Appendix H-2
Focused Human Health Risk Evaluation

At the request of MBOH, a focused risk evaluation was conducted to evaluate the potential risk to human health from inhalation exposure to fugitive dust. Although no compounds were detected in soil at concentrations above their respective USEPA Region 9 Inhalation PRG, a quantitative risk assessment was performed consistent with USEPA guidance which states that inhalation of fugitive dusts should be evaluated for sites with proposed future commercial/industrial land use. This focused risk evaluation was based on analytical results from soil samples collected throughout Bailey Point during Fall 2001 and Spring 2002 and current USEPA and MDEP risk assessment guidance (MDEP, 1994; USEPA, 1991a, 1994 and 2001b).

Exposure Assessment

Inhalation exposure to fugitive dust can be a significant route of exposure during site remediation or construction as dust may be generated by wind erosion of exposed soils. Consistent with USEPA guidance, this exposure assessment evaluates exposure to construction workers present through out a construction project as well as exposures to nearby off-site residents (USEPA, 2001b). These receptors are potentially subject to higher contaminant exposures due to increased emissions during construction activities. However, to be consistent with the Baseline HHRA, an on-site worker exposure was also evaluated. The following exposure assumptions were used and are consistent with standard USEPA and MDEP guidance (MDEP, 1994, USEPA 1991a and 2001b):

Resident: A person resides at the site for 30 years (6-years as a child and 24 years as an adult) and is exposed to soils through inhalation of fugitive dust generated by wind erosion. An exposure frequency of 150 days per year for a 30-year exposure duration was assumed (USEPA, 1994). An inhalation rate of 20 m^3/day was assumed over a 24 hour exposure time (USEPA, 2001b). The USEPA default particulate emission factor (PEF) of 1.32×10^9 m^3/kg was used to relate the soil contaminant concentration to a dust particulate contaminant concentration (USEPA, 2001b).

On-Site Worker: An On-site worker is exposed to soils through the inhalation of fugitive dust. An inhalation rate of 20 m^3/day over an 8 hour exposure time was assumed for an exposure frequency of 150 days per year over a 25 year exposure duration (USEPA, 1994). The USEPA default PEF of 1.32×10^9 m^3/kg was used to relate the soil contaminant concentration to a dust particulate contaminant concentration (USEPA, 2001b).

Construction Worker: A construction worker is exposed to soils through the inhalation of fugitive dust generated as a result of construction related activities (i.e., excavation and vehicle traffic on unpaved roads). The construction worker is assumed to have a more intense exposure to soil contaminants resulting from the increased "dust" level in the breathing zone. The construction worker, however, is assumed to have

a shorter exposure duration than the on-site worker as most construction projects are expected to last one-year. An inhalation rate of 20 m^3/day for an 8 hour exposure time was assumed to occur 150 days over a 1-year exposure duration (USEPA, 1994 and 2001b).

The USEPA default PEF could not be used for the construction worker scenario as it is likely to underestimate dust concentrations in air resulting from construction activities. Although emission factors are available for specific construction activities, their application requires more information on the types, locations and schedule of construction activities proposed for this site than is currently available. Therefore, dust emission for the construction worker was estimated using the construction emission factor for Total Suspended Particulate (TSP) emissions recommended by USEPA of 1.2 tons/acre/month or 1.04 x 10^{-4} g/m^2-sec (USEPA, 1993). Using this factor, the contaminant emissions from soil can be calculated as:

$$Q = E \times C \times 10^{-6}$$

Where:
Q = contaminant emissions flux (g/m^2-s)
E = heavy construction dust emissions factor (g/m^2-s)
C = contaminant concentration in soil (mg/kg)
10^{-6} = conversion factor

A box model was used to calculate the contaminant concentrations in the air over the source area. The box model assumed the air concentrations within a box is proportional to the emission rate and wind speed across the source area:

$$C_c = \frac{Q \times A \times 1{,}000 mg/g}{L \times V \times H}$$

Where:
C_c = concentration in air
Q = surface emission flux (g/m^2-s)
A = source area m^2
L = width of source area perpendicular to wind direction (m)
V = average wind speed (m/s)
H = box height (m)

A source area (A) of 2.5 acres square (10,120 m^2) corresponding to a width (L) of 100 m was assumed as a reasonable estimate of an area of the site undergoing remediation. This was based on the discrete areas of contamination that have been characterized and may require remediation. The USEPA default wind speed and box height values were used as model inputs.

The exposure parameters for these scenarios are presented in **Table H-1.**

To provide an overly conservative estimate of risk, no compounds were excluded from this risk evaluation. A total of 74 compounds were detected in at least one soil sample (all depths) and were selected as a Compounds of Potential Concern (COPCs) and retained for the focused risk evaluation. The Exposure Point Concentration (EPCs) for each COPC was set at the maximum detected concentration. As such, the exposure scenarios assume long-term concurrent exposure to the maximum detected contaminant concentration. This is an extremely conservative assumption as the location of the maximum detected concentrations varied across the site. Actual exposure and subsequent risk will be much less than estimated in this evaluation. The COPCs and EPCs are presented in **Table H-2**.

Toxicity Assessment

Quantitative estimates of inhalation toxicity (e.g., Reference Concentrations (RfCs) and Unit Risk Factors (URFs) were obtained from the USEPA Integrated Risk and Information System (IRIS) or National Center for Environmental Assessment (NCEA) for all COPCs. RfCs for carcinogenic compounds were identified and used to evaluate the noncarcinogenic risks from exposure to carcinogenic compounds. RfCs and URFs can be converted to inhalation Reference Dose (RfDs) and inhalation cancer slope factors (CSF) using the following equations:

Inhalation RfD (mg/kg-day) = RfC (mg/m^3) x 20 m^3/day x 1/70 kg

Inhalation CSF $(mg/kg\text{-}day)^{-1}$ = URF $(ug/m^3)^{-1}$ x day/20 m^3 x 70 kg x 10^3 ug/mg

Chronic URF and/or RfC were available for 19 of the 74 soil COPCs. Many of these compounds are not considered to be toxic through inhalation exposure. USPEA guidance states that inhalation of fugitive dust is typically not a concern for organic compounds and has developed Soil Screening Levels only for inorganic compounds (USEPA, 2001b).

Subchronic RfCs and URFs are available for only three of the 74 soil COPCs. USEPA guidance states that risks from subchronic inhalation exposure be evaluated using only subchronic toxicity information (USEPA, 2001b). As such, the non carcinogenic risks to the construction worker from inhalation exposure could not be evaluated.

A summary of the toxicity information for the soil COPCs is presented in **Table H-2**.

Risk Assessment

The non-carcinogenic risks from exposure to fugitive dust are expressed in terms of a Hazard Index (HI), which is calculated by dividing the estimated exposure dose by the inhalation RfD:

Hazard Index (HI) = Exposure Dose (mg/kg-day) / Inhalation RfD (mg/kg-day)

If the HI is less than 1.0, no adverse health effects are anticipated from the predicted exposure dose level. If the HI is greater than 1, the predicted exposure dose level could potentially cause adverse effects (USEPA, 1989).

The non-carcinogenic risks associated with exposure to fugitive dust from Bailey Point are presented in **Table H-3 and H-4** for the resident and on-site worker scenario. As stated, non carcinogenic risks to the construction worker could not be evaluated because of the lack of subchronic toxicity information. The non carcinogenic risks associated with a 6-year childhood exposure duration were also calculated and are presented in **Table H-5**. All non cancer risks were below an HI of 1.0 and include HI = 0.013 (residential), HI = 0.0038 (on-site worker) and HI = 0.029 (child).

The carcinogenic risk from exposure to soils is evaluated by multiplying the estimated exposure dose of each carcinogenic COPC by its respective inhalation CSF to obtain an estimate of incremental risk, as follows:

$$\text{Carcinogenic Risk} = \text{Exposure Dose (mg/kg-day)} \times \text{Inhalation CSF (mg/kg-day)}^{-1}$$

The CSF converts the estimated daily intake of a chemical averaged over a lifetime of exposure to an incremental risk of an individual developing cancer. The CSF used in these calculations is often the upper 95-percentile confidence limit of the probability of a response based on experimental data. As such, the carcinogenic risk estimates presented in this assessment are considered to be an upper-bound estimate of risk. The "true risk" to an individual is likely to be much less than predicted in this assessment (USEPA, 1989a).

USEPA guidelines state that the total incremental carcinogenic risk for an individual resulting from exposure at a RCRA Corrective Action site should not exceed a target risk range of $1x10^{-6}$ to $1x10^{-4}$ (USEPA, 1990). The MDEP has set $1x10^{-5}$ as the upper bound for an acceptable incremental lifetime cancer risk (MDEP, 1994).

The incremental carcinogenic risk associated with exposure to fugitive dust at Bailey Point are presented in **Table H-6, H-7 and H-8** for resident, on-site worker and construction worker scenarios, respectively. Cancer risks were estimated by multiplying the exposure dose of each COPC by its inhalation CSF. These risks were then summed to provide a total site incremental cancer risk. All cancer risks were below the MDEP target risk of 10^{-5} and the USEPA target risk range of 10^{-4} to 10^{-6} and include 2.6×10^{-8} (resident), 7.2×10^{-9} (on site worker) and 8.7×10^{-7} (construction worker).

Summary and Conclusions

The purpose of this focused risk evaluation was to evaluate potential human health risks from exposure to fugitive dust. The risk assessment was conducted in accordance with USEPA and MDEP guidance and is consistent with standard USEPA and MDEP methodology. The exposure scenario and assumptions used in this evaluation were overly conservative including long-term repetitive exposure to the maximum detected

chemical concentration. However, even with these assumptions, the noncarcinogenic risk estimates are well below the target HI of 1.0 and the carcinogenic risk estimates are below the MDEP target risk level and the USEPA target risk range. These risk estimates support the conclusion that inhalation of fugitive dust is not a significant route of exposure at this site.