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## MEMORANDUM

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**To:** Ngozi Ibe, Greenfield Environmental Multistate Trust LLC

**From:** Todd Martin, Sara Barbuto

**Date:** December 23, 2021

**Subject:** Ecological Risk Reduction as a Result of Remediating OU2 Parcels  
Navassa Site Kerr-McGee Chemical Corp. — Navassa Superfund Site  
Navassa, North Carolina, EPA ID #NCD980557805

**Project No.:** E158

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At the request of Greenfield Environmental Multistate Trust LLC, not individually but solely in its representative capacity as Trustee of the Multistate Environmental Response Trust (Multistate Trust), Integral Engineering, P.C. (Integral) has prepared this memorandum to document the decrease in surface weighted area concentrations (SWACs) and hazard quotients (HQs) for the American robin that will occur as a result of remediating parcels with potential unacceptable risk to future residents in Operable Unit 2 (OU2). As discussed in the Navassa Weekly Progress Meeting on October 20, 2021, SWACs were calculated for three 2-acre exposure units, circles centered on the three parcels (TB-16, TB-12, and SS-117; Figure 1) with the highest concentrations of high molecular weight polycyclic aromatic hydrocarbons (HMW PAHs). The SWACs were then used to compute current and post-remediation HQs for the American robin under various diet scenarios to support development of an ecological preliminary remediation goal (PRG). SWACs and HQs were calculated using the methodology presented in the September 2021 *OU2 Ecological Risk Assessment Technical Memorandum* (hereafter referred to as the “2021 OU2 ERA”).

To calculate SWACs based on potential post-remedy conditions, the HMW PAH concentration was set to 0 mg/kg for each of the 19 parcels identified in the September 2021 *OU2 Soil Sampling Results and Human Health Risk Assessment* as having unacceptable risk based on potential for exposure to a future resident. These parcels are shown in Figure 1. Table 1 provides the current HMW PAH representative concentrations in the parcels. The HMW PAH SWACs for the three 2-acre exposure units centered on parcels TB-16, TB-12,

and SS-117 before remediation to protect human health are 80, 48, and 45 mg/kg, respectively; and the post-remediation HMW PAH SWACs are 19, 5.5, and 22 mg/kg, respectively. Tables 2, 3, and 4 present the SWAC calculations for the 2-acre exposure units centered on Parcels TB-16, TB-12, and SS-117, respectively.

Table 5 summarizes the before and after remediation SWACs and the estimated HQs for the American robin for each of the four diet scenarios presented in the 2021 OU2 ERA. The post-remediation HQ range for the American robin under the four evaluated diet scenarios is 0.5 to 4.3. Overall, the remediation to protect human health will reduce ecological risk for the American robin by 77%, 89%, and 52% in the exposure areas centered on Parcels TB-16, TB-12, and SS-117, respectively.

For OU1, EPA prepared the October 14, 2020, memorandum, *Revised Semi-Screening Level Ecological Risk Assessment Calculations for OU1 of the Kerr-McGee Chemical Company Site in Navassa, North Carolina*. The EPA memorandum estimated HQs ranging from 4.2 to 2.9 for the American robin for a 100% earthworm diet and for a 50% belowground/50% aboveground invertebrate diet. Note that EPA rounded the HQs to 3 and 4. The 100% earthworm diet corresponds to Scenario 1 in Table 5 and the 50% belowground/50% aboveground invertebrate diet corresponds to Scenario 3 in Table 5.

This memorandum estimates that after the OU2 remediation to protect human health is complete, that the resulting range of HQs for the American robin would be 0.5 to 4.3 under the four evaluated diet scenarios. This memorandum calculates that a SWAC-based PRG of 22 mg/kg HMW PAHs or less over a 2-acre ecological exposure unit would result in an HQ of 4.3 or less under diet Scenario 1 and an HQ of 2.4 or less under diet Scenario 3. This range of HQs is consistent with the diet scenarios and HQs in OU1 where EPA's risk management decision was no action for ecological risks.

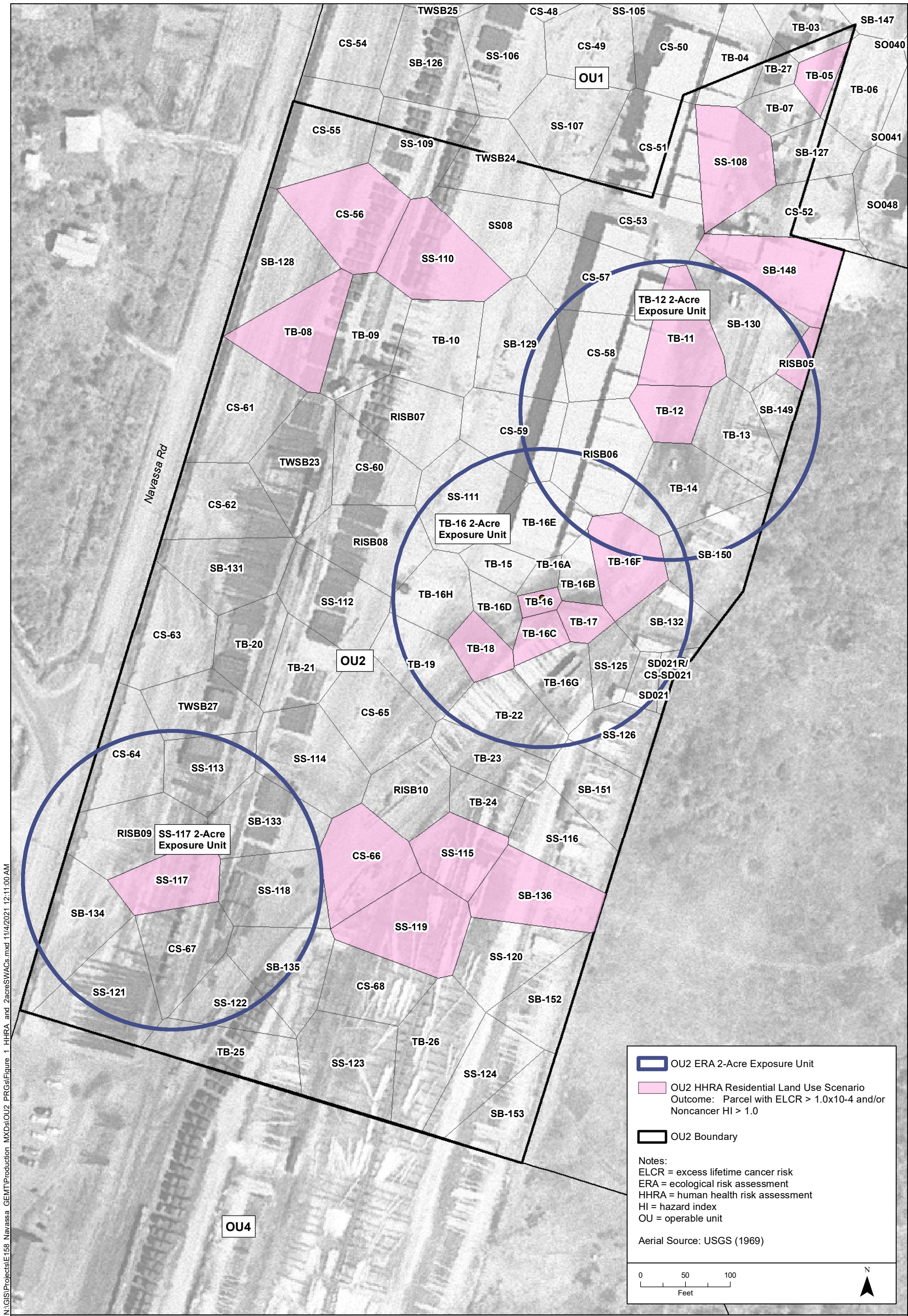
## **Attachments**

- Figure 1. OU2 ERA 2-Acre Exposure Units and Outcome of OU2 HHRA under Residential Land Use
- Table 1. OU2 Parcel List for SWAC Updates to Support Ecological PRG Development
- Table 2. Post-remedy HMW PAH SWAC Calculation for 2-Acre Exposure Unit Centered at Parcel TB-16
- Table 3. Post-remedy HMW PAH SWAC Calculation for 2-Acre Exposure Unit Centered at TB-12
- Table 4. Post-remedy HMW PAH SWAC Calculation for 2-Acre Exposure Unit Centered at SS-117

Table 5. American Robin HQ Results Based on Post-remedy HMW PAH SWAC Calculations

## **Figures**

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N:\GIS\Projects\158 Navassa\_GEMT\Production\_MXD\OU2 PRGs\Figure 1 HHRA and 2-acreSWACs.mxd 11/4/2021 12:11:00 AM

**Figure 1.**  
 OU2 ERA 2-Acre Exposure Units and Outcome of OU2 HHRA  
 under Residential Land Use  
 Kerr-McGee Chemical Corp. - Navassa Superfund Site  
 Navassa, North Carolina  
 November 2021

## **Tables**

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Table 1. OU2 Parcel List for SWAC Updates to Support Ecological PRG

| OU2 Parcel | $\Sigma$ 10 HMW PAHs Representative Concentration, Current Conditions (mg/kg) |
|------------|---|
| CS-56      | 33.4  |
| CS-66      | 5.09  |
| RISB05     | --  |
| SB-136     | 6.63  |
| SB-148     | 1.79  |
| SS-108     | 139   |
| SS-110     | 111.3   |
| SS-115     | 63.5  |
| SS-117     | 272   |
| SS-119     | 83.2  |
| TB-05      | 111   |
| TB-08      | 95.4  |
| TB-11      | 131   |
| TB-12      | 273   |
| TB-16      | 2020  |
| TB-16C     | 133   |
| TB-16F     | 259   |
| TB-17      | 95.9  |
| TB-18      | 101   |

Notes:

The 19 parcels in this list were identified in the 2021 OU2 HHRA as having unacceptable risk (i.e., excess lifetime cancer risk greater than  $1.0 \times 10^{-4}$  or noncancer risk hazard index greater than 1.0) to potential future residential receptors.

- = insufficient individual PAH data for calculation
- HHRA = human health risk
- HWM = high molecular weight
- OU2 = Operable Unit 2
- PAH = polycyclic aromatic hydrocarbon
- PRG = preliminary remediation goal
- SWAC = surface weighted average concentration

Table 2. Post-remedy HMW PAH SWAC Calculation for 2-Acre Exposure Unit Centered at Parcel TB-16

| Parcel <sup>a</sup>   | Parcel Size (acres) | Percent of Parcel Area within 2-Acre Exposure Unit | Parcel Area within 2-Acre Exposure Unit (acres) <sup>b</sup> | Σ10 HMW PAHs Representative Concentration (mg/kg) <sup>c</sup> |                  |
|---|---------------------|--|--|--|------------------|
|   |                     |  |  | Current Conditions   | Post Remediation |
| RISB06  | 0.250               | 37%  | 0.092  | --   | --               |
| RISB08  | 0.226               | 19%  | 0.043  | --   | --               |
| TB-16   | 0.026               | 100%   | 0.026  | 2020   | 0                |
| TB-16F  | 0.165               | 100%   | 0.165  | 259  | 0                |
| SD021   | 0.045               | 93%  | 0.042  | 147  | 147              |
| TB-16C  | 0.056               | 100%   | 0.056  | 133  | 0                |
| TB-18   | 0.078               | 100%   | 0.078  | 101  | 0                |
| TB-17   | 0.048               | 100%   | 0.048  | 95.9   | 0                |
| TB-16D  | 0.067               | 100%   | 0.067  | 52.6   | 52.6             |
| SS-126  | 0.121               | 38%  | 0.046  | 50.1   | 50.1             |
| TB-16A  | 0.029               | 100%   | 0.029  | 45.2   | 45.2             |
| TB-16G  | 0.126               | 100%   | 0.126  | 43.2   | 43.2             |
| TB-23   | 0.133               | 6%   | 0.008  | 43.1   | 43.1             |
| SB-132  | 0.130               | 77%  | 0.100  | 41.1   | 41.1             |
| SS-125  | 0.086               | 100%   | 0.086  | 36.0   | 36.0             |
| TB-16B  | 0.064               | 100%   | 0.064  | 32.6   | 32.6             |
| SB-150  | 0.225               | 13%  | 0.028  | 22.0   | 22.0             |
| TB-14   | 0.221               | 14%  | 0.032  | 16.0   | 16.0             |
| TB-22   | 0.174               | 97%  | 0.169  | 10.3   | 10.3             |
| TB-16H  | 0.141               | 100%   | 0.141  | 8.6  | 8.6              |
| SD021R  | 0.028               | 47%  | 0.013  | 8.1  | 8.1              |
| TB-19   | 0.170               | 72%  | 0.122  | 7.4  | 7.4              |
| SS-112  | 0.211               | 0%   | 0.00011  | 6.5  | 6.5              |
| TB-16E  | 0.150               | 100%   | 0.150  | 5.2  | 5.2              |
| SB-151  | 0.161               | 2%   | 0.003  | 2.9  | 2.9              |
| TB-15   | 0.066               | 100%   | 0.066  | 2.8  | 2.8              |
| CS-59   | 0.205               | 18%  | 0.036  | 1.3  | 1.3              |
| SS-111  | 0.224               | 73%  | 0.164  | 0.9  | 0.9              |
| <i>Total Area</i>   |                     |  | <i>2.0</i>   |  |                  |
| <b>Total Area for SWAC Calculation (Excluding RISB06 and RISB08)<sup>d</sup>:</b> |                     |  | <b>1.86</b>  | <b>SWAC (mg/kg)<sup>d</sup>:</b>                               |                  |
|   |                     |  |  | <b>80</b>  | <b>19</b>        |

## Notes:

-- = insufficient individual PAH data for calculation

Σ = sum of

ERA = ecological risk assessment

HHRA = human health risk assessment

HMW = high molecular weight

PAH = polycyclic aromatic hydrocarbon

SWAC = surface weighted average concentration

<sup>a</sup> Data handling was performed as presented in the 2021 OU2 ERA.

<sup>b</sup> As presented in the 2021 OU2 ERA, a 2-acre radius was used to define the exposure unit and identify the parcels for consideration. Only the area of the parcel inside the 2-acre radius was used to calculate the SWAC.

<sup>c</sup> The Σ10 HMW PAH concentration for a parcel was changed to 0 mg/kg if the parcel was identified in the 2021 OU2 HHRA as having unacceptable risk (i.e., excess lifetime cancer risk greater than  $1.0 \times 10^{-4}$  or noncancer risk hazard index greater than 1.0) to potential future residential receptors. Table 1 provides this parcel list.

<sup>d</sup> Two parcels (RISB06 and RISB08) that intersect the 2-acre exposure unit had insufficient individual PAH results to calculate HMW PAH sums. The total area for the SWAC calculation presented in this table excludes these two parcels.

SWACs were calculated as follows:

$$SWAC = \frac{(Area_{parcel\ 1} \times Concentration_{parcel\ 1}) + (Area_{parcel\ 2} \times Concentration_{parcel\ 2}) + \dots}{Area_{parcel\ 1} + Area_{parcel\ 2} + \dots}$$



Table 3. Post-remedy HMW PAH SWAC Calculation for 2-Acre Exposure Unit Centered at TB-12

| Parcel <sup>a</sup>  | Parcel Size (acres) | Percent of Parcel Area within 2-Acre Exposure Unit | Parcel Area within 2-Acre Exposure Unit (acres) <sup>b</sup> | Σ10 HMW PAHs Concentration (mg/kg) <sup>c</sup> |                  |
|--|---------------------|--|--|---|------------------|
|  |                     |  |  | Current Conditions                              | Post Remediation |
| RISB05   | 0.0376              | 73%  | 0.0274   | --  | --               |
| RISB06   | 0.25                | 100%   | 0.25   | --  | --               |
| SB-129   | 0.247               | 28%  | 0.0689   | 5.41  | 5.41             |
| SB-130   | 0.232               | 93%  | 0.215  | 6.32  | 6.32             |
| TB-16B   | 0.0638              | 1%   | 0.000599   | 32.6  | 32.6             |
| TB-16E   | 0.15                | 19%  | 0.0287   | 5.15  | 5.15             |
| TB-16F   | 0.165               | 39%  | 0.0644   | 259   | 0.0              |
| SB-148   | 0.239               | 0%   | 0.00113  | 1.79  | 0.0              |
| SB-150   | 0.225               | 48%  | 0.108  | 22  | 22               |
| TB-14  | 0.221               | 100%   | 0.221  | 16  | 16               |
| TB-11  | 0.197               | 100%   | 0.197  | 131   | 0.0              |
| SB-149   | 0.0684              | 100%   | 0.0684   | 4.64  | 4.64             |
| TB-12  | 0.101               | 100%   | 0.101  | 273   | 0.0              |
| TB-13  | 0.164               | 100%   | 0.164  | 1.45  | 1.45             |
| CS-53  | 0.25                | 1%   | 0.0032   | 1.59  | 1.59             |
| CS-59  | 0.205               | 38%  | 0.0787   | 1.26  | 1.26             |
| CS-57  | 0.238               | 43%  | 0.103  | 0.343   | 0.343            |
| CS-58  | 0.201               | 100%   | 0.201  | 1.95  | 1.95             |
|  |                     | <i>Area Outside of OU2</i>                         | <i>0.0972</i>  |   |                  |
|  |                     | <i>Total Area</i>                                  | <i>2.0</i>   |   |                  |
| <b>Total Area for SWAC Calculation (Excludes Area Outside of OU2, RISB05, and RISB06)<sup>d</sup>:</b> |                     |  | <b>1.6</b>   | <b>SWAC (mg/kg): 48</b>                         | <b>5.5</b>       |

Notes:

-- = insufficient individual PAH data for calculation

Σ = sum of

ERA = ecological risk assessment

HHRA = human health risk assessment

HMW = high molecular weight

PAH = polycyclic aromatic hydrocarbons

SWAC = surface weighted average concentration

<sup>a</sup> Data handling was performed as presented in the 2021 OU2 ERA.

<sup>b</sup> As presented in the 2021 OU2 ERA, a 2-acre radius was used to define the exposure unit and identify the parcels for consideration. Only the area of the parcel inside the 2-acre radius was used to calculate a SWAC.

<sup>c</sup> The Σ10 HMW PAH concentration for a parcel was changed to 0 mg/kg if the parcel was identified in the 2021 OU2 HHRA as having unacceptable risk (i.e., excess lifetime cancer risk greater than 1.0×10<sup>-4</sup> or noncancer risk hazard index greater than 1.0) to potential future residential receptors. Table 1 provides this parcel list.

<sup>d</sup> A portion (0.0972 acre) of the 2-acre exposure unit centered around TB-12 is outside of OU2 to the east where PAH data are not available. Additionally, there are 2 parcels (RISB05 and RISB06) with insufficient individual PAH data to calculate a comparable PAH sum. The total area for the SWAC calculation presented in this table excludes the area outside of OU2 and the areas for parcels RISB05 and RISB06.

SWACs were calculated as follows:

$$SWAC = \frac{(Area_{Parcel\ 1} \times Concentration_{Parcel\ 1}) + (Area_{Parcel\ 2} \times Concentration_{Parcel\ 2}) + \dots}{Area_{Parcel\ 1} + Area_{Parcel\ 2} + \dots}$$

Table 4. Post-remedy HMW PAH SWAC Calculation for 2-Acre Exposure Unit Centered at SS-117

| Parcel <sup>a</sup>  | Parcel Size (acres) | Percent of Parcel Area within 2-Acre Exposure Unit | Parcel Area within 2-Acre Exposure Unit (acres) <sup>b</sup> | Σ10 HMW PAHs Concentration (mg/kg) <sup>c</sup> |                  |
|--|---------------------|--|--|---|------------------|
|  |                     |  |  | Current Conditions                              | Post Remediation |
| RISB09   | 0.222               | 100%   | 0.222  | 19.8  | 19.8             |
| SB-133   | 0.202               | 91%  | 0.184  | 10.2  | 10.2             |
| SB-134   | 0.223               | 83%  | 0.185  | 2.93  | 2.93             |
| SB-135   | 0.211               | 53%  | 0.111  | 7.69  | 7.69             |
| TWSB27   | 0.168               | 5%   | 0.008  | 18.8  | 18.8             |
| TB-25  | 0.193               | 6%   | 0.012  | 0.799   | 0.799            |
| SS-117   | 0.157               | 100%   | 0.157  | 272   | 0                |
| SS-113   | 0.165               | 91%  | 0.150  | 55.1  | 55.1             |
| SS-114   | 0.247               | 5%   | 0.011  | 108   | 108              |
| SS-118   | 0.217               | 95%  | 0.205  | 8.78  | 8.78             |
| SS-122   | 0.141               | 71%  | 0.100  | 4.82  | 4.82             |
| SS-121   | 0.247               | 68%  | 0.167  | 27.4  | 27.4             |
| CS-67  | 0.194               | 100%   | 0.194  | 79.4  | 79.4             |
| CS-64  | 0.191               | 68%  | 0.130  | 0.891   | 0.891            |
|  |                     | <i>Area Outside of OU2</i>                         | <i>0.163</i>   |   |                  |
|  |                     | <i>Total Area</i>                                  | <i>2.0</i>   |   |                  |
| <b>Total Area for SWAC Calculation (Excludes Area Outside of OU2)<sup>d</sup>:</b> |                     |  | <b>1.84</b>  | <b>SWAC (mg/kg):</b>                            |                  |
|  |                     |  |  | <b>45</b>                                       | <b>22</b>        |

Notes:

-- = no PAH data available

Σ = sum of

ERA = ecological risk assessment

HHRA = human health risk assessment

HMW = high molecular weight

PAH = polycyclic aromatic hydrocarbon

SWAC = surface weighted average concentration

<sup>a</sup> Data handling was performed as presented in the 2021 OU2 ERA.

<sup>b</sup> As presented in the 2021 OU2 ERA, a 2-acre radius was used to define the exposure unit and identify the parcels for consideration. Only the area of the parcel inside the 2-acre radius was used to calculate the SWAC.

<sup>c</sup> The Σ10 HMW PAH concentration for a parcel was changed to 0 mg/kg if the parcel was identified in the 2021 OU2 HHRA as having unacceptable risk (i.e., excess lifetime cancer risk greater than 1.0×10<sup>-4</sup> or noncancer risk hazard index greater than 1.0) to potential future residential receptors. Table 1 provides this parcel list.

<sup>d</sup> A portion (0.163 acre) of the 2-acre exposure unit centered around SS-117 is outside of OU2 and PAH data are not available. The total area for the SWAC calculation presented in this table excludes the area outside of OU2.

SWACs were calculated as follows:

$$SWAC = \frac{(Area_{parcel\ 1} \times Concentration_{parcel\ 1}) + (Area_{parcel\ 2} \times Concentration_{parcel\ 2}) + \dots}{Area_{parcel\ 1} + Area_{parcel\ 2} + \dots}$$

Table 5. American Robin HQ Results Based on Post-remedy HMW PAH SWAC Calculations

| 2-Acre Circle | Conditions               | HMW PAH SWAC (mg/kg) | Resulting HQ <sup>a</sup> , American Robin       |   |  |  |
|---------------|--------------------------|----------------------|--|---|--|--|
|               |                          |                      | Diet Scenario 1 (100% belowground invertebrates) | Diet Scenario 2 (50% belowground invertebrates/ 50% plants) | Diet Scenario 3 (50% belowground invertebrates/ 50% aboveground invertebrates) | Diet Scenario 4 (35% belowground invertebrates, 35% aboveground invertebrates, 30% plants) |
| TB-16         | Current                  | 80                   | 16   | 9.9   | 8.9  | 7.3  |
|               | Post-Remediation         | 19                   | 3.7  | 2.3   | 2.1  | 1.7  |
|               | <i>Percent Reduction</i> | <i>77%</i>           | <i>77%</i>                                       | <i>77%</i>  | <i>77%</i>   | <i>77%</i>   |
| TB-12         | Current                  | 49                   | 9.8  | 6.0   | 5.4  | 4.4  |
|               | Post-Remediation         | 5.5                  | 1.1  | 0.69  | 0.61   | 0.51   |
|               | <i>Percent Reduction</i> | <i>89%</i>           | <i>89%</i>                                       | <i>89%</i>  | <i>89%</i>   | <i>89%</i>   |
| SS-117        | Current                  | 45                   | 9.1  | 5.6   | 5.0  | 4.1  |
|               | Post-Remediation         | 22                   | 4.3  | 2.7   | 2.4  | 2.0  |
|               | <i>Percent Reduction</i> | <i>52%</i>           | <i>52%</i>                                       | <i>52%</i>  | <i>52%</i>   | <i>52%</i>   |

Notes:

HMW = high molecular weight

HQ = hazard quotient

PAH = polycyclic aromatic hydrocarbon

SWAC = surface weighted average concentration

<sup>a</sup> HQ Results in the 2021 OU2 ERA were presented for the 2-acre exposure unit centered on TB-16, and rounded to one significant figure.