

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

SWMU 58 RCRA Facility Investigation Report



Prepared for:

USACE Baltimore District
10 S. Howard St.
Baltimore, MD 21201



Prepared by:

Shaw Environmental, Inc.
2113 Emmorton Park Rd.
Edgewood, MD 21040
Contract No. DACA31-01-F-0085

Final Document

December 2003

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Decision Document

SWMU 58: Rubble Pile – No Further Action

FINAL

Au gust 2004

13

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1.0 PURPOSE

This Decision Document (DD) is prepared in accordance with the Assistant Chief of Staff for Installation Management (ACSIM) memorandum (ACSIM, 2003) detailing policies for staffing and approving DDs, Defense Environmental Restoration Program (DERP) management guidance (DERP, 2001) and the RFAAP RCRA Permit, Part II sect. D (4) (USEPA, 2000) (EPA ID No. VA1210020730). This DD describes the selection of No Further Action for Solid Waste Management Unit 58 - the "Rubble Pile" at Radford Army Ammunition Plant (RFAAP). No Further Action was selected in accordance with the Resource Conservation and Recovery Act of 1976 (RCRA), the Hazardous and Solid Waste Amendments of 1984 (HSWA), the RFAAP Resource Conservation and Recovery Act (RCRA) Permit requirements (USEPA, 2000) (EPA ID No. VA1210020730), and the Final RCRA Corrective Action Plan (USEPA, 1994), as applicable.

SWMU 58 is located in the south-central portion of the Horseshoe Area, east of the main bridge over the New River and directly west of SWMU 32 (Inert Waste Landfill No. 1). There are several buildings, an overhead steam pipe, and gravel and paved roads in the vicinity. SWMU 58 is roughly triangular in shape with each side approximately 300 ft long. Although the pile is irregular in height, the highest elevation point measured at the top of the pile during the advancement of soil boring 58SB04 in July 2002 was 1,771 ft msl or 35 ft above the natural ground surface elevation of 1,736 ft msl. According to facility representatives interviewed during a March 1990 facility visit, SWMU 58 was used as a one-time construction debris disposal site in 1979. During clearing activities prior to the construction of the Continuous Automated Multi-Base Line (CAMBL), pine trees and surface debris were pushed into a pile and then covered with dirt and fill material. It is believed that vegetation (trees/brush) from the clearing activities was burned to reduce the volume of the pile. It is also believed that no other materials were disposed at SWMU 58.

The results of the RCRA Facility Investigation (RFI) human health and ecological risk assessment results indicated that no unacceptable risk is associated with unrestricted reuse of the SWMU 58 area. This is a more conservative use of the property than the current or anticipated future land use for SWMU 58 (open riparian space). Based on no unacceptable risk to human health and the environment, the Army has selected No Further Action as the preferred remedial alternative for SWMU 58 with concurrence from the U.S. Environmental Protection Agency (USEPA) Region III, Virginia Department of Environmental Quality (VDEQ) and the U.S. Army for Health Promotion and Preventive Medicine (USACHPPM). Documents supporting this decision are located in the RFAAP information repository.

2.0 SITE RISK

A baseline human health risk assessment (HHRA) and screening-level ecological risk assessment (SLERA) were conducted as part of the SWMU 58 RFI.

An HHRA was performed to evaluate the potential human health effects associated with past activities at SWMU 58. Using the results of the human exposure assessment and toxicity information, potential human health risks for each Contaminant of Potential Concern (COPC) and selected exposure pathway were evaluated. Results of the HHRA indicate that the

cumulative cancer risk associated with both surface soil and total soil for maintenance workers, and total soil for excavation workers, adult residents, and child residents were below or within the U.S. Environmental Protection Agency (USEPA) target risk range of 1×10^{-6} to 1×10^{-4} . The non-carcinogenic Hazard Index (HI) was below 1 for maintenance workers, excavation workers, and adult residents. For child residents, the non-carcinogenic HI was equal to 1.1. However, there were no predominant COPCs representing non-carcinogenic hazards (i.e., no chemical HI was equal to or exceeded 1). Trichloroethene (TCE) and benzo(a)pyrene were the risk drivers for the limited potential human health risk calculated.

A SLERA was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases at SWMU 58. Environmental Effects Quotients (EEQs) and hazard indices were estimated for five selected receptor species, and direct contact exposure for terrestrial invertebrates was assessed, as these invertebrates may serve as a food supply for some of the selected receptor species. Initial results indicated the potential for adverse effects to some of the five species, however, based on likely overestimates of (1) toxicity; and, (2) uptake of inorganics by earthworms from soil; and, that no wildlife rare, threatened, or endangered species have been confirmed at the SWMU 58 study area, no further action is recommended for the site for food chain exposure considerations. A similar recommendation of no further action results from the finding of limited potential for a reduction in terrestrial invertebrates that may serve as a food supply for higher order wildlife, based on direct contact considerations.

3.0 REMEDIAL ALTERNATIVES

Based on the results of the human health and ecological risk assessments, no unacceptable risk to human health or the environment exists at SWMU 58; therefore, no remedial alternatives have been considered. The Army has selected No Further Action as the preferred remedial alternative for SWMU 58.

4.0 PUBLIC/COMMUNITY INVOLVEMENT

RFAAP has a Restoration Advisory Board (RAB) that has been actively involved throughout the environmental investigation activities conducted during the RFI. The RAB includes representatives from USEPA and the Virginia Department of Environmental Quality (VDEQ), as well as members of the local community.

Comments on the RFI were solicited from the USEPA and VDEQ. Comments were received and considered by the U.S. Army prior to selection of the No Further Action alternative for SWMU 58.

5.0 DECLARATION

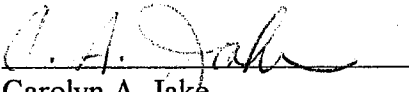
No remedial action is necessary at SWMU 58 to ensure the protection of human health and the environment. Therefore, none of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 statutory determinations are necessary since no remedy is

6.0 APPROVAL AND SIGNATURE

Approved By:


James J. McKenna
Restoration Program Manager
Radford AAP

13 Dec 2004
Date


Carolyn A. Jake
Environmental Manager
Alliant Ammunition and Powder Company, LLC

12/13/04
Date


Robert G. Thomson
Remedial Project Manager
USEPA Region III

12/16/04
Date

7.0 REFERENCES

Assistant Chief of Staff for Installation Management (ACSIM), 2003. *Memorandum from Major General Larry J. Lust: Policies for Staffing and Approving Decision Documents (DDs)*, dated 09 September 2003.

Defense Environmental Restoration Program (DERP), 2001. *Memorandum for Assistant Secretary of the Army: Management Guidance for the Defense Environmental Restoration Program*, dated 28 September 2001.

U.S. Environmental Protection Agency (USEPA), 1994. *Final RCRA Corrective Action Plan*, Office of Solid Waste and Emergency Response. EPA/520/R/94/004.

U.S. Environmental Protection Agency (USEPA), 2000. *Radford Army Ammunition Plant Permit for Corrective Action and Waste Minimization*. Permit No. VA1210020730. 31 October 2000.

U.S. Army Radford Army Ammunition Plant (RFAAP), 2003. *SWMU 58 RCRA Facility Investigation Report, Final Document December 2003*.



Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100
USA

December 17, 2004

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: Decision Document, SWMU 58: Rubble Pile- No Further Action, Final August 2004
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

This letter is confirmation that the approved and signed copies of the subject document were provided to you and Messrs. Perry and Wood listed below on the distribution list during the December 16, 2004 Radford AAP Restoration Advisory Board meeting. A copy will be mailed to Ms. Lohman and Mr. Willis. The subject document is unchanged from when it was submitted September 10, 2004 as there were no comments from EPA.

The subject document was prepared per Part II, D.4 of the RCRA Corrective Action permit. It contains a summary discussion of the assessments and evaluations performed in the SWMU 58 RCRA Facility Investigation Report, Final Document, December 2003 that supports the RFI conclusion of no further action. EPA and DEQ respectively approved the RFI on May 24, 2004 and August 5, 2003.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

A handwritten signature in black ink that reads "C. A. Jake". The signature is written in a cursive, flowing style.

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

Enclosure

w/enclosure

c:

Durwood Willis (2 copies)
Virginia Department of Environmental Quality
P. O. Box 10009
Richmond, VA 23240-0009

E. A. Lohman
Virginia Department of Environmental Quality
West Central Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

Mr. Robert Thomson
Decision Document, SWMU 58: Rubble Pile- No Further Action, Final August 2004
December 17, 2004
Page #

w/o enclosure

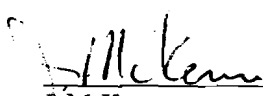
Russell Fish, P.E., EPA Region III

Tony Perry
U.S. Army Environmental Center
5179 Hoadley Road, Attn: SFIM-AEC-ERP
Aberdeen Proving Ground, MD 21010-5401

Steve Wood
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

bc: Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File

Coordination:


J. McKenna



5.

Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24141
USA

September 10, 2004

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: Decision Document, SWMU 58: Rubble Pile- No Further Action, Final August 2004
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed are three copies of the Decision Document, SWMU 58: Rubble Pile- No Further Action, Final August 2004 per Part II, D.4 of the RCRA Corrective Action permit. This document has been prepared as a summary discussion of the assessments and evaluations performed in the SWMU 58 RCRA Facility Investigation Report, Final Document, December 2003 that supports the RFI conclusion of no further action. EPA and DEQ respectively approved the RFI on May 24, 2004 and August 5, 2003.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

A handwritten signature in black ink, appearing to read "C. A. Jake".

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

Enclosure

c: Russell Fish, P.E., EPA Region III

Durwood Willis (2 copies)
Virginia Department of Environmental Quality
P. O. Box 10009
Richmond, VA 23240-0009

E. A. Lohman
Virginia Department of Environmental Quality
West Central Regional Office
3019 Peters Creek Road
Roanoke, VA 24019

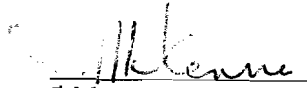
Tony Perry
U.S. Army Environmental Center
5179 Hoadley Road, Attn: SFIM-AEC-ERP
Aberdeen Proving Ground, MD 21010-5401

Keith Williams
U.S. Army Center for Health Promotion and Preventive Medicine
5158 Blackhawk Road, Attn: MCHB-TS-REH
Aberdeen Proving Ground, MD 21010-5403

John Tesner
Corps of Engineers, Baltimore District
ATTN: CENAB-EN-HM
10 South Howard Street
Baltimore, MD 21201

bc: Administrative File
J. McKenna, ACO Staff
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File

Coordination:


J. McKenna

Concerning the following:

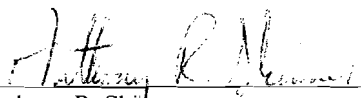
Decision Document,
SWMU 58: Rubble Pile-No Further Action
Final August 2004
Radford Army Ammunition Plant

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE:

PRINTED NAME:

TITLE:

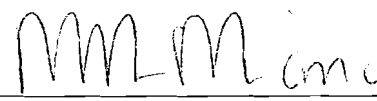


Anthony R. Skinner
LTC, CM, Commanding
Radford AAP

SIGNATURE:

PRINTED NAME:

TITLE:



Anthony Miano
Vice President Operations
Alliant Ammunition and Powder Company, LLC

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

Decision Document

SWMU 58: Rubble Pile – No Further Action

FINAL

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This Decision Document (DD) is prepared in accordance with the Assistant Chief of Staff for Installation Management (ACSIM) memorandum (ACSIM, 2003) detailing policies for staffing and approving DDs, Defense Environmental Restoration Program (DERP) management guidance (DERP, 2001) and the RFAAP RCRA Permit, Part II sect. D (4) (USEPA, 2000) (EPA ID No. VA1210020730). This DD describes the selection of No Further Action for Solid Waste Management Unit 58 - the "Rubble Pile" at Radford Army Ammunition Plant (RFAAP). No Further Action was selected in accordance with the Resource Conservation and Recovery Act of 1976 (RCRA), the Hazardous and Solid Waste Amendments of 1984 (HSWA), the RFAAP Resource Conservation and Recovery Act (RCRA) Permit requirements (USEPA, 2000) (EPA ID No. VA1210020730), and the Final RCRA Corrective Action Plan (USEPA, 1994), as applicable.

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An HHRA was performed to evaluate the potential human health effects associated with past activities at SWMU 58. Using the results of the human exposure assessment and toxicity information, potential human health risks for each Contaminant of Potential Concern (COPC) and selected exposure pathway were evaluated. Results of the HHRA indicate that the

7

cumulative cancer risk associated with both surface soil and total soil for maintenance workers, and total soil for excavation workers, adult residents, and child residents were below or within the U.S. Environmental Protection Agency (USEPA) target risk range of 1×10^{-6} to 1×10^{-4} . The non-carcinogenic Hazard Index (HI) was below 1 for maintenance workers, excavation workers, and adult residents. For child residents, the non-carcinogenic HI was equal to 1.1. However, there were no predominant COPCs representing non-carcinogenic hazards (i.e., no chemical HI was equal to or exceeded 1). Trichloroethene (TCE) and benzo(a)pyrene were the risk drivers for the limited potential human health risk calculated.

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Based on the results of the human health and ecological risk assessments, no unacceptable risk to human health or the environment exists at SWMU 58; therefore, no remedial alternatives have been considered. The Army has selected No Further Action as the preferred remedial alternative for SWMU 58.

4.0 PUBLIC/COMMUNITY INVOLVEMENT

RFAAP has a Restoration Advisory Board (RAB) that has been actively involved throughout the environmental investigation activities conducted during the RFI. The RAB includes representatives from USEPA and the Virginia Department of Environmental Quality (VDEQ), as well as members of the local community.

Comments on the RFI were solicited from the USEPA and VDEQ. Comments were received and considered by the U.S. Army prior to selection of the No Further Action alternative for SWMU 58.

5.0 DECLARATION

No remedial action is necessary at SWMU 58 to ensure the protection of human health and the environment. Therefore, none of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 statutory determinations are necessary since no remedy is

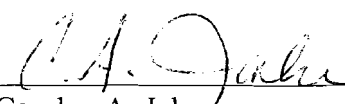
being selected. Since no site-related hazardous substances are present onsite above levels that allow for unlimited use and unrestricted exposure, the five-year review will not apply at this site.

6.0 APPROVAL AND SIGNATURE

Approved By:


James J. McKenna
Restoration Program Manager
Radford AAP

14 Sep 2004
Date


Carolyn A. Jake
Environmental Manager
Alliant Ammunition and Powder Company, LLC

9/14/04
Date

Robert G. Thomson
Remedial Project Manager
USEPA Region III

Date

7.0 REFERENCES

Assistant Chief of Staff for Installation Management (ACSIM), 2003. *Memorandum from Major General Larry J. Lust: Policies for Staffing and Approving Decision Documents (DDs)*, dated 09 September 2003.

Defense Environmental Restoration Program (DERP), 2001. *Memorandum for Assistant Secretary of the Army: Management Guidance for the Defense Environmental Restoration Program*, dated 28 September 2001.

U.S. Environmental Protection Agency (USEPA), 1994. *Final RCRA Corrective Action Plan*, Office of Solid Waste and Emergency Response. EPA/520/R/94/004.

U.S. Environmental Protection Agency (USEPA), 2000. *Radford Army Ammunition Plant Permit for Corrective Action and Waste Minimization*. Permit No. VA1210020730. 31 October 2000.

U.S. Army Radford Army Ammunition Plant (RFAAP), 2003. *SWMU 58 RCRA Facility Investigation Report, Final Document December 2003*.

7A'
McKenna, Jim

From: McKenna, Jim
Sent: Monday, July 12, 2004 2:49 PM
To: 'Tony Perry'
Subject: SWMU 58 RFI Report, regulatory letters approval letters
Importance: High

Tony, Just faxed you the SWMU 58 RFI Report approval letters from EPA and DEQ. Also included USACHPPM's approval. 5 pages total were faxed to 410 436 1548.

Jim McKenna

IMPORTANT NOTE: When replying to this message cut and paste Jim_McKenna@ATK.com into the address line. Please do not hit reply. Thanks.

McKenna, Jim

From: Thomson.Bob@epamail.epa.gov
 To: Redder, Jerome; john e tesner; Parks, Jeffrey N
Subject: RE: SWMU 58 Final RFI.
Importance: High

Rob and all:

Please see Rob's message below and send him two additional copies of the Final SWMU 58 RFI report. Include a copy of the email as the transmittal letter. Thanks.

Jim McKenna

IMPORTANT NOTE: When replying to this message cut and paste Jim_McKenna@ATK.com into the address line. Please do not hit reply. Thanks.

-----Original Message-----

From: Thomson.Bob@epamail.epa.gov [mailto:Thomson.Bob@epamail.epa.gov]
 Sent: Thursday, June 24, 2004 9:43 AM
 To: McKenna, Jim
 Subject: RE: SWMU 58 Final RFI.

----- Forwarded by Bob Thomson/R3/USEPA/US on 06/24/2004 09:43 AM -----

Bob Thomson

To: "McKenna, Jim" <jim.mckenna@us.army.mil>
 06/24/2004 09:32 AM cc: "Redder, Jerome" <Jerome.Redder@ATK.COM>, "john e tesner" <john.e.tesner@usace.army.mil>
 Subject: RE: SWMU 58 Final RFI.(Document link: Bob Thomson)

Jim:

Basically, EPA is requesting that two final copies of the RFI be submitted for insertion into the project files. The previous copies were distributed for review and of course are not in the best of shape now. No final approval letter is needed as long as the final documents satisfy the May 24, 2004 EPA letter.

Rob

"McKenna, Jim"

<jim.mckenna@us.army.mil> To: Bob Thomson/R3/USEPA/US@EPA
cc: "Redder, Jerome" <Jerome.Redder@ATK.COM>, "john e tesner"
<john.e.tesner@usace.army.mil>

06/24/2004 07:57 Subject: RE: SWMU 58 Final RFI.
AM

Rob, Any word on how to proceed with this? My thought is that since the reports have been revised in accordance with our responses (you will probably want to confirm) all you need to do is send out an approval letter.

Jim

Jim McKenna

IMPORTANT NOTE: When replying to this message cut and paste Jim_McKenna@ATK.com into the address line. Please do not hit reply. Thanks.

-----Original Message-----

> From: McKenna, Jim
> Sent: Tuesday, June 15, 2004 11:30 AM
> To: 'rob thomson'
> Cc: Redder, Jerome; 'john e tesner'
> Subject: SWMU 58 Final RFI.
>
> Rob,
>
> Looking over your May 24, 2004 letter, the SWMU 58 RFI report is
> conditionally approved based on our March 2004 response to comments.
Also
> it says to forward two additional of the revised report. Please note
that
> the four SWMU 58 RFI reports that are now in your possession have
already
> been revised in accordance with these responses with each entitled as
a
> "Final Document". Our March 2004 response was actually included (or
> should have been) when we transmitted this final document to you on
> December 23, 2003 but some how the responses weren't attached and we
> didn't find out until March 2004 during EPA review. In any case we can
end two more copies. Hope this isn't too confusing.
>
> Jim McKenna

> IMPORTANT NOTE: When replying to this message cut and paste
> Jim_McKenna@ATK.com into the address line. Please do not hit
reply.
Thanks.

✓

A.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

May 24, 2004

In reply
Refer to 3HS13

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commander,
Radford Army Ammunition Plant
Attn: SIORF-SE-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

Carolyn A. Jake
Environmental Manager
Alliant Techsystems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

Re: Radford Army Ammunition Plant
SWMU 58
Rubble Pile
Document submittal and review

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the U.S. Army's (Army's) March 2004 response to EPA's September 18, 2003 review comments pertaining to the draft *RCRA Facility Investigation Report* (RFI) for SWMU 58, located at the Radford Army Ammunition Plant (RFAAP). Based upon that review, EPA finds the Army's March 2004 response to be acceptable.

Given the above, the referenced draft *RCRA Facility Investigation Report* (RFI) is conditionally approved by EPA, provided that EPA's comments are satisfactorily addressed in the final RFI Report. Please forward two copies of the final SWMU 58 RFI Report to EPA for review and approval.

41
If you have any questions, please call me at 215-814-3357.

Sincerely,

A handwritten signature in cursive script, appearing to read "Robert Thomson".

Robert Thomson, PE
Federal Facilities Branch

cc: Russell Fish, EPA
Leslie Romanchik, VDEQ-RCRA

37.
McKenna, Jim

From: Thomson.Bob@epamail.epa.gov
Sent: Monday, March 01, 2004 10:51 AM
To: McKenna, Jim
Cc: 'Parks, Jeffrey N'; Redder, Jerome; 'john e tesner'
Subject: RE: Review of SWMU 58 draft RFI



SWMU 58 RFI RTC
attachment.doc...

This is okay...

Rob

Also, just a quick note on SWMU 51, WP Addendum 17. We reviewed the Feb, 2004 draft WP Addendum with the corrected/updated Figure 1-7. The Feb. 2004 draft WP Addendum is okay, and an approval letter will be forthcoming. However, the accompanying Feb. 26, 2004 cover letter mentions the addition of chemical sampling locations (51SBC 10, 51SBC18 and 51SBC16). Please note that these sampling locations are not reflected on the revised Figure 1-7, but not to worry as other samples are. The nomenclature for the sampling locations must have been mixed up with the generation of the revised Figure. However, the correct number of sampling locations is all that matters. Sure had us scratching our heads for a moment.....

Rob

"McKenna, Jim"
<jim.mckenna@us.army.mil> To: Bob Thomson/R3/USEPA/US@EPA
cc: "Redder, Jerome" <Jerome.Redder@ATK.COM>, 'john e tesner'
<john.e.tesner@usace.army.mil>, "Parks, Jeffrey N"
<Jeffrey.Parks@shawgrp.com>
03/01/2004 10:35 AM Subject: RE: Review of SWMU 58 draft RFI

Rob, Yes there was a response but apparently it did not get attached to the

12/23/2003 transmittal letter. The responses are in the attached file.

Is

this ok or do you want us to send a hard copy?

Jim McKenna

IMPORTANT NOTE: When replying to this message cut and paste

Jim_McKenna@ATK.com into the address line. Please do not hit reply.

Thanks.

-----Original Message-----

From: Thomson.Bob@epamail.epa.gov [mailto:Thomson.Bob@epamail.epa.gov]

Sent: Monday, March 01, 2004 10:23 AM

To: McKenna, Jim; Redder, Jerome

Cc: John.E.Tesner@nab02.usace.army.mil

Subject: Review of SWMU 58 draft RFI

Hi Folks:

EPA is currently in receipt of the Dec 2003/Jan 2004 version of the draft RFI for SWUM 58. In reviewing the draft final submittal, we noted that for all three copies of the draft final report at Region III, there did not appear to be a response to EPA's September 18, 2003 review comments. Is there a response to comments out there?

Thanks...Rob Thomson

(See attached file: SWMU 58 RFI RTC attachment.doc)



Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100
USA

January 6, 2004

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: SWMU 58 RCRA Facility Investigation Report Final, December 2003
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is the certification for the SWMU 58 RCRA Facility Investigation Report Final, December 2003 Radford Army Ammunition Plant that was sent to you on December 23, 2003.

Please coordinate with and provide any questions or comments to Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

Lo- JJ Redder
C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company, LLC

Enclosure

w/o enclosure

c: Russell Fish, P.E., EPA Region III

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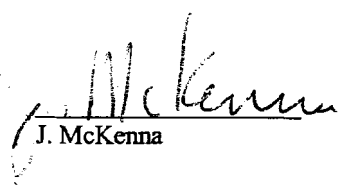
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J. McKenna

Concerning the following:

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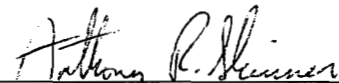
SWMU 58 RCRA Facility Investigation Report Final, December 2003
Radford Army Ammunition Plant

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

SIGNATURE:

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TITLE:



Anthony R. Skinner
LTC, CM, Commanding
Radford AAP

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Anthony Miano
Vice President Operations
Alliant Ammunition and Powder Company, LLC

December 23, 2003

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: SWMU 58 RCRA Facility Investigation Report Final, December 2003
Radford Army Ammunition Plant
EPA ID# VA1 210020730

Dear Mr. Thomson:

Enclosed is one copy of the SWMU 58 RCRA Facility Investigation Report Final, December 2003 Radford Army Ammunition Plant for your review and comment or approval. Your additional three copies and certification will be sent under separate cover as well as additional copies to the Virginia Department of Environmental Quality (VDEQ), U.S. Army Environmental Center, U.S. Army Center for Health Promotion and Preventive Medicine. Also attached are our responses to the comments contained in your September 18, 2003 letter.

Please coordinate with and provide any questions or comments to Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company, LLC

Enclosure

w/o enclosure

c: Russell Fish, P.E., EPA Region III

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Response to USEPA Comments dated 18 September 2003
for
Draft SWMU 58 RCRA Facility Investigation Report
Dated March 2003

Background and Format

On July 18, 2003 EPA e-mailed RFAAP draft comments on the subject report. On August 5, 2003, RFAAP e-mailed responses to EPA on these comments. On September 18, 2003, EPA sent formal comments and included RFAAP responses. For some comments, EPA found RFAAP's response acceptable, and for other responses, EPA had an additional comment. For clarity, the beginning of EPA's original comment, RFAAP's response, and EPA's finding/additional comment and additional RFAAP responses are shown in bold.

General Comments

EPA Comment 1

Figures 2-5, 4-1, 4-2, Tables 4-1, 4-2 of the RFI Report, and Tables C-1 through C-3 in Appendix C should be revised to compare the detected soil concentrations to the current EPA Region 3 industrial soil Risk-Based Concentration (RBC) values (April 25, 2003 version), which incorporates changes resulting from the new soil ingestion rate for outdoor workers. Any conclusions drawn, if different from those presented in the draft RFI Report, due to this new comparison should also be identified in the revised RFI Report. All statements regarding the number of constituents and sample results exceeding the industrial RBC values should be revised. The legends of the figures should also identify the date of the RBC table used.

RFAAP Response:

Data in the report will be compared to the updated EPA soil RBC values. It should be noted that the data was compared to the current RBCs at the time the report was issued for regulatory review. Statements and conclusions in the report resulting from the comparison of the RBCs will be reviewed and revised, as appropriate, based on the updated RBCs. In addition, the legends of the figures will be revised to identify the date of the RBC table used.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 2

The draft RFI Report concludes that representative samples of soil have been collected throughout the solid waste management unit (SWMU) 58 to fully characterize the site and that the nature and extent of contamination at SWMU 58 has been determined. These conclusions can only be reached after the horizontal and vertical extent of contamination at the site has been determined. Based on the data presented in the draft RFI Report, the vertical and horizontal extent of metals contamination in general and several volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) has not been determined. The data presented in Figure 4-2 of the RFI Report indicate that the concentrations of arsenic increase with depth, but the vertical extent of these contaminants has not been determined at all sample locations. The horizontal extent of most of the metals, and other constituents such as cis-1,2, dichloroethene,

benzo(a)pyrene, methylene chloride and trichloroethene has not been determined. The draft RFI Report should be revised to address these concerns.

RFAAP Response:

RFAAP believes that the horizontal and vertical extent of contamination at the site has been determined. Cross-sectional Figures 2-3 (A-A') and 2-4 (B-B') demonstrate that representative soil samples have been collected from each of the different portions of the Rubble Pile and native soil down to bedrock at the site. Site characterization and nature and extent should include the delineation of chemical concentrations, as well as, site geology, site history, and site processes. Each of these elements are needed to fully evaluate and support nature and extent conclusions. Therefore, RFAAP does not believe that chemical concentrations detected at the site need to be bounded by additional samples in order to make valid nature and extent conclusions and develop risk-based management decisions.

Specific examples mentioned in the comment:

- Arsenic concentrations were within background at every depth sampled.
- Two of the compounds (cis-1,2-dichloroethene, methylene chloride) were detected once at concentrations significantly below the r-RBC.
- Methylene chloride - max concentration - 3 ug/kg vs. r-RBC of 85,000 ug/kg, Frequency of Detection 1/13.
- cis-1,2-dichloroethene - max concentration - 730 ug/kg vs. r-RBC of 78,000 ug/kg, Frequency of Detection 1/13.
- Trichloroethene and benzo(a)pyrene were each detected once at concentrations greater than the residential RBC, but below the industrial RBC.
- Trichloroethene - max concentration - 2,700 ug/kg vs. i-RBC of 14,000 ug/kg, Frequency of Detection 1/13.
- Benzo(a)pyrene - max concentration - 240 ug/kg vs. i-RBC of 780 ug/kg, Frequency of Detection 5/13.

SWMU 58's RFI was performed in accordance with the approved Work Plan Addendum (WPA) 12 to Radford AAP's Master Work Plan (MWP). This WPA went through a series of reviews with both USEPA Region III and VDEQ starting in April 2001 and culminating in WPA approval in June 2002. Based on the results of the data gap analysis performed in WPA 12, new data collection was designed to supplement existing data and provide a sufficient data set to identify significant new COPCs, if present and for completion of a risk assessment. It is the Installation's opinion that SWMU 58's investigation fulfilled this criteria.

Additional EPA comment: It is important to recognize that, even though sampling at a site may occur under the auspices of "an approved" work plan, the sampling accomplished may not adequately define the limits of contamination. To say otherwise is not technically sound. Only the analytical data obtained after the sampling event is completed can demonstrate whether the limits of contamination have been defined. Sometimes it is a hit or miss scenario. More importantly, for this site in particular it is crucial that the limits of contamination be bounded, especially for defining use restrictions. For example, if the sampling data only defines the limits of exceedances of the industrial RBC in soil, then how will we know the area to include in a use restriction for the residential scenario? Please address this issue.

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RFAAP Response:

An evaluation of residential RBCs will be added to the report. Results and conclusions drawn from the evaluation of constituents found to exceed screening levels will be used to further assess the limits of contamination at the site.

EPA Comment 3

The nature and extent assessment focuses on the EPA Region 3 industrial soil RBCs and background exceedances. Any constituent that has not exceeded the EPA Region 3 industrial RBC and the background concentration was eliminated from further consideration in the nature and extent evaluation, even when constituents that exceed other screening criteria (e.g., residential RBC, Soil Screening Levels (SSLs), etc.), have been detected above detection limits. Please revise the RFI Report to include an assessment of the residential RBC values as well.

RFAAP Response:

Both the residential and industrial risk scenarios are in the report. The residential evaluation will be moved from Appendix E-2 to Section 6.0 and discussed. Evaluation of residential RBCs and SSLs will be added to the nature and extent section of the report.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 4

Some of the comparisons required by the screening procedure of the Site Screening Process (SSP) for RAAP (October 26, 2001) were not conducted. These include the EPA Region 3 SSLs and the EPA Region 3 Biological and Technical Assistance Group (BTAG) Ecological Risk Assessment guidelines. Please revise the RFI Report to compare all the available data to the SSLs and EPA Region 3 BTAG values and revise any conclusion drawn from the current comparisons accordingly.

RFAAP Response:

Evaluation of the SSLs will be added to the nature and extent section of the report. Use of BTAG values has been discussed during a teleconference with the Army and BTAG on 17 July 2003. The SLERA process outlined in the Master Work Plan, WPA 12, and this teleconference will be incorporated into the revised report.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 5

The detection limits for the sampling data presented in the RFI Report are not clearly indicated in the tables. The SSP requires, to the greatest extent practicable, that the analytical reporting limits (RLs) should be ensured not to exceed the screening levels the resulting data will be compared to. Please revise the RFI Report to include the detection limits of all constituents analyzed for within the text or summary tables of the report and discuss the RLs that do not comply with the SSP requirement (e.g. detection limits for the polynuclear aromatic hydrocarbons).

RFAAP Response:

The report will be revised to include the detection and reporting limits for each of constituents analyzed for within the text or summary tables of the report. Limits that are found to exceed the appropriate screening levels will be discussed in the revised report.

As discussed in Section 7.2.6, detected chemicals with detection limits greater than the screening values were evaluated during the COPEC selection process. As shown in Tables 7-5 and 7-6, the detection limits for each of the chemicals were evaluated and selected as a COPEC if the screening concentrations were found to exceed screening levels.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 6

In the draft RFI, COPCs were eliminated from the risk assessment by comparing the UTL of the background data to on-site data, which is okay for the purpose of site screening. However, since this is an RFI, further evaluation is necessary. The expectation is that a more rigorous statistical analysis will be conducted, consistent with EPA guidance. In general two questions should be answered regarding site contamination compared to background: One, are there any hotspots on site? Two, is the average concentration on site the same or higher than the average concentration of background? Hotspots can be identified by the UTL, which was done in the report. However, there was no comparison of the means. Means comparison should be done by hypothesis testing (t-test, Wilcoxon Rank Sum test, etc.). EPA guidance outlines which tests are the most appropriate based on the number of samples and the distribution of the data sets.

EPA recommends that no chemical be eliminated before the risk is assessed. Once the risk assessment identifies the risk drivers, then a statistical comparison should be done on chemicals that exceed EPA's risk range. In this case, only thallium.

RFAAP Response:

Means comparison will be conducted by hypothesis testing. Such hypothesis testing will include tests for similarities in shape and location between the site and background data sets. Depending on these initial tests, other tests (e.g., t-test, Mann-Whitney U, or Kolmogorov-Smirnov) will be used to assess whether there is a difference between the means. Likewise, statistical procedures will also be used for assessing outliers.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Additional Comment:

The Army agrees that hot spots are defined by the UTLs. Means testing will be conducted using guidance at the location noted above. The purpose of undertaking a facility-wide background study for Radford AAP was to establish a background data set for use in risk assessment. Based on discussions with USEPA early in the RFI process, it is the Army's understanding that the development of a background data set would allow for the elimination of chemicals from further consideration based on comparisons of site concentrations to background data. USEPA's *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual* (RAGS; USEPA, 1989), Section 5.7, permits the use of background data as a selection criterion for

chemicals of potential concern (COPCs). For several constituents, the 95% UTLs are below the RBCs, which will be used to screen COPCs at the site. Those chemicals detected at concentrations below RBCs would be "screened out" of the risk assessment process and would not be carried forward for further quantitative evaluation. Thus, the potential for carrying naturally occurring elements through the quantitative risk assessment would be minimized. The use of UTLs for defining the nature and extent will not change.

Additional EPA comment: Since this is a RFI, not a site screening report, EPA's original comment must be addressed.

RFAAP Response:

To maintain consistency, the approach to evaluating background for SWMU 58 is identical to the approach used in the RFI/CMS Report for Building 4343 (See responses to USEPA comments on the Draft Building 4343 RFI Report, Comment #4, dated 9 June 2003). To clarify the role of the background comparisons in the human health risk assessment (HHRA), however, the process for comparing site data to background data is described, as follows:

Inorganic chemicals detected at concentrations exceeding Risk-Based Concentrations (RBCs) and Acceptable Daily Intakes (ADIs) are compared to background data contained in the Facility-Wide Background Study Report (FWBSR) (IT, 2001) to assess whether these chemicals are present at concentrations below naturally occurring levels. For the HHRA, the evaluation of site concentrations to background concentrations is achieved using two methods of comparison. First, the maximum detected concentration for each inorganic constituent is compared to the background UTL, as established in the FWBSR. The second method involves the statistical comparison of site concentrations to background concentrations to evaluate whether the populations are similar. Based on these evaluations, chemicals are eliminated from further quantitative evaluation if they meet both of the following conditions:

- The maximum detected concentration is below the UTL, and
- Based on statistical comparisons, site concentrations are within or below background concentrations.

Reference: IT Corporation (IT), 2001. *Facility-Wide Background Study Report*. Radford Army Ammunition Plant, Virginia. Final Report. December 2001. Delivery Order No. 0013, Contract No. DACA31-94-D-0064.

During the SWMU 58 conference call on 22 October 2003, the Army pointed out that previous discussions/agreements with EPA/VDEQ had been to screen site data prior to proceeding with the RFI process. EPA stated that this method would be allowed to continue for sites that collected data under work plans that had already been approved. This was clarified to mean sites covered under Work Plan Addendum (WPA) 16 and prior. For WPA 17 and beyond, any comment on or any change to this process would be forthcoming from the EPA's toxicologist during the review and comment cycle. Note the SWMU 58 effort was performed as part of WPA 012.

Specific Comments

EPA Comment 7

Section 3.1, General Soil Sampling Procedures, on page 3-1 the draft RFI states that soil samples were collected from 0 to 0.5 feet to characterize soil deposited on the rubble pile, and from subsurface soil below the pile (top of native soil) to assess any potential vertical migration of contaminants below the pile. However, Section 2.1, Site Description and History, on page 2-10 states that the rubble pile consists of varying quantities of ash, coal, and concrete. Because samples were not collected in this debris, and it could be a source of contamination (particularly ash), no contaminant characterization of this debris has been performed. This issue needs to be addressed.

RFAAP Response:

Please refer to the cross-sections provided in the report to see the extent of sampling at SWMU 58. Section 3 “General Soil Sampling Procedures” refers to samples collected during the 2002 field investigation. Samples were collected from within the rubble zone during previous investigations. Sample locations for the 2002 investigation at SWMU 58, and other sites in WPA12, were selected by a combined team of RFAAP, USACE, USEPA, VDEQ, and contractor personnel to complete the characterization of the site. The 2002 samples were collected from potentially impacted areas of the site that had not been sampled during the previous investigations and are therefore intended to characterize the site in the context of the complete dataset.

As illustrated on cross-sectional Figures 2-3 and 2-4, subsurface soil samples 58SB1A and 58SB3A were collected directly from the layer of soil containing ash, coal, and concrete. In addition, subsurface soil samples 58SB04B, 58SB04C, and 58SB04D were collected in intervals immediately below this layer. Subsurface soil samples collected in and immediately below this layer and down to bedrock have been analyzed for TAL metals, VOCs, SVOCs, PAHs, explosives, PCBs, and dioxins/furans. Therefore, RFAAP contends that this layer and soil below this layer down to bedrock has been fully characterized.

EPA Response: The Army’s response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 8

Section 3.1.1.2, Procedures, page 3-2: It is stated in this section that soil for VOC analysis was collected from 0.5-1.0 feet using EnCore sampler. However, Table 3-1 indicates all surface soil samples, including VOCs and SVOCs, were collected from the depth of 0 to 0.5 ft below ground surface. Please clarify which is correct and revise the table or the text accordingly.

RFAAP Response:

Surface soil samples were collected from 0-0.5 ft bgs for all parameter groups except VOCs. The sample fraction for VOC analysis was collected from 0.5-1 ft bgs to ensure that constituents had not been volatilized.

It should be noted that this procedure was agreed upon as a result of teleconference negotiations that occurred with the USEPA and VDEQ during WPA 12 and MWP development. Meeting minutes regarding this issue from the 20 and 21 September 2001 teleconference are provided below.

6. *Surface soil sampling depth, end use of data*

After some discussion on this issue, the group agreed on the following regarding surface soil sampling at RFAAP:

- *Future surface soil sampling, including that proposed in WPA's 9 and 12, would be defined as soil in the first six inches below the root mat.*
- *Sampling for VOC compounds (where proposed) would occur from the interval between 6 and 12 inches in realization that the volatile nature of VOC compounds makes their detection in the 0-6 inch interval unlikely.*
- *Previous surface soil sampling, that until now had been 0 to 2 feet at Radford AAP, would still be considered valid for characterizing exposure and extent of contamination in the surface soil interval. Additional sampling at previous sampling locations would not be required.*

For clarity, a footnote will be added to the table to reflect the fact that VOCs were collected from 0.5–1 ft bgs.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 9

Section 4.0, Nature and Extent of Contamination, page 4-1: The first paragraph states "the following sections provide a discussion of the site conditions and the nature and extent of chemicals found in soil and sludge at SWMU 58, the Rubble Pile." However, the RFI Report does not identify which samples are considered sludge samples. Please revise the RFI Report to identify the sludge samples. In addition, please discuss or provide in a table the physical characterization of the fill material.

RFAAP Response:

Use of the word "sludge" was in error. Sludge samples were not collected at SWMU 58. The report will be revised to remove references to sludge.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 10

Section 4.1.3, Nature and Extent Conclusions, page 4-7: The last paragraph states "based on (1) the elevation of groundwater (1,680 msl [mean sea level]) at a nearby bedrock well and the elevation of bedrock (1,710 ft msl) encountered beneath the Rubble Pile and (2) the lack of constituents of concern in both the Rubble Pile and native soil beneath the pile, it is unlikely that groundwater has been impacted as a result of this SWMU." It is not clear what the "lack of constituents of concern" means in this context, since the human health risk assessment identifies benzo(a)pyrene, 4-isopropyltoluene, trichloroethene and thallium as chemicals of potential concern. In addition, the impact to groundwater can only be evaluated by either sampling the groundwater beneath the site or by conducting a fate and transport analysis of the contaminants determined from the RFI effort. Since the vertical extent of contaminants has not been determined and the fact that numerous constituents (e.g., arsenic, thallium, manganese,

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antimony, trichloroethene, cis-1,2-dichloroethene, benzo(a)pyrene, methylene chloride, etc.) exceed the EPA Region 3 soil to groundwater migration SSLs at dilution attenuation factor (DAF) of 20, a conclusion that groundwater is not impacted is premature at this time. Please revise the RFI Report to remove the conclusions regarding groundwater impact and to conduct fate and transport analysis after the vertical extent of contamination is fully delineated.

RFAAP Response:

The Army agrees that while most of the above-mentioned constituents exceed the SSLs, thallium was the sole inorganic compound detected above background in surface soil samples. As detailed in Response to Comment #2, cis-1,2-dichloroethene and methylene chloride each had a single detection at concentrations significantly below the r-RBC. Trichloroethene and benzo(a)pyrene were each detected once at concentrations greater than the residential RBC, but below the industrial RBC. It should be noted that a review of the benzo(a)pyrene concentrations (58SB1 = 240 ug/kg; 58SB2B = 4.2 ug/kg; 58SB3A = 38 ug/kg; 58SS04 = 3.1; 58SB04A = 1.9 ug/kg) detected at SWMU 58 were below the benzo(a)pyrene SSL of 370 ug/kg.

While SSL exceedances indicate a theoretical potential for impact to groundwater, empirical evidence in the form of soil boring characterization, chemical analyses, and soil characteristics/chemistry offer more concrete evidence of site conditions and potential impact to groundwater.

Additional information that was evaluated:

- Groundwater at the site was not encountered at depths to 55 ft bgs,
- Chemical data from six subsurface soil samples collected in native soil below the Rubble Pile show no elevated concentrations for those chemicals found to exceed SSLs,

Regardless, an evaluation of the SSLs will be added to the nature and extent section of the report. The Army is willing to conduct a fate and transport analysis on constituents found to exceed EPA Region III residential screening levels. Results from the fate and transport analysis and conclusions drawn from the evaluation of constituents found to exceed screening levels will be used to further assess the vertical extent of contamination at the site.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 11

Section 4.1.3, Nature and Extent of Contamination, on page 4-7 states that it is unlikely that groundwater has been impacted as a result of this SWMU because of the lack of constituents of concern in the rubble pile. There is considerable uncertainty in this statement if potential sources of contamination in the rubble pile, such as ash and coal, were not sampled.

RFAAP Response:

Please refer to the response to Comment # 7.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 12

Table 4-2, Soil Sample Summary, pages 4-10 through 4-12: Please revise this table to remove the “zeros” entered for the number of background exceedances for other than the inorganics.

RFAAP Response:

Zeros will be replaced with N/A (not applicable) in the column for background exceedances other than inorganics.

EPA Response: The Army’s response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 13

Section 5.0, Contaminant Fate and Transport, page 5-1: This section states “because the nature and extent contamination assessment in Section 4.0 did not identify presenting a concern at the SWMU 58 study area, no fate and transport analysis was conducted.” One of the primary objectives of a RFI is to assess the horizontal and vertical extent of contamination so that potential migration of contaminants can be further assessed. Since the RFI Report has not fully delineated the vertical and horizontal extent of contaminants, contaminant fate and transport analysis should be conducted in the revised RFI. This fate and transport analysis should include soil to groundwater migration.

RFAAP Response:

Refer to Response to Comment # 10.

EPA Response: The Army’s response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 14

Section 6.0, Human Health Risk Assessment, Table 6-1, Selection of Exposure Pathways:

For the “current” and “future” scenarios, it is indicated that no analysis will be conducted for the trespasser “due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposure that would be experienced by a trespasser.” It is not clear how the maintenance worker (an adult) scenario would be protective of a child/adolescent trespasser, unless the child/adolescent trespasser is separately considered. This child/adolescent trespasser could also be from within the secured installation, unless children do not live or enter the installation. Please clarify this issue and also explain why trespasser exposure is considered unlikely in the future.

RFAAP Response:

Text will be added to Section 6.2.1 to clarify the level of security at the Installation. Given the rigorous security at Radford AAP (e.g., strict security at entry gates, guard towers, barbed-wire fences), it is not reasonable to assume that children would be able to trespass at the Installation. Hypothetical future exposures to children were considered, however, in the residential scenario that was evaluated in Appendix E. The exposure parameters for residents are more conservative than those for trespassers.

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It would also be extremely difficult for an adolescent to trespass at the site given that children do not live on or enter the Installation. Housing at RFAAP is limited and it is outside the cantonment area. Even if an older adolescent were able to evade security measures, it would be very difficult to do so on a routine basis. The frequency and duration of exposure for the maintenance worker is 50 days per year (i.e., once per week, except for two weeks while on vacation) and 25 years, respectively.

Additional EPA Comment: The Army's response is acceptable in as far as explaining why trespasser exposure is considered unlikely. However, in order to evaluate any SWMU at Radford, it is necessary to evaluate the residential scenario as the baseline for "clean closure" of a site, irrespective of the future projected land use. Please insure that the residential scenario was considered.

RFAAP Response: The residential scenario was evaluated in Appendix E-2. As previously requested, the residential evaluation will be moved from Appendix E-2 to Section 6.0 and discussed.

EPA Comment 15

Section 7.0, Ecological Risk Assessment: Section 7.7, Results and Conclusions, concludes "The assessment suggests potential adverse impacts to terrestrial wildlife, especially shrews, for modeled contact with the hazard driver (thallium) in surface soil. However, based on likely overestimates of (1) toxicity and (2) uptake of inorganics by earthworms from soil (especially for thallium) ..., and on the fact that no wildlife RTE [rare, threatened and endangered] species have been confirmed at the SWMU 58 study area, no further action is recommended for the site." Page 7-1 of this section describes the scientific/management decision point (SMDP) expected to be reached from the conduct of the Screening Level Ecological Risk Assessment (SLERA). The conclusions drawn do not reflect these SMDPs. The SLERA concluded potential adverse impacts to terrestrial wildlife, especially shrews. Therefore, the ecological concerns should be addressed or the other SMDP decision points should be pursued.

RFAAP Response:

The potential adverse impacts to shrews are discussed in detail in the Uncertainty Analysis (Section 7.6), and alternative HQs are presented. These alternative HQs suggest that adverse impacts to shrews are unlikely. Section 7.0 will be reworded to state that the following Scientific/Management Decision Point (SMDP) has been reached: "There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk."

Additional EPA comment: Was the SMDP agreed upon jointly by the U.S. EPA BTAG team members and the Army? Were the alternative HQs agreed upon by the EPA BTAG?

RFAAP Response:

Section 7.0 will be reworded to state that the following Scientific/Management Decision Point (SMDP) is recommended: "There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk." The additional EPA comment is the first incidence of these questions being made, therefore, there has been no direct input from BTAG in the crafting of this response.

EPA Comment 16

Section 7.0, Ecological Risk Assessment, on page 7-1 states that groundwater data are irrelevant for this site as groundwater does not discharge to the surface and there is no potential exposure for ecological receptors to groundwater. It was the EPA BTAG's understanding that most groundwater at the base discharged to the New River. If this is the case, the statement on page 7-1 is false, since groundwater does discharge to the surface and potential exposure to ecological receptors in the New River could occur. This issue should be clarified.

RFAAP Response:

This issue will be clarified in the RFI. Groundwater is not known to discharge to the surface in the vicinity of SWMU 58.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 17

Section 7.2.5, Comparison to Risk-Based Screening Ecotoxicity Values, on page 7-14 lists the screening values that were used to assess risk to terrestrial receptors. EPA Region III BTAG values were not used to evaluate risk from direct exposure to soil at the site. For the screening ERA, the BTAG screening values should be used to evaluate risk to terrestrial receptors. Other values will be considered if no BTAG value is available. The EPA BTAG would like to emphasize that the EPA BTAG values are the current set of values that receive primary consideration by EPA BTAG for screening ERAs in Region 3. The direction of further ecological studies, if necessary, will consider comparison of site concentrations to these benchmarks.

RFAAP Response:

A direct contact surface soil exposure assessment will be added to the RFI (Step 3A). As the RFI already evaluates terrestrial plant impacts (i.e., flora; Section 7.5.3.1), only potential direct contact exposure for fauna will be included. Both BTAG fauna screening values and Oak Ridge National Laboratory (ORNL) earthworm toxicity benchmark screening values will be used in the assessment.

EPA Response: The Army's response is acceptable to EPA.

RFAAP Response: Acceptance of the response is noted.

EPA Comment 18

Section 7.4.1, Assessment Endpoints, on page 7-23, the draft RFI discusses the assessment endpoints that will be evaluated in the ERA. Protection of terrestrial invertebrates should be listed as an assessment endpoint from direct exposure to soils. The measurement endpoint would be a comparison of soil concentrations to EPA BTAG screening values. Currently the ERA only evaluates risk to upper trophic level receptors exposed through the food chain and does not evaluate direct toxicity to soil invertebrates.

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RFAAP Response:

See response to Comment No. 17. Protection of terrestrial invertebrates will be added as a measurement endpoint, as these invertebrates may be an important food source for birds and mammals feeding at the site. The current assessment endpoints for SWMU 58 are stated as the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds. Three of the five site receptors already selected (short-tailed shrews, American robins, and red fox) would be expected to use terrestrial invertebrates as a food source. Therefore, potential reductions in terrestrial invertebrates (due to direct contact with surface soil COPECs) could reduce the food supply for the selected assessment endpoint species.

Additional EPA Comment: The Army's response is acceptable, however, did the Army and the EPA BTAG agree upon the assessment endpoints?

RFAAP Response:

It is the Army's understanding that EPA BTAG agreed to the assessment endpoint, as long as a direct contact evaluation for terrestrial invertebrates was included in the SLERA. Such a direct contact evaluation is being included.

EPA Comment 19

Section 7.7, Results and Conclusions, on page 7-35, the draft RFI states that the ecological risk assessment suggests potential adverse impacts to terrestrial wildlife, especially shrews, for modeled contact with thallium in surface soil. The section further states that the assessment likely overestimates risk based on likely overestimates of (1) toxicity, and (2) uptake of inorganics by earthworms from soil, and that no threatened and endangered species have been confirmed at SWMU 58. Because of these reasons, no further action is recommended for this site. The conclusion of no further action is not supported by the information provided in this report. Section 7.6, Uncertainty Analysis, on page 7-33 recalculates environmental effects quotients (EEQ) for thallium using less conservative parameters, and EEQs are still greater than one for both the shrew and robin. In addition, the lack of any threatened and endangered species on the site is **not** sufficient justification for no further action. Therefore, BTAG recommends that additional evaluation of this pathway to birds and mammals be performed.

RFAAP Response:

See response to Comment No. 15. The Army believes that the recalculated EEQs for thallium are sufficiently low that by taking into consideration other conservative assumptions used in the SLERA (e.g., use of the maximum detected thallium concentration in soil as the exposure point concentration and the assumption of 100 percent bioavailability), they are essentially equal to one. Based on this information, no further action is recommended for ecological receptors.

Additional EPA comment: Was the SMDP agreed upon jointly by the U.S. EPA BTAG team members and the Army?

RFAAP Response:

Section 7.0 will be reworded to state that the following Scientific/Management Decision Point (SMDP) is recommended: "There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological

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risk." Since this is the first time this issue has been brought forward, there has been no direct input from BTAG.

During the SWMU 58 conference call on 22 October 2003, there was discussion of the two elevated concentrations of thallium detected in soil during the 1992 VI and the impact to ecological risk. It was the Army's opinion that these sample results were unrepeatable and that actual thallium exceedances do not exist at the site. The discussion focused on two possible options:

- a. Try to explain the issues surrounding the thallium exceedances and why they are not an issue in the RFI report, or
- b. Collect two additional soil samples at the locations where samples were collected in 1992 and reanalyze for thallium. If the results indicate that the 1992 levels are not repeatable, the RFI can proceed toward the No Further Action alternative with conclusive evidence.

The Army has selected option "b" as the alternative and collected two additional soil samples for analysis of thallium at the 1992 VI elevated thallium concentration locations. The results were non-detect. The revised report incorporates this data.

EPA Comment 20

Section 8.0, Summary and Conclusions, on page 8-1 states that the results of the ERA concluded that there are no ecological concerns requiring further action at the site. EPA BTAG believes that this conclusion is not supported. As stated earlier, direct toxicity to soil invertebrates was not evaluated as part of the ERA. In addition, the risk assessment indicates that there is potential risk to birds and mammals from thallium. These issues need to be addressed for this site.

RFAAP Response:

As agreed in Response to Comment #18, the soil community will be assessed and changes the assessment causes to the calculated risk will be incorporated into the report. For the thallium issue, refer to response to Comment #19. Additionally, during a review of the 1992 Verification Investigation (VI) data, it was noted that a practical quantitation limit (PQL) of 20 mg/kg for thallium was in the 1992 VI Report (Dames & Moore, 1992). The thallium values detected (11.8 and 11.4 mg/kg) were half of the PQL value, and therefore the data should be considered estimated in terms of usability. In addition, high concentrations of aluminum (15,200 and 18,600 mg/kg) were noted for these same samples. Aluminum typically (under standard ICP runs) causes interference with thallium if not properly corrected, causing false positives. Analytical results from every soil sample (10 out of 10) collected during the 1998 and 2002 RFI indicate that site thallium concentrations are below the thallium background concentration of 2.11 mg/kg. For these reasons, the Army believes that ecological risk to the environment due to thallium is negligible.

Additional EPA Comment: See response to Comment 15 & 18.

RFAAP Response: See response to Comment 15 & 18.



Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24143-0100
USA

November 5, 2003

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: SWMU 58 RCRA Facility Investigation Report (RFI), Radford Army Ammunition Plant EPA ID# VA1
210020730

Dear Mr. Thomson:

We are planning to resample two surface soil locations at SWMU 58 to assess if the 1992 detections of thallium are repeatable. This work will be conducted per Work Plan Addendum 12 and per the October 22, 2003 conference call among yourself, Mssrs. Jim McKenna, ACO staff; John Tesner, Baltimore District and Jeff Parks, Shaw Group.

Also as additional time will be needed to conduct the sampling, data validation, risk assessments, report preparation, etc. we request an extension until January 9, 2004 to submit the revised SWMU 58 RFI report.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

A handwritten signature in black ink that reads "C. A. Jake". The signature is written in a cursive, flowing style.

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company LLC

c: Russell Fish, P.E., EPA Region III

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bc: Administrative File
~~J. McKenna ACO Staff~~
Rob Davie-ACO Staff
C. A. Jake
J. J. Redder
Env. File

Coordination:


J. McKenna

17
McKenna, Jim

From: McKenna, Jim
Sent: Friday, October 24, 2003 7:09 AM
To: 'rob thomson'
Cc: 'john e tesner'; 'durwood willis'; 'mark leeper'; Redder, Jerome
Subject: SWMU 58 conference call on Wednesday, 10/22/2003

Importance: High

Rob,

Notes from the subject conference are provided below.

1. As a result of two exceedances for thallium that occurred in two surface soil samples collected during the 1992 VI field effort, a ecological risk of 1.5 versus 1.0 was calculated at SWMU 58. It is the Army's opinion that these sample results are unrepeatable and that actual thallium exceedances do not exist at the site. The discussion focused on two possible options:

- a. Try to explain the issues surrounding the thallium exceedance's and why they are not an issue in the RFI report, or
- b. Collect two additional soil samples at the locations where samples were collected in 1992 and re-analyze for thallium. If the results indicate that the 1992 levels are not repeatable, the RFI can proceed toward the No Further Action alternative with conclusive evidence.

EPA's additional RFI comment 6 left open the possibility that the comment required further response from the Army. EPA clarified that the additional comment was to make clear that the use of 95% UTL values for background comparison was a screening level activity and that RFI risk assessments require the statistical testing and comparison of the background database to the site's database to assess similarities or differences. This appeared to leave open the question whether screening compounds out at the beginning of the RFI risk assessment was acceptable. The Army pointed out that even though these were RFI reports, previous discussions/agreements with EPA/DEQ had been to screen site data prior to proceeding with the RFI process. EPA stated that this method would be allowed to continue for sites that collected data under workplans that had already been approved. This was clarified to mean sites covered under Work Plan Addendum (WPA) 16 and prior. For WPA 17 and beyond, any comment on or any change to this process would be forthcoming from the EPA's toxicologist during the review and comment cycle.

Note since our conference call, we are anticipating that we will proceed along 1b and that means we will be sending an extension request.

Thanks,
Jim

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

September 18, 2003

In reply
Refer to 3HS13

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commander,
Radford Army Ammunition Plant
Attn: SIORF-SE-EQ (Jim McKenna)
P.O. Box 2
Radford, VA 24141-0099

Carolyn A. Jake
Environmental Manager
Alliant Techsystems, Inc.
Radford Army Ammunition Plant
P.O. Box 1
Radford, VA 24141-0100

Re: Radford Army Ammunition Plant
SWMU 58
Rubble Pile
Document submittal and review

Dear Mr. McKenna and Ms. Jake:

The U.S. Environmental Protection Agency (EPA) has reviewed the Army's draft March, 2003 *RCRA Facility Investigation Report* (RFI) for SWMU 58, located at the Radford Army Ammunition Plant (RFAAP), as well as the Army's response to EPA's initial July 18, 2003 review comments. Outlined below, please find EPA's final comments based upon that review:

GENERAL COMMENTS

- ✓ 1. Figures 2-5, 4-1, 4-2, Tables 4-1, 4-2 of the RFI Report, and Tables C-1 through C-3 in Appendix C should be revised to compare the detected soil concentrations to the current EPA Region 3 industrial soil Risk-Based Concentration (RBC) values (April 25, 2003 version), which incorporates changes resulting from the new soil ingestion rate for outdoor workers. Any

conclusions drawn, if different from those presented in the draft RFI Report, due to this new comparison should also be identified in the revised RFI Report. All statements regarding the number of constituents and sample results exceeding the industrial RBC values should be revised. The legends of the figures should also identify the date of the RBC table used.

Army Response: Data in the report will be compared to the updated EPA soil RBC values. It should be noted that the data was compared to the current RBCs at the time the report was issued for regulatory review. Statements and conclusions in the report resulting from the comparison of the RBCs will be reviewed and revised, as appropriate, based on the updated RBCs. In addition, the legends of the figures will be revised to identify the date of the RBC table used. *The Army's response is acceptable to EPA.*

2. The draft RFI Report concludes that representative samples of soil have been collected throughout the solid waste management unit (SWMU) 58 to fully characterize the site and that the nature and extent of contamination at SWMU 58 has been determined. These conclusions can only be reached after the horizontal and vertical extent of contamination at the site has been determined. Based on the data presented in the draft RFI Report, the vertical and horizontal extent of metals contamination in general and several volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) has not been determined. The data presented in Figure 4-2 of the RFI Report indicate that the concentrations of arsenic increase with depth, but the vertical extent of these contaminants has not been determined at all sample locations. The horizontal extent of most of the metals, and other constituents such as cis-1,2, dichloroethene, benzo(a)pyrene, methylene chloride and trichloroethene has not been determined. The draft RFI Report should be revised to address these concerns.

Army Response: RFAAP believes that the horizontal and vertical extent of contamination at the site has been determined. Cross-sectional Figures 2-3 (A-A') and 2-4 (B-B') demonstrate that representative soil samples have been collected from each of the different portions of the Rubble Pile and native soil down to bedrock at the site. Site characterization and nature and extent should include the delineation of chemical concentrations, as well as, site geology, site history, and site processes. Each of these elements are needed to fully evaluate and support nature and extent conclusions. Therefore, RFAAP does not believe that chemical concentrations detected at the site need to be bounded by additional samples in order to make valid nature and extent conclusions and develop risk-based management decisions.

Specific examples mentioned in the comment:

- Arsenic concentrations were within background at every depth sampled.
- Two of the compounds (cis-1,2, dichloroethene, methylene chloride) were detected once at concentrations significantly below the r-RBC.
- Methylene chloride - max concentration - 3 ug/kg vs. r-RBC of 85,000 ug/kg, Frequency of Detection 1/13.
- cis-1,2-dichloroethene - max concentration - 730 ug/kg vs. r-RBC of 78,000 ug/kg, Frequency of Detection 1/13.
- Trichloroethene and benzo(a)pyrene were each detected once at concentrations greater than the residential RBC, but below the industrial RBC.
- Trichloroethene - max concentration - 2,700 ug/kg vs. i-RBC of 14,000 ug/kg, Frequency of Detection 1/13.
- Benzo(a)pyrene - max concentration - 240 ug/kg vs. i-RBC of 780 ug/kg, Frequency of Detection 5/13.

SWMU 58's RFI was performed in accordance with the approved Work Plan Addendum (WPA) 12 to Radford AAP's Master Work Plan (MWP). This WPA went through a series of reviews with both USEPA Region III and VDEQ starting in April 2001 and culminating in WPA approval in June 2002. Based on the results of the data gap analysis performed in WPA 12, new data collection was designed to supplement existing data and provide a sufficient data set to identify significant new COPCs, if present and for completion of a risk assessment. It is the Installation's opinion that SWMU 58's investigation fulfilled this criteria.

Additional EPA comment: It is important to recognize that, even though sampling at a site may occur under the auspices of "an approved" work plan, the sampling accomplished may not adequately define the limits of contamination. To say otherwise is not technically sound. Only the analytical data obtained after the sampling event is completed can demonstrate whether the limits of contamination have been defined. Sometimes it is a hit or miss scenario. More importantly, for this site in particular it is crucial that the limits of contamination be bounded, especially for defining use restrictions. For example, if the sampling data only defines the limits of exceedances of the industrial RBC in soil, then how will we know the area to include in a use restriction for the residential scenario? Please address this issue.

3. The nature and extent assessment focuses on the EPA Region 3 industrial soil RBCs and background exceedances. Any constituent that has not exceeded the EPA Region 3 industrial RBC and the background concentration was eliminated from further consideration in the nature and extent evaluation, even when constituents that exceed other screening criteria (e.g., residential RBC, Soil Screening Levels (SSLs), etc.), have been

detected above detection limits. Please revise the RFI Report to include an assessment of the residential RBC values as well.

Army Response: Both the residential and industrial risk scenarios are in the report. The residential evaluation will be moved from Appendix E-2 to Section 6.0 and discussed. Evaluation of residential RBCs and SSLs will be added to the nature and extent section of the report. *The Army's response is acceptable to EPA.*

✓ 4. Some of the comparisons required by the screening procedure of the Site Screening Process (SSP) for RAAP (October 26, 2001) were not conducted. These include the EPA Region 3 SSLs and the EPA Region 3 Biological and Technical Assistance Group (BTAG) Ecological Risk Assessment guidelines. Please revise the RFI Report to compare all the available data to the SSLs and EPA Region 3 BTAG values and revise any conclusion drawn from the current comparisons accordingly.

Army Response: Evaluation of the SSLs will be added to the nature and extent section of the report. Use of BTAG values has been discussed during a teleconference with the Army and BTAG on 17 July 2003. The SLERA process outlined in the Master Work Plan, WPA 12, and this teleconference will be incorporated into the revised report. *The Army's response is acceptable.*

✓ 5. The detection limits for the sampling data presented in the RFI Report are not clearly indicated in the tables. The SSP requires, to the greatest extent practicable, that the analytical reporting limits (RLs) should be ensured not to exceed the screening levels the resulting data will be compared to. Please revise the RFI Report to include the detection limits of all constituents analyzed for within the text or summary tables of the report and discuss the RLs that do not comply with the SSP requirement (e.g. detection limits for the polynuclear aromatic hydrocarbons).

Army Response: The report will be revised to include the detection and reporting limits for each of constituents analyzed for within the text or summary tables of the report. Limits that are found to exceed the appropriate screening levels will be discussed in the revised report.

As discussed in Section 7.2.6, detected chemicals with detection limits greater than the screening values were evaluated during the COPEC selection process. As shown in Tables 7-5 and 7-6, the detection limits for each of the chemicals were evaluated and selected as a COPEC if the screening concentrations were found to exceed screening levels. *The Army's response is acceptable.*

*6. In the draft RFI, COPCs were eliminated from the risk assessment by comparing the UTL of the background data to on-site data, which is okay for the purpose of site screening. However, since this is an RFI, further evaluation is necessary. The expectation is that a more rigorous statistical analysis will be conducted, consistent with EPA guidance. In general two questions should be answered regarding site contamination compared to background: One, are there any hotspots on site? Two, is the average concentration on site the same or higher than the average concentration of background? Hotspots can be identified by the UTL, which was done in the report. However, there was no comparison of the means. Means comparison should be done by hypothesis testing (t-test, Wilcoxon Rank Sum test, etc.). EPA guidance outlines which tests are the most appropriate based on the number of samples and the distribution of the data sets.

EPA recommends that no chemical be eliminated before the risk is assessed. Once the risk assessment identifies the risk drivers, then a statistical comparison should be done on chemicals that exceed EPA's risk range. In this case, only thallium.

Army Response: Means comparison will be conducted by hypothesis testing. Such hypothesis testing will include tests for similarities in shape and location between the site and background data sets. Depending on these initial tests, other tests (e.g., t-test, Mann-Whitney U, or Kolmogorov-Smirnov) will be used to assess whether there is a difference between the means. Likewise, statistical procedures will also be used for assessing outliers. *The Army's response is acceptable to EPA.*

The Army agrees that hot spots are defined by the UTLs. Means testing will be conducted using guidance at the location noted above. The purpose of undertaking a facility-wide background study for Radford AAP was to establish a background data set for use in risk assessment. Based on discussions with USEPA early in the RFI process, it is the Army's understanding that the development of a background data set would allow for the elimination of chemicals from further consideration based on comparisons of site concentrations to background data. USEPA's *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual* (RAGS; USEPA, 1989), Section 5.7, permits the use of background data as a selection criterion for chemicals of potential concern (COPCs). For several constituents, the 95% UTLs are below the RBCs, which will be used to screen COPCs at the site. Those chemicals detected at concentrations below RBCs would be "screened out" of the risk assessment process and would not be carried forward for further quantitative evaluation. Thus, the potential for carrying naturally occurring elements through the quantitative risk assessment would be minimized. The use of UTLs for defining the nature and extent will not change.

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Additional EPA comment: Since this is a RFI, not a site screening report, EPA's original comment must be addressed.

SPECIFIC COMMENTS

7. **Section 3.1, General Soil Sampling Procedures**, on page 3-1 the draft RFI states that soil samples were collected from 0 to 0.5 feet to characterize soil deposited on the rubble pile, and from subsurface soil below the pile (top of native soil) to assess any potential vertical migration of contaminants below the pile. However, Section 2.1, Site Description and History, on page 2-10 states that the rubble pile consists of varying quantities of ash, coal, and concrete. Because samples were not collected in this debris, and it could be a source of contamination (particularly ash), no contaminant characterization of this debris has been performed. This issue needs to be addressed.

Army Response: Please refer to the cross-sections provided in the report to see the extent of sampling at SWMU 58. Section 3 "General Soil Sampling Procedures" refers to samples collected during the 2002 field investigation. Samples were collected from within the rubble zone during previous investigations. Sample locations for the 2002 investigation at SWMU 58, and other sites in WPA12, were selected by a combined team of RFAAP, USACE, USEPA, VDEQ, and contractor personnel to complete the characterization of the site. The 2002 samples were collected from potentially impacted areas of the site that had not been sampled during the previous investigations and are therefore intended to characterize the site in the context of the complete dataset.

As illustrated on cross-sectional Figures 2-3 and 2-4, subsurface soil samples 58SB1A and 58SB3A were collected directly from the layer of soil containing ash, coal, and concrete. In addition, subsurface soil samples 58SB04B, 58SB04C, and 58SB04D were collected in intervals immediately below this layer. Subsurface soil samples collected in and immediately below this layer and down to bedrock have been analyzed for TAL metals, VOCs, SVOCs, PAHs, explosives, PCBs, and dioxins/furans. Therefore, RFAAP contends that this layer and soil below this layer down to bedrock has been fully characterized. *The Army's response is acceptable.*

V8. **Section 3.1.1.2, Procedures, page 3-2:** It is stated in this section that soil for VOC analysis was collected from 0.5-1.0 feet using EnCore sampler. However, Table 3-1 indicates all surface soil samples, including VOCs and SVOCs, were collected from the depth of 0 to 0.5 ft below ground surface. Please

clarify which is correct and revise the table or the text accordingly.

Army Response: Surface soil samples were collected from 0-0.5 ft bgs for all parameter groups except VOCs. The sample fraction for VOC analysis was collected from 0.5-1 ft bgs to ensure that constituents had not been volatilized.

It should be noted that this procedure was agreed upon as a result of teleconference negotiations that occurred with the USEPA and VDEQ during WPA 12 and MWP development. Meeting minutes regarding this issue from the 20 and 21 September 2001 teleconference are provided below.

6. Surface soil sampling depth, end use of data

After some discussion on this issue, the group agreed on the following regarding surface soil sampling at RFAAP:

- Future surface soil sampling, including that proposed in WPA's 9 and 12, would be defined as soil in the first six inches below the root mat.*
- Sampling for VOC compounds (where proposed) would occur from the interval between 6 and 12 inches in realization that the volatile nature of VOC compounds makes their detection in the 0-6 inch interval unlikely.*
- Previous surface soil sampling, that until now had been 0 to 2 feet at Radford AAP, would still be considered valid for characterizing exposure and extent of contamination in the surface soil interval. Additional sampling at previous sampling locations would not be required.*

For clarity, a footnote will be added to the table to reflect the fact that VOCs were collected from 0.5-1 ft bgs. *The Army's response is acceptable.*

9. Section 4.0, Nature and Extent of Contamination, page 4-1:

The first paragraph states "the following sections provide a discussion of the site conditions and the nature and extent of chemicals found in soil and sludge at SWMU 58, the Rubble Pile." However, the RFI Report does not identify which samples are considered sludge samples. Please revise the RFI Report to identify the sludge samples. In addition, please discuss or provide in a table the physical characterization of the fill material.

Army Response: Use of the word "sludge" was in error. Sludge samples were not collected at SWMU 58. The report will be revised to remove references to sludge. *The Army's response is acceptable.*

10. **Section 4.1.3, Nature and Extent Conclusions, page 4-7:** The last paragraph states "based on (1) the elevation of groundwater (1,680 msl [mean sea level]) at a nearby bedrock well and the elevation of bedrock (1,710 ft msl) encountered beneath the Rubble Pile and (2) the lack of constituents of concern in both the Rubble Pile and native soil beneath the pile, it is unlikely that groundwater has been impacted as a result of this SWMU." It is not clear what the "lack of constituents of concern" means in this context, since the human health risk assessment identifies benzo(a)pyrene, 4-isopropyltoluene, trichloroethene and thallium as chemicals of potential concern. In addition, the impact to groundwater can only be evaluated by either sampling the groundwater beneath the site or by conducting a fate and transport analysis of the contaminants determined from the RFI effort. Since the vertical extent of contaminants has not been determined and the fact that numerous constituents (e.g., arsenic, thallium, manganese, antimony, trichloroethene, cis-1,2-dichloroethene, benzo(a)pyrene, methylene chloride, etc.) exceed the EPA Region 3 soil to groundwater migration SSLs at dilution attenuation factor (DAF) of 20, a conclusion that groundwater is not impacted is premature at this time. Please revise the RFI Report to remove the conclusions regarding groundwater impact and to conduct fate and transport analysis after the vertical extent of contamination is fully delineated.

Army Response: The Army agrees that while most of the above-mentioned constituents exceed the SSLs, thallium was the sole inorganic compound detected above background in surface soil samples. As detailed in Response to Comment #2, cis-1,2-dichloroethene and methylene chloride each had a single detection at concentrations significantly below the r-RBC. Trichloroethene and benzo(a)pyrene were each detected once at concentrations greater than the residential RBC, but below the industrial RBC. It should be noted that a review of the benzo(a)pyrene concentrations (58SB1 = 240 ug/kg; 58SB2B = 4.2 ug/kg; 58SB3A = 38 ug/kg; 58SS04 = 3.1; 58SB04A = 1.9 ug/kg) detected at SWMU 58 were below the benzo(a)pyrene SSL of 370 ug/kg.

While SSL exceedances indicate a theoretical potential for impact to groundwater, empirical evidence in the form of soil boring characterization, chemical analyses, and soil characteristics/chemistry offer more concrete evidence of site conditions and potential impact to groundwater.

Additional information that was evaluated:

- Groundwater at the site was not encountered at depths to 55 ft bgs,
- Chemical data from six subsurface soil samples collected in native soil below the Rubble Pile show no elevated concentrations for those chemicals found to exceed SSLs,

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Regardless, an evaluation of the SSLs will be added to the nature and extent section of the report. The Army is willing to conduct a fate and transport analysis on constituents found to exceed EPA Region III residential screening levels. Results from the fate and transport analysis and conclusions drawn from the evaluation of constituents found to exceed screening levels will be used to further assess the vertical extent of contamination at the site. *The Army's response is acceptable.*

11. Section 4.1.3, Nature and Extent of Contamination, on page 4-7 states that it is unlikely that groundwater has been impacted as a result of this SWMU because of the lack of constituents of concern in the rubble pile. There is considerable uncertainty in this statement if potential sources of contamination in the rubble pile, such as ash and coal, were not sampled.

Army Response: Please refer to the response to Comment # 7. *The Army's response is acceptable.*

✓ 12. Table 4-2, Soil Sample Summary, pages 4-10 through 4-12: Please revise this table to remove the "zeros" entered for the number of background exceedances for other than the inorganics.

Army Response: Zeros will be replaced with N/A (not applicable) in the column for background exceedances other than inorganics. *The Army's response is acceptable.*

✓ 13. Section 5.0, Contaminant Fate and Transport, page 5-1: This section states "because the nature and extent contamination assessment in Section 4.0 did not identify presenting a concern at the SWMU 58 study area, no fate and transport analysis was conducted." One of the primary objectives of a RFI is to assess the horizontal and vertical extent of contamination so that potential migration of contaminants can be further assessed. Since the RFI Report has not fully delineated the vertical and horizontal extent of contaminants, contaminant fate and transport analysis should be conducted in the revised RFI. This fate and transport analysis should include soil to groundwater migration.

Army Response: Refer to Response to Comment # 10. *The Army's response is acceptable.*

14. Section 6.0, Human Health Risk Assessment, Table 6-1, Selection of Exposure Pathways: For the "current" and "future" scenarios, it is indicated that no analysis will be conducted for the trespasser "due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposure that would be experienced by a trespasser." It is not clear how the maintenance worker (an adult) scenario would be protective of a child/adolescent trespasser, unless the child/adolescent trespasser is separately considered. This child/adolescent

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trespasser could also be from within the secured installation, unless children do not live or enter the installation. Please clarify this issue and also explain why trespasser exposure is considered unlikely in the future.

Army Response: Text will be added to Section 6.2.1 to clarify the level of security at the Installation. Given the rigorous security at Radford AAP (e.g., strict security at entry gates, guard towers, barbed-wire fences), it is not reasonable to assume that children would be able to trespass at the Installation. Hypothetical future exposures to children were considered, however, in the residential scenario that was evaluated in Appendix E. The exposure parameters for residents are more conservative than those for trespassers.

It would also be extremely difficult for an adolescent to trespass at the site given that children do not live on or enter the Installation. Housing at RFAAP is limited and it is outside the cantonment area. Even if an older adolescent were able to evade security measures, it would be very difficult to do so on a routine basis. The frequency and duration of exposure for the maintenance worker is 50 days per year (i.e., once per week, except for two weeks while on vacation) and 25 years, respectively.

Additional EPA Comment: The Army's response is acceptable in as far as explaining why trespasser exposure is considered unlikely. However, in order to evaluate any SWMU at Radford, it is necessary to evaluate the residential scenario as the baseline for "clean closure" of a site, irrespective of the future projected land use. Please insure that the residential scenario was considered.

15. **Section 7.0, Ecological Risk Assessment:** Section 7.7, Results and Conclusions, concludes "The assessment suggests potential adverse impacts to terrestrial wildlife, especially shrews, for modeled contact with the hazard driver (thallium) in surface soil. However, based on likely overestimates of (1) toxicity and (2) uptake of inorganics by earthworms from soil (especially for thallium) ..., and on the fact that no wildlife RTE [rare, threatened and endangered] species have been confirmed at the SWMU 58 study area, no further action is recommended for the site." Page 7-1 of this section describes the scientific/management decision point (SMDP) expected to be reached from the conduct of the Screening Level Ecological Risk Assessment (SLERA). The conclusions drawn do not reflect these SMDPs. The SLERA concluded potential adverse impacts to terrestrial wildlife, especially shrews. Therefore, the ecological concerns should be addressed or the other SMDP decision points should be pursued.

Army Response: The potential adverse impacts to shrews are discussed in detail in the Uncertainty Analysis (Section 7.6),

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and alternative HQs are presented. These alternative HQs suggest that adverse impacts to shrews are unlikely. Section 7.0 will be reworded to state that the following Scientific/Management Decision Point (SMDP) has been reached: "There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk."

Additional EPA comment: Was the SMDP agreed upon jointly by the U.S. EPA BTAG team members and the Army? Were the alternative HQs agreed upon by the EPA BTAG?

✓ 16. **Section 7.0, Ecological Risk Assessment, on page 7-1** states that groundwater data are irrelevant for this site as groundwater does not discharge to the surface and there is no potential exposure for ecological receptors to groundwater. It was the EPA BTAG's understanding that most groundwater at the base discharged to the New River. If this is the case, the statement on page 7-1 is false, since groundwater does discharge to the surface and potential exposure to ecological receptors in the New River could occur. This issue should be clarified.

Army Response: This issue will be clarified in the RFI. Groundwater is not known to discharge to the surface in the vicinity of SWMU 58. *The Army's response is acceptable.*

✓ 17. **Section 7.2.5, Comparison to Risk-Based Screening Ecotoxicity Values, on page 7-14** lists the screening values that were used to assess risk to terrestrial receptors. EPA Region III BTAG values were not used to evaluate risk from direct exposure to soil at the site. For the screening ERA, the BTAG screening values should be used to evaluate risk to terrestrial receptors. Other values will be considered if no BTAG value is available. The EPA BTAG would like to emphasize that the EPA BTAG values are the current set of values that receive primary consideration by EPA BTAG for screening ERAs in Region 3. The direction of further ecological studies, if necessary, will consider comparison of site concentrations to these benchmarks.

Army Response: A direct contact surface soil exposure assessment will be added to the RFI (Step 3A). As the RFI already evaluates terrestrial plant impacts (i.e., flora; Section 7.5.3.1), only potential direct contact exposure for fauna will be included. Both BTAG fauna screening values and Oak Ridge National Laboratory (ORNL) earthworm toxicity benchmark screening values will be used in the assessment. *The Army's response is acceptable.*

✓ 18. **Section 7.4.1, Assessment Endpoints, on page 7-23,** the draft RFI discusses the assessment endpoints that will be evaluated in the ERA. Protection of terrestrial invertebrates should be listed

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as an assessment endpoint from direct exposure to soils. The measurement endpoint would be a comparison of soil concentrations to EPA BTAG screening values. Currently the ERA only evaluates risk to upper trophic level receptors exposed through the food chain and does not evaluate direct toxicity to soil invertebrates.

Army Response: See response to Comment No. 17. Protection of terrestrial invertebrates will be added as a measurement endpoint, as these invertebrates may be an important food source for birds and mammals feeding at the site. The current assessment endpoints for SWMU 58 are stated as the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds. Three of the five site receptors already selected (short-tailed shrews, American robins, and red fox) would be expected to use terrestrial invertebrates as a food source. Therefore, potential reductions in terrestrial invertebrates (due to direct contact with surface soil COPECs) could reduce the food supply for the selected assessment endpoint species.

Additional EPA Comment: The Army's response is acceptable, however, did the Army and the EPA BTAG agree upon the assessment endpoints?

19. **Section 7.7, Results and Conclusions**, on page 7-35, the draft RFI states that the ecological risk assessment suggests potential adverse impacts to terrestrial wildlife, especially shrews, for modeled contact with thallium in surface soil. The section further states that the assessment likely overestimates risk based on likely overestimates of (1) toxicity, and (2) uptake of inorganics by earthworms from soil, and that no threatened and endangered species have been confirmed at SWMU 58. Because of these reasons, no further action is recommended for this site. The conclusion of no further action is not supported by the information provided in this report. Section 7.6, Uncertainty Analysis, on page 7-33 recalculates environmental effects quotients (EEQ) for thallium using less conservative parameters, and EEQs are still greater than one for both the shrew and robin. In addition, the lack of any threatened and endangered species on the site **is not** sufficient justification for no further action. Therefore, BTAG recommends that additional evaluation of this pathway to birds and mammals be performed.

Army Response: See response to Comment No. 15. Although the recalculated EEQs for thallium are still greater than one for the shrew and the robin, the values (1.5 and 2, respectively) are sufficiently low that by taking into consideration other conservative assumptions used in the SLERA (e.g., use of the maximum detected thallium concentration in soil as the exposure

point concentration and the assumption of 100 percent bioavailability), they are essentially equal to one. Based on this information, no further action is recommended for ecological receptors.

Additional EPA comment: Was the SMDP agreed upon jointly by the U.S. EPA BTAG team members and the Army?

20. **Section 8.0, Summary and Conclusions**, on page 8-1 states that the results of the ERA concluded that there are no ecological concerns requiring further action at the site. EPA BTAG believes that this conclusion is not supported. As stated earlier, direct toxicity to soil invertebrates was not evaluated as part of the ERA. In addition, the risk assessment indicates that there is potential risk to birds and mammals from thallium. These issues need to be addressed for this site.

Army Response: As agreed in Response to Comment #18, the soil community will be assessed and changes the assessment causes to the calculated risk will be incorporated into the report. For the thallium issue, refer to response to Comment #15. Additionally, during a review of the 1992 Verification Investigation (VI) data, it was noted that a practical quantitation limit (PQL) of 20 mg/kg for thallium was in the 1992 VI Report (Dames & Moore, 1992). The thallium values detected (11.8 and 11.4 mg/kg) were half of the PQL value, and therefore the data should be considered estimated in terms of usability. In addition, high concentrations of aluminum (15,200 and 18,600 mg/kg) were noted for these same samples. Aluminum typically (under standard ICP runs) causes interference with thallium if not properly corrected, causing false positives. Analytical results from every soil sample (10 out of 10) collected during the 1998 and 2002 RFI indicate that site thallium concentrations are below the thallium background concentration of 2.11 mg/kg. For these reasons, the Army believes that ecological risk to the environment due to thallium is negligible.

Additional EPA Comment: See response to Comment 15 & 18.

This concludes EPA's review of the Army's draft RCRA Facility Investigation Report for SWMU 58, located at the RFAAP. The referenced draft RFI is disapproved by EPA in its current form, and must be revised to reflect the comments above. Per Part II, Section E.4.e. of the EPA RCRA Corrective Action Permit, the Army is required to revise the draft document and submit a revised draft copy to EPA for review within 60 days of the receipt of EPA comments on the draft document. Part II, Section E.4.f. of the Permit allows for an additional 20 days for issuing the revised draft document to EPA, provided that timely notice is given, i.e. within 10 days. Additional time extensions can be requested under Part II, Section F. of the permit.

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If you have any questions, please call me at 215-814-3357.

Sincerely,

A handwritten signature in cursive script, appearing to read "Robert Thomson".

Robert Thomson, PE
Federal Facilities Branch

cc: Russell Fish, EPA
Leslie Romanchik, VDEQ-RCRA
Mark Leeper, VDEQ-CERCLA



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COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

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5 August 03

Mr. James McKenna
Radford Army Ammunition Plant
SIORF-SE-EQ
P.O. Box 2
Radford, VA 24141-0099

RE: Draft SWMU 58 RCRA Facility Investigation Report

Dear Mr. McKenna:

This office has reviewed the Draft SWMU 58 RCRA Facility Investigation Report and concurs with the findings. This office has no comments at this time. Please forward a copy of the final document, preferably on CD, when it is available.

If you have any questions, please do not hesitate to call.

Sincerely,

A handwritten signature in cursive script, reading "Mark S. Leeper".

Mark S. Leeper
RPM

cc: Mr. Robert G. Thomson - EPA Region III
Mr. Garwin Eng - VDEQ - CO

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McKenna, Jim

From: McKenna, Jim
Sent: Tuesday, August 05, 2003 2:04 PM
To: 'Thomson.Bob@epamail.epa.gov'; Redder, Jerome
Cc: John.E.Tesner@nab02.usace.army.mil; msleeper@deq.state.va.us
Subject: RE: RFAAP - SWMU 58 RFI comments

Importance: High



RTC USEPA SWMU
58 RFI Draft.do...

Rob,

Attached file has our responses to EPA's comments on the SWMU 58 RFI.

Jim

-----Original Message-----

From: Thomson.Bob@epamail.epa.gov [mailto:Thomson.Bob@epamail.epa.gov]
Sent: Friday, July 18, 2003 11:48 AM
To: Redder, Jerome; McKenna, Jim
Cc: John.E.Tesner@nab02.usace.army.mil; msleeper@deq.state.va.us
Subject: RFAAP - SWMU 58 RFI comments

Attached, please find EPA's draft comments on the review of the Army's RFI for SWMU 58 at RFAAP.

Please review and give me a call next week. (7/23-25).

Rob Thomson

PS. - I am under the impression that this is the last of the remaining comments that need to be issued. Please let me know if there is anything else outstanding.

(See attached file: SWMU58RFI.rev.doc)

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Response to USEPA Comments dated XX July 2003
Received via e-mail on 18 July 2003
for
Draft SWMU 58 RCRA Facility Investigation Report
Dated March 2003

General Comments

EPA Comment 1

Figures 2-5, 4-1, 4-2, Tables 4-1, 4-2 of the RFI Report, and Tables C-1 through C-3 in Appendix C should be revised to compare the detected soil concentrations to the current EPA Region 3 industrial soil Risk-Based Concentration (RBC) values (April 25, 2003 version), which incorporates changes resulting from the new soil ingestion rate for outdoor workers. Any conclusions drawn, if different from those presented in the draft RFI Report, due to this new comparison should also be identified in the revised RFI Report. All statements regarding the number of constituents and sample results exceeding the industrial RBC values should be revised. The legends of the figures should also identify the date of the RBC table used.

Response

Data in the report will be compared to the updated EPA soil RBC values. It should be noted that the data was compared to the current RBCs at the time the report was issued for regulatory review. Statements and conclusions in the report resulting from the comparison of the RBCs will be reviewed and revised, as appropriate, based on the updated RBCs. In addition, the legends of the figures will be revised to identify the date of the RBC table used.

EPA Comment 2

The draft RFI Report concludes that representative samples of soil have been collected throughout the solid waste management unit (SWMU) 58 to fully characterize the site and that the nature and extent of contamination at SWMU 58 has been determined. These conclusions can only be reached after the horizontal and vertical extent of contamination at the site has been determined. Based on the data presented in the draft RFI Report, the vertical and horizontal extent of metals contamination in general and several volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) has not been determined. The data presented in Figure 4-2 of the RFI Report indicate that the concentrations of arsenic increase with depth, but the vertical extent of these contaminants has not been determined at all sample locations. The horizontal extent of most of the metals, and other constituents such as cis-1,2, dichloroethene, benzo(a)pyrene, methylene chloride and trichloroethene has not been determined. The draft RFI Report should be revised to address these concerns.

Response

RFAAP believes that the horizontal and vertical extent of contamination at the site has been determined. Cross-sectional Figures 2-3 (A-A') and 2-4 (B-B') demonstrate that representative soil samples have been collected from each of the different portions of the Rubble Pile and native soil down to bedrock at the site. Site characterization and nature and extent should include the delineation of chemical concentrations, as well as, site geology, site history, and site processes. Each of these elements are needed to fully

evaluate and support nature and extent conclusions. Therefore, RFAAP does not believe that chemical concentrations detected at the site need to be bounded by additional samples in order to make valid nature and extent conclusions and develop risk-based management decisions.

Specific examples mentioned in the comment:

- Arsenic concentrations were within background at every depth sampled.
- Two of the compounds (cis-1,2, dichloroethene, methylene chloride) were detected once at concentrations significantly below the r-RBC.
- Methylene chloride - max concentration - 3 ug/kg vs. r-RBC of 85,000 ug/kg, Frequency of Detection 1/13.
- cis-1,2-dichloroethene - max concentration - 730 ug/kg vs. r-RBC of 78,000 ug/kg, Frequency of Detection 1/13.
- Trichloroethene and benzo(a)pyrene were each detected once at concentrations greater than the residential RBC, but below the industrial RBC.
 - Trichloroethene - max concentration - 2,700 ug/kg vs. i-RBC of 14,000 ug/kg, Frequency of Detection 1/13.
 - Benzo(a)pyrene - max concentration - 240 ug/kg vs. i-RBC of 780 ug/kg, Frequency of Detection 5/13.

SWMU 58's RFI was performed in accordance with the approved Work Plan Addendum (WPA) 12 to Radford AAP's Master Work Plan (MWP). This WPA went through a series of reviews with both USEPA Region III and VDEQ starting in April 2001 and culminating in WPA approval in June 2002. Based on the results of the data gap analysis performed in WPA 12, new data collection was designed to supplement existing data and provide a sufficient data set to identify significant new COPCs, if present and for completion of a risk assessment. It is the Installation's opinion that SWMU 58's investigation fulfilled this criteria.

EPA Comment 3

The nature and extent assessment focuses on the EPA Region 3 industrial soil RBCs and background exceedances. Any constituent that has not exceeded the EPA Region 3 industrial RBC and the background concentration was eliminated from further consideration in the nature and extent evaluation, even when constituents that exceed other screening criteria (e.g., residential RBC, Soil Screening Levels (SSLs), etc.), have been detected above detection limits. Please revise the RFI Report to include an assessment of the residential RBC values as well.

Response

Both the residential and industrial risk scenarios are in the report. The residential evaluation will be moved from Appendix E-2 to Section 6.0 and discussed. Evaluation of residential RBCs and SSLs will be added to the nature and extent section of the report.

EPA Comment 4

Some of the comparisons required by the screening procedure of the Site Screening Process (SSP) for RAAP (October 26, 2001) were not conducted. These include the EPA Region 3 SSLs and the EPA Region 3 Biological and Technical Assistance Group (BTAG) Ecological Risk Assessment guidelines. Please revise the RFI Report to compare all the available data to the

SSLs and EPA Region 3 BTAG values and revise any conclusion drawn from the current comparisons accordingly.

Response

Evaluation of the SSLs will be added to the nature and extent section of the report. Use of BTAG values has been discussed during a teleconference with the Army and BTAG on 17 July 2003. The SLERA process outlined in the Master Work Plan, WPA 12, and this teleconference will be incorporated into the revised report.

EPA Comment 5

The detection limits for the sampling data presented in the RFI Report are not clearly indicated in the tables. The SSP requires, to the greatest extent practicable, that the analytical reporting limits (RLs) should be ensured not to exceed the screening levels the resulting data will be compared to. Please revise the RFI Report to include the detection limits of all constituents analyzed for within the text or summary tables of the report and discuss the RLs that do not comply with the SSP requirement (e.g. detection limits for the polynuclear aromatic hydrocarbons).

Response

The report will be revised to include the detection and reporting limits for each of constituents analyzed for within the text or summary tables of the report. Limits that are found to exceed the appropriate screening levels will be discussed in the revised report.

As discussed in Section 7.2.6, detected chemicals with detection limits greater than the screening values were evaluated during the COPEC selection process. As shown in Tables 7-5 and 7-6, the detection limits for each of the chemicals were evaluated and selected as a COPEC if the screening concentrations were found to exceed screening levels.

EPA Comment 6

In the draft RFI, COPCs were eliminated from the risk assessment by comparing the UTL of the background data to on-site data, which is okay for the purpose of site screening. However, since this is an RFI, further evaluation is necessary. The expectation is that a more rigorous statistical analysis will be conducted, consistent with EPA guidance. In general two questions should be answered regarding site contamination compared to background: One, are there any hotspots on site? Two, is the average concentration on site the same or higher than the average concentration of background? Hotspots can be identified by the UTL, which was done in the report. However, there was no comparison of the means. Means comparison should be done by hypothesis testing (t-test, Wilcoxon Rank Sum test, etc.). EPA guidance outlines which tests are the most appropriate based on the number of samples and the distribution of the data sets.

EPA recommends that no chemical be eliminated before the risk is assessed. Once the risk assessment identifies the risk drivers, then a statistical comparison should be done on chemicals that exceed EPA's risk range. In this case, only thallium.

Response

Means comparison will be conducted by hypothesis testing. Such hypothesis testing will include tests for similarities in shape and location between the site and background data sets. Depending on these initial tests, other tests (e.g., t-test, Mann-Whitney U, or

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Kolmogorov-Smirnov) will be used to assess whether there is a difference between the means. Likewise, statistical procedures will also be used for assessing outliers.

The Army agrees that hot spots are defined by the UTLs. Means testing will be conducted using guidance at the location noted above. The purpose of undertaking a facility-wide background study for Radford AAP was to establish a background data set for use in risk assessment. Based on discussions with USEPA early in the RFI process, it is the Army's understanding that the development of a background data set would allow for the elimination of chemicals from further consideration based on comparisons of site concentrations to background data. USEPA's *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual* (RAGS; USEPA, 1989), Section 5.7, permits the use of background data as a selection criterion for chemicals of potential concern (COPCs). For several constituents, the 95% UTLs are below the RBCs, which will be used to screen COPCs at the site. Those chemicals detected at concentrations below RBCs would be "screened out" of the risk assessment process and would not be carried forward for further quantitative evaluation. Thus, the potential for carrying naturally occurring elements through the quantitative risk assessment would be minimized. The use of UTLs for defining the nature and extent will not change.

Specific Comments

EPA Comment 7

Section 3.1, General Soil Sampling Procedures, on page 3-1 the draft RFI states that soil samples were collected from 0 to 0.5 feet to characterize soil deposited on the rubble pile, and from subsurface soil below the pile (top of native soil) to assess any potential vertical migration of contaminants below the pile. However, Section 2.1, Site Description and History, on page 2-10 states that the rubble pile consists of varying quantities of ash, coal, and concrete. Because samples were not collected in this debris, and it could be a source of contamination (particularly ash), no contaminant characterization of this debris has been performed. This issue needs to be addressed.

Response

Please refer to the cross-sections provided in the report to see the extent of sampling at SWMU 58. Section 3 "General Soil Sampling Procedures" refers to samples collected during the 2002 field investigation. Samples were collected from within the rubble zone during previous investigations. Sample locations for the 2002 investigation at SWMU 58, and other sites in WPA12, were selected by a combined team of RFAAP, USACE, USEPA, VDEQ, and contractor personnel to complete the characterization of the site. The 2002 samples were collected from potentially impacted areas of the site that had not been sampled during the previous investigations and are therefore intended to characterize the site in the context of the complete dataset.

As illustrated on cross-sectional Figures 2-3 and 2-4, subsurface soil samples 58SB1A and 58SB3A were collected directly from the layer of soil containing ash, coal, and concrete. In addition, subsurface soil samples 58SB04B, 58SB04C, and 58SB04D were collected in intervals immediately below this layer. Subsurface soil samples collected in and immediately below this layer and down to bedrock have been analyzed for TAL metals, VOCs, SVOCs, PAHs, explosives, PCBs, and dioxins/furans. Therefore, RFAAP

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contends that this layer and soil below this layer down to bedrock has been fully characterized.

EPA Comment 8

Section 3.1.1.2, Procedures, page 3-2: It is stated in this section that soil for VOC analysis was collected from 0.5-1.0 feet using EnCore sampler. However, Table 3-1 indicates all surface soil samples, including VOCs and SVOCs, were collected from the depth of 0 to 0.5 ft below ground surface. Please clarify which is correct and revise the table or the text accordingly.

Response

Surface soil samples were collected from 0-0.5 ft bgs for all parameter groups except VOCs. The sample fraction for VOC analysis was collected from 0.5-1 ft bgs to ensure that constituents had not been volatilized.

It should be noted that this procedure was agreed upon as a result of teleconference negotiations that occurred with the USEPA and VDEQ during WPA 12 and MWP development. Meeting minutes regarding this issue from the 20 and 21 September 2001 teleconference are provided below.

6. Surface soil sampling depth, end use of data

After some discussion on this issue, the group agreed on the following regarding surface soil sampling at RFAAP.

- Future surface soil sampling, including that proposed in WPA's 9 and 12, would be defined as soil in the first six inches below the rock mat.*
- Sampling for VOC compounds (where proposed) would occur from the interval between 6 and 12 inches in realization that the volatile nature of VOC compounds makes their detection in the 0-6 inch interval unlikely.*
- Previous surface soil sampling, that until now had been 0 to 2 feet at Radford AAP, would still be considered valid for characterizing exposure and extent of contamination in the surface soil interval. Additional sampling at previous sampling locations would not be required.*

For clarity, a footnote will be added to the table to reflect the fact that VOCs were collected from 0.5-1 ft bgs.

EPA Comment 9

Section 4.0, Nature and Extent of Contamination, page 4-1: The first paragraph states "the following sections provide a discussion of the site conditions and the nature and extent of chemicals found in soil and sludge at SWMU 58, the Rubble Pile." However, the RFI Report does not identify which samples are considered sludge samples. Please revise the RFI Report to identify the sludge samples. In addition, please discuss or provide in a table the physical characterization of the fill material.

Response

Use of the word "sludge" was in error. Sludge samples were not collected at SWMU 58. The report will be revised to remove references to sludge.

EPA Comment 10

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Section 4.1.3, Nature and Extent Conclusions, page 4-7: The last paragraph states “based on (1) the elevation of groundwater (1,680 msl [mean sea level]) at a nearby bedrock well and the elevation of bedrock (1,710 ft msl) encountered beneath the Rubble Pile and (2) the lack of constituents of concern in both the Rubble Pile and native soil beneath the pile, it is unlikely that groundwater has been impacted as a result of this SWMU.” It is not clear what the “lack of constituents of concern” means in this context, since the human health risk assessment identifies benzo(a)pyrene, 4-isopropyltoluene, trichloroethene and thallium as chemicals of potential concern. In addition, the impact to groundwater can only be evaluated by either sampling the groundwater beneath the site or by conducting a fate and transport analysis of the contaminants determined from the RFI effort. Since the vertical extent of contaminants has not been determined and the fact that numerous constituents (e.g., arsenic, thallium, manganese, antimony, trichloroethene, cis-1,2-dichloroethene, benzo(a)pyrene, methylene chloride, etc.) exceed the EPA Region 3 soil to groundwater migration SSLs at dilution attenuation factor (DAF) of 20, a conclusion that groundwater is not impacted is premature at this time. Please revise the RFI Report to remove the conclusions regarding groundwater impact and to conduct fate and transport analysis after the vertical extent of contamination is fully delineated.

Response

The Army agrees that while most of the above-mentioned constituents exceed the SSLs, thallium was the sole inorganic compound detected above background in surface soil samples. As detailed in Response to Comment #2, cis-1,2-dichloroethene and methylene chloride each had a single detection at concentrations significantly below the r-RBC. Trichloroethene and benzo(a)pyrene were each detected once at concentrations greater than the residential RBC, but below the industrial RBC. It should be noted that a review of the benzo(a)pyrene concentrations (58SB1 = 240 ug/kg; 58SB2B = 4.2 ug/kg; 58SB3A = 38 ug/kg; 58SS04 = 3.1; 58SB04A = 1.9 ug/kg) detected at SWMU 58 were below the benzo(a)pyrene SSL of 370 ug/kg.

While SSL exceedances indicate a theoretical potential for impact to groundwater, empirical evidence in the form of soil boring characterization, chemical analyses, and soil characteristics/chemistry offer more concrete evidence of site conditions and potential impact to groundwater.

Additional information that was evaluated:

- Groundwater at the site was not encountered at depths to 55 ft bgs,
- Chemical data from six subsurface soil samples collected in native soil below the Rubble Pile show no elevated concentrations for those chemicals found to exceed SSLs,

Regardless, an evaluation of the SSLs will be added to the nature and extent section of the report. The Army is willing to conduct a fate and transport analysis on constituents found to exceed EPA Region III residential screening levels. Results from the fate and transport analysis and conclusions drawn from the evaluation of constituents found to exceed screening levels will be used to further assess the vertical extent of contamination at the site.

EPA Comment 11

Section 4.1.3, Nature and Extent of Contamination, on page 4-7 states that it is unlikely that groundwater has been impacted as a result of this SWMU because of the lack of constituents of concern in the rubble pile. There is considerable uncertainty in this statement if potential sources of contamination in the rubble pile, such as ash and coal, were not sampled.

Response

Please refer to the response to Comment # 7.

EPA Comment 12

Table 4-2, Soil Sample Summary, pages 4-10 through 4-12: Please revise this table to remove the “zeros” entered for the number of background exceedances for other than the inorganics.

Response

Zeros will be replaced with N/A (not applicable) in the column for background exceedances other than inorganics.

EPA Comment 13

Section 5.0, Contaminant Fate and Transport, page 5-1: This section states “because the nature and extent contamination assessment in Section 4.0 did not identify presenting a concern at the SWMU 58 study area, no fate and transport analysis was conducted.” One of the primary objectives of a RFI is to assess the horizontal and vertical extent of contamination so that potential migration of contaminants can be further assessed. Since the RFI Report has not fully delineated the vertical and horizontal extent of contaminants, contaminant fate and transport analysis should be conducted in the revised RFI. This fate and transport analysis should include soil to groundwater migration.

Response

Refer to Response to Comment # 10.

EPA Comment 14

Section 6.0, Human Health Risk Assessment, Table 6-1, Selection of Exposure Pathways:

For the “current” and “future” scenarios, it is indicated that no analysis will be conducted for the trespasser “due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposure that would be experienced by a trespasser.” It is not clear how the maintenance worker (an adult) scenario would be protective of a child/adolescent trespasser, unless the child/adolescent trespasser is separately considered. This child/adolescent trespasser could also be from within the secured installation, unless children do not live or enter the installation. Please clarify this issue and also explain why trespasser exposure is considered unlikely in the future.

Response

Text will be added to Section 6.2.1 to clarify the level of security at the Installation. Given the rigorous security at Radford AAP (e.g., strict security at entry gates, guard towers, barbed-wire fences), it is not reasonable to assume that children would be able to trespass at the Installation. Hypothetical future exposures to children were considered, however, in the residential scenario that was evaluated in Appendix E. The exposure parameters for residents are more conservative than those for trespassers.

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It would also be extremely difficult for an adolescent to trespass at the site given that children do not live on or enter the Installation. Housing at RFAAP is limited and it is outside the cantonment area. Even if an older adolescent were able to evade security measures, it would be very difficult to do so on a routine basis. The frequency and duration of exposure for the maintenance worker is 50 days per year (i.e., once per week, except for two weeks while on vacation) and 25 years, respectively.

EPA Comment 15

Section 7.0, Ecological Risk Assessment: Section 7.7, Results and Conclusions, concludes "The assessment suggests potential adverse impacts to terrestrial wildlife, especially shrews, for modeled contact with the hazard driver (thallium) in surface soil. However, based on likely overestimates of (1) toxicity and (2) uptake of inorganics by earthworms from soil (especially for thallium) ..., and on the fact that no wildlife RTE [rare, threatened and endangered] species have been confirmed at the SWMU 58 study area, no further action is recommended for the site." Page 7-1 of this section describes the scientific/management decision point (SMDP) expected to be reached from the conduct of the Screening Level Ecological Risk Assessment (SLERA). The conclusions drawn do not reflect these SMDPs. The SLERA concluded potential adverse impacts to terrestrial wildlife, especially shrews. Therefore, the ecological concerns should be addressed or the other SMDP decision points should be pursued.

Response

The potential adverse impacts to shrews are discussed in detail in the Uncertainty Analysis (Section 7.6), and alternative HQs are presented. These alternative HQs suggest that adverse impacts to shrews are unlikely. Section 7.0 will be reworded to state that the following Scientific/Management Decision Point (SMDP) has been reached: "There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk."

EPA Comment 16

Section 7.0, Ecological Risk Assessment, on page 7-1 states that groundwater data are irrelevant for this site as groundwater does not discharge to the surface and there is no potential exposure for ecological receptors to groundwater. It was the EPA BTAG's understanding that most groundwater at the base discharged to the New River. If this is the case, the statement on page 7-1 is false, since groundwater does discharge to the surface and potential exposure to ecological receptors in the New River could occur. This issue should be clarified.

Response

This issue will be clarified in the RFI. Groundwater is not known to discharge to the surface in the vicinity of SWMU 58.

EPA Comment 17

Section 7.2.5, Comparison to Risk-Based Screening Ecotoxicity Values, on page 7-14 lists the screening values that were used to assess risk to terrestrial receptors. EPA Region III BTAG values were not used to evaluate risk from direct exposure to soil at the site. For the screening ERA, the BTAG screening values should be used to evaluate risk to terrestrial receptors. Other values will be considered if no BTAG value is available. The EPA BTAG would like to emphasize that the EPA BTAG values are the current set of values that receive primary

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consideration by EPA BTAG for screening ERAs in Region 3. The direction of further ecological studies, if necessary, will consider comparison of site concentrations to these benchmarks.

Response

A direct contact surface soil exposure assessment will be added to the RFI (Step 3A). As the RFI already evaluates terrestrial plant impacts (i.e., flora; Section 7.5.3.1), only potential direct contact exposure for fauna will be included. Both BTAG fauna screening values and Oak Ridge National Laboratory (ORNL) earthworm toxicity benchmark screening values will be used in the assessment.

EPA Comment 18

Section 7.4.1, Assessment Endpoints, on page 7-23, the draft RFI discusses the assessment endpoints that will be evaluated in the ERA. Protection of terrestrial invertebrates should be listed as an assessment endpoint from direct exposure to soils. The measurement endpoint would be a comparison of soil concentrations to EPA BTAG screening values. Currently the ERA only evaluates risk to upper trophic level receptors exposed through the food chain and does not evaluate direct toxicity to soil invertebrates.

Response

See response to Comment No. 17. Protection of terrestrial invertebrates will be added as a measurement endpoint, as these invertebrates may be an important food source for birds and mammals feeding at the site. The current assessment endpoints for SWMU 58 are stated as the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds. Three of the five site receptors already selected (short-tailed shrews, American robins, and red fox) would be expected to use terrestrial invertebrates as a food source. Therefore, potential reductions in terrestrial invertebrates (due to direct contact with surface soil COPECs) could reduce the food supply for the selected assessment endpoint species.

EPA Comment 19

Section 7.7, Results and Conclusions, on page 7-35, the draft RFI states that the ecological risk assessment suggests potential adverse impacts to terrestrial wildlife, especially shrews, for modeled contact with thallium in surface soil. The section further states that the assessment likely overestimates risk based on likely overestimates of (1) toxicity, and (2) uptake of inorganics by earthworms from soil, and that no threatened and endangered species have been confirmed at SWMU 58. Because of these reasons, no further action is recommended for this site. The conclusion of no further action is not supported by the information provided in this report. Section 7.6, Uncertainty Analysis, on page 7-33 recalculates environmental effects quotients (EEQ) for thallium using less conservative parameters, and EEQs are still greater than one for both the shrew and robin. In addition, the lack of any threatened and endangered species on the site **is not** sufficient justification for no further action. Therefore, BTAG recommends that additional evaluation of this pathway to birds and mammals be performed.

Response

See response to Comment No. 15. Although the recalculated EEQs for thallium are still greater than one for the shrew and the robin, the values (1.5 and 2, respectively) are

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sufficiently low that by taking into consideration other conservative assumptions used in the SLERA (e.g., use of the maximum detected thallium concentration in soil as the exposure point concentration and the assumption of 100 percent bioavailability), they are essentially equal to one. Based on this information, no further action is recommended for ecological receptors.

EPA Comment 20

Section 8.0, Summary and Conclusions, on page 8-1 states that the results of the ERA concluded that there are no ecological concerns requiring further action at the site. EPA BTAG believes that this conclusion is not supported. As stated earlier, direct toxicity to soil invertebrates was not evaluated as part of the ERA. In addition, the risk assessment indicates that there is potential risk to birds and mammals from thallium. These issues need to be addressed for this site.

Response

As agreed in Response to Comment #18, the soil community will be assessed and changes the assessment causes to the calculated risk will be incorporated into the report. For the thallium issue, refer to response to Comment #15. Additionally, during a review of the 1992 Verification Investigation (VI) data, it was noted that a practical quantitation limit (PQL) of 20 mg/kg for thallium was in the 1992 VI Report (Dames & Moore, 1992). The thallium values detected (11.8 and 11.4 mg/kg) were half of the PQL value, and therefore the data should be considered estimated in terms of usability. In addition, high concentrations of aluminum (15,200 and 18,600 mg/kg) were noted for these same samples. Aluminum typically (under standard ICP runs) causes interference with thallium if not properly corrected, causing false positives. Analytical results from every soil sample (10 out of 10) collected during the 1998 and 2002 RFI indicate that site thallium concentrations are below the thallium background concentration of 2.11 mg/kg. For these reasons, the Army believes that ecological risk to the environment due to thallium is negligible.



Radford Army Ammunition Plant
Route 114, P.O. Box 1
Radford, VA 24141
USA

April 1, 2003

Mr. Robert Thomson
U. S. Environmental Protection Agency
Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Subject: SWMU 58 RCRA Facility Investigation Report, March 2003, Radford Army Ammunition Plant EPA ID#
VA1 210020730

Dear Mr. Thomson:

Enclosed is one certified copy of SWMU 58 RCRA Facility Investigation Report, March 2003, Radford Army Ammunition Plant. Your additional five copies will be sent under separate cover as well as additional copies to the Virginia Department of Environmental Quality (VDEQ), U.S. Army Environmental Center, U.S. Army Center for Health Promotion and Preventive Medicine. Note this is the initial submission of this document.

Please coordinate with and provide any questions or comments to myself at (540) 639-8266, Jerry Redder of my staff (540) 639-7536 or Jim McKenna, ACO Staff (540) 639-8641.

Sincerely,

A handwritten signature in cursive script that reads "C. A. Jake".

C. A. Jake, Environmental Manager
Alliant Ammunition and Powder Company, LLC

Enclosure

w/o enclosure

c: Russell Fish, P.E., EPA Region III

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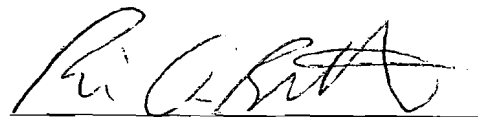
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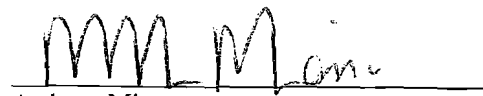
SWMU 58
RCRA FACILITY INVESTIGATION REPORT
March 2003
Radford Army Ammunition Plant

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

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TITLE:


Brian A. Butler
LTC, CM, Commanding
Radford AAP

SIGNATURE:
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Anthony Miano
Vice President Operations
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McKenna, Jim

From: Williams, Keith J Mr USACHPPM [Keith.Williams@APG.AMEDD.ARMY.MIL]
It: Monday, March 17, 2003 7:59 AM
To: McKenna, Jim
Subject: RE: SWMU 58 Rubble Pile (RFAAP-027) draft RCRA Facility Investigation Report



Radford SWMU 58
RFI.doc

Hi Jim,

Attached is our review of SWMU 58 Draft RFI. We concur with the recommendation of no further action. Hard copy to follow. Call with questions.

Thanks,
Keith

-----Original Message-----

From: McKenna, Jim [mailto:Jim.McKenna@ATK.COM]
Sent: Wednesday, March 05, 2003 10:02 AM
To: 'Williams, Keith J Mr USACHPPM'; 'Tony Perry'
'dennis druck'; 'john e tesner'; Davie, Robert; Redder, Jerome;
Latie Watson'
Subject: SWMU 58 Rubble Pile (RFAAP-027) draft RCRA Facility
Investigation Report
Importance: High

Keith, Tony:

Each of you should have received a copy of the SAB by now. Please review and get comments back to me and cc John Tesner ASAP. Need to keep this rolling.

Thanks,
Jim

MCHB-TS-REH (40)

MEMORANDUM FOR Radford Army Ammunition Plant ATTN: SOSRF-OP-EQ (Jim McKenna), PO Box 2, Radford, VA 24143-0002

SUBJECT: Draft SWMU 58 RCRA Facility Investigation Report, February, 2003

1. The US Army Center for Health Promotion and Preventive Medicine reviewed the subject document on behalf of the Office of The Surgeon General pursuant to AR 200-1 (Environmental Protection and Enhancement). Thank you for the opportunity to review this document. One comment follows. We concur with the conclusions and recommendations contained in this report.
2. The scientist reviewing this document and our point of contact is Mr. Keith Williams, Environmental Health Risk Assessment Program, at DSN 584-7722 or commercial (410) 436-7722.

FOR THE COMMANDER:

DAVID L. DAUGHDRILL
Program Manager
Environmental Health Risk
Assessment

CF:
HQDA(DASG-HS-PE)
USAMEDCOM (MCHO-CL-W)
USACE (CENWO-HX-H)
USAEC (SFIM-AEC-ER)

RADFORD ARMY AMMUNITION PLANT, VIRGINIA

SWMU 58 RCRA Facility Investigation Report



Prepared for:

USACE Baltimore District
10 S. Howard St.
Baltimore, MD 21201



Prepared by:

Shaw Environmental, Inc.
2113 Emmorton Park Rd.
Edgewood, MD 21040
Contract No. DACA31-01-F-0085

Final Document

December 2003

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LIST OF ACRONYMS AND ABBREVIATIONS

ADD.....Average Daily Dose	MDC.....Maximum Detected Concentration
ADI.....Allowable Daily Intake	MHSP.....Master Health and Safety Plan
BAFs.....Bioaccumulation Factors	MMA.....Main Manufacturing Area
BCFs.....Bioconcentration Factors	MQAP.....Master Quality Assurance Plan
°C.....Degrees Celcius	MWP.....Master Work Plan
CD.....Compact Disc	NCEA.....National Center for Environmental Assessment
CFR.....Code of Federal Regulations	NCP.....National Contingency Plan
COPC.....Chemical of Potential Concern	NG.....Nitroglycerin
COPEC(s).....Chemical(s) of Potential Ecological Concern	NOAEL.....No Observable Adverse Effect Level
CSEM.....Conceptual Site Exposure Model	NRU.....New River Unit
CSFs.....Cancer Slope Factors	PAH.....Polynuclear Aromatic Hydrocarbon
CSM.....Conceptual Site Model	PCB.....Polychlorinated Biphenyl
DNAPL.....Dense Non-Aqueous Phase Liquid	PEF.....Particulate Emission Factor
DQO.....Data Quality Objective	PETN.....Pentaerythritol tetranitrate
EEQ.....Environmental Effects Quotient	PID.....Photoionization Detector
EPC(s).....Exposure Point Concentration(s)	PPE.....Personal Protective Equipment and Clothing
ERIS.....Environmental Restoration Information System	QA.....Quality Assurance
ft bgs.....feet below ground surface	QA/QC.....Quality Assurance/Quality Control
ft msl.....feet above mean sea level	QC.....Quality Control
FWBSR.....Facility-Wide Background Study Report	RBC.....Risk Based Concentration
GPS.....Global Positioning System	RBRG.....Risk-Based Remediation Goal
HEAST.....Health Effects Assessment Summary Tables	RCRA.....Resource Conservation and Recovery Act
HHRA.....Human Health Risk Assessment	RFAAP.....Radford Army Ammunition Plant
HI.....Hazard Index	RfCs.....Risk Reference Concentrations
HQ.....Hazard Quotient	RfDs.....Risk Reference Doses
ICF KE.....ICF Kaiser Engineers	RFI.....RCRA Facility Investigation
IDM.....Investigative-derived Materials	RME.....Reasonable Maximum Exposure
IRIS.....Integrated Risk Information System	RTE.....Rare, Threatened, or Endangered
IT.....IT Corporation	SLERA.....Screening Level Ecological Risk Assessment
LADD.....Lifetime Average Daily Dose	SMDP.....Scientific/Management Decision Point
LOAEL.....Lowest Observable Adverse Effect Level	SQL.....Sample Quantitation Limit
LOC.....Level of Concern	SSL.....Soil Screening Level

SVOC.....Semivolatile Organic
Compound
TAL.....Target Analyte List
TCE.....Trichloroethene
TCL.....Target Compound List
TOC Total Organic Carbon
TRVs.....Toxicity Reference Values
UCL Upper Confidence Limit
USACE U.S. Army Corps of Engineers
USEPA.....U.S. Environmental Protection
Agency
UTL.....Upper Tolerance Limits
VDEQ Virginia Department of
Environmental Quality
VOC.....Volatile Organic Compound

EXECUTIVE SUMMARY

Shaw Environmental, Inc. (Shaw) conducted a Resource Conservation and Recovery Act (RCRA) Facility Investigation at Solid Waste Management Unit (SWMU) 58, the Rubble Pile, during the month of July 2002. The investigation is required by the 2000 RCRA Corrective Action permit (USEPA, 2000a) for the Radford Army Ammunition Plant (RFAAP) and was performed in accordance with Master Work Plan (MWP) Addendum 012 (IT 2002a). MWP Addendum 012 was prepared to facilitate the investigation effort to comply with the requirements set forth in the 2000 RCRA Corrective Action permit and was approved by the Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality (VDEQ).

Two previous investigations were conducted at SWMU 58 in 1992 and 1998, which had identified thallium and iron in soil at concentrations exceeding background (IT, 2001) and USEPA Region III industrial screening levels (USEPA, 2003a). Thallium was detected above its industrial screening level in two surface soil samples collected from the Rubble Pile surface during the 1992 Verification Investigation (VI). Subsequent investigations have not been able to confirm the elevated thallium concentrations. Iron exceeded its industrial screening level in two subsurface soil samples collected below the pile.

Previous investigation sampling strategies were targeted towards potential contaminants that may have been present at SWMU 58, based on site history. Per the 2000 RCRA permit, a broader sampling strategy was required to complete the delineation of known site contaminants and characterize the site for chemical parameters not previously investigated.

A sampling strategy was developed in MWP Addendum 012 (IT, 2002a) to complete the delineation and characterization of the site. RCRA Facility Investigation (RFI) activities included the collection and chemical and physical analysis of two surface and three subsurface soil samples. These samples and chemical results from previous investigations were combined for the nature and extent of contamination assessment. The nature and extent assessment indicated that isolated occurrences of trichloroethene (TCE) and benzo(a)pyrene (both single detections) exist in the fill material at concentrations exceeding residential screening levels. In addition, occurrences of iron are present in native soil at the soil bedrock interface at concentrations exceeding background (IT, 2001) and industrial screening levels.

A Human Health Risk Assessment (HHRA) was performed to evaluate the potential human health effects associated with chemical contamination from past activities at SWMU 58. Soil data collected in 1992, 1998, and 2002 were analyzed and chemicals of potential concern (COPCs) were selected for quantitative evaluation in the HHRA. Organic and inorganic compounds detected at concentrations above screening criteria were selected as COPCs. Both current land-use conditions and future land-use conditions were evaluated. For each complete exposure pathway, an exposure point concentration was derived. The human toxicity assessment was performed in order to identify numerical toxicity criteria with which to assess human health exposures.

Using the results of the human exposure assessment and the toxicity information, potential human health risks for each COPC and selected exposure pathway were evaluated. Upper bound excess lifetime cancer risks for carcinogenic chemicals and hazard quotients and hazard index (HI) values for noncarcinogenic chemicals were estimated. The upper-bound lifetime excess

cancer risks derived in this report can be compared to USEPA's target risk range for health protectiveness at Superfund sites of 1×10^{-6} to 1×10^{-4} . In addition, the noncarcinogenic hazard indices can be compared to a value of 1, because hazard indices greater than 1 indicate a potential for adverse health effects.

Maintenance Worker. For the current maintenance worker exposures at SWMU 58, the risk characterization results showed that there were no carcinogenic COPCs to be evaluated. The cumulative HI for the maintenance worker's exposure to surface soil is below 1.

For the future maintenance worker exposures at SWMU 58, the risk characterization results showed cumulative cancer risk associated with surface soil (based on soil depths revised for assumed future conditions) is within the target risk range. The cumulative HI is below 1.

For the future maintenance worker exposures at SWMU 58, the risk characterization results showed cumulative cancer risk associated with total soil (based on soil depths revised for assumed future conditions) is within the target risk range. The cumulative HI is less than 1.

Excavation Worker. For the future excavation worker at SWMU 58, the risk characterization results showed cumulative cancer risk associated with total soil (based on soil depths revised for assumed future conditions) is below the target risk range. The cumulative HI is below 1.

Adult Resident. For the future adult resident at SWMU 58, the risk characterization results showed cumulative cancer risk associated with total soil (based on soil depths revised for assumed future conditions) is within the target risk range. The cumulative HI is below 1.

Child Resident. For the future child resident at SWMU 58, the risk characterization results showed cumulative cancer risk associated with total soil (based on soil depths revised for assumed future conditions) is within the target risk range. The cumulative HI is equal to 1.1. No individual chemical or target organ HI was equal to or exceeded 1.

The major risk drivers for the HHRA were TCE and benzo(a)pyrene.

A screening level ecological risk assessment (SLERA) was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases at SWMU 58. Chemicals of potential ecological concern (COPECs) were selected for surface soil under current and future exposure scenarios. Five representative receptor species expected or possible in the area of the site were selected as indicator species for the potential effects of COPECs. Direct contact exposure for terrestrial invertebrates was also assessed, as these invertebrates may serve as a food supply for some of the selected wildlife receptor species.

In the risk characterization that combined the results of the exposure assessment and the effects assessment, Tier 1 and Tier 2 COPEC environmental effect quotients (EEQs) and HIs (summed EEQs) were estimated for the five selected receptor species. Under Tier 1 EEQs, the short-tailed shrew was predicted to be the most impacted, followed by the American robin, the meadow vole, the red fox, and red-tailed hawk. Tier 2 future hazard indices, based on lowest observable adverse effect level (LOAEL) values, were 27 for the American robin, 249 for the short-tailed shrew, 4 for the meadow vole, and less than 1 for both the red-tailed hawk and red fox. Similar results were found for the current exposure scenario. Thallium and chromium were the COPECs contributing the most to the summed EEQ for the wildlife receptors with HIs greater than 1. Exposure pathways of most concern, based on the results of the food-chain modeling, were earthworm ingestion and, to a much lower degree, soil ingestion. The SLERA initial assessment results suggest potential adverse impacts to terrestrial wildlife, especially shrews and robins, for

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modeled exposure to the hazard drivers (thallium and chromium) in surface soil. However, based on likely overestimates of (1) toxicity; (2) uptake of inorganics by earthworms from soil (especially for thallium and chromium); and, (3) thallium concentrations (discussed in detail in *Section 7.6* and demonstrating alternative EEQs less than 1), and that no wildlife RTE species have been confirmed at the SWMU 58 study area, no further action is recommended for the site for food chain exposure considerations. A similar recommendation of no further action results from the finding of limited potential for a reduction in terrestrial invertebrates that may serve as a food supply for higher order wildlife, based on direct contact considerations.

Because of the ecological concern for elevated thallium concentrations detected during the 1992 VI, confirmation sampling was conducted in November 2003. Two soil samples were collocated at the 1992 thallium locations. Analytical results for both samples were below the residential screening level for thallium. These results indicate that the previously reported elevated concentrations of thallium at the Rubble Pile are not repeatable and, therefore, thallium is not a COPEC.

Based on the results from the nature and extent, human health, and ecological risk assessments, no further action is recommended for the SWMU 58 study area.

1.0 INTRODUCTION

Shaw Environmental, Inc. (Shaw) was tasked by the U.S. Army Corps of Engineers (USACE), Baltimore District, to perform additional characterization activities at eight sites in the Main Manufacturing Area (MMA) and six sites at the New River Unit (NRU) of Radford Army Ammunition Plant (RFAAP), in accordance with Contract No. DACA31-01-F-0085.

Samples were collected for most analyte classes during previous investigations at these sites; however, data gaps existed in certain chemical parameters and in completing the characterization of the sites. A data review, including the development of a conceptual site model and conducting a data gap analysis, was performed for each site in Master Work Plan (MWP) Addendum 012 (IT, 2002a). Once the data needs were identified, sampling strategies were developed to complete characterization and delineation for each site.

The 2002 RFI field investigation at Solid Waste Management Unit (SWMU) 58, the "Rubble Pile," was specifically conducted to (1) further assess the potential horizontal and vertical migration of constituents from the Rubble Pile, and (2) characterize site soil for previously untested analyte classes which included, pesticides, polychlorinated biphenyls (PCBs), herbicides, explosives (including nitroglycerin [NG] and pentaerythritol tetranitrate [PETN]), and dioxins/furans. In addition, soil samples were analyzed for total organic carbon (TOC), grain size, and pH to assess the bioavailability and mobility of constituents in the soil. This data, in conjunction with the existing data, provided a sufficient data set for completion of a Nature and Extent of Contamination Assessment (*Section 4.0*), Fate and Transport Evaluation (*Section 5.0*), and a Human Health (*Section 6.0*) and Screening Level Ecological Risk Assessment (SLERA) (*Section 7.0*) for the SWMU 58 study area.

Field activities were conducted in accordance with the Master Work Plan (MWP), Master Quality Assurance Plan (MQAP), the Master Health and Safety Plan (MHSP) (URS, 2002), and MWP Addendum 012 (IT, 2002a), as approved by U.S. Environmental Protection Agency (USEPA) Region III and the Virginia Department of Environmental Quality (VDEQ). Modifications to MWP Addendum 012 proposed sampling activities are presented in *Section 3.5*.

2.0 SITE BACKGROUND

2.1 Site Description and History

SWMU 58 is located in the south-central portion of the Horseshoe Area, east of the main bridge over the New River and directly west of SWMU 32 (Inert Waste Landfill No. 1) (**Figure 2-1**). It is located along the lower portion of the plateau at approximately 1,740 feet (ft) above mean sea level (msl). Topography in the area of SWMU 58 is moderately sloping towards the north. There are several buildings, an overhead steam pipe, and gravel and paved roads in the vicinity. Surface water appears to flow radially off the Rubble Pile with a majority of flow following a dirt access road leading up the middle of the pile. Natural ground surface runoff is expected to flow northward following topography and infiltrate into the ground.

SWMU 58, the Rubble Pile, is roughly triangular in shape with each side approximately 300 ft long (**Figure 2-2 and Photo 1**). Although the pile is irregular in height, the highest elevation

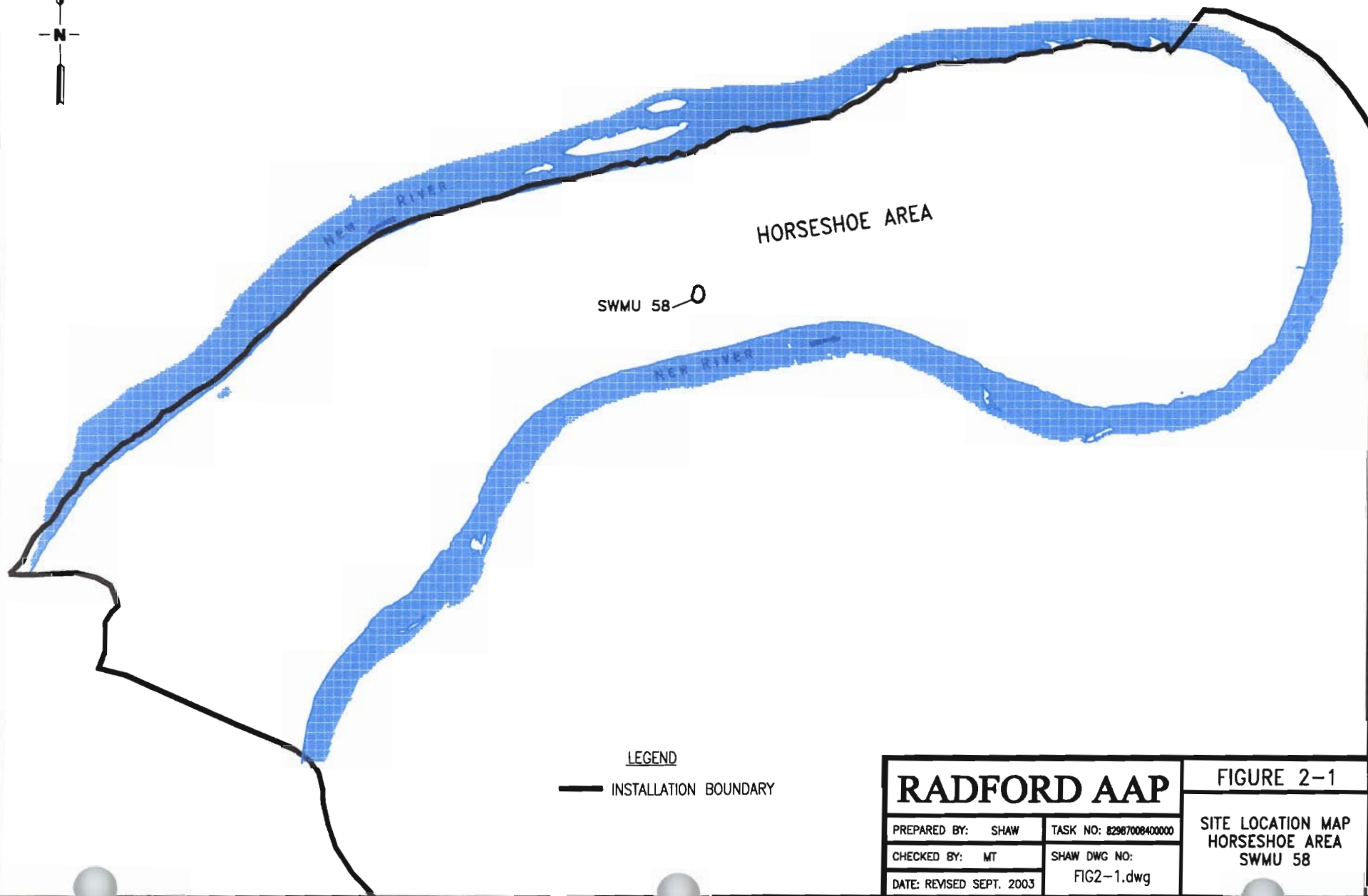
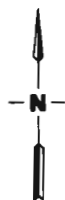


Photo 1. View of Rubble Pile looking northwest

point measured at the top of the pile during the advancement of soil boring 58SB04 in July 2002 was 1,771 ft msl or 35 ft above the natural ground surface elevation of 1,736 ft msl. According to facility representatives interviewed during a March 1990 facility visit, SWMU 58 was used as a one-time construction debris disposal site in 1979. During clearing activities prior to the construction of the Continuous Automated Multi-Base Line (CAMBL), pine trees and surface debris were pushed into a pile and then covered with dirt and fill material. It is believed that vegetation (trees/brush) from the clearing activities was burned to reduce the volume of the pile. It is also believed that no other materials were disposed of at SWMU 58.

Subsurface soil samples were collected from borings advanced through the Rubble Pile into native soil below the pile during the 1998 and 2002 RFI field sampling events (ICF KE, 1999; IT, 2002a). The deepest of these borings was advanced to a depth of 58 ft from the top of the pile. Geologic cross sections were constructed based upon a review of boring logs (**Appendix B**) recorded during the advancement of these borings and the boring log of a bedrock well (32MW1) (installed during the 1992 Verification Investigation [VI] [Dames & Moore, 1992]) located in the vicinity. Plan view of the geologic cross sections is presented on **Figure 2-3**. Cross-sections A-A' and B-B' are presented as **Figures 2-4 and 2-5**.

As depicted in **Figures 2-4 and 2-5**, three of the four borings were advanced through the Rubble Pile into the native soil below. At these boring locations, the fill material ranges in thickness



LEGEND

— INSTALLATION BOUNDARY

RADFORD AAP

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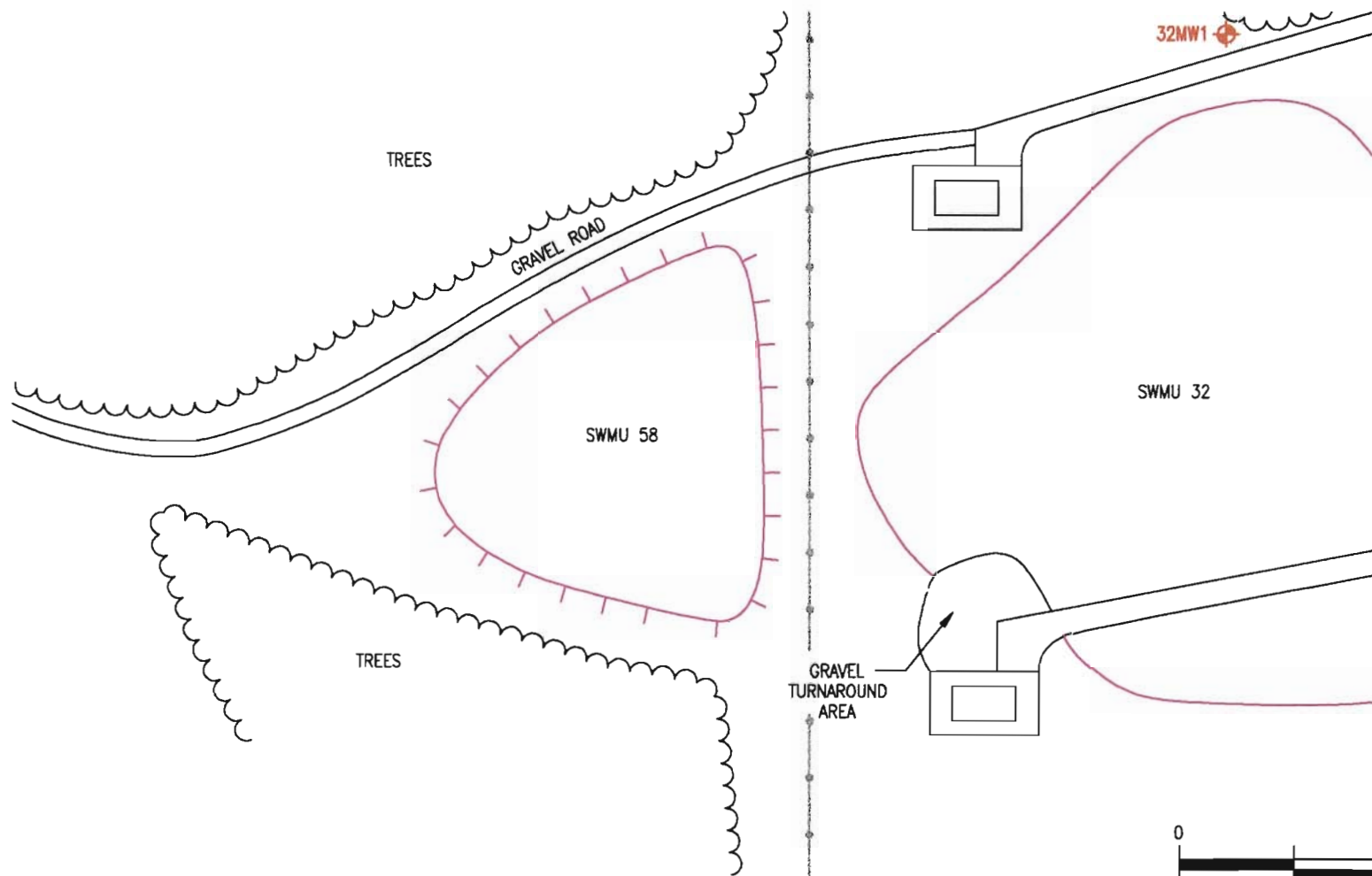
SHAW DWG NO:

DATE: REVISED SEPT. 2003

FIG2-1.dwg

FIGURE 2-1

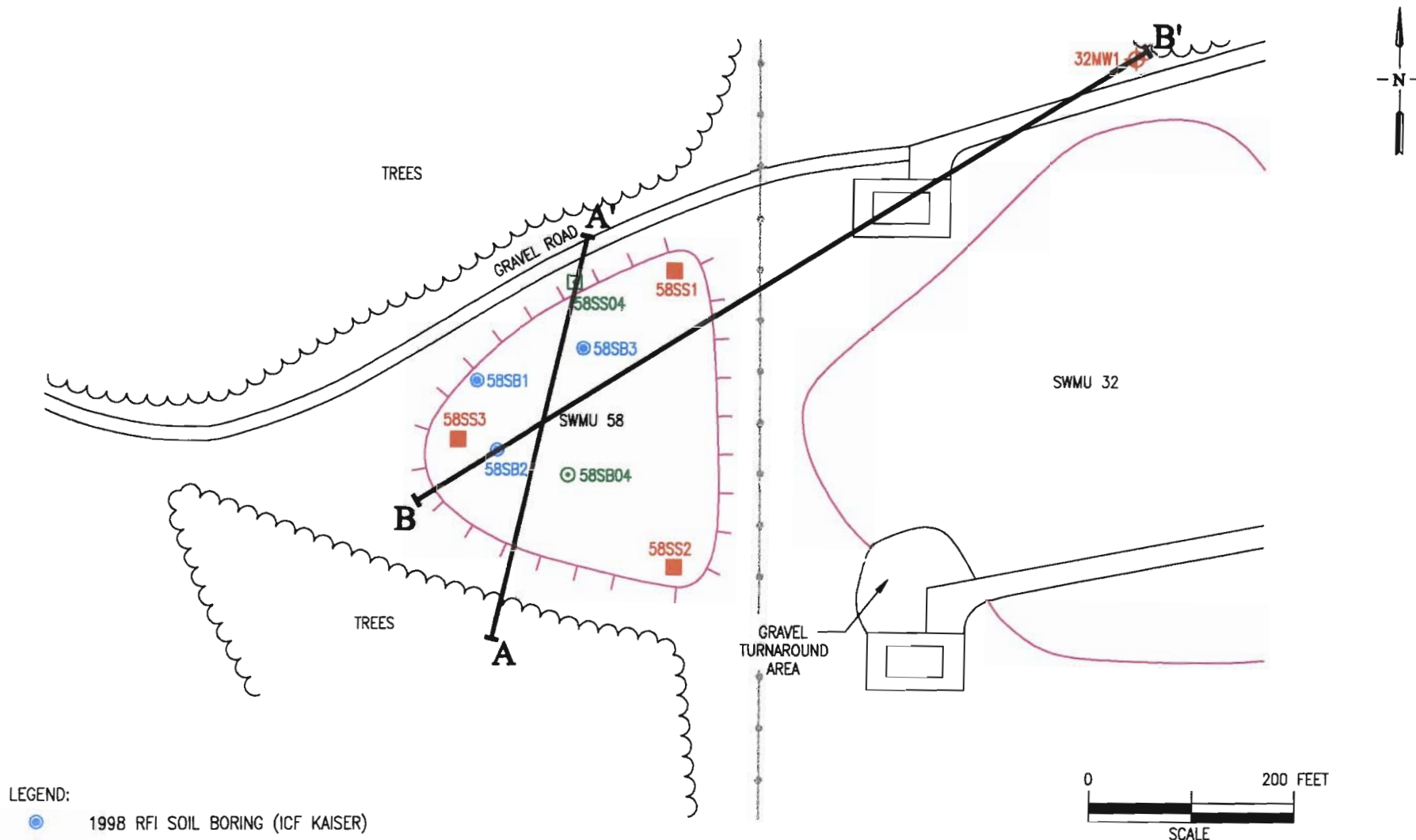
**SITE LOCATION MAP
HORSESHOE AREA
SWMU 58**



LEGEND:

-  1992 VI MONITORING WELL (DAMES & MOORE)
-  OVERHEAD PIPELINE
-  SWMU BOUNDARIES

RADFORD AAP		FIGURE 2-2
PREPARED BY: SHAW	TASK NO: 82987002400000	SWMU 58 SITE MAP
CHECKED BY: MT	SHAW DWG NO: FIG2-2.dwg	
DATE: REVISED SEPT. 2003		



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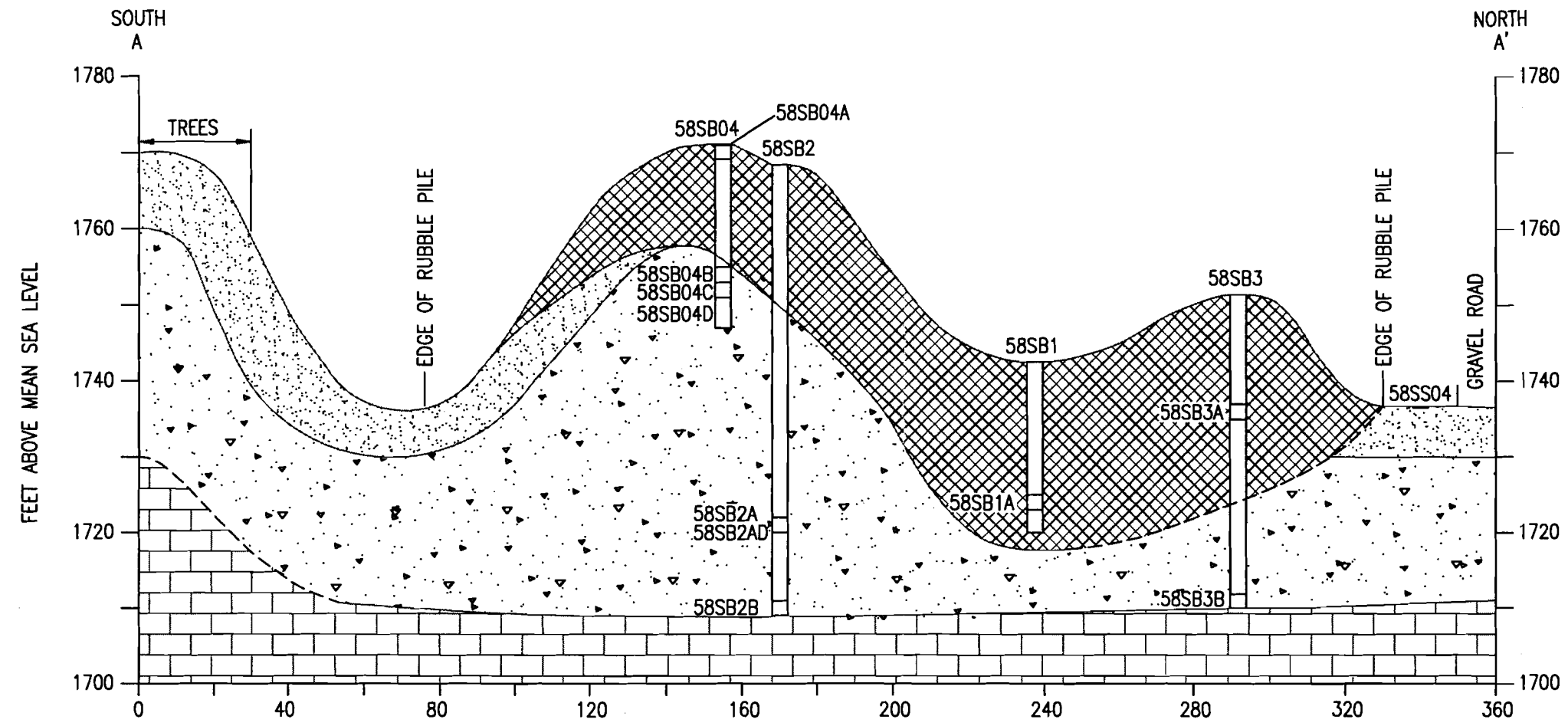
- 1998 RFI SOIL BORING (ICF KAISER)
- ⊕ 1992 VI MONITORING WELL (DAMES & MOORE)
- 1992 VI SURFACE SOIL SAMPLE (DAMES & MOORE)
- OVERHEAD PIPELINE
- SWMU BOUNDARIES
- ⊙ 2002 RFI SOIL BORING LOCATION (SHAW)
- ⊠ 2002 RFI SURFACE SOIL LOCATION (SHAW)

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PREPARED BY: SHAW	TASK NO: 62987002400000
CHECKED BY: MT	SHAW DWG NO: FIG2-3.dwg
DATE: REVISED SEPT. 2003	

FIGURE 2-3

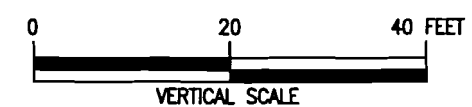
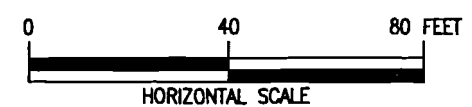
SWMU 58
GEOLOGIC CROSS SECTION
LINES A-A' AND B-B'



LEGEND

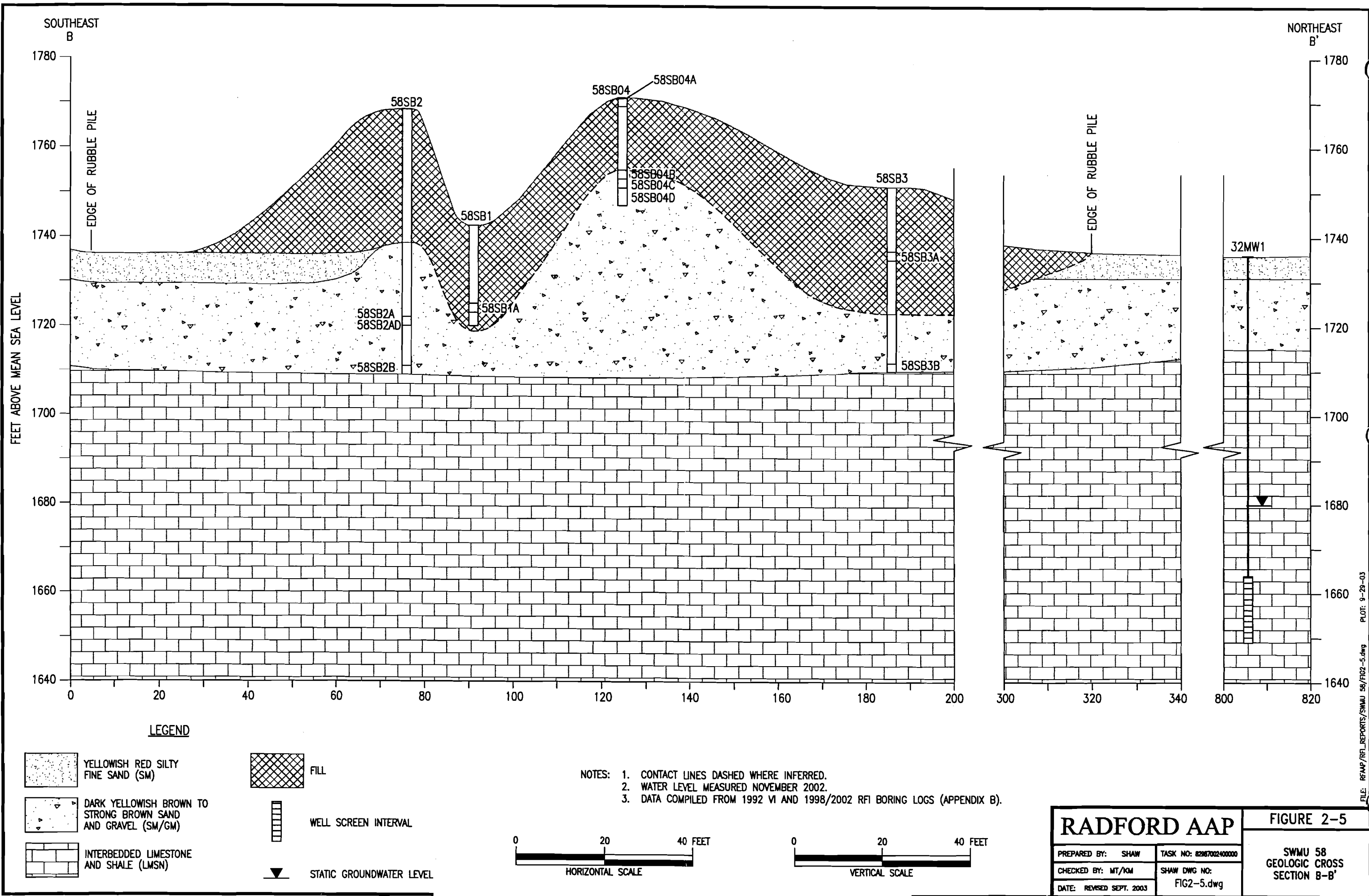
- YELLOWISH RED SILTY FINE SAND (SM)
- DARK YELLOWISH BROWN TO STRONG BROWN SAND AND GRAVEL (SM/GM)
- INTERBEDDED LIMESTONE AND SHALE (LMSN)
- FILL

NOTE: CONTACT LINES DASHED WHERE INFERRED.
DATA COMPILED FROM 1998 AND 2002 RFI BORING LOGS (APPENDIX B).



RADFORD AAP	
PREPARED BY: SHAW	TASK NO: 62967002400000
CHECKED BY: MT/KM	SHAW DWG NO: FIG2-4.dwg
DATE: REVISED SEPT. 2003	

FIGURE 2-4
SWMU 58
GEOLOGIC CROSS
SECTION A-A'



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from approximately 16 (58SB04) to 30 ft (58SB3) from the pile surface. The total estimated volume of fill material present at the site is approximately 48,888 cubic yards or 32,592 tons. Subsurface soil conditions were characterized during the 1998 and 2002 RFIs using soil borings advanced vertically through the pile. The pile is characterized as a heterogeneous mix of soil, vegetation, and minor construction debris (concrete, rebar, wood, etc.). ICF KE (1999) indicated that there are varying quantities of ash, coal, and concrete mixed in the fill. It should be noted that these quantities of fill material consisted of isolated pockets of debris encountered in the pile during boring advancement, and it is unlikely that these materials are representative of the fill material. Because no vegetation such as trees or shrubs were encountered in the borings, it is believed that vegetation was burned to reduce the mass of the pile and that this is the source of the ash/coal. The native soil overburden that is encountered below the fill material consists of silt, sand, gravel, and clay overlying carbonate bedrock. Depth to bedrock ranges from approximately 40 (58SB3) to 58 ft (58SB2) from the top of the pile surface. Bedrock is present at an approximate elevation of 1,710 ft msl. Bedrock consists of gray limestone and dolostone of the Elbrook Formation. As depicted in **Figure 2-5**, monitoring well 32MW1 was completed in bedrock approximately 500 ft northeast of the Rubble Pile. During the advancement of the borehole for this well, bedrock was encountered at 1,715 ft msl. Groundwater was measured in monitoring well 32MW1 in November 2002 at an elevation of 1,680 ft msl. Groundwater was not encountered in the overburden during the advancement of soil borings (in either the 1998 or 2002 RFIs) in the Rubble Pile.

2.1.1 Previous Investigations

Two previous investigations have been conducted at this SWMU. In 1992, Dames & Moore performed VI surface soil sampling to evaluate potential soil contamination in accordance with the 1989 RCRA permit requirements. In 1998, ICF Kaiser Engineers (ICF KE) performed an RFI to assess the vertical extent of constituents detected during the 1992 VI. These investigations and results of the chemical data are summarized below.

Chemical results from the VI and RFI are compared to adjusted USEPA Region III industrial and residential RBCs (USEPA, 2003a), where non-carcinogenic analytes are adjusted downward to a hazard index (HI) of 0.1, as well as facility-wide background inorganic concentrations (IT, 2001), and other regulatory criteria. Industrial and residential RBCs were adjusted downward to an HI of 0.1 for non-carcinogenic compounds to ensure that chemicals with additive effects are not prematurely eliminated during screening. Current (April, 2003) RBC screening values and background 95% UTLs are presented for comparison in **Appendix C, Tables C-1 and C-2**. Analytical results for inorganics are indicated on the tables and figures as exceedances when they exceed both the background value and a screening value. Eliminating screening level exceedances in the contamination assessment of SWMU 58 that are below the background value allows site-specific constituents to be more clearly indicated on the tables and figures.

1992 Verification Investigation (Dames & Moore, 1992). The VI field program consisted of the collection and analysis of three surface soil samples from the Rubble Pile for target analyte list (TAL) metals, target compound list (TCL) volatile organic compounds (VOCs), and TCL semivolatile organic compounds (SVOCs) (**Table 2-1**). Detected analytical results are presented in **Appendix C, Table C-1**. Sampling locations and chemical exceedance results are shown on **Figure 2-6**.

Table 2-1
Previous Investigation Environmental Samples and Analyses

Media	Sample ID	Depth	Analyses
1992 VI – Dames & Moore			
Surface Soil	58SS1	0-1 ft below pile surface	TAL metals, VOCs, SVOCs
	58SS2	0-1 ft below pile surface	TAL metals, VOCs, SVOCs
	58SS3	0-1 ft below pile surface	TAL metals, VOCs, SVOCs
1998 RFI – ICF Kaiser			
Subsurface Soil	58SB1A	15-17 ft below pile surface (fill)	TAL metals, VOCs, SVOCs, PAHs
	58SB1A2	15-17 ft below pile surface (fill)	VOCs (methanol preservation)
	58SB2A	46-48 ft below pile surface or 30 ft below fill	TAL metals, VOCs, SVOCs, PAHs
	58SB2B	57-58 ft below pile surface or 41 ft below fill	TAL metals, VOCs, SVOCs, PAHs
	58SB3A	15-17 ft below pile surface (fill)	TAL metals, VOCs, SVOCs, PAHs
	58SB3B	38-40 ft below pile surface or 13 ft below fill	TAL metals, VOCs, SVOCs, PAHs

SITE ID	58SB3A	58SB3B
DEPTH (ft)	15-17	38-40
TAL Metals (mg/kg)		
Iron	16300	64200
Volatiles (ug/kg)		
Trichloroethene	2700 J	< 920

SITE ID	58SB1A
DEPTH (ft)	15-17
PAHs (ug/kg)	
Benzo(a)pyrene	240

SITE ID	58SS3
DEPTH (ft)	0-1
NO EXCEEDANCES	

SITE ID	58SB2A	58SB2B
DEPTH (ft)	46-48	57-58
TAL Metals (mg/kg)		
Iron	36300	51000

SITE ID	58SS1
DEPTH (ft)	0-1
TAL Metals (mg/kg)	
Thallium	11.8

SITE ID	58SS2
DEPTH (ft)	0-1
TAL Metals (mg/kg)	
Thallium	11.4

Sample Summary																				
Investigation	Contractor	TAL Metals		VOCs		SVOCs		Pest		PCBs		Herb		Explosives		PAHs		Dioxins/Furans		Total
		SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	
1992 VI	D&M	3	---	3	---	3	---	---	---	---	---	---	---	---	---	---	---	---	---	9
1998 RFI	ICF Kaiser	---	5	---	6	---	5	---	---	---	---	---	---	---	---	---	5	---	5	21
2002 RFI	Shaw	2	3	2	3	2	3	2	---	2	3	2	---	2	3	2	3	2	3	39

- LEGEND:
- 1998 RFI SOIL BORING (ICF KAISER)
 - 1992 VI MONITORING WELL (DAMES & MOORE)
 - 1992 VI SURFACE SOIL SAMPLE (DAMES & MOORE)
 - OVERHEAD PIPELINE
 - SWMU BOUNDARIES

NOTE:

J = ESTIMATED CONCENTRATION

DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003)

SHADING = VALUE EXCEEDS THE INDUSTRIAL SCREENING LEVEL (USEPA; APRIL, 2003)

BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)

VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN



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FIGURE 2-6

SWMU 58
PREVIOUS INVESTIGATIONS
SAMPLING LOCATIONS
AND RESULTS

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Samples were collected from beneath the cover material along the edges of the Rubble Pile at a depth of 0–1 ft below the pile surface.

A total of 19 TAL metals were detected in the samples. Thallium was the sole constituent found to exceed screening levels at the site. Thallium was detected above its residential (0.55 mg/kg) and industrial (7.2 mg/kg) screening levels in surface soil samples 58SS1 and 58SS2. Concentrations of thallium were 11.8 mg/kg in 58SS1 and 11.4 mg/kg in sample 58SS2. Thallium was not detected in sample 58SS3. TCL VOCs and TCL SVOCs were not detected in the soil samples.

1998 RCRA Facility Investigation (ICF KE, 1999). Five subsurface soil samples were collected from three soil borings (58SB1, 58SB2, and 58SB3) advanced in the Rubble Pile (**Figures 2-4 and 2-5**) to assess whether constituents were migrating vertically from the Rubble Pile. Samples were analyzed for TAL metals, TCL VOCs, TCL SVOCs, and polynuclear aromatic hydrocarbons (PAHs) (**Table 2-1**). Sampling locations and chemical exceedance results are shown on **Figure 2-6**. Detected analytical results are presented in **Appendix C, Table C-2**.

One PAH [benzo(a)pyrene] and one VOC [trichloroethene (TCE)] were detected in the fill material of the Rubble Pile at concentrations between residential and industrial screening levels. Both samples were collected at 15-17 ft below the pile surface. Benzo(a)pyrene was detected in subsurface soil sample 58SB1A at a concentration of 240 µg/kg (residential RBC = 87 µg/kg) and TCE was detected in subsurface soil sample 58SB3A at a concentration of 2,700 µg/kg (residential RBC = 1,600 µg/kg).

Iron was the sole metal found to exceed its background (50,962 mg/kg) (IT, 2001) and industrial screening level (31,000 mg/kg). Iron was detected above these screening levels at concentrations of 51,000 mg/kg in subsurface soil sample 58SB2B (46-48 ft below pile surface) and 64,200 mg/kg in subsurface soil sample 58SB3B (38-40 ft below pile surface). Both samples were collected from native soil immediately above bedrock.

The RFI was effective in characterizing the vertical extent of metals, VOC, and SVOC concentrations in the Rubble Pile. Representative soil samples were collected throughout the fill and native soil down to bedrock (**Figures 2-4 and 2-5**). The investigation demonstrated that two organics [benzo(a)pyrene and TCE] exist above residential screening levels within the pile and one metal (iron) exists above background and industrial screening levels in native soil below the pile. Thallium concentrations were below background (IT, 2001) in the five soil samples collected at the site.

2.2 Facility-Wide Background Study (IT, 2001)

A Facility-Wide Background Study was conducted at the MMA and NRU at RFAAP in 2001. Task objectives were to characterize naturally occurring background soil inorganic concentrations to establish a baseline for inorganic compounds of concern at RFAAP. Data was statistically evaluated across soil types, soil horizons, and study areas to assess the potential for expanding the effective data into one set. Statistical tests demonstrated that the data was statistically similar across soil types and study areas, resulting in one set of background values for both surface and subsurface soil. Facility-wide point estimates for background soil data were calculated as 95% upper tolerance limits (UTLs) and are presented in **Table 2-2**. In general, UTLs were calculated as follows:

$$UTL = \bar{X} + k(a)$$

where:

UTL = upper tolerance limit (confidence factor of 0.95 and coverage of 95 percent)
 $\bar{x}$ = arithmetic mean
 a = standard deviation
 k = tolerance factor

It should be noted that for seven (aluminum, arsenic, chromium, iron, manganese, thallium, and vanadium) of the constituents, the 95% UTLs are greater than their respective residential screening levels. In addition, the 95% UTLs for arsenic, iron, and manganese are greater than their industrial screening levels.

Inorganic constituents detected at concentrations exceeding screening levels are compared to the background concentrations to assess whether these metals are present at concentrations greater than naturally occurring levels. Inorganics detected at concentrations less than background levels are not considered site-related constituents.

Table 2-2
Facility-Wide Point Estimates for Background Soil

Chemical Name	Range of Data (mg/kg)	Background Concentration 95 % UTL (mg/kg)
Aluminum	3,620 - 47,900	40,041
Arsenic	1.2 - 35.9	15.8
Barium	23.4 - 174	209
Beryllium	0.61 - 5.4	1.02
Cadmium	0.62 - 2.5	0.69
Chromium	6.3 - 75.8	65.3
Cobalt	5.9 - 130	72.3
Copper	1.6 - 38.7	53.5
Iron	7,250 - 67,700	50,962
Lead	2.1 - 256	26.8
Manganese	16.7 - 2,040	2,543
Mercury	0.038 - 1.2	0.13
Nickel	4.6 - 94.2	62.8
Thallium	1.3 - 5.0	2.11
Vanadium	12.2 - 114	108
Zinc	4.7 - 598	202

3.0 FIELD INVESTIGATION PROGRAM

3.1 General Soil Sampling Procedures

Soil samples were collected for chemical and physical analysis during 2002 RFI sampling activities at SWMU 58 (Table 3-1 and Figure 2-2). Because the Rubble Pile is a heterogeneous mixture of soil and construction debris, investigation efforts were focused on characterizing constituent concentrations in the Rubble Pile and identifying potential constituent migration through overland pathways and vertical migration through the pile. Sampling locations were selected based on previous sample results, site visit observations, negotiations with regulators, and the conceptual site model (CSM).

Upon retrieval of soil for sample processing, the soil was field screened for the presence of volatile organic vapors using a properly calibrated photoionization detector (PID). Field screening consisted of cutting a cross-sectional slice from the core or center of the sample with a decontaminated stainless steel trowel and inserting the PID probe. After the PID readings were recorded, a sample for VOC analysis was immediately collected from the appropriate interval using a disposable EnCore sampler.

Table 3-1
2002 RFI Environmental Samples and Analyses

Media	Sample ID	Depth	Analyses	Purpose
Surface Soil	58SS04	0–0.5 ft bgs	TCL VOCs*, SVOCs, herbicides, PAHs, TAL metals, pesticides/PCBs, explosives, dioxins/furans	Identify constituents potentially migrating from the Rubble Pile through overland flow.
	58SB04A	0–0.5 ft below pile surface	TCL VOCs*, SVOCs, PAHs, pesticides/PCBs, herbicides, TAL metals, explosives, dioxins/furans, TOC, grain size, pH	Characterize soil deposited on the Rubble Pile.
Subsurface Soil	58SB04B	16–18 ft below pile surface or 0–2 ft below fill	TCL VOCs, SVOCs, PAHs, TAL metals, PCBs, explosives, dioxins/furans, TOC, grain size, pH	Assess native soil conditions and potential vertical migration of constituents below the Rubble Pile.
	58SB04C	18–20 ft below pile surface or 2–4 ft below fill	TCL VOCs, SVOCs, PAHs, TAL metals, PCBs, explosives, dioxins/furans	
	58SB04D	20–24 ft below pile surface or 4–8 ft below fill	TCL VOCs, SVOCs, PAHs, TAL metals, PCBs, explosives, dioxins/furans	

Refer to Appendix A-1, Table A-1 for the preparation and analytical methodologies used.

* VOCs were collected from a depth of 0.5–1.0 ft

Once the fraction for VOC analysis was completed, the soil recovered from the boring was classified by the site geologist and recorded in the field logbook. Soil for non-VOC analysis was then extracted from the appropriate interval, placed in a stainless steel bowl, and homogenized. The appropriate sample containers were filled, labeled, and placed into coolers with ice and maintained at 4 degrees Celsius (°C).

3.1.1 Surface Soil

In accordance with *Section 5.2.9* of the MWP (URS, 2002), surface soil samples were collected from 0 to 0.5 ft for non-VOC analyses. Surface soil samples for VOC analysis were collected from 0.5-1.0 ft. For combined analysis of previous sampling data (*Section 4.1.2* of this report), soil samples collected from 0 to 2 ft were considered surface soil.

3.1.1.1 Rationale

Two surface soil samples (58SS04 and 58SB04A) were collected from the SWMU 58 study area during the 2002 RFI (**Figure 2-3**). Sample 58SS04 was collected at the northern toe of the pile where a dirt/grass access road leads to the top of the pile. The access road acts as a surface water drainage pathway, capturing runoff from the pile. This sample was collected to identify if constituents are migrating from the Rubble Pile through overland flow. The second sample (58SB04A) was collected from the 0–0.5-ft interval of a soil boring (58SB04), located on top of the Rubble Pile. This sample was collected to characterize the soil cover deposited on the pile. In addition, both samples were analyzed for the chemical parameters listed in **Table 3-1** to characterize site surface soil for previously untested analyte classes.

3.1.1.2 Procedures

Once the vegetative mat was removed at sampling location 58SS04 using a decontaminated spade shovel, soil from 0-0.5 ft was collected using a stainless steel trowel and placed in a stainless steel bowl. Because subsurface soil samples were proposed below surface soil sample 58SB04A, the sample was collected from boring 58SB04 using direct push methodologies. Soil for VOC analysis was collected from 0.5-1.0 ft using an EnCore sampler. Following VOC collection, soil from the 0-0.5 ft interval was then collected from the stainless steel bowl for non-VOC sample processing.

3.1.2 Subsurface Soil

3.1.2.1 Rationale

Previous samples (58SB1A and 58SB3A) were collected directly from areas containing ash, coal and concrete. Three subsurface soil samples (58SB04B, 58SB04C, and 58SB04D) were collected from boring 58SB04, at intervals below the previous samples (**Figures 2-3 and 2-4**). Sample 58SB04B was collected from a depth of 16-18 ft below the top of the pile. This sample was collected immediately below the contact between fill material and the underlying native soil (identified by continuous coring). Samples 58SB04C and 58SB04D were collected at depths of 18-20 (2-4 ft below the fill) and 20-24 ft (4-8 ft below the fill) below the top of the pile. These samples were analyzed for TAL metals, VOCs, SVOCs, PAHs, explosives, PCBs, and dioxin/furans to assess native soil conditions and potential vertical migration of constituents from the Rubble Pile into native soil below the pile. Subsurface soil samples were analyzed for the chemical parameters listed in **Table 3-1** to characterize native soil beneath the fill material for previously untested analyte classes.

3.1.2.2 Procedures

Subsurface soil samples 58SB04B, 58SB04C, and 58SB04D were collected from three intervals (**Table 3-1**) of native soil below the fill material. Soil borings were advanced using a truck-mounted direct push Geoprobe. The direct push rig was equipped with 1.25-in diameter push rods; 4-ft long, 2-in diameter stainless steel open-tube macro-core samplers; and stainless steel

cutting shoes. The macro-core samplers were lined with a dedicated 4 ft long, 1.5-in diameter Teflon sample tube. Using a hydraulic percussion hammer, the Geoprobe drove the open-tube macro-core sampler to the proposed sampling depth. Following the withdrawal of the macro-core and the removal of the Teflon tube, a cutting device was used to remove a 1-3/8-in section along the length of the tube to access the soil stratigraphic characterization and sample processing. Once adequate sample volume was achieved, the boring hole was backfilled with bentonite chips. Excess soil cuttings remaining after sample processing were temporarily stored in a 55-gallon drum at an Installation-approved area.

3.2 Global Positioning System Activities

Sample location coordinates and elevations were obtained using a Trimble Pathfinder Pro XRS global positioning system (GPS). The Pathfinder Pro XRS system was used to obtain real-time position information with submeter accuracy and elevations at 1.5 to 2 times the horizontal accuracy. Horizontal position information was recorded in the U.S. State [Virginia (South)] Plane Coordinate System (measured in U.S. survey feet) using the North American Datum 1983. The vertical control was measured in feet using the National Geodetic Vertical Datum of 1929. Position information will be entered into the Environmental Restoration Information System (ERIS) database. Sample location coordinates and elevations are presented in **Appendix D-1**.

3.3 Management of Investigative-Derived Material

Activities were performed in accordance with MWP Addendum 012 (IT, 2002a), as approved by USEPA Region III and the VDEQ, regarding the identification, handling, and disposal of nonhazardous investigative-derived materials (IDM). Material disposal was documented in the field logbook. Specific compliance issues that were confronted during investigative activities included the following:

- **Accumulation and storage.** IDM accumulated during field sampling activities included soil cuttings, decontamination water, direct push acetate liners, and personal protective equipment and clothing (PPE). Soil cuttings and decontamination water were stored in separate appropriately labeled 55-gallon steel drums. Direct push acetate liners and used PPE were stored together in 55-gallon drums. Containerized materials were stored at Installation-approved areas.
- **Material characterization.** Soil cuttings and decontamination water were sampled before disposal to assess waste characteristics, in accordance with 40 Code of Federal Regulations (CFR) 264 and Virginia Hazardous Waste Management Regulations. Based on analytical results, soil and decontamination water sampled were classified as nonhazardous materials.
- **Transporter, storage, and disposal facility.** Soil cuttings, acetate liners, and PPE were disposed of at Cloyds Mountain Landfill in Pulaski County, VA. Before disposal, waste profile results were provided to the Installation, IDM management subcontractor, and the disposal facility for review and approval. An alternate straight bill of lading was obtained before transport of IDM from the accumulation and storage areas to the disposal facility. Disposal records were provided to the Installation and are kept on file by Shaw.
- **Decontamination water.** Following analysis, the Installation and RFAAP Wastewater Treatment Plant engineers were provided with a copy of the

decontamination water sample results for review. After receiving approval, decontamination water from both the MMA and the NRU was disposed into the collection system of the Wastewater Treatment Plant.

3.4 Quality Assurance

Quality Assurance (QA) is defined as the overall system for assuring the reliability of data produced. The system integrates the quality planning, assessment, and improvement efforts of Shaw and its subcontractors, to provide the independent QA program necessary to establish and maintain an effective system for collection and analysis of environmental samples and related activities. The program encompasses the review and assessment of the documentation, data validation, and the data quality indicators including precision, accuracy, completeness (generation of usable and complete data), representativeness, comparability, and sensitivity.

The accuracy and integrity of RFI data were ensured through the implementation of internal quality control measures in accordance with MWP Addendum 012 (IT, 2002a), as approved by USEPA Region III and the VDEQ. QA and quality control (QC) activities, including field quality control, laboratory quality control, data management, and data validation were integrated into the investigation program to meet data quality objectives (DQOs) established for the RFI. The data were evaluated for each of the data quality objective indicators in **Appendix A-2, Table A-3** and found to meet the pre-established goals. Qualified data did not impact the data quality of the RFI. Complete details of the RFI quality assurance/quality control (QA/QC) analysis and activities are presented in **Appendices A-1 and A-2**. Chemical data validation reports and analytical data are provided on a compact disc (CD) found at the back of this report.

3.4.1 SWMU 58 Data Review

During a review of the SWMU 58 comprehensive dataset, it was noted that thallium had a practical quantitation limit (PQL) of 20 mg/kg according to the 1992 VI Report (Dames & Moore, 1992). The thallium values detected (11.8 and 11.4 mg/kg) were less than the PQL value, and therefore, in accordance with USACE (2001), the data should be considered estimated in terms of usability. In addition to the thallium detections, high concentrations of aluminum (15,200 and 18,600 mg/kg) were noted for these same samples. Aluminum typically [under standard inductively coupled plasma (ICP) runs] causes interference with thallium if not properly corrected, causing false positives. Because of the high concentrations of aluminum and iron in the samples, the high PQLs suggest a dilution of around 10 times was performed adding to the possibility of dilution errors to the thallium values. Analytical results from every soil sample (10 out of 10) collected during the 1998 and 2002 RFI indicate that site thallium concentrations are below the thallium background concentration of 2.11 mg/kg (IT, 2001). For these reasons, the thallium-related risk at the SWMU 58 study area is considered suspect and limited.

3.5 Modifications to Sampling Plan

As discussed in *Sections 2.1.1* and *3.4.1*, the 1992 VI reported concentrations of thallium above the established background screening level (2.11 mg/kg) and the industrial risk-based screening level (7.2 mg/kg) in two surface soil samples (58SS1 and 58SS2) collected from 0-1 ft bgs. Thallium was detected in sample 58SS1 at a concentration of 11.8 mg/kg and in sample 58SS2 at a concentration of 11.4 mg/kg. Subsequent investigations have been unable to confirm elevated thallium concentrations detected during the 1992 VI, making thallium-related risk at the SWMU 58 study area suspect.

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In an effort to confirm elevated thallium concentrations reported in the 1992 VI Report, two additional surface soil samples (58SS05 and 58SS06) were collected on 05 November 2003 at former sample locations 58SS1 and 58SS2. Samples 58SS05 and 58SS06 were collocated with 58SS1 and 58SS2, respectively. Both samples were collected from 0-0.5 ft bgs and analyzed for TAL metals. The analytical results are presented in **Appendix D-2, Table D-1**.

4.0 NATURE AND EXTENT OF CONTAMINATION

The following sections provide a discussion of the site conditions and the nature and extent of chemicals found in soil at SWMU 58, the Rubble Pile. As described in *Section 2.1.1*, chemical results from this report are compared to adjusted USEPA Region III industrial and residential RBCs (USEPA, 2003a), where non-carcinogenic analytes are adjusted downward to a hazard index (HI) of 0.1, as well as facility-wide background inorganic concentrations (IT, 2001), and other regulatory criteria. Industrial and residential RBCs were adjusted downward to an HI of 0.1 for non-carcinogenic compounds to ensure that chemicals with additive effects are not prematurely eliminated during screening. Current (April, 2003) RBC screening values and background 95% UTLs are presented for comparison in **Table 4-1**. Analytical results for inorganics are indicated on the tables and figures as exceedances when they exceed both the background value and a screening value. Eliminating screening level exceedances that are below the background value allows site-specific constituents to be more clearly indicated on the tables and figures.

4.1 Nature and Distribution of Chemicals at SWMU 58

Surface and subsurface soil samples were collected from the SWMU 58 study area to assess the nature and distribution of potential chemical contaminants and to assess potential risk to human health and the environment. Analytical parameters for each sample are presented in **Table 3-1**.

4.1.1 Soil Sample Results - 2002 RCRA Facility Investigation (Shaw)

Chemical detections are presented in **Table 4-1**. Exceedances of regulatory criteria are presented on **Figure 4-1**.

VOCs. Two VOCs were detected. No sample concentrations exceeded industrial or residential screening levels in surface or subsurface soil.

SVOCs. Four SVOCs were detected. No sample concentrations exceeded industrial or residential screening levels in surface or subsurface soil.

PAHs. Sixteen PAHs were detected by this more sensitive method of analyses for SVOCs. No sample concentrations exceeded industrial or residential screening levels in either surface or subsurface soil.

Pesticides. Five pesticides were detected. No sample concentrations exceeded industrial or residential screening levels in surface or subsurface soil.

PCBs. No PCBs were detected in surface or subsurface soil.

Explosives. There were no explosive compounds detected in surface or subsurface soil samples.

Herbicides. Herbicides were not detected in surface or subsurface soil.

Dioxins/Furans. Ten dioxins/furans were detected. No sample toxicity equivalent (TEQ) concentrations exceeded the industrial or residential screening levels of 19 and 4.3 ng/kg, respectively. Dioxin-like compounds were treated according to procedures provided by USEPA and WHO (USEPA, 1989b, 1994a; WHO, 1998). An explanation of the calculation of the TEQs for dioxin/furans is discussed in *Section 6.1.1*.

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Table 4-1
Table Legend

12	J	Shading and black font indicates an industrial RBC exceedence
12	J	Bold outline indicates a residential RBC exceedence.
12	J	Bold, underlined font indicates a background exceedence.
12	J	Shading and white font indicates a SSL exceedence.
12	J	Mixed shading indicates an industrial RBC and a SSL exceedence.
12	12	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

RBCs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.

The pyrene RBCs and SSL were used for acenaphthylene, benzo(g,h,i)perylene and phenanthrene.

Inorganic results below background UTLs are not indicated as exceedences on the table.

RBC = Risk Based Concentration (April, 2003).

RBC values in table are for the more conservative chromium VI

RBC values for chromium III are 150,000 (ind) and 12,000 (res), which were not exceeded

Lead screening values from Technical Review Workgroup for Lead: Guidance Document (April, 1999)

mg/kg = milligrams per kilogram (parts per million).

ng/kg = nanograms per kilogram (parts per trillion).

ug/kg = micrograms per kilogram (parts per billion).

NA = not applicable.

NT = analyte not tested.

LQ = Lab Data Qualifiers

B = (organics) Blank contamination. Value detected in sample and associated blank.

B = (metals) Value <MRL and >MDL and is considered estimated.

E (metals) = Reported value is estimated because of the presence of interferences.

J = (organics) Value <MRL and >MDL and is considered estimated.

U = Analyte not-detected at the method reporting limit.

X = (dioxins) Ion abundance ratio outside acceptable range. Value reported is EMPC

VQ = Validation Data Qualifiers:

B = blank contamination. Value detected in sample and associated blank.

J = estimated concentration

K = estimated concentration bias high

L = estimated concentration bias low

N = presumptive evidence for tentatively identified compounds using a library search

U = analyte not detected

UJ = estimated concentration non-detect

UL = estimated concentration non-detect bias low

SAMPLE ID	58SB04A	58SB04B	58SB04C	58SB04D
SAMPLE DEPTH (ft. bgs)	0-0.5	16-18	18-20	20-24
NO EXCEEDANCES				

SAMPLE ID	58SS04
SAMPLE DEPTH (ft. bgs)	0-0.5
NO EXCEEDANCES	

TREES

GRAVEL ROAD

SWMU 58

58SB04

TREES

GRAVEL
TURNAROUND
AREA

SWMU 32

Sample Summary																				
Investigation	Contractor	TAL Metals		VOCs		SVOCs		Pest		PCBs		Herb		Explosives		PAHs		Dioxins/Furans		Total
		SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	SS	SB	
1992 VI	D&M	3	---	3	---	3	---	---	---	---	---	---	---	---	---	---	---	---	---	9
1998 RFI	ICF Kaiser	---	5	---	6	---	5	---	---	---	---	---	---	---	---	---	5	---	5	21
2002 RFI	Shaw	2	3	2	3	2	3	2	---	2	3	2	---	2	3	2	3	2	3	39

LEGEND:

- ⊙ 2002 RFI SOIL BORING LOCATION (SHAW)
- 2002 RFI SURFACE SOIL LOCATION (SHAW)
- +— OVERHEAD PIPELINE
- SWMU BOUNDARIES

NOTE:

J = ESTIMATED CONCENTRATION
 DARK BORDER = VALUE EXCEEDS THE RESIDENTIAL SCREENING LEVEL (USEPA; APRIL, 2003)
 SHADING = VALUE EXCEEDS THE INDUSTRIAL SCREENING LEVEL (USEPA; APRIL, 2003)
 BOLD = VALUE EXCEEDS THE BACKGROUND CRITERION (IT, 2001)
 VALUES DETECTED BELOW BACKGROUND ARE NOT SHOWN



RADFORD AAP

PREPARED BY: SHAW
 CHECKED BY: MT
 DATE: REVISED SEPT. 2003

TASK NO: 82987002400000
 SHAW DWG NO:
 FIG4-1XLS.dwg

FIGURE 4-1

SWMU 58
 2002 RFI SAMPLING
 LOCATIONS AND RESULTS

FILE: RFAP/RFI_REPORTS/SWMU_58/FIG4-1XLS.dwg PLOT: 9-29-03

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TAL Metals. Twenty-two metals were detected in soil samples collected from the site. None of the detected concentrations were found to exceed both background (IT, 2001) and residential screening levels.

4.1.2 Nature and Extent Summary

This section evaluates the combined analytical data collected from previous investigations and the 2002 RFI. Analytical data collected during the 2002 RFI are presented on **Table 4-1**. Previous investigation analytical data is presented in **Appendix C, Tables C-1 and C-2**. **Figure 4-2** presents exceedances of screening levels from both the current and previous investigations.

Evaluating the combined chemical database from each of the SWMU 58 investigations (**Table 4-2**), two single detections of organics [TCE and benzo(a)pyrene] exceeded residential screening levels. Two inorganics (iron and thallium) are present above industrial screening levels. *Section 4.1.3* discusses confirmation sampling of the elevated thallium sample locations. PCBs, herbicides, and explosive compounds were not detected in soil samples, indicating that these chemical parameters are not a concern at SWMU 58. Dioxins/furans were detected, but the TEQs were less than residential screening levels; therefore, these compounds are not a concern at this site.

4.1.2.1 Soil Screening Level Comparison

As presented in **Table 4-1 and Appendix C, Tables C-1 and C-2**, chemical concentrations detected in surface and subsurface soil samples collected from the SWMU 58 study area were compared to USEPA Region III Soil Screening Level (SSL) soil transfer to groundwater values, using a dilution attenuation factor (DAF) of 20 (USEPA, 2003a). As shown in the tables and summarized in **Table 4-2**, thallium was the sole metal found to exceed its SSL of 3.6 mg/kg. The thallium SSL exceedances occurred in two 1992 VI surface soil samples (58SS1- thallium = 11.8 mg/kg; 58SS2- thallium = 11.4 mg/kg). It should be noted that in accordance with the Soil Screening Guidance: User's Guide (USEPA, 1996), SSL soil transfer to groundwater values were developed based on assumptions in the subsurface, therefore the applicability of SSL soil to transfer values to surface soil concentrations is limited.

TCE and cis-1,2-dichloroethene were the sole organic compounds found to exceed SSLs (0.26 and 350 µg/kg, respectively) at the site. These exceedances occurred in a single subsurface soil sample (58SB3A), collected at a depth of 15-17 ft below the surface of the Rubble Pile. TCE was detected at a concentration of 2,700 µg/kg and cis-1,2-dichloroethene was detected at a concentration of 730 µg/kg. As illustrated on cross-sectional **Figure 2-4**, this sample was collected from the middle of the fill material. TCE and cis-1,2-dichloroethene were not detected in subsurface soil sample 58SB3B, collected from below subsurface soil sample 58SB3A in the same boring at a depth of 38-40 ft below the surface of the pile. The absence of TCE and cis-1,2-dichloroethene in subsurface soil sample 58SB3B or in other samples collected throughout the site indicates that these compounds are limited in distribution and do not appear to be migrating vertically through the subsurface. Because of limited (single) detections of VOCs, samples with no detections of VOCs below the detected concentrations, and depth to groundwater, it is unlikely that these compounds have impacted groundwater present in bedrock beneath the site.

While SSL exceedances indicate a theoretical potential for impact to groundwater, empirical evidence in the form of soil boring characterization and chemical analyses, soil

characteristics/chemistry, and fate and transport analysis offer more concrete evidence of site conditions and potential impact to groundwater.

4.1.3 Nature and Extent Conclusions

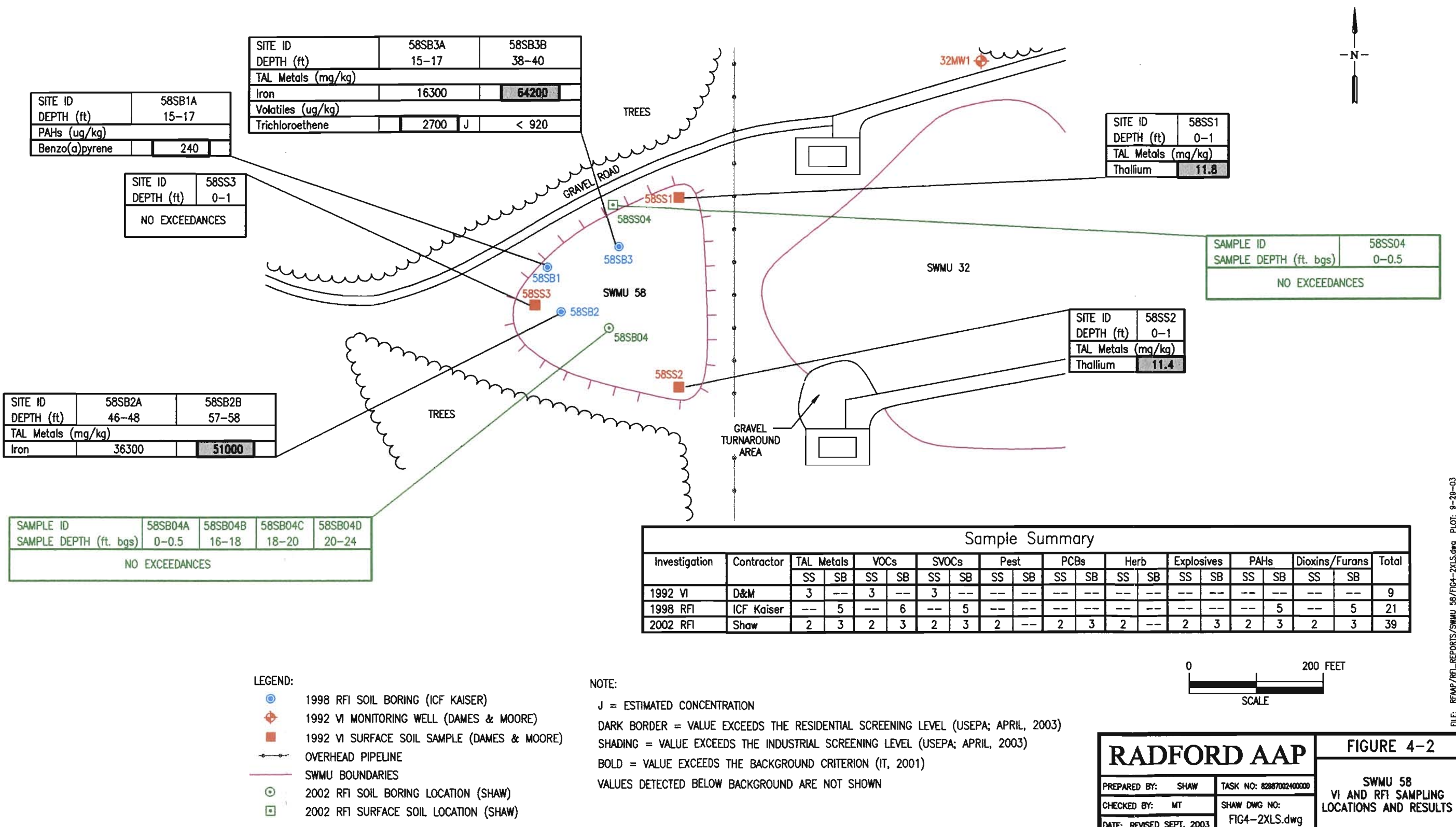
As shown on the Rubble Pile cross-sections (**Figures 2-4 and 2-5**), representative samples of soil have been collected throughout the SWMU 58 study area to fully characterize the site. Because the Rubble Pile is a heterogeneous mix of debris with no specific source area to delineate, samples were collected at random locations on the surface and at different depths and locations throughout the Rubble Pile to characterize the chemical and physical make-up of the debris. Samples were collected in native soil below the Rubble Pile and from a major surface water drainage pathway to assess whether constituents from the Rubble Pile are migrating by surface water flow or vertically through the soil column. Chemical results indicate that pesticides, PCBs, herbicides, and explosives are not a concern at the study area. Dioxin/furan samples were collected because ash/cinder material was identified in a boring. Chemical results indicate that dioxins/furans are not a concern at the site. There were single residential screening level exceedances of TCE and benzo(a)pyrene. The fact that these compounds were single detections in the fill material and were not detected in native soil below the fill material indicates that these compounds do not appear to be migrating and are not widespread throughout the Rubble Pile.

The exceedances of iron above its background and industrial screening level were detected in two subsurface soil samples collected from native soil at a depth of 38-40 ft below the surface of the pile at the overburden-bedrock interface. These two exceedances of iron are also isolated and are within the range of naturally occurring iron concentrations present at RFAAP (**Table 2-2**). Thallium concentrations detected above industrial screening levels in two surface soil samples during the 1992 VI were not repeated in surface or subsurface soil samples collected throughout the site in subsequent investigations. Thallium concentrations were below the established background value in every other soil sample collected from the SWMU 58 study area. As discussed in *Section 3.5*, soil samples were recollected in 2003 at the locations of the elevated thallium concentrations. Thallium results were non-detect in the two additional surface soil samples; therefore, thallium is not considered to be a concern at SWMU 58.

There were no exceedances of compounds in the major drainage from the Rubble Pile or in native soil (except for iron) beneath the Rubble Pile, indicating the lack of migration of constituents of concern.

Groundwater was not encountered in the overburden during the advancement of soil borings through the pile. Based on (1) the elevation of groundwater (1,680 ft msl) at a nearby bedrock well and the elevation of bedrock (1,710 ft msl) encountered beneath the Rubble Pile (**Figures 2-4 and 2-5**) and (2) the lack of constituents of concern in both the Rubble Pile and native soil beneath the pile, it is unlikely that groundwater has been impacted as a result of this SWMU. Chemical data from six subsurface soil samples collected in native soil below the Rubble Pile indicate no elevated concentrations for those chemicals found to exceed SSLs.

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FILE: RFI/RFI_REPORTS/SWMU 58/FIG4-2XLS.dwg PLOT: 9-29-03

Table 4-2
SWMU 58 Soil Sampling Summary

Analyte	i-RBC	r-RBC	Background	SSL Transfer	# of i-RBC Exceedances	# of r-RBC Exceedances	# of Background Exceedances	# of SSL Transfer Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
VOCs (ug/kg)													
Acetone	10000000	780000	na	2500	0	0	na	0	7	14	17	1400	58SB2A
Carbon Disulfide	10000000	780000	na	19000	0	0	na	0	1	14	0.57	0.57	58SB04B
Ethylbenzene	10000000	780000	na	15000	0	0	na	0	1	14	3	3	58SB1A
Methylene Chloride	380000	85000	na	19	0	0	na	0	1	14	3	3	58SB1A
Trichloroethene	7200	1600	na	0.26	0	1	na	1	1	14	2700	2700	58SB3A
cis-1,2-Dichloroethene	1000000	78000	na	350	0	0	na	1	1	14	730	730	58SB3A
PAHs (ug/kg)													
2-Methylnaphthalene	2000000	160000	na	22000	0	0	na	0	4	5	1.7	7.3	58SB04B
Acenaphthene	6100000	470000	na	100000	0	0	na	0	1	10	3.7	3.7	58SB04B
Acenaphthylene	3100000	230000	na	680000	0	0	na	0	1	10	3.7	3.7	58SB04B
Anthracene	31000000	2300000	na	470000	0	0	na	0	3	10	1.1	200	58SB1A
Benzo(a)anthracene	3900	870	na	1500	0	0	na	0	5	10	1.4	220	58SB1A
Benzo(a)pyrene	390	87	na	370	0	1	na	0	5	10	1.9	240	58SB1A
Benzo(b)fluoranthene	3900	870	na	4500	0	0	na	0	5	10	3.3	230	58SB1A
Benzo(g,h,i)perylene	3100000	230000	na	680000	0	0	na	0	2	10	0.79	2.8	58SB04A
Benzo(k)fluoranthene	39000	8700	na	45000	0	0	na	0	5	10	1.2	110	58SB1A
Chrysene	390000	87000	na	150000	0	0	na	0	6	10	1.3	260	58SB1A
Fluoranthene	4100000	310000	na	6300000	0	0	na	0	6	10	2.6	660	58SB1A
Fluorene	4100000	310000	na	140000	0	0	na	0	3	10	2.7	48	58SB1A
Indeno(1,2,3-cd)pyrene	3900	870	na	13000	0	0	na	0	2	5	1.4	1.7	58SS04
Naphthalene	2000000	160000	na	150	0	0	na	0	4	10	2.3	7.7	58SB04B
Phenanthrene	3100000	230000	na	680000	0	0	na	0	7	10	1.7	620	58SB1A
Pyrene	3100000	230000	na	680000	0	0	na	0	7	10	1.1	650	58SB1A
SVOCs (ug/kg)													
2-Methylnaphthalene	2000000	160000	na	22000	0	0	na	0	1	13	8.1	8.1	58SS04
Benzoic acid	410000000	31000000	na	na	0	0	na	na	3	13	130	180	58SB04B
Bis(2-ethylhexyl)phthalate	200000	46000	na	2900000	0	0	na	0	7	13	21	180	58SB1A
Butylbenzylphthalate	20000000	1600000	na	17000000	0	0	na	0	1	13	9.3	9.3	58SB04D
Pesticides (ug/kg)													
4,4'-DDD	12000	2700	na	11000	0	0	na	0	1	2	0.289	0.289	58SS04
alpha-Chlordane	8200	1800	na	920	0	0	na	0	1	2	0.16	0.16	58SS04
delta-BHC	na	na	na	na	na	na	na	na	1	2	2.07	2.07	58SB04A
Dieldrin	180	40	na	2.2	0	0	na	0	1	2	0.478	0.478	58SS04
Methoxychlor	510000	39000	na	310000	0	0	na	0	1	2	0.629	0.629	58SS04
PCBs (mg/kg)													
<i>None detected</i>													
Explosives (mg/kg)													
<i>None detected</i>													
Herbicides (ug/kg)													
<i>None detected</i>													

Table 4-2
SWMU 58 Soil Sampling Summary

Analyte	l-RBC	r-RBC	Background	SSL Transfer	# of l-RBC Exceedances	# of r-RBC Exceedances	# of Background Exceedances	# of SSL Transfer Exceedances	# of Detections	# of Samples	Minimum Concentration	Maximum Concentration	Location of Maximum
Dioxins/Furans (ng/kg)													
1,2,3,4,7,8-HxCDD	na	na	na	na	na	na	na	na	1	5	0.676	0.676	58SB04A
1,2,3,6,7,8-HxCDD	na	na	na	na	na	na	na	na	2	5	0.838	1.096	58SB04A
1,2,3,7,8,9-HxCDD	460	100	na	na	0	0	na	na	4	5	0.285	1.575	58SB04A
1,2,3,4,6,7,8-HPCDD	na	na	na	na	na	na	na	na	5	5	7.129	43.19	58SB04A
OCDD	na	na	na	na	na	na	na	na	5	5	807.3	2810	58SB04B
1,2,3,6,7,8-HxCDF	na	na	na	na	na	na	na	na	2	5	0.771	1.355	58SB04A
1,2,3,4,6,7,8-HPCDF	na	na	na	na	na	na	na	na	5	5	0.319	4.981	58SB04A
OCDF	na	na	na	na	na	na	na	na	5	5	0.9	17.66	58SB04A
TOTAL HxCDD	na	na	na	na	na	na	na	na	5	5	0.673	9.539	58SB04A
TOTAL HPCDD	na	na	na	na	na	na	na	na	5	5	15.02	79.72	58SB04A
TOTAL PCDF	na	na	na	na	na	na	na	na	1	5	0.428	0.428	58SS04
TOTAL HxCDF	na	na	na	na	na	na	na	na	4	5	0.144	6.046	58SB04A
TOTAL HPCDF	na	na	na	na	na	na	na	na	5	5	0.538	14.38	58SB04A
TCDD TE	19	4.3	8.6	0	0	0	0	0	5	5	0.3448	1.618	58SB04A
Metals (mg/kg)													
Aluminum	100000	7800	40041	na	0	0	0	na	13	13	12600	36500	58SB3B
Antimony	41	3.1	na	13	0	0	na	0	6	13	0.21	1.6	58SB2B
Arsenic	1.9	0.43	15.8	0.026	0	0	0	0	13	13	2.53	12.6	58SB3B
Barium	7200	550	209	2100	0	0	0	0	13	13	49.7	160	58SB2A
Beryllium	200	16	1.02	1200	0	0	3	0	11	13	0.46	2.7	58SB3B
Calcium	na	na	na	na	na	na	na	na	13	13	1210	82700	58SB3A
Chromium	310	23	65.3	42	0	0	0	0	13	13	20.6	42.7	58SS1
Cobalt	2000	160	72.3	na	0	0	0	na	13	13	5.5	34.9	58SB2A
Copper	4100	310	53.5	11000	0	0	0	0	13	13	8.7	43	58SB3B
Iron	31000	2300	50962	na	2	2	2	na	13	13	16300	64200	58SB3B
Lead	750	400	26.8	na	0	0	2	na	11	13	11.9	28.4	58SB3A
Magnesium	na	na	na	na	na	na	na	na	13	13	1400	42100	58SB3A
Manganese	2000	160	2543	950	0	0	0	0	13	13	162	1110	58SB3B
Mercury	31	2.3	0.13	na	0	0	0	na	6	13	0.0612	0.1	58SS1
Nickel	2000	160	62.8	na	0	0	0	na	13	13	8.91	32.4	58SB3B
Potassium	na	na	na	na	na	na	na	na	13	13	1030	3140	58SB2B
Selenium	510	39	na	19	0	0	na	0	1	13	0.41	0.41	58SS04
Silver	510	39	na	31	0	0	na	0	1	13	0.37	0.37	58SB3B
Sodium	na	na	na	na	na	na	na	na	13	13	15	3690	58SB2A
Thallium	7.2	0.55	2.11	3.6	2	2	2	2	8	13	0.13	11.8	58SS1
Vanadium	720	55	108	5100	0	0	0	0	13	13	33.7	101	58SB3B
Zinc	31000	2300	202	14000	0	0	0	0	13	13	24.4	134	58SB2B

Notes: 1) QA/QC samples were not included in totals

2) RBCs (USEPA; April, 2003) were adjusted downward to a HQ of 0.1

5.0 CONTAMINANT FATE AND TRANSPORT

This section presents a discussion of the fate and transport of the chemicals identified in the nature and extent assessment as exceeding both the residential screening levels (USEPA, 2003a) and the established background concentrations (IT, 2001). Physical and chemical properties of the impacted media and of the contaminant(s) affect the fate and persistence of contamination in the environment (Rosenblatt, 1975). A general discussion of the physical properties and mechanisms which may govern the fate of contaminants in the environment, and a discussion of contaminant transport is presented in **Appendix G**.

Two organic compounds [TCE and benzo(a)pyrene] and two metals (iron and thallium) were detected in soil above residential screening levels and established background concentrations (IT, 2001). The fate and transport of these constituents are presented in the following sections.

5.1 Organic Compounds

5.1.1 Trichloroethene

Trichloroethene (TCE) was detected above the residential screening level (1,600 µg/kg) in one soil sample, 58SB3A (2,700 µg/kg) at a depth of 15-17 ft below the pile surface. TCE was not detected above the industrial screening level of 7,200 µg/kg. TCE is a solvent and is most likely present as a result of past disposal and decontamination activities at SWMU 58, thus it is unlikely that TCE exists in significant concentrations.

TCE is a chemically stable compound of high volatility. When released to surface soil, it tends to volatilize rather than degrade. Consequently, the ultimate fate of TCE typically resides in the atmospheric medium, where it exists as a vapor and degrades in air by reaction with photochemically-produced hydroxyl radicals.

Releases to the subsurface environment are "trapped" by soil cover, in which TCE has a limited ability to volatilize. In the subsurface environment, TCE has a low absorbency rate to the soil matrix. As a result TCE slowly leaches towards groundwater, and, if a large quantity is present, a Dense Non-Aqueous Phase Liquid (DNAPL) pool may form.

When TCE is released to the soil, very little chemical or biological degradation is expected to occur. Instead, fate and transport of TCE in soil is usually dominated by volatilization. TCE that is not evaporated into the atmosphere generally infiltrates into the subsurface.

In subsurface soil, TCE has a high mobility because of its low absorbence into soil. This is indicated by its high solubility ($1.1\text{E}+03$ at 25°C) and low K_{ow} value (2.38). Consequently, most of the TCE in sandy soil is highly mobile and is leached to the groundwater. Residuals that remain in soil do not hydrolyze under normal environmental conditions, and biodegradation of these residuals is expected to be slow. As illustrated on cross-sectional **Figures 2-4 and 2-5**, native soil below the fill material where TCE was detected above the residential screening level consists of sand and gravel. The fact that TCE was not detected in native soil below the fill material indicates that TCE was not mobilized and did not affect native soil below the pile.

Once in the atmosphere, TCE can be expected to exist mainly in the vapor phase. Gas phase TCE is expected to degrade in air by reaction with photochemically-produced hydroxyl radicals. In a photochemical smog situation, the half-lives of reactions with hydroxyl radicals are expected to be reduced dramatically. Direct photolysis, hydrolysis, and biodegradation reactions are of little importance to the fate of TCE in the ambient atmosphere (Callahan, 1979). Some TCE in

the atmosphere may be subjected to washout in rain, which is expected of compounds with moderate to high solubility (Howard, 1991).

Based on its high Henry's Law constant ($9.10\text{E-}03$) and low K_{ow} value (2.38), TCE is expected to volatilize to the atmosphere. Its ultimate fate, therefore, lies in the atmosphere, where it is photooxidized by hydroxyl radicals. Based on its low K_{oc} (126 mL/g) and K_{ow} values, it is not expected to adsorb to sediments, while hydrolysis, oxidation, and bioaccumulation are also not expected to be significant. Biodegradation occurs slowly for residuals in an aquatic environment.

5.1.2 Benzo(a)pyrene

Benzo(a)pyrene was detected above the residential screening level ($87\text{ }\mu\text{g/kg}$) in one soil sample, 58SB1A (240 mg/kg), which was collected at 15-17 ft below the pile surface. Benzo(a)pyrene was not detected in above the industrial screening level of $390\text{ }\mu\text{g/kg}$. The presence of benzo(a)pyrene is likely due to leachate from buried asphalt or treated wood generated during construction of the CAMBL.

PAHs are a group of more than a hundred organic compounds of two or more aromatic rings. As a general rule, when PAH compounds grow in molecular weight, their solubility in water decreases, solubility in fat tissue increases, and their melting and boiling points increase (Environment Canada, 1997).

The vapor pressure of benzo(a)pyrene is $5.60\text{E-}09$ at 20°C . This value indicates that this compound will not readily volatilize into the atmosphere. This is confirmed by its Henry's Law Constant, which is $< 2.4\text{E-}06\text{ atm-m}^3/\text{mole}$ at 20°C . Based on the K_{oc} value ($5.50\text{E+}06\text{ mL/g}$), benzo(a)pyrene will rarely leach into groundwater or surface water runoff. The log K_{ow} values (6.06) further support this fact. Therefore, as mentioned above, benzo(a)pyrene will tend to sorb to soil rather than partition into the water phase.

In summary, the high K_{oc} and K_{ow} values coupled with low vapor pressure and Henry's Law Constant are physical properties that indicate the strong tendency of benzo(a)pyrene to have relatively low mobility and to be very persistent in the environment. The fact that benzo(a)pyrene was not detected in native soil below the fill material indicates that benzo(a)pyrene was sorbed to soil in the fill material and did not affect native soil below the pile.

5.2 Inorganic Compounds

Metal constituents, including iron and thallium, were detected in soil above residential screening levels and background concentrations at SWMU 58. Since most metals are indigenous to the earth, they are usually found at varying concentration levels in most environmental media. The majority of the metals are non-toxic while some metals are toxic to human health and the environment. Non-toxic metals such as barium are required for the growth of young animals and plants, while heavy metals such as lead may inhibit their growth. Humans are good examples for both scenarios. Some metals build up in animal tissue (e.g., zinc accumulation in fish) while some metals accumulate in plants (e.g., vanadium).

Trace levels of metals may be released into the atmosphere from the off-gas of open-hearth furnaces in steel mills, metal smelters (e.g., lead) and incinerators. The airborne particulates are present mainly as oxides or in the form of chlorides in some incinerator emissions. Significant coagulation and interaction can occur in the atmosphere between emitted species and ambient particles of both natural and artificial origin. The particulate matter eventually will be removed

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from the atmosphere by wet or dry deposition and will be dispersed to a wide area of soil, causing soil contamination or damage to plants.

In soil, metal contaminants are dissolved in the soil solution, adsorbed or ion-exchanged on inorganic soil constituents, complexed with soluble soil organic matter, and precipitated as pure or mixed solids. Metals in the soil solution are subject to movement with soil water and may be transported through the vadose zone to groundwater, taken up by plants and aquatic organisms or volatilized. Unlike organic constituents, metals cannot be degraded, however, some metals such as arsenic and chromium can be transformed among various oxidation states altering their mobility and toxicity. Metal contaminants participate in chemical reactions with the solid soil phase. Immobilization of metals by adsorption, ion exchange, complexation and precipitation can prevent the movement of metal contaminants to groundwater. Changes in soil conditions, such as degradation of organic matrices and changes in pH, redox potential or soil solution composition, due to various remediation schemes or to natural weathering processes, also may change metal mobility in soil.

Fate and transportation mechanisms of the metals with concentrations found to exceed residential screening levels and background concentrations are discussed in more detail in the following sections.

5.2.1 Iron

Iron (Fe) was detected above the residential (2,300 mg/kg) and industrial (31,000 mg/kg) screening level in two soil samples, 58SB2B (51,000 mg/kg) and 58SB3B (64,200 mg/kg). The established background value for iron is 50,962 mg/kg (IT, 2001). Both of these samples were collected at depth (57-58 ft bgs for 58SB2B and 38-40 ft bgs for 58SB3B). The presence of iron at these depths is likely due to infiltration of the iron during rain events.

Corrosion (chemical and biological) of metal debris generated during construction of the CAMBL and buried in the Rubble Pile is the primary environmental degradation process for iron at the site. Corrosion of iron is an electrochemical phenomenon in which ions go into solution (anodic reaction) and the electrons generated by the reaction diffuse through the metal to the cathode where they are consumed (cathodic reaction). Biologically induced corrosion occurs when microorganisms are able to initiate, facilitate, or accelerate the corrosion reaction without changing the electrochemical nature of the process.

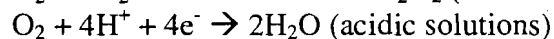
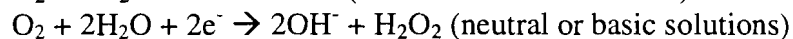
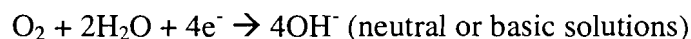
The anodic reaction (also referred to as oxidation reaction) involves the production of electrons, an increase in the valence state of iron, or the conversion of the metal to its ion.



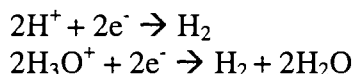
In the above equation, the iron atom has been transformed into an ion and two electrons are released.

At the cathode, electrons are consumed to complete the corrosion process. This is usually the rate-controlling step, and it can occur in a variety of ways. The most common cathodic (reduction) reactions are the following:

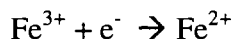
Oxygen reduction



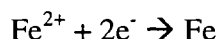
Hydrogen evolution



Metal ion reduction

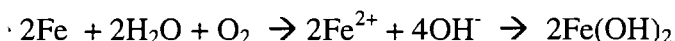


Metal deposition

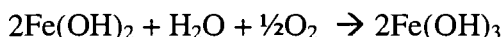


Hydrogen evolution and oxygen reduction are the more common cathodic reactions in the environment where an aqueous medium (acidic, basic or neutral) and air (oxygen) are often present.

The anodic and cathodic reactions occur simultaneously and at the same rate in terms of electron activity such that the iron metal does not become electrically charged. Thus, in the presence of oxygen and water molecules, iron would undergo an electrochemical reaction to produce ferrous hydroxide as follows:



Ferrous hydroxide would precipitate from solution at elevated pH; but in the presence of oxygen and water, ferrous hydroxide is unstable and would readily oxidize to the ferric salt (rust).



The locations of anodes and cathodes on a metal surface area can be a grain size apart. The surface characteristics and oxygen availability vary slightly from one grain to another. At any given time, therefore, some of the grains would act as anodes while others would act as cathodes. This condition may be reversed a fraction of a second later. This changing anodic and cathodic sites explains the occurrence of uniform corrosion over an entire area. Thus, when a piece of iron encounters a low pH environment, the metal would tend to dissolve uniformly over its entire surface, the surface would become thinner, and would eventually fail.

On the other hand, when anodic and cathodic reaction sites are permanently separated either microscopically or macroscopically, localized corrosion is said to occur. Localized corrosion has been identified as a reliable signature for the occurrence of biocorrosion. Localized corrosion can be caused by a microbial colony that creates a differential oxygen availability. Pitting corrosion is an intense form of localized corrosion, which occurs when discrete sites on a surface undergo rapid attack, causing the formation of holes in the metal. The area under the microbial colony (area with the lowest oxygen availability) becomes the anode, while the area outside the deposit acts as the cathode. In general, biological activity that enhances or restricts either the anodic or cathodic reactions or permanently separates the reaction sites will promote corrosion.

Evaluation of the physical data and the lack of iron detections in surface soil indicate that iron is undergoing corrosion reactions at the SWMU 58 study area. Iron is migrating from the surface to the subsurface where it is not anticipated to impact human health or ecological receptors.

5.2.2 Thallium

Thallium (Tl) was detected in two surface soil samples, 58SS1 (11.8 mg/kg) and 58SS2 (11.4 mg/kg), during the 1992 sampling event at concentrations exceeding the industrial screening level of 7.2 mg/kg and background concentration of 2.11 mg/kg (IT, 2001). There is no history

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of the use of thallium in or near SWMU 58 and it is further believed that the detections may be the result of false positives accompanied with analytical dilution errors.

For ICP USEPA SW-846 6010B analysis, which was the method most likely used for this analysis, the high concentrations of aluminum in the samples (15,200 mg/kg for 58SS1 and 18,600 mg/kg for 58SS2) may cause false positives. Concentrations greater than 1,000 mg/kg for aluminum may cause interference for thallium determination if not properly corrected for during analysis. Additionally, it should be noted that there is a high reporting limit for thallium in these samples. Method 6010B usually has a reporting limit of approximately 1-2 mg/kg. The reporting limit for samples 58SS1 and 58SS2 was 10 times higher, indicating a possible 10x dilution which would enhance the magnitude of error for the data reported. Given the high aluminum and iron, it is likely that the sample had interferences for the thallium determination and thus was possibly diluted and reported. This is further verified by the 10x higher reporting limit than normal for Method 6010B. The thallium values detected were less than the reporting limit, and therefore, in accordance with USACE (2001), should be considered estimated in terms of usability. In addition, analytical results from every soil sample (10 out of 10) collected during the 1998 and 2002 RFI indicate that site thallium concentrations are below the thallium background concentration of 2.11 mg/kg (IT, 2001).

Pure thallium is a bluish-white metal that is found in trace amounts in the earth's crust. In the past, thallium was obtained as a by-product from smelting other metals; however, it has not been produced in the United States since 1984. Currently, thallium is obtained from imports and from thallium reserves. Thallium stays in the air, water, and soil for a long time, as it does not readily biodegrade. Some thallium compounds are removed from the atmosphere in rain and snow. Thallium is absorbed by plants and thereby enters the food chain. In the food chain, thallium has been demonstrated to bioaccumulate in fish and shellfish.

6.0 HUMAN HEALTH RISK ASSESSMENT

The human health risk assessment (HHRA) has been prepared to evaluate the probability and magnitude of potential adverse effects on human health associated with actual or potential exposure to site-related chemicals at SWMU 58.

The HHRA is consistent with Section 300.430(d)(4) of the National Contingency Plan (NCP) (40 CFR 300), which directs that a HHRA be conducted “to characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to groundwater or surface water, releasing to air, leaching through soil, remaining in the soil, and bioaccumulating in the food chain.” This section of the NCP was applied to the HHRA in which human health effects associated with site-related chemicals in surface soil and subsurface soil were evaluated. This HHRA is consistent with USEPA guidance and standards (USEPA, 1986a,b; 1989a; 1991a,b; 1992a,b,c; 1995a,b; 1997a,b; 2001a,b,c,d; 2003a). In addition, site-specific guidance was applied, as appropriate. This guidance included the *RFAAP Final Master Work Plan* (URS, 2002) and the *RFAAP Site Screening Process* (USEPA, 2001c). The exposure media and exposure pathways that will be quantitatively evaluated in the HHRA are summarized in **Table 6-1**.

The HHRA is organized as follows:

- Data Summary and Selection of COPCs (Section 6.1). The chemicals detected in environmental media are identified and discussed. The data are summarized by presenting the frequency of detection and the range of detected concentrations in site-related samples, and the concentrations in background samples. In addition, COPCs are selected for quantitative evaluation in the HHRA based on a review of the data and a comparison to appropriate screening levels.
- Human Health Exposure Assessment (Section 6.2). The potential pathways by which individuals may be exposed to COPCs are discussed, and exposure pathways are selected for further evaluation. The chemical concentrations at the points of potential exposure are presented for each complete exposure pathway. Standard exposure factors and health-protective assumptions are used to assess the magnitude, frequency, and duration of exposure for each pathway, and potential exposures (intakes) are then estimated.
- Human Health Toxicity Assessment (Section 6.3). The potential toxicity of chemicals to humans and the chemical-specific health effects criteria to be used in the quantitative assessment are presented.
- Human Health Risk Characterization (Section 6.4). Quantitative risk estimates are calculated for each complete exposure pathway by combining the toxicity criteria with estimated intakes of potentially exposed individuals.
- Uncertainties in the HHRA (Section 6.5). Major sources of uncertainty in the HHRA are discussed.
- HHRA Summary (Section 6.6). The HHRA is briefly summarized.

Table 6-1
Selection of Exposure Pathways

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	Groundwater	Groundwater	SWMU 58	None	None	None	On-site	None	On-site groundwater is being addressed under a separate evaluation, the results of which will be presented in the Current Conditions of Ground Water report.
	Surface Soil	Surface Soil	SWMU 58	Maintenance Worker	Adult	Ingestion	On-site	Quant	Maintenance workers could contact surface soil at SWMU 58 and be exposed to COPCs via incidental ingestion. The current scenario assumes that the rubble pile is in place.
						Dermal	On-site	Quant	Maintenance workers could contact surface soil at SWMU 58 and be exposed to COPCs via dermal absorption.
				Trespasser	Adolescent	Ingestion	On-site	None	Due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
						Dermal	On-site	None	Due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
		Air	SWMU 58	Maintenance Worker	Adult	Inhalation	On-site	Quant	Maintenance workers could be exposed to airborne volatiles or particulate matter released from surface soil at SWMU 58.
				Trespasser	Adolescent	Inhalation	On-site	None	Due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
		Total Soil (Surface and Subsurface)	SWMU 58	None	None	None	On-site	None	Current excavation or construction activities are not occurring at SWMU 58. The current scenario assumes that the rubble pile is in place.
Future	Surface Soil	Surface Soil	SWMU 58	Maintenance Worker	Adult	Ingestion	On-site	Quant	Maintenance workers could contact surface soil at SWMU 58 and be exposed to COPCs via incidental ingestion. The future scenario assumes that the rubble pile has been removed and soil from the pile has been redistributed on site.
						Dermal	On-site	Quant	Maintenance workers could contact surface soil at SWMU 58 and be exposed to COPCs via dermal absorption.
				Trespasser	Adolescent	Ingestion	On-site	None	Due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
						Dermal	On-site	None	Due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
		Air	SWMU 58	Maintenance Worker	Adult	Inhalation	On-site	Quant	Maintenance workers could be exposed to airborne volatiles or particulate matter released from surface soil at SWMU 58.
				Trespasser	Adolescent	Inhalation	On-site	None	Due to security at the installation, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
	Total Soil (Surface and Subsurface)	Total Soil (Surface and Subsurface)	SWMU 58	Maintenance Worker	Adult	Ingestion	On-site	Quant	Maintenance workers could contact soil at SWMU 58 and be exposed to COPCs via incidental ingestion. The future scenario assumes that the rubble pile has been removed and soil from the pile has been redistributed on site.
						Dermal	On-site	Quant	Maintenance workers could contact soil at SWMU 58 and be exposed to COPCs via dermal absorption.
				Excavation Worker	Adult	Ingestion	On-site	Quant	Excavation workers could contact soil at SWMU 58 and be exposed to COPCs via incidental ingestion. The future scenario assumes that the rubble pile has been removed and soil from the pile has been redistributed on site.
						Dermal	On-site	Quant	Excavation workers could contact soil at SWMU 58 and be exposed to COPCs via dermal absorption.

**Table 6-1
Selection of Exposure Pathways**

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (con't)	Total Soil (Surface and Subsurface)	Total Soil (Surface and Subsurface)		Resident	Adult	Ingestion	On-site	Quant	If SWMU 58 were to be further developed for residential purposes, residents could be exposed to COPCs in total soil via ingestion. The future land use scenario assumes that the rubble pile has been removed and soil from the pile has been redistributed on site. The residential scenario is not considered to be a reasonably anticipated land use; however, it is being included in this evaluation to meet "clean closure" requirements under RCRA.
						Dermal	On-site	Quant	If SWMU 58 were to be further developed for residential purposes, residents could be exposed to COPCs in total soil via dermal absorption.
					Child	Ingestion	On-site	Quant	If SWMU 58 were to be further developed for residential purposes, residents could be exposed to COPCs in total soil via ingestion. The future land use scenario assumes that the rubble pile has been removed and soil from the pile has been redistributed on site. The residential scenario is not considered to be a reasonably anticipated land use; however, it is being included in this evaluation to meet "clean closure" requirements under RCRA.
						Dermal	On-site	Quant	If SWMU 58 were to be further developed for residential purposes, residents could be exposed to COPCs in total soil via dermal absorption.
				Trespasser	Adolescent	Ingestion	On-site	None	Given the industrial nature of the site, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
						Dermal	On-site	None	Given the industrial nature of the site, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.
		Air	SWMU 58	Maintenance Worker	Adult	Inhalation	On-site	Quant	Maintenance workers could be exposed to airborne volatiles or particulate matter released from soils at SWMU 58.
				Excavation Worker	Adult	Inhalation	On-site	Quant	Excavation workers could be exposed to airborne volatiles or particulate matter released from soils at SWMU 58.
				Resident	Adult	Inhalation	On-site	Quant	If SWMU 58 were to be further developed for residential purposes, residents could be exposed to airborne volatiles or particulate matter released from total soil.
					Child	Inhalation	On-site	Quant	If SWMU 58 were to be further developed for residential purposes, residents could be exposed to airborne volatiles or particulate matter released from total soil.
				Trespasser	Adolescent	Inhalation	On-site	None	Given the industrial nature of the site, trespasser exposures are unlikely. However, the maintenance worker scenario would be protective of the limited exposures that would be experienced by a trespasser.

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6.1 Data Summary and Selection of COPCs

This section of the HHRA discusses the methodologies used to summarize the data for the HHRA (*Section 6.1.1*) and to select COPCs for detailed evaluation in the HHRA (*Section 6.1.2*). The summarization of data and selection of human health COPCs are then presented for the sampled medium at SWMU 58 in *Section 6.1.3*. Finally, a summary of the COPCs selected in each medium is provided in *Section 6.1.4*.

6.1.1 Methodology for Data Summary

The first step of the HHRA process was to summarize the analytical data collected at SWMU 58. Detailed discussions of sampling approaches and the quality assurance/quality control activities implemented during the collection of the data are provided in **Appendix A-2**.

The following steps, which are in accordance with USEPA (1989a) guidance, were used to summarize the analytical data for this HHRA:

- Analytical data collected between February 1992 and July 2002 were summarized by environmental medium (i.e., surface soil and total soil). In general, surface soil was defined as soil samples that were collected from 0 to 2 ft. Total soil consisted of surface soil and subsurface soil, assuming that soil would mix as a result of potential disturbance (e.g., excavation, construction) in the future. Subsurface soil samples were collected between 2 to 10 ft bgs. In addition, the samples were divided into groups that describe conditions relevant to potential exposure by receptors or were pertinent to site environmental factors. Due to the presence of the Rubble Pile at SWMU 58, the original soil depths for these soil samples were revised and the samples were reclassified for use in the future land use scenario. The sample groupings used in the HHRA are described in the sections below.
- The qualification and validation of the analytical data included a comparison of the site data to corresponding blank (laboratory, equipment rinse, field, and trip) concentration data. If the detected concentration in a site sample was less than ten times (for common laboratory contaminants) or five times (for other compounds) the concentration in the corresponding blank sample, the sample was qualified with a "B." According to USEPA Region III guidance (USEPA, 1995c; USEPA, 2000a), it cannot be unequivocally stated that the report is not "non-detected" at that concentration. Therefore, B-qualified data are typically eliminated from the data set.

Data sets for this HHRA were evaluated for B-qualified data on an "analyte-by-analyte" basis. Because of the amount of B-qualified data reported for some analytes, one-half of the sample quantitation limit (SQL) was used as a proxy value for B-qualified data points to address potential uncertainty associated with eliminating these data. If the proportion of B-qualified results in the data set for SWMU 58 was greater than 50 percent, one-half of the SQL was used to represent the concentration. If the proportion of B-qualified results in the data set was less than 50 percent, the B-qualified data for the analyte were eliminated. The exception to this approach was the dioxin/furan results used to estimate a 2,3,7,8-TCDD toxicity equivalent concentration. For screening purposes, the B-qualified data were included in calculations of the dioxin toxicity equivalence (TCDD TE), as described in the sections below.

- Data that were considered estimated values (e.g., J-qualified) were used in the HHRA without modification.

- Arithmetic mean chemical concentrations were calculated by averaging the detected concentrations with one-half the sample quantitation limit of non-detects. One-half of the sample quantitation limit (SQL) is typically used in assessments (USEPA, 1989a) when averaging non-detect concentrations, because the actual value can be between zero and a value just below the SQL. In accordance with USEPA Region III guidance (USEPA, 1995c), this procedure was used even when the non-detect SQL was two or more times higher than the maximum detected concentration in that medium. The uncertainties associated with this methodology will be discussed in *Section 6.5*.
- Data from duplicate samples were averaged together and treated as one result. If a chemical was detected in one of two duplicate samples, one-half of the SQL was used for the non-detected value and averaged together with the detected result.
- Frequency of detection was calculated as the number of samples in which the chemical was detected over the total number of samples analyzed. The frequency of detection was assessed after the exclusion of B-qualified data, and after the treatment of duplicate sample data. Because samples were sometimes analyzed for different sets of analytes, the frequencies of detection varied by analyte. Frequency of detection, however, was generally not used as a selection criterion for COPCs in this HHRA.
- If a constituent was analyzed by two different methods, results from the most sensitive analytical method were generally used.

Dioxin-like compounds were treated according to procedures provided by USEPA and WHO (USEPA, 1989b, 1994a; WHO, 1998). Dioxin-like compounds (PCDDs and PCDFs) are present in the environmental media as complex mixtures. PCDDs and PCDFs consist of a family of approximately 75 and 135 congeners, respectively. To simplify the task of screening PCDDs/PCDFs for evaluation in this risk assessment, these compounds were evaluated with respect to a single member of this class of compounds. The concentration of each congener was evaluated on the basis of its concentration relative to that of 2,3,7,8-TCDD, which has been shown to be the most potent congener of the class of PCDDs/PCDFs. This procedure is described in the following steps:

- 1) For each sample, the detected concentration of each congener was multiplied by a toxicity equivalence factor (TEF) to derive a 2,3,7,8-TCDD equivalent (TCDD TE) concentration (USEPA, 1989b). If the value for a particular congener was reported as a "non-detect" (ND), then the reported detection limit was used to represent a conservative concentration for the congener. If the result for a particular congener was B-qualified, then the result was conservatively retained for the calculation (Note: three results were B-qualified).
- 2) To calculate the 2,3,7,8 TCDD TE for each sample, the TCDD TEs for individual congeners were summed. The TEF values for each congener are listed in **Table 6-2** (WHO, 1998).
- 3) The total TCDD TE values for each medium were summarized by selecting the maximum and minimum TCDD TEs across each of the samples for that medium.

6.1.2 Methodology for Selection of COPCs for Human Health

Once the sampling data for SWMU 58 were grouped and summarized, COPCs for the HHRA were selected. The purpose of selecting COPCs is to identify those chemicals that are

Table 6-2
Toxicity Equivalence Factors (TEFs)

Congener	TEF
Dioxins	
2,3,7,8-TCDD or TCDD	1.0
HxCDD	0.1
2,3,7,8-HpCDD or HpCDD	0.01
OCDD	0.0001
PeCDD	1.0
Furans	
TCDFs	0.1
HxCDF	0.1
2,3,7,8-HpCDF or HpCDF	0.01
OCDF	0.0001
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5

present as a result of past activities at the site and most likely to be of concern to human health. Therefore, the screening process eliminates from the HHRA:

- those chemicals present in surface soil and total soil at concentrations below conservative health-based screening levels, represented by the USEPA Region III RBCs corresponding to a carcinogenic risk of 1×10^{-6} or adjusted to reflect one-tenth (0.1) of the hazard index (HI) for noncarcinogenic effects (USEPA, 2003a);
- those chemicals below background concentrations (inorganics); and,
- those chemicals that are essential human nutrients and unlikely to pose risks to human health.

The following methodologies were used to eliminate chemicals detected at maximum concentrations below screening levels from quantitative evaluation in the HHRA, and to compare inorganic chemicals detected above screening levels to background concentrations. The RBCs used for this HHRA are presented in **Table 6-3**.

6.1.2.1 Comparison of Detected Chemicals to Relevant Health-Based Levels

The maximum concentrations of detected chemicals were compared to RBCs (USEPA, 2003a), in accordance with Region III guidance. The RBCs presented in the USEPA Region III RBC table are health-protective chemical concentrations that are back-calculated using conservative exposure parameters and either carcinogenic toxicity criteria and a 1×10^{-6} target risk level, or noncarcinogenic toxicity criteria and an HI of 1.0 (whichever results in a lower RBC). For the purposes of this HHRA, RBCs that were back-calculated using carcinogenic toxicity criteria were used directly as screening criteria, whereas RBCs that were back-calculated using noncarcinogenic toxicity criteria were adjusted downward by a factor of 10 in order to add a ten-fold measure of safety (i.e., to ensure that compounds that could combine to result in an HI greater than 1 for a specific target organ/critical effect were not eliminated from the assessment). If the maximum detected on-site chemical concentration was less than the RBC (or adjusted

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Table 6-3
USEPA Region III RBCs for Chemicals Detected at SWMU 58

Chemical	USEPA Region III RBC (a)
	Residential Soil (organics - mg/kg; inorganics - mg/kg)
Organics	
Acenaphthene	4.7E+02
Acenaphthylene (b)	2.3E+02
Acetone	7.8E+02
Anthracene	2.3E+03
Benz(a)anthracene	8.7E-01
Benzo(a)pyrene	8.7E-02
Benzo(b)fluoranthene	8.7E-01
Benzo(g,h,i)perylene (b)	2.3E+02
Benzo(k)fluoranthene	8.7E+00
Benzoic acid	3.1E+04
delta-BHC (c)	4.9E-01
Butyl benzyl phthalate	1.6E+03
Carbon disulfide	7.8E+02
alpha-Chlordane (d)	1.8E+00
Chrysene	8.7E+01
4,4'-DDD	2.7E+00
cis-1,2-Dichloroethene	7.8E+01
Dieldrin	4.0E-02
Ethylbenzene	7.8E+02
bis(2-Ethylhexyl)phthalate	4.6E+01
Fluoranthene	3.1E+02
Fluorene	3.1E+02
Indeno(1,2,3-c,d)pyrene	8.7E-01
Isopropylbenzene	7.8E+02
4-Isopropyltoluene	NRA
Methylene chloride	8.5E+01
2-Methylnaphthalene	1.6E+02
Naphthalene	1.6E+02
Phenanthrene (b)	2.3E+02
Pyrene	2.3E+02
Total Organic Carbon	NRA
TCDD Toxicity Equivalent	4.3E-06
Toluene	1.6E+03
Trichloroethene	1.6E+00
p&m-Xylene	1.6E+03
Inorganics	
Aluminum	7.8E+03
Antimony	3.1E+00
Arsenic	4.3E-01
Barium	5.5E+02
Beryllium	1.6E+01
Calcium (e,f)	1.0E+06
Chromium (g)	2.3E+01
Cobalt	1.6E+02
Copper	3.1E+02
Iron	2.3E+03

Table 6-3
USEPA Region III RBCs for Chemicals Detected at SWMU 58

Chemical	USEPA Region III RBC (a)
	Residential Soil (organics - mg/kg; inorganics - mg/kg)
Lead (h)	4.0E+02
Magnesium (e,i)	1.0E+06
Manganese (j)	1.6E+02
Mercury (k)	2.3E+00
Nickel	1.6E+02
Potassium (e,i)	1.0E+06
Selenium	3.9E+01
Sodium (e,i)	1.0E+06
Thallium	5.5E-01
Vanadium	5.5E+01
Zinc	2.3E+03

- (a) USEPA Region III residential soil RBCs are used as screening values for soil (USEPA, 2003a). RBCs for noncarcinogenic chemicals are conservatively based on a hazard quotient of 0.1, following USEPA Region III guidance.
- (b) The RBC for pyrene was used for non-carcinogenic polynuclear aromatic hydrocarbons (PAHs) lacking RBCs.
- (c) The RBC for gamma-BHC was used.
- (d) The RBC for chlordane was used.
- (e) The value is an Allowable Daily Intake (ADI) for essential human nutrients based on a Recommended Dietary Allowance (RDA) and incidental soil intake of 100 mg/day, where:

$$ADI (mg/kg) = RDA (mg/day) / Soil Intake (0.0001 kg/day)$$
- NOTE: The calculated ADIs exceed one million parts per million, therefore, a maximum value of 1,000,000 is presented.
- (f) Source of RDA: Recommended daily intake for men 25-65 years of age. *Consensus Statement on Optimal Calcium Intake*. Journal of the American Medical Association (JAMA), December 28, 1994.
- (g) The RBC for chromium VI was conservatively used for screening purposes. There is no evidence that chromium VI was associated with site activities.
- (h) Because lead does not have an RBC, the 400 mg/kg residential screening level (USEPA, 1994a) was used for soil.
- (i) Source of RDA: *Recommended Dietary Allowances*. 10th Edition. National Academy of Sciences, National Research Council, 1989.
- (j) The RBC for non-food was used.
- (k) The RBC for mercury chloride was used.
- NRA = No RBC Available.

RBC for noncarcinogenic chemicals), the excess probability of developing cancer would be less than 1 in 1 million, and adverse noncarcinogenic effects would not be expected to occur. As a result, those chemicals detected at levels greater than RBCs (or adjusted RBCs) were retained for evaluation.

Although current and future land-uses at SWMU 58 are most likely to be industrial in nature (see *Section 6.2*), residential (rather than industrial) soil RBCs were used for comparisons to soil concentrations. Because the resident scenario was evaluated for this HHRA, residential soil RBCs were used to screen chemicals in soil as a conservative measure.

RBCs are not available for lead. For screening purposes, however, the maximum detected lead concentrations in soil were conservatively compared to USEPA's residential soil screening level (SSL) of 400 mg/kg (USEPA, 1994b). Per 40 CFR 745, the lead concentration of 400 mg/kg applies to areas where children play. Lead was selected for further evaluation in the HHRA where MDCs of lead exceed screening levels.

6.1.2.2 Comparison of Essential Human Nutrients to Allowable Daily Intakes

The maximum concentrations of the four essential human nutrients that do not have RBCs (i.e., calcium, magnesium, potassium, and sodium) were compared to dietary Allowable Daily Intakes (ADIs). As recommended in both the *Site Screening Process* (USEPA, 2001c) and the *Final Master Work Plan* (URS, 2002) the essential nutrients calcium, magnesium, potassium and sodium were eliminated as COPCs. Although iron is also an essential nutrient, there is an RBC available for iron. It is noted in the SSP (USEPA, 2001c), however, that if iron concentrations in soil or water result in a hazard quotient (HQ) of 0.5 or greater, then a "margin of exposure" evaluation would be performed. Risks from exposure to iron would be characterized by comparing estimated iron intake to the RDA and concentrations known to cause effects in children (USEPA, 1996c).

6.1.2.3 Comparison of Inorganic Compounds to Background Levels

Inorganic chemicals detected at concentrations exceeding RBCs and ADIs were compared to background data contained in the Facility-Wide Background Study Report (FWBSR) (IT, 2001) to assess whether these chemicals were present at concentrations below naturally occurring levels. For the HHRA, the evaluation of site concentrations to background concentrations was achieved using two methods of comparison. First, the maximum detected concentration for each inorganic constituent was compared to the background UTL, as established in the FWBSR. A brief description of background determination is provided in *Section 2.2* and the background UTLs are presented in **Table 2-2**. A detailed discussion can be found in the FWBSR (IT, 2001).

The second method involved the statistical comparison of site concentrations to background concentrations to evaluate whether the populations were similar. This approach paralleled the methodology applied to population comparisons for the FWBSR. Chemicals with data sets containing non-detects at a frequency less than 50 percent were first evaluated to assess whether data were normally distributed. The site data sets and background data sets were tested individually. The Shapiro-Wilk test was used for data sets with sample sizes less than 50. The Shapiro-Francia test was used for data sets with sample sizes greater than 50. If these tests indicated that the data sets did not follow a normal distribution, data points were log-transformed and the tests were used to assess whether the data were lognormally distributed.

When data were found to follow a normal distribution, the F-test was applied to assess whether there was a statistical difference between the variances of the two groups. When data from both

the site and background data sets were log-normally distributed, the F-test was applied to log-transformed data.

Results from the F-test were used to identify the appropriate t-test. For example, when the variances were found to be similar, the t-test was calculated using equal variances. Conversely, t-tests were calculated using unequal variances when the F-test demonstrated that the variances between the data sets were not similar.

The t-test was used to assess whether the means of the data sets for the site concentrations were similar or greater than the background concentrations. If the t-test indicated that the means between the two data groups were similar, site concentrations were considered to be within or below background levels. If the t-test indicated that the mean for the site data set was greater than the mean for the background data set, then site concentrations were considered to be above background concentrations.

When site and background data sets had different distributions or did not pass the normal or lognormal distribution test, the Mann-Whitney U test was used to assess whether the medians of the data sets for the site concentrations were similar or greater than the background concentrations. The Mann-Whitney U test is a nonparametric test that involves ranking the data. This test is not dependent upon the distribution of the data. If the Mann-Whitney U test indicated that the medians between the two data groups were similar, site concentrations were considered to be within or below background levels. If the Mann-Whitney U indicated that the median for the site data set was greater than the mean for the background concentrations, then site concentrations were considered to be above background concentrations.

Based on these evaluations, chemicals were eliminated from further quantitative evaluation if they met both of the following conditions:

- 1) The maximum detected concentration was below the UTL, and
- 2) Based on statistical comparisons, site concentrations were within or below background concentrations.

The results of these analyses are included in **Appendix E-2**. For current and future surface soil conditions, arsenic and manganese exceeded screening criterion but were shown to be within background concentrations and were eliminated from the quantitative HHRA. For total soil, arsenic, chromium, iron, manganese, and vanadium exceeded screening criteria but were excluded on the basis of background comparisons.

6.1.3 Data Summary and Selection of COPCs for Sampled Media

The following sections describe the environmental samples collected at SWMU 58, the sample groupings selected for the HHRA, and the COPCs selected within each of the sample groupings. In addition, the background data obtained from the FWBSR (IT, 2001) for each medium are discussed. Summary tables present chemical data by timeframe, medium, and data grouping and contain parameters such as the range of detected concentrations, location of the MDC, frequency of detection, screening criteria, and the 95% UTL of the background concentrations. The tables presenting the summarized data and selected COPCs are included in **Appendix E-1**.

The sample groupings selected for the HHRA consist of surface soil and total soil (i.e., surface soil and subsurface soil combined). As described in *Section 6.2.1*, the HHRA evaluates risks under both current land use conditions (i.e., conditions as they currently exist at the site) and future land use conditions (i.e., conditions accounting for probable changes in site use, assuming

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no remedial action occurs). Under current land use conditions, it is assumed that the Rubble Pile remains in its original configuration when the environmental samples (i.e., surface and subsurface soil samples) were collected. Samples collected from the top 0–2 ft of the Rubble Pile are considered to be surface soil. Samples collected from the pile but below 2 ft of the top of the Rubble Pile are considered to be subsurface samples. Samples collected beneath the Rubble Pile are also considered to be subsurface samples. It is assumed that there would be no exposure to subsurface soil under current land use. As described in *Section 6.2.1*, surface soil samples are used in the HHRA evaluation under current land use conditions.

Under future land use conditions, it is conservatively assumed that the contents of the Rubble Pile are removed and that the soil on top of and within the Rubble Pile would be redistributed on the site. Redistribution could occur via either surface soil erosion from the top of the pile to the toe of the slope, or during physical removal of the rubble material allowing the soil on top of the Rubble Pile to be deposited on the ground surface. With the redistribution of soil, soil depths at which samples were originally collected would change. That is, some subsurface soil would now be considered surface soil because it may lie within 2 feet of the surface. Some of the soil samples collected from beneath the pile are greater than ten feet below the top of the pile, and thus would be excluded from use in a risk assessment because exposure to contamination greater than ten feet is normally not considered. However, if the contents of the Rubble Pile are removed in the future, native ground surface may be exposed and some of these “deeper” soil samples would then be considered surface soil, and additional samples would be closer to the surface and within the potential exposure depth of ten feet. To correctly address the future scenario, soil depths have been edited to reflect the change in conditions. As shown in **Table 6-4**, although the total number of soil samples remains fixed at 11 for both current and future scenarios, the number of surface soil samples (0-2 ft bgs) increases from five to nine (current to future, respectively), while the number of subsurface soil samples (2-10 ft bgs) decreases from 6 to 2 (current to future, respectively).

As described in *Section 6.2.1.2*, surface soil samples and subsurface soil samples (as part of total soil) are used in the HHRA evaluation under future land use conditions. Two sample groupings are evaluated. For the surface soil sample grouping, it is assumed that the Rubble Pile is removed down to the original ground surface and redistributed. Samples with revised depths of 0 to 2 ft comprised a “reclassified” surface soil data set under this scenario. For the total soil sample grouping, it was assumed that the Rubble Pile and the original ground surface would both be disturbed by excavation, resulting in the mixing of surface and subsurface soil. Therefore, samples with revised depths of 0 to 2 ft (reclassified as surface soil) and 2 to 10 ft (reclassified as subsurface soil) were combined into one data set to represent total soil.

6.1.3.1 Surface Soil – Current Conditions

Surface soil samples (collected from the 0 to 2 ft soil interval from the Rubble Pile) included in the HHRA for evaluation under current conditions are shown in **Table 6-4**. A total of 5 surface soil samples collected between February 1992 and July 2002 at SWMU 58 were evaluated in the HHRA. Surface soil samples were analyzed for VOCs, SVOCs, PAHs, pesticides, and TAL metals.

Surface soil background samples selected from the FWBSR (IT, 2001) for use in the HHRA are also listed in **Table 6-4**. A total of 28 surface soil background samples were included for use in the HHRA.

Table 6-4
SWMU 58 Sample Groupings

CURRENT CONDITIONS			
SURFACE SOIL			
SWMU 58	58SS1 (0 - 1 ft)	58SS3 (0 - 1 ft)	58SB04A (0 - 0.5 ft)
Surface Soil	58SS2 (0 - 1 ft)	58SS04 (0 - 0.5 ft)	
SUBSURFACE SOIL^b			
SWMU 58	58SB1A (15 - 17 ft)	58SB3A (15 - 17 ft)	58SB04C (18 - 20 ft)
Subsurface Soil	58SB2A (46 - 48 ft)	58SB04B (16 - 18 ft)	58SB04D (20 - 24 ft)
FUTURE CONDITIONS			
SURFACE SOIL^d			
SWMU 58	58SS1 (0 - 1 ft)	58SS04 (0 - 0.5 ft)	58SB3A (0 - 2 ft)
Surface Soil	58SS2 (0 - 1 ft)	58SB1A (0 - 2 ft)	58SB04A (0 - 0.5 ft)
Samples	58SS3 (0 - 1 ft)	58SB2A (0 - 2 ft)	58SB04B (0 - 2 ft)
TOTAL SOIL^e			
SWMU 58	58SS1 (0 - 1 ft)	58SS04 (0 - 0.5 ft)	58SB3A (0 - 2 ft)
Surface Soil	58SS2 (0 - 1 ft)	58SB1A (0 - 2 ft)	58SB04A (0 - 0.5 ft)
Samples	58SS3 (0 - 1 ft)	58SB2A (0 - 2 ft)	58SB04B (0 - 2 ft)
SWMU 58	58SB04C (2 - 4 ft)	58SB04D (4 - 8 ft)	
Subsurface Soil			
BACKGROUND SAMPLES			
SURFACE SOIL			
Surface Soil Background Samples from FWBSR (IT, 2001)	MMAB1A	MMAW3A	NRUC1A
	MMAB2A	MMAW4A	NRUC2A
	MMAB3A	NRUL1A	NRUC3A
	MMAB4A	NRUL2A	NRUC4A
	MMAU1A	NRUL3A	NRUG1A
	MMAU2A	NRUL4A	NRUG2A
	MMAU3A	NRUW1A	NRUG3A
	MMAU4A	NRUW2A	NRUG4A
	MMAW1A	NRUW3A	
	MMAW2A	NRUW4A	
SUBSURFACE SOIL			
Subsurface Soil Background Samples from FWBSR (IT, 2001)	MMAB1B	MMAW2C	NRUW3B
	MMAB1C	MMAW3B	NRUW3C
	MMAB2B	MMAW3C	NRUW4B
	MMAB3B	MMAW4B	NRUW4C
	MMAB4B	MMAW4C	NRUC1B
	MMAB4C	NRUL1B	NRUC2B
	MMAU1B	NRUL1C	NRUC3B
	MMAU1C	NRUL2B	NRUC4B
	MMAU2B	NRUL2C	NRUC4C
	MMAU2C	NRUL3B	NRUG1B
	MMAU3B	NRUL3C	NRUG1C
	MMAU3C	NRUL4B	NRUG2B
	MMAU4B	NRUL4C	NRUG2C
	MMAU4C	NRUW1B	NRUG3B
	MMAW1B	NRUW1C	NRUG3C
	MMAW1C	NRUW2B	NRUG4B
	MMAW2B	NRUW2C	NRUG4C

^a Depths of samples are listed in parentheses. These depths, recorded when the samples were originally collected, represent the depth below the top of the rubble pile.

^b Under current conditions, there would be no exposure to subsurface soil. Risk and hazard estimates were not calculated for this combination of data.

^c The depths of the samples have been revised to reflect assumed future conditions.

^d Assumed removal of the contents of the rubble pile and redistribution of soil.

^e Assumed removal of the contents of the rubble pile, disturbance of the original ground surface, and redistribution of soil.

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Summaries of the ranges of detected concentrations, locations of the MDCs, and frequencies of detection of chemicals in the surface soil evaluated in the HHRA are presented in **Appendix E-1, Table E-1a**. Surface soil COPCs were selected by comparing maximum concentrations of detected chemicals to residential soil RBCs and inorganic chemical background concentrations (total soil), and by comparing maximum concentrations of essential human nutrients to ADIs.

As shown in **Appendix E-1, Table E-1a**, 20 inorganics were detected in surface soil at SWMU 58. Four inorganics (aluminum, chromium, iron, and thallium) were detected at concentrations above residential soil RBCs, or other screening criteria, and were selected as COPCs. Eighteen organic compounds and eight dioxin/furans were detected. None were detected at a concentration above the residential soil RBC; no organic compounds were selected as a COPC for surface soil under current conditions.

Chemicals that were not detected in at least one medium have not been included in the HHRA. The detection limits for the non-detected constituents were screened against the RBCs to ensure that the range of detection limits was generally low enough to detect constituents that would exceed RBCs. The maximum detection limits for these constituents were compared to RBCs. Four inorganic compounds and 143 organic compounds were reported as non-detected. The maximum detection limits of eight chemicals were above RBCs: antimony; MCPA; MCPP; 3,3'-dichlorobenzidine; 4,6-dinitro-o-cresol; dibenz(a,h)anthracene; n-nitroso-di-n-propylamine; and pentachlorophenol. Ten chemicals had no RBCs to be compared against. These included: PETN, sodium, dichloroprop, 2-nitroaniline, 2-nitrophenol, bis(2-chloroethoxy)methane, p-chloro-m-cresol, 4-bromophenyl phenylether, 4-chlorophenyl phenylether, and chloromethane. The results of the screening are included in **Appendix E, Table E-1b**.

6.1.3.2 Surface Soil – Future Conditions

Surface soil samples included in the HHRA for evaluation under future conditions (i.e., samples collected from the 0 to 2 ft interval assuming removal of the rubble from the pile and redistribution of the soil) are shown in **Table 6-4**. After adjusting the sample depths to reflect the redistribution of soil from the Rubble Pile, nine soil samples collected between February 1992 and July 2002 at SWMU 58 are considered to be surface soil under future conditions and were evaluated in the HHRA. Surface soil samples were analyzed for VOCs, SVOCs, PAHs, pesticides, and TAL metals.

Surface soil background samples selected from the FWBSR (IT, 2001) for use in the HHRA are also listed in **Table 6-4**. A total of 28 surface soil background samples were included for use in the HHRA.

Summaries of the ranges of detected concentrations, locations of the MDCs, and frequencies of detection of chemicals in the surface soil evaluated in the HHRA are presented in **Appendix E-1, Table E-2a**. Surface soil COPCs were selected by comparing maximum concentrations of detected chemicals to residential soil RBCs and inorganic chemical background concentrations (total soil), and by comparing maximum concentrations of essential human nutrients to ADIs.

As shown in **Appendix E-1, Table E-2a**, 21 inorganics were detected in surface soil at SWMU 58. Five inorganics (aluminum, chromium, iron, thallium, and vanadium) were detected at concentrations above residential soil RBCs, or other screening criteria, and were selected as COPCs. Thirty-three organic compounds and nine dioxin/furans were detected. One PAH [benzo(a)pyrene] and one VOC (TCE) were detected at a concentration above the residential soil

RBC and were selected as COPCs. One VOC (4-isopropyltoluene) was retained because there was no RBC available for comparison.

Two inorganic compounds and 158 organic compounds were reported as non-detected. The maximum detection limits of 12 organic compounds were above RBCs: 1,2,3-trichloropropane; 1,2-dibromo-3-chloropropane; 1,2-dibromoethane; MCPA; MCPP; 3,3'-dichlorobenzidine; 4,6-dinitro-o-cresol; dibenz(a,h)anthracene; hexachlorobenzene; n-nitroso-di-n-propylamine; pentachlorophenol and vinyl chloride. Seventeen chemicals had no RBCs to be compared against. These included: 1,1-dichloropropene; 1,2,3-trichlorobenzene; 1,3-dichloropropane; 2,2-dichloropropane; 2-chloroethyl vinyl ether; bromobenzene; chlorobromomethane; p-chlorotoluene; PETN; dichloroprop; 2-nitroaniline; 2-nitrophenol; bis(2-chloroethoxy)methane; p-chloro-m-cresol; 4-bromophenyl phenylether; 4-chlorophenyl phenylether; and chloromethane. The results of the screening are included in **Appendix E-1, Table E-2b**.

6.1.3.3 Total Soil – Future Conditions

Total soil samples included in the HHRA for evaluation under future conditions (i.e., samples collected from the 0 to 10 ft soil interval assuming removal of the rubble from the pile, disturbance of the original ground surface, and redistribution of the soil at the site) are shown in **Table 6-4**. A total of 9 soil samples collected at SWMU 58 between February 1992 and July 2002 were considered to be surface soil samples under future conditions. Two soil samples collected between April 1998 and July 2002 were considered to be subsurface soil samples under future conditions. Therefore, a total of eleven samples were evaluated in the HHRA as total soil. Surface and subsurface soil samples were analyzed for VOCs, SVOCs, PAHs, pesticides, herbicides, PCBs, and metals.

Surface soil and subsurface soil background samples selected from the FWBSR (IT, 2001) for use in the HHRA are also listed in **Table 6-4**. A total of 28 surface soil background samples and 51 subsurface soil background samples were included for use in the HHRA.

Summaries of the ranges of detected concentrations, locations of the MDCs, and frequencies of detection of chemicals in the total soil evaluated in the HHRA are presented in **Appendix E-1, Table E-3a**. Total soil COPCs were selected by comparing maximum concentrations of detected chemicals to residential soil RBCs and inorganic chemical background concentrations (total soil), and by comparing maximum concentrations of essential human nutrients to ADIs.

As shown in **Appendix E-1, Table E-3a**, 21 inorganics were detected in total soil at SWMU 58. Two inorganics (aluminum and thallium) were detected at concentrations above residential soil RBCs, or other screening criteria, and were selected as COPCs. Thirty-three organic compounds and nine dioxin/furans were detected. One PAH [benzo(a)pyrene] and one VOC (TCE) were detected at a concentration above the residential soil RBC and were selected as COPCs. One VOC (4-isopropyltoluene) was retained because there was no RBC available for comparison.

Two inorganic compounds and 157 organic compounds were reported as non-detected. The maximum detection limits of 12 organic compounds were above RBCs: 1,2,3-trichloropropane; 1,2-dibromo-3-chloropropane; 1,2-dibromoethane; MCPA; MCPP; 3,3'-dichlorobenzidine; 4,6-dinitro-o-cresol; dibenz(a,h)anthracene; hexachlorobenzene; n-nitroso-di-n-propylamine; pentachlorophenol and vinyl chloride. Seventeen chemicals had no RBCs to be compared against. These included: 1,1-dichloropropene; 1,2,3-trichlorobenzene; 1,3-dichloropropane; 2,2-dichloropropane; 2-chloroethyl vinyl ether; bromobenzene; chlorobromomethane; p-chlorotoluene; PETN; dichloroprop; 2-nitroaniline; 2-nitrophenol; bis(2-chloroethoxy)methane;

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p-chloro-m-cresol; 4-bromophenyl phenylether; 4-chlorophenyl phenylether; and chloromethane. The results of the screening are included in **Appendix E-1, Table E-3b**.

6.1.4 Summary of Chemicals Selected as COPCs

COPCs selected at SWMU 58 are summarized in **Table 6-5**. Contamination at this site is primarily due to five inorganics, one PAH, and two VOCs.

6.2 Human Health Exposure Assessment

In this section, the potential pathways by which individuals may be exposed to the COPCs in each environmental medium are identified and exposures are quantified. A discussion of potential current and future exposure pathways through which populations could be exposed to chemicals at or originating from SWMU 58 is presented in *Section 6.2.1*.

For each pathway selected for quantitative evaluation, the chemical concentrations at the points of exposure are estimated (*Section 6.2.2*), and the methodology for calculating potential chemical intakes for each pathway selected for quantitative evaluation is discussed (*Section 6.2.3*).

6.2.1 Potential Human Exposure Pathways

An exposure pathway describes the course a chemical takes from the source to the exposed individual, and is defined by four elements: 1) a source and mechanism of chemical release to the environment; 2) an environmental transport medium (e.g., groundwater) for the released chemical; 3) a point of potential contact with the contaminated medium (referred to as the exposure point); and, 4) an exposure route (e.g., ingestion) at the contact point. An exposure pathway is considered complete when each of the four elements is present. In risk assessments, complete exposure pathways are quantitatively evaluated.

When conducting an exposure assessment, USEPA (1989a, 1991b) guidance requires that plausible exposures under both current and future land-use scenarios be evaluated in a HHRA. Accordingly, potential human exposure pathways are identified for current and potential future land-use conditions at SWMU 58 in the following sections. The current land-use scenario is based on conditions, as they currently exist, while the future land-use scenario evaluates potential risks that may be associated with possible changes in site use, assuming no remedial action occurs.

The potential exposure pathways through which humans could currently be exposed to contamination resulting from past activities at SWMU 58 are discussed below. **Table 6-1** presents an exposure pathway analysis for potential current/future land-use conditions, indicating the exposure media, exposure points, potential receptors, and exposure routes. This table also indicates whether a quantitative analysis was conducted for the pathway and the rationale for selection or exclusion of the pathway.

Receptor Characterization. The area around MMA is not highly developed and land use in the vicinity of the facility is mostly rural, with less rugged areas having been primarily used for agriculture. Residential and recreational areas are located adjacent to the facility (IT, 2001). It is unlikely, however, that the uses of land within MMA will change significantly in the future. The MMA contains numerous buildings and facilities, and it is likely that the area (including SWMU 58) will remain industrial in nature. An aerial photograph of the surrounding land use is presented in **Appendix F-1, Photo 3**.

Because SWMU 58 is not currently in use, maintenance workers are the most likely receptors at the site.

Table 6-5
Summary of Chemicals of Potential Concern

Chemical (a)	Surface Soil (Current Land Use)	Surface Soil (Future Land Use)	Total Soil (Future Land Use)
Organics			
Acenaphthene			
Acenaphthylene			
Acetone			
Anthracene			
Benz(a)anthracene			
Benzo(a)pyrene		X	X
Benzo(b)fluoranthene			
Benzo(g,h,i)perylene			
Benzo(k)fluoranthene			
Benzoic acid			
delta-BHC			
Butyl benzyl phthalate			
Carbon disulfide			
alpha-Chlordane			
Chrysene			
4,4'-DDD			
cis-1,2-Dichloroethene			
Dieldrin			
Ethylbenzene			
bis(2-Ethylhexyl)phthalate			
Fluoranthene			
Fluorene			
Indeno(1,2,3-c,d)pyrene			
Isopropylbenzene			
4-Isopropyltoluene		X	X
Methylene chloride			
2-Methylnaphthalene			
Naphthalene			
Phenanthrene			
Pyrene			
Total Organic Carbon			
TCDD TE			
Toluene			
Trichloroethene		X	X
p&m-Xylene			
Inorganics			
Aluminum	X	X	X
Antimony			
Arsenic			
Barium			
Beryllium			
Calcium			
Chromium	X	X	
Cobalt			
Copper			
Iron	X	X	
Lead			
Magnesium			
Manganese			
Mercury			
Nickel			
Potassium			
Selenium			
Sodium			
Thallium	X	X	X
Vanadium		X	
Zinc			

(a) Chemicals detected in soil at SWMU 58.

X = Selected as a COPC.

If future development occurs, excavation workers could be receptors. Therefore, maintenance worker and excavation worker exposures at SWMU 58 were evaluated in the HHRA.

Due to security at the Installation (e.g., strict security at entry gates, guard towers, barbed-wire fences), it is not likely that children would be able to trespass at the Installation. It would also be difficult for an adolescent to trespass at the site. Even if an older adolescent were able to evade security measures, it would be difficult to do so on a routine basis. Therefore, a trespasser scenario was not evaluated. However, hypothetical future exposures to children were considered in the residential scenario described below. The exposure parameters for residents are more conservative than those for children trespassers. Also, the maintenance worker scenario that is being evaluated would be similar to the limited exposure that an adolescent trespasser could experience at the site and would be protective of the trespasser.

Because land use is expected to remain industrial, a residential scenario is not considered to be a reasonably anticipated land use. However, the residential scenario was evaluated to meet "clean closure" requirements under RCRA. Therefore, adult resident and child resident exposures at SWMU 58 were evaluated in the HHRA.

Exposure Pathway Identification. The exposure pathways associated with maintenance and excavation workers and residents at SWMU 58 were identified based on consideration of the sources and releases of chemicals. The exposure pathways considered for evaluation under current land-use conditions are described below.

Groundwater. Because groundwater flow at RFAAP is complex due to karst features, it is difficult to associate specific sites with groundwater exposures. Groundwater was not encountered at the site, does not discharge at this site, and is not accessible to receptors at the site. Therefore, groundwater exposures were not evaluated in this HHRA.

Surface Soil. Human exposures to chemicals in surface soil could occur by direct contact and subsequent dermal absorption and/or incidental ingestion of COPCs. As a result, maintenance worker exposures to COPCs in surface soil via incidental ingestion and dermal absorption were evaluated under current land-use conditions for SWMU 58. Because current land-use of the site does not include residents, adult and child resident exposures to chemicals in surface soil would not occur. Therefore, residential exposures to chemicals in surface soil were not evaluated under current land-use conditions.

Total Soil. Because ground-intrusive or construction/excavation activities are not currently taking place, potential excavation worker exposures to chemicals in surface and subsurface soil (i.e., total soil) would not occur. In addition, it is not likely that maintenance workers would have the opportunity to be exposed to total soil when on-site; thus, exposures to chemicals in total soil were not evaluated under current land-use conditions. Because current land-use of the site does not include residents, adult and child resident exposures to chemicals in surface and subsurface soil (i.e., total soil) would not occur. Therefore, residential exposures to chemicals in total soil were not evaluated under current land-use conditions.

Air. Airborne releases of COPCs can occur via the direct volatilization of chemicals and the wind entrainment of chemicals on dust particles. Maintenance workers could potentially be exposed to airborne chemicals released from soil at SWMU 58. Excavation worker and residential exposures were not evaluated under current land-use conditions.

6.2.1.1 Summary of Potential Exposure Pathways under Current Land-Use Conditions

In summary, the potential exposure pathways that were quantitatively evaluated under current land-use conditions are:

- Incidental ingestion, dermal absorption, and inhalation of chemicals in surface soil at SWMU 58 by a maintenance worker.

6.2.1.2 Potential Exposure Pathways under Future Land-Use Conditions

According to USEPA (1995a), a risk assessment evaluating potential future exposures should reflect the most reasonably anticipated future land uses. The potential future exposure pathways through which humans could be exposed to environmental media at SWMU 58 are discussed below. **Table 6-1** presents an exposure pathway analysis for potential future land-use conditions, indicating the exposure media, exposure points, potential receptors, and exposure routes. This table also indicates whether a quantitative analysis was conducted for the pathway and the rationale for selection or exclusion of the pathway.

As described in *Section 6.2.1*, future land use at SWMU 58 is expected to remain industrial. Maintenance workers are considered the most likely receptors to potential contamination at SWMU 58. Given the industrial nature of the site, the maintenance worker scenario would be protective of exposures to trespassers. If future development occurs, excavation workers could also be receptors. Assuming that future construction/excavation activities could occur, future maintenance worker and excavation worker exposures to surface and subsurface soil at SWMU 58 were evaluated in the HHRA. It is assumed that surface and subsurface soil would mix as a result of these activities. Therefore, future exposures to these sites were evaluated as exposures to total soil.

Although it is unlikely, the site could potentially be used for residential land-use in the future; therefore, hypothetical residential exposures were evaluated.

Groundwater. Because groundwater flow at RFAAP is complex due to karst features, it is difficult to associate specific sites with groundwater exposures. Groundwater was not encountered at the site, does not discharge at this site, and is not accessible to receptors at the site. Therefore, groundwater exposures were not evaluated in this HHRA.

Surface Soil. Maintenance worker exposures to surface soil under future industrial land-use conditions will be the same as those described under current industrial land-use conditions. Excavation worker exposures to surface soil were not evaluated in the HHRA because excavation worker exposures would involve both surface and subsurface soil (i.e., total soil) that would be mixed during construction/excavation activities. Resident exposures to surface soil were not evaluated in the HHRA because it was assumed that both surface and subsurface soil (i.e., total soil) would have become mixed during construction/excavation activities for the future development area.

Total Soil. Future development at SWMU 58 could result in exposures to individuals performing excavation activities via contact with chemicals in total soil. In addition, maintenance workers may contact soil after the site has been disturbed and soil has been dispersed after construction or excavation activities. Therefore, potential incidental ingestion and dermal absorption exposures to chemicals in total soil by maintenance workers and excavation workers were evaluated. Although future residential development of this site is unlikely, the residential scenario was evaluated for total soil. Hypothetical future residents may

contact soil after the site has been developed and soil has been dispersed after construction or excavation activities. Therefore, potential incidental ingestion and dermal absorption exposures to chemicals in total soil by residents were evaluated. (It is assumed that surface and subsurface soil would mix as a result of construction/excavation activities and future exposures to the site were evaluated as exposures to total soil.)

Air. Airborne releases of COPCs can occur via the direct volatilization of chemicals and the wind entrainment of chemicals on dust particles. Maintenance and excavation workers and residents could potentially be exposed to airborne chemicals released from soil at SWMU 58.

6.2.1.3 Summary of Potential Exposure Pathways under Future Land-Use Conditions

In summary, the following exposure pathways were selected for quantitative evaluation under future land-use conditions:

- Incidental ingestion, dermal absorption, and inhalation of chemicals in surface soil at SWMU 58 by a maintenance worker.
- Incidental ingestion, dermal absorption, and inhalation of chemicals in total soil at SWMU 58 by a maintenance worker.
- Incidental ingestion, dermal absorption, and inhalation of chemicals in total soil at SWMU 58 by an excavation worker.
- Incidental ingestion, dermal absorption, and inhalation of chemicals in total soil at SWMU 58 by a resident (adult and child).

6.2.2 Determination of Exposure Point Concentrations

To evaluate the magnitude of exposures and risks that may be experienced by an individual, the concentration of the COPCs in the exposure medium must be known or estimated. This concentration is referred to as an exposure point concentration (EPC). The EPCs used in the HHRA are based on the data summarized in *Section 6.1.1*, and were assessed for each of the selected COPCs. Exposure point concentrations for surface soil and total soil are shown in **Appendix E-1, Tables E-4 through E-6**.

The approach used to estimate EPCs in the media sampled at SWMU 58 follows that recommended by USEPA (1989a, 1992b, 2002) guidance. According to this guidance, the most appropriate measurement of central tendency for exposure to environmental chemical concentrations is the arithmetic mean. To account for uncertainty associated with this value, USEPA guidance requires the use of the 95% upper confidence limit (UCL) on the arithmetic mean concentration for the estimation of the Reasonable Maximum Exposure (RME) risk. The term RME is defined as the maximum exposure that is reasonably expected to occur at a site (USEPA, 1989a). The RME concentration of each COPC in each medium was assumed to represent the concentration to which receptors could be exposed at these sites.

Because of the uncertainty associated with characterizing contamination in environmental media, the 95 percent UCL of the mean has been estimated for chemicals selected as COPCs. In general, outliers are included in the calculation of the UCL because high values in environmental data are seldom true statistical outliers. Inclusion of outliers increases the overall conservatism of the risk estimate, and the likelihood of rejecting the null hypothesis (i.e., there are no chemical stressors at the site).

Data sets have been tested for normality and lognormality based on the Shapiro-Wilk test (USEPA, 1992a). Statistical analysis has been performed on chemicals selected as COPCs. If statistical tests support the assumption that the data set is normally distributed, the UCL for a normal distribution is calculated. If the statistical analysis shows the data to be lognormally distributed, the UCL is calculated for a lognormal distribution. It should be noted that the designation of normal or lognormal data distributions also included data sets that were "close" to their respective categorizations, i.e., within 5 percent of being categorized as normal or lognormal, using the Shapiro-Wilk test criterion. This is a conservative approach, especially for those data sets that are close to being lognormal, as the lognormal UCL equation (Gilbert, 1987) generally overestimates the UCL, compared with the alternative bootstrap method. If a data set passes both the normal and lognormal distribution tests, the distribution with the best fit (i.e., the distribution with the value that is closest to the critical value) is selected.

The UCL is calculated for a normal distribution as follows (USEPA, 1992b):

$$UCL = \bar{x} + t_{1-\alpha, n-1} s / \sqrt{n}$$

where:

- $\bar{x}$ = sample arithmetic mean
- t = critical value for student's t distribution
- $1-\alpha$ = 0.05 (95 percent confidence limit for a one-tailed test)
- n = number of samples in the set
- s = sample standard deviation.

The UCL is calculated for a lognormal distribution as follows (Gilbert, 1987):

$$UCL = e^{\left[\bar{y} + (0.5 \cdot s_y^2) + \left[H_{0.95} \cdot \frac{s_y}{(n-1)^{0.5}} \right] \right]}$$

where:

- $\bar{y}$ = $\sum y/n$ = sample arithmetic mean of the log-transformed data, $y = \ln x$
- s_y = sample standard deviation of the log-transformed data
- n = number of samples in the data set
- $H_{0.95}$ = value for computing the one-sided 95 percent UCL on a lognormal mean from standard statistical tables (Land, 1975).

A nonparametric confidence limit is used when the data set fits neither a normal nor a lognormal distribution. The "bootstrap" method (Efron, 1981), a nonparametric method recommended by USEPA for censored data (USEPA, 2002), was used to calculate 95% UCLs on the arithmetic means for these COPC data. This method, which estimates the UCL by simulation, is a computer-based replacement method for assigning measures of accuracy to statistical estimates. This method does not require assumptions regarding the statistical distribution of the underlying population (Efron, 1981). Bootstrap 95% UCLs were calculated as follows (Efron, 1981; Efron and Tibshirani, 1993):

1. The data set was randomly resampled with replacement;
2. The arithmetic mean of the resampled data set was estimated;
3. Based on guidance from USEPA (2002), "thousands of iterations" are recommended for the bootstrap method. Therefore, steps 1 and 2 were performed 5,000 times and a new data set of 5,000 resampled means was created; and,
4. The 95th percentile of the resampled mean data set created during Step 3 was selected. Per Efron and Tibshirani (1993), the 95th percentile of the resampled mean data set is a good approximation to the 95% UCL on the mean of the original data set.

6.2.3 Quantification of Dose Due to Chemical Exposures

This section describes the development of the exposure estimates (chemical doses) that serve as the basis of the risk estimates in *Section 6.4*. To estimate doses, EPCs for each COPC are combined with information describing the extent, frequency, and duration of exposure for each potential receptor of concern. This section presents an overview of the approaches and equations used in quantifying exposures and specific details relevant to each selected exposure pathway. The approaches used to quantify exposures are consistent with guidance provided by USEPA (1989a; 1991a; 1992a,b,c, 2001a).

Methodology for Deriving Dose Estimates. For the exposure pathways that involve ingestion or dermal contact, quantification of exposure involves the estimation of an average daily dose (ADD), expressed in units of mg chemical/kg body weight per day (mg/kg-day). Dose can be defined as an exposure rate to a chemical assessed over an exposure period per unit body weight, and is calculated similarly for ingestion and dermal absorption pathways. There are, however, significant differences in the meaning and terms used to describe doses for the ingestion pathways as compared to the dermal absorption pathways. For the ingestion exposure pathways, the doses calculated in this assessment are referred to as "potential doses." The potential dose is the amount of chemical ingested and available for uptake in the body, and is analogous to the administered dose in a dose-response toxicity experiment. For the dermal absorption pathways, the estimated dose is referred to as an "internal dose," and reflects the amount of chemical that has been absorbed into the body and is available for interaction with biologically important tissues.

ADDs are estimated differently for chemicals exhibiting noncarcinogenic and carcinogenic effects, since different toxicity criteria are available for carcinogenic effects and noncarcinogenic effects of chemicals (see *Section 6.3*, Human Health Toxicity Assessment). ADDs for noncarcinogens are averaged over the duration of exposure and, following USEPA (2001a) guidance, are given the acronym ADD for average daily doses. ADDs for carcinogens are averaged over a lifetime, and are given the acronym LADD for lifetime average daily doses.

The ADDs and LADDs are estimated using EPCs of chemicals together with exposure parameters that specifically describe the exposure pathway. ADDs and LADDs for each pathway were derived by combining the selected EPC (based on the maximum or on the 95% UCL on the mean concentration) of each chemical with reasonable maximum values describing the extent, frequency, and duration of exposure (USEPA, 1989a; 1992c, 2001a).

The following sections present the equations and exposure parameters used in the HHRA to estimate potential doses (ADD_{pot} and $LADD_{pot}$) for ingestion exposures, internal doses (ADD_{int} and $LADD_{int}$) for dermal absorption exposures, and (ADD_{pot} and $LADD_{pot}$) for

inhalation exposures. It was assumed that the chemical concentrations in the media evaluated would remain constant over the exposure period.

The particulate emission factor (PEF) used to calculate the particulate inhalation ADDs and LADDs was calculated based on an equation provided by USEPA (1996a), and is shown below. It should be noted that one of the inputs for calculating the PEF is the Q/C value, which represents both local climatic conditions and the size of the contaminated area. Q/C values are provided by USEPA (1996a) for 29 different cities in the United States and for contaminated areas ranging from 0.5 to 30 acres. For this HHRA, Q/C value representing climatic conditions for Zone VII, Huntington, WV was selected. A site-specific PEF value was calculated to account for the approximate size of the site. Based on a 2-acre site, a Q/C value of 41.83 was selected to represent the SWMU 58 study area.

The variable for vegetative cover used to calculate the PEF accounts for the percentage of ground cover (e.g., pavement, gravel, or vegetation) that potentially inhibits the release of VOCs and particulate matter from soil into ambient air. Although the majority of the site is currently covered, the fraction of the vegetative cover was conservatively assumed to be 50 percent to allow for potential changes to site conditions in the future. USEPA's default value was used to represent the mean annual wind speed [4.69 meters/second (m/s)].

Using the following equation and the assumptions described above, a PEF of $6.06 \times 10^8 \text{ m}^3/\text{kg}$ was calculated for SWMU 58.

$$PEF = \frac{Q}{C} * \frac{3,600 \frac{\text{sec}}{\text{hr}}}{0.036 * (1 - V) * \left(\frac{U_m}{U_t} \right)^3 * F(x)}$$

where:

- PEF = particulate emission factor (m^3/kg)
- $\frac{Q}{C}$ = inverse of the mean concentration at the center of a 2-acre source (equal to 41.83 $\text{g}/\text{m}^2 \cdot \text{sec}$ per kg/m^3) for Climatic Zone VII, Huntington, WV (USEPA, 1996a)
- V = fraction of vegetative cover (assumed to be 50 percent, default)
- U_m = mean annual windspeed (4.69 m/sec, default)
- U_t = equivalent threshold value of windspeed at 7 m (11.32 m/sec, default)
- $F(x)$ = function dependent on U_m/U_t derived using Cowherd et al. (as cited in USEPA, 1996a)

The volatilization factor (VF) used to calculate the volatile inhalation ADDs and LADDs was calculated based on an equation provided by USEPA (1996a), and is shown below.

$$VF = \frac{\frac{Q}{C} * (3.14 * D_A * T)^{1/2} * 10^{-4} \left(\frac{\text{m}^2}{\text{cm}^2} \right)}{(2 * \rho_b * D_A)}$$

where:

- VF = volatilization factor (m^3/kg)

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$\frac{Q}{C}$ = inverse of the mean concentration at the center of a 2-acre source (equal to 41.83 g/m²·sec per kg/m³) for Climatic Zone VII, Huntington, WV (USEPA, 1996a)
 T = exposure interval (9.5x10⁸ sec, default)
 ρ_b = dry bulk density (1.5 g/cm³, default)
 DA = apparent diffusivity (cm²/sec, chemical-specific)

$$DA = \frac{\left(\frac{(\Theta_a^{10/3} * D_i * H') + (\Theta_w^{10/3} * D_w)}{n^2} \right)}{(\rho_b * K_d) + \Theta_w + (\Theta_a * H')}$$

where:

Θ_a = air-filled soil porosity = $n - \Theta_w$ (L_{air}/L_{soil})
 n = total soil porosity = $1 - (\rho_b/\rho_s)$ (L_{pore}/L_{soil})
 ρ_s = soil particle density (2.65 g/cm³, default)
 Θ_w = water-filled soil porosity (0.15 L_{water}/L_{soil} , default)
 D_i = diffusivity in air (cm²/sec, chemical-specific)
 H' = dimensionless Henry's law constant (chemical-specific)
 D_w = diffusivity in water (cm²/sec, chemical-specific)
 K_d = soil-water partition coefficient (cm³/g, organics)

$$K_d = K_{oc} * f_{oc}$$

where:

K_{oc} = soil organic carbon partition coefficient (cm³/g, chemical-specific)
 f_{oc} = fraction of organic carbon in soil (0.006 g/g, site-specific)

Current and Future Maintenance Worker Dose Equations and Exposure Parameters for Soil. The potential chemical doses for current and future maintenance worker exposures to surface soil and total soil at SWMU 58 were estimated using the equations and exposure parameters presented below. The EPCs used to estimate potential chemical doses for each evaluated medium and data grouping were presented in *Section 6.2.2*, while the calculated LADDs for carcinogenic effects and ADDs for noncarcinogenic effects are presented in the corresponding tables for workers in the *Section 6.4*.

Incidental Ingestion of Soil by Maintenance Workers. The exposure for incidental ingestion of COPCs in soil by workers was calculated using the equation and the exposure parameters presented in **Appendix E-1, Tables E-7 and E-8**. Where relevant, standard adult parameters were used to characterize worker exposures, since most workers are adults (> 18 years of age).

Workers were assumed to be exposed to soil 50 days/year, based on the assumption that maintenance/inspection activities are conducted 1 day/week based on a 5-day work week for 50 weeks/year (workers were assumed to spend 2 weeks a year on vacation). Duration of exposure for workers was assumed to be 25 years, a USEPA (1991a) upper-bound default estimate of the time spent working in one location. The body weight value used for workers was 70 kg, the standard USEPA (1991a) default value for adult body weight. An averaging time of 70 years was used for carcinogenic COPCs, while 25 years was used for noncarcinogenic COPCs.

The daily soil ingestion rate for workers was assumed to be 100 mg/day, a standard USEPA (2001b) default value for exposure to adults in the workplace. It was conservatively assumed that soil ingested during the workday by workers would originate in the sampled areas; however, most maintenance workers would likely visit other portions of the Installation. Furthermore, it was assumed that the chemical would be totally available for intake into the body rather than bound to the soil.

Dermal Absorption of Chemicals in Soil by Maintenance Workers. The internal dose due to dermal absorption of COPCs in soil by workers was estimated using the equation and the exposure parameters presented in **Appendix E-1, Tables E-7 and E-8**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by a worker.

Parameters that are specific to the dermal absorption exposure scenario include the area of exposed skin, the amount of soil adhering to the skin, and amount of chemical absorbed through the skin from soil. It was assumed that a worker's head, hands and forearms would be exposed to soil, based on the likelihood that workers at the site will wear long pants but may wear short sleeve shirts. Using data from USEPA (1997b), and averaging across gender and age, it was estimated that the exposed skin surface area for workers would be 3,300 cm². The soil-to-skin adherence factor was assumed to be 0.2 mg/cm²-event, based on 50th percentile values for similar activities (USEPA, 1997b; 2001b).

The amount of chemical in soil absorbed through the skin must be estimated in order to calculate dermal absorption doses. For a chemical to be absorbed through the skin from soil, it must be released from the soil matrix, pass through the layers of the skin, and enter into the systemic circulation. This series of events is dependent on a number of factors including the characteristics of the chemical, the concentration in the applied dose, the site of exposure, inter-individual variability, and characteristics of soil (e.g., particle size and organic carbon content). Data regarding the amount of specific chemicals that may be absorbed through the skin under conditions normally encountered in the environment (and assumed to occur for this assessment) are lacking. While a number of approaches have been developed to estimate absorption of compounds from the soil matrix, the resulting dose estimates are highly uncertain (USEPA, 1992c). Chemical-specific dermal absorption factors provided by USEPA Region III (USEPA, 1995b) were used to estimate absorption of COPCs from soil. The dermal absorption factors include: inorganics (1 percent), VOCs (3 percent), and SVOCs/PAHs (10 percent).

Inhalation of Particulates from Soil by Maintenance Workers. The exposure for inhalation of COPCs in soil by maintenance workers was calculated using the equation and the exposure parameters presented in **Appendix E-1, Tables E-9 and E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by a maintenance worker.

The inhalation rate of 2.5 m³ per hour for maintenance workers was derived by dividing the adult daily rate of 20 m³/day (USEPA, 1991a) by an 8-hour workday. The exposure time is 8 hours per day. It was conservatively assumed that soil inhaled during the visit would originate in the sampled areas; however, it is unlikely that a worker would spend the entire day at just one location on the Installation every day.

Inhalation of Volatiles from Soil by Maintenance Workers. The exposure for inhalation of volatile COPCs in soil by maintenance workers was calculated using the equation and the exposure parameters presented in **Appendix E-1, Tables E-9 and E-10**. The parameters

describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by a maintenance worker.

The inhalation rate of 2.5 m^3 per hour for maintenance workers was derived by dividing the adult daily rate of $20 \text{ m}^3/\text{day}$ (USEPA, 1991a) by an 8-hour workday. The exposure time is 8 hours per day. It was conservatively assumed that soil inhaled during the visit would originate in the sampled areas.

Future Excavation Worker Dose Equations and Exposure Parameters for Soil. The potential chemical doses for future excavation worker exposures to total soil at SWMU 58 were estimated using the equations and exposure parameters presented below. The EPCs used to estimate potential chemical doses for each evaluated medium and data grouping were presented in *Section 6.2.2*, while the calculated LADDs for carcinogenic effects and ADDs for noncarcinogenic effects are presented in the corresponding tables in the Risk Characterization section (*Section 6.4*).

Incidental Ingestion of Soil by Excavation Workers. The exposure for incidental ingestion of COPCs in soil by excavation workers was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-8**. Excavation workers were assumed to be exposed to soil 250 days/year, a standard USEPA (2001b) default assumption assuming a 5-day work week for 50 weeks/year (workers were assumed to spend 2 weeks a year on vacation). Duration of exposure for excavation workers was assumed to be 1 year, a standard USEPA default (2001b). The body weight value used for excavation workers was 70 kg, the standard USEPA (1991a) default value for adult body weight. An averaging time of 70 years was used for carcinogenic COPCs, while 1 year was used for noncarcinogenic COPCs.

The daily soil ingestion rate for excavation workers was assumed to be 330 mg/day, a standard USEPA (2001b) default value for exposure to construction workers. It was conservatively assumed that soil ingested during the workday by workers would originate in the sampled areas; however, most maintenance workers would likely visit other portions of the Installation. Furthermore, it was assumed that the chemical would be totally available for intake into the body rather than bound to the soil.

Dermal Absorption of Chemicals in Soil by Excavation Workers. The internal dose due to dermal absorption of COPCs in total soil by excavation workers was estimated using the equation and the exposure parameters presented in **Appendix E-1, Table E-8**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by an excavation worker.

Parameters that are specific to the dermal absorption exposure scenario include the area of exposed skin, the amount of soil adhering to the skin, and the amount of chemical absorbed through the skin from soil. It was assumed that an excavation worker's head, hands, and forearms would be exposed to soil, based on the likelihood that workers at the site will wear long pants but may wear short sleeve shirts. Using data from USEPA (USEPA Tables 6-2 and 6-3; USEPA, 1997b), and averaging 50th percentile values across gender and age, it was estimated that the exposed skin surface area for excavation workers would be $3,300 \text{ cm}^2$. The soil-to-skin adherence factor was assumed to be $0.3 \text{ mg/cm}^2\text{-event}$, based on 50th percentile values for similar activities (USEPA, 2001b).

The amount of chemical in soil absorbed through the skin must be estimated in order to calculate dermal absorption doses. The estimation of absorbed dose is described in the previous section

for maintenance worker exposures. Chemical-specific dermal absorption factors provided by USEPA Region III (USEPA, 1995b) were used to estimate absorption of COPCs from soil.

Inhalation of Particulates from Soil by Excavation Workers. The exposure for inhalation of COPCs in total soil by excavation workers was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by an excavation worker.

The inhalation rate of 2.5 m³ per hour for excavation workers was derived by dividing the adult daily rate of 20 m³/day (USEPA, 1991a) by an 8-hour workday. The exposure time is 8 hours per day. It was conservatively assumed that soil inhaled during the visit would originate in the sampled areas.

Inhalation of Volatiles from Soil by Excavation Workers. The exposure for inhalation of volatile COPCs in total soil by excavation workers was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by an excavation worker.

The inhalation rate of 2.5 m³ per hour for excavation workers was derived by dividing the adult daily rate of 20 m³/day (USEPA, 1991a) by an 8-hour workday. The exposure time is 8 hours per day. It was conservatively assumed that soil inhaled during the visit would originate in the sampled areas.

Future Adult Resident Dose Equations and Exposure Parameters for Soil. The potential chemical doses for future hypothetical adult resident exposures to total soil at SWMU 58 were estimated using the equations and exposure parameters presented below. The exposure point concentrations used to estimate potential chemical doses for each evaluated medium and data grouping were presented in *Section 6.2.2*, while the calculated LADDs for carcinogenic effects and ADDs for noncarcinogenic effects are presented in the corresponding tables for residents in the Risk Characterization section (*Section 6.4*).

Incidental Ingestion of Soil by Adult Residents. The exposure for incidental ingestion of COPCs in total soil by adult residents was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-8**. Standard parameters were used to characterize adult exposures (> 18 years of age).

Adult residents were assumed to be exposed to surface soil 350 days/year, a standard USEPA (1991a) default assumption assuming a 7-day week for 50 weeks/year (residents were assumed to spend 2 weeks a year on vacation). Duration of exposure for residents was assumed to be 30 years, a USEPA (1991a) upper-bound default estimate of the time spent residing in one location. The body weight value used for adult residents was 70 kg, the standard USEPA (1991a) default value for adult body weight. An averaging time of 70 years was used for carcinogenic COPCs, while 30 years was used for noncarcinogenic COPCs.

The daily soil ingestion rate for adult residents was assumed to be 100 mg/day, a standard USEPA (1991a) default value for exposure to soil for the residential scenario. It was conservatively assumed that soil ingested during time at home by residents would originate in the sampled areas. Furthermore, it was assumed that the chemical would be totally available for intake into the body rather than bound to the soil.

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Dermal Absorption of Chemicals in Soil by Adult Residents. The internal dose due to dermal absorption of COPCs in total soil by adult residents was estimated using the equation and the exposure parameters presented in **Appendix E-1, Table E-8**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by an adult resident.

Parameters that are specific to the dermal absorption exposure scenario include the area of exposed skin, the amount of soil adhering to the skin, and the amount of chemical absorbed through the skin from soil. It was assumed that a resident's head, hands, arms, and lower legs would be exposed to soil. Using data from USEPA (USEPA Tables 6-2 and 6-3; USEPA, 1997b), and averaging 50th percentile values across gender and age, it was estimated that the exposed skin surface area for adult residents would be 5,700 cm². The soil-to-skin adherence factor was assumed to be 0.07 mg/cm²-event, based on 50th percentile values for similar activities (USEPA, 1997b, 2001a).

The amount of chemical in soil absorbed through the skin must be estimated in order to calculate dermal absorption doses. The estimation of absorbed dose is described in the previous section for maintenance worker exposures. Chemical-specific dermal absorption factors provided by USEPA Region III (USEPA, 1995b) were used to estimate absorption of COPCs from soil.

The amount of chemical in soil absorbed through the skin must be estimated in order to calculate dermal absorption doses. The estimation of absorbed dose is described in the previous section for maintenance worker exposures. Chemical-specific dermal absorption factors provided by USEPA Region III (USEPA, 1995b) were used to estimate absorption of COPCs from soil.

Inhalation of Particulates from Soil by Adult Residents. The exposure for inhalation of COPCs in soil by adult residents was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by an adult resident used for estimating the inhalation rate of 0.83 m³ per hour for adult residents was derived by dividing the adult daily rate of 20 m³/day (USEPA, 1991a) by 24 hours per day.

The inhalation rate of 0.83 m³ per hour for adult residents was derived by dividing the adult daily rate of 20 m³/day (USEPA, 1991a) by 24 hours per day. The exposure time is 1 hour per day based on the average time an adult spends outside (1.5 hours/day; USEPA, 1997b) with the exception of the three coldest months of the year. It was conservatively assumed that soil inhaled at the residence would originate in the sampled areas.

Inhalation of Volatiles from Soil by Adult Residents. The exposure for inhalation of volatile COPCs in soil by adult residents was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by an adult resident.

The inhalation rate of 0.83 m³ per hour for adult residents was derived by dividing the adult daily rate of 20 m³/day (USEPA, 1991a) by 24 hours per day. The exposure time is 1 hour per day based on the average time an adult spends outside (1.5 hours/day; USEPA, 1997b) with the exception of the three coldest months of the year. It was conservatively assumed that soil inhaled at the residence would originate in the sampled areas. The exposure time is 1 hour per day based on the average time an adult spends outside (1.5 hours/day; USEPA, 1997b) with the

exception of the three coldest months of the year. It was conservatively assumed that soil inhaled at the residence would originate in the sampled areas.

Future Child Resident Dose Equations and Exposure Parameters for Soil. The potential chemical doses for future hypothetical child resident exposures to soil at SWMU 58 were estimated using the equations and exposure parameters presented below. The exposure point concentrations used to estimate potential chemical doses for each evaluated medium and data grouping were presented in *Section 6.2.2*, while the calculated LADDs for carcinogenic effects and ADDs for noncarcinogenic effects are presented in the corresponding tables for residents in *Section 6.4*.

Incidental Ingestion of Soil by Child Residents. The exposure for incidental ingestion of COPCs in soil by child residents was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-8**. Standard parameters were used to characterize exposures by children of 6 years of age or less.

Child residents were assumed to be exposed to surface soil 350 days/year, a standard USEPA (1991a) default assumption assuming a 7-day week for 50 weeks/year (residents were assumed to spend 2 weeks a year on vacation). Duration of exposure for children was assumed to be 6 years (USEPA, 1991a). The body weight value used for child residents was 15 kg, the standard USEPA (1991a) default value for a child's body weight averaged over 0 to 6 years of age. An averaging time of 70 years was used for carcinogenic COPCs, while 6 years was used for noncarcinogenic COPCs.

The daily soil ingestion rate for child residents was assumed to be 200 mg/day, a standard USEPA (1991a) default value for exposure to soil for the children of 6 years of age and under. It was conservatively assumed that soil ingested during time at home by child residents would originate in the sampled areas. Furthermore, it was assumed that the chemical would be totally available for intake into the body rather than bound to the soil.

Dermal Absorption of Chemicals in Soil by Child Residents. The internal dose due to dermal absorption of COPCs in soil by child residents was estimated using the equation and the exposure parameters presented in **Appendix E-1, Table E-8**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by a child resident.

Parameters that are specific to the dermal absorption exposure scenario include the area of exposed skin, the amount of soil adhering to the skin, and the amount of chemical absorbed through the skin from soil. It was assumed that a child's head, hands, forearms, lower legs, and feet would be exposed to soil. Using data from USEPA (USEPA Tables 6-6, 6-7, 6-8; USEPA, 1997b), and averaging 50th percentile values across gender and age, it was estimated that the exposed skin surface area for child residents would be 2,800 cm². The soil-to-skin adherence factor was assumed to be 0.2 mg/cm²-event, based on 50th percentile values for upper boundsimilar activities (USEPA, 1997b, 2001a).

The amount of chemical in soil absorbed through the skin must be estimated in order to calculate dermal absorption doses. The estimation of absorbed dose is described in the previous section for maintenance worker exposures. Chemical-specific dermal absorption factors provided by USEPA Region III (USEPA, 1995b) were used to estimate absorption of COPCs from soil.

Inhalation of Particulates from Soil by Child Residents. The exposure for inhalation of COPCs in soil by child residents was calculated using the equation and the exposure parameters

presented in **Appendix E-1, Table E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by a child resident.

The inhalation rate of 0.5 m³ per hour for child residents was derived by dividing the child's daily rate of 12 m³/day (USEPA, 2003a) by 24 hours per day. The exposure time is 1 hour per day. It was assumed that children under the age of 6 years year old are likely to be accompanied or supervised by an adult during their time spent outdoors. Therefore, the exposure time was assumed to be equivalent to that of the adult resident. It was conservatively assumed that soil inhaled at the residence would originate in the sampled areas. An oral bioavailability factor of 100% (or 1.0) was assumed for each chemical.

Inhalation of Volatiles from Soil by Child Residents. The exposure for inhalation of volatile COPCs in soil by child residents was calculated using the equation and the exposure parameters presented in **Appendix E-1, Table E-10**. The parameters describing the frequency of exposure, duration of exposure, body weight, and averaging time are identical to those used for estimating the ingestion of soil by a child resident.

The inhalation rate of 0.5 m³ per hour for child residents was derived by dividing the child's daily rate of 12 m³/day (USEPA, 2003a) by 24 hours per day. The exposure time is 1 hour per day. It was assumed that children under the age of 6 years year old are likely to be accompanied or supervised by an adult during their time spent outdoors. Therefore, the exposure time was assumed to be equivalent to that of the adult resident. It was conservatively assumed that soil inhaled at the residence would originate in the sampled areas. An oral bioavailability factor of 100% (or 1.0) was assumed for each chemical.

6.3 Human Health Toxicity Assessment

The general methodology for the classification of health effects and the development of health effects criteria is described in *Section 6.3.1* to provide the analytical framework for the characterization of human health risks. In *Section 6.3.2*, the health effects criteria, or toxicity values, used to derive estimates of risk are presented. These values are combined with dose information for each complete exposure pathway quantitatively evaluated to predict potential risks associated with exposures to COPCs in environmental media at SWMU 58 (*Section 6.4*).

The methodology used for classifying health effects from exposure to chemicals is recommended by USEPA (1986a,b; 1989a; 1997a; 2003b). The health effects analysis considers chronic (long-term) exposures. The chronic toxicity criteria were obtained from USEPA's Integrated Risk Information System (IRIS) (USEPA, 2003b), Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a), and the National Center for Environmental Assessment (NCEA).

6.3.1 Health Effects Classification and Criteria Development

According to USEPA's science policy, there are two primary approaches to developing toxicity values or health criteria. The non-threshold approach is based on USEPA's scientific policy position that a small number of molecular events can evoke changes in a single cell, or a small number of cells. This is described as a non-threshold initiator mechanism, because there is essentially no level of exposure (i.e., a threshold) to a constituent that will not result in some finite possibility of causing an adverse effect. Another assumption stemming from USEPA's science policy is that the dose-response curve is linear at low doses. For most carcinogens, toxicity values are based on the non-threshold approach.

The threshold approach is based on the assumption that organisms have repair and detoxification capabilities that must be exceeded by some critical concentration (threshold) before the adverse effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before the effect on the organ is realized. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects. Toxicity values for noncarcinogenic effects are based on the threshold approach. Furthermore, as additional information regarding the mechanisms of toxicity becomes available, the threshold approach may also apply to some carcinogens (e.g., chloroform).

Health Effects Criteria for Potential Carcinogens. For carcinogens, USEPA estimates the excess lifetime cancer risks associated with various levels of exposure by developing cancer slope factors (CSFs) and unit risks. CSFs are expressed in terms of reciprocal dose, as units of $(\text{mg chemical/kg body weight-day})^{-1}$, which describes the upper-bound increase in an individual's risk of developing cancer over a 70-year lifetime per unit of exposure. Unit risks are expressed either as a reciprocal air concentration, in units of $(\mu\text{g}/\text{m}^3)^{-1}$, or as a reciprocal drinking water concentration, in units of $(\mu\text{g}/\text{L})^{-1}$. Similarly, they are defined as the probability of an individual developing cancer over a 70-year lifetime as a result of exposure to one unit of concentration in air or water. Because regulatory efforts are geared to be protective of public health, including even the most sensitive members of the population, the CSFs are derived using conservative assumptions.

CSFs and unit risks are derived from the results of human epidemiological studies or chronic animal bioassays. The animal studies usually must be conducted using relatively high doses to detect possible adverse effects. Because humans are expected to be exposed to doses lower than those used in the animal studies, the potential cancer risks at lower doses are estimated by using mathematical models. The data from animal studies are typically fitted to the linearized multistage model to obtain a dose-response relationship. In general, after the data are fit to the dose-response model, the 95 percent UCL of the slope of the resulting dose-response relationship at low doses is calculated. This upper-bound limit is subjected to various adjustments, and an interspecies scaling factor is applied to derive the slope factor or unit risk for humans. Thus, the actual risks associated with a given intake of a potential carcinogen quantitatively evaluated based on animal data are generally regarded as not likely to exceed the risks estimated using these CSFs or unit risks, and they may be as low as zero (USEPA, 1986a). Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves. These models provide rough, but plausible, estimates of the upper limits on lifetime risk. CSFs and unit risks based on human epidemiological data are derived using conservative assumptions and, as such, they too are unlikely to underestimate risks for a given level of exposure.

Weight-of-evidence categories represent an assessment of the amount and quality of the data, which support the finding that specific chemicals and elements can cause cancer in humans. Although USEPA's guidelines for carcinogen risk assessment (USEPA, 1996; 1999a) proposes a weight-of-evidence narrative, IRIS currently uses the original alphanumeric classification. Under the existing guidelines (USEPA, 1986a), chemicals are classified as either Group A, Group B1, Group B2, Group C, Group D, or Group E. Group A includes those substances for which high-quality studies have demonstrated a relationship between the exposure to the substance in question and the development of cancer in human populations. Groups B1, B2, and C represent chemicals with limited (B1) or insufficient (B2) human evidence of carcinogenicity, and sufficient (B1, B2) or insufficient (C) animal data. Group D substances are those for which

there is insufficient or no evidence of carcinogenicity in humans or animals, while Group E substances are those for which no evidence of carcinogenicity is available in adequate human or animal studies.

Health Effects Criteria for Noncarcinogens. Health effects criteria for chemicals exhibiting noncarcinogenic effects are generally developed using verified risk reference doses (RfDs) and reference concentrations (RfCs). These are developed by USEPA and listed in IRIS (USEPA, 2003b), or can be obtained from HEAST (USEPA, 1997a) and supplements. The RfD is expressed in units of dose (mg chemical/kg body weight-day) and are usually derived either from human studies involving workplace exposures or from animal studies. The RfDs are estimates (with uncertainty spanning perhaps several orders of magnitude) of the daily exposure to the human population (including sensitive subpopulations) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The RfD is used as a reference point for gauging the potential effects of exposures. Usually, exposures (as chemical intakes or doses) that are less than the RfD are not likely to be associated with adverse health effects. As the frequency and/or magnitude of the exposures exceeding the RfD increase, the probability of adverse effects in a human population increases.

RfDs are developed for both chronic and subchronic exposures. Chronic RfDs are presented in IRIS or HEAST and are intended for use in evaluating exposures of durations greater than seven years. Subchronic RfDs are developed by USEPA's NCEA and are used to characterize the potential for the occurrence of noncarcinogenic effects associated with short-term exposures [two weeks to seven years as defined by USEPA (1989a)]. The subchronic RfDs are developed similarly to chronic RfDs, and are typically equal to chronic RfDs or are 1 order of magnitude greater (less stringent). The subchronic RfDs are presented in HEAST, but they are no longer being reviewed and updated in the same manner as IRIS. Because there is greater uncertainty associated with the subchronic RfDs, chronic RfDs have been used in this HHRA.

The RfDs are derived using uncertainty factors that reflect scientific judgment regarding the various types of data used to estimate the RfD. RfDs are typically estimated from no observable adverse effect levels (NOAELs) or lowest observable adverse effect levels (LOAELs) in human or animal studies. Uncertainty factors, generally 10-fold factors, are intended to account for:

- The variation in sensitivity among members of the human population;
- The uncertainty in extrapolating animal data to the case of humans;
- The uncertainty in extrapolating from data obtained in a study that is less-than-lifetime exposure;
- The uncertainty in using LOAEL data, when necessary, rather than NOAEL data; and,
- The inability of a single study to adequately address every possible adverse outcome in humans.

To derive RfDs, NOAELs or LOAELs are divided by one or more uncertainty factors, as appropriate. When taken together, these uncertainty factors may confer an extra margin of safety of up to a factor of 10,000 below a LOAEL. In some cases, modifying factors are also applied to RfDs to take into account other uncertainties in the toxicity database and reflect the professional judgment of those reviewing the database. The net result is that RfDs are generally considered to provide a conservative estimate of the likelihood of adverse noncarcinogenic effects.

6.3.2 Health Effects Criteria for COPCs

Health effects criteria for chronic exposures to COPCs via the oral route of exposure are presented in **Appendix E-1, Tables E-11 and E-12**. Health effects criteria for chronic exposures to the COPCs in soil via the inhalation of particulate matter and volatiles are presented in **Appendix E-1, Tables E-13 and E-14**. Toxicity data for the carcinogens identified at SWMU 58 (benzo(a)pyrene and trichloroethylene) are specifically discussed in the following sections.

Chromium. The toxic effects associated with chromium are dependent upon its valence state (USEPA, 1998). Two common forms of chromium are trivalent chromium (chromium III) and hexavalent chromium (chromium VI). Chromium III is the predominant form of chromium in nature and is the less toxic of the two forms. Hexavalent chromium is the more toxic form of chromium and is considered to be a Class A carcinogen via the route of inhalation. The speciation of hexavalent chromium (Cr VI) is not routinely performed during a sampling program due to the very short holding time and the unique stability issues associated with hexavalent chromium (i.e., it tends to change valence states very easily after sample collection). Unless there is convincing evidence that hexavalent chromium may be present at a site (such as its for control of scale in non-contact cooling water piping for a power plant or a chromium plating operation), it is generally not included in an analytical program. For the SWMU 58 site, hexavalent chromium analyses were not performed for the environmental media samples.

It was assumed that the majority of the chromium that was detected at the site would be in the trivalent form. Hexavalent chromium is relatively unstable in the environment and is typically converted to trivalent chromium. As stated in *Water-Related Environmental Fate of 129 Priority Pollutants* (USEPA, 1979), hexavalent chromium or Cr(VI) is a moderately strong oxidizing agent and reacts with reducing materials to form trivalent chromium or Cr(III). Chemical speciation is an important fate process for chromium and in aquatic environments. Cr(VI), if present, would be expected to remain in a soluble form, while trivalent chromium would be expected to hydrolyze and precipitate as $\text{Cr}(\text{OH})_3$. Cr(III) the most stable form under reducing conditions normally found in natural waters and sediments, and when in solution at pH greater than 5, quickly precipitates due to formation of the insoluble hydroxide or oxide.

Cr (III) is the stable form of chromium in soil (FRTR, 2002). Cr (III) hydroxy compounds precipitate at pH 4.5 and complete precipitation of the hydroxy species occurs at pH 5.5. In contrast to Cr (VI), Cr (III) is relatively immobile in soil. Two surface soil samples from SWMU 58 were analyzed for pH. The resulting pH values (7.2 and 7.5) would favor precipitation.

Because of its anionic nature, Cr (VI) associates with soil surfaces at positively charged exchange sites (FRTR, 2002). This association decreases with increasing soil pH. Regardless of pH and redox potential, most Cr(VI) in soil is reduced to Cr(III). Soil organic matter and iron (Fe II) minerals donate electrons in this reaction. The reduction reaction in the presence of organic matter proceeds at a slow rate under normal environmental pH and temperatures, but the rate of reaction increases with decreasing soil pH.

A number of studies have been conducted with respect to the fate and transport of chromium in soil. For example, the objectives of a study conducted by the Oak Ridge National Laboratory (Jardine et al, 1999), were to investigate the impact of coupled hydrologic and geochemical processes on the fate and transport of Cr(VI) in undisturbed soil cores. The reduction of Cr(VI) to Cr(III) was dramatically more significant on soil with higher levels of surface-bound natural

organic matter. This indicated that natural organic matter was serving as a suitable reductant during Cr(VI) transport even in the presence of potentially competing geochemical oxidation reactions involving chromium. In another example, seven organic amendments (e.g., composts, manures) were investigated for their effects on the reduction of Cr(VI) in a mineral soil low in organic matter content (Bolan, et al, 2003). Addition of organic amendments enhanced the rate of reduction of Cr(VI) to Cr(III) in the soil. Finally, it was found that the distribution of metal contaminants such as chromium in soil can be strongly localized by transport limitations and redox gradients within soil aggregates (Tokunaga et al, 2001). Shifts in characteristic redox potential and the extent of Cr(VI) reduction to Cr(III) were related to organic matter availability.

Two surface soil samples from SWMU 58 were analyzed for total organic carbon (TOC), with results of 7,160 and 8,760 mg/kg. These results are within the range of other sites at the Installation. For example, the TOC values for the New River Unit sites ranged from 1,880 to 29,400 mg/kg for surface soil. Increasing chromium concentrations are associated with increasing levels of organic matter. Even if trace amounts of Cr(VI) were present at the site, the environmental conditions at RFAAP, including typical precipitation events over the years, would tend to favor the conversion of this form of chromium to the more stable (less toxic) trivalent state. For these reasons, it was assumed that toxicity associated with chromium would be most accurately represented by the use of chromium III toxicity data.

Under the existing cancer guidelines (USEPA, 1986a, 2003b), benzo(a)pyrene is classified as B2, a probable human carcinogen. Although human data specifically linking benzo(a)pyrene to a carcinogenic effect are lacking, multiple animal studies have demonstrated carcinogenicity in several species by numerous routes. Tumor types have included forestomach, larynx and esophagus, papillomas, and carcinomas. In addition, benzo(a)pyrene has produced positive results in genotoxicity assays. An oral slope factor was calculated based on the geometric mean of four slope factors obtained by different modeling procedures, which were derived from a combination of multiple data sets from two different reports using more than one sex and species.

The toxicity values for trichloroethylene were recently updated on the basis of an extensive database comprised of epidemiologic studies, animal bioassays, metabolism studies, and mechanistic studies (USEPA, 2001e). In particular, epidemiologic studies have associated exposure to trichloroethylene with excess risk of kidney cancer, liver cancer, lymphohematopoietic cancer, cervical cancer, and prostate cancer. Under USEPA's proposed cancer guidelines (USEPA, 1996; 1999a), TCE can be characterized as "highly likely to produce cancer in humans". A range of slope factors has been developed (2×10^{-2} to 4×10^{-1} per mg/kg-day). At this time, USEPA has not reduced the slope factor to a single number. Rather, USEPA believes that a range of values is reasonable in view of the risk factors that can modify the effects of TCE in different populations. As a conservative measure, a slope factor of 4×10^{-1} per mg/kg-day was used in this HHRA.

For effects other than cancer, USEPA also updated the RfD and RfC (USEPA, 2001e). An oral RfD of 3×10^{-4} mg/kg-day was based on critical effects in the liver, kidney, and developing fetus. The RfD was derived using an uncertainty factor of 3,000. An inhalation RfC of 4×10^{-2} mg/m³ was based on critical effects in the central nervous system, liver, and endocrine system and an uncertainty factor of 1,000.

6.3.3 Adjustment for Dermal Absorption

Toxicity criteria have not been developed by USEPA specifically for the dermal absorption route of exposure; instead, oral health effects criteria are adjusted to assess this pathway. In order to have a meaningful comparison between the dermal absorption dose estimates, which represent internal (or absorbed) doses, and oral toxicity criteria, which typically represent potential (or administered) doses, toxicity criteria are modified to represent absorbed doses. The method for modifying toxicity criteria involves determination of an absolute oral absorption factor for each chemical and use of this value to increase the chemical's CSF or to decrease the chemical's RfD, as shown in the following equations:

$$\begin{aligned}(\text{CSF}) / (\text{Absolute oral absorption factor}) &= \text{Adjusted Dermal CSF} \\ (\text{RfD}) \times (\text{Absolute oral absorption factor}) &= \text{Adjusted Dermal RfD}\end{aligned}$$

The absolute oral absorption factors that are applied should reflect the specific conditions under which the toxicological study was conducted (e.g., method of administration such as gavage, water or diet, and vehicle of administration such as solvent or solution). The absolute oral absorption factors and adjusted toxicity criteria for the COPCs used when evaluating dermal absorption are also presented in **Appendix E-1, Tables E-11 and E-12**. The adjusted CSFs and RfDs presented in these tables were used to evaluate potential risks associated with dermal absorption exposures.

6.4 Human Health Risk Characterization

In this section, the potential human health cancer risks and noncancer hazards associated with selected human exposure pathways are calculated and detailed results are provided in **Appendix E-1, Tables E-15 through E-26**. To quantitatively assess risks at SWMU 58, the average daily doses (LADDs and ADDs) calculated in the exposure section are combined with the health effects criteria presented in the toxicity section. USEPA has developed guidance for assessing the potential risks to individuals from exposure to carcinogenic and noncarcinogenic chemicals, and uses separate methodologies for estimating the risks from these two different classes of compounds.

For exposures to potential carcinogens, the individual upper-bound excess lifetime cancer risk was calculated by multiplying the estimated LADD by the upper-bound CSF. Upper-bound is a term used by USEPA to describe CSFs, meaning that actual risks are unlikely to be higher than the risks predicted using the upper-bound CSFs. Using this approach, a risk level of 1×10^{-6} , for example, represents an upper-bound increase in the lifetime probability of 1 in 1,000,000 that an individual could develop cancer as a result of exposure.

The approach of calculating carcinogenic risks by multiplying the LADD by the CSF assumes that the increased risk of cancer resulting from exposure to a constituent is linearly proportional to the amount of chemical intake averaged over a lifetime. According to USEPA (1989a) risk assessment guidance, this approach is appropriate when the estimated carcinogenic risks calculated are less than 10^{-2} (i.e., one excess cancer case per 100 people exposed). If the estimated risks are above 10^{-2} , the assumption of linearity is not valid. In such cases, the carcinogenic risks should be calculated using the following equation, per USEPA risk assessment guidance (USEPA, 1989a):

$$\text{Risk} = 1 - e^{(-\text{LADD} \cdot \text{CSF})}$$

It is important to note that although the upper-bound cancer risk estimates provide plausible estimates of the upper limits of risk, the actual risk could be considerably lower.

In order to assess the upper-bound individual excess lifetime cancer risks associated with simultaneous exposure to COPCs, the risks derived from the individual chemicals were summed within each exposure pathway. This approach is consistent with the USEPA's guidelines for evaluating the toxic effects of chemical mixtures (USEPA, 1986b; 1989a).

Potential adverse health effects for noncarcinogens were calculated by means of an HI technique as recommended by USEPA (1989a). The ratio of the ADD to the reference dose (ADD:RfD) was derived for each chemical. Values of these ratios, called hazard quotients (HQs), which are greater than 1 are indicative of the potential for adverse health effects. The effects from simultaneous exposures to COPCs were computed by summing the individual ratios (HQs) within each exposure pathway. This sum, known as the HI, serves the same function for the mixture as the HQ does for the individual compound. In general, HIs that are less than 1 are not likely to be associated with health risks and are, therefore, less likely to be of regulatory concern than HIs greater than 1. If an HI is greater than 1, the COPCs are subdivided into categories based on target organ affected by exposure (e.g., liver, kidney) in accordance with USEPA (1989a) guidance. HIs are then recalculated for these categories to better identify whether noncarcinogenic effects to specific target organs or endpoints might occur.

The upper-bound excess lifetime cancer risks derived in this report can be compared to USEPA's target risk range for health protectiveness at Superfund sites of 1×10^{-6} to 1×10^{-4} (USEPA, 1990). In addition, USEPA's Office of Solid Waste and Emergency Response (USEPA, 1991b) has issued a directive clarifying the role of HHRA in the Superfund process. The directive states that, where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 1×10^{-4} , and the noncarcinogenic HI is less than 1, action generally is not warranted unless there could be adverse environmental effects (see *Section 7.0* for a discussion of potential ecological hazards).

6.4.1 Risk Estimates for Maintenance Workers under Current Land-Use Conditions at SWMU 58

A summary of the upper-bound excess lifetime cancer risks and HIs associated with maintenance worker exposures to surface soil at SWMU 58 under current land-use conditions are provided in **Appendix E-1, Table E-27**. For each exposure pathway evaluated, the predominant chemicals contributing to total upper-bound excess lifetime cancer risks above 1×10^{-6} or HIs above 1 are identified in the text below. Since maintenance workers may be exposed at one time by a combination of pathways (e.g., incidental ingestion and dermal absorption), the cumulative pathway risks for plausible multiple pathway exposures are also provided in **Appendix E-1, Table E-27** and discussed below.

Surface Soil. No carcinogenic COPCs were selected for surface soil. Therefore, a total upper-bound excess lifetime cancer risk was not calculated. The HI associated with exposures to noncarcinogenic COPCs in surface soil by a maintenance worker was less than 1.

Cumulative Risk and Hazard. No carcinogenic COPCs were selected for surface soil. Therefore, a total upper-bound excess lifetime cancer risk was not calculated. The potential cumulative HI for maintenance workers was less than 1.

6.4.2 Risk Estimates for Maintenance Workers under Future Land-Use Conditions at SWMU 58

A summary of the upper-bound excess lifetime cancer risks and HIs associated with maintenance worker exposures to surface soil at SWMU 58 under future land-use conditions are provided in **Appendix E-1, Table E-28**. For each exposure pathway evaluated, the predominant chemicals contributing to total upper-bound excess lifetime cancer risks above 1×10^{-6} or HIs above 1 are identified in the text below. Since maintenance workers may be exposed at one time by a combination of pathways (e.g., incidental ingestion and dermal absorption), the cumulative pathway risks for plausible multiple pathway exposures are also provided in **Appendix E-1, Table E-28** and discussed below.

Surface Soil. The total upper-bound excess lifetime cancer risks associated with exposures to COPCs in surface soil by a maintenance worker were 1.8×10^{-6} , for inhalation of VOCs, which is within the target risk range of 1×10^{-6} to 1×10^{-4} , due to TCE. The HIs associated with exposures to noncarcinogenic COPCs in total soil were less than 1.

Total Soil. The total upper-bound excess lifetime cancer risks associated with exposures to COPCs in total soil were 1.4×10^{-6} , for inhalation of VOCs (primarily TCE), which is within the target risk range of 1×10^{-6} to 1×10^{-4} . The HIs associated with exposures to noncarcinogenic COPCs in total soil by a maintenance worker were less than 1.

Cumulative Risk and Hazard. Since surface soil represents the more highly contaminated portion of soil, cumulative risk and hazard estimates are conservatively based on this soil data grouping. The potential cumulative risk for maintenance workers exposed to surface soil at SWMU 58 under future land-use conditions was 2.0×10^{-6} , which is within the USEPA's target risk range of 1×10^{-6} to 1×10^{-4} for health protectiveness at Superfund sites (USEPA, 1990). The potential cumulative HIs for maintenance workers were less than 1.

6.4.3 Risk Estimates for Excavation Worker under Future Land-use Conditions at SWMU 58

A summary of the upper-bound excess lifetime cancer risks and HIs associated with excavation worker exposures to total soil at SWMU 58 under future land-use conditions is provided in **Appendix E-1, Table E-29**. For each exposure pathway evaluated, the predominant chemicals contributing to total upper-bound excess lifetime cancer risks above 1×10^{-6} or HIs above 1 are identified in the text below. Since excavation workers may be exposed at one time by a combination of pathways (e.g., incidental ingestion and dermal absorption), the cumulative pathway risks for plausible multiple pathway exposures are also provided in **Appendix E-1, Table E-29** and discussed below.

Total Soil. The total upper-bound excess lifetime cancer risks associated with exposures to COPCs in total soil were less than the target risk range of 1×10^{-6} to 1×10^{-4} . The HIs associated with exposures to noncarcinogenic COPCs in total soil by an excavation worker were less than 1.

Cumulative Risk and Hazard. The potential cumulative risk for excavation workers exposed to total soil at SWMU 58 under future land-use conditions was 4.0×10^{-7} , which is below the USEPA's target risk range of 1×10^{-6} to 1×10^{-4} for health protectiveness at Superfund sites (USEPA, 1990). The potential cumulative HI for excavation workers was less than 1.

6.4.4 Risk Estimates for Adult Residents under Future Land-Use Conditions at SWMU 58

A summary of the upper-bound excess lifetime cancer risks and HIs associated with adult resident exposures to total soil at SWMU 58 under future land-use conditions is provided in **Appendix E-1, Table E-30**. For each exposure pathway evaluated, the predominant chemicals contributing to total upper-bound excess lifetime cancer risks above 1×10^{-6} or HIs above 1 are identified in the text below. Since residents may be exposed at one time by a combination of pathways (e.g., incidental ingestion and dermal absorption), the cumulative pathway risks for plausible multiple pathway exposures are also provided in **Appendix E-1, Table E-30** and discussed below.

Total Soil. The total upper-bound excess lifetime cancer risks associated with exposures to COPCs in total soil via ingestion, inhalation, and dermal absorption were below the target risk range of 1×10^{-6} to 1×10^{-4} . The HIs associated with exposures to noncarcinogenic COPCs in total soil by an adult resident were below 1.

Cumulative Risk and Hazard. The potential cumulative risk for adult residents exposed to total soil at SWMU 58 under future land-use conditions was 1.3×10^{-6} , which is within the USEPA's target risk range of 1×10^{-6} to 1×10^{-4} for health protectiveness at Superfund sites (USEPA, 1990). The potential cumulative HI for adult residents is below 1.

6.4.5 Risk Estimates for Child Resident under Future Land-use Conditions at SWMU 58

A summary of the upper-bound excess lifetime cancer risks and HIs associated with child resident exposures to total soil at SWMU 58 under future land-use conditions is provided in **Appendix E-1, Table E-31**. For each exposure pathway evaluated, the predominant chemicals contributing to total upper-bound excess lifetime cancer risks above 1×10^{-6} or HIs above 1 are identified in the text below. Since residents may be exposed at one time by a combination of pathways (e.g., incidental ingestion and dermal absorption), the cumulative pathway risks for plausible multiple pathway exposures are also provided in **Appendix E-1, Table E-31** and discussed below.

Total Soil. The total upper-bound excess lifetime cancer risks associated with exposures to COPCs in total soil were estimated to be 1.5×10^{-6} via ingestion and dermal absorption, primarily due to benzo(a)pyrene. This value is within the target risk range of 1×10^{-6} to 1×10^{-4} . The HIs associated with exposures to noncarcinogenic COPCs in total soil by a child resident was equal to 1.0 for ingestion. No individual chemical HQ was equal to or exceeded 1.

Cumulative Risk and Hazard. The potential cumulative risk for child residents exposed to total soil at SWMU 58 under future land-use conditions was 1.8×10^{-6} , which is within the USEPA's target risk range of 1×10^{-6} to 1×10^{-4} for health protectiveness at Superfund sites (USEPA, 1990). The potential cumulative HI for child residents was equal to 1.1. No individual chemical or target organ HI was equal to or exceeded 1.

6.4.6 Summary of Predominant COPCs at SWMU 58

This section summarizes the predominant COPCs associated with potential risks and hazards at SWMU 58. For the purposes of the HHRA, predominant COPCs are defined as chemicals contributing to exposure route total cancer risks (i.e., based on the sum of every route evaluated) greater than or equal to 1×10^{-6} or exposure route total HIs greater than or equal to one. The predominant COPCs are summarized by receptor, media, and exposure route, in **Appendix E-1**,

Tables E-32 through E-36. The predominant COPCs are discussed according to exposure medium in the text below.

Surface Soil. As shown in **Appendix E-1, Tables E-32 and E-33**, there are no predominant COPCs representing cancer risk for current exposures to surface soil at SWMU 58. The predominant COPC representing cancer risk for future exposures to surface soil by maintenance workers is TCE. The total cancer risk estimates for future surface soil exposure were within the USEPA target risk range for health protectiveness. There are no predominant COPCs representing non-carcinogenic hazard. The HIs for current and future exposures to surface soil were less than 1.

Total Soil. As shown in **Appendix E-1, Tables E-33 and E-36**, the predominant COPC representing cancer risk for total soil are benzo(a)pyrene and TCE. The total cancer risk estimate for total soil exposures is within the USEPA target risk range for health protectiveness for the maintenance worker and the adult resident. The total cancer risk estimate for total soil exposures is equal to the lower limit of the target risk range for the child resident. The total cancer risk estimate for total soil exposures is below the target risk range for the excavation worker. There are no predominant COPCs representing non-carcinogenic hazard. The HI for total soil was less than 1 for receptors except the child resident, which was equal to 1.

6.5 Uncertainties in the HHRA

Risk assessments involve the use of assumptions, judgments, and incomplete data to varying degrees that contribute to the uncertainty of the final estimates of risk. Uncertainties result both from the use of assumptions or models in lieu of actual data and from the error inherent in the estimation of risk-related parameters, and may cause risk to be overestimated or underestimated. Based on the uncertainties described below, this risk assessment should not be construed as presenting an absolute estimate of risk to persons potentially exposed to chemicals at SWMU 58.

Consideration of the uncertainty attached to various aspects of the risk assessment process allows one to better interpret the risk assessment results and understand the potential adverse effects on human health. In general, the primary sources of uncertainty are associated with environmental sampling and analysis, selection of chemicals for evaluation, toxicological data, and exposure assessment. The effects of these uncertainties on the risk estimates are discussed below.

Environmental Sampling and Analysis. Uncertainty in environmental chemical analysis can stem from several sources including errors inherent in the sampling or analytical procedures. Analytical accuracy errors or sampling errors can result in rejection of data, which decreases the available data for use in the HHRA, or in the qualification of data, which increases the uncertainty in the detected chemical concentrations. There is uncertainty associated with chemicals reported in samples at concentrations below the reported detection limit, but still included in data analysis, and with those chemicals qualified with the letter J, indicating that the concentrations are estimated. Another issue involves the amount of blank-related (i.e., B-qualified) data in the data set. These data were eliminated from the HHRA. The effects of using data with these uncertainties may over- or underestimate risks.

The data set for each medium represented a compilation of several subsets. These subsets consisted of samples that were collected at various times under different investigations and analyzed by different laboratories. Combining these data involves some uncertainty in the risk assessment. The degree of potential overestimation or underestimation is not known. However,

several measures were taken to minimize this uncertainty, which included using validated data, ensuring that chemical names in the file were comparable, and reviewing data qualifiers.

As discussed in *Section 7.6.3*, two additional surface soil samples were collected on 05 November 2003 to verify suspect historic thallium results. In addition to thallium, these two samples were analyzed for TAL metals. The goal of the 05 November 2003 sampling event was to assess thallium for ecological concerns; therefore the results for these inorganics have not been included in the quantitative HHRA. While this approach results in some uncertainty, a review of the inorganic constituent concentrations demonstrates that HHRA conclusions and recommendations would not change if results from these two samples were included in the quantitative HHRA.

Selection of Chemicals for Evaluation. A comparison of maximum detected chemical concentrations to USEPA Region III RBCs was conducted for each medium. Chemicals whose maximum concentrations were below their respective RBCs were not carried through the assessment. It is unlikely that this risk-based screening would have excluded chemicals that would be of concern, based on the conservative exposure assumptions and conservatively derived toxicity criteria that are the basis of the RBCs. Although following this methodology does not provide a quantitative risk estimate for every chemical, it focuses the assessment on the chemicals accounting for the greatest risks (i.e., chemicals whose maximum concentrations exceed their respective RBCs), and the overall cumulative risk estimates would not be expected to be significantly (if at all) greater.

Toxicological Data. The assessment of risks relied on USEPA-derived dose-response criteria. These health effects criteria are conservative and are designed to be protective of sensitive subpopulations. The health criteria used to evaluate long-term exposures, such as RfDs or CSFs, are based on concepts and assumptions that bias an evaluation in the direction of overestimation of health risk. As USEPA notes in its Guidelines for Carcinogenic Risk Assessment (USEPA, 1986a): "There are major uncertainties in extrapolating both from animals to humans and from high to low doses. There are important species differences in uptake, metabolism, and organ distribution of carcinogens, as well as species and strain differences in target site susceptibility. Human populations are variable with respect to genetic constitution, diet, occupational and home environment, activity patterns and other cultural factors."

These uncertainties are compensated for by using upper-bound 95% UCLs for CSFs for carcinogens, and safety factors for RfDs for noncarcinogens. The assumptions used here provide a rough but plausible estimate of the upper limit of risk; in other words, it is not likely that the true risk would be much more than the estimated risk, but it could very well be considerably lower, even approaching zero. More refined modeling in the area of dose-response calculation (e.g., using maximum likelihood dose-response values rather than the 95% UCL) would be expected to substantially lower the final risk. For example, a single slope factor for benzo(a)pyrene was calculated using the geometric mean of several slope factors, each considered to be of equal merit (USEPA, 2003b). These four slope factor estimates span less than a factor of three and each is based on an acceptable, albeit less than optimal, data set. Each estimate is based on a low-dose extrapolation procedure, which entails the use of multiple assumptions and default procedures.

For dermal absorption exposure pathways, the absence of dermal toxicity criteria necessitated the use of oral toxicity data. In order to calculate risk estimates for the dermal absorption pathway, absorbed dermal absorption doses were combined with oral toxicity values. As described in

Section 6.3, oral toxicity values, which are typically expressed in terms of potential (or administered) doses, should be adjusted when assessing dermal absorption doses, which are expressed as internal (or absorbed) doses. In this assessment, absolute oral absorption factors that reflect the toxicity study conditions were used to modify the oral toxicity criteria. For those organic chemicals for which sufficient information is lacking, a default oral absorption factor of 1.0 was used, as recommended by USEPA. The risk estimates for the dermal absorption pathways may be over- or underestimated depending on how closely the values used in the HHRA reflect the difference between the oral and dermal routes.

For chemicals without IRIS or HEAST toxicity criteria, provisional toxicity criteria were used if available (**Appendix E-1, Tables E-11 through E-14**). Provisional toxicity criteria present a source of uncertainty, since USEPA has evaluated the compound, but consensus has not been established on the toxicity criteria. For this assessment, use of provisional toxicity criteria was preferable to not evaluating the chemical in order to limit data gaps. However, because the toxicity criteria have not been formally accepted by USEPA, there is uncertainty with these values and, therefore, with the risks calculated using these toxicity criteria. For example, the updated toxicity data for trichloroethylene have been presented in a document that is currently designated as an "External Review Draft" (USEPA, 2001e). As such, the document has not been formally released by USEPA. Furthermore, the uncertainty associated with these values is reflected in the use of a range of slope factors due to potential differences in susceptibility in exposed populations. The uncertainty factors for the RfD and RfC (3,000 and 1,000, respectively) reflect the uncertainty associated with noncancer effects. A key uncertainty with respect to the RfD and RfC is the relative lack of chronic studies. The uncertainty factors for the RfD and RfC (3,000 and 1,000, respectively) reflect the uncertainty associated with noncancer effects. However, use of the updated values in this HHRA is preferable to using previous provisional values, which would be considered outdated. These toxicity values have been used as the basis for USEPA Region III RBCs (USEPA, 2003a).

For some chemicals (e.g., 4-isopropyltoluene), there are no toxicity criteria available (**Appendix E-1, Tables E-11 through E-14**). Although lack of published toxicity data could result in an underestimation of risk, this uncertainty is likely to be balanced by using the toxicity value of isopropylbenzene as a surrogate.

Exposure Assessment. The primary areas of uncertainty affecting exposure parameter estimation involve the assumptions regarding exposure pathways, the estimation of EPCs, and the parameters used to estimate chemical doses. The uncertainties associated with these various sources are discussed below.

An underlying assumption in the HHRA is that individuals at the site would engage in certain activities that would result in exposures via each selected pathway. For example, it was assumed that receptors would engage in regular activities under current and future land-use conditions that would result in exposures to COPCs. This assumption is conservative, in that it is more likely that the activity patterns assumed to occur in this analysis would likely occur occasionally.

With respect to calculating EPCs, one assumption was that the concentrations of chemicals in the media evaluated would remain constant over time. Depending on the properties of the chemical and the media in which it was detected, this assumption could over- or underestimate risks to a low or high degree, depending on the degree of chemical degradation or transport to other media, although for the site in question, it is likely an overestimation, as further degradation is likely.

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When calculating EPCs from sampling data, one-half of the reported quantitation limit was used for non-detect samples in the calculation of the 95% UCL on the mean. An approach dealing with non-detected chemical concentrations is associated with some uncertainty, because chemicals that were not detected at the specified sample quantitation limit may be absent from the medium or may be present at a concentration below the sample quantitation limit. The uncertainty of the EPC will increase as the number of non-detects in a data set increases, and the uncertainty could result in either the over- or underestimation of EPCs. It should be noted that for the estimation of the 2,3,7,8-TCDD toxicity equivalent concentration, non-detect sample results were conservatively used as is, and not treated at one-half of the reporting limit.

The 95 percent UCL was used preferably as the EPC for each medium if at least 5 samples were available for a data grouping. If the 95 percent UCL exceeded the maximum detected value or if fewer than 5 samples were available for a data grouping, the maximum was conservatively used as a default for the EPC. Using a value that is based on one sampling location (i.e., the maximum) is associated with some uncertainty, and adds a great deal of conservatism to the assessment.

The parameter values used to describe the extent, frequency, and duration of exposure are associated with some uncertainty. Actual risks for certain individuals within an exposed population may vary from those predicted depending upon their actual intake rates (e.g., soil ingestion rates), nutritional status, or body weights. The exposure assumptions were selected to produce an upper-bound estimate of exposure in accordance with USEPA guidelines regarding evaluation of potential exposures at Superfund sites (e.g., exposures were assumed to occur for 25 years for workers). In addition, many USEPA (1991a) default exposure parameters are highly conservative and are based on risk management interpretations of limited data. An example is soil ingestion rates. Although current USEPA guidance recommends default soil ingestion rates of 100 mg/day for individuals over 6 years of age, other studies, such as Calabrese et al. (1990), have shown that the USEPA default soil ingestion rate of 100 mg/day is likely to greatly overestimate adult exposures and risks. In addition, chemicals in soil were assumed to be 100% bioavailable; this assumes that ingested chemicals present in a soil matrix are completely absorbed through the gastrointestinal tract, which is unlikely due to their affinity to the soil particles. Therefore, based on the conservative exposure assumptions used in the HHRA, exposures and estimated potential risks are likely to be overestimated for the ingestion of soil pathways.

Evaluation of the dermal absorption exposure pathway is affected by uncertainties in exposure parameters specific to dermal contact. For example, there is uncertainty associated with the exposed skin surface areas used, since the choice of exposed body parts could slightly over- or underestimate risks. More significant uncertainties are associated with the selection and use of dermal absorption factors. For this HHRA, the dermal absorption factors were based on USEPA Region III's guidance, *Assessing Dermal Exposure from Soil* (USEPA, 1995b). There were no specific dermal absorption factors for aluminum, chromium, iron, thallium, or vanadium. According to the Agency for Toxic Substances Disease Registry (ATSDR), no reliable quantitative studies were located regarding absorption in humans or animals for the dermal exposure to aluminum, thallium, and vanadium (ATSDR, 1992a,b, 1999). Although chromium III and chromium VI can penetrate the skin to some extent, studies were based on direct contact with chromium compounds (ATSDR, 2000) rather than chromium in soil. The default dermal absorption factor for inorganics is 1 percent (USEPA, 1995b). However, USEPA's *Risk Assessment Guidance for Superfund (RAGS)*, (Part E, Supplemental Guidance for Dermal Risk

Assessment; USEPA 2001a), states that the speciation of the compound is critical to the dermal absorption of inorganics and there are too little data to extrapolate a reasonable default value (USEPA, 2001a). Therefore, the impact of using the dermal absorption factors to evaluate dermal absorption exposures is not known.

6.6 HHRA Summary

This HHRA was performed to evaluate the potential human health effects associated with chemical contamination from past operations at SWMU 58. For the purposes of the HHRA, surface soil and total soil were evaluated.

The HHRA was performed for both current and future land-use conditions. Under current land-use conditions, maintenance worker exposures to surface soil were evaluated. Although exposures to trespassers were considered, it is unlikely that a trespasser would have access to SWMU 58 due to security at the Installation. However, the maintenance worker scenario would be similar to the limited exposure that a trespasser could experience at the site and would be protective of the trespasser.

Under future conditions, maintenance worker exposures to surface soil and maintenance worker and excavation worker exposures to total soil were evaluated. Exposures to surface soil by a maintenance worker were assumed to be the same under future land-use conditions as those under current land-use conditions. In addition, adult resident and child resident exposures to total soil were evaluated under future conditions.

Upper-bound excess lifetime cancer risks and non-cancer HIs were estimated for the exposure pathways and data groupings described above. Estimations of non-cancer HIs and excess lifetime cancer risks and non-cancer HIs for maintenance worker, excavation worker, adult resident, and child resident exposures evaluated in the HHRA are presented in **Appendix E-1, Tables E-15 through E-26**. Summaries of upper-bound excess lifetime cancer risks and non-cancer HIs for exposures evaluated in the HHRA are presented in **Appendix E-1, Tables E-27 through E-31**; the predominant exposure pathways and COPCs are shown in **Appendix E-1, Tables E-32 through E-36**. These results are summarized for each receptor group.

Maintenance Worker. For the current maintenance worker exposures to surface soil at SWMU 58, the risk characterization results showed a total HI less than 1. No carcinogenic COPCs were selected for surface soil. Therefore, a total upper-bound excess lifetime cancer risk was not calculated.

For the future maintenance worker exposures at SWMU 58, the risk characterization results showed total cancer risk associated with surface soil (1.8×10^{-6}) and total soil (1.4×10^{-6}) were within the target risk range. The total HIs were below 1.

Excavation Worker. For the future excavation worker, the risk characterization results showed total cancer risks associated with total soil were below the target risk range. The total HI was less than 1.

Adult Resident. For the future adult resident, the risk characterization results showed total cancer risks associated with total soil (1.3×10^{-6}) were within the target risk range. The total HI was less than 1.

Child Resident. For the future child resident, the risk characterization results showed total cancer risks associated with total soil (1.8×10^{-6}) were within the target risk range. The total HI was equal to 1.1. No individual chemical or target organ HI was equal to or exceeded 1.

7.0 ECOLOGICAL RISK ASSESSMENT

A screening level ecological risk assessment (SLERA) has been performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases at SWMU 58. The results of the SLERA contribute to the overall characterization of the site and the scientific/management decision point (SMDP) reached from the SLERA includes one of the following:

- There is adequate information to conclude that ecological risks are negligible and therefore there is no need for further action at the site on the basis of ecological risk;
- The information is not adequate to make a decision at this point and further refinement of data is needed to augment the ecological risk screening; or
- The information collected and presented indicates that a more thorough assessment is warranted.

The SLERA has been performed following the *RFAAP Final Master Work Plan* (URS, 2002), the *RFAAP Site Screening Process* (USEPA, 2001c), the *Tri-Service Procedural Guidelines for Ecological Risk Assessments* (Wentzel et al., 1996), and Steps 1, 2, and 3a of the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997b). Steps 1, 2, and 3a have been completed as part of the SLERA. The addition of Step 3a focuses the outcome of the SLERA, streamlines the review process, and allows one document to function as the initial forum for ecological risk management decision making at SWMU 58.

The primary objective of the SLERA is to assess whether there is enough information to state that there is the potential for unacceptable risks to ecological receptors as a result of potential hazardous substance releases. This objective is met by characterizing the ecological communities in the vicinity of SWMU 58, assessing the particular hazardous substances being released, identifying pathways for receptor exposure, and estimating the magnitude and likelihood of potential risk to identified receptors. The SLERA addresses the potential for adverse effects to vegetation, the soil invertebrate community, wildlife, endangered and threatened species, and wetlands or other sensitive habitats that may be associated with SWMU 58.

Concentrations of chemicals have been measured in relevant environmental media including soil. No groundwater data have been collected in association with SWMU 58 [as groundwater is being assessed under MWP Work Plan Addendum 009, "Horseshoe Area Groundwater Study" (IT, 2002b)], however, groundwater data are irrelevant for this site as groundwater does not discharge to the surface in the vicinity of the SWMU 58 and there is no potential exposure for ecological receptors to groundwater. Although area-wide groundwater does ultimately discharge to the New River, groundwater is being assessed as a separate operable unit. Using available concentration data, a SLERA has been performed by following Steps 1 and 2 of USEPA (1997), where Step 1 includes a screening-level problem formulation and ecological effects evaluation; and Step 2 includes a screening level preliminary exposure estimate and risk calculation. The SLERA is organized as follows: Site Characterization (*Section 7.1*); Identification of Chemicals of Potential Ecological Concern (COPEC) and Concentration Statistics (*Section 7.2*); Identification of Exposure Pathways and Potential Receptors for Analysis (*Section 7.3*);

Identification of Assessment and Measurement Endpoints (Section 7.4); Exposure Estimation and Risk Characterization (Section 7.5); Uncertainty Analysis (Section 7.6); and Results and Conclusions (Section 7.7).

7.1 Site Characterization

This site characterization section includes a general discussion of SWMU 58 itself, vegetative communities, a species inventory, and a discussion on threatened and endangered species.

SWMU 58, the Rubble Pile, is approximately 50 ft high and roughly triangular in shape with each side approximately 300 ft long. SWMU 58 was used as a one-time disposal site in 1979. During clearing activities prior to the construction of the Continuous Automated Multi-Base Line (CAMBL), pine trees and surface debris were pushed into a pile and then covered with dirt and fill material. It was believed that no other materials were disposed of at SWMU 58.

SWMU 58 is located in the south-central portion of the Horseshoe Area, east of the main bridge over the New River and directly west of SWMU 32 (Inert Waste Landfill No. 1). It is located along the lower portion of the plateau at approximately 1,740 ft msl. Topography in the area of SWMU 58 is moderately sloping towards the north. There are several buildings, an overhead steam pipe, and gravel and paved roads in the vicinity. Surface water appears to flow in each direction from the debris pile at SWMU 58. Runoff is expected to flow northward following topography and infiltrate into the ground.

7.1.1 General Installation Background

The Virginia Department of Game and Inland Fisheries (1999) conducted the most recent Installation-wide biological survey at RFAAP. Major objectives of this survey were to sample flora and fauna, identify and delineate the major habit community types, and provide management recommendations for both community types and threatened, endangered or species of concern. Eight community types were identified at RFAAP:

- bottomland forest;
- calcareous forest;
- cliffs;
- grasslands;
- oak forest;
- pine plantation;
- successional forest; and,
- water.

Endangered plants or animals were not observed at RFAAP during the biological survey. Five state-listed rare plants were observed at RFAAP during this survey: *Clematis coattails*, *Cystopteris tennesseensis*, *Hasteola suaveolens*, *Sagittaria rigida*, and *Eleocharis intermedia*. State threatened animals located at RFAAP include the invertebrate *Speyeria idalia* and the birds *Ammodramus henslowii* (Henslow's sparrow) and *Lanius ludovicianus* (loggerhead shrike).

An earlier comprehensive inventory of the mammals, birds, reptiles, aquatic invertebrates, trees, and plants found on the Installation, and of fish inhabiting the New River where it flows through

the Installation, was conducted in 1976 during the RFAAP Installation Assessment (USATHAMA, 1976). Information from that assessment was summarized in previous documents (Dames & Moore, 1992). The summarized information was updated for the RFI through personal communication with RFAAP biologists and is presented in the following paragraphs (from URS, 2002).

Many of the reptiles, mammals, and birds listed in the assessment (USATHAMA, 1976) are believed to breed on the Installation. However, indications are that some species, including ruffed grouse and upland plovers, have decreased in number or have disappeared from RFAAP. Foxes, which were once trapped to prevent rabies outbreaks (the last trapping program for foxes was conducted in 1966), were reintroduced to RFAAP as a control for groundhogs. Deer are common at RFAAP and bow hunting has been allowed at the facility since 1991. Migratory waterfowl are found throughout the spring and winter near the New River because the Installation is on the Atlantic Flyway. Federally protected black vultures are present at RFAAP during certain times of the year. Between 1,500 and 3,000 of these migratory birds nest in thickets on the facility (Washington Post, 1995). Public fishing occurs in the New River where it flows through RFAAP.

The Virginia Department of Game and Inland Fisheries has identified the following flora and fauna as endangered or threatened for Pulaski and Montgomery Counties:

- Plant species - six endangered, three threatened;
- Mollusk species - one endangered, one threatened;
- Insect species - one endangered, four threatened;
- Bird species - three endangered; and,
- The locally endangered mountain lion.

In addition, a fish, salamander, four additional bird species, and the river otter are identified as species of concern in the two counties in which RFAAP is located.

According to the RFAAP Installation Assessment (USATHAMA, 1976), timber harvesting occurred at RFAAP in the past. The most recent harvest was conducted in 1987. Tree species at RFAAP include the shortleaf pine, loblolly pine, eastern white pine, yellow poplar, and black walnut. There are 2,537 acres of managed woodland on site (personal communication with T. Thompson, RFAAP Conservation Specialist 1995, as cited in URS, 2002). In 1964, 922 acres of the Horseshoe Area were reforested. No reforestation has occurred in the Main Manufacturing Area.

RFAAP is located at the boundary of the central Appalachian Ridges and Valleys Ecoregion and the central Appalachian Ecoregion (Omernik, 1986). These two Ecoregions are characterized in **Table 7-1**.

Table 7-1
Ecoregions of RFAAP

Ecoregion	Land Surface Form	Potential Natural Vegetation	Land Use
Central Appalachian Ridges and Valleys	Open low hills to open low mountains	Appalachian oak in undisturbed areas	Mosaic of cropland and pasture with some woodland and forest
Central Appalachian	Open low to high hills, open mountains	Mixed mesophytic forest ¹ , Appalachian oak, northern hardwoods ²	Forest and woodland mostly ungrazed

¹maple, buckeye, beech, tuliptree, oak, linden

²maple, birch, beech, hemlock

SWMU 58, limited to 2.2 acres in size (as defined by the approximate area of soil samples collected at the site), is approximately 850 feet north of the New River. The area surrounding the site is mowed grass at an elevation of approximately 1,740 ft msl. Surface water runoff is expected to flow to the north.

Based on previous site visits a limited photographic record was prepared (**Appendix F-1**). During the preparation of this ecological risk assessment, relevant information was obtained, including topographic maps, township, county, and/or other appropriate maps. This information was used to identify the location of potential ecological units such as streams, creeks, ponds, grasslands, forest, and wetlands on or near the site. Additionally, the Virginia Department of Game and Inland Fisheries (1999) Installation-Wide Biological Survey, which identifies the locations of threatened and endangered species at RFAAP, was reviewed. The location of known or potential contaminant sources affecting the site and the probable gradient of the pathway by which contaminants may be released to the surrounding environment were identified. This information was used to evaluate more subtle clues of potential effects from contaminant releases.

7.1.2 Surface Water

If present, surface water would drain to the north. However, there is no surface water or aquatic habitat at the site.

7.1.3 Wetlands

According to the information presented in the Virginia Department of Game and Inland Fisheries (1999) Installation-Wide Biological Survey, and confirmed from the review of site photographs, there are no designated wetlands at SWMU 58.

7.1.4 Vegetative Communities

Vegetative communities at the site, as presented in the Virginia Department of Game and Inland Fisheries (1999) Installation-Wide Biological Survey, were verified from the review of available site photographs. As shown in **Appendix F-1, Photos 1 through 3**, the area is primarily maintained and unmaintained grass, with a few shrubs.

These habitat types can be expected to support different wildlife species assemblages; however, given the close proximity of the habitats to each other, many species would be expected to spend some amount of time within each community type for foraging, resting, and loafing activities, depending on the season.

Based on information from the Virginia Department of Game and Inland Fisheries (1999) Installation-Wide Biological Survey, and confirmed during review of available site photographs, the following community description is presented for typical grassland communities at RFAAP.

The grassland communities at RFAAP are an aggregation of several community types that are so intermingled that delineation is impractical. Grassland may conveniently be subdivided into old field, meadow, and cultivated field. The term old field is used here to denote areas that were formerly open and subsequently abandoned, but are still open. In most cases, these areas were formerly pasture or hayfield. Trees or shrubs may be present individually or in small groups, but a canopy is lacking. At SWMU 58, there are no trees and a few shrubs present. Where shrub invasion has progressed to form larger patches (as in other areas near SWMU 58), a shrubland subtype may be recognizable. Old fields, in most cases, are dominated by native, warm-season species with a wide variety of other grasses, sedges, and herbs mixed in. The two dominants are little bluestem (*Schizachyrium scoparium*) and broomsedge (*Andropogon virginicus*) with others such as *Tridens flavus*, *Panicum oligosanthos*, *Panicum anceps*, *Eragrostis spectabilis*, *Setaria glauca*, *Sorghastrum nutans*, and *Paspalum* being frequent. Much of the old field community is mowed (on an infrequent basis) to help keep woody plants maintained.

Meadows are areas that are mowed regularly and, in most cases, have been planted in forage grasses for haying. These are typically non-native, cool-season species such as *Festuca elatior*, *Poa pratensis*, *Phleum pratense*, *Agrostis gigantea*, *Bromus inermis*, *Dactylis glomerata*, and *Arrhenatherum elatius*. These species may also be mixed with native species characteristic of old fields.

Cultivated fields are areas that have been plowed and seeded with various cover crops. These areas have a major ruderal component that persists after abandonment. Principal weed species are *Cirsium arvense*, *Carduus acanthoides*, *Carduus nutans*, *Erechtites hieracifolia*, *Hypochaeris radicata*, *Verbascum thapsus*, *Hieracium pilosella*, and *Datura stramonium*.

Grassland communities at RFAAP comprise 4,379 acres, or about 63 percent of the 6,901-acre total (Virginia Department of Game and Inland Fisheries [1999] Installation-Wide Biological Survey).

7.1.5 Species Inventory

As presented in the Virginia Department of Game and Inland Fisheries (1999) Installation-Wide Biological Survey, six different taxa and several species were recorded during the survey. **Table 7-2** presents the numbers of species recorded at RFAAP associated with the grassland community type.

Table 7-2
Species Inventory within RFAAP's Grassland Community Type

Taxa	Number of Species	Typical Examples
Plants	24	little bluestem, broomsedge, panic grass, orchard grass, foxtail, timothy, thistle, fireweed, hawkweed
Invertebrates	~250 in 17 taxonomic orders	millipedes, beetles, flies, springtails, seed bugs, bees, ants, moths, butterflies, dragonflies, mantis, caddisflies, isopods, pill bugs, amphipods
Reptiles and amphibians	24	salamanders, toads, frogs, turtles, snakes
Fish	12	sunfish, minnows, trout (not expected at the site)
Birds	83	robin, swift, dove, sparrow, warbler, wren, hawk
Mammals	13	red fox, white-tailed deer, shrew, meadow vole

7.1.6 Threatened, Rare and Endangered Species Information

Threatened, rare, or endangered species found within the grassland community type at RFAAP included those presented in **Table 7-3** (Virginia Department of Game and Inland Fisheries [1999] Installation-Wide Biological Survey).

Table 7-3
Threatened, Rare, and Endangered Species within RFAAP's Grassland Community Type

Common Name	Scientific Name	Federal Status	State Status
Midland sedge	<i>Carex mesochorea</i>	not available	Watchlist
Shaggy false gromwell	<i>Onosmodium hispidissimum</i>	not available	Watchlist
Regal fritillary butterfly	<i>Speyeria idalia</i>	not available	State threatened
Henslow's sparrow	<i>Ammodramus henslowii</i>	not available	State threatened
Loggerhead shrike	<i>Lanius ludovicianus</i>	not available	State threatened

None of these species are expected at SWMU 58; however, their occurrence is possible given the existing habitat type. Although a unique community type (the calcareous fen) exists within the RFAAP grassland community type, it is not found at or near SWMU 58.

7.2 Identification of Chemicals of Potential Ecological Concern and Concentration Statistics

A list of surface soil samples used in the SLERA is presented in **Table 7-4**, based on information presented in *Section 6.0*, as the HHRA also used surface soil samples to assess exposure to some human receptors. From the chemical results of samples on this list, a subset of the chemicals detected has data of good quality and are not a result of non-site sources. Examples of screening criteria that have been used include the following: analytical detection limit (**Tables 7-5 through 7-8**) and comparison with risk-based ecotoxicity screening values [based on BTAG Screening Levels (**Tables 7-5 and 7-6**) and other screening levels appropriate for food-chain exposure, based on information presented in **Tables 7-7 through 7-9**]. The COPEC selection process is described in more detail in the following subsections.

Table 7-4
Surface Soil Samples Used in the SWMU 58 SLERA

Current Conditions^a		
58SS1 (0 - 1 ft)	58SS3 (0 - 1 ft)	58SB04A (0 - 0.5 ft)
58SS2 (0 - 1 ft)	58SS04 (0 - 0.5 ft)	
Future Conditions^b		
58SS1 (0 - 1 ft)	58SS04 (0 - 0.5 ft)	58SB03A (0 - 2 ft)
58SS2 (0 - 1 ft)	58SB1A (0 - 2 ft)	58SB04A (0 - 0.5 ft)
58SS3 (0 - 1 ft)	58SB2A (0 - 2 ft)	58SB04B (0 - 2 ft)

^a Depths of samples are listed in parentheses. These depths, recorded when the samples were originally collected, represent the depth below the top of the Rubble Pile

^b The depths of these samples have been revised to reflect the removal of the contents of the Rubble Pile.

7.2.1 Data Organization

The data for each chemical have been sorted by medium. To assess potential ecological impacts, soil from 0-2 ft bgs have been considered. The 0-2 ft depth interval was selected for three primary reasons: (1) to maintain consistency with other RFAAP ecological risk assessment documents that used 0-2 ft, or a similar depth interval (e.g., *Ecological Risk Assessment Approach*, IT, 1998; *Screening Ecological Risk Assessment*, IT, 1999); (2) to address the most important ecological soil depth exposure interval, as soil depths below two feet would be infrequently contacted; and (3) to focus on the soil depth interval expected to have the highest COPEC concentrations, as discharges at SWMU 58 were expected to have been surficial. Although some burrowing wildlife (e.g., the red fox) may actually burrow to depths greater than two feet, their prey items would be primarily associated with surface soil, and incidental contact by the fox with deeper soil is expected to be insignificant compared to exposures associated with soil in the 0-2 ft depth range.

Chemicals that were not detected at least once in a medium have not been included in the risk assessment. Available background data exist for soil, as summarized in the Site Screening Process (USEPA, 2001c), and these data are used in the Risk Characterization (*Section 7.5.3*) to screen out COPECs considered to be background related (*Section 7.2.4*).

The analytical data may have qualifiers from the analytical laboratory quality control or from the data validation process that reflect the level of confidence in the data. Some of the more common qualifiers and their meanings are (USEPA, 1989):

- U - chemical was analyzed for but not detected; the associated value is the sample quantitation limit.
- J - value is estimated, most likely below the contract-required quantitation limit.
- R - quality control indicates that the data are unusable (chemical may or may not be present).
- B - concentration of chemical in sample is not sufficiently higher than concentration in the blank (using five-times, ten-times rule).

"J" qualified data are used in the risk assessment; "R" qualified data are not. Due to the relatively infrequent "B" qualified data, these results were eliminated from the database, as

Table 7-5
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Current) at SWMU 58 for Direct Contact Exposure

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
Soil (0-2')	7429-90-5	Aluminum	15200	23300	mg/kg	58SB04A	5/5	N/A	23300	1	Yes	ASL
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	5/5	N/A	6.99	328	No	BSL
	7440-39-3	Barium	49.2	69.9	mg/kg	58SS1	5/5	N/A	69.9	440	No	BSL
	7440-41-7	Beryllium	0.57J	1.21	mg/kg	58SS2	3/5	0.5000-0.5000	1.21	0.02	Yes	ASL
	7440-70-2	Calcium	1420	8040	mg/kg	58SS2	3/3	N/A	8040	NVA	No	NUT
	7440-47-3	Chromium	27.6	42.7	mg/kg	58SS1	5/5	N/A	42.7	0.0075	Yes	ASL
	7440-48-4	Cobalt	5.99	20.6	mg/kg	58SS2	5/5	N/A	20.6	100	No	BSL
	7440-50-8	Copper	10.9	16.2	mg/kg	58SS1	5/5	N/A	16.2	15	Yes	ASL
	7439-89-6	Iron	24900	27800	mg/kg	58SB04A	5/5	N/A	27800	12	Yes	ASL
	7439-92-1	Lead	13.4	16.3	mg/kg	58SS3	3/5	10.5000-10.5000	16.3	0.01	Yes	ASL
	7439-95-4	Magnesium	1400J	10300	mg/kg	58SS2	4/4	N/A	10300	NVA	No	NUT
	7439-96-5	Manganese	272	465	mg/kg	58SS1	5/5	N/A	465	330	Yes	ASL
	7439-97-6	Mercury (Inorganic)	0.0718	0.0832	mg/kg	58SB04A	3/5	0.0500-0.0500	0.0832	0.058	Yes	ASL
	7440-02-0	Nickel	8.91J	26.5	mg/kg	58SS2	5/5	N/A	26.5	2	Yes	ASL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	5/5	N/A	2590	NVA	No	NUT
	7782-49-2	Selenium	0.41J	0.41J	mg/kg	58SS04	1/5	0.2500-1.1100	0.41J	1.8	No	BSL
	7440-23-5	Sodium	25	25	mg/kg	58SB04A	1/1	N/A	25	NVA	No	NUT
	7440-28-0	Thallium	0.13J	11.8	mg/kg	58SS1	3/4	6.6200-6.6200	11.8	0.001	Yes	ASL
	7440-62-2	Vanadium	44.3	53.7	mg/kg	58SS3	5/5	N/A	53.7	0.5	Yes	ASL
	7440-66-6	Zinc	32.6	41.8	mg/kg	58SB04A	5/5	N/A	41.8	10	Yes	ASL
	7440-44-0	Total Organic Carbon	8760	8760	mg/kg	58SB04A	1/1	N/A	8760	NVA	No	PHYS
	72-54-8	4,4'-DDD	0.000289NJ	0.000289NJ	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289NJ	0.1	No	BSL
	5103-71-9	alpha-Chlordane	0.00016J	0.00016J	mg/kg	58SS04	1/2	0.0007-0.0007	0.00016J	0.1	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	0.1	No	BSL
	60-57-1	Dieldrin	0.000478J	0.000478J	mg/kg	58SS04	1/2	0.0007-0.0007	0.000478J	0.1	No	BSL
	91-57-6	2-Methylnaphthalene	0.0023	0.0023	mg/kg	58SB04A	1/4	0.0490-0.2000	0.0023	NVA	Yes	TX
	56-55-3	Benzo(a)anthracene	0.0014J	0.0036	mg/kg	58SS04	2/5	0.1700-0.8000	0.0036	0.1	No	BSL
	50-32-8	Benzo(a)pyrene	0.0019	0.0031	mg/kg	58SS04	2/5	0.2500-1.0000	0.0031	0.1	No	BSL
	205-99-2	Benzo(b)fluoranthene	0.0033	0.005	mg/kg	58SS04	2/5	0.2100-1.0000	0.005	0.1	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.00079J	0.0028	mg/kg	58SB04A	2/5	0.2500-1.0000	0.0028	0.1	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.0012J	0.002	mg/kg	58SS04	2/5	0.0660-0.3000	0.002	0.1	No	BSL
	218-01-9	Chrysene	0.0029	0.0034	mg/kg	58SS04	2/5	0.1200-0.6000	0.0034	0.1	No	BSL
	206-44-0	Fluoranthene	0.0026	0.0049	mg/kg	58SS04	2/5	0.0680-0.3000	0.0049	0.1	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.0014J	0.0017J	mg/kg	58SS04	2/5	0.2900-1.0000	0.0017J	0.1	No	BSL
	91-20-3	Naphthalene	0.0024	0.0024	mg/kg	58SB04A	1/4	0.0370-0.2000	0.0024	0.1	No	BSL
	85-01-8	Phenanthrene	0.0028	0.0039	mg/kg	58SS04	2/5	0.0330-0.2000	0.0039	0.1	No	BSL
	129-00-0	Pyrene	0.004	0.0066J	mg/kg	58SS04	2/5	0.0330-0.2000	0.0066J	0.1	No	BSL
	65-85-0	Benzoic Acid	0.13J	0.13J	mg/kg	58SB04A	1/2	0.9400-0.9400	0.13J	NVA	Yes	TX
	117-81-7	bis(2-Ethylhexyl) phthalate	0.061J	0.061J	mg/kg	58SB04A	1/4	0.6200-3.0000	0.061J	NVA	Yes	TX

Table 7-5
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Current) at SWMU 58 for Direct Contact Exposure

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.000003296	0.000004981	mg/kg	58SB04A	2/2	N/A	0.000004981	NVA	No	TEQ
	35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00003134	0.00004319	mg/kg	58SB04A	2/2	N/A	0.00004319	NVA	No	TEQ
	39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000676	0.000000676	mg/kg	58SB04A	1/2	0.000000329-0.000000329	0.000000676	NVA	No	TEQ
	57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.000000771	0.000001355	mg/kg	58SB04A	2/2	N/A	0.000001355	NVA	No	TEQ
	57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.000000838	0.000001096	mg/kg	58SB04A	2/2	N/A	0.000001096	NVA	No	TEQ
	19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.000001167	0.000001575	mg/kg	58SB04A	2/2	N/A	0.000001575	NVA	No	TEQ
	3268-87-9	Octachlorodibenzodioxin	0.001728	0.001858	mg/kg	58SB04A	2/2	N/A	0.001858	NVA	No	TEQ
	39001-02-0	Octachlorodibenzofuran	0.000008901	0.00001766	mg/kg	58SB04A	2/2	N/A	0.00001766	NVA	No	TEQ
	N/A	TCDD TE	0.00000129	0.00000162	mg/kg	58SB04A	2/2	N/A	0.00000162	0.01	No	BSL
	N/A	Total HPCDD	0.00006863	0.00007972	mg/kg	58SB04A	2/2	N/A	0.00007972	NVA	No	TEQ
	N/A	Total HPCDF	0.000007183	0.00001438	mg/kg	58SB04A	2/2	N/A	0.00001438	NVA	No	TEQ
	N/A	Total HXCDD	0.000006541	0.000009539	mg/kg	58SB04A	2/2	N/A	0.000009539	NVA	No	TEQ
	N/A	Total HXCDF	0.000003978	0.000006046	mg/kg	58SB04A	2/2	N/A	0.000006046	NVA	No	TEQ
	N/A	Total PECDF	0.000000428	0.000000428	mg/kg	58SS04	1/2	0.000000142-0.000000142	0.000000428	NVA	No	TEQ

(1) Maximum concentration used for screening.

(2) Screening toxicity values from Region 3 BTAG (USEPA Region 3, 1995)

(3) Rationale Codes Selection Reason:

Infrequent Detection but Associated Historically (HIST)
Toxicity Information May Be Available (TX)
Above Screening Levels (ASL)
Elevated Detected Concentration (EDC)

Deletion Reason:

Infrequent Detection (<= 5%, IFD)
Below Screening Level (BSL)
Nutrient (NUT)
Soil pH > 5.5 (pH)
Physical/Chemical (PHYS)
While some individual chlorinated dioxin and furan constituents are provided by the TCDD-TE (TEQ).
Not Important Bioaccumulative Constituent (NIBC)

Definitions:

N/A = Not Applicable or Not Available

SQL = Sample Quantitation Limit

COPEC = Chemical of Potential Ecological Concern

J = Estimated Value

NVA = No Value Available

Table 7-6
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Future) at SWMU 58 for Direct Contact Exposure

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface	7429-90-5	Aluminum	12600	29300	mg/kg	58SB1A	9/9	N/A	29300	1	Yes	ASL
Soil (0-2')	7440-36-0	Antimony	0.6975J	1.3J	mg/kg	58SB1A	3/7	0.3670-7.1400	1.3J	0.48	Yes	ASL
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	9/9	N/A	6.99	328	No	BSL
	7440-39-3	Barium	49.2	131L	mg/kg	58SB2A	9/9	N/A	131L	440	No	BSL
	7440-41-7	Beryllium	0.57J	1.3J	mg/kg	58SB2A	4/6	0.5000-0.3000	1.3J	0.02	Yes	ASL
	7440-70-2	Calcium	1160	82700	mg/kg	58SB3A	7/7	N/A	82700	NVA	No	NUT
	7440-47-3	Chromium	20.6	42.7	mg/kg	58SS1	9/9	N/A	42.7	0.0075	Yes	ASL
	7440-48-4	Cobalt	5.99	24.4L	mg/kg	58SB2A	9/9	N/A	24.4L	100	No	BSL
	7440-50-8	Copper	8.7	22.2K	mg/kg	58SB1A	8/8	N/A	22.2K	15	Yes	ASL
	7439-89-6	Iron	16300	36150	mg/kg	58SB2A	9/9	N/A	36150	12	Yes	ASL
	7439-92-1	Lead	11.9	28.4	mg/kg	58SB3A	7/9	10.5000-10.5000	28.4	0.01	Yes	ASL
	7439-95-4	Magnesium	1400J	42100	mg/kg	58SB3A	8/8	N/A	42100	NVA	No	NUT
	7439-96-5	Manganese	162	465	mg/kg	58SS1	9/9	N/A	465	330	Yes	ASL
	7439-97-6	Mercury (Inorganic)	0.0718	0.0832	mg/kg	58SB04A	4/9	0.0500-0.1200	0.0832	0.058	Yes	ASL
	7440-02-0	Nickel	8.91J	26.5	mg/kg	58SS2	9/9	N/A	26.5	2	Yes	ASL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	9/9	N/A	2590	NVA	No	NUT
	7782-49-2	Selenium	0.41J	0.41J	mg/kg	58SS04	1/9	0.2500-1.1400	0.41J	1.8	No	BSL
	7440-23-5	Sodium	25	2945K	mg/kg	58SB2A	5/5	N/A	2945K	NVA	No	NUT
	7440-28-0	Thallium	0.13J	11.8	mg/kg	58SS1	4/7	0.6900-6.6200	11.8	0.001	Yes	ASL
	7440-62-2	Vanadium	33.7K	66.6K	mg/kg	58SB1A	9/9	N/A	66.6K	0.5	Yes	ASL
	7440-66-6	Zinc	24.4	59.1K	mg/kg	58SB1A	9/9	N/A	59.1K	10	Yes	ASL
	7440-44-0	Total Organic Carbon	7160	8760	mg/kg	58SB04A	2/2	N/A	8760	NVA	No	PHYS
	72-54-8	4,4'-DDD	0.000289NJ	0.000289NJ	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289NJ	0.1	No	BSL
	5103-71-9	alpha-Chlordane	0.00016J	0.00016J	mg/kg	58SS04	1/2	0.0007-0.0007	0.00016J	0.1	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	0.1	No	BSL
	60-57-1	Dieldrin	0.000478J	0.000478J	mg/kg	58SS04	1/2	0.0007-0.0007	0.000478J	0.1	No	BSL
	91-57-6	2-Methylnaphthalene	0.0023	0.0073	mg/kg	58SB04B	2/8	0.0490-0.4050	0.0073	NVA	Yes	TX
	83-32-9	Acenaphthene	0.0037	0.0037	mg/kg	58SB04B	1/9	0.0019-0.2000	0.0037	0.1	No	BSL
	208-96-8	Acenaphthylene	0.0037	0.0037	mg/kg	58SB04B	1/9	0.0019-0.3700	0.0037	0.1	No	BSL
	120-12-7	Anthracene	0.0011J	0.2	mg/kg	58SS3	3/9	0.0019-0.2000	0.2	0.1	Yes	ASL
	56-55-3	Benzo(a)anthracene	0.0014J	0.22	mg/kg	58SB1A	4/9	0.0019-0.8000	0.22	0.1	Yes	ASL
	50-32-8	Benzo(a)pyrene	0.0019	0.24	mg/kg	58SB1A	4/9	0.0019-1.0000	0.24	0.1	Yes	ASL
	205-99-2	Benzo(b)fluoranthene	0.0033	0.23	mg/kg	58SB1A	4/9	0.0019-1.0000	0.23	0.1	Yes	ASL
	191-24-2	Benzo(g,h,i)perylene	0.00079J	0.0028	mg/kg	58SB04A	2/9	0.0019-1.0000	0.0028	0.1	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.0012J	0.11	mg/kg	58SB1A	4/9	0.0019-0.3000	0.11	0.1	Yes	ASL
	65-85-0	Benzoic Acid	0.13	0.18J	mg/kg	58SB04B	2/6	0.9400-2.0000	0.18J	NVA	Yes	TX
	117-81-7	bis(2-Ethylhexyl) phthalate	0.035	0.18J	mg/kg	58SB1A	4/8	0.4050-3.0000	0.18J	NVA	Yes	TX
	218-01-9	Chrysene	0.0013J	0.26	mg/kg	58SB1A	5/9	0.0021-0.6000	0.26	0.1	Yes	ASL
	206-44-0	Fluoranthene	0.0026	0.66	mg/kg	58SB1A	5/9	0.0019-0.3000	0.66	0.1	Yes	ASL
	86-73-7	Fluorene	0.0027	0.048	mg/kg	58SB1A	4/9	0.0019-0.2000	0.048	0.1	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.0014J	0.058	mg/kg	58SB1A	4/9	0.0019-1.0000	0.058	0.1	No	BSL
	91-20-3	Naphthalene	0.0024	0.0077	mg/kg	58SB04B	2/8	0.0205-0.2000	0.0077	0.1	No	BSL

Table 7-6
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Future) at SWMU 58 for Direct Contact Exposure

Scenario Timeframe: Future
 Medium: Soil
 Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	85-01-8	Phenanthrene	0.001625	0.62	mg/kg	58SB1A	6/9	0.0330-0.2000	0.62	0.1	Yes	ASL
	129-00-0	Pyrene	0.0018J	0.65	mg/kg	58SB1A	5/9	0.0021-0.2000	0.65	0.1	Yes	ASL
	67-64-1	Acetone	0.027	0.027	mg/kg	58SB04B	1/6	0.0050-0.0170	0.027	NVA	Yes	TX
	75-15-0	Carbon disulfide	0.00057	0.00057J	mg/kg	58SB04B	1/9	0.0040-0.7650	0.00057J	NVA	Yes	TX
	156-59-2	cis-1,2-Dichloroethene	0.73J	0.73J	mg/kg	58SB3A	1/6	0.0050-0.7650	0.73J	0.3	Yes	ASL
	98-82-8	Isopropylbenzene (Cumene)	0.096J	0.096J	mg/kg	58SB1A	1/3	0.7500-0.7650	0.096J	NVA	Yes	TX
	100-41-4	Ethylbenzene	0.003	0.003J	mg/kg	58SB1A	1/9	0.0020-0.7650	0.003J	0.1	No	BSL
	75-09-2	Methylene chloride	0.8875	0.8875	mg/kg	58SB2A	1/8	0.0050-0.7500	0.8875	0.3	Yes	ASL
	1330-20-7	p&m-Xylene	0.18J	0.18J	mg/kg	58SB2A	1/6	0.0060-0.7500	0.285J	0.1	Yes	ASL
	99-87-6	4-Isopropyltoluene (Cymene)	0.044J	0.044J	mg/kg	58SB1A	1/3	0.7500-0.7650	0.044J	NVA	Yes	TX
	108-88-3	Toluene	0.3075	0.3075J	mg/kg	58SB2A	1/9	0.0010-0.7500	0.3075J	0.1	Yes	ASL
	79-01-6	Trichloroethene	2.7	2.7J	mg/kg	58SB3A	1/9	0.0030-0.7650	2.7J	0.3	Yes	ASL
	67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.000003296	0.000004981	mg/kg	58SB04A	2/2	N/A	4.98E-06	NVA	No	TEQ
	35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00001106	0.00004319	mg/kg	58SB04A	3/3	N/A	4.32E-05	NVA	No	TEQ
	70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	0.000000144	0.000000144	mg/kg	58SB04B	1/3	0.000000127-0.00000014	1.44E-07	NVA	No	TEQ
	39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000676	0.000000676	mg/kg	58SB04A	1/3	0.000000085-0.000000329	6.76E-07	NVA	No	TEQ
	57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.000000771	0.000001355	mg/kg	58SB04A	2/3	0.000000037-0.0000000370	1.36E-06	NVA	No	TEQ
	57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.000000838J	0.000001096	mg/kg	58SB04A	2/3	0.000000062-0.000000062	1.10E-06	NVA	No	TEQ
	19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.000001167	0.000001575	mg/kg	58SB04A	2/3	0.000000069-0.000000069	1.58E-06	NVA	No	TEQ
	3268-87-9	Octachlorodibenzodioxin	0.001728	0.00281	mg/kg	58SB04B	3/3	N/A	2.81E-03	NVA	No	TEQ
	39001-02-0	Octachlorodibenzofuran	0.000001162	0.00001766	mg/kg	58SB04A	3/3	N/A	1.77E-05	NVA	No	TEQ
	N/A	TCDD TE	0.000000606	0.00000162	mg/kg	58SB04A	3/3	N/A	1.62E-06	0.01	No	BSL
	N/A	Total HPCDD	0.00002223	0.00007972	mg/kg	58SB04A	3/3	N/A	7.97E-05	NVA	No	TEQ
	N/A	Total HPCDF	0.000000585	0.00001438	mg/kg	58SB04A	3/3	N/A	1.44E-05	NVA	No	TEQ
	N/A	Total HXCDD	0.000000673	0.000009539	mg/kg	58SB04A	3/3	N/A	9.54E-06	NVA	No	TEQ
	N/A	Total HXCDF	0.000000144	0.000006046	mg/kg	58SB04A	3/3	N/A	6.05E-06	NVA	No	TEQ
	N/A	Total PECDF	0.000000428	0.000000428	mg/kg	58SS04	1/3	0.000000035-0.000000142	4.28E-07	NVA	No	TEQ

(1) Maximum concentration used for screening.

(2) Screening toxicity values from Region 3 BTAG (USEPA Region 3, 1995)

(3) Rationale Codes Selection Reason:

Infrequent Detection but Associated Historically (HIST)
 Toxicity Information May Be Available (TX)
 Above Screening Levels (ASL)

Deletion Reason:

Below Screening Level (BSL)
 Nutrient (NUT)
 Soil pH > 5.5 (pH)
 Physical/Chemical (PHYS)
 While some individual chlorinated dioxin and furan consti
 provided by the TCDD-TE (TEQ).

Definitions:

N/A = Not Applicable or Not Available
 SQL = Sample Quantitation Limit
 COPEC = Chemical of Potential Ecological Concern
 J = Estimated Value
 NVA = No Value Available

Table 7-7
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Current) at SWMU 58 for Food Chain Exposure

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
Soil (0-2')	7429-90-5	Aluminum	15200	23300	mg/kg	58SB04A	5/5	N/A	23300	5	No	pH, NIBC
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	5/5	N/A	6.99	9.9	No	BSL
	7440-39-3	Barium	49.2	69.9	mg/kg	58SS1	5/5	N/A	69.9	283	No	BSL
	7440-41-7	Beryllium	0.571	1.21	mg/kg	58SS2	3/5	0.5000-0.5000	1.21	10	No	BSL
	7440-70-2	Calcium	1420	8040	mg/kg	58SS2	3/3	N/A	8040	N/A	No	NUT
	7440-47-3	Chromium	27.6	42.7	mg/kg	58SS1	5/5	N/A	42.7	0.4	Yes	ASL
	7440-48-4	Cobalt	5.99	20.6	mg/kg	58SS2	5/5	N/A	20.6	20	Yes	ASL
	7440-50-8	Copper	10.9	16.2	mg/kg	58SS1	5/5	N/A	16.2	60	No	BSL
	7439-89-6	Iron	24900	27800	mg/kg	58SB04A	5/5	N/A	27800	N/A	No	NIBC
	7439-92-1	Lead	13.4	16.3	mg/kg	58SS3	3/5	10.5000-10.5000	16.3	40.5	No	BSL
	7439-95-4	Magnesium	14001	10300	mg/kg	58SS2	4/4	N/A	10300	N/A	No	NUT
	7439-96-5	Manganese	272	465	mg/kg	58SS1	5/5	N/A	465	50	No	NIBC
	7439-97-6	Mercury (Inorganic)	0.0718	0.0832	mg/kg	58SB04A	3/5	0.0500-0.0500	0.0832	0.00051	Yes	ASL
	7440-02-0	Nickel	8.911	26.5	mg/kg	58SS2	5/5	N/A	26.5	30	No	BSL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	5/5	N/A	2590	N/A	No	NUT
	7782-49-2	Selenium	0.411	0.411	mg/kg	58SS04	1/5	0.2500-1.1100	0.411	0.21	Yes	ASL
	7440-23-5	Sodium	25	25	mg/kg	58SB04A	1/1	N/A	25	N/A	No	NUT
	7440-28-0	Thallium	0.131	11.8	mg/kg	58SS1	3/4	6.6200-6.6200	11.8	1	Yes	ASL
	7440-62-2	Vanadium	44.3	53.7	mg/kg	58SS3	5/5	N/A	53.7	2	No	NIBC
	7440-66-6	Zinc	32.6	41.8	mg/kg	58SB04A	5/5	N/A	41.8	8.5	Yes	ASL
	7440-44-0	Total Organic Carbon	8760	8760	mg/kg	58SB04A	1/1	N/A	8760	N/A	No	PHYS
	72-54-8	4,4'-DDD	0.000289NJ	0.000289NJ	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289NJ	0.75815	No	BSL
	5103-71-9	alpha-Chlordane	0.000161	0.000161	mg/kg	58SS04	1/2	0.0007-0.0007	0.000161	0.224	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	9.94	No	BSL
	60-57-1	Dieldrin	0.000478J	0.000478J	mg/kg	58SS04	1/2	0.0007-0.0007	0.000478J	0.011	No	BSL
	91-57-6	2-Methylnaphthalene	0.0023	0.0023	mg/kg	58SB04A	1/4	0.0490-0.2000	0.0023	3.24	No	BSL
	56-55-3	Benzo(a)anthracene	0.00141	0.0036	mg/kg	58SS04	2/5	0.1700-0.8000	0.0036	5.21	No	BSL
	50-32-8	Benzo(a)pyrene	0.0019	0.0031	mg/kg	58SS04	2/5	0.2500-1.0000	0.0031	1.52	No	BSL
	205-99-2	Benzo(b)fluoranthene	0.0033	0.005	mg/kg	58SS04	2/5	0.2100-1.0000	0.005	59.8	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.000791	0.0028	mg/kg	58SB04A	2/5	0.2500-1.0000	0.0028	119	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.00121	0.002	mg/kg	58SS04	2/5	0.0660-0.3000	0.002	148	No	BSL
	218-01-9	Chrysene	0.0029	0.0034	mg/kg	58SS04	2/5	0.1200-0.6000	0.0034	4.73	No	BSL
	206-44-0	Fluoranthene	0.0026	0.0049	mg/kg	58SS04	2/5	0.0680-0.3000	0.0049	122	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.00141	0.00171	mg/kg	58SS04	2/5	0.2900-1.0000	0.00171	109	No	BSL
	91-20-3	Naphthalene	0.0024	0.0024	mg/kg	58SB04A	1/4	0.0370-0.2000	0.0024	0.09939	No	BSL
	85-01-8	Phenanthrene	0.0028	0.0039	mg/kg	58SS04	2/5	0.0330-0.2000	0.0039	45.7	No	BSL
	129-00-0	Pyrene	0.004	0.00661	mg/kg	58SS04	2/5	0.0330-0.2000	0.00661	78.5	No	BSL
	65-85-0	Benzoic Acid	0.131	0.131	mg/kg	58SB04A	1/2	0.9400-0.9400	0.131	N/A	Yes	TX
	117-81-7	bis(2-Ethylhexyl) phthalate	0.0611	0.0611	mg/kg	58SB04A	1/4	0.6200-3.0000	0.0611	0.92594	No	BSL

Table 7-7
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Current) at SWMU 58 for Food Chain Exposure

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.000003296	0.000004981	mg/kg	58SB04A	2/2	N/A	0.000004981	0.0000386	No	TEQ
	35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00003134	0.00004319	mg/kg	58SB04A	2/2	N/A	0.00004319	0.00000199	No	TEQ
	39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000676	0.000000676	mg/kg	58SB04A	1/2	0.000000329-0.00000329	0.000000676	0.00000199	No	TEQ
	57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.000000771	0.000001355	mg/kg	58SB04A	2/2	N/A	0.000001355	0.0000386	No	TEQ
	57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.000000838J	0.000001096	mg/kg	58SB04A	2/2	N/A	0.000001096	0.00000199	No	TEQ
	19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.000001167	0.000001575	mg/kg	58SB04A	2/2	N/A	0.000001575	0.00000199	No	TEQ
	3268-87-9	Octachlorodibenzodioxin	0.001728	0.001858	mg/kg	58SB04A	2/2	N/A	0.001858	0.00000199	No	TEQ
	39001-02-0	Octachlorodibenzofuran	0.000008901	0.00001766	mg/kg	58SB04A	2/2	N/A	0.00001766	0.0000386	No	TEQ
	N/A	TCDD TE	0.00000129	0.00000162	mg/kg	58SB04A	2/2	N/A	0.00000162	0.0000315	No	BSL
	N/A	Total HPCDD	0.00006863	0.00007972	mg/kg	58SB04A	2/2	N/A	0.00007972	0.00000199	No	TEQ
	N/A	Total HPCDF	0.000007183	0.00001438	mg/kg	58SB04A	2/2	N/A	0.00001438	0.0000386	No	TEQ
	N/A	Total HXCDD	0.000006541	0.000009539	mg/kg	58SB04A	2/2	N/A	0.000009539	0.00000199	No	TEQ
	N/A	Total HXCDF	0.000003978	0.000006046	mg/kg	58SB04A	2/2	N/A	0.000006046	0.0000386	No	TEQ
	N/A	Total PECDF	0.000000428	0.000000428	mg/kg	58SS04	1/2	0.000000142-0.00000142	0.000000428	0.0000386	No	TEQ

- (1) Maximum concentration used for screening.
- (2) Screening toxicity values from USEPA SSLs (2000); Efroymson et al., PRGs (1997); and USEPA Region V EDQLs (1999). See text for derivation.
- (3) Rationale Codes Selection Reason: Deletion Reason:
- Infrequent Detection but Associated Historically (HIST)
- Toxicity Information May Be Available (TX)
- Above Screening Levels (ASL)
- Elevated Detected Concentration (EDC)
- Infrequent Detection (<= 5%, IFD)
- Below Screening Level (BSL)
- Nutrient (NUT)
- Soil pH > 5.5 (pH)
- Physical/Chemical (PHYS)
- While some individual chlorinated dioxin and furan constituents provided by the TCDD-TE (TEQ).
- Not Important Bioaccumulative Constituent (NIBC)

Definitions:

N/A = Not Applicable or Not Available
SQL = Sample Quantitation Limit
COPEC = Chemical of Potential Ecological Concern
J = Estimated Value
NVA = No Value Available

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Table 7-8
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Future) at SWMU 58 for Food Chain Exposure

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2')	7429-90-5	Aluminum	12600	29300	mg/kg	58SB1A	9/9	N/A	29300	5	No	pH, NIBC
	7440-36-0	Antimony	0.6975J	1.3J	mg/kg	58SB1A	3/7	0.5670-7.1400	1.3J	5	No	BSL
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	9/9	N/A	6.99	9.9	No	BSL
	7440-39-3	Barium	49.2	131L	mg/kg	58SB2A	9/9	N/A	131L	283	No	BSL
	7440-41-7	Beryllium	0.57J	1.3J	mg/kg	58SB2A	4/6	0.5000-0.5000	1.3J	10	No	BSL
	7440-70-2	Calcium	1160	82700	mg/kg	58SB3A	7/7	N/A	82700	NVA	No	NUT
	7440-47-3	Chromium	20.6	42.7	mg/kg	58SS1	9/9	N/A	42.7	0.4	Yes	ASL
	7440-48-4	Cobalt	5.99	24.4L	mg/kg	58SB2A	9/9	N/A	24.4L	20	Yes	ASL
	7440-50-8	Copper	8.7	22.2K	mg/kg	58SB1A	8/8	N/A	22.2K	60	No	BSL
	7439-89-6	Iron	16300	36150	mg/kg	58SB2A	9/9	N/A	36150	NVA	No	NIBC
	7439-92-1	Lead	11.9	28.4	mg/kg	58SB3A	7/9	10.5000-10.5000	28.4	40.5	No	BSL
	7439-95-4	Magnesium	1400J	42100	mg/kg	58SB3A	8/8	N/A	42100	NVA	No	NUT
	7439-96-5	Manganese	162	465	mg/kg	58SS1	9/9	N/A	465	50	No	NIBC
	7439-97-6	Mercury (Inorganic)	0.0718	0.0832	mg/kg	58SB04A	4/9	0.0500-0.1200	0.0832	0.00051	Yes	ASL
	7440-02-0	Nickel	8.91J	26.5	mg/kg	58SS2	9/9	N/A	26.5	30	No	BSL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	9/9	N/A	2590	NVA	No	NUT
	7782-49-2	Selenium	0.41J	0.41J	mg/kg	58SS04	1/9	0.2500-1.1400	0.41J	0.21	Yes	ASL
	7440-23-5	Sodium	25	2945K	mg/kg	58SB2A	5/5	N/A	2945K	NVA	No	NUT
	7440-28-0	Thallium	0.13J	11.8	mg/kg	58SS1	4/7	0.6900-6.6200	11.8	1	Yes	ASL
	7440-62-2	Vanadium	33.7K	66.6K	mg/kg	58SB1A	9/9	N/A	66.6K	2	No	NIBC
	7440-66-6	Zinc	24.4	59.1K	mg/kg	58SB1A	9/9	N/A	59.1K	8.5	Yes	ASL
	7440-44-0	Total Organic Carbon	7160	8760	mg/kg	58SB04A	2/2	N/A	8760	NVA	No	PHYS
	72-54-8	4,4'-DDD	0.000289NJ	0.000289NJ	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289NJ	0.75815	No	BSL
	5103-71-9	alpha-Chlordane	0.00016J	0.00016J	mg/kg	58SS04	1/2	0.0007-0.0007	0.00016J	0.224	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	9.94	No	BSL
	60-57-1	Dieldrin	0.000478J	0.000478J	mg/kg	58SS04	1/2	0.0007-0.0007	0.000478J	0.011	No	BSL
	91-57-6	2-Methylnaphthalene	0.0023	0.0073	mg/kg	58SB04B	2/8	0.0490-0.4050	0.0073	3.24	No	BSL
	83-32-9	Acenaphthene	0.0037	0.0037	mg/kg	58SB04B	1/9	0.0019-0.2000	0.0037	20	No	BSL
	208-96-8	Acenaphthylene	0.0037	0.0037	mg/kg	58SB04B	1/9	0.0019-0.3700	0.0037	682	No	BSL
	120-12-7	Anthracene	0.0011J	0.2	mg/kg	58SS3	3/9	0.0019-0.2000	0.2	1480	No	BSL
	56-55-3	Benzo(a)anthracene	0.0014J	0.22	mg/kg	58SB1A	4/9	0.0019-0.8000	0.22	5.21	No	BSL
	50-32-8	Benzo(a)pyrene	0.0019	0.24	mg/kg	58SB1A	4/9	0.0019-1.0000	0.24	1.52	No	BSL
	205-99-2	Benzo(b)fluoranthene	0.0033	0.23	mg/kg	58SB1A	4/9	0.0019-1.0000	0.23	59.8	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.00079J	0.0028	mg/kg	58SB04A	2/9	0.0019-1.0000	0.0028	119	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.0012J	0.11	mg/kg	58SB1A	4/9	0.0019-0.3000	0.11	148	No	BSL
	65-85-0	Benzoic Acid	0.13	0.18J	mg/kg	58SB04B	2/6	0.9400-2.0000	0.18J	NVA	Yes	TX
	117-81-7	bis(2-Ethylhexyl) phthalate	0.035	0.18J	mg/kg	58SB1A	4/8	0.4050-3.0000	0.18J	0.92594	No	BSL
	218-01-9	Chrysene	0.0013J	0.26	mg/kg	58SB1A	5/9	0.0021-0.6000	0.26	4.73	No	BSL
	206-44-0	Fluoranthene	0.0026	0.66	mg/kg	58SB1A	5/9	0.0019-0.3000	0.66	122	No	BSL
	86-73-7	Fluorene	0.0027	0.048	mg/kg	58SB1A	4/9	0.0019-0.2000	0.048	122	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.0014J	0.058	mg/kg	58SB1A	4/9	0.0019-1.0000	0.058	109	No	BSL
	91-20-3	Naphthalene	0.0024	0.0077	mg/kg	58SB04B	2/8	0.0205-0.2000	0.0077	0.09939	No	BSL

Table 7-8
Occurrence, Distribution and Selection of Chemicals of Potential Ecological Concern (Future) at SWMU 58 for Food Chain Exposure

Scenario Timeframe: Future
 Medium: Soil
 Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2)	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	85-01-8	Phenanthrene	0.001625	0.62	mg/kg	58SB1A	6/9	0.0330-0.2000	0.62	45.7	No	BSL
	129-00-0	Pyrene	0.0018J	0.65	mg/kg	58SB1A	5/9	0.0021-0.2000	0.65	78.5	No	BSL
	67-64-1	Acetone	0.027	0.027	mg/kg	58SB04B	1/6	0.0050-0.0170	0.027	2.5	No	BSL
	75-15-0	Carbon disulfide	0.00057	0.00057J	mg/kg	58SB04B	1/9	0.0040-0.7650	0.00057J	0.09412	No	BSL
	156-59-2	cis-1,2-Dichloroethene	0.73J	0.73J	mg/kg	58SB3A	1/6	0.0050-0.7650	0.73J	0.78373	No	BSL
	98-82-8	Isopropylbenzene (Cumene)	0.096J	0.096J	mg/kg	58SB1A	1/3	0.7500-0.7650	0.096J	NVA	Yes	TX
	100-41-4	Ethylbenzene	0.003	0.003J	mg/kg	58SB1A	1/9	0.0020-0.7650	0.003J	5.16	No	BSL
	75-09-2	Methylene chloride	0.8875	0.8875	mg/kg	58SB2A	1/8	0.0050-0.7500	0.8875	4.05	No	BSL
	1330-20-7	p&m-Xylene	0.18J	0.18J	mg/kg	58SB2A	1/6	0.0060-0.7500	0.285J	10	No	BSL
	99-87-6	4-Isopropyltoluene (Cymene)	0.044J	0.044J	mg/kg	58SB1A	1/3	0.7500-0.7650	0.044J	NVA	Yes	TX
	108-88-3	Toluene	0.3075	0.3075J	mg/kg	58SB2A	1/9	0.0010-0.7500	0.3075J	200	No	BSL
	79-01-6	Trichloroethene	2.7	2.7J	mg/kg	58SB3A	1/9	0.0030-0.7650	2.7J	12.4	No	BSL
	67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.000003296	0.000004981	mg/kg	58SB04A	2/2	N/A	4.98E-06	3.86E-05	No	TEQ
	35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00001106	0.00004319	mg/kg	58SB04A	3/3	N/A	4.32E-05	1.99E-07	No	TEQ
	70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	0.000000144	0.000000144	mg/kg	58SB04B	1/3	0.000000127-0.00000014	1.44E-07	3.86E-05	No	TEQ
	39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000676	0.000000676	mg/kg	58SB04A	1/3	0.000000085-0.000000329	6.76E-07	1.99E-07	No	TEQ
	57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.000000771	0.000001355	mg/kg	58SB04A	2/3	0.000000037-0.000000370	1.36E-06	3.86E-05	No	TEQ
	57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.000000838J	0.000001096	mg/kg	58SB04A	2/3	0.000000062-0.000000062	1.10E-06	1.99E-07	No	TEQ
	19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.000001167	0.000001575	mg/kg	58SB04A	2/3	0.000000069-0.000000069	1.58E-06	1.99E-07	No	TEQ
	3268-87-9	Octachlorodibenzodioxin	0.001728	0.00281	mg/kg	58SB04B	3/3	N/A	2.81E-03	1.99E-07	No	TEQ
	39001-02-0	Octachlorodibenzofuran	0.000001162	0.00001766	mg/kg	58SB04A	3/3	N/A	1.77E-05	3.86E-05	No	TEQ
	N/A	TCDD TE	0.000000606	0.00000162	mg/kg	58SB04A	3/3	N/A	1.62E-06	3.15E-06	No	BSL
	N/A	Total HPCDD	0.00002223	0.00007972	mg/kg	58SB04A	3/3	N/A	7.97E-05	1.99E-07	No	TEQ
	N/A	Total HPCDF	0.000000585	0.00001438	mg/kg	58SB04A	3/3	N/A	1.44E-05	3.86E-05	No	TEQ
	N/A	Total HXCDD	0.000000673	0.000009539	mg/kg	58SB04A	3/3	N/A	9.54E-06	1.99E-07	No	TEQ
	N/A	Total HXCDF	0.000000144	0.000006046	mg/kg	58SB04A	3/3	N/A	6.05E-06	3.86E-05	No	TEQ
	N/A	Total PECDF	0.000000428	0.000000428	mg/kg	58SS04	1/3	0.000000035-0.000000142	4.28E-07	3.86E-05	No	TEQ

(1) Maximum concentration used for screening.

(2) Screening toxicity values from USEPA SSLs (2000); Efroymson et al., PRGs (1997); and USEPA Region V EDQLs (1999). See text for derivation.

(3) Rationale Codes Selection Reason:

Infrequent Detection but Associated Historically (HIST)
 Toxicity Information May Be Available (TX)
 Above Screening Levels (ASL)

Deletion Reason:

Below Screening Level (BSL)
 Nutrient (NUT)
 Soil pH > 5.5 (pH)
 Physical/Chemical (PHYS)
 While some individual chlorinated dioxin and furan consti
 provided by the TCDD-TE (TEQ).

Definitions:

N/A = Not Applicable or Not Available
 SQL = Sample Quantitation Limit
 COPEC = Chemical of Potential Ecological Concern
 J = Estimated Value
 NVA = No Value Available

Table 7-9
Selection of Ecological Screening Toxicity Values at SWMU 58 for Food Chain Exposure

Parameter (only detected constituents listed)	Ecological Soil Screening Levels ^a (mg/kg)	Ecological Preliminary Remediation Goals ^b (mg/kg)	Ecological Data Quality Levels ^c (mg/kg)	Selected Ecological Screening Toxicity Value ^d (mg/kg)
Inorganics				
Aluminum	NVA ^e	NVA	NVA	NVA
Antimony	21 _(mammal)	5 _(plant)	0.1423	5
Arsenic	37 _(plant)	9.9 _(mammal, plant)	5.7	9.9
Barium	NVA	283	1.04	283
Beryllium	NVA	10	1.06	10
Calcium	NVA	NVA	NVA	Nutrient
Chromium	5 _(plant)	0.4 _(earthworm)	0.4	0.4
Cobalt	32 _(bird)	20 _(plant)	0.14033	20
Copper	61 _(earthworm)	60 _(earthworm)	0.3132	60
Iron	NVA	NVA	NVA	NVA
Lead	NVA	40.5	0.05373	40.5
Magnesium	NVA	NVA	NVA	Nutrient
Manganese	NVA	NVA	NVA	NVA
Mercury (Inorganic)	NVA	0.00051	0.1	0.00051
Nickel	NVA	30	13.6	30
Potassium	NVA	NVA	NVA	Nutrient
Selenium	NVA	0.21	0.02765	0.21
Sodium	NVA	NVA	NVA	Nutrient
Thallium	NVA	1	0.05692	1
Vanadium	NVA	2	1.59	2
Zinc	120 _(earthworm)	8.5 _(bird)	6.62	8.5
Total Organic Carbon	NVA	NVA	NVA	NVA
Volatile Organic Compounds				
Acetone	NVA	NVA	2.5	2.5
Carbon disulfide	NVA	NVA	0.09412	0.09412
cis-1,2-Dichloroethene	NVA	NVA	0.78373	0.78373
Isopropylbenzene (cumene)	NVA	NVA	NVA	NVA
Ethylbenzene	NVA	NVA	5.16	5.16
Methylene chloride	NVA	NVA	4.05	4.05
p&m-Xylene	NVA	NVA	10	10
4-Isopropyltoluene (cymene)	NVA	NVA	NVA	NVA
Toluene	NVA	200 _(plant)	5.45	200
Trichloroethene	NVA	NVA	12.4	12.4
Pesticides				
4,4'-DDD	NVA	NVA	0.75815	0.75815
alpha-Chlordane	NVA	NVA	0.224	0.224
delta-BHC	NVA	NVA	9.94	9.94
Dieldrin	0.011 _(bird)	NVA	0.00238	0.011
Semivolatile Organic Compounds				
2-Methylnaphthalene	NVA	NVA	3.24	3.24
Acenaphthene	NVA	20 _(plant)	682	20
Acenaphthylene	NVA	NVA	682	682
Anthracene	NVA	NVA	1480	1480
Benzoic acid	NVA	NVA	NVA	NVA
Benzo(a)anthracene	NVA	NVA	5.21	5.21
Benzo(a)pyrene	NVA	NVA	1.52	1.52
Benzo(b)fluoranthene	NVA	NVA	59.8	59.8
Benzo(g,h,i)perylene	NVA	NVA	119	119
Benzo(k)fluoranthene	NVA	NVA	148	148
bis(2-Ethylhexyl)phthalate	NVA	NVA	0.92594	0.92594
Chrysene	NVA	NVA	4.73	4.73

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Table 7-9
Selection of Ecological Screening Toxicity Values at SWMU 58 for Food Chain Exposure

Parameter <i>(only detected constituents listed)</i>	Ecological Soil Screening Levels^a (mg/kg)	Ecological Preliminary Remediation Goals^b (mg/kg)	Ecological Data Quality Levels^c (mg/kg)	Selected Ecological Screening Toxicity Value^d (mg/kg)
Fluoranthene	NVA	NVA	122	122
Fluorene	NVA	NVA	122	122
Indeno(1,2,3-cd)pyrene	NVA	NVA	109	109
Naphthalene	NVA	NVA	0.09939	0.09939
Phenanthrene	NVA	NVA	45.7	45.7
Pyrene	NVA	NVA	78.5	78.5
Dioxins/Furans				
1,2,3,4,6,7,8-Heptachlorodibenzofuran	NVA	NVA	0.0000386	0.0000386
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	NVA	NVA	0.000000199	0.000000199
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	NVA	NVA	0.000000199	0.000000199
1,2,3,4,7,8-Hexachlorodibenzofuran	NVA	NVA	0.0000386	0.0000386
1,2,3,6,7,8-Hexachlorodibenzofuran	NVA	NVA	0.0000386	0.0000386
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	NVA	NVA	0.000000199	0.000000199
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	NVA	NVA	0.000000199	0.000000199
Octachlorodibenzodioxin	NVA	NVA	0.000000199	0.000000199
Octachlorodibenzofuran	NVA	NVA	0.0000386	0.0000386
TCDD TE	NVA	0.00000315	0.000000199	0.00000315
Total HPCDD	NVA	NVA	0.000000199	0.000000199
Total HPCDF	NVA	NVA	0.0000386	0.0000386
Total HXCDD	NVA	NVA	0.000000199	0.000000199
Total HXCDF	NVA	NVA	0.0000386	0.0000386
Total PECDF	NVA	NVA	0.0000386	0.0000386

a Ecological Soil Screening Level Guidance, USEPA, July 2000, Draft.

b Preliminary Remediation Goals for Ecological Endpoints, R. A. Efronson, et. al., August 1997.

c Ecological Data Quality Levels, USEPA Region 5, October 1999.

d The following hierarchy was utilized to select the final Ecological Screening Toxicity Values for this assessment:

1. The lower value of either the Ecological Soil Screening Level Guidance or the Preliminary Remediation

Goals for Ecological Endpoints.

2. Ecological Data Quality Levels, USEPA Region 5

e NVA = No Value Available

Table 7-10
Medium-Specific Exposure Point Concentration Summary for Ecological Receptors (Current) at SWMU 58

Scenario Timeframe: Current

Medium: Soil

Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Soil (0-2')	Aluminum	mg/kg	18,220	21720.1 (T)	23,300	2.17E+04	mg/kg	95%UCL-T	Test(2)
	Beryllium	mg/kg	0.5982	2.17438 (T)	1.21	1.21E+00	mg/kg	Max	Test(5)
	Chromium	mg/kg	35.74	42.5974 (N)	42.7	4.26E+01	mg/kg	95%UCL-N	Test(4)
	Cobalt	mg/kg	10.23	22.350497 (T)	20.6	2.06E+01	mg/kg	Max	Test(5)
	Copper	mg/kg	14.3	16.2445 (N)	16.2	1.62E+01	mg/kg	Max	Test(5)
	Iron	mg/kg	26,180	27409.5 (T)	27,800	2.74E+04	mg/kg	95%UCL-T	Test(2)
	Lead	mg/kg	10.76	15.678217 (N)	16.3	1.57E+01	mg/kg	95%UCL-N	Test(4)
	Manganese	mg/kg	355.8	569.643 (T)	465	4.65E+02	mg/kg	Max	Test(5)
	Mercury	mg/kg	0.0568	0.084748 (N)	0.0832	8.32E-02	mg/kg	Max	Test(5)
	Nickel	mg/kg	14.45	27.8806 (T)	26.5	2.65E+01	mg/kg	Max	Test(5)
	Selenium	mg/kg	0.268	N/A	0.41	4.10E-01	mg/kg	Max	Test (3)
	Thallium	mg/kg	6.66	N/A	11.8	1.18E+01	mg/kg	Max	Test(3)
	Vanadium	mg/kg	49.76	53.4349 (N)	53.7	5.34E+01	mg/kg	95%UCL-N	Test(4)
	Zinc	mg/kg	35.18	39.047251 (T)	41.8	3.90E+01	mg/kg	95%UCL-T	Test(2)
	2-Methylnaphthalene	mg/kg	0.03783	N/A	0.0023	2.30E-03	mg/kg	Max	Test(3)
	Benzoic acid	mg/kg	0.3	N/A	0.13	1.30E-01	mg/kg	Max	Test(3)
	Bis(2-ethylhexyl)phthalate	mg/kg	0.54525	N/A	0.061	6.10E-02	mg/kg	Max	Test(3)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T);

Mean of Normal Data (Mean-N), 95% UCL based on bootstrap statistic (95% UCL-Bst).

N/A - Not Applicable; Not Available

Distributions: Normal (N); Lognormal/Transformed (T); Undefined/Nonparametric (NP).

Test(1) The data were determined to be neither normally or lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50), and the bootstrap statistic used.

Test(2) The data were determined to be lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(3) The 95% UCL was not calculated due to limited number of samples (n<=5); therefore, the maximum detect was used as the EPC.

Test(4) The data were determined to be normally distributed using Shapiro-Wilks Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(5) The 95% UCL exceeds the maximum detected concentration; therefore, the maximum detect was used as the EPC.

Table 7-11
Medium-Specific Exposure Point Concentration Summary for Ecological Receptors (Future) at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Surface Soil (0-2')	Aluminum	mg/kg	1.97E+04	2.37E+04 (T)	2.93E+04	2.37E+04	mg/kg	95%UCL-T	Test(2)
	Antimony	mg/kg	1.98E+00	1.01E+01 (T)	1.30E+00	1.30E+00	mg/kg	Max	Test(5)
	Beryllium	mg/kg	7.15E-01	1.09E+00 (N)	1.30E+00	1.09E+00	mg/kg	95%UCL-N	Test(4)
	Chromium	mg/kg	3.09E+01	3.71E+01 (T)	4.27E+01	3.71E+01	mg/kg	95%UCL-T	Test(2)
	Cobalt	mg/kg	1.08E+01	1.70E+01 (T)	2.44E+01	1.70E+01	mg/kg	95%UCL-T	Test(2)
	Copper	mg/kg	1.50E+01	1.78E+01 (N)	2.22E+01	1.78E+01	mg/kg	95%UCL-N	Test(4)
	Iron	mg/kg	2.63E+04	3.05E+04 (N)	3.62E+04	3.05E+04	mg/kg	95%UCL-N	Test(4)
	Lead	mg/kg	1.53E+01	2.04E+01 (N)	2.84E+01	2.04E+01	mg/kg	95%UCL-N	Test(4)
	Manganese	mg/kg	3.08E+02	3.89E+02 (T)	4.65E+02	3.89E+02	mg/kg	95%UCL-T	Test(2)
	Mercury	mg/kg	6.07E-02	7.45E-02 (N)	8.32E-02	7.45E-02	mg/kg	95%UCL-N	Test(4)
	Nickel	mg/kg	1.38E+01	1.79E+01 (T)	2.65E+01	1.79E+01	mg/kg	95%UCL-T	Test(2)
	Selenium ^a	mg/kg	2.91E-01	3.37E-01 (T)	4.10E-01	3.37E-01	mg/kg	95%UCL-T	Test(2)
	Thallium	mg/kg	4.01E+00	5.88E+02 (T)	1.18E+01	1.18E+01	mg/kg	Max	Test(5)
	Vanadium	mg/kg	4.89E+01	5.52E+01 (N)	6.66E+01	5.52E+01	mg/kg	95%UCL-N	Test(4)
	Zinc	mg/kg	3.88E+01	4.67E+01 (T)	5.91E+01	4.67E+01	mg/kg	95%UCL-T	Test(2)
	2-Methylnaphthalene	mg/kg	9.51E-02	5.17E+00 (T)	7.30E-03	7.30E-03	mg/kg	Max	Test(5)
	Anthracene	mg/kg	3.92E-02	6.07E+00 (T)	2.00E-01	2.00E-01	mg/kg	Max	Test(5)
	Benzo(a)anthracene	mg/kg	9.09E-02	9.59E+01 (T)	2.20E-01	2.20E-01	mg/kg	Max	Test(5)
	Benzo(a)pyrene	mg/kg	1.15E-01	2.54E+02 (T)	2.40E-01	2.40E-01	mg/kg	Max	Test(5)
	Benzo(b)fluoranthene	mg/kg	1.13E-01	6.99E+01 (T)	2.30E-01	2.30E-01	mg/kg	Max	Test(5)
	Benzo(k)fluoranthene	mg/kg	4.27E-02	1.04E+01 (T)	1.10E-01	1.10E-01	mg/kg	Max	Test(5)
	Benzoic acid	mg/kg	2.60E-01	N/A	1.80E-01	1.80E-01	mg/kg	Max	Test(3)
	Bis(2-ethylhexyl)phthalate	mg/kg	3.50E-02	N/A	3.50E-02	3.50E-02	mg/kg	Max	Test(3)
	Chrysene	mg/kg	8.04E-02	2.89E+01 (T)	2.60E-01	2.60E-01	mg/kg	Max	Test(5)
	Fluoranthene	mg/kg	1.10E-01	2.66E+01 (T)	6.60E-01	6.60E-01	mg/kg	Max	Test(5)
	Phenanthrene	mg/kg	9.59E-02	1.20E+01 (T)	6.20E-01	6.20E-01	mg/kg	Max	Test(5)
	Pyrene	mg/kg	1.02E-01	1.50E+01 (T)	6.50E-01	6.50E-01	mg/kg	Max	Test(5)
	Acetone	mg/kg	9.59E-03	4.68E-02 (T)	2.70E-02	2.70E-02	mg/kg	Max	Test(5)
	Carbon disulfide	mg/kg	5.70E-04	N/A	5.70E-04	5.70E-04	mg/kg	Max	Test(3)
	cis-1,2-Dichloroethene	mg/kg	1.87E-01	3.89E-01 (NP)	7.30E-01	3.89E-01	mg/kg	95%UCL-Bst	Test(1)
	Methylene chloride	mg/kg	6.31E-01	N/A	8.88E-01	8.88E-01	mg/kg	Max	Test(3)
	m&p-Xylenes	mg/kg	1.13E-01	2.15E-01 (NP)	2.85E-01	2.15E-01	mg/kg	95%UCL-Bst	Test(1)
	Toluene	mg/kg	7.72E-02	1.47E-01 (NP)	3.08E-01	1.47E-01	mg/kg	95%UCL-Bst	Test(1)
	Trichloroethene	mg/kg	3.44E-01	6.44E-01 (NP)	2.70E+00	6.44E-01	mg/kg	95%UCL-Bst	Test(1)
	4-Isopropyltoluene (cymene)	mg/kg	2.67E-01	N/A	4.40E-02	4.40E-02	mg/kg	Max	Test(3)
	Isopropylbenzene (cumene)	mg/kg	2.85E-01	N/A	9.60E-02	9.60E-02	mg/kg	Max	Test(3)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N), 95% UCL based on bootstrap statistic (95% UCL-Bst).

N/A - Not Applicable; Not Available

Distributions: Normal (N); Lognormal/Transformed (T); Undefined/Nonparametric (NP).

Test(1) The data were determined to be neither normally or lognormally distributed using Shapiro-Wilks (sample size <=50) or the Shapiro-Francia Calculation (sample size > 50), and the bootstrap statistic used.

Test(2) The data were determined to be lognormally distributed using Shapiro-Wilks (sample size <=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(3) The 95% UCL was not calculated due to limited number of samples (n<=5); therefore, the maximum detect was used as the EPC.

Test(4) The data were determined to be normally distributed using Shapiro-Wilks (sample size <=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(5) The 95% UCL exceeds the maximum detected concentration; therefore, the maximum detect was used as the EPC.

^a For selenium, analytical data for samples 58SB04A and 58SB04B had elevated detection limits greater than two times the maximum detected selenium concentration. These data were eliminated prior to calculating the statistics presented in this table.

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recommended by USEPA Region III. The handling of nondetects ("U" and "B" qualified data) is described in *Section 7.2.2*.

7.2.2 Descriptive Statistical Calculations

Because of the uncertainty associated with characterizing contamination in environmental media, the 95 percent UCL of the mean has been estimated for chemicals selected as COPECs [**Table 7-10** (current scenario) and **Table 7-11** (future scenario)]. The calculation of exposure point concentrations follows the same procedure used for the HHRA (*Section 6.1.3*).

7.2.3 Frequency of Detection

Chemicals that are detected infrequently may be artifacts in the data that may not reflect site-related activity or disposal practices. These chemicals, however, have been included in the risk evaluation and a low frequency of detection was not used to deselect COPECs.

7.2.4 Natural Site Constituents (Background and Essential Nutrients)

Chemical concentrations are compared to RFAAP background concentrations as an indication of whether a chemical is present from site-related activity or as natural background. This comparison, performed as part of the Risk Characterization (*Section 7.5.3*) is generally valid for inorganic chemicals, but not for organic chemicals, because inorganic chemicals are naturally occurring and most organic chemicals are not. The 95 percent UTL (**Table 2-12**), was used as one of the background comparison statistics.

Table 7-12
Facility-Wide Background Soil Concentrations

Chemical	Minimum Concentration	Maximum Concentration	95% UTL
Aluminum	3,620	47,900	40,041
Arsenic	1.2	35.9	15.8
Barium	23.4	174	209
Beryllium	0.61	5.4	1.02
Cadmium	0.62	2.5	0.69
Chromium	6.3	75.8	65.3
Cobalt	5.9	130	72.3
Copper	1.6	38.7	53.5
Iron	7,250	67,700	50,962
Lead	2.1	256	26.8
Manganese	16.7	2,040	2,543
Mercury	0.038	1.2	0.13
Nickel	4.6	94.2	62.8
Thallium	1.3	5	2.11
Vanadium	12.2	114	108
Zinc	4.7	598	202

Chemicals with MDCs less than the background UTL and shown to be statistically different based on appropriate population statistical tests are eliminated from further consideration in the Risk Characterization (*Section 7.5.3*). If the MDC exceeds the UTL or the populations are shown to be statistically different, the chemical is retained as a COPEC. In general, UTLs were

calculated as discussed in *Section 6.2.3* and population statistics were performed as also discussed in *Section 6.1.2.3*.

As recommended in both the Site Screening Process (USEPA, 2001c) and the Final Master Work Plan (URS, 2002) the essential nutrients calcium, magnesium, potassium and sodium were eliminated as COPECs. The elimination of essential nutrients was the same for the SLERA and the HHRA (*Section 6.1.2.3*).

7.2.5 Comparison to Risk-Based Screening Ecotoxicity Values

A comparison was performed between MDCs of chemicals in sampled media and risk-based ecotoxicity screening values for ecological endpoints. Chemicals that exceeded the screening values, or for which no screening values are available, have been retained as COPECs. The following screening values, or screening value hierarchy (as noted), have been used to select COPECs:

- **Soil.** Soil screening values have been selected using the following hierarchy:

For Direct Contact Exposure

- The lower of the flora and fauna *BTAG Screening Values* (USEPA Region III, 1995)

For Food Chain Exposure

- The lower of *Ecological Soil Screening Levels* (USEPA, 2000b) and *Preliminary Remediation Goals for Ecological Endpoints* (Efroymson et al., 1997a);
- *Ecological Endpoints* (Efroymson et al., 1997);
- *Ecological Data Quality Levels* (EDQLs; USEPA, 1999b); and
- *Environmental Screening Levels (ESL) from Los Alamos National Laboratory* (LANL, 2002).

For direct contact exposure, the results of the COPEC screening (for both current and future surface soil scenarios) are presented in **Tables 7-5 and 7-6**, respectively. For food chain exposure, the results of the COPEC screening for both current and future surface soil scenarios are presented in **Tables 7-7 and 7-8**, respectively. COPECs were selected for further consideration in the SLERA if the MDC exceeded the available screening value. If no screening value was available, the constituent was carried forward for consideration in the SLERA, unless it was an essential nutrient, or site-specific information exists to eliminate it from further consideration (see following discussion). Note: **Table 7-9** presents a compilation of the screening toxicity values for soil food chain exposure, and shows the final values that are used in the screening assessment to select COPECs for the food chain pathway.

Aluminum was not selected as a COPEC for food chain exposure, as USEPA (2000b) recommends that this metal be identified as a COPEC for those sites with soil with a pH less than 5.5. The technical basis for this rationale is that soluble and toxic forms of aluminum are present

in soil under soil pH values of less than 5.5. At SWMU 58 the pH in surface soil ranged from 7.2 to 7.5, therefore, pH was not below 5.5 and aluminum was not considered to be a COPEC for food chain exposure.

7.2.6 Summary of COPEC Selection

Tables 7-5 through 7-8 have been prepared for constituent concentrations in soil, with the following information:

- CAS number;
- Chemical name;
- Range of detected concentrations, and associated qualifiers;
- Concentration units;
- Location of maximum detected concentration;
- Frequency of detection;
- Range of detection limits;
- Concentration used for screening (i.e., maximum);
- Risk-based screening criterion, if available (BTAG screening values for direct contact exposure and values from **Table 7-9** for food chain exposure);
- COPEC selection conclusion: YES or NO; and,
- Rationale for selection or rejection as a COPEC.

Footnotes in the tables provide the rationale for selecting or rejecting a chemical as a COPEC. An evaluation of the constituents that were eliminated from further consideration was performed to assess whether constituents should be reinstated as COPECs due to other considerations. Examples of these exceptions include: chemicals known to have been used on-site historically and detected chemicals with detection limits greater than the screening values. Based on this evaluation, no additional COPECs are recommended.

For direct contact exposure, 15 COPECs (twelve inorganics and three organic compounds) have been selected for surface soil under current exposure conditions (**Table 7-5**) and 34 COPECs (13 inorganics and 21 organic compounds) have been selected for surface soil under future exposure conditions (**Table 7-6**). Future exposure conditions assume removal of the Rubble Pile, as discussed in *Section 6.1.3*). Chemicals not eliminated using the screening procedures previously presented are considered final COPECs and have been quantitatively evaluated in this SLERA.

For food chain exposure, seven COPECs (six inorganics and one organic compound [benzoic acid]) have been selected for surface soil under current exposure conditions (**Table 7-7**), and nine COPECs (six inorganics and three organic compounds [benzoic acid, cymene, cumene]) have been selected for surface soil under future exposure conditions (**Table 7-8**). Future exposure conditions assume removal of the Rubble Pile, as discussed in *Section 6.1.3*). Chemicals not eliminated using the screening procedures previously presented are considered final COPECs and have been quantitatively evaluated in this SLERA. It should be noted that some COPECs were not selected if they are considered to be Not Important Bioaccumulative

Constituents (NIBC), per Table 4.2 in *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment – Status and Needs* (USEPA, 2000c).

Tables 7-10 and 7-11 present exposure point concentrations for these COPECs, based on the statistical procedures discussed in Section 7.2.2. Arithmetic mean concentrations are also presented for informational purposes.

7.3 Identification of Exposure Pathways and Potential Receptors for Analysis

RFAAP terrestrial wildlife may be exposed to COPECs by several pathways, including: (1) the ingestion of impacted soil, sediment, surface water, or food while foraging; (2) dermal absorption of chemicals from soil, sediment, or surface water; and (3) inhalation of chemicals that have been wind-eroded from soil or have volatilized from soil or water. Among these potential exposure pathways, the greatest potential for exposure to chemicals is likely to result from the ingestion of chemicals in food and surface water. The incidental ingestion of impacted soil or sediment (while foraging) is a less important exposure route. The ingestion of food, soil, sediment, and surface water, however, are viable exposure pathways and were considered in this SLERA, if relevant. As surface water and sediment are not associated with SWMU 58, exposures to these media were not included, nor are aquatic receptors identified for the site. Receptor-specific exposures via inhalation or dermal absorption were not selected for further evaluation because of a lack of appropriate exposure data and the expectation that these pathways would be insignificant in comparison to the other exposure pathways quantified.

The appropriate assessment receptors have been selected for evaluation during the SLERA. In order to narrow the exposure characterization portion of the SLERA on species or components that are the most likely to be affected, given the toxicological and mobility characteristics of the COPECs, and on those COPECs that, if affected, are most likely to produce greater effects in the on-site ecosystem, the SLERA has focused the selection process on species, groups of species, or functional groups, rather than higher organization levels such as communities or ecosystems. Site biota are organized into major functional groups. For terrestrial communities, the major groups are plants and wildlife, including terrestrial invertebrates, mammals, and birds. For aquatic and/or wetland communities, the major groups are flora and fauna, including vertebrates (water fowl and fish), aquatic invertebrates, and wetland/terrestrial mammals. Species presence was assessed during a literature review and during the site reconnaissance (Section 7.1) prior to identification of target receptor species.

Primary criteria for selecting appropriate assessment receptors included, but were not limited to, the following:

- The assessment receptor will have a relatively high likelihood of contacting chemicals via direct or indirect exposure.
- The assessment receptor will exhibit marked sensitivity to the COPECs given their mode of toxicity, propensity to bioaccumulate, etc.
- The assessment receptor will be a key component of ecosystem structure or function (e.g., importance in the food web, ecological relevance).
- The assessment receptor may be listed as rare, threatened, or endangered (RTE) by a governmental organization; or the receptor will consist of critical habitat for RTE species.

Based on the availability of species-specific data, a RTE surrogate species may be selected.

Additional criteria for selection of assessment receptors were used to identify species that offer the most favorable combination of characteristics for determining the implications of on-site contaminants. These criteria included: (1) limited home range; (2) role in local nonhuman food chains; (3) potential high abundance and wide distribution; (4) sufficient toxicological information available in the literature for comparative and interpretive purposes; (5) sensitivity to COPECs; (6) relatively high likelihood of occurrence on-site following remediation (if required); (7) suitability for long-term monitoring; (8) importance to the stability of the ecological food chain or biotic community of concern; and, (9) relatively high likelihood that they will be present or that habitats present could support the species.

It is important that sufficient toxicological information is available in the literature on the receptor species, or that a closely related species may be selected. While the ecological communities have species with many desirable characteristics for use as receptor species, not every species has been used extensively for toxicological testing.

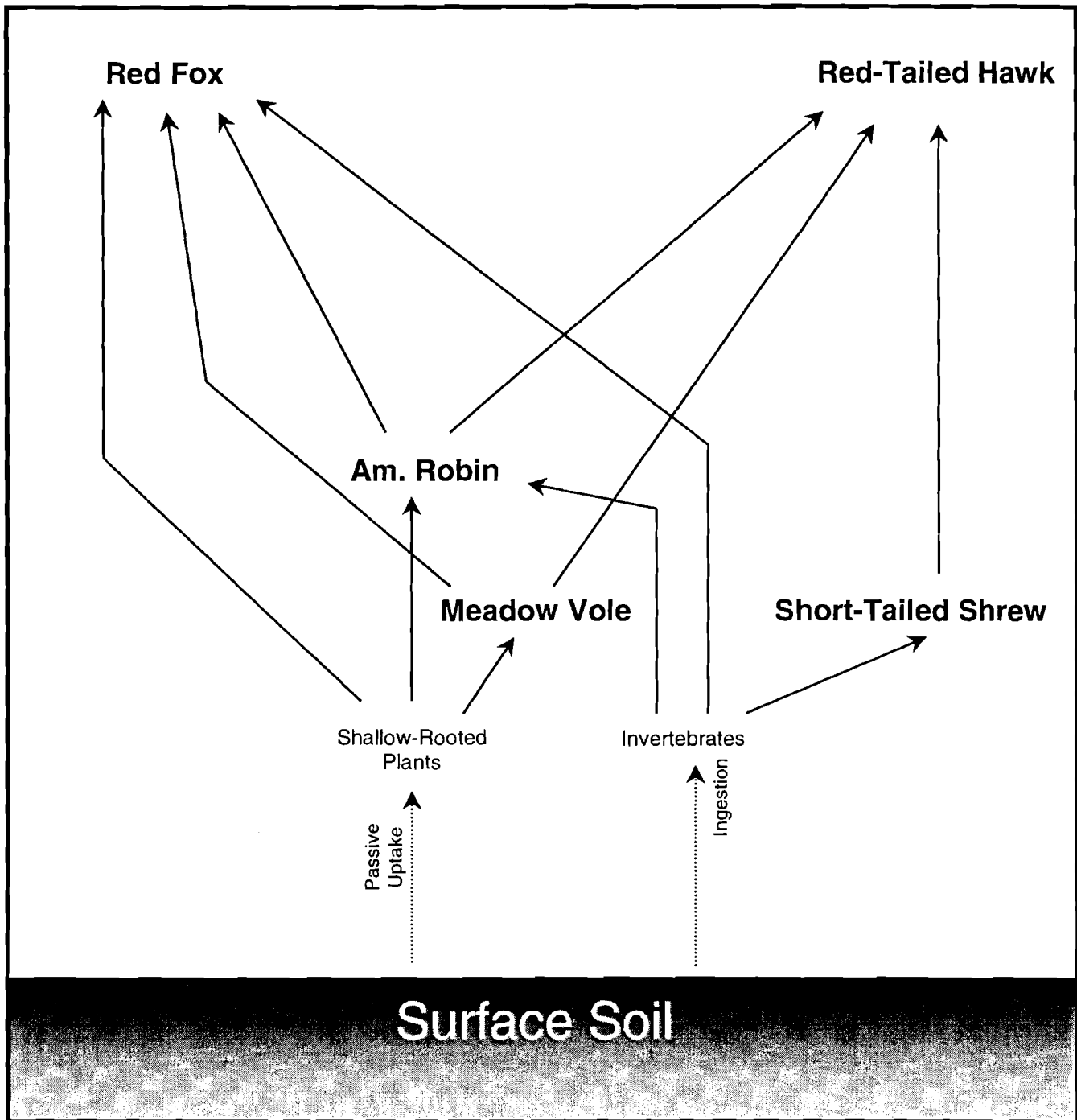
7.3.1 Terrestrial Receptors

Five representative receptor species that are expected or possible in the area of SWMU 58 (Section 7.1) were selected as indicator species for the potential effects of COPECs. These indicator species represent two classes of vertebrate wildlife (mammals and birds) and a range of both body size and food habits, including herbivory, omnivory, and carnivory. Note: potential impacts to terrestrial plants were considered by documenting the presence or absence of vegetative stress at the site (Section 7.1.4). The five animal species selected include the meadow vole (*Microtus pennsylvanicus*) (small, herbivorous mammal), short-tailed shrew (*Blarina brevicauda*) (small, insectivorous mammal), American robin (*Turdus migratorius*) (small omnivorous bird), red-tailed hawk (*Buteo jamaicensis*) (large, carnivorous bird), and red fox (medium, carnivorous mammal). Data used to model exposure for these species are summarized in **Appendix F-2, Table F-1**.

The meadow vole, shrew, and robin represent the prey base for the larger predators of the area (represented by the red-tailed hawk and the red fox). A terrestrial food web is presented in **Figure 7-1**. Many of these species have limited home ranges, particularly the meadow vole, shrew, and American robin, which make them particularly vulnerable to exposure from site constituents. The selected terrestrial receptor species have a potential high abundance and wide distribution at the site; also, sufficient toxicological information (with the exception of some bird species) is available in the literature for comparative and interpretive purposes. In addition, the selected species are likely to occur after site remediation (if risk management decisions require it). Every species is considered important to the stability of the local ecological food chain and biotic community. Finally, the selected species have readily-available exposure data, as summarized in the Wildlife Exposure Factors Handbook (USEPA, 1993).

Larger mammal species were generally not selected as sensitive receptors due to their large home ranges; however, the far-ranging red-tailed hawk and red fox were retained due to their unique role as top predators in the food chain. The potential risk to species with larger home ranges and migratory avian species are generally included within the predicted risks to the selected terrestrial indicator receptors. Receptor profiles for these five selected species are presented in the following five sections.

Figure 7-1
Simplified Terrestrial Food Web
Site Conceptual Exposure Model (CSEM)



Meadow Vole. The meadow vole inhabits grassy areas (upland and wetland) and obtains a significant portion of its herbivorous diet from the site. The vole resides in every area of the United States and Canada where there is good grass cover, ranges in size from about 9 to 13 centimeters in length, and weighs between 17 and 52 grams (USEPA, 1993). It is likely to have a relatively high rate of incidental soil ingestion given that it is sometimes coprophagous (consumes its own feces for secondary nutrient adsorption) and builds runways and burrows in the soil. The meadow vole has a limited foraging range, increasing its potential to be exposed (directly or indirectly) to COPECs in on-site surface soil. The vole has an average home range of 0.09 acres, with summer ranges larger than winter ranges. The vole does not hibernate and is active year-round. Population densities can range up to several hundred per hectare (USEPA, 1993).

Short-Tailed Shrew. The short-tailed shrew is an insectivore that feeds largely on soil invertebrates. It would be potentially exposed to COPECs through prey items and have a relatively high rate of incidental ingestion of soil while foraging on earthworms. This shrew is the largest found in North America. It is solid gray above and below, with a short tail, and weighs between 15 and 29 grams (Whitaker, 1995). Total length of this shrew is 76 to 102 millimeters (Burt and Grossenheider, 1980). The range of this shrew extends from southeastern Canada and the northeastern U.S. to Nebraska, Missouri, Kentucky, and in the mountains to Alabama (Whitaker, 1995). Preferable habitat for the shrew includes forests, grasslands, marshes, and brushy areas. It will make a nest of dry leaves, grass, and hair beneath logs, stumps, rocks, or debris (Burt and Grossenheider, 1980). This mammal has a voracious appetite, and will consume earthworms, other terrestrial invertebrates, and sometimes young mice (Whitaker, 1995). Mean population densities range from 5.7, in the winter, to 28 per acre in the summer (USEPA, 1993). Their home range varies from 0.5 to 1 acre (Burt and Grossenheider, 1980) and an average value of 0.96 acres has been used in this SLERA (**Appendix F-2, Table F-1**). Longevity is typically around 20 months (USEPA, 1993), with 5 to 8 young born to each of 2 to 3 litters (Burt and Grossenheider, 1980).

American Robin. The American robin is an omnivore that feeds on both plants (primarily fruit) and terrestrial invertebrates including earthworms. The robin occurs throughout most of the continental United States and Canada during the breeding season and winters in the southern half of the United States and Mexico and Central America. They live in a variety of habitats, including woodlands, wetlands, suburbs and parks. Robins are likely to forage throughout RFAAP and are present year-round. Most robins build nests of mud and vegetation on the ground or in the crotches of trees or shrubs. Robins forage primarily on the ground and in low vegetation by probing and gleaning. They are approximately 25 centimeters in size, have a body weight range of 63 to 103 grams, and an average home range of 1.2 acres (USEPA, 1993). The average longevity of a robin that survives to its first January is from 1.3 to 1.4 years (USEPA, 1993).

Red-Tailed Hawk. The red-tailed hawk is a common predator in the mixed landscapes typifying RFAAP. The wooded habitats and riverside trees within RFAAP are considered ideal foraging and nesting habitats for these raptors. This hawk is one of the most common and widespread members of the genus *Buteo* in the continental United States and Canada (Brown and Amadon, 1968). Red-tailed hawks live in a variety of habitats, such as farmlands, woodlands, mountains, and deserts, as long as there is open country interspersed with woods, bluffs, or streamside trees. They are primarily carnivorous, feeding on small rodents, as well as fish.

Other prey items include amphibians, reptiles, crayfish, and other birds (Adamcik et al., 1979; Ehrlich et al., 1988). Home range has been reported as small as 66.8 acres, with a population density of 0.16 pairs per acre (Janes, 1984), although USEPA (1993) reports an average territory size of 2,081 acres. Breeding population density is one nest per 0.009 acre or one individual per 0.004 acre. Body weight for male red-tails is 1,028.6 to 1,142.9 grams, and for females 1,371.4 to 1,600 grams (Brown and Amadon, 1968), although USEPA (1993) reports an average body weight of 1,134 grams. More northerly populations are migratory, while the more southerly are year-round residents. They typically mate for life or until one of the pair dies, with pairs clinging to territories year after year (Austing, 1964).

Red Fox. The red fox is a carnivorous predator that occurs in a wide range of habitats typical of RFAAP. Red fox use many types of habitat, including cropland, rolling farmland, brush, pastures, hardwood stands, and coniferous forests. They are present throughout the United States and Canada, and are the most widely distributed carnivore in the world. These foxes have a length of 56 to 63 centimeters, with a 35 to 41 centimeter tail and an average weight of 4,530 grams. They do not undergo hibernation, and most often occupy abandoned burrows or dens of other species.

One fox family per 100 to 1,000 hectares is typical, and the average home range is 892 hectares (2,204 acres) (USEPA, 1993). Red fox incur high mortality rates as a result of shooting, trapping, disease, and accidents. Fecundity is higher in areas of high mortality and low population density.

A pictorial representation of potential exposure has been prepared and is presented as **Figure 7-1**. This food web pictorial clarifies the conceptual site exposure model (CSEM). The CSEM traces the contaminant pathways through both abiotic components and biotic food web components of the environment. The CSEM presents potentially complete exposure pathways. The CSEM has been used as a tool for judging the appropriateness and usefulness of the selected measurement endpoints in evaluating the assessment endpoints, and for identifying sources of uncertainty in the exposure characterization.

7.4 Identification of Assessment and Measurement Endpoints

The protection of ecological resources, such as habitats and species of plants and animals, is a principal motivation for conducting the SLERA. Key aspects of ecological protection are presented as policy goals. These are general goals established by legislation or agency policy that are based on societal concern for the protection of certain environmental resources. For example, environmental protection is mandated by a variety of legislation and government agency policies (e.g., CERCLA, National Environmental Policy Act). Other legislation includes the Endangered Species Act 16 U.S.C. 1531-1544 (1993, as amended) and the Migratory Bird Treaty Act 16 U.S.C. 703-711 (1993, as amended). To assess whether these protection goals are met at the site, assessment and measurement endpoints have been formulated to define the specific ecological values to be protected and to define the degree to which each may be protected.

Unlike the human health risk assessment process, which focuses on individual receptors, the SLERA focuses on populations or groups of interbreeding nonhuman, nondomesticated receptors. In the SLERA process, the risks to individuals are generally assessed if they are protected under the Endangered Species Act.

Given the diversity of the biological world and the multiple values placed on it by society, there is no universally applicable list of assessment endpoints. Suggested criteria that may be considered in selecting assessment endpoints suitable for a specific ecological risk assessment are: (1) ecological relevance; (2) susceptibility to the contaminant(s); (3) accessibility to prediction and/or measurement; and (4) definable in clear, operational terms (Suter, 1993). Selected assessment endpoints should reflect environmental values that are protected by law, are critical resources, or have relevance to ecological functions that may be impaired. Both the entity and attribute are identified for each assessment endpoint.

Assessment endpoints are inferred from effects to one or more measurement endpoints. The measurement endpoint is a measurable response to a stressor that is related to the valued attribute of the chosen assessment endpoint. It serves as a surrogate attribute of the ecological entity of interest (or of a closely related ecological entity) that can be used to draw a predictive conclusion about the potential for effects to the assessment endpoint. Information gained during the site reconnaissance was used to assist in the selection of assessment and measurement endpoints. These endpoints, formal expressions of the environmental values to be protected (Suter, 1993), have been used to focus the goals of the SLERA.

Measurement endpoints for this SLERA are based on toxicity values from the available literature and not statistical summaries of actual field or laboratory observations or measurements. When possible, receptors and endpoints have been concurrently selected by identifying those that are known to be adversely affected by chemicals at the site based on published literature. COPECs for those receptors and endpoints have been identified by drawing on the scientific literature to obtain information regarding potential toxic effects of site chemicals to site species. This process ensures that a conservative approach is taken in selecting endpoints and evaluating receptors that are likely to be adversely affected by the potentially most toxic chemicals at SWMU 58.

7.4.1 Assessment Endpoints

Ecological Risk assessment Guidance for Superfund (ERAGS) (USEPA, 1997d) states: "For the screening-level ecological risk assessment, assessment endpoints are any adverse effects on ecological receptors, where receptors are plant and animal populations and communities, habitats, and sensitive environments. Adverse effects on populations can be inferred from measures related to impaired reproduction, growth, and survival. Adverse effects on communities can be inferred from changes in community structure or function. Adverse effects on habitats can be inferred from changes in composition and characteristics that reduce the habitats' ability to support plant and animal populations and communities."

The assessment endpoints for SWMU 58 are stated as the protection of long-term survival and reproductive capabilities for populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds. The corresponding null hypothesis (H_0) for each of the assessment endpoints is stated as: the presence of site contaminants within soil, vegetation, and prey will have no effect on the survival or reproductive capabilities of populations of herbivorous, insectivorous, and carnivorous mammals, and omnivorous and carnivorous birds.

Assessment receptor species were selected based on the likelihood of finding the species at SWMU 58. Historical information, the site reconnaissance, and the availability of toxicological data were used to select terrestrial receptor species. These receptors species are depicted in the

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food web model (**Figure 7-1**). Food web models are simplified versions of the possible movement of contaminants through the food chain present or potentially present. Due to lack of data for every possible species, key species have been selected to represent broad classes, or guilds.

The food web CSEM was developed to illustrate how the selected terrestrial species are ecologically linked within food webs. One species was used to represent each of the major trophic levels and habitats. The decision was made not to complicate the food web models with detailed species selection at the base of the food web (i.e. specific terrestrial invertebrates). Thus, generic terrestrial invertebrates were used to represent the bottom of the food chain. For terrestrial invertebrates and plants, partitioning coefficients and simple empirical uptake models were employed to estimate COPEC concentrations within tissues (*Section 7.5*). These tissue concentrations were then used as input values for exposure to higher trophic level receptors through the dietary route of exposure. Brief life-history descriptions for the selected receptor species are provided in *Section 7.3.1*.

Trophic levels may be exposed to COPECs, either by direct exposure to contaminated abiotic media or through ingestion of lower trophic level food items. Primary producers (plants) absorb COPECs (as well as nutrients) from soil and/or water. In terrestrial species bioconcentration occurs in plants and invertebrates, and higher food chain receptors bioaccumulate COPECs through the ingestion of food items.

7.4.2 Measurement Endpoints

Measurement endpoints are frequently numerical expressions of observations (e.g. toxicity test results or community diversity indices) that can be compared statistically to detect adverse responses to a site contaminant. Examples of typical measurement endpoints include mortality, growth or reproduction in toxicity tests; individual abundance; species diversity; and the presence or absence of indicator data in field surveys of existing impacts (USEPA, 1997b).

For assessments, measurable responses to stressors may include LOAELs, NOAELs, LC₅₀s (lethal concentration to 50 percent of the test population), LD₅₀s (lethal dose to 50 percent of the test population), collectively termed toxicity endpoint values (see *Section 7.5* for further explanation). The most appropriate measurement endpoint(s) were chosen based on exposure pathways as well as ecotoxicity of the contaminant.

As two of the selected receptor species (the American robin and the short-tailed shrew) feed on terrestrial invertebrates, a reduction in the abundance of these invertebrates could result in an adverse impact due to food shortages. Therefore, the direct contact toxicity of COPECs to soil invertebrates was selected as a measurement endpoint for protection of long-term survival and reproductive capabilities for populations of insectivorous mammals and omnivorous birds.

7.5 Exposure Estimation and Risk Characterization

This section includes a discussion of how COPEC exposures were quantified (*Section 7.5.1*), how COPEC effects were assessed (*Section 7.5.2*), and a presentation of the resultant risk characterization (*Section 7.5.3*) that combines both exposure and effects.

7.5.1 Exposure Analysis

An estimate of the nature, extent, and magnitude of potential exposure of assessment receptors to COPECs that are present at or migrating from the site was developed, considering both current

and reasonably plausible future use scenarios. Exposure characterization is critical in further evaluating the risk of compounds identified as COPECs during the selection process (*Section 7.2*). The exposure assessment was conducted by linking the magnitude (concentration) and distribution (locations) of the constituents detected in the media sampled during the investigation, evaluating pathways by which chemicals may be transported through the environment, and identifying the points at which organisms found in the study area may contact contaminants.

An exposure analysis was performed, which combines the spatial and temporal distribution of the ecological receptors with those of the COPEC to evaluate exposure. The exposure analysis focuses on the chemical amounts that are assumed to be bioavailable, and the means by which the ecological receptors are exposed (e.g., exposure pathways). The focus of the analysis is dependent on the assessment receptors being evaluated as well as the assessment and measurement endpoints.

Ecological routes of exposure for biota may be direct (bioconcentration) or through the food web via the consumption of contaminated organisms (bioaccumulation). Food web exposure can occur when terrestrial (or aquatic) fauna consume contaminated biota. Examples of food web exposure include animals at higher trophic levels consuming plants or animals that bioaccumulate contaminants. Direct exposure routes include dermal contact, absorption, inhalation, and ingestion. Examples of direct exposure include animals incidentally ingesting contaminated soil (or sediment); animals ingesting surface water; plants absorbing contaminants by uptake from contaminated soil (or sediment); and the dermal contact of aquatic organisms with contaminated surface water or sediment. As discussed previously, no surface water or sediment was present within the drainage ditches, and exposure to these media are not considered. In addition, as discussed in *Section 7.3*, dermal contact and inhalation exposures are considered insignificant compared to other quantified routes of exposure.

Contamination of biota could result from exposure to one or more COPEC. Bioavailability is an important contaminant characteristic that influences the degree of chemical-receptor interaction. Bioavailable compounds are those that a receptor can take in from the environment. Bioavailability of a chemical is a function of several physical and chemical factors such as grain size and organic carbon content. Environmental conditions such as soil moisture, soil pH, and cation exchange capacities significantly influence whether potential soil contaminants remain chemically bound in the soil matrix or whether they can be chemically mobilized (in a bioavailable form) and released for plant absorption. Generally, neutral to alkaline soil (soil pH of 6.5 or greater) restrict the absorption of toxic metals, making pathway completion to plants difficult. The pH in surface soil at SWMU 58 ranged from 7.2 to 7.5. For purposes of this SLERA, bioavailability is conservatively assumed to be 100 percent.

Exposure pathways consist of four primary components: source and mechanism of contaminant release, transport medium, potential receptors, and exposure route. A chemical may also be transferred between several intermediate media before reaching the potential receptor. These components have been addressed within this SLERA. If these components are not complete, then contaminants in those media do not constitute an environmental risk at that specific site. The major fate and transport properties associated with typical site contaminants directly affect a contaminant's behavior in each of the exposure pathway components.

For terrestrial faunal receptors, calculation of exposure rates relies upon determination of an organism's exposure to COPECs found in surface soil, and on transfer factors used for food-chain exposure. Exposure rates for terrestrial wildlife receptors in this SLERA are based upon ingestion of contaminants from these media and from consumption of other organisms.

The first step in estimating exposure rates for terrestrial wildlife involves the calculation of food ingestion (and drinking water intake) rates for site receptors. USEPA (1993) includes a variety of exposure information for a number of avian and mammalian species. Information regarding feeding (and watering) rates, and dietary composition are available for many species, or may be estimated using allometric equations (Nagy, 1987). Data have also been gathered on incidental ingestion of soil, and are incorporated for the receptor species. This information is summarized in **Appendix F-2, Table F-1**. For this SLERA, conservative Tier 1 exposures are based on maximum dietary intake, maximum incidental soil intake, minimum body weight, 100 percent site exposure (i.e., area use factor (AUF) set equal to unity), and the use of COPEC MDCs as exposure point concentrations. Less conservative Tier 2 exposures are based on average dietary and incidental soil intake, average body weight, calculated AUF based on site area and home range of the receptor species, and COPEC exposure point concentrations set equal to 95 percent UCLs.

Algorithms have been evaluated for calculating exposure for terrestrial vertebrates that account for exposure via ingestion of contaminated water, incidental ingestion of contaminated soil, ingestion of plants grown in contaminated soil, and prey items. Singular algorithms have been developed for soil to plant uptake and for animal bioaccumulation (transfer factors).

The basic equation for estimating dose through the dietary pathway is:

$$D_p = \sum_{k=1}^m (C_k \times F_k \times I_k) / W$$

where:

- D_p = the potential average daily dose (mg/kg-day),
- C_k = the average COPEC concentration in the k^{th} food type (mg/kg dry weight)
- F_k = the fraction of the k^{th} food type that is contaminated
- I_k = the ingestion rate of the k^{th} food type (kg dry weight/day)
- W = the body weight of the receptor (kg wet weight).

Literature values for animal-specific sediment ingestion have been used if available. However, such values generally are not available in the literature. Where sediment ingestion rates could not be found, the animal-specific incidental soil ingestion rate is used for sediment ingestion as well, if the receptors life history profile suggests a significant aquatic component, and if sediments are a medium of concern at the site.

For the current SLERA, bioaccumulation factors (BAFs) and bioconcentration factors (BCFs) for soil-to-plants, soil-to-earthworms, and soil-to-small mammals and birds are presented in **Appendix F-2, Tables F-2, F-3, and F-4**, respectively. BAFs and/or BCFs were not available for every COPEC, but were estimated as described in the footnotes to these tables. For each BAF/BCF pathway, both a Tier 1 and Tier 2 value is presented, as recommended in the Site

Screening Process (USEPA, 2001c) and the RFAAP Final MWP (URS, 2002). The Tier 1 BAF/BCF is generally the maximum value found in the literature, to represent a worst-case exposure scenario, while the Tier 2 BAF/BCF represents a conservative, yet more realistic exposure value.

Soil-to-plant BAF/BCF values for inorganics (**Appendix F-2, Table F-2**) are based on information from USEPA (2000b), Efroymson et al. (2001), Baes et al. (1984), and IAEA (1994). For organics, the Kow regression equation from Travis and Arms (1988) has been used to estimate the BAF/BCF value, as shown in **Appendix F-2, Table F-2**. Tier 2 values are based on soil and plant regression equations, if available, that produce a BAF/BCF value that scales in a non-linear fashion with soil COPEC concentration. If a regression equation is not available, or not recommended for a particular COPEC, an upper-bound or median value is used. It should be noted that as the regression equation predicts COPEC concentrations in plants, the actual BAF/BCF value is estimated by dividing the estimated plant COPEC concentration by the soil COPEC concentration.

Soil-to-earthworm BAF/BCF values (**Appendix F-2, Table F-3**) are based on information from Sample et al. (1998), Sample et al. (1999), USEPA (2000b), and Beyer (1990). Earthworms are used as a surrogate species to represent terrestrial invertebrates including insects. Tier 2 values are based on regression equations, if available, that produce a BAF/BCF value that scales in a non-linear fashion with soil COPEC concentration. If a regression equation is not available, or not recommended for a particular COPEC, an upper-bound or mean value is used. It should be noted that as the regression equation predicts COPEC concentrations in earthworms, the actual BAF/BCF value is estimated by dividing the earthworm COPEC concentration by the soil COPEC concentration.

For the organic COPEC at SWMU 58, the following equation from USEPA (2000b) was used to estimate the BAF/BCF, along with the COPEC-specific K_{ow} and site-specific fraction of organic carbon information:

$$BAF/BCF = \frac{10^{(\log K_{ow} - 0.6)}}{F_{oc} \times 10^{(0.98 \times \log K_{ow} + 0.00028)}}$$

where:

- Log K_{ow} = log octanol-water partition coefficient (1.87 for benzoic acid; 3.66 for cumene; and 4.0 for cymene),
 F_{oc} = fraction of organic carbon (SWMU 58 minimum = 0.0072, average = 0.008).

For organics, the Tier 1 BAF/BCF values were estimated using the minimum site F_{oc} , whereas the Tier 2 BAF/BCF was estimated using the average site F_{oc} .

Soil-to-small mammal and small bird BAF/BCF values (**Appendix F-2, Table F-4**) are based on information from Sample et al. (1998). Tier 2 values are based on available 90th percentile BAF/BCF values. Conservative values for the organics were estimated to be 1 and 0.5 (for Tier 1 and Tier 2, respectively), based on a review of data from Sample et al. (1998) available for the known bioaccumulative organic TCDD/TCDF. Benzoic acid, cumene, and cymene are

conservatively assumed to be similar to, although lower than TCDD/TCDF in bioaccumulation potential.

The estimated chemical intakes for each exposed receptor group under each exposure pathway and scenario are presented in the risk characterization spreadsheets referenced in *Section 7.5.3*. These intake estimates are combined with the COPEC toxicity values, discussed in the following section, to characterize potential ecological risk. The uncertainties associated with the estimation of chemical intake are discussed in *Section 7.6*.

For direct contact exposure for soil invertebrates to COPECs in surface soil, measured COPEC concentrations were simply compared with direct contact benchmarks appropriate for the soil invertebrate community.

7.5.2 Ecological Effects Characterization

The ecological effects characterization includes the selection of literature benchmark values and the development of reference toxicity values.

7.5.2.1 Selection of Literature Benchmark Values

Appropriate sources for literature benchmark values have been consulted, such as (1) Toxicological Benchmarks for Wildlife (Sample, et al., 1996); Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California (Engineering Field Activity, West, 1998); Review of the Navy - USEPA Region IX BTAG Toxicity Reference Values for Wildlife (CH2M-Hill, 2000); and, (2) LD₅₀ values from data bases such as the Registry of Toxic Effects Concentrations (RTEC) (extrapolated to chronic NOAEL or LOAEL values using recommended Tri-Service [Wentzel et al., 1996] uncertainty factors). The level of effort has been limited to documents that summarize the available ecotoxicological information and does not consist of a review of the primary toxicological literature (i.e., details of toxicity test conditions were not reviewed to assess validity of the tests performed).

7.5.2.2 Development of Toxicity Reference Values

Toxicity reference values (TRV) have been developed for the SWMU 58 study area. These TRVs focus on the growth, survival, and reproduction of species and/or populations. Empirical data are available for the specific receptor-endpoint combinations in some instances. However, for some COPECs, data on surrogate species and/or on endpoints other than the NOAEL and LOAEL had to be used. The NOAEL is a dose of each COPEC that will produce no known adverse effects in the test species. The NOAEL was judged to be an appropriate toxicological endpoint for the Tier 1 approach since it would provide the greatest degree of protection to the receptor species, however, both NOAELs and LOAELs are used for informational purposes in the Tier. Both the NOAEL and the LOAEL were also used in the Tier 2 approach, however, the LOAEL is recommended as a point of comparison for decision-making for risk management purposes. In general, LOAELs are thought to be protective at the population level of biological organization. In addition, in instances where data are unavailable for a Site-associated COPEC, toxicological information for surrogate chemicals had to be used. Safety factors are used to adjust for these differences and extrapolate risks to the site's receptors at the NOAEL and/or LOAEL endpoint. This process is described in the following paragraphs.

Toxicity information pertinent to identified receptors has been gathered for those analytes identified as COPECs. Because the measurement endpoint ranges from the NOAEL to the LOAEL, preference has been given to chronic studies noting concentrations at which no adverse effects were observed and ones for which the lowest concentrations associated with adverse effects were observed. As previously noted, where data are unavailable for the exposure of a receptor to a COPEC, data for a surrogate chemical have been gathered for use in the SLERA.

Using the relevant toxicity information, TRVs have been calculated for each of the COPECs. TRVs represent NOAELs and LOAELs with safety factors incorporated for toxicity information derived from studies other than no-effects or lowest-effects studies.

TRVs have been calculated using safety factors specified in Ford et al. (1992) and reported in Wentzel et al. (1996) and summarized in the footnotes to **Appendix F-2, Tables F-5 and F-6** for NOAEL and LOAEL TRVs, respectively. Interclass toxicity extrapolations were not performed, as physiological differences between classes are too great to be addressed with the use of simplistic safety factors. Separate uncertainty factors are used to account for extrapolation to the no effects or lowest-effects endpoints, for study duration, and for extrapolation across taxonomic groups (e.g., species, genus, family, order), as shown in **Appendix F-2, Table F-7** for the receptors used in this SLERA. Although additional safety factors may be employed for endangered species, no endangered species were selected as representative receptors and these additional safety factors were not required.

These factors were used together to derive a final adjusted TRV, as shown in the risk characterization spreadsheets (**Appendix F-2**) referenced in *Section 7.5.3*. Reference toxicity threshold value uncertainties are discussed in *Section 7.6*.

Exposure TRVs provide a reference point for the comparison of toxicological effects upon exposure to a contaminant. To complete this comparison, receptor exposures to site contaminants are calculated.

To assess direct contact exposure for terrestrial invertebrates, the following three sources were evaluated and used as appropriate:

- BTAG screening values for fauna (USEPA Region III, 1995);
- Screening toxicity values for earthworms from ORNL (1997); and,
- Screening toxicity values for earthworms from Los Alamos National Laboratory (LANL) (2002).

7.5.3 Risk Characterization

The risk characterization phase integrates information on exposure, exposure-effects relationships, and defined or presumed target populations. The result is a determination of the likelihood, severity, and characteristics of adverse effects to environmental stressors present at a site. Qualitative and semiquantitative approaches have been taken to estimate the likelihood of adverse effects occurring as a result of exposure of the selected site receptors to COPECs.

For this assessment, TRVs and exposure rates have been calculated and are used to generate HQs (Wentzel et al., 1996), by dividing the receptor exposure rate for each contaminant by the calculated TRV. Environmental effects quotients (EEQs) or HQs are a means of estimating the

potential for adverse effects to organisms at a contaminated site, and for assessing the potential that toxicological effects will occur among site receptors.

7.5.3.1 Terrestrial Plant Impact Assessment

To assess the potential impact of COPEC concentrations in surface soil on terrestrial plant species, photographic records collected during previous investigations were reviewed (*Sections 7.1.1 and 7.1.4*), and no obvious signs of vegetative stress were noted. The overall health of the grassland community at the site was comparable to the grasslands in the surrounding area. As allowed in the RFAAP Final MWP (URS, 2002) that states that owing to the invasive and successive nature of plants communities, plants as receptors do not typically warrant a detailed examination of effects, therefore, plants were not quantitatively evaluated in this SLERA. As there were no unique or site-specific terrestrial plant issues discovered at SWMU 58, a qualitative evaluation was deemed adequate. Given these reasons, and because of the disturbed nature of the site, risks to plants are not quantitatively evaluated; however, plants are included in the SLERA as media through which the wildlife receptors may be exposed indirectly to COPECs in the soil by means of the food chain.

7.5.3.2 Predictive Risk Estimation for Terrestrial Wildlife

The risk associated with SWMU 58 has been estimated. The risk estimation has been performed through a series of quantitative HQ calculations that compare receptor-specific exposure values with TRVs. The EEQs (or HQs) are compared to HQ guidelines for assessing the risk posed from contaminants. It should be noted that HQs are not measures of risk, are not population-based statistics, and are not linearly-scaled statistics, and therefore an HQ above 1, even exceedingly so, does not guarantee that there is even one individual expressing the toxicological effect associated with a given chemical to which it was exposed (Tannenbaum, 2001; Bartell, 1996).

The simple HQ ratios have been summed to provide conservative hazard index estimates for chemicals and exposure pathways of a given receptor. HQ summation is appropriate and scientifically defensible, for a given receptor, if HQs for those chemicals that have a similar mode of toxicological action. While individual contaminants may affect distinct target organs or systems within an organism, classes of chemicals may act in similar ways, thus being additive in effect. The summation of HQs into a hazard index was performed, in part, to assess whether or not individual COPEC HQs should be segregated based on dissimilar modes of toxicological action. However, as risk drivers resulted in HQs greater than approximately 10 to 100 (see following paragraphs), segregation of other COPECs by mode of toxicological action was not necessary.

Tier 1 and Tier 2 individual COPEC EEQs and hazard indices (summed EEQs) for terrestrial receptors at SWMU 58 are presented in risk characterization tables (**Appendix F-2, Tables F-8 through F-27**) for the five selected receptor species. These summed EEQs are presented in **Table 7-13 and Table 7-14**, along with the hazard driver (the COPEC contributing the majority of the total estimated EEQ) and the exposure pathway of concern (the pathway contributing the most to the total estimated EEQ).

As shown, current and future scenario Tier 1 EEQs were considerably greater than 100 for many of the five receptor species, using either TRVs based on NOAEL or LOAEL values. The short-

tailed shrew was predicted to be the most impacted, followed by the American robin and the meadow vole, the red fox, and red-tailed hawk.

Table 7-13
Wildlife EEQ Hazard Summary (Current Scenario) for Food Chain Exposure

Receptor	Tier 1 ^a		Tier 2 ^b	
	NOAEL-Based EEQ	LOAEL-Based EEQ	NOAEL-Based EEQ	LOAEL-Based EEQ
Meadow vole	499	270	38	4
Hazard Driver(s) ^c :	Se (plant ingestion)		Tl (soil ingestion)	
Short-tailed shrew	10,216	1,065	2,456	249
Hazard Driver(s) ^c :	Tl (invertebrate ingestion)		Tl (invertebrate ingestion)	
American robin	624	134	149	29
Hazard Driver(s) ^c :	Se, Zn (plant ingestion), Tl (invertebrate ingestion)		Cr, Tl (invertebrate ingestion)	
Red-tailed hawk	46	7	0.012	0.0023
Hazard Driver(s) ^c :	Cr, Zn (mammal ingestion)		---	
Red fox	406	59	0.1	0.01
Hazard Driver(s) ^c :	Tl (invertebrate ingestion)		---	

Table 7-14
Wildlife EEQ Hazard Summary (Future Scenario) for Food Chain Exposure

Receptor	Tier 1 ^a		Tier 2 ^b	
	NOAEL-Based EEQ	LOAEL-Based EEQ	NOAEL-Based EEQ	LOAEL-Based EEQ
Meadow vole	508	274	37	4
Hazard Driver(s) ^c :	Se (plant ingestion)		Tl (soil ingestion)	
Short-tailed shrew	10,230	1,071	2,455	249
Hazard Driver(s) ^c :	Tl (invertebrate ingestion)		Tl (invertebrate ingestion)	
American robin	745	148	138	27
Hazard Driver(s) ^c :	Se, Zn (plant ingestion) Tl (invertebrate ingestion)		Cr, Tl (invertebrate ingestion)	
Red-tailed hawk	56	9	0.012	0.0022
Hazard Driver(s) ^c :	Zn (mammal ingestion)		---	
Red fox	409	60	0.1	0.01
Hazard Driver(s) ^c :	Tl (invertebrate ingestion)		---	

^a Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.

^b Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, average Intake Rates, average BW and calculated FHR less than or equal to 1.

^c Hazard drivers are those chemicals contributing the most to the total estimated EEQ, and the primary route of exposure associated with this driver.

Notes for Tables 7-13 and 7-14:

EEQ = Ecological Effects Quotient.

LOAEL = Lowest Observed Adverse Effect Level

NOAEL = No Observed Adverse Effect Level

FHR = Fraction home range

BW = body weight.

BAF/BCF = Bioaccumulation Factor/Bioconcentration Factor.

EPC = exposure point concentration.

More realistic Tier 2 EEQs were also elevated, especially those based on NOAEL TRVs, however, they were considerably lower than the Tier 1 estimates. Tier 2 EEQs, based on LOAEL values (for both the current and future exposure scenarios), were 249 for the short-tailed shrew, 27 to 29 for the American robin, 4 for the meadow vole, and less than 1 for both the red fox and red-tailed hawk and red fox (**Tables 7-13 and 7-14**). Thallium and chromium were the COPECs contributing the most to the total EEQ for those wildlife receptors with EEQs greater than 1. Exposure pathways of most concern, based on the results of the food-chain modeling, were earthworm ingestion and, to a much lower extent, soil ingestion.

A potential reduction in wildlife food supply was evaluated using a direct contact toxicity evaluation for soil invertebrates (such as earthworms) exposed to COPECs in surface soil. Fifteen COPECs were identified from the direct contact exposure screen for surface soil current scenario, and 34 COPECs were identified from the direct contact exposure screen for surface soil future scenario (**Tables 7-5 and 7-6**). These COPECs were evaluated for potential toxicity to the terrestrial soil invertebrate community for both current and future scenarios. BTAG screening values for faunal toxicity were used, as well as earthworm toxicity benchmarks from ORNL and LANL (**Tables 7-15 and 7-16**). The lowest relevant screening value was selected from the available screening values, as discussed in the footnotes to **Tables 7-15 and 7-16**. Maximum detected concentrations were used to estimate Tier 1 EEQs, and EPCs more appropriate for invertebrate populations (e.g., the 95% UCL concentration) were used to estimate Tier 2 EEQs.

For the current scenario, direct contact Tier 1 EEQs ranged from 0.033 to 107, with chromium having one single EEQ above 100. If chromium is assumed to be in the trivalent form, and not hexavalent, the chromium EEQ drops from 107 to 1.3. Tier 2 EEQs ranged from 0.031 to 107. If chromium is assumed to be in the trivalent form, the EEQ drops from 107 to 1.3. Based on the Tier 2 results, and assuming chromium is in the trivalent form (based on site-specific information), chromium is the sole direct contact COPEC in soil that is estimated to potentially impact the terrestrial invertebrate community, and therefore potentially reduce the food supply for higher trophic level wildlife such as the American robin and short-tailed shrew. However, as the chromium EEQ is 1.3 it may be rounded to 1 and not be considered significantly greater than unity.

For the future scenario, direct contact Tier 1 EEQs ranged from 0.06 to 107, with chromium having one single EEQ above 100. If chromium is assumed to be in the trivalent form, and not hexavalent, the chromium EEQ drops from 107 to 1.3. Tier 2 EEQs ranged from 0.04 to 93. If chromium is assumed to be in the trivalent form, the EEQ drops from 93 to 1.2. Based on the Tier 2 results, and assuming chromium is in the trivalent form (based on site-specific information), chromium is the sole direct contact COPEC in soil that is estimated to potentially impact the terrestrial invertebrate community, and therefore potentially reduce the food supply for higher trophic level wildlife such as the American robin and short-tailed shrew. However, as the chromium EEQ is 1.2 to 1.3 it may be rounded to 1 and not be considered significantly greater than unity.

While the food-chain EEQs suggest unacceptable ecological risks are associated with SWMU 58, there are important uncertainties with the hazard drivers (thallium and chromium) that must be considered. These uncertainties, plus others, are presented and discussed in the *Section 7.6*.

Table 7-15
Direct Contact Evaluation for Surface Soil (Current) at SWMU 58

Chemical (1)	Detection Frequency	Maximum Concentration	EPC	Units	BTAG Screening Toxicity Value (2)	Comment on BTAG Value	ORNL Screening Toxicity Value (3)	Comment on ORNL Value	LANL Screening Toxicity Value (4)	Lowest Relevant Screening Value (5)	Tier 1 EEQ (6)	Tier 2 EEQ (7)
Aluminum	5/5	23,300	21,720	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Beryllium	3/5	1.21	1.21	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Chromium	5/5	42.7	42.6	mg/kg	NVA	---	32	Cr III	1.4	32	1.3	1.3
Chromium	5/5	42.7	42.6	mg/kg	0.0075	For Bacteria	0.4	Cr VI	0.2	0.4	107	107
Copper	5/5	16.2	16.2	mg/kg	15	---	50	---	13	50	0.32	0.32
Iron	5/5	27,800	27,410	mg/kg	12	Rabbit LD-50	NVA	---	NVA	NVA	---	---
Lead	3/5	16.3	15.7	mg/kg	0.01	Quail Impact	500	---	2000	500	0.033	0.031
Manganese	5/5	465	465	mg/kg	330	No reference	NVA	---	NVA	NVA	---	---
Mercury (Inorganic)	3/5	0.0832	0.0832	mg/kg	0.058	No reference	0.1	For organic and inorganic forms	0.05	0.1	0.83	0.83
Nickel	5/5	26.5	26.5	mg/kg	NVA	---	200	---	100	200	0.13	0.133
Thallium	3/4	11.8	11.8	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Vanadium	5/5	53.7	53.4	mg/kg	58	No reference	NVA	---	NVA	NVA	---	---
Zinc	5/5	41.8	39.0	mg/kg	NVA	---	200	---	350	200	0.21	0.20
2-Methylnaphthalene	1/4	0.0023	0.0023	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Benzoic acid	1/2	0.130	0.130	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
bis(2-Ethylhexyl) phthalate	1/4	0.061	0.061	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---

NVA = No Value Available

EPC = Exposure Point Concentration.

(1) COPECs from Table 7-10.

(2) Screening toxicity values for fauna from BTAG (1995).

(3) Screening toxicity values for earthworms from ORNL (1997, ES/ER/TM-126/R2).

(4) Screening toxicity values for earthworms from Los Alamos National Laboratory (2002), Environmental Restoration Project, Environmental Screening Levels, Release 1.5, Sept.

(5) The lowest relevant screening value is the lowest value appropriate for the RFAAP site:

Non referenced values are omitted.

Bacteria and amoeba are deemed inappropriate receptor species.

Rabbit and quail are omitted, as wildlife impacts are evaluated in the food chain model section of the SLERA.

As LANL values were developed for a desert environment, they are only used if no other appropriate values are available.

(6) Tier 1 ecological effect quotient (EEQ) is estimated by dividing the maximum soil concentration by the lowest relevant direct contact screening value.

(7) Tier 2 EEQ is estimated by dividing the EPC by the lowest relevant direct contact screening value.

Table 7-16
Direct Contact Toxicity Evaluation for Surface Soil (Future) at SWMU 58

Chemical (1)	Detection Frequency	Maximum Concentration	EPC	Units	BTAG Screening Toxicity Value (2)	Comment on BTAG Value	ORNL Screening Toxicity Value (3)	Comment on ORNL Value	LANL Screening Toxicity Value (4)	Lowest Relevant Screening Value (5)	Tier 1 EEQ (6)	Tier 2 EEQ (7)
Aluminum	9/9	29,300	23,660	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Antimony	3/7	1.30	1.30	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Beryllium	4/6	1.30	1.09	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Chromium	9/9	42.7	37.1	mg/kg	NVA	---	32	Cr III	1.4	32	1.3	1.2
Chromium	9/9	42.7	37.1	mg/kg	0.0075	For Bacteria	0.4	Cr VI	0.2	0.4	107	93
Copper	8/8	22.2	17.8	mg/kg	15	---	50	---	13	50	0.44	0.36
Iron	9/9	36,150	30,530	mg/kg	12	Rabbit LD-50	NVA	---	NVA	NVA	---	---
Lead	7/9	28	20.4	mg/kg	0.01	Quail Impact	500	---	2000	500	0.06	0.04
Manganese	9/9	465	389	mg/kg	330	No reference	NVA	---	NVA	NVA	---	---
Mercury (Inorganic)	4/9	0.0832	0.0745	mg/kg	0.058	No reference	0.1	For organic and inorganic forms	0.05	0.1	0.83	0.75
Nickel	9/9	26.5	17.9	mg/kg	NVA	---	200	---	100	200	0.13	0.090
Thallium	4/7	11.8	11.8	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Vanadium	9/9	66.6	55.2	mg/kg	58	No reference	NVA	---	NVA	NVA	---	---
Zinc	9/9	59.1	46.7	mg/kg	NVA	---	200	---	350	200	0.30	0.23
2-Methylnaphthalene	2/8	0.0073	0.0073	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
4-Isopropyltoluene (cymene)	1/3	0.044	0.044	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Anthracene	3/9	0.200	0.200	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Benzo(a)anthracene	4/9	0.220	0.220	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Benzo(a)pyrene	4/9	0.240	0.240	mg/kg	0.1	For mice, No Reference	NVA	---	NVA	NVA	---	---
Benzo(b)fluoranthene	4/9	0.230	0.230	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Benzo(k)fluoranthene	4/9	0.110	0.110	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Benzoic acid	2/6	0.180	0.180	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
bis(2-Ethylhexyl)phthalate	4/8	0.035	0.035	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Chrysene	5/9	0.260	0.260	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Fluoranthene	5/9	0.660	0.660	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Phenanthrene	6/9	0.620	0.620	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Pyrene	5/9	0.650	0.650	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Acetone	1/6	0.027	0.027	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Carbon disulfide	1/9	0.001	0.001	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
cis-1,2-Dichloroethene	1/6	0.730	0.389	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Isopropylbenzene (cumene)	1/3	0.096	0.096	mg/kg	NVA	---	NVA	---	NVA	NVA	---	---
Methylene chloride	1/8	0.888	0.888	mg/kg	0.3	No reference	NVA	---	NVA	NVA	---	---
m&p-Xylenes	1/6	0.285	0.215	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Toluene	1/9	0.308	0.147	mg/kg	0.1	No reference	NVA	---	NVA	NVA	---	---
Trichloroethene	1/9	2.7	0.64	mg/kg	0.3	No reference	NVA	---	NVA	NVA	---	---

NVA = No Value Available

EPC = Exposure Point Concentration.

(1) COPECs from Table 7-10.

(2) Screening toxicity values for fauna from BTAG (1995).

(3) Screening toxicity values for earthworms from ORNL (1997, ES/ER/TM-126/R2).

(4) Screening toxicity values for earthworms from Los Alamos National Laboratory (2002), Environmental Restoration Project, Environmental Screening Levels, Release 1.5, Sept.

(5) The lowest relevant screening value is the lowest value appropriate for the RFAAP site:

Non referenced values are omitted.

Bacteria and amoeba are deemed inappropriate receptor species.

Rabbit and quail are omitted, as wildlife impacts are evaluated in the food chain model section of the SLERA.

As LANL values were developed for a desert environment, they are only used if no other appropriate values are available.

(6) Tier 1 ecological effect quotient (EEQ) is estimated by dividing the maximum soil concentration by the lowest relevant direct contact screening value.

(7) Tier 2 EEQ is estimated by dividing the EPC by the lowest relevant direct contact screening value.

7.5.3.3 Background Evaluation

A background evaluation was conducted on the soil analytical results to assess whether inorganic COPEC drivers discussed in the previous section were potentially related to naturally occurring soil concentrations. Inorganic COPEC drivers for the food chain assessment are chromium and thallium, while the sole direct contact assessment COPEC driver is chromium. Inorganic constituents with maximum detected concentrations (MDCs) less than the background UTL and shown not to be statistically different based on appropriate population statistical tests are considered background related. For SWMU 58, neither of the inorganic COPEC drivers for surface soil could be attributed to background because either the surface soil MDC exceeded the UTL or the SWMU 58 surface soil data were shown to be significantly different as compared to background surface soil, summarized as follows:

SWMU 58 Background Evaluation (Surface Soil)				
COPEC	Maximum Detection (mg/kg)	UTL (mg/kg)	Maximum Above UTL?	SWMU 58 Population Statistic Above Background?
Current and Future Scenarios				
Chromium	42.7	65.3	No	Yes
Thallium	11.8	2.11	Yes	No

Therefore, neither of the inorganic COPEC drivers is considered background-related.

7.6 Uncertainty Analysis

The results of the SLERA are influenced to some degree by variability and uncertainty. In theory, investigators might reduce variability by increasing sample size of the media or species sampled. Alternatively, uncertainty within the risk analysis can be reduced by using species-specific and site-specific data (i.e., to better quantify contamination of media, vegetation, and prey through: direct field measurements, toxicity testing of site-specific media, and field studies using site-specific receptor species). Detailed media, prey, and receptor field studies are costly; thus, the preliminary analyses of risk have been conducted to limit the potential use of these resource-intensive techniques to those COPECs that continue to show a relatively high potential for ecological risk. Since assessment criteria were developed based on conservative assumptions, the result of the assessment errs on the side of conservatism. This has the effect of maximizing the likelihood of accepting a false positive (Type I error: the rejection of a true null hypothesis) and simultaneously minimizing the likelihood of accepting a true negative (Type II error: the acceptance of a false null hypothesis).

7.6.1 General Variability and Uncertainty

A number of factors contribute to the overall variability and uncertainty inherent in ecological risk assessments. Variability is due primarily to measurement error; laboratory media analyses and receptor study design are the major sources of this kind of error. Uncertainty, on the other hand, is associated primarily with deficiency or irrelevancy of effects, exposure, or habitat data to actual ecological conditions at the site. Species physiology, feeding patterns, and nesting

behavior are poorly predictable; therefore, toxicity information derived from toxicity testing, field studies, or observation will have uncertainties associated with them. Laboratory studies conducted to obtain site-specific, measured information often suffer from poor relevance to the actual exposure and uptake conditions on site (i.e., bioavailability, exposure, assimilation, etc., are generally greater under laboratory conditions as compared to field conditions). Calculating an estimated value based on a large number of assumptions is often the alternative to the accurate (but costly) method of direct field or laboratory observation, measurement, or testing. Finally, habitat- or site-specific species may be misidentified if, for example, the observational assessment results are based on one brief site reconnaissance.

7.6.2 Toxicity Values and Bioaccumulation Factors

Of most concern is the uncertainty associated with the EEQs based on thallium and chromium, the estimated hazard drivers for the site. The EEQ for thallium is quite elevated for two primary reasons: (1) an unrealistically low mammalian TRV; and (2) an unrealistically high earthworm bioaccumulation factor from soil used in the food-chain model. The thallium TRVs used for mammals are from Sample et al. (1996) and are based on a subchronic rat study for one dose that was used to derive a LOAEL for reproductive (male testicular function) effects. Due to the limitations of the study, an uncertainty factor of 100 was used by Sample et al. (1996) to estimate a NOAEL from a LOAEL and to estimate a chronic TRV from a subchronic study. An alternative rat study is available from Downs et al. (1960), however, that evaluates chronic thallium exposure to weanlings, with measured effects including weight loss, histological changes in skin, increase in kidney weights, increases in mortality, and hair loss. Use of the Downs et al. (1960) study results in a low mammalian TRV of 0.48 mg/kg-day (as adopted by *Development of Toxicity Reference Values for Conducting Ecological Risk Assessments at Naval Facilities in California* (Engineering Field Activity, West, 1998). This TRV is 65-fold higher than the Sample et al. (1996) thallium NOAEL TRV of 0.0074 mg/kg-day used in the current assessment. If this NOAEL of 0.48 mg/kg-day were multiplied by a factor of 5 to estimate a LOAEL, based on the recommended approach from Wentsel et al. (1996), this would result in a LOAEL of 2.4 mg/kg-day. This LOAEL TRV is 32-fold higher than the Sample et al. (1996) thallium LOAEL TRV of 0.074 mg/kg-day used in the current assessment.

The BAF/BCF values used for thallium uptake by earthworms in the current assessment are 3.2 for the conservative Tier 1 approach and 1.2 for the more realistic Tier 2 approach. The values are based, respectively, on the geometric mean of maximum and 90th percentile BAF/BCF values available for 18 inorganics from Sample et al. (1998) (**Appendix F-2, Table F-3**), as no literature BAF/BCF values are available for thallium itself. An alternative thallium BAF/BCF value may be estimated from data presented in the *Screening Level Ecological Risk Assessment Protocol* (USEPA, 1999b). This guidance presents alternative thallium BCF information, including a conservative default BCF of 0.22. The BCF of 0.22, however, is based on the assumption that thallium is as bioaccumulative as eight other inorganics (e.g., arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) for which empirical data are available. This is an overly conservative approach because thallium is not expected to be as bioaccumulative as these eight inorganics. Thallium is not listed as one of the Important Bioaccumulative Constituents, per Table 4.2 in *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment – Status and Needs* (USEPA, 2000c), whereas these other eight inorganics are listed.

USEPA (1999b) presents soil-to-earthworm BCFs for the eight inorganics listed in the previous paragraph, however, the BCF for cadmium is unusually elevated (e.g., 0.96) compared with the other seven inorganics (e.g., 0.11, 0.01, 0.04, 0.03, 0.04, 0.02, and 0.56 for an arithmetic average of 0.12). Cadmium may thus be excluded from a list of reasonable surrogate inorganics for thallium because cadmium is listed as having a high potential for terrestrial bioaccumulation, whereas the other inorganics, including thallium, are listed as having a moderate potential for terrestrial bioaccumulation (Table 2-1 in *Data Requirements and Confidence Indicators for Ecological Benchmarks Supporting Exemption Criteria for the Hazardous Waste Identification Rule* [USEPA, 1999c]). Therefore, using BCF data for inorganics from USEPA (1999b) and excluding cadmium, the average surrogate BCF for moderately bioaccumulative inorganics is 0.12, and this BCF may be conservatively used to estimate the soil-to-earthworm bioaccumulation factor for thallium.

The alternative BAF/BCF value for thallium of 0.12 is 27-fold and 10-fold lower than the Tier 1 and Tier 2 BAF/BCF values, respectively, used in the current assessment.

Use of these two alternative references for thallium (for TRVs and for BAF/BCF values) would result in modification of the Tier 2 thallium EEQs for mammals as follows:

- Change in LOAEL EEQ for thallium: $32 \times 10 = 320$ -fold reduction
- Change in NOAEL EEQ for thallium: $65 \times 10 = 650$ -fold reduction

This would reduce the short-tailed shrew Tier 2 NOAEL-based EEQ from 2,456 to approximately 4, and would reduce the short-tailed shrew Tier 2 LOAEL-based EEQ from 249 to approximately 0.8. Similar EEQ reductions would be expected for the meadow vole, resulting in revised EEQs less than 1. For the American robin the reduction in the EEQ would be from the use of the alternative BAF/BCF factor (as the robin's thallium TRV is not based on a mammalian toxicity study). Thus, the Tier 2 LOAEL-based EEQ for the robin, based on thallium, would be reduced from 8 to approximately 0.8.

Finally, thallium was detected in surface soil in three out of four samples for the current scenario, and in four out of seven samples for the future scenario (**Tables 7-10 and 7-11**). The maximum detected concentration (11.8 mg/kg) was used for both scenarios as the exposure point concentration due to the 95% UCL being greater than the maximum. This was a very conservative assumption and adds a great deal of uncertainty to the assessment, as it is very unlikely the maximum detected concentration of thallium is a realistic EPC.

The BAF/BCF values used for chromium uptake by earthworms in the current assessment are 11 for the conservative Tier 1 approach and 3.2 for the more realistic Tier 2 approach. An alternative chromium BAF/BCF value may be estimated from data presented in the *Screening Level Ecological Risk Assessment Protocol* (USEPA, 1999b). This guidance presents an alternative chromium BAF/BCF of 0.01. The alternative BAF/BCF value for chromium is 1,100-fold and 320-fold lower than the Tier 1 and Tier 2 BAF/BCF values, respectively, used in the current assessment. This would reduce the American robin Tier 2 NOAEL-based chromium EEQs of 79 - 90 to less than 0.1 and would reduce the American robin Tier 2 LOAEL-based chromium EEQs of 16 - 18 to less than 0.06.

Use of these alternative values for thallium and chromium would thus reduce receptor EEQs to less than 1, suggesting no adverse risks to ecological receptors.

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7.6.3 Historic Thallium Results

Due to suspected laboratory analysis associated with elevated concentrations of thallium (11.8 and 11.6 mg/kg) in two historic soil samples (e.g., 58SS1 and 58SS2, respectively), these two surface soil samples were recollected on 05 November 2003 (refer to *Section 3.5*). Thallium non-detect results of 0.227 and 0.271 mg/kg for replacement surface soil samples 58SS05 and 58SS06 demonstrated that the historic samples results from 58SS1 and 58SS2 were not repeatable. Substitution of the historic surface soil samples 58SS1 and 58SS2 with the results from the two new sample results (58SS05 and SS5806) would result in the following change in thallium EPCs:

Previous Thallium EPC (mg/kg)	Revised Thallium EPC (mg/kg)	Exposure Scenario	Reduction in EPC
11.8	0.18	Current	66-fold
11.8	0.73	Future	16-fold

Thus, the revised thallium EPCs would drop 66-fold for the current SLERA exposure scenario, and would drop 16-fold for the future SLERA exposure scenario. These thallium EPC reductions would translate into even further reductions in the EEQs estimated for the receptors evaluation in the SLERA. Use of these revised EPC values for thallium provide even stronger evidence that receptor EEQs are less than 1, further supporting that there are no adverse risks to ecological receptors.

7.6.4 Implications of 2003 Surface Soil Sample Results

As discussed in *Section 7.6.3*, two additional surface soil samples were collected on 05 November 2003 to verify suspect historic thallium results. In addition to thallium, these two samples were analyzed for TAL metals. The goal of the 05 November 2003 sampling event was to assess thallium; therefore, the results for the other inorganics have not been included in the quantitative SLERA. While this approach results in some uncertainty, a review of the inorganic constituent concentrations, excluding thallium that is discussed in *Section 7.6.3*, demonstrates that SLERA conclusions and recommendations would not change if results from these two samples were included in the quantitative SLERA.

7.6.5 Evaluation of Non-Detect Results

Constituents that were entirely non-detect in the surface soil current and future data sets were evaluated in **Appendix F-2, Tables F-28, F-29, and F-30**. Many constituents were not detected in surface soil analytical samples. To evaluate the uncertainty associated with these constituents' detection limits, the maximum detection limit for each non-detect constituent in this medium was compared with a conservative ecological toxicity screening value. **Appendix F-2, Table F-28** presents the selection of the ecological soil screening values used to screen the non-detect results, based on the lowest available screening value for both direct-contact and food-chain exposure scenarios. For food-chain exposure, ecological screening values were compiled from up to four sources, and for direct contact exposure BTAG screening values were used, as discussed in *Section 7.2.5*. For the current surface soil data set, 37 of the 147 non-detect constituents had maximum detection limits that exceeded the screening criteria (**Appendix F-2, Table F-29**). For the future surface soil data set, 56 of the 160 non-detect constituents had

maximum detection limits that exceeded the screening criteria (**Appendix F-2, Table F-30**). These findings are not unexpected, given the conservative and numerically low screening values.

7.6.6 Uncertainty Analysis Summary

The uncertainty analysis is presented in **Table 7-17** and lists some of the major assumptions made for the SLERA; the direction of bias caused by each assumption (i.e., if the uncertainty results in an overestimate or underestimate of risk); the likely magnitude of impact (quantitative [percent difference], or qualitative [high, medium, low, or unknown]); if possible, a description of recommendations for minimizing the identified uncertainties if the SLERA progresses to higher level assessment phases; and the ease of implementing the recommendation (USEPA, 1997b).

The uncertainty analysis identifies and, if possible, quantifies the uncertainty in the individual preliminary scoping assessment, problem formulation, exposure and effects assessment, and risk characterization phases of this SLERA. Based on this uncertainty analysis, the most important biases that may result in an overestimation of risk include the following:

- Assuming that COPECs are 100 percent bioavailable;
- Using some laboratory-derived or empirically-estimated partitioning and transfer factors to predict COPEC concentrations in plants, invertebrates, and prey species. This is especially important for thallium and chromium in soil uptake by earthworms;
- Using toxicity data from laboratory studies not based on a chronic exposure period, and/or without a NOAEL endpoint, thereby requiring the use of large uncertainty factors. This is especially important for mammalian exposure to thallium;
- Inclusion of sample outliers in the estimation of exposure point concentrations for risk drivers, in particular historic soil sample results for thallium; and,
- Use of the hazard quotient method to estimate risks to populations or communities.

7.7 Results and Conclusions

The data, results, and conclusions of the SLERA are described in this section. No recommendations concerning types of interim remedial measures to be conducted are given other than to present the specific interim remedial measure objectives, if any. Conclusions are derived from the risk assessment and are based on the responses to the assessment hypotheses and assessment endpoints. The assessment results are summarized in **Tables 7-13 and 7-14** for food chain exposure and **Tables 7-15 and 7-16** for direct contact exposure. The food chain assessment results initially suggested potential adverse impacts to terrestrial wildlife, especially shrews and American robins, for modeled food chain exposure to the hazard drivers (thallium and chromium) in surface soil. However, based on likely overestimates of (1) toxicity; (2) uptake of inorganics by earthworms from soil (especially for thallium and chromium); and, (3) thallium concentrations (discussed in detail in *Section 7.6* and demonstrating alternative EEQs less than 1), and on the fact that no wildlife RTE species have been confirmed at the SWMU 58 study area, no further action is recommended for the site for food chain exposure considerations. A similar recommendation of no further action results from the finding of limited potential for a reduction in terrestrial invertebrates that may serve as a food supply for higher order wildlife, based on direct contact considerations.

It is very important to note that many conservative assumptions and modeling approaches were used in the assessment, and actual hazards to wildlife may be orders of magnitude lower than predicted herein. Based on the results of the SLERA, no further action is recommended for SWMU 58.

Table 7-17
Uncertainty Analysis

Component	Bias	Magnitude	Ways to Minimize Uncertainty	Additional Comments
Use of 95% UCL as source-term concentration	Overestimates Risk	Medium	Use central tendency	Easy to implement, but may not be acceptable to Agency.
Assumption that soil depth interval of 0-2 ft is representative of surface soil	Overestimates Risk	Low to Medium	Resample to obtain additional samples 0-0.5 ft. for surface soil characterization	Moderately costly to implement.
Use of representative receptor species for site ecological community	Underestimates Risk	Low	Select additional receptor species	Easy to implement, but unlikely to change conclusions.
Use of conservative foraging factors (i.e., 100%) for some species	Overestimates Risk	Medium	Use more site-specific foraging factors, i.e., less than 100%	May be difficult to obtain site-specific foraging factors.
Assumption that COPECs are 100% bioavailable	Overestimates Risk	Medium to High	Obtain medium- and COPEC-specific bioavailability factors	Would be very difficult and costly to obtain these bioavailability factors.
Discounting of dermal and inhalation exposure routes	Underestimates Risk	Low	Include dermal and inhalation routes of exposure	Would be difficult to quantify these routes of exposure.
Use of partitioning and transfer factors to estimate COPEC concentrations in plants, invertebrates, and prey items.	Overestimates Risk	Medium to High	Measure COPEC concentrations in site plants, invertebrates, and other prey species, especially Tl and Cr.	Would be costly to implement.
Use of safety factors to convert subchronic LOAEL and LD ₅₀ toxicity data to NOAELs	Overestimates Risk	Medium to High	Obtain COPEC-specific chronic NOAEL data, especially for thallium.	Would be costly to implement, unless data available in the literature.

Component	Bias	Magnitude	Ways to Minimize Uncertainty	Additional Comments
Use of uncertainty factor of 8 to extrapolate TRVs between most species within the same class	Overestimates Risk	Medium	1) Assume TRVs similar for species in the same genus, family, or order; or 2) obtain species-specific NOAEL data	1) May not be accepted by Agency. 2) Would be very difficult to obtain species-specific NOAEL data.

Table 7-17 (Continued)
Uncertainty Analysis

Component	Bias	Magnitude	Ways to Minimize Uncertainty	Additional Comments
Use of surrogate constituents to estimate toxicity for those COPECs without available toxicity data	Overestimates Risk	Low to Medium	Obtain COPEC-specific toxicity data	Would be very costly to obtain COPEC-specific toxicity data, unless available in the literature.
Use of hazard quotient method to estimate risks to populations or communities may be biased	Overestimates Risk	High	Perform population or community studies	Would be very costly to perform.

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8.0 SUMMARY AND CONCLUSIONS

Additional environmental samples were collected during the 2002 RFI to supplement existing chemical data. The combined data set was evaluated to characterize the site for known elevated chemical concentrations (metals) and for chemical parameters not previously investigated (pesticides, PCBs, herbicides, explosives, and dioxins/furans).

The results of the nature and extent assessment (*Section 4.0*) indicate that pesticides, herbicides, PCBs, explosives, and dioxin/furans are not a concern at the site. Two organics [TCE and benzo(a)pyrene] were single exceedances above the residential RBC but below the industrial RBC. Borings below the pile and at other locations show that there are no elevated concentrations of VOCs or SVOCs in native soil below the pile indicating that these are isolated detections and there is no migration of these parameters from the Rubble Pile into soil below the pile. Two metals (iron and thallium) had concentrations above industrial RBCs in two samples each. The elevated concentrations of thallium in surface soil detected in the 1992 VI were not repeatable in two subsequent investigations, which included samples collocated at the former 1992 VI surface soil sampling locations. Therefore, thallium is not considered to be a concern at SWMU 58. The two exceedances of iron were detected at the soil/bedrock interface. Since iron exceedances were not detected in the Rubble Pile, it is believed that these concentrations are not site related. Sample 58SS04 was collected in a major surface water drainage area of the Rubble Pile. The lack of exceedances in this sample indicate that constituents of concern are not migrating from the Rubble Pile by surface water flow.

A HHRA (*Section 6.0*) was performed to evaluate the potential human health effects associated with past activities at SWMU 58. Using the results of the human exposure assessment and toxicity information, potential human health risks for each COPC and selected exposure pathway were evaluated. Results of the HHRA indicate that the cumulative cancer risk associated with both surface soil and total soil for maintenance workers, and total soil for excavation workers, adult residents, and child residents were below or within the USEPA target risk range of 1×10^{-6} to 1×10^{-4} . The non-carcinogenic HI was below 1 for maintenance workers, excavation workers, and adult residents. For child residents, the non-carcinogenic HI was equal to 1.1. However, there were no predominant COPCs representing non-carcinogenic hazards (i.e., no chemical HI was equal to or exceeded 1). TCE and benzo(a)pyrene were the risk drivers for the limited potential human health risk calculated.

A SLERA (*Section 7.0*) was performed to provide an estimate of current and future ecological risk associated with potential hazardous substance releases at SWMU 58. EEQs and hazard indices were estimated for five selected receptor species, and direct contact exposure for terrestrial invertebrates was assessed, as these invertebrates may serve as a food supply for some of the selected receptor species. Initial results indicated the potential for adverse effects to some of the five species. Thallium and chromium were the COPECs contributing the most to the Tier 2 HIs for the wildlife receptors (for those receptors with HIs greater than 1). However, based on likely overestimates of (1) toxicity; (2) uptake of inorganics by earthworms from soil (especially for thallium and chromium); and, (3) thallium concentrations (discussed in detail in *Section 7.6* and demonstrating alternative EEQs less than 1), and that no wildlife RTE species have been confirmed at the SWMU 58 study area, no further action is recommended for the site for food chain exposure considerations. A similar recommendation of no further action results from the

finding of limited potential for a reduction in terrestrial invertebrates that may serve as a food supply for higher order wildlife, based on direct contact considerations.

Because the nature and extent, human health, and ecological risk assessments conclude that there are no significant potential adverse human health or ecological risks associated with the Rubble Pile, this RFI recommends no further action for the SWMU 58 study area.

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Appendix A

Quality Assurance/Quality Control

This Appendix Contains:

Appendix A-1 Analytical Services and Procedures

Appendix A-2 Quality Assurance/Quality Control Evaluation

Appendix A-1

Analytical Services and Procedures

ANALYTICAL SERVICES AND PROCEDURES

ANALYTICAL SERVICES

The analytical services for the field investigation program were provided by the following USACE-validated laboratories:

- DataChem Laboratories (DCL), Salt Lake City, UT. DCL used USEPA-SW846, 3rd ed., Test Methods for Evaluating Solid Waste, Update III (USEPA, 1996b) methodologies in providing analytical support for this project for every parameter except dioxins/furans, total petroleum hydrocarbons (TPH), grain size, and total organic halides (TOX). These parameters were subcontracted by DCL. DCL used Standard Methods for the Examination of Water and Wastewater, 18th Edition (APHA, 1992) for hardness and USEPA Methods for Chemical Analysis of Water and Wastes (MCAWW) (USEPA, 1983) for perchlorate and chemical oxygen demand (COD).
- Southwest Laboratory of Oklahoma, Inc. (SWOK), Broken Arrow, OK. SWOK used USEPA-SW846, 3rd ed., Test Methods for Evaluating Solid Waste, Update III (USEPA, 1996b) methodologies in providing analytical support for dioxins/furans.
- Mountain States Analytical, Inc. (MSAI), Salt Lake City, UT. MSAI used USEPA-SW846, 3rd ed., Test Methods for Evaluating Solid Waste, Update III (USEPA, 1996b) methodologies in providing analytical support for TOX and used USEPA's Office of Water methodology (USEPA, 1999c) in providing analytical support for TPH.
- Applied Geotechnical Engineering Consultants, Inc. (AGEC), Sandy, UT. AGEC used American Society for Testing and Materials (ASTM) (ASTM, 1991) in providing support for grain size analysis.

ANALYTICAL PROCEDURES

Analytical protocols used were in accordance with USEPA-approved methods for the analysis of environmental (i.e., organic, inorganic, and physical parameters) and waste characterization samples. The methodologies for environmental samples are summarized in **Table A-1** and for waste characterization samples in **Table A-2**. A brief discussion of the methodologies is presented in the following sections below.

Organics

Target compound list (TCL) VOCs, TCL SVOCs, TCL pesticides, TCL polychlorinated biphenyls (PCBs), herbicides, explosives, including nitroglycerin (NG) and pentaerythritol tetranitrate (PETN), polynuclear aromatic hydrocarbons (PAHs), dioxins/furans, and total petroleum hydrocarbons (TPH) were analyzed using USEPA-approved methodologies. The laboratory procedures and methodologies for organic compounds are summarized below.

TCL VOCs. Samples were analyzed for TCL VOCs using USEPA SW-846 Method 5030B/8260B for aqueous samples and USEPA SW-846 5035B/8260B for solid matrices using purge and trap technology. Soil samples were collected using an EnCore sampling device and subsequently sent to the laboratory for analysis. No sodium bisulfate was added to the soils due to the possibility of effervescence and ketone formation. An inert gas is bubbled through a mixture of reagent water and 5 gram soil sample or through a 25 mL aqueous sample contained in a specifically designed purging chamber at 40°C for solid and ambient temperature for water. The vapor was swept through a sorbent column where the purgeable compounds were trapped.

Table A-1
Summary of Analytical Methods for Environmental Samples

Parameter	Matrix	Analytical Method
TCL VOCs	Aqueous	USEPA SW-846 5030B/8260B
	Solid	USEPA SW-846 5035B/8260B
TCL SVOCs	Aqueous	USEPA SW-846 3510C/8270C
	Solid	USEPA SW-846 3550C/8270C
TCL Pesticides	Aqueous	USEPA SW-846 3510C/8081A
	Solid	USEPA SW-846 3550C/8081A
TCL PCBs	Aqueous	USEPA SW-846 3510C/8082
	Solid	USEPA SW-846 3550C/8082
Herbicides	Aqueous	USEPA SW-846 8151A
	Solid	USEPA SW-846 8151A
Explosives	Aqueous	USEPA SW-846 8330
	Solid	USEPA SW-846 8330
Nitroglycerin	Aqueous	USEPA SW-846 8332
	Solid	USEPA SW-846 8332
PETN	Aqueous	USEPA SW-846 8332
	Solid	USEPA SW-846 8332
Polynuclear Aromatic Hydrocarbons	Aqueous	USEPA SW-846 3510C/8270C SIM
	Solid	USEPA SW-846 3550C/8270C SIM
Total Petroleum Hydrocarbons	Solid	USEPA 1664
TAL Metals	Aqueous	USEPA SW-846 3015A/6010B; 3010(Mod.)/6020; and 7470A
	Solid	USEPA SW-846 3051A/6010B; ILM05.0 Draft/6020; 7471A
TAL Dissolved Metals	Aqueous	USEPA SW-846 3015A/6010B; 3010(Mod.)/6020; and 7470A
Dioxins/Furans	Aqueous	USEPA SW-846 8290
	Solid	USEPA SW-846 8290
Perchlorate	Aqueous	USEPA 314.0
pH	Solid	USEPA SW-846 9045C
Grain Size	Solid	ASTM Method D-422
Hardness	Aqueous	SM 2340B (Calc.)
Total Organic Carbon	Aqueous	USEPA SW-846 9060A
	Solid	USEPA Lloyd Kahn
Total Organic Halides	Aqueous	USEPA SW-846 9020B
Asbestos	Solid	USEPA 600/R-93/116

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Table A-2
Summary of Analytical Methods for Waste Characterization Samples

Parameter	Matrix	Analytical Method
TCLP VOCs	Aqueous	USEPA SW-846 1311/5030B/8260B
	Solid	USEPA SW-846 1311/5030B//8260B
TCLP SVOCs	Aqueous	USEPA SW-846 1311/3510C/8270C
	Solid	USEPA SW-846 1311/3550C/8270C
TCLP Metals	Aqueous	USEPA SW-846 1311/3015A/6010B/7470A
	Solid	USEPA SW-846 1311/3015A/6010B/7471A
TCLP Pesticides	Aqueous	USEPA SW-846 1311/3510C/8081A
	Solid	USEPA SW-846 1311/3550C/8081A
TCL PCBs	Aqueous	USEPA SW-846 3510C/8082
	Solid	USEPA SW-846 3550C/8082
Chemical Oxygen Demand	Aqueous	USEPA 410.4
Corrosivity as pH	Aqueous	USEPA SW-846 9040B
	Solid	USEPA SW-846 9045C
Reactive Cyanide	Aqueous	USEPA SW-846 Chapter 7.3.3
	Solid	USEPA SW-846 Chapter 7.3.3
Reactive Sulfide	Aqueous	USEPA SW-846 Chapter 7.3.4
	Solid	USEPA SW-846 Chapter 7.3.4
Ignitability	Aqueous	USEPA SW-846 1010
	Solid	USEPA SW-846 Chapter 7.1.2.2

After purging was completed for both solid and aqueous samples, the sorbent column was heated and backflushed with the inert gas to desorb the purgeable compounds onto a gas chromatograph programmed to separate the purgeable compounds, which are then detected with a mass spectrometer.

TCL SVOCs/PAHs. Samples were analyzed for TCL SVOCs/PAHs using USEPA SW-846 Method 8270C. The use of selective ion monitoring (SIM) using USEPA SW-846 Method 8270C SIM was employed for PAH analysis to achieve lower quantitation and detection limits in order to meet screening criteria. Solid samples were extracted using soxhlet according to USEPA SW-846 Method 3550C and aqueous samples were extracted using a continuous liquid-liquid extraction technique according to USEPA SW-846 Method 3510C. The extract was injected into a gas chromatograph programmed to separate the compounds, which are then detected with a mass spectrometer.

TCL Pesticides/PCBs. Samples were analyzed for TCL pesticides using USEPA SW-846 Method 8081A and for TCL PCBs using USEPA SW-846 Method 8082. Aqueous and solid samples were prepared for analysis using extraction techniques. Solid samples were extracted using soxhlet method USEPA SW-846 Method 3550C for samples. Aqueous samples were extracted using a continuous liquid-liquid extraction technique by USEPA SW-846 Method

3510C. The extract was injected onto a gas chromatography programmed to separate the compounds, which are then detected with an electronic capture device (ECD). Sulfur cleanups were employed to aid in the quantification based upon the matrix interferences. Sample concentrations were confirmed on dissimilar columns.

Herbicides. Samples were analyzed for herbicides according to USEPA SW-846 Method 8151A. Aqueous and solid samples were extracted with diethyl ether and then esterified with diazomethane. The derivatives are determined by gas chromatography with an electron capture detector (GC/ECD). The results were reported as acid equivalents. Sample concentrations were confirmed on dissimilar columns.

Explosives. Samples were analyzed for explosives using USEPA SW-846 Method 8330. Aqueous samples of low concentration were extracted by a salting-out extraction procedure with acetonitrile and sodium chloride. The small volume of acetonitrile that remained undissolved above the salt water was drawn off and transferred to a smaller volumetric flask. It was back extracted by vigorous stirring with a specific volume of salt water. After equilibration, the phases were allowed to separate and the small volume of acetonitrile residing in the narrow neck of the volumetric flask was removed. The concentrated extract was diluted with reagent grade water, and an aliquot is separated on a C-18 reverse phase column. The wavelength was set at 254 nanometers and confirmed on a cyanide reverse column. Solid samples were extracted using acetonitrile in an ultrasonic bath, then filtered and chromatographed similarly to aqueous samples. Sample concentrations were confirmed on dissimilar columns.

NG/PETN. Samples were analyzed for NG/PETN using USEPA SW-846 Method 8332. Solid samples were extracted with acetonitrile in an ultrasonic bath, then filtered and mixed with a calcium chloride solution. Aqueous samples were extracted according to USEPA SW-846 Method 8330, using a double salting-out procedure with acetonitrile. The extract is mixed with calcium chloride just prior to analysis. The concentration was quantified using an isocratic HPLC system equipped with a column heater and UV detector. Sample concentrations were confirmed on dissimilar columns.

Dioxins/furans. Samples were analyzed for dioxin/furans using USEPA SW-846 Method 8290. The analytical method used high-resolution gas chromatography and high-resolution mass spectrometry (HRGC/HRMS) on purified sample extracts. This method is specific for the analysis of 2,3,7,8-tetrachlorinated dibenzofuran (2,3,7,8-TCDD), substituted penta-, hexa-, hepta- and octachlorinated dibenzo-p-dioxins and substituted penta-, hexa-, hepta- and octachlorinated dibenzofurans in water and solid samples. The extracts were injected onto a high-resolution gas chromatograph programmed to separate the compounds, which are then detected with a high-resolution mass spectrometer as confirmation.

TPH. Samples were analyzed for solids for TPH-Hexane Extractable Material (HEM) using USEPA Method 1664. A representative portion of soil sample was acidified and chemically dried with acidified sodium sulfate. The HEM was extracted with n-hexane using a sonication method. The n-hexane is then filtered into a pre-weighed vessel and evaporated. The vessel was desiccated and weighed. The HEM was re-dissolved in n-hexane. Silica gel was added to the HEM, shaken, filtered, and evaporated for silica gel treated-HEM determination.

Inorganics

Target analyte list (TAL) metals, mercury, cyanide, and hardness were analyzed using USEPA SW-846 methodologies. Perchlorate was analyzed using USEPA MCAWW methodologies. The laboratory procedures for inorganic compounds are summarized below.

TAL Metals/Hardness. TAL metals and hardness were analyzed using a combination of the following methodologies: inductively coupled plasma (ICP), ICP/ mass spectroscopy (MS), and cold vapor atomic absorption (CVAA). Trace metals were analyzed using USEPA SW-846 Methods 3015A/6010B and 3010(Mod.)/6020 for aqueous samples and Methods ILM05.0 Draft/6020 and 3051A/6010B for solid samples. Total hardness was calculated from the calcium and magnesium concentrations using Standard Method 2340B. The ICP method involved the simultaneous or sequential multi-element determination of trace elements in solution. The basis of the method is the measurement of atomic emission by optical spectrometry. Samples were nebulized and the aerosol that was produced was transported to the plasma torch where excitation occurs. Characteristic atomic-line emission spectra are produced by a radio-frequency ICP. A background correction technique was utilized to compensate for variable background contribution for the determination of trace elements.

Mercury was analyzed using CVAA according to USEPA SW-846 Method 7470A for aqueous samples and Method 7471A for solid samples. A sample aliquot was initially digested with nitric acid to free combined mercury. The mercury was then reduced to its elemental state and aerated from the solution into a closed system. The mercury vapor was passed through a cell positioned in the path of the mercury light source and the measured abundance was proportional to the concentration of mercury in the sample.

Perchlorate. Perchlorate was analyzed using ion chromatographic method USEPA MCAWW Method 314.0 for aqueous samples. Perchlorate was measured by the peak height or area generated from the sample elution through an anion separator column with a conductivity detector.

Waste Characterization

Samples collected to characterize investigative-derived materials were analyzed for hazardous waste characteristics using USEPA-approved methodologies, including toxicity characteristic leachate procedure (TCLP) VOCs, TCLP SVOCs, TCLP metals, TCLP pesticides, TCL PCBs, chemical oxygen demand (COD), corrosivity as pH, reactive cyanide, reactive sulfide, and ignitability. The laboratory procedures and methodologies are summarized below.

TCLP Extraction. Soil samples collected for material characterization were extracted using the USEPA SW-846 Method 1311. The final liquid extract was separated from the solid material and combined with the initial liquid phase (if applicable). The sample TCLP extract was then treated as an aqueous sample for analysis for VOCs, SVOCs, pesticides, and metals.

Reactivity. Reactivity comprises of reactive sulfide and reactive cyanide. Reactive sulfide was analyzed in aqueous and solid samples using USEPA SW-846 Method Chapter 7.3.4. This procedure was a colorimetric determination. Sulfide reacted with dimethyl-p-phenylenediamine in the presence of ferric chloride to produce methylene blue. Reactive cyanide was analyzed in aqueous and solid samples using USEPA SW-846 Method Chapter 7.3.3.

Ignitability. Ignitability was analyzed using USEPA SW-846 Method 1010 for aqueous samples and USEPA SW-846 Method Chapter 7.1.2.2 for solid samples. A sample was heated at a slow, constant rate with continual stirring. A small flame was directed into the cup at regular intervals with simultaneous interruption of stirring. The flash point was the lowest temperature at which application of the test flame ignited the vapor above the sample.

Corrosivity as pH. Corrosivity as pH was analyzed using USEPA SW-846 Method 9040B for aqueous samples and Method 9045C for solid samples. A sample pH was directly measured electrometrically using either a glass electrode in combination with a reference potential or a

combination electrode. For solids, samples were mixed 1:1 with reagent water prior to measurement.

COD. COD was analyzed using USEPA MCAWW Method 410.4. A sample was heated under acidic conditions at a slow, constant rate in an oven or block digester in the presence of dichromate at 150°C for two hours. The COD was measured at 600 nm spectrophotometrically.

Physical Analyses

Grain size. Grain size distribution was determined using ASTM Method D-422 for solid samples. A No. 200 sieve was used to separate particles larger than 75 micrometer (μm) from the soil, while the distribution of particles smaller than 75 μm was determined by a sedimentation process, using a hydrometer to secure the necessary data.

TOC. Samples were analyzed for TOC using the USEPA Kahn Method for solid samples. Samples were subjected to either a catalytic combustion or wet chemical oxidation to convert the organic carbon in the sample to carbon dioxide. The carbon dioxide formed was then measured directly by an infrared detector or converted to methane and measured by a flame ionization detector. The amount of carbon dioxide or methane produced was directly proportional to the concentration of carbonaceous material.

TOX. Aqueous samples were analyzed for TOX using USEPA SW-846 Method 9020B. Samples were passed through a conditioned column containing activated carbon, which adsorbs the organohalides. The activated carbon was then combusted to convert the organohalides to hydrogen halide, which was trapped and titrated electrolytically using a microcoulometric detector.

pH. Samples were analyzed for pH using USEPA SW-846 Method 9045C for solid samples. A sample pH was directly measured electrometrically using either a glass electrode in combination with a reference potential or a combination electrode. For solids, samples are mixed 1:1 with reagent water prior to measurement.

Asbestos. Samples were analyzed for asbestos using method USEPA 600/R-93/116. Samples were ground to insure homogeneity. A polarizing light microscope equipped with 10x and 16x objectives and a 10x eyepiece was used for the analysis. If present, asbestos identities were confirmed with the appropriate refractive index liquids applying dispersion staining techniques. The area percentages of asbestos and other fibrous constituents were estimated microscopically by a visual examination of the fibers with an aspect ratio of 3:1 or greater. For the purposes of the reports generated, fiberglass was defined as fibrous glass with parallel sides and mineral wool was defined as fibrous glass with nonparallel sides.

Appendix A-2
Quality Assurance/Quality Control Evaluation

QUALITY ASSURANCE/QUALITY CONTROL EVALUATION

An independent Quality Assurance Project Plan Addendum (QAPA) was developed as part of MWP Addendum 012 (IT, 2002a). The QAPA was implemented through the integration of well-defined quality control elements for activities associated with the task assignment. The quality control criteria defined for sampling and analysis activities were developed in conjunction with specifications contained in USACE EM200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans*, (USACE, 2001) as well as the USACE Shell Guidance for Analytical Chemistry (USACE, 1998).

Table A-3 outlines the data quality indicators as to their definitions, project goals, sampling and analytical assessments. Data quality was assessed through the evaluation of sampling activities and field measurements associated with the chemical analytical data in order to assess the reliability of the chemical analyses and the accuracy and precision of information acquired from the laboratory.

Table A-3
RFI Data Quality Indicators

Data Quality Indicator	Definition	Goal	Sampling Assessment	Analytical Assessment
Precision	Quantitative measure of the variability of a group of measurements in comparison to the average value	Low relative percent difference	Duplicate samples	MS/MSD or sample duplicate
Accuracy	Bias in a measurement system	Low bias	Blank contamination	Analysis spike results
Representativeness	Degree to which the measured results accurately reflect the medium being sampled	100%	Holding times, blanks, associated documentation	Inferred from accuracy, precision, and completeness evaluation
Completeness	Percentage of measurements which are judged to be usable	98±2%	Records review	Data validation
Comparability	Qualitative parameter expressing the confidence with which one data set can be compared with another	High	Work plans, quality documents	Analytical methods
Sensitivity	Quantitative measure of the level of detection and quantitation.	High	Review of analytical method or procedures and instrumentation	Analysis of MDL studies and practical quantitation limits per analytical method and matrix

Review of Documentation

The following documentation was required by the field investigation program in order to provide a quality assessment of data collected during routine investigative activities:

- **Field Logbooks:** Hardback logbooks with numbered pages were used to log daily activities, and data collected during the course of field activities. Designated logbooks

were also used to record calibration records and equipment maintenance as they were performed. Entries into field logbooks were evaluated for completeness and accuracy.

- **Field Parameter Forms:** Documentation of collected samples was provided to the laboratory on parameter forms developed by Shaw specifically for USACE investigations. Field Parameter Forms were electronically generated based on information recorded in field logbooks and were completed at the time of shipment to be included with the Chain-of-Custody for every sample, including QC samples. The completed forms contained the required information for encoding chemical data into ERIS database.
- **Chain-of-Custody:** Samples were collected and relinquished under stringent Chain-of-Custody protocols as specified in the project QA plan. A review of the Chain-of-Custody identified transcription errors that were corrected by drawing a single line through the incorrect information and subsequently correct information was supplied, dated, and initialed.
- **Sample Tracking Table:** Documentation of collected samples was recorded in an electronic sample tracking table on a daily basis. Field entries included the field sample identification, sample depth (where applicable), date collected, chain of custody and/or field parameter form number, and laboratory analyses requested.

Sampling activities were performed in compliance with standard operating procedures (SOPs) and each individual performing sampling was aware of the requisite protocols for collection of environmental samples. Each geologist was experienced in characterization of soil samples and soil sampling techniques.

Data Reporting

Data packages were provided to Shaw in CLP-like deliverables with electronic data deliverable files from the laboratory. Detected target compound values above the reporting limit and within the acceptable calibration range were reported as determined to no more than three significant figures. Target analytes detected below the lower calibration standard or reporting limit and above the method detection limit were reported as estimated values. Appropriate data qualifiers were applied during validation process and recorded in an electronic database.

Data Reduction and Validation

Data validation determines the acceptability or unacceptability of the data quality based on a set of pre-defined criteria. Data validation is defined as the systematic process for reviewing a data package against a set of criteria to provide assurance that the data is adequate for its intended uses. These criteria depend upon the type(s) of data involved and the purpose for which data are collected. The intended use of the data and the associated acceptance criteria for data quality was identified before the data collection effort began. Both the organic and inorganic chemical data (except for the waste characterization) were validated. The validation services for the sampling effort were performed using (as appropriate) USEPA-SW846, Third Edition, Test Methods for Evaluating Solid Waste, Update III (USEPA, 1996e), laboratory SOP, USEPA Region III Modification to the National Functional Guidelines for Organic Data Review, Multimedia, Multi-concentration (USEPA, 1994c), the USEPA Region III Modifications of the Functional Guidelines for Inorganic Data Review (USEPA, 1993b), and the USEPA Region III

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Dioxin/Furan Data Validation Guidance (USEPA, 1999d) in providing validation support for this project.

Data packages were validated to ensure compliance with specified analytical, Quality Assurance/Quality Control (QA/QC) requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria. This includes (as applicable), but is not limited to:

- Sample preservation and holding times;
- Instrument performance check;
- Calibration (initial and continuing);
- Blanks (calibration, preparatory, rinse, trip);
- Matrix spike and spike duplicate recoveries;
- Sample duplicate;
- Surrogate spike recoveries;
- Laboratory control samples;
- Interference check sample (for metals);
- Serial dilution (for metals);
- Internal standards and retention times (for GC/GC/MS/IC); and,
- Quantitative verification.

Results were assessed for accuracy and precision of laboratory analysis to identify the limitations and quantity of data. The data validation reports are presented on the CD located at the back of this report. The quality of the data collected in support of the sampling activity was considered acceptable, unless qualified rejected "R" during the validation process. Samples qualified "B" were considered non-detect at the MRL or level of blank contamination, whichever was greater. Samples qualified "J", "UJ", "L", "UL", or "K" were considered acceptable as estimated.

Data Review

Data obtained from both the laboratory and data validation were reviewed by the Shaw Project Chemist to assess whether the project-specific data quality objectives, as defined in the associated QAP, were met.

Data Quality Objectives

Data quality objectives were developed concurrently with the Work Plan to ensure: (1) the reliability of field sampling, chemical analyses, and physical analyses; (2) the collection of sufficient data; (3) the quality of data generated was acceptable for its intended use; and (4) valid assumptions could be inferred from the data. Attainment of data quality objectives was assessed through evaluation of data collected using the following data quality indicators:

- **Precision** - a quantitative measure of the variability of a group of measurements in comparison to the average value;
- **Accuracy** - the bias in a measurement system;

- **Representativeness** - the degree to which the measured results accurately reflect the medium being sampled. Representativeness will be assessed based on accuracy, precision, and completeness;
- **Completeness** - the percentage of measurements which are judged to be useable;
- **Comparability** - defined as a qualitative parameter expressing the confidence with which one data set can be compared with another; and,
- **Sensitivity** - describes the method detection, quantitation, and reporting limits. It also may be expressed as the slope of the analytical curve (intensity verses concentration).

Data quality was assessed through the evaluation of sampling activities and field measurements associated with the chemical data in order to verify the reliability of the chemical analyses and the accuracy and precision of information acquired from the laboratory.

Precision. Method or laboratory precision performed by the laboratory was evaluated during the validation process. Overall sampling or field precision was evaluated during the data review process. Precision is measured by calculating and evaluating the relative percent difference (RPD) between the results of field or laboratory duplicates. The RPD is calculated by the following equation:

$$RPD (\%) = \frac{|XA - XB|}{XM * 100}$$

Where:

XA and XB are duplicate analyses, and

XM is the mean value $[(XA + XB)/2]$ of the duplicate analyses.

The RPD was calculated for those analytes which were detected at levels exceeding the method detection limits in both samples of the duplicate pair. Analytes that were qualified because of blank contamination (B-qualified) or were rejected (R-qualified) in either sample of the duplicate pair were excluded from the duplicate assessment. Analytical results were qualified as estimated (J) for RPDs exceeding criteria for both the sample and its duplicate pair.

Laboratory duplicate sample determinations were used to demonstrate acceptable method precision by the laboratory at the time of analysis and evaluated. Laboratory precision was performed either on the sample and its duplicate pair or the matrix spike and its spike duplicate pair. Duplicate analyses were performed to generate data in order to assess the long-term precision of the analytical method on various matrices. RPDs must be within established control limits. Laboratory duplicate pairs or laboratory spiked duplicate pairs were evaluated. Laboratory duplicate pairs or laboratory spiked duplicate pairs were within specified precision criteria for each parameter and/or compound except for 2,4-D, 2,4-DB, dinoseb, cadmium, lead, thallium, and endrin aldehyde. Analytical results were qualified as estimated (J) for RPDs exceeding criteria for where the associated compounds were detected. While these parameters were qualified estimated due to the high RPDs, the data was still considered useable, the precision data quality goal was met, and the qualified data did not impact the data quality for the RFI. Further discussion may be found in the data validation reports located on the CD at the back of this report.

Field duplicates were collected site-wide during the RFI on a 10% frequency per matrix to identify the cumulative precision of the sampling and analytical process, which includes the homogenization of soil and sediment samples. Precision control criterion was established at 35% RPD for the soil samples. Field precision frequency was conducted on a site-wide basis. Field duplicates were not collected at Building 4343 because the site-wide 10% frequency had not yet been obtained for soil, therefore the precision data quality goal was met and no impact reflected toward the data quality for the RFI.

Accuracy. Accuracy is the measure of bias in a system. The accuracy of the results is measured by percent recovery (%R). Laboratory analytical accuracy was assessed through the use of laboratory blanks (method and instrument), rinse blanks, laboratory control samples (LCSs), and matrix spikes (MSs). Laboratory analytical accuracy was reviewed during the validation of data. Sampling accuracy was assessed by evaluating blank contamination and the impact of contaminant contributions originating from non-point sources, such as field sampling equipment decontamination procedures, or laboratory contamination. QC samples evaluated for this assessment included equipment blanks and laboratory method or preparatory blanks. The data validation qualifiers would be applied for analytical non-conformances as outlined in the USEPA Region III validation guidance. For non-spiked samples, accuracy was measured by the following equation:

$$\%R = \frac{\text{test value}}{\text{true value}} * 100$$

For spiked samples, accuracy was measured by the following equation:

$$\%R = \frac{\text{test value} - \text{spiked value}}{\text{true value}} * 100$$

Method blanks, laboratory control samples, matrix spikes, and rinse blanks discussion follows. Method blanks, laboratory control samples, matrix spikes, and rinse blanks were evaluated.

- **Method blanks.** A method blank is a volume of analyte-free water or soil that is processed through the entire analytical scheme (i.e., extraction, digestion, concentration, and analysis) as with the actual samples. Method blanks monitor potential laboratory-induced contamination. Results were qualified "B" for blank contamination by the laboratory and/or through the data validation process. In accordance with USEPA Region III data validation guidelines, reported sample results were considered "non-detect" and qualified with the letter "B" if the detected sample concentration was within 5 times (10 times for common laboratory contaminants: methylene chloride, acetone, 2-butanone, OCDD/OCDF, and common phthalate esters) the concentration in the associated method blank. The method blank contamination assessment was evaluated during the data validation process and may be found in the data validation reports located on the CD at the back of this report. Method blanks were calculated and compared

against the same matrix environmental samples on a batch specific basis. No unit conversions were necessary for method blanks since they were treated in the same manner as the samples. Calibration blanks were also compared against the environmental samples. Calibration blanks are aqueous samples and were reported in $\mu\text{g/L}$ or mg/L units. Performing blank assessments for solid matrix samples, action levels were calculated and expressed in soil units $\mu\text{g/kg}$ or mg/kg from the given aqueous rinse blank concentrations to be compared against actual solid sample concentrations. This conversion is dependent upon the method performed, sample amounts used, and final digestate or extract volumes used during the analytical analysis. Action levels were based upon 100% solids and 1x dilution factor and adjusted for each sample as appropriate. Method and calibration blanks were within specified criteria for each parameter and/or compound except for silver, magnesium, vanadium, lead, selenium, naphthalene, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, and TOC. Select samples were qualified "B" for silver, naphthalene, 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, and di-n-octylphthalate and were considered non-detect at the MRL or level of contamination, whichever was greater. While these parameters were qualified "B" due to the blank contamination, the data was still considered useable, the accuracy data quality goal was met, and the qualified data did not impact the data quality for the RFI.

- **Laboratory control sample.** The LCS was analyzed to assess general method performance by the ability of the laboratory to successfully recover the target analytes from a control matrix. The LCS is similar in composition to the method blank. For aqueous analyses, spiked analyte-free reagent water was used. For soil analyses, a purified solid matrix (e.g., sand, sodium sulfate, or other purified solid) was used. The LCS was spiked with single-component target analytes before it is carried through the preparation, cleanup, and determinative procedures. LCSs were performed at a rate of one per preparation batch per matrix. When samples were not subjected to a separate preparatory procedure (i.e., purge and trap VOC analyses, or aqueous Hg analysis), the CCV may have been used as the LCS, provided the CCV acceptance limits were used for evaluation. The results of the LCS were evaluated, in conjunction with other QC information during the data validation process to ascertain the acceptability of the data generated for that batch of samples. LCSs were within specified criteria for each parameter and/or compound except for 4-amino-2,6-dinitrotoluene, 2-butanone, acetone, cis-1,3-dichloropropene, and trans-1,3-dichloropropene. The LCS recoveries were high for these associated compounds. While LCS recoveries were outside criteria, the data was still considered useable, the accuracy data quality goal was met, and the qualified data did not impact the data quality for the RFI. Further details may be found in the data validation reports located on the CD at the back of this report.
- **Matrix spikes.** The MS was used to assess the performance of the method as applied to a particular project matrix. An MS is an environmental sample to which known concentrations of certain target analytes have been added before sample manipulation from the preparation, cleanup, and determinative procedures have been implemented. The original field sample was mixed or shaken to ensure homogeneous fractions when allowed by the method. MSs were performed at a rate of one per preparation batch or 5% whichever was more frequent per matrix. The results of the MS are evaluated, in

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conjunction with other QC information during the validation process to assess the effect of the matrix on the bias of the analysis. Matrix spikes and matrix spike duplicates were within specified criteria for each parameter and/or compound except for 2,4-DB, dicamba, dinoseb, zinc, antimony, mercury, endrin aldehyde, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, bromoform, chlorobenzene, dibromochloromethane, styrene, trichloroethene, cis-1,3-dichloropropene, and trans-1,3-dichloropropene. Samples were qualified as applicable. While qualification was applied due to high or low MS or MSD recoveries, the data was still considered useable, the accuracy data quality goal was met, and the qualified data did not impact the data quality for the RFI. Further details may be found in the data validation reports located on the CD at the back of this report.

- **Rinse blanks.** The blank contamination assessment was performed to assess the impact of contaminant contributions originating from non-point sources, such as field sampling equipment decontamination procedures. Rinse blanks are intended to identify cross-contamination between samples as a result of sampling equipment decontamination procedures. Rinse blanks were collected by pouring the required volume of deionized, organic-free water over the equipment and collecting the water in the appropriate sample containers. Rinse blanks were performed at a rate of one per 20 samples collected or 5% per matrix per sampling technique. The rinse blank results were evaluated to ascertain the efficiency of decontamination and assess the potential for cross-contamination. Rinse blanks were analyzed for the analytes of concern for the RFI. In accordance with USEPA Region III data validation guidelines, the detected concentration in the sample was qualified "B" for blank contamination and was considered non-detect if the sample concentration was within five times (10 times for common laboratory contaminants such as acetone, 2-butanone, methylene chloride, OCDD/OCDF, and phthalate esters) the concentration in the associated equipment blank. Rinse blanks are aqueous samples and were reported in µg/L or mg/L units. Performing blank assessments for solid matrix samples, action levels were calculated and expressed in soil units µg/kg or mg/kg from the given aqueous rinse blank concentrations to be compared against actual solid sample concentrations. This conversion is dependent upon the method performed, sample amounts used, and final digestate or extract volumes used during the analytical analysis. Action levels were based upon 100% solids and 1x dilution factor and adjusted for each sample as appropriate.
- Soil rinse blanks included samples 061102R, 061902R1, 071002R2, and 072502RB. The maximum concentration from these rinse blanks was used for this assessment. Rinse blanks were within specified criteria for each parameter and/or compound except for 1,3,5-trinitrobenzene, 2-nitrotoluene, 4-nitrotoluene, PETN, nitroglycerine, 2,4-DB, MCP, antimony, beryllium, cadmium, lead, calcium, chromium, iron, manganese, sodium, naphthalene, 2-methylnaphthalene, acenaphthene, 4,4'-DDE, 4,4'-DDT, lindane, phenol, benzyl alcohol, 2-methylphenol, 4-methylphenol, benzoic acid, diethylphthalate, di-n-butylphthalate, butylbenzylphthalate, bis(2-ethylhexyl)phthalate, acetone, carbon disulfide, methylene chloride, chloroform, carbon tetrachloride, bromodichloromethane, 4-methyl-2-pentanone, toluene, and m&p-xylene. Select samples were qualified "B" as applicable and were considered non-detect at the MRL or level of contamination, whichever was greater. While these parameters were qualified "B" due to the blank

contamination, the data was still considered useable, the accuracy data quality goal was met, and the qualified data did not impact the data quality for the RFI. A discussion of the blank results is provided within each validation report located on the CD at the back of this report. **Table A-4** indicates those data that are “B” flagged due to blank contamination and should be considered non-detect. Those compounds that were detected in both the blanks and the associated samples below the USEPA guidance blank action levels are listed.

Completeness. Completeness is a measure of the amount of information that must be collected during the field investigation to allow for successful achievement of the objectives. An adequate amount and type of data must be collected for conclusions to be valid. Missing data may reduce the precision of estimates or introduce bias, thus lowering the confidence level of the conclusions. While completeness has been historically presented as a percentage of the data that is considered usable, this does not take into account critical sample locations or critical analytical parameters.

The amount and type of data that may be lost due to sampling or analytical error cannot be predicted or evaluated in advance. The importance of lost or suspect data will be evaluated in terms of the sample location, analytical parameter, nature of the problem, decision to be made, and the consequence of an erroneous decision. Critical locations or parameters for which data is found to be inadequate will either be re-sampled and re-analyzed or the data will be appropriately qualified based on the decision of the project QA manager. The completeness goal percentage of usable data is set at 98+2%.

Sampling completeness was assessed through evaluation of the total number of samples proposed for collection in the work plan versus the actual number of samples collected and analyzed. Analytical completeness was assessed by comparing the number of useable data points collected to the total number of data points generated. Completeness is calculated using the following equations:

$$\% \text{ Sampling Completeness} = \frac{\text{No. of actual samples collected}}{\text{No. of proposed samples}}$$

$$\% \text{ Analytical Completeness} = \frac{\text{No. of usable data}}{\text{No. of requested analyses}}$$

For the purposes of this report, unusable data are defined to include rejected data points (“R” qualifier). No data points were rejected through the validation process.

One surface water and seven soil samples were proposed for collection at Building 4343 in MWP Addendum 12 (IT, 2002a). The field duplicate and rinse blanks were collected on a site-wide basis. Every soil sample was collected and analyzed for the parameters specified in the Work Plan.

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**Table A-4
B-Qualified Data Summary**

Field ID	Analyte	Result	Lab Q	Units
B43SB35A	Acenaphthene	5.5		UG/KG
B43SB35B	Naphthalene	1.7	JB*	UG/KG
B43SB34A	2-Methylnaphthalene	1.7	JB*	UG/KG
B43SB34A	Naphthalene	2.7	B*	UG/KG
B43SB34B	Naphthalene	2.0	JB*	UG/KG
B43SB35A	Bis(2-ethylhexyl)phthalate	53	JB*	UG/KG
B43SB35B	Bis(2-ethylhexyl)phthalate	86	JB*	UG/KG
B43SB35B	Di-n-octylphthalate	23	JB*	UG/KG
B43SB34A	Bis(2-ethylhexyl)phthalate	55	JB*	UG/KG
B43SB34A	Di-n-octylphthalate	51	JB*	UG/KG
B43SB34B	Bis(2-ethylhexyl)phthalate	66	JB*	UG/KG
B43SB34B	Di-n-octylphthalate	11	JB*	UG/KG
B43SB35B	Silver	0.80	B**	MG/KG
B43SB35B	Sodium	12.0	B**	MG/KG
B43SS01	Silver	0.69	B**	MG/KG
B43SS02	Silver	0.66	B**	MG/KG
B43SS02	Sodium	13.0	B**	MG/KG
B43SS03	Silver	0.73	B**	MG/KG
B43SS03	Sodium	8.50	B**	MG/KG
B43SB34B	Sodium	31.1		MG/KG
B43SS01	Antimony	0.39	B**	MG/KG
B43SS02	Antimony	0.20	B**	MG/KG
B43SS03	Antimony	0.20	B**	MG/KG

B* = the analyte or compound has been detected in the sample and laboratory method blank and/or associated field sample.

B** = Value <MRL and >MDL. Reported value may be biased (estimated).

J = Value <MRL and >MDL. Reported value may be biased (estimated).

Surface water sample B43SW01 was not collected due to the drought conditions at the time. The resulting sampling completeness quotient is 87.5%. Although this did not meet the completeness goal, the impact of the sampling completeness did not affect the data quality of the RFI.

The overall analytical percent completeness was also assessed by parameter group for the soil samples collected. Analysis of the soil samples resulted in the generation of 792 out of 792 data points determined to be useable, resulting in an overall analytical completeness quotient of 100%. The overall completeness percentages met the pre-defined goal of 98±2% for the soil sampling event.

Representativeness. Representativeness is a measure of the degree to which the measured results accurately reflect the medium being sampled. It is a qualitative parameter that is addressed through the proper design of the sampling program in terms of sample location, number of samples, and actual material collected as a “sample” of the whole.

Sampling protocols were developed to assure that samples collected are representative of the media. Field handling protocols (e.g., storage, handling in the field, and shipping) were designed to protect the representativeness of the collected samples. Proper field documentation and QC inspections were used to establish that protocols were followed and that sample identification and integrity was maintained and met pre-defined goals.

Comparability. Comparability is the confidence with which one data set can be compared to another. Comparability was controlled through the use of SOPs that have been developed to standardize the collection of measurements and samples and approved analytical technique with defined QC criteria. USEPA-approved methodologies were used in providing laboratory analytical support for this project. Laboratory SOPs were developed from these methods. Consistent and proper calibration of equipment throughout the field exercises, as described in the MQAP and QAPA, will assist in the comparability of measurements. Field documentation and QA audits were used to establish that protocols for sampling and measurement follow appropriate SOPs and met pre-defined goals.

Sensitivity (quantitation, reporting, and detection limits). The term sensitivity is used broadly to describe the method detection, quantitation, and reporting limits established to meet project-specific data quality objectives; and not limited to the definition which describes the capability of a method or instrument to discriminate between measurement responses. The method detection limits (MDLs) and the practical quantitation limits (PQLs) published within USEPA methods are based upon a reagent water matrix, and are not necessarily reflective of typical sample matrices; therefore, care was taken in establishing limits for laboratory analysis. Methods were selected based upon their sensitivity, technological, and economical considerations while keeping the screening values and available methodology in mind and were sufficient in meeting the given levels of concern (LOCs). Each target compound for every sample was reported at a specific method reporting limit (MRL). The target analytes detected above the MDL, but less than the MRL, were reported as estimated values "J". Target analytes detected above the upper calibration standard were diluted and analyzed within established calibration windows.

The MQLs and MDLs were compared at the onset of the project. The MDL is the minimum concentration of an analyte that can be measured and reported with a 99% confidence that the analyte is above zero and is identified from the analysis of a sample in a given matrix containing the analyte. The MDLs are derived by the method based upon 40 CFR (Code of Federal Regulations) Chapter 136 Appendix B. The MDL established using this procedure was used to assess the importance of the measurement of a future sample. The laboratory MDLs derived were less than the MQLs. The laboratory has statistically derived MDLs below the MQLs. The MDL values are different and change periodically because each MDL is laboratory, instrument, analyst, matrix, and method specific.

MQLs are the values at which the laboratory has demonstrated the ability to reliably quantitate the target value of an analyte for the method performed. MQLs are based upon the lowest calibration standard used for the initial calibration curve or the lowest verification standard performed. Data is calculated over a linear range. The highest concentration of the standards is truncated until linearity is achieved (minimum of three concentration levels must remain). The resulting highest concentration within the linear range represents the upper quantitation limit.

The laboratory used a MRL for each sample. The MRL is the USACE term for sample quantitation limit (USACE, 1998). The reporting limit is the threshold value below which the

laboratory reports non-detected values as “U,” “ND,” or “<” and will vary for each sample based upon dilution, sample volumes, percent moistures (for solids), and the method performed. Positive values found in blanks (method, rinse, and trip) above the MDL were reported. Positive results below the MRL and above the MDL were reported as estimated “J” for both inorganics and organics. The units for aqueous samples were µg/L and for solid samples were mg/kg, µg/kg, or ng/kg.

The method sensitivities (i.e., MDLs) were adequate to meet the data quality objectives for Building 4343, except for the following. Comparing against the soil screening levels (SSLs), compounds 1,1,2-trichloroethane, trichloroethene, vinyl chloride, cis-1,3-dichloropropene, trans-1,3-dichloropropene, 1,4-dichlorobenzene, 3,3'-dichlorobenzidine, bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, n-nitrosodi-n-propylamine, nitrobenzene, MCPA, MCPP, and arsenic had MDLs greater than the given SSLs for select samples. Comparing against the residential RBCs, MCPP, MCPA, vinyl chloride, and arsenic had MDLs greater than the given residential RBCs for select samples. Comparing against the industrial RBCs, MCPA had a MDL greater than the given industrial RBCs for select samples. Though an uncertainty may be present with these sensitivity gaps between the SSLs/RBCs and MDLs for these compounds, it is unlikely that they present an impact to the decisions regarding the RFI.

Levels Of Concern

An integral part of the identification of DQOs is the establishment of LOCs. These levels were compared with analytical method reporting limits prior to analytical method selection to ensure the method was capable of addressing project DQOs, preclude occurrence of false negative issues, and assess best available technology limitations. Although LOCs selected as potential concerns may not necessarily reflect RFI-specific objectives, they were developed to ensure that the chosen analytical methods have detection limits sensitive enough to achieve compliance with appropriate site-specific screening levels or other specified criteria for soil, sediment, and surface water. The laboratory MDLs were sufficient to meet (i.e., below) the LOCs for the Building 4343 RFI. LOCs for Building 4343 are based on soil applicable or relevant and appropriate requirements (ARARs) and To-Be-Considered Guidance (TBG). The soil TBC guidance includes:

- Facility-Wide Background inorganic concentrations (IT, 2001).
- USEPA Region III risk based concentrations (April, 2003).

Appendix B

Lithologic Boring Logs

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB1</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1742.56</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>22.5 ft.</u>
Drilling Method <u>3.25" HSA Truck Mounted Rig</u>	Start Date <u>04-02-98</u>
Logged By <u>L. Hass</u>	Finish Date <u>04-02-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/6in.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
		9-15			0-6", Soft red silt, some yellow mottling, 2.5YR 4/6, small (<2mm) gravel, roots.			Fill material, from surface to bedrock.
	14	24-21	0.0		6-9" Abrupt transition to hard dark brown silt with black gravel 7.5YR 4/4.			
					9-11" Concrete.			
		8-13			11-14" Very hard dark brown silt, 9.5YR 3/4, brittle, dry, with black gravel (<5mm).			
	12	13-14	0.0		0-2" asphalt gravel.			
					2-12" strong brown silt and clay, 7.5YR 4/6, hard, brittle, dry. Light color micaceous flecks and small (<1mm) black flecks.	ML		
5		4-18			0-2", Same as above.			
	12	20-24	0.0		2-12" Abrupt transition to black, hard, brittle, very dry silt with some gravel. Gravel is angular, black and crystalline.			
		8-8			0-6", Dark grayish brown silt and clay, 7.5YR 5/6, some small (<1mm) angular, buff gravel.			
	16	9-9	0.0		6-10", strong brown silt and clay, 10YR 3/2.			
					10-12", gray angular gravel (>2").			
					12-16" mottled orange and brown silt and sand.			
		5-4			Brownish yellow silt and clay with angular dark gray gravel <1/2 inch, 10YR 6/6, some black staining. Slight petroleum odor.	GM		
10	4	4-5	0.0		0-1" same as above.			
		4-5			1-4" dark brown mottled with red, gray, orange clay. Some gravel (<2mm).			
	4	4-5	0.0					
					Advanced augers to 15 ft. bgs. Cuttings were dark brown and plastic, silt and clay containing 1/4" clumps of black, fibrous material.	CL		
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RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB1</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1742.56</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>22.5 ft.</u>
Drilling Method <u>3.25" HSA Truck Mounted Rig</u>	Start Date <u>04-02-98</u>
Logged By <u>L. Hass</u>	Finish Date <u>04-02-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/6in.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
	6	3-6 7-7	0.0	58SB1A	Bottom ash, silver fibrous material, black coal chunks, dark brown silt and clay, 7.5YR 4/2. Transition to soft dark grayish brown silt, 2.5YR 4/2.			
	6	NA			Mottled red, black, brown silty clay with moderately low plasticity, moderately hard.	CL		
20	10	5-4 4-8	0.0		3" of fibrous material and plastic sheeting, 7" of coal gravel.			
					Advance augers to 22.5 ft.	GP		
25					Refusal at bedrock, End of Boring 22.5 ft. bgs.			
					NOTES: 1. Depths and elevations in feet unless otherwise noted. 2. USCS Classification based on visual-manual procedures.			
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RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG 237

Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB2</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1768.31</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>59 ft.</u>
Drilling Method <u>6" Air bit, Roller cone, Truck Mounted Rig</u>	Start Date <u>04-06-98</u>
Logged By <u>L. Hass/D. Batts</u>	Finish Date <u>04-07-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/6in.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
5					Cuttings 0-20 feet contain red silt, bottom ash, coal and concrete.	ML		Fill material from surface to 52-59 ft.
10					Advance Rods 5'-20' using 6" wing bit.			
15					Hit concrete 10-12 feet bgs.	SM		
20					Installed temporary casing 0-20 feet.			
25					Advance Rods 20-30 feet.			

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB2</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1768.31</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>59 ft.</u>
Drilling Method <u>6" Air bit, Roller cone, Truck Mounted Rig</u>	Start Date <u>04-06-98</u>
Logged By <u>L. Hass/D. Batts</u>	Finish Date <u>04-07-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/ft.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
30					Cuttings 20-30' contain red silt, trace small gravel.			
					Advance rods 30-40 feet.			
35					Cuttings 30-40 feet are red silt with trace rounded gravel.			
						SM		
40					Advance Rods 40-46 feet.			
					Cuttings same as above.			
45					0-12" Silt, brownish yellow mottled with gray, 10YR 6/6, black shiny flecks, moderate plasticity.			
	22	11-9 14-15	0.0	58SB2A 58SB2AD	12-16" dark brown silt and sand 7.5YR 4/4.			
					16-22" yellowish-red sand, 5YR 4/6, slight plasticity.			
50					Advance rods 46-50 feet.			

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

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Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB2</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1768.31</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>59 ft.</u>
Drilling Method <u>6" Air bit, Roller cone, Truck Mounted Rig</u>	Start Date <u>04-06-98</u>
Logged By <u>L. Hass/D. Batts</u>	Finish Date <u>04-07-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/ft.	PTD (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
	14	9-15 12-10	NA		Yellowish-red sand, 5YR 4/6, with some silt. Concrete in bottom of spoon.			
					Advance rods 50-55 feet.			
55	3	9-7 7-8	NA		Dark yellowish brown sand, silt and clay, 10YR 4/6, with trace gravel, low plasticity.	SM		55
	8	50/2	NA	58SB2B	Same as above.			
60					Bedrock at 59 ft. bgs.			60
					NOTES: 1. Depths and elevations in feet unless otherwise noted. 2. USCS Classification based on visual-manual procedures.			
65								65
70								70
75								75

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB3</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1751.71</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>40.5 ft.</u>
Drilling Method <u>6" Air Bit, Roller cone, Truck Mounted Rig</u>	Start Date <u>04-07-98</u>
Logged By <u>L. Hass/D. Batts</u>	Finish Date <u>04-08-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/6in. PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
5				Advance rods 0-12 feet using 6" wing bit.	ML/CL		Fill material from surface to unknown depth.
10							
15	8	21-20 18-12		0-3", Strong brown silty clay, 7.5YR 4/6, trace fine sand, mica, trace very fine gravel, med. to high plasticity, dry.			
				3-8", gray fine and medium loose sand with gravel (up to 1.5"), 7.5YR 6/2, angular to subrounded, dry. (Fill material)			
				Layer of gravel.			
	13	14-12 10-19	58SB3A	Very dark gray fine and medium sand with clay and some fine gravel, 10YR 3/1; grades down to all medium grained sand, wet to moist.	CL		
20				Advance rods with roller cone bit 15-20 feet bgs, and insert 20' of temporary casing.			
				Dark grayish brown mottled with strong brown fine sand and clay, 2.5YR 9/2, trace silt, trace fine gravel, low to medium plasticity, moist. Sand decreasing downward.			
				Same as above.			
	12	4-5 7-8					
	9	7-12 9-8					
	10	7-7 10-12		0-3" same as above, sand increasing downward.			
25							

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

Project Name <u>Radford Army Ammunition Plant D.O. 13</u>	Soil Boring Number <u>58SB3</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1751.71</u>
Drilling Firm <u>Hardin and Huber, Inc.</u>	Total Depth <u>40.5 ft.</u>
Drilling Method <u>6" Air Bit, Roller cone, Truck Mounted Rig</u>	Start Date <u>04-07-98</u>
Logged By <u>L. Hass/D. Batts</u>	Finish Date <u>04-08-98</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/6in.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
		12-12 15-20	0.0		3-10" strong brown fine sand and silt, slightly moist to dry, crumbly, trace medium grained sand, 10YR 4/6.			
	16				Same as above, with sand increasing downward.			
		4-7 6-10	0.0		Fine and medium strong brown sand, trace silt, slightly moist, crumbly.			
30	4				Same as above with 30% gravel (up to 1.25"), trace to little silt, wet.			
		8-6 7-5	0.0					
	6							
		3-3 3-3	0.0		Yellowish brown gravelly fine and medium sand, 10YR 5/8, trace silt, saturated.	CL		
	1							
35		11-10 15-14	0.0					
	0							
		21-5 4-9	NA		Strong brown clayey silt, 7.5YR 4/6, with trace fine sand, trace fine gravel, slightly moist, low to medium plasticity.			
	14				0-11" Clay, same as above.			
		8-24 50/4"	NA	58SB3B	11-16" very dark gray silty clay, 10YR 3/1, medium plasticity, going to very dark weathered bedrock in bottom 2".			
40	16							
		50/2"	NA		Spoon refusal and end of boring at 40.5 ft. bgs.			
	1				NOTES:			
45					1. Depths and elevations in feet unless otherwise noted.			
					2. USCS Classification based on visual-manual procedures.			
50								

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG

Project Name <u>Radford Army Ammunition Plant</u>	Soil Boring Number <u>58SB4</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1771.09</u>
Drilling Firm <u>Marshall Miller</u>	Total Depth <u>24 ft.</u>
Drilling Method <u>Truck Mounted Direct Push Rig</u>	Start Date <u>07-10-02</u>
Logged By <u>C. Tucker</u>	Finish Date <u>07-10-02</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/ft.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
			0.0	58SB4A	Yellowish red sand with small rocks/pebbles and organic matter, 5YR 4/6, dry.	SW		Fill material from surface to approximately 17 ft.
5					No description			
10								
15								

RADFORD ARMY AMMUNITION PLANT

SOIL BORING LOG yob

Project Name <u>Radford Army Ammunition Plant</u>	Soil Boring Number <u>58SB4</u>
Site Location <u>SWMU 58</u>	Ground Surface Elevation <u>1771.09</u>
Drilling Firm <u>Marshall Miller</u>	Total Depth <u>24 ft.</u>
Drilling Method <u>Truck Mounted Direct Push Rig</u>	Start Date <u>07-10-02</u>
Logged By <u>C. Tucker</u>	Finish Date <u>07-10-02</u>

Depth (ft bgs)	Split Spoon Sample Recovery (in)	Blows/6in.	PID (ppm)	Sample	Material Description	USCS Class.	Symbol	Remarks
					No description			
			0.0	58SB4B	Yellowish red clay, 5YR 4/6, soft, wet.	CL		
			0.0	58SB4C	Yellowish red clay with gray streaks, 5YR 4/6, stiff, moist.	CL		
20			0.0	58SB4D	Strong brown silty, sandy clay with some fine gravel, 7.5YR 4/6.	CL		
			0.0	58SB4D	Yellowish brown silty clay with fine gravel, 10YR 5/8.	CL		
25					End of Boring 24 ft. bgs.			
					NOTES:			
					1. Depths and elevations in feet unless otherwise noted.			
					2. USCS Classification based on visual-manual procedures.			
30								

BORING 32MW1

Surface Elevation: 1736.4 Feet

Location: Radford AAP, Virginia

Start: 2:11 on 10-30-91

Finish: 1:20 on 11-1-91

Depth (Feet)	Sampling Method	Sample No.	Blows/Foot	Core Run No.	% Recovery	RQD %	Sample Interval	Symbols	Description
0	SPT	1	24		65			SM	YELLOWISH RED (5YR 5/8) SILTY FINE SAND, MICACEOUS, TRACE BLACK COALY STAINING
5	SPT	2	15		50				YELLOWISH RED (5YR 5/8) SANDY GRAVEL, SLIGHTLY MOIST
10	SPT	3	52		65			GM	GRADES TO DARK YELLOWISH BROWN (10YR 4/4), WITH SOME SILT
15									COBBLE SEAM 13.5 TO 16.0 FEET
20								SM	STRONG BROWN SILTY SAND (7.5YR 5/6), VERY MOIST
25	NX			1	60	0			LIGHT OLIVE (2.5Y 5/4) CLAYEY SILTY SAND SEAM OVERLYING BEDROCK
30									HIGHLY WEATHERED BRECCIATED LIMESTONE, SOFT, WITH PIECES OF RED AND GREEN SHALE AND OCCASIONAL SILTSTONE AND SHALE SEAMS
35	NX			2	30	30		LS Shale	BECOMES 5Y 5/1 GRAY LIMESTONE BRECCIA WITH DUSKY RED (2.5YR 3/2) SHALE SEAMS, HIGHLY PITTED, SOFT BECOMES BRECCIATED, WITH ABUNDANT CALCITE INFILLING OF CRACKS AND PITS
40	AH	4							GREENISH GRAY, 5G 6/1 LIMESTONE, WITH OCCASIONAL SILTSTONE AND SHALE SEAMS
45	AH	5							BECOMING HARDER MORE COMPETENT LIMESTONE

PLATE
LOG OF BORING

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BORING 32MW1 (Cont'd)

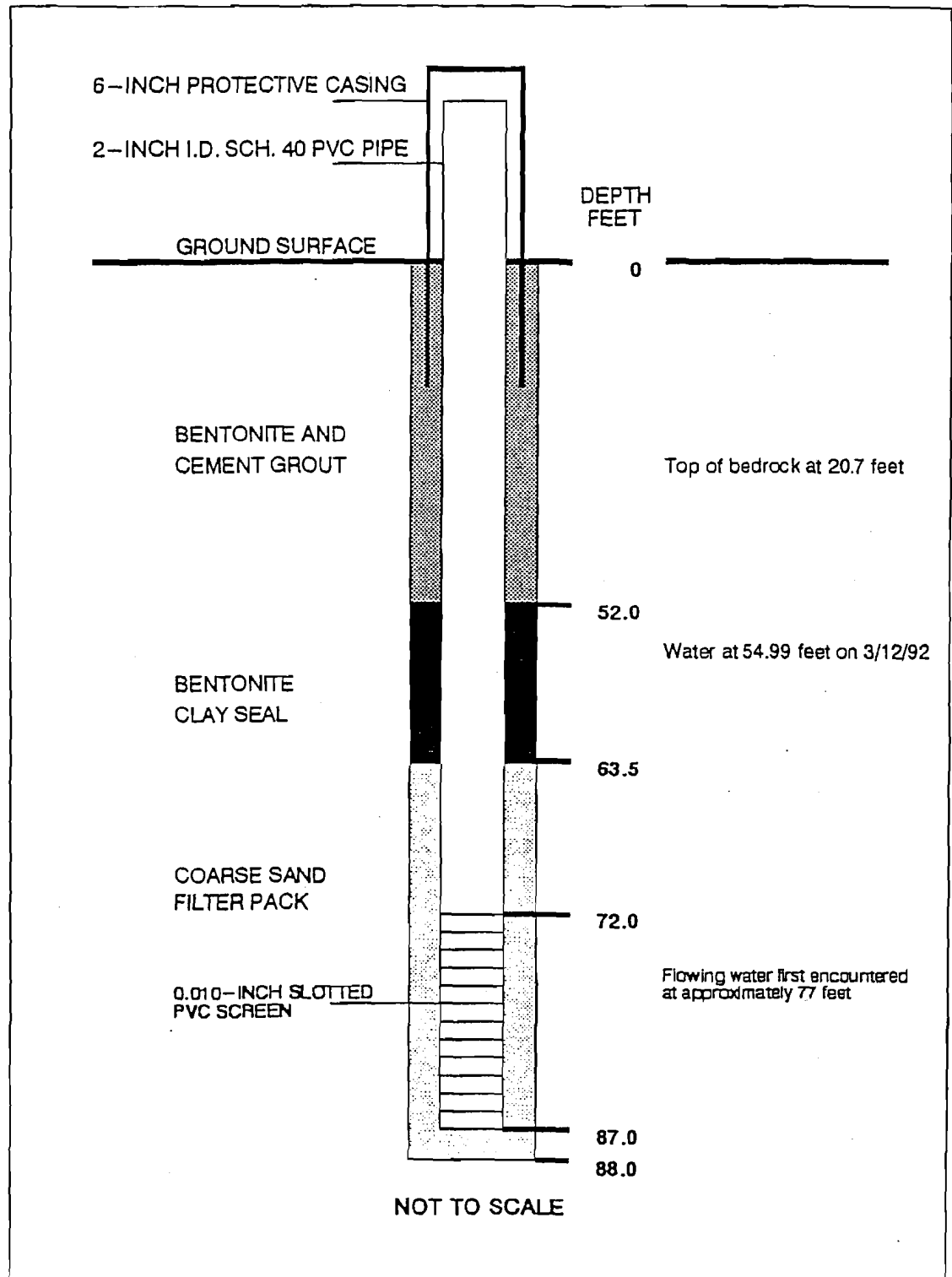
Depth (Feet)	Sampling Method	Sample No.	Blows/Foot	Core Run No.	% Recovery	RQD %	Sample Interval	Symbols	Description
40	AH	6							DRY LIMESTONE 5G61 GRAY, OCCASIONAL SOFT ZONES SILTSTONE AND SHALE
45	AH	7							GRADING SOFTER VERY SLIGHTLY MOIST, INCREASED SHALE
50	AH	8							CONTINUED SOFT LIMESTONE, BECOMING DARK GRAY 10YR 4/1
55	AH	9							GREENISH GRAY (5G 6/1) SILTY LIMESTONE, CONTINUED BEDS OF LIMESTONE, SHALE, AND SILTSTONE
60	AH	10						LS Shale	VERY DARK GRAY (10YR 5/1) LIMESTONE AND LIGHT GRAY (5G 6/1) SILTSTONE, ABUNDANT CALCITE PIECES
65	AH	11							DARK GRAY (2.5Y N/4) LIMESTONE BECOMING HARDER, SOME CLAY PARTINGS
70	AH	12							CUTTINGS ARE VERY SOFT DARK GRAY (2.5Y N/3) INTERBEDDED LIMESTONE AND SHALE
75	AH	13							BECOMING VERY MOIST, SILTY AND SANDY INTERBEDDED LIMESTONE AND SHALE
80	AH	14							WET AND MUDDY

BORING 32MW1 (Cont'd)

Depth (Feet)	Sampling Method	Sample No.	Blows/Foot	Core Run No.	% Recovery	RQD %	Sample Interval	Symbols	Description
80	AH 12								CONTINUED WET
85								LS Shale	
90									TERMINATE BOREHOLE AT A DEPTH OF 88.0 FEET

WELL INSTALLATION DIAGRAM
FOR VERIFICATION INVESTIGATION
RADFORD AAP, VIRGINIA

Location: 32MW1
Installation Date: 9/27/91
Surface Elevation: 1736.4 Feet
Top of PVC Elevation: 1738.31 Feet



Appendix C
Previous Investigation Analytical Data Tables

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Appendix C

Previous Investigation Analytical Data Tables Master Legend

12	J	Shading and black font indicates an industrial RBC exceedance
12	J	Bold outline indicates a residential RBC exceedance.
<u>12</u>	<u>J</u>	Bold, underlined font indicates a background exceedance.
12	J	Shading and white font indicates a SSL exceedance.
12	J	Mixed shading indicates an industrial RBC and a SSL exceedance.
12	12	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

RBCs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.

The pyrene RBCs and SSL were used for acenaphthylene, benzo(g,h,i)perylene and phenanthrene.

Inorganic results below background UTLs are not indicated as exceedances on the table.

RBC = Risk Based Concentration (April, 2003).

RBC values in table are for the more conservative chromium VI

RBC values for chromium III are 150,000 (ind) and 12,000 (res), which were not exceeded

Lead screening values from Technical Review Workgroup for Lead: Guidance Document (April, 1999)

mg/kg = milligrams per kilogram (parts per million).

ug/kg = micrograms per kilogram (parts per billion).

NA = not applicable.

NT = analyte not tested.

LQ = Lab Data Qualifiers

B = (organics) Blank contamination. Value detected in sample and associated blank.

B = (metals) Value <MRL and >MDL and is considered estimated.

E (metals) = Reported value is estimated because of the presence of interferences.

J = (organics) Value <MRL and >MDL and is considered estimated.

U = Analyte not-detected at the method reporting limit.

VQ = Validation Data Qualifiers:

B = blank contamination. Value detected in sample and associated blank.

J = estimated concentration

K = estimated concentration bias high

L = estimated concentration bias low

U = analyte not detected

UJ = estimated concentration non-detect

UL = estimated concentration non-detect bias low

Table C-1
SWMU 58 - VI Detected Soil Results - 1992

SITE ID	PQL mg/kg	Comparison Criteria				58SS1 RVFS*53 10-FEB-92	58SS2 RVFS*54 10-FEB-92	58SS3 RVFS*55 10-FEB-92
FIELD ID								
SAMPLING DATE								
DEPTH (ft)		Industrial	Residential	Facility-Wide	SSL Transfer	0-1	0-1	0-1
MATRIX		RBC	RBC	Background	Soil to GW	CSO	CSO	CSO
UNITS		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Metals								
Aluminum	14.1	100000	7800	40041	na	15200	18600	16400
Arsenic	30	1.9	0.43	15.8	0.026	3.8	7	7
Barium	1	7200	550	209	2100	69.9	49.2	67.3
Beryllium	0.2	200	16	1.02	1200	nd	1.2	nd
Calcium	100	na	na	na	na	1100	8040	5570
Chromium	4	310	23	65.3	42	42.7	38.1	27.6
Cobalt	3	2000	160	72.3	na	6	20.6	6.2
Copper	7	4100	310	53.5	11000	16.2	15.4	10.9
Iron	1000	31000	2300	50962	na	24900	26900	25300
Lead	2	750	400	26.8	na	nd	nd	16.3
Magnesium	50	na	na	na	na	751	10300	3900
Manganese	0.275	2000	160	2543	950	465	283	453
Mercury	0.1	31	2.3	0.13	na	0.1	nd	nd
Nickel	3	2000	160	62.8	na	15.8	26.5	8.9
Potassium	37.5	na	na	na	na	515	2590	1350
Sodium	150	na	na	na	na	151	188	171
Thallium	20	7.2	0.55	2.11	3.6	11.8	11.4	nd
Vanadium	0.775	720	55	108	5100	51.5	44.3	53.7
Zinc	30.2	31000	2300	202	14000	32.6	32.9	34.2

Note: Refer to the Master Table Legend at the beginning of this Appendix for a list of definitions and table notes

Table C-2
RFI Detected Results in Subsurface Soil - 1998

Analyte	Sample ID Sample Date Sample Depth				58SB1A 4/2/98 15-17					58SB1A2 4/8/98 15-17					58SB2A 4/6/98 46-48				
	i-RBC	r-RBC	Background	SSL Transfer	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																			
Acetone	10000000	780000	na	2500	22		B	5	5	690	B	B	5	5	1400	B	B	5	5
Ethylbenzene	10000000	780000	na	15000	3	J	J	5	5	760	U		760	760	750	U		750	750
Methylene Chloride	380000	85000	na	19	3	J	B	5	5	760	U		760	760	750	U		750	750
Trichloroethene	7200	1600	na	0.26	6	U		6	6	760	U		760	760	750	U		750	750
cis-1,2-Dichloroethene	1000000	78000	na	350	6	U		6	6	760	U		760	760	750	U		750	750
PAHs (ug/kg)																			
Anthracene	31000000	2300000	na	470000	200			10	10	NT					2	U		2	2
Benzo(a)anthracene	3900	870	na	1500	220			10	10	NT					2	U		2	2
Benzo(a)pyrene	390	87	na	370	240			10	10	NT					2	U		2	2
Benzo(b)fluoranthene	3900	870	na	4500	230			20	20	NT					3.9	U		3.9	3.9
Benzo(k)fluoranthene	39000	8700	na	45000	110			10	10	NT					2	U		2	2
Chrysene	390000	87000	na	150000	260			10	10	NT					2	U		2	2
Fluoranthene	4100000	310000	na	6300000	660			20	20	NT					4			3.9	3.9
Fluorene	4100000	310000	na	140000	48			20	20	NT					3.9	U		3.9	3.9
Indeno(1,2,3-cd)pyrene	3900	870	na	13000	58			10	10	NT					2	U		2	2
Phenanthrene	3100000	230000	na	680000	620			10	10	NT					2.2			2	2
Pyrene	3100000	230000	na	680000	650			10	10	NT					2	U		2	2
SVOCs (ug/kg)																			
Bis(2-ethylhexyl)phthalate	200000	46000	na	2900000	180	J	J	400	400	NT					400	U		400	400
Metals (mg/kg)																			
Aluminum	100000	7800	40041	na	29300			0.71	0.71	NT					25700			0.71	0.71
Antimony	41	3.1	na	13	1.3	B	J	0.6	0.6	NT					0.59	U		0.59	0.59
Arsenic	1.9	0.43	15.8	0.026	6.3			0.71	0.71	NT					9.6			0.71	0.71
Barium	7200	550	209	2100	76.1		L	0.12	0.12	NT					160		L	0.12	0.12
Beryllium	200	16	1.02	1200	0.56	B	B	0.12	0.12	NT					1.5		J	0.12	0.12
Calcium	na	na	na	na	11400			2.7	2.7	NT					1210			2.7	2.7
Chromium	310	23	65.3	42	30			0.12	0.12	NT					26.7			0.12	0.12
Cobalt	2000	160	72.3	na	9.6		L	0.12	0.12	NT					34.9		L	0.12	0.12
Copper	4100	310	53.5	11000	22.2		K	0.12	0.12	NT					11		B	0.12	0.12
Iron	31000	2300	50962	na	35900			2.1	2.1	NT					36300			2.1	2.1
Lead	750	400	26.8	na	27.6			0.24	0.24	NT					19.4			0.24	0.24
Magnesium	na	na	na	na	7410			3.7	3.7	NT					2460			3.7	3.7
Manganese	2000	160	2543	950	270			0.12	0.12	NT					181			0.12	0.12
Nickel	2000	160	62.8	na	13.6		K	0.12	0.12	NT					17.8		K	0.12	0.12
Potassium	na	na	na	na	1810		K	5.2	5.2	NT					1960		K	5.2	5.2
Silver	510	39	na	31	0.24	U		0.24	0.24	NT					0.24	U		0.24	0.24
Sodium	na	na	na	na	1770		K	3.6	3.6	NT					3690		K	3.5	3.5
Thallium	7.2	0.55	2.11	3.6	0.71	U		0.71	0.71	NT					0.71	U		0.71	0.71
Vanadium	720	55	108	5100	66.6		K	0.12	0.12	NT					50.1		K	0.12	0.12
Zinc	31000	2300	202	14000	59.1		K	0.24	0.24	NT					36.6		K	0.24	0.24

Note: Refer to the Master Table Legend at the beginning of this Appendix
for a list of definitions and table notes

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Table C-2
RFI Detected Results in Subsurface Soil - 1998

Analyte	Sample ID Sample Date Sample Depth				58SB2B 4/7/98 57-58					58SB3A 4/7/98 15-17					58SB3B 4/8/98 38-40				
	i-RBC	r-RBC	Background	SSL Transfer	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
VOCs (ug/kg)																			
Acetone	1000000	780000	na	2500	1200	B	B	5	5	810	B	B	5	5	920	U		920	920
Ethylbenzene	10000000	780000	na	15000	750	U		750	750	750	U		750	750	920	U		920	920
Methylene Chloride	380000	85000	na	19	750	U		750	750	750	U		750	750	920	U		920	920
Trichloroethene	7200	1600	na	0.26	750	U		750	750	750	U		750	750	920	U		920	920
cis-1,2-Dichloroethene	1000000	78000	na	350	750	U		750	750	750	U		750	750	920	U		920	920
PAHs (ug/kg)																			
Anthracene	31000000	2300000	na	470000	2.2	U		2.2	2.2	16	J	J	19	19	2.5	U		2.5	2.5
Benzo(a)anthracene	3900	870	na	1500	6.5			2.2	2.2	21			19	19	2.5	U		2.5	2.5
Benzo(a)pyrene	390	87	na	370	4.2			2.2	2.2	38			19	19	2.5	U		2.5	2.5
Benzo(b)fluoranthene	3900	870	na	4500	5.7			4.4	4.4	63			37	37	4.9	U		4.9	4.9
Benzo(k)fluoranthene	39000	8700	na	45000	2.5			2.2	2.2	53			19	19	2.5	U		2.5	2.5
Chrysene	390000	87000	na	150000	9.9			2.2	2.2	35			19	19	2.5	U		2.5	2.5
Fluoranthene	4100000	310000	na	6300000	12			4.4	4.4	100			37	37	4.9	U		4.9	4.9
Fluorene	4100000	310000	na	140000	4.4	U		4.4	4.4	24	J	J	37	37	4.9	U		4.9	4.9
Indeno(1,2,3-cd)pyrene	3900	870	na	13000	4.2			2.2	2.2	21			19	19	2.5	U		2.5	2.5
Phenanthrene	3100000	230000	na	680000	4			2.2	2.2	100			19	19	2.5	U		2.5	2.5
Pyrene	3100000	230000	na	680000	25			2.2	2.2	120			19	19	2.5	U		2.5	2.5
SVOCs (ug/kg)																			
Bis(2-ethylhexyl)phthalate	200000	46000	na	2900000	440	U		440	440	53	J	J	400	400	490	U		490	490
Metals (mg/kg)																			
Aluminum	100000	7800	40041	na	17200			0.79	0.79	12600			0.69	0.69	36500			0.88	0.88
Antimony	41	3.1	na	13	1.6	B	J	0.66	0.66	0.87	B	J	0.58	0.58	1.5	B	J	0.73	0.73
Arsenic	1.9	0.43	15.8	0.026	11.8			0.79	0.79	5			0.69	0.69	12.6			0.88	0.88
Barium	7200	550	209	2100	80.7		L	0.13	0.13	62.4		L	0.12	0.12	144		L	0.15	0.15
Beryllium	200	16	1.02	1200	1.3			0.13	0.13	0.7		B	0.12	0.12	2.7		J	0.15	0.15
Calcium	na	na	na	na	5690			3	3	82700			2.7	2.7	5340			3.4	3.4
Chromium	310	23	65.3	42	32.6			0.13	0.13	20.6			0.12	0.12	33.3			0.15	0.15
Cobalt	2000	160	72.3	na	12.6		L	0.13	0.13	6		L	0.12	0.12	10		L	0.15	0.15
Copper	4100	310	53.5	11000	35.7		K	0.13	0.13	17.9		K	0.12	0.12	43		K	0.15	0.15
Iron	31000	2300	50962	na	51000			2.4	2.4	16300			2.1	2.1	64200			2.6	2.6
Lead	750	400	26.8	na	18.3			0.26	0.26	28.4			0.23	0.23	23.5			0.29	0.29
Magnesium	na	na	na	na	9450			4.1	4.1	42100			3.6	3.6	5460			4.6	4.6
Manganese	2000	160	2543	950	575			0.13	0.13	254			0.12	0.12	1110		J	0.15	0.15
Nickel	2000	160	62.8	na	29.9		K	0.13	0.13	10.8		K	0.12	0.12	32.4		K	0.15	0.15
Potassium	na	na	na	na	3140		K	5.8	5.8	2300		K	5.1	5.1	2860		K	6.5	6.5
Silver	510	39	na	31	0.26	U		0.26	0.26	0.23	U		0.23	0.23	0.37	B	K	0.29	0.29
Sodium	na	na	na	na	269	B	K	4	4	268	B	K	3.5	3.5	215	B	J	4.4	4.4
Thallium	7.2	0.55	2.11	3.6	1.2	B	K	0.79	0.79	0.69	U		0.69	0.69	0.88	U		0.88	0.88
Vanadium	720	55	108	5100	52.3		K	0.13	0.13	33.7		K	0.12	0.12	101		K	0.15	0.15
Zinc	31000	2300	202	14000	134		K	0.26	0.26	40.3		K	0.23	0.23	96.2		K	0.29	0.29

Note: Refer to the Master Table Legend at the beginning of this Appendix
for a list of definitions and table notes

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Appendix D

Sample Location Coordinates and Elevations and Confirmation Samples for Thallium Detections

This Appendix Contains:

Appendix D-1 Sample Location Coordinates and Elevations

Appendix D-2 Confirmation Samples for Thallium Detections

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Appendix D-1

Sample Location Coordinates and Elevations

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RFI/RI Sample Location Coordinates and Elevations

Site ID	Northing	Easting	Elevation
Bag Loading Area			
BLASB01	283759.34	1368917.41	2084.76
BLASB02	283502.61	1368951.35	2084.35
BLASB03	283341.75	1369107.91	2084.86
BLASD01	283903.51	1369209.54	2073.65
BLASD02	283115.70	1368168.26	2072.20
BLASW/SD04	283971.07	1367733.04	2003.67
BLASW/SD05	284400.83	1368617.19	1994.87
BLASS01	283735.43	1368904.58	2087.90
BLASS02	283747.77	1368919.86	2085.32
BLASS03	283723.57	1369027.29	2088.47
BLASS04	283732.33	1368791.41	2086.38
BLASS05	283590.26	1368532.63	2086.33
BLASS06	283353.92	1368682.97	2086.15
BLASS07	283109.21	1368757.63	2082.85
BLASS08	283247.04	1369015.59	2068.37
BLASS09	283468.23	1369148.14	2086.32
BLASS10	283521.12	1369131.36	2085.47
BLASS11	283651.84	1369055.02	2081.54
BLATR01	283784.45	1368843.33	2084.80
BLATR02	283690.21	1369522.45	2076.28
BLATR03	283241.96	1369122.06	2084.10
Building Debris Disposal Trench			
DTSB46	284166.38	1371883.27	1960.03
DTSB47	284128.88	1371950.70	1958.73
DTSW/SD05	284005.92	1372244.52	1952.75
DTSW/SD06	284086.19	1372031.44	1954.19
DTSW/SD07	284096.56	1371844.27	1953.76
DTSW/SD08	284144.86	1371572.38	1956.36
DTSW/SD09	284186.47	1371237.62	1958.86
DTSW/SD10	283930.50	1372438.79	1948.05
Igniter Assembly Area			
IASB06	286793.22	1366464.42	2127.94
IASB07	286836.19	1366537.77	2127.80
IASB08	286844.39	1366540.86	2128.29
IASB09	286836.85	1366552.22	2122.26
IASB10	286914.21	1366737.27	2124.12
IASB11	286979.25	1366847.43	2120.85
IASB12	287192.44	1367238.81	2121.22
IASB13	286025.74	1367290.50	2112.37
IASB14	286028.60	1367313.30	2107.72
IASB15	286008.67	1367303.03	2108.68
IASD04	287910.37	1367497.94	2114.74
IASD05	287657.23	1367299.29	2118.76
IASD06	287170.01	1367537.44	2108.59
IASD07	286025.18	1367841.73	2080.95
IASD08	286514.15	1366312.47	2105.73

RFI/RI Sample Location Coordinates and Elevations

Site ID	Northing	Easting	Elevation
IASD09	286338.22	1366718.88	2122.81
IASD10	285779.61	1367016.88	2111.93
IASD11	286747.03	1366543.95	2126.90
IASD12	286943.25	1366899.46	2119.96
IASS01	286917.34	1366709.66	2123.41
IASS02	286897.08	1366725.28	2121.09
IASS03	286988.86	1366823.72	2121.87
IASS04	286947.80	1366843.37	2123.94
IASS05	286894.43	1367088.92	2126.78
IATR01	287823.59	1367495.93	2122.32
IATR02	287109.19	1366902.82	2126.63
IATR03	286905.87	1366899.75	2128.09
IATR04	287025.14	1367291.87	2121.66
IATR05	286459.03	1367090.96	2118.92
IATR06	286083.39	1367320.73	2109.75
IATR07	286161.33	1367703.26	2093.21
IATR08	285414.85	1366624.76	2081.53
Northern Burning Ground			
NBGSB11	288870.45	1368833.53	2154.81
NBGSB12	288871.04	1368826.40	2118.54
NBGSB13	288885.28	1368831.82	2128.63
NBGSB14	288893.22	1368805.31	2115.73
NBGSB15	288922.64	1368810.35	2110.33
NBGSB16	288859.88	1368801.27	2135.99
NBGSB17	288818.07	1368645.78	2130.78
NBGSB18	288797.04	1368646.91	2122.95
NBGSB19	288801.32	1368670.82	2130.48
NBGSD01	289003.59	1368849.12	2101.81
Rail Yard			
RYSB08	286615.43	1368757.30	2041.52
RYSB09	284542.93	1367320.88	2033.13
RYSD01	286830.09	1369221.73	2030.06
RYSW/SD03	286473.61	1369453.72	2013.26
RYSW/SD04	286368.75	1369597.05	2016.95
RYSW/SD05	286264.79	1369793.40	2002.11
RYSD06	284899.91	1370631.43	1971.93
RYSD07	285279.54	1368461.72	2039.99
RYSD08	284683.05	1368403.52	2003.63
RYSD09	284540.72	1367223.66	2035.61
RYSD10	284362.09	1366945.98	2037.34
RYSW/SD12	284208.69	1367255.84	2013.41
RYSW/SD13	283950.73	1367533.00	2007.47
RYSS01	285974.05	1368568.78	2045.32
RYSS02	285178.41	1368053.61	2047.59
RYSS03	284855.42	1368029.77	2041.99
RYSS04	286911.05	1369352.62	2048.07

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RFI/RI Sample Location Coordinates and Elevations

Site ID	Northing	Easting	Elevation
RYSS05	286849.89	1369465.50	2048.13
RYSS06	286296.66	1368624.47	2043.12
RYSS07	286140.09	1369021.93	2054.61
RYSS08	286142.52	1368914.54	2047.75
RYSS09	285772.89	1368473.07	2043.17
RYSS10	285630.88	1368573.94	2039.95
RYSS11	285640.85	1368771.27	2042.85
RYSS12	285400.47	1368530.00	2043.83
RYSS13	285181.89	1367961.93	2045.67
RYSS14	284630.09	1367511.38	2039.10
RYSS15	284796.18	1367441.78	2046.45
RYSS16	284074.95	1366562.65	2065.39
RYSW02	286579.33	1369337.92	2020.67
RYSW15	284877.53	1368094.86	2049.27
RYTR01	286633.00	1369318.92	2044.84
RYTR02	285973.88	1369088.62	2046.17
RYTR03	284670.93	1367814.54	2048.24
Western Burning Ground			
WBGSB22	284851.29	1366227.70	2059.31
WBGSB23	284790.45	1366222.56	2047.80
WBGSB24	284961.73	1366250.12	2051.85
WBGSB25	284935.45	1366172.97	2042.82
WBGSW/SD07	284894.86	1365981.81	2035.08
WBGSW/SD08	284475.46	1366635.69	2031.46
WBGSW/SD09	284307.45	1366821.35	2023.52
WBGSW/SD10	284671.29	1366304.58	2033.71
WBGSD11	284645.80	1366262.78	2041.21
WBGSD12	284767.63	1366126.27	2038.34
WBGSW/SD13	284429.37	1366592.28	2027.15
WBGSW/SD14	283749.40	1367174.17	2013.71
WBGSW/SD15	284590.53	1365617.15	2043.91
SWMU 31			
31SB5	319274.11	1397144.57	1696.65
31SE07	319082.44	1396997.74	1678.92
31SE08	319195.52	1397149.85	1687.90
31SE09	319115.09	1397190.57	1685.51
31SE10	319032.18	1397061.01	1685.90
31SE11	319259.24	1397221.85	1684.85
31SE12	319285.59	1397386.15	1686.62
31SE13	319336.53	1397453.76	1693.18
31SE14	319395.27	1397412.05	1692.46
31SW10	319032.18	1397061.01	1685.90
31SW12	319285.59	1397386.15	1686.62
31SW14	319375.01	1397477.91	1693.98
SWMU 39			
39SS08	321302.51	1403422.04	1700.60

RFI/RI Sample Location Coordinates and Elevations

Site ID	Northing	Easting	Elevation
39SS07	321268.19	1403446.59	1701.35
39SB05	321280.53	1403572.97	1695.95
39SS10	321191.31	1403579.29	1701.35
39SB06	321168.54	1403484.18	1697.50
39SS12	321132.53	1403758.27	1700.54
39SS09	321359.21	1403646.31	1701.70
39SS11	321111.42	1403466.10	1698.86
SWMU 48			
48SB08	319794.89	1409321.52	1821.46
48SB09	319798.39	1409276.73	1818.62
48SB10	319883.83	1409354.18	1829.80
SWMU 49			
49SB02	319580.55	1409695.49	1822.51
49SS01	319564.90	1409729.76	1826.82
SWMU 50			
50SB04	319589.68	1409465.00	1817.07
50SB05	319535.10	1409565.65	1817.72
50SS01	319720.75	1409575.01	1817.54
50SS02	319594.60	1409300.53	1813.66
50SS03	319490.84	1409427.01	1814.32
SWMU 58			
58SB04	320598.06	1404050.91	1771.09
58SS04	320789.00	1404151.25	1736.95
SWMU 59			
59SB01	319758.86	1409727.32	1822.39
59SS03	319836.99	1409715.36	1826.83
59SS04	319833.15	1409669.00	1827.62
59SS05	319657.37	1409707.51	1822.70
Building 4343			
B43SB34	318498.04	1399103.57	1810.50
B43SB35	318221.52	1399079.40	1832.03
B43SS01	318172.98	1399050.16	1831.32
B43SS02	318551.51	1399055.04	1807.16
B43SS03	318560.34	1399094.03	1810.54
Former Lead Furnace Area			
LFSB12	313403.07	1404006.95	1885.30
LFSB13	313283.58	1403971.45	1875.13
LFSB14	313268.78	1404005.57	1888.08
LFSB15	313253.86	1403925.02	1875.74
LFSB16	313298.16	1403964.35	1871.75
LFSB17	313320.86	1403964.67	1872.85
LFSS01	313377.33	1403978.38	1875.17
LFSS02	313309.24	1404015.18	1888.10
LFSS03	313242.30	1403943.03	1880.75

Appendix D-2
Confirmation Samples for Thallium Detections

Table D-1
Confirmation Samples for Thallium Detections

Analyte	Sample ID Sample Date Sample Depth				58SS05 11/5/03 0-0.5					58SS06 11/5/03 0-0.5				
	i-RBC	r-RBC	Background	SSL Transfer	Result	Lab Q	Val Q	MDL	MRL	Result	Lab Q	Val Q	MDL	MRL
Metals (mg/kg)														
Aluminum	100000	7800	40041	na	30900			5.7	22.7	60500			6.8	27.1
Antimony	41	3.1	na	13	0.567	U	UL	0.19	0.567	0.678	U		0.23	0.678
Arsenic	1.9	0.43	15.8	0.026	3.15			0.76	2.27	2.1	B	J	0.91	2.71
Barium	7200	550	209	2100	79			0.57	2.27	161			0.68	2.71
Beryllium	200	16	1.02	1200	1.02	U		0.31	1.02	1.22	U		0.37	1.22
Cadmium	51	3.9	0.69	27	0.567	U		0.037	0.567	0.678	U		0.045	0.678
Calcium	na	na	na	na	1200			3.4	11.3	1450			4.1	13.6
Chromium	310	23	65.3	42	27			0.57	2.27	42			0.68	2.71
Cobalt	2000	160	72.3	na	11.4			1.1	5.67	16.2			1.4	6.78
Copper	4100	310	53.5	11000	29.4		J	0.57	2.27	23.1			0.68	2.71
Iron	31000	2300	50962	na	22400			3.4	11.3	38500			4.1	13.6
Lead	750	400	26.8	na	13.1			0.023	0.227	19.9			0.027	0.271
Magnesium	na	na	na	na	1620			3.4	11.3	3780			4.1	13.6
Manganese	2000	160	2543	950	186		K	0.34	1.13	446			0.41	1.36
Mercury	31	2.3	0.13	na	<u>0.179</u>			0.0117	0.0567	0.114			0.014	0.0678
Nickel	2000	160	62.8	na	17.5			1.7	5.67	28.4			2	6.78
Potassium	na	na	na	na	2450			79	567	4710			95	678
Selenium	510	39	na	19	11.3	U	UL	3.9	11.3	13.6	U		4.7	13.6
Silver	510	39	na	31	2.27	U		0.57	2.27	2.71	U		0.68	2.71
Sodium	na	na	na	na	79.4			6.8	22.7	133			8.1	27.1
Thallium	7.2	0.55	2.11	3.6	0.227	U		0.025	0.227	0.271	U		0.03	0.271
Vanadium	31	2.3	108	220	51.6			1.7	5.67	91.6			2	6.78
Zinc	31000	2300	202	14000	38.5			1.1	3.4	70.2			1.4	4.07

Note: Refer to the Table Legend following this table for a list of definitions and table notes

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Appendix D-2

Table D-1 Legend

12	J	Shading and black font indicates an industrial RBC exceedance
12	J	Bold outline indicates a residential RBC exceedance.
<u>12</u>	<u>J</u>	Bold, underlined font indicates a background exceedance.
12	J	Shading and white font indicates a SSL exceedance.
12	J	Mixed shading indicates an industrial RBC and a SSL exceedance.
12	12	Shading in the MDL/MRL columns indicates the MDL exceeds a criterion.

RBCs for non-Carcinogenic compounds have been recalculated to an HI of 0.1.

The pyrene RBCs and SSL were used for acenaphthylene, benzo(g,h,i)perylene and phenanthrene.

Inorganic results below background UTLs are not indicated as exceedances on the table.

RBC = Risk Based Concentration (April, 2003).

RBC values in table are for the more conservative chromium VI

RBC values for chromium III are 150,000 (ind) and 12,000 (res), which were not exceeded

Lead screening values from Technical Review Workgroup for Lead: Guidance Document (April, 1999)

mg/kg = milligrams per kilogram (parts per million).

ug/kg = micrograms per kilogram (parts per billion).

NA = not applicable.

NT = analyte not tested.

LQ = Lab Data Qualifiers

B = (organics) Blank contamination. Value detected in sample and associated blank.

B = (metals) Value <MRL and >MDL and is considered estimated.

E (metals) = Reported value is estimated because of the presence of interferences.

J = (organics) Value <MRL and >MDL and is considered estimated.

U = Analyte not-detected at the method reporting limit.

VQ = Validation Data Qualifiers:

B = blank contamination. Value detected in sample and associated blank.

J = estimated concentration

K = estimated concentration bias high

L = estimated concentration bias low

U = analyte not detected

UJ = estimated concentration non-detect

UL = estimated concentration non-detect bias low

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Appendix E HHRA Tables and Statistical Comparison Results

This Appendix Contains:

Appendix E-1 HHRA Tables

Appendix E-2 Statistical Comparison Results

Appendix E-1

HHRA Tables

Table E-1a
Occurrence, Distribution and Selection of Chemicals of Potential Concern
Current - Surface Soil

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Soil (0-2')	7429-90-5	Aluminum	15200	23300	mg/kg	58SB04A	5/5	N/A	23300	40041	7,821.4286N	N/A	N/A	Yes	ASL, ABKG
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	5/5	N/A	6.99	15.8	0.4258C	N/A	N/A	No	BKG
	7440-39-3	Barium	49.2	69.9	mg/kg	58SS1	5/5	N/A	69.9	209	547.5000N	N/A	N/A	No	BSL
	7440-41-7	Beryllium	0.571	1.21	mg/kg	58SS2	3/5	0.5000-0.5000	1.21	1.02	15.6429N	N/A	N/A	No	BSL
	7440-70-2	Calcium	1420	8040	mg/kg	58SS2	3/3	N/A	8040	N/A	N/A	1,000,000	RDA	No	NTX
	7440-47-3	Chromium	27.6	42.7	mg/kg	58SS1	5/5	N/A	42.7	65.3	23.5000N	N/A	N/A	Yes	ASL, ABKG
	7440-48-4	Cobalt	5.99	20.6	mg/kg	58SS2	5/5	N/A	20.6	72.3	160.0000N	N/A	N/A	No	BSL
	7440-50-8	Copper	10.9	16.2	mg/kg	58SS1	5/5	N/A	16.2	53.5	312.8571N	N/A	N/A	No	BSL
	7439-89-6	Iron	24900	27800	mg/kg	58SB04A	5/5	N/A	27800	50962	2,300.0000N	N/A	N/A	Yes	ASL, ABKG
	7439-92-1	Lead	13.4	16.3	mg/kg	58SS3	3/5	10.5000-10.5000	16.3	26.8	N/A	400	USEPA	No	BSL
	7439-95-4	Magnesium	14001	10300	mg/kg	58SS2	4/4	N/A	10300	N/A	N/A	1,000,000	RDA	No	NTX
	7439-96-5	Manganese	272	465	mg/kg	58SS1	5/5	N/A	465	2543	156.4286N	N/A	N/A	No	BKG
	7439-97-6	Mercury (Inorganic)	0.0718	0.0832	mg/kg	58SB04A	3/5	0.0500-0.0500	0.0832	0.13	2.3N	N/A	N/A	No	BSL
	7440-02-0	Nickel	8.911	26.5	mg/kg	58SS2	5/5	N/A	26.5	62.8	156.4286N	N/A	N/A	No	BSL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	5/5	N/A	2590	N/A	N/A	1,000,000	RDA	No	NTX
	7782-49-2	Selenium	0.411	0.411	mg/kg	58SS04	1/5	0.2500-1.1100	0.411	N/A	39.1071N	N/A	N/A	No	BSL
	7440-23-5	Sodium	25	25	mg/kg	58SB04A	1/1	N/A	25	N/A	N/A	1,000,000	RDA	No	NTX
	7440-28-0	Thallium	0.131	11.8	mg/kg	58SS1	4/5	6.6200-6.6200	11.8	2.11	0.5475N	N/A	N/A	Yes	ASL, ABKG
	7440-62-2	Vanadium	44.3	53.7	mg/kg	58SS3	5/5	N/A	53.7	108	54.7500N	N/A	N/A	No	BSL
	7440-66-6	Zinc	32.6	41.8	mg/kg	58SB04A	5/5	N/A	41.8	202	2,346.4286N	N/A	N/A	No	BSL
	7440-44-0	Total Organic Carbon	8760	8760	mg/kg	58SB04A	1/1	N/A	8760	N/A	N/A	N/A	N/A	No	NTX
	72-54-8	4,4'-DDD	0.000289N1	0.000289N1	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289N1	N/A	2.6614C	N/A	N/A	No	BSL
	5103-71-9	alpha-Chlorodane	0.000161	0.000161	mg/kg	58SS04	1/2	0.0007-0.0007	0.000161	N/A	1.8200C	N/A	N/A	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	N/A	0.4910C	N/A	N/A	No	BSL
	60-57-1	Dieldrin	0.0004781	0.0004781	mg/kg	58SS04	1/2	0.0007-0.0007	0.0004781	N/A	0.0399C	N/A	N/A	No	BSL
	91-57-6	2-Methylnaphthalene	0.0023	0.0023	mg/kg	58SB04A	1/4	0.0490-0.2000	0.0023	N/A	156.4286N	N/A	N/A	No	BSL
	56-55-3	Benzo(a)anthracene	0.00141	0.0036	mg/kg	58SS04	2/5	0.1700-0.8000	0.0036	N/A	0.8750C	N/A	N/A	No	BSL
	50-32-8	Benzo(a)pyrene	0.0019	0.0031	mg/kg	58SS04	2/5	0.2500-1.0000	0.0031	N/A	0.0875C	N/A	N/A	No	BSL
	205-99-2	Benzo(h)fluoranthene	0.0033	0.005	mg/kg	58SS04	2/5	0.2100-1.0000	0.005	N/A	0.8750C	N/A	N/A	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.000791	0.0028	mg/kg	58SB04A	2/5	0.2500-1.0000	0.0028	N/A	235.0000N	N/A	N/A	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.00121	0.002	mg/kg	58SS04	2/5	0.0660-0.3000	0.002	N/A	8.7497C	N/A	N/A	No	BSL
	218-01-9	Chrysene	0.0029	0.0034	mg/kg	58SS04	2/5	0.1200-0.6000	0.0034	N/A	87.4967C	N/A	N/A	No	BSL
	206-44-0	Fluoranthene	0.0026	0.0049	mg/kg	58SS04	2/5	0.0680-0.3000	0.0049	N/A	312.8571N	N/A	N/A	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.00141	0.00171	mg/kg	58SS04	2/5	0.2900-1.0000	0.00171	N/A	0.8750C	N/A	N/A	No	BSL
	91-20-3	Naphthalene	0.0024	0.0024	mg/kg	58SB04A	1/4	0.0370-0.2000	0.0024	N/A	156.4286N	N/A	N/A	No	BSL
	85-01-8	Phenanthrene	0.0028	0.0039	mg/kg	58SS04	2/5	0.0330-0.2000	0.0039	N/A	235.0000N	N/A	N/A	No	BSL
	129-00-0	Pyrene	0.004	0.00661	mg/kg	58SS04	2/5	0.0330-0.2000	0.00661	N/A	234.6429N	N/A	N/A	No	BSL
	65-85-0	Benzoic Acid	0.131	0.131	mg/kg	58SB04A	1/2	0.9400-0.9400	0.131	N/A	31,285.7143N	N/A	N/A	No	BSL
	117-81-7	bis(2-Ethylhexyl) phthalate	0.0611	0.0611	mg/kg	58SB04A	1/4	0.6200-3.0000	0.0611	N/A	45.6233C	N/A	N/A	No	BSL
	67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.000003296	0.000004981	mg/kg	58SB04A	2/2	N/A	0.000004981	N/A	N/A	N/A	N/A	No	NTX
	35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00003134	0.00004319	mg/kg	58SB04A	2/2	N/A	0.00004319	N/A	N/A	N/A	N/A	No	NTX
	39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000676	0.000000676	mg/kg	58SB04A	1/2	0.000000329-0.000000329	0.000000676	N/A	N/A	N/A	N/A	No	NTX
	57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.000000771	0.000001355	mg/kg	58SB04A	2/2	N/A	0.000001355	N/A	N/A	N/A	N/A	No	NTX
	57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.0000008381	0.000001096	mg/kg	58SB04A	2/2	N/A	0.000001096	N/A	N/A	N/A	N/A	No	NTX

Table E-1a
Occurrence, Distribution and Selection of Chemicals of Potential Concern
Current - Surface Soil

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.000001167	0.000001575	mg/kg	58SB04A	2/2	N/A	0.000001575	N/A	N/A	N/A	N/A	No	NTX
	3268-87-9	Octachlorodibenzodioxin	0.001728	0.001858	mg/kg	58SB04A	2/2	N/A	0.001858	N/A	N/A	N/A	N/A	No	NTX
	39001-02-0	Octachlorodibenzofuran	0.000008901	0.00001766	mg/kg	58SB04A	2/2	N/A	0.00001766	N/A	N/A	N/A	N/A	No	NTX
	IT-PTA02	TCDD TE	0.00000129	0.00000162	mg/kg	58SB04A	2/2	N/A	0.00000162	N/A	0.0000043	N/A	N/A	No	BSL
		Total HPCDD	0.00006863	0.00007972	mg/kg	58SB04A	2/2	N/A	0.00007972	N/A	N/A	N/A	N/A	No	NTX
		Total HPCDF	0.000007183	0.00001438	mg/kg	58SB04A	2/2	N/A	0.00001438	N/A	N/A	N/A	N/A	No	NTX
		Total HXCDD	0.000006541	0.000009539	mg/kg	58SB04A	2/2	N/A	0.000009539	N/A	N/A	N/A	N/A	No	NTX
		Total HXCDF	0.000003978	0.000006046	mg/kg	58SB04A	2/2	N/A	0.000006046	N/A	N/A	N/A	N/A	No	NTX
		Total PECDF	0.000000428	0.000000428	mg/kg	58SS04	1/2	0.000000142-0.000000142	0.000000428	N/A	N/A	N/A	N/A	No	NTX

(1) Maximum concentration used for screening.

(2) N/A - Refer to supporting information for background discussion.

Background values derived from site-specific statistical analysis. See text for supporting information.

(3) Screening toxicity values from USEPA Region 3 RBC Table (April 2003). See text for derivation of Nutrient RDAs.

(4) Rationale Codes Selection Reason:

Infrequent Detection but Associated Historically (HIST)
Toxicity Information Available (TX)
Above Screening Levels (ASL)
Group A Carcinogen (GAC)
Break Down Product (BDP)
Elevated Detected Concentration (EDC)

Deletion Reason:

Infrequent Detection (<= 5%, IFD)
Background Levels (BKG)
No Toxicity Information (NTX)
Below Screening and/or ARAR/TBC Level (BSL)

Definitions:

N/A = Not Applicable or Not Available

SQL = Sample Quantitation Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

I = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

RDA = Recommended Daily Allowance

Table E-1b
Summary of Screening for Non-Detected Chemicals - Human Health
Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2')	99-35-4	1,3,5-Trinitrobenzene			mg/kg		0/2	0.1000-0.1000	1.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	99-65-0	1,3-Dinitrobenzene			mg/kg		0/2	0.1000-0.1000	1.00E-01	7.82E-01	N	N/A	N	BSL, IFD
	118-96-7	2,4,6-Trinitrotoluene			mg/kg		0/2	0.2000-0.2000	2.00E-01	3.90E+00	N	N/A	N	BSL, IFD
	35572-78-2	2-amino-4,6-Dinitrotoluene			mg/kg		0/2	0.2000-0.2000	2.00E-01	4.69E-01	N	N/A	N	BSL, IFD
	88-72-2	2-Nitrotoluene			mg/kg		0/2	0.4000-0.4000	4.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	99-08-1	3-Nitrotoluene			mg/kg		0/2	0.4000-0.4000	4.00E-01	1.56E+02	N	N/A	N	BSL, IFD
	19406-51-0	4-amino-2,6-Dinitrotoluene			mg/kg		0/2	0.2000-0.2000	2.00E-01	4.69E-01	N	N/A	N	BSL, IFD
	99-99-0	4-Nitrotoluene			mg/kg		0/2	0.4000-0.4000	4.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	100-51-6	Benzyl alcohol			mg/kg		0/5	0.1900-10.0000	1.00E+01	2.35E+03	N	N/A	N	BSL, IFD
	156-59-2	cis-1,2-Dichloroethene			mg/kg		0/2	0.0050-0.0051	5.10E-03	7.82E+01	N	N/A	N	BSL, IFD
	121-82-4	Cyclonite			mg/kg		0/2	0.2000-0.2000	2.00E-01	5.81E+00	C	N/A	N	BSL, IFD
	2691-41-0	HMX			mg/kg		0/2	0.2000-0.2000	2.00E-01	3.91E+02	N	N/A	N	BSL, IFD
	ICF87	m+p-Xylenes			mg/kg		0/2	0.0100-0.0100	1.00E-02	1.56E+03	N	N/A	N	BSL, IFD
	55-63-0	Nitroglycerin			mg/kg		0/2	0.3340-0.3400	3.40E-01	4.56E+01	C	N/A	N	BSL, IFD
	95-47-6	o-Xylene			mg/kg		0/2	0.0050-0.0051	5.10E-03	1.56E+03	N	N/A	N	BSL, IFD
	78-11-5	Pentaerythritol tetranitrate (PETN)			mg/kg		0/2	0.3340-0.3400	3.40E-01	N/A	N/A	N/A	N	IFD, NTX
	110-86-1	Pyridine			mg/kg		0/2	0.1900-0.1900	1.90E-01	7.82E+00	N	N/A	N	BSL, IFD
	479-45-8	Tetryl			mg/kg		0/2	0.2000-0.2000	2.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	156-60-5	trans-1,2-Dichloroethene			mg/kg		0/2	0.0050-0.0051	5.10E-03	1.56E+02	N	N/A	N	BSL, IFD
	75-69-4	Trichlorofluoromethane			mg/kg		0/3	0.0060-0.0060	6.00E-03	2.30E+03	N	N/A	N	BSL, IFD
	108-05-4	Vinyl acetate			mg/kg		0/3	0.0030-0.0030	3.00E-03	7.80E+03	N	N/A	N	BSL, IFD
	7440-36-0	Antimony			mg/kg		0/4	0.5670-7.1400	7.14E+00	3.10E+00	N	N/A	N	ASL, IFD
	7440-43-9	Cadmium			mg/kg		0/5	0.1110-0.7000	7.00E-01	3.90E+00	N	N/A	N	BSL, IFD
	7440-22-4	Silver			mg/kg		0/5	0.5890-1.1300	1.13E+00	3.90E+01	N	N/A	N	BSL, IFD
	7440-23-5	Sodium			mg/kg		0/5	15.0000-188.0000	1.88E+02	N/A	N/A	N/A	N	IFD, NTX
	93-76-5	2,4,5-T			mg/kg		0/2	0.1110-0.1130	1.13E-01	7.82E+01	N	N/A	N	BSL, IFD
	93-72-1	2,4,5-TP (Silvex)			mg/kg		0/2	0.1110-0.1130	1.13E-01	6.26E+01	N	N/A	N	BSL, IFD
	94-75-7	2,4-D			mg/kg		0/2	0.2220-0.2270	2.27E-01	7.82E+01	N	N/A	N	BSL, IFD
	94-82-6	2,4-DB			mg/kg		0/2	1.1100-1.1300	1.13E+00	6.26E+01	N	N/A	N	BSL, IFD
	72-55-9	4,4'-DDE			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.88E+00	C	N/A	N	BSL, IFD
	50-29-3	4,4-DDT			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.90E+00	C	N/A	N	BSL, IFD
	309-40-2	Aldrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.76E-02	C	N/A	N	BSL, IFD
	319-84-6	alpha-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.01E-01	C	N/A	N	BSL, IFD
	319-85-7	beta-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.55E-01	C	N/A	N	BSL, IFD
	75-99-0	Dalapon			mg/kg		0/2	1.1100-1.1300	1.13E+00	2.35E+02	N	N/A	N	BSL, IFD

Table E-1b
Summary of Screening for Non-Detected Chemicals - Human Health
Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2") (Continued)	1918-00-9	Dicamba			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.35E+02	N	N/A	N	BSL, IFD
	120-36-5	Dichloroprop			mg/kg		0/2	0.2220-0.2270	2.27E-01	N/A	N/A	N/A	N	IFD, NTX
	959-98-8	Endosulfan I			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	33213-65-9	Endosulfan II			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	1031-07-8	Endosulfan sulfate			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	72-20-8	Endrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	7421-93-4	Endrin aldehyde			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	53494-70-5	Endrin ketone			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	58-89-9	gamma-BHC (Lindane)			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.91E-01	C	N/A	N	BSL, IFD
	5103-74-2	gamma-Chlordane			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.82E+00	C	N/A	N	BSL, IFD
	76-44-8	Heptachlor			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.42E-01	C	N/A	N	BSL, IFD
	1024-57-3	Heptachlor epoxide			mg/kg		0/2	0.0007-0.0008	7.56E-04	7.02E-02	C	N/A	N	BSL, IFD
	94-74-6	MCPA			mg/kg		0/4	111.0000-113.0000	1.13E+02	3.91E+00	N	N/A	N	ASL, IFD
	93-65-2	MCPP			mg/kg		0/2	111.0000-113.0000	1.13E+02	7.82E+00	N	N/A	N	ASL, IFD
	72-43-5	Methoxychlor			mg/kg		0/1	0.0007-0.0007	7.42E-04	3.91E+01	N	N/A	N	BSL, IFD
	8001-35-2	Toxaphene			mg/kg		0/2	0.0370-0.0378	3.78E-02	5.81E-01	C	N/A	N	BSL, IFD
	12674-11-2	Aroclor 1016			mg/kg		0/2	0.0370-0.0378	3.78E-02	5.50E-01	N	N/A	N	BSL, IFD
	11104-28-2	Aroclor 1221			mg/kg		0/2	0.0742-0.0756	7.56E-02	3.19E-01	C	N/A	N	BSL, IFD
	11141-16-5	Aroclor 1232			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.19E-01	C	N/A	N	BSL, IFD
	53469-21-9	Aroclor 1242			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.19E-01	C	N/A	N	BSL, IFD
	12672-29-6	Aroclor 1248			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.19E-01	C	N/A	N	BSL, IFD
	11097-69-1	Aroclor 1254			mg/kg		0/2	0.0370-0.0378	3.78E-02	1.56E-01	N	N/A	N	BSL, IFD
	11096-82-5	Aroclor 1260			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.19E-01	C	N/A	N	BSL, IFD
	131-11-3	Dimethylphthalate			mg/kg		0/5	0.1700-0.8000	8.00E-01	7.82E+04	N	N/A	N	BSL, IFD
	120-82-1	1,2,4-Trichlorobenzene			mg/kg		0/5	0.0400-0.2000	2.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	95-50-1	1,2-Dichlorobenzene			mg/kg		0/5	0.1100-0.6000	6.00E-01	7.04E+02	N	N/A	N	BSL, IFD
	541-73-1	1,3-Dichlorobenzene			mg/kg		0/5	0.1300-0.6000	6.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	106-46-7	1,4-Dichlorobenzene			mg/kg		0/5	0.0980-0.5000	5.00E-01	2.66E+01	C	N/A	N	BSL, IFD
	95-95-4	2,4,5-Trichlorophenol			mg/kg		0/5	0.1000-0.5000	5.00E-01	7.82E+02	N	N/A	N	BSL, IFD
	88-06-2	2,4,6-Trichlorophenol			mg/kg		0/5	0.1700-0.8000	8.00E-01	5.81E+01	C	N/A	N	BSL, IFD
	120-83-2	2,4-Dichlorophenol			mg/kg		0/5	0.1800-0.9000	9.00E-01	2.35E+01	N	N/A	N	BSL, IFD
	105-67-9	2,4-Dimethylphenol			mg/kg		0/5	0.1900-3.0000	3.00E+00	1.56E+02	N	N/A	N	BSL, IFD
	51-28-5	2,4-Dinitrophenol			mg/kg		0/5	0.9300-6.0000	6.00E+00	1.56E+01	N	N/A	N	BSL, IFD
	121-14-2	2,4-Dinitrotoluene			mg/kg		0/5	0.1400-0.7000	7.00E-01	9.40E-01	C	N/A	N	BSL, IFD
	606-20-2	2,6-Dinitrotoluene			mg/kg		0/5	0.0850-0.4000	4.00E-01	9.40E-01	C	N/A	N	BSL, IFD

Table E-1b
Summary of Screening for Non-Detected Chemicals - Human Health
Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2') (Continued)	91-58-7	2-Chloronaphthalene			mg/kg		0/5	0.0360-0.2000	2.00E-01	6.26E+02	N	N/A	N	BSL, IFD
	95-57-8	2-Chlorophenol			mg/kg		0/5	0.0600-0.3000	3.00E-01	3.91E+01	N	N/A	N	BSL, IFD
	91-57-6	2-Methylnaphthalene			mg/kg		0/3	0.0490-0.2000	2.00E-01	1.56E+02	N	N/A	N	BSL, IFD
	88-74-4	2-Nitroaniline			mg/kg		0/5	0.0620-0.3000	3.00E-01	N/A	N/A	N/A	N	IFD, NTX
	88-75-5	2-Nitrophenol			mg/kg		0/5	0.1400-0.7000	7.00E-01	N/A	N/A	N/A	N	IFD, NTX
	88-85-7	2-sec-butyl-4,6-dinitrophenol			mg/kg		0/2	0.2220-0.2270	2.27E-01	7.82E+00	N	N/A	N	BSL, IFD
	91-94-1	3,3'-Dichlorobenzidine			mg/kg		0/5	0.1900-30.0000	3.00E+01	1.42E+00	C	N/A	N	ASL, IFD
	99-09-2	3-Nitroaniline			mg/kg		0/5	0.1900-2.0000	2.00E+00	2.35E+00	N	N/A	N	BSL, IFD
	534-52-1	4,6-Dinitro-o-cresol			mg/kg		0/5	0.5500-3.0000	3.00E+00	7.82E-01	N	N/A	N	ASL, IFD
	100-01-6	4-Nitroaniline			mg/kg		0/5	0.1900-2.0000	2.00E+00	2.35E+01	N	N/A	N	BSL, IFD
	100-02-7	4-Nitrophenol			mg/kg		0/5	0.9300-7.0000	7.00E+00	6.26E+01	N	N/A	N	BSL, IFD
	83-32-9	Acenaphthene			mg/kg		0/5	0.0019-0.2000	2.00E-01	4.69E+02	N	N/A	N	BSL, IFD
	208-96-8	Acenaphthylene			mg/kg		0/5	0.0019-0.2000	2.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	120-12-7	Anthracene			mg/kg		0/5	0.0019-0.2000	2.00E-01	2.35E+03	N	N/A	N	BSL, IFD
	65-85-0	Benzoic Acid			mg/kg		0/1	0.9400-0.9400	9.40E-01	3.13E+04	N	N/A	N	BSL, IFD
	111-91-1	bis(2-Chloroethoxy)methane			mg/kg		0/5	0.0590-0.3000	3.00E-01	N/A	N/A	N/A	N	IFD, NTX
	111-44-4	bis(2-Chloroethyl)ether			mg/kg		0/5	0.0330-0.2000	2.00E-01	5.81E-01	C	N/A	N	BSL, IFD
	108-60-1	bis(2-Chloroisopropyl)ether			mg/kg		0/5	0.1900-1.0000	1.00E+00	9.12E+00	C	N/A	N	BSL, IFD
	117-81-7	bis(2-Ethylhexyl) phthalate			mg/kg		0/3	0.6200-3.0000	3.00E+00	4.56E+01	C	N/A	N	BSL, IFD
	85-68-7	Butyl benzyl phthalate			mg/kg		0/5	0.1700-0.8000	8.00E-01	1.56E+03	N	N/A	N	BSL, IFD
	86-74-8	Carbazole			mg/kg		0/2	0.1900-0.1900	1.90E-01	3.19E+01	C	N/A	N	BSL, IFD
	84-74-2	Di-n-butyl phthalate			mg/kg		0/5	0.0610-0.3000	3.00E-01	7.82E+02	N	N/A	N	BSL, IFD
	117-84-0	Di-n-octyl phthalate			mg/kg		0/5	0.1900-10.0000	1.00E+01	1.56E+02	N	N/A	N	BSL, IFD
	53-70-3	Dibenz(a,h)anthracene			mg/kg		0/5	0.0019-1.0000	1.00E+00	8.75E-02	C	N/A	N	ASL, IFD
	132-64-9	Dibenzofuran			mg/kg		0/5	0.0350-0.2000	2.00E-01	1.56E+01	N	N/A	N	BSL, IFD
	84-66-2	Diethyl phthalate			mg/kg		0/5	0.1900-1.0000	1.00E+00	6.26E+03	N	N/A	N	BSL, IFD
	86-73-7	Fluorene			mg/kg		0/5	0.0019-0.2000	2.00E-01	3.13E+02	N	N/A	N	BSL, IFD
	118-74-1	Hexachlorobenzene			mg/kg		0/5	0.0330-0.2000	2.00E-01	3.99E-01	C	N/A	N	BSL, IFD
	87-68-3	Hexachlorobutadiene			mg/kg		0/5	0.1900-1.0000	1.00E+00	1.56E+00	N	N/A	N	BSL, IFD
	77-47-4	Hexachlorocyclopentadiene			mg/kg		0/5	0.1900-30.0000	3.00E+01	4.69E+01	N	N/A	N	BSL, IFD
	67-72-1	Hexachloroethane			mg/kg		0/5	0.1500-0.8000	8.00E-01	7.80E+00	N	N/A	N	BSL, IFD
	78-59-1	Isophorone			mg/kg		0/5	0.0330-0.2000	2.00E-01	6.72E+02	C	N/A	N	BSL, IFD
	621-64-7	n-Nitroso-di-n-propylamine			mg/kg		0/5	0.1900-1.0000	1.00E+00	9.12E-02	C	N/A	N	ASL, IFD
	86-30-6	n-Nitrosodiphenylamine			mg/kg		0/5	0.1900-10.0000	1.00E+01	1.30E+02	C	N/A	N	BSL, IFD
	91-20-3	Naphthalene			mg/kg		0/3	0.0370-0.2000	2.00E-01	1.56E+02	N	N/A	N	BSL, IFD

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Table E-1b
Summary of Screening for Non-Detected Chemicals - Human Health
Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2') (Continued)	98-95-3	Nitrobenzene			mg/kg		0/5	0.0450-0.2000	2.00E-01	3.91E+00	N	N/A	N	BSL, IFD
	95-48-7	o-Cresol			mg/kg		0/5	0.0290-0.1900	1.90E-01	3.91E+02	N	N/A	N	BSL, IFD
	59-50-7	p-Chloro-m-cresol			mg/kg		0/5	0.0950-0.5000	5.00E-01	N/A	N/A	N/A	N	IFD, NTX
	106-47-8	p-Chloroaniline			mg/kg		0/5	0.1900-4.0000	4.00E+00	3.13E+01	N	N/A	N	BSL, IFD
	106-44-5	p-Cresol			mg/kg		0/5	0.1900-1.0000	1.00E+00	3.91E+01	N	N/A	N	BSL, IFD
	87-86-5	Pentachlorophenol			mg/kg		0/5	0.9300-6.0000	6.00E+00	5.32E+00	C	N/A	N	ASL, IFD
	108-95-2	Phenol			mg/kg		0/5	0.1100-0.6000	6.00E-01	2.35E+03	N	N/A	N	BSL, IFD
	71-55-6	1,1,1-Trichloroethane			mg/kg		0/5	0.0040-0.0051	5.10E-03	2.19E+03	N	N/A	N	BSL, IFD
	79-34-5	1,1,2,2-Tetrachloroethane			mg/kg		0/5	0.0020-0.0051	5.10E-03	3.19E+00	C	N/A	N	BSL, IFD
	79-00-5	1,1,2-Trichloroethane			mg/kg		0/5	0.0050-0.0051	5.10E-03	1.12E+01	C	N/A	N	BSL, IFD
	75-34-3	1,1-Dichloroethane			mg/kg		0/5	0.0020-0.0051	5.10E-03	7.82E+02	N	N/A	N	BSL, IFD
	75-35-4	1,1-Dichloroethene			mg/kg		0/5	0.0040-0.0051	5.10E-03	3.91E+02	N	N/A	N	BSL, IFD
	107-06-2	1,2-Dichloroethane			mg/kg		0/5	0.0020-0.0051	5.10E-03	7.02E+00	C	N/A	N	BSL, IFD
	540-59-0	1,2-Dichloroethene (total)			mg/kg		0/2	0.0030-0.0030	3.00E-03	7.82E+01	N	N/A	N	BSL, IFD
	78-87-5	1,2-Dichloropropane			mg/kg		0/5	0.0030-0.0051	5.10E-03	9.39E+00	C	N/A	N	BSL, IFD
	78-93-3	2-Butanone			mg/kg		0/5	0.0050-0.0700	7.00E-02	4.69E+03	N	N/A	N	BSL, IFD
	591-78-6	2-Hexanone			mg/kg		0/5	0.0050-0.0320	3.20E-02	3.13E+02	N	N/A	N	BSL, IFD
	101-55-3	4-Bromophenyl phenylether			mg/kg		0/5	0.0330-0.2000	2.00E-01	N/A	N/A	N/A	N	IFD, NTX
	7005-72-3	4-Chlorophenyl phenylether			mg/kg		0/5	0.0330-0.2000	2.00E-01	N/A	N/A	N/A	N	IFD, NTX
	108-10-1	4-Methyl-2-pentanone			mg/kg		0/5	0.0050-0.0270	2.70E-02	6.26E+02	N	N/A	N	BSL, IFD
	67-64-1	Acetone			mg/kg		0/5	0.0050-0.0170	1.70E-02	7.80E+02	N	N/A	N	BSL, IFD
	71-43-2	Benzene			mg/kg		0/5	0.0020-0.0051	5.10E-03	1.16E+01	C	N/A	N	BSL, IFD
	75-27-4	Bromodichloromethane			mg/kg		0/5	0.0030-0.0051	5.10E-03	1.03E+01	C	N/A	N	BSL, IFD
	74-83-9	Bromomethane			mg/kg		0/5	0.0050-0.0060	6.00E-03	1.10E+01	N	N/A	N	BSL, IFD
	75-15-0	Carbon disulfide			mg/kg		0/5	0.0040-0.0051	5.10E-03	7.82E+02	N	N/A	N	BSL, IFD
	56-23-5	Carbon tetrachloride			mg/kg		0/5	0.0050-0.0070	7.00E-03	4.91E+00	C	N/A	N	BSL, IFD
	108-90-7	Chlorobenzene			mg/kg		0/5	0.0010-0.0051	5.10E-03	1.56E+02	N	N/A	N	BSL, IFD
	75-00-3	Chloroethane			mg/kg		0/5	0.0050-0.0120	1.20E-02	2.20E+02	C	N/A	N	BSL, IFD
	74-87-3	Chloromethane			mg/kg		0/5	0.0050-0.0090	9.00E-03	N/A	N/A	N/A	N	IFD, NTX
	10061-01-5	cis-1,3-Dichloro-1-propene			mg/kg		0/5	0.0030-0.0051	5.10E-03	6.40E+00	C	N/A	N	BSL, IFD
	124-48-1	Dibromochloromethane			mg/kg		0/5	0.0030-0.0051	5.10E-03	7.60E+00	C	N/A	N	BSL, IFD
	100-41-4	Ethylbenzene			mg/kg		0/5	0.0020-0.0051	5.10E-03	7.82E+02	N	N/A	N	BSL, IFD
	75-09-2	Methylene chloride			mg/kg		0/5	0.0050-0.0120	1.20E-02	8.52E+01	C	N/A	N	BSL, IFD
	100-42-5	Styrene			mg/kg		0/5	0.0030-0.0051	5.10E-03	1.56E+03	N	N/A	N	BSL, IFD
	127-18-4	Tetrachloroethene			mg/kg		0/5	0.0010-0.0051	5.10E-03	3.19E+01	C	N/A	N	BSL, IFD

Table E-1b
Summary of Screening for Non-Detected Chemicals - Human Health
Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2') (Continued)	108-88-3	Toluene			mg/kg		0/5	0.0010-0.0051	5.10E-03	1.56E+03	N	N/A	N	BSL, IFD
	10061-02-6	trans-1,3-Dichloropropene			mg/kg		0/5	0.0030-0.0051	5.10E-03	6.39E+00	C	N/A	N	BSL, IFD
	75-25-2	Tribromomethane			mg/kg		0/5	0.0050-0.0070	7.00E-03	8.09E+01	C	N/A	N	BSL, IFD
	79-01-6	Trichloroethene			mg/kg		0/5	0.0030-0.0051	5.10E-03	1.60E+00	C	N/A	N	BSL, IFD
	67-66-3	Chloroform			mg/kg		0/5	0.0010-0.0051	5.10E-03	7.82E+01	N	N/A	N	BSL, IFD
	75-01-4	Vinyl Chloride			mg/kg		0/5	0.0050-0.0060	6.00E-03	9.00E-02	C	N/A	N	BSL, IFD
	1330-20-7	Xylenes (total)			mg/kg		0/3	0.0020-0.0020	2.00E-03	1.56E+03	N	N/A	N	BSL, IFD

(1) Maximum non-detect concentration used for screening.

(2) Screening toxicity values from USEPA Region 3 RBC Table (April 2003). See text for derivation of Nutrient RDAs.
RBCs are based on a risk level of 1.0E-6 and a HQ=0.1. See text for derivation of Nutrient RDAs.

(3) Rationale Codes Selection Reason:

- Infrequent Detection but Associated Historically (HIST)
- No Toxicity Information (NTX)
- Above Screening Levels (ASL)
- Break Down Product (BDP)
- Elevated Detected Concentration (EDC)
- Infrequent Detection (<= 5%, IFD)
- Background Levels (BKG)
- Tentatively Identified Compound not used in the risk evaluation (TI)
- Below Screening and/or ARAR/TBC Level (BSL)

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Table E-2a
Occurrence, Distribution and Selection of Chemicals of Potential Concern
Future - Surface Soil

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Surface Soil (0-2')	7429-90-5	Aluminum	12600	29300	mg/kg	58SB1A	9/9	N/A	29300	40,041	7,821.4286N	N/A	N/A	Yes	ASL, ABKG
	7440-36-0	Antimony	0.6975J	1.3J	mg/kg	58SB1A	3/7	0.5670-7.1400	1.3J	N/A	3.1286N	N/A	N/A	No	BSL
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	9/9	N/A	6.99	15.8	0.4258C	N/A	N/A	No	BKG
	7440-39-3	Barium	49.2	131L	mg/kg	58SB2A	9/9	N/A	131L	209	547.5000N	N/A	N/A	No	BSL
	7440-41-7	Beryllium	0.57J	1.3J	mg/kg	58SB2A	5/7	0.5000-0.5000	1.3J	1.02	15.6429N	N/A	N/A	No	BSL
	7440-70-2	Calcium	1160	82700	mg/kg	58SB3A	7/7	N/A	82700	N/A	N/A	1,000,000	RDA	No	NTX
	7440-47-3	Chromium	20.6	42.7	mg/kg	58SS1	9/9	N/A	42.7	65.3	23.5000N	N/A	N/A	Yes	ASL, ABKG
	7440-48-4	Cobalt	5.99	24.4L	mg/kg	58SB2A	9/9	N/A	24.4L	72.3	160.0000N	N/A	N/A	No	BSL
	7440-50-8	Copper	8.7	22.2K	mg/kg	58SB1A	9/9	N/A	22.2K	53.5	312.8571N	N/A	N/A	No	BSL
	7439-89-6	Iron	16300	36150	mg/kg	58SB2A	9/9	N/A	36150	50,962	2,300.0000N	N/A	N/A	Yes	ASL, ABKG
	7439-92-1	Lead	11.9	28.4	mg/kg	58SB3A	7/9	10.5000-10.5000	28.4	26.8	N/A	400	USEPA	No	BSL
	7439-95-4	Magnesium	1400J	42100	mg/kg	58SB3A	8/8	N/A	42100	N/A	N/A	1,000,000	RDA	No	NTX
	7439-96-5	Manganese	162	465	mg/kg	58SS1	9/9	N/A	465	2,543	156.4286N	N/A	N/A	No	BKG
	7439-97-6	Mercury (Inorganic)	0.0718	0.0832	mg/kg	58SB04A	4/9	0.0500-0.1200	0.0832	0.13	2.3N	N/A	N/A	No	BSL
	7440-02-0	Nickel	8.91J	26.5	mg/kg	58SS2	9/9	N/A	26.5	62.8	156.4286N	N/A	N/A	No	BSL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	9/9	N/A	2590	N/A	N/A	1,000,000	RDA	No	NTX
	7782-49-2	Selenium	0.41J	0.41J	mg/kg	58SS04	1/9	0.2500-1.1400	0.41J	N/A	39.1071N	N/A	N/A	No	BSL
	7440-23-5	Sodium	25	2945K	mg/kg	58SB2A	5/5	N/A	2945K	N/A	N/A	1,000,000	RDA	No	NTX
	7440-28-0	Thallium	0.13J	11.8	mg/kg	58SS1	5/9	0.6900-6.6200	11.8	2.11	0.5475N	N/A	N/A	Yes	ASL, ABKG
	7440-62-2	Vanadium	33.7K	66.6K	mg/kg	58SB1A	9/9	N/A	66.6K	108	54.7500N	N/A	N/A	Yes	ASL, ABKG
	7440-66-6	Zinc	24.4	59.1K	mg/kg	58SB1A	9/9	N/A	59.1K	202	2,346.4286N	N/A	N/A	No	BSL
	7440-44-0	Total Organic Carbon	7160	8760	mg/kg	58SB04A	2/2	N/A	8760	N/A	N/A	N/A	N/A	No	NTX
	72-54-8	4,4'-DDD	0.000289N	0.000289N	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289N	N/A	2.6614C	N/A	N/A	No	BSL
	5103-71-9	alpha-Chlordane	0.00016J	0.00016J	mg/kg	58SS04	1/2	0.0007-0.0007	0.00016J	N/A	1.8200C	N/A	N/A	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	N/A	0.4910C	N/A	N/A	No	BSL
	60-57-1	Dieldrin	0.000478J	0.000478J	mg/kg	58SS04	1/2	0.0007-0.0007	0.000478J	N/A	0.0399C	N/A	N/A	No	BSL
	91-57-6	2-Methylnaphthalene	0.0023	0.0073	mg/kg	58SB04B	2/8	0.0490-0.4050	0.0073	N/A	156.4286N	N/A	N/A	No	BSL
	83-32-9	Acenaphthene	0.0037	0.0037	mg/kg	58SB04B	1/9	0.0019-0.2000	0.0037	N/A	469.2857N	N/A	N/A	No	BSL
	208-96-8	Acenaphthylene	0.0037	0.0037	mg/kg	58SB04B	1/9	0.0019-0.3700	0.0037	N/A	235.0000N	N/A	N/A	No	BSL
	120-12-7	Anthracene	0.0011J	0.2	mg/kg	58SB1A	3/9	0.0019-0.2000	0.2	N/A	2,346.4286N	N/A	N/A	No	BSL
	56-55-3	Benzo(a)anthracene	0.0014J	0.22	mg/kg	58SB1A	4/9	0.0019-0.8000	0.22	N/A	0.8750C	N/A	N/A	No	BSL
	50-32-8	Benzo(a)pyrene	0.0019	0.24	mg/kg	58SB1A	4/9	0.0019-1.0000	0.24	N/A	0.0875C	N/A	N/A	Yes	ASL
	205-99-2	Benzo(h)fluoranthene	0.0033	0.23	mg/kg	58SB1A	4/9	0.0019-1.0000	0.23	N/A	0.8750C	N/A	N/A	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.00079J	0.0028	mg/kg	58SB04A	2/9	0.0019-1.0000	0.0028	N/A	235.0000N	N/A	N/A	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.0012J	0.11	mg/kg	58SB1A	4/9	0.0019-0.3000	0.11	N/A	8.7497C	N/A	N/A	No	BSL
	218-01-9	Chrysene	0.0013J	0.26	mg/kg	58SB1A	5/9	0.0021-0.6000	0.26	N/A	87.4967C	N/A	N/A	No	BSL
	206-44-0	Fluoranthene	0.0026	0.66	mg/kg	58SB1A	5/9	0.0019-0.3000	0.66	N/A	312.8571N	N/A	N/A	No	BSL
	86-73-7	Fluorene	0.0027	0.048	mg/kg	58SB1A	4/9	0.0019-0.2000	0.048	N/A	312.8571N	N/A	N/A	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.0014J	0.058	mg/kg	58SB1A	4/9	0.0019-1.0000	0.058	N/A	0.8750C	N/A	N/A	No	BSL
	91-20-3	Naphthalene	0.0024	0.0077	mg/kg	58SB04B	2/8	0.0205-0.2000	0.0077	N/A	156.4286N	N/A	N/A	No	BSL
	85-01-8	Phenanthrene	0.001625	0.62	mg/kg	58SB1A	6/9	0.0330-0.2000	0.62	N/A	235.0000N	N/A	N/A	No	BSL

Table E-2a
Occurrence, Distribution and Selection of Chemicals of Potential Concern
Future - Surface Soil

Exposure	Point	CAS	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Unit	Location of Maximum Concentration	Detection Frequency	Range of Detection	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARA/TBC Value	Potential ARA/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Detection (4)
		129-00-0	Pyrene	0.00181	0.65	mg/kg	5S8B1A	5/9	0.0021-0.2000	0.65	N/A	234.6429N	N/A	N/A	No	BSL
		67-64-1	Acetone	0.027	0.181	mg/kg	5S8B04B	1/6	0.0050-0.0170	0.027	N/A	782.1429N	N/A	N/A	No	BSL
		65-85-0	Benzoic Acid	0.13	0.181	mg/kg	5S8B04B	2/6	0.9400-2.0000	0.181	N/A	31.285, 7143N	N/A	N/A	No	BSL
		117-81-7	bis(2-Ethylhexyl) phthalate	0.035	0.181	mg/kg	5S8B1A	4/8	0.4050-3.0000	0.181	N/A	45.6233C	N/A	N/A	No	BSL
		75-15-0	Carbon disulfide	0.00057	0.000571	mg/kg	5S8B04B	1/9	0.0040-0.7650	0.000571	N/A	782.1429N	N/A	N/A	No	BSL
		156-59-2	cis-1,2-Dichloroethene	0.731	0.731	mg/kg	5S8B3A	1/6	0.0050-0.7650	0.731	N/A	782.1429N	N/A	N/A	No	BSL
		98-82-8	Isopropylbenzene	0.0961	0.0961	mg/kg	5S8B1A	1/3	0.7500-0.7650	0.0961	N/A	782.1429N	N/A	N/A	No	BSL
		100-41-4	Ethylbenzene	0.003	0.0031	mg/kg	5S8B1A	1/9	0.0020-0.7650	0.0031	N/A	782.1429N	N/A	N/A	No	BSL
		75-09-2	Methylene chloride	0.8875	0.8875	mg/kg	5S8B2A	1/8	0.0050-0.7500	0.8875	N/A	85.1635C	N/A	N/A	No	BSL
		130-312	p-tert-Butylphenol	0.181	0.181	mg/kg	5S8B2A	1/6	0.0060-0.7500	0.2851	N/A	1600N	N/A	N/A	No	BSL
		99-87-6	4-Isopropylphenol	0.0441	0.0441	mg/kg	5S8B1A	1/3	0.7500-0.7650	0.0441	N/A	N/A	N/A	N/A	Yes	NTX
		108-88-3	Toluene	0.3075	0.30751	mg/kg	5S8B2A	1/9	0.0010-0.7500	0.30751	N/A	1,564.2857N	N/A	N/A	No	BSL
		79-01-6	Trichloroethylene	2.7	2.71	mg/kg	5S8B3A	1/9	0.0030-0.7650	2.71	N/A	1.6000C	N/A	N/A	Yes	ASL
		67562-39-4	1,2,3,4,6,7,8-Hepachlorodibenzofuran	0.000003296	0.000004981	mg/kg	5S8B04A	2/2	N/A	0.000004981	N/A	N/A	N/A	N/A	No	NTX
		35822-46-9	1,2,3,4,6,7,8-Hepachlorodibenzop-dioxin	0.00001106	0.00004319	mg/kg	5S8B04A	3/3	N/A	0.00004319	N/A	N/A	N/A	N/A	No	NTX
		70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	0.000000144	0.000000144	mg/kg	5S8B04B	1/3	0.000000127-0.00000014	0.000000144	N/A	N/A	N/A	N/A	No	NTX
		29227-28-6	1,2,3,4,7,8-Hexachlorodibenzop-dioxin	0.000000676	0.000000676	mg/kg	5S8B04A	1/3	0.000000085-0.000000139	0.000000676	N/A	N/A	N/A	N/A	No	NTX
		57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.0000001355	0.0000001355	mg/kg	5S8B04A	2/3	0.000000037-0.0000000370	0.0000001355	N/A	N/A	N/A	N/A	No	NTX
		57653-85-7	1,2,3,6,7,8-Hexachlorodibenzop-dioxin	0.0000008381	0.000001096	mg/kg	5S8B04A	2/3	0.000000062-0.000000062	0.000001096	N/A	N/A	N/A	N/A	No	NTX
		19408-74-3	1,2,3,7,8,9-Hexachlorodibenzop-dioxin	0.000001167	0.000001575	mg/kg	5S8B04A	2/3	0.000000069-0.000000069	0.000001575	N/A	N/A	N/A	N/A	No	NTX
		3268-87-9	Octachlorodibenzodioxin	0.001728	0.00281	mg/kg	5S8B04B	3/3	N/A	0.00281	N/A	N/A	N/A	N/A	No	NTX
		19001-02-0	Octachlorodibenzofuran	0.000001162	0.00001766	mg/kg	5S8B04A	3/3	0.00001766	0.00001766	N/A	N/A	N/A	N/A	No	NTX
		140-019	TCDD TE	0.00000606	0.00000162	mg/kg	5S8B04A	3/3	0.0000162	0.0000162	N/A	0.0000043C	N/A	N/A	No	BSL
			Total HPCDD	0.00000223	0.00007972	mg/kg	5S8B04A	3/3	N/A	0.00007972	N/A	N/A	N/A	N/A	No	NTX
			Total HPCDF	0.000000585	0.00001438	mg/kg	5S8B04A	3/3	N/A	0.00001438	N/A	N/A	N/A	N/A	No	NTX
			Total HXCD	0.000000673	0.000009539	mg/kg	5S8B04A	3/3	N/A	0.000009539	N/A	N/A	N/A	N/A	No	NTX
			Total HXCDF	0.000000646	0.000000646	mg/kg	5S8B04A	3/3	N/A	0.000000646	N/A	N/A	N/A	N/A	No	NTX
			Total PECDF	0.000000428	0.000000428	mg/kg	5S8B04	1/3	0.000000035-0.000000142	0.000000428	N/A	N/A	N/A	N/A	No	NTX

Definitions:

N/A = Not Applicable or Not Available

SOL = Sample Quantitation Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

J = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

RDA = Recommended Daily Allowance

Detection Reason:

No Toxicity Information (NTX)

Below Screening and/or ARAR/TBC Level (BSL)

Evaluated Detected Concentration (EDC)

Break Down Product (BDP)

Group A Carcinogen (GAC)

Above Screening Levels (ASL)

Toxicity Information Available (TX)

Inrequent Detection but Associated Historically (HIST)

Rationale Codes Selection Reason:

Background values derived from site-specific statistical analysis. See text for supporting information.

N/A - Refer to supporting information for background discussion

Maximum concentration used for screening.

Table E-2b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2')	563-58-6	1,1-Dichloropropene			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	87-61-6	1,2,3-Trichlorobenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NYX
	96-18-4	1,2,3-Trichloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.20E-01	C	N/A	N	ASL, IFD
	95-63-6	1,2,4-Trimethylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.90E+02	N	N/A	N	BSL, IFD
	96-12-8	1,2-Dibromo-3-chloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	4.60E-01	C	N/A	N	ASL, IFD
	106-93-4	1,2-Dibromoethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	7.50E-03	C	N/A	N	ASL, IFD
	122-66-7	1,2-Diphenylhydrazine			mg/kg		0/3	0.4000-0.4050	4.05E-01	8.00E-01	C	N/A	N	BSL, IFD
	108-67-8	1,3,5-Trimethylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.90E+02	N	N/A	N	BSL, IFD
	99-35-4	1,3,5-Trinitrobenzene			mg/kg		0/3	0.1000-0.1000	1.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	142-28-9	1,3-Dichloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	99-65-0	1,3-Dinitrobenzene			mg/kg		0/3	0.1000-0.1000	1.00E-01	7.82E-01	N	N/A	N	BSL, IFD
	590-20-7	2,2-Dichloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	118-96-7	2,4,6-Trinitrotoluene			mg/kg		0/3	0.2000-0.2000	2.00E-01	3.90E+00	N	N/A	N	BSL, IFD
	35572-78-2	2-amino-4,6-Dinitrotoluene			mg/kg		0/3	0.2000-0.2000	2.00E-01	4.69E-01	N	N/A	N	BSL, IFD
	110-75-8	2-Chloroethyl vinyl ether			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	95-49-8	2-Chlorotoluene			mg/kg		0/3	0.0060-0.7650	7.65E-01	1.60E+02	N	N/A	N	BSL, IFD
	88-72-2	2-Nitrotoluene			mg/kg		0/3	0.4000-0.4000	4.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	Shaw 02	3+4-Methylphenols			mg/kg		0/2	0.4000-0.4050	4.05E-01	3.90E+01	N	N/A	N	BSL, IFD
	99-08-1	3-Nitrotoluene			mg/kg		0/3	0.4000-0.4000	4.00E-01	1.56E+02	N	N/A	N	BSL, IFD
	19406-51-0	4-amino-2,6-Dinitrotoluene			mg/kg		0/3	0.2000-0.2000	2.00E-01	4.69E-01	N	N/A	N	BSL, IFD
	99-99-0	4-Nitrotoluene			mg/kg		0/3	0.4000-0.4000	4.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	107-02-8	Acrolehyde			mg/kg		0/3	0.0060-0.7650	7.65E-01	1.60E+02	N	N/A	N	BSL, IFD
	107-13-1	Acrylonitrile			mg/kg		0/3	0.0060-0.7650	7.65E-01	1.20E+00	C	N/A	N	BSL, IFD
	100-51-6	Benzyl alcohol			mg/kg		0/9	0.1900-10.0000	1.00E+01	2.35E+03	N	N/A	N	BSL, IFD
	108-86-1	Bromobenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	74-97-5	Chlorobromomethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	121-82-4	Cyclonite			mg/kg		0/3	0.2000-0.2000	2.00E-01	5.81E+00	C	N/A	N	BSL, IFD
	74-95-3	Dibromomethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	7.80E+01	N	N/A	N	BSL, IFD
	75-71-8	Dichlorodifluoromethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	1.60E+03	N	N/A	N	BSL, IFD
	2691-41-0	HMX			mg/kg		0/3	0.2000-0.2000	2.00E-01	3.91E+02	N	N/A	N	BSL, IFD
	104-51-8	n-Butylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.10E+02	N	N/A	N	BSL, IFD
	103-65-1	n-Propylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.10E+02	N	N/A	N	BSL, IFD
	55-63-0	Nitroglycerin			mg/kg		0/3	0.3340-0.3430	3.43E-01	4.56E+01	C	N/A	N	BSL, IFD
	95-47-6	o-Xylene			mg/kg		0/6	0.0050-0.7650	7.65E-01	1.56E+03	N	N/A	N	BSL, IFD
	106-43-4	p-Chlorotoluene			mg/kg		0/3	0.0060-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	78-11-5	Pentaerythritol tetranitrate			mg/kg		0/3	0.3340-0.3430	3.43E-01	N/A	N/A	N/A	N	IFD, NTX
	110-86-1	Pyridine			mg/kg		0/3	0.1900-0.1900	1.90E-01	7.82E+00	N	N/A	N	BSL, IFD
	135-98-8	sec-Butylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.10E+02	N	N/A	N	BSL, IFD
	98-06-6	tert-Butylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.10E+02	N	N/A	N	BSL, IFD

Table E-2b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2') (Continued)	479-45-8	Tetryl			mg/kg		0/3	0.2000-0.2000	2.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	156-60-5	trans-1,2-Dichloroethene			mg/kg		0/6	0.0050-0.7650	7.65E-01	1.56E+02	N	N/A	N	BSL, IFD
	75-69-4	Trichlorofluoromethane			mg/kg		0/6	0.0060-0.7650	7.65E-01	2.30E+03	N	N/A	N	BSL, IFD
	108-05-4	Vinyl acetate			mg/kg		0/6	0.0030-0.7650	7.65E-01	7.80E+03	N	N/A	N	BSL, IFD
	7440-43-9	Cadmium			mg/kg		0/9	0.1110-0.7000	7.00E-01	3.90E+00	N	N/A	N	BSL, IFD
	7440-22-4	Silver			mg/kg		0/9	0.2300-1.1300	1.13E+00	3.90E+01	N	N/A	N	BSL, IFD
	93-76-5	2,4,5-T			mg/kg		0/2	0.1110-0.1130	1.13E-01	7.82E+01	N	N/A	N	BSL, IFD
	93-72-1	2,4,5-TP (Silvex)			mg/kg		0/2	0.1110-0.1130	1.13E-01	6.26E+01	N	N/A	N	BSL, IFD
	94-75-7	2,4-D			mg/kg		0/2	0.2220-0.2270	2.27E-01	7.82E+01	N	N/A	N	BSL, IFD
	94-82-6	2,4-DB			mg/kg		0/2	1.1100-1.1300	1.13E+00	6.26E+01	N	N/A	N	BSL, IFD
	72-55-9	4,4'-DDE			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.88E+00	C	N/A	N	BSL, IFD
	50-29-3	4,4-DDT			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.90E+00	C	N/A	N	BSL, IFD
	309-00-2	Aldrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.76E-02	C	N/A	N	BSL, IFD
	319-84-6	alpha-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.01E-01	C	N/A	N	BSL, IFD
	319-85-7	beta-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.55E-01	C	N/A	N	BSL, IFD
	75-99-0	Dalapon			mg/kg		0/2	1.1100-1.1300	1.13E+00	2.35E+02	N	N/A	N	BSL, IFD
	1918-00-9	Dicamba			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.35E+02	N	N/A	N	BSL, IFD
	120-36-5	Dichloroprop			mg/kg		0/2	0.2220-0.2270	2.27E-01	N/A	N/A	N/A	N	IFD, NTX
	959-98-8	Endosulfan I			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	33213-65-9	Endosulfan II			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	1031-07-8	Endosulfan sulfate			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	72-20-8	Endrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	7421-93-4	Endrin aldehyde			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	53494-70-5	Endrin ketone			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	58-89-9	gamma-BHC (Lindane)			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.91E-01	C	N/A	N	BSL, IFD
	5103-74-2	gamma-Chlordane			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.82E+00	C	N/A	N	BSL, IFD
	76-44-8	Heptachlor			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.42E-01	C	N/A	N	BSL, IFD
	1024-57-3	Heptachlor epoxide			mg/kg		0/2	0.0007-0.0008	7.56E-04	7.02E-02	C	N/A	N	BSL, IFD
	94-74-6	MCPA			mg/kg		0/4	111.0000-113.0000	1.13E+02	3.91E+00	N	N/A	N	ASL, IFD
	93-65-2	MCPP			mg/kg		0/2	111.0000-113.0000	1.13E+02	7.82E+00	N	N/A	N	ASL, IFD
	72-43-5	Methoxychlor			mg/kg		0/1	0.0007-0.0007	7.42E-04	3.91E+01	N	N/A	N	BSL, IFD
	8001-35-2	Toxaphene			mg/kg		0/2	0.0370-0.0378	3.78E-02	5.81E-01	C	N/A	N	BSL, IFD
	12674-11-2	Aroclor 1016			mg/kg		0/3	0.0370-0.0381	3.81E-02	5.50E-01	N	N/A	N	BSL, IFD
	11104-28-2	Aroclor 1221			mg/kg		0/3	0.0742-0.0762	7.62E-02	3.19E-01	C	N/A	N	BSL, IFD
	11141-16-5	Aroclor 1232			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.19E-01	C	N/A	N	BSL, IFD
	53469-21-9	Aroclor 1242			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.19E-01	C	N/A	N	BSL, IFD
	12672-29-6	Aroclor 1248			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.19E-01	C	N/A	N	BSL, IFD
	11097-69-1	Aroclor 1254			mg/kg		0/3	0.0370-0.0381	3.81E-02	1.56E-01	N	N/A	N	BSL, IFD
	11096-82-5	Aroclor 1260			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.19E-01	C	N/A	N	BSL, IFD

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Table E-2b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2") (Continued)	131-11-3	Dimethylphthalate			mg/kg		0/9	0.1700-0.8000	8.00E-01	7.82E+04	N	N/A	N	BSL, IFD
	120-82-1	1,2,4-Trichlorobenzene			mg/kg		0/14	0.0060-0.7650	7.65E-01	7.82E+01	N	N/A	N	BSL, IFD
	95-50-1	1,2-Dichlorobenzene			mg/kg		0/9	0.1100-0.6000	6.00E-01	7.04E+02	N	N/A	N	BSL, IFD
	541-73-1	1,3-Dichlorobenzene			mg/kg		0/9	0.1300-0.6000	6.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	106-46-7	1,4-Dichlorobenzene			mg/kg		0/9	0.0980-0.5000	5.00E-01	2.66E+01	C	N/A	N	BSL, IFD
	95-95-4	2,4,5-Trichlorophenol			mg/kg		0/9	0.1000-0.9800	9.80E-01	7.82E+02	N	N/A	N	BSL, IFD
	88-06-2	2,4,6-Trichlorophenol			mg/kg		0/9	0.1700-0.8000	8.00E-01	5.81E+01	C	N/A	N	BSL, IFD
	120-83-2	2,4-Dichlorophenol			mg/kg		0/9	0.1800-0.9000	9.00E-01	2.35E+01	N	N/A	N	BSL, IFD
	105-67-9	2,4-Dimethylphenol			mg/kg		0/9	0.1900-3.0000	3.00E+00	1.56E+02	N	N/A	N	BSL, IFD
	51-28-5	2,4-Dinitrophenol			mg/kg		0/9	0.9300-6.0000	6.00E+00	1.56E+01	N	N/A	N	BSL, IFD
	121-14-2	2,4-Dinitrotoluene			mg/kg		0/9	0.1400-0.7000	7.00E-01	9.40E-01	C	N/A	N	BSL, IFD
	606-20-2	2,6-Dinitrotoluene			mg/kg		0/9	0.0850-0.4050	4.05E-01	9.40E-01	C	N/A	N	BSL, IFD
	91-58-7	2-Chloronaphthalene			mg/kg		0/9	0.0360-0.4050	4.05E-01	6.26E+02	N	N/A	N	BSL, IFD
	95-57-8	2-Chlorophenol			mg/kg		0/9	0.0600-0.4050	4.05E-01	3.91E+01	N	N/A	N	BSL, IFD
	91-57-6	2-Methylnaphthalene			mg/kg		0/6	0.0490-0.4050	4.05E-01	1.56E+02	N	N/A	N	BSL, IFD
	88-74-4	2-Nitroaniline			mg/kg		0/9	0.0620-2.0000	2.00E+00	N/A	N/A	N/A	N	IFD, NTX
	88-75-5	2-Nitrophenol			mg/kg		0/9	0.1400-0.7000	7.00E-01	N/A	N/A	N/A	N	IFD, NTX
	88-85-7	2-sec-butyl-4,6-dinitrophenol			mg/kg		0/2	0.2220-0.2270	2.27E-01	7.82E+00	N	N/A	N	BSL, IFD
	91-94-1	3,3'-Dichlorobenzidine			mg/kg		0/9	0.1900-30.0000	3.00E+01	1.42E+00	C	N/A	N	ASL, IFD
	99-09-2	3-Nitroaniline			mg/kg		0/9	0.1900-2.0000	2.00E+00	2.30E+00	N	N/A	N	BSL, IFD
	534-52-1	4,6-Dinitro-o-cresol			mg/kg		0/9	0.5500-3.0000	3.00E+00	7.82E-01	N	N/A	N	ASL, IFD
	100-01-6	4-Nitroaniline			mg/kg		0/9	0.1900-2.0000	2.00E+00	2.35E+01	N	N/A	N	BSL, IFD
	100-02-7	4-Nitrophenol			mg/kg		0/9	0.9300-7.0000	7.00E+00	6.26E+01	N	N/A	N	BSL, IFD
	83-32-9	Acenaphthene			mg/kg		0/8	0.0019-0.2000	2.00E-01	4.69E+02	N	N/A	N	BSL, IFD
	65-85-0	Benzoic Acid			mg/kg		0/4	0.9400-2.0000	2.00E+00	3.13E+04	N	N/A	N	BSL, IFD
	111-91-1	bis(2-Chloroethoxy)methane			mg/kg		0/9	0.0590-0.4050	4.05E-01	N/A	N/A	N/A	N	IFD, NTX
	111-44-4	bis(2-Chloroethyl)ether			mg/kg		0/9	0.0330-0.4050	4.05E-01	5.81E-01	C	N/A	N	BSL, IFD
	108-60-1	bis(2-Chloroisopropyl)ether			mg/kg		0/9	0.1900-1.0000	1.00E+00	9.12E+00	C	N/A	N	BSL, IFD
	85-68-7	Butyl benzyl phthalate			mg/kg		0/9	0.1700-0.8000	8.00E-01	1.56E+03	N	N/A	N	BSL, IFD
	86-74-8	Carbazole			mg/kg		0/6	0.1900-0.4050	4.05E-01	3.19E+01	C	N/A	N	BSL, IFD
	84-74-2	Di-n-butyl phthalate			mg/kg		0/9	0.0610-0.4050	4.05E-01	7.82E+02	N	N/A	N	BSL, IFD
	117-84-0	Di-n-octyl phthalate			mg/kg		0/9	0.1900-10.0000	1.00E+01	1.56E+02	N	N/A	N	BSL, IFD
	53-70-3	Dibenz(a,h)anthracene			mg/kg		0/9	0.0019-1.0000	1.00E+00	8.75E-02	C	N/A	N	ASL, IFD
	132-64-9	Dibenzofuran			mg/kg		0/9	0.0350-0.4050	4.05E-01	1.56E+01	N	N/A	N	BSL, IFD
	84-66-2	Diethyl phthalate			mg/kg		0/9	0.1900-1.0000	1.00E+00	6.26E+03	N	N/A	N	BSL, IFD
	118-74-1	Hexachlorobenzene			mg/kg		0/9	0.0330-0.4050	4.05E-01	3.99E-01	C	N/A	N	ASL, IFD
	87-68-3	Hexachlorobutadiene			mg/kg		0/9	0.1900-1.0000	1.00E+00	1.56E+00	N	N/A	N	BSL, IFD
	77-47-4	Hexachlorocyclopentadiene			mg/kg		0/9	0.1900-30.0000	3.00E+01	4.69E+01	N	N/A	N	BSL, IFD
	67-72-1	Hexachloroethane			mg/kg		0/9	0.1500-0.8000	8.00E-01	7.80E+00	N	N/A	N	BSL, IFD

Table E-2b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2') (Continued)	78-59-1	Isophorone			mg/kg		0/9	0.0330-0.4050	4.05E-01	6.72E+02	C	N/A	N	BSL, IFD
	621-64-7	n-Nitroso-di-n-propylamine			mg/kg		0/9	0.1900-1.0000	1.00E+00	9.12E-02	C	N/A	N	ASL, IFD
	86-30-6	n-Nitrosodiphenylamine			mg/kg		0/9	0.1900-10.0000	1.00E+01	1.30E+02	C	N/A	N	BSL, IFD
	91-20-3	Naphthalene			mg/kg		0/6	0.0205-0.2000	2.00E-01	1.56E+02	N	N/A	N	BSL, IFD
	98-95-3	Nitrobenzene			mg/kg		0/9	0.0450-0.4050	4.05E-01	3.91E+00	N	N/A	N	BSL, IFD
	95-48-7	o-Cresol			mg/kg		0/9	0.0290-0.4050	4.05E-01	3.91E+02	N	N/A	N	BSL, IFD
	59-50-7	p-Chloro-m-cresol			mg/kg		0/9	0.0950-0.7900	7.90E-01	N/A	N/A	N/A	N	IFD, NTX
	106-47-8	p-Chloroaniline			mg/kg		0/9	0.1900-4.0000	4.00E+00	3.13E+01	N	N/A	N	BSL, IFD
	106-44-5	p-Cresol			mg/kg		0/7	0.1900-1.0000	1.00E+00	3.91E+01	N	N/A	N	BSL, IFD
	87-86-5	Pentachlorophenol			mg/kg		0/9	0.9300-6.0000	6.00E+00	5.32E+00	C	N/A	N	ASL, IFD
	108-95-2	Phenol			mg/kg		0/9	0.1100-0.6000	6.00E-01	2.35E+03	N	N/A	N	BSL, IFD
	630-20-6	1,1,1,2-Tetrachloroethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	2.50E+01	C	N/A	N	BSL, IFD
	71-55-6	1,1,1-Trichloroethane			mg/kg		0/9	0.0040-0.7650	7.65E-01	2.19E+03	N	N/A	N	BSL, IFD
	79-34-5	1,1,2,2-Tetrachloroethane			mg/kg		0/9	0.0020-0.7650	7.65E-01	3.19E+00	C	N/A	N	BSL, IFD
	79-00-5	1,1,2-Trichloroethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	1.12E+01	C	N/A	N	BSL, IFD
	75-34-3	1,1-Dichloroethane			mg/kg		0/9	0.0020-0.7650	7.65E-01	7.82E+02	N	N/A	N	BSL, IFD
	75-35-4	1,1-Dichloroethene			mg/kg		0/9	0.0040-0.7650	7.65E-01	3.91E+02	N	N/A	N	BSL, IFD
	107-06-2	1,2-Dichloroethane			mg/kg		0/9	0.0020-0.7650	7.65E-01	7.02E+00	C	N/A	N	BSL, IFD
	540-59-0	1,2-Dichloroethene (total)			mg/kg		0/2	0.0030-0.0030	3.00E-03	7.82E+01	N	N/A	N	BSL, IFD
	78-87-5	1,2-Dichloropropane			mg/kg		0/9	0.0030-0.7650	7.65E-01	9.39E+00	C	N/A	N	BSL, IFD
	78-93-3	2-Butanone			mg/kg		0/9	0.0050-0.7650	7.65E-01	4.69E+03	N	N/A	N	BSL, IFD
	591-78-6	2-Hexanone			mg/kg		0/9	0.0050-0.7650	7.65E-01	3.13E+02	N	N/A	N	BSL, IFD
	101-55-3	4-Bromophenyl phenylether			mg/kg		0/9	0.0330-0.4050	4.05E-01	N/A	N/A	N/A	N	IFD, NTX
	7005-72-3	4-Chlorophenyl phenylether			mg/kg		0/9	0.0330-0.4050	4.05E-01	N/A	N/A	N/A	N	IFD, NTX
	108-10-1	4-Methyl-2-pentanone			mg/kg		0/9	0.0050-0.7650	7.65E-01	6.26E+02	N	N/A	N	BSL, IFD
	67-64-1	Acetone			mg/kg		0/9	0.0050-1.3500	1.35E+00	7.80E+02	N	N/A	N	BSL, IFD
	71-43-2	Benzene			mg/kg		0/9	0.0020-0.7650	7.65E-01	1.16E+01	C	N/A	N	BSL, IFD
	75-27-4	Bromodichloromethane			mg/kg		0/9	0.0030-0.7650	7.65E-01	1.03E+01	C	N/A	N	BSL, IFD
	74-83-9	Bromomethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	1.10E+01	N	N/A	N	BSL, IFD
	75-15-0	Carbon disulfide			mg/kg		0/8	0.0040-0.7650	7.65E-01	7.82E+02	N	N/A	N	BSL, IFD
	56-23-5	Carbon tetrachloride			mg/kg		0/9	0.0050-0.7650	7.65E-01	4.91E+00	C	N/A	N	BSL, IFD
	108-90-7	Chlorobenzene			mg/kg		0/9	0.0010-0.7650	7.65E-01	1.56E+02	N	N/A	N	BSL, IFD
	75-00-3	Chloroethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	2.20E+02	C	N/A	N	BSL, IFD
	74-87-3	Chloromethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	N/A	N/A	N/A	N	IFD, NTX
	10061-01-5	cis-1,3-Dichloro-1-propene			mg/kg		0/9	0.0030-0.7650	7.65E-01	6.40E+00	C	N/A	N	BSL, IFD
	124-48-1	Dibromochloromethane			mg/kg		0/9	0.0030-0.7650	7.65E-01	7.60E+00	C	N/A	N	BSL, IFD
	100-42-5	Styrene			mg/kg		0/9	0.0030-0.7650	7.65E-01	1.56E+03	N	N/A	N	BSL, IFD
	127-18-4	Tetrachloroethene			mg/kg		0/9	0.0010-0.7650	7.65E-01	1.20E+00	C	N/A	N	BSL, IFD
	10061-02-6	trans-1,3-Dichloropropene			mg/kg		0/9	0.0030-0.7650	7.65E-01	6.39E+00	C	N/A	N	BSL, IFD

Table E-2b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2') (Continued)	75-25-2	Tribromomethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	8.09E+01	C	N/A	N	BSL, IFD
	67-66-3	Chloroform			mg/kg		0/9	0.0010-0.7650	7.65E-01	7.82E+01	N	N/A	N	BSL, IFD
	75-01-4	Vinyl Chloride			mg/kg		0/9	0.0050-0.7650	7.65E-01	9.00E-02	C	N/A	N	ASL, IFD
	1330-20-7	Xylenes (total)			mg/kg		0/3	0.0020-0.0020	2.00E-03	1.56E+03	N	N/A	N	BSL, IFD

- (1) Maximum non-detect concentration used for screening.
- (2) Screening toxicity values from USEPA Region 3 RBC Table (April 2003). See text for derivation of Nutrient RDAs. RBCs are based on a risk level of 1.0E-6 and a HQ=0.1. See text for derivation of Nutrient RDAs.
- (3) Rationale Codes Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
 - No Toxicity Information (NTX)
 - Above Screening Levels (ASL)
 - Break Down Product (BDP)
 - Elevated Detected Concentration (EDC)
 - Infrequent Detection (<= 5%, IFD)
 - Background Levels (BKG)
 - Tentatively Identified Compound not used in the risk evaluation (TIC)
 - Below Screening and/or ARAR/TBC Level (BSL)

Table E-3a
Occurrence, Distribution and Selection of Chemicals of Potential Concern
Future - Total Soil

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
Mixed Surface and Subsurface Soil	7429-90-5	Aluminum	12600	29300	mg/kg	58SB1A	11/11	N/A	29300	40041	7,821.4286N	N/A	N/A	Yes	ASL, ABKG
	7440-36-0	Antimony	0.6975J	1.3J	mg/kg	58SB1A	3/9	0.5670-7.1400	1.3J	N/A	3.1286N	N/A	N/A	No	BSL
	7440-38-2	Arsenic	2.53	6.99	mg/kg	58SS2	11/11	N/A	6.99	15.8	0.4258C	N/A	N/A	No	BKG
	7440-39-3	Barium	49.2	131L	mg/kg	58SB2A	11/11	N/A	131L	209	547.5000N	N/A	N/A	No	BSL
	7440-41-7	Beryllium	0.57J	1.3J	mg/kg	58SB2A	7/9	0.5000-0.5000	1.3J	1.02	15.6429N	N/A	N/A	No	BSL
	7440-70-2	Calcium	1160	82700	mg/kg	58SB3A	9/9	N/A	82700	N/A	N/A	1,000,000	RDA	No	NTX
	7440-47-3	Chromium	20.6	42.7	mg/kg	58SS1	11/11	N/A	42.7	65.3	23.5000N	N/A	N/A	No	BKG
	7440-48-4	Cobalt	5.99	24.4L	mg/kg	58SB2A	11/11	N/A	24.4L	72.3	160.0000N	N/A	N/A	No	BSL
	7440-50-8	Copper	8.7	22.2K	mg/kg	58SB1A	11/11	N/A	22.2K	53.5	312.8571N	N/A	N/A	No	BSL
	7439-89-6	Iron	16300	36150	mg/kg	58SB2A	11/11	N/A	36150	50962	2,300.0000N	N/A	N/A	No	BKG
	7439-92-1	Lead	11.9	28.4	mg/kg	58SB3A	9/11	10.5000-10.5000	28.4	26.8	N/A	400	USEPA	No	BSL
	7439-95-4	Magnesium	1400J	42100	mg/kg	58SB3A	10/10	N/A	42100	N/A	N/A	1,000,000	RDA	No	NTX
	7439-96-5	Manganese	162	465	mg/kg	58SS1	11/11	N/A	465	2543	156.4286N	N/A	N/A	No	BKG
	7439-97-6	Mercury (Inorganic)	0.0612	0.0832	mg/kg	58SB04A	6/11	0.0500-0.1200	0.0832	0.13	2.3N	N/A	N/A	No	BSL
	7440-02-0	Nickel	8.91J	26.5	mg/kg	58SS2	11/11	N/A	26.5	62.8	156.4286N	N/A	N/A	No	BSL
	7440-09-7	Potassium	515	2590	mg/kg	58SS2	11/11	N/A	2590	N/A	N/A	1,000,000	RDA	No	NTX
	7782-49-2	Selenium	0.41J	0.41J	mg/kg	58SS04	1/11	0.2500-1.1900	0.41J	N/A	39.1071N	N/A	N/A	No	BSL
	7440-23-5	Sodium	25	2945K	mg/kg	58SB2A	6/6	N/A	2945K	N/A	N/A	1,000,000	RDA	No	NTX
	7440-28-0	Thallium	0.13J	11.8	mg/kg	58SS1	8/11	0.6900-6.6200	11.8	2.11	0.5475N	N/A	N/A	Yes	ASL, ABKG
	7440-62-2	Vanadium	33.7K	66.6K	mg/kg	58SB1A	11/11	N/A	66.6K	108	54.7500N	N/A	N/A	No	BKG
	7440-66-6	Zinc	24.4	59.1K	mg/kg	58SB1A	11/11	N/A	59.1K	202	2,346.4286N	N/A	N/A	No	BSL
	7440-44-0	Total Organic Carbon	7160	8760	mg/kg	58SB04A	2/2	N/A	8760	N/A	N/A	N/A	N/A	No	NTX
	72-54-8	4,4'-DDD	0.000289NJ	0.000289NJ	mg/kg	58SS04	1/2	0.0007-0.0007	0.000289NJ	N/A	2.6614C	N/A	N/A	No	BSL
	5103-71-9	alpha-Chlordane	0.00016J	0.00016J	mg/kg	58SS04	1/2	0.0007-0.0007	0.00016J	N/A	1.8200C	N/A	N/A	No	BSL
	319-86-8	delta-BHC	0.00207	0.00207	mg/kg	58SB04A	1/2	0.0008-0.0008	0.00207	N/A	0.4910C	N/A	N/A	No	BSL
	60-57-1	Dieldrin	0.000478J	0.000478J	mg/kg	58SS04	1/2	0.0007-0.0007	0.000478J	N/A	0.0399C	N/A	N/A	No	BSL
	91-57-6	2-Methylnaphthalene	0.0017J	0.0073	mg/kg	58SB04B	3/10	0.0020-0.4050	0.0073	N/A	156.4286N	N/A	N/A	No	BSL
	83-32-9	Acenaphthene	0.0037	0.0037	mg/kg	58SB04B	1/11	0.0019-0.2000	0.0037	N/A	469.2857N	N/A	N/A	No	BSL
	208-96-8	Acenaphthylene	0.0037	0.0037	mg/kg	58SB04B	1/11	0.0019-0.3700	0.0037	N/A	235.0000N	N/A	N/A	No	BSL
	120-12-7	Anthracene	0.0011J	0.2	mg/kg	58SB1A	3/11	0.0019-0.2000	0.2	N/A	2,346.4286N	N/A	N/A	No	BSL
	56-55-3	Benz(a)anthracene	0.0014J	0.22	mg/kg	58SB1A	4/11	0.0019-0.8000	0.22	N/A	0.8750C	N/A	N/A	No	BSL
	50-32-8	Benzo(a)pyrene	0.0019	0.24	mg/kg	58SB1A	4/11	0.0019-1.0000	0.24	N/A	0.0875C	N/A	N/A	Yes	ASL
	205-99-2	Benzo(b)fluoranthene	0.0033	0.23	mg/kg	58SB1A	4/11	0.0019-1.0000	0.23	N/A	0.8750C	N/A	N/A	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.00079J	0.0028	mg/kg	58SB04A	2/11	0.0019-1.0000	0.0028	N/A	235.0000N	N/A	N/A	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.0012J	0.11	mg/kg	58SB1A	4/11	0.0019-0.3000	0.11	N/A	8.7497C	N/A	N/A	No	BSL
	65-85-0	Benzoic Acid	0.13	0.18J	mg/kg	58SB04B	3/8	0.9400-2.0000	0.18J	N/A	31,285.7143N	N/A	N/A	No	BSL
	117-81-7	bis(2-Ethylhexyl) phthalate	0.035	0.18J	mg/kg	58SB1A	6/10	0.4050-3.0000	0.18J	N/A	45.6233C	N/A	N/A	No	BSL
	85-68-7	Butyl benzyl phthalate	0.0093	0.0093J	mg/kg	58SB04D	1/11	0.1700-0.8000	0.0093J	N/A	1,564.2857N	N/A	N/A	No	BSL
	218-01-9	Chrysene	0.0013J	0.26	mg/kg	58SB1A	5/11	0.0020-0.6000	0.26	N/A	87.4967C	N/A	N/A	No	BSL
	206-44-0	Fluoranthene	0.0026	0.66	mg/kg	58SB1A	5/11	0.0019-0.3000	0.66	N/A	312.8571N	N/A	N/A	No	BSL
	86-73-7	Fluorene	0.0027	0.048	mg/kg	58SB1A	4/11	0.0019-0.2000	0.048	N/A	312.8571N	N/A	N/A	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.0014J	0.058	mg/kg	58SB1A	4/11	0.0019-1.0000	0.058	N/A	0.8750C	N/A	N/A	No	BSL
	91-20-3	Naphthalene	0.0023	0.0077	mg/kg	58SB04B	3/10	0.0020-0.2000	0.0077	N/A	156.4286N	N/A	N/A	No	BSL
	85-01-8	Phenanthrene	0.001625	0.62	mg/kg	58SB1A	6/11	0.0020-0.2000	0.62	N/A	235.0000N	N/A	N/A	No	BSL
	129-00-0	Pyrene	0.0011J	0.65	mg/kg	58SB1A	6/11	0.0020-0.2000	0.65	N/A	234.6429N	N/A	N/A	No	BSL

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Table E-3a
Occurrence, Distribution and Selection of Chemicals of Potential Concern
Future - Total Soil

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
	99-87-6	4-Isopropyltoluene	0.044J	0.044J	mg/kg	58SB1A	1/3	0.7500-0.7650	0.044J	N/A	N/A	N/A	N/A	Yes	NTX
	67-64-1	Acetone	0.017	0.027	mg/kg	58SB04B	2/8	0.0050-0.0170	0.027	N/A	782.1429N	N/A	N/A	No	BSL
	75-15-0	Carbon disulfide	0.00057	0.00057J	mg/kg	58SB04B	1/11	0.0040-0.7650	0.00057J	N/A	782.1429N	N/A	N/A	No	BSL
	156-59-2	cis-1,2-Dichloroethane	0.73J	0.73J	mg/kg	58SB3A	1/8	0.0048-0.7650	0.73J	N/A	78.2143N	N/A	N/A	No	BSL
	100-41-4	Ethylbenzene	0.003	0.003J	mg/kg	58SB1A	1/11	0.0020-0.7650	0.003J	N/A	782.1429N	N/A	N/A	No	BSL
	98-82-8	Isopropylbenzene	0.096J	0.096J	mg/kg	58SB1A	1/3	0.7500-0.7650	0.096J	N/A	782.1429N	N/A	N/A	No	BSL
	75-09-2	Methylene chloride	0.8875	0.8875	mg/kg	58SB2A	1/10	0.0048-0.7500	0.8875	N/A	85.1635C	N/A	N/A	No	BSL
	130-312	p&m-Xylene	0.18J	0.18J	mg/kg	58SB2A	1/8	0.0060-0.7800	0.18J	N/A	1600N	N/A	N/A	No	NTX
	108-88-3	Toluene	0.3075J	0.3075J	mg/kg	58SB2A	1/11	0.0010-0.7500	0.3075J	N/A	1,564.2857N	N/A	N/A	No	BSL
	79-01-6	Trichloroethene	2.7J	2.7J	mg/kg	58SB3A	1/11	0.0030-0.7650	2.7J	N/A	1.6000C	N/A	N/A	Yes	ASL
	67562-39-4	1,2,3,4,6,7,8-Hepachlorodibenzofuran	0.000003296	0.000004981	mg/kg	58SB04A	2/2	N/A	0.000004981	N/A	N/A	N/A	N/A	No	NTX
	35822-46-9	1,2,3,4,6,7,8-Hepachlorodibenzo-p-dioxin	0.000007129	0.000004319	mg/kg	58SB04A	5/5	N/A	0.000004319	N/A	N/A	N/A	N/A	No	NTX
	70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	0.000000144	0.000000219J	mg/kg	58SB04C	2/5	0.00000003-0.00000014	0.000000219J	N/A	N/A	N/A	N/A	No	NTX
	39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.000000676	0.000000676	mg/kg	58SB04A	1/5	0.000000065-0.000000329	0.000000676	N/A	N/A	N/A	N/A	No	NTX
	57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	0.000000771	0.000001355	mg/kg	58SB04A	2/5	0.000000027-0.000000037	0.000001355	N/A	N/A	N/A	N/A	No	NTX
	57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.000000841	0.000001096	mg/kg	58SB04A	2/5	0.000000048-0.000000062	0.000001096	N/A	N/A	N/A	N/A	No	NTX
	19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.000000285	0.000001575	mg/kg	58SB04A	4/5	0.000000069-0.000000069	0.000001575	N/A	N/A	N/A	N/A	No	NTX
	3268-87-9	Octachlorodibenzodioxin	0.0008073	0.00281	mg/kg	58SB04B	5/5	N/A	0.00281	N/A	N/A	N/A	N/A	No	NTX
	39001-02-0	Octachlorodibenzofuran	0.0000009	0.00001766	mg/kg	58SB04A	5/5	N/A	0.00001766	N/A	N/A	N/A	N/A	No	NTX
	IT-PTA02	TCDD TE	0.000000345	0.00000162	mg/kg	58SB04A	5/5	N/A	0.00000162	N/A	0.0000043C	N/A	N/A	No	BSL
	140-019	Total HPCDD	0.00001502	0.00007972	mg/kg	58SB04A	5/5	N/A	0.00007972	N/A	N/A	N/A	N/A	No	NTX
	140-020	Total HPCDF	0.000000538	0.00001438	mg/kg	58SB04A	5/5	N/A	0.00001438	N/A	N/A	N/A	N/A	No	NTX
	140-200	Total HXCDD	0.000000673	0.000009539	mg/kg	58SB04A	5/5	N/A	0.000009539	N/A	N/A	N/A	N/A	No	NTX
	140-201	Total HXCDF	0.000000144	0.000006046	mg/kg	58SB04A	4/5	0.0290-0.0290	0.000006046	N/A	N/A	N/A	N/A	No	NTX
	140-290	Total PECDF	0.000000428	0.000000428	mg/kg	58SS04	1/5	0.0300-0.1420	0.000000428	N/A	N/A	N/A	N/A	No	NTX

- (1) Maximum concentration used for screening.
(2) N/A - Refer to supporting information for background discussion.
Background values derived from site-specific statistical analysis. See text for supporting information.
(3) Screening toxicity values from USEPA Region 3 RBC Table (April 2003). See text for derivation of Nutrient RDAs.
(4) Rationale Codes Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Below Screening and/or ARAR/TBC Level (BSL)

Definitions:
N/A = Not Applicable or Not Available
SQL = Sample Quantitation Limit
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level
J = Estimated Value
C = Carcinogenic
N = Non-Carcinogenic
RDA = Recommended Daily Allowance

Table E-3b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Total Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface and Subsurface Soil (0-10')	563-58-6	1,1-Dichloropropene			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	87-61-6	1,2,3-Trichlorobenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	96-18-4	1,2,3-Trichloropropane			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.20E-01	C	N/A	N	ASL, IFD
	95-63-6	1,2,4-Trimethylbenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.90E+02	N	N/A	N	BSL, IFD
	96-12-8	1,2-Dibromo-3-chloropropane			mg/kg		0/4	0.0060-0.7800	7.80E-01	4.60E-01	C	N/A	N	ASL, IFD
	106-93-4	1,2-Dibromoethane			mg/kg		0/4	0.0060-0.7800	7.80E-01	7.50E-03	C	N/A	N	ASL, IFD
	122-66-7	1,2-Diphenylhydrazine			mg/kg		0/4	0.4000-0.4100	4.10E-01	8.00E-01	C	N/A	N	BSL, IFD
	108-67-8	1,3,5-Trimethylbenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.90E+02	N	N/A	N	BSL, IFD
	99-35-4	1,3,5-Trinitrobenzene			mg/kg		0/5	0.1000-0.1000	1.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	142-28-9	1,3-Dichloropropane			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	99-65-0	1,3-Dinitrobenzene			mg/kg		0/5	0.1000-0.1000	1.00E-01	7.82E-01	N	N/A	N	BSL, IFD
	590-20-7	2,2-Dichloropropane			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	118-96-7	2,4,6-Trinitrotoluene			mg/kg		0/5	0.2000-0.2000	2.00E-01	3.90E+00	N	N/A	N	BSL, IFD
	35572-78-2	2-amino-4,6-Dinitrotoluene			mg/kg		0/5	0.2000-0.2000	2.00E-01	4.69E-01	N	N/A	N	BSL, IFD
	110-75-8	2-Chloroethyl vinyl ether			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	95-49-8	2-Chlorotoluene			mg/kg		0/4	0.0060-0.7800	7.80E-01	1.60E+02	N	N/A	N	BSL, IFD
	88-72-2	2-Nitrotoluene			mg/kg		0/5	0.4000-0.4000	4.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	Shaw 02	3+4-Methylphenols			mg/kg		0/3	0.4000-0.4100	4.10E-01	3.90E+01	N	N/A	N	BSL, IFD
	99-08-1	3-Nitrotoluene			mg/kg		0/5	0.4000-0.4000	4.00E-01	1.56E+02	N	N/A	N	BSL, IFD
	19406-51-0	4-amino-2,6-Dinitrotoluene			mg/kg		0/5	0.2000-0.2000	2.00E-01	4.69E-01	N	N/A	N	BSL, IFD
	99-99-0	4-Nitrotoluene			mg/kg		0/5	0.4000-0.4000	4.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	107-02-8	Acetaldehyde			mg/kg		0/4	0.0060-0.7800	7.80E-01	1.60E+02	N	N/A	N	BSL, IFD
	107-13-1	Acrylonitrile			mg/kg		0/4	0.0060-0.7800	7.80E-01	1.20E+00	C	N/A	N	BSL, IFD
	100-51-6	Benzyl alcohol			mg/kg		0/12	0.1900-10.0000	1.00E+01	2.35E+03	N	N/A	N	BSL, IFD
	108-86-1	Bromobenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	74-97-5	Chlorobromomethane			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	121-82-4	Cyclonite			mg/kg		0/5	0.2000-0.2000	2.00E-01	5.81E+00	C	N/A	N	BSL, IFD
	74-95-3	Dibromomethane			mg/kg		0/4	0.0060-0.7800	7.80E-01	7.80E+01	N	N/A	N	BSL, IFD
	75-71-8	Dichlorodifluoromethane			mg/kg		0/4	0.0060-0.7800	7.80E-01	1.60E+03	N	N/A	N	BSL, IFD
	2691-41-0	HMX			mg/kg		0/5	0.2000-0.2000	2.00E-01	3.91E+02	N	N/A	N	BSL, IFD
	104-51-8	n-Butylbenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.10E+02	N	N/A	N	BSL, IFD
	103-65-1	n-Propylbenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.10E+02	N	N/A	N	BSL, IFD
	55-63-0	Nitroglycerin			mg/kg		0/5	0.3340-0.3570	3.57E-01	4.56E+01	C	N/A	N	BSL, IFD
	95-47-6	o-Xylene			mg/kg		0/9	0.0048-0.7800	7.80E-01	1.56E+03	N	N/A	N	BSL, IFD
	106-43-4	p-Chlorotoluene			mg/kg		0/4	0.0060-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	78-11-5	Pentaerythritol tetranitrate			mg/kg		0/5	0.3340-0.3570	3.57E-01	N/A	N/A	N/A	N	IFD, NTX
	110-86-1	Pyridine			mg/kg		0/5	0.1900-0.2000	2.00E-01	7.82E+00	N	N/A	N	BSL, IFD
	135-98-8	sec-Butylbenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.10E+02	N	N/A	N	BSL, IFD

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Table E-3b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Total Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface and Subsurface Soil (0-10") (Continued)	98-06-6	tert-Butylbenzene			mg/kg		0/4	0.0060-0.7800	7.80E-01	3.10E+02	N	N/A	N	BSL, IFD
	479-45-8	Tetryl			mg/kg		0/5	0.2000-0.2000	2.00E-01	7.82E+01	N	N/A	N	BSL, IFD
	156-60-5	trans-1,2-Dichloroethene			mg/kg		0/9	0.0048-0.7800	7.80E-01	1.56E+02	N	N/A	N	BSL, IFD
	75-69-4	Trichlorofluoromethane			mg/kg		0/7	0.0060-0.7800	7.80E-01	2.30E+03	N	N/A	N	BSL, IFD
	108-05-4	Vinyl acetate			mg/kg		0/7	0.0030-0.7800	7.80E-01	7.80E+03	N	N/A	N	BSL, IFD
	7440-43-9	Cadmium			mg/kg		0/12	0.1110-0.7000	7.00E-01	3.90E+00	N	N/A	N	BSL, IFD
	7440-22-4	Silver			mg/kg		0/12	0.2300-1.2000	1.20E+00	3.90E+01	N	N/A	N	BSL, IFD
	93-76-5	2,4,5-T			mg/kg		0/2	0.1110-0.1130	1.13E-01	7.82E+01	N	N/A	N	BSL, IFD
	93-72-1	2,4,5-TP (Silvex)			mg/kg		0/2	0.1110-0.1130	1.13E-01	6.26E+01	N	N/A	N	BSL, IFD
	94-75-7	2,4-D			mg/kg		0/2	0.2220-0.2270	2.27E-01	7.82E+01	N	N/A	N	BSL, IFD
	94-82-6	2,4-DB			mg/kg		0/2	1.1100-1.1300	1.13E+00	6.26E+01	N	N/A	N	BSL, IFD
	72-55-9	4,4'-DDE			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.88E+00	C	N/A	N	BSL, IFD
	50-29-3	4,4-DDT			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.90E+00	C	N/A	N	BSL, IFD
	309-00-2	Aldrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.76E-02	C	N/A	N	BSL, IFD
	319-84-6	alpha-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.01E-01	C	N/A	N	BSL, IFD
	319-85-7	beta-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.55E-01	C	N/A	N	BSL, IFD
	75-99-0	Dalapon			mg/kg		0/2	1.1100-1.1300	1.13E+00	2.35E+02	N	N/A	N	BSL, IFD
	1918-00-9	Dicamba			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.35E+02	N	N/A	N	BSL, IFD
	120-36-5	Dichloroprop			mg/kg		0/2	0.2220-0.2270	2.27E-01	N/A	N/A	N/A	N	IFD, NTX
	959-98-8	Endosulfan I			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	33213-65-9	Endosulfan II			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	1031-07-8	Endosulfan sulfate			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.69E+01	N	N/A	N	BSL, IFD
	72-20-8	Endrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	7421-93-4	Endrin aldehyde			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	53494-70-5	Endrin ketone			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.35E+00	N	N/A	N	BSL, IFD
	58-89-9	gamma-BHC (Lindane)			mg/kg		0/2	0.0007-0.0008	7.56E-04	4.91E-01	C	N/A	N	BSL, IFD
	5103-74-2	gamma-Chlordane			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.82E+00	C	N/A	N	BSL, IFD
	76-44-8	Heptachlor			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.42E-01	C	N/A	N	BSL, IFD
	1024-57-3	Heptachlor epoxide			mg/kg		0/2	0.0007-0.0008	7.56E-04	7.02E-02	C	N/A	N	BSL, IFD
	94-74-6	MCPA			mg/kg		0/4	111.0000-113.0000	1.13E+02	3.91E+00	N	N/A	N	ASL, IFD
	93-65-2	MCPP			mg/kg		0/2	111.0000-113.0000	1.13E+02	7.82E+00	N	N/A	N	ASL, IFD
	72-43-5	Methoxychlor			mg/kg		0/1	0.0007-0.0007	7.42E-04	3.91E+01	N	N/A	N	BSL, IFD
	8001-35-2	Tuxaphene			mg/kg		0/2	0.0370-0.0378	3.78E-02	5.81E-01	C	N/A	N	BSL, IFD
	12674-11-2	Aroclor 1016			mg/kg		0/5	0.0370-0.0396	3.96E-02	5.50E-01	N	N/A	N	BSL, IFD
	11104-28-2	Aroclor 1221			mg/kg		0/5	0.0742-0.0793	7.93E-02	3.19E-01	C	N/A	N	BSL, IFD
	11141-16-5	Aroclor 1232			mg/kg		0/5	0.0370-0.0396	3.96E-02	3.19E-01	C	N/A	N	BSL, IFD
	53469-21-9	Aroclor 1242			mg/kg		0/5	0.0370-0.0396	3.96E-02	3.19E-01	C	N/A	N	BSL, IFD
	12672-29-6	Aroclor 1248			mg/kg		0/5	0.0370-0.0396	3.96E-02	3.19E-01	C	N/A	N	BSL, IFD

Table E-3b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Total Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface and Subsurface Soil (0-10') (Continued)	11097-69-1	Aroclor 1254			mg/kg		0/5	0.0370-0.0396	3.96E-02	1.56E-01	N	N/A	N	BSL, IFD
	11096-82-5	Aroclor 1260			mg/kg		0/5	0.0370-0.0396	3.96E-02	3.19E-01	C	N/A	N	BSL, IFD
	131-11-3	Dimethylphthalate			mg/kg		0/12	0.1700-0.8000	8.00E-01	7.82E+04	N	N/A	N	BSL, IFD
	120-82-1	1,2,4-Trichlorobenzene			mg/kg		0/16	0.0060-0.7800	7.80E-01	7.82E+01	N	N/A	N	BSL, IFD
	95-50-1	1,2-Dichlorobenzene			mg/kg		0/12	0.1100-0.6000	6.00E-01	7.04E+02	N	N/A	N	BSL, IFD
	541-73-1	1,3-Dichlorobenzene			mg/kg		0/12	0.1300-0.6000	6.00E-01	2.35E+02	N	N/A	N	BSL, IFD
	106-46-7	1,4-Dichlorobenzene			mg/kg		0/12	0.0980-0.5000	5.00E-01	2.66E+01	C	N/A	N	BSL, IFD
	95-95-4	2,4,5-Trichlorophenol			mg/kg		0/12	0.1000-0.9900	9.90E-01	7.82E+02	N	N/A	N	BSL, IFD
	88-06-2	2,4,6-Trichlorophenol			mg/kg		0/12	0.1700-0.8000	8.00E-01	5.81E+01	C	N/A	N	BSL, IFD
	120-83-2	2,4-Dichlorophenol			mg/kg		0/12	0.1800-0.9000	9.00E-01	2.35E+01	N	N/A	N	BSL, IFD
	105-67-9	2,4-Dimethylphenol			mg/kg		0/12	0.1900-3.0000	3.00E+00	1.56E+02	N	N/A	N	BSL, IFD
	51-28-5	2,4-Dinitrophenol			mg/kg		0/12	0.9300-6.0000	6.00E+00	1.56E+01	N	N/A	N	BSL, IFD
	121-14-2	2,4-Dinitrotoluene			mg/kg		0/12	0.1400-0.7000	7.00E-01	9.40E-01	C	N/A	N	BSL, IFD
	606-20-2	2,6-Dinitrotoluene			mg/kg		0/12	0.0850-0.4100	4.10E-01	9.40E-01	C	N/A	N	BSL, IFD
	91-58-7	2-Chloronaphthalene			mg/kg		0/12	0.0360-0.4100	4.10E-01	6.26E+02	N	N/A	N	BSL, IFD
	95-57-8	2-Chlorophenol			mg/kg		0/12	0.0600-0.4100	4.10E-01	3.91E+01	N	N/A	N	BSL, IFD
	91-57-6	2-Methylnaphthalene			mg/kg		0/8	0.0020-0.4100	4.10E-01	1.56E+02	N	N/A	N	BSL, IFD
	88-74-4	2-Nitroaniline			mg/kg		0/12	0.0620-2.0000	2.00E+00	N/A	N/A	N/A	N	IFD, NTX
	88-75-5	2-Nitrophenol			mg/kg		0/12	0.1400-0.7000	7.00E-01	N/A	N/A	N/A	N	IFD, NTX
	88-85-7	2-sec-butyl-4,6-dinitrophenol			mg/kg		0/2	0.2220-0.2270	2.27E-01	7.82E+00	N	N/A	N	BSL, IFD
	91-94-1	3,3'-Dichlorobenzidine			mg/kg		0/12	0.1900-30.0000	3.00E+01	1.42E+00	C	N/A	N	ASL, IFD
	99-09-2	3-Nitroaniline			mg/kg		0/12	0.1900-2.0000	2.00E+00	2.35E+00	N	N/A	N	BSL, IFD
	534-52-1	4,6-Dinitro-o-cresol			mg/kg		0/12	0.5500-3.0000	3.00E+00	7.82E-01	N	N/A	N	ASL, IFD
	100-01-6	4-Nitroaniline			mg/kg		0/12	0.1900-2.0000	2.00E+00	2.35E+01	N	N/A	N	BSL, IFD
	100-02-7	4-Nitrophenol			mg/kg		0/12	0.9300-7.0000	7.00E+00	6.26E+01	N	N/A	N	BSL, IFD
	83-32-9	Acenaphthene			mg/kg		0/11	0.0019-0.2000	2.00E-01	4.69E+02	N	N/A	N	BSL, IFD
	65-85-0	Benzoic Acid			mg/kg		0/6	0.9400-2.0000	2.00E+00	3.13E+04	N	N/A	N	BSL, IFD
	111-91-1	bis(2-Chloroethoxy)methane			mg/kg		0/12	0.0590-0.4100	4.10E-01	N/A	N/A	N/A	N	IFD, NTX
	111-44-4	bis(2-Chloroethyl)ether			mg/kg		0/12	0.0330-0.4100	4.10E-01	5.81E-01	C	N/A	N	BSL, IFD
	108-60-1	bis(2-Chloroisopropyl)ether			mg/kg		0/12	0.1900-1.0000	1.00E+00	9.12E+00	C	N/A	N	BSL, IFD
	85-68-7	Butyl benzyl phthalate			mg/kg		0/11	0.1700-0.8000	8.00E-01	1.56E+03	N	N/A	N	BSL, IFD
	86-74-8	Carbazole			mg/kg		0/9	0.1900-0.4100	4.10E-01	3.19E+01	C	N/A	N	BSL, IFD
	84-74-2	Di-n-butyl phthalate			mg/kg		0/12	0.0610-0.4100	4.10E-01	7.82E+02	N	N/A	N	BSL, IFD
	117-84-0	Di-n-octyl phthalate			mg/kg		0/12	0.1900-10.0000	1.00E+01	1.56E+02	N	N/A	N	BSL, IFD
	53-70-3	Dibenz(a,h)anthracene			mg/kg		0/12	0.0019-1.0000	1.00E+00	8.75E-02	C	N/A	N	ASL, IFD
	132-64-9	Dibenzofuran			mg/kg		0/12	0.0350-0.4100	4.10E-01	1.56E+01	N	N/A	N	BSL, IFD
	84-66-2	Diethyl phthalate			mg/kg		0/12	0.1900-1.0000	1.00E+00	6.26E+03	N	N/A	N	BSL, IFD
	118-74-1	Hexachlorobenzene			mg/kg		0/12	0.0330-0.4100	4.10E-01	3.99E-01	C	N/A	N	ASL, IFD

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Table E-3b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Total Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface and Subsurface Soil (0-10') (Continued)	87-68-3	Hexachlorobutadiene			mg/kg		0/12	0.1900-1.0000	1.00E+00	1.56E+00	N	N/A	N	BSL, IFD
	77-47-4	Hexachlorocyclopentadiene			mg/kg		0/12	0.1900-30.0000	3.00E+01	4.69E+01	N	N/A	N	BSL, IFD
	67-72-1	Hexachloroethane			mg/kg		0/12	0.1500-0.8000	8.00E-01	7.80E+00	N	N/A	N	BSL, IFD
	78-59-1	Isophorone			mg/kg		0/12	0.0330-0.4100	4.10E-01	6.72E+02	C	N/A	N	BSL, IFD
	621-64-7	n-Nitroso-di-n-propylamine			mg/kg		0/12	0.1900-1.0000	1.00E+00	9.12E-02	C	N/A	N	ASL, IFD
	86-30-6	n-Nitrosodiphenylamine			mg/kg		0/12	0.1900-10.0000	1.00E+01	1.30E+02	C	N/A	N	BSL, IFD
	98-95-3	Nitrobenzene			mg/kg		0/12	0.0450-0.4100	4.10E-01	3.91E+00	N	N/A	N	BSL, IFD
	95-48-7	o-Cresol			mg/kg		0/12	0.0290-0.4100	4.10E-01	3.91E+02	N	N/A	N	BSL, IFD
	59-50-7	p-Chloro-m-cresol			mg/kg		0/12	0.0950-0.8000	8.00E-01	N/A	N/A	N/A	N	IFD, NTX
	106-47-8	p-Chloroaniline			mg/kg		0/12	0.1900-4.0000	4.00E+00	3.13E+01	N	N/A	N	BSL, IFD
	106-44-5	p-Cresol			mg/kg		0/9	0.1900-1.0000	1.00E+00	3.91E+01	N	N/A	N	BSL, IFD
	87-86-5	Pentachlorophenol			mg/kg		0/12	0.9300-6.0000	6.00E+00	5.32E+00	C	N/A	N	ASL, IFD
	108-95-2	Phenol			mg/kg		0/12	0.1100-0.6000	6.00E-01	2.35E+03	N	N/A	N	BSL, IFD
	630-20-6	1,1,1,2-Tetrachloroethane			mg/kg		0/4	0.0060-0.7800	7.80E-01	2.50E+01	C	N/A	N	BSL, IFD
	71-55-6	1,1,1-Trichloroethane			mg/kg		0/12	0.0040-0.7800	7.80E-01	2.19E+03	N	N/A	N	BSL, IFD
	79-34-5	1,1,2,2-Tetrachloroethane			mg/kg		0/12	0.0020-0.7800	7.80E-01	3.19E+00	C	N/A	N	BSL, IFD
	79-00-5	1,1,2-Trichloroethane			mg/kg		0/12	0.0048-0.7800	7.80E-01	1.12E+01	C	N/A	N	BSL, IFD
	75-34-3	1,1-Dichloroethane			mg/kg		0/12	0.0020-0.7800	7.80E-01	7.82E+02	N	N/A	N	BSL, IFD
	75-35-4	1,1-Dichloroethene			mg/kg		0/12	0.0040-0.7800	7.80E-01	3.91E+02	N	N/A	N	BSL, IFD
	107-06-2	1,2-Dichloroethane			mg/kg		0/12	0.0020-0.7800	7.80E-01	7.02E+00	C	N/A	N	BSL, IFD
	540-59-0	1,2-Dichloroethene (total)			mg/kg		0/2	0.0030-0.0030	3.00E-03	7.82E+01	N	N/A	N	BSL, IFD
	78-87-5	1,2-Dichloropropane			mg/kg		0/12	0.0030-0.7800	7.80E-01	9.39E+00	C	N/A	N	BSL, IFD
	78-93-3	2-Butanone			mg/kg		0/12	0.0048-0.7800	7.80E-01	4.69E+03	N	N/A	N	BSL, IFD
	591-78-6	2-Hexanone			mg/kg		0/12	0.0048-0.7800	7.80E-01	3.13E+02	N	N/A	N	BSL, IFD
	101-55-3	4-Bromophenyl phenylether			mg/kg		0/12	0.0330-0.4100	4.10E-01	N/A	N/A	N/A	N	IFD, NTX
	7005-72-3	4-Chlorophenyl phenylether			mg/kg		0/12	0.0330-0.4100	4.10E-01	N/A	N/A	N/A	N	IFD, NTX
	108-10-1	4-Methyl 2-pentanone			mg/kg		0/12	0.0048-0.7800	7.80E-01	6.26E+02	N	N/A	N	BSL, IFD
	67-64-1	Acetone			mg/kg		0/12	0.0050-1.4000	1.40E+00	7.80E+02	N	N/A	N	BSL, IFD
	71-43-2	Benzene			mg/kg		0/12	0.0020-0.7800	7.80E-01	1.16E+01	C	N/A	N	BSL, IFD
	75-27-4	Bromodichloromethane			mg/kg		0/12	0.0030-0.7800	7.80E-01	1.03E+01	C	N/A	N	BSL, IFD
	74-83-9	Bromomethane			mg/kg		0/12	0.0048-0.7800	7.80E-01	1.10E+01	N	N/A	N	BSL, IFD
	75-15-0	Carbon disulfide			mg/kg		0/11	0.0040-0.7800	7.80E-01	7.82E+02	N	N/A	N	BSL, IFD
	56-23-5	Carbon tetrachloride			mg/kg		0/12	0.0048-0.7800	7.80E-01	4.91E+00	C	N/A	N	BSL, IFD
	108-90-7	Chlorobenzene			mg/kg		0/12	0.0010-0.7800	7.80E-01	1.56E+02	N	N/A	N	BSL, IFD
	75-00-3	Chloroethane			mg/kg		0/12	0.0048-0.7800	7.80E-01	2.20E+02	C	N/A	N	BSL, IFD
	74-87-3	Chloromethane			mg/kg		0/12	0.0048-0.7800	7.80E-01	N/A	N/A	N/A	N	IFD, NTX
	10061-01-5	cis-1,3-Dichloro-1-propene			mg/kg		0/12	0.0030-0.7800	7.80E-01	6.40E+00	C	N/A	N	BSL, IFD
	124-48-1	Dibromochloromethane			mg/kg		0/12	0.0030-0.7800	7.80E-01	7.60E+00	C	N/A	N	BSL, IFD

Table E-3b
Summary of Screening for Non-Detected Chemicals - Human Health
Future - Total Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Screening Toxicity Value (2) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface and Subsurface Soil (0-10') (Continued)	100-42-5	Styrene			mg/kg		0/12	0.0030-0.7800	7.80E-01	1.56E+03	N	N/A	N	BSL, IFD
	127-18-4	Tetrachloroethene			mg/kg		0/12	0.0010-0.7800	7.80E-01	1.20E+00	C	N/A	N	BSL, IFD
	10061-02-6	trans-1,3-Dichloropropene			mg/kg		0/12	0.0030-0.7800	7.80E-01	6.39E+00	C	N/A	N	BSL, IFD
	75-25-2	Tribromomethane			mg/kg		0/12	0.0048-0.7800	7.80E-01	8.09E+01	C	N/A	N	BSL, IFD
	67-66-3	Chloroform			mg/kg		0/12	0.0010-0.7800	7.80E-01	7.82E+01	N	N/A	N	BSL, IFD
	75-01-4	Vinyl Chloride			mg/kg		0/12	0.0048-0.7800	7.80E-01	9.00E+02	C	N/A	N	ASL, IFD
	1330-20-7	Xylenes (total)			mg/kg		0/3	0.0020-0.0020	2.00E-03	1.56E+03	N	N/A	N	BSL, IFD

- (1) Maximum non-detect concentration used for screening.
- (2) Screening toxicity values from USEPA Region 3 RBC Table (April 2003). See text for derivation of Nutrient RDAs.
RBCs are based on a risk level of 1.0E-6 and a HQ=0.1. See text for derivation of Nutrient RDAs.
- (3) Rationale Codes Selection Reason:
- Infrequent Detection but Associated Historically (HIST)
 - N Toxicity Information (NTX)
 - Above Screening Levels (ASL)
 - Break Down Product (BDP)
 - Elevated Detected Concentration (EDC)
 - Infrequent Detection (<= 5%, IFD)
 - Background Levels (BKG)
 - Tentatively Identified Compound Not used in the risk evaluation (TIC)
 - Below Screening and/or ARAR/TBC Level (BSL)

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Table E-4
Medium-specific Exposure Point Concentration Summary
Current - Surface Soil

Scenario Timeframe: Current
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Soil (0-2')	Aluminum	mg/kg	1.82E+04	NA	2.33E+04	2.33E+04	mg/kg	Max	W-Test(3)
	Chromium	mg/kg	3.57E+01	NA	4.27E+01	4.27E+01	mg/kg	Max	W-Test(3)
	Iron	mg/kg	2.61E+04	NA	2.78E+04	2.78E+04	mg/kg	Max	W-Test(3)
	Thallium	mg/kg	5.36E+00	N/A	1.18E+01	1.18E+01	mg/kg	Max	W-Test(3)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T); Mean of Normal Data (Mean-N), 95% UCL based on bootstrap statistic (95% UCL-Bst).

N/A - Not Applicable; Not Available

Distributions: Normal (N); Lognormal/Transformed (T); Undefined/Nonparametric (NP).

Test(1) The data were determined to be neither normally or lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50), and the bootstrap statistic used.

Test(2) The data were determined to be lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(3) The 95% UCL was not calculated due to limited number of samples (n<=5); therefore, the maximum detect was used as the EPC.

Test(4) The data were determined to be normally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(5) The 95% UCL exceeds the maximum detected concentration; therefore, the maximum detect was used as the EPC.

Table E-5
Medium-specific Exposure Point Concentration Summary
Future - Surface Soil

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Soil (0-2')	Aluminum	mg/kg	1.97E+04	2.37E+04 (T)	2.93E+04	2.37E+04	mg/kg	95%UCL-T	W-Test(2)
	Chromium	mg/kg	3.09E+01	3.71E+01 (T)	4.27E+01	3.71E+01	mg/kg	95%UCL-T	W-Test(2)
	Iron	mg/kg	2.63E+04	3.05E+04(N)	3.62E+04	3.05E+04	mg/kg	95%UCL-N	W-Test(4)
	Thallium	mg/kg	3.15E+00	1.03E+02 (T)	1.18E+01	1.18E+01	mg/kg	Max	W-Test(5)
	Vanadium	mg/kg	4.89E+01	5.52E+01 (N)	6.66E+01	5.52E+01	mg/kg	95%UCL-N	W-Test(4)
	4-Isopropyltoluene	mg/kg	2.67E-01	N/A	4.40E-02	4.40E-02	mg/kg	Max	W-Test(3)
	Benzo(a)pyrene	mg/kg	1.15E-01	1.24E+02 (T)	2.40E-01	2.40E-01	mg/kg	Max	W-Test(5)
	Trichloroethene	mg/kg	3.44E-01	6.44E-01	2.70E+00	6.44E-01	mg/kg	95%UCL-Bst	W-Test(1)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T);

Mean of Normal Data (Mean-N), 95% UCL based on bootstrap statistic (95% UCL-Bst).

N/A - Not Applicable; Not Available

Distributions: Normal (N); Lognormal/Transformed (T); Undefined/Nonparametric (NP).

Test(1) The data were determined to be neither normally or lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50), and the bootstrap statistic used.

Test(2) The data were determined to be lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(3) The 95% UCL was not calculated due to limited number of samples (n<=5); therefore, the maximum detect was used as the EPC.

Test(4) The data were determined to be normally distributed using Shapiro-Wilks Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(5) The 95% UCL exceeds the maximum detected concentration; therefore, the maximum detect was used as the EPC.

Table E-6
Medium-specific Exposure Point Concentration Summary
Future - Total Soil

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Mixed Surface and Subsurface Soil	Aluminum	mg/kg	2.00E+04	2.31E+04 (T)	2.93E+04	2.31E+04	mg/kg	95%UCL-T	W-Test(2)
	Thallium	mg/kg	2.63E+00	4.48E+00 (T)	1.18E+01	4.48E+00	mg/kg	95%UCL-Bst	W-Test(1)
	Benzo(a)pyrene	mg/kg	9.43E-02	1.02E-01 (NP)	2.40E-01	1.02E-01	mg/kg	95%UCL-Bst	W-Test(1)
	4-Isopropyltoluene	mg/kg	2.67E-01	N/A	4.40E-02	4.40E-02	mg/kg	Max	W-Test(3)
	Trichloroethene	mg/kg	2.82E-01	5.13E-01 (NP)	2.70E+00	5.13E-01	mg/kg	95%UCL-Bst	W-Test(1)

Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); 95% UCL of Log-transformed Data (95% UCL-T); Mean of Log-transformed Data (Mean-T);
Mean of Normal Data (Mean-N), 95% UCL based on bootstrap statistic (95% UCL-Bst).

N/A - Not Applicable; Not Available

Distributions: Normal (N); Lognormal/Transformed (T); Undefined/Nonparametric (NP).

Test(1) The data were determined to be neither normally or lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50), and the bootstrap statistic used.

Test(2) The data were determined to be lognormally distributed using Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(3) The 95% UCL was not calculated due to limited number of samples (n<=5); therefore, the maximum detect was used as the EPC.

Test(4) The data were determined to be normally distributed using Shapiro-Wilks Shapiro-Wilks (sample size<=50) or the Shapiro-Francia Calculation (sample size > 50).

Test(5) The 95% UCL exceeds the maximum detected concentration; therefore, the maximum detect was used as the EPC.

Table E-7
Values Used for Daily Intake Calculations- Current and Future Exposures to Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose $[(L)ADD_{oral}] \text{ (mg/kg-day)} =$ $\frac{CS \times IR-S \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 2001	
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
Dermal Absorption	Maintenance Worker	Adult	SWMU 58	CF2	Conversion Factor 2	365	days/year	---	Internal (Lifetime) Average Daily Dose $[(L)ADD_{derm}] \text{ (mg/kg-day)} =$ $\frac{CS \times SSAF \times DABS \times SA \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm ² -day	USEPA, 1997, 2001	
				DABS	Dermal Absorption Factor (Solid)	(2)	--	USEPA, 1995	
				SA	Skin Surface Area Available for Contact	3,300 (3)	cm ²	USEPA, 1997	
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF2	Conversion Factor 2	365	days/year	---	

(1) Best professional judgement. Based on site maintenance/inspection activities conducted 1day/week and assuming 2 weeks on vacation.

(2) Dermal absorption factors are presented in Section 6.2.3 of the text.

(3) Value derived from data presented in USEPA (1997b), averaging across gender and age. It is assumed that head, hands, and forearms are exposed to surface soil.

USEPA, 1991: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 1995: Assessing Dermal Exposure from Soil Hazardous Waste Management Division. Office of Superfund Programs, Region III, Philadelphia, PA.

USEPA, 1997: Exposure Factors Handbook, Volume I. EPA/600/P-95/002Fa.

USEPA, 2001: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Peer Review Draft. OSWER 9355.4-24.

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Table E-8
Values Used for Daily Intake Calculations- Future Exposures to Total Soil

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times IR-S \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 2001	
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
	Excavation Worker	Adult	SWMU 58	AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF2	Conversion Factor 2	365	days/year	---	
				CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times IR-S \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				IR-S	Ingestion Rate of Soil	330	mg/day	USEPA, 2001	
				EF	Exposure Frequency	250	days/year	USEPA, 2001	
				ED	Exposure Duration	1	years	USEPA, 2001	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
	Resident	Adult	SWMU 58	AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	30	years	USEPA, 1991	
				CF2	Conversion Factor 2	365	days/year	---	
				CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times IR-S \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				IR-S	Ingestion Rate of Soil	100	mg/day	USEPA, 1991	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
	Child	Child	SWMU 58	ED	Exposure Duration	30	years	USEPA, 1991	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	30	years	USEPA, 1991	
				CF2	Conversion Factor 2	365	days/year	---	
Dermal Absorption	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Internal (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times SSAF \times DABS \times SA \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm ² -day	USEPA, 1997, 2001	
				DABS	Dermal Absorption Factor (Solid)	(2)	---	USEPA, 1995	
				SA	Skin Surface Area Available for Contact	3,300 (3)	cm ²	USEPA, 1997	
				EF	Exposure Frequency	50	days/year	(1)	
				ED	Exposure Duration	25	years	USEPA, 2001	
	Excavation Worker	Adult	SWMU 58	CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF2	Conversion Factor 2	365	days/year	---	
				CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Internal (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times SSAF \times DABS \times SA \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm ² -day	USEPA, 2001	
				DABS	Dermal Absorption Factor (Solid)	(2)	---	USEPA, 1995	
				SA	Skin Surface Area Available for Contact	3,300 (3)	cm ²	USEPA, 1997	
				EF	Exposure Frequency	250	days/year	USEPA, 2001	
				ED	Exposure Duration	1	years	USEPA, 2001	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	1	years	USEPA, 2001	
				CF2	Conversion Factor 2	365	days/year	---	

Table E-8
Values Used for Daily Intake Calculations- Future Exposures to Total Soil

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal Absorption (cont)	Resident	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Internal (Lifetime) Average Daily Dose [(L)ADD _{int}] (mg/kg-day) = $\frac{CS \times SSAF \times DABS \times SA \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm ² -day	USEPA, 1997, 2001	
				DABS	Dermal Absorption Factor (Solid)	(2)	--	USEPA, 1995	
				SA	Skin Surface Area Available for Contact	5,700 (4)	cm ²	USEPA, 1997	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	30	years	USEPA, 1991	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	70	kg	USEPA, 1991	
		Child	SWMU 58	AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	Internal (Lifetime) Average Daily Dose [(L)ADD _{int}] (mg/kg-day) = $\frac{CS \times SSAF \times DABS \times SA \times EF \times ED \times CF1}{BW \times AT \times CF2}$
				AT-N	Averaging Time (Non-Cancer)	30	years	USEPA, 1991	
				CF2	Conversion Factor 2	365	days/year	---	
				CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm ² -day	USEPA, 1997, 2001	
				DABS	Dermal Absorption Factor (Solid)	(2)	--	USEPA, 1995	
				SA	Skin Surface Area Available for Contact	2,800 (5)	cm ²	USEPA, 1997	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	6	years	USEPA, 1991	
				CF1	Conversion Factor 1	1/10 ⁶	kg/mg	---	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	6	years	USEPA, 1991	
				CF2	Conversion Factor 2	365	days/year	---	

(1) Best professional judgement. Based on site maintenance/inspection activities conducted 1 day/week and assuming 2 weeks on vacation.

(2) Dermal absorption factors are presented in Section 6.2.3 of the text.

(3) Value derived from data presented in USEPA (1997b), averaging across gender and age. It is assumed that head, hands, and forearms are exposed to soil.

(4) Value derived from data presented in USEPA (1997b), averaging across gender and age. It is assumed that head, hands, forearms, and lower legs are exposed to soil.

(5) Value derived from data presented in USEPA (1997b), averaging across gender and age. It is assumed that head, hands, forearms, lower legs, and feet are exposed to soil.

USEPA, 1991: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 1995: Assessing Dermal Exposure from Soil Hazardous Waste Management Division. Office of Superfund Programs, Region III, Philadelphia, PA.

USEPA, 1997: Exposure Factors Handbook, Volume I. EPA/600/P-95/002Fa.

USEPA, 2001: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Peer Review Draft. OSWER 9355.4-24.

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Table E-9
Values Used for Daily Intake Calculations- Current/Future Exposures to Surface Soil- Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation (Particulates)	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{pot}] (mg/kg-day) = $\frac{CS \times (1/PEF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				PEF	Particulate Emission Factor	Site-Specific PEF	m ³ /kg	Site-Specific PEF	
				IN	Inhalation Rate	2.5	m ³ /h	(1)	
				EF	Exposure Frequency	50	days/year	(2)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				ET	Exposure Time	8	hr/day	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	365	days/year	---	
Inhalation (Volatiles)	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{pot}] (mg/kg-day) = $\frac{CS \times (1/VF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				VF	Volatilization Factor	Chemical-Specific	m ³ /kg	Chemical-Specific	
				IN	Inhalation Rate	2.5	m ³ /h	(1)	
				EF	Exposure Frequency	50	days/year	(2)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				ET	Exposure Time	8	hr/day	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	365	days/year	---	

(1) The hourly inhalation rate was derived by dividing the adult's daily 20 m³/day USEPA (1991a) inhalation rate by 8 hours per day.

(2) Best professional judgement. Based on site maintenance/inspection activities conducted 1 day/week and assuming 2 weeks on vacation.

USEPA, 1991: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 2001: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Peer Review Draft. OSWER 9355.4-24.

Table E-10
Values Used for Daily Intake Calculations- Future Exposures to Total Soil- Air

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/Model Name
Inhalation (Particulates)	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose $[(L)ADD_{\text{soil}}] \text{ (mg/kg-day)} =$ $\frac{CS \times (1/PEF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				PEF	Particulate Emission Factor	Site-Specific PEF	m ³ /kg	Site-Specific PEF	
				IN	Inhalation Rate	2.5	m ³ /h	(1)	
				EF	Exposure Frequency	50	days/year	(2)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				ET	Exposure Time	8	hr/day	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	365	days/year	---	
	Excavation Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose $[(L)ADD_{\text{soil}}] \text{ (mg/kg-day)} =$ $\frac{CS \times (1/PEF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				PEF	Particulate Emission Factor	Site-Specific PEF	m ³ /kg	Site-Specific PEF	
				IN	Inhalation Rate	2.5	m ³ /h	(1)	
				EF	Exposure Frequency	250	days/year	USEPA, 2001	
				ED	Exposure Duration	1	years	USEPA, 2001	
				ET	Exposure Time	8	hr/day	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	1	years	USEPA, 2001	
				CF1	Conversion Factor 1	365	days/year	---	
	Resident	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose $[(L)ADD_{\text{soil}}] \text{ (mg/kg-day)} =$ $\frac{CS \times (1/PEF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				PEF	Particulate Emission Factor	Site-Specific PEF	m ³ /kg	Site-Specific PEF	
				IN	Inhalation Rate	0.83	m ³ /h	(3)	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	30	years	USEPA, 1991	
				ET	Exposure Time	1	hr/day	(4)	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	30	years	USEPA, 1991	
				CF1	Conversion Factor 1	365	days/year	---	
		Child	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose $[(L)ADD_{\text{soil}}] \text{ (mg/kg-day)} =$ $\frac{CS \times (1/PEF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				PEF	Particulate Emission Factor	Site-Specific PEF	m ³ /kg	Site-Specific PEF	
				IN	Inhalation Rate	0.5	m ³ /h	(5)	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	6	years	USEPA, 1991	
				ET	Exposure Time	1	hr/day	(6)	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	6	years	USEPA, 1991	
				CF1	Conversion Factor 1	365	days/year	---	
Inhalation (Volatiles)	Maintenance Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose $[(L)ADD_{\text{soil}}] \text{ (mg/kg-day)} =$ $\frac{CS \times (1/VF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				VF	Volatilization Factor	Chemical-Specific	m ³ /kg	Chemical-Specific	
				IN	Inhalation Rate	2.5	m ³ /h	(1)	
				EF	Exposure Frequency	50	days/year	(2)	
				ED	Exposure Duration	25	years	USEPA, 2001	
				ET	Exposure Time	8	hr/day	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	25	years	USEPA, 2001	
				CF1	Conversion Factor 1	365	days/year	---	

Table E-10
Values Used for Daily Intake Calculations- Future Exposures to Total Soil- Air

Scenario Timeframe:	Future
Medium:	Total Soil
Exposure Medium:	Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation (Volatiles) (con't)	Excavation Worker	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times (1/VF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				VF	Volatilization Factor	Chemical-Specific	m ³ /kg	Chemical-Specific	
				IN	Inhalation Rate	2.5	m ³ /h	(1)	
				EF	Exposure Frequency	250	days/year	USEPA, 2001	
				ED	Exposure Duration	1	years	USEPA, 2001	
				ET	Exposure Time	8	hr/day	USEPA, 1991	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	1	years	USEPA, 2001	
				CF1	Conversion Factor 1	365	days/year	---	
	Resident	Adult	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times (1/VF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				VF	Volatilization Factor	Chemical-Specific	m ³ /kg	Chemical-Specific	
				IN	Inhalation Rate	0.83	m ³ /h	(3)	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	30	years	USEPA, 1991	
				ET	Exposure Time	1	hr/day	(4)	
				BW	Body Weight	70	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	30	years	USEPA, 1991	
				CF1	Conversion Factor 1	365	days/year	---	
	Child	Child	SWMU 58	CS	Chemical Concentration in Soil	See site-specific EPC tables	mg/kg	See site-specific EPC tables	Potential (Lifetime) Average Daily Dose [(L)ADD _{soil}] (mg/kg-day) = $\frac{CS \times (1/VF) \times IN \times EF \times ED \times ET}{BW \times AT \times CF1}$
				VF	Volatilization Factor	Chemical-Specific	m ³ /kg	Chemical-Specific	
				IN	Inhalation Rate	0.5	m ³ /h	(5)	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED	Exposure Duration	6	years	USEPA, 1991	
				ET	Exposure Time	1	hr/day	(6)	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	70	years	USEPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	6	years	USEPA, 1991	
				CF1	Conversion Factor 1	365	days/year	---	

(1) The maintenance worker and excavation worker hourly inhalation rate was derived by dividing the adult's daily 20 m³/day USEPA (1991a) inhalation rate by 8 hours per day.

(2) Best professional judgement. Based on site maintenance/inspection activities conducted 1day/week and assuming 2 weeks on vacation.

(3) The adult resident hourly inhalation rate was derived by dividing the adult daily 20 m³/day USEPA (1991a) inhalation rate by 24 hours per day.

(4) Exposure time is based upon the average time an adult spends outdoors, assuming 1.5 hours/day (USEPA, 1997b) with the exception of the three coldest months of the year.

(5) The child resident hourly inhalation rate was derived by dividing the child daily 12 m³/day USEPA (2002a) inhalation rate by 24 hours per day.

(6) Exposure time is based upon the assumption that children (ages 6 years and under) would be accompanied or supervised by an adult during time spent outdoors. Therefore, the exposure time for the child is is equivalent to the adult, i.e., an average time of 1.5 hours/day (USEPA, 1997b) with the exception of the coldest months of the year.

USEPA, 1991: Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER 9285.6-03.

USEPA, 2001: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Peer Review Draft. OSWER 9355.4-24.

Table E-11
Non-Cancer Toxicity Data- Oral/Dermal

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral to Dermal Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Dates of RfD (3): (MM/DD/YY)
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4-Isopropyltoluene (4)	Chronic	1E-01	mg/kg-day	100%	1.0E-01	mg/kg-day	Kidney	N/A	VDEQ, 2003	6/19/03
Trichloroethene	Chronic	3E-04	mg/kg-day	100%	3.0E-04	mg/kg-day	Liver, Kidney, Developing Fetus	3,000	NCEA	8/01
Aluminum	Chronic	1E+00	mg/kg-day	100%	1.0E+00	mg/kg-day	Developmental Neurotoxicity	100	EPA, 2003; NCEA	8/13/99
Chromium (III)	Chronic	1.5E+00	mg/kg-day	1.3%	2.0E-02	mg/kg-day	NOAEL	1,000	IRIS	10/7/03/03:9/3/98
Iron	Chronic	3E-01	mg/kg-day	100%	3.0E-01	mg/kg-day	Blood, Liver, GI Irritation	1	VDEQ, 2003; NCEA	10/7/03/03:4/25/03
Thallium (5)	Chronic	8E-05	mg/kg-day	100%	8.0E-05	mg/kg-day	Blood, Liver, Hair	3,000	VDEQ, 2003; IRIS	10/7/03:9/1/90
Vanadium	Chronic	7E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	NOAEL	100	HEAST	1997

(1) Source: Risk Assessment Guidance for Superfund Volume 1: Human Health
Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.
Section 4.2 and Exhibit 4-1.

(2) The equation used to derive the adjusted dermal RfD is presented in the text.

(3) For IRIS values, the date IRIS was searched and the date of the most recent review are provided.

For NCEA values, the date of the article provided by NCEA is provided.

(4) Toxicity value was based on isopropylbenzene (VDEQ, 2003).

(5) The toxicity information for thallium sulfate was used.

Definitions:

N/A = Not Available

IRIS = Integrated Risk Information System

NCEA = National Center for Environmental Assessment

EPA, 2003 = EPA Region III April 25, 2003 RBC table.

10/1

Table E-12
Cancer Toxicity Data- Oral/Dermal

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source	Date (3) (MM/DD/YY)
Benzo(a)pyrene	7.3E+00	(mg/kg-day) ⁻¹	100%	7.3E+00	(mg/kg-day) ⁻¹	B2	IRIS	10/7/03:11/1/94
4-Isopropyltoluene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trichloroethene	4.0E-01	(mg/kg-day) ⁻¹	100%	4.0E-01	(mg/kg-day) ⁻¹	B1	NCEA	8/01
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chromium (III)	N/A	N/A	N/A	N/A	N/A	D	IRIS	10/7/03:9/3/98
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium (4)	N/A	N/A	N/A	N/A	N/A	D	IRIS	10/7/03:9/1/90
Vanadium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

(1) Source: Risk Assessment Guidance for Superfund Volume 1: Human Health
Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim.
Section 4.2 and Exhibit 4-1.

(2) The equation for deriving the adjusted dermal cancer slope factors are presented in the text.

(3) For IRIS values, the date IRIS was searched and the date of the most recent review are provided.
For NCEA values, the date of the article provided by NCEA is provided.

(4) The toxicity information for thallium sulfate was used.

Definitions: N/A = Not Available
IRIS = Integrated Risk Information System
NCEA = National Center for Environmental Assessment
EPA, 2003 = EPA Region III April 25, 2003 RBC table.

EPA Group:

- A - Human carcinogen
- B1 - Probable human carcinogen - indicates that limited human data are available
- B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
- C - Possible human carcinogen
- D - Not classifiable as a human carcinogen
- E - Evidence of noncarcinogenicity

Table E-13
Non-Cancer Toxicity Data- Inhalation

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD (1)		Primary Target Organ (s)	Combined Uncertainty/ Modifying Factors	RfC:Target Organ(s)	
		Value	Units	Value	Units			Source(s) (2)	Dates of RfD: (MM/DD/YY)
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4-Isopropyltoluene (3)	Chronic	4.0E-01	mg/m ³	1.1E-01	mg/kg-day	Kidney	N/A	VDEQ, 2003	6/19/03
Trichloroethene	Chronic	4E-02	mg/m ³	1.0E-02	mg/kg-day	Liver, CNS, Endocrine System	1,000	NCEA	8/01
Aluminum	Chronic	3.5E-03	mg/m ³	1.0E-03	mg/kg-day	N/A	N/A	EPA, 2003; NCEA	4/25/03
Chromium (III)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

- (1) The adjusted inhalation RfD was derived from the RfC value assuming a 70 kg adult inhales 20 m³/day as follows: RfD = RfC * (20 m³/day / 70 kg).
- (2) For NCEA values, the date of the article provided by NCEA is provided.
For IRIS values, the date IRIS was searched and the date of the most recent review are provided.
- (3) Toxicity value was based on isopropylbenzene (VDEQ, 2003).

Definitions: N/A = Not Available
 IRIS = Integrated Risk Information System
 NCEA = National Center for Environmental Assessment
 EPA, 2003 = EPA Region III April 25, 2003 RBC table.

2002

Table E-14
Cancer Toxicity Data- Inhalation

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation CSF	
	Value	Units	Value	Units		Source	Date (1) (MM/DD/YY)
Benzo(a)pyrene	N/A	N/A	3.1E+00	(mg/kg-day) ⁻¹	B2	EPA, 2003; NCEA	10/8/03
4-Isopropyltoluene	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Trichloroethene	1.1E-04	(ug/m ³) ⁻¹	4.0E-01	(mg/kg-day) ⁻¹	B1	NCEA	8/01
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chromium (III)	N/A	N/A	N/A	N/A	D	IRIS	10/7/03;9/3/98
Iron	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Thallium	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vanadium	N/A	N/A	N/A	N/A	N/A	N/A	N/A

(1) For IRIS values, the date IRIS was searched and the date of the most recent review are provided.
For NCEA values, the date of the article provided by NCEA is provided.

Definitions: IRIS = Integrated Risk Information System
NCEA = National Center for Environmental Assessment
EPA, 2003 = EPA Region III April 25, 2003 RBC table.

EPA Group:

A - Human carcinogen

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

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

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

Tab E-15
Calculation of Cancer Risks
Reasonable Maximum Exposure
Current - Surface Soil - Maintenance Worker

Scenario Timeframe: Current
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	
							Value	Units	Value	Units		
Surface Soil	Surface Soil	SWMU 58	Ingestion	Organics No COPCs								
				Inorganics Aluminum	2.33E+04	mg/kg	1.6E-03	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Chromium	4.27E+01	mg/kg	3.0E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Iron	2.78E+04	mg/kg	1.9E-03	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	1.18E+01	mg/kg	8.2E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Exp. Route Total						0.0E+00		
			Dermal Absorption	Organics No COPCs								
				Inorganics Aluminum	2.33E+04	mg/kg	1.1E-04	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Chromium	4.27E+01	mg/kg	2.0E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Iron	2.78E+04	mg/kg	1.3E-04	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	1.18E+01	mg/kg	5.4E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Exp. Route Total						0.0E+00		
			Exposure Point Total							0.0E+00		
			Exposure Media Total							0.0E+00		
		Air (Particulates)	SWMU 58	Inhalation	Organics No COPCs							
					Inorganics Aluminum	2.33E+04	mg/kg	5.4E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
					Chromium	4.27E+01	mg/kg	9.8E-10	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
					Iron	2.78E+04	mg/kg	6.4E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
					Thallium	1.18E+01	mg/kg	2.7E-10	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
					Exp. Route Total						0.0E+00	
				Exposure Point Total							0.0E+00	
				Exposure Media Total							0.0E+00	
				Air (Volatiles)	SWMU 58	Inhalation	Organics No COPCs					
Inorganics Aluminum	2.33E+04						mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
Chromium	4.27E+01	mg/kg	N/A				mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
Iron	2.78E+04	mg/kg	N/A				mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
Thallium	1.18E+01	mg/kg	N/A				mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
Exp. Route Total							0.0E+00					
Exposure Point Total							0.0E+00					
Exposure Media Total							0.0E+00					
Soil Total							0.0E+00					
Total of Receptor Risks Across All Media										0.0E+00		

N/A = Not Applicable.

505

Tab E-16
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future - Surface Soil - Maintenance Worker

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	
							Value	Units	Value	Units		
Surface Soil	Surface Soil	SWMU 58	Ingestion	Organics								
				Benzo(a)pyrene	2.40E-01	mg/kg	1.7E-08	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	1.2E-07	
				4-Isopropyltoluene	4.40E-02	mg/kg	3.1E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Trichloroethene	6.44E-01	mg/kg	4.5E-08	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	1.8E-08	
				Inorganics								
				Aluminum	2.37E+04	mg/kg	1.7E-03	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Chromium	3.71E+01	mg/kg	2.6E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Iron	3.05E+04	mg/kg	2.1E-03	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	1.18E+01	mg/kg	8.2E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Vanadium	5.52E+01	mg/kg	3.9E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
			Exp. Route Total							1.4E-07		
			Dermal Absorption	Organics								
				Benzo(a)pyrene	2.40E-01	ng/kg	1.1E-08	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	8.1E-08	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.7E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Trichloroethene	6.44E-01	mg/kg	2.5E-08	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	1.0E-08	
				Inorganics								
				Aluminum	2.37E+04	mg/kg	1.1E-04	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Chromium	3.71E+01	mg/kg	1.7E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Iron	3.05E+04	mg/kg	1.4E-04	ng/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	1.18E+01	ng/kg	5.4E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Vanadium	5.52E+01	mg/kg	2.5E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
			Exp. Route Total							9.1E-08		
			Exposure Point Total								2.3E-07	
			Exposure Media Total								2.3E-07	
	Air (Particulates)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	2.40E-01	mg/kg	5.5E-12	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	1.7E-11	
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A	
				Trichloroethene	6.44E-01	mg/kg	N/A	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	N/A	
				Inorganics								
				Aluminum	2.37E+04	mg/kg	5.5E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Chromium	3.71E+01	mg/kg	8.6E-10	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Iron	3.05E+04	ng/kg	7.0E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	1.18E+01	ng/kg	2.7E-10	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Vanadium	5.52E+01	mg/kg	1.3E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
			Exp. Route Total							1.7E-11		
			Exposure Point Total								1.7E-11	
			Exposure Media Total								1.7E-11	
Air (Volatiles)	SWMU 58	Inhalation	Organics									
			Benzo(a)pyrene	2.40E-01	mg/kg	N/A	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	N/A		
			4-Isopropyltoluene	4.40E-02	ng/kg	1.1E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
			Trichloroethene	6.44E-01	mg/kg	4.5E-06	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	1.8E-06		
			Inorganics									
			Aluminum	2.37E+04	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
			Chromium	3.71E+01	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
			Iron	3.05E+04	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
			Thallium	1.18E+01	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
			Vanadium	5.52E+01	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
		Exp. Route Total							1.8E-06			
		Exposure Point Total								1.8E-06		
		Exposure Media Total								1.8E-06		
Soil Total								2.0E-06				
Total of Receptor Risks Across All Media											2.0E-06	

N/A = Not Applicable.

Table E-17
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future - Total Soil - Maintenance Worker

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations						
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk		
							Value	Units	Value	Units			
Total Soil	Total Soil	SWMU 58	Ingestion	Organics									
				Benzo(a)pyrene	1.02E-01	mg/kg	7.1E-09	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	5.2E-08		
				4-Isopropyltoluene	4.40E-02	mg/kg	3.1E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
				Trichloroethene	5.13E-01	mg/kg	3.6E-08	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	1.4E-08		
				Inorganics									
				Aluminum	2.31E+04	mg/kg	1.6E-03	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
				Thallium	4.48E+00	mg/kg	3.1E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
			Exp. Route Total										6.6E-08
			Dermal Absorption	Organics									
				Benzo(a)pyrene	1.02E-01	mg/kg	4.7E-09	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	3.4E-08		
				4-Isopropyltoluene	4.40E-02	mg/kg	1.7E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
				Trichloroethene	5.13E-01	mg/kg	2.0E-08	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	8.0E-09		
				Inorganics									
				Aluminum	2.31E+04	mg/kg	1.1E-04	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
				Thallium	4.48E+00	mg/kg	2.1E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
			Exp. Route Total										4.2E-08
		Exposure Point Total											
		Exposure Media Total											1.1E-07
		Air (Particulates)	SWMU 58	Inhalation	Organics								
					Benzo(a)pyrene	1.02E-01	mg/kg	2.4E-12	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	7.3E-12	
					4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A	
					Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	N/A	
					Inorganics								
Aluminum	2.31E+04				mg/kg	5.3E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---			
Thallium	4.48E+00				mg/kg	1.0E-10	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---			
Exp. Route Total										7.3E-12			
Exposure Point Total													7.3E-12
Exposure Media Total													7.3E-12
Air (Volatiles)	SWMU 58			Inhalation	Organics								
					Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	N/A	
					4-Isopropyltoluene	4.40E-02	mg/kg	1.1E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
					Trichloroethene	5.13E-01	mg/kg	3.6E-06	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	1.4E-06	
					Inorganics								
					Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A	
		Thallium	4.48E+00		mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A			
		Exp. Route Total										1.4E-06	
		Exposure Point Total											1.4E-06
		Exposure Media Total											1.4E-06
Soil Total											1.6E-06		
Total of Receptor Risks Across All Media											1.6E-06		

N/A = Not Applicable.

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Table E-18
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future - Total Soil - Excavation Worker

Scenario Timeframe: Future
Receptor Population: Excavation Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	
							Value	Units	Value	Units		
Total Soil	Total Soil	SWMU 58	Ingestion	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	4.7E-09	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	3.4E-08	
				4-Isopropyltoluene	4.40E-02	mg/kg	2.0E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Trichloroethene	5.13E-01	mg/kg	2.4E-08	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	9.5E-09	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	1.1E-03	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	4.48E+00	mg/kg	2.1E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
			Exp. Route Total							4.4E-08		
			Dermal Absorption	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	1.4E-09	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	1.0E-08	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.3E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Trichloroethene	5.13E-01	mg/kg	1.5E-07	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	6.0E-08	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	3.2E-05	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
				Thallium	4.48E+00	mg/kg	6.2E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---	
			Exp. Route Total							7.0E-08		
		Exposure Point Total							1.1E-07			
		Exposure Media Total							1.1E-07			
		Air (Particulates)	SWMU 58	Inhalation	Organics							
					Benzo(a)pyrene	1.02E-01	mg/kg	4.7E-13	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	1.5E-12
					4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
					Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	N/A
					Inorganics							
Aluminum	2.31E+04				mg/kg	1.1E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
Thallium	4.48E+00				mg/kg	2.1E-11	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
Exp. Route Total							1.5E-12					
Exposure Point Total							1.5E-12					
Exposure Media Total							1.5E-12					
Air (Volatiles)	SWMU 58			Inhalation	Organics							
					Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	N/A
		4-Isopropyltoluene	4.40E-02		mg/kg	2.2E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---		
		Trichloroethene	5.13E-01		mg/kg	7.2E-07	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	2.9E-07		
		Inorganics										
		Aluminum	2.31E+04		mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
		Thallium	4.48E+00		mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A		
		Exp. Route Total							2.9E-07			
		Exposure Point Total							2.9E-07			
		Exposure Media Total							2.9E-07			
		Soil Total							4.0E-07			
		Total of Receptor Risks Across All Media										

N/A = Not Applicable.

Table E-19
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future - Total Soil - Adult Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk
							Value	Units	Value	Units	
Total Soil	Total Soil	SWMU 58	Ingestion	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	6.0E-08	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	4.4E-07
				4-Isopropyltoluene	4.40E-02	mg/kg	2.6E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Trichloroethene	5.13E-01	mg/kg	3.0E-07	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	1.2E-07
				Inorganics							
				Aluminum	2.31E+04	mg/kg	1.4E-02	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Thallium	4.48E+00	mg/kg	2.6E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
			Exp. Route Total								5.6E-07
			Dermal Absorption	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	2.4E-08	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	1.7E-07
				4-Isopropyltoluene	4.40E-02	mg/kg	7.2E-09	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Trichloroethene	5.13E-01	mg/kg	8.4E-08	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	3.4E-08
				Inorganics							
				Aluminum	2.31E+04	mg/kg	5.4E-04	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Thallium	4.48E+00	mg/kg	1.0E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
			Exp. Route Total								2.1E-07
		Exposure Point Total									7.7E-07
	Exposure Media Total										7.7E-07
	Air (Particulates)	SWMU 58	Inhalation	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	8.2E-13	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	2.5E-12
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
				Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	N/A
				Inorganics							
				Aluminum	2.31E+04	mg/kg	1.9E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Thallium	4.48E+00	mg/kg	3.6E-11	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
			Exp. Route Total								2.5E-12
		Exposure Point Total									2.5E-12
	Exposure Media Total										2.5E-12
	Air (Volatiles)	SWMU 58	Inhalation	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	N/A
				4-Isopropyltoluene	4.40E-02	mg/kg	3.8E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Trichloroethene	5.13E-01	mg/kg	1.3E-06	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	5.0E-07
				Inorganics							
				Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
				Thallium	4.48E+00	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
			Exp. Route Total								5.0E-07
		Exposure Point Total									5.0E-07
	Exposure Media Total										5.0E-07
Soil Total											1.3E-06
Total of Receptor Risks Across All Media											1.3E-06

N/A = Not Applicable.

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Table E-20
Calculation of Cancer Risks
Reasonable Maximum Exposure
Future - Total Soil - Child Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk
							Value	Units	Value	Units	
Total Soil	Total Soil	SWMU 58	Ingestion	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	1.1E-07	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	8.2E-07
				4-Isopropyltoluene	4.40E-02	mg/kg	4.8E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Trichloroethene	5.13E-01	mg/kg	5.6E-07	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	2.2E-07
				Inorganics							
				Aluminum	2.31E+04	mg/kg	2.5E-02	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Thallium	4.48E+00	mg/kg	4.9E-06	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
			Exp. Route Total								1.0E-06
			Dermal Absorption	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	3.1E-08	mg/kg-day	7.3E+00	(mg/kg-day) ⁻¹	2.3E-07
				4-Isopropyltoluene	4.40E-02	mg/kg	4.7E-08	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Trichloroethene	5.13E-01	mg/kg	5.5E-07	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	2.2E-07
				Inorganics							
				Aluminum	2.31E+04	mg/kg	7.1E-04	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Thallium	4.48E+00	mg/kg	1.4E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
			Exp. Route Total								4.5E-07
		Exposure Point Total									1.5E-06
	Exposure Media Total										1.5E-06
	Air (Particulates)	SWMU 58	Inhalation	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	4.6E-13	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	1.4E-12
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
				Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	N/A
				Inorganics							
				Aluminum	2.31E+04	mg/kg	1.0E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Thallium	4.48E+00	mg/kg	2.0E-11	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
			Exp. Route Total								1.4E-12
		Exposure Point Total									1.4E-12
	Exposure Media Total										1.4E-12
	Air (Volatiles)	SWMU 58	Inhalation	Organics							
				Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	3.1E+00	(mg/kg-day) ⁻¹	N/A
				4-Isopropyltoluene	4.40E-02	mg/kg	2.1E-07	mg/kg-day	N/A	(mg/kg-day) ⁻¹	---
				Trichloroethene	5.13E-01	mg/kg	7.1E-07	mg/kg-day	4.0E-01	(mg/kg-day) ⁻¹	2.8E-07
				Inorganics							
				Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
				Thallium	4.48E+00	mg/kg	N/A	mg/kg-day	N/A	(mg/kg-day) ⁻¹	N/A
			Exp. Route Total								2.8E-07
		Exposure Point Total									2.8E-07
	Exposure Media Total										2.8E-07
Soil Total											1.8E-06
Total of Receptor Risks Across All Media											1.8E-06

N/A = Not Applicable.

Table E-21
Calculation of Non-cancer Hazards
Reasonable Maximum Exposure
Current - Surface Soil - Maintenance Worker

Scenario Timeframe: Current
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		RID/R/C		Hazard Quotient		
							Value	Units	Value	Units			
Surface Soil	Surface Soil	SWMU 58	Ingestion	Organics No COPCs									
				Inorganics									
				Aluminum	2.33E+04	mg/kg	4.6E-03	mg/kg-day	1.0E+00	mg/kg-day	4.6E-03		
				Chromium	4.27E+01	mg/kg	8.4E-06	mg/kg-day	1.5E+00	mg/kg-day	5.6E-06		
				Iron	2.78E+04	mg/kg	5.4E-03	mg/kg-day	3.0E-01	mg/kg-day	1.8E-02		
				Thallium	1.18E+01	mg/kg	2.3E-06	mg/kg-day	8.0E-05	mg/kg-day	2.9E-02		
				Exp. Route Total							5.2E-02		
				Dermal Absorption	Organics No COPCs								
					Inorganics								
					Aluminum	2.33E+04	mg/kg	3.0E-04	mg/kg-day	1.0E+00	mg/kg-day	3.0E-04	
					Chromium	4.27E+01	mg/kg	5.5E-07	mg/kg-day	2.0E-02	mg/kg-day	2.8E-05	
					Iron	2.78E+04	mg/kg	3.6E-04	mg/kg-day	3.0E-01	mg/kg-day	1.2E-03	
					Thallium	1.18E+01	mg/kg	1.5E-07	mg/kg-day	8.0E-05	mg/kg-day	1.9E-03	
				Exp. Route Total							3.4E-03		
			Exposure Point Total								5.5E-02		
			Exposure Media Total								5.5E-02		
			Air (Particulates)	SWMU 58	Inhalation	Organics No COPCs							
						Inorganics							
						Aluminum	2.33E+04	mg/kg	1.5E-06	mg/kg-day	1.0E-03	mg/kg-day	1.5E-03
						Chromium	4.27E+01	mg/kg	2.8E-09	mg/kg-day	N/A	mg/kg-day	---
						Iron	2.78E+04	mg/kg	1.8E-06	mg/kg-day	N/A	mg/kg-day	---
						Thallium	1.18E+01	mg/kg	7.6E-10	mg/kg-day	N/A	mg/kg-day	---
						Exp. Route Total							1.5E-03
						Exposure Point Total							
					Exposure Media Total								1.5E-03
					Air (Volatiles)	SWMU 58	Inhalation	Organics No COPCs					
			Inorganics										
Aluminum	2.33E+04	mg/kg	N/A	mg/kg-day				1.0E-03	mg/kg-day	N/A			
Chromium	4.27E+01	mg/kg	N/A	mg/kg-day				N/A	mg/kg-day	N/A			
Iron	2.78E+04	mg/kg	N/A	mg/kg-day				N/A	mg/kg-day	N/A			
Thallium	1.18E+01	mg/kg	N/A	mg/kg-day				N/A	mg/kg-day	N/A			
Exp. Route Total								0.0E+00					
Exposure Point Total										0.0E+00			
Exposure Media Total									0.0E+00				
Soil Total									5.6E-02				
Total of Receptor Hazards Across All Media								5.6E-02					

N/A = Not Applicable.

5.6E-02

Table E-22
Calculation of Non-cancer Hazards
Reasonable Maximum Exposure
Future - Surface Soil - Maintenance Worker

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
Surface Soil	Surface Soil	SWMU 58	Ingestion	Organics								
				Benzo(a)pyrene	2.40E-01	mg/kg	4.7E-08	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	8.6E-09	mg/kg-day	1.0E-01	mg/kg-day	8.6E-08	
				Trichloroethene	6.44E-01	mg/kg	1.3E-07	mg/kg-day	3.0E-04	mg/kg-day	4.2E-04	
				Inorganics								
				Aluminum	2.37E+04	mg/kg	4.6E-03	mg/kg-day	1.0E+00	mg/kg-day	4.6E-03	
				Chromium	3.71E+01	mg/kg	7.3E-06	mg/kg-day	1.5E+00	mg/kg-day	4.8E-06	
				Iron	3.05E+04	mg/kg	6.0E-03	mg/kg-day	3.0E-01	mg/kg-day	2.0E-02	
				Thallium	1.18E+01	mg/kg	2.3E-06	mg/kg-day	8.0E-05	mg/kg-day	2.9E-02	
				Vanadium	5.52E+01	mg/kg	1.1E-05	mg/kg-day	7.0E-03	mg/kg-day	1.5E-03	
				Exp. Route Total							5.5E-02	
			Dermal Absorption	Organics								
				Benzo(a)pyrene	2.40E-01	mg/kg	3.1E-08	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.7E-09	mg/kg-day	1.0E-01	mg/kg-day	1.7E-08	
				Trichloroethene	6.44E-01	mg/kg	2.5E-08	mg/kg-day	3.0E-04	mg/kg-day	8.3E-05	
				Inorganics								
				Aluminum	2.37E+04	mg/kg	3.1E-04	mg/kg-day	1.0E+00	mg/kg-day	3.1E-04	
				Chromium	3.71E+01	mg/kg	4.8E-07	mg/kg-day	2.0E-02	mg/kg-day	2.5E-05	
				Iron	3.05E+04	mg/kg	3.9E-04	mg/kg-day	3.0E-01	mg/kg-day	1.3E-03	
				Thallium	1.18E+01	mg/kg	1.5E-07	mg/kg-day	8.0E-05	mg/kg-day	1.9E-03	
				Vanadium	5.52E+01	mg/kg	7.1E-07	mg/kg-day	1.8E-04	mg/kg-day	3.9E-03	
				Exp. Route Total							7.5E-03	
			Exposure Point Total								6.3E-02	
		Exposure Media Total								6.3E-02		
	Air (Particulates)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	2.40E-01	mg/kg	1.5E-11	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	1.1E-01	mg/kg-day	N/A	
				Trichloroethene	6.44E-01	mg/kg	N/A	mg/kg-day	1.0E-02	mg/kg-day	N/A	
				Inorganics								
				Aluminum	2.37E+04	mg/kg	1.5E-06	mg/kg-day	1.0E-03	mg/kg-day	1.5E-03	
				Chromium	3.71E+01	mg/kg	2.4E-09	mg/kg-day	N/A	mg/kg-day	---	
				Iron	3.05E+04	mg/kg	2.0E-06	mg/kg-day	N/A	mg/kg-day	---	
				Thallium	1.18E+01	mg/kg	7.6E-10	mg/kg-day	N/A	mg/kg-day	---	
				Vanadium	5.52E+01	mg/kg	3.6E-09	mg/kg-day	N/A	mg/kg-day	---	
				Exp. Route Total							1.5E-03	
			Exposure Point Total								1.5E-03	
			Exposure Media Total								1.5E-03	
Air (Volatiles)			SWMU 58	Inhalation	Organics							
					Benzo(a)pyrene	2.40E-01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A
					4-Isopropyltoluene	4.40E-02	mg/kg	3.0E-06	mg/kg-day	1.1E-01	mg/kg-day	2.8E-05
					Trichloroethene	6.44E-01	mg/kg	1.3E-05	mg/kg-day	1.0E-02	mg/kg-day	1.3E-03
					Inorganics							
					Aluminum	2.37E+04	mg/kg	N/A	mg/kg-day	1.0E-03	mg/kg-day	N/A
					Chromium	3.71E+01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A
					Iron	3.05E+04	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A
					Thallium	1.18E+01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A
					Vanadium	5.52E+01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A
		Exp. Route Total									1.3E-03	
	Exposure Point Total									1.3E-03		
	Exposure Media Total								1.3E-03			
Soil Total										6.6E-02		
						Total of Receptor Hazards Across All Media						6.6E-02

N/A = Not Applicable.

Table E-23
Calculation of Non-cancer Hazards
Reasonable Maximum Exposure
Future - Total Soil - Maintenance Worker

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		
Total Soil	Total Soil	SWMU 58	Ingestion	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	2.0E-08	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	8.6E-09	mg/kg-day	1.0E-01	mg/kg-day	8.6E-08	
				Trichloroethene	5.13E-01	mg/kg	1.0E-07	mg/kg-day	3.0E-04	mg/kg-day	3.3E-04	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	4.5E-03	mg/kg-day	1.0E+00	mg/kg-day	4.5E-03	
				Thallium	4.48E+00	mg/kg	8.8E-07	mg/kg-day	8.0E-05	mg/kg-day	1.1E-02	
			Exp. Route Total								1.6E-02	
			Dermal Absorption	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	1.3E-08	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.7E-09	mg/kg-day	1.0E-01	mg/kg-day	1.7E-08	
				Trichloroethene	5.13E-01	mg/kg	2.0E-08	mg/kg-day	3.0E-04	mg/kg-day	6.6E-05	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	3.0E-04	mg/kg-day	1.0E+00	mg/kg-day	3.0E-04	
				Thallium	4.48E+00	mg/kg	5.8E-08	mg/kg-day	8.0E-05	mg/kg-day	7.2E-04	
			Exp. Route Total								1.1E-03	
		Exposure Point Total								1.7E-02		
		Exposure Media Total								1.7E-02		
		Air (Particulates)	SWMU 58	Inhalation	Organics							
					Benzo(a)pyrene	1.02E-01	mg/kg	6.6E-12	mg/kg-day	N/A	mg/kg-day	---
					4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	1.1E-01	mg/kg-day	N/A
					Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	1.0E-02	mg/kg-day	N/A
					Inorganics							
					Aluminum	2.31E+04	mg/kg	1.5E-06	mg/kg-day	1.0E-03	mg/kg-day	1.5E-03
	Thallium				4.48E+00	mg/kg	2.9E-10	mg/kg-day	N/A	mg/kg-day	---	
	Exp. Route Total										1.5E-03	
	Exposure Point Total									1.5E-03		
	Exposure Media Total									1.5E-03		
	Air (Volatiles)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A	
				4-Isopropyltoluene	4.40E-02	mg/kg	3.0E-06	mg/kg-day	1.1E-01	mg/kg-day	2.8E-05	
				Trichloroethene	5.13E-01	mg/kg	1.0E-05	mg/kg-day	1.0E-02	mg/kg-day	1.0E-03	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	1.0E-03	mg/kg-day	N/A	
				Thallium	4.48E+00	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A	
			Exp. Route Total								1.0E-03	
		Exposure Point Total								1.0E-03		
		Exposure Media Total								1.0E-03		
Soil Total									1.9E-02			
Total of Receptor Hazards Across All Media											1.9E-02	

N/A = Not Applicable.

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Table E-24
Calculation of Non-cancer Hazards
Reasonable Maximum Exposure
Future - Total Soil - Excavation Worker

Scenario Timeframe: Future
Receptor Population: Excavation Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations					
							Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
					Value	Units	Value	Units	Value	Units		
Total Soil	Total Soil	SWMU 58	Ingestion	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	3.3E-07	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.4E-07	mg/kg-day	1.0E-01	mg/kg-day	1.4E-06	
				Trichloroethene	5.13E-01	mg/kg	1.7E-06	mg/kg-day	3.0E-04	mg/kg-day	5.5E-03	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	7.5E-02	mg/kg-day	1.0E+00	mg/kg-day	7.5E-02	
				Thallium	4.48E+00	mg/kg	1.4E-05	mg/kg-day	8.0E-05	mg/kg-day	1.8E-01	
			Exp. Route Total									2.6E-01
			Dermal Absorption	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	9.9E-08	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.3E-08	mg/kg-day	1.0E-01	mg/kg-day	1.3E-07	
				Trichloroethene	5.13E-01	mg/kg	1.5E-07	mg/kg-day	3.0E-04	mg/kg-day	5.0E-04	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	2.2E-03	mg/kg-day	1.0E+00	mg/kg-day	2.2E-03	
				Thallium	4.48E+00	mg/kg	4.3E-07	mg/kg-day	8.0E-05	mg/kg-day	5.4E-03	
			Exp. Route Total									8.2E-03
		Exposure Point Total								2.7E-01		
		Exposure Media Total								2.7E-01		
	Air (Particulates)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	3.3E-11	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	1.1E-01	mg/kg-day	N/A	
				Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	1.0E-02	mg/kg-day	N/A	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	7.5E-06	mg/kg-day	1.0E-03	mg/kg-day	7.5E-03	
				Thallium	4.48E+00	mg/kg	1.4E-09	mg/kg-day	N/A	mg/kg-day	---	
			Exp. Route Total									7.5E-03
		Exposure Point Total								7.5E-03		
		Exposure Media Total								7.5E-03		
	Air (Volatiles)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A	
				4-Isopropyltoluene	4.40E-02	mg/kg	1.5E-05	mg/kg-day	1.1E-01	mg/kg-day	1.4E-04	
				Trichloroethene	5.13E-01	mg/kg	5.0E-05	mg/kg-day	1.0E-02	mg/kg-day	5.0E-03	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	1.0E-03	mg/kg-day	N/A	
				Thallium	4.48E+00	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A	
			Exp. Route Total									5.2E-03
		Exposure Point Total								5.2E-03		
		Exposure Media Total								5.2E-03		
Soil Total								2.8E-01				
Total of Receptor Hazards Across All Media									2.8E-01			

--- = Not Applicable.

Table E-25
Calculation of Non-cancer Hazards
Reasonable Maximum Exposure
Future - Total Soil - Adult Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations					
					Value	Units	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient	
							Value	Units	Value	Units		
Total Soil	Total Soil	SWMU 58	Ingestion	Organics	1.02E-01	mg/kg	1.4E-07	mg/kg-day	N/A	mg/kg-day	---	
				Benzo(a)pyrene	4.40E-02	mg/kg	6.0E-08	mg/kg-day	1.0E-01	mg/kg-day	6.0E-07	
				Trichloroethene	5.13E-01	mg/kg	7.0E-07	mg/kg-day	3.0E-04	mg/kg-day	2.3E-03	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	3.2E-02	mg/kg-day	1.0E+00	mg/kg-day	3.2E-02	
				Thallium	4.48E+00	mg/kg	6.1E-06	mg/kg-day	8.0E-05	mg/kg-day	7.7E-02	
			Exp. Route Total							1.1E-01		
			Dermal Absorption	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	5.6E-08	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	7.2E-09	mg/kg-day	1.0E-01	mg/kg-day	7.2E-08	
				Trichloroethene	5.13E-01	mg/kg	8.4E-08	mg/kg-day	3.0E-04	mg/kg-day	2.8E-04	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	1.3E-03	mg/kg-day	1.0E+00	mg/kg-day	1.3E-03	
			Thallium	4.48E+00	mg/kg	2.4E-07	mg/kg-day	8.0E-05	mg/kg-day	3.1E-03		
			Exp. Route Total							4.6E-03		
			Exposure Point Total							1.2E-01		
		Exposure Media Total							1.2E-01			
	Air (Particulates)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	1.9E-12	mg/kg-day	N/A	mg/kg-day	---	
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	1.1E-01	mg/kg-day	N/A	
				Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	1.0E-02	mg/kg-day	N/A	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	4.3E-07	mg/kg-day	1.0E-03	mg/kg-day	4.3E-04	
			Thallium	4.48E+00	mg/kg	8.4E-11	mg/kg-day	N/A	mg/kg-day	---		
			Exp. Route Total							4.3E-04		
		Exposure Point Total							4.3E-04			
		Exposure Media Total							4.3E-04			
	Air (Volatiles)	SWMU 58	Inhalation	Organics								
				Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A	
				4-Isopropyltoluene	4.40E-02	mg/kg	8.8E-07	mg/kg-day	1.1E-01	mg/kg-day	8.0E-06	
				Trichloroethene	5.13E-01	mg/kg	2.9E-06	mg/kg-day	1.0E-02	mg/kg-day	2.9E-04	
				Inorganics								
				Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	1.0E-03	mg/kg day	N/A	
			Thallium	4.48E+00	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A		
			Exp. Route Total							3.0E-04		
		Exposure Point Total							3.0E-04			
		Exposure Media Total							3.0E-04			
	Soil Total							1.2E-01				
Total of Receptor Hazards Across All Media							1.2E-01					

N/A = Not Applicable.

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Table E-26
Calculation of Non-cancer Hazards
Reasonable Maximum Exposure
Future - Total Soil - Child Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Non-Cancer Hazard Calculations						
					Value	Units	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient		
							Value	Units	Value	Units			
Total Soil	Total Soil	SWMU 58	Ingestion	Organics									
				Benzo(a)pyrene	1.02E-01	mg/kg	1.3E-06	mg/kg-day	N/A	mg/kg-day	---		
				4-Isopropyltoluene	4.40E-02	mg/kg	5.6E-07	mg/kg-day	1.0E-01	mg/kg-day	5.6E-06		
				Trichloroethene	5.13E-01	mg/kg	6.6E-06	mg/kg-day	3.0E-04	mg/kg-day	2.2E-02		
				Inorganics									
				Aluminum	2.31E+04	mg/kg	3.0E-01	mg/kg-day	1.0E+00	mg/kg-day	3.0E-01		
			Thallium	4.48E+00	mg/kg	5.7E-05	mg/kg-day	8.0E-05	mg/kg-day	7.2E-01			
			Exp. Route Total								1.0E+00		
			Dermal Absorption	Organics									
				Benzo(a)pyrene	1.02E-01	mg/kg	3.7E-07	mg/kg-day	N/A	mg/kg-day	---		
				4-Isopropyltoluene	4.40E-02	mg/kg	4.7E-08	mg/kg-day	1.0E-01	mg/kg-day	4.7E-07		
				Trichloroethene	5.13E-01	mg/kg	5.5E-07	mg/kg-day	3.0E-04	mg/kg-day	1.8E-03		
				Inorganics									
				Aluminum	2.31E+04	mg/kg	8.3E-03	mg/kg-day	1.0E+00	mg/kg-day	8.3E-03		
			Thallium	4.48E+00	mg/kg	1.6E-06	mg/kg-day	8.0E-05	mg/kg-day	2.0E-02			
			Exp. Route Total								3.0E-02		
		Exposure Point Total										1.1E+00	
	Exposure Media Total										1.1E+00		
	Air (Particulates)	SWMU 58	Inhalation	Organics									
				Benzo(a)pyrene	1.02E-01	mg/kg	5.4E-12	mg/kg-day	N/A	mg/kg-day	---		
				4-Isopropyltoluene	4.40E-02	mg/kg	N/A	mg/kg-day	1.1E-01	mg/kg-day	N/A		
				Trichloroethene	5.13E-01	mg/kg	N/A	mg/kg-day	1.0E-02	mg/kg-day	N/A		
				Inorganics									
				Aluminum	2.31E+04	mg/kg	1.2E-06	mg/kg-day	1.0E-03	mg/kg-day	1.2E-03		
			Thallium	4.48E+00	mg/kg	2.4E-10	mg/kg-day	N/A	mg/kg-day	---			
			Exp. Route Total								1.2E-03		
			Exposure Point Total										1.2E-03
			Exposure Media Total										1.2E-03
			Air (Volatiles)	SWMU 58	Inhalation	Organics							
						Benzo(a)pyrene	1.02E-01	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A
						4-Isopropyltoluene	4.40E-02	mg/kg	2.5E-06	mg/kg-day	1.1E-01	mg/kg-day	2.3E-05
						Trichloroethene	5.13E-01	mg/kg	8.2E-06	mg/kg-day	1.0E-02	mg/kg-day	8.2E-04
						Inorganics							
						Aluminum	2.31E+04	mg/kg	N/A	mg/kg-day	1.0E-03	mg/kg-day	N/A
		Thallium			4.48E+00	mg/kg	N/A	mg/kg-day	N/A	mg/kg-day	N/A		
	Exp. Route Total								8.5E-04				
	Exposure Point Total										8.5E-04		
	Exposure Media Total										8.5E-04		
Soil Total										1.1E+00			
					Total of Receptor Hazards Across All Media					1.1E+00			

N/A = Not Applicable.

Table E-27
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Current - Maintenance Worker

Scenario Timeframe: Current Receptor Population: Maintenance Worker Receptor Age: Adult													
Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 58	Aluminum	---		---		---	Developmental Neurotoxicity	4.6E-03		3.0E-04	4.9E-03
			Chromium ^a	---		---		---	NOAEL	5.6E-06		2.8E-05	3.4E-05
			Iron	---		---		---	Blood, Liver, GI Irritation	1.8E-02		1.2E-03	1.9E-02
			Thallium	---		---		---	Blood, Liver, Hair	2.9E-02		1.9E-03	3.1E-02
			Chemical Total	---		---		---		0.052		0.0034	0.055
		Radionuclide Total											
		Exposure Point Total											
	Exposure Media Total												0.055
	Air (Particulates and Volatiles)	SWMU 58	Aluminum		---			---	N/A		1.5E-03		1.5E-03
			Chromium		---			---	N/A		---		---
			Iron		---			---	N/A		---		---
			Thallium		---			---	N/A		---		---
			Chemical Total		---			---			---		0.0015
	Radionuclide Total												
Exposure Point Total												0.0015	
Exposure Media Total												0.0015	
Soil Total												0.056	
Receptor Total												0.056	

Total Risk Across All Media = ---

Total Hazard Across All Media = 0.056

(a) Chromium RfD is based on NOAEL; no target organ is identified.

NOAEL = No Observable Adverse Effects Level.
 GI = Gastrointestinal.

Total Developmental Neurotoxicity HI Across All Media =	0.0049
Total NOAEL HI Across All Media =	0.000034
Total Blood HI Across All Media =	0.050
Total Liver HI Across All Media =	0.050
Total GI Irritation HI Across All Media =	0.019
Total Hair HI Across All Media =	0.031

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Table E-28
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Maintenance Worker

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 58	Benzo(a)pyrene	1.2E-07		8.1E-08		2.0E-07	N/A	---		---	---
			4-Isopropyltoluene	---		---		---	Kidney	8.6E-08		1.7E-08	1.0E-07
			Trichloroethene	1.8E-08		1.0E-08		2.8E-08	Liver, Kidney, Developing Fetus	4.2E-04		8.3E-05	5.0E-04
			Aluminum	---		---		---	Developmental Neurotoxicity	4.6E-03		3.1E-04	4.9E-03
			Chromium*	---		---		---	NOAEL	4.8E-06		2.5E-05	2.9E-05
			Iron	---		---		---	Blood, Liver, GI Irritation	2.0E-02		1.3E-03	2.1E-02
			Thallium	---		---		---	Blood, Liver, Hair	2.9E-02		1.9E-03	3.1E-02
			Vanadium*	---		---		---	NOAEL	1.5E-03		3.9E-03	5.5E-03
			Chemical Total	1.4E-07		9.1E-08		2.3E-07		0.055		0.0075	0.063
		Radionuclide Total											
	Exposure Point Total					2.3E-07					0.063		
	Exposure Media Total					2.3E-07					0.063		
	Air (Particulates and Volatiles)	SWMU 58	Benzo(a)pyrene		1.7E-11			1.7E-11	N/A		---		---
			4-Isopropyltoluene		---			---	Kidney		2.8E-05		2.8E-05
			Trichloroethene		1.8E-06			1.8E-06	Liver, CNS, Endocrine System		1.3E-03		1.3E-03
			Aluminum		---			---	N/A		1.5E-03		1.5E-03
			Chromium		---			---	N/A		---		---
			Iron		---			---	N/A		---		---
			Thallium		---			---	N/A		---		---
			Vanadium		---			---	N/A		---		---
			Chemical Total		1.8E-06			1.8E-06			2.9E-03		0.0029
		Radionuclide Total											
Exposure Point Total					1.8E-06					0.0029			
Exposure Media Total					1.8E-06					0.0029			
Surface Soil Total								2.0E-06				0.066	
Total Soil	Total Soil	SWMU 58	Benzo(a)pyrene	5.2E-08		3.4E-08		8.6E-08	N/A	---		---	---
			4-Isopropyltoluene	---		---		---	Kidney	8.6E-08		1.7E-08	1.0E-07
			Trichloroethene	1.4E-08		8.0E-09		2.2E-08	Liver, Kidney, Developing Fetus	3.3E-04		6.6E-05	4.0E-04
			Aluminum	---		---		---	Developmental Neurotoxicity	4.5E-03		3.0E-04	4.8E-03
			Thallium	---		---		---	Blood, Liver, Hair	1.1E-02		7.2E-04	1.2E-02
			Chemical Total	6.6E-08		4.2E-08		1.1E-07		0.016		0.0011	0.017
			Radionuclide Total										
		Exposure Point Total					1.1E-07					0.017	
	Exposure Media Total					1.1E-07					0.017		

Table E-28
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Maintenance Worker

Scenario Timeframe: Future
 Receptor Population: Maintenance Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
	Air (Particulates and Volatiles)	SWMU 58	Benzo(a)pyrene		7.3E-12			7.3E-12	N/A Kidney Liver, CNS, Endocrine System		---		---
			4-Isopropyltoluene		---			---			2.8E-05		2.8E-05
			Trichloroethene		1.4E-06			1.4E-06			1.0E-03		1.0E-03
			Aluminum		---			---	N/A		1.5E-03		1.5E-03
			Thallium		---			---	N/A		---		---
			Chemical Total		1.4E-06			1.4E-06			2.5E-03		0.0025
			Radionuclide Total										
			Exposure Point Total					1.4E-06					0.0025
			Exposure Media Total					1.4E-06					0.0025
Total Soil Total					1.5E-06					0.066			
Receptor Total ^a					2.0E-06					0.066			

Total Risk Across All Media^b = 2.0E-06

Total Hazard Across All Media^b = 0.066

(a) Chromium and vanadium RfDs are based on NOAEL; no target organ is identified.

(b) Since surface soil represents the more highly contaminated portion of soil, total risk and hazard estimates are conservatively based on this soil data grouping.

CNS = Central nervous system.

GI = Gastrointestinal.

NOAEL = No Observable Adverse Effects Level.

N/A = Not Available.

Total Liver HI Across All Media =	0.054
Total Kidney HI Across All Media =	0.00053
Total Developing Fetus HI Across All Media =	0.00050
Total Developmental Neurotoxicity HI Across All Media =	0.0049
Total NOAEL HI Across All Media =	0.0055
Total Blood HI Across All Media =	0.052
Total GI Irritation HI Across All Media =	0.021
Total Hair HI Across All Media =	0.031
Total CNS HI Across All Media =	0.0013
Total Endocrine System HI Across All Media =	0.0013

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Table E-29
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Excavation Worker

Scenario Timeframe: Future
Receptor Population: Excavation Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	SWMU 58	Benzo(a)pyrene	3.4E-08		1.0E-08		4.4E-08	N/A	---		---	---
			4-Isopropyltoluene	---		---		---	Kidney	1.4E-06		1.3E-07	1.5E-06
			Trichloroethene	9.5E-09		6.0E-08		6.9E-08	Liver, Kidney, Developing Fetus	5.5E-03		5.0E-04	6.0E-03
			Aluminum	---		---		---	Developmental Neurotoxicity	7.5E-02		2.2E-03	7.7E-02
			Thallium	---		---		---	Blood, Liver, Hair	1.8E-01		5.4E-03	1.9E-01
			Chemical Total	4.4E-08		7.0E-08		1.1E-07		0.26		0.0082	0.27
			Radionuclide Total										
			Exposure Point Total					1.1E-07					0.27
	Exposure Media Total					1.1E-07					0.27		
	Air (Particulates and Volatiles)	SWMU 58	Benzo(a)pyrene		1.5E-12			1.5E-12	N/A			---	---
			4-Isopropyltoluene		---			---	Kidney		1.4E-04		1.4E-04
			Trichloroethene		2.9E-07			2.9E-07	Liver, CNS, Endocrine System		5.0E-03		5.0E-03
			Aluminum		---			---	N/A		7.5E-03		7.5E-03
			Thallium		---			---	N/A		---		---
			Chemical Total		2.9E-07			2.9E-07			1.3E-02		0.013
			Radionuclide Total										
Exposure Point Total							2.9E-07					0.013	
Exposure Media Total					2.9E-07					0.013			
Soil Total					4.0E-07					0.28			
Receptor Total					4.0E-07					0.28			

Total Risk Across All Media = 4.0E-07

Total Hazard Across All Media = 0.28

CNS = Central nervous system.
N/A = Not Available.

Total Kidney HI Across All Media =	0.0062
Total Liver HI Across All Media =	0.20
Total Developing Fetus HI Across All Media =	0.0060
Total Developmental Neurotoxicity HI Across All Media =	0.077
Total Blood HI Across All Media =	0.19
Total Hair HI Across All Media =	0.19
Total CNS HI Across All Media =	0.0050
Total Endocrine System HI Across All Media =	0.0050

Table E-30
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Adult Resident

Scenario Timeframe: Future
 Receptor Population: Resident
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	SWMU 58	Benzo(a)pyrene	4.4E-07		1.7E-07		6.1E-07	N/A	---		---	---
			4-Isopropyltoluene	---		---		---	Kidney	6.0E-07		7.2E-08	6.7E-07
			Trichloroethene	1.2E-07		3.4E-08		1.5E-07	Liver, Kidney, Developing Fetus	2.3E-03		2.8E-04	2.6E-03
			Aluminum	---		---		---	Developmental Neurotoxicity	3.2E-02		1.3E-03	3.3E-02
			Thallium	---		---		---	Blood, Liver, Hair	7.7E-02		3.1E-03	8.0E-02
			Chemical Total	5.6E-07		2.1E-07		7.7E-07		0.11		0.0046	0.12
			Radionuclide Total										
			Exposure Point Total					7.7E-07					0.12
			Exposure Media Total					7.7E-07					0.12
	Air (Particulates and Volatiles)	SWMU 58	Benzo(a)pyrene		2.5E-12			2.5E-12	N/A		---		---
			4-Isopropyltoluene		---			---	Kidney		8.0E-06		8.0E-06
			Trichloroethene		5.0E-07			5.0E-07	Liver, CNS, Endocrine System		2.9E-04		2.9E-04
			Aluminum		---			---	N/A		4.3E-04		4.3E-04
			Thallium		---			---	N/A		---		---
			Chemical Total		5.0E-07			5.0E-07			0.00073		0.00073
			Radionuclide Total										
			Exposure Point Total					5.0E-07					0.00073
			Exposure Media Total					5.0E-07					0.00073
			Soil Total					1.3E-06					0.12
			Receptor Total					1.3E-06					0.12

Total Risk Across All Media = 1.3E-06

Total Hazard Across All Media = 0.12

CNS = Central nervous system.
 N/A = Not Available.

Total Kidney HI Across All Media = 0.0026
 Total Liver HI Across All Media = 0.083
 Total Developing Fetus HI Across All Media = 0.0026
 Total Developmental Neurotoxicity HI Across All Media = 0.033
 Total Blood HI Across All Media = 0.080
 Total Hair HI Across All Media = 0.080
 Total CNS HI Across All Media = 0.00029

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Table E-31
Summary of Receptor Risks and Hazards for COPCs
Reasonable Maximum Exposure
Future - Child Resident

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	SWMU 58	Benzo(a)pyrene	8.2E-07		2.3E-07		1.0E-06	N/A	---		---	---
			4-Isopropyltoluene	---		---		---	Kidney	5.6E-06		4.7E-07	6.1E-06
			Trichloroethene	2.2E-07		2.2E-07		4.5E-07	Liver, Kidney, Developing Fetus	2.2E-02		1.8E-03	2.4E-02
			Aluminum	---		---		---	Developmental Neurotoxicity Blood, Liver, Hair	3.0E-01		8.3E-03	3.0E-01
			Thallium	---		---		---		7.2E-01		2.0E-02	7.4E-01
			Chemical Total	1.0E-06		4.5E-07		1.5E-06		1.0		0.030	1.1
			Radionuclide Total										
			Exposure Point Total					1.5E-06					1.1
	Exposure Media Total					1.5E-06					1.1		
	Air (Particulates and Volatiles)	SWMU 58	Benzo(a)pyrene		1.4E-12		1.4E-12	N/A		---		---	
			4-Isopropyltoluene		---		---	Kidney		2.3E-05		2.3E-05	
			Trichloroethene		2.8E-07		2.8E-07	Liver, CNS, Endocrine System		8.2E-04		8.2E-04	
			Aluminum		---		---	N/A		1.2E-03		1.2E-03	
			Thallium		---		---	N/A		---		---	
			Chemical Total		2.8E-07		2.8E-07			0.0021		0.0021	
			Radionuclide Total										
Exposure Point Total							2.8E-07					0.0021	
Exposure Media Total					2.8E-07					0.0021			
Soil Total								1.8E-06			1.1		
Receptor Total								1.8E-06			1.1		

Total Risk Across All Media = 1.8E-06

Total Hazard Across All Media = 1.1

CNS = Central nervous system.
N/A = Not Available.

Total Kidney HI Across All Media =	0.024
Total Liver HI Across All Media =	0.76
Total Developing Fetus HI Across All Media =	0.024
Total Developmental Neurotoxicity HI Across All Media =	0.30
Total Blood HI Across All Media =	0.74
Total Hair HI Across All Media =	0.74
Total CNS HI Across All Media =	0.00082
Total Endocrine System HI Across All Media =	0.00082

Table E-32
Risk Assessment Summary
Reasonable Maximum Exposure
Current - Maintenance Worker

Scenario Timeframe: Current
 Receptor Population: Maintenance Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 58											
			Chemical Total				---						<1
			Radionuclide Total										
		Exposure Point Total				---						<1	
	Exposure Media Total						---					<1	
	Air (Particulates and Volatiles)	SWMU 58											
			Chemical Total				---						<1
			Radionuclide Total										
		Exposure Point Total				---						<1	
	Exposure Media Total						---					<1	
Soil Total						---					<1		
Receptor Total						---					<1		

Total Risk Across All Media = ---

Total Hazard Across All Media = <1

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Table E-33
Risk Assessment Summary
Reasonable Maximum Exposure
Future - Maintenance Worker

Scenario Timeframe: Future
 Receptor Population: Maintenance Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 58											
			Chemical Total					<1.0E-06					<1
		Radionuclide Total											
		Exposure Point Total						<1.0E-06					<1
	Exposure Media Total							<1.0E-06					<1
	Air (Particulates and Volatiles)	SWMU 58											
			Trichloroethene		1.8E-06			1.8E-06					
			Chemical Total		1.8E-06			1.8E-06					<1
		Radionuclide Total											
	Exposure Point Total						1.8E-06					<1	
	Exposure Media Total							1.8E-06					<1
Total Soil	Total Soil	SWMU 58											
			Chemical Total					<1.0E-06					<1
		Radionuclide Total											
		Exposure Point Total						<1.0E-06					<1
	Exposure Media Total							<1.0E-06					<1
	Air (Particulates and Volatiles)	SWMU 58											
			Trichloroethene		1.4E-06			1.4E-06					
			Chemical Total		1.4E-06			1.4E-06					<1
		Radionuclide Total											
	Exposure Point Total						1.4E-06					<1	
	Exposure Media Total							1.4E-06					<1
Soil Total*								1.8E-06				<1	
Receptor Total*								1.8E-06				<1	

Total Risk Across All Media* = 1.8E-06

Total Hazard Across All Media* = <1

(a) Since surface soil represents the more highly contaminated portion of soil, total risk and hazard estimates are conservatively based on this soil data grouping.

Table E-34
Risk Assessment Summary
Reasonable Maximum Exposure
Future - Excavation Worker

Scenario Timeframe: Future
 Receptor Population: Excavation Worker
 Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	SWMU 58											
			Chemical Total					<1.0E-06					<1
			Radionuclide Total										
		Exposure Point Total						<1.0E-06					<1
		Exposure Media Total						<1.0E-06					<1
	Air (Particulates and Volatiles)	SWMU 58											
			Chemical Total					<1.0E-06					<1
			Radionuclide Total										
		Exposure Point Total						<1.0E-06					<1
		Exposure Media Total						<1.0E-06					<1
	Soil Total							<1.0E-06					<1
	Receptor Total							<1.0E-06					<1

Total Risk Across All Media = <1.0E-06

Total Hazard Across All Media = <1

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Table E-35
Risk Assessment Summary
Reasonable Maximum Exposure
Future - Adult Resident

Scenario Timeframe: Future Receptor Population: Resident Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	SWMU 58											
			Chemical Total					<1.0E-06					<1
		Radionuclide Total											
		Exposure Point Total					<1.0E-06					<1	
	Exposure Media Total							<1.0E-06				<1	
	Air (Particulates and Volatiles)	SWMU 58											
			Chemical Total					<1.0E-06					<1
		Radionuclide Total											
		Exposure Point Total					<1.0E-06					<1	
	Exposure Media Total							<1.0E-06				<1	
	Soil Total*							1.3x10 ⁻⁶				<1	
	Receptor Total*							1.3x10 ⁻⁶				<1	

Total Risk Across All Media^a = 1.3x10⁻⁶

Total Hazard Across All Media = <1

(a) No individual chemical, exposure point total, or exposure media total cancer risk was equal to or exceeded 1x10⁻⁶.

Table E-36
Risk Assessment Summary
Reasonable Maximum Exposure
Future - Child Resident

Scenario Timeframe: Future
 Receptor Population: Resident
 Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient					
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ	Ingestion	Inhalation	Dermal	Exposure Routes Total	
Total Soil	Total Soil	SWMU 58	Benzo(a)pyrene	8.2E-07		2.3E-07		1.0E-06						
			Chemical Total	8.2E-07		2.3E-07		1.0E-06		1.0 (a)			1.0 (a)	
			Radionuclide Total											
		Exposure Point Total								1.0E-06				1.0 (a)
	Exposure Media Total								1.0E-06				1.0 (a)	
	Air (Particulates and Volatiles)	SWMU 58												
			Chemical Total					<1.0E-06					<1	
			Radionuclide Total											
			Exposure Point Total								<1.0E-06			
		Exposure Media Total								<1.0E-06				<1
	Soil Total								1.0E-06				1.0 (a)	
	Receptor Total								1.0E-06				1.0 (a)	

Total Risk Across All Media = 1.0E-06

Total Hazard Across All Media = 1.0 (a)

(a) No individual chemical HI was equal to or exceeded 1.

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Appendix E-2

Statistical Comparison Results

Appendix E-2, Table 1
Statistical Summary Spreadsheet
SWMU 58 and Background

	Distribution		Sample Size		Test?	Levene's Test (F) Variances Similar?	T-Test Site > Background?	Mann Whitney Site>Background?	
>BG?	Compound	On-site	Background	On-site	Background				
<u>Total Soil - Future Conditions</u>									
x	Aluminum	Lognormal*	Lognormal	11	79	T-test	No(.005)	====>	Yes
	Arsenic	Lognormal*	Lognormal	11	69	T-test	Yes(.103)	No(.360)	---
x	Barium	LognormalQ	Neither	11	79	MWU	====>	====>	Yes
	Beryllium	Lognormal*	Neither	9	79	MWU	====>	====>	No
x	Calcium	Lognormal	Lognormal	9	79	T-test	Yes(.739)	Yes(<.001)	---
	Chromium	Lognormal*	Lognormal	11	79	T-test	No(.043)	====>	No
	Cobalt	Lognormal	Lognormal	11	79	T-test	No(.049)	====>	No
x	Copper	Normal*	Lognormal	11	79	MWU	====>	====>	Yes
	Iron	Normal*	Normal	11	79	T-test	No(.034)	====>	No
	Lead	Lognormal*	Neither	11	79	MWU	====>	====>	No
x	Magnesium	Lognormal	Lognormal	10	79	T-test	No(.040)	====>	Yes
	Manganese	Normal*	Lognormal	11	79	MWU	====>	====>	No
x	Mercury	NormalQ	Neither	11	79	MWU	====>	====>	Yes
	Nickel	Lognormal	Lognormal	11	79	T-test	No(.002)	====>	No
x	Potassium	Normal*	Lognormal	11	79	MWU	====>	====>	Yes
	Thallium	Neither	Neither	11	79	MWU	====>	====>	No
	Vanadium	Normal*	Lognormal	11	79	MWU	====>	====>	No
	Zinc	Lognormal*	Lognormal	11	79	T-test	No(.007)	====>	No
<u>Surface Soil - Future Conditions</u>									
x	Aluminum	Lognormal*	Lognormal	9	28	T-test	No (0.03)	====>	Yes
	Arsenic	Lognormal*	Lognormal	9	24	T-test	Yes (.259)	No(.066)	---
	Barium	Lognormal	Normal	9	28	MWU	====>	====>	No
x	Beryllium	Lognormal*	Neither	7	28	MWU	====>	====>	Yes
x	Calcium	Lognormal	Lognormal	7	28	T-test	Yes (.264)	Yes(<.001)	---
x	Chromium	Lognormal*	Lognormal	9	28	T-test	No(.012)	====>	Yes
	Cobalt	LognormalQ	Neither	9	28	MWU	====>	====>	No
x	Copper	Normal*	Normal	9	28	T-test	Yes(.989)	Yes(<.001)	---
x	Iron	Normal*	Lognormal	9	28	MWU	====>	====>	Yes
	Lead	Normal*	Neither	9	28	MWU	====>	====>	No
x	Magnesium	Lognormal	Lognormal	8	28	T-test	Yes(.438)	Yes(.001)	---
	Manganese	Lognormal*	Lognormal	9	28	T-test	No(.019)	====>	No
x	Mercury	Normal	Neither	9	28	MWU	====>	====>	Yes
x	Nickel	Lognormal*	Neither	9	28	MWU	====>	====>	Yes
x	Potassium	Normal*	Lognormal	9	28	MWU	====>	====>	Yes
	Thallium	LognormalQ	Neither	9	28	MWU	====>	====>	No
x	Vanadium	Normal*	Lognormal	9	28	MWU	====>	====>	Yes
	Zinc	Lognormal*	Lognormal	9	28	T-test	No(.016)	====>	No

Appendix E-2, Table 1
Statistical Summary Spreadsheet
SWMU 58 and Background

>BG? Compound	Distribution		Sample Size		Test?	Levene's Test (F) Variances Similar?	T-Test Site > Background?	Mann Whitney Site>Background?
	On-site	Background	On-site	Background				
Surface Soil - Current Conditions								
x Aluminum	Lognormal*	Lognormal	5	28	T-test	No (0.018)	==>	Yes
Arsenic	Lognormal*	Lognormal	5	24	T-test	Yes (0.576)	No (0.267)	---
Barium	Normal*	Normal	5	28	T-test	No (0.017)	==>	No
Beryllium	Lognormal*	Neither	5	28	MWU	==>	==>	No
x Calcium	Lognormal*	Lognormal	3	28	T-test	Yes (0.657)	Yes (0.008)	---
x Chromium	Normal*	Lognormal	5	28	MWU	==>	==>	Yes
Cobalt	Lognormal*	Neither	5	28	MWU	==>	==>	No
x Copper	Normal*	Normal	5	28	T-test	Yes (0.055)	Yes (<0.001)	---
x Iron	Lognormal*	Lognormal	5	28	T-test	No (0.004)	==>	Yes
Lead	Normal*	Neither	5	28	MWU	==>	==>	No
x Magnesium	Lognormal*	Lognormal	4	28	T-test	Yes (0.205)	Yes (0.042)	---
Manganese	Lognormal*	Lognormal	5	28	T-test	Yes (0.079)	No (0.484)	---
Mercury	Normal	Neither	5	28	MWU	==>	==>	No
x Nickel	Lognormal*	Neither	5	28	MWU	==>	==>	Yes
x Potassium	Lognormal*	Lognormal	5	28	T-test	Yes (0.206)	Yes (0.014)	---
Thallium	Lognormal*	Neither	5	28	MWU	==>	==>	No
x Vanadium	Normal*	Lognormal	5	28	MWU	==>	==>	Yes
Zinc	LognormalQ	Lognormal	5	28	T-test	No (0.017)	==>	No

X = Site concentrations of this chemical are significantly greater than background concentrations; or chemical was detected onsite but not detected (or not analyzed for) in background samples.

M = Maximum to maximum comparison will be performed because not enough samples were available for statistical comparison.

* or Q = The designation of normal or lognormal data distributions also included data sets that were "close" to their respective categorizations, i.e., within 5 percent of being categorized as normal or lognormal, using the Shapiro-Wilk test criterion. If a data set passed both the normal and lognormal distribution tests, the distribution with the best fit (i.e., distribution with the value that is closest to the critical value) is selected.

Notes:

Antimony was not detected in any background samples, therefore no comparisons were run.

Selenium, Silver, and Sodium were more than 80% Non-Detects (ND) in background, and Upper Tolerance Limits (UTLs) were not presented in the Facility-Wide Background Study Report (FWBSR), therefore no comparisons were run.

Cadmium had more than 80% NDs in background. However, a UTL was developed in the FWBSR, and therefore a comparison was run.

Thallium had 80% NDs in background, and in the FWBSR a UTL had been developed; therefore a comparison was run.

For arsenic in background, there were 10 samples that were B-qualified. These samples were excluded to be consistent with the data used in the risk assessment.

Duplicate samples in the SWMU 58 dataset were averaged prior to running statistical tests. Duplicate data issues had already been resolved in the background dataset.

Tests for normality were run using the Shapiro-Francia test for sample sizes > 50 and the Shapiro-Wilk test for sample sizes <= 50.

Appendix E-2, Table 2
Mann-Whitney Test (General) Results Spreadsheet
SWMU 58 and Background

Chemical	Distribution		Site Samples	Background Samples	Site Rank Sum (a)	W _{.05} (b)	W _{.95}	On-site Concentrations > Background
	On-site	Background	n	m	T			Concentrations? (c)
Total Soil - Future Conditions								
Aluminum	Lognormal*	Lognormal	11	79	728	367	634	Yes
Barium	LognormalQ	Neither	11	79	664.5	367	634	Yes
Beryllium	Lognormal*	Neither	9	79	461.5	281	520	No
Chromium	Lognormal*	Lognormal	11	79	563	367	634	No
Cobalt	Lognormal	Lognormal	11	79	454.5	367	634	No
Copper	Normal*	Lognormal	11	79	650	367	634	Yes
Iron	Normal*	Normal	11	79	471	367	634	No
Lead	Lognormal*	Neither	11	79	585.5	367	634	No
Magnesium	Lognormal	Lognormal	10	79	639.5	323	577	Yes
Manganese	Normal*	Lognormal	11	79	448.5	367	634	No
Mercury	NormalQ	Neither	11	79	680	367	634	Yes
Nickel	Lognormal	Lognormal	11	79	578.5	367	634	No
Potassium	Normal*	Lognormal	11	79	679.5	367	634	Yes
Thallium	Neither	Neither	11	79	488	367	634	No
Vanadium	Normal*	Lognormal	11	79	560.5	367	634	No
Zinc	Lognormal*	Lognormal	11	79	564	367	634	No
Surface Soil - Future Conditions								
Aluminum	Lognormal*	Lognormal	9	28	285	125	217	Yes
Barium	Lognormal	Normal	9	28	193.5	125	217	No
Calcium	Lognormal	Lognormal	7	28	210	86	166	Yes
Chromium	Lognormal*	Lognormal	9	28	242	125	217	Yes
Cobalt	LognormalQ	Neither	9	28	166	125	217	No
Iron	Normal*	Lognormal	9	28	231	125	217	Yes
Lead	Normal*	Neither	9	28	161.5	125	217	No
Manganese	Lognormal*	Lognormal	9	28	115.5	125	217	No
Mercury	Normal	Neither	9	28	241	125	217	Yes
Nickel	Lognormal*	Neither	9	28	252	125	217	Yes
Potassium	Normal*	Lognormal	9	28	262.5	125	217	Yes
Thallium	LognormalQ	Neither	9	28	201	125	217	No
Vanadium	Normal*	Lognormal	9	28	255	125	217	Yes
Zinc	Lognormal*	Lognormal	9	28	195	125	217	No

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Appendix E-2, Table 2
Mann-Whitney Test (General) Results Spreadsheet
SWMU 58 and Background

Chemical	Distribution		Site Samples	Background Samples	Site Rank Sum (a)	W _{.05} (b)	W _{.95}	On-site Concentrations > Background Concentrations? (c)
	On-site	Background	n	m	T			
<u>Surface Soil - Current Conditions</u>								
Aluminum	Lognormal*	Lognormal	5	28	149	52	118	Yes
Barium	Normal*	Normal	5	28	90.5	52	118	No
Beryllium	Lognormal*	Neither	5	28	97	52	118	No
Chromium	Normal*	Lognormal	5	28	141	52	118	Yes
Cobalt	Lognormal*	Neither	5	28	81	52	118	No
Iron	Lognormal*	Lognormal	5	28	125	52	118	Yes
Lead	Normal*	Neither	5	28	60.5	52	118	No
Mercury	Normal	Neither	5	28	107	52	118	No
Nickel	Lognormal*	Neither	5	28	128	52	118	Yes
Thallium	Lognormal*	Neither	5	28	99	52	118	No
Vanadium	Normal*	Lognormal	5	28	142	52	118	Yes
Zinc	LognormalQ	Lognormal	5	28	94	52	118	No

* or Q = The designation of normal or lognormal data distributions also included data sets that were "close" to their respective categorizations, i.e., within 5 percent of being categorized as normal or lognormal, using the Shapiro-Wilk test criterion. If a data set passed both the normal and lognormal distribution tests, the distribution with the best fit (i.e., distribution with the value that is closest to the critical value) is selected.

Appendix E, Table 3
Mann-Whitney Test Results Spreadsheet with Correction for Non-Detects (Ties)
SWMU 58 and Background

Chemical	Number of Non-Detects	Background		Site Rank Sum T	W.95	On-site Concentrations > Background Concentrations
		Site Samples n	Samples m			
<u>Surface Soil Current Conditions</u>						
Chromium	2	5	28	141	118	Yes
Vanadium	2	5	28	142	118	Yes
<u>Surface Soil - Future Conditions</u>						
Chromium	2	9	28	242	217	Yes
Vanadium	2	9	28	255	217	Yes

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Appendix E-2, Table 4
Mann-Whitney Test Results Spreadsheet with Correction for Ties
SWMU 58 and Background

Chemical	t ³ -t	Background			W.95	On-Site Concentrations > Background Concentrations
		Site Samples n	Samples m	Site Rank Sum T		
Total Soil - Future Conditions						
Aluminum	48	11	79	728	634	Yes
Barium	192	11	79	664.5	634	Yes
Beryllium	1428	9	79	461.5	520	No
Chromium	66	11	79	563	634	No
Copper	102	11	79	650	634	Yes
Lead	126	11	79	585.5	634	No
Magnesium	36	10	79	639.5	577	Yes
Mercury	22272	11	79	680	632	Yes
Nickel	330	11	79	578.5	634	No
Potassium	24	11	79	679.5	634	Yes
Vanadium	24	11	79	560.5	634	No
Zinc	24	11	79	564	634	No
Surface Soil - Future Conditions						
Barium	12	9	28	193.5	217	No
Cobalt	18	9	28	166	217	No
Iron	12	9	28	231	217	Yes
Lead	42	9	28	161.5	217	No
Mercury	1962	9	28	241	217	Yes
Nickel	96	9	28	252	217	Yes
Potassium	12	9	28	262.5	217	Yes
Thallium	4092	9	28	201	216	No
Surface Soil - Current Conditions						
Barium	12	5	28	90.5	118	No
Beryllium	186	5	28	97	118	No
Cobalt	18	5	28	81	118	No
Iron	12	5	28	125	118	Yes
Lead	42	5	28	60.5	118	No
Mercury	1938	5	28	107	117	No
Nickel	96	5	28	128	118	Yes
Thallium	4086	5	28	99	116	No

Appendix F

SLERA Site Reconnaissance Photographs and SLERA Risk Characterization Tables

This Appendix Contains:

- Appendix F-1 SLERA Site Reconnaissance Photographs**
- Appendix F-2 SLERA Risk Characterization Tables**

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Appendix F-1
SLERA Site Reconnaissance Photographs



Photo 1. Northwest view of Rubble Pile from surrounding ground. April 1998.



Photo 2. View of typical habitat along slope of Rubble Pile. April 1998.



Photo 3. Aerial view of Rubble Pile, showing grass and limited shrub habitat at the site, and the wooded areas beyond the site. July 1986.

Appendix F-2
SLERA Risk Characterization Tables

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Table F-1
Data Used to Model Exposure^a in the Indicator Wildlife Species at SWMU 58

Indicator Species	Body Weight Range (average) (kg)	Average Home Range (ha) [ac]	Maximum Dietary Intake ^b (kg[dw]/day)	Average Dietary Intake ^c (kg[dw]/day)	Soil/Sed. Intake ^d (%Diet) (Avg – Max) (kg[dw]/day)	Maximum Water Intake ^b (L/day)	Average Water Intake ^c (L/day)	Trophic Level	Dietary Composition
Meadow vole (<i>Microtus pennsylvanicus</i>)	0.0170-0.0524 (0.037)	0.036 [0.089]	0.010	0.0080	(2.4%) 0.00019-0.00024	0.0070	0.0051	Herbivore	Plants: 100%
Short-tailed shrew (<i>Blarina brevicauda</i>)	0.0125-0.0225 (0.015)	0.39 [0.96]	0.0030	0.0022	(10.4%) 0.00023-0.00031	0.0033	0.0023	Insectivore	Terrestrial Invertebrates: 100%
American robin (<i>Turdus migratorius</i>)	0.0635-0.103 (0.0773)	0.48 [1.2]	0.020	0.016	(4%) 0.00064-0.00080	0.013	0.011	Omnivore	Plants: 62% Terrestrial Invertebrates: 38%
Red-tailed hawk (<i>Buteo jamaicensis</i>)	0.957-1.235 (1.134)	842 [2081]	0.063	0.059	(0%)	0.068	0.064	Carnivore	Mammals: 76% Birds: 24%
Red fox (<i>Vulpes vulpes</i>)	2.95-7.04 (4.53)	892 [2204]	0.34	0.24	(2.8%) 0.0067-0.0095	0.57	0.39	Carnivore	Mammals: 65% Birds: 14% Plants: 17% Terr. Inverts: 4%

^a From EPA (1993), except as noted.
^b Maximum dietary and water intake based on appropriate allometric equation using maximum body weight.
^c Average dietary and water intake based on appropriate allometric equation using average body weight.
^d Soil/sediment ingestion rate based on estimated percent soil in diet (dry weight), and maximum or average dietary intake.

Allometric equations for mammals and birds from EPA (1993), as follows, where FI = food ingestion (dry weight [dw]), WI = water ingestion, Wt = body weight, kg = kilogram, L = liter, and g = gram:

$FI \text{ (kg/day)} = 0.0687 \text{ Wt}^{0.822}$ for mammals (shrew and red fox),
 $FI \text{ (g/day)} = 0.577 \text{ Wt}^{0.727}$ for herbivores (meadow vole),
 $FI \text{ (g/day)} = 0.301 \text{ Wt}^{0.751}$ for non-passerine birds (red-tail hawk),
 $FI \text{ (g/day)} = 0.398 \text{ Wt}^{0.850}$ for passerine birds (American robin).
 $WI \text{ (L/day)} = 0.099 \text{ Wt}^{0.90}$ (Wt in kg) for mammals,
 $WI \text{ (L/day)} = 0.059 \text{ Wt}^{0.67}$ (Wt in kg) for birds.

ha = hectare
ac = acre, and a hectare = 2.471 acres.

Notes:
The soil ingestion rate for the shrew set equal to the rate for the American woodcock (10.4% of diet), as both species feed predominantly on earthworms.
The soil ingestion rate for the American robin set equal to 48% of the American woodcock value (0.38 x 10.4% = 4%), based on a robin diet of 38% invertebrates (earthworms).

Table F-2
Recommended Bioaccumulation/Bioconcentration Factors or Regression Equations Utilized for the Soil-to-Plant Pathway at SWMU 58

Constituent	USEPA, 2000 ^a				Regression Equation ^b	Other BAF/BCF	Recommended Tier 1 (Maximum) BAF/BCF	Recommended Tier 2 (RME) BAF/BCF	Rationale for Recommended Tier 2 BAF/BCF
	Minimum BAF/BCF	Median BAF/BCF	90 th Percentile BAF/BCF ^b	Maximum BAF/BCF					
Benzoic acid	-- ^c	--	--	--	$\text{Log (BCF)} = -0.578(\text{Log[Kow]}) + 1.588$	--	4.1 ^d	3.2 ^d	Travis & Arms Kow Regression Eq.
Isopropylbenzene (Cumene)	--	--	--	--	$\text{Log (BCF)} = -0.578(\text{Log[Kow]}) + 1.588$	--	0.39 ^d	0.39 ^d	Travis & Arms Kow Regression Eq.
Isopropyltoluene (Cymene)	--	--	--	--	$\text{Log (BCF)} = -0.578(\text{Log[Kow]}) + 1.588$	--	0.19 ^d	0.19 ^d	Travis & Arms Kow Regression Eq.
Chromium	0.021	0.041	--	0.48	--	0.001 ^e	0.48	0.041	Median BAF from USEPA (2000)
Cobalt	0.0019	0.0075	--	0.045	--	0.054 ^e	0.054	0.0075	Median BAF from USEPA (2000).
Mercury	0.0015 ^b	0.65 ^b	5	12 ^b	$\ln (\text{AGP}) = 0.54(\ln[\text{soil}]) - 1.00$	0.55 ^f	12	Regression Equation	Chemical-specific Regression Eq.
Selenium	0.02	0.67189	3.0	77	$\ln (\text{AGP}) = 1.1(\ln[\text{soil}]) - 0.68$	0.025 ^f	77	Regression Equation	Chemical-specific Regression Eq.
Thallium	--	--	--	--	--	0.0022 ^f	0.0022	0.0022	Value from Baes et al. (1984).
Zinc	0.00855	0.36616	1.8	34.2857	$\ln (\text{APG}) = 0.56(\ln[\text{soil}]) + 1.58$	1.2 ^f	34	Regression Equation	Chemical-specific Regression Eq.

^a USEPA, 2000, *Ecological Soil Screening Level Guidance*, Draft.

^b Efroymson, R.A., et. al., 2001, *Uptake of Inorganic Chemicals from Soil by Plant Leaves: Regressions of Field Data*, Environ. Tox. Chem., 20:2561-2571 for AGP (above ground plant tissue concentration) and Travis and Arms (1988) for BCF.

^c -- indicates that a BAF/BCF or regression equation is not available.

^d Values estimated using Tavis and Arms (1988) Kow regression equation, with the Tier 1 BCF using the lowest literature value and the Tier 2 BCF using the Kow estimated from syrres.com SMILES fragment summarized as follows:

Constituent	Tier 1 Log Kow	Tier 2 Log Kow	Tier 1 Reference
Benzoic acid	1.68	1.87	Montgomery, 1996
Cumene	>3.66	3.66	Montgomery, 1996
Cymene	>4.0	4.0	Hansch, 1995

^e IAEA (1994); note: value from this reference used, compared with Baes et al (1984), as IAEA (1994) is more current.

^f Baes et al (1984); note: value from this reference used if no appropriate value available from IAEA (1994).

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Table F-3
Recommended Bioaccumulation/Bioconcentration Factors or Regression Equations Utilized for the Soil-to-Earthworm Pathway at SWMU 58

Constituent	Sample, et. al. ^a			Regression Equation ^b	Beyer ^c BAF/BCF	Recommended Tier 1 (Maximum) BAF/BCF	Recommended Tier 2 (RME) BAF/BCF	Rationale for Tier 2 (RME) BAF/BCF
	Median BAF/BCF	90th Percentile BAF/BCF	Maximum BAF/BCF					
Benzoic acid	-- ^d	--	--	see footnote "b" below	--	38	34	Kow Regression Eq., using average TOC
Isopropylbenzene (Cumene)	--	--	--	see footnote "b" below	--	40	36	Kow Regression Eq., using average TOC
4-Isopropyltoluene (Cymene)	--	--	--	see footnote "b" below	--	41	37	Kow Regression Eq., using average TOC
Chromium	0.306	3.162	11.416	--	--	11	3.2	90th percentile value, from field studies.
Cobalt	0.122	0.291	0.321	--	--	0.32	0.29	90th percentile value, from field studies.
Mercury	1.693	20.625	33	$\ln(EW)=0.33(\ln[soil])+0.078$	--	33	Regression Equation	Chemical-specific Regression Eq.
Selenium	0.985	1.34	13.733	$\ln(EW)=0.73(\ln[soil])-0.075$	--	14	Regression Equation	Chemical-specific Regression Eq.
Thallium	--	--	--	--	--	3.2	1.2	Geom. mean of 18 values, see Note (1).
Zinc	3.201	12.885	49.51	$\ln(EW)=0.33(\ln[soil])+4.44$	--	50	Regression Equation	Chemical-specific Regression Eq.

^a Sample, B. E. et. al., 1998. Development and Validation of Bioaccumulation Models for Earthworms, ES/ER/TM-220.

^b For Inorganics: Sample, B.E. et. al., 1999, Literature-Derived Bioaccumulation Models for Earthworms: Development and Validation,

Environ. Toxicol. Chem., 18:2,110-2,120. (models from Table 3 of publication). EW = earthworm tissue concentration.

For Organics: Ecological Soil Screening Level (SSL) Guidance, USEPA, 2000 (Section 2.0 in Appendix 4-1, given site specific soil total organic carbon [TOC]).

TOC concentrations utilized are as follows: Minimum TOC = 0.72%, Average TOC = 0.8%.

Median Organic BAF presented, if available, from SSL (USEPA, 2000), or estimated using the following regression equation and log Kow values

from <http://esc.syrres.com/interkow>:

$$BAF = 10^{(0.981 \cdot \log Kow - 0.6)}$$

$$foc = 10^{(0.981 \cdot \log Kow + 0.00028)}$$

Constituent

Benzoic Acid

Isopropylbenzene

Cymene

Log Kow

1.87

3.66

4

^c Beyer, W. N., 1990. Evaluating Soil Contamination, Biological Report 90(2), U.S. Department of the Interior, U.S. Fish and Wildlife Service.

^d -- indicates that a BAF/BCF or regression equation is either not available or not recommended.

Note (1): For inorganics without BAF/BCF data, the following data (from Sample et al., 1998) were used to estimate Tier 1 and Tier 2 values:

	<u>Max BAF/BCF</u>	<u>90th Percentile BAF/BCF</u>
Aluminum	0.197	0.118
Arsenic	0.925	0.523
Barium	0.31	0.16
Beryllium	1.429	1.182
Cadmium	190	40.69
Chromium	11.416	3.162
Cobalt	0.321	0.291
Copper	5.492	1.531
Iron	0.1	0.078
Manganese	0.228	0.124
Mercury	33	20.625
Molybdenum	2.091	2.091
Nickel	7.802	4.73
Lead	228.261	1.522
Selenium	13.733	1.34
Silver	19.5	15.338
Vanadium	0.088	0.088
Zinc	49.51	12.885
Geometric Mean	3.16	1.24

Table F-4
Recommended Bioaccumulation/Bioconcentration Factors Utilized for the Soil-to-Small Mammal and Bird Pathways at SWMU 58

Constituent	Sample et al., 1998 ^a						Recommended Tier 1 (Maximum) BAF/BCF	Recommended Tier 2 (90th Percentile - RME) BAF/BCF	Rationale for Recommended Tier 2 BAF/BCF
	Insectivore Median BAF/BCF	Herbivore Median BAF/BCF	Omnivore Median BAF/BCF	General ^b Median BAF/BCF	General ^b Maximum BAF/BCF	General ^b 90th percentile BAF/BCF			
Benzoic acid ^c	-- ^d	--	--	--	--	--	1	0.5	Conservative value for Tier 2 organics see "c."
Isopropylbenzene (Cumene)	--	--	--	--	--	--	1	0.5	Conservative value for Tier 2 organics see "c."
Isopropyltoluene (Cymene)	--	--	--	--	--	--	1	0.5	Conservative value for Tier 2 organics see "c."
Chromium	0.0815	0.0884	0.0699	0.0846	0.8	0.3333	0.8	0.33	General 90th percentile value is upper bound.
Cobalt	--	0.021	0.0158	0.0205	0.18	0.1	0.18	0.1	General 90th percentile value is upper bound.
Mercury	1.046 ^e	0.0239 ^e	0.0543	0.0543	1.046	0.192	1.1	0.19	General 90th percentile value is upper bound.
Selenium	0.7241	0.0221 ^f	0.2062	0.1619	1.754	1.1867	1.8	1.2	General 90th percentile value is upper bound.
Thallium	--	--	0.1124	0.1124	0.123	0.1227	0.12	0.12	General 90th percentile value is upper bound.
Zinc	0.83277	0.50429	0.55772	0.7717	16.364	2.6878	16	2.7	General 90th percentile value is upper bound.

^a Sample et al., 1998, *Development and Validation of Bioaccumulation Models for Small Mammals*, ES/ER/TM-219.

^b General = combination dataset used for insectivore, herbivore, and omnivore receptors to estimate a "general" receptor BAF/BCF value.

^c Known bioaccumulative organics (TCDD and TCDF) have BAFs/BCFs of 1.1 and 0.13 (median) and 2.2 and 0.16 (maximum) from Sample et al. (1998).
Conservative BAF/BCF default values of 1 and 0.5 were selected for other organics at the site, as they are not expected to be as bioaccumulative as TCDD/TCDF.

^d -- indicates that a BAF/BCF is not available.

^e Only one BAF/BCF value available for exposure to mercury in soil (median is also 90th percentile value and maximum value).

^f Mean value presented, as median value not given in Sample et al. (1998).

Notes:

(1) Bird BAF/BCF values were based on the recommended small mammal BAF/BCF values, as bird uptake values are not readily available.

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Table F-5

NOAEL Toxicity Reference Values Used to Derive Wildlife Toxicity Benchmarks for Chemicals of Potential Ecological Concern at SWMU 58

COPEC	Mammalian Data				Avian Data			
	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	NOAEL (mg/kg/d)	Test Species	Reference
Organics								
Benzoic Acid	40 (LOAEL)	4.0	mouse	Shienberg & Ignat'ev, 1970 (IRIS)	NA	NA	NA	NA
Isopropylbenzene (Cumene)	1,400 (LD ₅₀)	14.0	rat	AMA Archives of Industrial Health (1956)	NA	NA	NA	NA
4-Isopropyl Toluene (Cymene)	4,750 (LD ₅₀)	47.5	rat	Food and Cosmetics Toxicology (1964)	NA	NA	NA	NA
Inorganics								
Chromium	--	2737	rat	Sample, et. al. (1996)	--	1	black duck	Sample, et al. (1996)
Cobalt	--	1.2	rat	US Navy (1998) TRV low	NA	NA	NA	NA
Mercury	--	1.0	mink	Sample, et al. (1996)	--	0.45	Japanese quail	Sample, et al. (1996)
Selenium	--	0.2	rat	Sample, et al. (1996)	--	0.5	mallard duck	Sample, et al. (1996)
Thallium	--	0.0074	rat	Sample, et al. (1996)	23.7 (LD ₅₀)	0.237	pheasant	Hudson, et. al. (1984)
Zinc	--	160	rat	Sample, et al. (1996)	--	14.5	hens	Sample, et al. (1996)

Notes:

NA indicates that the information is not available.

As recommended by Wentsel, et. al. (1996), Tri-Service Procedural Guidelines for Ecological Risk Assessments, the following adjustments were made to toxicity data when NOAEL or LOAEL data were not available

- Subchronic LOAELs were converted to chronic NOAELs by dividing by a factor of 20.
- Chronic NOAELs were converted to chronic LOAELs by multiplying by a factor of 5.0.
- Subchronic NOAELs/LOAELs were converted to chronic NOAELs/LOAELs by dividing by a factor of 10.
- Chronic LOAELs were converted to chronic NOAELs by dividing by a factor of 10.
- LD₅₀ concentrations were converted to chronic NOAELs by dividing by a factor of 100.

Table F-6
LOAEL Toxicity Reference Values Used to Derive Wildlife Toxicity Benchmarks for Chemicals of Potential Ecological Concern at SWMU 58

COPEC	Mammalian Data				Avian Data			
	Toxicity Value	LOAEL (mg/kg/d)	Test Species	Reference	Toxicity Value	LOAEL (mg/kg/d)	Test Species	Reference
Organics								
Benzoic Acid	--	40.0	mouse	Shienberg & Ignat'ev, 1970 (IRIS)	NA	NA	NA	NA
Isopropylbenzene (Cumene)	1,400 (LD ₅₀)	70.0	rat	AMA Archives of Industrial Health (1956)	NA	NA	NA	NA
4-Isopropyl Toluene (Cymene)	4,750 (LD ₅₀)	238.0	rat	Food and Cosmetic Toxicology (1964)	NA	NA	NA	NA
Inorganics								
Chromium	2,737 (NOAEL)	13,690	rat	Sample, et. al. (1996)	--	5.0	black duck	Sample, et al. (1996)
Cobalt	1.2 (NOAEL)	6.0	rat	US Navy (1998) TRV low	NA	NA	NA	NA
Mercury	1.0 (NOAEL)	5.0	mink	Sample, et al. (1996)	--	0.9	Japanese quail	Sample, et al. (1996)
Selenium	--	0.3	rat	Sample, et al. (1996)	--	1.0	mallard duck	Sample, et al. (1996)
Thallium	--	0.074	rat	Sample, et al. (1996)	23.7 (LD ₅₀)	1.19	pheasant	Hudson, et. al. (1984)
Zinc	--	320	rat	Sample, et al. (1996)	--	131	hens	Sample, et al. (1996)

Notes:

NA indicates that the information is not available.

As recommended by Wentsel, et. al. (1996), Tri-Service Procedural Guidelines for Ecological Risk Assessments, the following adjustments were made to toxicity data when NOAEL or LOAEL data were not available

- Subchronic LOAELs were converted to chronic NOAELs by dividing by a factor of 20.
- Chronic NOAELs were converted to chronic LOAELs by multiplying by a factor of 5.0.
- Subchronic NOAELs/LOAELs were converted to chronic NOAELs/LOAELs by dividing by a factor of 10.
- Chronic LOAELs were converted to chronic NOAELs by dividing by a factor of 10.
- LD₅₀ concentrations were converted to chronic NOAELs by dividing by a factor of 100.

Table F-7
Uncertainty Factors^a for Ecological TRV^b Extrapolations^c at SWMU 58

Laboratory Animals (toxicity data base)		Selected Site Receptor Species	
Rat	G: Rattus F: Muridae O: Rodentia	Meadow vole	G: Microtus F: Muridae O: Rodentia
Mouse	G: Mus F: Muridae O: Rodentia	Short-tailed shrew	G: Blarina F: Soricidae O: Insectivora
Mink	G: Mustela F: Mustelidae O: Carnivora	American robin	G: Turdus F: Muscicapidae O: Passeriformes
Pheasant	G: Phasianus F: Phasianidae O: Galliformes	Red-tailed hawk	G: Buteo F: Accipitridae O: Ciconiiformes
Chick, Poultry	G: Gallus F: Phasianidae O: Galliformes	Red fox	G: Vulpes F: Canidae O: Carnivora
Black duck, Mallard	G: Anas F: Anatidae O: Anseriformes		
Japanese quail	G: Coturnix F: Phasianidae O: Galliformes		

^a From *Tri-Service Procedural Guidelines for Ecological Risk Assessment* (Wentzel et al. 1996)

^b TRV = Toxicity Reference Value

^c Interclass extrapolations not performed; only within bird class or within mammal class.

The Uncertainty Factors Used for TRV Extrapolations are Summarized Below:

- Extrapolation between two different species = uncertainty factor of 2
- Extrapolation between two different genera (G) = uncertainty factor of 4
- Extrapolation between two different families (F) or orders (O) = uncertainty factor of 8
- Thus, for all extrapolations used in the SLERA food chain model (except for rat or mouse toxicity values extrapolated to the meadow vole), an uncertainty factor of 8 was used. For the latter, an uncertainty factor of 4 was used.

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TABLE F-8
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR MEADOW VOLES AT SWMU 58 - CURRENT

Hazard Estimate - Tier 1
Meadow Vole

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL		Adjusted LOAEL		
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	mg/kg-d	EEQ L	
Benzoic acic	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	1.84E-03	NA	NA	0.00E+00	3.14E-01	0.00E+00	0.00E+00	3.15E-01	4	4.00E+00	1.00E+00	3.15E-01	4.00E+01	1.00E+01	3.15E-02
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	6.03E-01	NA	NA	0.00E+00	1.21E+01	0.00E+00	0.00E+00	1.27E+01	4	2.74E+03	6.85E+02	1.85E-02	1.37E+04	3.43E+03	3.70E-03
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	2.91E-01	NA	NA	0.00E+00	6.54E-01	0.00E+00	0.00E+00	9.45E-01	4	1.20E+00	3.00E-01	3.15E+00	6.00E+00	1.50E+00	6.30E-01
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	1.17E-03	NA	NA	0.00E+00	5.87E-01	0.00E+00	0.00E+00	5.88E-01	8	1.00E+00	1.25E-01	4.71E+00	5.00E+00	6.25E-01	9.42E-01
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	5.79E-03	NA	NA	0.00E+00	1.86E+01	0.00E+00	0.00E+00	1.86E+01	4	2.00E-01	5.00E-02	3.72E+02	3.00E-01	7.50E-02	2.48E+02
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	1.67E-01	NA	NA	0.00E+00	1.53E-02	0.00E+00	0.00E+00	1.82E-01	4	7.40E-03	1.85E-03	9.83E+01	7.40E-02	1.85E-02	9.83E+00
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.18E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	5.90E-01	NA	NA	0.00E+00	8.36E+02	0.00E+00	0.00E+00	8.37E+02	4	1.60E+02	4.00E+01	2.09E+01	3.20E+02	8.00E+01	1.05E+01
Hazard Index (Total EEQ):																							4.99E+02		2.70E+02				

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used a default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00024	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.01	kg/d
Body weight =	0.017	kg
Home range =	0.089	acres
Water intake rate =	0.007	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-9
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR MEADOW VOLES AT SWMU 58 - FUTURE

Hazard Estimate - Tier 1
Meadow Vole

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00024	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.01	kg/d
Body weight =	0.017	kg
Home range =	0.089	acres
Water intake rate =	0.007	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-10
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR SHORT-TAILED SHREW AT SWMU 58 - CURRENT

Hazard Estimate - Tier 1
Short-tailed Shrew

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL			
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	mg/kg-d	EEQ L	
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	3.22E-03	NA	NA	1.19E+00	0.00E+00	0.00E+00	0.00E+00	1.19E+00	8	4.00E+00	5.00E-01	2.38E+00	4.00E+01	5.00E+00	2.38E-01
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	1.06E+00	NA	NA	4.92E+00	0.00E+00	0.00E+00	0.00E+00	5.98E+00	8	2.74E+03	3.43E+02	1.75E-02	1.37E+04	1.71E+03	3.49E-03
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	5.11E-01	NA	NA	1.58E+00	0.00E+00	0.00E+00	0.00E+00	2.09E+00	8	1.20E+00	1.50E-01	1.40E+01	6.00E+00	7.50E-01	2.79E+00
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	2.06E-03	NA	NA	6.59E-01	0.00E+00	0.00E+00	0.00E+00	6.61E-01	8	1.00E+00	1.25E-01	5.29E+00	5.00E+00	6.25E-01	1.06E+00
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	1.02E-02	NA	NA	1.38E+00	0.00E+00	0.00E+00	0.00E+00	1.39E+00	8	2.00E-01	2.50E-02	5.55E+01	3.00E-01	3.75E-02	3.70E+01
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	2.93E-01	NA	NA	9.06E+00	0.00E+00	0.00E+00	0.00E+00	9.36E+00	8	7.40E-03	9.25E-04	1.01E+04	7.40E-02	9.25E-03	1.01E+03
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.18E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	1.04E+00	NA	NA	5.02E+02	0.00E+00	0.00E+00	0.00E+00	5.03E+02	8	1.60E+02	2.00E+01	2.51E+01	3.20E+02	4.00E+01	1.26E+01
Hazard Index (Total EEQ):																									1.0E+04				1.1E+03

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00031	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.003	kg/d
Body weight =	0.0125	kg
Home range =	0.96	acres
Water intake rate =	0.0033	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-11
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR SHORT-TAILED SHREWS AT SWMU 58 - FUTURE

Hazard Estimate - Tier 1
Short-tailed Shrew

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
	Concentration	Units	Point	Concentration	Units		Concentration	Units				unitless						mg/kg-d	mg/kg-d	mg/kg-d				mg/kg-d		mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00031	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.003	kg/d
Body weight =	0.0125	kg
Home range =	0.96	acres
Water intake rate =	0.0033	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-12
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN ROBINS AT SWMU 58 - CURRENT

Hazard Estimate - Tier 1
American Robin

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L	
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	1.64E-03	NA	NA	5.91E-01	1.04E-01	0.00E+00	0.00E+00	6.97E-01	8	NA	NA	NA	NA	NA	
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	5.38E-01	NA	NA	2.45E+00	4.00E+00	0.00E+00	0.00E+00	6.99E+00	8	1.00E+00	1.25E-01	5.59E+01	5.00E+00	6.25E-01	1.12E+01
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	2.60E-01	NA	NA	7.89E-01	2.17E-01	0.00E+00	0.00E+00	1.27E+00	8	NA	NA	NA	NA	NA	
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	1.05E-03	NA	NA	3.29E-01	1.95E-01	0.00E+00	0.00E+00	5.25E-01	8	4.50E-01	5.63E-02	9.33E+00	9.00E-01	1.13E-01	4.66E+00
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	5.17E-03	NA	NA	6.87E-01	6.16E+00	0.00E+00	0.00E+00	6.86E+00	8	5.00E-01	6.25E-02	1.10E+02	1.00E+00	1.25E-01	5.49E+01
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	1.49E-01	NA	NA	4.52E+00	5.07E-03	0.00E+00	0.00E+00	4.67E+00	8	2.37E-01	2.96E-02	1.58E+02	1.19E+00	1.49E-01	3.14E+01
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.18E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	5.27E-01	NA	NA	2.50E+02	2.78E+02	0.00E+00	0.00E+00	5.28E+02	8	1.45E+01	1.81E+00	2.91E+02	1.31E+02	1.64E+01	3.23E+01
Hazard Index (Total EEQ):																								6.2E+02		1.3E+02			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.62	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.38	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0008	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.02	kg/d
Body weight =	0.0635	kg
Home range =	1.2	acres
Water intake rate =	0.013	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-13
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN ROBINS AT SWMU 58 - FUTURE

Hazard Estimate - Tier 1
American Robin

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL		
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	mg/kg-d	EEQ L
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.80E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	2.27E-03	NA	NA	8.19E-01	1.44E-01	0.00E+00	0.00E+00	9.65E-01	3	NA	NA	NA	NA	NA	NA
Cumene	0.00E+00	mg/L	0.0E+00	mg/kg	9.60E-02	mg/kg	NA	NA	4.00E+01	3.90E-01	1.00E+00	1.00E+00	0.00E+00	0.00E+00	1.21E-03	NA	NA	4.60E-01	7.31E-03	0.00E+00	0.00E+00	4.68E-01	3	NA	NA	NA	NA	NA	NA
Cymene	0.00E+00	mg/L	0.0E+00	mg/kg	4.40E-02	mg/kg	NA	NA	4.10E+01	1.90E-01	1.00E+00	1.00E+00	0.00E+00	0.00E+00	5.54E-04	NA	NA	2.16E-01	1.63E-03	0.00E+00	0.00E+00	2.18E-01	3	NA	NA	NA	NA	NA	NA
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	5.38E-01	NA	NA	2.45E+00	4.00E+00	0.00E+00	0.00E+00	6.99E+00	3	1.00E+00	1.25E-01	5.59E+01	5.00E+00	6.25E-01	1.12E+01
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.44E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	3.07E-01	NA	NA	9.35E-01	2.57E-01	0.00E+00	0.00E+00	1.50E+00	3	NA	NA	NA	NA	NA	NA
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	1.05E-03	NA	NA	3.29E-01	1.95E-01	0.00E+00	0.00E+00	5.25E-01	3	4.50E-01	5.63E-02	9.33E+00	9.00E-01	1.13E-01	4.66E+00
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	5.17E-03	NA	NA	6.87E-01	6.16E+00	0.00E+00	0.00E+00	6.86E+00	3	5.00E-01	6.25E-02	1.10E+02	1.00E+00	1.25E-01	5.49E+01
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	1.49E-01	NA	NA	4.52E+00	5.07E-03	0.00E+00	0.00E+00	4.67E+00	3	2.37E-01	2.96E-02	1.58E+02	1.19E+00	1.49E-01	3.14E+01
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	5.91E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	7.45E-01	NA	NA	3.54E+02	3.92E+02	0.00E+00	0.00E+00	7.47E+02	3	1.45E+01	1.81E+00	4.12E+02	1.31E+02	1.64E+01	4.56E+01
Hazard Index (Total EEQ):																								7.4E+02		1.5E+02			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used a default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.62	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.38	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.0008	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.02	kg/d
Body weight =	0.0635	kg
Home range =	1.2	acres
Water intake rate =	0.013	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-14
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED-TAILED HAWKS AT SWMU 58 - CURRENT

Hazard Estimate - Tier 1
Red-tailed Hawk

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert.	Terr. Invert.	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	EEQ N	LOAEL	Adjusted LOAEL	EEQ L		
	Concentration	Units	Point Concentration	Units	Concentration		Units	BAF				BAF	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d
	----- unitless -----																													
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	6.50E-03	2.05E-03	8.56E-03	8	NA	NA	NA	NA	NA		
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	1.71E+00	5.40E-01	2.25E+00	8	1.00E+00	1.25E-01	1.80E+01	5.00E+00	6.25E-01	3.60E+00	
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	1.86E-01	5.86E-02	2.44E-01	8	NA	NA	NA	NA	NA	NA	
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	4.58E-03	1.45E-03	6.02E-03	8	4.50E-01	5.63E-02	1.07E-01	9.00E-01	1.13E-01	5.36E-02	
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	3.69E-02	1.17E-02	4.86E-02	8	5.00E-01	6.25E-02	7.77E-01	1.00E+00	1.25E-01	3.89E-01	
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	7.08E-02	2.24E-02	9.32E-02	8	2.37E-01	2.96E-02	3.15E+00	1.19E+00	1.49E-01	6.27E-01	
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.18E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	3.35E+01	1.06E+01	4.40E+01	8	1.45E+01	1.81E+00	2.43E+01	1.31E+02	1.64E+01	2.69E+00	
Hazard index (Total EEQ):																							4.6E+01				7.4E+00			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (l) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.76	unitless
Bird diet fraction =	0.24	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.063	kg/d
Body weight =	0.957	kg
Home range =	2081	acres
Water intake rate =	0.068	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-15
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED-TAILED HAWKS AT SWMU 58 - FUTURE

Hazard Estimate - Tier 1
Red-tailed Hawk

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL		
	Concentration	Units	Point Concentration	Units	Concentration	Units																							
	----- unitless -----																												
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.80E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	9.01E-03	2.84E-03	1.18E-02	8	NA	NA	NA	NA	NA	NA
Cumene	0.00E+00	mg/L	0.0E+00	mg/kg	9.60E-02	mg/kg	NA	NA	4.00E+01	3.90E-01	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	4.80E-03	1.52E-03	6.32E-03	8	NA	NA	NA	NA	NA	NA
Cymene	0.00E+00	mg/L	0.0E+00	mg/kg	4.40E-02	mg/kg	NA	NA	4.10E+01	1.90E-01	1.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	2.20E-03	6.95E-04	2.90E-03	8	NA	NA	NA	NA	NA	NA
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	1.71E+00	5.40E-01	2.25E+00	8	1.00E+00	1.25E-01	1.80E+01	5.00E+00	6.25E-01	3.60E+00
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.44E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	2.20E-01	6.94E-02	2.89E-01	8	NA	NA	NA	NA	NA	NA
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	4.58E-03	1.45E-03	6.02E-03	8	4.50E-01	5.63E-02	1.07E-01	9.00E-01	1.13E-01	5.36E-02
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	3.69E-02	1.17E-02	4.86E-02	8	5.00E-01	6.25E-02	7.77E-01	1.00E+00	1.25E-01	3.89E-01
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	7.08E-02	2.24E-02	9.32E-02	8	2.37E-01	2.96E-02	3.15E+00	1.19E+00	1.49E-01	6.27E-01
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	5.91E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	4.73E+01	1.49E+01	6.22E+01	8	1.45E+01	1.81E+00	3.43E+01	1.31E+02	1.64E+01	3.80E+00
Hazard Index (Total EEQ):																								5.6E+01		8.5E+00			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^n \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.76	unitless
Bird diet fraction =	0.24	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.063	kg/d
Body weight =	0.957	kg
Home range =	2081	acres
Water intake rate =	0.068	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-16
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED FOXES AT SWMU 58 - CURRENT

Hazard Estimate - Tier 1
Red Fox

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL		
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless						mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		
Benzoic acic	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.80E+01	4.10E+00	1.00E+00	1.00E+00	0.00E+00	0.00E+00	4.19E-04	NA	NA	2.28E-02	1.04E-02	9.74E-03	2.10E-03	4.55E-02	8	4.00E+00	5.00E-01	9.09E-02	4.00E+01	5.00E+00	9.09E-03
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.27E+01	mg/kg	NA	NA	1.10E+01	4.80E-01	8.00E-01	8.00E-01	0.00E+00	0.00E+00	1.38E-01	NA	NA	9.45E-02	4.02E-01	2.56E+00	5.51E-01	3.74E+00	8	2.74E+03	3.43E+02	1.09E-02	1.37E+04	1.71E+03	2.19E-03
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	3.20E-01	5.40E-02	1.80E-01	1.80E-01	0.00E+00	0.00E+00	6.63E-02	NA	NA	3.04E-02	2.18E-02	2.78E-01	5.98E-02	4.56E-01	8	1.20E+00	1.50E-01	3.04E+00	6.00E+00	7.50E-01	6.08E-01
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	3.30E+01	1.20E+01	1.10E+00	1.10E+00	0.00E+00	0.00E+00	2.68E-04	NA	NA	1.27E-02	1.96E-02	6.86E-03	1.48E-03	4.08E-02	8	1.00E+00	1.25E-01	3.27E-01	5.00E+00	6.25E-01	6.53E-02
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.40E+01	7.70E+01	1.80E+00	1.80E+00	0.00E+00	0.00E+00	1.32E-03	NA	NA	2.65E-02	6.19E-01	5.53E-02	1.19E-02	7.14E-01	8	2.00E-01	2.50E-02	2.85E+01	3.00E-01	3.75E-02	1.90E+01
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	3.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	3.80E-02	NA	NA	1.74E-01	5.09E-04	1.06E-01	2.28E-02	3.42E-01	8	7.40E-03	9.25E-04	3.69E+02	7.40E-02	9.25E-03	3.69E+01
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.18E+01	mg/kg	NA	NA	5.00E+01	3.40E+01	1.60E+01	1.60E+01	0.00E+00	0.00E+00	1.35E-01	NA	NA	9.64E+00	2.78E+01	5.01E+01	1.08E+01	9.85E+01	8	1.60E+02	2.00E+01	4.93E+00	3.20E+02	4.00E+01	2.46E+00
Hazard Index (Total EEQ):																								4.1E+02		5.9E+01			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.17	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.04	unitless
Mammal diet fraction =	0.65	unitless
Bird diet fraction =	0.14	unitless
Soil ingestion rate =	0.0095	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.34	kg/d
Body weight =	2.95	kg
Home range =	2204	acres
Water intake rate =	0.57	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-17
TIER 1 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED FOXES AT SWMU 58 - FUTURE

Hazard Estimate - Tier 1
Red Fox

Chemical	Surface Water Exposure		Sediment Exposure		Soil Exposure		Fish BAF	Aq. Invert.	Terr. Invert.	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted	LOAEL	Adjusted																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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Chemical	Concentration	Units	Point	Concentration	Units	Concentration	Units	----- unitless -----					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical

A = Site Area

HR = Home Range

m = Total number of ingested media

i = counter

IRi = Consumption Rate for Medium

Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)

BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.

Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.

BAF = Bioaccumulation Factor (may be BCF if this is the only value available)

EEQ = Ecological Effects Quotient.

L = LOAEL based; N = NOAEL based

LOAEL = Lowest Observed Adverse Effect Level

NOAEL = No Observed Adverse Effect Level

NA = Not applicable/Not available

PDE = Predicted Daily Exposure

BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)

Some BAF (or BCF) values based on media regression equations (value in box):

n See appropriate text tables for equations.

If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.

LOAEL and NOAEL values from appropriate toxicity summary tables in the text.

UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF

A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.

Receptor diet data and home range data from appropriate text table.

Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.17	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.04	unitless
Mammal diet fraction =	0.65	unitless
Bird diet fraction =	0.14	unitless
Soil ingestion rate =	0.0095	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.34	kg/d
Body weight =	2.95	kg
Home range =	2204	acres
Water intake rate =	0.57	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-18
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR MEADOW VOLES AT SWMU 58 - CURRENT

Hazard Estimate - Tier 2
Meadow Vole

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert.	Terr. Invert.	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL									
	Concentration	Units	Point Concentration	Units	Concentration		Units	BAF				BAF	mg/kg-d			mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d				mg/kg-d		mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d
	unitless																							EEQ N		mg/kg-d	mg/kg-d	EEQ L							
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	0.00E+00	0.00E+00	6.68E-04	NA	NA	0.00E+00	8.99E-02	0.00E+00	0.00E+00	9.06E-02	4	4.00E+00	1.00E+00	9.06E-02	4.00E+01	1.00E+01	9.06E-03						
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.26E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	0.00E+00	0.00E+00	2.19E-01	NA	NA	0.00E+00	3.78E-01	0.00E+00	0.00E+00	5.96E-01	4	2.74E+03	6.85E+02	8.71E-04	1.37E+04	3.43E+03	1.74E-04						
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	0.00E+00	0.00E+00	1.06E-01	NA	NA	0.00E+00	3.34E-02	0.00E+00	0.00E+00	1.39E-01	4	1.20E+00	3.00E-01	4.64E-01	6.00E+00	1.50E+00	9.28E-02						
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	5.72E+00	1.15E+00	1.90E-01	1.90E-01	0.00E+00	0.00E+00	4.27E-04	NA	NA	0.00E+00	2.08E-02	0.00E+00	0.00E+00	2.12E-02	8	1.00E+00	1.25E-01	1.70E-01	5.00E+00	6.25E-01	3.39E-02						
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.18E+00	4.63E-01	1.20E+00	1.20E+00	0.00E+00	0.00E+00	2.11E-03	NA	NA	0.00E+00	4.11E-02	0.00E+00	0.00E+00	4.32E-02	4	2.00E-01	5.00E-02	8.64E-01	3.00E-01	7.50E-02	5.76E-01						
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	6.06E-02	NA	NA	0.00E+00	5.61E-03	0.00E+00	0.00E+00	6.62E-02	4	7.40E-03	1.85E-03	3.58E+01	7.40E-02	1.85E-02	3.58E+00						
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	3.91E+01	mg/kg	NA	NA	7.28E+00	9.68E-01	2.70E+00	2.70E+00	0.00E+00	0.00E+00	2.01E-01	NA	NA	0.00E+00	8.17E+00	0.00E+00	0.00E+00	8.37E+00	4	1.60E+02	4.00E+01	2.09E-01	3.20E+02	8.00E+01	1.05E-01						
Hazard Index (Total EEQ):																								3.8E+01		4.4E+00									

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00019	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.008	kg/d
Body weight =	0.037	kg
Home range =	0.089	acres
Water intake rate =	0.0051	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-19
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR MEADOW VOLES AT SWMU 58 - FUTURE

Hazard Estimate - Tier 2
Meadow Vole

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL			
	Concentration	Units	Point	Concentration	Units	Concentration																						Units		
	----- unitless -----																													
Benzoic acid	0.00E+00	mg/L		0.0E+00	mg/kg	1.80E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	0.00E+00	0.00E+00	9.24E-04	NA	NA	0.00E+00	1.25E-01	0.00E+00	0.00E+00	1.25E-01	4	4.00E+00	1.00E+00	1.25E-01	4.00E+01	1.00E+01	1.25E-02
Cumene	0.00E+00	mg/L		0.0E+00	mg/kg	9.60E-02	mg/kg	NA	NA	3.60E+01	3.90E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	4.93E-04	NA	NA	0.00E+00	8.10E-03	0.00E+00	0.00E+00	8.59E-03	4	1.40E+01	3.50E+00	2.45E-03	7.00E+01	1.75E+01	4.91E-04
Cymene	0.00E+00	mg/L		0.0E+00	mg/kg	4.40E-02	mg/kg	NA	NA	3.70E+01	1.90E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	2.26E-04	NA	NA	0.00E+00	1.81E-03	0.00E+00	0.00E+00	2.03E-03	4	4.75E+01	1.19E+01	1.71E-04	2.38E+02	5.95E+01	3.42E-05
Chromium	0.00E+00	mg/L		0.0E+00	mg/kg	3.71E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	0.00E+00	0.00E+00	1.91E-01	NA	NA	0.00E+00	3.29E-01	0.00E+00	0.00E+00	5.19E-01	4	2.74E+03	6.85E+02	7.58E-04	1.37E+04	3.43E+03	1.52E-04
Cobalt	0.00E+00	mg/L		0.0E+00	mg/kg	1.70E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	0.00E+00	0.00E+00	8.73E-02	NA	NA	0.00E+00	2.76E-02	0.00E+00	0.00E+00	1.15E-01	4	1.20E+00	3.00E-01	3.83E-01	6.00E+00	1.50E+00	7.66E-02
Mercury	0.00E+00	mg/L		0.0E+00	mg/kg	7.45E-02	mg/kg	NA	NA	6.16E+00	1.21E+00	1.90E-01	1.90E-01	0.00E+00	0.00E+00	3.83E-04	NA	NA	0.00E+00	1.96E-02	0.00E+00	0.00E+00	2.00E-02	8	1.00E+00	1.25E-01	1.60E-01	5.00E+00	6.25E-01	3.19E-02
Selenium	0.00E+00	mg/L		0.0E+00	mg/kg	3.37E-01	mg/kg	NA	NA	1.24E+00	4.54E-01	1.20E+00	1.20E+00	0.00E+00	0.00E+00	1.73E-03	NA	NA	0.00E+00	3.31E-02	0.00E+00	0.00E+00	3.48E-02	4	2.00E-01	5.00E-02	6.97E-01	3.00E-01	7.50E-02	4.65E-01
Thallium	0.00E+00	mg/L		0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	6.06E-02	NA	NA	0.00E+00	5.61E-03	0.00E+00	0.00E+00	6.62E-02	4	7.40E-03	1.85E-03	3.58E+01	7.40E-02	1.85E-02	3.58E+00
Zinc	0.00E+00	mg/L		0.0E+00	mg/kg	4.67E+01	mg/kg	NA	NA	6.45E+00	8.95E-01	2.70E+00	2.70E+00	0.00E+00	0.00E+00	2.40E-01	NA	NA	0.00E+00	9.03E+00	0.00E+00	0.00E+00	9.27E+00	4	1.60E+02	4.00E+01	2.32E-01	3.20E+02	8.00E+01	1.16E-01
Hazard Index (Total EEQ):																							3.7E+01				4.3E+00			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	1	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00019	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.008	kg/d
Body weight =	0.037	kg
Home range =	0.089	acres
Water intake rate =	0.0051	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-20
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR SHORT-TAILED SHREWS AT SWMU 58 - CURRENT

Hazard Estimate - Tier 2
Short-tailed Shrew

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless						mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00023	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0022	kg/d
Body weight =	0.015	kg
Home range =	0.96	acres
Water intake rate =	0.0023	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-21
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR SHORT-TAILED SHREWS AT SWMU 58 - FUTURE

Hazard Estimate - Tier 2
Short-tailed Shrew

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
	Concentration	Units	Point	Concentration	Units	Concentration																						Units	unitless		mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d</

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical

A = Site Area

HR = Home Range

m = Total number of ingested media

i = counter

IRi = Consumption Rate for Medium

Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)

BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.

Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.

BAF = Bioaccumulation Factor (may be BCF if this is the only value available)

EEQ = Ecological Effects Quotient.

L = LOAEL based; N = NOAEL based

LOAEL = Lowest Observed Adverse Effect Level

NOAEL = No Observed Adverse Effect Level

NA = Not applicable/Not available

PDE = Predicted Daily Exposure

BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)

Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.

If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.

LOAEL and NOAEL values from appropriate toxicity summary tables in the text.

UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF

A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.

Receptor diet data and home range data from appropriate text table.

Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	1	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00023	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.0022	kg/d
Body weight =	0.015	kg
Home range =	0.96	acres
Water intake rate =	0.0023	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-22
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN ROBINS AT SWMU 58 - CURRENT

Hazard Estimate - Tier 2
American Robin

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert.		Terr. Invert.	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL		Adjusted LOAEL	
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	mg/kg-d	EEQ L
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.08E-03	NA	NA	3.48E-01	5.34E-02	0.00E+00	0.00E+00	4.02E-01	8	NA	NA	NA	NA	NA	NA
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.26E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	0.00E+00	0.00E+00	3.53E-01	NA	NA	1.07E+01	2.24E-01	0.00E+00	0.00E+00	1.13E+01	8	1.00E+00	1.25E-01	9.04E+01	5.00E+00	6.25E-01	1.81E+01
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	0.00E+00	0.00E+00	1.71E-01	NA	NA	4.70E-01	1.98E-02	0.00E+00	0.00E+00	6.60E-01	8	NA	NA	NA	NA	NA	NA
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	5.72E+00	1.15E+00	1.90E-01	1.90E-01	0.00E+00	0.00E+00	6.89E-04	NA	NA	3.74E-02	1.23E-02	0.00E+00	0.00E+00	5.04E-02	8	4.50E-01	5.63E-02	8.97E-01	9.00E-01	1.13E-01	4.48E-01
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.18E+00	4.63E-01	1.20E+00	1.20E+00	0.00E+00	0.00E+00	3.39E-03	NA	NA	3.81E-02	2.44E-02	0.00E+00	0.00E+00	6.58E-02	8	5.00E-01	6.25E-02	1.05E+00	1.00E+00	1.25E-01	5.27E-01
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	9.77E-02	NA	NA	1.11E+00	3.33E-03	0.00E+00	0.00E+00	1.21E+00	8	2.37E-01	2.96E-02	4.10E+01	1.19E+00	1.49E-01	8.17E+00
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	3.91E+01	mg/kg	NA	NA	7.28E+00	9.68E-01	2.70E+00	2.70E+00	0.00E+00	0.00E+00	3.23E-01	NA	NA	2.23E+01	4.85E+00	0.00E+00	0.00E+00	2.75E+01	8	1.45E+01	1.81E+00	1.52E+01	1.31E+02	1.64E+01	1.68E+00
Hazard Index (Total EEQ):																								1.5E+02				2.9E+01	

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.62	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.38	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00064	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.016	kg/d
Body weight =	0.0773	kg
Home range =	1.2	acres
Water intake rate =	0.011	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

TABLE F-23
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR AMERICAN ROBINS AT SWMU 58 - FUTURE

Hazard Estimate - Tier 2
American Robin

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert.	Terr. Invert.	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted	LOAEL	Adjusted																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	Concentration	Units	Point Concentration	Units	Concentration	Units		BAF	BAF																NOAEL		LOAEL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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g/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

E_j = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IR_i = Consumption Rate for Medium
C_{ij} = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.62	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.38	unitless
Mammal diet fraction =	0	unitless
Bird diet fraction =	0	unitless
Soil ingestion rate =	0.00064	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.016	kg/d
Body weight =	0.0773	kg
Home range =	1.2	acres
Water intake rate =	0.011	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.00E+00	unitless

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TABLE F-24
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED-TAILED HAWKS AT SWMU 58 - CURRENT

Hazard Estimate - Tier 2
Red-tailed Hawk

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL			
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	mg/kg-d	EEQ L	
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	2.72E-06	8.58E-07	3.58E-06	8	NA	NA	NA	NA	NA	NA
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.26E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	5.88E-04	1.86E-04	7.73E-04	8	1.00E+00	1.25E-01	6.19E-03	5.00E+00	6.25E-01	1.24E-03
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	8.61E-05	2.72E-05	1.13E-04	8	NA	NA	NA	NA	NA	NA
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	5.72E+00	1.15E+00	1.90E-01	1.90E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	6.61E-07	2.09E-07	8.69E-07	8	4.50E-01	5.63E-02	1.55E-05	9.00E-01	1.13E-01	7.73E-06
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.18E+00	4.63E-01	1.20E+00	1.20E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	2.06E-05	6.49E-06	2.71E-05	8	5.00E-01	6.25E-02	4.33E-04	1.00E+00	1.25E-01	2.16E-04
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	5.92E-05	1.87E-05	7.79E-05	8	2.37E-01	2.96E-02	2.63E-03	1.19E+00	1.49E-01	5.24E-04
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	3.91E+01	mg/kg	NA	NA	7.28E+00	9.68E-01	2.70E+00	2.70E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	4.41E-03	1.39E-03	5.80E-03	8	1.45E+01	1.81E+00	3.20E-03	1.31E+02	1.64E+01	3.54E-04
Hazard Index (Total EEQ):																								1.2E-02				2.3E-03	

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.76	unitless
Bird diet fraction =	0.24	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.059	kg/d
Body weight =	1.134	kg
Home range =	2081	acres
Water intake rate =	0.064	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.06E-03	unitless

TABLE F-25
TIER 2 CHEMICALS OF POTENTIAL ECOLOGICAL CONCERN EEQs AND HAZARD INDICES FOR RED -TAILED HAWKS AT SWMU 58 - FUTURE

Hazard Estimate - Tier 2
Red-tailed Hawk

Chemical	Surface Water Exposure Point		Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL		
	Concentration	Units	Point Concentration	Units	Concentration	Units																							
	-----unitless-----																												
Benzoic acic	0.00E+00	mg/L	0.0E+00	mg/kg	1.80E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	3.76E-06	1.19E-06	4.95E-06	8	NA	NA	NA	NA	NA	
Cumene	0.00E+00	mg/L	0.0E+00	mg/kg	9.60E-02	mg/kg	NA	NA	3.60E+01	3.90E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	2.01E-06	6.34E-07	2.64E-06	8	NA	NA	NA	NA	NA	
Cymene	0.00E+00	mg/L	0.0E+00	mg/kg	4.40E-02	mg/kg	NA	NA	3.70E+01	1.90E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	9.20E-07	2.90E-07	1.21E-06	8	NA	NA	NA	NA	NA	
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	3.71E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	5.12E-04	1.62E-04	6.73E-04	8	1.00E+00	1.25E-01	5.39E-03	5.00E+00	6.25E-01	1.08E-03
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	1.70E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	7.11E-05	2.24E-05	9.35E-05	8	NA	NA	NA	NA	NA	NA
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	7.45E-02	mg/kg	NA	NA	6.16E+00	1.21E+00	1.90E-01	1.90E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	5.92E-07	1.87E-07	7.79E-07	8	4.50E-01	5.63E-02	1.38E-05	9.00E-01	1.13E-01	6.92E-06
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	3.37E-01	mg/kg	NA	NA	1.24E+00	4.54E-01	1.20E+00	1.20E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	1.69E-05	5.34E-06	2.22E-05	8	5.00E-01	6.25E-02	3.56E-04	1.00E+00	1.25E-01	1.78E-04
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	5.92E-05	1.87E-05	7.79E-05	8	2.37E-01	2.96E-02	2.63E-03	1.19E+00	1.49E-01	5.24E-04
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.67E+01	mg/kg	NA	NA	6.45E+00	8.95E-01	2.70E+00	2.70E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	0.00E+00	0.00E+00	5.27E-03	1.66E-03	6.94E-03	8	1.45E+01	1.81E+00	3.83E-03	1.31E+02	1.64E+01	4.24E-04
Hazard Index (Total EEQ):																								1.2E-02		2.2E-03			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box): n See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0	unitless
Mammal diet fraction =	0.76	unitless
Bird diet fraction =	0.24	unitless
Soil ingestion rate =	0	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.059	kg/d
Body weight =	1.134	kg
Home range =	2081	acres
Water intake rate =	0.064	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	1.06E-03	unitless

TABLE F-26
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED FOXES AT SWMU 58 - CURRENT

Hazard Estimate - Tier 2
Red Fox

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert. BAF	Terr. Invert. BAF	Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL			
	Concentration	Units	Point Concentration	Units	Concentration	Units	unitless					mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d		mg/kg-d	mg/kg-d	EEQ N	mg/kg-d	mg/kg-d	EEQ L	
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.30E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.92E-07	NA	NA	9.35E-06	3.74E-06	2.23E-06	4.81E-07	1.60E-05	8	4.00E+00	5.00E-01	3.20E-05	4.00E+01	5.00E+00	3.20E-06
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	4.26E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	0.00E+00	0.00E+00	6.29E-05	NA	NA	2.88E-04	1.57E-05	4.83E-04	1.04E-04	9.54E-04	8	2.74E+03	3.43E+02	2.79E-06	1.37E+04	1.71E+03	5.57E-07
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	2.06E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	0.00E+00	0.00E+00	3.04E-05	NA	NA	1.26E-05	1.39E-06	7.08E-05	1.53E-05	1.31E-04	8	1.20E+00	1.50E-01	8.70E-04	6.00E+00	7.50E-01	1.74E-04
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	8.32E-02	mg/kg	NA	NA	5.72E+00	1.15E+00	1.90E-01	1.90E-01	0.00E+00	0.00E+00	1.23E-07	NA	NA	1.01E-06	8.64E-07	5.43E-07	1.17E-07	2.65E-06	8	1.00E+00	1.25E-01	2.12E-05	5.00E+00	6.25E-01	4.25E-06
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	4.10E-01	mg/kg	NA	NA	1.18E+00	4.63E-01	1.20E+00	1.20E+00	0.00E+00	0.00E+00	6.05E-07	NA	NA	1.02E-06	1.71E-06	1.69E-05	3.64E-06	2.39E-05	8	2.00E-01	2.50E-02	9.56E-04	3.00E-01	3.75E-02	6.37E-04
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	0.00E+00	0.00E+00	1.74E-05	NA	NA	3.00E-05	2.33E-07	4.87E-05	1.05E-05	1.07E-04	8	7.40E-03	9.25E-04	1.15E-01	7.40E-02	9.25E-03	1.15E-02
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	3.91E+01	mg/kg	NA	NA	7.28E+00	9.68E-01	2.70E+00	2.70E+00	0.00E+00	0.00E+00	5.77E-05	NA	NA	6.01E-04	3.40E-04	3.62E-03	7.81E-04	5.40E-03	8	1.60E+02	2.00E+01	2.70E-04	3.20E+02	4.00E+01	1.35E-04
Hazard Index (Total EEQ):																								1.2E-01		1.2E-02			

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical
A = Site Area
HR = Home Range
m = Total number of ingested media
i = counter
IRi = Consumption Rate for Medium
Cij = Chemical concentration (j) in medium (I) (mg/kg or mg/L)
BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR = 1.
Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.
BAF = Bioaccumulation Factor (may be BCF if this is the only value available)
EEQ = Ecological Effects Quotient.
L = LOAEL based; N = NOAEL based
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
NA = Not applicable/Not available
PDE = Predicted Daily Exposure
BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)
Some BAF (or BCF) values based on media regression equations (value in box):

n

 See appropriate text tables for equations.
If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.
LOAEL and NOAEL values from appropriate toxicity summary tables in the text.
UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF
A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.
Receptor diet data and home range data from appropriate text table.
Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.17	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.04	unitless
Mammal diet fraction =	0.65	unitless
Bird diet fraction =	0.14	unitless
Soil ingestion rate =	0.0067	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.24	kg/d
Body weight =	4.53	kg
Home range =	2204	acres
Water intake rate =	0.39	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	9.98E-04	unitless

TABLE F-27
TIER 2 CHEMICALS OF POTENTIAL CONCERN EEQs AND HAZARD INDICES FOR RED FOXES AT SWMU 58 - FUTURE

Hazard Estimate - Tier 2
Red Fox

Chemical	Surface Water Exposure Point	Sediment Exposure		Soil Exposure Point		Fish BAF	Aq. Invert.		Terr. Invert.		Plant BAF	Mammal BAF	Bird BAF	PDE Surface Water	PDE Sediment	PDE Soil	PDE Fish	PDE Aq. Invert.	PDE Terr. Invert.	PDE Plants	PDE Mammals	PDE Birds	Total PDE	Chemical-Specific Toxicity Value UF	NOAEL	Adjusted NOAEL	LOAEL	Adjusted LOAEL	EEQ N	EEQ L							
	Concentration	Units	Point Concentration	Units	Concentration		Units	BAF	BAF	mg/kg-d				mg/kg-d	mg/kg-d			mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d			mg/kg-d		mg/kg-d			mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d	mg/kg-d
	unitless																																				
Benzoic acid	0.00E+00	mg/L	0.0E+00	mg/kg	1.80E-01	mg/kg	NA	NA	3.40E+01	3.20E+00	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	2.66E-07	NA	NA	1.29E-05	5.18E-06	3.09E-06	6.66E-07	2.22E-05	8	4.00E+00	5.00E-01	4.43E-05	4.00E+01	5.00E+00	4.43E-06							
Cumene	0.00E+00	mg/L	0.0E+00	mg/kg	9.60E-02	mg/kg	NA	NA	3.60E+01	3.90E-01	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	1.42E-07	NA	NA	7.31E-06	3.37E-07	1.65E-06	3.55E-07	9.79E-06	8	1.40E+01	1.75E+00	5.60E-06	7.00E+01	8.75E+00	1.12E-06							
Cymene	0.00E+00	mg/L	0.0E+00	mg/kg	4.40E-02	mg/kg	NA	NA	3.70E+01	1.90E-01	5.00E-01	5.00E-01	5.00E-01	0.00E+00	0.00E+00	6.50E-08	NA	NA	3.44E-06	7.52E-08	7.56E-07	1.63E-07	4.50E-06	8	4.75E+01	5.94E+00	7.58E-07	2.38E+02	2.98E+01	1.51E-07							
Chromium	0.00E+00	mg/L	0.0E+00	mg/kg	3.71E+01	mg/kg	NA	NA	3.20E+00	4.10E-02	3.30E-01	3.30E-01	3.30E-01	0.00E+00	0.00E+00	5.48E-05	NA	NA	2.51E-04	1.37E-05	4.21E-04	9.06E-05	8.31E-04	8	2.74E+03	3.43E+02	2.43E-06	1.37E+04	1.71E+03	4.85E-07							
Cobalt	0.00E+00	mg/L	0.0E+00	mg/kg	1.70E+01	mg/kg	NA	NA	2.90E-01	7.50E-03	1.00E-01	1.00E-01	1.00E-01	0.00E+00	0.00E+00	2.51E-05	NA	NA	1.04E-05	1.15E-06	5.84E-05	1.26E-05	1.08E-04	8	1.20E+00	1.50E-01	7.18E-04	6.00E+00	7.50E-01	1.44E-04							
Mercury	0.00E+00	mg/L	0.0E+00	mg/kg	7.45E-02	mg/kg	NA	NA	6.16E+00	1.21E+00	1.90E-01	1.90E-01	1.90E-01	0.00E+00	0.00E+00	1.10E-07	NA	NA	9.71E-07	8.14E-07	4.87E-07	1.05E-07	2.49E-06	8	1.00E+00	1.25E-01	1.99E-05	5.00E+00	6.25E-01	3.98E-06							
Selenium	0.00E+00	mg/L	0.0E+00	mg/kg	3.37E-01	mg/kg	NA	NA	1.24E+00	4.54E-01	1.20E+00	1.20E+00	1.20E+00	0.00E+00	0.00E+00	4.98E-07	NA	NA	8.87E-07	1.38E-06	1.39E-05	2.99E-06	1.97E-05	8	2.00E-01	2.50E-02	7.86E-04	3.00E-01	3.75E-02	5.24E-04							
Thallium	0.00E+00	mg/L	0.0E+00	mg/kg	1.18E+01	mg/kg	NA	NA	1.20E+00	2.20E-03	1.20E-01	1.20E-01	1.20E-01	0.00E+00	0.00E+00	1.74E-05	NA	NA	3.00E-05	2.33E-07	4.87E-05	1.05E-05	1.07E-04	8	7.40E-03	9.25E-04	1.15E-01	7.40E-02	9.25E-03	1.15E-02							
Zinc	0.00E+00	mg/L	0.0E+00	mg/kg	4.67E+01	mg/kg	NA	NA	6.45E+00	8.95E-01	2.70E+00	2.70E+00	2.70E+00	0.00E+00	0.00E+00	6.89E-05	NA	NA	6.38E-04	3.76E-04	4.33E-03	9.34E-04	6.35E-03	8	1.60E+02	2.00E+01	3.17E-04	3.20E+02	4.00E+01	1.59E-04							
Hazard Index (Total EEQ):																										1.2E-01		1.2E-02									

Intake Equation:

$$E_j = \left(\frac{A}{HR} \left[\sum_{i=1}^m \left(\frac{IR_i \times C_{ij}}{BW} \right) \right] \right)$$

Where:

Ej = Total Exposure to Chemical

A = Site Area

HR = Home Range

m = Total number of ingested media

i = counter

IRi = Consumption Rate for Medium

Cij = Chemical concentration (j) in medium (i) (mg/kg or mg/L)

BW = Body Weight

Notes:

Tier 1 = Max EEQ using max EPC, max BAF/BCF, max Intake Rates, min BW, and FHR =1.

Tier 2 = EEQ using 95% EPC, non-max BAF/BCF, avg Intake Rates, avg BW and calculated FHR.

BAF = Bioaccumulation Factor (may be BCF if this is the only value available)

EEQ = Ecological Effects Quotient.

L = LOAEL based; N = NOAEL based

LOAEL = Lowest Observed Adverse Effect Level

NOAEL = No Observed Adverse Effect Level

NA = Not applicable/Not available

PDE = Predicted Daily Exposure

BAF (or BCF) values from appropriate text tables (BCF = bioconcentration factor)

Some BAF (or BCF) values based on media regression equations (value in box):

n See appropriate text tables for equations.

If BAF/BCF regression equation produced Tier 2 value exceeding maximum Tier 1 BAF/BCF value, Tier 1 value used as default.

LOAEL and NOAEL values from appropriate toxicity summary tables in the text.

UF = Uncertainty Factor for toxicity factor extrapolation, and Adjusted LOAEL or NOAEL = LOAEL/UF or NOAEL/UF

A "0" entry in the exposure concentration column indicates this chemical not selected as a COPEC for this medium.

Receptor diet data and home range data from appropriate text table.

Exposure point concentrations (EPCs) from appropriate text tables.

Species-Specific Factors

Plant diet fraction =	0.17	unitless
Fish diet fraction =	0	unitless
Aq. Invert diet fraction =	0	unitless
Terr. Invert diet fraction =	0.04	unitless
Mammal diet fraction =	0.65	unitless
Bird diet fraction =	0.14	unitless
Soil ingestion rate =	0.0067	kg/d
Sediment ingestion rate =	0	kg/d
Food ingestion rate =	0.24	kg/d
Body weight =	4.53	kg
Home range =	2204	acres
Water intake rate =	0.39	L/d
Site Area =	2.2	acres
Frac. home range (FHR) =	9.98E-04	unitless

Table F-28
Selection of Ecological Soil Screening Toxicity Values for Non-Detect Constituents

Parameter	Ecological Soil Screening Levels ^a (mg/kg)	Ecological Preliminary Remediation Goals ^b (mg/kg)	Ecological Data Quality Levels ^c (mg/kg)	Other Ecological Soil Screening Levels ^d (mg/kg)	Selected Ecological Screening Toxicity Value ^e (mg/kg)
1,1,1,2-Tetrachloroethane	NVA	NVA	225	--	225
1,1,1-Trichloroethane	NVA	NVA	29.8	--	29.8
1,1,2,2-Tetrachloroethane	NVA	NVA	0.12722	--	0.12722
1,1,2-Trichloroethane	NVA	NVA	28.6	--	28.6
1,1-Dichloroethane	NVA	NVA	20.1	--	20.1
1,1-Dichloroethene	NVA	NVA	8.28	--	8.28
1,1-Dichloropropene	NVA	NVA	NVA	NVA	NVA
1,2,3-Trichlorobenzene	NVA	20(earthworm)	NVA	--	20
1,2,3-Trichloropropane	NVA	NVA	3.36	--	3.36
1,2,4-Trichlorobenzene	NVA	20(earthworm)	11.1	--	20
1,2,4-Trimethylbenzene	NVA	NVA	NVA	NVA	NVA
1,2-Dibromo-3-chloropropane	NVA	NVA	0.03518	--	0.03518
1,2-Dibromoethane	NVA	NVA	1.23	--	1.23
1,2-Dichlorobenzene	NVA	NVA	2.96	--	2.96
1,2-Dichloroethane	NVA	NVA	21.2	--	21.2
1,2-Dichloroethene (total)	NVA	NVA	0.78373	--	0.78373
1,2-Dichloropropane	NVA	NVA	32.7	--	32.7
1,2-Diphenylhydrazine	NVA	NVA	NVA	NVA	NVA
1,3,5-Trimethylbenzene	NVA	NVA	NVA	NVA	NVA
1,3,5-Trinitrobenzene	NVA	NVA	0.37615	--	0.37615
1,3-Dichlorobenzene	NVA	NVA	37.7	--	37.7
1,3-Dichloropropane	NVA	NVA	NVA	NVA	NVA
1,3-Dinitrobenzene	NVA	NVA	0.6547	--	0.6547
1,4-Dichlorobenzene	NVA	20(earthworm)	0.54559	--	20
2,2-Dichloropropane	NVA	NVA	NVA	NVA	NVA
2,4,5-T	NVA	NVA	0.59634	--	0.59634
2,4,5-TP (Silvex)	NVA	NVA	0.1088	--	0.1088
2,4,5-Trichlorophenol	NVA	9(earthworm)	14.1	--	9
2,4,6-Trichlorophenol	NVA	4(plant)	9.94	--	4
2,4,6-Trinitrotoluene	NVA	NVA	NVA	0.7 ^f	0.7
2,4-D	NVA	NVA	0.02725	--	0.02725
2,4-DB	NVA	NVA	NVA	NVA	NVA
2,4-Dichlorophenol	NVA	NVA	87.5	--	87.5
2,4-Dimethylphenol	NVA	NVA	0.01	--	0.01
2,4-Dinitrophenol	NVA	20(plant)	0.06086	--	20
2,4-Dinitrotoluene	NVA	NVA	1.28	--	1.28
2,6-Dinitrotoluene	NVA	NVA	0.03283	--	0.03283
2-amino-4,6-Dinitrotoluene	NVA	NVA	NVA	5.3	5.3
2-Butanone	NVA	NVA	89.6	--	89.6
2-Chloroethyl vinyl ether	NVA	NVA	NVA	NVA	NVA
2-Chloronaphthalene	NVA	NVA	0.01218	--	0.01218
2-Chlorophenol	NVA	NVA	0.24266	--	0.24266
2-Chlorotoluene	NVA	NVA	NVA	NVA	NVA
2-Hexanone	NVA	NVA	12.6	--	12.6
2-Methylnaphthalene	NVA	NVA	3.24	--	3.24
2-Nitroaniline	NVA	NVA	74.1	--	74.1
2-Nitrophenol	NVA	NVA	1.6	--	1.6

Table F-28
Selection of Ecological Soil Screening Toxicity Values for Non-Detect Constituents

Parameter	Ecological Soil Screening Levels ^a (mg/kg)	Ecological Preliminary Remediation Goals ^b (mg/kg)	Ecological Data Quality Levels ^c (mg/kg)	Other Ecological Soil Screening Levels ^d (mg/kg)	Selected Ecological Screening Toxicity Value ^e (mg/kg)
2-Nitrotoluene	NVA	NVA	NVA	4.1	4.1
2-sec-butyl-4,6-dinitrophenol	NVA	NVA	0.0218	--	0.0218
3&4-Methylphenol	NVA	NVA	3.49	--	3.49
3,3'-Dichlorobenzidine	NVA	NVA	0.64636	--	0.64636
3-Nitroaniline	NVA	NVA	3.16	--	3.16
3-Nitrotoluene	NVA	NVA	NVA	5.3 ^f	5.3
4,4'-DDE	NVA	NVA	0.59587	--	0.59587
4,4'-DDT	NVA	NVA	0.0175	--	0.0175
4,6-Dinitro-o-cresol	NVA	NVA	0.14408	--	0.14408
4-amino-2,6-Dinitrotoluene	NVA	NVA	NVA	3.6 ^f	3.6
4-Bromophenyl phenylether	NVA	NVA	NVA	NVA	NVA
4-Chlorophenyl phenylether	NVA	NVA	NVA	NVA	NVA
4-Methyl-2-pentanone	NVA	NVA	443	--	443
4-Nitroaniline	NVA	NVA	21.9	--	21.9
4-Nitrophenol	NVA	7(earthworm)	5.12	--	7
4-Nitrotoluene	NVA	NVA	NVA	9.4	9.4
Acenaphthene	NVA	20(plant)	682	--	20
Acenaphthylene	NVA	NVA	682	--	682
Acetone	NVA	NVA	2.5	--	2.5
Acraldehyde	NVA	NVA	5.27	--	5.27
Acrylonitrile	NVA	NVA	0.02393	--	0.02393
Aldrin	NVA	NVA	0.00332	--	0.00332
alpha-BHC	NVA	NVA	0.09939	--	0.09939
Anthracene	NVA	NVA	1480	--	1480
Antimony	21(mammal)	5(plant)	0.1423	--	5
Aroclor 1016	NVA	0.371(mammal)	0.000332	--	0.371
Aroclor 1221	NVA	0.371(mammal)	0.000332	--	0.371
Aroclor 1232	NVA	0.371(mammal)	0.000332	--	0.371
Aroclor 1242	NVA	0.371(mammal)	0.000332	--	0.371
Aroclor 1248	NVA	0.371(mammal)	0.000332	--	0.371
Aroclor 1254	NVA	0.371(mammal)	0.000332	--	0.371
Aroclor 1260	NVA	0.371(mammal)	0.000332	--	0.371
Benzene	NVA	NVA	0.25462	--	0.25462
Benzoic Acid	NVA	NVA	NVA	7.3 ^f	7.3
Benzyl alcohol	NVA	NVA	65.8	--	65.8
beta-BHC	NVA	NVA	0.00398	--	0.00398
bis(2-Chloroethoxy)methane	NVA	NVA	0.30209	--	0.30209
bis(2-Chloroethyl)ether	NVA	NVA	23.7	--	23.7
bis(2-Chloroisopropyl)ether	NVA	NVA	19.9	--	19.9
bis(2-Ethylhexyl) phthalate	NVA	NVA	0.92594	--	0.92594
Bromobenzene	NVA	NVA	NVA	NVA	NVA
Bromodichloromethane	NVA	NVA	0.53978	--	0.53978
Bromomethane	NVA	NVA	0.23516	--	0.23516
Butyl benzyl phthalate	NVA	NVA	0.23889	--	0.23889
Cadmium	29(plant)	4(plant, bird)	0.00222	--	4
Carbazole	NVA	NVA	NVA	NVA	NVA

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Table F-28
Selection of Ecological Soil Screening Toxicity Values for Non-Detect Constituents

Parameter	Ecological Soil Screening Levels ^a (mg/kg)	Ecological Preliminary Remediation Goals ^b (mg/kg)	Ecological Data Quality Levels ^c (mg/kg)	Other Ecological Soil Screening Levels ^d (mg/kg)	Selected Ecological Screening Toxicity Value ^e (mg/kg)
Carbon disulfide	NVA	NVA	0.09412	--	0.09412
Carbon tetrachloride	NVA	NVA	2.98	--	2.98
Chlorobenzene	NVA	40(earthworm)	13.1	--	40
Chlorobromomethane	NVA	NVA	NVA	NVA	NVA
Chloroethane	NVA	NVA	NVA	NVA	NVA
Chloromethane	NVA	NVA	10.4	--	10.4
cis-1,2-Dichloroethene	NVA	NVA	0.78373	--	0.78373
cis-1,3-Dichloro-1-propene	NVA	NVA	0.39786	--	0.39786
Cyclonite	5.8(mammal)	NVA	NVA	--	5.8
Dalapon	NVA	NVA	NVA	NVA	NVA
Dibenz(a,h)anthracene	NVA	NVA	18.4	--	18.4
Dibenzofuran	NVA	NVA	NVA	6.1 ^f	6.1
Dibromochloromethane	NVA	NVA	2.05	--	2.05
Dibromomethane	NVA	NVA	65	--	65
Dicamba	NVA	NVA	NVA	NVA	NVA
Dichlorodifluoromethane	NVA	NVA	39.5	--	39.5
Dichloroprop	NVA	NVA	NVA	NVA	NVA
Diethyl phthalate	NVA	100(plant)	24.8	--	100
Dimethylphthalate	NVA	NVA	734	--	734
Di-n-butyl phthalate	NVA	200(plant)	0.14979	--	200
Di-n-octyl phthalate	NVA	NVA	709	--	709
Endosulfan I	NVA	NVA	0.11927	--	0.11927
Endosulfan II	NVA	NVA	0.11927	--	0.11927
Endosulfan sulfate	NVA	NVA	0.03578	--	0.03578
Endrin	NVA	NVA	0.0101	--	0.0101
Endrin aldehyde	NVA	NVA	0.0105	--	0.0105
Endrin ketone	NVA	NVA	NVA	NVA	NVA
Ethylbenzene	NVA	NVA	5.16	--	5.16
Fluorene	NVA	NVA	122	--	122
gamma-BHC (Lindane)	NVA	NVA	0.005	--	0.005
gamma-Chlordane	NVA	NVA	0.224	--	0.224
Heptachlor	NVA	NVA	0.00598	--	0.00598
Heptachlor epoxide	NVA	NVA	0.15188	--	0.15188
Hexachlorobenzene	NVA	NVA	0.19878	--	0.19878
Hexachlorobutadiene	NVA	NVA	0.03976	--	0.03976
Hexachlorocyclopentadiene	NVA	10(plant)	0.75537	--	10
Hexachloroethane	NVA	NVA	0.59634	--	0.59634
HMX	NVA	NVA	NVA	43	43
Isophorone	NVA	NVA	139	--	139
m+p-Xylenes	NVA	NVA	10	--	10
MCPA	NVA	NVA	NVA	NVA	NVA
MCPP	NVA	NVA	NVA	NVA	NVA
Methoxychlor	NVA	NVA	0.01988	--	0.01988
Methylene chloride	NVA	NVA	4.05	--	4.05
Naphthalene	NVA	NVA	0.09939	--	0.09939
n-Butylbenzene	NVA	NVA	NVA	NVA	NVA
Nitrobenzene	NVA	NVA	1.31	--	1.31

Table F-28
Selection of Ecological Soil Screening Toxicity Values for Non-Detect Constituents

Parameter	Ecological Soil Screening Levels ^a (mg/kg)	Ecological Preliminary Remediation Goals ^b (mg/kg)	Ecological Data Quality Levels ^c (mg/kg)	Other Ecological Soil Screening Levels ^d (mg/kg)	Selected Ecological Screening Toxicity Value ^e (mg/kg)
Nitroglycerin	NVA	NVA	NVA	150 ^f	150
n-Nitroso-di-n-propylamine	NVA	NVA	0.54368	--	0.54368
n-Nitrosodiphenylamine	NVA	NVA	0.54514	--	0.54514
n-Propylbenzene	NVA	NVA	NVA	NVA	NVA
o-Cresol	NVA	NVA	40.4	--	40.4
o-Xylene	NVA	NVA	10	--	10
p-Chloroaniline	NVA	NVA	1.1	--	1.1
p-Chloro-m-cresol	NVA	NVA	7.95	--	7.95
p-Chlorotoluene	NVA	NVA	NVA	NVA	NVA
p-Cresol	NVA	NVA	163	--	163
Pentachlorophenol	NVA	3(plant)	0.11927	--	3
Pentaerythritol tetranitrate (PETN)	NVA	NVA	NVA	14,000 ^f	14000
Phenol	NVA	30(earthworm)	120	--	30
Pyridine	NVA	NVA	1.03	--	1.03
sec-Butylbenzene	NVA	NVA	NVA	NVA	NVA
Silver	NVA	2(plant)	4.04	--	2
Sodium	NVA	NVA	NVA	NVA	Nutrient
Styrene	NVA	300(plant)	4.69	--	300
tert-Butylbenzene	NVA	NVA	NVA	NVA	NVA
Tetrachloroethene	NVA	NVA	9.92	--	9.92
Tetryl	NVA	NVA	NVA	2 ^f	2
Toluene	NVA	200(plant)	5.45	--	200
Toxaphene	NVA	NVA	0.11927	--	0.11927
trans-1,2-Dichloroethene	NVA	NVA	0.78373	--	0.78373
trans-1,3-Dichloropropene	NVA	NVA	0.39786	--	0.39786
Tribromomethane	NVA	NVA	15.9	--	15.9
Trichloroethene	NVA	NVA	12.4	--	12.4
Trichlorofluoromethane	NVA	NVA	16.4	--	16.4
Trichloromethane	NVA	NVA	1.19	--	1.19
Vinyl acetate	NVA	NVA	12.7	--	12.7
Vinyl Chloride	NVA	NVA	0.64614	--	0.64614
Xylenes (total)	NVA	NVA	10	--	10

^a Ecological Soil Screening Level Guidance, U.S.EPA, July 2000, Draft.

^b Preliminary Remediation Goals for Ecological Endpoints, R. A. Efroymson, et. al., August 1997.

^c Ecological Data Quality Levels, U.S.EPA Region 5, October 1999.

^d Los Alamos National Laboratory, 2002, Environmental Restoration Project, Environmental Screening Levels, Release 1.5, September.

^e The following hierarchy was utilized to select the final Ecological Screening Toxicity Values for this assessment:

1. The lower value of either the Ecological Soil Screening Level Guidance or the Preliminary Remediation Goals for Ecological Endpoints.
2. Ecological Data Quality Levels, U.S.EPA Region 5

^f Value is from Los Alamos

NVA = No Value Available

Table F-29
Summary of Screening for Non-Detect Chemicals - Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0-2')	99-35-4	1,3,5-Trinitrobenzene			mg/kg		0/2	0.1000-0.1000	1.00E-01	3.76E-01	NVA	N	BSL
	99-65-0	1,3-Dinitrobenzene			mg/kg		0/2	0.1000-0.1000	1.00E-01	6.55E-01	NVA	N	BSL
	118-96-7	2,4,6-Trinitrotoluene			mg/kg		0/2	0.2000-0.2000	2.00E-01	7.00E-01	NVA	N	BSL
	35572-78-2	2-amino-4,6-Dinitrotoluene			mg/kg		0/2	0.2000-0.2000	2.00E-01	5.30E+00	NVA	N	BSL
	88-72-2	2-Nitrotoluene			mg/kg		0/2	0.4000-0.4000	4.00E-01	4.10E+00	NVA	N	BSL
	99-08-1	3-Nitrotoluene			mg/kg		0/2	0.4000-0.4000	4.00E-01	5.30E+00	NVA	N	BSL
	19406-51-0	4-amino-2,6-Dinitrotoluene			mg/kg		0/2	0.2000-0.2000	2.00E-01	3.60E+00	NVA	N	BSL
	99-99-0	4-Nitrotoluene			mg/kg		0/2	0.4000-0.4000	4.00E-01	9.40E+00	NVA	N	BSL
	100-51-6	Benzyl alcohol			mg/kg		0/5	0.1900-10.0000	1.00E+01	6.58E+01	NVA	N	BSL
	156-59-2	cis-1,2-Dichloroethene			mg/kg		0/2	0.0050-0.0051	5.10E-03	7.84E-01	0.3	N	BSL
	121-82-4	Cyclonite			mg/kg		0/2	0.2000-0.2000	2.00E-01	5.80E+00	NVA	N	BSL
	2691-41-0	HMX			mg/kg		0/2	0.2000-0.2000	2.00E-01	4.30E+01	NVA	N	BSL
	ICP87	m+p-Xylenes			mg/kg		0/2	0.0100-0.0100	1.00E-02	1.00E+01	0.1	N	BSL
	55-63-0	Nitroglycerin			mg/kg		0/2	0.3340-0.3400	3.40E-01	1.50E+02	NVA	N	BSL
	95-47-6	o-Xylene			mg/kg		0/2	0.0050-0.0051	5.10E-03	1.00E+01	0.1	N	BSL
	78-11-5	Penterythritol tetranitrate (PETN)			mg/kg		0/2	0.3340-0.3400	3.40E-01	1.40E+04	NVA	N	NTX
	110-86-1	Pyridine			mg/kg		0/2	0.1900-0.1900	1.90E-01	1.03E+00	NVA	N	BSL
	479-45-8	Tetryl			mg/kg		0/2	0.2000-0.2000	2.00E-01	2.00E+00	NVA	N	BSL
	156-60-5	trans-1,2-Dichloroethene			mg/kg		0/2	0.0050-0.0051	5.10E-03	7.84E-01	0.3	N	BSL
	75-69-4	Trichlorofluoromethane			mg/kg		0/3	0.0060-0.0060	6.00E-03	1.64E+01	NVA	N	BSL
	108-05-4	Vinyl acetate			mg/kg		0/3	0.0030-0.0030	3.00E-03	1.27E+01	NVA	N	BSL
	7440-36-0	Antimony			mg/kg		0/4	0.5670-7.1400	7.14E+00	5.00E+00	NVA	Y	ASL
	7440-43-9	Cadmium			mg/kg		0/5	0.1110-0.7000	7.00E-01	4.00E+00	NVA	N	BSL
	7440-22-4	Silver			mg/kg		0/5	0.5890-1.1300	1.13E+00	2.00E+00	NVA	N	BSL
	7440-23-5	Sodium			mg/kg		0/5	15.0000-188.0000	1.88E+02	NVA	NVA	N	NTX
	93-76-5	2,4,5-T			mg/kg		0/2	0.1110-0.1130	1.13E-01	5.96E-01	NVA	N	BSL
	93-72-1	2,4,5-TP (Silvex)			mg/kg		0/2	0.1110-0.1130	1.13E-01	1.09E-01	NVA	Y	ASL
	94-75-7	2,4-D			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.73E-02	NVA	Y	ASL
	94-82-6	2,4-DB			mg/kg		0/2	1.1100-1.1300	1.13E+00	NVA	NVA	N	NTX
	72-55-9	4,4'-DDE			mg/kg		0/2	0.0007-0.0008	7.56E-04	5.96E-01	0.1	N	BSL
	50-29-3	4,4'-DDT			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.75E-02	0.1	N	BSL
	309-00-2	Aldrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.32E-03	0.1	N	BSL
	319-84-6	alpha-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	9.94E-02	NVA	N	BSL
	319-85-7	beta-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.98E-03	NVA	N	BSL
	75-99-0	Dalapon			mg/kg		0/2	1.1100-1.1300	1.13E+00	NVA	NVA	N	NTX

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Table F-29
Summary of Screening for Non-Detect Chemicals - Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	1918-00-9	Dicamba			mg/kg		0/2	0.2220-0.2270	2.27E-01	NVA	NVA	N	NTX
	120-36-5	Dichloroprop			mg/kg		0/2	0.2220-0.2270	2.27E-01	NVA	NVA	N	NTX
	959-98-8	Endosulfan I			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.19E-01	NVA	N	BSL
	33213-65-9	Endosulfan II			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.19E-01	NVA	N	BSL
	1031-07-8	Endosulfan sulfate			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.58E-02	NVA	N	BSL
	72-20-8	Endrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.01E-02	0.1	N	BSL
	7421-93-4	Endrin aldehyde			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.05E-02	0.1	N	BSL
	53494-70-5	Endrin ketone			mg/kg		0/2	0.0007-0.0008	7.56E-04	NVA	NVA	N	NTX
	58-89-9	gamma-BHC (Lindane)			mg/kg		0/2	0.0007-0.0008	7.56E-04	5.00E-03	0.1	N	BSL
	5103-74-2	gamma-Chlordane			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.24E-01	0.1	N	BSL
	76-44-8	Heptachlor			mg/kg		0/2	0.0007-0.0008	7.56E-04	5.98E-03	NVA	N	BSL
	1024-57-3	Heptachlor epoxide			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.52E-01	0.1	N	BSL
	94-74-6	MCPA			mg/kg		0/4	111.0000-113.0000	1.13E+02	NVA	NVA	N	NTX
	93-65-2	MCPP			mg/kg		0/2	111.0000-113.0000	1.13E+02	NVA	NVA	N	NTX
	72-43-5	Methoxychlor			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.99E-02	0.1	N	BSL
	8001-35-2	Toxaphene			mg/kg		0/2	0.0370-0.0378	3.78E-02	1.19E-01	NVA	N	BSL
	12674-11-2	Aroclor 1016			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.71E-01	0.1	N	BSL
	11104-28-2	Aroclor 1221			mg/kg		0/2	0.0742-0.0756	7.56E-02	3.71E-01	0.1	N	BSL
	11141-16-5	Aroclor 1232			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.71E-01	0.1	N	BSL
	53469-21-9	Aroclor 1242			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.71E-01	0.1	N	BSL
	12672-29-6	Aroclor 1248			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.71E-01	0.1	N	BSL
	11097-69-1	Aroclor 1254			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.71E-01	NVA	N	BSL
	11096-82-5	Aroclor 1260			mg/kg		0/2	0.0370-0.0378	3.78E-02	3.71E-01	0.1	N	BSL
	131-11-3	Dimethylphthalate			mg/kg		0/5	0.1700-0.8000	8.00E-01	7.34E+02	NVA	N	BSL
	120-82-1	1,2,4-Trichlorobenzene			mg/kg		0/5	0.0400-0.2000	2.00E-01	2.00E+01	0.1	Y	ASL
	95-50-1	1,2-Dichlorobenzene			mg/kg		0/5	0.1100-0.6000	6.00E-01	2.96E+00	0.1	Y	ASL
	541-73-1	1,3-Dichlorobenzene			mg/kg		0/5	0.1300-0.6000	6.00E-01	3.77E+01	NVA	N	BSL
	106-46-7	1,4-Dichlorobenzene			mg/kg		0/5	0.0980-0.5000	5.00E-01	2.00E+01	0.1	Y	ASL
	95-95-4	2,4,5-Trichlorophenol			mg/kg		0/5	0.1000-0.5000	5.00E-01	9.00E+00	0.1	Y	ASL
	88-06-2	2,4,6-Trichlorophenol			mg/kg		0/5	0.1700-0.8000	8.00E-01	4.00E+00	0.1	Y	ASL
	120-83-2	2,4-Dichlorophenol			mg/kg		0/5	0.1800-0.9000	9.00E-01	8.75E+01	0.1	Y	ASL
	105-67-9	2,4-Dimethylphenol			mg/kg		0/5	0.1900-3.0000	3.00E+00	1.00E-02	0.1	Y	ASL
	51-28-5	2,4-Dinitrophenol			mg/kg		0/5	0.9300-6.0000	6.00E+00	2.00E+01	0.1	Y	ASL
	121-14-2	2,4-Dinitrotoluene			mg/kg		0/5	0.1400-0.7000	7.00E-01	1.28E+00	NVA	N	BSL
	606-20-2	2,6-Dinitrotoluene			mg/kg		0/5	0.0850-0.4000	4.00E-01	3.28E-02	NVA	Y	ASL

Table F-29
Summary of Screening for Non-Detect Chemicals - Current - Surface Soil at SWMU 58

Scenario Timeframe: Current

Medium: Soil

Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	91-58-7	2-Chloronaphthalene			mg/kg		0/5	0.0360-0.2000	2.00E-01	1.22E-02	NVA	Y	ASL
	95-57-8	2-Chlorophenol			mg/kg		0/5	0.0600-0.3000	3.00E-01	2.43E-01	0.1	Y	ASL
	91-57-6	2-Methylnaphthalene			mg/kg		0/3	0.0490-0.2000	2.00E-01	3.24E+00	NVA	N	BSL
	88-74-4	2-Nitroaniline			mg/kg		0/5	0.0620-0.3000	3.00E-01	7.41E+01	NVA	N	NTX
	88-75-5	2-Nitrophenol			mg/kg		0/5	0.1400-0.7000	7.00E-01	1.60E+00	NVA	N	NTX
	88-85-7	2-sec-butyl-4,6-dinitrophenol			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.18E-02	NVA	Y	ASL
	91-94-1	3,3'-Dichlorobenzidine			mg/kg		0/5	0.1900-30.0000	3.00E+01	6.46E-01	NVA	Y	ASL
	99-09-2	3-Nitroaniline			mg/kg		0/5	0.1900-2.0000	2.00E+00	3.16E+00	NVA	N	BSL
	534-52-1	4,6-Dinitro-o-cresol			mg/kg		0/5	0.5500-3.0000	3.00E+00	1.44E-01	NVA	Y	ASL
	100-01-6	4-Nitroaniline			mg/kg		0/5	0.1900-2.0000	2.00E+00	2.19E+01	NVA	N	BSL
	100-02-7	4-Nitrophenol			mg/kg		0/5	0.9300-7.0000	7.00E+00	7.00E+00	0.1	Y	ASL
	83-32-9	Acenaphthene			mg/kg		0/5	0.0019-0.2000	2.00E-01	2.00E+01	0.1	Y	ASL
	208-96-8	Acenaphthylene			mg/kg		0/5	0.0019-0.2000	2.00E-01	6.82E+02	0.1	Y	ASL
	120-12-7	Anthracene			mg/kg		0/5	0.0019-0.2000	2.00E-01	1.48E+03	0.1	Y	ASL
	65-85-0	Benzoic Acid			mg/kg		0/1	0.9400-0.9400	9.40E-01	7.30E+00	NVA	N	BSL
	111-91-1	bis(2-Chloroethoxy)methane			mg/kg		0/5	0.0590-0.3000	3.00E-01	3.02E-01	NVA	N	NTX
	111-44-4	bis(2-Chloroethyl)ether			mg/kg		0/5	0.0330-0.2000	2.00E-01	2.37E+01	NVA	N	BSL
	108-60-1	bis(2-Chloroisopropyl)ether			mg/kg		0/5	0.1900-1.0000	1.00E+00	1.99E+01	NVA	N	BSL
	117-81-7	bis(2-Ethylhexyl) phthalate			mg/kg		0/3	0.6200-3.0000	3.00E+00	9.26E-01	NVA	Y	ASL
	85-68-7	Butyl benzyl phthalate			mg/kg		0/5	0.1700-0.8000	8.00E-01	2.39E-01	NVA	Y	ASL
	86-74-8	Carbazole			mg/kg		0/2	0.1900-0.1900	1.90E-01	NVA	NVA	N	NTX
	84-74-2	Di-n-butyl phthalate			mg/kg		0/5	0.0610-0.3000	3.00E-01	2.00E+02	NVA	N	BSL
	117-84-0	Di-n-octyl phthalate			mg/kg		0/5	0.1900-10.0000	1.00E+01	7.09E+02	NVA	N	BSL
	53-70-3	Dibenz(a,h)anthracene			mg/kg		0/5	0.0019-1.0000	1.00E+00	1.84E+01	0.1	Y	ASL
	132-64-9	Dibenzofuran			mg/kg		0/5	0.0350-0.2000	2.00E-01	6.10E+00	NVA	N	BSL
	84-66-2	Diethyl phthalate			mg/kg		0/5	0.1900-1.0000	1.00E+00	1.00E+02	NVA	N	BSL
	86-73-7	Fluorene			mg/kg		0/5	0.0019-0.2000	2.00E-01	1.22E+02	0.1	Y	ASL
	118-74-1	Hexachlorobenzene			mg/kg		0/5	0.0330-0.2000	2.00E-01	1.99E-01	NVA	Y	ASL
	87-68-3	Hexachlorobutadiene			mg/kg		0/5	0.1900-1.0000	1.00E+00	3.98E-02	NVA	Y	ASL
	77-47-4	Hexachlorocyclopentadiene			mg/kg		0/5	0.1900-30.0000	3.00E+01	1.00E+01	NVA	Y	ASL
	67-72-1	Hexachloroethane			mg/kg		0/5	0.1500-0.8000	8.00E-01	5.96E-01	NVA	Y	ASL
	78-59-1	Isophorone			mg/kg		0/5	0.0330-0.2000	2.00E-01	1.39E+02	NVA	N	BSL
	621-64-7	n-Nitroso-di-n-propylamine			mg/kg		0/5	0.1900-1.0000	1.00E+00	5.44E-01	NVA	Y	ASL
	86-30-6	n-Nitrosodiphenylamine			mg/kg		0/5	0.1900-10.0000	1.00E+01	5.45E-01	NVA	Y	ASL
	91-20-3	Naphthalene			mg/kg		0/3	0.0370-0.2000	2.00E-01	9.94E-02	0.1	Y	ASL

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Table F-29
Summary of Screening for Non-Detect Chemicals - Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	98-95-3	Nitrobenzene			mg/kg		0/5	0.0450-0.2000	2.00E-01	1.31E+00	NVA	N	BSL
	95-48-7	o-Cresol			mg/kg		0/5	0.0290-0.1900	1.90E-01	4.04E+01	0.1	Y	ASL
	59-50-7	p-Chloro-m-cresol			mg/kg		0/5	0.0950-0.5000	5.00E-01	7.95E+00	NVA	N	NTX
	106-47-8	p-Chloroaniline			mg/kg		0/5	0.1900-4.0000	4.00E+00	1.10E+00	NVA	Y	ASL
	106-44-5	p-Cresol			mg/kg		0/5	0.1900-1.0000	1.00E+00	1.63E+02	0.1	Y	ASL
	87-86-5	Pentachlorophenol			mg/kg		0/5	0.9300-6.0000	6.00E+00	3.00E+00	0.1	Y	ASL
	108-95-2	Phenol			mg/kg		0/5	0.1100-0.6000	6.00E-01	3.00E+01	0.1	Y	ASL
	71-55-6	1,1,1-Trichloroethane			mg/kg		0/5	0.0040-0.0051	5.10E-03	2.98E+01	0.3	N	BSL
	79-34-5	1,1,2,2-Tetrachloroethane			mg/kg		0/5	0.0020-0.0051	5.10E-03	1.27E-01	0.3	N	BSL
	79-00-5	1,1,2-Trichloroethane			mg/kg		0/5	0.0050-0.0051	5.10E-03	2.86E+01	0.3	N	BSL
	75-34-3	1,1-Dichloroethane			mg/kg		0/5	0.0020-0.0051	5.10E-03	2.01E+01	0.3	N	BSL
	75-35-4	1,1-Dichloroethene			mg/kg		0/5	0.0040-0.0051	5.10E-03	8.28E+00	NVA	N	BSL
	107-06-2	1,2-Dichloroethane			mg/kg		0/5	0.0020-0.0051	5.10E-03	2.12E+01	870	N	BSL
	540-59-0	1,2-Dichloroethene (total)			mg/kg		0/2	0.0030-0.0030	3.00E-03	7.84E-01	0.3	N	BSL
	78-87-5	1,2-Dichloropropane			mg/kg		0/5	0.0030-0.0051	5.10E-03	3.27E+01	NVA	N	BSL
	78-93-3	2-Butanone			mg/kg		0/5	0.0050-0.0700	7.00E-02	8.96E+01	NVA	N	BSL
	591-78-6	2-Hexanone			mg/kg		0/5	0.0050-0.0320	3.20E-02	1.26E+01	NVA	N	BSL
	101-55-3	4-Bromophenyl phenylether			mg/kg		0/5	0.0330-0.2000	2.00E-01	NVA	NVA	N	NTX
	7005-72-3	4-Chlorophenyl phenylether			mg/kg		0/5	0.0330-0.2000	2.00E-01	NVA	NVA	N	NTX
	108-10-1	4-Methyl-2-pentanone			mg/kg		0/5	0.0050-0.0270	2.70E-02	4.43E+02	100	N	BSL
	67-64-1	Acetone			mg/kg		0/5	0.0050-0.0170	1.70E-02	2.50E+00	NVA	N	BSL
	71-43-2	Benzene			mg/kg		0/5	0.0020-0.0051	5.10E-03	2.55E-01	0.1	N	BSL
	75-27-4	Bromodichloromethane			mg/kg		0/5	0.0030-0.0051	5.10E-03	5.40E-01	450	N	BSL
	74-83-9	Bromomethane			mg/kg		0/5	0.0050-0.0060	6.00E-03	2.35E-01	NVA	N	BSL
	75-15-0	Carbon disulfide			mg/kg		0/5	0.0040-0.0051	5.10E-03	9.41E-02	NVA	N	BSL
	56-23-5	Carbon tetrachloride			mg/kg		0/5	0.0050-0.0070	7.00E-03	2.98E+00	0.3	N	BSL
	108-90-7	Chlorobenzene			mg/kg		0/5	0.0010-0.0051	5.10E-03	4.00E+01	0.1	N	BSL
	75-00-3	Chloroethane			mg/kg		0/5	0.0050-0.0120	1.20E-02	NVA	NVA	N	NTX
	74-87-3	Chloromethane			mg/kg		0/5	0.0050-0.0090	9.00E-03	1.04E+01	NVA	N	NTX
	10061-01-5	cis-1,3-Dichloro-1-propene			mg/kg		0/5	0.0030-0.0051	5.10E-03	3.98E-01	0.3	N	BSL
	124-48-1	Dibromochloromethane			mg/kg		0/5	0.0030-0.0051	5.10E-03	2.05E+00	NVA	N	BSL
	100-41-4	Ethylbenzene			mg/kg		0/5	0.0020-0.0051	5.10E-03	5.16E+00	0.1	N	BSL
	75-09-2	Methylene chloride			mg/kg		0/5	0.0050-0.0120	1.20E-02	4.05E+00	0.3	N	BSL
	100-42-5	Styrene			mg/kg		0/5	0.0030-0.0051	5.10E-03	3.00E+02	0.1	N	BSL
	127-18-4	Tetrachloroethene			mg/kg		0/5	0.0010-0.0051	5.10E-03	9.92E+00	0.3	N	BSL

Table F-29
Summary of Screening for Non-Detect Chemicals - Current - Surface Soil at SWMU 58

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	108-88-3	Toluene			mg/kg		0/5	0.0010-0.0051	5.10E-03	2.00E+02	0.1	N	BSL
	10061-02-6	trans-1,3-Dichloropropene			mg/kg		0/5	0.0030-0.0051	5.10E-03	3.98E-01	0.3	N	BSL
	75-25-2	Tribromomethane			mg/kg		0/5	0.0050-0.0070	7.00E-03	1.59E+01	1470	N	BSL
	79-01-6	Trichloroethene			mg/kg		0/5	0.0030-0.0051	5.10E-03	1.24E+01	0.3	N	BSL
	67-66-3	Trichloromethane			mg/kg		0/5	0.0010-0.0051	5.10E-03	1.19E+00	0.3	N	BSL
	75-01-4	Vinyl Chloride			mg/kg		0/5	0.0050-0.0060	6.00E-03	6.46E-01	0.3	N	BSL
	1330-20-7	Xylenes (total)			mg/kg		0/3	0.0020-0.0020	2.00E-03	1.00E+01	0.1	N	BSL

- (1) Maximum non-detect limit value used for screening.
- (2) Screening toxicity values from USEPA SSLs (2000); Efroymson et al., PRGs (1997); and USEPA Region V EDQLs (1999); and other sources. See text for derivation. Region 3 BTAG Screening Levels (1995) have also been utilized.
- (3) Reasons for Selection:
ASL = Above Screening Level
Reasons for Deletion:
BSL = Below Screening Level
NTX = No Toxicity Data

Definitions: N/A = Not Applicable or Not Available
NVA = No Value Available
N = No
Y = Yes

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Table F-30
Summary of Screening for Non-Detect Chemicals - Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
Surface Soil (0 - 2')	563-58-6	1,1-Dichloropropene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	87-61-6	1,2,3-Trichlorobenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	2.00E+01	1.00E-01	Yes	ASL
	96-18-4	1,2,3-Trichloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.36E+00	NVA	No	BSL
	95-63-6	1,2,4-Trimethylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	96-12-8	1,2-Dibromo-3-chloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.52E-02	NVA	Yes	ASL
	106-93-4	1,2-Dibromoethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	1.23E+00	NVA	No	BSL
	122-66-7	1,2-Diphenylhydrazine			mg/kg		0/3	0.4000-0.4050	4.05E-01	NVA	NVA	No	NTX
	108-67-8	1,3,5-Trimethylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	99-35-4	1,3,5-Trinitrobenzene			mg/kg		0/3	0.1000-0.1000	1.00E-01	3.76E-01	NVA	No	BSL
	142-28-9	1,3-Dichloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	99-65-0	1,3-Dinitrobenzene			mg/kg		0/3	0.1000-0.1000	1.00E-01	6.55E-01	NVA	No	BSL
	590-20-7	2,2-Dichloropropane			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	118-96-7	2,4,6-Trinitrotoluene			mg/kg		0/3	0.2000-0.2000	2.00E-01	7.00E-01	NVA	No	BSL
	35572-78-2	2-amino-4,6-Dinitrotoluene			mg/kg		0/3	0.2000-0.2000	2.00E-01	5.30E+00	NVA	No	BSL
	110-75-8	2-Chloroethyl vinyl ether			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	95-49-8	2-Chlorotoluene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	88-72-2	2-Nitrotoluene			mg/kg		0/3	0.4000-0.4000	4.00E-01	4.10E+00	NVA	No	BSL
	Shaw 02	3&4-Methylphenol			mg/kg		0/2	0.4000-0.4050	4.05E-01	3.49E+00	1.00E-01	Yes	ASL
	99-08-1	3-Nitrotoluene			mg/kg		0/3	0.4000-0.4000	4.00E-01	5.30E+00	NVA	No	BSL
	19406-51-0	4-amino-2,6-Dinitrotoluene			mg/kg		0/3	0.2000-0.2000	2.00E-01	3.60E+00	NVA	No	BSL
	99-99-0	4-Nitrotoluene			mg/kg		0/3	0.4000-0.4000	4.00E-01	9.40E+00	NVA	No	BSL
	107-02-8	Acetaldehyde			mg/kg		0/3	0.0060-0.7650	7.65E-01	5.27E+00	NVA	No	BSL
	107-13-1	Acrylonitrile			mg/kg		0/3	0.0060-0.7650	7.65E-01	2.39E-02	NVA	Yes	ASL
	100-51-6	Benzyl alcohol			mg/kg		0/9	0.1900-10.0000	1.00E+01	6.58E+01	NVA	No	BSL
	108-86-1	Bromobenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	74-97-5	Chlorobromomethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	3.00E+03	No	BSL
	121-82-4	Cyclonite			mg/kg		0/3	0.2000-0.2000	2.00E-01	5.80E+00	NVA	No	BSL
	74-95-3	Dibromomethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	6.50E+01	NVA	No	BSL
	75-71-8	Dichlorodifluoromethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	3.95E+01	NVA	No	BSL
	2691-41-0	HMX			mg/kg		0/3	0.2000-0.2000	2.00E-01	4.30E+01	NVA	No	BSL
	104-51-8	n-Butylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	103-65-1	n-Propylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	55-63-0	Nitroglycerin			mg/kg		0/3	0.3340-0.3430	3.43E-01	1.50E+02	NVA	No	BSL
	95-47-6	o-Xylene			mg/kg		0/6	0.0050-0.7650	7.65E-01	1.00E+01	1.00E-01	Yes	ASL
	106-43-4	p-Chlorotoluene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	78-11-5	Pentaerythritol tetranitrate			mg/kg		0/3	0.3340-0.3430	3.43E-01	1.40E+04	NVA	No	BSL

Table F-30
Summary of Screening for Non-Detect Chemicals - Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	110-86-1	Pyridine			mg/kg		0/3	0.1900-0.1900	1.90E-01	1.03E+00	NVA	No	BSL
	135-98-8	sec-Butylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	98-06-6	tert-Butylbenzene			mg/kg		0/3	0.0060-0.7650	7.65E-01	NVA	NVA	No	NTX
	479-45-8	Tetral			mg/kg		0/3	0.2000-0.2000	2.00E-01	2.00E+00	NVA	No	BSL
	156-60-5	trans-1,2-Dichloroethene			mg/kg		0/6	0.0050-0.7650	7.65E-01	7.84E-01	3.00E-01	Yes	ASL
	75-69-4	Trichlorofluoromethane			mg/kg		0/6	0.0060-0.7650	7.65E-01	1.64E+01	NVA	No	BSL
	108-05-4	Vinyl acetate			mg/kg		0/6	0.0030-0.7650	7.65E-01	1.27E+01	NVA	No	BSL
	7440-43-9	Cadmium			mg/kg		0/9	0.1110-0.7000	7.00E-01	4.00E+00	NVA	No	BSL
	7440-22-4	Silver			mg/kg		0/9	0.2300-1.1300	1.13E+00	2.00E+00	NVA	No	BSL
	93-76-5	2,4,5-T			mg/kg		0/2	0.1110-0.1130	1.13E-01	5.96E-01	NVA	No	BSL
	93-72-1	2,4,5-TP (Silvex)			mg/kg		0/2	0.1110-0.1130	1.13E-01	1.09E-01	NVA	Yes	ASL
	94-75-7	2,4-D			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.73E-02	NVA	Yes	ASL
	94-82-6	2,4-DB			mg/kg		0/2	1.1100-1.1300	1.13E+00	NVA	NVA	No	NTX
	72-55-9	4,4'-DDE			mg/kg		0/2	0.0007-0.0008	7.56E-04	5.96E-01	1.00E-01	No	BSL
	50-29-3	4,4'-DDT			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.75E-02	1.00E-01	No	BSL
	309-00-2	Aldrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.32E-03	1.00E-01	No	BSL
	319-84-6	alpha-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	9.94E-02	NVA	No	BSL
	319-85-7	beta-BHC			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.98E-03	NVA	No	BSL
	75-99-0	Dalapon			mg/kg		0/2	1.1100-1.1300	1.13E+00	NVA	NVA	No	NTX
	1918-00-9	Dicamba			mg/kg		0/2	0.2220-0.2270	2.27E-01	NVA	NVA	No	NTX
	120-36-5	Dichloroprop			mg/kg		0/2	0.2220-0.2270	2.27E-01	NVA	NVA	No	NTX
	959-98-8	Endosulfan I			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.19E-01	NVA	No	BSL
	33213-65-9	Endosulfan II			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.19E-01	NVA	No	BSL
	1031-07-8	Endosulfan sulfate			mg/kg		0/2	0.0007-0.0008	7.56E-04	3.58E-02	NVA	No	BSL
	72-20-8	Endrin			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.01E-02	1.00E-01	No	BSL
	7421-93-4	Endrin aldehyde			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.05E-02	1.00E-01	No	BSL
	53494-70-5	Endrin ketone			mg/kg		0/2	0.0007-0.0008	7.56E-04	NVA	NVA	No	NTX
	58-89-9	gamma-BHC (Lindane)			mg/kg		0/2	0.0007-0.0008	7.56E-04	5.00E-03	1.00E-01	No	BSL
	5103-74-2	gamma-Chlordane			mg/kg		0/2	0.0007-0.0008	7.56E-04	2.24E-01	1.00E-01	No	BSL
	76-44-8	Heptachlor			mg/kg		0/2	0.0007-0.0008	7.56E-04	5.98E-03	NVA	No	BSL
	1024-57-3	Heptachlor epoxide			mg/kg		0/2	0.0007-0.0008	7.56E-04	1.52E-01	1.00E-01	No	BSL
	94-74-6	MCPA			mg/kg		0/4	111.0000-113.0000	1.13E+02	NVA	NVA	No	NTX
	93-65-2	MCPP			mg/kg		0/2	111.0000-113.0000	1.13E+02	NVA	NVA	No	NTX
	72-43-5	Methoxychlor			mg/kg		0/1	0.0007-0.0007	7.42E-04	1.99E-02	1.00E-01	No	BSL
	8001-35-2	Toxaphene			mg/kg		0/2	0.0370-0.0378	3.78E-02	1.19E-01	NVA	No	BSL
	12674-11-2	Aroclor 1016			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.71E-01	1.00E-01	No	BSL

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Table F-30
Summary of Screening for Non-Detect Chemicals - Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	11104-28-2	Aroclor 1221			mg/kg		0/3	0.0742-0.0762	7.62E-02	3.71E-01	1.00E-01	No	BSL
	11141-16-5	Aroclor 1232			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.71E-01	1.00E-01	No	BSL
	53469-21-9	Aroclor 1242			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.71E-01	1.00E-01	No	BSL
	12672-29-6	Aroclor 1248			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.71E-01	1.00E-01	No	BSL
	11097-69-1	Aroclor 1254			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.71E-01	NVA	No	BSL
	11096-82-5	Aroclor 1260			mg/kg		0/3	0.0370-0.0381	3.81E-02	3.71E-01	1.00E-01	No	BSL
	131-11-3	Dimethylphthalate			mg/kg		0/9	0.1700-0.8000	8.00E-01	7.34E+02	NVA	No	BSL
	120-82-1	1,2,4-Trichlorobenzene			mg/kg		0/14	0.0060-0.7650	7.65E-01	2.00E+01	1.00E-01	Yes	ASL
	95-50-1	1,2-Dichlorobenzene			mg/kg		0/9	0.1100-0.6000	6.00E-01	2.96E+00	1.00E-01	Yes	ASL
	541-73-1	1,3-Dichlorobenzene			mg/kg		0/9	0.1300-0.6000	6.00E-01	3.77E+01	NVA	No	BSL
	106-46-7	1,4-Dichlorobenzene			mg/kg		0/9	0.0980-0.5000	5.00E-01	2.00E+01	1.00E-01	Yes	ASL
	95-95-4	2,4,5-Trichlorophenol			mg/kg		0/9	0.1000-0.9800	9.80E-01	9.00E+00	1.00E-01	Yes	ASL
	88-06-2	2,4,6-Trichlorophenol			mg/kg		0/9	0.1700-0.8000	8.00E-01	4.00E+00	1.00E-01	Yes	ASL
	120-83-2	2,4-Dichlorophenol			mg/kg		0/9	0.1800-0.9000	9.00E-01	8.75E+01	1.00E-01	Yes	ASL
	105-67-9	2,4-Dimethylphenol			mg/kg		0/9	0.1900-3.0000	3.00E+00	1.00E-02	1.00E-01	Yes	ASL
	51-28-5	2,4-Dinitrophenol			mg/kg		0/9	0.9300-6.0000	6.00E+00	2.00E+01	1.00E-01	Yes	ASL
	121-14-2	2,4-Dinitrotoluene			mg/kg		0/9	0.1400-0.7000	7.00E-01	1.28E+00	NVA	No	BSL
	606-20-2	2,6-Dinitrotoluene			mg/kg		0/9	0.0850-0.4050	4.05E-01	3.28E-02	NVA	Yes	ASL
	91-58-7	2-Chloronaphthalene			mg/kg		0/9	0.0360-0.4050	4.05E-01	1.22E-02	NVA	Yes	ASL
	95-57-8	2-Chlorophenol			mg/kg		0/9	0.0600-0.4050	4.05E-01	2.43E-01	1.00E-01	Yes	ASL
	91-57-6	2-Methylnaphthalene			mg/kg		0/6	0.0490-0.4050	4.05E-01	3.24E+00	NVA	No	BSL
	88-74-4	2-Nitroaniline			mg/kg		0/9	0.0620-2.0000	2.00E+00	7.41E+01	NVA	No	BSL
	88-75-5	2-Nitrophenol			mg/kg		0/9	0.1400-0.7000	7.00E-01	1.60E+00	NVA	No	BSL
	88-85-7	2-sec-butyl-4,6-dinitrophenol			mg/kg		0/2	0.2220-0.2270	2.27E-01	2.18E-02	NVA	Yes	ASL
	91-94-1	3,3'-Dichlorobenzidine			mg/kg		0/9	0.1900-30.0000	3.00E+01	6.46E-01	NVA	Yes	ASL
	99-09-2	3-Nitroaniline			mg/kg		0/9	0.1900-2.0000	2.00E+00	3.16E+00	NVA	No	BSL
	534-52-1	4,6-Dinitro-o-cresol			mg/kg		0/9	0.5500-3.0000	3.00E+00	1.44E-01	NVA	Yes	ASL
	100-01-6	4-Nitroaniline			mg/kg		0/9	0.1900-2.0000	2.00E+00	2.19E+01	NVA	No	BSL
	100-02-7	4-Nitrophenol			mg/kg		0/9	0.9300-7.0000	7.00E+00	7.00E+00	1.00E-01	Yes	ASL
	83-32-9	Acenaphthene			mg/kg		0/8	0.0019-0.2000	2.00E-01	2.00E+01	1.00E-01	Yes	ASL
	65-85-0	Benzoic Acid			mg/kg		0/4	0.9400-2.0000	2.00E+00	7.30E+00	NVA	No	BSL
	111-91-1	bis(2-Chloroethoxy)methane			mg/kg		0/9	0.0590-0.4050	4.05E-01	3.02E-01	NVA	Yes	ASL
	111-44-4	bis(2-Chloroethyl)ether			mg/kg		0/9	0.0330-0.4050	4.05E-01	2.37E+01	NVA	No	BSL
	108-60-1	bis(2-Chloroisopropyl)ether			mg/kg		0/9	0.1900-1.0000	1.00E+00	1.99E+01	NVA	No	BSL
	85-68-7	Butyl benzyl phthalate			mg/kg		0/9	0.1700-0.8000	8.00E-01	2.39E-01	NVA	Yes	ASL
	86-74-8	Carbazole			mg/kg		0/6	0.1900-0.4050	4.05E-01	NVA	NVA	No	NTX

Table F-30
Summary of Screening for Non-Detect Chemicals - Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	84-74-2	Di-n-butyl phthalate			mg/kg		0/9	0.0610-0.4050	4.05E-01	2.00E+02	NVA	No	BSL
	117-84-0	Di-n-octyl phthalate			mg/kg		0/9	0.1900-10.0000	1.00E+01	7.09E+02	NVA	No	BSL
	53-70-3	Dibenz(a,h)anthracene			mg/kg		0/9	0.0019-1.0000	1.00E+00	1.84E+01	1.00E-01	Yes	ASL
	132-64-9	Dibenzofuran			mg/kg		0/9	0.0350-0.4050	4.05E-01	6.10E+00	NVA	No	BSL
	84-66-2	Diethyl phthalate			mg/kg		0/9	0.1900-1.0000	1.00E+00	1.00E+02	NVA	No	BSL
	118-74-1	Hexachlorobenzene			mg/kg		0/9	0.0330-0.4050	4.05E-01	1.99E-01	NVA	Yes	ASL
	87-68-3	Hexachlorobutadiene			mg/kg		0/9	0.1900-1.0000	1.00E+00	3.98E-02	NVA	Yes	ASL
	77-47-4	Hexachlorocyclopentadiene			mg/kg		0/9	0.1900-30.0000	3.00E+01	1.00E+01	NVA	Yes	ASL
	67-72-1	Hexachloroethane			mg/kg		0/9	0.1500-0.8000	8.00E-01	5.96E-01	NVA	Yes	ASL
	78-59-1	Isophorone			mg/kg		0/9	0.0330-0.4050	4.05E-01	1.39E+02	NVA	No	BSL
	621-64-7	n-Nitroso-di-n-propylamine			mg/kg		0/9	0.1900-1.0000	1.00E+00	5.44E-01	NVA	Yes	ASL
	86-30-6	n-Nitrosodiphenylamine			mg/kg		0/9	0.1900-10.0000	1.00E+01	5.45E-01	NVA	Yes	ASL
	91-20-3	Naphthalene			mg/kg		0/6	0.0205-0.2000	2.00E-01	9.94E-02	1.00E-01	Yes	ASL
	98-95-3	Nitrobenzene			mg/kg		0/9	0.0450-0.4050	4.05E-01	1.31E+00	NVA	No	BSL
	95-48-7	o-Cresol			mg/kg		0/9	0.0290-0.4050	4.05E-01	4.04E+01	1.00E-01	Yes	ASL
	59-50-7	p-Chloro-m-cresol			mg/kg		0/9	0.0950-0.7900	7.90E-01	7.95E+00	NVA	No	BSL
	106-47-8	p-Chloroaniline			mg/kg		0/9	0.1900-4.0000	4.00E+00	1.10E+00	NVA	Yes	ASL
	106-44-5	p-Cresol			mg/kg		0/7	0.1900-1.0000	1.00E+00	1.63E+02	1.00E-01	Yes	ASL
	87-86-5	Pentachlorophenol			mg/kg		0/9	0.9300-6.0000	6.00E+00	3.00E+00	1.00E-01	Yes	ASL
	108-95-2	Phenol			mg/kg		0/9	0.1100-0.6000	6.00E-01	3.00E+01	1.00E-01	Yes	ASL
	630-20-6	1,1,1,2-Tetrachloroethane			mg/kg		0/3	0.0060-0.7650	7.65E-01	2.25E+02	3.00E-01	Yes	ASL
	71-55-6	1,1,1-Trichloroethane			mg/kg		0/9	0.0040-0.7650	7.65E-01	2.98E+01	3.00E-01	Yes	ASL
	79-34-5	1,1,2,2-Tetrachloroethane			mg/kg		0/9	0.0020-0.7650	7.65E-01	1.27E-01	3.00E-01	Yes	ASL
	79-00-5	1,1,2-Trichloroethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	2.86E+01	3.00E-01	Yes	ASL
	75-34-3	1,1-Dichloroethane			mg/kg		0/9	0.0020-0.7650	7.65E-01	2.01E+01	3.00E-01	Yes	ASL
	75-35-4	1,1-Dichloroethene			mg/kg		0/9	0.0040-0.7650	7.65E-01	8.28E+00	NVA	No	BSL
	107-06-2	1,2-Dichloroethane			mg/kg		0/9	0.0020-0.7650	7.65E-01	2.12E+01	8.70E+02	No	BSL
	540-59-0	1,2-Dichloroethene (total)			mg/kg		0/2	0.0030-0.0030	3.00E-03	0.78373	3.00E-01	No	BSL
	78-87-5	1,2-Dichloropropane			mg/kg		0/9	0.0030-0.7650	7.65E-01	3.27E+01	NVA	No	BSL
	78-93-3	2-Butanone			mg/kg		0/9	0.0050-0.7650	7.65E-01	8.96E+01	NVA	No	BSL
	591-78-6	2-Hexanone			mg/kg		0/9	0.0050-0.7650	7.65E-01	1.26E+01	NVA	No	BSL
	101-55-3	4-Bromophenyl phenylether			mg/kg		0/9	0.0330-0.4050	4.05E-01	NVA	NVA	No	NTX
	7005-72-3	4-Chlorophenyl phenylether			mg/kg		0/9	0.0330-0.4050	4.05E-01	NVA	NVA	No	NTX
	108-10-1	4-Methyl-2-pentanone			mg/kg		0/9	0.0050-0.7650	7.65E-01	4.43E+02	1.00E+02	No	BSL
	67-64-1	Acetone			mg/kg		0/9	0.0050-1.3500	1.35E+00	2.50E+00	NVA	No	BSL
	71-43-2	Benzene			mg/kg		0/9	0.0020-0.7650	7.65E-01	2.55E-01	1.00E-01	Yes	ASL

Table F-30
Summary of Screening for Non-Detect Chemicals - Future - Surface Soil at SWMU 58

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Ecological Screening Toxicity Value (2)	Region III BTAG Screening Levels	COPEC Flag (Y/N)	Rationale for Selection or Deletion (3)
	75-27-4	Bromodichloromethane			mg/kg		0/9	0.0030-0.7650	7.65E-01	5.40E-01	4.50E+02	Yes	ASL
	74-83-9	Bromomethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	2.35E-01	NVA	Yes	ASL
	75-15-0	Carbon disulfide			mg/kg		0/8	0.0040-0.7650	7.65E-01	9.41E-02	NVA	Yes	ASL
	56-23-5	Carbon tetrachloride			mg/kg		0/9	0.0050-0.7650	7.65E-01	2.98E+00	3.00E-01	Yes	ASL
	108-90-7	Chlorobenzene			mg/kg		0/9	0.0010-0.7650	7.65E-01	4.00E+01	1.00E-01	Yes	ASL
	75-00-3	Chloroethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	NVA	NVA	No	NTX
	74-87-3	Chloromethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	1.04E+01	NVA	No	BSL
	10061-01-5	cis-1,3-Dichloro-1-propene			mg/kg		0/9	0.0030-0.7650	7.65E-01	3.98E-01	3.00E-01	Yes	ASL
	124-48-1	Dibromochloromethane			mg/kg		0/9	0.0030-0.7650	7.65E-01	2.05E+00	NVA	No	BSL
	100-42-5	Styrene			mg/kg		0/9	0.0030-0.7650	7.65E-01	3.00E+02	1.00E-01	Yes	ASL
	127-18-4	Tetrachloroethene			mg/kg		0/9	0.0010-0.7650	7.65E-01	9.92E+00	3.00E-01	Yes	ASL
	10061-02-6	trans-1,3-Dichloropropene			mg/kg		0/9	0.0030-0.7650	7.65E-01	3.98E-01	3.00E-01	Yes	ASL
	75-25-2	Tribromomethane			mg/kg		0/9	0.0050-0.7650	7.65E-01	1.59E+01	1.47E+03	No	BSL
	67-66-3	Trichloromethane			mg/kg		0/9	0.0010-0.7650	7.65E-01	1.19E+00	3.00E-01	Yes	ASL
	75-01-4	Vinyl Chloride			mg/kg		0/9	0.0050-0.7650	7.65E-01	6.46E-01	3.00E-01	Yes	ASL
	1330-20-7	Xylenes (total)			mg/kg		0/3	0.0020-0.0020	2.00E-03	1.00E+01	1.00E-01	No	BSL

(1) Maximum non-detect limit value used for screening.

(2) Screening toxicity values from USEPA SSLs (2000); Efroymson et al., PRGs (1997); and USEPA Region V EDQLs (1999); and other sources. See text for derivation. Region 3 BTAG Screening Levels (1995) have also been utilized.

(3) Reasons for Selection:

ASL = Above Screening Level

Reasons for Deletion:

BSL = Below Screening Level

NTX = No Toxicity Data

Definitions:

N/A = Not Applicable or Not Available

NVA = No Value Available

N = No

Y = Yes

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Appendix G

Contaminant Fate and Transport

G.1 TRANSFORMATION AND FATE OF CONTAMINANTS

When contaminants are exposed to the environment, the potential for transformations of the chemical exists. The endpoint of the transformation process is referenced as the “fate” of the chemical. The ultimate “fate” refers to the expected final state that an element, compound, or group of compounds will achieve following release to the environment. The fate processes for organic contaminants may include sorption, volatilization, hydrolysis, and abiotic and biotic degradation, while the fate processes for inorganic contaminants may include ion exchange, chemical speciation, and oxidation/reduction. These fate processes dictate how contaminants will be transported in the environment. Contaminants can be transported with little attenuation or retardation due to these fate processes, or they can be delayed or transformed so that little migration occurs. Various fate processes, as well as the properties that may affect the fate of contaminants, are discussed below.

G.1.1 Contaminant Properties Affecting Fate

The physical and chemical properties of contaminants play a large role in determining their fate after release to the environment. The following section provides a discussion of several of these key properties.

G.1.1.1 Specific Gravity

Specific gravity is the ratio of the density of a compound to the density of water. It is a measure of the tendency of a compound to float (specific gravity <1) or sink (specific gravity >1) in water. Contaminants that are immiscible in water can exist as separate phase liquids and are referred to as Light Non-Aqueous Phase Liquids (LNAPLs) if their specific gravity is less than one, or Dense Non-Aqueous Phase Liquids (DNAPLs) if their specific gravity is greater than one.

G.1.1.2 Water Solubility

The solubility of a compound in water is the maximum or saturated concentration of the compound in pure water at a specific temperature. Compounds with high solubility in water tend to remain in the aqueous phase and not partition to soil or sediment, are less likely to volatilize from water, and are generally more likely to biodegrade. Conversely, compounds with low water solubilities tend to partition to soil or sediment, volatilize more readily from water, and are less likely to be biodegradable. The solubility of inorganic chemicals varies widely from insoluble to greater than 100,000 mg/L, depending on temperature, pH, ORP, and the concentrations of dissolved constituents such as humic and fulvic acids.

G.1.1.3 Vapor Pressure

Vapor pressure is a property of a chemical in its pure state, which indicates how readily it will volatilize to the atmosphere. Volatilization from water is dependent upon vapor pressure and Henry's Law Constant. Vapor pressures for chemicals in their pure states range from 0.001 to 760 mm mercury (mm Hg) for liquids to less than 10^{-10} mm Hg for solids.

G.1.1.4 Henry's Law Constant

The Henry's Law Constant of a compound is essentially the air/water partition coefficient. In dimensional form, the Henry's Law Constant is the ratio of the vapor pressure to the water solubility (in $\text{atm}\cdot\text{m}^3/\text{mole}$). The Henry's Law Constant indicates how a chemical will partition

between air and water at equilibrium, and can be used to calculate the rate of volatilization of a chemical from water.

G.1.1.5 Organic Carbon/Water Partition Coefficient

The organic carbon/water partition coefficient (K_{oc}) is a measure of the tendency for a chemical to be sorbed to the organic fraction of soil and sediment. Normal K_{oc} values range from 1 to 10^7 L/kg, with higher values indicating greater sorption potential by the soil and lower values indicating high leaching capabilities for the contaminants from the waste source into surface runoff and groundwater.

G.1.1.6 Octanol/Water Partition Coefficient

The octanol/water partition coefficient (K_{ow}) is a measure of the distribution of a compound at equilibrium between n-octanol and water. The octanol/water partition coefficient, K_{ow} , gives an indication of how a compound will preferentially distribute into a solvent or water, and is a measure of how hydrophobic a compound is. A chemical with a high K_{ow} is hydrophobic and may be relatively immobile in an aqueous system (e.g., contaminant sorbs to soil particles), but may be mobilized in the presence of an organic solvent.

G.1.2 Fate of Organic Contaminants

G.1.2.1 Sorption

Sorption and desorption are two major mechanisms affecting the fate of contaminants in the subsurface. Sorption includes both adsorption and absorption. Adsorption is defined as the accumulation occurring at an interface, while absorption is the partitioning between two phases (Knox et al., 1993).

Sorption is the process by which a compound is retained onto a solid particle rather than remaining dissolved in solution. The sorption of contaminants to the soil matrix is an important factor affecting their transport in terrestrial environments. The sorption of contaminants to suspended sediments and bottom sediment is an important factor affecting chemical transport in aquatic environments.

In general, sorption reactions may be classified as either sorbent or solvent-motivated. Sorbent-motivated sorption occurs when an attraction between the sorbent (subsurface material) and the solute (contaminant), and the contaminant accumulates at the surface due to the affinity of the surface for the contaminant. An example of sorbent-motivated sorption would be a highly polar or ionizable contaminant interaction with the cation exchange sites of clay minerals. This type of sorption typically occurs with inorganics and is more commonly referred to as ion exchange. Solvent-motivated sorption occurs when the contaminant is hydrophobic, such as nonpolar organics, which prefer nonpolar phases to the polar water phase. Hydrophobic contaminants will accumulate at an interface or partition into a nonpolar phase (e.g., associate with the organic content of the subsurface medium) rather than partition into the water phase. The sorption of most neutral organic constituents falls into the category of hydrophobic, or solvent-motivated sorption (Knox et al., 1993). The best indicators of the partitioning of a compound between soil and water are the organic carbon/water partition coefficient (K_{oc}), the soil/water distribution coefficient (K_d), the octanol/water partition coefficient (K_{ow}), and the retardation factor (R).

For nonionic organic chemicals and aquifer materials, sorption is largely controlled by the clay and organic carbon content of the soil. The distribution of an organic chemical between water

and a specific soil matrix is characterized by the organic carbon/water partition coefficient, K_{oc} . This coefficient, which is based on the specific organic carbon content of the soil, is typically measured empirically using a linear adsorption isotherm where the partitioning between the two phases is determined by the following equation (Olsen and Davis, 1990):

$$K_d = \frac{C_s}{C_w} \quad \text{Equation 1}$$

where:

- K_d = Soil/water distribution coefficient (L/kg)
- C_s = Mass of the solute on the solid phase per unit mass of the solid phase (mg/kg)
- C_w = Mass of the solute per unit volume of solution (mg/L)

The soil/water distribution coefficient, K_d , obtained from the above equation is then normalized to correct for variations in the organic carbon content of differing soil matrices to calculate K_{oc} :

$$K_{oc} = \frac{K_d}{f_{oc}} \quad \text{Equation 2}$$

where:

- K_{oc} = Organic carbon/water partition coefficient (L/kg)
- K_d = Soil/water distribution coefficient (L/kg)
- f_{oc} = Fraction of organic carbon in the soil

The normalization of the adsorption coefficient to ascertain K_{oc} correlates well with other adsorption coefficient estimation methods which use other properties of the chemical such as water solubility or octanol/water partitioning (Callahan et al., 1979).

If the empirical K_d or K_{oc} value for the chemical is not available, the most widely accepted method of estimating the organic carbon/water partition coefficient involves the octanol/water partition coefficient, K_{ow} . The octanol/water partition coefficient, K_{ow} , has been correlated to water solubility, the organic carbon/water partition coefficient, and bioconcentration factors for aquatic life and represents the extent of partitioning by a chemical between organic and aqueous phases (Lyman et al., 1990). The relationship between K_{oc} and K_{ow} is expressed as a regression equation:

$$\log K_{oc} = a \log K_{ow} + b \quad \text{Equation 3}$$

where a and b are constants derived from specific data sets which represent differing classes of chemicals such as pesticides, aromatic compounds, and chlorinated hydrocarbons. Chemicals with low K_{ow} (i.e., less than 10 L/kg) are considered relatively hydrophilic and tend to have high water solubilities and small K_{oc} values. Conversely, hydrophobic compounds typically have K_{ow} values greater than 10^4 L/kg (Lyman et al., 1990). In general, the more hydrophobic a contaminant is, the more likely the contaminant will be sorbed to soil.

From Equation 1, when C_s is equal to zero, K_d also equals zero. Under this condition, no adsorption or retardation of the chemical occurs. This implies that the contaminant moves at the same velocity as the groundwater and in this case, the contaminant is termed a conservative or nonreactive solute. However, the velocity of the contaminant front can be substantially different for solutes that are adsorbed within the soil matrix. The retardation factor is defined as the ratio of the groundwater flow velocity to the contaminant front velocity:

$$R = 1 + \rho_b \frac{K_d}{n_e} \quad \text{Equation 4}$$

where:

- R = Retardation factor (dimensionless)
- θ_b = Bulk density of the soil (g/mL)
- K_d = Distribution coefficient (mL/g)
- n_e = Effective porosity of the soil (dimensionless)

The retardation factor indicates the extent of retardation of contaminant migration in groundwater due to adsorption. A retardation factor of 1.0 indicates that the contaminant has little tendency to bind to soils and, hence, moves freely in the groundwater. By contrast, the larger the R, the greater the tendency for a contaminant to bind to the soil matrix and the slower it will move in the groundwater. The retardation factor cannot fall below 1.0.

Other factors which affect the adsorption of chemicals to the soil matrix include temperature, pH of the soil and water, particle size distribution, and surface area of solids. The value of the distribution coefficient K_d usually decreases with increasing temperature because adsorption is an exothermic process. Neutral and slightly polarized organic compounds are somewhat affected by pH. Chemicals that tend to ionize are significantly affected by pH (Lyman et al., 1990). When the pH of the groundwater is approximately 1.0 to 1.5 units above the negative log of the acid dissociation constant (pK_a), adsorption becomes significant. A comparison of the pK_a of an organic acid with the pH of the groundwater indicates the potential importance of the dissociation of the organic compound in determining the degree of partitioning. The size of affected soil particles also plays a role in a contaminant's sorption characteristics. Particles of small size, such as particles of fine silt or clay, will have a greater tendency to adsorb chemicals.

G.1.2.2 Volatilization

Volatilization is a process whereby a compound changes state from the aqueous phase to the vapor phase. Compounds that do not adsorb onto soil/sediment or dissolve in water have the greatest tendency to volatilize. The volatility of a compound can be evaluated from its K_{oc} and by assessing its Henry's Law Constant. The value of K_{oc} indicates the degree of sorption of a compound to soil/sediment. A compound with a high K_{oc} value will have a reduced volatility because the compound sorbs extensively to the soil/sediment surface. The Henry's Law Constant can be considered the partition coefficient of the contaminant between the aqueous phase and the gas phase. A Henry's Law Constant of greater than 10^{-3} atm-m³/mol indicates a high volatility, and a Henry's Law Constant of less than 10^{-5} atm-m³/mol indicates a low volatility. **Table G-1** provides a rough outline of relative volatility of a solute according to its Henry's Law Constant.

Table G-1
Volatility of Compounds Based on Henry's Law Constants

Volatility	Henry's Law Constant
Volatilization is very slow, at a rate controlled by slow diffusion through air	$< 10^{-5}$ atm-m ³ /mol
Volatilization is not rapid but significant	10^{-5} atm-m ³ /mol to 10^{-3} atm-m ³ /mol
Volatilization is rapid	$> 10^{-3}$ atm-m ³ /mol

The Henry's Law Constant is related to other physical properties of the compound, the most important of which are vapor pressure and water solubility. Compounds exhibiting high vapor pressures and low water solubilities tend to have high volatilization rates. In fact, in the absence of literature values, Henry's Law Constants can be estimated from the following equation (Olsen and Davis, 1990):

$$H = \frac{(V_p)(MW)(16.04)}{(WS)(T)} \quad \text{Equation 5}$$

where:

- V_p = Vapor pressure of the chemical (mm Hg)
- MW = Molecular weight of the chemical (g/mol)
- WS = Solubility in water (mg/L)
- T = Temperature ($^{\circ}$ K)
- H = Henry's Law Constant ([mg/L]/[mg/L])

From this equation, it is evident that the volatilization of a compound to air will depend on its vapor pressure, water solubility, and temperature. Other important factors affecting volatilization include wind speed, the depth of the aquifer, and the geology of the unsaturated zone.

G.1.2.3 Hydrolysis

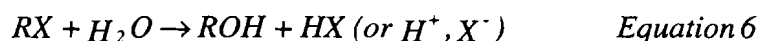
Hydrolysis is the reaction of a compound with water. It usually involves the introduction of a hydroxyl (-OH) group into an organic compound, usually at a point of unbalanced charge distribution (Cherry et al., 1983). The hydrolysis reaction can displace halogens, and may be catalyzed by the presence of acids, bases, or metal ions. Therefore, the rate of hydrolysis is pH and metal-ion concentration dependent. Surface effects also may affect the rate of hydrolysis. Halogenated aliphatics are susceptible to hydrolysis, with reactions proceeding most rapidly for monohalogenated compounds, and much more slowly as the number of halogen ions increases (Fetter, 1993).

Hydrolysis applies to a limited number of chemicals. These contain hydrolyzable groups, such as esters, aliphatic halogens, amides, carbamates, and phosphate esters (Howard, 1991). Compounds that are not susceptible include: alkanes, alkenes, aldehydes, amines, and carboxy-containing compounds (Olsen and Davis, 1990).

G.1.2.4 Abiotic Degradation

Abiotic degradation is the chemical degradation of compounds without the assistance of biological activities. In the natural environment, the most common abiotic degradation processes are hydrolysis and hydroxyl radical reactions. Other abiotic degradation processes include direct photolysis, dehydrohalogenation, and oxidation.

Hydrolysis, as mentioned above, is a chemical reaction in which compounds react with water molecules in the environment, resulting in the introduction of a hydroxyl group (-OH) and the loss of a leaving group (-X), typically a halogen.

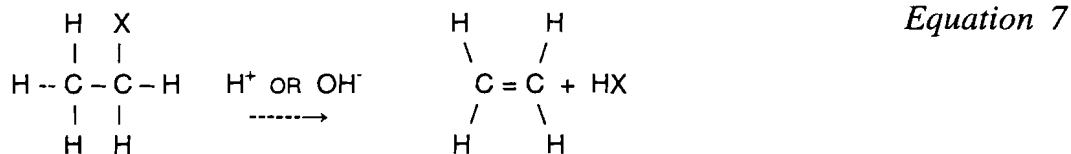


These reactions are catalyzed mainly by hydronium (H_3O^+) and/or hydroxyl ions (OH^-). Therefore, as mentioned above, hydrolysis reactions are pH dependent. Selected metals may also catalyze a hydrolysis reaction (Olsen and Davis, 1990).

Hydroxyl radical reactions are reactions with hydroxyl radicals photochemically generated from sunlight. These reactions may occur mostly in the atmosphere and to a lesser degree in surface water. Once the free radicals are formed, they will react with organic molecules to form an intermediate organic-free radical, which usually reacts further with other compounds. For most chemicals in the atmosphere, reaction with photochemically-generated hydroxyl radicals is the most common degradation process. For many chemicals, experimental reaction rate constants for reactions involving hydroxyl radicals are available in the scientific literature and are used to calculate an estimated half-life by assuming an average hydroxyl radical concentrations of 5×10^5 molecules/cm³ in non-smog conditions (Howard, 1991).

Occasionally, other reactions besides hydroxyl radical reactions occur in the atmosphere such as ozone oxidation and direct photolysis. Direct photolysis is a photochemical alteration of the compound as a result of the compound absorbing direct sunlight. The possibility of direct photolysis in air or water can be partially assessed by examining the UV spectrum of the chemical. If the chemical does not absorb sunlight at wavelengths greater than 290 nm, the chemical cannot directly photolyze.

Dehydrohalogenation is an elimination reaction in which an alkyl derivative will eliminate HX to form an alkene, where X is commonly a halogen, hydroxyl radical, or ester group:



G.1.2.5 Biotic Degradation

Biodegradation is the process in which the chemical degradation of a compound is assisted by soil microorganisms (e.g., fungi, bacteria). Reactions include oxidation, reduction, hydrolysis, and sometimes rearrangement of the molecule. Though biodegradation may occur very slowly for some compounds, the eventual mineralization of almost every organic compound in the

terrestrial and aquatic environment can be attributed to biodegradation (Alexander, 1978). A typical range of half lives for different degradation rates are summarized in **Table G-2**.

Rates of biotic degradation depend on many factors. Microorganisms require a carbon source (e.g., organic matter), an electron acceptor (e.g., oxygen, nitrate), nutrients (e.g., nitrogen, phosphorus), and various trace elements in order to maintain existing cells and produce new cells. Many environmental factors can also serve to limit the occurrence of microbial metabolism in the subsurface. These factors include pH, temperature, toxics, substrate concentration, and the presence of microbes. Most bacteria find the optimum pH range to be 6.5 to 7.5 and are not able to survive at pH values greater than 9.5 or below 4.0 (Knox et al., 1993). Microbial activity generally increases with increasing temperature. The presence of certain compounds may also be toxic to microorganisms. Heavy metals, acids, bases, or high concentrations of the substrate can serve to limit microbial activity. Finally, for biotic degradation to occur in the subsurface, microbes capable of metabolizing (or cometabolizing) the substrate must be present.

Table G-2
Rate of Biodegradation Based on Half Lives

Biodegradation Rate	Approximate Biodegradation Half-Life
Fast	1 day to 7 days
Moderately Fast	7 days to 4 weeks
Slow	4 weeks to 6 months
Resistant	6 months to 1 year

Complete biotic degradation of organic chemicals by microorganisms, utilizing enzymes to facilitate degradation, ultimately produces microbial cells, water, and carbon dioxide, which eventually lead to mineralization of the compound. Whether or not a chemical is transformed by enzymes depends on the configuration alignment of the enzyme with the organic chemical during the reaction. If an ideal configuration of the enzyme with organic chemicals occurs, the reaction will occur. Persistent chemicals have less favorable alignments, and non-reacting or recalcitrant chemicals fail to bond or produce favorable alignments.

Biotic degradation can be either aerobic or anaerobic. An aerobic reaction occurs in the presence of oxygen. Aerobic reactions occur in oxygen-rich environments such as surface soil (i.e., 0 to 6 inches bgs) and upper layers of sediment. An aerobic reaction is usually an oxidation reaction. An anaerobic reaction occurs in the absence of oxygen. Anaerobic reactions occur in such places as the saturated zone in terrestrial environments and the bottom layer of sediment in aquatic environments. Because of the lack of oxygen in these environments, an anaerobic reaction usually favors dehydrohalogenation reactions or reductive reactions.

G.1.3 Fate of Inorganic Contaminants

G.1.3.1 Ion Exchange

Metals in soil are generally immobile, particularly under neutral or alkaline conditions, and tend to sorb to soil particles. Sorption can be considered as either sorbent- or solvent-motivated.

Solvent-motivated sorption (partitioning) typically occurs for nonpolar, hydrophobic organic chemicals in groundwater by accumulation occurring on the organic content of the media. Ion exchange is sorbent-motivated sorption and occurs for inorganic chemicals due to an affinity of the solid surface for the compound. Typically, the sorbent surface contains a charge deficiency and requires the accumulation of ions near the solid/liquid interface to neutralize the surface charge. In subsurface media, the mineral fraction most commonly involved in ion exchange is the clay fraction (Knox et al., 1993). Ion exchange occurs when the sorbent charge deficiency can be neutralized more efficiently by ions in solution than by those ions currently adsorbed. For example, if sodium ions (monovalent) have accumulated and calcium ions (divalent) suddenly appear, the excess surface charge can be more efficiently neutralized by the calcium ions than by sodium. Thus, the sodium ions will desorb, the calcium ions will adsorb, and an exchange of ions occurs. The cation exchange capacity of a given aquifer material indicates the probable type and amount of clay minerals present, and can be used as an indication of the ability of a soil to attenuate cations found in the groundwater (Makeig, 1982).

G.1.3.2 Chemical Speciation

Most inorganic chemicals occur in more than one ionic form, or species, in soils and groundwater. These species, which form as a result of hydrolysis, oxidation/reduction, and complexation reactions, may have different valences and mobilities in groundwater due to different affinities for adsorption and different solubility controls. Simple ionic species often combine with ligands to form ionic or neutral-charge aqueous complexes. The major inorganic ligands in groundwater are generally Cl^- , HCO_3^{2-} , CO_2 , and SO_4^{2-} , and in some cases, NH_3 , NO_3^- and F^- (Cherry et al., 1983). Environmental conditions which affect speciation of inorganic chemicals include pH, redox potential, and inorganic ligands.

G.1.3.3 Oxidation/Reduction

Oxidation and reduction ("redox") refers to the transfer of electrons and the resultant species change of ions or compounds. Oxidation is the loss of electrons, while reduction is the gain of electrons. Redox processes are important because they can cause changes in the mobility of many inorganic compounds. The ability of a redox reaction to occur is a function of the redox potential. The redox potential is defined in terms of the negative logarithm of the free-electron activity and is referred to as pE. The redox potential can also be expressed in terms of volts (E_h). Low values of pE indicate high electron activity and favor electron-rich species (reduced). High values of pE indicate low electron activity and favor electron-poor species (oxidized).

G.2 TRANSPORT OF CONTAMINANTS

Contaminant transport refers to the mechanisms and rates of migration of contaminants away from the source area. Migration pathways often include air, water, soil, and the interfaces between the phases of the contaminant (i.e., solid, liquid, or gas). Mechanisms controlling the movement of contaminants include advection, dispersion, diffusion, volatilization, and sorption. These mechanisms are dictated by the physical and chemical nature of the environmental media and their interaction with the potential COCs. Water pathways include surface water, storm water runoff, groundwater, infiltration/percolation, and precipitation. The air pathways include uptake into the atmosphere and deposition from it either in a dry or wet form. The soil pathways include sediment and soil transported by erosion or by site activities such as construction and movement through the vadose zone as soil gas. Transport across an interface is primarily due to partitioning. The degree of partitioning will depend on the volatility, solubility, and sorptive

capacity of the phases. The primary transport mechanism across the water-air and soil-air interfaces are volatilization and sorption, while transport across the soil-water interface is controlled by sorption/desorption and dissolution (solubilization).

G.2.1 Advection

Contaminant transport by advection occurs when the contaminant is moved in and with the bulk flow of either water or the atmosphere. The primary advective transport pathway at Building 4343 is migration into surface water.

G.2.2 Diffusion

Transport by diffusion is the result of a concentration gradient in the contaminant plume or the soil gas within the vadose zone. The rate of diffusion is expressed by the diffusivity coefficient, which is affected by temperature, pressure, density, and soil porosity. Diffusion in soil is strongly dependent on the effective porosity of the soil. Residual clays have high porosity but low effective (interconnected) porosity. Transport due to diffusion in clays is usually minimal.

G.2.3 Volatilization

Volatilization occurs when a liquid changes its phase to a gas. This is primarily a mechanism for organic contaminants migrating from the soil or surface water to the air. Volatilization is a mass transfer process that is limited by a compound's solubility in water, molecular weight, vapor pressure, K_{oc} value, and by the local temperature.

G.2.4 Sorption

As discussed previously, sorption is a general term used in place of the specific terms absorption or adsorption. Adsorption describes the process whereby a contaminant is bound to the surface of a medium, whereas absorption occurs when the contaminant is bound within the medium. The distinction between the two is not always relevant, but the fact that a contaminant has been sorbed indicates that it has been bound to its new medium and will be transported with this new medium. This transport mechanism may be significant when a high concentration of suspended solids is found in water samples.

Desorption is the release (leaching) of a contaminant from the sorbent phase.

Sorption/desorption is a primary mechanism of transport for water and soil pathways. In a water-soil environment, soil is the adsorbent and the contaminants are the adsorbates.

Sorption/desorption of organic and inorganic compounds within soil-water systems is assessed by several physical and chemical properties of both the compound and the soil or sediment (see *Section G.1.2.1*).