1238266
[0077021H]

From: Tabor, Cynthia L
To: Julie Robertson; Beach, Ryan E; Johnson, Jeremy M; Lyon, Jeffery; Barnes, Michael; Caggiano, Joseph; Rochette, Beth; Delistraty, Damon; Skorska, Maria; Faulk, Dennis (EPA); Gerhart, Rebecca; Rutland, Paul L; Parker, Dan L (Danny); Radloff, Anna W; Robertson, Julie R; Bergeron, Marcel P; Singleton, Kristin M; Aly, Alaa H; Mahmudur Rahman; Hopkins, Andrea M
Subject: Updated BRA and RFI/BRA comments
Date: Tuesday, February 02, 2016 10:48:46 AM
Attachments: UpdatedCR_BRA_1118_0107.pdf
Updated_Figure3-1.pdf
Updated_Table8-1.pdf

Hi All
The attached file includes updated responses with respect to Damon's BRA comments and also RFI Section 7 comments, which summarize the BRA. The file shows the original responses (for reference) and the updated responses. Additionally attached are an update figure and table from the BRA (i.e., Figure 3-1 and Table 8-1).

The original responses and updates were discussed in the November 18th meeting (link: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0078955H) and the January 7 meeting (notes are not yet in the Administrative Record). The January 7th meeting led to updating the following Damon RFI comment responses : 6, 18, 21, and 31.

Damon – please let us know if you agree with the updates. I have a note that you already approved Damon BRA 5.

Appreciate your all input and a new set of responses will be going out this week.
Thank you

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Julie Robertson

From: Tabor, Cynthia L <Cynthia_L_Tabor@rl.gov>
Sent: Tuesday, February 02, 2016 10:48 AM
To: Julie Robertson; Beach, Ryan E; Johnson, Jeremy M; Lyon, Jeffery; Barnes, Michael; Caggiano, Joseph; Rochette, Beth; Delistraty, Damon; Skorska, Maria; Faulk, Dennis (EPA); Gerhart, Rebecca; Rutland, Paul L; Parker, Dan L (Danny); Radloff, Anna W; Robertson, Julie R; Bergeron, Marcel P; Singleton, Kristin M; Aly, Alaa H; Mahmudur Rahman; Hopkins, Andrea M
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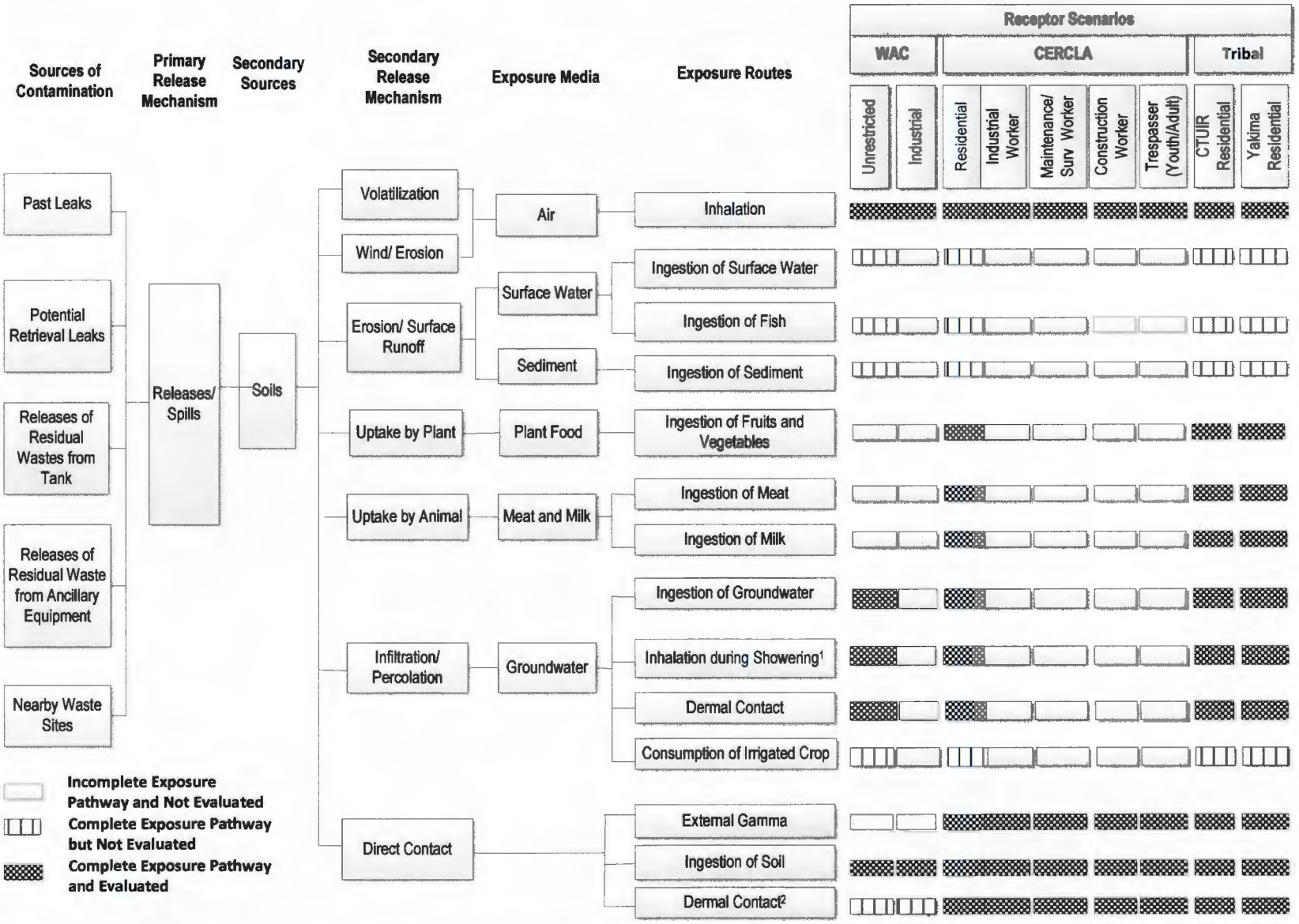
Comment From (ECY)	Item	Page #/ section # Line #	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	*Doc*	Old Response	Updated Response
Damon	6	P 7-6, S 7.2.1.1, L 18	Text describes one COPC exclusion criteria as, "Analytes without known toxicity data information." This exclusion should be described as an uncertainty. A recent editorial in Toxicol Sci notes, "Surprisingly, the current model deems that if we have no reliable toxicity data for a given chemical then it must be assumed to be safe. Although we may be blissfully ignorant of the toxicity this could indeed be very dangerous for the health of the human race and for the planet" (Miller, 2015) (http://toxsci.oxfordjournals.org/content/early/2015/02/25/toxsci.kfu310.full.pdf).	RFI	Concur with the statement. Therefore the following text will be included to provide information related to analytes with no toxicity as a part of the uncertainty analysis: "Human health risk assessment was performed for radionuclides, metals, VOC, SVOCs/PAHs and pesticides/herbicides. Toxicity information was not available for 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 3 VOCs, 11 SVOCs and 4 pesticides/herbicides. All excluded metals are radiological in nature. Only risk coefficients are available for their radiological isotopes, and were used when they were detected during radiological risk assessment. Among 2 VOCs, one has not been detected and the other, (m+p)-Xylene was detected in one sample out of 47 samples with a very low concentration (less than 1% of the screening values for the surrogate compounds). None of the SVOCs and pesticides were detected. Because of the lack of detection, those analytes will not contribute to the total risks. "	Text will be updated to reflect information in Damon #5 BRA: "Human health risk assessment was performed for radionuclides, metals, VOC, SVOCs/PAHs and pesticides/herbicides. Toxicity information was not available for 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 11 SVOCs and 4 pesticides/herbicides. All excluded metals are radiological in nature. Only risk coefficients are available for their radiological isotopes, and were used when they were detected during radiological risk assessment. Among 2 VOCs, one has not been detected and the other, (m+p)-Xylene was detected in one sample out of 47 samples with a very low concentration (less than 1% of the screening values for the surrogate compounds). None of the SVOCs and pesticides were detected. Because of the lack of detection, those analytes will not contribute to the total risks. " In addition, the lines 38-42 of Page 3-3, S 3.1.1 will be updated as follows: "A total of 35 analytes without known toxicity information were eliminated for the identification of COPCs. This total included 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 11 SVOCs and 4 pesticides/herbicides."
Damon	18	P 7-20, S 7.2.5.6, L 14-15	WAC 173-340-745 applies to industrial soils but not to a "youth trespasser exposure scenario" (MTCA Method C exposure parameters are not compatible with intermittent exposure and a youth receptor).	RFI	The youth trespasser exposure scenario is one of six CERCLA scenarios identified to represent the range of receptors that could be exposed to COPCs in soil from WMA C. It was not evaluated as a part of WAC receptor scenario. Text changes will be made throughout the document to represent each receptor as either CERCLA or WAC receptor.	The youth trespasser exposure scenario is one of six CERCLA scenarios identified to represent the range of receptors that could be exposed to COPCs in soil from WMA C. It was not evaluated as a part of WAC receptor scenario. Text changes will be made throughout the document to represent each receptor as either CERCLA or WAC receptor. It should be noted that for WAC receptors, the total ELCR will be compared to the 2007 MTCA ("Human Health Risk Assessment Procedures" [WAC 173 340 708(5)]) cumulative risk threshold of 1×10^{-5}. For CERCLA receptors, the ELCRs below 10^{-6} are considered acceptable risks whereas ELCRs above 10^{-4} are considered unacceptable risks. Risks between 10^{-4} to 10^{-6} are generally referred to as the "acceptable risk range."
Damon	21	P 7-26, S 7.2.6, L 4-7	Clarify more specifically where evaluation of the groundwater protection pathway will be evaluated for rads.	RFI	Radiological COPCs in the vadose zone will be evaluated using vadose zone models developed in support of the WMA C Performance Assessment. The groundwater protection evaluation for the radiological contaminants will be added to this report.	The groundwater protection evaluation for the radiological contaminants will be added to this RFI report (RPP-RPT-58339).

Damon	31	P 7-43, S 7.5.5, L 9-10	MTCA defines the biologically active soil zone as 0-6 ft (not 6-15 ft), per WAC 173-340-7490 (4)(a).	RFI	Concur. Per WAC 173-340-7490 (4)(a), the biologically active soil zone (a conditional point of compliance) is assumed to extend to a depth of six feet. Text will be corrected as follows: WAC 173-340-7490(4)(a) identifies the biologically active zone extends to a depth of six feet.	Concur. Per WAC 173-340-7490 (4)(a), the biologically active soil zone (a conditional point of compliance) is assumed to extend to a depth of six feet. Text will be corrected as follows: WAC 173-340-7490(4)(a) identifies the biologically active zone extends to a depth of six feet. It should be noted that based on the requirements included in WAC 340-7490[4][b], soil sampling results upto a depth of 15 ft below ground surface were considered during the ecological risk assessment.
Damon	5	P 3-3, S 3.1.1, L 37-42	Text describes one COPC exclusion criteria as, "Analytes without Known Toxicity Information." This exclusion should be described as an uncertainty. A recent editorial in Toxicol Sci notes, "Surprisingly, the current model deems that if we have no reliable toxicity data for a given chemical then it must be assumed to be safe. Although we may be blissfully ignorant of the toxicity this could indeed be very dangerous for the health of the human race and for the *planet" (Miller, 2015)* (http://toxsci.oxfordjournals.org/content/early/2015/02/25/toxsci.kfu310.full.pdf).	BRA	Concur with the statement. Section 3.6.3, P 3-95, Lines 9 to 15 provided information related to analytes with no toxicity as a part of the uncertainty analysis. However, the text will be updated as follows for further clarification: "Human health risk assessment was performed for radionuclides, metals, VOC, SVOCs/PAHs and pesticides/herbicides. Toxicity information was not available for 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 10 SVOCs and 4 pesticides/herbicides. All excluded metals are radiological in nature. Only risk coefficients are available for their radiological isotopes, and were used when they were detected during radiological risk assessment. Among 2 VOCs, one has not been detected and the other, (m+p)-Xylene was detected in one sample out of 47 samples with a very low concentration (less than 1% of the screening values for the surrogate compounds). None of the SVOCs and pesticides were detected. Because of the lack of detection, those analytes will not contribute to the total risks. "	Concur with the statement. Section 3.6.3, P 3-95, Lines 9 to 15 provided information related to analytes with no toxicity as a part of the uncertainty analysis. However, the text will be updated as follows for further clarification: "Human health risk assessment was performed for radionuclides, metals, VOC, SVOCs/PAHs and pesticides/herbicides. Toxicity information was not available for 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 11 SVOCs and 4 pesticides/herbicides. All excluded metals are radiological in nature. Only risk coefficients are available for their radiological isotopes, and were used when they were detected during radiological risk assessment. Among 2 VOCs, one has not been detected and the other, (m+p)-Xylene was detected in one sample out of 47 samples with a very low concentration (less than 1% of the screening values for the surrogate compounds). None of the SVOCs and pesticides were detected. Because of the lack of detection, those analytes will not contribute to the total risks. " In addition, the lines 38-42 of Page 3-3, S 3.1.1 will be updated as follows: "A total of 35 analytes without known toxicity information were eliminated for the identification of COPCs. This total included 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 11 SVOCs and 4 pesticides/herbicides."

Damon	6	P 3-4, S 3.1.2, L 3-5	Eliminating nondetects is appropriate only if detection limits are sufficiently low (e.g., at established PQLs).	BRA	Concur with the statement. Therefore, the following text will be added for clarification: "Both human health risk-based screening levels and ecological screening values were considered during the selection of the detection limits achievable for each of the analytes evaluated. The results for WMA C Phase 2 RFI samples were reported to the laboratories' MDL. The MDL is the lowest concentration at which an analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero. If an analyte is not detected at a concentration greater than or equal to the MDL, it cannot be stated that the analyte is not present in the sample; but rather, with 99% certainty, the analyte is not present at a concentration greater than or equal to the MDL. Few sampling results for a number of COPCs were reported as not detected at MDLs exceeding required detection limits listed in RPP-PLAN-38777. "	Concur with the statement. Therefore, the following text will be added for clarification: "Both human health risk-based screening levels and ecological screening values were considered during the selection of the detection limits achievable for each of the analytes evaluated. The results for WMA C Phase 2 RFI samples were reported to the laboratories' method detection limit (MDL). The MDL is the lowest concentration at which an analyte can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. If an analyte is not detected at a concentration greater than or equal to the MDL, it cannot be stated that the analyte is not present in the sample; but rather, with 99% certainty, the analyte is not present at a concentration greater than or equal to the MDL. Sampling results for 37 primary and secondary contaminants were reported as not detected at MDLs exceeding required detection limits listed in RPP-PLAN-38777. "
Damon	9	P 3-7, S 3.2.2.1, L 31-33	Text notes that only contaminants in the vadose zone (UPRs or planned releases) and surface soils (past operations) are addressed in this BRA. However, Figure 3-1 also includes "potential retrieval leaks." Please reconcile. Clarify why contaminants in residual waste in tanks and ancillary equipment are excluded in the BRA.	BRA	Concur. Four sources were identified for WMA C - Past Leaks, Release from Residual Tank Waste, Release from Ancillary Equipment, and wastes from neayby properties. Figure 3-1 will be updated by deleting "Potential Retrieval Leak" and adding two additional sources identified above.	Concur. Five sources were identified for WMA C - Past Leaks, Potential Retrieval Leaks, Release from Residual Tank Waste, Release from Ancillary Equipment, and Wastes from nearby properties. Figure 3-1 will be updated by adding two additional sources identified above.
Damon	12	P 3-9, Figure 3-1	For transparency, Figure 3-1 should be labeled as human health conceptual exposure model and should present all exposure pathways (even if all are not evaluated). Therefore, in addition to soil ingestion and soil inhalation, MTCA (WAC 173-340) includes soil dermal contact and soil contaminants leaching to groundwater with subsequent ingestion of groundwater by residential receptors. Also, CERCLA includes soil contaminants leaching to groundwater with subsequent ingestion of groundwater by residential and tribal receptors or other subsequent uses (e.g., showering, irrigation of crops). Contaminated groundwater may also impact fish in the Columbia River which may be consumed by residential or tribal receptors.	BRA	The title of the Figure 3-1 will be labeled as "Human Health Conceptural Exposure Model" Both complete and incomplete exposure pathways will be included in the updated Figure 3-1.	Figure 3-1 will be revised. The title of the Figure 3-1 will be labeled as "Human Health Conceptual Exposure Model" Three types of exposure pathways - (1) Complete and Evaluated; (2) Complete, but not Evlauated; and (3) Incomplete, hence not Evaluated will be included in the updated Figure 3-1. The pathways listed in the comments will be included as completed by not evluated. Text will be updated to state the reasoning for not evaluating those completed exposure pathways.

Damon	15	P 3-13, S 3.2.1.4.2, L 7-8	Dermal contact may also be evaluated for MTCA Method C industrial worker scenario (WAC 174-34-745[5][c][iii]).	BRA	Concur. The following text will be added to Section 3.2.1.4.2: Dermal contact pathway is applicable for petroleum mixture hydrocarbon. However, petroleum mixture is not a contaminant of concernfor WMA C.	Under WAC 174-340-745[5][c][iii], dermal contact pathway is applicable for other hazardous substances based on modified MTCA Method C industrial worker scenario. This particular section of the WAC is only applicable when "the proposed changes to Equations 745-1 and 745-2 would result in a significantly higher soil cleanup level than would be calculated without the proposed changes". For WMA C, the risk assessment was only performed for the standard MTCA Method C industrial worker scenario; and no modification is proposed. Under MTCA Method C industrial worker scenario, dermal contact pathway is applicable for petroleum mixture hydrocarbon, which is not a contaminant of concern for WMA C. Therefore, dermal contact pathway was not evaluated. However, Figure 3-1 will be updated to show this pathway as completed but not evaluated.
Damon	18	P 3-16, S 3.2.2, L 37	ProUCL 4.00.05 has been updated. Please use ProUCL 5.0 (Sept 2013) (http://www.epa.gov/OSP/hstl/tsc/software.htm#about).	BRA	In general, the comment is correct about using the most up-to-date guidance and tools for the risk assessment. ProUCL 5.0 was considered for the WMA C BRA (and other BRAs). However, initial testing and evaluation of ProUCL v5 revealed some issues related to the estimation of the population mean using the Kaplan-Meier (KM) method. To understand the reasoning behind the change, correspondence with ProUCL's developers was initiated and they provided an explanation for the change which is being reviewed. Another issue (considerably long time to save results) was discussed with the developers and they indicated they would try to address it in version 5.1. Unfortunately, version 5.1 has not yet been released. This makes the use of version 5.0 extremely time consuming. In the meantime, literature search was conducted about the application of ProUCL version 4 for various projects. This showed that the KM results produced in ProUCL version 4 agree with studies conducted at other sites using SAS (Beal 2009; USGS NADA package using R; independent test cases used to qualify ProUCL at Hanford, etc.). Therefore, ProUCL version 4 model was used during this BRA.	ProUCL 5.0 includes a number of modifications including minor correction of the Kaplan-Meier (KM) method and utilization of smaller detected samples during the calculation of UCL95. To compare the results of exposure point concentrations (EPCs) calculated during the WMA C BRA, the UCL95 for all radiological and nonradiological COPCs within each exposure area were calculated using ProUCL 5.0. The results of the comparison are summarized as follows: • Sampling results with non-detect samples - When the number of detected sample results are less than 5, ProUCL 4.0 did not calculate a valid UCL95. In such case, the WMA C BRA utilized the maximum detected concentration as the UCL95. On the contrary, ProUCL 5.0 calculates UCL95 by utilizing those smaller detected results. Hence, the UCL95 results based on ProUCL 5.0 are less. That means, EPCs calculated using ProUCL 5.0 for smaller detected sample results are less conservative. • Detected Sample Results – The UCL95 for seven analytes (less than 1% of samples) based on 95% Approximate Gamma UCL using ProUCL 5.0 resulted in higher UCL95 (more than 55) as compared to that for ProUCL version 4.0. Among those, except for fluoride, the EPCs for other six analytes are less than their corresponding 90% site background concentration. • Time Consuming - ProUCL 5.0 requires a considerable amount of time to save the results of the runs as compared to that required by ProUCL 4.0. This issue was discussed with the developers and they indicated they would try to address it in version 5.1. Unfortunately, version 5.1 has not yet been released. This makes the use of version 5.0 extremely time consuming. Therefore, the EPCs based on ProUCL 5.0 are less conservative as compared to the EPCs calculated during the WMA C BRA. An appendix will be added within WMA C BRA report to include the results of EPCs using ProUCL 5.0.
Damon	38	P 3-70, S 3.5.11, L 35-45	This data evaluation should compare EPC with CUL (first bullet) or background concentration (second bullet). In the first bullet, text specifies "maximum detected concentration and EPC," while in the second bullet, text specifies "maximum detected concentration." EPC is the key metric which includes both max detect and 95UCL (Table 3-2).	BRA	Concur. Instead of maximum detected concentration, new data evaluation was performed based on the results of EPCs. The results of the evaluation showed that the EPCs for cadmium, lindane and beta-BHC are greater their corresponding three-phase model calculated concentrations. Text will be updated throughout the BRA report based on the results of new data evaluation.	Concur. Instead of maximum detected concentration, new data evaluation was performed based on the results of EPCs. It should be noted that the EPC includes both 95%UCL and the maximum detected concentration. The results of the evaluation showed that the EPCs for cadmium, lindane and beta-BHC are greater their corresponding three-phase model calculated concentrations. Text will be updated throughout the BRA report based on the results of new data evaluation.

Damon	45	P 3-95, S 3.6.3, L 13-15	Specify how many analytes (with no tox data) appear in Table 8-2 of RPP-RPT-57218 (since this document does not appear to be available on the web).	BRA	The whole paragraph will be modified as follows: ""Human health risk assessment was performed for radionuclides, metals, VOC, SVOCs/PAHs and pesticides/herbicides. Toxicity information was not available for 2 radiological parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 10 SVOCs and 4 pesticides/herbicides. All excluded metals are radiological in nature. Only risk coefficients are available for their radiological isotopes, and were used when they were detected during radiological risk assessment. Among 2 VOCs, one has not been detected and the other, (m+p)-Xylene was detected in one sample out of 47 samples with a very low concentration (less than 1% of the screening values for the surrogate compounds). None of the SVOCs and pesticides were detected. Because of the lack of detection, those analytes will not contribute to the total risks. "	Text will be updated to reflect information in Damon #5 BRA and Table 8-1 will be revised: "Human health risk assessment was performed for radionuclides, metals, VOC, SVOCs/PAHs and pesticides/herbicides. Toxicity information was not available for 2 radiological indicator parameters (gross alpha and gross beta), 17 metals, 2 VOCs, 11 SVOCs and 4 pesticides/herbicides. All excluded metals are radiological in nature. Only risk coefficients are available for their radiological isotopes, and were used when they were detected during radiological risk assessment. Among 2 VOCs, one has not been detected and the other, (m+p)-Xylene was detected in one sample out of 47 samples with a very low concentration (less than 1% of the screening values for the surrogate compounds). None of the SVOCs and pesticides were detected. Because of the lack of detection, those analytes will not contribute to the total risks. "
Damon	53	P 4-11, S 4.4.1.1, L 38-42	Text states, "Therefore, both dermal and inhalation exposure were assumed to be negligible." Re inhalation, this may not be true in burrowing animals for inhalation of VOCs (e.g.,; Gallegos et al, 2007 [ETC 26:1299-1303]; Carlsen, 1996 [Risk Anal 16:211-219]) and inhalation of metals (e.g., Bench et al, 2001 [ES&T 35:270-277]).	BRA	Concur. Text will be updated as follows: "Inhalation is generally considered a relatively minor pathway for exposure relative to direct ingestion by wildlife of chemicals of concern. For example, the USEPA's Exposure factors and bioaccumulation models for derivation of wildlife Eco-SSLs, OSWER Directive 9285.7-55. Revised November 2005, did not use inhalation of soil particles in deriving the national ecological soil-screening levels, because exposure is accounted for by the soil-ingestion route. An evaluation of risk to receptors via the inhalation pathway may be warranted, in cases where VOCs are expected site chemicals and pathways of exposure are complete. One possible pathway for inhalation is the potential for volatilization of chemicals and exposure to burrowing animals in subsurface soils. However, methods and data necessary to calculate inhalation exposures are poorly developed (EPA/600/R-93/187). Therefore, inhalation pathway was not considered during the development of SSLs."	Concur. Text will be updated as follows: "Inhalation is generally considered a relatively minor pathway for exposure relative to direct ingestion by wildlife of chemicals of concern. For example, the USEPA's *Exposure factors and bioaccumulation models for derivation of wildlife Eco -SSLs,* OSWER Directive 9285.7-55. Revised November 2005, did not use inhalation of soil particles in deriving the national ecological soil-screening levels, because exposure is accounted for by the soil-ingestion route. As stated in the comment, an evaluation of risk to receptors via the inhalation pathway may be warranted, in cases where VOCs are expected site chemicals and pathways of exposure are complete. One possible pathway for inhalation is the potential for volatilization of chemicals and exposure to burrowing animals in subsurface soils. However, methods and data necessary to calculate inhalation exposures are poorly developed (EPA/600/R 93/187). Bench et al (2001), also noted olfactory bulb uptake in fossorial mammals affords a significant exposure route to manganese and cadmium in soils. However, methods for olfactory exposure and risk characterization are not well established. However, VOCs were not found to be elevated in general for shallow soils on the hanford Site Central Plateau, including WMA C. Similarly, managanese and cadmium are not significant Hanford Site contaminants that needed to be evaluated using such site-specific methods.Therefore, inhalation pathway was not considered during the development of SSLs."



[1] Inhalation during Showering is a complete exposure pathway and will be evaluated for both CTUIR and Yakama Nation Sweat Lodge Uses exposure scenario

[2] Applicable for radiological contaminants

Table 8-1: Waste Management Area C Soil Analytes Excluded from Further Consideration (5 sheets)

Analyte	Analyte Class	CAS#	Units	First Sample Date	Last Sample Date	Total Samples	Total Detects	Frequency of Detects (%)	Min Non-Detect	Max Non-Detect	Min Detect	Max Detect	Reason for Exclusion
Actinium-228	RAD	14331-83-0	pCi/g	5/15/2008	11/8/2011	38	34	89.47	0.819	1.26	0.526	1.9	Half-Life less than 3 years
Antimony-125		14234-35-6	pCi/g	5/15/2008	11/8/2011	134	3	2.24	0.149	7.47	0.309	2.1	
Barium-133		13981-41-4	pCi/g	5/15/2008	7/19/2011	9	0	0	-0.028	0.419	–	–	
Beryllium-7		13966-02-4	pCi/g	6/29/2011	7/19/2011	7	0	0	-0.05	0.18	–	–	
Bismuth-212		14913-49-6	pCi/g	3/21/2011	10/25/2011	13	12	92.31	1.11	1.11	0.77	2.49	
Bismuth-214		14733-03-0	pCi/g	5/15/2008	11/8/2011	56	55	98.21	0.544	0.544	0.343	1.24	
Cadmium-109[1]		14109-32-1	pCi/g	5/15/2008	6/5/2008	2	0	0	3.07	3.22	–	–	
Cerium/ Praseodymium-144		CE/PR-144	pCi/g	6/29/2011	7/19/2011	7	0	0	-0.43	0.11	–	–	
Cerium-144		14762-78-8	pCi/g	5/15/2008	7/19/2011	9	0	0	-0.22	1.06	–	–	
Cesium-134		13967-70-9	pCi/g	5/15/2008	7/21/2011	10	0	0	0.322	0.738	–	–	
Chromium-51[1]		14392-02-0	pCi/g	5/15/2008	6/5/2008	2	0	0	2	2.06	–	–	
Cobalt-57		13981-50-5	pCi/g	5/15/2008	7/19/2011	9	0	0	-0.037	0.135	–	–	
Curium-242		15510-73-3	pCi/g	4/14/2009	11/8/2011	132	0	0	0.0101	0.787	–	–	
Iodine-131[1]		10043-66-0	pCi/g	5/15/2008	6/5/2008	2	0	0	0.248	0.249	–	–	
Iron-59[1]		14596-12-4	pCi/g	5/15/2008	6/5/2008	2	0	0	0.536	0.547	–	–	
Lead-212		15092-94-1	pCi/g	5/15/2008	11/8/2011	82	77	93.9	0.391	0.565	0.358	1.5	
Lead-214		15067-28-4	pCi/g	5/15/2008	11/8/2011	66	62	93.94	0.518	0.678	0.409	2.6	
Manganese-54		13966-31-9	pCi/g	5/15/2008	7/19/2011	9	1	11.11	-0.00047	0.307	0.035	0.035	
Radium-224[1]		13233-32-4	pCi/g	5/15/2008	6/5/2008	2	0	0	5.82	5.91	–	–	
Ruthenium-103		13968-53-1	pCi/g	5/15/2008	7/19/2011	9	0	0	-0.021	0.251	–	–	
Ruthenium-106		13967-48-1	pCi/g	6/29/2011	7/19/2011	7	0	0	-0.067	0.076	–	–	
Sodium-22[1]		13966-32-0	pCi/g	5/15/2008	6/5/2008	2	0	0	0.313	0.331	–	–	
Thallium-208		14913-50-9	pCi/g	5/15/2008	11/8/2011	37	36	97.3	0.265	0.265	0.2	1.22	
Tin-113		13966-06-8	pCi/g	5/15/2008	7/19/2011	9	0	0	-0.031	0.308	–	–	
Tin-117		13981-59-4	µg/kg	4/14/2009	11/8/2011	134	36	26.87	9.78	65.6	10.7	129	
Zinc-65		13982-39-3	pCi/g	5/15/2008	7/19/2011	9	1	11.11	0.0036	0.758	0.11	0.11	
Zirconium/Niobium-95		ZR/NB-95	pCi/g	5/15/2008	6/5/2008	2	0	0	0.533	0.587	–	–	
Gross alpha		12587-46-1	pCi/g	6/29/2011	7/19/2011	7	0	0	-1.1	1.8	–	–	Indicators; No Toxicity Value
Gross beta		12587-47-2	pCi/g	6/29/2011	7/19/2011	7	7	100	–	–	4.6	14	
Potassium-40		13966-00-2	pCi/g	5/15/2008	11/8/2011	112	112	100	–	–	7.34	21.7	Background Radionuclide—not site-related
Radium-226		13982-63-3	pCi/g	5/15/2008	7/19/2011	20	17	85	1.39	5.08	0.67	6.98	
Radium-228		15262-20-1	pCi/g	6/29/2011	7/19/2011	7	7	100	–	–	0.71	1.4	
Thorium-228		14274-82-9	pCi/g	5/15/2008	11/8/2011	134	0	0	7.87	137	–	–	
Thorium-230		14269-63-7	pCi/g	4/14/2009	11/8/2011	134	29	21.64	0.493	1.8	0.495	1.85	
Thorium-232		TH-232	pCi/g	4/14/2009	11/8/2011	134	134	100	–	–	0.178	1.8	
Calcium	METAL	7440-70-2	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	3660000	32200000	Essential Nutrient
Magnesium		7439-95-4	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	2650000	8620000	
Potassium		7440-09-7	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	586000	1600000	
Sodium		7440-23-5	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	139000	1930000	
Bismuth		7440-69-9	µg/kg	5/15/2008	11/8/2011	22	17	77.27	8310	34300	7230	50500	
Cerium		7440-45-1	µg/kg	4/21/2009	11/8/2011	133	130	97.74	26000	48000	12800	33200	

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Europium	METAL	7440-53-1	µg/kg	4/21/2009	6/8/2010	37	36	97.3	921	921	575	4520	No Toxicity Value
Lanthanum		7439-91-0	µg/kg	4/14/2009	11/8/2011	134	134	100	–	–	4770	17300	
Neodymium		7440-00-8	µg/kg	4/14/2009	11/8/2011	56	55	98.21	16000	16000	8910	33400	
Palladium		7440-05-3	µg/kg	4/14/2009	8/11/2009	6	6	100	–	–	41500	132000	
Praseodymium		7440-10-0	µg/kg	5/13/2009	6/30/2011	33	33	100	–	–	1660	4980	
Rhenium[1]		7440-15-5	µg/kg	5/15/2008	6/5/2008	2	0	0	543	5140	–	–	
Rubidium		7440-17-7	µg/kg	6/15/2009	6/15/2009	3	3	100	–	–	265000	316000	
Ruthenium		7440-18-8	µg/kg	5/21/2009	8/23/2010	4	4	100	–	–	8170	18200	
Samarium		7440-19-9	µg/kg	7/30/2009	10/25/2011	5	5	100	–	–	2950	5050	
Tantalum		7440-25-7	µg/kg	4/14/2009	4/4/2011	9	9	100	–	–	5410	58600	
Tellurium		13494-80-9	µg/kg	7/30/2009	3/21/2011	4	4	100	–	–	5980	25800	
Thallium		7440-28-0	µg/kg	5/15/2008	11/8/2011	136	112	82.35	52	17100	54.1	20800	
Titanium		7440-32-6	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	505000	3410000	
Tungsten		7440-33-7	µg/kg	6/3/2009	10/25/2011	17	15	88.24	36200	36600	31800	102000	
Yttrium		7440-65-5	µg/kg	4/14/2009	11/8/2011	134	134	100	–	–	3750	15900	
Zirconium		7440-67-7	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	1280	30700	
(m+p)-Xylene	VOC	179601-23-1	µg/kg	4/14/2009	9/1/2010	101	1	0.99	0.13	0.7	0.334	0.334	No Toxicity Value
1,3-Cyclopentadiene[1]		542-92-7	µg/kg	7/21/2010	7/21/2010	1	1	100	–	–	2.7	2.7	
1,3-Dichlorobenzene		541-73-1	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	–	–	
1,3-Diphenylbenzene[2]		92-06-8	µg/kg	5/11/2010	5/11/2010	1	1	100	–	–	24	24	
2,3-Dimethylpentane[1]		565-59-3	µg/kg	12/29/2009	7/21/2010	3	3	100	–	–	2.6	6.1	
2-Ethyl-1-hexanol[1]		104-76-7	µg/kg	4/30/2009	8/25/2010	16	16	100	–	–	1.2	30	
2-Ethylhexyl Aldehyde[2]		123-05-7	µg/kg	6/1/2009	7/29/2010	2	2	100	–	–	2.7	5.5	
2-Pentanone[2]		107-87-9	µg/kg	7/29/2010	7/29/2010	1	1	100	–	–	6.8	6.8	
3,3-Dimethylpentane[1]		562-49-2	µg/kg	12/29/2009	12/29/2009	1	1	100	–	–	4.3	4.3	
3,7-Dimethyldecane[1]		17312-54-8	µg/kg	7/21/2010	7/29/2010	2	2	100	–	–	4.2	6.9	
3-Ethylpentane[1]		617-78-7	µg/kg	12/29/2009	12/29/2009	1	1	100	–	–	2.7	2.7	
3-Heptanone[2]		106-35-4	µg/kg	5/20/2010	8/25/2010	3	3	100	–	–	2.5	11	
5-Methylundecane[2]		1632-70-8	µg/kg	7/29/2010	7/29/2010	1	1	100	–	–	52	52	
Butyraldehyde[2]		123-72-8	µg/kg	7/29/2010	7/29/2010	1	1	100	–	–	2.3	2.3	
Diisobutyl Phthalate		84-69-5	µg/kg	6/9/2009	11/7/2011	70	70	100	–	–	180	4900	
Hexanal[2]		66-25-1	µg/kg	7/29/2010	7/29/2010	1	1	100	–	–	10	10	
Hexyl methyl ketone[2]		111-13-7	µg/kg	8/25/2010	8/25/2010	1	1	100	–	–	4.6	4.6	
Isobutylene[1]		115-11-7	µg/kg	7/21/2010	7/21/2010	1	1	100	–	–	3.7	3.7	
n-Heptyl Aldehyde[2]		111-71-7	µg/kg	7/29/2010	7/29/2010	1	1	100	–	–	10	10	
Nonaldehyde (pelargonic aldehyde)[2]		124-19-6	µg/kg	4/30/2009	6/4/2009	4	4	100	–	–	2.1	6.5	
Pentadecane[2]		629-62-9	µg/kg	7/21/2010	7/21/2010	1	1	100	–	–	3.2	3.2	
1,2-Benzenedicarboxylic acid, butyl, 2-methylpropylester[1]		17851-53-5	µg/kg	12/30/2009	12/30/2009	1	1	100	–	–	210	210	
1,2-Dichloro-3-isocyanatobenzene[1]		41195-90-8	µg/kg	2/24/2011	2/24/2011	1	1	100	–	–	340	340	

Analyte	Analyte Class	CAS#	Units	First Sample Date	Last Sample Date	Total Samples	Total Detects	Frequency of Detects (%)	Min Non-Detect	Max Non-Detect	Min Detect	Max Detect	Reason for Exclusion
1,6-Dimethyl-4-(1-Methylethyl)Naphthalene[1]	SVOC	483-78-3	µg/kg	2/24/2011	2/24/2011	1	1	100	--	--	840	840	No Toxicity Value
1-Docosene[1]		1599-67-3	µg/kg	2/24/2011	11/7/2011	4	4	100	--	--	340	1200	
1-Eicosene[1]		3452-07-1	µg/kg	6/3/2010	5/25/2011	2	2	100	--	--	230	360	
1-Naphthaleneacetic acid, ethenyl ester[2]		74797-84-5	µg/kg	7/14/2011	7/14/2011	1	1	100	--	--	1.8	1.8	
1-Nonadecene[1]		18435-45-5	µg/kg	4/22/2010	4/22/2010	1	1	100	--	--	260	260	
1-Tricosene[1]		18835-32-0	µg/kg	3/1/2011	3/1/2011	1	1	100	--	--	330	330	
2-(2-ethylhexoxycarbonyl)benzoic acid[1]		4376-20-9	µg/kg	12/29/2009	10/26/2011	3	3	100	--	--	230	450	
2,3,5-Trimethylnaphthalene[1]		2245-38-7	µg/kg	2/24/2011	2/24/2011	1	1	100	--	--	270	270	
2,3,6-Trimethylnaphthalene[1]		829-26-5	µg/kg	2/24/2011	2/24/2011	1	1	100	--	--	290	290	
2,3-Epoxy-2-methylbutane[1]		5076-19-7	µg/kg	12/29/2009	12/30/2009	3	3	100	--	--	290	370	
2-Hexyldecan-1-ol[1]		2425-77-6	µg/kg	7/19/2010	7/19/2010	1	1	100	--	--	360	360	
2-Methylbut-3-en-2-ol[1]		115-18-4	µg/kg	7/19/2010	7/19/2010	1	1	100	--	--	250	250	
2-Nitrophenol		88-75-5	µg/kg	4/14/2009	11/8/2011	131	0	0	44.1	200	--	--	
3,4-Dichlorophenyl isocyanate[1]		102-36-3	µg/kg	7/19/2010	2/24/2011	2	2	100	--	--	260	460	
3+4 Methylphenol (cresol, m+p)		65794-96-9	µg/kg	4/14/2009	11/8/2011	129	0	0	42.2	200	--	--	
4-Bromophenylphenyl ether		101-55-3	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	--	--	
4-Chlorophenylphenyl ether		7005-72-3	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	--	--	
7,9-Di-tert-butyl-1-oxaspiro(4,5)deca-6,9-diene-2,8-dione[2]		82304-66-3	µg/kg	8/4/2009	8/13/2009	2	2	100	--	--	200	220	
Acenaphthylene		208-96-8	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	--	--	
Benzo(ghi)perylene		191-24-2	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	--	--	
Butyl cyclohexyl phthalate[1]		84-64-0	µg/kg	10/25/2011	10/25/2011	1	1	100	--	--	970	970	
Cholesta-3,5-dien-7-one[1]		567-72-6	µg/kg	2/24/2011	2/24/2011	1	1	100	--	--	630	630	
Dibutylphosphate[1]		107-66-4	µg/kg	4/22/2009	9/1/2010	49	0	0	860	1200	--	--	
Dimethyl phthalate		131-11-3	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	--	--	
Di-n-nonyl phthalate[1]		84-76-4	µg/kg	1/19/2010	5/17/2010	3	3	100	--	--	210	1800	
Di-n-octylphthalate		117-84-0	µg/kg	4/14/2009	11/8/2011	131	12	9.16	39.2	200	79	1220	
Eicosane[1]		112-95-8	µg/kg	2/24/2011	2/24/2011	1	1	100	--	--	340	340	
Enanthoic Acid[2]		111-14-8	µg/kg	7/27/2010	7/27/2010	1	1	100	--	--	380	380	
Hexadecane[2]		544-76-3	µg/kg	2/24/2011	2/24/2011	1	1	100	--	--	170	170	
Hexadecanoic acid (9CI)[1]		57-10-3	µg/kg	5/18/2009	2/24/2011	5	5	100	--	--	220	1900	
Isopropenyl methyl ketone[1]		814-78-8	µg/kg	7/19/2010	5/25/2011	3	3	100	--	--	250	680	
Methyl eicosanoate[1]		1120-28-1	µg/kg	6/3/2009	6/3/2009	1	1	100	--	--	350	350	
Methyl hexadecanoate[1]		112-39-0	µg/kg	6/3/2009	6/3/2009	1	1	100	--	--	460	460	
Methyl octadec-9-enoate[1]		1937-62-8	µg/kg	6/3/2009	6/3/2009	1	1	100	--	--	3600	3600	

Analyte	Analyte Class	CAS#	Units	First Sample Date	Last Sample Date	Total Samples	Total Detects	Frequency of Detects (%)	Min Non-Detect	Max Non-Detect	Min Detect	Max Detect	Reason for Exclusion
Methyl octadecanoate[1]	SVOC	112-61-8	µg/kg	6/3/2009	6/3/2009	1	1	100	–	–	690	690	No Toxicity Value
Monobutyl phosphate		1623-15-0	µg/kg	4/22/2009	9/1/2010	49	0	0	630	98300	–	–	
n-Heptane[1]		142-82-5	µg/kg	2/24/2011	6/20/2011	8	8	100	–	–	210	15000	
n-Tetracosane[2]		646-31-1	µg/kg	9/1/2010	9/1/2010	1	1	100	–	–	290	290	
Octacosane[1]		630-02-4	µg/kg	2/24/2011	2/24/2011	1	1	100	–	–	240	240	
Octadecanoic acid[1]		57-11-4	µg/kg	2/24/2011	2/24/2011	1	1	100	–	–	310	310	
Phenanthrene		85-01-8	µg/kg	6/29/2011	7/21/2011	8	0	0	200	200	–	–	
Phthalic acid bis(7-methyloctyl)ester[1]		20548-62-3	µg/kg	6/1/2011	11/7/2011	3	3	100	–	–	0.91	250	
Ricinoleic acid[2]		141-22-0	µg/kg	5/7/2010	5/7/2010	1	1	100	–	–	2800	2800	
Stigmastane[1]		601-58-1	µg/kg	2/24/2011	2/24/2011	1	1	100	–	–	1300	1300	
Stigmastanol[1]		19466-47-8	µg/kg	2/24/2011	2/24/2011	1	1	100	–	–	910	910	
Trichloroacetic acid palmityl ester[2]		74339-54-1	µg/kg	4/23/2010	4/23/2010	1	1	100	–	–	200	200	
Bromacil (ACN)[1]	PESTICIDE	314-40-9	µg/kg	8/10/2009	2/24/2011	6	6	100	–	–	200	1300	No Toxicity Value
Delta-BHC		319-86-8	µg/kg	12/29/2009	10/26/2011	38	0	0	0.24	0.77	–	–	
Endosulfan sulfate		1031-07-8	µg/kg	2/24/2011	10/26/2011	14	0	0	0.25	0.52	–	–	
Endrin aldehyde		7421-93-4	µg/kg	2/24/2011	10/26/2011	14	0	0	0.39	0.81	–	–	
Endrin ketone		53494-70-5	µg/kg	2/24/2011	10/26/2011	14	0	0	0.3	0.62	–	–	
Total petroleum hydrocarbons - diesel range	TPH	TPHDIESEL	µg/kg	4/14/2009	8/29/2010	42	8	19.05	330	35000	12000	135000	No Toxicity Value
Total petroleum hydrocarbons - gasoline range		TPHGASOLINE	µg/kg	4/14/2009	8/29/2010	38	1	2.63	10	335	100	100	
2-Hydroxyacetate	ANION	GLYCOLATE	µg/kg	4/14/2009	11/8/2011	133	1	0.75	82.6	123	663	663	
Acetate		71-50-1	µg/kg	4/14/2009	11/8/2011	133	96	72.18	53.7	75.5	105	24500	
Bromide		24959-67-9	µg/kg	5/15/2008	11/8/2011	135	4	2.96	511	4500	27.5	1760	
Chloride		16887-00-6	µg/kg	5/15/2008	11/8/2011	135	132	97.78	540	3200	303	69000	
Formate		FORMATE	µg/kg	4/14/2009	11/8/2011	133	124	93.23	44.1	491	109	7060	
Oxalate		338-70-5	µg/kg	4/14/2009	11/8/2011	133	75	56.39	204	298	210	14300	
Phosphate		14265-44-2	µg/kg	5/15/2008	11/8/2011	135	107	79.26	151	8280	188	11600	
Sulfate		14808-79-8	µg/kg	5/15/2008	11/8/2011	135	132	97.78	620	3800	1710	592000	
Sulfide		18496-25-8	µg/kg	4/14/2009	9/1/2010	100	86	86	5250	29200	7080	42200	
Ammonium ion	CATION	14798-03-9	µg/kg	4/14/2009	11/8/2011	132	90	68.18	92.7	19900	156	22800	
Phosphorus	GEN CHEM	7723-14-0	µg/kg	5/15/2008	11/8/2011	136	136	100	–	–	354000	1350000	Special Analysis - Method 6010 Artifact
Silicon		7440-21-3	µg/kg	5/15/2008	11/8/2011	136	134	98.53	8570	8570	10800	2330000	No Toxicity Value
Sulfur		7704-34-9	µg/kg	5/15/2008	11/8/2011	131	131	100	–	–	32800	595000	
Alkalinity		ALKALINITY	mEQ/g	5/15/2008	6/5/2008	2	1	50	0.0008	0.0008	0.0119	0.0119	Physical Property
Bicarbonate		71-52-3	mEQ/g	12/29/2009	4/15/2010	10	10	100	–	–	0.0009	0.0021	
Bulk density - wet		BULKDENSITY-WET	ug/L	4/14/2009	11/8/2011	89	89	100	–	–	1740000000	2550000000	
Carbonate ion		3812-32-6	mEQ/g	12/29/2009	4/15/2010	10	2	20	0.0000047	0.0000049	0.0001	0.0002	

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Percent moisture (wet sample)		%MOISTURE	%	5/15/2008	4/10/2013	131	131	100	--	--	0.8	18.11	No Toxicity Value
pH Measurement		PH	unitless	5/15/2008	11/8/2011	139	139	100	--	--	7.21	11.1	Physical Property
Specific Conductance		CONDUCT	uS/cm	5/15/2008	11/8/2011	36	36	100	--	--	60.9	1240	

Footnotes

[1] Tracer and Tentatively Identified Compounds. Not considered during the risk assessment.

[2] Mostly one time sampling event. Not part of site characterization studies, hence not considered during the risk assessment.