

**Final Task I Risk Assessment Amendment and Montana
Department of Environmental Quality
Approved Remedy
For Newly Identified Contaminants of Concern
in Indoor Air**

**Burlington Northern Livingston Shop Complex
Livingston, Montana**

**January 2010
Prepared by Montana Department of Environmental Quality (DEQ)**

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1.0 Introduction

The purpose of this risk assessment amendment is to present site-specific cleanup levels for indoor air for the BNSF Livingston Shop Complex Facility (Facility). These cleanup levels are risk-based values derived to be protective of residents living in Livingston and workers at the Livingston railyard, with the exception of DEQ's approach to benzene and ethylbenzene in indoor air, which is explained further below. The cleanup levels are calculated to meet the requirements in DEQ's 2001 Record of Decision (ROD) for the Burlington Northern Livingston Shop Complex and the August 2005 Spring Statement of Work (SOW), as updated by the Montana Department of Environmental Quality's (DEQ) March 10, 2009 letter to the BNSF Railway Company (BNSF).

In addition, this document presents an evaluation of clean-up alternatives and a DEQ-approved remedy for newly identified contaminants of concern (COC), as required by the ROD (ROD at 6).

In January 2009, BNSF requested that site-specific cleanup levels be developed for the Facility, as allowed under the SOW. DEQ determined that it was necessary to update the parameters in the tables in Attachment 2 of the SOW, which must be used to calculate site-specific cleanup levels for indoor air at the Facility for two primary reasons.

First, Attachment 2 of the SOW provides: “[a]dditional tables may be required or additional information may need to be added to the existing tables based on future analytical results, *particularly if new contaminants of concern* are identified during supplemental investigations.” (SOW, Attachment 2, Section A.) As outlined in greater detail below, additional COCs in indoor air have been identified during the additional investigations in structures both on the railyard and in nearby structures. These additional COCs in indoor air necessitate the addition of information to the tables in Attachment 2.

Second, the text and Table 4 of Attachment 2 of the SOW state that DEQ will update the toxicity data provided in the SOW, as necessary. Specifically, Attachment 2 of the SOW provides: “[i]f necessary, DEQ will apply the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003) to the process of updating to the toxicity values in the future.” The United States Environmental Protection Agency (EPA) has updated the toxicity data, and DEQ has reviewed these updates and determined that it is necessary to update the toxicity data in Attachment 2. The EPA's toxicity data update includes an update in the approach to calculation of inhalation risk provided in the January 2009 *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*. The updated approach also includes guidance on assessing risk from early-life exposures to vinyl chloride because it acts by a mutagenic mode of action for carcinogenicity. (U.S. EPA, 2009a). This means that the

toxicity value for vinyl chloride is adjusted to account for greater risks from exposure during early life when humans are more sensitive to these effects. As stated in greater detail below, DEQ provided the requisite updated parameters to BNSF in its March 10, 2009 letter to BNSF.

2.0 Background

The ROD-selected remedy for indoor air, which is outlined in greater detail in “Task I: Basement VOC Gas Investigation and Removal” of the SOW, includes indoor air sampling at certain inhabitable structures to evaluate if these structures have indoor air concentrations of COCs above screening levels. (SOW at 21, ROD at 47). If an exceedance of a screening level in an inhabitable structure is identified, the exceedance must be reproducible and reasonably attributable to vapor intrusion by VOCs migrating from the subsurface. (SOW at 21). Figure 1 and Table 1 of Attachment 2 of the SOW depict migration of VOCs from both contaminated groundwater and contaminated subsurface soil, which demonstrates that the SOW addresses vapor intrusion from various subsurface sources of contamination, and not just contaminated groundwater. (Figure 1 and Table 1; *see also* SOW at 154). If the exceedance is reproducible and attributable, BNSF must conduct additional sampling, and implement mitigation systems to meet final site-specific cleanup levels, unless the VOCs in indoor air are not related to the Facility (SOW at 21, ROD at 47).

The procedures for ambient (outdoor) air sampling, indoor air, and soil gas sampling at the Facility are described in the DEQ-approved *Final Task I Supplemental Investigation Work Plan for Indoor Air* (Kennedy/Jenks, 2005) and addenda thereto. (DEQ, 2006a, 2007a).

This Task also includes a provision for the development of alternate cleanup levels than those presented in the ROD (SOW at 21). BNSF previously developed site-specific screening levels that were included in the SOW and the SOW allows these screening levels to be used as cleanup levels. However, it also allows for the development of alternate site-specific cleanup levels that comply with Attachment 2 of the SOW (SOW, Attachment 2, Section B), which is the purpose of this Risk Assessment Amendment.

3.0 Selection of COCs

Five COCs were identified for indoor air in the ROD: tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE), vinyl chloride, and trans-1,2-DCE (ROD at 50). These were the five COCs identified in the SOW and for which BNSF developed site-specific screening levels (SOW at 22). However, both the ROD and the SOW included provisions for the identification of additional COCs based upon the investigations required as part of the remedy (ROD at 6). Specifically, the ROD anticipated that new COCs might be discovered, and the ROD requires “an evaluation of clean-up alternatives and a DEQ-approved remedy” for any new contaminants (ROD at 6). Similarly, the SOW provides that “[a]dditional tables may be required or additional information may need to be added to the existing tables based on future analytical

results, *particularly if new contaminants of concern are identified during supplemental investigations.*” (SOW, Attachment 2, Section A) (emphasis added).

Because of all the potential chemicals used at the railyard, DEQ required analysis of the full list of volatile organic compounds (VOCs) in indoor air in buildings on and near the railyard. (DEQ, 2007a). Later, DEQ compared the analytical results to screening levels developed by EPA for contaminants not identified in the SOW, in addition to those screening levels developed by BNSF and presented in the SOW. (DEQ, 2007a).

As outlined in its March 10, 2009 letter, DEQ identified two new COCs in indoor air for both residential structures and commercial/industrial structures located on the railyard: benzene and ethylbenzene, as well as three additional new COCs for indoor air in commercial/industrial structures: chloroform, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene.

In accordance with the ROD and the SOW, DEQ has considered the data collected in 2005, 2006, 2007, and 2008 during investigations at the Facility, and DEQ has determined that these new contaminants are COCs for the Facility based upon the following reasons. (Kennedy/Jenks, 2009d; Kennedy/Jenks, 2009f). The identification of these COCs is based upon the criteria included in the SOW that BNSF agreed to follow. Under the SOW, site-specific cleanup levels must be developed for a contaminant in indoor air if DEQ identifies an exceedance of a screening level in an inhabitable structure and the exceedance is reproducible and reasonably attributable to vapor intrusion by VOCs migrating from the subsurface. Based upon these criteria and the presence of these compounds in contaminated media at the Facility and in indoor air in certain locations above the screening levels and higher concentrations of these contaminants in the beneath certain structures,¹ DEQ must identify these contaminants as COCs for the Facility.

Some of the detected concentrations of all the COCs DEQ has identified meet the criteria provided in the SOW; however, it is clear that some concentrations of the COCs may be the result of other sources. In addition, DEQ uses a weight-of-evidence approach for decision-making related to indoor air contamination. A weight of evidence approach (also known as a multiple lines of evidence approach) generally means that DEQ considers all available evidence—including indoor air concentrations, subslab concentrations (concentrations of contaminants found beneath the slab of structures), soil gas probe data, ambient air concentrations, groundwater data, soil concentrations, and sampling results from nearby

¹ Previous work plans and reports included a 0.02 attenuation factor for soil gas below structures. EPA and DEQ no longer employ this generic attenuation factor for soil gas below structures (DEQ, 2009c; U.S. EPA, 2009g). At this Facility, empirical data is available for indoor air and soil gas below structures; it is not necessary to apply attenuation factors that are to be used for screening. Therefore, DEQ determined that it would use empirical data rather than a generic attenuation factor in determining the COCs at the Facility.

buildings—in its decision-making, but DEQ does not rely on any one data set to the exclusion of the other data.

Based upon this same analysis, DEQ was also able to eliminate contaminants as COCs, including the two 1,2-DCE compounds, because their concentrations did not exceed their screening levels for indoor air anywhere at the Facility.

Based upon a review of the relevant data, DEQ has determined that the newly identified COCs listed above are attributable to subsurface contamination and related to the Facility, although as discussed further herein, DEQ acknowledges that there may be other potential sources of certain of these COCs, and this Risk Assessment Amendment is not intended to be a determination as to whether COCs in any particular structure are related to the Facility. DEQ analyzed soil gas concentrations and bioventing samples collected by both BNSF and DEQ and determined that all the COCs listed above are present in the subsurface at the Facility. For example, samples from soil gas probes: SGP-20, SGP-CN, SGP-CE, SGP-12S, 07-SG-ES-9, 07-SG-LS-23, 08-SG-68, 08-SG-76A, 07-SG-154, 07-SG-NE-4-1, 08-SG-SE-9, as well as the influent vapor stream samples from the bioventing samples show concentrations of benzene and ethylbenzene, which demonstrates subsurface benzene and ethylbenzene contamination. (Kennedy/Jenks, 2009d; Kennedy/Jenks 2009f). Also, all of the new COCs were detected in indoor air samples above the screening levels and at higher levels in the subslab samples from railyard buildings (Kennedy/Jenks, 2007). Finally, while the indoor air samples collected prior to the ROD were not analyzed for the new COCs (ROD, Tables 14-18), benzene and ethylbenzene were identified in the ROD as components of the petroleum contamination at the Facility. (ROD at 7, 11).

Therefore, in compliance with the ROD and the SOW, DEQ has identified new COCs for the Facility. Accordingly, as outlined below in Section 8, this document provides: “an evaluation of clean-up alternatives and a DEQ-approved remedy.” (ROD at 6).

In accordance with EPA risk assessment guidance, the site-specific cleanup levels will account for the cumulative risk associated with all of the identified COCs. EPA guidance states that cumulative risks should be evaluated and several factors, including the presence of Category A carcinogens such as benzene and vinyl chloride, and the mobility (e.g., volatility), persistence, bioaccumulation, and special exposure routes (e.g., volatile inhalation in homes) of the contaminants should be considered before eliminating any contaminant from evaluation. (U.S. EPA 1989, U.S. EPA 2003a). DEQ also considered whether the contaminants were degradation products of PCE in determining whether a contaminant should be retained as a COC. (U.S. EPA, 1989).

The following are lists of COCs for indoor air in residential structures (these COCs are also those identified for commercial/industrial structures located off the railyard) and commercial/industrial structures located on the railyard impacted by vapor intrusion.

| Residential COCs | Commercial/Industrial COCs |
|-------------------|----------------------------|
| Tetrachloroethene | Tetrachloroethene |
| Trichloroethene | Trichloroethene |
| Vinyl Chloride | Vinyl Chloride |
| Benzene | Benzene |
| Ethylbenzene | Ethylbenzene |
| | Chloroform |
| | 1,3,5-Trimethylbenzene |
| | 1,2,4-Trimethylbenzene |

While DEQ generally requires that all COCs be considered in calculating cumulative human health risks under the Comprehensive Environmental Cleanup and Responsibility Act, DEQ must also take into account concentrations of compounds that are not present due to an environmental spill or release but may be found in the environment either naturally or through anthropogenic (related to human activities) causes. An example of this is the DEQ policy regarding arsenic in surface soil. (DEQ, 2005a). Because naturally-occurring arsenic is ubiquitous in Montana soils, DEQ has determined that it is not appropriate to consider arsenic as part of cumulative risk calculations, but instead set the arsenic action level based upon arsenic concentrations found naturally in Montana soils.

While benzene can form naturally in forest fires or volcanoes, most benzene and ethylbenzene are not naturally-occurring. However, these compounds are found in petroleum products, like gasoline, lubricants, detergents, combustion engines, and even in cigarette smoke. (ATSDR, 2007a). Therefore, benzene and ethylbenzene are commonly found in both indoor and outdoor air at concentrations that exceed risk-based concentrations calculated based upon cumulative risk and residential exposure. (DEQ 2009f).

In Livingston, benzene and ethylbenzene concentrations in typical indoor air at locations without detections of any subsurface vapors can range from 0.36 $\mu\text{g}/\text{m}^3$ to 2.2 $\mu\text{g}/\text{m}^3$, and 0.11 $\mu\text{g}/\text{m}^3$ to 2.4 $\mu\text{g}/\text{m}^3$, respectively. (Tables 6 and 7). DEQ calculated upper prediction limits (UPLs) for benzene and ethylbenzene using the data from locations in Livingston without subsurface contamination. (Table 8; U.S. EPA, 2009c). These UPLs are values that will equal or exceed any new value 95% of the time if a new sample is collected. (U.S. EPA, 2009c). Therefore, they are meant to provide a reasonable estimate of what might be found in the air inside structures in Livingston without subsurface sources of vapor intrusion. (Attachment 1). DEQ has also reviewed data collected from other locations in Montana, including Glendive, Basin, Bozeman, Helena, Wibaux, Winnett, Chinook, Molt, Condon and Missoula and these data are consistent with the Livingston results. (DEQ, 2009f). Therefore, DEQ will consider these compounds separately from the other COCs in indoor air in non-railyard buildings. The calculated UPLs based upon the data from Livingston will be the cleanup levels for the benzene and ethylbenzene for indoor air at the Facility.

DEQ calculated cleanup levels for indoor air in non-railyard buildings based upon residential exposure to tetrachloroethene, trichloroethene, and vinyl chloride, as required by the ROD and

the SOW. DEQ has found that all structures with vapor intrusion from subsurface sources related to the railyard have had tetrachloroethene or trichloroethene in the soil gas below the structures. (DEQ, 2009d, Attachment 14). These structures may also have benzene or ethylbenzene or both in the soil gas beneath them. (DEQ, 2009d, Attachment 14). When this is the case, DEQ has determined that mitigation to prevent tetrachloroethene or trichloroethene from entering the building will also prevent benzene or ethylbenzene from entering the building. (ITRC, 2007). Therefore, a mitigation system that reduces tetrachloroethene and trichloroethene to risk-based concentrations will also remove the contribution of benzene and ethylbenzene from the subsurface. (ITRC, 2007). However, benzene and ethylbenzene concentrations will be reduced to typical Livingston concentrations that are consistent with data collected elsewhere in Montana concentrations, rather than risk-based concentrations. In cases where indoor sources such as cigarette smoke or combustion engines are present, mitigation would not be expected to reduce indoor air concentrations to typical Livingston concentrations that are consistent with data collected elsewhere in Montana, but would only be expected to remove the contribution of contaminants from the subsurface sources.

Commercial/industrial cleanup levels applicable to railyard buildings in Livingston and based upon cumulative risk are above the range of typical Livingston concentrations and therefore will apply as the site-specific cleanup levels without further adjustment. In railyard buildings where indoor sources such as combustion engines are present, mitigation will not be expected to reduce indoor air concentrations of benzene and ethylbenzene to the commercial/industrial cleanup levels but will only be expected to remove the contribution of contaminants from the subsurface sources.

4.0 Health Effects and Risk Levels

The site-specific cleanup levels are calculated for two types of health effects. Some compounds are known or thought to cause cancer with long term exposure. These compounds are referred to as carcinogens and they may also cause other negative health effects. (U.S. EPA, 2009e). Other non-carcinogenic compounds are not likely to cause cancer but are known to cause other negative health effects. (U.S. EPA, 2009e). DEQ must address both types of health effects that may be associated with compounds linked to the Facility. For compounds associated with both carcinogenic and non-carcinogenic effects, DEQ selects the lowest cleanup level that is protective of both types of effects. For non-carcinogens, DEQ selects cleanup levels that are protective of non-cancer health effects.

Long-term exposure to any concentration of a cancer-causing compound is assumed to have some risk so DEQ must choose concentrations that are very protective. (U.S. EPA, 1989). The term “excess lifetime cancer risk” is used because all people have a risk of getting cancer due to genetics or other causes not related to the Facility. (U.S. EPA, 1989). According to the SEER Cancer Statistics Review, American men have a 44% lifetime risk of being diagnosed with cancer, while American women have a 38% lifetime risk. (NCI 2009). This is a little over a 1 in 3 chance (or 33% or 0.33) that a person will get some type of cancer at some time in his or her life. The “excess lifetime cancer risk” that is referred to here is additional risk that someone might have of getting cancer if that person is exposed to compounds linked to the Facility as

described below (30 years of exposure, etc.). DEQ considers an additional or excess 1 in 100,000 chance (or 0.001% or 0.00001 or 1×10^{-5}) allowable. (The Montana Legislature has directed that 1×10^{-5} is an allowable risk for surface water, § 75-5-301, MCA, and based on that level, DEQ has determined that 1×10^{-5} is an appropriate risk). DEQ derives the site-specific cleanup levels such that they do not result in a cumulative excess lifetime cancer risk greater than 1 in 100,000.

For non-cancer health effects, there is a concentration of each compound at which negative health effects do not appear to occur. (U.S. EPA, 1989). DEQ requires cleanup levels for each compound at the Facility that are designed to prevent negative health effects to any organ in the body or any bodily function even if someone is also exposed to other compounds linked to the Facility. To do this DEQ uses a ratio, called a hazard index, to compare concentrations of contaminants at the Facility to concentrations that have not been found to cause negative health effects in scientific studies. (U.S. EPA, 1989). A hazard index of 1 indicates that the concentrations at the Facility are no higher than those found to cause negative health effects. (U.S. EPA, 1989).

The exposure assumptions used to develop the cleanup levels are meant to be protective of children and other sensitive people and are determined based upon how residents and workers may be exposed to contaminants in indoor air. The exposure assumptions included in the SOW as updated by the March 10, 2009 DEQ letter are included in **Tables 2** and **3**. Please note that some exposure parameters such as body weight and inhalation rate were previously used in risk assessments to calculate an exposure. However, updated EPA inhalation risk assessment guidance now recommends calculation of exposure concentrations and the body weight and inhalation rate parameters are no longer used. (U.S. EPA, 2009a). Although they are no longer used, DEQ maintained the parameters in the tables to be consistent with information previously presented in the SOW and the ROD.

The following information provides an explanation for the assumptions used to calculate cleanup levels.

5.0 Exposure Assumptions

The cleanup levels are developed based upon the type and magnitude of potential current and future human exposures to the COCs. (DEQ, 2005b). Exposure assumptions are combined with chemical-specific toxicity values to derive cleanup levels. **Figure 1** is the Site Conceptual Exposure Model (SCEM) included in Attachment 2 of the SOW that graphically depicts the ways by which contaminants are released into the environment, are transported through media, and ultimately become available for human contact.

As presented in **Figure 1**, leaks and spills of chlorinated solvents and petroleum were released to surface and subsurface soils at the Facility. Contaminants in soils leached to groundwater where the contamination was transported off the railyard through groundwater flow and soil gas

migration. Volatile contaminants in both soils and groundwater volatilize both on and off the railyard and migrate into buildings through cracks and other features in basement floors or building slabs. (ITRC, 2007; Kennedy/Jenks, 2009d; Kennedy/Jenks; 2009f). As discussed further herein, DEQ acknowledges that there may be other potential sources of certain COCs in indoor air, and this Risk Assessment Amendment is not intended to be a determination as to whether COCs in any particular structure are related to the Facility.

Based on the SCEM, **Table 1** presents the exposure pathways for indoor air that were selected for investigation and evaluation at the Facility. As presented in Table 1, both current and potentially foreseeable exposures were considered. Therefore, DEQ evaluated current and future off-railyard residents, non-railyard commercial/industrial workers, and commercial/industrial railyard workers for inhalation exposures from VOCs in indoor air originating from both subsurface soils contamination and groundwater contamination.

5.1 Exposure Assumptions for Residential Exposure to Indoor Air

The residential exposure assumptions are included in **Table 2**. These exposure assumptions were contained within Attachment 2 of the SOW as clarified by the March 10, 2009 DEQ letter. (DEQ, 2009c). The SOW also provided that DEQ would update the toxicity values as necessary, and DEQ would apply the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003) to the process of updating to the toxicity values.

Exposure Time – Residents are assumed to potentially be exposed to indoor air in their homes for 24 hours a day resulting in an exposure time of 24 out of a total of 24 hours per day and a ratio of 1. This is meant to be protective of sensitive populations that may include young children, adults who stay at home, home-schooled children, or the elderly.

Exposure Frequency – Residents are assumed to be exposed to indoor air in their homes for 350 days per year allowing for two weeks away from home per year.

Exposure Duration – Residents are assumed to potentially be living in a given home for 30 years starting when someone is a baby.

Averaging Time (Cancer) – Carcinogenic risks are averaged over a lifetime, which is assumed to be 75 years based upon research conducted by the EPA. Averaging time is expressed by multiplying 75 years by 365 days per year resulting in an averaging time of 27,375 days.

Averaging Time (Non-Cancer) – Non-carcinogenic exposures are averaged over the exposure duration. The assumed duration of exposure is 30 years. The calculated non-cancer averaging time is 30 years multiplied by 365 days per year resulting in an averaging time of 10,950 days.

5.2 Exposure Assumptions for Commercial/Industrial Workers Exposure to Indoor Air

The commercial/industrial worker exposure assumptions are included in **Table 3**. These exposure assumptions were contained within Attachment 2 of the SOW SOW as clarified by the March 10, 2009 DEQ letter. (DEQ, 2009c). The SOW also provided that DEQ would update the toxicity values as necessary, and DEQ would apply the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003) to the process of updating to the toxicity values.

Exposure Time – Workers are assumed to potentially be exposed to indoor air at work for 8 hours a day resulting in an exposure time of 8 out of a total of 24 hours per day or a ratio of 0.33.

Exposure Frequency – Workers are assumed to be exposed to indoor air at work for 250 days per year allowing for a five day work week and two weeks vacation per year.

Exposure Duration – Workers in Livingston are assumed to potentially work at a given business for 30 years. This assumption is based upon railyard employee interviews indicating that a typical Livingston railyard worker may spend at least 30 years working at the railyard.

Averaging Time (Cancer) – Carcinogenic risks are averaged over a lifetime, which is assumed to be 75 years based upon research conducted by the EPA. Averaging time is expressed by multiplying 75 years by 365 days per year resulting in an averaging time of 27,375 days.

Averaging Time (Non-Cancer) – Non-carcinogenic exposures are averaged over the exposure duration. The assumed duration of exposure is 30 years. The calculated non-cancer averaging time is 30 years multiplied by 365 days per year resulting in an averaging time of 10,950 days.

6.0 Toxicity Assessment

Because RAGS Part F now recommends the calculation of an exposure concentration rather than an exposure dose for the assessment of inhalation exposures, inhalation unit risk and reference concentration toxicity values are now used in risk calculations rather than cancer slope factors or reference doses. (U.S. EPA, 2009a). **Tables 4** and **5** presents the inhalation unit risk values and reference concentrations used in the derivation of the site-specific cleanup levels for indoor air. These tables include the latest updated carcinogenic inhalation unit risk values and non-carcinogenic reference concentrations in accordance with Attachment 2 of the SOW, which states that DEQ will update the toxicity data originally provided in the SOW, as necessary. Toxicity values have been selected following the hierarchy described in the December 2003 OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments.

7.0 Derivation of Site-Specific Cleanup Levels for Indoor Air

DEQ calculated the site-specific cleanup levels based upon a cumulative cancer excess lifetime risk of 1×10^{-5} and a total non-carcinogenic hazard index of 1 (U.S. EPA, 1989) for any given

health effect using the equations presented in **Tables 2** (residential) and **3** (commercial/industrial). All the compounds, with the exception of the two trimethylbenzenes, have both carcinogenic and noncarcinogenic effects. Without exception, the calculated cleanup levels based upon carcinogenic effects were lower than those based upon non-carcinogenic effects. Therefore, of the cleanup levels provided in the following table, only the cleanup levels for the two trimethylbenzenes are based upon noncarcinogenic risk. Site-specific cleanup levels determined by DEQ for residential indoor air and for commercial/industrial indoor air are presented below.

| Residential COCs | Cleanup Levels ($\mu\text{g}/\text{m}^3$) |
|---|---|
| Tetrachloroethene | 1.46 |
| Trichloroethene | 4.3 |
| Vinyl Chloride | 0.77 |
| Benzene | 2.2 |
| Ethylbenzene | 2.3 |
| Commercial/Industrial COCs² | Cleanup Levels ($\mu\text{g}/\text{m}^3$) |
| Tetrachloroethene | 3.1 |
| Trichloroethene | 9.1 |
| Vinyl Chloride | 4.2 |
| Benzene | 2.3 |
| Ethylbenzene | 7.3 |
| Chloroform | 0.80 |
| 1,3,5-Trimethylbenzene | 26 |
| 1,2,4-Trimethylbenzene | 10 |

As provided in the SOW that BNSF agreed to follow, the residential site-specific cleanup levels apply uniformly to all residential and commercial/industrial structures with screening level exceedances due to subsurface vapor intrusion not located on the railyard. DEQ and BNSF agreed in the SOW that the commercial/industrial site-specific cleanup levels apply only to

² The SOW requires BNSF to use residential cleanup levels on non-rail yard structures. (SOW, Attachment 2, Section B). BNSF will only be allowed to employ commercial/industrial cleanup levels for railyard structures if BNSF places DEQ-approved institutional controls on the rail yard that limit future use to industrial/commercial. (SOW, Attachment 2, Section B). If BNSF does not place institutional controls on the railyard, BNSF will be required to meet residential cleanup levels for all indoor air contaminants found in the railyard structures. (SOW, Attachment 2, Section B).

commercial/industrial structures located on the railyard. The ROD and the SOW, as updated by DEQ's March 10, 2009 letter, do not provide for the performance of building-specific risk assessments on specific properties sampled by BNSF. In addition, in making decisions about indoor air mitigation, DEQ does not allow building-specific risk assessment for vapor intrusion because of the extreme variability involved and the number of factors influencing indoor air concentrations. Rather, in order to be protective and conservative, DEQ requires that screening or cleanup levels (sometimes referred to as target or action levels) be applied uniformly to buildings within a given facility.

8.0 Evaluation of Clean-up Alternatives and DEQ-Approved Remedy for Newly Identified Contaminants of Concern

As discussed previously, DEQ identified two new COCs in indoor air for residential structures and commercial/industrial structures: benzene and ethylbenzene, as well as three additional new COCS for indoor air in commercial/industrial structures located on the railyard: chloroform, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene. The ROD provides that any "new COCs or media will require an evaluation of clean-up alternatives and a DEQ-approved remedy." (ROD at 6).

All of the COCs in indoor air, including both the COCs identified in the ROD and SOW, and the newly identified COCs, are sampled and analyzed in the same manner, and all COCs for indoor air present above site-specific cleanup levels due to subsurface contamination can be mitigated by the same type of system to meet site-specific cleanup levels. (SOW at 21, ROD at 47). For all COCs in indoor air, newly identified or not, DEQ uses the same weight of the evidence approach to review the data and make determinations regarding the data.

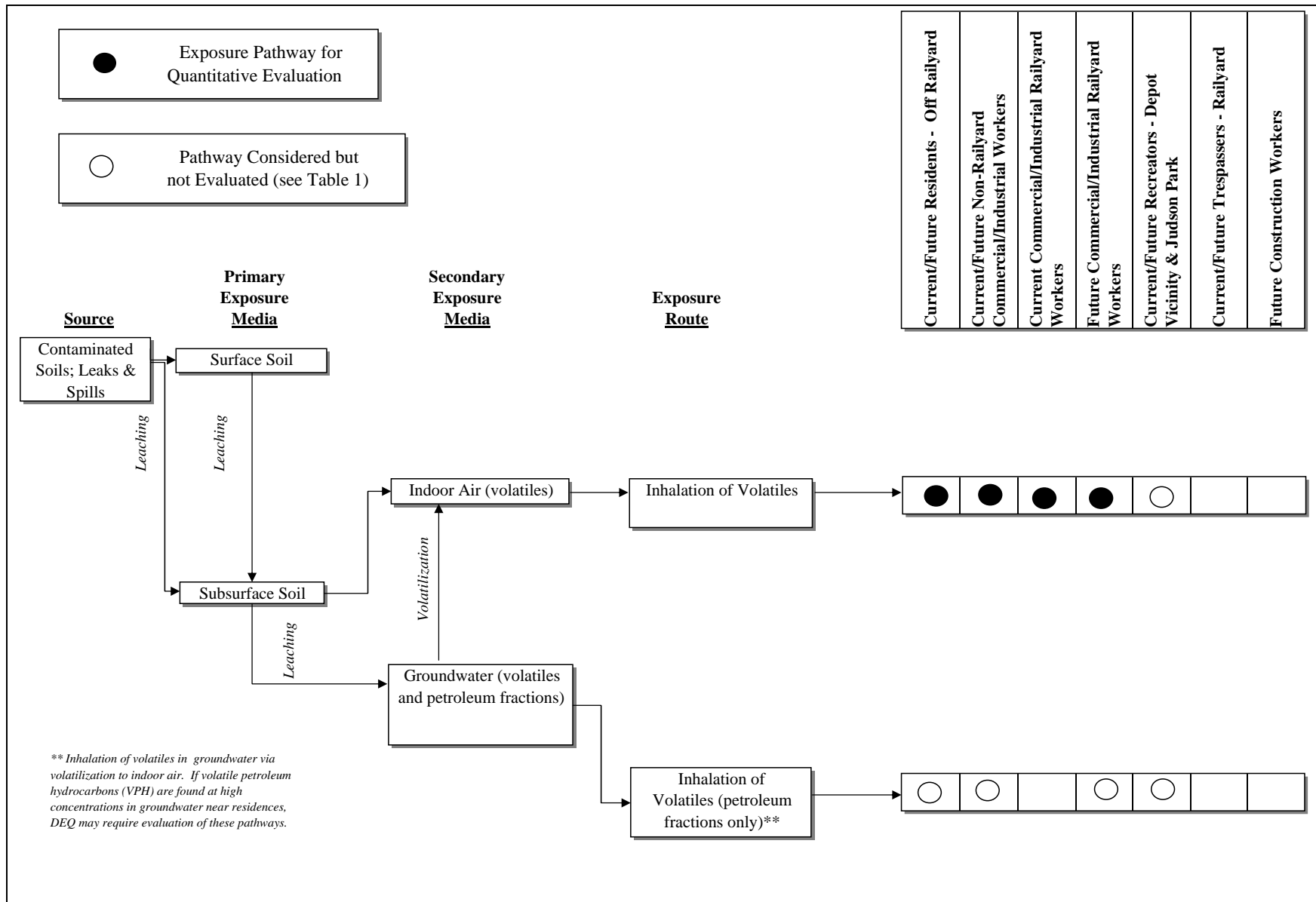
The newly identified COCs do not require an additional or different remedy from the DEQ-approved remedy in the ROD, which is outlined in greater detail in "Task I: Basement VOC Gas Investigation and Removal" of the SOW (SOW at 21, ROD at 47). The DEQ-approved remedy for indoor air was previously evaluated in the ROD as part of the ROD's evaluation of cleanup alternatives. Therefore, the DEQ-approved remedy for the newly identified COCs in indoor air: benzene and ethylbenzene in residential and commercial/industrial structures, as well as chloroform, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene in commercial/industrial structures located on the railyard, is the ROD-selected remedy for indoor air.

The DEQ-approved remedy for all COCs in indoor air is described in detail in the ROD and "Task I: Basement VOC Gas Investigation and Removal" of the SOW. However, in brief, the remedy consists of: indoor air sampling at certain inhabitable structures to evaluate if these structures have indoor air concentrations of COCs above screening levels (SOW at 21, ROD at 47). If an exceedance of an indoor air screening level in an inhabitable structure is identified, the exceedance must be reproducible and due to vapor intrusion by VOCs migrating from the subsurface (SOW at 23). If the exceedance is reproducible and attributable, BNSF must conduct

additional sampling, and implement mitigation systems to meet final site-specific cleanup levels unless DEQ determines the VOCs in indoor air are not related to the Facility (SOW at 21, ROD at 47).

9.0 References

Full citations to the references cited herein can be found within the administrative record in Attachment 3. However, not all of the documents contained within the administrative record are specifically referenced within this document, because the administrative record also contains all documents DEQ relied upon or considered in developing this document.



**TABLE 1
SELECTION OF EXPOSURE PATHWAYS FOR INDOOR AIR
BNSF Livingston Shop Complex Facility**

| <i>Scenario Time Frame</i> | <i>Medium</i> | <i>Receptor Population</i> | <i>Exposure Medium</i> | <i>Receptor Age</i> | <i>Exposure Route</i> | <i>Type of Analysis</i> | <i>Rationale for Elimination of Exposure Pathway</i> | |
|------------------------------|-----------------|---|-----------------------------------|---------------------|--|-------------------------|--|--|
| Current and Future | Subsurface Soil | | | | | | | |
| | | Depot Recreators | Indoor Air (VOCs from Subsurface) | Child/Adolescent | Inhalation | None | Exposures expected to be minimal | |
| | | Off Railyard Resident | Indoor Air (VOCs from Subsurface) | Adult Child | Inhalation Inhalation | Quant. Quant. | NE NE | |
| | | Non-Railyard Commercial/Industrial Worker | Indoor Air (VOCs from Subsurface) | Adult | Inhalation | Quant. | NE | |
| | | Commercial/Industrial Railyard Worker | Indoor Air (VOCs from Subsurface) | Adult | Inhalation | Quant. | NE | |
| Potential Current and Future | Groundwater | Off Railyard Resident | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | Irrigation Well | | Adult Child | Inhalation of Volatiles Inhalation of Volatiles | None None | Screened in the BRA - exposures ranges from 10 ⁻⁷ to 10 ⁻⁸ Screened in the BRA - exposures ranges from 10 ⁻⁷ to 10 ⁻⁸ | |
| | | Indoor Air (VOCs from Subsurface) | | Adult Child | Inhalation Inhalation | Quant. Quant. | NE NE | |
| | | Non-Railyard Commercial/Industrial Worker | | | | | | |
| | | | | Adult | Inhalation of Volatiles | None | Exposures expected to be minimal and difficult to quantify | |
| | | Irrigation Well | | Adult | Inhalation of Volatiles | None | Exposures expected to be less than residential | |
| | | Indoor Air (VOCs from Subsurface) | | Adult | Inhalation | Quant. | NE | |
| | | Judson Park Recreators | Irrigation Well | | Child/Adolescent | Inhalation of Volatiles | None | Exposures expected to be less than residential |
| | | Depot Recreators | Indoor Air (VOCs from Subsurface) | | Child/Adolescent | Inhalation | None | Exposures expected to be minimal |
| | | Commercial/Industrial Railyard Worker | Indoor Air (VOCs from Subsurface) | | Adult | Inhalation | Quant. | NE |
| Future | Groundwater | Commercial/Industrial Railyard Worker | Tap | | | | | |
| | | | | Adult | Inhalation of Volatiles | None | Exposures expected to be minimal and difficult to quantify | |
| | | | Irrigation Well | Adult | Inhalation of Volatiles | None | Exposures expected to be less than residential | |

NE = Not Eliminated
 BRA = CDM 1993, Final Report Baseline Risk Assessment Livingston Rail Yard, May 1993.

VOC = Volatile Organic Compound
 VPH = Volatile Petroleum Hydrocarbon
 EPH = Extractable Petroleum Hydrocarbon

TABLE 2
EXPOSURE ASSUMPTIONS FOR RESIDENTS - VOLATILES IN INDOOR AIR
BNSF Livingston Shop Complex Facility

| |
|---|
| Scenario Timeframe: Current & Future |
| Medium: Indoor Air |
| Exposure Medium: Indoor Air |
| Receptor Population: Resident |
| Receptor Age: Carcinogenic (Lifetime) Exposure - Age Adjusted Factor Approach Noncarcinogenic exposure - 0-6 years |

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/Reference | Intake Equation/Model Name (EPA 2009) |
|--|-------------------------------------|---|---------------------|------------|-------------------------|---|
| Inhalation of VOCs Migrating to Indoor Air from Subsurface | ET | Exposure Time | unitless | 1 | SOW 2005 | $NCL = \frac{THQ \cdot AT \cdot N \cdot CF}{EF \cdot ED \cdot ET \cdot 1 / RfC}$ $CCL = \frac{TR \cdot AT \cdot C}{EF \cdot ED \cdot ET \cdot IUR}$ |
| | EF | Exposure Frequency | days/year | 350 | EPA 2002, CDM 1993 | |
| | ED | Exposure Duration (Total - Carcinogenic Exposure) | years | 30 | EPA 2002, CDM 1993 | |
| | ED-A | Exposure Duration (Adult) | years | 24 | EPA 2002, CDM 1993 | |
| | ED-C | Exposure Duration (Child) | years | 6 | EPA 2002 | |
| | BW-A | Body Weight - Adult | kg | 70 | EPA 2002, CDM 1993 | |
| | BW-C | Body Weight - Child | kg | 15 | EPA 1997 | |
| | AT-C | Averaging Time (Cancer) | days | 27,375 | EPA 1997 | |
| | AT-N | Averaging Time (Non-Cancer) | days | 10,950 | EPA 1989 | |
| | IRA-A | Inhalation Rate (Adult) | m ³ /day | 15.2 | EPA 1997 | |
| | IRA-C | Inhalation Rate (Child) | m ³ /day | 7.5 | EPA 1997 | |
| IRAadj | Age Adjusted Inhalation Rate Factor | m ³ -y/kg-day | 8.0 | Calculated | | |

Sources:

- CDM 1993. Final Report Baseline Risk Assessment Livingston Rail Yard, May.
- EPA 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part A) Interim Final, December. EPA/540/1-89/002.
- EPA 1997. Exposure Factors Handbook, August. EPA /600/P-95/002 Fa.
- EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24.
- EPA 2009. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)

NCL = Noncarcinogenic cleanup level

CCL - Carcinogenic cleanup level

CF = 1000 ug/mg

ET = 24 hours/day*1 day/24 hours (August 2005 Spring Scope of Work)

THQ = Target hazard quotient (1)

TR = Target cancer risk (1 x 10⁻⁵)

RfC = Reference concentration

IUR = Inhalation Unit Risk

**TABLE 3
EXPOSURE ASSUMPTIONS FOR COMMERCIAL/INDUSTRIAL WORKER - VOLATILES IN INDOOR AIR
BNSF Livingston Shop Complex Facility**

| |
|---|
| Scenario Timeframe: Current & Future |
| Medium: Indoor Air |
| Exposure Medium: Indoor Air |
| Receptor Population: Commercial/Industrial Worker |
| Receptor Age: Adults |

| Exposure Route | Parameter Code | Parameter Definition | Units | RME Value | RME Rationale/Reference | Intake Equation/ Model Name (EPA 2009) |
|--|-------------------------|-----------------------------|-----------|-----------|-------------------------|--|
| Inhalation of VOCs Migrating to Indoor Air from Subsurface | ET | Exposure Time | unitless | 0.33 | SOW 2005 | NCL = $\frac{THQ \cdot AT \cdot N \cdot CF}{EF \cdot ED \cdot ET \cdot 1 / RfC}$ |
| | EF | Exposure Frequency | days/year | 250 | EPA 1991 | |
| | ED | Exposure Duration | years | 30 | CDM 1993 | |
| | BW-A | Body Weight - Adult | kg | 70 | EPA 2002, CDM 1993 | CCL = $\frac{TR \cdot AT \cdot C}{EF \cdot ED \cdot ET \cdot IUR}$ |
| | AT-C | Averaging Time (Cancer) | days | 27,375 | EPA 1997 | |
| | AT-N | Averaging Time (Non-Cancer) | days | 10,950 | EPA 1989 | |
| IRA-A | Inhalation Rate (Adult) | m ³ /day | 10.4 | EPA 1997 | | |

Sources:

CDM 1993. Final Report Baseline Risk Assessment Livingston Rail Yard, May.

EPA 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part A) Interim Final, December. EPA/540/1-89/002.

EPA 1991. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals) Interim, December. EPA/540/1-92/003.

EPA 1997. Exposure Factors Handbook, August. EPA /600/P-95/002 Fa.

EPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, December. OSWER 9355.4-24.

EPA 2009. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)

NCL = Noncarcinogenic cleanup level

CCL = Carcinogenic cleanup level

CF = 1000 ug/mg

ET = 8 hours/24 hours (August 2005 Spring Scope of Work)

THQ = Target hazard quotient (1)

TR = Target cancer risk (1×10^{-5})

RfC = Reference concentration

IUR = Inhalation Unit Risk

**TABLE 4
CANCER TOXICITY DATA -- INHALATION
BNSF Livingston Shop Complex Facility**

| Chemical of Potential Concern | Inhalation Unit Risk | Units | Cancer Guideline Description | Source | Date |
|-------------------------------|----------------------|------------------------------------|------------------------------|--------|------|
| TPH Ranges | | | | | |
| Aliphatic | | | | | |
| C5 - C8 | NA | NA | NA | MADEP | 2003 |
| C9 - C18 | NA | NA | NA | MADEP | 2003 |
| C19 - C32 | NA | NA | NA | MADEP | 2003 |
| Aromatic | | | | | |
| C9 - C18 | NA | NA | NA | MADEP | 2003 |
| C9 - C32 | NA | NA | NA | MADEP | 2003 |
| Benzene | 7.80E-06 | (ug/m ³) ⁻¹ | Class A | IRIS | 2009 |
| Chlorobenzene | NA | NA | Class D | IRIS | 2009 |
| Chloroform | 2.30E-05 | (ug/m3)-1 | Class B2 | IRIS | 2009 |
| 1,2-Dichlorobenzene | NA | NA | Class D | IRIS | 2009 |
| 1,4-Dichlorobenzene | 1.10E-05 | (ug/m3)-1 | NA | CA EPA | 2008 |
| cis-1,2-Dichloroethene | NA | NA | Class D | IRIS | 2009 |
| trans-1,2-Dichloroethene | NA | NA | NA | IRIS | 2009 |
| Ethylbenzene | 2.50E-06 | (ug/m3)-1 | NA | CA EPA | 2008 |
| Methylene chloride | 4.70E-07 | (ug/m3)-1 | Class B2 | IRIS | 2009 |
| Tetrachloroethylene | 5.90E-06 | (ug/m3)-1 | NA | CA EPA | 2008 |
| Trichloroethylene | 2.00E-06 | (ug/m3)-1 | NA | CA EPA | 2009 |
| 1,3,5-Trimethylbenzene | NA | NA | NA | IRIS | 2009 |
| 1,2,4-Trimethylbenzene | NA | NA | NA | IRIS | 2009 |
| Vinyl Chloride (adult/child) | 8.80E-06 | (ug/m3)-1 | Class A | IRIS | 2009 |
| Vinyl Chloride (adult) | 4.40E-06 | (ug/m3)-1 | Class A | IRIS | 2009 |
| Anthracene | NA | NA | Class D | IRIS | 2009 |
| Acenaphthalene | NA | NA | NA | IRIS | 2009 |
| Benzo(a)anthracene | 1.10E-04 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Benzo(a)pyrene | 1.10E-03 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Benzo(b)fluoranthene | 1.10E-04 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Benzo(k)fluoranthene | 1.10E-04 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Chrysene | 1.10E-05 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Dibenzo(a,h)anthracene | 1.20E-03 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Fluoranthene | NA | NA | Class D | IRIS | 2009 |
| Fluorene | NA | NA | Class D | IRIS | 2009 |
| Indeno(1,2,3-cd)pyrene | 1.10E-04 | (ug/m3)-1 | Class B2 | CA EPA | 2008 |
| Naphthalene | 3.40E-05 | (ug/m3)-1 | Class C | CA EPA | 2008 |
| Pyrene | NA | NA | Class D | IRIS | 2009 |
| Lead* | NA | NA | Class B2 | IRIS | 2009 |

*Lead is evaluated separately using lead-specific models.

NA = Not Applicable or Not Available

References

CA EPA = California EPA as referenced in the EPA Regional Screening Levels Table, April 2009

IRIS = EPA Integrated Risk Information System

HEAST = EPA Health Effects Assessment Summary Tables, 1997.

MADEP = Massachusetts Department of Environmental Protection Updated Petroleum Hydrocarbon

Fraction Toxicity Values for the VPH/EPH/APH Methodology, 2003.

NCEA = EPA National Center for Environmental Assessment as referenced in the Region 9 PRG Table

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

These toxicity data have been updated as of September 2009 following the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003). DEQ will update these toxicity data as necessary in the future, following the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003).

**TABLE 5
NONCANCER TOXICITY DATA -- INHALATION
BNSF Livingston Shop Complex Facility**

| Chemical of Potential Concern | Inhalation Reference Concentration | Units | Primary Target Organ | Source | Date |
|-------------------------------|------------------------------------|-------------------|----------------------------|--------|------|
| TPH Ranges | | | | | |
| Aliphatic | | | | | |
| C5 - C8 | 2.00E-01 | mg/m ³ | Neurotoxicity | MADEP | 2003 |
| C9 - C18 | 2.00E-01 | mg/m ³ | Neurotoxicity | MADEP | 2003 |
| C19 - C32 | NA | NA | NA | MADEP | 2003 |
| Aromatic | | | | | |
| C9 - C18 | 5.00E-02 | mg/m ³ | (a) | MADEP | 2003 |
| C9 - C32 | NA | NA | NA | MADEP | 2003 |
| Benzene | 3.00E-02 | mg/m ³ | Decreased lymphocyte count | IRIS | 2009 |
| Chlorobenzene | 5.00E-02 | mg/m ³ | Hepatic | PPRTV | 2008 |
| Chloroform | 9.80E-02 | mg/m ³ | Hepatic | ATSDR | 2008 |
| 1,2-Dichlorobenzene | 2.00E-01 | mg/m ³ | Decreased weight gain | HEAST | 1997 |
| 1,4-Dichlorobenzene | 8.00E-01 | mg/m ³ | Increased liver weight | IRIS | 2009 |
| cis-1,2-Dichloroethene | NA | NA | NA | IRIS | 2009 |
| trans-1,2-Dichloroethene | 6.00E-02 | mg/m ³ | Nervous system | PPRTV | 2008 |
| Ethylbenzene | 1.00E+00 | mg/m ³ | Developmental toxicity | IRIS | 2009 |
| Methylene chloride | 1.10E+00 | mg/m ³ | Hepatic | ATSDR | 2008 |
| Tetrachloroethylene | 2.70E-01 | mg/m ³ | Neurotoxicity | ATSDR | 2008 |
| Trichloroethylene | 1.00E-02 | mg/m ³ | Nervous system | NYSDOH | 2006 |
| 1,3,5-Trimethylbenzene | 6.00E-03 | mg/m ³ | Decreased body weight | PPRTV | 2008 |
| 1,2,4-Trimethylbenzene | 7.00E-03 | mg/m ³ | Nervous system | PPRTV | 2008 |
| Vinyl Chloride (adult/child) | 1.00E-01 | mg/m ³ | Liver cell polymorphism | IRIS | 2009 |
| Vinyl Chloride (adult) | 1.00E-01 | mg/m ³ | Liver cell polymorphism | IRIS | 2009 |
| Anthracene | NA | NA | NA | IRIS | 2009 |
| Acenaphthalene | NA | NA | NA | IRIS | 2009 |
| Benzo(a)anthracene | NA | NA | NA | IRIS | 2009 |
| Benzo(a)pyrene | NA | NA | NA | IRIS | 2009 |
| Benzo(b)fluoranthene | NA | NA | NA | IRIS | 2009 |
| Benzo(k)fluoranthene | NA | NA | NA | IRIS | 2009 |
| Chrysene | NA | NA | NA | IRIS | 2009 |
| Dibenzo(a,h)anthracene | NA | NA | NA | IRIS | 2009 |
| Fluoranthene | NA | NA | NA | IRIS | 2009 |
| Fluorene | NA | NA | NA | IRIS | 2009 |
| Indeno(1,2,3-cd)pyrene | NA | NA | NA | IRIS | 2009 |
| Naphthalene | 3.00E-03 | mg/m ³ | Nasal effects | IRIS | 2009 |
| Pyrene | NA | NA | NA | IRIS | 2009 |
| Lead* | NA | NA | NA | IRIS | 2009 |

*Lead is evaluated separately using lead-specific models.

(a) Body weight reduction, hepatic, renal, and developmental effects

NA = Not Applicable or Not Available

References

CA EPA = California EPA as referenced in the EPA Regional Screening Levels Table, September 2008

NYSDOH = Center for Environmental Health, Bureau of Toxic Substances Assessment, Trichloroethene Air Criteria Document, October 2006

IRIS = EPA Integrated Risk Information System

ATSDR = Agency for Toxic Substances and Disease Registry as referenced in the EPA Regional Screening Levels Table, September 2008

MADEP = Massachusetts Department of Environmental Protection Updated Petroleum Hydrocarbon

Fraction Toxicity Values for the VPH/EPH/APH Methodology, 2003.

PPTRV = Provisional Peer-Reviewed Toxicity Value as referenced in the EPA Regional Screening Levels Table, September 2008

HEAST = EPA Health Effects Assessment Summary Tables, 1997.

These toxicity data have been updated as of September 2009 following the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003). DEQ will update these toxicity data as necessary in the future, following the hierarchy described in OSWER Directive 9285.7-53 Human Health Toxicity Values in Superfund Risk Assessments (December 2003).

**TABLE 6
LOCATIONS WITH NO VOC DETECTIONS IN SUBSURFACE**

| Location ID | Sample_ID | Sample Type | Date | Benzene | Ethylbenzene |
|-------------|-----------------------------------|-------------|-----------|---------|--------------|
| 131-2 | 09-AS-131-2 | Indoor Air | 2/12/2009 | 1.3 | 0.97 |
| 131-2 | 09-SG-131-2 | Soil Gas | 2/12/2009 | <5 | <5 |
| 44 | 09-AS-44 | Indoor Air | 3/5/2009 | 0.41 | 0.098 J |
| 44 | 09-SG-44 | Soil Gas | 3/5/2009 | <5 | <5 |
| 521 | 09-AS-521 | Indoor Air | 2/9/2009 | 0.62 | 0.21 |
| 521 | 09-SG-521 | Soil Gas | 2/9/2009 | <5 | <5 |
| 528 | 09-AS-528 | Indoor Air | 2/25/2009 | 0.96 | 0.14 |
| 528 | 09-SG-528 | Soil Gas | 2/25/2009 | <5 | <5 |
| 530 | 09-AS-530 | Indoor Air | 2/23/2009 | 0.36 | 0.11 J |
| 530 | 09-SG-530 | Soil Gas | 2/23/2009 | <5 | <5 |
| 538 | 09-AS-538 | Indoor Air | 2/11/2009 | 0.89 | 0.28 |
| 538 | 09-SG-538 | Soil Gas | 2/11/2009 | <5 | <5 |
| 539 | 09-AS-539 | Indoor Air | 2/26/2009 | 2.1 | 0.73 |
| 539 | 09-SG-539 | Soil Gas | 2/26/2009 | <5 | <5 |
| 549A | 08-AS-549A | Indoor Air | 2/28/2008 | 1.2 | 2.2 |
| 549A | D1-AS-02-28-08 | Indoor Air | 2/28/2008 | 1.3 | 2.1 |
| 549A | 08-SG-549A | Soil Gas | 2/28/2008 | <25 | <25 |
| 549A | 09-AS-549A | Indoor Air | 2/10/2009 | 2.2 | 2 |
| 549A | 09-SG-549A | Soil Gas | 2/10/2009 | <5 | <5 |
| 549B | 08-AS-549B | Indoor Air | 2/28/2008 | 0.86 | 0.26 |
| 549B | 08-SG-549B | Soil Gas | 2/28/2008 | <25 | <25 |
| 552 | 09-AS-552 | Indoor Air | 2/24/2009 | 0.81 | 0.66 |
| 552 | 09-SG-552 | Soil Gas | 2/24/2009 | <5 | <5 |
| 584 | 09-AS-584L | Indoor Air | 3/16/2009 | 0.72 | 0.23 |
| 584 | 09-AS-584B | Indoor Air | 3/16/2009 | 0.53 | 0.15 |
| 584 | 09-SG-584 | Soil Gas | 3/16/2009 | <5 | <5 |
| 591 | 09-AS-591 | Indoor Air | 3/16/2009 | 1.1 | 0.17 J |
| 591 | 09-SG-591 | Soil Gas | 3/16/2009 | <5 | <5 |
| 708 | 09-AS-AMB-708-03-16-09 | Outdoor Air | 3/16/2009 | 3.8 | 12 |
| 708 | 09-AS-708 | Indoor Air | 3/16/2009 | 1.7 J | 0.27 J |
| 708 | 09-SG-708 | Soil Gas | 3/16/2009 | <5 | <5 |
| 710 | 09-AS-AMB-710-02-13-09 | Outdoor Air | 2/13/2009 | 0.74 | 1.9 |
| 710 | 09-AS-710 | Indoor Air | 2/13/2009 | 1.4 | 6.9 |
| 710 | D1-AS-02-13-08 (Dup of 09-AS-710) | Indoor Air | 2/13/2009 | 1.5 | 6 |
| 710 | 09-SG-710 | Soil Gas | 2/13/2009 | <5 | <5 |

**TABLE 6
LOCATIONS WITH NO VOC DETECTIONS IN SUBSURFACE**

| | | | | | |
|-------|------------------------------------|------------|-----------|--------|--------|
| 710 | 09-SG-710 Dup | Soil Gas | 2/13/2009 | <5 | <5 |
| 721-1 | 09-AS-721-1L | Indoor Air | 2/10/2009 | 0.74 | 0.8 |
| 721-1 | 09-AS-721-1B | Indoor Air | 2/10/2009 | 0.62 | 0.31 |
| 721-2 | 09-AS-721-2L | Indoor Air | 2/10/2009 | 0.68 | 0.11 J |
| 721-2 | 09-AS-721DEQ-2L | Indoor Air | 2/10/2009 | 0.75 | 0.23 |
| 721-2 | 09-SG-721-2 | Soil Gas | 2/10/2009 | <5 (R) | <5 (R) |
| 721-2 | 09-SG-721DEQ | Soil Gas | 2/10/2009 | <2.9 | <2.9 |
| 721-2 | 09-SG-721-2 | Soil Gas | 3/3/2009 | <5 | <5 |
| 735 | 09-AS-735L | Indoor Air | 2/13/2009 | 3.3 | 2.4 |
| 735 | 09-AS-735B | Indoor Air | 2/13/2009 | 1.8 | 2.4 |
| 735 | 09-SG-735 | Soil Gas | 2/13/2009 | <5 | <5 |
| 89-1 | 09-AS-89-1 | Indoor Air | 2/26/2009 | 0.57 | 0.14 |
| 89-1 | 09-SG-89-1 | Soil Gas | 2/26/2009 | <5 | <5 |
| 89-3 | 09-AS-89-3 | Indoor Air | 2/12/2009 | 1.3 | 0.33 |
| 89-3 | 09-SG-89-3 | Soil Gas | 2/12/2009 | <5 | <5 |
| 89-3 | 09-SG-89-3DEQ | Soil Gas | 2/12/2009 | <2.9 | <2.9 |
| 89-4 | 09-AS-89-4L | Indoor Air | 2/25/2009 | 1.2 | 0.14 J |
| 89-4 | 09-AS-89-4B | Indoor Air | 2/25/2009 | 0.96 | 0.16 |
| 89-4 | 09-SG-89-4 | Soil Gas | 2/25/2009 | <5 | <5 |
| 89-4 | D1-SG-02-25-09 | Soil Gas | 2/25/2009 | <5 | <5 |
| NE-14 | 08-AS-NE-14 | Indoor Air | 3/4/2008 | 1.7 | 0.48 |
| NE-14 | 08-SG-NE-14 | Soil Gas | 3/4/2008 | <25 | <25 |
| SE-16 | 09-AS-SE-16 | Indoor Air | 3/3/2009 | 0.89 | 0.22 |
| SE-16 | 09-SG-SE-16 | Soil Gas | 3/3/2009 | <5 | <5 |
| SE-18 | 09-AS-SE-18 | Indoor Air | 3/19/2009 | 1.3 | 1.8 |
| SE-18 | 09-SG-SE-18 | Soil Gas | 3/19/2009 | <5 | <5 |
| SE-19 | 09-AS-SE-19 | Indoor Air | 3/17/2009 | 0.48 | 0.11 J |
| SE-19 | 09-SG-SE-19 | Soil Gas | 3/17/2009 | <5 | <5 |
| SE-25 | 09-AS-SE-25 | Indoor Air | 2/25/2009 | 0.67 | 0.15 |
| SE-25 | 09-SG-SE-25 | Soil Gas | 2/25/2009 | <5 | <5 |
| SE-7 | 09-AS-SE-7L | Indoor Air | 3/17/2009 | 0.92 | 0.3 |
| SE-7 | 09-AS-SE-7B | Indoor Air | 3/17/2009 | 0.96 | 0.3 |
| SE-7 | 09-SG-SE-7 | Soil Gas | 3/17/2009 | <5 | <5 |
| SE-7 | D2-SG-03-17-09 (Dup of 09-SG-SE-7) | Soil Gas | 3/17/2009 | <5 | <5 |

**TABLE 7
TYPICAL LIVINGSTON BENZENE AND ETHYLBENZENE INDOOR AIR DATA SET**

| Location ID | Sample ID | Date | Benzene | Ethylbenzene |
|--------------------|-----------------------------------|-------------|----------------|---------------------|
| 131-2 | 09-AS-131-2 | 2/12/2009 | 1.3 | 0.97 |
| 44 | 09-AS-44 | 3/5/2009 | 0.41 | 0.098 J |
| 521 | 09-AS-521 | 2/9/2009 | 0.62 | 0.21 |
| 528 | 09-AS-528 | 2/25/2009 | 0.96 | 0.14 |
| 530 | 09-AS-530 | 2/23/2009 | 0.36 | 0.11 J |
| 538 | 09-AS-538 | 2/11/2009 | 0.89 | 0.28 |
| 539 | 09-AS-539 | 2/26/2009 | 2.1 | 0.73 |
| 549A | D1-AS-02-28-08 | 2/28/2008 | 1.3 | 2.2 |
| 549A | 09-AS-549A | 2/10/2009 | 2.2 | 2 |
| 549B | 08-AS-549B | 2/28/2008 | 0.86 | 0.26 |
| 552 | 09-AS-552 | 2/24/2009 | 0.81 | 0.66 |
| 584 | 09-AS-584L | 3/16/2009 | 0.72 | 0.23 |
| 591 | 09-AS-591 | 3/16/2009 | 1.1 | 0.17 J |
| 708 | 09-AS-708 | 3/16/2009 | 1.7 J | 0.27 J |
| 710 | D1-AS-02-13-08 (Dup of 09-AS-710) | 2/13/2009 | 1.5 | 6.9 |
| 721-1 | 09-AS-721-1L | 2/10/2009 | 0.74 | 0.8 |
| 721-2 | 09-AS-721DEQ-2L | 2/10/2009 | 0.75 | 0.23 |
| 735 | 09-AS-735L | 2/13/2009 | 3.3 | 2.4 |
| 89-1 | 09-AS-89-1 | 2/26/2009 | 0.57 | 0.14 |
| 89-3 | 09-AS-89-3 | 2/12/2009 | 1.3 | 0.33 |
| 89-4 | 09-AS-89-4L | 2/25/2009 | 1.2 | 0.14 J |
| NE-14 | 08-AS-NE-14 | 3/4/2008 | 1.7 | 0.48 |
| SE-16 | 09-AS-SE-16 | 3/3/2009 | 0.89 | 0.22 |
| SE-18 | 09-AS-SE-18 | 3/19/2009 | 1.3 | 1.8 |
| SE-19 | 09-AS-SE-19 | 3/17/2009 | 0.48 | 0.11 J |
| SE-25 | 09-AS-SE-25 | 2/25/2009 | 0.67 | 0.15 |
| SE-7 | 09-AS-SE-7L | 3/17/2009 | 0.92 | 0.3 |

TABLE 8
STATISTICAL SUMMARY OF TYPICAL LIVINGSTON BENZENE AND ETHYLBENZENE CONCENTRATIONS

| | Benzene | Ethylbenzene |
|--|---------|--------------|
| # samples | 26 | 26 |
| frequency of detection | 100% | 100% |
| minimum concentration (ug/m ³) | 0.36 | 0.11 |
| maximum concentration (ug/m ³) | 2.2 | 2.4 |
| Outlier at 5% found | Yes 3.3 | Yes 6.9 |
| 95% UPL (ug/m ³) | 2.1 | 2.3 |

All samples collected from locations with soil gas/subslab concentrations below detection limits.
 95% UPL = 95% Upper Prediction Limit is the value that will equal or exceed any new value 95%
 of the time if a new sample is collected.

ATTACHMENT 1
PROUCL CALCULATIONS

PROUCL OUTLIER TEST FOR BENZENE DATA SET

Outlier Tests for Selected Variables

User Selected Options

| | |
|--|---------------|
| From File | WorkSheet.wst |
| Full Precision | OFF |
| Test for Suspected Outliers with Dixon test | 1 |
| Test for Suspected Outliers with Rosner test | 1 |

Rosner's Outlier Test for C0

| | |
|------------------------------|-------|
| Mean | 1.135 |
| Standard Deviation | 0.646 |
| Number of data | 27 |
| Number of suspected outliers | 1 |

| # | Mean | sd | Potential outlier | Obs. Number | Test value | Critical value (5%) | Critical value (1%) |
|---|-------|-------|-------------------|-------------|------------|---------------------|---------------------|
| 1 | 1.135 | 0.634 | 3.3 | 18 | 3.415 | 2.86 | 3.18 |

For 5% Significance Level, there is 1 Potential Outlier
Therefore, Observation 3.3 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier
Therefore, Observation 3.3 is a Potential Statistical Outlier

PROUCL CALCULATIONS FOR BENZENE

General Background Statistics for Full Data Sets

User Selected Options
 From File WorkSheet.wst
 Full Precision OFF
 Confidence Coefficient 95%
 Coverage 90%
 Different or Future K Values 1
 Number of Bootstrap Operations 2000

C0

General Statistics
 Total Number of Observations 26 Number of Distinct Observations 21
 Number of Missing Values 2

| | | |
|--------------------------|----------------------------|---------|
| Raw Statistics | Log-Transformed Statistics | |
| Minimum | 0.36 Minimum | -1.022 |
| Maximum | 2.2 Maximum | 0.788 |
| Second Largest | 2.1 Second Largest | 0.742 |
| First Quartile | 0.708 First Quartile | -0.346 |
| Median | 0.905 Median | -0.1 |
| Third Quartile | 1.3 Third Quartile | 0.262 |
| Mean | 1.052 Mean | -0.0538 |
| SD | 0.489 SD | 0.474 |
| Coefficient of Variation | 0.465 | |
| Skewness | 0.816 | |

| | | |
|---|--|------|
| Background Statistics | Lognormal Distribution Test | |
| Normal Distribution Test | | |
| Shapiro Wilk Test Statistic | 0.933 Shapiro Wilk Test Statistic | 0.98 |
| Shapiro Wilk Critical Value | 0.92 Shapiro Wilk Critical Value | 0.92 |
| Data appear Normal at 5% Significance Level | Data appear Lognormal at 5% Significance Level | |

| | | |
|------------------------------|---------------------------------|-------|
| Assuming Normal Distribution | Assuming Lognormal Distribution | |
| 95% UTL with 90% Coverage | 1.944 95% UTL with 90% Coverage | 2.248 |
| 95% UPL (t) | 1.903 95% UPL (t) | 2.161 |
| 90% Percentile (z) | 1.679 90% Percentile (z) | 1.739 |
| 95% Percentile (z) | 1.857 95% Percentile (z) | 2.065 |
| 99% Percentile (z) | 2.19 99% Percentile (z) | 2.852 |

| | | |
|---------------------------|---|--|
| Gamma Distribution Test | Data Distribution Test | |
| k star | 4.402 Data appear Normal at 5% Significance Level | |
| Theta Star | 0.239 | |
| MLE of Mean | 1.052 | |
| MLE of Standard Deviation | 0.501 | |
| nu star | 228.9 | |

| | | |
|--|--------------------------------|-------|
| A-D Test Statistic | 0.204 Nonparametric Statistics | |
| 5% A-D Critical Value | 0.746 90% Percentile | 1.82 |
| K-S Test Statistic | 0.0964 95% Percentile | 2.165 |
| 5% K-S Critical Value | 0.172 99% Percentile | 2.2 |
| Data appear Gamma Distributed at 5% Significance Level | | |

| | | |
|--|--|--------------|
| Assuming Gamma Distribution | 95% UTL with 90% Coverage | 2.1 |
| 90% Percentile | 1.724 95% Percentile Bootstrap UTL with 90% Coverage | 2.1 |
| 95% Percentile | 1.989 95% BCA Bootstrap UTL with 90% Coverage | 2.1 |
| 99% Percentile | 2.552 95% UPL | 2.165 |
| | 95% Chebyshev UPL | 3.225 |
| 95% WH Approx. Gamma UPL | 2.022 Upper Threshold Limit Based upon IQR | 2.189 |
| 95% HW Approx. Gamma UPL | 2.05 | |
| 95% WH Approx. Gamma UTL with 90% Coverage | 2.085 | |
| 95% HW Approx. Gamma UTL with 90% Coverage | 2.117 | |

Note: UPL represents a preferred estimate of BTV

PROUCL OUTLIER TEST FOR ETHYLBENZENE DATA SET

Outlier Tests for Selected Variables

User Selected Options

| | |
|--|---------------|
| From File | WorkSheet.wst |
| Full Precision | OFF |
| Test for Suspected Outliers with Dixon test | 1 |
| Test for Suspected Outliers with Rosner test | 1 |

Rosner's Outlier Test for C2

| | |
|------------------------------|-------|
| Mean | 0.827 |
| Standard Deviation | 1.394 |
| Number of data | 27 |
| Number of suspected outliers | 1 |

| # | Mean | sd | Potential outlier | Obs. Number | Test value | Critical value (5%) | Critical value (1%) |
|---|-------|-------|-------------------|-------------|------------|---------------------|---------------------|
| 1 | 0.827 | 1.368 | 6.9 | 15 | 4.439 | 2.86 | 3.18 |

For 5% Significance Level, there is 1 Potential Outlier
Therefore, Observation 6.9 is a Potential Statistical Outlier

For 1% Significance Level, there is 1 Potential Outlier
Therefore, Observation 6.9 is a Potential Statistical Outlier

PROUCL CALCULATIONS FOR ETHYLBENZENE

General Background Statistics for Full Data Sets

User Selected Options
 From File WorkSheet.wst
 Full Precision OFF
 Confidence Coefficient 95%
 Coverage 90%
 Different or Future K Values 1
 Number of Bootstrap Operations 2000

C2

| | | |
|------------------------------|----|---|
| General Statistics | | |
| Total Number of Observations | 26 | Number of Distinct Observations 22 |
| Number of Missing Values | 2 | |

| | | | |
|--------------------------|-------|----------------------------|--------|
| Raw Statistics | | Log-Transformed Statistics | |
| Minimum | 0.098 | Minimum | -2.323 |
| Maximum | 2.4 | Maximum | 0.875 |
| Second Largest | 2.2 | Second Largest | 0.788 |
| First Quartile | 0.148 | First Quartile | -1.914 |
| Median | 0.265 | Median | -1.328 |
| Third Quartile | 0.748 | Third Quartile | -0.292 |
| Mean | 0.593 | Mean | -1.051 |
| SD | 0.699 | SD | 0.994 |
| Coefficient of Variation | 1.178 | | |
| Skewness | 1.712 | | |

| | | | |
|--|-------|---|-------|
| Background Statistics | | | |
| Normal Distribution Test | | | |
| Shapiro Wilk Test Statistic | 0.691 | Lognormal Distribution Test | |
| Shapiro Wilk Critical Value | 0.92 | Shapiro Wilk Test Statistic | 0.897 |
| Data not Normal at 5% Significance Level | | Shapiro Wilk Critical Value | 0.92 |
| | | Data not Lognormal at 5% Significance Level | |

| | | | |
|------------------------------|-------|---------------------------------|-------|
| Assuming Normal Distribution | | Assuming Lognormal Distribution | |
| 95% UTL with 90% Coverage | 1.869 | 95% UTL with 90% Coverage | 2.141 |
| 95% UPL (t) | 1.811 | 95% UPL (t) | 1.971 |
| 90% Percentile (z) | 1.49 | 90% Percentile (z) | 1.249 |
| 95% Percentile (z) | 1.744 | 95% Percentile (z) | 1.792 |
| 99% Percentile (z) | 2.22 | 99% Percentile (z) | 3.528 |

| | | |
|---------------------------|-------|--|
| Gamma Distribution Test | | |
| k star | 0.982 | Data Distribution Test |
| Theta Star | 0.604 | Data do not follow a Discernable Distribution (0.05) |
| MLE of Mean | 0.593 | |
| MLE of Standard Deviation | 0.599 | |
| nu star | 51.04 | |

| | | | |
|---|-------|--------------------------|------|
| A-D Test Statistic | 1.657 | Nonparametric Statistics | |
| 5% A-D Critical Value | 0.772 | 90% Percentile | 2.06 |
| K-S Test Statistic | 0.241 | 95% Percentile | 2.33 |
| 5% K-S Critical Value | 0.176 | 99% Percentile | 2.4 |
| Data not Gamma Distributed at 5% Significance Level | | | |

| | | | |
|--|-------|--|-------------|
| Assuming Gamma Distribution | | 95% UTL with 90% Coverage | 2.2 |
| 90% Percentile | 1.373 | 95% Percentile Bootstrap UTL with 90% Coverage | 2.28 |
| 95% Percentile | 1.789 | 95% BCA Bootstrap UTL with 90% Coverage | 2.28 |
| 99% Percentile | 2.758 | 95% UPL | 2.33 |
| | | 95% Chebyshev UPL | 3.7 |
| 95% WH Approx. Gamma UPL | 1.813 | Upper Threshold Limit Based upon IQR | 1.648 |
| 95% HW Approx. Gamma UPL | 1.835 | | |
| 95% WH Approx. Gamma UTL with 90% Coverage | 1.917 | | |
| 95% HW Approx. Gamma UTL with 90% Coverage | 1.949 | | |

Note: UPL represents a preferred estimate of BTV

ATTACHMENT 2
RESPONSIVENESS SUMMARY

**RESPONSIVENESS SUMMARY FOR FINAL TASK I RISK ASSESSMENT
AMENDMENT AND MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
APPROVED REMEDY FOR NEWLY IDENTIFIED CONTAMINANTS OF CONCERN
IN INDOOR AIR**

1.0 INTRODUCTION

The Montana Department of Environmental Quality (DEQ) solicited public comment on the September 2009 Final Draft Task I Risk Assessment Amendment and Montana Department of Environmental Quality Approved Remedy for Newly Identified Contaminants of Concern in Indoor Air (Risk Assessment Amendment) for the Burlington Northern Livingston Shop Complex Facility (the Facility) during a public comment period that ran from September 24, 2009 to October 23, 2009. DEQ received written comments from a number of individuals and businesses during the public comment period. DEQ also held a public meeting on October 22, 2009, in which DEQ discussed the proposed cleanup levels, as well as other issues related to the Facility.

1.1 Community Involvement Background

It is the intent of DEQ that the citizens of Montana have the opportunity to be actively involved in the DEQ decision-making process with respect to state Superfund sites. The 2001 Record of Decision (ROD) (DEQ, 2001) also provided for public comment on any risk assessment amendments.

1.2 Notification of Public Comment Period

Printed notices were published in the Bozeman Daily Chronicle and the Livingston Enterprise, daily newspapers, and on DEQ's website. DEQ sent notice of the public comment period and the October 22, 2009 meeting to the approximately 400 people on its mailing list for the Facility, including members of local government. DEQ also provided notice to the Associated Press and other state and local news organizations for media distribution. In addition, DEQ provided a copy of the document to the Park County Environmental Council for their review.

1.3 Explanation of Responsiveness Summary

All comments received during the public comment period on the Risk Assessment Amendment have been reviewed and considered by DEQ in the decision-making process and are addressed in this Responsiveness Summary. To assist in developing responses, DEQ added its own numbering to comments where appropriate to add clarity. Each specific written comment is stated verbatim. In order to avoid duplication of some responses, similar comments are usually addressed only once for the first occurrence of the comment and thereafter referenced to the appropriate response. All documents cited in DEQ's responses are part of the administrative record that is included as Attachment 3 of the Risk Assessment Amendment.

In addition, BNSF Railway Company (BNSF) cited certain references in its comments that it included on its secure "Livshare" website. DEQ has printed out these references and included

them within the administrative record in Attachment 3 of the Risk Assessment Amendment for the cleanup levels, because “Livshare” information is not available to the public. DEQ reviewed and considered all of these references. DEQ accorded the appropriate weight to any draft documents or excerpts of documents, and in reviewing the references included by BNSF, considered the relevance of a certain reference or study to the Facility, based on study location, methods or other characteristics of the study. For example, DEQ determined that studies conducted in urban areas of New Jersey had little relevance to Livingston, Montana.

In order to make sure the public, including the commenters, clearly understands the document and DEQ’s decision-making, DEQ has also added additional citations to references within the Risk Assessment Amendment, as appropriate.

As a note for the entire responsiveness summary, the term facility as it is used here is defined in Section 75-10-701(4), Montana Code Annotated (MCA) to include any site or area where hazardous or deleterious substances have come to be located. When DEQ refers to the previously and currently operating railyard and not the entire Facility, it refers to it as “the railyard,” not “the Facility.” In responding to these comments, DEQ interprets BNSF’s use of the terms “onsite” and “offsite” to mean “on the railyard” or “off the railyard,” either of which may be part of the Facility if hazardous or deleterious substances have come to be located there.

General Comment #1: Amendment of a Risk Assessment. Per U.S. EPA’s Risk Assessment Guidance for Superfund (RAGS) Part D (U.S. EPA 2001), if new chemicals of concern (COCs) are identified following the Record of Decision (ROD), there should be a risk evaluation of those COCs. Per RAGS Part A (U.S. EPA 1989), the identification of potential COCs is the first step in the risk assessment process. The amendment prepared by DEQ does not present a risk assessment with an evaluation of the baseline risks posed by the newly identified COCs, as prescribed by RAGS.

Response: Both the ROD and the Spring 2005 Statement of Work (SOW) (DEQ, 2005b) contemplated that investigations at the Facility might result in the discovery of new COCs. The ROD did not require an “evaluation of the baseline risks posed by the newly identified COCs,” as stated in this comment. The ROD states that “any new COCs... will require an evaluation of clean-up alternatives and a DEQ-approved remedy.” (ROD at 6). Through the Risk Assessment Amendment, DEQ has complied with the ROD. In addition, the SOW provided for the possibility that new indoor air cleanup levels could be calculated. (SOW Attachment 2, page 2). The SOW does not provide for conducting an additional baseline risk assessment. Unless otherwise required by law, regulation or administrative document, DEQ is not mandated to follow a particular process laid out in guidance from EPA or other states. DEQ will use those portions of guidance that DEQ determines is appropriate for Montana, based on DEQ’s technical and scientific expertise. DEQ is also not mandated to follow guidance in its entirety, even if DEQ determines that a portion of the guidance is appropriate for Montana. This approach is consistent with EPA’s approach to its own guidance. One EPA guidance provides:

Please recognize that this is a guidance document, not a regulation. This document presents current technical and policy recommendations of the Office of Solid Waste and Emergency Response, based on our current understanding of the phenomenon of

subsurface vapor intrusion. EPA personnel (and of course, states) are free to use and accept other technically sound approaches, either on their own initiative, or at the suggestion of responsible parties or other interested parties. In addition, personnel who use this guidance document are free to modify the approach recommended in this guidance. This guidance document does not impose any requirements or obligations on EPA, states, or the regulated community. Rather, the sources of authority and requirements for addressing subsurface vapor intrusion are the relevant statutes and regulations (e.g., RCRA, CERCLA and the NCP).

(U.S. EPA, 2002b).

In this case, DEQ is mandated to comply with the ROD and the SOW and DEQ has done so.

General Comment #2: Consideration of Background Concentrations in Assessing the Vapor Intrusion Pathway. As noted in DEQ's letter dated 16 September 2009, the August 2005 Spring Statement of Work (SOW) states that BNSF Railway Company (BNSF) shall develop site-specific cleanup levels "if screening levels are exceeded due to subsurface vapor intrusion from VOCs" (emphasis added). The U.S. Environmental Protection Agency's (U.S. EPA's) Draft Vapor Intrusion Guidance (U.S. EPA 2002) states that "indoor air sampling results can be misleading because it is difficult and sometimes impossible to eliminate or adequately account for contributions from "background" sources." The guidance goes on to state that "it is critical to consider the presence of background concentrations in assessing the vapor intrusion pathway." In addition to atmospheric emission sources that can impact general air quality, human activities (e.g., smoking, hobbies) and/or consumer products (e.g., cleaners, paints, fuels) can contribute to indoor air concentrations in individual homes. U.S. EPA's guidance recommends that "vapors attributable to background sources be accounted for during the "Site Specific Assessment" to properly assess the potential risk posed by exposures via the vapor intrusion pathway."

The Interstate Technology Regulatory Council's (ITRC's) Vapor Intrusion Pathway Guidance (ITRC 2007) notes that background contributions of chemicals can exceed health-based target concentrations. Specifically, it is acknowledged that the background indoor air concentration of benzene "often represents an incremental cancer risk greater than 10⁻⁵." The ITRC guidance states that "if measured indoor air concentrations are greater than the screening levels, it is necessary to assess whether the measured chemical concentrations are due to subsurface vapor intrusion, interior background sources, or ambient outdoor air."

DEQ's Risk Assessment Amendment is inconsistent with U.S. EPA's and ITRC's guidance documents in that it does not account for background sources of volatile organic compounds (VOCs) in indoor air. DEQ concludes that COCs are reasonably attributable to vapor intrusion based simply on the presence of COCs in indoor air at concentrations above screening levels and detected higher concentrations in soil gas samples. The analysis presented in DEQ's Risk Assessment Amendment does not include a description of how or whether DEQ accounted for background sources of those COCs. As noted in the ITRC guidance, "subslab soil gas concentrations, by themselves, do not necessarily indicate the extent to which vapor intrusion is occurring or, if it is occurring, whether vapor intrusion represents a health risk." The ITRC

guidance recommends considering lines of evidence in addition to subslab data to establish the presence of a subsurface vapor intrusion pathway. Additional lines of evidence recommended by ITRC include constituent ratios (i.e., attenuation factors) and spatial correlation.

Additional federal and state guidance that recognize the importance of background in evaluating pathways and setting clean-up goals include:

- Colorado Department of Public Health and Environment, “Indoor Air Guidance,” September 2004. <http://www.cdphe.state.co.us/HM/indoorair.pdf>
- Massachusetts Department of Environmental Protection, “Indoor Air Sampling and Evaluation Guide,” April 2002. <http://www.state.ma.us/dep/bwsc/finalpol.htm>
- U.S. EPA, “Role of Background in the CERCLA Cleanup Program,” April 2002. <http://www.epa.gov/superfund/programs/risklrole.pdf>

Response:

Benzene and Ethylbenzene: Petroleum contamination exists at the Facility and was identified as a contaminant group attributable to the Facility in the ROD. (ROD at 7). Benzene and ethylbenzene are components of petroleum. (ROD at 7, 11; ATSDR, 2007). Benzene and ethylbenzene have been detected above screening levels and above “background” levels in media currently contaminated at the Facility (i.e., groundwater, soil gas, bioventing emissions, substructure vapor, and indoor air). (DEQ, 2007c; Kennedy/Jenks, 2009d; Kennedy/Jenks 2009f). Benzene and ethylbenzene have been detected at higher levels beneath structures than in indoor air, particularly those structures on the railyard. (Kennedy/Jenks, 2009d; Kennedy/Jenks 2009f). DEQ notes that the DRAFT Task I Supplemental Investigation Report is a reasonable compilation of the data and questionnaires, although because it is a draft report, DEQ has not approved the conclusions contained within the report. DEQ has also preliminarily reviewed this report and notified BNSF that this report is not sufficient, as noted in response to other comments.

Benzene and ethylbenzene have been detected in indoor air in inhabitable structures at levels above EPA screening levels for ambient air. DEQ has determined that in certain locations, the screening levels have been exceeded due to subsurface vapor intrusion from benzene and ethylbenzene contamination. (Kennedy/Jenks, 2009d; Kennedy/Jenks 2009f). The identification of these COCs is based upon the criteria included in the SOW that BNSF agreed to follow. Under the SOW, site-specific cleanup levels must be developed for a contaminant in indoor air if DEQ identifies an exceedance of a screening level in an inhabitable structure and the exceedance is reproducible and reasonably attributable to vapor intrusion by VOCs migrating from the subsurface. (SOW at 21, 23). Based upon these criteria and the presence of these compounds in contaminated media at the Facility and in certain locations in indoor air above the screening levels and higher concentrations of these contaminants in the subslab, DEQ must identify them as COCs for the Facility. Therefore, benzene and ethylbenzene are COCs for indoor air at the Facility.

However, DEQ has never asserted that all benzene and ethylbenzene present in Livingston is attributable to the Facility as this commenter seems to imply. DEQ acknowledges that while some of the detected concentrations of all the COCs DEQ has identified meet the criteria provided in the SOW, it is clear that some concentrations of the COCs may be the result of other sources.

Chlorinated Solvents: For the COCs in indoor air identified in the ROD and the SOW, tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride, the Risk Assessment Amendment is intended to simply propose cleanup levels. Although the Risk Assessment Amendment is not intended to analyze background sources of contamination in depth, and instead is simply designed to propose site-specific cleanup levels, DEQ has considered and continues to consider background sources of contaminants. (DEQ, 2009j). Please note that this draft flowchart has not yet been finalized and is potentially subject to change. This draft flowchart is guidance, not regulation. However, DEQ believes it is a useful document because it depicts DEQ's general decision-making process for vapor intrusion in indoor air. It does not create any requirements or obligations on the regulated community. Instead, the sources of authority and requirements for addressing subsurface vapor intrusion are the relevant statutes, including in particular, CECRA; regulations; the ROD; the SOW; and the 1990 Modified Partial Consent Decree.

Typical Benzene and Ethylbenzene Indoor Air Analysis: After reviewing the information provided in the comments on the Risk Assessment Amendment, DEQ conducted further analysis on typical indoor air concentrations of benzene and ethylbenzene in Livingston and elsewhere in Montana. While the Risk Assessment Amendment provided DEQ's typical approach of requiring that all COCs be considered in calculating cumulative human health risks, DEQ has determined that it is appropriate to take into account concentrations of compounds that are not present due to an environmental spill or release but may be found in the environment either naturally or through anthropogenic (related to human activities) causes. An example of this is the DEQ policy regarding arsenic in surface soil. (DEQ, 2005a). Because naturally-occurring arsenic is ubiquitous in Montana soils, DEQ has determined that it is not appropriate to consider arsenic as part of cumulative risk calculations but instead set the arsenic action level based upon arsenic concentrations found naturally in Montana soils.

While benzene can form naturally in forest fires or volcanoes, most benzene and ethylbenzene are not naturally-occurring. However, these compounds are found in petroleum products, like gasoline, lubricants, detergents, combustion engines, and even in cigarette smoke. (ATSDR, 2007). Therefore, benzene and ethylbenzene are commonly found in both indoor and outdoor air at concentrations that may exceed risk-based concentrations calculated based upon cumulative risk and residential exposure.

In Livingston, benzene and ethylbenzene concentrations in typical indoor air at locations without detections of any subsurface vapors can range from 0.36 $\mu\text{g}/\text{m}^3$ to 2.2 $\mu\text{g}/\text{m}^3$, and 0.11 $\mu\text{g}/\text{m}^3$ to 2.4 $\mu\text{g}/\text{m}^3$, respectively. (Tables 6 and 7 of the Risk Assessment Amendment). DEQ calculated upper prediction limits (UPLs) for benzene and ethylbenzene using the data from locations in Livingston without subsurface contamination. (Table 8 of the Risk Assessment Amendment). These UPLs are values that will equal or exceed any new value 95% of the time if a new sample

is collected. Therefore, they are meant to provide a reasonable estimate of what might be found in the air inside structures without subsurface sources of vapor intrusion. (Attachment 1 to the Risk Assessment Amendment). DEQ has also reviewed data collected from other locations in Montana, including Glendive, Basin, Bozeman, Helena, Wibaux, Winnett, Chinook, Molt, Condon and Missoula and these data are consistent with the Livingston results. (DEQ, 2009f). Therefore, DEQ will consider these compounds separately from the other COCs in indoor air in non-railyard buildings as required in the SOW. (SOW, Attachment 2). The calculated UPLs based upon the data from Livingston will be the cleanup levels for the benzene and ethylbenzene in residential and off-railyard commercial/industrial indoor air at the Facility.

Non-Railyard Structure Cleanup Levels: Cleanup levels for indoor air in non-railyard buildings are calculated based upon residential exposure to PCE, TCE, and vinyl chloride. DEQ has found that all structures with vapor intrusion from subsurface sources related to the railyard have had PCE or TCE in the soil gas below the structures. These structures may also have benzene or ethylbenzene or both in the soil gas beneath them. When this is the case, mitigation to prevent PCE or TCE from entering the building will also prevent benzene or ethylbenzene from entering the building. (ITRC, 2007). Therefore, a mitigation system that reduces PCE and TCE to risk-based concentrations will also remove benzene and ethylbenzene from the subsurface. (ITRC, 2007). However, any DEQ-required mitigation will reduce benzene and ethylbenzene concentrations to typical Livingston concentrations that are consistent with data collected elsewhere in Montana, rather than risk-based concentrations. In cases where indoor sources such as cigarette smoke or combustion engines are present, mitigation would not be expected to reduce indoor air concentrations to typical Livingston concentrations that are consistent with data collected elsewhere in Montana but would only be expected to remove the contribution of contaminants from the subsurface sources. Whether the subsurface source of these contaminants has been removed will be determined through evaluation of mitigation system performance (e.g., changes in pressure, changes in the concentrations of PCE and TCE, etc.).

Railyard Building Cleanup Levels: Commercial/industrial cleanup levels for all COCs applicable to railyard buildings in Livingston and based upon cumulative risk are above the range of typical Livingston concentrations and therefore will apply as the site-specific cleanup levels without further adjustment. In railyard buildings where indoor sources such as combustion engines are present, any DEQ-required mitigation will not be expected to reduce indoor air concentrations of benzene and ethylbenzene to the commercial/industrial cleanup levels but will only be expected to remove the contribution of contaminants from the subsurface sources. Whether the subsurface source of these contaminants has been removed will be determined through evaluation of mitigation system performance (e.g., changes in pressure, changes in the concentrations of PCE and TCE, etc.)

Typical PCE and TCE Indoor Air Analysis: A review of sampling conducted in various areas of Montana, including Glendive, Basin, Bozeman, Helena, Wibaux, Winnett, Chinook, Molt, Condon and Missoula demonstrate that PCE is either not detected in indoor and/or outdoor air, or is detected at very low levels. (DEQ, 2009f; Ward, 2009a; Ward, 2009b). Therefore, DEQ has determined that PCE is not present in background air, or is present at very low levels that are below the site-specific cleanup levels.

In addition to the analysis of typical indoor air concentrations, the SOW requires BNSF to interview residents and inventory household items that “may influence indoor air quality.” (SOW at 24). In order to meet this requirement, Occupied Dwelling Questionnaires are provided to and completed by property owners where indoor air samples are collected. At this Facility, BNSF’s contractor helps property owners fill out these questionnaires as a measure of ensuring the accuracy of these questionnaires. These questionnaires are used specifically to solicit input from property owners about potential sources of VOCs that may be present inside the structure to be sampled. DEQ has analyzed these completed questionnaires, and information provided by property owners in the Occupied Dwelling Questionnaires does not provide conclusive evidence that indoor air quality is impacted by products or features stored inside structures for structures that may require mitigation. (DEQ, 2009d, Attachments 16, 17, and 18). In compliance with the SOW, DEQ will continue to require BNSF to collect information on other indoor sources by having property owners complete Occupied Dwelling Questionnaires.

DEQ compared completed questionnaires to a list of products containing PCE and TCE that BNSF had previously provided to DEQ, and none of these products were found in any of the houses that DEQ has indicated may require mitigation. (Kennedy/Jenks, 2009d). Also, DEQ has investigated the presence of these PCE and TCE-containing products in stores where Livingston citizens are likely to shop (Murdoch’s, Wal Mart, Albertsons, NAPA, Ace Hardware, Bob Ward’s, Costco, and Sportsman’s Warehouse), and found only ten products from BNSF’s list of PCE-containing products and two products from BNSF’s list of TCE-containing products for sale in these typical Montana stores. (DEQ, 2009e, Table 1). All but one of these products are used for automotive maintenance, which DEQ has found are typically stored in garages, not homes.

DEQ disagrees with the implication in this comment that PCE is prevalent in background outdoor air in Montana, with background air being defined as air that is unimpacted by Facility contamination. Instead, many of the structures sampled in Livingston did not have any detections of PCE or TCE or had only estimated detections below the reporting limit. (DEQ, 2009d, Attachment 10; Kennedy/Jenks, 2009d; Kennedy/Jenks 2009f). DEQ has analyzed the PCE inside structures with PCE detected below the surface, and has also analyzed the PCE inside structures without PCE detected below the surface. (DEQ, 2009e, Figure 2). These plots clearly show a difference between the two datasets and also document the nearly complete lack of “background” sources (i.e., sources not related to the subsurface) of PCE indoor air concentrations in Livingston.

Applicability of Guidance: In this comment, the commenter also cites various state and federal guidance in support of its comment. Please see DEQ’s previous response to General Comment #1 regarding DEQ’s use of guidance.

General Comment #3: Use of Attenuation Factors. DEQ states that it is not appropriate to apply generic attenuation factors when empirical evidence is available and cites discussions with the U.S. EPA. DEQ also states that the only generic attenuation factor for soil vapor to indoor air that DEQ is considering for certain situations where empirical data are not available is 0.1 based on U.S. EPA’s Draft Vapor Intrusion Guidance.

While it is true that the U.S. EPA supports the use of empirical data over generic attenuation factors, DEQ does not address the impact of background sources of chemicals in indoor air on the derivation of empirical attenuation factors. Background sources of chemicals in indoor air may confound the derivation of empirical attenuation factors by biasing the derived attenuation to be low. The U.S. EPA draft empirical database (March 2008) suggests that the majority of attenuation factors for subslab to indoor air concentrations fall between 0.01 to 0.001 (for residential structures) and attenuation factors greater than 0.01 are indicated to be biased by background indoor air sources. It follows that the generic attenuation factor of 0.02 used by DEQ in its Task I work plan addenda (DEQ 2006; 2007) is higher (i.e., more conservative) than the range of empirical attenuation factors indicated to not be biased by confounding background sources. Given the impact of confounding background sources on the derivation of empirical attenuation factors, the use of generic attenuation factors may be considered appropriate if the measured indoor air concentrations are so impacted by background concentrations that the derived attenuation factors are biased.

Response: Please see DEQ's previous response to General Comment #2 regarding how the final cleanup levels address the issue of potential background sources of the Facility COCs. DEQ has determined that the use of empirical data is a better approach than relying upon a generic attenuation factor that has not been shown to be supported by the site-specific data. (ITRC, 2007; Kennedy/Jenks 2009d; Kennedy/Jenks 2009f). The vapor intrusion data obtained by DEQ throughout Montana does not even support the use of a building-specific attenuation factor since spatial and temporal variability within particular structures is very high for vapor intrusion samples. (DEQ, 2009f).

PCE is widely used in dry cleaners (ATSDR, 1997a) and PCE concentrations in air are expected to be much lower without the presence of dry cleaners. The data from Livingston and the other Montana cities listed above support this conclusion. (DEQ, 2009f). The Livingston residents whose homes were sampled almost universally indicated that they did not use a dry cleaner (Kennedy/Jenks 2009d, Appendix B). Further, Livingston's only dry cleaner does not use PCE (DEQ, 2009e). Also, there is no evidence of any other source of PCE releases in Livingston except the railyard, which has extensive, well documented, and undisputed releases of PCE. (E.g., DEQ, 2009a).

Therefore, DEQ has considered the comment. However, given the approach that DEQ is taking towards typical concentrations of benzene and ethylbenzene, and the fact that Montana and Livingston specific data demonstrate that PCE is only present at low levels in typical indoor air, DEQ has determined that the use of generic attenuation factors is not appropriate. Contrary to what the commenter suggests, there is not a significant confounding impact of background sources of chlorinated solvents that requires the application of an unsupported attenuation factor, and a change to the Risk Assessment Amendment is not warranted.

Finally, this commenter provided comments that appear to suggest that it believes DEQ will only rely upon its cleanup levels in making decisions regarding vapor intrusion. First it is critical to point out that DEQ has not currently made any decisions regarding vapor intrusion based upon the proposed or final cleanup levels. DEQ previously made some vapor intrusion decisions

based upon PCE and TCE concentrations in subsurface and indoor air compared to the site-specific screening levels BNSF developed for the SOW. DEQ has since retracted those decisions until the new site-specific cleanup levels are final. DEQ intends to use the site-specific cleanup levels along with other lines of evidence in its decision-making. For example, if a building has an exceedance of the cleanup levels but indoor sources are identified on the questionnaire or the levels below the building are lower than indoor air or the contaminant ratios do not indicate that all contamination is attributable to subsurface or any other lines of evidence suggests that the contamination may not be attributable to the subsurface or related to the Facility, DEQ will verify the results and only require mitigation where it is appropriate. DEQ has complied with and will continue to comply with the requirements of the SOW, including: “The ROD selected remedy requires all residences and businesses that have indoor air VOC concentrations from subsurface vapor intrusion above site-specific cleanup levels for indoor air to have a protection system installed at no cost to the owner, *unless the VOCs in indoor air are not related to the Facility.*” (SOW at 23) (emphasis added).

General Comment #4: Consistency of Chemical Concentration Ratios. Both the U.S. EPA and ITRC vapor intrusion guidance documents recommend the use of constituent ratios as a line of evidence in evaluating the vapor intrusion pathway. The ITRC guidance (2007) states “evaluating the ratio between different COCs in groundwater, soil gas, slab and/or indoor air may help to identify potential vapor intrusion contributions or to screen out background sources.” U.S. EPA’s guidance (2002) recommends the use of ratios to distinguish subsurface-derived VOCs from other non-subsurface related sources. In particular, the ratios of chlorinated hydrocarbons should be similar, whether they are compared within media [e.g. the ratio of tetrachloroethene (PCE) to trichloroethene (TCE) in soil gas should be similar to the ratio of PCE to TCE in indoor air] or across media (e.g. the soil gas to indoor air ratios should be similar for both PCE and TCE). If chemical concentration ratios are not similar, the ITRC guidance states that “it is reasonable to conclude there is an interior or background source.”

In its evaluation of attenuation factors in the U.S. EPA Vapor Intrusion Database, U.S. EPA uses consistency in attenuation factors to determine the influence of background. DEQ’s Risk Assessment Amendment does not include any analysis of attenuation factors or other concentration ratios. In contrast, the Supplemental Investigation Report (SI Report) includes a detailed analysis of attenuation factors for multiple COCs, which is consistent and in accordance with the ITRC guidance. An evaluation of ratios of PCE to TCE in multiple media (e.g., soil gas and indoor air) found differences between the media. These analyses support the conclusion that PCE is the only COC for which detectable indoor concentrations relevant to potential risk-based levels could be reasonably attributable to subsurface vapor intrusion.

Response: DEQ agrees that evaluation of constituent ratios is a line of evidence that can be considered in determining whether vapor intrusion from subsurface contamination is occurring. In fact, DEQ has used and will continue to use constituent ratios to determine that indoor air contamination is likely due to another source besides the Facility. An example of this is location 108. (DEQ, 2009d, Attachment 15). However, as stated in the ITRC guidance regarding multiple lines of evidence, “It is possible that, even if the ratio analysis suggests that indoor or ambient sources are likely responsible for some of the measured indoor air concentrations, subsurface sources may still be contributing to indoor air concentrations.” (ITRC, 2007).

More importantly, the Risk Assessment Amendment upon which DEQ requested comments proposed cleanup levels based upon a risk assessment for contaminants in indoor air that were previously identified in the ROD, except for benzene and ethylbenzene. The Risk Assessment Amendment is not intended to provide an analysis of attenuation factors or other constituent ratios. Instead, as required by the ROD and the SOW, the Risk Assessment Amendment provides site-specific cleanup levels for indoor air because screening levels for indoor air were exceeded due to subsurface vapor intrusion from VOCs.

Finally, please see DEQ's response to General Comment #2, which explains DEQ's determination that subsurface benzene and ethylbenzene contamination is attributable to the Facility.

General Comment #5: Ambient Air. Data from 2005, 2007 and 2008 demonstrate that ambient air, upwind of the Town of Livingston, contains low levels of various VOCs including PCE, TCE, benzene and ethylbenzene. For example, samples of ambient air upwind of the facility on April 2, 2007, contained PCE at 0.094 ug/m³, benzene at 0.64 ug/m³, and ethylbenzene at 1.0 ug/m³. On April 5, 2007, samples of upwind ambient air contained PCE at 0.079 ug/m³, TCE at 0.024 ug/m³, benzene at 0.52 ug/m³, and ethylbenzene at 0.59 ug/m³. On March 5, 2008, samples of upwind ambient air contained PCE at 0.82 ug/m³, TCE at 0.090 ug/m³, benzene at 2.3 ug/m³, and ethylbenzene at 1.6 ug/m³. On July 14, 2008, samples of upwind ambient air contained PCE at 0.22 ug/m³, TCE at 0.042 ug/m³, benzene at 0.85 ug/m³, and ethylbenzene at 2.4 ug/m³. This line of evidence is especially important in light of the very low cleanup levels proposed by DEQ: PCE at 0.88 ug/m³, TCE at 2.6 ug/m³, benzene at 0.67 ug/m³, ethylbenzene at 2.1 ug/m³. Task I Supplemental Investigation Report, Table 3.

Response: Please see DEQ's previous response to General Comment #2 regarding how the final cleanup levels for benzene and ethylbenzene address background levels of benzene and ethylbenzene in indoor and outdoor air. DEQ notes that the levels of PCE and TCE in ambient air cited in this comment are at or below (in some cases significantly below) the final cleanup levels. Although outdoor ambient air contamination levels—many of which are an order of magnitude or more lower than the final cleanup levels—might have a slight impact on indoor air contamination, a review of the all the evidence, including the data provided, does not show that outdoor air contamination would make it impossible for BNSF to meet the final cleanup levels. In its decision-making, DEQ uses a multiple lines of evidence approach, that includes consideration of the ambient air samples results, similar to that described in EPA (U.S. EPA, 2002a) and ITRC (ITRC, 2007) guidance documents. (DEQ, 2009j).

This comment also references 2008 ambient air data. As DEQ has previously determined using its technical and scientific expertise and informed BNSF, most of the 2008 outdoor ambient air data are anomalous, because the levels of contamination measured in 2008 were typically significantly higher than the 2005, 2007 and 2009 outdoor air results. (DEQ, 2009d). Further, the 2008 outdoor air levels of contamination did not appear to impact the indoor air, because in 2008, 42 houses in Livingston had indoor air concentrations of PCE below the lowest outdoor ambient air level of PCE. (DEQ, 2009d, Attachment 10). Because DEQ has considered the data and determined that the 2008 outdoor air data are anomalous, DEQ has given limited weight to these data in its decision-making.

Also, DEQ calculated the 95% upper confidence limit (UCL)—which is the scientifically accepted method for analyzing data (U.S. EPA, 2002a)—for all ambient air data for PCE, including the anomalously high 2008 data but excluding two extreme outliers (6.5 and 20 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$)) that are three and ten times higher than the next highest value of PCE is $2.1 \mu\text{g}/\text{m}^3$. (DEQ, 2009e). The 95% UCL for all of the outdoor air data is below the final PCE cleanup level. (DEQ, 2009e). DEQ has carefully considered the outdoor air data, and has incorporated the background data as appropriate into the final site-specific cleanup levels.

General Comment #6: Selection of COCs. As stated in the SOW, calculation of site-specific cleanup levels for indoor air is required only “if screening levels are exceeded in inhabitable structures, are reproducible, and are reasonably attributable to vapor intrusion by VOCs partitioning from groundwater.” DEQ identified COCs based on detections in indoor air above the screening levels and detections at higher concentrations in soil gas samples collected below the structures. As discussed in General Comments #1 and #2, this analysis does not consider the lines of evidence recommended by ITRC and U.S. EPA to differentiate between VOCs resulting from subsurface vapor intrusion versus those from other sources, including background. As a result, DEQ’s analysis is not sufficient to determine whether the chemical concentrations in indoor air are reasonably attributable to vapor intrusion by VOCs partitioning from groundwater.

When attenuation factors and evaluation of background sources of VOCs are considered, BNSF concludes that: “Of the COCs identified by DEQ in the ROD and its 10 March 2009 letter to BNSF, PCE is the only COC detected in indoor air for which the detected indoor air concentrations above a screening level might reasonably be attributable to vapor intrusion by partitioning from groundwater based on evaluation of the investigative data and information using multiple lines of evidence. The evidence suggests that a potential for subsurface TCE vapor intrusion reasonably exists at some onsite railroad buildings where soil VOC source(s) are present. The findings do not support a conclusion that TCE; cis-1,2-DCE; trans-1,2-DCE; vinyl chloride; benzene; or ethylbenzene detected above current screening levels in offsite indoor air are reasonably attributable to subsurface vapor intrusion related to the Facility.” (Kennedy/Jenks Consultants 2009a). A detailed analysis of attenuation factors and potential background sources is included in the Task I Supplemental Investigation Report, Burlington Northern Livingston Shop Complex, Livingston, Montana (Kennedy/Jenks Consultants 2009a) (SI Report) to support this conclusion.

Response: First, this comment cites ITRC and EPA guidance to state that DEQ’s analysis is not sufficient. Please see DEQ’s previous response to General Comment #1 regarding the use of guidance, as well as DEQ’s previous response to General Comment # 5 regarding ITRC guidance. Please also refer to DEQ’s previous responses to comments regarding “background” concentrations and attenuation factors.

Second, this comment asserts that DEQ identified COCs based on detections in indoor air above the screening levels and detections of higher concentrations of the COCs in soil gas samples collected below the structures. Although as noted in the Risk Assessment Amendment, these are two lines of evidence that DEQ used to determine the proper COCs, DEQ also identified benzene

and ethylbenzene as COCs because of their widespread presence in subsurface soil gas at the Facility. (Risk Assessment Amendment at Section 3.0 and previous comment responses).

Both TCE and vinyl chloride are breakdown products of PCE (ATSDR, 1997a, 2006) that have been detected in all currently impacted media at the Facility. (DEQ, 2007c). In addition, vinyl chloride is a Class A or known human carcinogen that should not be eliminated as a COC at facilities where it has been detected. (ATSDR, 2006; U.S. EPA, 1989; US. EPA, 2003a). DEQ must ensure that cumulative risks from all three of these contaminants associated with the solvents used at the Facility do not exceed a 1×10^{-5} excess lifetime cancer risk. (The Montana Legislature has directed that 1×10^{-5} is an allowable risk for surface water, § 75-5-301, MCA, and based on that level, DEQ has determined that 1×10^{-5} is an appropriate risk). DEQ has determined that as a degradation byproduct, vinyl chloride attributable to PCE from the site may not form until some distance downgradient. The distance between the PCE source and the vinyl chloride appearance downgradient depends on several hydrogeological and geochemical factors. The absence of vinyl chloride at a source is not an effective argument that the vinyl chloride is not attributable to a source. The same is true for any other degradation byproduct. Finally, vinyl chloride detection limits in the soil gas and subslab are not low enough to conclusively determine that vinyl chloride is not present in these media. (Kennedy/Jenks 2009d; Kennedy/Jenks 2009f).

Third, this comment states that there is no evidence that cis-1,2-DCE and trans-1,2-DCE are present above screening levels in offsite indoor air. It is DEQ's understanding that in this context, the commenter means off-railyard when it states "offsite." This statement is misplaced, because DEQ has previously eliminated cis-1,2-DCE and trans-1,2-DCE as COCs because their concentrations did not exceed their screening levels for indoor air. (Risk Assessment Amendment at Section 3.0). Finally, the commenter references conclusions within a DRAFT Task I Supplemental Investigation Report submitted on behalf of BNSF that DEQ is in the process of reviewing but that DEQ has already determined does not meet its requirements (i.e., it does not provide an appropriate calculation of cleanup levels as required by DEQ and therefore, DEQ calculated cleanup levels itself). As noted in previous responses, the DRAFT Task I Supplemental Investigation Report is a reasonable compilation of the data and questionnaires. However, the conclusions within this draft document do not hold significant weight with DEQ, and do not warrant a change to the Risk Assessment Amendment. Previous comments address DEQ's approach.

General Comment #6(a): Data Clearly Demonstrate that Benzene, Ethylbenzene, and Vinyl Chloride are Not Associated with the Offsite Groundwater Plume from the Railyard Facility. In the Risk Assessment Amendment, DEQ proposes COCs for the vapor intrusion pathway that are not associated with the offsite affected groundwater plume from the railyard facility and cannot be associated with any other mechanism of chemical migration from this facility. Evaluation of test results from hundreds of environmental samples collected from multiple environmental media (groundwater, soil gas, subslab zone) over a period of more than 10 years (1998 - 2009) clearly demonstrates that benzene, ethylbenzene, and vinyl chloride have not migrated from the Livingston Railyard and Shops Complex to offsite locations, either via groundwater or, as apparently hypothesized by DEQ, as a vapor cloud within the sub-surface soil vadose zone.

Inclusion of these inappropriate COCs in the calculation of cumulative risk limits artificially lowers the cleanup levels for VOCs that are potentially attributable to vapor emissions from the affected groundwater plume.

As shown on Table 1, benzene, ethylbenzene, and vinyl chloride, which have been proposed by DEQ as COCs for residential properties, are not associated with the affected groundwater plume offsite of the Livingston Railyard Facility, as they have been found to be non-detectable in all of the 576 or more offsite groundwater samples collected and analyzed to date for these compounds. Similarly, for the 3 additional compounds proposed as industrial site COCs, the compounds 1,2,4-trimethylbenzene (TMB) and 1,3,5-TMB have never been detected in 451 offsite groundwater samples, and chloroform has been detected in only 10 of 761 (-1%) of offsite groundwater samples at a maximum concentration of 0.0019 mg/L. Clearly, these compounds are not characteristic or representative of the offsite affected groundwater plume.

U.S. EPA Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway (U.S. EPA, 2002) explicitly notes that "indoor air sampling results can be misleading because it is difficult and sometimes impossible to eliminate or adequately account for contributions from "background sources," (U.S. EPA, 2002, page 6). Therefore, U.S. EPA recommends consideration of the pathway when volatile chemicals are present in soil or groundwater "in close proximity" to existing buildings (U.S. EPA, 2002, page 8). Furthermore, RAGS (U.S. EPA, 1989) identifies frequency of detection as an important consideration for selection of COCs for risk assessment purposes. Quite logically, compounds that are not present (or are only rarely detected) in groundwater and are not in close proximity to a building cannot reasonably be identified as COCs for vapor intrusion from affected groundwater.

Detection frequencies of the 8 proposed COCs in groundwater samples collected on and off of the railyard are summarized on Table 1. Proper characterization of the offsite groundwater plume based on the frequency of detection of the detected VOCs would identify the principal COC as PCE (present in 58% of offsite groundwater samples), followed to a lesser extent by TCE (present in 18% of offsite groundwater samples), with none of the other proposed COCs detected in any offsite groundwater sample (with the exception of chloroform, as noted previously). For the onsite groundwater plume, PCE and TCE are again the predominant plume constituents, detected in 79% and 72% of samples tested, within the other proposed COCs detected in only 2 to 8% of samples.

Response: First, the commenter states that benzene, ethylbenzene, and vinyl chloride are not associated with the offsite affected groundwater plume from the railyard. However, the SOW does not limit the source of vapor intrusion to the groundwater, and instead also states that a COC must be reasonably attributable to vapor intrusion from VOCs migrating from the *subsurface*. (SOW at 23). The SOW addresses vapor intrusion from all subsurface contamination related to the Facility, and not simply vapor intrusion from "partitioning from groundwater." (See, e.g., SOW at 154 and Attachment 2, Figure 1 and Table 1). In addition vapor source materials currently exist beneath the railyard buildings (Kennedy/Jenks 2009d; Kennedy/Jenks 2009f), so it would be inappropriate to limit the COCs only to those contaminants currently present in groundwater on the railyard.

In addition, as stated in previous comment responses petroleum is a COC for the facility and does contain benzene and ethylbenzene. Vapor intrusion can and does occur due to petroleum contamination in the soil and groundwater, regardless of whether benzene and ethylbenzene have dissolved into the groundwater. (U.S. EPA, 2002a; ITRC, 2007). Additionally, BNSF does not sample groundwater in wells with any visible evidence of petroleum contamination (Kennedy/Jenks, 2006a, page 5-5). BNSF did not know it had petroleum contamination off the railyard until DEQ required that BNSF install additional wells in 2006 and none of the 2006 wells located offsite within the petroleum plume have ever been sampled for VOCs. (Kennedy/Jenks, 2009a, 2009c, 2009e).

This comment also states that inclusion of benzene and ethylbenzene “artificially lowers the cleanup levels” of other VOCs. Please see DEQ’s previous response to General Comment #2 regarding the calculation of cleanup levels for benzene and ethylbenzene. Inclusion of these COCs with consideration of typical Montana indoor air concentrations will not lower the cleanup levels for the other COCs. In addition, as clearly stated in DEQ’s response to General Comment #2, DEQ acknowledges that other sources of benzene and ethylbenzene exist in indoor and outdoor air. Therefore, DEQ is not asserting that all benzene and ethylbenzene detected in indoor air in Livingston is related to subsurface contamination related to the Facility, which is the standard contained within the SOW. However, DEQ has determined that benzene and ethylbenzene detected in the subsurface and indoor air in certain locations in Livingston are related to the Facility and there are exceedances of EPA screening levels for benzene and ethylbenzene in indoor air, and therefore, these compounds are COCs for indoor air for the Facility. As indicated in DEQ’s response to General Comment #2, DEQ is using an appropriate approach to account for ubiquitous concentrations of benzene and ethylbenzene.

Please see DEQ’s previous response to Comment # 6 regarding retention of vinyl chloride as a COC.

The commenter also states that 1,2,4-trimethylbenzene, 1,3,5- trimethylbenzene and chloroform were either not detected at all offsite, or were only detected in ten offsite groundwater samples. Again, it is DEQ’s understanding that in this context, the commenter means off-railyard when it states “offsite.”

The incidence of these COCs off-railyard is not relevant, because DEQ is only proposing commercial/industrial cleanup levels for 1,2,4-trimethylbenzene, 1,3,5- trimethylbenzene and chloroform, and these commercial/industrial cleanup levels only apply to structures located on railyard property. The SOW clearly states that “residential exposure assumptions, including a 24-hour exposure time...must be used for *all off-railyard property regardless of its current use.*” (SOW, Attachment 2, Section B). BNSF must meet the residential cleanup levels for all off-railyard properties, and DEQ has not identified 1,2,4-trimethylbenzene, 1,3,5- trimethylbenzene and chloroform as COCs in residential air, nor has it calculated residential cleanup levels for these COCs. Therefore, the lack of 1,2,4-trimethylbenzene, 1,3,5- trimethylbenzene and chloroform contamination off of the railyard does not change the commercial/industrial cleanup levels, because these levels **only** apply to structures on the railyard.

This comment cites EPA guidance to again state that DEQ's analysis is not sufficient. Please see DEQ's previous response to Comment #1 regarding the use of guidance. This comment again references "background" sources; please see responses to previous comments regarding background sources.

DEQ does consider frequency of detection when selecting COCs for facilities. The criterion for removal of contaminants from COC lists based upon low frequency of detection is 5% or less detection in all media at a Facility. (U.S. EPA, 1989). DEQ notes that Tables 1 and 2 provided by the commenter clearly show that all the COCs have been detected at a greater frequency than 5 % in some media at the Facility and most particularly in indoor air. Therefore, on the basis of the detection frequency criterion alone (U.S. EPA, 1989), all the COCs identified by DEQ are appropriately considered COCs. Again, DEQ is asserting that some of the indoor air concentrations of benzene and ethylbenzene detected in Livingston are attributable to the Facility. However, DEQ acknowledges that other sources also exist in some locations. Please refer to information provided above as well as DEQ's responses to previous comments for further explanation of the basis for DEQ's COC selection.

General Comment #6(b): Passive Diffusion Bag (PDB) Test Results Confirm that Proposed COCs Are not Present in the Affected Groundwater Plume. The 2008 Annual Monitoring and Maintenance Report, issued March 2009 (Kennedy/Jenks, 2009b), provides the results of a sampling and testing program, specifically requested by DEQ, which utilized passive diffusion bag (PDB) samplers to obtain a more sensitive measurement of the chemicals present within the affected groundwater plume. For this purpose, PDBs were placed at three discrete depths within each of 4 onsite monitoring wells and 1 offsite monitoring well during two monitoring events (December 2007 and August 2008) representing low and high water table conditions. The PDBs are considered to provide a more sensitive analysis of the presence or absence of a chemical in groundwater, as they provide a discrete depth, longer-time sample which is not subject to the possible dilution effects of a long well screen interval. Results of these analyses found PCE and TCE to be present at concentrations comparable to those previously measured in conventional groundwater samples from these locations. No benzene, ethylbenzene, vinyl chloride, or chloroform were detected above the detection limit of 0.5 ug/L in any of the PDB samples, confirming the absence of these chemicals in the affected groundwater zone.

Response: DEQ acknowledges that no benzene or ethylbenzene were detected in the passive diffusion bag (PDB) samples from the five wells tested in this manner. However, no PDB sampling was conducted in wells impacted with petroleum contamination where one would be most likely to find benzene and ethylbenzene. (Kennedy/Jenks 2009c, 2009e). Also, DEQ did not require BNSF to conduct a comprehensive PDB investigation in order to identify all COCs related to vapor intrusion. (DEQ, 2007c). In fact, as the commenter notes, only five of the hundreds of wells at the Facility were sampled in this manner. While DEQ had thought that this sampling might provide some information regarding vapor intrusion, this sampling is part of the general investigation into the VOC contamination in the alluvial aquifer and has shown a potential vertical gradient with higher chlorinated solvent concentrations in the lower part of the aquifer than in the upper part in some wells. In addition, please refer DEQ's response to General Comment #6a and others regarding the presence of contaminants in other media at the Facility besides groundwater.

However, most importantly, because this PDB sampling was not conducted in the areas where one would expect to find benzene and ethylbenzene in groundwater, DEQ has determined that this limited sampling is not strong evidence that benzene and ethylbenzene vapor intrusion are not occurring. Finally, please see DEQ response to previous General Comment # 2 regarding benzene and ethylbenzene in indoor air and subsurface contamination at the Facility. DEQ has not yet made a decision based on these cleanup levels. However, when DEQ does make decisions regarding indoor air vapor intrusion at the Facility, DEQ will continue to comply with the requirements of the SOW, including: “The ROD selected remedy requires all residences and businesses that have indoor air VOC concentrations from subsurface vapor intrusion above site-specific cleanup levels for indoor air to have a protection system installed at no cost to the owner, *unless the VOCs in indoor air are not related to the Facility.*” (SOW at 23) (emphasis added).

General Comment #6(c): COC Detection Frequency in Vapor Samples Shows Indoor Sources and Supports Elimination of Non-Groundwater COCs. For each of the proposed COCs, Table 2 summarizes the frequency of detection in soil gas, subslab vapor and indoor air for all samples collected and analyzed to date. As shown, at offsite locations, the detection frequency of 7 of the 8 proposed COCs (i.e., with the exception of PCE, which is commonly detected in subsurface vapor due to its presence in the groundwater plume) is significantly greater in indoor air than in either the soil gas or subslab vapor indicating that these indoor air detections are related to indoor sources. Similarly, for the onsite samples, 5 of 8 of the proposed COCs (benzene, ethylbenzene, vinyl chloride, 1,2,4-TMB, and 1,3,5-TMB) are detected at much higher frequencies in the indoor air space than in subsurface vapor samples. In fact, as shown on Table 2, vinyl chloride has never been detected in any of the hundreds of onsite or offsite soil gas or subslab samples collected and analyzed to date, demonstrating that this compound cannot represent a COC for purpose of vapor intrusion.

Under the COC selection guidelines discussed in the U.S. EPA Risk Assessment Guide for Superfund (U.S. EPA RAGS, 1989), low frequency of detection is an important consideration for elimination of compounds from consideration as COCs. On this basis, as discussed above, all COCs other than PCE and TCE should be eliminated from consideration as groundwater COCs as they are not present or detected at very low frequency and concentrations. Detection in other media (such as subsurface vapors, in this case), as discussed in the RAGS guide, is a consideration for retention only if there is a reasonable basis for the facility to be the source of these vapors. As discussed further below, the railyard facility cannot be the source of the benzene, ethylbenzene, vinyl chloride, chloroform, 1,2,4-TMB, or 1,3,5-TMB measured in offsite soil gas or subslab vapor samples as there is no plausible physical mechanism for these compounds to have migrated offsite, except within the groundwater plume, and they are not present in the offsite groundwater plume.

Response: Please see DEQ’s previous response to General Comment #6(a) regarding the commenter’s stated frequency of detection of the various COCs. Please see DEQ’s previous response to General Comment #6 regarding the retention of vinyl chloride as a COC due to its status as a breakdown product of the primary COC at the Facility, PCE, as well as TCE and as a Class A carcinogen and the high sample detection limits. Please refer to DEQ’s response to

General Comment #6(a) regarding chloroform, 1,2,4-TMB, and 1,3,5-TMB that are only found in rail yard buildings with numerous residual sources located beneath them. Again, the commercial/industrial cleanup levels are only applicable to railyard buildings and DEQ has not asserted that these compounds exist in indoor air in off-railyard buildings as a result of subsurface contamination from the railyard.

This comment cites EPA guidance to again state that DEQ's analysis is not sufficient. Please see DEQ's previous response to Comment #1 regarding the use of guidance. In particular, the commenter states that the guidance places limits on retention of COCs that are detected in other media, including subsurface vapors. Please see DEQ's previous response to Comment #6(a), explaining that the SOW specifically outlines that cleanup levels must be developed for all screening level exceedances that are reasonably attributable to vapor intrusion from VOCs migrating from the subsurface. Finally, please see Section 3.0 of the Risk Assessment Amendment, which explains DEQ's determination that subsurface benzene and ethylbenzene contamination is attributable to the Facility. Subsurface contamination can exist in the form of residual soil contamination from groundwater previously contaminated at higher levels as well as from soil vapor migration vertically and laterally away from groundwater. (NJDEP, 2005; ITRC, 2007). Please also see DEQ's response to previous General Comment # 2 regarding benzene and ethylbenzene.

General Comment #6(d): Scientific Research Shows that Vapor Migration Does not Occur Over 100 Feet from Affected Groundwater Plume. The technical guidelines issued for evaluation of vapor intrusion effects by U.S. EPA, ITRC, and many states are in complete agreement that VOCs in affected groundwater pose no concern with regard to vapor intrusion at a distance of more than 100 feet from the edge of the affected groundwater zone (or as little as 30 feet for non-chlorinated VOCs, such as benzene and ethylbenzene). Nevertheless, the DEQ is proposing that benzene, ethylbenzene, vinyl chloride, chloroform, 1,2,4-TMB, or 1,3,5-TMB have migrated via subsurface vapors from the Railyard Facility (where they have been detected in only 2 to 8% of onsite groundwater samples) to locations over 1500 feet away.

Scientific studies have established that VOC vapors in the unsaturated soil zone migrate only very limited distances from the associated source area (i.e., affected groundwater, soil, or free-phase material). Numerous laboratory studies, field studies, and model simulations have shown diffusion, rather than advection, to be the primary transport mechanism for VOC vapor migration in the unsaturated soil zone (Jellali et al., 2001; Jellali et al., 2003; Conant et al., 1996; Moldrup et al., 2003; Choi et al., 2002; Choi and Smith, 2005). As a result, VOC vapor concentrations in the vadose zone decrease exponentially with lateral distance from the source (Lowell and Eklund, 2004; Abreu and Johnson, 2005). For typical soil conditions, VOC vapor concentrations in the vadose zone will decrease by 90% for every 20 to 40 ft distance away from the affected soil, groundwater, or free-phase material source zone. For petroleum-related VOCs such as benzene and ethylbenzene, the decrease in concentration is even more rapid due to the effect of microbial biodegradation (Abreu and Johnson, 2006; DeVauil, 2007).

There is no documented case of vapor migration away from affected groundwater over the distance suggested by the DEQ. Rather, any impacts from the compounds benzene, ethylbenzene, vinyl chloride, 1,2,4-TMB, or 1,3,5-TMB, which occur only in onsite groundwater

(in a low percentage of samples), could reasonably be anticipated only within the near vicinity of the location where these compounds were detected in the groundwater.

Response: This comment cites EPA guidance to again state that DEQ's analysis is not sufficient. Please see DEQ's previous response to Comment #1 regarding the use of guidance and the use of empirical data.

DEQ is aware that there are limits to the distance vapors can travel in the subsurface. DEQ has not made the assertions the commenter claims. Please refer to previous DEQ comment responses regarding benzene and ethylbenzene. Please see DEQ's previous response to General Comment #6(a) regarding the retention of vinyl chloride as a COC. Please also refer to previous comments regarding other contaminated media in addition to contaminated groundwater.

The commenter also refers to the impossibility of 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform migrating via subsurface vapors to locations over 1,500 feet away. However, DEQ does not contend that this has occurred. Instead, as outlined in DEQ's previous response to General Comment #6(a), the commercial/industrial cleanup levels established for 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform only apply to mitigation of railyard structures where the sources of these contaminants exist. The cleanup levels for these COCs do not apply off of the railyard, so the issue of whether or not these COCs can migrate 1,500 feet is not relevant to the Risk Assessment Amendment.

Finally, this comment implies that DEQ has identified specific off-railyard locations where vapor intrusion of specific contaminants is occurring. DEQ has merely developed cleanup levels in the Risk Assessment Amendment, which as required by the SOW, must be developed "if screening levels are exceeded due to subsurface vapor intrusion from VOCs." (SOW at 23). DEQ has not yet made any decisions regarding vapor intrusion based upon the proposed or final cleanup levels. As stated previously, DEQ intends to use the cleanup levels along with other lines of evidence in its decision-making. As outlined in the SOW, DEQ will require indoor air mitigation for "all residences and businesses that have indoor air VOC concentrations from subsurface vapor intrusion above site-specific cleanup levels for indoor air...unless the VOCs in indoor air are not related to the Facility." (SOW at 23).

General Comment #6(e): Soil Gas and Subslab Vapor Data Show No Lateral Migration of VOC Vapors from the Railyard Facility. Consistent with scientific research at other sites, evaluation of the soil gas and subslab vapor data collected at numerous onsite and offsite locations demonstrates there to be no migration of VOC vapors from the railyard to offsite areas. Specifically, if such migration were occurring, then VOC concentrations in subsurface vapors beneath the railyard would be much higher than those in offsite locations, decreasing with greater distance from the railyard. However, no such pattern is observed for the proposed COCs benzene, ethylbenzene, vinyl chloride, chloroform, 1,2,4-TMB, or 1,3,5-TMB. (In fact, vinyl chloride has never been detected in any onsite or offsite soil gas or subslab vapor sample collected to date.)

As shown on Figures 1A and 1B, concentrations of benzene and ethylbenzene in soil gas and subslab vapor samples, respectively, show no relationship to distance from the railyard facility.

Rather, the range of concentrations detected onsite and offsite are the same, with no observable trend of decreasing concentration with distance from the site, and no increasing concentration trend onsite from the site perimeter inward. Plots of vinyl chloride, chloroform, 1,2,4-TMB, or 1,3,5-TMB show similar results. If the railyard and shops complex were sources of these VOCs in offsite soil vapor or subslab vapor samples, trends of decreasing concentration with distance from the source would be evident.

In contrast to benzene and ethylbenzene, a plot of PCE and TCE concentrations versus distance from the site boundaries shows a clearly decreasing trend in PCE concentration with distance from the site (see Figures 2A and 2B). Upper-bound onsite concentrations also generally increase with distance from the site perimeter inward (i.e., toward areas of higher groundwater concentration).

Maps of soil vapor and subslab vapor test results conducted in 1988 (ReTec, 1989) and 2007-08 (Kennedy/Jenks, 2009b) are consistent with the data plots discussed above, in that they show there to be no contiguous zones of elevated benzene or ethylbenzene concentrations emanating offsite from the railyard facility. Furthermore, all individual offsite locations with elevated concentrations of these constituents are isolated from one another, and from the railyard, by surrounding locations with significantly lower or nondetectable concentrations. In contrast, offsite soil vapor concentrations of PCE and TCE correlate with the offsite affected groundwater plume.

As observed in other scientific studies, these site-specific observations confirm that vapors do not migrate a significant distance from the affected groundwater zone. The spatial pattern of PCE in the soil gas does correlate with the affected groundwater plume, showing that compounds detected in the groundwater, such as PCE, are logically present in soil gas proximal to the plume due to diffusion effects. Compounds not detected in the groundwater plume (such as benzene and ethylbenzene) do not correlate with proximity to the affected groundwater. If benzene, ethylbenzene, chloroform, 1,2,4-TMB, or 1,3,5-TMB are indeed present in offsite soil vapors (and not an artifact of analytical variability), they cannot be a result of the affected groundwater plume from the railyard facility.

These compounds are all VOCs with similar chemical/physical properties. Therefore, it is not plausible that these similar compounds could migrate to offsite locations by totally different transport mechanisms, i.e., PCE (the more persistent compound) moving via groundwater migration and vapor diffusion, while benzene and ethylbenzene, supposedly move over the same distance via advective vapor flow. Rather, the data show that migration of dissolved VOCs within the affected groundwater plume is the only plausible mechanism for transport of these compounds from the railyard to offsite locations.

Vinyl chloride, which is a biodegradation product of PCE and TCE, could theoretically result from the breakdown of these compounds in the offsite groundwater plume. However, as shown on Table 2, vinyl chloride has never been detected in any of the over 255 soil gas and 418 subslab vapor samples collected to date at either onsite or offsite locations, showing that no such generation of vinyl chloride vapors is occurring.

Response: Please see DEQ's previous responses regarding benzene and ethylbenzene. Again, DEQ is not making the assertions the commenter attributes to it and this is evidenced by DEQ's response to General Comment #2 regarding how it has developed benzene and ethylbenzene cleanup levels. Please see DEQ's previous response to Comment #6(e) regarding the fact that the Risk Assessment Amendment provides the cleanup levels and does not provide decisions as to which structures will require indoor air mitigation. The commenter referenced Kennedy/Jenks 2009b (the 2008 Annual Monitoring and Maintenance Report) as containing maps related to vapor intrusion. The 2008 Annual Monitoring and Maintenance Report includes no such maps. (Kennedy/Jenks, 2009a).

The Task I Supplemental Investigation Report (Kennedy/Jenks 2009d) does include such maps. When DEQ reviewed the maps referenced by the commenter, DEQ found that the maps showed what one would expect, that there are multiple sources of benzene and ethylbenzene in Livingston, including the railyard. However, DEQ also found that benzene and ethylbenzene concentrations in subslab samples collected from railyard buildings were conspicuously absent from the figures. These data show that benzene and ethylbenzene have been detected beneath the railyard structures at concentrations greater than indoor air. In addition, the depiction of benzene and ethylbenzene non-detects on the figures is misleading. The figures do not adequately demonstrate that the detection limits for benzene and ethylbenzene in subsurface samples were $25 \mu\text{g}/\text{m}^3$ or higher for many subslab/soil gas samples collected by BNSF. (Kennedy/Jenks, 2009d; 2009f). Thus, it is not possible to determine whether these compounds are present in the subsurface at concentrations that could lead to vapor intrusion at many locations. In addition, this is a DRAFT Task I Supplemental Investigation Report submitted on behalf of BNSF that DEQ is in the process of reviewing, but that DEQ has already preliminarily evaluated the document and determined does not meet its requirements (i.e., it does not provide an appropriate calculation of cleanup levels as required by DEQ and therefore, DEQ calculated cleanup levels itself). Because of this, the conclusions within this draft document do not hold significant weight with DEQ. For these reasons, these figures do not provide an accurate portrayal of benzene and ethylbenzene in the subsurface at the Facility, and do not warrant a change to the Risk Assessment Amendment.

The commenter again questions whether 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform are present off-railyard. Please see DEQ's previous response to General Comment #6(a) explaining that the commercial/industrial cleanup levels established for 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform only apply to mitigation of railyard structures.

Finally, as the commenter acknowledges, vinyl chloride is a breakdown product of PCE and TCE. Please see DEQ's previous response to General Comment #6(a) regarding the retention of vinyl chloride as a COC.

General Comment #6(f): Offsite Subsurface Vapors Cannot be Associated with the Historical Groundwater Plume. In addition to there being no basis for offsite migration of the proposed COCs as a vapor phase, there is also no indication that these compounds could be present at offsite locations due to an historical affected groundwater plume that has now diminished to non-detectable levels. To the contrary, the groundwater monitoring data collected

over the time period of 1989 to the present show that benzene, ethylbenzene, vinyl chloride, 1,2,4-TMB, and 1,3,5-TMB have never been detected in offsite groundwater, and chloroform has been detected very infrequently and at low concentrations. If these compounds were present in offsite soil gas or slab vapor samples due to an historical groundwater plume, then detections of these compounds would have been more frequent in groundwater samples collected 20 years ago than today. However, this is not the case.

Furthermore, it is important to recognize that subsurface vapors cannot persist for extended time periods after the removal of the source medium (in this case, affected groundwater). Rather, diffusion and biodegradation effects result in relatively short half-lives for VOC vapors in the subsurface, particularly for the petroleum hydrocarbons (DeVaul, 2007). In addition, significant dilution of intruding subsurface vapors occurs in indoor air due to the common ventilation of indoor air spaces with fresh air. Indoor air exchange rates vary widely based on construction and ventilation, but, vapor intrusion guidance prepared for U.S. EPA for evaluation of subsurface vapor intrusion (EQM, 2003) recommends a default air exchange rate of 0.25-hr^{-1} (i.e., 6 times/day) as representative of the lower end of air exchange rate distributions published in the literature. Consequently, in order to cause detectable levels of a VOC in the indoor air space, the intruding subsurface vapor mass must be continually replenished representing a mass flux that cannot be sustained by soil vapor alone in the absence of a concentrated source mass, such as affected soil or groundwater. No affected soils or groundwater containing benzene, ethylbenzene, vinyl chloride, chloroform, 1,2,4-TMB, or 1,3,5-TMB associated with the railyard are present beneath the offsite locations.

Response: Please refer to previous DEQ responses to comments regarding benzene and ethylbenzene. The commenter again states that 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform have not been detected off-railyard in the soil or groundwater. Please see DEQ's previous response to General Comment #6(a) explaining that the commercial/industrial cleanup levels established for 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene and chloroform only apply to mitigation of railyard structures. In addition, BNSF has not collected soil samples from beneath offsite structures. Also, please see DEQ's previous response to General Comment #6(a) regarding vinyl chloride.

Additionally, BNSF does not sample groundwater in wells with evidence of petroleum contamination. (Kennedy/Jenks, 2006a, page 5-5). BNSF did not know it had petroleum contamination off the railyard until DEQ required that BNSF install additional wells in 2006 and none of the 2006 wells located offsite within the petroleum plume have ever been sampled for VOCs. (Kennedy/Jenks, 2009a, 2009c, 2009e).

General Comment #7: Building-Specific Risk Assessments. DEQ states that site-specific cleanup levels apply uniformly to all structures impacted by vapor intrusion. BNSF concurs with this statement based upon the understanding that the cleanup level established for indoor air COCs is a cumulative excess lifetime cancer risk (ELCR) criterion of 1×10^{-5} and/or a cumulative, non-carcinogenic hazard index (HI) for any exposure pathway, target organ, and exposure area of less than 1. The site-specific cleanup level for PCE developed in the SI Report is intended to be applied to all buildings where the indoor air COC concentrations are due to subsurface vapor intrusion (emphasis added). Furthermore, the risk calculation screening levels

(RCSLs) presented in the SI Report and the U.S. EPA Regional Screening Levels (RSLs) were applied to all buildings in calculating the risk estimates.

DEQ also states that building-specific risk assessment is not allowed for vapor intrusion due to the extreme variability inherent in this pathway and the number of factors influencing indoor air concentrations. BNSF disagrees. Building-specific risk assessment for vapor intrusion is especially appropriate because of the extreme variability in this pathway. Building-specific exposure point concentrations were used in the risk assessment, as indoor air concentrations likely will vary between buildings due to differences in foundation conditions and building construction as well as differences in subsurface concentrations. Both the U.S. EPA and ITRC vapor intrusion guidance documents recommend sampling and data evaluation on an individual building basis to assess the vapor intrusion pathway. Therefore, not considering building-specific differences in assessing risk is inconsistent with both U.S. EPA and ITRC guidance.

Response: The commenter references conclusions within a DRAFT Task I Supplemental Investigation Report submitted on behalf of BNSF that DEQ is in the process of reviewing but that DEQ has already preliminarily reviewed and determined does not meet its requirements (i.e., it does not provide an appropriate calculation of cleanup levels as required by DEQ and therefore, DEQ calculated cleanup levels itself). Because of this, the conclusions within this draft document do not hold significant weight with DEQ, and do not warrant a change to the Risk Assessment Amendment. The Report did not calculate appropriate cleanup levels as directed by DEQ that include all COCs for indoor air at the Facility.

DEQ concurs with the commenter that sampling buildings on an individual basis and evaluating this data on an individual basis is important to assess the vapor intrusion pathway. That is why DEQ has required the amount of sampling it has and why DEQ has relied upon empirical data in its decision-making rather than generic attenuation factors. However, the need for sampling individual buildings and evaluating the data individually, to determine among other things whether the VOCs in indoor air are related to the Facility, is significantly different from conducting building-specific risk assessments. Neither the ROD nor the SOW provides for building-specific risk assessments that might result in different cleanup levels for different buildings. Instead, the ROD and SOW provide for the calculation of site-specific cleanup levels that apply to all structures Facility-wide. (SOW at 21).

This comment cites ITRC and EPA guidance to again state that DEQ's analysis is not sufficient. Please see DEQ's previous response to Comment #1 regarding the use of guidance. However, the EPA and ITRC guidance indicate that building-specific data should be evaluated and DEQ has done that and will continue to evaluate building-specific data. They do not however, indicate that building-specific risk assessments should be conducted. In fact the ITRC guidance states "Despite the lack of verifying data, choosing to mitigate based upon exceeding generic screening levels may be acceptable as a proactive, protective measure." (ITRC, 2007). The guidance additionally states that "Due to the nature of the screening levels, an exceedance could simply be an indication that further site-specific evaluation is needed." (ITRC 2007). The development of site-specific cleanup levels based upon the COCs present at the Facility and the other multiple lines of evidence considered by DEQ is appropriately consistent with the EPA and ITRC guidance.

General Comment #8: Multiple Lines of Evidence. DEQ states that a multiple lines of evidence approach was used for decision-making related to indoor air contamination; however, no analysis of DEQ's multiple lines of evidence approach is provided. DEQ further states that all available evidence, including indoor air concentrations, subslab concentrations, soil gas probe data, ambient air concentrations, groundwater data, soil concentrations, and sampling results from nearby buildings, was used in the decision-making. However, DEQ then states that COCs were identified based only on detections in indoor air and soil gas samples from below the structures. It is not clear how the other data (e.g., groundwater, ambient air, and soil) were used in the identification of COCs.

Furthermore, DEQ did not use lines of evidence that are recommended by ITRC and U.S. EPA to assess the vapor intrusion pathway. Specifically, both U.S. EPA and ITRC recommend the use of constituent ratios (i.e., attenuation factors), as discussed in General Comment #2. ITRC also recommends the use of spatial correlation to assess whether indoor air concentrations are consistent with a groundwater plume or are more randomly distributed. Neither of these lines of evidence was discussed by DEQ in the Risk Assessment Amendment. In summary, DEQ needs to document how it has evaluated all available data, including ambient air data, soil gas data (vs. subslab), background data, radon data, chemical ratios, groundwater data, soil data, distribution of chemicals within each structure, distribution of chemicals in groundwater and soil gas relative to structures, or the frequency of detection of chemicals in groundwater and soil gas vs. indoor air. In this evaluation documentation, DEQ needs to describe how these data were incorporated into its conclusions regarding subsurface vapor intrusion for various VOCs.

Examples of how BNSF presented these evaluations in the SI Report are as follows:

- 76A (residential) - Ninety-nine (99) percent of the calculated 2×10^{-5} ELCR is attributable to PCE ($6.1 \mu\text{g}/\text{m}^3$ PCE detected). Background concentration – The measured ambient air PCE concentration on the day when the indoor air sample was collected at location 76A was $2.0 \mu\text{g}/\text{m}^3$. Building condition - The structure has a concrete floor plus a crawlspace. Subslab data - The reported subslab soil gas PCE concentration was $180 \mu\text{g}/\text{m}^3$. Spatial Distribution of PCE – The structure is located in an area underlain by groundwater containing PCE at detectable concentrations. Constituent ratios - The calculated soil gas-to-indoor air attenuation factor for PCE is 0.034 (based on measured soil gas and indoor air concentrations) compared to a calculated TCE attenuation factor of 0.0046 (or about an order-of-magnitude difference). Finding - The evidence suggests that a potential for subsurface PCE vapor intrusion reasonably exists; however, the data also indicate that an indoor source of PCE was present in the structure at the time the sample was collected. The indoor air PCE concentration has not been reproduced by re-sampling.
- 80 (residential) - Ninety-seven (97) percent of the calculated 2×10^{-5} ELCR is attributable to PCE ($6.4 \mu\text{g}/\text{m}^3$ PCE detected). Background concentration – The measured ambient air PCE concentration on the day when the indoor air sample was collected at location 80 was $0.82 \mu\text{g}/\text{m}^3$. Building condition - The structure is a mobile home on a concrete pad with a crawlspace. Subslab data – A crawlspace air grab sample contained a reported PCE concentration of $21 \mu\text{g}/\text{m}^3$. Spatial Distribution of PCE - The structure is located in an area

underlain by groundwater containing PCE at detectable concentrations. Constituent ratios The PCE attenuation factor from crawlspace air-to-indoor air (based on air sample from the crawl space and the living space) was 0.30 compared to a TCE crawlspace air-to-indoor air compared attenuation factor of 0.11. Finding – The evidence suggests that a potential for subsurface PCE vapor intrusion may exist; however, the data also indicate that an indoor source of PCE may have been present in the structure at the time the sample was collected. The indoor air PCE concentration has not been reproduced by re-sampling. (Note: This is now BNSF-owned and is no longer occupied.)

- 76C (residential) - Over 99 percent of the calculated 3×10^{-5} ELCR is attributable to PCE ($13 \mu\text{g}/\text{m}^3$ PCE detected). Background concentration - The measured ambient air PCE concentration on the day when the indoor air sample was collected at location 76C were non-detect and $0.91 \mu\text{g}/\text{m}^3$. Building condition – The structure is a mobile home with a crawlspace. Subslab data - PCE was not detected at a method reporting limit of $5 \mu\text{g}/\text{m}^3$ in a crawlspace air grab sample collected from a driven probe beneath the mobile home. Spatial Distribution of PCE - The structure is located in an area underlain by groundwater containing PCE at detectable concentrations. Constituent ratios - PCE was not detected in crawlspace air beneath the mobile home (at the method reporting limit of $5 \mu\text{g}/\text{m}^3$), but was detected in indoor air at an anomalous concentration of $13 \mu\text{g}/\text{m}^3$. No other constituents were detected in crawlspace air beneath the mobile home. Finding - The evidence suggests that a potential for subsurface PCE vapor intrusion may exist; however, the data also indicate that an indoor source of PCE was present in the structure at the time the sample was collected. The indoor air PCE concentration has not been reproduced by re-sampling.

- 138C (commercial/automotive repair shop) - One hundred (100) percent of the calculated 2×10^{-5} ELCR is attributable to PCE ($30 \mu\text{g}/\text{m}^3$ PCE detected). Background concentration - The measured ambient air PCE concentrations on the day when the indoor air sample was collected at location 138C ranged from non-detect to $0.53 \mu\text{g}/\text{m}^3$. The presence of products/materials containing PCE inside of the structure at the time of sampling is probable based on the nature of the activity inside of the structure. Building condition - The structure is a commercial building with slab-on-grade construction. Subslab data – The reported subslab soil gas PCE concentration was $23 \mu\text{g}/\text{m}^3$. The reported radon level in subslab soil gas was 476 picoCuries per liter (pCi/L). Spatial Distribution of PCE - The structure is located in an area underlain by groundwater containing PCE at detectable concentrations. Constituent ratios - The reported indoor air PCE concentration was $30 \mu\text{g}/\text{m}^3$, which is greater than the reported soil gas PCE concentration of $23 \mu\text{g}/\text{m}^3$. Application of the structure-specific radon attenuation factor of 0.0023 indicates that subslab soil gas concentration would not indicate that an indoor air PCE concentration above screening level would be present. Finding - The evidence suggests that a potential for subsurface PCE vapor intrusion reasonably exists; however, the data also indicate that an indoor source of PCE was present in the structure at the time the sample was collected. The indoor air PCE concentration has not been reproduced by re-sampling.

- 115 (commercial/automotive repair shop) - Ninety-nine (99) percent of the calculated 4×10^{-5} ELCR is attributable to PCE ($81 \mu\text{g}/\text{m}^3$ PCE detected). Background concentration - The measured ambient air PCE concentration on the day when the indoor air sample was

collected at location 115 was non-detect. The presence of products/materials containing PCE inside of the structure at the time of sampling is probable based on the nature of the activity inside of the structure. Building condition - The structure is a commercial building with slab-on-grade construction. Subslab data - The reported subslab soil gas PCE concentration was non-detect at a method reporting limit of $500 \mu\text{g}/\text{m}^3$. The reported radon level in subslab soil gas was 383 Ci/L. Spatial Distribution of PCE - The structure is located in an area underlain by groundwater containing PCE at detectable concentrations. Constituent ratios - An elevated soil gas method reporting limit of $500 \mu\text{g}/\text{m}^3$ for PCE was reported due to matrix interferences caused by the presence of petroleum vapors in the sample. Structure soil gas-to-indoor air factors of 0.015, 0.032, and 0.062 were calculated based on reported soil gas and indoor air sampling results for radon, benzene, and ethylbenzene, respectively. Using these attenuation factors to back-calculate the soil gas PCE concentration that would be required for subsurface vapor intrusion to account for the reported indoor air PCE concentration of $81 \mu\text{g}/\text{m}^3$ show that the soil gas PCE concentration would need to be in the range of 1,300 to $5,500 \mu\text{g}/\text{m}^3$. This concentration of PCE would have been detected in soil gas even at the elevated method reporting limit achieved following sample dilution for analysis. Further, none of the soil gas PCE concentrations detected in other soil gas samples collected from locations near this structure approached the $1,300 \mu\text{g}/\text{m}^3$ level. Finding - The evidence suggests that a potential for subsurface PCE vapor intrusion reasonably exists; however, the data also indicate that an indoor source of PCE was present in the structure at the time the sample was collected. The indoor air PCE concentration has not been reproduced by re-sampling.

Response: This comment does not address DEQ's proposed cleanup levels, and instead is related to DEQ's decision-making process for determining which properties require mitigation to address indoor air contamination from vapor intrusion. Please see DEQ's responses to previous comments as to the purpose of the Risk Assessment Amendment. BNSF is contesting DEQ's decision-making regarding indoor air mitigation in the U.S. District Court for the District of Montana, and this issue is not appropriately raised by commenting on the Risk Assessment Amendment. However, DEQ will again respond to the commenter regarding its decision-making process.

Three of the COCs for residential indoor air, PCE, TCE and vinyl chloride, were previously identified in the ROD and the SOW. For these COCs, the Risk Assessment Amendment is intended to simply determine cleanup levels. Please see Section 3.0 of the Risk Assessment Amendment, which explains DEQ's determination that subsurface benzene and ethylbenzene contamination is attributable to the Facility. Please also refer to DEQ's previous responses regarding COC selection.

Spatial correlation may be one line of evidence that can be used. DEQ has used this line of evidence in choosing structures to sample and in previous vapor intrusion decision-making based upon the site-specific screening levels. (DEQ has since retracted these decisions until the cleanup levels are final.) However, spatial correlations are confounded by the variability caused by building construction. (ITRC, 2007). The greatest source of variability in vapor intrusion is building construction. (ITRC, 2007; U.S. EPA 2009g). DEQ has found that in Livingston, the structures sampled for vapor intrusion include numerous types of construction (e.g., slab on

grade, basements, mobile homes, wood floors on grade, partial basements, full basements, homes with basements and crawlspaces, basements with concrete floors, basements with dirt floors, basements with wood floors, etc.). Thus, spatial correlation has only very limited utility as a line of evidence in Livingston and must be considered in conjunction with all of the other lines of evidence.

DEQ notes this comment regarding documenting its evaluation of available data, and has attached its December 2009 Draft Flowchart of DEQ Vapor Intrusion General Decision-Making Process to show how DEQ has and will make its decisions regarding vapor intrusion.

However, as DEQ has previously stated, radon attenuation data cannot be used in Livingston to predict how much PCE would be expected to be present in indoor air from vapor intrusion, and DEQ will not include radon data in its analysis. (DEQ, 2009e). DEQ has determined that in order to use radon as a tracer, a spatial analysis, paired with lithological analysis of the soil type, including porosity and moisture content, must be conducted. BNSF has not done this analysis. Also, ITRC states that “naturally occurring compounds (e.g., Rn-222) can be used **in some cases**” (emphasis added) but cautions that “the method assumes that the tracer and subsurface contaminants move into the building at the same rate.” (ITRC, 2007). BNSF has not demonstrated that there is any correlation between radon and PCE in Livingston. DEQ’s analysis of data received for Livingston indicates that no correlation exists. (Kennedy/Jenks, 2009d, 2009f; DEQ, 2009e). In addition, according to discussions with Ron Mosley, an EPA radon expert, the methods used by BNSF to collect the radon data may not be appropriate and the radon data may be questionable. (U.S. EPA, 2009g).

DEQ has reviewed the radon data presented by BNSF, and notes that the radon concentrations found in samples collected in 2006 were extremely variable. (Kennedy/Jenks, 2006b). In order to predict vapor intrusion, radon concentrations should be uniformly distributed, which is not what exists in Livingston. In Livingston, within less than 3,000 feet radon in soil gas varies from 39 picocuries per liter (pCi/L) to 1,189 pCi/L. (DEQ, 2009e, Figure 3).

BNSF has calculated radon attenuation factors for Livingston that range over three orders of magnitude. (Kennedy/Jenks, 2009d). For example, the radon attenuation factors for one building in Livingston differ from 0.0008 to 0.0023. (DEQ, 2009e, Figure 4). Therefore, if one were to use the samples from the center of the building to predict the radon inside another portion of the building, one would think that only 0.38 pCi/L radon would be present. However, the measured concentration of radon in that portion of the building was 1.1 pCi/L. It would not be protective of public health, safety and welfare for DEQ to potentially underestimate PCE concentrations by relying on highly variable radon data that have not been shown to correlate with PCE data at the Facility.

In at least one study, EPA has also indicated that more research is necessary before using radon data to calculate site-specific attenuation factors. A study conducted at the Raymark Superfund Site concluded: “[W]hen basement/sub-slab air concentration ratios were compared for radon and indicator VOCs, statistical non-equivalency occurred at three out of the four locations evaluated...Further research is needed at other sites containing indicator VOCs to determine the usefulness of radon in assessing vapor intrusion.” (U.S. EPA, 2006a).

Finally, DEQ notes the examples of how BNSF presented its evaluation of the data for locations 76A, 80, 76C, 138C and 115 in its DRAFT Task I Supplemental Investigation Report. However, this Responsiveness Summary is not intended to provide comments on this DRAFT Report; DEQ has already preliminarily reviewed it and determined that the Report does not meet its requirements (i.e., it does not provide an appropriate calculation of cleanup levels as required by DEQ and therefore, DEQ calculated cleanup levels itself). DEQ will provide comments on the DRAFT Report in a separate document at a later date. DEQ will also provide its own decisions regarding all the properties sampled between 2005 and 2009, including DEQ's rationale, under separate cover to BNSF and the property owners.

General Comment #9: Target Risk Level. The acceptable cumulative excess lifetime cancer risk (ELCR) criterion of 1×10^{-5} was established in the ROD and in Attachment 2 to the SOW. This criterion should be used as the basis of site-specific cleanup levels for chemicals in indoor air that are reasonably attributable to vapor intrusion by VOCs partitioning from groundwater. As discussed in the previous comments, when background sources and multiple lines of evidence, including attenuation factors and spatial correlation, are considered, PCE is the only chemical that may be attributable to vapor intrusion by VOCs partitioning from groundwater. Therefore, the site-specific cleanup level for PCE should be based on the ELCR criterion of 1×10^{-5} .

If other chemicals are found to be attributable to vapor intrusion by VOCs partitioning from groundwater in future investigations, site-specific cleanup levels would need to be developed such that the associated cumulative risk would not exceed 1×10^{-5} . However, the relative contributions of the other chemical(s) to the cumulative risk would need to be considered in developing the site-specific cleanup levels.

DEQ used the ELCR criterion of 1×10^{-5} and divided it by the number of COCs identified by DEQ to develop the site-specific cleanup levels in the Risk Assessment Amendment. This approach incorrectly apportions the majority of the acceptable ELCR criterion to COCs which are not significant for the subsurface vapor intrusion pathway and artificially reduces the level which should appropriately be assigned to PCE. As discussed in previous comments, BNSF disagrees with the COCs identified by DEQ, as the approach used by DEQ did not consider background sources or the multiple lines of evidence recommended by U.S. EPA and ITRC. Furthermore, the approach used by DEQ in developing the site-specific cleanup levels does not consider differences in contributions to the cumulative risk by the COCs. If additional COCs are identified through a multiple lines of evidence approach consistent with U.S. EPA and ITRC guidance, the site-specific cleanup levels should be developed based on the relative contributions of the COCs to the cumulative risk. Failure to limit the COCs used to develop risk-based cleanup levels to only the chemicals that can reasonably be attributed to subsurface vapor intrusion and then basing mitigation requirements on artificially reduced cleanup concentration levels will result in the installation and operation of mitigation systems where none are needed pursuant to the ROD and SOW ELCR and HI cleanup levels, and will unnecessarily disrupt activities in a structure and waste valuable resources. Further, mitigation systems designed to address subsurface vapor intrusion cannot be expected to change the VOC concentrations in indoor air that are attributable to aboveground sources.

DEQ also provides no guidelines for how their “cleanup levels” will be used or applied. By using the term "cleanup level" for its risk-based indoor air concentrations, DEQ implies that any location with a detected chemical concentration in indoor air exceeding its cleanup level would be mitigated. Such application may result in mitigation beyond that which required by Montana legislative directive (i.e., a cumulative ELCR of 1×10^{-5}). The DEQ cleanup levels for their five residential COCs (tetrachloroethene, trichloroethene, vinyl chloride, benzene, and ethylbenzene) are based on the 1×10^{-5} lifetime cancer risk value divided by 5 (i.e., 2×10^{-6} risk attributable to each chemical). Consider the following hypothetical scenario where PCE, TCE, benzene, and ethylbenzene are detected in indoor air. In this example, indoor air concentrations of PCE and benzene exceed their Montana DEQ-derived cleanup levels. However, the aggregate lifetime cancer risk from the four detected VOCs is less than 1×10^{-5} . In such a case, although the cleanup levels are exceeded by 2 chemicals, no mitigation would be necessary since the summed lifetime cancer risk is less than 1×10^{-5} . Thus, the arbitrary assignment of 1/5 of the acceptable risk to each chemical of concern will not necessarily result in mitigation that complies with the Montana legislative directive.

Hypothetical Example: Evaluation of Indoor Air Results

| Chemical | Detected Concentration in Indoor Air (ug/m³) | Montana DEQ cleanup level (ug/m³) | Indoor Air Concentration Exceeds Cleanup Level? | Calculated Indoor Air Cancer Risk |
|--|--|---|--|--|
| Tetrachloroethene | 1.76 | 0.88 | YES | 4.0E-6 |
| Trichloroethene | 0.26 | 2.6 | no | 2.0E-7 |
| Vinyl chloride | ND | 0.47 | no | ND |
| Benzene | 1 | 0.67 | YES | 3.0E-6 |
| Ethylbenzene | 0.8 | 2.1 | no | 7.6E-7 |
| Summed Theoretical Lifetime Cancer Risk | | | | 8.0E-6 |

Response: DEQ agrees with the commenter that for human health, the appropriate cleanup levels are calculated based on cumulative risk levels less than or equal to a total excess cancer risk of 1×10^{-5} for carcinogens. However, DEQ disagrees with the commenter that PCE is the only COC that requires a site-specific cleanup level. All COCs in the Risk Amendment have had exceedances of their relevant screening levels in indoor air attributable to subsurface contamination and thus must have a site-specific cleanup level. Please see DEQ’s previous response to General Comment #6(a) regarding the retention of vinyl chloride as a COC. Please see DEQ’s previous responses to comments regarding background sources of COCs, and DEQ’s handling of the cleanup levels for benzene and ethylbenzene. DEQ finds this comment confusing given that the commenter referred to relative concentrations of TCE and PCE from the subsurface regarding the specific structures listed in General Comment #8.

The commenter suggests that the relative contributions of the COCs be considered in vapor intrusion decision-making. DEQ has determined that it is not protective to do so in the manner suggested by the commenter. DEQ has analyzed the data and determined that spatial and

temporal variability require the conservative application of site-specific (by this DEQ means specific to the Facility, not each structure) cleanup levels. (Kennedy/Jenks, 2009d, 2009f). Multiple samples collected from the same structure at the same time and at different times have shown variable results. (Kennedy/Jenks, 2009d, 2009f). Therefore, risk calculations conducted at one time or on one sample may indicate that no unacceptable risk exists while another sample collected at the same time in a different location of the structure or at a different time may indicate that the risks are unacceptable. The different samples may also reflect different relative contributions of COCs. Therefore, DEQ will apply site-specific cleanup levels and use multiple lines of evidence described in previous comments and shown on the attached December 2009 Draft Flowchart of DEQ Vapor Intrusion General Decision-Making Process. This approach is consistent with DEQ's approach to addressing other property-specific cleanup determinations, such as residential yards. DEQ intends to use all the information available for each structure to ensure that the final cleanup levels will not result in the installation of mitigation systems to address above-ground sources of COCs, as required by the ROD and SOW.

This comment mistakenly suggests that the Risk Assessment Amendment should include an explanation of how DEQ intends to use the cleanup levels when there is no requirement or expectation that this information be included in the document. The SOW, a document negotiated by DEQ and BNSF, requires that the document establish the cleanup levels and provide a remedy for newly identified COCs for indoor air. DEQ has provided information regarding this issue in previous comment responses and in the attached flowchart. Additionally, the SOW states that "the ROD selected remedy requires all residences and businesses that have indoor air VOC concentrations from subsurface vapor intrusion above site-specific cleanup levels for indoor air to have a protection system installed at no cost to the owner, unless the VOCs in indoor air are not related to the Facility." (SOW at 23). DEQ will continue to comply with the SOW.

Specific Comment #1: Section 3.0 - Selection of COCs (second paragraph): Addendum No.2 to Final Task I Supplemental Investigation Work Plan for Indoor Air (Addendum No.2) is referenced in this section as a document prepared by Kennedy/Jenks Consultants. It is important to note that while Addendum No.2 was originally prepared by Kennedy/Jenks Consultants, it subsequently was reviewed and unilaterally modified by DEQ. Following unilateral modification, DEQ required that all of its modifications be incorporated into the document. Kennedy/Jenks Consultants explained to DEQ that a professional work product so modified no longer represents the professional work product of the originator, and DEQ acknowledged this understanding. Addendum No.2 was printed by Kennedy/Jenks Consultants as a DEQ work product and DEQ should be appropriately referenced as the author of this document.

Response: DEQ has revised the Final Risk Assessment Amendment to ensure that Addendum No. 2 is properly attributed to DEQ.

Specific Comment #2: Section 3.0 - Selection of COCs (fourth paragraph): DEQ states that "a multiple lines of evidence approach" has been used for "decision-making related to indoor air contamination." BNSF is unaware of the documentation of this evaluation and requests that the written documentation of DEQ's evaluation using a multiple lines of evidence approach be provided to the public for review. In contrast, Kennedy/Jenks Consultants presents and documents BNSF's evaluation of multiple lines of evidence in the SI Report, draws conclusions

based upon the weights of the evidence, and then formulates specific recommendations for action based upon the conclusions.

Response: As noted previously, DEQ has attached its December 2009 Draft Flowchart of DEQ Vapor Intrusion General Decision-Making Process. This document depicts DEQ's general decision-making process for vapor intrusion in indoor air. However, mitigation decisions have not been made in this Risk Assessment Amendment and, once decisions have been made, DEQ will provide the analysis and results to BNSF and the property owners. DEQ uses its scientific and technical expertise to make mitigation decisions for indoor air at the Facility that are in compliance with CECRA, the ROD and the SOW. DEQ is the regulatory agency tasked with protecting the public health and welfare of all Montana citizens against the dangers arising from releases of hazardous or deleterious substances, and as such, DEQ, not BNSF, is mandated with making the remedial action decisions for the Facility. Please refer to previous comment responses regarding DEQ's decision-making process and the status of BNSF's DRAFT Task I Supplemental Investigation Report.

Specific Comment #3: Section 3.0 - Selection of COCs (fourth paragraph): DEQ states that "DEQ identified the above COCs because they were detected in indoor air samples above the screening levels and detected at higher concentrations in soil gas samples collected from below the structures, thus indicating that these COCs were reasonably attributable to vapor intrusion by VOCs migrating from the subsurface." This overly simplistic conceptual basis for concluding that vapor intrusion is occurring at a significant level is shown to lead to incorrect conclusions by the multiple lines of evidence evaluations documented in the SI Report and the body of scientific literature available regarding interpretation of indoor air and soil gas sampling data for vapor intrusion investigations. Dawson and McAlary (2009) observe that "Indoor air quality typically contains chemicals from consumer products, building materials, and outdoor (ambient) air that may be detectable and may be present at levels that exceed health-based target concentrations. Any indoor air sample collected for assessment of subsurface vapor intrusion is likely to detect chemicals from these other sources, and in many cases, the compounds may be the same as the compounds present in soil or groundwater attributable to contaminated land" (emphasis added). DEQ has not documented any accounting for the presence of typical indoor air concentrations of common VOCs from non-vapor-intrusion-related sources, nor has it examined the normal distribution of such typical concentrations which are documented in the literature to span a range from non-detects to concentrations above risk-based target levels (i.e., the presence of detectable COC concentrations in indoor air in structures located near other structures with non-detects for the same COCs does not constitute conclusive evidence of subsurface vapor intrusion, but is to be expected and may merely be indicative of the normal statistical distribution, and variability, of typical indoor air VOC concentrations from common aboveground sources.) Further, it is unclear from its statement how DEQ has accounted for the overwhelming body of data that demonstrate substantial attenuation of VOC concentrations from soil gas to indoor air occurs.

Response: Please refer to previous comments regarding COCs selection, other sources of VOCs in indoor air, including the use of "appropriate methods" for determining whether indoor air contamination is attributable to vapor intrusion, and issues related to attenuation.

Specific Comment #4: Section 3.0 - Selection of COCs (footnote 1): DEQ should correct this footnote to acknowledge that DEQ has previously included a 0.02 attenuation factor for soil gas below structures in its work plans. As mentioned above, the work plan addenda that reference a 0.02 attenuation factor were DEQ work products. While the use of structure specific attenuation factors is appropriate, where available, generic factors are still useful in data evaluations to avoid incorrect conclusions. It is not clear where or how DEQ has considered the structure specific attenuation data that are available for the Facility.

Response: DEQ has revised footnote 1 accordingly. While DEQ did originally approve of BNSF's proposed attenuation factor of 0.02, DEQ notified BNSF verbally in 2008 and in writing in its March 10, 2009 letter that neither DEQ, nor the EPA, supported the use of that attenuation factor any longer. (DEQ, 2009c). The data collected in Livingston and across the country since January 2007, when the Task I Supplemental Investigation Work Plan Addendum No. 2 was approved, do not support the application of this factor. (Dawson, 2008). While DEQ had established this fact with BNSF's representatives in 2008, DEQ documented it in its March 10, 2009 letter to BNSF. In addition, DEQ has indicated on numerous occasions that it is not adequately protective of human health and that the data does not support applying structure specific attenuation factors in lieu of collecting empirical data and analyzing those data. Attenuation factors are a screening tool that is supplanted by real data. Please refer to DEQ's previous comment responses regarding the use of radon data at the Facility.

Specific Comment #5: Section 3.0 - Selection of COCs (sixth paragraph): DEQ states that samples from selected soil gas probes and the influent vapor stream bioventing samples show elevated concentrations of benzene and ethylbenzene. DEQ does not define what are considered to be elevated concentrations. Furthermore, these samples do not demonstrate that VOCs are partitioning from groundwater, as specified in the SOW.

Response: Comment noted. The data demonstrate that benzene and ethylbenzene contamination is present in many locations in the subsurface at the Facility, and DEQ has revised the Final Risk Assessment Amendment accordingly. Please refer to DEQ's previous comment responses, particularly its response to General Comment #2, regarding what the SOW states and DEQ's decisions regarding benzene and ethylbenzene.

Specific Comment #6: Section 4.0 - Exposure Assumptions (Second Paragraph): As noted above, there is no evidence that the offsite transport pathway described in this paragraph is completed for all of the COCs. This should be noted to avoid confusion and misinterpretation of the indoor air results.

Response: DEQ has revised this paragraph to reiterate that the Risk Assessment Amendment is not intended to be a determination as to whether COCs in any particular structure are related to the Facility, and to acknowledge that there are other potential sources of these COCs in indoor air. Please refer to DEQ's previous comment responses regarding COC selection, the requirements in the SOW for developing site-specific cleanup levels, and the fact that this document is not intended to make any mitigation decisions. In any future mitigation decisions, DEQ will ensure that it complies with the SOW's requirement that "the ROD selected remedy requires all residences and businesses that have indoor air VOC concentrations from subsurface

vapor intrusion above site-specific cleanup levels for indoor air to have a protection system installed at no cost to the owner, unless the VOCs in indoor air are not related to the Facility.” (SOW at 23).

Specific Comment #7: Section 4.1 - Exposure Assumptions for Residential Exposure to Indoor Air: The exposure duration is assumed to be 30 years. Since the ROD requires cleanup of the VOC-containing groundwater within a reasonable timeframe (i.e., 20 years) it is not clear whether or how DEQ has accounted for the inevitable reduction in potential subsurface vapor source concentrations that will occur over time. If the groundwater must be cleaned up under CECRA within 20 years and groundwater is the source of potential VOCs for subsurface vapor intrusion into indoor air (as stated in the SOW), then a 30 year exposure timeframe exceeds a reasonable maximum exposure duration.

Response: The ROD and the negotiated SOW, which BNSF agreed to follow, require that cleanup levels be established based upon a 30-year exposure duration. (SOW, Attachment 2). DEQ is required to comply with the SOW, and cannot revise the 30-year exposure assumption. In addition, BNSF has not yet completed the tasks required in the ROD and the SOW to demonstrate that it can clean up the VOC-containing groundwater within 20 years. In addition to the fact that BNSF has previously agreed to this exposure duration, the Facility has already been contaminated for well over 30 years and has been in the Superfund process for over 20 years.

Specific Comment #8: Section 4.2 - Exposure Assumptions for Commercial/ Industrial Workers Exposure to Indoor Air: The exposure duration is assumed to be 30 years at a given business, which DEQ states is typical for a railyard worker. However, this value is higher than U.S. EPA’s default value of 25 years. Railyard workers are not likely to be exposed to indoor air for the assumed exposure time and frequency (i.e., 8 hours per day for 250 days per year). Furthermore, assumptions for railyard workers are not applicable to other businesses. Finally, DEQ does not provide specifics regarding the number or content of the employee interviews used to establish a “typical” exposure scenario. BNSF disagrees that 30 years should be used to derive a cleanup level for generic commercial/industrial worker exposure or for onsite indoor air exposures.

Response: The ROD and the negotiated SOW that BNSF agreed to follow require that cleanup levels be established based upon a 30-year exposure duration. (SOW, Attachment 2). DEQ’s letter of February 6, 2009 indicates that railyard employee interviews fully support the 30-year exposure duration included in the 1993 CDM Baseline Risk Assessment and the SOW. (DEQ, 2009b). Moreover as stated in previous comment responses, the SOW provides that commercial/industrial cleanup levels only apply to structures located on railyard property. The SOW clearly states that “residential exposure assumptions, including a 24-hour exposure time...must be used for *all off-railyard property regardless of its current use.*” (SOW, Attachment 2, Section B). BNSF must meet the residential cleanup levels for all off-railyard properties, which it already agreed to do in the SOW.

Specific Comment #9: Section 6.0 - Derivation of Site-Specific Cleanup Levels for Indoor Air (second paragraph): DEQ states that the ROD and the SOW do not provide for the performance of building-specific risk assessments. However, the exposure assumptions included

in the SOW along with the data collected during the Supplemental Investigation provide the information needed to perform building-specific risk assessments. Furthermore, the Baseline Risk Assessment for the Facility (prepared by CDM on behalf of DEQ) includes building-specific risk assessments.

Response: The ROD and the negotiated SOW that BNSF agreed to follow provide only for the calculation of site-specific cleanup levels for the Facility, not for conducting building specific risk assessments. The provision of exposure parameters was necessary for DEQ to ensure that the cleanup levels were developed properly. BNSF failed to meet DEQ’s requirements and DEQ was required to use the parameters provided in the SOW to develop cleanup levels that met its requirements. The 1993 CDM Baseline Risk Assessment has been updated by Attachment 2 of the SOW. (SOW at 23). Please refer to previous comment responses that describe why building-specific risk assessments are not appropriate in this situation.

Specific Comment #10: Section 6.0 - Derivation of Site-Specific Cleanup Levels for Indoor Air (site-specific cleanup level table): DEQ has set cleanup levels for PCE, benzene, and ethylbenzene at or below typical background levels for residential indoor air. According to a recent summary by Dawson and McClary (2009) of North American residences and a study by Ward et al. (2009) of residences in Missoula, Montana (copy attached hereto), the DEQ has established cleanup levels for tetrachloroethene, benzene, and ethylbenzene at levels that are the same or lower than typical indoor air concentrations meaning that these cleanup limits will frequently be exceeded in indoor air even in the absence of vapor intrusion.

According to the review by Dawson and McClary of indoor air studies of residences unaffected by subsurface vapor intrusion conducted since 1990, cleanup levels of PCE, benzene, and ethylbenzene set by the DEQ exceed even the median (50th percentile) concentrations reported by Dawson and McClary. The statistical summary of studies conducted since 1990 prepared by Dawson and McClary are summarized in the table below.

Comparison of DEQ Cleanup Levels for Indoor Air to Typical Indoor Air Concentrations (Dawson and McClary, 2009)

| Chemical | *DEQ Cleanup Level | *Dawson and McClary (2009) Summary | | | | | | Maximum |
|-------------------|--------------------|------------------------------------|-----|-----|-----|-----|-----|---------|
| | | Number of Samples | 25% | 50% | 75% | 90% | 95% | |
| Tetrachloroethene | 0.88 | 2312 | <RL | 0.9 | 1.8 | 4.0 | 7.4 | 171.2 |
| Benzene | 0.67 | 2615 | 1.9 | 2.5 | 4.5 | 10 | 17 | 93 |
| Ethylbenzene | 2.1 | 1484 | 0.8 | 2.0 | 3.0 | 8.6 | 14 | 126 |

*Air concentrations in micrograms per cubic meter of indoor air
 <RL = less than reporting limit

In the case of benzene, the DEQ cleanup level is more than 3 times lower than the 50th percentile value for benzene from the Dawson and McClary summary. For tetrachloroethene and ethylbenzene, the DEQ cleanup levels are established at the 50th percentile for these chemicals in indoor air. The summary of Dawson and McClary (2009) indicates that the cleanup levels

established by DEQ would be exceeded in more than 50% of homes unaffected by vapor intrusion in North America.

Because the DEQ cleanup levels for tetrachloroethene, benzene, and ethylbenzene lie well within or even below the range of background concentrations presented in the Dawson and McClary (2009) summary, the likelihood is high that DEQ will require remediation of conditions that are generally typical of the average residence in North America.

This point is similarly illustrated by the recent results of Ward et al. (2009) study. Ward et al. sampled the indoor air of 35 residences in Missoula, Montana during 2004-2005 and 51 residences in 2005-2006. Ward et al. described the sampling locations in Missoula as a "semi-rural valley location located in the Northern Rocky Mountain/Western Montana region." A comparison of the indoor air results of Ward et al. to the DEQ cleanup levels for benzene and ethylbenzene is presented below. Ward et al. did not analyze air samples for tetrachloroethene.

Comparison of DEQ Cleanup Levels for Indoor Air to Typical Indoor Air Concentrations (Ward et al. 2009)

| Chemical | *DEQ Cleanup Level | *Ward et al. 2004/2005 Study Results (n = 35) | | *Ward et al. 2005/2006 Study Results (n = 51) | |
|--------------|--------------------|---|-------------------------|---|-------------------------|
| | | Indoor median | Indoor minimum, maximum | Indoor median | Indoor minimum, maximum |
| Benzene | 0.67 | 1.8 | <0.1, 34.3 | 1.2 | <0.1, 21.6 |
| Ethylbenzene | 2.1 | 2.0 | NR, 20.6 | 1.1 | |

*Air concentrations in micrograms per cubic meter of indoor air; in the Ward et al. 2009 article, the results for 2005/2006 are presented in units of nanograms per cubic meter; Ward indicated that this is an error and that the units should be micrograms per cubic meter.
NR = not reported

The study of Ward et al. confirms that even in "semi-rural" Montana, the DEQ cleanup level for benzene is well-above typical indoor air concentrations, even when compared to sampling results from recent years. Furthermore, the background concentrations of ethylbenzene are equal to or a substantial fraction of the DEQ cleanup level for ethylbenzene. This study confirms the results of Dawson and McClary, indicating that application of the DEQ cleanup levels established for benzene and ethylbenzene will likely result in a decision to mitigate typical ambient background concentrations of these chemicals.

Average levels of benzene and ethylbenzene detected in the indoor air of locations that DEQ indicates "mitigation is required" are not different from the locations that DEQ indicates that "no further action is required. In its December 18, 2008 letter, the DEQ indicated that 18 sampled locations required mitigation for vapor intrusion and that 32 locations for which air monitoring had been conducted required no further action. We have compared the results of benzene and ethylbenzene sampling conducted at these locations by selecting the maximum value in any room or area within the structure from the 2007 and 2008 sampling results. The maximum detected results for benzene and ethylbenzene in the "mitigation" locations and "no further action" locations are summarized in Tables 1 and 2, respectively.

We evaluated the results of these samples by comparing the "mitigation" and "no further action" locations and have summarized simple statistics for these locations in the table below.

| Chemical | *Locations DEQ identified for Mitigation | | | | *Locations DEQ Indicates No Further Action | | | |
|--------------|--|-----------------|--------|---------|--|-----------------|--------|---------|
| | Number of locations | Arithmetic mean | Median | Maximum | Number of locations | Arithmetic mean | Median | Maximum |
| Benzene | 18 | 2.20 | 1.5 | 10 | 29 | 2.48 | 1.3 | 13 |
| Ethylbenzene | 18 | 2.82 | 2.5 | 8.2 | 29 | 2.14 | 0.65 | 10 |

*Air concentrations in micrograms per cubic meter of indoor air

The above table indicates the similarity of the benzene and ethylbenzene concentrations in the "mitigation" versus the "no further action" locations. For example, the arithmetic mean concentration of benzene for the "mitigation" locations is 2.20 ug/m³ versus the mean concentration of benzene of 2.48 ug/m³ for the "no further action" locations.

Likewise, maximum detected concentrations of benzene and ethylbenzene were detected in the "no further action" properties. Further, if the DEQ cleanup level for benzene is applied to the "no further action" locations, 23 of 29 sampled locations (almost 80%) exceed the cleanup level. Approximately 60% of the "mitigation" locations have benzene concentrations that exceed the DEQ cleanup level.

This comparison indicates that as a group, the "mitigation" and "no further action" locations are not different with regard to the benzene and ethylbenzene in indoor air. Use of DEQ levels as a decision point to mitigate indoor air levels would require mitigation of homes for background levels of benzene and ethylbenzene in indoor air, including those locations that the DEQ has identified as requiring "no further action".

If retained, the proposed COCs not associated with the offsite groundwater plume would drive the vast majority of mitigation requirements. As shown on Table 2, benzene and ethylbenzene have been detected in indoor air at 100% and 94% of the over 284 offsite residential buildings sampled to date. The detection frequency of these two compounds is significantly greater than that of either PCE or TCE in indoor air, again showing benzene and ethylbenzene to be associated with indoor sources not subsurface groundwater impacts. However, as shown on Table 3, the proposed residential concentration limits proposed by DEQ for benzene (0.67 µg/m³) is exceeded in 86% of the residences tested to date (118 of 137 locations). Similarly, ethylbenzene has been reported above the proposed DEQ limit in 29% of the residences sampled (40 of 137). The proposed indoor air limits for PCE and TCE are exceeded in only 28% of the residences sampled to date (see Table 3), meaning that the proposed DEQ limits for benzene and ethylbenzene would drive response actions at an additional 59% of the locations (86 of 145 residences) where no plume constituents are present above the proposed limits in indoor air. This increased incidence of benzene and ethylbenzene exceedances in indoor air clearly reflects the impact of background indoor sources, not the groundwater plume. As a result, inclusion of benzene, ethylbenzene, and vinyl chloride as residential COCs for the offsite vapor intrusion investigation only serves to complicate and confuse efforts to identify and mitigate vapor intrusion actually associated with VOCs originating from the site.

For commercial/industrial facilities, benzene has been detected in indoor air above the proposed DEQ commercial/industrial (C/I) limit of $3.1 \mu\text{g}/\text{m}^3$ at 41% (20 of 34) offsite commercial locations tested, and ethylbenzene has been detected in indoor air above the proposed (C/I) limit of $7.3 \mu\text{g}/\text{m}^3$ at 48% (13 of 34) sites tested (see Table 4). At the 21 offsite commercial locations where benzene or ethylbenzene has been reported in indoor air above its respective proposed CII limit, PCE, the principal constituent of concern (COC) associated with groundwater beneath the facility, was either not detected or reported at concentrations below the proposed CII standard for PCE at 70% (15) of the sites - meaning that the proposed benzene limit would frequently trigger a response action even when the principal plume constituent is not present above its proposed limit in the indoor air.

Therefore, adaptation of the proposed standards for benzene and ethylbenzene would drive mitigation decisions based on indoor air concentration at a majority of both residential and commercial sites tested, irrespective of the presence or absence of VOCs associated with the railyard and shops complex (and irrespective of other evidence of vapor intrusion). However, these compounds are very clearly not associated with the affected groundwater plume offsite of the Livingston Railyard Facility, as discussed in detail above. Inclusion of COCs not associated with the affected groundwater plume but very commonly present in indoor air due to background sources places an undue burden on BNSF to repeatedly demonstrate that these compounds are not present as the result of vapor intrusion.

Response: DEQ reviewed sampling conducted in various areas of Montana, including Glendive, Basin, Bozeman, Helena, Wibaux, Winnett, Chinook, Molt, Condon and Missoula. (DEQ, 2009f). These data showed that indoor and outdoor air concentrations of benzene, ethylbenzene, PCE, and TCE in Montana are not as high as the North American data suggests. The data DEQ reviewed suggest that typical Montana indoor air concentrations are in the 50th percentile or less of the North American data. (See, e.g., DEQ, 2009e, Figure 2). Therefore, DEQ does not simply accept these data as typical for Montana but rather developed Livingston-specific concentrations using data from structures without subsurface contamination and excluding outliers caused by obvious indoor sources like smokers and combustion engines. As stated in previous comment responses, DEQ has also indicated how structures with obvious indoor sources will be evaluated.

DEQ reviewed the data collected by Dr. Ward and his students. (Ward, 2009a). DEQ found Dr. Ward's data to be consistent with that found in Livingston and elsewhere in Montana. The commenter incorrectly indicates that Dr. Ward did not analyze his samples for PCE. In fact, DEQ had a conversation with Dr. Ward on June 12, 2009 and Dr. Ward indicated that PCE was analyzed in the samples but was never detected. (Ward, 2009b). Therefore, Dr. Ward's data support DEQ's conclusions that typical PCE concentrations in Montana are much lower than the North American data suggest and that the final cleanup levels can be achieved without the confounding issue of "background." DEQ's previous comments indicate how the final cleanup levels for benzene and ethylbenzene address this issue of "background."

It is important to note that DEQ has not currently made any decisions regarding vapor intrusion based upon the proposed or final cleanup levels. As DEQ has indicated to BNSF, DEQ previously made some vapor intrusion decisions based upon PCE and TCE concentrations in

subsurface and indoor air compared to the site-specific screening levels BNSF developed for the SOW. The decisions DEQ previously made on the 18 properties described in the comment were based upon PCE and TCE, not benzene and ethylbenzene. DEQ has since retracted those decisions until the new cleanup levels are final. (DEQ, 2009c).

As stated in previous comments, DEQ intends to use the cleanup levels along with other lines of evidence in its decision-making. For example, if a building has an exceedance of the cleanup levels but indoor sources are identified on the questionnaire or the levels below the building are lower than indoor air or the contaminant ratios do not indicate that all contamination is attributable to subsurface or any other lines of evidence suggests that the contamination may not be related to the Facility, DEQ will verify the results and only require mitigation where it is appropriate. Please also refer to DEQ's responses to previous comments regarding these issues.

Please see previous comments regarding the use of industrial/commercial cleanup levels for railyard structures, and not off-railyard structures.

Specific Comment #11: Section 6.0 - Derivation of Site-Specific Cleanup Levels for Indoor Air (footnote 2): DEQ states:

"BNSF will only be allowed to employ commercial/industrial cleanup levels for rail yard structures if BNSF places institutional controls on the rail yard that limit future use to industrial/commercial."

Furthermore, the DEQ has stated that BNSF will not be allowed to use for commercial/industrial cleanup levels for non-rail yard properties, even those of a commercial/industrial type. For reasons described below it is inappropriate to use residential cleanup levels for structures on the BNSF property or commercial/industrial properties not on the rail yard property. In its land use memorandum, the U.S. EPA (U.S. EPA 1995) states that:

"For example, future industrial land use is likely to be a reasonable assumption where a site is currently used for industrial purposes, is located in an area where the surroundings are zoned for industrial use, and the comprehensive plan predicts the site will continue to be used for industrial purposes."

And

"In cases where the reasonably anticipated future land use is highly uncertain, a range of the reasonably likely future land uses should be considered in developing remedial action objectives."

The U.S.EPA indicates that the assumption of future industrial land use is "reasonable" when it is expected that such land use will continue. It is only when the anticipated future land use is "highly uncertain" that alternative land uses should be considered. Given BNSF's control of the Livingston Shop Complex Facility, it is certain that the rail yard will remain in its commercial/industrial state.

It is also inappropriate to require the same air cleanup levels for non-yard commercial/industrial properties as residential properties. Workers are assumed to be inside only 24% as much as

residents, indicating that higher cleanup levels in indoor air are justified for commercial/industrial properties.

Furthermore, in the unlikely event that an off rail yard commercial/industrial property is converted to residential use in the future, re-zoning and extensive building deconstruction, reconstruction and renovation (such as removing and adding walls, changes in heating and cooling systems, plumbing, underground utilities, removing or constructing parking lots, etc.) are almost always required before commercial/industrial space can meet residential building codes. Given the DEQ contention that indoor air results for a particular structure are inextricably linked to the type of structure and its construction, the indoor air results for a present commercial/industrial structure are unlikely to represent a hypothetical future residential structure that is substantially changed from the current commercial/industrial structure.

For the above reasons, the arbitrary application of residential air cleanup levels to commercial/industrial properties, when according to the DEQ, the property is used for residential purposes, is entirely hypothetical, technically unjustified, and unnecessary.

Response: Comment noted as to railyard structures. In this comment, the commenter also cites various guidance documents in support of its comment. Please see DEQ's previous response to General Comment #1 regarding DEQ's use of guidance. The negotiated SOW that BNSF agreed to follow states that commercial/industrial cleanup levels will only apply to structures located on railyard property. The SOW clearly states that "residential exposure assumptions, including a 24-hour exposure time...must be used for *all off-railyard property regardless of its current use.*" (SOW, Attachment 2, Section B). BNSF must meet the residential cleanup levels for all off-railyard properties, which it already agreed to do in the SOW.

Specific Comment #12: Section 6.0 - Evaluation of Cleanup Alternatives and DEQ-Approved Remedy for Newly Identified Contaminant of Concern (fourth paragraph): This paragraph should incorporate a discussion of the concept that time-weighted averaging of indoor air data collected at an exposure area (e.g., residential dwelling) is appropriate to evaluate the temporal fluctuations in indoor air concentrations that may occur over the longer-term exposure duration. The use of time-weighted averaging in the calculation of exposure point concentrations for use in the risk assessment and remedial action decision-making is consistent with the U.S. EPA (1989,1992) guidelines and is the appropriate method for calculating human health risks based on chronic, long-term exposures because it incorporates temporal and seasonal fluctuations in indoor air concentrations. As stated in U.S. EPA guidance (1989), it is not reasonable to assume long-term contact with the maximum concentration. Decisions to perform mitigation should be based on an evaluation of time-weighted averaged results from indoor air sampling. The DEQ has stated that it is not appropriate to use average values for evaluating risk from VOCs in indoor air, indicating that "statistically, the few samples collected from each property cannot be considered representative of the population as a whole." It is unclear what DEQ means by "the population as a whole". However, it is also clear that one value (i.e., the maximum detected concentration in indoor air) is even less representative of an exposure period of 30 years (as is assumed in the calculation of its cleanup levels) than would be the average of multiple samples from the same property.

The U.S. EPA has advocated the use of averaging when evaluating a home for mitigation of indoor air radon concerns. For example, the U.S. EPA has stated that for two sequential short term (48 hours or longer) radon tests, the home should be mitigated if the average of the two results exceeds 4 picocuries per liter (U.S. EPA, 2009c). Similar to VOCs, the risks of radon are primarily associated with long-term exposures to indoor air.

Response: In this comment, the commenter also cites various guidance documents in support of its comment. Please see DEQ's previous response to General Comment #1 regarding DEQ's use of guidance.

DEQ does not consider averages as exposure point concentrations for risk management decisions. The SOW provides as follows:

“If exposure point concentrations are calculated, they shall be calculated in accordance with guidance listed in Section 2.1; when fewer than 20 data points are available, discussions with DEQ will determine whether the data are adequate to calculate the UCL. Exposure point concentration calculations are appropriate only for evaluation of soils with regard to human health-based cleanup levels. In all deliverables under the SOW, analytical data shall be compared to ROD cleanup levels for the facility, (see Attachment 1).” (SOW at 56).

DEQ uses upper confidence limits on the mean for these decisions if the data set is large enough. The vapor intrusion data sets for all the off-railyard buildings and all but two of the railyard buildings are not large enough to perform these statistics. (Kennedy/Jenks, 2009d, 2009f). DEQ has determined that a conservative application of the site-specific cleanup levels along with a multiple lines of evidence evaluation will result in reasonable and protective decisions regarding vapor intrusion. Comparison of maximum concentrations in small indoor air data sets to cleanup levels for decision-making is consistent with the approaches defined by Colorado, California, New York, and the Department of Defense. (CDPHE, 2004; DTSC, 2004, 2008; NYSDOH, 2006; Department of Defense, 2009).

Specific Comment #13: It is more than curious that all these government sponsored “public meetings” occur right at the end of any comment periods.

Response: DEQ is unclear as to the commenter's concern. DEQ schedules meetings to allow time for the public to review the document while still allowing additional time to comment. In addition, they are scheduled based upon personnel and meeting facility availability. Printed notices of the public comment period were published in the Bozeman Daily Chronicle and the Livingston Enterprise, daily newspapers, and on DEQ's website. DEQ sent notice of the public comment period and meeting to the approximately 400 people on its mailing list for the Facility. DEQ also provided notice to the Associated Press for media distribution. In addition, DEQ provided a copy of the document to the Park County Environmental Council for their review.

Specific Comment #14: My first comment, based on your lack of comprehension for my question at your Thursday night presentation, is that a field of medical cause and effect called homeopathy (which has been a viable treatment protocol for otherwise undiagnosable disease since the early 1800's) has not been consulted or implemented by your people, to the benefit of

the people who live in areas that are contaminated by the BNSF spills. The theory of Homeopathy is that minuscule amounts of a substance can affect biological systems (humans) far more than large concentrations of the same substances. Until qualified practitioners of Homeopathy have been consulted on your project, you have no idea whether you are actually remediating the dangers of the railroad spills or not. If you fail to follow up on this comment, you may be responsible for untold health problems of an innocent community.

Response: All remedial actions performed under CECRA, including the development of site-specific cleanup levels, must comply with Section 75-10-721 of CECRA. DEQ is confident that the Risk Assessment Amendment complies with Section 721, and “attain[s] a degree of cleanup of the hazardous or deleterious substance and control of a threatened release or further release of that substance that assures protection of public health, safety, and welfare and of the environment.” DEQ and the Agency for Toxic Substances and Disease Registry (ATSDR) have conducted or are in the process of conducting appropriate human health evaluations for the Facility. Because low concentrations of contaminants can potentially cause adverse health effects, DEQ has set cleanup levels with units of micrograms per cubic meter and micrograms per liter, which DEQ has determined will protect human health.

Specific Comment #15: Second, there is an incredibly effective geopathic dowser in Bozeman named Verne Bandy (586-9635- 201 Acola Drive, 59715) who only charges \$50 per location to find, underground, whatever you are looking for. If he does not find what you are looking for, he does not charge. He used to dowse for oil for Montana Power Co from helicopters. He places a sample of what you are looking for in a capsule at the end of his rods and can find any amounts of what you seek from the surface. I have never seen him to be wrong in the last 30 years of my observations of him. He can easily find any stray pockets of contamination without ever scratching the surface of the ground. As I indicated to you in your “meeting”, because of the nature of floods and droughts and sites from which Livingston pumps well water and supplies groundwater from the Livingston ditch, it is entirely possible that there are several isolated pockets of contaminants as far away as Green Acres subdivision, which your expensive test well program has not discerned. It seems that if you really care about what you are attempting to do, in terms of health--not just spending--you would avail yourself of Mr. Bandy’s expertise before he dies and is no longer available.

Response: DEQ has required appropriate investigations into the nature and extent of contamination at the Facility and DEQ will continue to require appropriate remedial actions, including investigations. DEQ has determined that homeopathic dowsing is not necessary.

Specific Comment #16: Third, it appears that by setting your background collection instrument southeast of the high school, you inadvertently exposed it to all the exhaust fumes from the I- 90 Interstate a few hundred yards to the south. The fumes in this area would be heavier than other areas because of gear shifting on the hill the vehicles have to climb coming off of the river valley going up onto Harvat’s Flatts. Also, the heavy use of jake brakes coming down the hill would increase the unburned exhaust emitted in that area. You may have had other background recording stations to draw a mean from, but you did not state so.

Response: Numerous outdoor ambient air samples have been collected throughout Livingston and elsewhere in Montana. (Kennedy/Jenks, 2009d, 2009f; DEQ, 2009f). DEQ has reviewed the significant volume of data available and overall does not find that the results for the samples collected at the school differ significantly from the results for samples collected at locations further from I-90.

Specific Comment #17: Fourth, your avoiding comments about the synergistic effects of various combinations of pollutants indicates to me that your crew has a very shallow understanding of biological and physiological interactions, which you shine off as being based on what Californicators or biased NIH researchers feel.

Response: DEQ relies on its scientific and technical expertise and thorough, peer-reviewed, scientific research in determining appropriate toxicity values. DEQ has set conservative cleanup levels based upon these toxicity values and cumulative effects. DEQ is not aware of any research showing that the COCs at the Facility are not known to exhibit synergistic effects with combined exposure.

Specific Comment #18: I would like BN to clean up the site and also the surrounding areas in town and outside of town. I feel that the gas levels of harmful contaminants are not safe for humans. There are apparently accelerated numbers of Lupus in Livingston, also mental illness that may be attributed to those gases. Please keep me posted. I feel that BN has let the ball drop on this issue and is stalling—clean up needs to happen before 20 years have gone by. I dealt with this issue when my children were babies... carrying around my daughter when she was two years old and she is now 25 – we toured the MRL facility with Roy Korkolo.... For the DEQ to not have this reconciled and people compensated but most importantly the site not cleaned up is not appropriate – peoples’ health is at issue. The treatment needs to be conducted now – the tests should have been accomplished – too much time has elapsed for the DEQ to not have this issue under wraps. Clean up levels for VOCs should have been finalized years ago with all the test having been accomplished years ago ...I do not understand why you even have pathways considered and not evaluated when this issue has been ongoing. Please take immediate action and do not let BN steer away from the final consent decree that was issued with Gov. Stephens – how many years ago???

Response: Although DEQ does not believe that this comment relates directly to the Risk Assessment Amendment or the selection of new COCs, DEQ acknowledges the comment. DEQ is working to address these issues in a timely manner, and in compliance with CECRA, the ROD and the SOW.

Specific Comment #19: I support the clean up levels presented and the additional COCs that were added.

Response: Comment noted.

Specific Comment #20: I am concerned that the letter from ATSDR to Kennedy/Jenks, August 27, 2009, brings up a vague but sinister comment regarding public health protection activities regarding residential exposure. Below is the quote that I recommend be addressed by DEQ in

the above risk assessment or in a separate response as this paragraph implies that exposure or risk has changed but doesn't explain why. In our past dealings with ATSDR, I am not comfortable that the review will happen any time soon. I want to make sure that there isn't a hidden issue that will concern the community.

“A brief review of the data indicates the PCE and TCE levels are similar to those described in the 1997 Public Health Assessment. However, ATSDR's knowledge of, and concern for potential residential exposure to soil gas contaminants via soil vapor intrusion has grown since the release of that document. As a result, ATSDR will review the provided data to determine if additional public health assessment activities are necessary to protect public health”.

Response: DEQ believes that it has adequately addressed how it has considered additional information regarding contaminant toxicity and vapor intrusion that have come to light since ATSDR's 1997 evaluation. These developments have brought about the extensive vapor intrusion investigations required by DEQ and that were used in the development of the final cleanup levels. However, DEQ cannot speculate on what ATSDR intends by its statement or the outcome of ATSDR's evaluation that BNSF's representatives requested.

Specific Comment #21: I just got a “citizen call” asking if there was some way to better advertise the public meetings. She suggested radio and a mailing list.

Response: Printed notices of the public comment period were published in the Bozeman Daily Chronicle and the Livingston Enterprise, daily newspapers, and on DEQ's website. DEQ sent notice of the public comment period and meeting to the approximately 400 people on its mailing list for the Facility. Please notify project manager, Aimee Reynolds via email at areynolds@mt.gov, or mail at PO Box 200901, Helena, MT 59620-0901, or by telephone at 406-841-5065 if you would like to be added to the mailing list. DEQ also provided notice to the Associated Press and other state and local news organizations for media distribution. However, in order to ensure maximum public coverage in the future, DEQ will attempt to place public service announcements on the radio, distribute fact sheets/fliers to members and places in the community, place notice of the meeting on community calendar(s), purchase display ads, or other steps, when possible.

Specific Comment #22: How would DEQ handle a reading that came in just barely above the proposed levels, like 0.89Mg/m³ for PCE? Would you look at the accuracy of the measuring instrument?

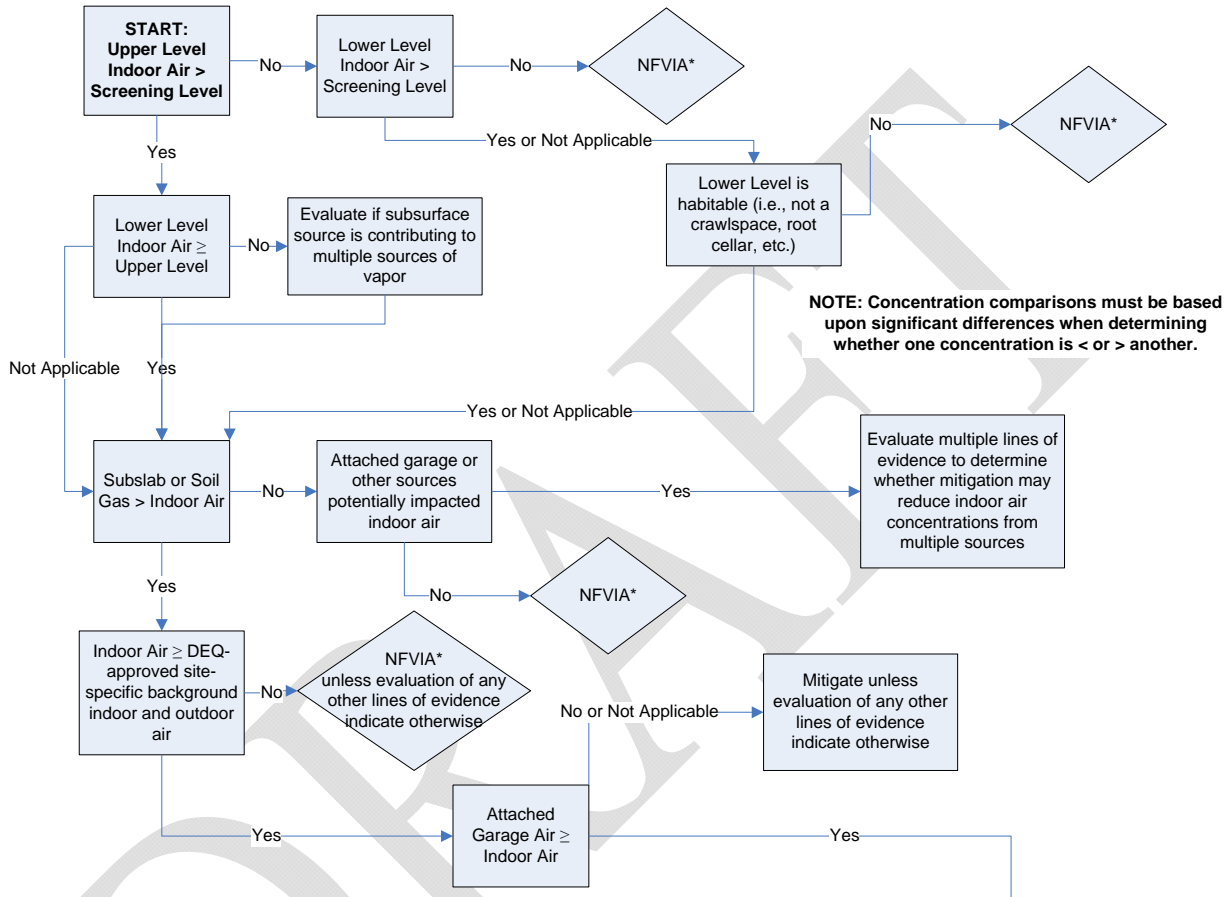
Response: Yes, as stated in DEQ's responses to previous comments, DEQ would look at multiple lines of evidence, including the accuracy of the instruments, in making vapor intrusion decisions. In the event the detection was very close to the final cleanup level, either just above it or just below it, DEQ would require resampling to verify the result and to verify whether the VOCs in indoor air are attributable to a subsurface source and related to the Facility.

Specific Comment #23: My only ‘need to improve’ comment relates to how poorly this meeting was publicized.

Response: Please see DEQ's previous response to Specific Comment # 21.

Second Round of Samples DEQ Vapor Intrusion General Decision-Making Process

12/8/09



NOTE: Concentration comparisons must be based upon significant differences when determining whether one concentration is < or > another.

Multiple Lines of Evidence:
At all times during the process, DEQ will consider multiple lines of evidence, including the following:

- Soil, groundwater, and soil gas concentrations with vertical profiling, if appropriate
- Proximity of structure to contaminated media
- Ratio of indoor air to substructure soil gas concentrations
- Whether samples were collected during worst case conditions
- The time required to remediate the Facility
- Whether the data suggests a significant source exists directly below the structure
- Building construction and current conditions
- The potential contribution of indoor sources
- The potential contribution of outdoor sources
- Building owner surveys
- Detection limit comparison to screening levels
- Constituent ratios in media
- Temporal variability
- Professional judgment
- Sampling results from nearby buildings

Note: Uncertainty will lead to conservative risk management decisions.

***All No Further Vapor Intrusion Action determinations must be based upon appropriate sampling methods and detection limits less than screening levels or as low as possible.**

ATTACHMENT 3
ADMINISTRATIVE RECORD

**ADMINISTRATIVE RECORD FOR FINAL TASK I RISK ASSESSMENT
AMENDMENT AND MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
APPROVED REMEDY FOR NEWLY IDENTIFIED CONTAMINANTS OF CONCERN
IN INDOOR AIR**

Introduction

The Risk Assessment Amendment and Montana Department of Environmental Quality Approved Remedy for Newly Identified Contaminants of Concern in Indoor Air is based on the administrative record, which are the documents DEQ cited, relied upon, or considered in developing this document. The administrative record was developed in accordance with Section 75-10-713, MCA, and is identified as Attachment 3 of the Risk Assessment Amendment. The complete administrative record is available for public review at the offices of DEQ, Remediation Division, located at 1100 North Last Chance Gulch in Helena, Montana. Portions of the administrative record are available at the Livingston Public Library in Livingston, Montana, and on DEQ's website at <http://www.deq.state.mt.us/StateSuperfund/BNLivingston.mcp#Documents>.

In addition, BNSF Railway Company (BNSF) cited certain references in its comments that it included on its secure "Livshare" website. DEQ has printed out these references and included them within the administrative record for the cleanup levels because documents on "Livshare" are not available to the public.

Administrative Record

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Exhibit L, CTEH *Risk Assessment and Site-Specific Action Levels for Residential and Commercial Properties*, April 23, 2009.

Exhibit M, GSI, *Evaluation of Technical Issues Related to Vapor Investigation and MDEQ Mitigation Requirements*, April 23, 2009.

Exhibit N, Kennedy/Jenks, *Analytical Results for Soil Gas, Flux Chamber, and Indoor Air Samples Collected 5 April 2006 to 8 April 2006*, May 9, 2006.

BNSF Railway Company, 2009b. Portions of correspondence from Allen Stegman, General Director Environmental, BNSF Railway Company, to DEQ, regarding the dispute resolution. May 26, 2009, including the following exhibits:

Exhibit P, Ambient Air and Indoor Air Background Studies.

Exhibit U, CTEH *Risk Assessment and Site-Specific Action Levels for Residential and Commercial Properties*, May 26, 2009.

Exhibit V, GSI, *Lines of Evidence for Evaluation of Vapor Intrusion Impacts: Application to Rail Yard and Shops Complex, Livingston, Montana*, May 26, 2009.

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Attachment 8, Ambient Air Sample Locations

Attachment 10, Summary of Indoor Air Concentrations Less than the Minimum Ambient Air Concentration in Ambient Air Samples Collected 2005, 2007, 2008

Attachment 11, Ambient Air Tetrachloroethene (PCE) Concentrations with Summary of Indoor Air Concentrations

Attachment 12, Indoor Air Tetrachloroethene (PCE) Concentrations

Attachment 13, Indoor Air Tetrachloroethene (PCE) Concentrations for Structures that May Require Mitigation

Attachment 14, Subslab Tetrachloroethene (PCE) Concentrations for Structures that May Require Mitigation

Attachment 15, Contaminants of Concern Indoor Air Concentrations for Structures Requiring No Further Action

Attachment 16, Structures Identified for No Further Action

Attachment 17, Structures Identified for Re-Sampling

Attachment 18, Structures that May Require Mitigation

Attachment 19, Structures that May Require Mitigation; with Tetrachloroethene Concentrations

Attachment 22, Contaminants of Concern Indoor Air Concentrations for Structures Requiring Re-Sampling

Attachment 23, Contaminants of Concern Indoor Air Concentrations for Structures that May Require Mitigation

Attachment 24, Benzene and Ethylbenzene Concentrations in Soil Gas Within and Surrounding the Livingston Rail Yard

Attachment 25, Benzene and Ethylbenzene Concentrations in Influent Vapor Stream to Task D/E Free Product Recovery and Petroleum Contaminated Subsurface Soil Remediation System.

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Figure 1: Contamination at 1221 E. Gallatin Street

Figure 2: Indoor Air Results for Structures With and Without PCE Detected in the Subsurface

Figure 3: Radon Concentrations in Soil Gas at Livingston

Figure 4: Radon Attenuation Factors of Three Businesses in One Building

Table 1: Examples of Consumer Products Containing PCE and TCE Found in Typical Montana Stores

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Data collected by Terracon in January and April 2007 for the Cenex Bulk Plant facility (contained within DEQ Petroleum Technical Section file, identification number 48-13552, release number 3634).

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Four indoor air samples collected by Olympus Technical Services on March 15, 2009 for Basin Grade School; three additional indoor and one outdoor sample collected by DEQ on April 13, 2009 (contained within DEQ Petroleum Technical Section file, facility identification number 22-13128, release 4715).

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