0		2.50	0.25		
3	3	10	10	100.0		2.26	0.23		
3	4	10	9	90.0		2.34	0.23		
3	5	10	10	100.0		2.71	0.27		
3	6	10	10	100.0		2.31	0.23		
3	7	10	7	70.0		1.15	0.12		
3	8	10	10	100.0	**91.3**	2.50	0.25	**0.21**	**0.07**

Table 1. Continued.

Sample	Rep	Number Initiated	Number Surviving	% Survival	Mean % Survival	Total Biomass	Growth[a]	Mean Growth	SD
4	1	10	10	100.0		2.88	0.29		
4	2	10	10	100.0		2.83	0.28		
4	3	10	10	100.0		2.98	0.30		
4	4	10	9	90.0		2.50	0.25		
4	5	10	9	90.0		2.78	0.28		
4	6	10	10	100.0		2.36	0.24		
4	7	10	10	100.0		2.77	0.28		
4	8	10	10	100.0	**97.5**	2.83	0.28	**0.27**	**0.02**
5	1	10	10	100.0		2.04	0.20		
5	2	10	10	100.0		2.23	0.22		
5	3	10	9	90.0		1.45	0.15		
5	4	10	10	100.0		1.98	0.20		
5	5	10	10	100.0		1.66	0.17		
5	6	10	10	100.0		1.60	0.16		
5	7	10	10	100.0		2.16	0.22		
5	8	10	10	100.0	**98.8**	1.73	0.17	**0.19**	**0.03**
7	1	10	8	80.0		1.31	0.13		
7	2	10	9	90.0		1.76	0.18		
7	3	10	9	90.0		1.85	0.19		
7	4	10	10	100.0		2.35	0.24		
7	5	10	10	100.0		1.97	0.20		
7	6	10	10	100.0		1.88	0.19		
7	7	10	10	100.0		1.93	0.19		
7	8	10	10	100.0	**95.0**	2.29	0.23	**0.19**	**0.03**

[a] Growth calculated as total biomass divided by number initiated.

Table 2. Summary of Water Quality Observations for 10-Day Benthic Test with *Hyalella azteca*, Red Dog mine Phase II, Exponent

Sample	Statistic	Dissolved Oxygen (mg/L)	Temperature (°C)	Conductivity (mS/cm)	pH
Control	Minimum	6.7	21.4	0.18	7.7
	Maximum	8.3	22.2	0.21	8.3
SD0001	Minimum	2.2	21.1	0.19	6.9
	Maximum	7.8	22.2	0.45	8.2
SD0002	Minimum	4.8	21.4	0.20	7.2
	Maximum	8.2	22.3	0.67	8.3
SD0003	Minimum	4.2	21.3	0.18	7.4
	Maximum	8.3	22.3	0.24	8.2
SD0004	Minimum	3.3	21.0	0.18	7.0
	Maximum	8.3	22.4	0.42	8.3
SD0005	Minimum	4.6	21.4	0.18	6.9
	Maximum	8.4	22.4	0.23	8.2
SD0007	Minimum	4.7	21.2	0.18	7.1
	Maximum	8.3	22.2	0.21	8.3

Table 3. Total Sulfides Measurements for 10-Day Benthic Test with *Hyalella azteca*, Red Dog mine Phase II, Exponent

Sample	Overlying water			Pore water		
	Day 0	Day 5	Day 10	Day 0	Day 5	Day 10
Control	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0001	**0.05**	**0.12**	**0.22**	**0.19**	**0.60**	<0.05
SD0002	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0004	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0005	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0007	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

10 DAY SOLID PHASE TEST DATA SHEET 3 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

CLIENT	PROJECT	MEC JOB NO.	PROJECT MAN.	MEC LABORATORY	PROTOCOL	SPECIES	ACCLM.MORT.
Exponent	Red Dog Mine Phase II Sampling Program		B. Gardiner	Carlsbad Room 3		*Hyalella azteca*	< 5%

ENDPOINT DATA & OBSERVATIONS

CLIENT/ MEC ID	REP	JAR #	INITIAL #	DAY 1 DATE 7-17-04 TECHNICIAN C	DAY 2 DATE 7.18.04 TECHNICIAN RM	DAY 3 DATE 7.19.04 TECHNICIAN TS	DAY 4 DATE 7/20/04 TECHNICIAN C	DAY 5 DATE 7/21/04 TECHNICIAN am	DAY 6 DATE 7/22/04 TECHNICIAN RM	DAY 7 DATE 7/23/04 TECHNICIAN RM	DAY 8 DATE 7/24/04 TECHNICIAN am	DAY 9 DATE 7/25/04 TECHNICIAN am	DAY 10 DATE 7/26/04 TECHNICIAN RM	TS/DH NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)
				#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.	#DEAD :#SURF.			7.27.04 TS
Control / .	1	41		N	N	N	N	N	N	N	N	N	N	7	45.78	46.61
	2	34												9	51.52	52.52
	3	31												8	41.65	42.11
	4	51												8	48.59	49.39
	5	8												10	52.79	53.91
	6	11												10	46.91	48.14
	7	23												10	50.03	51.42
	8	28												10	51.43	52.66
1 / .	1	56												9	49.85	52.18
	2	48												10	48.73	51.44
	3	37												10	49.88	52.24
	4	14												10	43.62	46.07
	5	35												10	41.57	44.49
	6	13												10	42.54	44.94
	7	49												10	40.43	43.25
	8	39									IA			10	41.80	44.86
2 / .	1	4									N			10	46.26	48.92
	2	6												10	40.32	43.06
	3	21												10	45.56	48.66
	4	55												10	45.24	47.49
	5	15												10	47.20	50.36
	6	29												10	47.30	50.40
	7	2												10	41.53	44.15
	8	19												10	44.26	47.08

weigh boat #1

24

① IE 7/26/04 am
② IE 7.26.04 TS

10 DAY SOLID PHASE TEST DATA SHEET 3 - FRESHWATER

MEC ANALYTICAL SYSTEMS INC

CLIENT	PROJECT	MEC JOB NO.	PROJECT MAN.	MEC LABORATORY	PROTOCOL	SPECIES	ACCLM.MORT.
Exponent	And Dog Mine Phase II Sampling Program		B. Gardiner	Carlsbad Room 3		*Hyalella azteca*	< 5%

ENDPOINT DATA & OBSERVATIONS

CLIENT/ MEC ID	REP	JAR #	INITIAL #	DAY 1 DATE 7.17.04 TECHNICIAN CW #DEAD	#SURF.	DAY 2 DATE 7.18.04 TECHNICIAN RM #DEAD	#SURF.	DAY 3 DATE 7.19.04 TECHNICIAN TS #DEAD	#SURF.	DAY 4 DATE 7/20/04 TECHNICIAN CW #DEAD	#SURF.	DAY 5 DATE 7/21/04 TECHNICIAN am #DEAD	#SURF.	DAY 6 DATE 7/22/04 TECHNICIAN RM #DEAD	#SURF.	DAY 7 DATE 7/23/04 TECHNICIAN RM #DEAD	#SURF.	DAY 8 DATE 7/24/04 TECHNICIAN am #DEAD	#SURF.	DAY 9 DATE 7/25/04 TECHNICIAN am #DEAD	#SURF.	DAY 10 DATE 7/26/04 TECHNICIAN RM #DEAD	#SURF.	NUMBER REMAINING	TARE WEIGHT (mg)	TOTAL WEIGHT (mg)
3 / .	1	50		N		N		N		N		N		N		N		N		N		N		7	44.85	46.83
	2	40																						10	44.35	46.85
	3	3																						10	39.14	41.40
	4	42																						9	41.96	44.30
	5	24																						10	41.85	44.56
	6	36																						10	47.84	50.15
	7	9																						10	52.05	53.20
	8	1																								
4 / .	1	22																						10	49.69	52.19
	2	38																						10	45.92	48.80
	3	53																						10	46.88	49.71
	4	27																						10	45.88	48.86
	5	26																						9	46.19	48.69
	6	16																						9	46.65	49.43
	7	10																						10	52.52	54.88
	8	30																						10	55.52	58.29
5 / .	1	47																						10	54.17	57.00
	2	20																						10	40.89	42.63
	3	46																						10	47.59	49.82
	4	25																						9	48.28	49.73
	5	52																						10	47.05	49.03
	6	7																						10	48.82	50.48
	7	12																						10	44.47	51.07
	8	18																						10	49.66	51.82
7 / .	1	5																						10	56.84	58.57
	2	17																						8	58.02	59.33
	3	43																						9	57.40	59.16
	4	32																						9	48.42	50.27
	5	33																						10	53.66	56.01
	6	54																						10	54.84	56.81
	7	45																						10	49.41	51.29
	8	44																						10	49.59	51.52
																								10	48.82	51.11

7.27.04 Ts

weigh boat # 25 25

T=2 → 10 | 47.84 | 50.15

T=3 → 7 | 52.05 | 53.20

JG

Osmall animals on sediment surface (≈5) 7/25/04 am

②WC 7.26.04 Ts ③IW 7.27.04 Ts

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

CLIENT	PROJECT	SPECIES	MEC LABORATORY	PROTOCOL
Exponent	Red Dog Mine Phase II Sampleing Program	*Hyalella azteca*	Carlsbad Room 3	
MEC JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE** / **TIME**	**TEST END DATE**	**TIME**
	B. Gardiner	16Jul04 / 1452	26Jul04	1515 TS

WATER QUALITY DATA

TEST — DO (mg/L): > 3.4 — TEMP (C): 23±1 — COND (µS/cm): vary < 50% — pH: 7.0±1.0 — NH3 (mg/L): vary < 50% — HARD./ALK.: vary < 50% — DILUTION WATER BATCH — TEMP.RECDR./HOBO#: ~ 11928

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg CaCO3/L	ALKALINITY Techn.	ALKALINITY mg CaCO3/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
Control / .	0	1		6	7.9	6	21.8	5	0.19	8	8.0							JW	6	JW	JW
		2			8.2		21.8		0.19		8.0										
		3			7.9		21.8		0.19		7.9										
		4			8.0		22.1		0.19		7.9										
		5			7.7		22.0		0.19		7.9										
		6			7.6		22.1		0.18		7.9										
		7			7.7		22.2		0.18		7.9										
		8			7.6		22.0		0.18		7.9										
Control / .	1	1		6	6.7	6	22.1	5	0.20	8	7.7							GC	JW	BH	MAI
Control / .	2	2		6	7.7	6	21.8	5	0.20	8	8.0							JW	RM	RM	RM
Control / .	3	3		6	7.9	6	21.7	5	0.20	8	8.1							TS	TS →		
Control / .	4	4		6	7.2	6	21.5	5	0.20	8	8.1							JW	JW	JW	RM
Control / .	5	1		6	8.1													AM		RM	RM
Control / .	5	2		6	8.2																
Control / .	5	3		6	8.1																
Control / .	5	4		6	8.2																
Control / .	5	5		6	8.2	6	22.0	5	0.18	8	8.3										
Control / .	5	6		6	8.1																
Control / .	5	7		6	8.2																
Control / .	5	8		6	8.3																
Control / .	6	6		6	7.5	6	21.4	5	0.18	8	8.1							RM	RM →		
Control / .	7	7		6	8.2	6	21.8	5	0.18	8	8.2							RM	RM →		
Control / .	8	8		6	8.2	6	21.7	5	0.18	8	8.3							AM	AM →		
Control / .	9	1		6	7.8	6	22.0	5	0.18	8	8.2							AM	AM →		
Control / .	10	1		6	8.2	6	21.4	5	0.18	8	8.3							RM	RM		
		2			8.1		21.4		0.18		8.3										
		3			8.3		21.5		0.18		8.3										
		4			8.1		21.9		0.18		8.3										
		5			8.1		21.6		0.18		8.3										
		6			8.1		21.4		0.18		8.3										
		7			8.2		21.9		0.18		8.3										
		8			8.2		21.7		0.21		8.3										

① FED 520 mL 7/16/04 JW

② Test was aerated due to low DO's in other chambers 7/7/04

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

CLIENT	PROJECT	SPECIES	MEC LABORATORY	PROTOCOL
Exponent	Red Dog Mine Phase II Sampleing Program	*Hyalella azteca*	Carlsbad Room 3	
MEC JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE** / **TIME**	**TEST END DATE**	**TIME**
	B. Gardiner	16Jul04 / 1452 dw	26Jul04	1515 TS

WATER QUALITY DATA

TEST | DO (mg/L) > 3.4 | TEMP (C) 23±1 | COND. (µS/cm) vary < 50% | pH 7.0±1.0 | NH3 (mg/L) vary < 50% | HARD./ALK. vary < 50% | DILUTION WATER BATCH | TEMP. RECDR./HOBO# 119278

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg CaCO3/L	ALKALINITY Techn.	ALKALINITY mg CaCO3/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
Odw		1		6	4.2	6	21.9	5	0.45	8	7.0							dw	Cr	dw	dw
		2			5.6		21.9		0.43		7.1										
		3			5.3		22.0		0.43		7.1										
1 / .	0	4			5.4		21.6		0.43		7.1										
		5			5.8		21.9		0.41		7.1										
		6			5.6		21.8		0.42		7.1										
		7			5.1		22.2		0.43		7.0										
		8			5.6		22.1		0.42		7.1										
1 / .	1	1		6	7.2	6	22.2	5	0.40	8	6.9							Cr	JW	BH	MAI
1 / .	2	2		6	6.5	6	21.8	5	0.31	8	7.7							dw	RM	RM	RM
1 / .	3	3		6	3.6②	6	21.6	5	0.39	8	7.3							TS	TS	→	
1 / .	4	4		6	3.6	6	22.1	5	0.26	8	7.9							dw	dw	RM	RM
1 / .	5	1		6	7.3													RM		RM	RM
1 / .	5	2		6	7.4																
1 / .	5	3		6	7.3																
1 / .	5	4		6	7.8																
1 / .	5	5		6	7.1	6	21.8	5	0.22	8	8.1										
1 / .	5	6		6	6.0																
1 / .	5	7		6	7.2																
1 / .	5	8		6	5.7																
1 / .	6	6		6	5.8	6	21.5	5	0.21	8	8.0							RM	RM	→	
1 / .	7	7		6	7.1	6	21.3	5	0.19	8	8.2							RM	RM	→	
1 / .	8	8		6	4.3	6	21.8	5	0.21	8	7.3							am	am	→	
1 / .	9	1		6	5.9	6	22.0	5	0.21	8	7.8							am	am	→	
1 / .	10	1		6	6.0	6	21.8	5	0.21	8	8.0							RM	RM		
		2			5.2		21.9		0.20		8.0										
		3			6.1		21.5		0.19		7.9										
		4			6.4		21.1		0.19		7.9										
		5			6.9		21.5		0.19		7.9										
		6			5.5		21.4		0.19		7.6										
		7			6.7		21.8		0.20		7.8										
		8			6.9		21.7		0.20		7.7										

① FED 520 mL 7/16/04 dw

7/16/2004 10 day hyalella WQ

② Adjusted air line 7/19/04 TS

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS INC.

CLIENT	PROJECT
Exponent	Red Dog Mine Phase II Sampleing Program
MEC JOB NUMBER	**PROJECT MANAGER**
	B. Gardiner

SPECIES		MEC LABORATORY	PROTOCOL
Hyalella azteca		Carlsbad Room 3	
TEST START DATE	**TIME**	**TEST END DATE**	**TIME**
16Jul04	1452	26Jul04	1515

WATER QUALITY DATA

TEST	DO (mg/L)	TEMP (C)	COND.(µS/cm)	pH	NH3 (mg/L)	HARD./ALK.	DILUTION WATER BATCH	TEMP.RECDR./HOBO#
	> 3.4	23±1	vary < 50%	7.0±1.0	vary < 50%	vary < 50%		# 19278

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg $CaCO_3$/L	ALKALINITY Techn.	ALKALINITY mg $CaCO_3$/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
① dw		1		6	5.9	6	21.6	5	0.67	8	7.2							dw	CR	dw	dw
		2		"	6.6	"	21.7	"	0.58	"	7.3										
		3		"	5.7	"	21.7	"	0.62	"	7.3										
2 / .	0	4		"	6.5	"	21.6	"	0.61	"	7.3										
		5		"	6.3	"	21.5	"	0.58	"	7.4										
		6		"	6.4	"	21.5	"	0.56	"	7.4										
		7		"	6.3	"	21.5	"	0.58	"	7.3										
		8		"	6.3	"	21.5	"	0.59	"	7.4										
2 / .	1	1		6	4.8	6	22.1	5	0.55	8	7.2							CR	JW	BH	MAI
2 / .	2	2		6	7.1	6	22.1	5	0.43	8	8.0							dw	RM	RM	RM
2 / .	3	3		6	7.5	6	21.6	5	0.44	8	8.1							TS	TS	→	
2 / .	4	4		6	6.1	6	21.5	5	0.36	8	7.9							ar	dw	→	RM
2 / .	5	1		6	5.9													arm		RM	RM
2 / .	5	2		6	7.0																
2 / .	5	3		6	7.8																
2 / .	5	4		6	7.5																
2 / .	5	5		6	6.4	6	22.3	5	0.29	8	8.0										
2 / .	5	6		6	7.7																
2 / .	5	7		6	7.0																
2 / .	5	8		6	7.2																
2 / .	6	6		6	7.5	6	21.4	5	0.28	8	8.2							RM	RM	→	
2 / .	7	7		6	7.5	6	21.7	5	0.24	8	8.2							RM	RM	→	
2 / .	8	8		6	7.5	6	21.9	5	0.26	8	7.9							arm	arm	→	
2 / .	9	1		6	6.5	6	21.8	5	0.26	8	7.8							arm	arm	→	
2 / .	10	1		6	7.1	6	21.6	5	0.22	8	7.7							RM	RM		
		2		"	7.6	"	21.6	"	0.22	"	8.0										
		3		"	8.2	"	21.6	"	0.21	"	8.3										
		4		"	8.1	"	21.8	"	0.23	"	8.3										
		5		"	7.9	"	21.9	"	0.22	"	8.2										
		6		"	7.5	"	21.8	"	0.22	"	8.2										
		7		"	7.8	"	21.6	"	0.21	"	8.2										
		8		"	8.0	"	21.7	"	0.22	"	8.2										

① FED 520 mL 7/16/04 dw

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

CLIENT	PROJECT
Exponent	Red Dog Mine Phase II Sampleing Program
MEC JOB NUMBER	**PROJECT MANAGER**
	B. Gardiner

SPECIES		MEC LABORATORY	PROTOCOL
Hyalella azteca		Carlsbad Room 3	
TEST START DATE	**TIME**	**TEST END DATE**	**TIME**
16Jul04	1452 JW	26Jul04	1515 TS

WATER QUALITY DATA

TEST	DO (mg/L)	TEMP (C)	COND.(µS/cm)	pH	NH3 (mg/L)	HARD./ALK.	DILUTION WATER BATCH	TEMP.RECDR./HOBO#
	> 3.4	23±1	vary < 50%	7.0±1.0	vary < 50%	vary < 50%		☆ 19278

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg $CaCO_3$/L	ALKALINITY Techn.	ALKALINITY mg $CaCO_3$/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
0 JW		1		6	6.2	6	22.0	5	0.24	8	7.7							JW	6	JW	JW
		2			6.0		22.0		0.24		7.6										
		3			5.7		21.9		0.24		7.6										
3 / .	0	4			6.5		22.0		0.24		7.9										
		5			6.2		22.0		0.24		7.7										
		6			6.0		21.9		0.24		7.7										
		7			6.1		21.8		0.23		7.7										
		8			5.7		22.0		0.24		7.7										
3 / .	1	1		6	4.2	6	22.3	5	0.24	8	7.4							CT	JW	BH	MAI
3 / .	2	2		6	7.0	6	21.9	5	0.21	8	8.0							JW	RM	RM	RM
3 / .	3	3		6	6.9	6	21.9	5	0.21	8	7.9							TS	TS →		
3 / .	4	4		6	6.8	6	21.8	5	0.20	8	8.0							JW	JW →		RM
3 / .	5	1		6	8.0													AM		RM	RM
3 / .	5	2		6	7.9																
3 / .	5	3		6	8.1																
3 / .	5	4		6	7.3																
3 / .	5	5		6	8.3	6	22.1	5	0.20	8	8.2										
3 / .	5	6		6	8.1																
3 / .	5	7		6	8.3																
3 / .	5	8		6	7.5																
3 / .	6	6		6	7.6	6	21.3	5	0.19	8	8.2							RM	RM →		
3 / .	7	7		6	8.2	6	21.6	5	0.18	8	8.3							RM	RM →		
3 / .	8	8		6	7.1	6	22.2	5	0.19	8	7.9							AM	AM →		
3 / .	9	1		6	7.6	6	22.2	5	0.19	8	8.0							AM	AM →		
3 / .	10	1		6	8.0	6	22.0	5	0.18	8	8.2							RM	RM		
		2			7.8		21.6		0.18		8.2										
		3			8.1		21.7		0.18		8.2										
		4			7.1		21.5		0.18		8.1										
		5			8.2		21.7		0.19		8.2										
		6			8.1		21.6		0.19		8.2										
		7			7.7		21.6		0.18		8.2										
		8			7.3		21.6		0.18		8.1										

@ FED 520 mL 7/16/04 JW

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

CLIENT	PROJECT	SPECIES	MEC LABORATORY	PROTOCOL
Exponent	Red Dog Mine Phase II Sampleing Program	*Hyalella azteca*	Carlsbad Room 3	
MEC JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE** / **TIME**	**TEST END DATE**	**TIME**
	B. Gardiner	15Jul04 / 1452 JW	26Jul04	1515 TS

WATER QUALITY DATA

TEST: DO (mg/L) > 3.4 | TEMP (C) 23±1 | COND.(µS/cm) vary < 50% | pH 7.0±1.0 | NH3 (mg/L) vary < 50% | HARD./ALK vary < 50% | DILUTION WATER BATCH | TEMP.RECDR./HOBO# ~~0~~ 119278

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg $CaCO_3$/L	ALKALINITY Techn.	ALKALINITY mg $CaCO_3$/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
		1		6	5.4	6	21.2	5	0.37	8	7.2							JW	6S	JW	JW
		2			5.5		21.4		0.42		7.1										
		3			5.6		21.0		0.40		7.1										
4 / .	0	4			5.4		21.9		0.40		7.1										
		5			5.0		21.9		0.37		7.1										
		6			5.1		21.6		0.39		7.1										
		7			5.0		21.6		0.42		7.0										
		8			5.0		21.5		0.41		7.1										
4 / .	1	1		6	3.3	6	22.4	5	0.32	8	7.1							CF	JW	BH	MAI
4 / .	2	2		6	6.2	6	22.1	5	0.29	8	7.7							JW	RM	RM	RM
4 / .	3	3		6	6.5	6	21.9	5	0.27	8	7.8							TS	TS	→	
4 / .	4	4		6	6.2	6	21.8	5	0.23	8	7.3							JW	→		RM
4 / .	5	1		6	7.5													AM		RM	RM
4 / .	5	2		6	7.0																
4 / .	5	3		6	7.2																
4 / .	5	4		6	8.3																
4 / .	5	5		6	8.1	6	21.8	5	0.20	8	8.1										
4 / .	5	6		6	8.2																
4 / .	5	7		6	7.9																
4 / .	5	8		6	7.8																
4 / .	6	6		6	7.3	6	21.8	5	0.19	8	8.2							↓	↓	↓	↓
4 / .	7	7		6	7.9	6	21.5	5	0.18	8	8.3							RM	RM	→	→
4 / .	8	8		6	7.9	6	21.8	5	0.19	8	8.0							RM	RM	→	→
4 / .	9	1		6	7.6	6	21.8	5	0.19	8	8.0							AM	AM	→	→
4 / .	10	1		6	7.6	6	21.7	5	0.19	8	8.0							RM	RM		
4 / .		2			7.6		21.6		0.18		8.0							↓	↓		
4 / .		3			7.4		21.9		0.18		8.0										
4 / .		4			8.0		21.8		0.20		8.0										
4 / .		5			7.7		21.7		0.20		8.1										
4 / .		6			7.9		21.8		0.19		8.2										
4 / .		7			8.1		21.2		0.19		8.2										
4 / .		8			7.8		21.7		0.19		8.2										

① FED 520 mL 7/16/04 JW

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC

CLIENT	PROJECT
Exponent	Red Dog Mine Phase II Sampling Program
MEC JOB NUMBER	**PROJECT MANAGER**
	B. Gardiner

SPECIES		MEC LABORATORY	PROTOCOL
Hyalella azteca		Carlsbad Room 3	
TEST START DATE	**TIME**	**TEST END DATE**	**TIME**
16Jul04	1452	26Jul04	1515 TS

WATER QUALITY DATA

TEST	DO (mg/L)	TEMP (C)	COND.(µS/cm)	pH	NH3 (mg/L)	HARD./ALK	DILUTION WATER BATCH	TEMP.RECDR./HOBO#
	> 3.4	23±1	vary < 50%	7.0±1.0	vary < 50%	vary < 50%		#11978

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg $CaCO_3$/L	ALKALINITY Techn.	ALKALINITY mg $CaCO_3$/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
① JW	0	1		6	6.2	6	21.7	5	0.23	8	7.0							JW	6	JW	JW
5 / .		2			5.5		21.9		0.23		6.9										
		3			5.3		21.9		0.23		6.9										
		4			5.5		21.9		0.23		6.9										
		5			5.6		22.1		0.22		6.9										
		6			5.8		22.1		0.23		6.9										
		7			5.9		21.9		0.23		6.9										
		8			5.5		22.4		0.23		7.0										
5 / .	1	1		6	4.6	6	22.0	5	0.22	8	7.1							GT	JN	BH	MAI
5 / .	2	2		6	7.3	6	22.2	5	0.20	8	7.9							JW	RM	RM	RM
5 / .	3	3		6	7.8	6	21.9	5	0.20	8	8.1							TS	TS →		
5 / .	4	4		6	7.4	6	21.7	5	0.20	8	7.2							JW	JW →		RM
5 / .	5	1		6	7.7													AMM		RM	RM
5 / .	5	2		6	7.7																
5 / .	5	3		6	8.2																
5 / .	5	4		6	8.1																
5 / .	5	5		6	8.4	6	22.1	5	0.18	8	8.2										
5 / .	5	6		6	8.2																
5 / .	5	7		6	8.0																
5 / .	5	8		6	8.1																
5 / .	6	6		6	7.7	6	21.4	5	0.18	8	8.2							RM	RM →		
5 / .	7	7		6	7.8	6	21.4	5	0.18	8	8.2							RM	PM →		
5 / .	8	8		6	7.6	6	21.8	5	0.18	8	8.0							AMM	AMM →		
5 / .	9	1		6	7.9	6	21.9	5	0.18	8	8.1							AMM	AMM →		
5 / .	10	1		6	8.2	6	22.1	5	0.18	8	8.2							RM	RM		
		2			7.5		22.0		0.18		8.1										
		3			8.2		22.1		0.18		8.2										
		4			8.3		22.0		0.18		8.2										
		5			8.0		21.8		0.18		8.2										
		6			8.2		21.9		0.18		8.2										
		7			8.0		21.6		0.18		8.2										
		8			7.6		21.9		0.18		8.1										

① FED 520 mL 7/16/04 JW

10 DAY SOLID PHASE TEST DATA SHEET 2 - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

CLIENT	PROJECT	SPECIES	MEC LABORATORY	PROTOCOL
Exponent	Red Dog Mine Phase II Sampleing Program	*Hyalella azteca*	Carlsbad Room 3	
MEC JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE** / **TIME**	**TEST END DATE**	**TIME**
	B. Gardiner	16Jul04 / 1452 dw	26Jul04	1515 TS

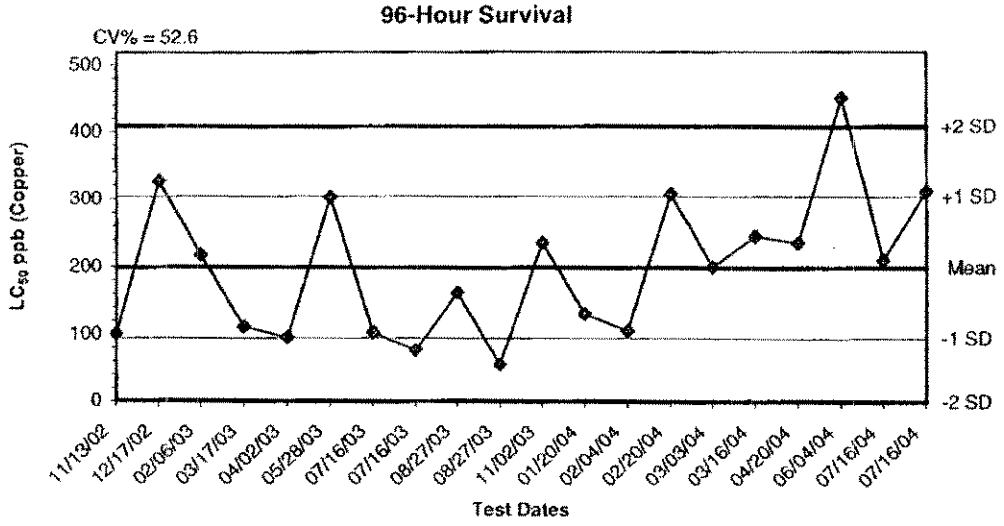
WATER QUALITY DATA

TEST	DO (mg/L)	TEMP (C)	COND (µS/cm)	pH	NH3 (mg/L)	HARD./ALK.	DILUTION WATER BATCH	TEMP.RECOR./HOBO#
	> 3.4	23±1	vary < 50%	7.0±1.0	vary < 50%	vary < 50%		119778 ⊖

CLIENT/MEC ID	DAY	REP	JAR #	D.O. meter	D.O. mg/L	TEMP meter	TEMP °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	OVERLY. NH3 Techn.	OVERLY. NH3 mg/L	HARDNESS Techn.	HARDNESS mg CaCO3/L	ALKALINITY Techn.	ALKALINITY mg CaCO3/L	TECHNICIAN	WATER RENEWAL AM	WATER RENEWAL PM	FEEDING
dw		1		6	6.3	6	21.2	5	0.21	8	7.2							dw			
		2			5.8		22.1		0.21		7.2										
7 / .	0	3			6.0		21.9		0.21		7.2										
		4			6.0		22.0		0.21		7.2										
		5			5.9		22.2		0.21		7.1										
		6			6.3		21.9		0.21		7.2										
		7			6.2		21.5		0.21		7.2										
		8			6.2		21.9		0.20		7.2										
7 / .	1	1		6	4.7	6	22.0	5	0.21	8	7.2							G	JW	BH	MH
7 / .	2	2		6	7.5	6	22.2	5	0.20	8	8.0							dw	RM	RM	RM
7 / .	3	3		6	7.8	6	21.9	5	0.20	8	8.2							TS	TS →		
7 / .	4	4		6	7.8	6	21.8	5	0.20	8	7.7							dw	dw →	RM	
7 / .	5	1		6	7.6													dw		RM	RM
7 / .	5	2		6	8.1																
7 / .	5	3		6	8.3																
7 / .	5	4		6	8.2																
7 / .	5	5		6	8.2	6	21.9	5	0.19	8	8.2										
7 / .	5	6		6	8.3																
7 / .	5	7		6	8.2																
7 / .	5	8		6	8.0																
7 / .	6	6		6	7.7	6	21.3	5	0.18	8	8.2							RM	RM →		
7 / .	7	7		6	8.2	6	21.8	5	0.18	8	8.2							RM	RM →		
7 / .	8	8		6	7.7	6	21.8	5	0.19	8	8.1							dw	dw →		
7 / .	9	1		6	7.1	6	21.9	5	0.19	8	8.0							dw	dw →		
		1		6	8.1	6	21.5	5	0.18	8	8.0							RM	RM		
		2			8.0		22.1		0.19		8.1										
		3			8.1		22.0		0.19		8.2										
7 / .	10	4			8.2		21.7		0.18		8.2										
		5			8.1		21.5		0.18		8.2										
		6			8.3		22.1		0.19		8.3										
		7			8.3		22.0		0.19		8.3										
		8			7.9		22.0		0.19		8.3										

OFED 520 mL 7/16/04 dw

Hyalella azteca Reference Toxicant Control Chart: 96-Hour Survival



Dates	Values	Mean	-1 SD	-2 SD	+1 SD	+2 SD
11/13/02	100.4460	198.7245	94.1799	0.0000	303.2692	407.8139
12/17/02	326.0900	198.7245	94.1799	0.0000	303.2692	407.8139
02/06/03	217.1340	198.7245	94.1799	0.0000	303.2692	407.8139
03/17/03	110.9400	198.7245	94.1799	0.0000	303.2692	407.8139
04/02/03	95.2116	198.7245	94.1799	0.0000	303.2692	407.8139
05/28/03	301.7120	198.7245	94.1799	0.0000	303.2692	407.8139
07/16/03	102.6800	198.7245	94.1799	0.0000	303.2692	407.8139
07/16/03	75.8930	198.7245	94.1799	0.0000	303.2692	407.8139
08/27/03	161.3200	198.7245	94.1799	0.0000	303.2692	407.8139
08/27/03	54.6880	198.7245	94.1799	0.0000	303.2692	407.8139
11/02/03	234.9690	198.7245	94.1799	0.0000	303.2692	407.8139
01/20/04	130.2640	198.7245	94.1799	0.0000	303.2692	407.8139
02/04/04	105.2500	198.7245	94.1799	0.0000	303.2692	407.8139
02/20/04	306.9640	198.7245	94.1799	0.0000	303.2692	407.8139
03/03/04	199.2700	198.7245	94.1799	0.0000	303.2692	407.8139
03/16/04	244.7800	198.7245	94.1799	0.0000	303.2692	407.8139
04/20/04	235.1490	198.7245	94.1799	0.0000	303.2692	407.8139
06/04/04	450.3920	198.7245	94.1799	0.0000	303.2692	407.8139
07/16/04	210.4460	198.7245	94.1799	0.0000	303.2692	407.8139
07/16/04	310.8920	198.7245	94.1799	0.0000	303.2692	407.8139

* Value within 95% CI range at time of testing

Updated 8/12/04 BH

Acute Sediment Test-4-day Survival

Start Date:	7/16/2004 16:05	Test ID:	C030314.211	Sample ID:	REF-Ref Toxicant
End Date:	7/20/2004 14:35	Lab ID:	CAMECW-MEC WESTON C	Sample Type:	CUSO-Copper sulfate
Sample Date:		Protocol:	EPA 00-EPA Freshwater Sed	Test Species:	HA-Hyalella azteca
Comments:					

Conc-ppb	1	2	3
Control	0.9000	1.0000	0.9000
62.5	1.0000	1.0000	1.0000
125	1.0000	1.0000	1.0000
250	0.7000	0.8000	0.6000
500	0.2000	0.0000	0.0000
1000	0.1000	0.0000	0.0000

			Transform: Untransformed					1-Tailed				
Conc-ppb	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
Control	0.9333	1.0000	0.9333	0.9000	1.0000	6.186	3				0.9333	0.0000
62.5	1.0000	1.0714	1.0000	1.0000	1.0000	0.000	3	-1.155	2.500	0.1443	1.0000	-0.0714
125	1.0000	1.0714	1.0000	1.0000	1.0000	0.000	3	-1.155	2.500	0.1443	1.0000	-0.0714
*250	0.7000	0.7500	0.7000	0.6000	0.8000	14.286	3	4.041	2.500	0.1443	0.7000	0.2500
*500	0.0667	0.0714	0.0667	0.0000	0.2000	173.205	3	15.011	2.500	0.1443	0.0667	0.9286
*1000	0.0333	0.0357	0.0333	0.0000	0.1000	173.205	3	15.588	2.500	0.1443	0.0333	0.9643

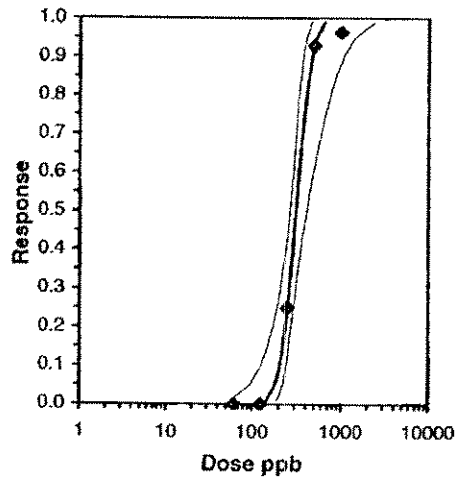
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91731	0.858	0.70135	0.425
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	125	250	176.777		0.14434	0.15465	0.62622	0.005	6.3E-10	5, 12

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	7.22675	2.20523	2.9045	11.549	0	1.81656	7.81472	0.61	2.49261	0.13837	5
Intercept	-13.013	5.39065	-23.579	-2.4478							
TSCR											

Point	Probits	ppb	95% Fiducial Limits	
EC01	2.674	148.15	56.8153	192.566
EC05	3.355	184.079	96.1863	223.653
EC10	3.718	206.669	126.492	243.874
EC15	3.964	223.457	151.256	260.094
EC20	4.158	237.767	173.259	275.479
EC25	4.326	250.771	193.286	291.473
EC40	4.747	286.783	242.71	352.513
EC50	5.000	310.892	268.001	410.475
EC60	5.253	337.029	290.124	487.531
EC75	5.674	385.427	323.72	663.557
EC80	5.842	406.508	336.766	752.895
EC85	6.036	432.54	352.073	873.717
EC90	6.282	467.675	371.698	1055.43
EC95	6.645	525.069	401.923	1399.64
EC99	7.326	652.406	463.557	2386.16



Reviewed by:_____

Test: SED-Acute Sediment Test | Test ID: 030314.211
Species: HA-Hyalella azteca | Protocol: EPA 00-EPA Freshwater Sediment
Sample ID: REF-Ref Toxicant | Sample Type: CUSO-Copper sulfate
Start Date: 7/16/2004 16:05 | End Date: 7/20/2004 14:35 | Lab ID: CAMECW-MEC WESTON Carlsbad

Pos	ID	Rep	Group	Day 0	Day 4	Day 7	Day 14	Day 21	Day 28	Total Wgt(mg)	Tare Wgt(mg)	Wgt Count
	1	1	Control	10	9							
	2	2	Control	10	10							
	3	3	Control	10	9							
	4	1	62.500	10	10							
	5	2	62.500	10	10							
	6	3	62.500	10	10							
	7	1	125.000	10	10							
	8	2	125.000	10	10							
	9	3	125.000	10	10							
	10	1	250.000	10	7							
	11	2	250.000	10	8							
	12	3	250.000	10	6							
	13	1	500.000	10	2							
	14	2	500.000	10	0							
	15	3	500.000	10	0							
	16	1	1000.000	10	1							
	17	2	1000.000	10	0							
	18	3	1000.000	10	0							

Comments:

10 DAY SOLID PHASE TEST DATA SHEET 3 - REF TOX - FW

MEC ANALYTICAL SYSTEMS, INC.

030319.211

CLIENT	PROJECT	MEC JOB NO.	SPECIES	PROJECT MANAGER	MEC LABORATORY	ACCLM.MORT.	PROTOCOL
Exponent			*Hyalella azteca*	B. Gardiner	Carlsbad Room 3	< 5%	

SURVIVAL & BEHAVIOR DATA

OBSERVATIONS KEY
N = normal; LOE= loss of equilibrium; Q = quiescent; SUR= surfacing; DC = discoloration; OB = on bottom; J = jumper; NB = no body

CLIENT/ MEC ID	CONC. value	CONC. units	REP	INITIAL NUMBER	DAY 1 DATE	DAY 1 TECHNICIAN	DAY 1 #ALIVE	DAY 1 #DEAD	DAY 1 OBS	DAY 2 DATE	DAY 2 TECHNICIAN	DAY 2 #ALIVE	DAY 2 #DEAD	DAY 2 OBS	DAY 3 DATE	DAY 3 TECHNICIAN	DAY 3 #ALIVE	DAY 3 #DEAD	DAY 3 OBS	DAY 4 DATE	DAY 4 TECHNICIAN	DAY 4 #ALIVE	DAY 4 #DEAD	DAY 4 OBS
Ref.Tox.-copper	0	~~mg/L~~ ppb	1																	7.20.04	CS	9	1	N
			2																			10	0	N
			3																			9	0	N
Ref.Tox.-copper	62.5	~~mg/L~~ ppb	1																			10	0	N
			2																			10	0	N
			3																			10	0	N
Ref.Tox.-copper	125	~~mg/L~~ ppb	1																			10	0	N
			2							(1) BH												10	0	N
			3																			10	0	N
Ref.Tox.-copper	250	~~mg/L~~ ppb	1																			7	2	N
			2																			8	1	N
			3																			6	1	IQ
Ref.Tox.-copper	500	~~mg/L~~ ppb	1																			2	7	IQ
			2																			0	10	—
			3																			0	10	—
Ref.Tox.-copper	1000	~~mg/L~~ ppb	1																			1	8	IQ
			2																			0	10	—
			3																			0	9	—

(1) count not performed due to sand substrate. Final counts performed on day 4 B.12.04 BH

10 DAY SOLID PHASE TEST DATA SHEET 2 - REF TOX WQ - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

C030314.211

CLIENT	PROJECT	SPECIES	MEC LABORATORY	PROTOCOL
Exponent	Red Dog Mine Phase II Sampleing Program	*Hyalella azteca*	Carlsbad Room 3	

MEC JOB NUMBER	PROJECT MANAGER	TEST START DATE	TIME	TEST END DATE	TIME
	B. Gardiner	15Jul04	1605 CT	29Jul04	1435 CT

WATER QUALITY DATA

TEST	TEMP (C)	CON.(µS/cm)	DO (mg/L)	HARD./ALK.	DILTN.WAT.BATCH	TEMP REC#	REFERENCE TOX. MATERIAL	REFERENCE TOXICANT	LOT NO.	96-HR LC50
	23±1	vary < 50%	> 3.4	vary < 50%		0	copper chloride	copper		

CLIENT/ MEC ID	CONCENTRATION value	CONCENTRATION units	DAY	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	HARNESS Techn.	HARNESS mg CaCO3/L	ALKALINITY Techn.	ALKALINITY mg CaCO3/L	TECHNICIAN	FEEDING am	FEEDING pm
Ref.Tox.-copper	250	~~mg/L~~ ppb	0	All	6	9.8	6	21.7	5	0.19	8	7.8					eu		
			1	1															
			2	2															
			3	3															
			4	1	6	8.1	6	22.8	5	~~0.22~~ 0.22	8	8.2					eu		
				2															
				3															
Ref.Tox.-copper	500	~~mg/L~~ ppb	0	All	6	9.8	6	21.7	5	0.19	8	7.7					eu		
			1	1															
			2	2															
			3	3															
			4	1	6	8.1	6	22.7	5	0.22	8	8.2					eu		
				2															
				3															
Ref.Tox.-copper	1000	~~mg/L~~ ppb	0	All	6	9.8	6	21.7	5	0.19	8	7.6					eu		
			1	1															
			2	2															
			3	3															
			4	1	6	6.9	6	22.9	5	0.22	8	8.1					eu		
				2															
				3															

① W.P. 7-20-04 eu

10 DAY SOLID PHASE TEST DATA SHEET 2 - REF TOX WQ - FRESHWATER

MEC ANALYTICAL SYSTEMS, INC.

C030314.211 3.932mL CuSO4 / 2000 DMW TS

CLIENT	PROJECT	SPECIES	MEC LABORATORY	PROTOCOL
Exponent	Red Dog Mine Phase II Sampleing Program	Hyalella azteca	Carlsbad Room 3	
MEC JOB NUMBER	**PROJECT MANAGER**	**TEST START DATE** / **TIME**	**TEST END DATE**	**TIME**
	B. Gardiner	15Jul04 / 1605 CW	29Jul04	1435 CW

WATER QUALITY DATA

TEST	TEMP (C)	CON.(µS/cm)	DO (mg/L)	HARD./ALK.	DILTN.WAT.BATCH	TEMP REC#	REFERENCE TOX. MATERIAL	REFERENCE TOXICANT	LOT NO.	96-HR LC50
	23±1	vary < 50%	> 3.4	vary < 50%		0	copper chloride	copper		

CLIENT/ MEC ID	CONCENTRATION value	CONCENTRATION units	DAY	REP	D.O. meter	D.O. mg/L	TEMP. meter	TEMP. °C	CONDUCTIVITY meter	CONDUCTIVITY µS/cm	pH meter	pH unit	HARNESS Techn.	HARNESS mg CaCO3/L	ALKALINITY Techn.	ALKALINITY mg CaCO3/L	TECHNICIAN	FEEDING am	FEEDING pm
Ref.Tox.-copper	0	~~mg/L~~ ppb	0	All	6	9.8	6	21.7	5	0.19	8	7.8					ec		
			1	1															
			2	2															
			3	3															
			4	1	6	8.0	6	23.0	5	0.22	8	8.2					ec		
				2															
				3															
Ref.Tox.-copper	62.5	~~mg/L~~ ppb	0	All	6	9.7	6	21.7	5	0.19	8	7.7					ec		
			1	1															
			2	2															
			3	3															
			4	1	6	8.1	6	22.8	5	0.22	8	8.2					ec		
				2															
				3															
Ref.Tox.-copper	125	~~mg/L~~ ppb	0	All	6	9.8	6	21.7	5	0.19	8	7.7					ec		
			1	1															
			2	2															
			3	3															
			4	1	6	8.0	6	22.9	5	0.21	8	8.2					ec		
				2															
				3															

Aquatic Indicators, Inc.

P.O. Box 632 • St. Augustine, FL 32085-0632 • (904) 829-2780

Date 07-14-04

Species:

1. H. azteca
2.
3.

Total Supplied:

1. 1000
2.
3.

Brood Description:

1. E.P.A.
2.
3.

Age:

1. 7 days
2.
3.

Environmental Regime

Feeding: Zooplankton
Artemia NH
✓ phytoplankton

Photo: L 16 D 8

P.H.: 8.0

Temp: 25°C

Salinity: 0 ‰

Comments:

Thanks!

MEC ANALYTICAL SYSTEMS WESTON

ORGANISM RECEIPT LOG

Date:	Time:	MEC Batch No.
7/15/04	1015	AI 4414

Organism:	Source:
H. AZTECA	AQUATIC INICATORS

Address:	Invoice Attached
SAME	Yes (No)

Phone:	Contact:
SAME	SAME

No. Ordered:	No. Received:	Source Batch:
1000	1000	7/~~7~~/04

Condition of Organisms:	Approximate Size or Age:
GOOD	7 DAYS

Shipper:	B of L (Tracking No.)
FED EX	6199 2457 4414

Condition of Container:	Received By:
GOOD	JW

Confirmation of ID of Organism:	Technician (Initials):
Yes (~~No~~)	

Notes:

pH (Units)	Temp. (°C)	D.O. (% Sat)	(Conductivity) or Salinity (Include Units)	Technician (Initials)
8.3	22.0	286	0.52 mS/cm	JS

Notes:

CHAIN OF CUSTODY RECORD/SAMPLE ANALYSIS REQUEST FORM

Project: (Name and Number) Red Dog Mine Phase II Sampling Program (8601997.001)

Exponent Contact: Scott Shock Office: BE

Ship to: MEC Analytical Systems, Inc.
2433 Impala Drive
Carlsbad CA 92008

Lab Contact/Phone: Brian Hestler/760-931-8081

Samplers: SEXTON, IPPOLITO, HARBIKE, MAIER

Exponent
Environmental Group
Bellevue, WA (425) 643-9803
Boston, MA (781) 466-6681
Boulder, CO (303) 444-7270
Portland, OR (503) 636-4338
Washington, D.C. (301) 577-7830

Sample No.	Tag No.	Date	Time	Matrix	Analyses Requested: Toxicity tests per SOW + amendment	Extra Container	Archive	Remarks
SD0001	65327	6/28/04	1420	SD	✓			1 of 4
↓	65328	↓	↓	↓	✓			2 of 4
↓	65329	↓	↓	↓	✓			3 of 4
↓	65375	↓	↓	↓	✓			4 of 4
SD0002	65339	6/30/04	1125	↓	✓			1 of 4
↓	65340	↓	↓	↓	✓			2 of 4
↓	65341	↓	↓	↓	✓			3 of 4
↓	65376	↓	↓	↓	✓			4 of 4
SD0003	65348	7/2/04	1045	↓	✓			1 of 4
↓	65349	↓	↓	↓	✓			2 of 4
↓	65350	↓	↓	↓	✓			3 of 4
↓	65368	↓	↓	↓	✓			4 of 4
SD0004	65378	7/2/04	1530	↓	✓			1 of 4
↓	65379	↓	↓	↓	✓			2 of 4
↓	65380	↓	↓	↓	✓			3 of 4
↓	65381	↓	↓	↓	✓			4 of 4
SD0005	65392	7/3/04	1445	↓	✓			1 of 4
↓	65393	↓	↓	↓	✓			2 of 4
↓	65394	↓	↓	↓	✓			3 of 4
↓	65395	↓	↓	↓	✓			4 of 4

Matrix Code: GW - Groundwater SL - Soil SD - Sediment SW - Surface water
OTHER - Please identify codes

Priority: ☑ Normal ☐ Rush Rush time period

Shipped via: ☐ FedEx/UPS ☐ Courier Other Northern Air Cargo

Condition of Samples Upon Receipt:

Custody Seal Intact: ☐ Yes ☐ No ☐ None

Relinquished by: Ly Maier (Signature) Date/Time: 7-6-04/0700 Received by: Red Dog Shipping Dept. (Signature) Tracking # 9117 2870 Date/Time: 7-6-04/0700

Relinquished by: (Signature) Date/Time: Received by: (Signature) Date/Time:

Distribution: White and Yellow Copies - Accompany Shipment; Pink Copy - Project File

05399

EnviroMatrix Analytical, Inc.

27 July 2004

MEC Analytical Systems
Attn: Brian Hester
2433 Impala Drive
Carlsbad, CA 92008-1514

EMA Log #: 0407183

Project Name: Exponent Red Dog Mine

Enclosed are the results of analyses for samples received by the laboratory on 07/19/04 09:22. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 1931

Client Name: MEC Analytical Systems
Project Name: Exponent Red Dog Mine

EMA Log #: 0407183

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
OV 001	0407183-01	Liquid	07/16/04 11:05	07/19/04 09:22
OV 002	0407183-02	Liquid	07/16/04 11:00	07/19/04 09:22
OV 003	0407183-03	Liquid	07/16/04 11:15	07/19/04 09:22
OV 004	0407183-04	Liquid	07/16/04 11:30	07/19/04 09:22
OV 005	0407183-05	Liquid	07/16/04 12:30	07/19/04 09:22
OV 007	0407183-06	Liquid	07/16/04 12:45	07/19/04 09:22
OV Control	0407183-07	Liquid	07/16/04 10:50	07/19/04 09:22
PW 001	0407183-08	Liquid	07/16/04 12:05	07/19/04 09:22
PW 002	0407183-09	Liquid	07/16/04 14:30	07/19/04 09:22
PW 003	0407183-10	Liquid	07/16/04 14:30	07/19/04 09:22
PW 004	0407183-11	Liquid	07/16/04 14:30	07/19/04 09:22
PW Control	0407183-12	Liquid	07/16/04 12:05	07/19/04 09:22

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Client Name: MEC Analytical Systems
Project Name: Exponent Red Dog Mine

EMA Log #: 0407183

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
OV 001 (0407183-01) Liquid Sampled: 07/16/04 11:05 Received: 07/19/04 09:22									
Total Sulfide	**0.05**	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
OV 002 (0407183-02) Liquid Sampled: 07/16/04 11:00 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
OV 003 (0407183-03) Liquid Sampled: 07/16/04 11:15 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
OV 004 (0407183-04) Liquid Sampled: 07/16/04 11:30 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
OV 005 (0407183-05) Liquid Sampled: 07/16/04 12:30 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
OV 007 (0407183-06) Liquid Sampled: 07/16/04 12:45 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
OV Control (0407183-07) Liquid Sampled: 07/16/04 10:50 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
PW 001 (0407183-08) Liquid Sampled: 07/16/04 12:05 Received: 07/19/04 09:22									
Total Sulfide	**0.19**	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
PW 002 (0407183-09) Liquid Sampled: 07/16/04 14:30 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	

Client Name: MEC Analytical Systems
Project Name: Exponent Red Dog Mine

EMA Log #: 0407183

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
PW 003 (0407183-10) Liquid Sampled: 07/16/04 14:30 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
PW 004 (0407183-11) Liquid Sampled: 07/16/04 14:30 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	
PW Control (0407183-12) Liquid Sampled: 07/16/04 12:05 Received: 07/19/04 09:22									
Total Sulfide	ND	0.05	mg/l	1	4072616	07/23/04	07/23/04	SM4500 S D	

EMA # 0407183

MEC ANALYTICAL SYSTEMS, INC.

☒ 2433 Impala Drive • Carlsbad, CA 92008 • (760) 931-8081, FAX 931-1580
☐ 98 Main Street, Suite #428 • Tiburon, CA 94920 • (415) 435-1847, FAX 435-0479
☐ 675 Hegenberger Rd., Ste. 200 • Oakland, CA 94621 • (510) 632-8990, FAX 632-0714
☐ 152 Sunset View Lane • Sequim, WA 98382 • (360) 582-1758, FAX 582-1679

CHAIN OF CUSTODY

№ 6791

DATE _____ PAGE _____ OF _____

PROJECT NAME/SURVEY/PROJECT NUMBER: Exponent Red Dog Mine
PROJECT MANAGER: Brian Hester
COMPANY: MEC
ADDRESS:
PHONE/FAX:

	SAMPLE I.D.	DATE	TIME	MATRIX	INITIALS	NUMBER & TYPE OF CONTAINERS	ANALYSIS/TEST REQUESTED: Total Sulfides	PRESERVED HOW/ COMMENTS	SAMPLE TEMP. UPON RECEIPT	FOR MEC USE ONLY: MEC LAB ID
1	OV 001	7/16/04	1105	L	CO		X	NaOH Zn acetate		
2	OV 002		1100							
3	OV 003		1115							
4	OV 004		1130							
5	OV 005		1230							
6	OV 007		1245							
7	OV control		1050							
8	PW 001		1205							
9	PW 002		1430							
10	PW 003		1430							
11	PW 004		1430							
12	PW control		1205							

SPECIAL INSTRUCTIONS/COMMENTS:
P/u T=6°C

SHIPPING:
Shipping VIA:
Airbill No:

SAMPLE CONDITION UPON RECEIPT (FOR MEC USE ONLY):

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature: Chris Ooseh	Signature: [illegible] EMA	Signature:	Signature:	Signature:	Signature:
Firm: MEC - Weston	Firm:	Firm:	Firm:	Firm:	Firm:
Date/Time: 7.19.04 0922	Date/Time: 7-19-04 0922	Date/Time:	Date/Time:	Date/Time:	Date/Time:

WHITE - return to originator • YELLOW - lab • PINK - retained by originator

EnviroMatrix Analytical, Inc.

28 July 2004

MEC Analytical Systems
Attn: Brian Hester
2433 Impala Drive
Carlsbad, CA 92008-1514

EMA Log #: 0407219

Project Name: Exponent- Red Dog Mine

Enclosed are the results of analyses for samples received by the laboratory on 07/22/04 10:05. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 1931

Client Name: MEC Analytical Systems
Project Name: Exponent- Red Dog Mine

EMA Log #: 0407219

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
002 PW	0407219-01	Liquid	07/21/04 12:35	07/22/04 10:05
Control PW	0407219-02	Liquid	07/21/04 11:55	07/22/04 10:05
007 OV	0407219-03	Liquid	07/21/04 13:30	07/22/04 10:05
001 PW	0407219-04	Liquid	07/21/04 11:57	07/22/04 10:05
003 OV	0407219-05	Liquid	07/21/04 11:35	07/22/04 10:05
Control OV	0407219-06	Liquid	07/21/04 11:05	07/22/04 10:05
001 OV	0407219-07	Liquid	07/21/04 11:00	07/22/04 10:05
004 OV	0407219-08	Liquid	07/21/04 11:50	07/22/04 10:05
003 PW	0407219-09	Liquid	07/21/04 12:37	07/22/04 10:05
002 OV	0407219-10	Liquid	07/21/04 11:30	07/22/04 10:05
004 PW	0407219-11	Liquid	07/21/04 13:10	07/22/04 10:05
005 PW	0407219-12	Liquid	07/21/04 13:12	07/22/04 10:05
007 PW	0407219-13	Liquid	07/21/04 14:35	07/22/04 10:05
005 OV	0407219-14	Liquid	07/21/04 13:15	07/22/04 10:05

Client Name: MEC Analytical Systems
Project Name: Exponent- Red Dog Mine

EMA Log #: 0407219

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
002 PW (0407219-01) Liquid Sampled: 07/21/04 12:35 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
Control PW (0407219-02) Liquid Sampled: 07/21/04 11:55 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
007 OV (0407219-03) Liquid Sampled: 07/21/04 13:30 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
001 PW (0407219-04) Liquid Sampled: 07/21/04 11:57 Received: 07/22/04 10:05									
Total Sulfide	**0.60**	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
003 OV (0407219-05) Liquid Sampled: 07/21/04 11:35 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
Control OV (0407219-06) Liquid Sampled: 07/21/04 11:05 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
001 OV (0407219-07) Liquid Sampled: 07/21/04 11:00 Received: 07/22/04 10:05									
Total Sulfide	**0.12**	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
004 OV (0407219-08) Liquid Sampled: 07/21/04 11:50 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
003 PW (0407219-09) Liquid Sampled: 07/21/04 12:37 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	

Client Name: MEC Analytical Systems
Project Name: Exponent- Red Dog Mine

EMA Log #: 0407219

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
002 OV (0407219-10) Liquid Sampled: 07/21/04 11:30 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
004 PW (0407219-11) Liquid Sampled: 07/21/04 13:10 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
005 PW (0407219-12) Liquid Sampled: 07/21/04 13:12 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
007 PW (0407219-13) Liquid Sampled: 07/21/04 14:35 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	
005 OV (0407219-14) Liquid Sampled: 07/21/04 13:15 Received: 07/22/04 10:05									
Total Sulfide	ND	0.05	mg/l	1	4072706	07/27/04	07/27/04	SM4500 S D	

Client Name: MEC Analytical Systems
Project Name: Exponent- Red Dog Mine

EMA Log #: 0407219

Conventional Chemistry Parameters by Standard/EPA Methods - Quality Control

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 4072706										
Blank (4072706-BLK1)				Prepared & Analyzed: 07/27/04						
Total Sulfide	ND	0.05	mg/l							
LCS (4072706-BS1)				Prepared & Analyzed: 07/27/04						
Total Sulfide	0.19	0.05	mg/l	0.200		95	80-120			
LCS Dup (4072706-BSD1)				Prepared & Analyzed: 07/27/04						
Total Sulfide	0.21	0.05	mg/l	0.200		105	80-120	10	20	
Duplicate (4072706-DUP1)		**Source: 0407219-03**		Prepared & Analyzed: 07/27/04						
Total Sulfide	ND	0.05	mg/l		ND				20	
Matrix Spike (4072706-MS1)		**Source: 0407219-04**		Prepared & Analyzed: 07/27/04						
Total Sulfide	1.44	0.25	mg/l	1.00	0.60	84	80-120			
Matrix Spike Dup (4072706-MSD1)		**Source: 0407219-04**		Prepared & Analyzed: 07/27/04						
Total Sulfide	1.74	0.25	mg/l	1.00	0.60	114	80-120	19	20	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

MEC 0407214

ANALYTICAL SYSTEMS, INC.

☒ 2433 Impala Drive • Carlsbad, CA 92008 • (760) 931-8081, FAX 931-1580
☐ 98 Main Street, Suite #428 • Tiburon, CA 94920 • (415) 435-1847, FAX 435-0479
☐ 675 Hegenberger Rd., Ste. 200 • Oakland, CA 94621 • (510) 632-8990, FAX 632-0714
☐ 152 Sunset View Lane • Sequim, WA 98382 • (360) 582-1758, FAX 582-1679

CHAIN OF CUSTODY

№ 6819

DATE 7-22-04 PAGE 1 OF 1

PROJECT NAME/SURVEY/PROJECT NUMBER: EXPONENT - RED DOG MINE

PROJECT MANAGER: BRIAN HESTER

COMPANY: MEC - WESTON

ADDRESS: SAME AS ABOVE

PHONE/FAX: " " "

SAMPLE I.D.	DATE	TIME	MATRIX	INITIALS	NUMBER & TYPE OF CONTAINERS	ANALYSIS/TEST REQUESTED: TOTAL SULFIDES	PRESERVED HOW/ COMMENTS	FOR MEC USE ONLY: SAMPLE TEMP. UPON RECEIPT	FOR MEC USE ONLY: MEC LAB ID
002 PW	7/21/04	1235	LIQUID	TS	1		NaOH Zn Acetate		
Control PW		1155			1				
007 OV		1330			1				
001 PW		1157			1				
003 OV		1135			1				
Control OV		1105			1				
001 OV		1100			1				
004 OV		1150			1				
003 PW		1237			1				
002 OV		1130			1				
004 PW		1310			1				
005 PW		1312			1				
007 PW		1435			1				
005 OV		1315			1				

SPECIAL INSTRUCTIONS/COMMENTS:
P/U F-EDC

SHIPPING:
Shipping VIA:
Airbill No:

SAMPLE CONDITION UPON RECEIPT (FOR MEC USE ONLY):

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Signature	Signature	Signature	Signature	Signature	Signature
Firm: MEC-Weston	Firm: EMA	Firm: EMA	Firm: EMA	Firm	Firm
Date/Time: 7.22.04 1005	Date/Time: 22 July 04	Date/Time: 22 July 04 1305	Date/Time: 7/22/04	Date/Time	Date/Time

WHITE - return to originator • YELLOW - lab • PINK - retained by originator

EnviroMatrix Analytical, Inc.

03 August 2004

MEC Analytical Systems
Attn: Brian Hester
2433 Impala Drive
Carlsbad, CA 92008-1514

EMA Log #: 0407290

Project Name: Exponent-Red Dog Mine

Enclosed are the results of analyses for samples received by the laboratory on 07/29/04 17:00. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 1931

Client Name: MEC Analytical Systems
Project Name: Exponent-Red Dog Mine

EMA Log #: 0407290

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SD0001-OV	0407290-01	Liquid	07/27/04 17:40	07/29/04 17:00
SD0002-OV	0407290-02	Liquid	07/27/04 17:40	07/29/04 17:00
SD0003-OV	0407290-03	Liquid	07/27/04 17:40	07/29/04 17:00
SD0004-OV	0407290-04	Liquid	07/27/04 17:40	07/29/04 17:00
SD0005-OV	0407290-05	Liquid	07/27/04 17:40	07/29/04 17:00
SD0007-OV	0407290-06	Liquid	07/27/04 17:40	07/29/04 17:00
SD0001-PW	0407290-07	Liquid	07/27/04 17:40	07/29/04 17:00
SD0002-PW	0407290-08	Liquid	07/27/04 17:40	07/29/04 17:00
SD0003-PW	0407290-09	Liquid	07/27/04 17:40	07/29/04 17:00
SD0004-PW	0407290-10	Liquid	07/27/04 17:40	07/29/04 17:00
SD0005-PW	0407290-11	Liquid	07/27/04 17:40	07/29/04 17:00
SD0007-PW	0407290-12	Liquid	07/27/04 17:40	07/29/04 17:00
0-OV	0407290-13	Liquid	07/27/04 17:40	07/29/04 17:00
0-PW	0407290-14	Liquid	07/27/04 17:40	07/29/04 17:00

Client Name: MEC Analytical Systems
Project Name: Exponent-Red Dog Mine

EMA Log #: 0407290

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SD0001-OV (0407290-01) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	**0.22**	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0002-OV (0407290-02) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0003-OV (0407290-03) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0004-OV (0407290-04) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0005-OV (0407290-05) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0007-OV (0407290-06) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0001-PW (0407290-07) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0002-PW (0407290-08) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0003-PW (0407290-09) Liquid	**Sampled: 07/27/04 17:40**		**Received: 07/29/04 17:00**						
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	

Client Name: MEC Analytical Systems
Project Name: Exponent-Red Dog Mine

EMA Log #: 0407290

Conventional Chemistry Parameters by Standard/EPA Methods

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SD0004-PW (0407290-10) Liquid Sampled: 07/27/04 17:40 Received: 07/29/04 17:00									
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0005-PW (0407290-11) Liquid Sampled: 07/27/04 17:40 Received: 07/29/04 17:00									
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
SD0007-PW (0407290-12) Liquid Sampled: 07/27/04 17:40 Received: 07/29/04 17:00									
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
0-OV (0407290-13) Liquid Sampled: 07/27/04 17:40 Received: 07/29/04 17:00									
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	
0-PW (0407290-14) Liquid Sampled: 07/27/04 17:40 Received: 07/29/04 17:00									
Total Sulfide	ND	0.05	mg/l	1	4080228	08/02/04	08/02/04	SM4500 S D	

1 of 2

CHAIN-OF-CUSTODY RECORD

EnviroMatrix EMA Analytical, Inc.
4340 Viewridge Ave., Ste. A • San Diego, CA 92123 • Phone (858) 560-7717 • Fax (858) 560-7763

JUL 29 '04 18:46

EMA DATE/TIME STAMP

EMA LOG #: 0407290

Client: MEC - Weston

Address: 2433 Impala D.
Carlsbad CA 92008

Attn: R. Hester Phone: 760-931-8091

Sampled by: RH Fax: 760-931-1580

Billing Address: Same

Project: Exponent - Red Hog Mine PO #:

REQUESTED ANALYSIS

EMA ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container(s) #	Container(s) Type*	418.1 (TRPH)	Oil & Grease 413.1 ___ 413.2 ___ 1664 ___	TPH (8015B) Gas ___ Diesel ___	TPH-Extended 8015B ___ ASTM D2887 ___	602 / 8021 BTXE ___ MTBE ___	601 / 8021 (Purgeable Halocarbons)	608 / 8081 (Pesticides)	608 / 8082 (PCB's)	624 / 8260 (Volatile Organics)	625 / 8270 (Semi Volatile Organics)	TTLC Metals (CAC Title 22)	STLC Metals (CAC Title 22)	TCLP (RCRA) Metals ___ Organics ___	Cd Cr Cu Pb Ni Ag Zn	pH EC TSS TDS	Tot/Solids
1	SD0001-OV	7/27/04	1740	L	1	P																X
2	SD0002-OV	↓	↓	↓	↓	↓																↓
3	SD0003-OV																					
4	SD0004-OV																					
5	SD0005-OV																					
6	SD0006-OV																					
7																						
8																						
9																						
10																						

*Container Types: B=Brass Tube; V=VOA; G=Glass; P=Plastic; O=Other (list)

Tamper-Proof Seals Intact: Yes No (N/A) Correct Containers: (Yes) No

Sample(s): (Cold) Ambient Warm VOAs w/ZHS: Yes No (N/A)

All Samples Properly Preserved: (Yes) No N/A

Disposal: (N/C (aqueous)) *EMA (@$5.00/sample) Return Hold

Turnaround Time: 24 hr 48 hr 3 day 4 day 5 day (Normal)

Comments:

5/6 1=9°C

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature: [signature]	29 July 04 1700	Signature: [signature]
Print: Traci Stuker		Print: Jeff Santos
Company: MEC Weston		Company: EMA
Signature		Signature
Print		Print
Company:		Company:
Signature		Signature
Print		Print
Company:		Company:

*EMA reserves the right to return samples that do not match our waste profile.

White - EMA Canary - Accounting Pink - Client (w/Report) Goldenrod - Client (Relinquish Samples)

CHAIN-OF-CUSTODY RECORD

EnviroMatrix EMA Analytical, Inc.
4340 Viewridge Ave., Ste. A • San Diego, CA 92123 • Phone (858) 560-7717 • Fax (858) 560-7763

JUL 29 '04 18:45

EMA LOG #: 0407290

EMA DATE/TIME STAMP

Client:

Address: Same as 1 of 2

Attn: Phone:

Sampled by: Fax:

Billing Address:

Project: PO #:

REQUESTED ANALYSIS

EMA ID #	Client Sample ID	Sample Date	Sample Time	Sample Matrix	Container(s) #	Container(s) Type*	418.1 (TRPH)	Oil & Grease 413.1 ___ 413.2 ___ 1664 ___	TPH (8015B) Gas ___ Diesel ___	TPH-Extended 8015B ___ ASTM D2887 ___	602 / 8021 BTXE ___ MTBE ___	601 / 8021 (Purgeable Halocarbons)	608 / 8081 (Pesticides)	608 / 8082 (PCB's)	624 / 8260 (Volatile Organics)	625 / 8270 (Semi Volatile Organics)	TTLC Metals (CAC Title 22)	STLC Metals (CAC Title 22)	TCLP (RCRA) Metals ___ Organics ___	Cd Cr Cu Pb Ni Ag Zn	pH EC TSS TDS	Total Sulfide								
1	SD0001 - PW	7/27/04	1410	L	1	P															X							
2	SD0002 - PW																											
3	SD0003 - PW																											
4	SD0004 - PW																											
5	SD0005 - PW																											
6	SD0007 - PW																											
7	SB 0-0V																											
8	0-PW																											
9																												
10																												

*Container Types: B=Brass Tube; V=VOA; G=Glass; P=Plastic; O=Other (list)

Tamper-Proof Seals Intact: Yes No N/A | Correct Containers: Yes No

Sample(s): Cold Ambient Warm | VOAs w/ZHS: Yes No N/A

All Samples Properly Preserved: Yes No N/A

Disposal: N/C (aqueous) *EMA (@$5.00/sample) Return Hold

Turnaround Time: 24 hr 48 hr 3 day 4 day 5 day Normal

Comments:

P/U

RELINQUISHED BY	DATE/TIME	RECEIVED BY
Signature	29 Jul 04	Signature
Print Tracy Stoker	1700	Print Jerry Sa. Fos
Company: MEC WESTON		Company: EMA
Signature		Signature
Print		Print
Company:		Company:
Signature		Signature
Print		Print
Company:		Company:

*EMA reserves the right to return samples that do not match our waste profile. White - EMA Canary - Accounting Pink - Client (w/Report) Goldenrod - Client (Relinquish Samples)

Supplemental Information Provided by MEC Analytical Systems

Table 3. Total Sulfides Measurements for 10-Day Benthic Test with *Hyalella azteca*, Red Dog mine Phase II, Exponent

Sample	Overlying water			Pore water		
	Day 0	Day 5	Day 10	Day 0	Day 5	Day 10
Control	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0001	**0.05**	**0.12**	**0.22**	**0.19**	**0.60**	<0.05
SD0002	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0003	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0004	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0005	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
SD0007	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

8601997.001

Jane Sexton

From: Scott S. Shock
Sent: Tuesday, November 23, 2004 12:19 PM
To: Jane Sexton
Cc: Scott Becker
Subject: FW: Additional information for Red Dog QA review

Jane, is this something you would like to add to the Red Dog toxicity testing review.

Scott

-----Original Message-----
From: Gardiner, William [mailto:Bill.Gardiner@WestonSolutions.com]
Sent: Tuesday, November 23, 2004 11:57 AM
To: ssshock@exponent.com
Subject: Additional information for Red Dog QA review

Scott,

Quite some time ago, Jane had asked me for some additional information for a QA review of the Red Dog Mine testing we had performed in September. I have that information, and I guess I thought I had sent it already, but apparently I did not. So, here is information on sand source, porewater salinity, and hardness/alkalinity.

The control sediment was #16 silica sand from Oglebay Norton Industrial Sands.

Day 10 porewater salinity was measured and the values are in the attached Excel files. I believe Jane only needed Day 10 salinities. I'll send the raw data sheets that have this data, although, I think you should already have them.

Water hardness and alkalinity were measured on Day 0 only and were:
Hardness: 88
Alkalinity: 92

My apologies for the delay.

Bill

Porewater Salinity on Day 10, Hyalella Acute Test, Red Dog Mine

	Salinity (ppt)	
Sample	Refractometer	Conductivity
Control	0	0.18
SD0001	0	0.3
SD0002	1	0.41
SD0003	0	0.34
SD0004	0	0.24
SD0005	0	0.19
SD0007	0	0.38