**REDACTED**

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**Sent:** Monday, July 3, 2023 12:32 PM
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**Subject:** RE: Details of Ecological Soil RBC/PRG Information Requested

Taku,

Thank you for the follow-up email. We have been working over the past couple of weeks to compile the information that you requested during our meeting on June 13th meeting. I've provided the requested information below. DEQ also has a few comments on the tables that were provided on May 22nd, which we will provide in a separate email. Once you have had the opportunity to review the information below, we can work towards scheduling a meeting to discuss.

1. In addition to providing the parameters for the exposure and toxicity assumptions used for the avian LPAH and HPAH RBCs, it is important to recognize the importance of evaluating toxicity according to chemical class. Both EPA and DEQ have identified chemical groups representative of the toxicity of compounds that have similar chemical and toxicological properties and act with the same mode of action. This is outlined in DEQ "Evaluating Acceptable Risk and Potential Hot Spots for Chemical Classes" memo (https://www.oregon.gov/deq/filterdocs/Cleanup-Chemicalclasses.pdf). Los Alamos (LANL) does not use chemical groups for ecological risk assessment in accordance with its screening-level ecological risk assessment (SLERA) methods and did not adopt chemical group TRVs derived by EPA to remain consistent with these methods (LANL, 2014. *Toxicity Reference Value Development Methods for the Los Alamos National Laboratory*, Revision 1, LA-UR-20694).

   RBCs for chemical classes are more appropriate PRGs compared to individual chemicals within these classes. Risk based concentrations representing chemical classes are presented in DEQs Chemical Class Memo Table 1a. There are different approaches applicable to the calculation of risks from exposure to a chemical class. LPAH and HPAH fall under (1) on page 2 of the memo: "For a chemical class with constituents that are assumed to act with the same level of toxicity, sum concentrations of constituents to calculate a single concentration

for comparison with risk-based concentrations." The calculation of risks from chemical classes is presented in (1) on Page 3: "For a chemical class with constituents that are assumed to act with the same level of toxicity, sum concentrations of constituents to calculate a single concentration for comparison with risk-based concentrations".

**Derivation of Risk Based Concentrations:** DEQ used a hierarchy of information to calculate RBCs. DEQ ranks EPA-derived information for exposure, uptake and toxicity reference value data higher than information derived by LANL. DEQ used this hierarchy to calculate risk-based concentrations (RBCs) for soil.

a. **DEQ Toxicity Reference Value Selection:** The EPA generates nationally accepted TRVs through Eco-SSL methodology and these toxicity values are considered to have a high confidence rating compared with other sources. Therefore, DEQ used EPA TRVs as the first source where available, and LANL TRVs as a secondary source.

There are some important differences in the objectives and technical evaluation process in TRVs between EPA and LANL. Therefore, additional studies were available for mortality endpoints for birds for TRV development for LPAHs that were not identified by EPA. See EPA 2003, Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs), Attachment 4-4 *Standard Operating Procedure #5" Wildlife TRV Data Evaluation* and *Toxicity Reference Value Development Methods for the Los Alamos National Laboratory*, Revision 1, LA-UR-20694).

i. **Deriving Chronic Effect Levels:** EPA excludes acute/subacute and sub chronic data in the development of TRVs. EPA does this to focus on establishing a dose protective of most species from adverse effects associated with long-term exposures (>90 days) and sublethal reproductive and growth endpoints (non-mortality). Los Alamos considers studies of shorter test duration including sub chronic (14-90 days) and acute (<14 days), and studies that report mortality as a test endpoint (See LANL 2014, Appendix B). LANL uses uncertainty factors to derive chronic effect levels consistent with EPA's definition (LANL 2014, Table A-13).

ii. **Endpoints:** EPA only utilizes studies where reproduction / development and growth endpoints are available (mortality only not considered). Los Alamos includes reproduction / growth, and survival endpoints for toxicological information in the development of the TRV (LANL, 2015). DEQ used EPA endpoints where available, but also considered survival endpoints with appropriate uncertainty factors following LANL process.

iii. **LOAEL Selection:**

1. If an EPA TRV was available for the NOAEL, DEQ selected the LOAEL from the same study from which the NOAEL was identified.
2. LANL calculates has a process for calculating their own LOAELs depending in the data availability. Section A-4.1.5 and Figure A-1 in *Toxicity Reference Value Development Methods* for the Los Alamos National Laboratory provides a step-by-step process for determined how to drive a LOAEL based effect level. Generally, where a NOAEL was not available, a factor of 0.1 applied to the LOAEL to estimate a NOAEL. Where a LOAEL was not available, a factor of 5 was applied to a NOAEL to estimate a LOAEL.

a. **LOAEL-based TRV Derivation for Total LPAHs and Total HPAHs:**

i. LPAHs:

1. Mammalian: 328 mg/kg/day based on 1-naphthalenacetic acid, EPA Eco SSL Table 6.1, Verschuuren et al., 1976. This is the same study selected by EPA for the NOAEL of 65.6 mg/kg/day.
2. Avian: 150 mg/kg/day based on naphthalene, bobwhite quail, LANL 2015, Landis Assoc., Inc., 1985

ii. HPAHs:

1. Mammalian: 3.01 mg/kg/day based on benzo(a)pyrene, EPA Eco SSL Table 6.2, Culp et al., 1998. This is the same study selected by EPA for the

NOAEL of 0.615 mg/kg/day.

2. Avian: 1.07 mg/kg/day, benzo(a)anthracene, bobwhite quail, LANL 2015, Beat, B.N. 2007. A pyrene TRV was also available from LANL. The benzo(a)anthracene TRV was selected to represent HPAHs because it was considered higher quality study based on the endpoints tested sub chronic NOEL (benzo(a)anthracene) as compared to an acute NOEL (pyrene), and following EPA guidance on the selection of a representative.

b. **Exposure Information**: EPA exposure and uptake information was used as the primary source for ground feeding birds and mammals (Attachment 4-1, Guidance for Development Ecological Soil Screening Levels (Eco-SSLs), *Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs*). EPA exposure factors were used to calculate the total LPAH and total HPAH RBCs for birds and mammals.

   i. Food Ingestion Rates (FIR): 0.209 g dw/g bw/day mammalian, 0.214 g dw/g bw/day avian (Table 1 in Attachment 4-1).

   ii. Proportion of Diet that is Soil ($P_s$): 3% mammalian, 16.4% avian (Table 3 in Attachment 4-1).

   iii. Uptake, Soil to Earthworms ($C_{biota}$): Uptake Equations for Non-Ionic Organics, Table 4b in Attachment 4-1.

      1. Total LMW PAHs, Soil to Earthworms: $C_{earthworm}=3.04*C_{soil}$ (range for all PAHs 1.47 to 22.9)
      2. Total HMW PAHs: $C_{earthworm}=2.6*C_{soil}$ (range for all PAHs 1.33 to 2.94)

c. **Wildlife RBC Calculation:** The RBCs are calculated by solving the general equation below for the concentration in soil (Cs) that represents acceptable risk (HQ = 1.0). HQs that exceed 1.0 suggest that adverse effects are possible. This calculation requires chemical- and receptor-specific values for the TRV, and knowledge about the relationship between soil (Cs) and uptake into biota (Cbiota). More information can be found in Section 2.0 of DEQ's 2020 *Conducting Ecological Risk Assessments*.

Exposure is estimated from calculated chemical intake of incidental soil ingestion and ingestion of biota as food:

$$\text{Exposure Estimate} = [(C_s \times P_s \times FIR) + (C_{biota} \times FIR)]$$

Therefore:

$$HQ = [(C_s \times P_s \times FIR) + (C_{biota} \times P_b \times FIR)]/TRV$$

Where:

$C_s$ = concentration of contaminant in soil (mg/Kg [dry weight])

$P_s$ = Soil ingestion as proportion of diet (unitless)

$P_b$ = Biota ingestion as proportion of diet (unitless)

FIR = food ingestion rate (kg food [dry weight]/kg body weight [wet weight]/day)

$C_{biota}$ = Concentration of contaminant in biota (mg/Kg [dry weight])

TRV = toxicity reference value

2. **Derivation of TPH RBCs for Terrestrial Biota.** Table 1a of DEQ's ecological risk guidance includes terrestrial plant and invertebrate soil SLVs for gasoline and diesel products developed by the Washington Department of Ecology (WA DOE, Ecology). However, the compositions of these products do not resemble the MGP petroleum products and wastes released at the Gasco site. As part of their evaluation of petroleum toxicity to terrestrial plants and soil invertebrates, Washington DOE compared the results of their evaluation to those derived from a Canadian Study published in 2008. The results of the two studies yielded similar results for equivalent TPH fractions (i.e., F1 and F2 as defined below). However, an advantage of the

Canadian Study is that it provided SLVs for the F3 fraction which is significant component of the petroleum contamination on the Gasco site. Based on a review of the two studies, it was concluded that the fraction-specific Canadian SLVs listed below enabled derivation of SLVs that more accurately reflected the composition and toxicity of contamination found in the various process and waste management areas of the Gasco site. The values represent TPH toxicity to terrestrial invertebrates (e.g., worms, insect larvae, etc.) TPH toxicity to plants (e.g., lettuce) was more variable and confidence in threshold values produced by the Washington and Canadian studies is lower. However, the invertebrate SLVs are considered protective of plants and other terrestrial organisms and are recommended for screening risks to terrestrial biota, in general. The following values from the Canadian Study were used to derive TPH-SLVs for each process and waste management area based on the Q25 of LC25 of terrestrial invertebrate toxicity:

- F1 = C6-C10 aliphatic and aromatic hydrocarbons = 75 mg/Kg
- F2 = C10-C16 aliphatic and aromatic hydrocarbons = 200 mg/Kg
- F3 = C16-C34 aliphatic and aromatic hydrocarbons = 250 mg/kg

The reference and link for the Canadian study is provided below:

Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale Supporting Technical Document January 2008, Canadian Council of Ministers of the Environment.

http://registry.mvlwb.ca/Documents/MV2010L1-0001/MV2010L1-0001%20-%20Canada%20Wide%20Standard%20for%20Petroleum%20HydroCarbons%20PHC%20in%20Soil%20-%20May12-10.pdf

Regards,

Wes

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**Subject:** Details of Ecological Soil RBC/PRG Information Requested

Good morning Wes,

I wanted to follow-up on our June 13, 2023, Ecological Soil PRG Meeting and provide details of the information that was requested from Jennifer Petersen and Henning Larsen. I noted during the June 27, 2023, Human Health TPH RBC Meeting that there was some confusion on the information requested. Please see below for the details of the ecological soil RBC/PRG information:

1. Ecological Soil RBC/PRG Information Requested: Specific details on the parameters (values and sources) for the exposure and toxicity assumptions used in the calculations of the bird LPAH and HPAH RBCs. These include fraction of soil in diet, food intake rate, transfer factor,

NOAEL and LOAEL TRVs. We would also like to request this information for the bird RBCs for benzo(a)anthracene, pyrene, and naphthalene.

2. Soil Biota TPH RBC: Current document(s) that show the Canadian Soil Standards for Petroleum Hydrocarbons and the current TPH percentile statistics for soil biota (e.g., earthworms).

Thanks, and please let me know if there are any questions related to this request.

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