**ATTACHMENT 1**

# Final Screening Level Risk Assessment for the LOP Properties, LLC Edison Building 933 South Edison Street, Salt Lake City, Utah

**Final Screening Level Risk Assessment for the**
**LOP Properties, LLC Edison Building**
**933 South Edison Street, Salt Lake City, Utah**

**Preface**

This risk assessment has been developed in response to Division of Waste Management and Radiation Control (DWMRC) comments on the Site Management Plan (SMP) for the Edison Building located at 933 South Edison Street in Salt Lake City, Utah. The following risk assessment comments were received concerning risk assessment issues.

- This section needs to address potential risk by identifying COCs recently detected in groundwater, sub-slab, and indoor air samples obtained with Division oversight. Consider using and condensing some narrative from the Facility Background section by identifying critical COCs, by media, and then list the sample concentrations in an accompanying table.

  *Concur. This attachment has been developed to address contaminants of concern (COCs) detected in all media, to include groundwater, sub-slab soil gas, bulk soil, and indoor air. Tables summarizing the data by media are included in this attachment.*

- Expand upon the COCs to discuss potential risks, and please note, risk is evaluated without institutional controls. The narrative need to correlate risks by discussing the COCs detected in the various media, and discuss the potential exposure routes (i.e., ingestion and inhalation).

  *Concur. Residential, industrial and construction worker risks have been quantitatively evaluated in this attachment. The assessment includes narratives discussing impacted media, exposure routes/pathways for all COCs, and all assumptions.*

- Although no formal risk assessment was conducted, this section needs to formulate the potential risks. The VISL calculator can be used to determine risk for each COC and added to obtain a calculated sum. Now summarize by specifying that these risks will be mitigated by institutional controls identified in the SMP (vapor extraction, GW use limitations, etc.). Once the risks (both industrial and residential) have been clarified, then this provides the justification for the Divisions' "request" for controls. The SMP documents that the recent indoor air sample did not exceed industrial risk levels, it should also document that the residential risk levels were exceeded since the SMP makes assessments regarding residential risks.

  *Concur. This attachment includes a quantitative analysis of risk for each complete exposure pathway along with cumulative risks for each identified receptor. The cumulative risk estimates are used to support a request for controls for future land use and development. In addition, an ecological assessment has been provided demonstrating no adverse ecological impact.*

- Note: The Division previously clarified that the recent single indoor air sample was not sufficient evidence for your conclusion regarding current risks with regards to indoor air. This position is further supported by the historical data which documented that both industrial and residential indoor air was exceeded with two (2) samples collected by Partner (which is also noted as omitted in the SMP's data). We also add that two indoor air sample rounds are insufficient to establish a decreasing trend, which is a conclusion in the SMP that the Division does not support. As we have previously stated, the potential of vapor intrusion needs to be addressed by using multiple lines of

evidence. The potential site risks need to incorporate data from groundwater, sub-slab, and indoor air samples. There are potential risks at the site which need to be clearly defined in the SMP. The proposed controls will be evaluated once we feel they are sufficiently outlined.
*Concur. In addition to calculation of risk via the vapor intrusion pathway, all potential media have been included in this evaluation. Use of the indoor air data were not included in the analysis, as one to two data points collected years apart are not sufficient to define trends and seasonal fluctuations in indoor air. Further, it is agreed that risk-based decisions can not be made using a data from the most recent sampling event. The attached discussion the indoor air results in further detail.*

**Human Health Risk Assessment**

In accordance with Utah Administrative Code (UAC) R315-101, to determine if site management options are warranted, a human health risk assessment must be conducted using standard exposure scenarios. For the residential exposure scenario, evaluation must include ingestion of groundwater (regardless of water quality), ingestion of soil and dust, and inhalation of contaminants via other transport mechanisms, such as the vapor intrusion pathway. In addition, actual land use conditions or potential land use conditions based upon applicable zoning and future land use planning considerations must also be evaluated assuming that contaminated media will not have undergone any remedial engineering.

The following assumptions were applied in this risk assessment.

Methodology

- The risk assessment was conducted in accordance with U.S. Environmental Protection Agency (USEPA) and DWMRC guidance and assumptions. For purposes of risk, the May 2020 Regional Screening Levels (RSLs) (https://www.epa.gov/risk/regional-screening-levels-rsls) were applied along with 2020 USEPA Vapor Intrusion Screening Levels (VISLs). VISLs were derived using the on-line VISL calculator (https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-level-calculator).

- To evaluate all potential current and future land uses, three receptors were identified for this risk evaluation: a resident, an indoor/industrial worker, and an outdoor construction worker.

- The residential RSLs and VISLs were applied for the residential scenario. For the indoor industrial worker, the industrial RSLs and VISLs were applied. For the construction worker, the RSL on-line calculator for a construction scenario was used, applying all default input parameters. [note: the 2020 RSL for naphthalene has been updated to include oral toxicity.]

- Cancer risk and noncancer risks were calculated following USEPA and DWMRC guidance. Individual and total cancer risks were determined using the approach listed in Equation 1. Hazard quotients and hazard indices were calculated using Equation 2.

**Equation 1. Cumulative Risk for Carcinogenic COPCs**

$$Cumulative\ Risk = \left[\left(\frac{C\_1}{RSL_1 or\ VISL_1}\right) + \left(\frac{C\_2}{RSL_2 or\ VISL_2}\right) + \cdots + \left(\frac{C\_i}{RSL_i or\ VISL_i}\right)\right] \times (TR)$$

| Parameter | Definition (units) |
|---|---|
| Cumulative Risk | Sum of individual constituents' risks (unitless; expressed as incremental probability of developing cancer over a lifetime) |
| $C_{\_1,2...i}$ | Maximum detected concentration or 95UCL for constituents 1 through *i* [mg/kg for soil [0-10 ft bgs] or (µg/m$^3$) for soil gas] |
| $RSL_{1,2...i}$ | US EPA RSL for constituents 1 through *i* (carcinogenic endpoint) (mg/kg for soil) |
| $VISL_{1,2...i}$ | US EPA VISL for constituents 1 through *i* (carcinogenic endpoint) (µg/m$^3$) |
| TR | DWMRC target risk level (1 x $10^{-6}$) (unitless; incremental probability) |
| mg/kg – milligrams per kilogram<br>µg/m$^3$ – micrograms per cubic meter | |

**Equation 2. Hazard Index for Noncarcinogenic COPCs**

$$HI = [(HQ_1) + (HQ_2) + \cdots + (HQ_i)] \times THQ$$

$$HQ_{1,2...i} = \frac{C}{RSL\ or\ VISL}$$

| Parameter | Definition (units) |
|---|---|
| HI | Hazard index; sum of HQs (unitless) |
| $HQ_{1,2...i}$ | Hazard quotient (unitless) |
| THQ | DWMRC Target hazard quotient (1.0) (unitless) |
| C | Maximum detected concentration or 95UCL for constituents 1 through *i* [mg/kg for soil [0-10 ft bgs] or (µg/m$^3$) for soil gas] |
| RSL | US EPA RSL (noncarcinogenic endpoint) (mg/kg for soil), based on target level of 1.0 |
| $VISL_{1,2...i}$ | US EPA VISL for constituents 1 through *i* (noncarcinogenic endpoint) (µg/m$^3$) |

- The total risk and hazard (cumulative risk) for each receptor was determined by summing the risks across each complete exposure pathway.

<u>Contaminants of Potential Concern (COPCs)</u>

- Contamination at the site consists of volatile organic compounds (VOCs). All VOCs detected at least once in each medium were retained as a contaminants of potential concern (COPC) for the risk evaluation.

- The maximum detected concentration for all COPCs was initially as the exposure point concentration (EPC).

Exposure

- Media of concern include bulk soil and groundwater resulting in the following exposure pathways being present: direct ingestion, inhalation, and dermal contact with soil, ingestion of groundwater, and inhalation of vapors migrating from groundwater and soil.
    - For the soil exposure intervals, data from 0-10 feet below ground surface (ft bgs) were used for the resident and construction worker; 0-1 ft bgs was applied for the indoor worker. As all contamination at the site is subsurface contamination, below a depth of four ft bgs, the soil exposure pathway for the indoor industrial worker was deemed incomplete.
    - While unlikely, potential ingestion of groundwater was evaluated for the hypothetical resident.
    - Potential ingestion of groundwater for an indoor industrial worker was deemed incomplete. The site is within a highly developed urban zone. It is assumed that culinary water will be provided to any structures erected on the site.
    - Vapor intrusion was assessed and discussed for each of these three mechanisms:
        - Evaluation of the potential for VOCs in groundwater to volatilize and migrate vertically into indoor air; assessment included utilization of the USEPA VISLs for groundwater;
        - Evaluation of the sub-slab soil gas data and application of the USEPA VISLs for sub-slab soil gas; and
        - Evaluation of the indoor air data.
    - For the indoor air data, samples were collected once in 2016 and once in 2019. The 2019 data consists of only a single indoor air sample. Use of one sample is not sufficient to characterize any trends in concentrations, account for seasonal fluctuations or to assess an exposure route in a risk assessment. As sufficient data are available for both groundwater and sub-slab soil gas to assess the vapor intrusion pathway, these data were used in the risk assessment in lieu of the indoor air sample.
    - For determining risk via the vapor intrusion pathway, exposure from both vapor migrating from groundwater and from the sub-slab soil gas were calculated. In looking at the bulk soil data, the detections of VOCs are variable with no discernable pattern. Further, the concentrations of VOCs decrease with depth. While VOCs in soil may be contribute to vapor intrusion, the predominant source of VOCs is groundwater. Comparison of risks from the sub-slab data and groundwater data were conducted to evaluate which data provided a better prediction of indoor air concentrations; for cumulative risk, the more conservative estimate of risk was applied.

- In order to comply with R315-101 principles of non-degradation, the maximum detected concentration was compared to the May 2020 RSL soil-to-groundwater screening level (SSL), adjusted to a dilution attenuation factor (DAF) of 20.

Data

Two sampling events have been conducted to define the nature and extent of contamination in bulk soil. The first event, conducted in 2014, consisted of three boreholes (BH-1 through BH-3). Sample depths included aliquots from 9.5, 18, and 20 feet below ground surface (ft bgs). The second event conducted in 2016 included seven subsurface sample locations, SB-1 through SB-7. The depth of the 2016 samples ranged from four to 12 ft bgs. These historical data are summarized in detail in Table 1 of the main text of the SMP.

As noted above, the soil exposure interval is complete for only the residential and construction worker. Soil data from the historical data representing 0-10 ft bgs are provided in Table 1 below.

**Table 1. Bulk Soil Data for the Residential and Construction Worker Scenarios**

| COPC | BH-3 @9.5' | SB-1 @10' | SB-3 @10' | SB-4 @10' | SB-5 @4.5 | SB-6 @9-10 |
|---|---|---|---|---|---|---|
| TPH-GRO (Low Fractionation) | NA | 90 | 190 | 160 | ND | 628 |
| TPH-DRO (High Fractionation) | NA | 3600 | 230 | 4.3 | ND | 293 |
| Tetrachloroethene (PCE) | ND | ND | ND | ND | 0.0394 | ND |
| Acetone | ND | 0.041 | ND | ND | ND | 1.18 |
| Benzene | 0.015 | 0.025 | ND | ND | 0.0138 | ND |
| n-Butylbenzene | 0.03 | 0.35 | 0.54 | ND | ND | 1.19 |
| sec-Butylbenzene | 0.015 | ND | ND | ND | ND | 0.978 |
| tert-Butylbenzene | ND | ND | ND | ND | ND | 0.244 |
| Chlorobenzene | ND | ND | ND | ND | ND | 0.143 |
| Ethylbenzene | ND | ND | ND | ND | 0.0025 | ND |
| Isopropylbenzene | ND | 0.67 | ND | ND | ND | 1.08 |
| p-Isopropyltoluene | ND | ND | ND | ND | ND | 0.158 |
| n-Propylbenzene | ND | 2.9 | ND | 0.39 | ND | 1.76 |
| Methylcyclohexane | NA | 1.5 | 3.6 | 2 | ND | ND |
| Napthalene | ND | 0.13 | 0.41 | 0.3 | ND | 2.05 |
| Toluene | ND | ND | ND | ND | 0.0142 | ND |
| Xylenes, Total | ND | ND | ND | ND | 0.00531 | ND |
| | | | | | | |
| Notes: | | | | | | |
| Data in units of milligrams per kilogram (mg/kg) | | | | | | |
| NA - Not analyzed | | | | | | |
| NA - Nondetected | | | | | | |

Groundwater data from the most current sampling event (December 2019) were applied for assessing both direct ingestion of groundwater and migration of vapors from groundwater into indoor air. Data from monitoring wells MW-1 through MW-5 were applied as summarized in Table 2.

**Table 2. Groundwater Data for the Residential and Indoor Industrial Scenarios**

| | MW-1 | MW-2 | MW-3 | MW-4 | MW-5 |
|---|---|---|---|---|---|
| Tetrachloroethene (PCE) | ND | ND | 228 | ND | 4.52 |
| Trichloroethene (TCE) | ND | ND | 54.9 | ND | 22.6 |
| 1,1-Dichloroethene (DCE) | ND | ND | ND | ND | ND |
| *cis* -1,2-Dichloroethene | 19.6 | 72.7 | 39.5 | ND | 17.7 |
| *trans* -1,2-Dichloroethene | ND | 3.42 | ND | ND | ND |
| Vinyl chloride | 2.84 | 22.3 | ND | ND | ND |
| 1,1,2-Trichloroethane | ND | ND | ND | ND | ND |
| Acetone | ND | 64.3 | ND | 135 | ND |
| 2-Butanone | ND | ND | ND | ND | ND |
| n-Butylbenezene | NA | NA | NA | NA | NA |
| sec-Butylbenzene | NA | NA | NA | NA | NA |
| tert-Butylbenzene | NA | NA | NA | NA | NA |
| Carbon Disulfide | ND | ND | ND | ND | ND |
| Cyclohexane | 6.09 | 54.3 | ND | 149 | ND |
| 2-Hexanone | ND | ND | ND | ND | ND |
| Methylcyclohexane | ND | 10.9 | ND | 274 | ND |
| Isopropylbenzene | ND | ND | ND | 15.6 | ND |
| p-Isopropyltoluene | NA | NA | NA | NA | NA |
| n-Propylbenzene | NA | NA | NA | NA | NA |
| 1,2,4-Trimethylbenzene | NA | NA | NA | NA | NA |
| 1,3,5-Trimethylbenzene | NA | NA | NA | NA | NA |
| Benzene | 6.55 | 12.9 | ND | ND | ND |
| Toluene | ND | ND | ND | ND | ND |
| m,p-Xylenes | ND | ND | ND | ND | ND |
| o-Xylenes | ND | ND | ND | ND | ND |
| Naphthalene | ND | ND | ND | 7.51 | ND |
| Ethylbenzene | ND | ND | ND | 5.18 | ND |
| TPH-GRO | NA | NA | NA | NA | NA |
| TPH-DRO | NA | NA | NA | NA | NA |
| | | | | | |
| Notes: | | | | | |
| Data in units of µg/L, micrograms per Liter | | | | | |
| NA - not analyzed | | | | | |
| ND - non detected | | | | | |

Soil gas samples were collected in 2016 and 2019/2020. Only the most current data were applied for the risk assessment. The 2019/2020 data were collected from 16 sample locations. The data are summarized in Table 3.

**Table 3. Sub-Slab Soil Gas Data for the Residential and Indoor Industrial Scenarios**

| | Sub-1 | Sub-2 | Sub-3 | Sub-4 | Sub-5 | Sub-6 | Sub-7 | Sub-8 | Sub-9 | Sub-10 | Sub-11 | Sub-12 | Sub-13 | Sub-14 | Sub-15 | Sub-16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ND | 0.749 | 7.640 | 14.800 | 5.270 | 7.930 | 2.100 | ND | ND | ND | 0.523 | ND | ND | ND | ND | ND |
| 1,1,1-Trichloroethane | ND | ND | ND | ND | 0.198 | ND | ND | 0.266 | 20.100 | 1.490 | 0.385 | ND | ND | ND | 0.168 | 0.226 |
| 1,1-Dichloroethane | ND | ND | ND | ND | ND | ND | ND | ND | 2.190 | ND | ND | ND | ND | ND | ND | ND |
| 1,1-Dichloroethene | 0.859 | 0.913 | 14.800 | 22.000 | 6.780 | ND | 6.300 | 1.260 | 17.200 | 5.730 | 2.850 | ND | 0.458 | ND | ND | ND |
| 1,2,4-Trimethylbenzene | 0.770 | 1.900 | 0.205 | 4.670 | 0.180 | ND | 1.470 | 3.070 | 35.200 | 2.360 | 1.390 | 54.400 | 0.134 | 0.364 | 31.500 | 2.840 |
| 1,2-Dichloroethane | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 2.880 | ND | ND | ND | ND |
| 1,3,5-Trimethylbenzene | 0.338 | 0.475 | ND | 1.480 | 0.229 | ND | 1.320 | 0.901 | 9.520 | 0.941 | 1.420 | 27.000 | 0.132 | 0.183 | 39.300 | 2.370 |
| 2-Methylnaphthalene | 0.189 | 0.433 | ND | 8.900 | 0.427 | 0.217 | 0.413 | 0.167 | 0.151 | ND | 0.137 | 3.200 | ND | 0.450 | 2.570 | 0.448 |
| Benzene | 0.766 | 0.551 | 1.070 | 1.850 | 1.130 | 0.229 | 1.470 | 0.485 | 1.610 | 2.800 | 2.310 | 9.430 | 0.417 | 0.667 | 0.202 | 0.571 |
| 1,2-Dichlorobenzene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 1,4-Dichlorobenzene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Methyl Tert-butyl Ether | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Chloroform | ND | ND | 1.550 | 4.320 | 1.470 | ND | ND | ND | 5.230 | 1.020 | 0.765 | ND | ND | ND | 3.500 | 2.950 |
| cis-1,2-Dichloroethene | 6.590 | 3.430 | 6.910 | 17.800 | 2.780 | ND | 6.250 | 2.050 | 0.577 | ND | 2.210 | 1.040 | 0.801 | 3.720 | ND | ND |
| Ethylbenzene | ND | ND | ND | 1.900 | ND | ND | 0.181 | ND | 0.602 | 0.769 | 0.414 | 5.170 | ND | ND | ND | 0.164 |
| Isopropylbenzene | ND | ND | ND | 0.757 | ND | ND | ND | ND | 1.940 | 0.132 | ND | 1.220 | ND | ND | 0.472 | ND |
| Naphthalene | 0.148 | 0.425 | 0.809 | 32.400 | 0.642 | 0.492 | 0.511 | 0.250 | 0.680 | ND | 0.189 | 2.570 | ND | 0.367 | 2.860 | 0.451 |
| o-Xylene | 0.119 | 0.175 | 0.247 | 0.981 | 0.219 | ND | 0.370 | 0.139 | 2.220 | 1.550 | 1.370 | 27.400 | 0.166 | 0.131 | 0.859 | 0.355 |
| m,p-Xylene | 0.291 | 0.425 | 0.375 | 1.890 | 0.331 | 0.180 | 0.747 | 0.355 | 2.720 | 1.370 | 3.080 | 70.200 | 0.377 | 0.384 | 1.890 | 0.835 |
| Tetrachloroethene | 693.0 | 466.0 | 9020.0 | 34900.0 | 15500.0 | 384.0 | 70.6 | 541.0 | 858.0 | 597.0 | 1740.0 | 742.0 | 62.9 | 138.0 | 3.8 | 15.2 |
| Toluene | 1.070 | 1.410 | 0.730 | 3.550 | 1.200 | ND | 1.370 | 0.586 | 2.970 | 3.990 | 5.730 | 36.000 | 0.634 | 1.140 | 0.383 | 1.190 |
| trans-1,2-Dichloroethene | 2.230 | 1.100 | 7.980 | 6.090 | 4.280 | ND | 2.310 | 0.955 | ND | ND | 0.779 | ND | 0.319 | 0.957 | ND | ND |
| Trichloroethene | 99.200 | 24.700 | 491.000 | 728.000 | 553.000 | 3.370 | 165.000 | 51.500 | 23.200 | 22.900 | 150.000 | 10.800 | 11.000 | 39.700 | ND | 2.970 |
| Vinyl Chloride | ND | ND | ND | ND | ND | ND | ND | ND | 4.320 | ND | ND | ND | ND | ND | ND | ND |
| Notes: | | | | | | | | | | | | | | | | |
| Data in units of micrograms per cubic meter ($\mu g/m^3$) | | | | | | | | | | | | | | | | |
| ND - Nondetect | | | | | | | | | | | | | | | | |

Risk

*Bulk Soil*

Table 4 summarizes the risks from exposure to soils at the Edison Building site. The total cancer risk is 1.05 E-06 and the hazard index (HI) is 2.34E-03. The cancer risk is driven by the maximum detected concentration of naphthalene. It is noted that the RSL for naphthalene drives cancer risk. Oral cancer toxicity data for naphthalene has been recently added to the RSL database; hence the change in the screening level for naphthalene between the November 2019 and May 2020 RSL tables. Overall, the cancer risk is essentially equal to the UAC R215-101 cancer risk level of 1E-06. The HI for the residential receptor is less than the target level of 1.0. There is no adverse risk to the resident from direct exposure to soil.

As noted in Table 4, the total cancer risk to the construction worker is 4.55E-07 and the HI is 7.2E-03. The cancer risk is below the target level of 1E-06 and the HI is below the target level of 1.0. There is no adverse risk from direct exposure to soil for the construction worker.

**Table 4. Residential and Construction Worker Risks, Soil**

| COPC | Max (mg/kg) | RSL Res (mg/kg) | C/NC | Res. HQ | Res. Cancer Risk | Constr. RSL* (mg/kg) | C/NC | Constr. HQ | Constr. Cancer Risk |
|---|---|---|---|---|---|---|---|---|---|
| TPH-GRO (Low Fractionation) | 6.28E+02 | NA | NC | | | NA | | | |
| TPH-DRO (High Fractionation) | 3.60E+03 | NA | NC | | | NA | | | |
| Tetrachloroethene (PCE) | 3.94E-02 | 2.40E+01 | C | | 1.64E-09 | | C | | |
| Acetone | 1.18E+00 | 6.10E+04 | NC | 1.93E-05 | | 6.11E+04 | NC | 1.93E-05 | |
| Benzene | 2.50E-02 | 1.20E+00 | C | | 2.08E-08 | 1.95E+01 | C | | 1.28E-09 |
| n-Butylbenzene | 1.19E+00 | 3.90E+03 | NC | 3.05E-04 | | 3.39E+04 | NC | 3.51E-05 | |
| sec-Butylbenzene | 9.78E-01 | 7.80E+03 | NC | 1.25E-04 | | 3.39E+04 | NC | 2.88E-05 | |
| tert-Butylbenzene | 2.44E-01 | 7.80E+03 | NC | 3.13E-05 | | 3.39E+04 | NC | 7.20E-06 | |
| Chlorobenzene | 1.43E-01 | 2.80E+02 | NC | 5.11E-04 | | 1.04E+03 | NC | 1.38E-04 | |
| Ethylbenzene | 2.50E-03 | 5.80E+00 | C | | 4.31E-10 | 6.17E+01 | C | | 4.05E-11 |
| Isopropylbenzene | 1.08E+00 | 1.90E+03 | NC | 5.68E-04 | | 1.95E+02 | NC | 5.54E-03 | |
| p-Isopropyltoluene | 1.58E-01 | NA | | | | NA | | | |
| n-Propylbenzene | 2.90E+00 | 3.80E+03 | NC | 7.63E-04 | | 2.04E+03 | NC | 1.42E-03 | |
| Methylcyclohexane | 3.60E+00 | NA | | | | NA | | | |
| Napthalene | 2.05E+00 | 2.00E+00 | C | | 1.03E-06 | 4.52E+00 | C | | 4.54E-07 |
| Toluene | 1.42E-02 | 4.90E+03 | NC | 2.90E-06 | | 1.04E+04 | NC | 1.37E-06 | |
| Xylenes, Total | 5.31E-03 | 5.80E+02 | NC | 9.16E-06 | | 8.64E+02 | NC | 6.15E-06 | |
| | **Total HI or Cancer Risk:** | | | **2.34E-03** | **1.05E-06** | | | **7.20E-03** | **4.55E-07** |
| Notes: | | | | | | | | | |
| C - Carcinogen | | | | | | | | | |
| NC - Noncarcinogen | | | | | | | | | |
| HI - Hazard Index | | | | | | | | | |
| HQ - Hazard Quotient | | | | | | | | | |
| *RSL on-line calculator used for construction worker RSLs; all defaults applied, with exception of average depth of contamintion (10 feet) (run 7/13/20) | | | | | | | | | |

*Ingestion of Groundwater*

The ingestion of groundwater pathway was evaluated for only the residential scenario. The overall cancer risk to a resident ingesting groundwater was 1.4E-03 while the HI was 2.08E+00. Both of these levels are above the State of Utah target levels of 1E-06 and 1.0, respectively. The risks are shown in Table 5.

**Table 5. Residential Risks, Ingestion Groundwater**

| | Max (µg/L) | Tap Water RSL (µg/L) | C/NC | Tap Water HQ | Tap Water Risk |
|---|---|---|---|---|---|
| Tetrachloroethene (PCE) | 2.28E+02 | 1.1E+01 | C | | 2.07E-05 |
| Trichloroethene (TCE) | 5.49E+01 | 4.90E-01 | C | | 1.12E-04 |
| 1,1-Dichloroethene (DCE) | 0.00E+00 | 2.80E+02 | NC | 0.00E+00 | |
| *cis* -1,2-Dichloroethene | 7.27E+01 | 3.60E+01 | NC | 2.02E+00 | |
| *trans* -1,2-Dichloroethene | 3.42E+00 | 3.60E+02 | NC | 9.50E-03 | |
| Vinyl chloride | 2.23E+01 | 1.90E-02 | C | | 1.17E-03 |
| 1,1,2-Trichloroethane | | | | | |
| Acetone | 1.35E+02 | 1.40E+04 | NC | 9.64E-03 | |
| 2-Butanone | | | | | |
| n-Butylbenezene | | | | | |
| sec-Butylbenzene | | | | | |
| tert-Butylbenzene | | | | | |
| Carbon Disulfide | | | | | |
| Cyclohexane | 1.49E+02 | 1.30E+04 | NC | 1.15E-02 | |
| 2-Hexanone | | | | | |
| Methylcyclohexane | 2.74E+02 | NA | | | |
| Isopropylbenzene | 1.56E+01 | 4.50E+02 | NC | 3.47E-02 | |
| p-Isopropyltoluene | | | | | |
| n-Propylbenzene | | | | | |
| 1,2,4-Trimethylbenzene | | | | | |
| 1,3,5-Trimethylbenzene | | | | | |
| Benzene | 1.29E+01 | 4.60E-01 | C | | 2.80E-05 |
| Toluene | | | | | |
| m,p-Xylenes | | | | | |
| o-Xylenes | | | | | |
| Naphthalene | 7.51E+00 | 1.20E-01 | C | | 6.26E-05 |
| Ethylbenzene | 5.18E+00 | 1.50E+00 | C | | 3.45E-06 |
| TPH-GRO | | | | | |
| TPH-DRO | | | | | |
| | **Total HI or Cancer Risk:** | | | **2.08E+00** | **1.40E-03** |

Notes:

µg/L, micrograms per Liter

C/NC - carcinogen/noncarcinogen

NA - Not available

*Vapor Intrusion*

For the vapor intrusion pathway, risks were calculated using two sources: groundwater and sub-slab soil gas data. While both predict indoor air concentrations, combing the risks derived from each data set would result in an overcounting risk. However, both were analyzed and the resulting risks compared for inclusion in cumulative site risk.

Table 6 summarizes the risks from VOCs in groundwater volatilized into indoor air. The USEPA on-line VISL calculator for groundwater was used to derive VISLs. The results are provided for both a resident and an indoor industrial worker.

## Table 6. Indoor Air Risk from Volatilization from Groundwater

| | Max (µg/L) | Res. GW Target VISL (µg/L) | C/NC | Res. GW VISL HQ | Res. GW VISL Risk | Ind. GW Target VISL (µg/L) | C/NC | Ind. GW VISL HQ | Ind. GW VISL Risk |
|---|---|---|---|---|---|---|---|---|---|
| Tetrachloroethene (PCE) | 2.28E+02 | 1.49E+01 | C | | 1.53E-05 | 6.52E+01 | C | | 3.50E-06 |
| Trichloroethene (TCE) | 5.49E+01 | 1.19E+00 | C | | 4.61E-05 | 7.43E+00 | C | | 7.39E-06 |
| 1,1-Dichloroethene (DCE) | | | | | | | | | |
| *cis* -1,2-Dichloroethene | 7.27E+01 | | | | | | | | |
| *trans* -1,2-Dichloroethene | 3.42E+00 | | | | | | | | |
| Vinyl chloride | 2.23E+01 | 1.47E-01 | C | | 1.52E-04 | 2.45E+00 | C | | 9.10E-06 |
| 1,1,2-Trichloroethane | | | | | | | | | |
| Acetone | 1.35E+02 | 2.25E+07 | NC | 6.00E-06 | | 9.45E+07 | NC | 1.43E-06 | |
| 2-Butanone | | | | | | | | | |
| n-Butylbenezene | | | | | | | | | |
| sec-Butylbenzene | | | | | | | | | |
| tert-Butylbenzene | | | | | | | | | |
| Carbon Disulfide | | | | | | | | | |
| Cyclohexane | 1.49E+02 | 1.02E+03 | NC | 1.46E-01 | | 4.29E+03 | NC | 3.47E-02 | |
| 2-Hexanone | | | | | | | | | |
| Methylcyclohexane | 2.74E+02 | | | | | | | | |
| Isopropylbenzene | 1.56E+01 | 8.87E+02 | NC | 1.76E-02 | | 3.73E+03 | NC | 4.18E-03 | |
| p-Isopropyltoluene | | | | | | | | | |
| n-Propylbenzene | | | | | | | | | |
| 1,2,4-Trimethylbenzene | | | | | | | | | |
| 1,3,5-Trimethylbenzene | | | | | | | | | |
| Benzene | 1.29E+01 | 1.59E+00 | C | | 8.11E-06 | 6.93E+00 | C | | 1.86E-06 |
| Toluene | | | | | | | | | |
| m,p-Xylenes | | | | | | | | | |
| o-Xylenes | | | | | | | | | |
| Naphthalene | 7.51E+00 | 4.59E+00 | C | | 1.64E-06 | 2.01E+01 | C | | 3.74E-07 |
| Ethylbenzene | 5.18E+00 | 3.49E+00 | C | | 1.48E-06 | 1.52E+01 | C | | 3.41E-07 |
| TPH-GRO | | | | | | | | | |
| TPH-DRO | | | | | | | | | |
| | | **HI or Cancer Risk:** | | **1.64E-01** | **2.24E-04** | | | **3.89E-02** | **2.26E-05** |
| Notes: | | | | | | | | | |
| µg/L, micrograms per Liter | | | | | | | | | |
| C/NC - carcinogen/noncarcinogen | | | | | | | | | |
| NA - Not available | | | | | | | | | |
| VISL on-line calculator for groundwater run 7/13/20 | | | | | | | | | |

As shown in Table 6, the risks from the vapor intrusion pathway for a resident based on volatilization from groundwater is a total cancer risk of 2.24E-4 and a HI of 1.64E-01. Both the cancer risk and HI are above the State of Utah target levels of 1E-06 and 1.0, respectively. For the indoor industrial worker, the total cancer risk was 2.26E-05 and the HI was 3.89E-02. The cancer risk for the indoor worker is above the State target level of 1E-06 for no controls. There is no adverse noncancer risk to the indoor worker.

Table 7 summarizes the risks from VOCs volatilized into indoor air using the sub-slab data. The USEPA on-line VISL calculator for sub-slab soil gas was used to derive VISLs for both a resident and the indoor industrial/commercial worker.

For the resident, the total cancer risk was 1.59E-04 and the HI was 7.89E-02. The cancer risk is above the State of Utah target level of 1E-06 while the HI is below the target level of 1.0. For the indoor

industrial worker, the total cancer risk was 3.32E-05 while the HI was 6.22E+00. Both the cancer risk and HI are above the State of Utah target levels.

**Table 7. Indoor Air Risk, Sub-Slab Data**

| | Max ($\mu g/m^3$) | Res Subslab VISL ($\mu g/m^3$) | C/NC | Res Subslab VISL HQ | Res Subslab VISL Risk | Ind/Com Subslab VISL ($\mu g/m^3$) | C/NC | Ind/Com Subslab VISL HQ | Ind/Com Subslab VISL Risk |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | 1.48E+01 | 1.26E+01 | C | | 1.17E-06 | 5.52E+01 | C | | 2.68E-07 |
| 1,1,1-Trichloroethane | 2.01E+01 | 1.74E+05 | NC | 1.16E-04 | | 7.30E+05 | NC | 2.75E-05 | |
| 1,1-Dichloroethane | 2.19E+00 | 5.85E+01 | C | | 3.74E-08 | 2.56E+02 | C | | 8.55E-09 |
| 1,1-Dichloroethene | 2.20E+01 | 3.95E+03 | NC | 5.57E-03 | | 2.92E+04 | NC | 7.53E-04 | |
| 1,2,4-Trimethylbenzene | 5.44E+01 | 2.09E+03 | NC | 2.60E-02 | | 8.76E+00 | NC | 6.21E+00 | |
| 1,2-Dichloroethane | 2.88E+00 | 3.60E+00 | C | | | 1.57E+01 | C | | 1.83E-07 |
| 1,3,5-Trimethylbenzene | 3.93E+01 | 2.09E+03 | NC | 1.88E-02 | | 8.76E+03 | NC | 4.49E-03 | |
| 2-Methylnaphthalene | 8.90E+00 | | | | | | | | |
| Benzene | 9.43E+00 | 1.20E+01 | C | | 7.86E-07 | 5.24E+01 | C | | 1.80E-07 |
| 1,2-Dichlorobenzene | | | | | | | | | |
| 1,4-Dichlorobenzene | | | | | | | | | |
| Methyl Tert-butyl Ether | | | | | | | | | |
| Chloroform | 5.23E+00 | 4.07E+00 | C | | 1.29E-06 | 1.78E+01 | C | | 2.94E-07 |
| cis-1,2-Dichloroethene | 1.78E+01 | | | | | | | | |
| Ethylbenzene | 5.17E+00 | 3.74E+01 | C | | 1.38E-07 | 1.64E+02 | C | | 3.15E-08 |
| Isopropylbenzene | 1.94E+00 | 1.39E+04 | NC | 1.40E-04 | | 5.84E+04 | NC | 3.32E-05 | |
| Naphthalene | 3.24E+01 | 2.75E+00 | C | | 1.18E-05 | 1.20E+01 | C | | 2.70E-06 |
| o-Xylene | 2.74E+01 | 3.48E+03 | NC | 7.87E-03 | | 1.46E+04 | NC | 1.88E-03 | |
| m,p-Xylene | 7.02E+01 | 3.48E+03 | NC | 2.02E-02 | | 1.46E+04 | NC | 4.81E-03 | |
| Tetrachloroethene | 3.49E+04 | 3.60E+02 | C | | 9.69E-05 | 1.57E+03 | C | | 2.22E-05 |
| Toluene | 3.60E+01 | 1.74E+05 | NC | 2.07E-04 | | 7.30E+05 | NC | 4.93E-05 | |
| trans-1,2-Dichloroethene | 7.98E+00 | | | | | | | | |
| Trichloroethene | 7.28E+02 | 1.59E+01 | C | | 4.58E-05 | 9.97E+01 | C | | 7.30E-06 |
| Vinyl Chloride | 4.32E+00 | 5.59E+00 | C | | 7.73E-07 | 9.30E+01 | C | | 4.65E-08 |
| Notes: | **Total HI or Cancer Risk:** | | | **7.89E-02** | **1.59E-04** | | | **6.22E+00** | **3.32E-05** |
| Data in units of micrograms per cubic meter ($\mu g/m^3$) | | | | | | | | | |
| C/NC - carcinogen/noncarcinogen | | | | | | | | | |

Table 8 shows the comparison of the two sources of data for estimating risk to indoor air, groundwater and sub-slab data. The resulting risks from use of the sub-slab data indicate higher risks. Given the age of the contamination and leakage into groundwater, it is likely that degradation of VOCs in groundwater is occurring. Most of the values are similar, except for the noncancer risk for the resident (difference of an order of magnitude) and the noncancer HI for the indoor worker (difference of two orders of magnitude). For purposes of estimating cumulative risk for each receptor, the more conservative of the two estimates of risk will be applied for each receptor.

**Table 8. Comparison of Indoor Air Risk**

| | Ground-water (Table 6) | Sub-Slab (Table 7) |
|---|---|---|
| Resident, Cancer | 2.24E-04 | 1.59E-04 |
| Resident, Noncancer | 1.64E-01 | 7.89E-02 |
| | | |
| Indoor Industrial Worker, Cancer | 2.26E-05 | 3.32E-05 |
| Indoor Industrial Worker, Noncancer | 3.89E-02 | 6.22E+00 |

*Cumulative Risk*

Table 9 presents the cumulative risk estimates for the residential scenario. The exposure pathways included ingestion of soil, ingestion of groundwater, and inhalation of vapors in indoor air. For the vapor intrusion pathway, the cancer risk was based on migration of vapors from groundwater while the HI was based on estimations from the sub-slab data. The cumulative risk for the resident is 1.63E-03 and a HI of 2.25E+00. Both of these levels are above the State target levels for non-restricted residential use.

**Table 9. Cumulative Risk, Resident**

| Medium | HI | Cancer Risk |
|---|---|---|
| Soil | 2.34E-03 | 1.05E-06 |
| Ingestion Groundwater | 2.08E+00 | 1.40E-03 |
| Inhalation vapors from groundwater | | 2.24E-04 |
| Inhalation vapors, subslab soil gas | 1.64E-01 | |
| **Total Res. HI or Cancer Risk:** | **2.25E+00** | **1.63E-03** |

Table 10 presents the cumulative risk estimates for the indoor industrial worker scenario. The only complete exposure pathway was inhalation of vapors in indoor air. For the vapor intrusion pathway, the cancer risk was based on migration of vapors from groundwater while the HI was based on estimations from the sub-slab data. The cumulative risk for the indoor industrial worker is 2.26E-05 and a HI of 6.22E+00. Both of these levels are above the State target levels for non-restricted industrial use.

**Table 10. Cumulative Risk, Indoor Industrial Worker**

| Medium | HI | Cancer Risk |
|---|---|---|
| Inhalation vapors from groundwater | | 2.26E-05 |
| Inhalation vapors, subslab soil gas | 6.22E+00 | |
| **Total Industrial HI or Cancer Risk:** | **6.22E+00** | **2.26E-05** |

Table 11 presents the cumulative risk estimates for the construction worker scenario. The only complete exposure pathway was ingestion and inhalation of bulk soil. The cumulative risk for the construction worker is 4.55E-07 and a HI of 7.2E-03. Both of these levels are below the State target levels. There is no adverse risk to a construction worker.

**Table 11. Cumulative Risk, Outdoor Construction Worker**

| Medium | HI | Cancer Risk |
|---|---|---|
| Bulk Soil | 7.20E-03 | 4.55E-07 |
| **Total Construction HI or Cancer Risk:** | **7.20E-03** | **4.55E-07** |

*Soil-to-Groundwater Migration*

For evaluation of the potential for COPCs in soil to migrate to groundwater, the detected site concentrations were compared to the RSL soil screening levels based on a dilution attenuation factor of 20. The results are shown in Table 12.

**Table 12. Soil-to-Groundwater Migration Assessment**

| COPC | Max (mg/kg) | SSL (mg/kg) | Max > SSL? |
|---|---|---|---|
| TPH-GRO (Low Fractionation) | 6.28E+02 | NA | |
| TPH-DRO (High Fractionation) | 3.60E+03 | NA | |
| Tetrachloroethene (PCE) | 3.94E-02 | 1.02E-01 | no |
| Acetone | 1.18E+00 | 5.80E+01 | no |
| Benzene | 2.50E-02 | 5.20E-02 | no |
| n-Butylbenzene | 1.19E+00 | 6.40E+01 | no |
| sec-Butylbenzene | 9.78E-01 | 1.18E+02 | no |
| tert-Butylbenzene | 2.44E-01 | 3.20E+01 | no |
| Chlorobenzene | 1.43E-01 | 1.36E+00 | no |
| Ethylbenzene | 2.50E-03 | 1.56E+01 | no |
| Isopropylbenzene | 1.08E+00 | 1.48E+01 | no |
| p-Isopropyltoluene | 1.58E-01 | NA | no |
| n-Propylbenzene | 2.90E+00 | 2.40E+01 | no |
| Methylcyclohexane | 3.60E+00 | NA | no |
| Napthalene | 2.05E+00 | 7.60E-03 | **yes** |
| Toluene | 1.42E-02 | 1.52E+01 | no |
| Xylenes, Total | 5.31E-03 | 1.98E+02 | no |
| | | | |
| Notes: | | | |
| Data in units of milligrams per kilogram (mg/kg) | | | |
| NA - Not analyzed | | | |

The analysis showed that there is potential for naphthalene to migrate to groundwater. However, given there is no continual source and the site is developed and covered in asphalt, infiltration of water that could mobilize any residual naphthalene in soil is minimal. The soil-to-groundwater pathway is likely negligent.

*Conclusion – Human Health Risk Assessment*

Cumulative risks for both the resident and indoor industrial worker exceeded State target levels for un-restricted land use. It is noted that total petroleum hydrocarbon (TPH) data were excluded from the risk estimations. The fractions of hydrocarbons in the site data do not align with the fractionations for RSL TPH screening levels, and thus risks from potential exposure to TPH in site media were not calculated. Further, it is possible that indicator compounds associated with diesel range organics, such as polycyclic aromatic hydrocarbons (PAHs) that are lower in volatility could be present in site media. Exclusion of these indicator compounds along with exclusion of the TPH data could result in an underestimation of the calculated risks. The land use controls as addressed in the main text of this SMP report are needed to ensure protection of human health. These include limitation of use of shallow groundwater for consumption and use of vapor barriers and ventilation in any buildings constructed on site.

**Ecological Risk Assessment**

The Edison Building is located at 933 South Edison Street in Salt Lake City. As shown in the below photograph of the site (Google Earth, 2020), the area around the site as well as the site itself is highly development and mostly paved. There is no viable habitat to support ecological receptors.


To further support the conclusion that there is no adverse risk to ecological receptors, an ecological screening assessment was conducted. The only complete exposure pathway for ecological receptors would be direct contact with soil, if the pavement were ever to be removed. While VOCs are present in soil gas, there is little information on the toxicity via inhalation to ecological receptors to complete a quantitative analysis.

The ecological screening levels (ESLs) were derived from the Los Alamos National Laboratory's EcoRisk database. Given the small size of the property, indicator receptors include generic plants, a deer mouse, and a horned lark. Table 11 below summarizes the ecological screening assessment for these indicator receptors. The methodology outlined in Equation 2 was applied in deriving the HQs and HIs.

As noted in the table, the overall HIs are deer mouse 2.34E-03, horned lark 3.3E-02, and plants 4.06E-03. All of these HIs are below a target level of 1.0, indicating no adverse ecological risk is present at the Edison Building site.

## Table 11. Ecological Screening Assessment

| COPC | BH-3 9.5 ft bgs | SB-1 10 ft bgs | SB-3 10 ft bgs | SB-4 10 ft bgs | SB- 4.5 ft bgs | SB-6 9-10 ft bgs | Max (mg/kg) | Mouse ESL (mg/kg) | Deer Mouse HQ | Horned Lark ESL (mg/kg) | Horned Lark HQ | Plant ESL (mg/kg) | Plant HQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPH-GRO (Low Fractionation) | NA | 9.00E+01 | 1.90E+02 | 1.60E+02 | ND | 6.28E+02 | 6.28E+02 | | | | | | |
| TPH-DRO (High Fractionation) | NA | 3.60E+03 | 2.30E+02 | 4.30E+00 | ND | 2.93E+02 | 3.60E+03 | | | | | | |
| Tetrachloroethene (PCE) | ND | ND | ND | ND | 3.94E-02 | ND | 3.94E-02 | 1.82E+01 | 2.16E-03 | | | 1.00E+01 | 3.94E-03 |
| Acetone | ND | 4.10E-02 | ND | ND | ND | 1.18E+00 | 1.18E+00 | 9.09E+01 | 1.30E-02 | 2.84E+02 | 4.15E-03 | | |
| Benzene | 1.50E-02 | 2.50E-02 | ND | ND | 1.38E-02 | ND | 2.50E-02 | 2.40E+02 | 1.04E-04 | | | | |
| n-Butylbenzene | 3.00E-02 | 3.50E-01 | 5.40E-01 | ND | ND | 1.19E+00 | 1.19E+00 | | | | | | |
| sec-Butylbenzene | 1.50E-02 | ND | ND | ND | ND | 9.78E-01 | 9.78E-01 | | | | | | |
| tert-Butylbenzene | ND | ND | ND | ND | ND | 2.44E-01 | 2.44E-01 | | | | | | |
| Chlorobenzene | ND | ND | ND | ND | ND | 1.43E-01 | 1.43E-01 | 5.45E+02 | 2.62E-04 | | | | |
| Ethylbenzene | ND | ND | ND | ND | 2.50E-03 | ND | 2.50E-03 | | | | | | |
| Isopropylbenzene | ND | 6.70E-01 | ND | ND | ND | 1.08E+00 | 1.08E+00 | | | | | | |
| p-Isopropyltoluene | ND | ND | ND | ND | ND | 1.58E-01 | 1.58E-01 | | | | | | |
| n-Propylbenzene | ND | 2.90E+00 | ND | 3.90E-01 | ND | 1.76E+00 | 2.90E+00 | | | | | | |
| Methylcyclohexane | NA | 1.50E+00 | 3.60E+00 | 2.00E+00 | ND | ND | 3.60E+00 | | | | | | |
| Napthalene | ND | 1.30E-01 | 4.10E-01 | 3.00E-01 | ND | 2.05E+00 | 2.05E+00 | 1.30E+02 | 1.58E-02 | 7.10E+01 | 2.89E-02 | | |
| Toluene | ND | ND | ND | ND | 1.42E-02 | ND | 1.42E-02 | | | | | 2.00E+02 | 7.10E-05 |
| Xylenes, Total | ND | ND | ND | ND | 5.31E-03 | ND | 5.31E-03 | 1.91E+01 | 2.78E-04 | 5.06E+02 | | 1.00E+02 | 5.31E-05 |
| | | | | | | | | **HI:** | **3.16E-02** | | **3.30E-02** | | **4.06E-03** |
| Data in units of milligrams per kilogram (mg/kg) | | | | | | | | | | | | | |
| NA - Not analyzed | | | | | | | | | | | | | |
| NA - Nondetected | | | | | | | | | | | | | |
| ESL - Ecological Screening Leve, LANL EcoRisk | | | | | | | | | | | | | |