

CERTIFICATE OF DISPOSAL

November 14,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-216/ was received by U.S. Ecology, Inc., on 11/09/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/09/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07110922943-USN 2000-003-216-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

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Reference Number: 07110922945-USN 2000-003-216-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 15,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-217/ was received by U.S. Ecology, Inc., on 11/12/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/12/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111223117-USN 2000-003-217-1-1

Material: 1 DUMP TRUCK

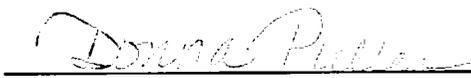
Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 15,2007

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Reference Number: 07111223120-USN 2000-003-217-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 15,2007

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Reference Number: 07111223122-USN 2000-003-217-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 15,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-218/ was received by U.S. Ecology, Inc., on 11/12/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/12/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111223124-USN 2000-003-218-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07111223149-USN 2000-003-218-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07111223150-USN 2000-003-218-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: _____



Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 10,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-219/ was received by U.S. Ecology, Inc., on 11/08/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/08/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07110822843-USN 2000-003-219-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07110822845-USN 2000-003-219-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07110822847-USN 2000-003-219-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07110822849-USN 2000-003-219-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
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This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-220/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723698-USN 2000-003-220-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07111723702-USN 2000-003-220-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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Reference Number: 07111723704-USN 2000-003-220-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

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Reference Number: 07111723732-USN 2000-003-220-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 19,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-221/ was received by U.S. Ecology, Inc., on 11/15/2007 .The waste(s) were subsequently treated, if required by, 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/15/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111523503-USN 2000-003-221-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:  _____

Title: RECEIVING SUPERVISOR

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November 19,2007

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GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

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Reference Number: 07111523504-USN 2000-003-221-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

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Reference Number: 07111523505-USN 2000-003-221-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

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Reference Number: 07111523506-USN 2000-003-221-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

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Title: RECEIVING SUPERVISOR

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US ARMY JMC
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Reference Number: 07111523506-USN 2000-003-222-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

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Reference Number: 07111523507-USN 2000-003-222-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

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Reference Number: 07111523508-USN 2000-003-222-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

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Reference Number: 07111523508-USN 2000-003-223-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

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Reference Number: 07111523509-USN 2000-003-223-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

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Reference Number: 07111523510-USN 2000-003-223-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

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US ARMY JMC
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This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-224/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723674-USN 2000-003-224-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

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Reference Number: 07111723678-USN 2000-003-224-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



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Reference Number: 07111723679-USN 2000-003-224-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-225/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723679-USN 2000-003-225-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-225/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723681-USN 2000-003-225-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-225/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723732-USN 2000-003-225-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: 

Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20, 2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-2251 was received by U.S. Ecology, Inc., on 11/17/2007. The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723735-USN 2000-003-225-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-226/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723663-USN 2000-003-226-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature:



Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 26,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-226/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723677-USN 2000-003-226-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: _____



Title: RECEIVING SUPERVISOR

CERTIFICATE OF DISPOSAL

November 20,2007

US ARMY JMC
GREAT LAKES NTS, MISSISSIPPI ST.
NORTH CHICAGO, IL

This is to certify that waste as defined on Uniform Hazardous Waste Manifest number USN 2000-003-226/ was received by U.S. Ecology, Inc., on 11/17/2007 .The waste(s) were subsequently treated, if required by 40 CFR Part 268 and U.S. Ecology's permits and disposed of by 11/17/2007 in accordance with permits and laws regulating this facility.

Reference Number: 07111723680-USN 2000-003-226-1-1

Material: 1 DUMP TRUCK

Process: Direct Landfill

Facility: U.S. ECOLOGY IDAHO, INC.
20400 LEMLEY ROAD
GRAND VIEW, ID 83624
EPA ID: IDD073114654

Waste Type: NON HAZARDOUS WASTE

Customer: CABRERA SERVICES, INC

Printed Name: DONNA PULLEN

Signature: _____



Title: RECEIVING SUPERVISOR

APPENDIX G

BACKFILL REQUEST AUTHORIZATION REQUEST LETTERS FOR SUs 6 through 15



03-3040.30
November 13, 2007

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 6

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 6 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 6 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (^{232}Th).

Complete excavation of the monazite sand contamination within several SUs of the PPV area will require mobilizations over multiple field seasons due to the presence of contaminated soils underneath building footprints in the PPV area. Given these limitations, CABRERA is proceeding with a step-wise completion strategy for these SUs by completing the accessible portions of each excavation and performing final status surveys as designed in the WPA. Upon return to the site, the remainder of the SU will be addressed with the remaining FSS data collected and appended to this current set.

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). Systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed. An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.



A summary of all SU 6 soil sample results is also attached, with summary statistics for the systematic and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_W of 4 pCi/g for ²³²Th. The GWS identified 1 area of elevated activity within the excavation footprint for follow-up biased sampling. However, analysis of the biased sample (SU06B-034) did not identify ²³²Th activity above DCGL_W. Therefore, no DCGL_{EMC} concerns were identified.

Table 1. Systematic Sample Summary Statistics for SU 6.
(All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 6	1.13	0.97	2.91	0.53

Table 2. Results of SU 6 Biased Sample

Sample ID	²³² Th (pCi/g)	2-σ Uncertainty (pCi/g)	Comments
SU06B-034	3.31	0.19	Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 6 presented above have all been shown to be below the DCGL_W of 4 pCi/g for ²³²Th. As such, CABRERA requests authorization to backfill the open excavation to grade in SU 6.

This data serves as a partial FSS package and will be incorporated into the complete FSS data package for SU 6, which will be assembled after all excavation activities are complete.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,

John Eberlin, PMP
Project Manager
Cabrera Services, Inc.

Attachment
cc: Project File



ATTCHMENTS

Gamma Walkover Survey Results Maps for SU 6 Excavation

Onsite Gamma Spec Lab Data Summary



SU 6 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Filename	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2σ Uncert	MDA
Class 1 FSS Samples							
SU6-106-1	1046	grams	7/24/2007	7:13:05 AM	0.95	0.20	0.41
SU6-107-1	1477	grams	7/24/2007	9:36:13 AM	0.98	0.16	0.23
SU06-108PR	1747	grams	11/7/2007	1:58:47 PM	1.07	0.12	0.23
SU6-109-1	958	grams	7/24/2007	12:52:43 PM	1.22	0.24	0.42
SU6-110-1	1039	grams	7/24/2007	4:29:11 PM	0.96	0.19	0.37
SU06-111PR	1950	grams	11/7/2007	2:17:32 PM	0.84	0.12	0.17
SU6-112-1	1918	grams	7/25/2007	8:40:24 AM	0.32	0.08	0.13
SU6-113-1	1192	grams	7/24/2007	1:28:37 PM	2.91	0.22	0.37
SU06-113PR	1664	grams	11/7/2007	2:34:49 PM	1.09	0.15	0.23
SU06-114PR	1715	grams	11/7/2007	2:57:59 PM	0.85	0.12	0.21
SU6-115-1	1201	grams	7/25/2007	9:50:01 AM	1.96	0.21	0.36
SU6-116-1	971	grams	7/25/2007	2:26:17 PM	1.94	0.22	0.44
SU06-117PR	1735	grams	11/7/2007	3:14:39 PM	0.96	0.12	0.21
SU6-118-1	1636	grams	7/25/2007	8:04:10 AM	0.62	0.12	0.26
SU6-119-1	1546	grams	7/24/2007	9:01:23 AM	0.58	0.11	0.15
SU6-120-1	941	grams	7/30/2007	7:13:42 PM	1.02	0.20	0.31
SU6-121-1	1128	grams	7/31/2007	11:33:46 AM	1.55	0.17	0.26
SU6-122-1	1266	grams	8/1/2007	10:54:01 AM	0.96	0.17	0.31
SU6-123-1	1025	grams	8/1/2007	1:46:33 PM	0.94	0.18	0.29
SU6-124-1	1062	grams	7/31/2007	8:33:55 AM	0.84	0.16	0.30
SU6-125-1	1431	grams	7/31/2007	9:45:56 AM	1.12	0.16	0.32
SU6-126-1	1379	grams	7/30/2007	9:00:41 PM	0.87	0.12	0.24
SU6-127-1	1201	grams	7/31/2007	10:19:29 AM	1.37	0.18	0.32
SU6-128-1	1199	grams	7/30/2007	11:06:03 PM	1.34	0.19	0.29
Biased Samples							
SU06B-034	1753	grams	11/7/2007	5:51:12 PM	3.31	0.19	0.26
Notes: 1. PR = post-remediation							



03-3040.30
November 13, 2007

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 7

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 7 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 7 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (^{232}Th).

Complete excavation of the monazite sand contamination within several SUs of the PPV area will require mobilizations over multiple field seasons due to the presence of contaminated soils underneath building footprints in the PPV area. Given these limitations, CABRERA is proceeding with a step-wise completion strategy for these SUs by completing the accessible portions of each excavation and performing final status surveys as designed in the WPA. Upon return to the site, the remainder of the SU will be addressed with the remaining FSS data collected and appended to this current set.

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). Systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed. An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.



A summary of all SU 7 soil sample results is also attached, with summary statistics for the systematic and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_W of 4 pCi/g for ²³²Th. The GWS identified 5 areas of elevated activity within the excavation footprint for follow-up biased sampling. However, analysis of these biased samples (Table 2) did not identify ²³²Th activity above DCGL_W. Therefore, no DCGL_{EMC} concerns were identified.

Table 1. Systematic Sample Summary Statistics for SU 7.
(All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 7	0.90	0.87	3.67	0.68

Table 2. Results of SU 7 Biased Samples

Sample ID	²³² Th (pCi/g)	2-σ Uncertainty (pCi/g)	Comments
SU07B-035PR	1.28	0.14	Concentration below DCGL.
SU07B-036PR	0.82	0.13	Concentration below DCGL.
SU07B-037PR	3.25	0.19	Concentration below DCGL.
SU7B-044PR	1.07	0.15	Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 7 presented above have all been shown to be below the DCGL_W of 4 pCi/g for ²³²Th. As such, CABRERA requests authorization to backfill the open excavation to grade in SU 7.

This data serves as a partial FSS package and will be incorporated into the complete FSS data package for SU 7, which will be assembled after all excavation activities are complete.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,

John Eberlin, PMP
Project Manager
Cabrera Services, Inc.

Attachment
cc: Project File



ATTCHMENTS

Gamma Walkover Survey Results Maps for SU 7 Excavation

Onsite Gamma Spec Lab Data Summary



SU 7 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Filename	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2σ Uncert	MDA
Class 1 FSS Samples							
SU7-129-1	1422	grams	7/30/2007	8:25:32 PM	0.31	0.00	0.38
SU7-130-1	1241	grams	8/1/2007	11:29:28 AM	0.46	0.11	0.20
SU7-131-1	1117	grams	8/1/2007	12:37:40 PM	0.44	0.00	0.52
SU7-132-1	1338	grams	8/17/2007	11:54:08 AM	0.83	0.15	0.25
SU7-133-1	1206	grams	7/30/2007	9:36:02 PM	1.39	0.19	0.32
SU7-134-1	1041	grams	8/1/2007	1:11:15 PM	1.19	0.20	0.32
SU07-135PR	1627	grams	11/7/2007	3:36:12 PM	0.81	0.11	0.24
SU7-136-1	1412	grams	8/1/2007	9:11:26 AM	0.96	0.00	0.52
SU7-137-1	1410	grams	8/1/2007	4:41:05 PM	0.43	0.11	0.23
SU7-138-1	1036	grams	8/1/2007	2:20:09 PM	0.90	0.17	0.32
SU7-139-1	1099	grams	7/30/2007	11:40:29 PM	1.24	0.17	0.39
SU7-140-1	1368	grams	7/30/2007	10:32:00 PM	0.69	0.13	0.23
SU07-143PR	1577	grams	11/7/2007	3:53:55 PM	3.67	0.21	0.32
SU7-144-1	1342	grams	8/7/2007	9:36:59 AM	0.91	0.13	0.23
SU7-145-1	890	grams	8/7/2007	10:45:02 AM	0.11	0.00	0.47
SU7-146-1	789	grams	7/24/2007	2:09:33 PM	0.99	0.22	0.36
SU7-147-1	1044	grams	7/24/2007	3:18:33 PM	1.10	0.21	0.29
SU07-148PR	1662	grams	11/7/2007	4:13:21 PM	0.99	0.13	0.21
SU7-149-1	1648	grams	7/25/2007	1:51:52 PM	1.07	0.14	0.19
SU7-150-1	1358	grams	7/24/2007	10:53:32 AM	0.40	0.00	0.45
SU7-151-1	1290	grams	7/24/2007	2:43:38 PM	1.01	0.16	0.33
SU07-153PR	1871	grams	11/8/2007	8:07:47 AM	0.79	0.13	0.17
SU7-154-1	1709	grams	7/25/2007	7:29:21 AM	0.36	0.09	0.14
SU7-155-1	1518	grams	7/24/2007	10:13:45 AM	0.64	0.00	0.42
Biased Samples							
SU07B-035PR	1629	grams	11/8/2007	10:31:17 AM	1.28	0.14	0.21
SU07B-036PR	1693	grams	11/8/2007	10:57:12 AM	0.82	0.13	0.22
SU07B-037PR	1746	grams	11/8/2007	11:14:25 AM	3.25	0.19	0.28
SU7B-044PR	1352	grams	11/12/2007	1:17:49 PM	1.07	0.15	0.26
Notes: 1. PR = post-remediation							



05-3060.01
May 30, 2008

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 7

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 7 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 7 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (^{232}Th).

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). During previous evolutions systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed.

During the current work evolution, additional areas in SU7 were excavated, along with 100% gamma walkover survey (GWS) and collection of biased soil samples, as required. The SU7 excavation was extended from its 2007 perimeter to remove material that was previously inaccessible under the foundation of the 4240 housing unit and a small section of the asphalt of the Vermont Court cul-de-sac. The sides of the excavation were benched back and some of the fill material from the 2007 excavation was removed in order to safely access the excavation for survey and data collection. The overlap if the perimeters of the 2007 and 2008 excavations on the attached map reflect this.

An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.

No FSS systematic sample locations were located within the areas that were excavated. However, remediation support samples collected during excavation were evaluated against the DCGL_w. A summary of SU 7 soil sample results collected during this phase is also attached,



with summary statistics for the excavation and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_W of 4 pCi/g for ²³²Th. The GWS identified several areas with elevated Z-scores within the excavation footprint where follow-up biased sampling was performed. However, analysis of these biased samples (Table 2) did not identify ²³²Th activity above DCGL_W. Therefore, no DCGL_{EMC} concerns were identified. In the sample results table below samples designated with a “BX” sample number are not a part of the FSS but were in process samples taken to direct the excavation and to allow personnel in the field to determine the limits of the excavation. Their results are included herein to demonstrate that the removal action is complete.

Table 1. Sample Summary Statistics for SU 7.
(All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 7	1.29	1.06	3.96	0.67

Table 2. Results of SU 7 Biased Samples

Sample ID	²³² Th (pCi/g)	2-σ Uncertainty (pCi/g)	Comments
SU7B-62	0.93	0.13	Concentration below DCGL.
SU7B-63	0.79	0.11	Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 7 presented above have all been shown to be below the DCGL_W of 4 pCi/g for ²³²Th. As such, CABRERA requests authorization to backfill the open excavation to grade in SU 7.

This data serves as a partial FSS package and will be incorporated into the complete FSS data package for SU 7, which will be assembled after all excavation activities are complete.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,

John Eberlin, PMP
Project Manager
Cabrera Services, Inc.

Attachment
cc: Project File



ATTACHMENTS

Gamma Walkover Survey Results Maps for SU 7 Excavation

SU 7 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Sample ID	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2 sigma Uncert	MDA
Excavation Support Samples							
SU07X-004	1533	gram	4/22/2008	3:06:33 PM	1.08	0.12	0.20
SU07X-005	1536	gram	4/22/2008	3:24:11 PM	1.10	0.12	0.19
SU07X-006	1597	gram	4/22/2008	3:46:54 PM	0.86	0.10	0.17
SU7X-014	1395	gram	4/23/2008	10:51:36 AM	2.23	0.16	0.27
SU7X-016	1353	gram	4/23/2008	11:30:40 AM	1.30	0.13	0.24
SU7X-017	1461	gram	4/23/2008	12:07:11 PM	0.93	0.13	0.22
SU7X-018	1450	gram	4/23/2008	12:33:39 PM	1.61	0.13	0.21
SU7X-019	1405	gram	4/23/2008	1:09:46 PM	0.74	0.12	0.22
SU7X-020	1512	gram	4/23/2008	2:13:14 PM	1.04	0.11	0.18
SU7X-021	1223	gram	4/23/2008	1:27:08 PM	1.95	0.16	0.26
SU7X-022	1184	gram	4/23/2008	1:55:40 PM	1.50	0.15	0.25
SU7X-027	1363	gram	4/24/2008	9:03:03 AM	0.93	0.11	0.20
SU7X-028	1350	gram	4/24/2008	9:30:55 AM	3.96	0.21	0.29
SU7X-035	1364	gram	4/28/2008	7:20:04 AM	0.99	0.12	0.21
SU7X-036	1302	gram	4/28/2008	7:37:58 AM	0.84	0.12	0.23
SU7X-037	1339	gram	4/28/2008	7:55:34 AM	1.01	0.14	0.20
SU7X-038	1210	gram	4/28/2008	8:13:05 AM	0.91	0.13	0.20
SU7X-039	1684	gram	4/28/2008	9:22:07 AM	1.10	0.11	0.18
SU7X-040	1531	gram	4/28/2008	9:40:21 AM	1.32	0.12	0.19
SU7X-041	1536	gram	4/28/2008	9:58:16 AM	1.24	0.12	0.19
SU7X-043	1411	gram	5/1/2008	2:28:35 PM	1.34	0.13	0.15
SU7X-044	1346	gram	5/1/2008	2:53:05 PM	0.87	0.13	0.23
SU7X-045	1435	gram	5/1/2008	3:12:57 PM	0.79	0.13	0.21
SU7X-046	1412	gram	5/1/2008	3:29:38 PM	0.84	0.13	0.22
SU7X-047	1477	gram	5/1/2008	3:47:06 PM	0.97	0.11	0.19
SU7X-049	1417	gram	5/5/2008	12:55:02 PM	2.02	0.15	0.25
Biased Samples							
SU7B-62	1429	gram	5/11/2008	5:34:01 PM	0.93	0.13	0.24
SU7B-63	1459	gram	5/11/2008	5:51:52 PM	0.78	0.11	0.17



03-3040.30
November 21, 2007

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 8

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 8 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 8 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (^{232}Th).

Complete excavation of the monazite sand contamination within several SUs of the PPV area will require mobilizations over multiple field seasons due to the presence of contaminated soils underneath building footprints in the PPV area. Given these limitations, CABRERA is proceeding with a step-wise completion strategy for these SUs by completing the accessible portions of each excavation and performing final status surveys as designed in the WPA. This Memorandum presents data from the excavated portion of the SU only. Upon return to the site, the remainder of the SU will be addressed with the remaining FSS data collected and appended to this current set.

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). Systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed. An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.



A summary of all SU 8 soil sample results is also attached, with summary statistics for the systematic and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_w of 4 pCi/g for ²³²Th. In addition to a biased sample identified during GWS, four additional biased samples were also taken from the creek bed of Skokie Creek, which represented the eastern edge of the current excavation. These samples were spaced along the creek bed to test whether the western portion of SU 8's excavation was bounded appropriately. Analysis of these biased samples (Table 2) did not identify ²³²Th activity above DCGL_w. Therefore, no DCGL_{EMC} concerns were identified.

Table 1. Systematic Sample Summary Statistics for SU 8.
(All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 8	0.99	0.90	1.96	0.35

Table 2. Results of SU 8 Biased Samples

Sample ID	²³² Th (pCi/g)	2-σ Uncertainty (pCi/g)	Comments
SU8B043PR	1.57	0.20	Concentration below DCGL.
SU8-B045PR	1.41	0.15	Original named CB-01 (i.e., creek bed-01). Taken from within Skokie Creek. Concentration below DCGL.
SU8-B046PR	2.42	0.16	Original named CB-02 (i.e., creek bed-02). Taken from within Skokie Creek. Concentration below DCGL.
SU8-B047PR	1.88	0.15	Original named CB-03 (i.e., creek bed-03). Taken from within Skokie Creek. Concentration below DCGL.
SU8-B048PR	2.94	0.20	Original named CB-04 (i.e., creek bed-04). Taken from within Skokie Creek. Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 8 presented above have all been shown to be below the DCGL_w of 4 pCi/g for ²³²Th. As such, CABRERA requests authorization to backfill the open excavation to grade in SU 8.

This data serves as a partial FSS package applicable to the open excavation portion of the SU only. This data will be incorporated into a complete FSS data package for SU 8 after all excavation activities have been completed.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,



John Eberlin, PMP
Project Manager
Cabrera Services, Inc.

Attachment
cc: Project File



ATTCHMENTS

Gamma Walkover Survey Results Maps for SU 8 Excavation

Onsite Gamma Spec Lab Data Summary



SU 8 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Filename	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2σ Uncert	MDA
Class 1 FSS Samples							
SU08-156PR	1858	grams	11/8/2007	8:24:38 AM	0.71	0.12	0.22
SU08-157PR	1660	grams	11/7/2007	4:29:50 PM	0.94	0.13	0.23
SU08-166PR	1619	grams	11/8/2007	8:41:21 AM	0.70	0.12	0.21
SU8-159-1	1380	grams	8/3/2007	8:37:54 PM	1.96	0.17	0.29
SU8-160-1	1176	grams	8/3/2007	7:58:06 PM	1.41	0.19	0.28
SU8-161-1	949	grams	7/25/2007	1:13:50 PM	1.14	0.19	0.34
SU8-162-1	1000	grams	7/25/2007	4:08:00 PM	1.10	0.18	0.27
SU8-164-1	1337	grams	7/31/2007	12:57:57 PM	1.23	0.17	0.30
SU8-165-1	1076	grams	7/31/2007	4:00:33 PM	0.69	0.14	0.31
SU8-167-1	1446	grams	7/25/2007	11:49:13 AM	0.66	0.14	0.23
SU8-169-1	1255	grams	7/31/2007	9:42:36 PM	0.89	0.16	0.30
SU8-170-1	1510	grams	7/31/2007	5:55:47 PM	0.75	0.13	0.20
SU8-171-1	1219	grams	8/3/2007	9:57:28 AM	0.90	0.18	0.31
SU8-172-1	1329	grams	8/3/2007	7:00:03 PM	0.80	0.15	0.28
SU8-175-1	1191	grams	8/1/2007	12:03:02 PM	0.93	0.17	0.29
Biased Samples							
SU8B043PR	1136	grams	11/12/2007	12:58:52 PM	1.57	0.20	0.35
Notes: 1. PR = post-remediation							



05-3060.1
May 30, 2008

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 8

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 8 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 8 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (^{232}Th).

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). Systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed. The 2008 excavation scope in SU-8 included removal of a small area that was identified in 2007, but was inaccessible near housing unit 4238; and the eastern bank of Skokie Creek and the historic roadway that crossed it. A majority of the 2008 remediation was performed east of Skokie Creek. The removal of contamination at the NE corner of the 4238 building was limited and resulted in less soil removal than what was anticipated.

Following excavation activities, a 100% gamma walkover survey (GWS) was performed along with collection of biased soil samples, as required. An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.

No FSS systematic sample locations were located within the areas that were excavated. However, remediation support samples collected during excavation were evaluated against the DCGL_w . A summary of SU 8 soil sample results collected during this phase is also attached, with summary statistics for the excavation and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_w of 4 pCi/g for ^{232}Th . The GWS identified areas of elevated Z-scores within the excavation footprint where follow-up



biased sampling was performed. However, analysis of these biased samples (Table 2) did not identify ^{232}Th activity above DCGL_W . Therefore, no DCGL_{EMC} concerns were identified. In the sample results table below samples designated with a "BX" sample number are not a part of the FSS but were in process samples taken to direct the excavation and to allow personnel in the field to determine the limits of the excavation. Their results are included herein to demonstrate that the removal action is complete.

Table 1. Sample Summary Statistics for SU 8.
 (All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 8	1.62	1.50	2.87	0.69

Table 2. Results of SU 8 Biased Samples

Sample ID	^{232}Th (pCi/g)	2- σ Uncertainty (pCi/g)	Comments
SU8B-64	1.12	0.12	Concentration below DCGL.
SU8B-66	1.72	0.14	Concentration below DCGL.
SU8B-67	1.01	0.12	Concentration below DCGL.
SU8B-70	1.01	0.14	Concentration below DCGL.
SU8B-71	3.64	0.21	Concentration below DCGL.
SU8B-72	2.50	0.17	Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 8 presented above have all been shown to be below the DCGL_W of 4 pCi/g for ^{232}Th . As such, CABRERA requests authorization to backfill the open excavation to grade in SU 8.

This data serves as a partial FSS package and will be incorporated into the complete FSS data package for SU 8, which will be assembled after all excavation activities are complete.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,

John Eberlin, PMP
 Project Manager
 Cabrera Services, Inc.

Attachment
 cc: Project File



ATTACHMENTS

Gamma Walkover Survey Results Maps for SU 8 Excavation

SU 8 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Sample ID	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2- sigma Uncert	MDA
Excavation Samples							
SU8X-031	1273	gram	4/24/2008	1:07:33 PM	2.87	0.18	0.29
SU8X-032	1527	gram	4/24/2008	1:24:33 PM	0.88	0.11	0.19
SU8X-033	1139	gram	4/24/2008	1:41:39 PM	0.99	0.13	0.21
SU8X-53	1339	gram	5/7/2008	8:59:15 AM	1.59	0.15	0.25
SU8X-55	1241	gram	5/8/2008	2:51:03 PM	1.46	0.15	0.28
SU8X-56	1303	gram	5/8/2008	3:08:37 PM	2.16	0.16	0.26
SU8X-57	1253	gram	5/8/2008	3:25:23 PM	0.75	0.12	0.23
SU8X-58	1298	gram	5/11/2008	4:00:29 PM	2.26	0.17	0.25
SU8X-59	1250	gram	5/11/2008	4:25:16 PM	1.01	0.14	0.26
SU8X-68	1533	gram	5/12/2008	12:06:42 PM	2.29	0.14	0.21
SU8X-69	1440	gram	5/12/2008	12:23:29 PM	1.50	0.13	0.20
Biased Samples							
SU8B-64	1327	gram	5/11/2008	6:09:09 PM	1.12	0.12	0.20
SU8B-66	1381	gram	5/12/2008	6:35:01 AM	1.72	0.14	0.23
SU8B-67	1474	gram	5/12/2008	6:51:33 AM	1.01	0.12	0.22
SU8B-070	1336	gram	5/13/2008	2:08:47 PM	1.01	0.14	0.19
SU8B-071	1273	gram	5/13/2008	2:25:36 PM	3.64	0.21	0.30
SU8B-072	1247	gram	5/13/2008	2:42:35 PM	2.50	0.17	0.27



03-3040.30
November 16, 2007

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 10

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 10 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 8 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (^{232}Th).

Complete excavation of the monazite sand contamination within several SUs of the PPV area will require mobilizations over multiple field seasons due to the presence of contaminated soils underneath building footprints in the PPV area. Given these limitations, CABRERA is proceeding with a step-wise completion strategy for these SUs by completing the accessible portions of each excavation and performing final status surveys as designed in the WPA. Upon return to the site, the remainder of the SU will be addressed with the remaining FSS data collected and appended to this current set.

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). Systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed. An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.



A summary of all SU 10 soil sample results is also attached, with summary statistics for the systematic and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_w of 4 pCi/g for ²³²Th. The GWS identified areas of elevated activity within the excavation footprint for follow-up biased sampling. However, analysis of these biased samples (Table 2) did not identify ²³²Th activity above DCGL_w. Therefore, no DCGL_{EMC} concerns were identified.

Table 1. Systematic Sample Summary Statistics for SU 10.
(All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 10	1.09	1.01	2.36	0.59

Table 2. Results of SU 10 Biased Samples

Sample ID	²³² Th (pCi/g)	2-σ Uncertainty (pCi/g)	Comments
SU10B-038PR	3.20	0.19	Concentration below DCGL.
SU10B-039PR	0.82	0.13	Concentration below DCGL.
SU10B-040PR	1.43	0.15	Concentration below DCGL.
SU10B-041PR	1.77	0.17	Concentration below DCGL.
SU10B-042PR	1.34	0.12	Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 10 presented above have all been shown to be below the DCGL_w of 4 pCi/g for ²³²Th. As such, CABRERA requests authorization to backfill the open excavation to grade in SU 8.

This data serves as a partial FSS package and will be incorporated into the complete FSS data package for SU 10, which will be assembled after all excavation activities are complete.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,

John Eberlin, PMP
Project Manager
Cabrera Services, Inc.

Attachment
cc: Project File



ATTACHMENTS

Gamma Walkover Survey Results Maps for SU 10 Excavation

Onsite Gamma Spec Lab Data Summary



SU 10 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Filename	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2σ Uncert	MDA
Class 1 FSS Samples							
SU10-197-1	1243	grams	7/23/2007	3:13:47 PM	2.36	0.20	0.32
SU10-198-1	1010	grams	7/23/2007	2:37:41 PM	1.57	0.23	0.34
SU10-199-1	1122	grams	7/23/2007	1:27:26 PM	1.02	0.14	0.28
SU10-200-1	705	grams	7/23/2007	9:40:13 AM	1.00	0.23	0.31
SU10-202PR	1556	grams	11/15/2007	1:52:00 PM	0.74	0.13	0.23
SU10-204-1	1098	grams	7/23/2007	2:03:35 PM	0.71	0.00	0.60
SU10-205-1	771	grams	7/23/2007	10:21:29 AM	1.19	0.24	0.29
SU10-207-1	723	grams	7/23/2007	4:39:23 PM	0.97	0.24	0.40
SU10-208-1	1239	grams	7/23/2007	8:54:25 AM	0.72	0.14	0.22
SU10-209-1	774	grams	7/23/2007	12:51:11 PM	0.08	0.00	0.53
SU10-210-1	711	grams	7/23/2007	10:57:42 AM	0.76	0.00	0.73
SU10-212-1	1196	grams	7/24/2007	8:25:23 AM	1.53	0.20	0.35
SU10-214PR	1750	grams	11/7/2007	4:51:45 PM	1.53	0.13	0.23
SU10-215-1	876	grams	7/23/2007	11:36:09 AM	1.11	0.20	0.31
Biased Samples							
SU10B-038PR	1786	grams	11/8/2007	11:32:53 AM	3.20	0.19	0.27
SU10B-039PR	1707	grams	11/8/2007	11:52:03 AM	0.82	0.13	0.21
SU10B-040PR	1976	grams	11/8/2007	12:09:53 PM	1.43	0.15	0.25
SU10B-041PR	1764	grams	11/12/2007	12:02:59 PM	1.77	0.17	0.30
SU10B-042PR	1935	grams	11/12/2007	12:37:42 PM	1.34	0.12	0.19
Notes:							
1. PR = post-remediation							



03-3040.30
November 13, 2007

Mr. David Horton, Project Manager
U.S. Army Joint Munitions Command
1 Rock Island Arsenal
Rock Island IL 61299-6000

RE: Backfill Authorization Request for Survey Unit No. 11

Dear Mr. Horton;

Cabrera Services, Inc. (CABRERA) requests authorization to backfill the open excavation in survey unit (SU) 11 within the Public Private Venture (PPV) area at the Naval Station Great Lakes. Results of the surveys and sampling performed within SU 11 have been shown to meet the criteria outlined in the *Public Private Venture Area Remediation, Addendum to Work Plan for the Remediation of the Recreation and Center Tank Areas and Site-Wide Final Status Survey (hereafter referred to as the Work Plan Addendum [WPA])*, dated May 2007. (CABRERA 2007a) as well as the recently developed derived concentration guideline level (DCGL) of 4 picocuries per gram (pCi/g) above background for thorium-232 (²³²Th).

Complete excavation of the monazite sand contamination within several SUs of the PPV area will require mobilizations over multiple field seasons due to the presence of contaminated soils underneath building footprints in the PPV area. Given these limitations, CABRERA is proceeding with a step-wise completion strategy for these SUs by completing the accessible portions of each excavation and performing final status surveys as designed in the WPA. Upon return to the site, the remainder of the SU will be addressed with the remaining FSS data collected and appended to this current set.

Summary of Results

The survey and sampling approach provided in the WPA was designed in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* for Class 1 final status surveys (FSS). Systematic soil samples on a specified grid, performance of a 100% gamma walkover survey (GWS), and collection of biased soil samples, as required, were all performed. An interpolated contour map of the GWS results, in terms of Z-score, is attached with locations of the biased samples noted. Z-score is an evaluation tool that presents each data point in terms of the number of standard deviations from the mean. Z-scores > 3 are evaluated as potential biased sample locations.



A summary of all SU 11 soil sample results is also attached, with summary statistics for the systematic and biased samples provided in Table 1 and Table 2, respectively. All soil sample results were shown to be below the DCGL_W of 4 pCi/g for ²³²Th. The GWS identified 1 area of elevated activity within the excavation footprint for follow-up biased sampling. However, analysis of this biased sample (SU11-B045PR) did not identify ²³²Th activity above DCGL_W. Therefore, no DCGL_{EMC} concerns were identified.

Table 1. Systematic Sample Summary Statistics for SU 11.
(All values in pCi/g)

Survey Unit	Mean	Median	Max	Standard Deviation
SU 11	0.82	0.77	1.34	0.14

Table 2. Results of SU 11 Biased Sample

Sample ID	²³² Th (pCi/g)	2-σ Uncertainty (pCi/g)	Comments
SU11-B045PR	0.72	0.13	Concentration below DCGL.

Summary and Conclusion

The results of the data for SU 11 presented above have all been shown to be below the DCGL_W of 4 pCi/g for ²³²Th. As such, CABRERA requests authorization to backfill the open excavation to grade in SU 11.

This data serves as a partial FSS package and will be incorporated into the complete FSS data package for SU 11, which will be assembled after all excavation activities are complete.

Should you have questions or comments, please contact me at 314.703.6784

Sincerely,

John Eberlin, PMP
Project Manager
Cabrera Services, Inc.

Attachment
cc: Project File



ATTCHMENTS

Gamma Walkover Survey Results Maps for SU 6 Excavation

Onsite Gamma Spec Lab Data Summary



SU 11 Onsite Gamma Spec Lab Data Summary (all Results in pCi/g)

Filename	Sample Size	Units	Date Started	Time Started	²²⁸ Ac- (²³² Th)	2σ Uncert	MDA
Class 1 FSS Samples							
SU11-216PR	1532	grams	10/11/2007	3:02:57 PM	0.88	0.16	0.25
SU11-217PR	1633	grams	10/12/2007	8:07:42 AM	1.34	0.13	0.22
SU11-218-PR	1705	grams	10/15/2007	8:06:43 AM	0.74	0.12	0.25
SU11-219	1282	grams	10/11/2007	9:15:19 AM	0.80	0.00	0.52
SU11-220PR	1506	grams	10/12/2007	10:31:24 AM	0.74	0.13	0.22
SU11-221PR	1645	grams	10/12/2007	10:59:46 AM	0.75	0.12	0.16
SU11-222	1323	grams	10/11/2007	9:40:12 AM	0.77	0.13	0.22
SU11-223	1550	grams	10/11/2007	10:42:36 AM	0.76	0.00	0.48
SU11-224PR	1347	grams	10/12/2007	8:32:23 AM	0.88	0.15	0.24
SU11-225PR	1731	grams	10/15/2007	10:15:26 AM	0.87	0.13	0.21
SU11-226PR	1747	grams	10/11/2007	3:31:47 PM	0.84	0.12	0.19
SU11-227	1392	grams	10/11/2007	11:39:58 AM	0.70	0.12	0.16
SU11-228PR	1420	grams	10/12/2007	2:16:03 PM	0.76	0.13	0.25
SU11-229PR	1619	grams	10/12/2007	11:17:37 AM	0.79	0.12	0.20
SU11-230	1490	grams	10/11/2007	10:21:50 AM	0.71	0.13	0.19
SU11-231	1497	grams	10/11/2007	11:10:57 AM	0.73	0.13	0.25
SU11-232PR	1416	grams	10/12/2007	8:48:58 AM	0.76	0.14	0.22
SU11-233PR	1525	grams	10/15/2007	10:37:35 AM	0.82	0.13	0.24
SU11-234PR	1355	grams	10/11/2007	3:49:24 PM	1.01	0.16	0.24
SU11-235	1357	grams	10/11/2007	12:14:11 PM	0.78	0.14	0.21
Biased Samples							
SU11-B-45PR	1551	grams	10/12/2007	2:59:09 PM	0.72	0.13	0.24
Notes:							
1. PR = post-remediation							

APPENDIX H

SITE-SPECIFIC DCGL DOCUMENT SUBMISSION

FINAL

**SITE-SPECIFIC
DERIVED CONCENTRATION GUIDELINE LEVEL**

ADDENDUM

**NAVAL STATION GREAT LAKES
RADIOLOGICAL REMEDIATION
GREAT LAKES, ILLINOIS**

Navy Control Number 2006-009
Contract number DAAA09-02-D-0024/30

Prepared for:
**DEPARTMENT OF THE ARMY
HEADQUARTERS, JOINT MUNITIONS COMMAND
ROCK ISLAND, IL**

Prepared by:



103 E. Mount Royal Ave., Suite 2B
Baltimore, Maryland

September 2007

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Appendix A RESRAD Input Parameters

LIST OF ACRONYMS

ALARA	as low as reasonably achievable
cc	cubic centimeter
CFR	Code of Federal Regulations
cm	centimeter
cm³	cubic centimeters
DCGL	derived concentration guideline level
DSR	dose-to-source ratio
EPA	U. S. Environmental Protection Agency
EMC	elevated measurement comparison
g	gram
K_d	element partition coefficient
m	meter
m²	square meter
NRC	U.S. Nuclear Regulatory Commission
pCi/g	picocurie per gram
RCOC	radionuclide contaminant of concern
TEDE	total effective dose equivalent
yr	year
²²⁸Ra	radium-228
²²⁸Th	thorium-228
²³²Th	thorium-232

1.0 INTRODUCTION

This report is an addendum to the site-specific derived concentration guideline level (DCGL) for the radionuclide contaminants of concern (RCOC) in soil at the Naval Station Great Lakes (hereafter referred to as the Site) resulting from storage of monazite sand in 1974. The original site-specific DCGL was based on an “industrial use” scenario. However, after further consideration, it has been determined that a more conservative approach to achieve unrestricted use of the Site is appropriate. Therefore, a “resident gardener” is proposed in lieu of an “industrial use” scenario.

1.1 Purpose

The purpose of the analyses presented in this report is to provide a site-specific DCGL in support of decisions regarding the need for additional remediation at the Site and/or demonstrating that the Site can be release for unrestricted use. Specifically, when the DCGL is applied to the final status survey and the survey data demonstrates that the DCGL has been satisfied, the following requirements of Title 10, Code of Federal Regulations (CFR), Part 20 (10 CFR 20), Paragraph 1402 (10 CFR 20.1402) are achieved:

A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account the consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

In addition to 10 CFR 20, several Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA) reference documents were used in the derivation of the site-specific DCGL presented in this report.

2.0 DETERMINATION OF DERIVED CONCENTRATION GUIDELINE LEVEL

Methods for determining the DCGL involved a three step process, presented in order in this section:

1. Identifying the regulatory limit for the total effective dose equivalent (TEDE) per year, to which an acceptable level of residual contamination corresponds;
2. Developing a site environmental model (conceptual site model) that accounts for the physical characteristics of the site, identifies exposure pathways from the residual radioactivity, and computes the annual TEDE per unit concentration of natural thorium and natural uranium;
3. Using RESRAD Version 6.3 (Yu 2005) to calculate the TEDE per year per unit concentration or area, respectively, of natural thorium. Computation models must output the TEDE as a function of time, out to 1000 years, to determine allowable soil concentrations to meet the requirements of 10 CFR 20.1402. Microsoft Excel was utilized to generate additional output results based on the dose assessment model results.

2.1 Annual Public Dose Limit

The NRC annual dose limit for a member of the public is 100 mrem TEDE associated with licensed activities and exclusive of background (and other) sources, as specified in 10 CFR 20.1301. As described in Section 1.1 of this report, 10 CFR 20.1402, *Radiological Criteria for Unrestricted Use*, specifies that an average member of the critical population group may not receive a TEDE in excess of 25 mrem, including groundwater sources of drinking water. The RESRAD model utilized this required input parameter (25 mrem) for the applicable dose limit to establish the resulting DCGL for the Site

2.2 Conceptual Site Model

The conceptual site model has been developed on the basis of Site review, how the Site is currently used and the most probable use of the Site once released, and a complete understanding of the most relevant exposure pathways to occupants/residents on the Site.

Figure 2-1, from the *Users Manual for RESRAD Version 6* (Yu 2001), presents all potential exposure pathways, using a worst case, resident farmer exposure scenario.

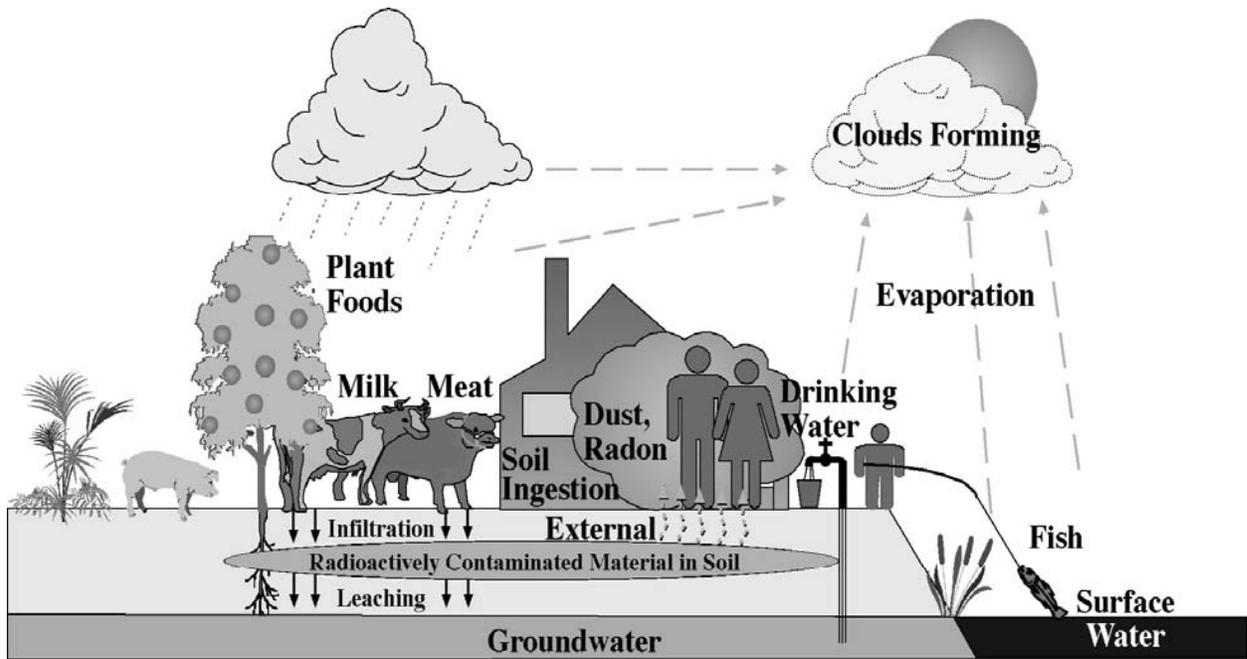


Figure 2-1: Exposure Pathways Considered in RESRAD

This is also presented schematically in Figure 2-2.

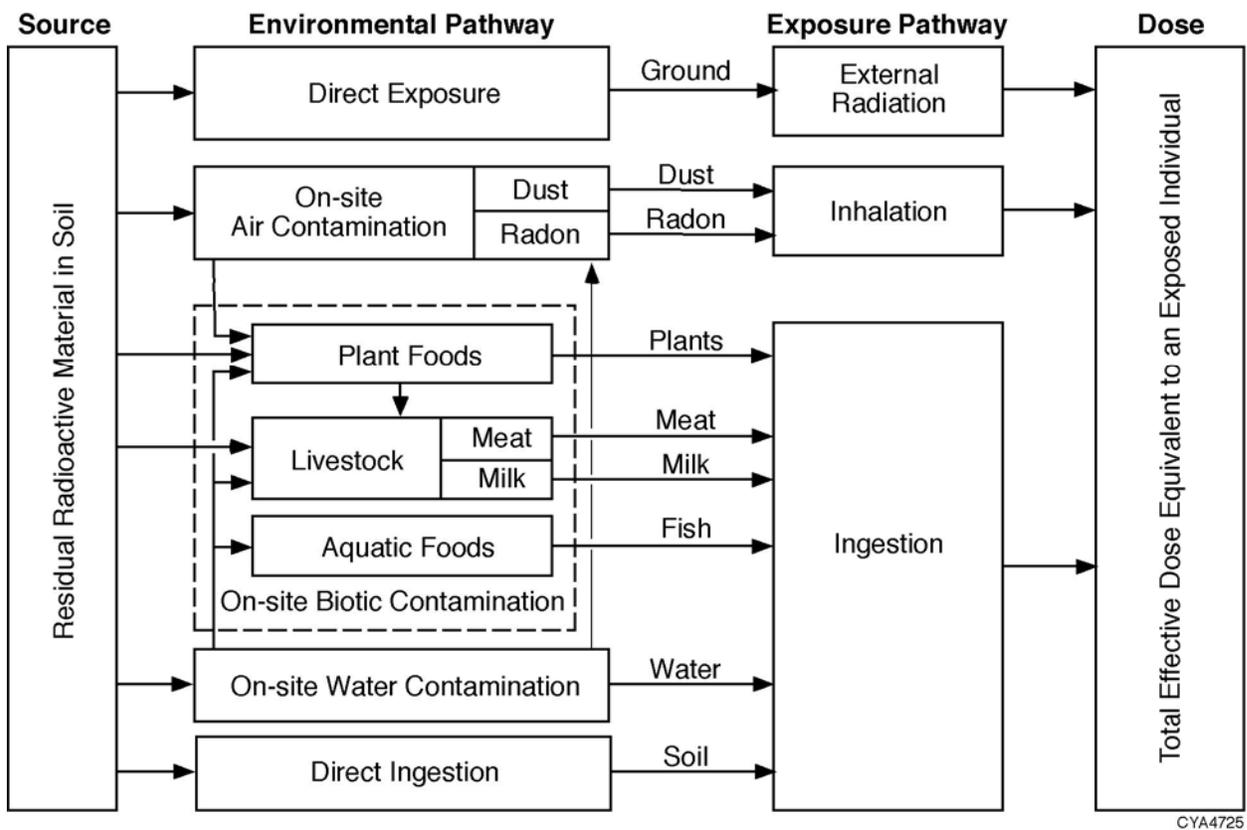


Figure 2-2: Schematic Representation of RESRAD Pathways

As mentioned previously, Figures 2-1 and 2-2 present all potential exposure pathways for a worst case resident farmer scenario. This assumes the area of a site that may be occupied by a future resident is large enough to support raising livestock for meat and milk, and growing crops, fruit, etc. to support a large portion of the resident farmer’s dietary intake needs, as well as provide feed for livestock. The Site, however, is not in a rural location conducive to farming activities at present nor will this be the most plausible future land use. Therefore, a site-specific exposure scenario is proposed based on the following justifications:

- The Site is located in an urbanized area of Lake County, used predominantly for single and multi-family residences, as well as industrial use.
- The Site is currently bounded on all sides by residential areas and industrial properties.
- The Site is approximately 36 miles from Chicago, Illinois, which is a rapidly expanding urban area.
- Portions of the Site are already designated for residential use and privatization efforts are underway to further utilize this area for residential purposes.

- The size of residential properties at the Site is typical of residential lots, averaging approximately 0.25 acres but not exceeding 0.5 acres. This property size is not sufficient to support a farm with livestock as a source of food and milk or raising crops for food. Additionally, typical urban area zoning ordinances prohibit raising livestock.
- The western portion of the Site, bounded on the west by the Site boundary and on the east by Mississippi Avenue, formerly designated Site 18, is currently an industrial area. This portion of the Site will continue to be used for industrial purposes in the foreseeable future. However, although unlikely, future changes in land use may utilize this portion of the Site for residential property expansion.

Given the above considerations regarding current and most probable future land use, the “critical group” is determined to be a relatively small group of residents who reside at the Site and obtain a small portion of their food from a backyard garden, i.e., resident gardener. Although a majority of residents in urban areas do not maintain a garden of any size for this purpose, this “critical group” is chosen as the worst case bounding condition for determining the individual who could receive the highest hypothetical exposure at some time in the future. As such, the exposure to a majority of residents who do not maintain a garden will be lower.

Exposure pathways considered in the resident gardener model are discussed below:

- Although potable water is supplied to the Site by public water sources, the resident gardener scenario developed for the Site assumes the resident does install a well on the property to provide a source of drinking water. This is believed highly unlikely, but provides a reasonable amount of conservatism in the model. It should be noted that considering the very low thorium mobility in soil, leaving the water pathway “on” has no impact on the resulting site-specific DCGL for natural thorium compared to values generated with the water pathway suppressed.
- There are no bodies of water on the Site of sufficient size to support aquatic life to provide a source of food for a resident gardener. Therefore, the aquatic foods pathway is not considered in the Site model.
- The radon pathway is suppressed in this assessment due to its inapplicability. In a Federal Register Notice (NRC 1994), issued as a result of comments received from a radon workshop, the NRC noted that “radon would not be evaluated when developing release

criteria due to: the ubiquitous nature of radon in the general environment, the large uncertainties in the models used to predict radon concentrations; and the inability to distinguish between naturally occurring radon and that which occurs due to licensed activities.”

Complete exposure pathways applicable to the resident gardener scenario include:

1. Direct radiation from radionuclides in the soil,
2. Inhalation of re-suspended contaminated dust,
3. Ingestion of home grown produce in the contaminated soil,
4. Ingestion of water from a contaminated well, and
5. Ingestion of contaminated soil.

These exposure pathways are depicted in the adjustment to the schematic representation of RESRAD pathways in Figure 2-3.

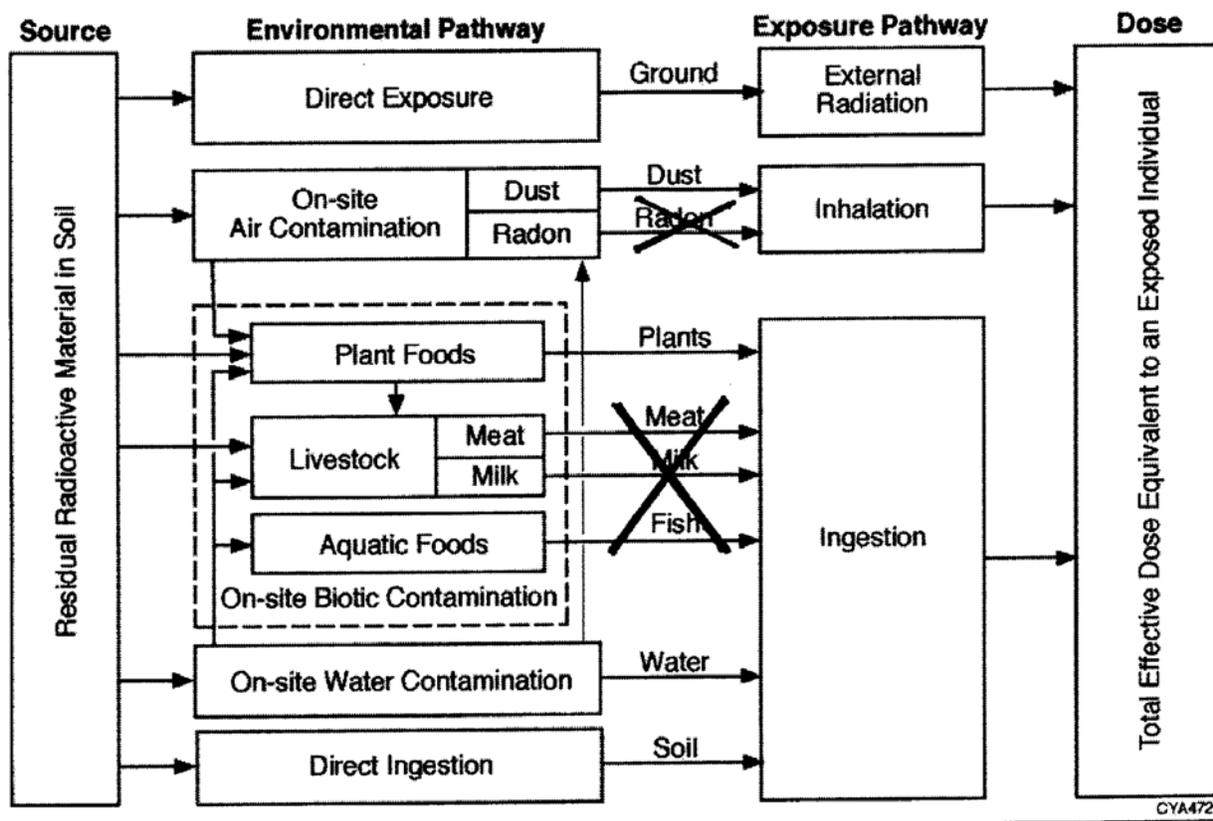


Figure 2-3: Adjusted Schematic of RESRAD Pathways for Resident Gardener

As will be shown, direct exposure to radiation from soil contamination, i.e., external radiation, results in the greatest contribution to dose. Direct ingestion of soil and foods grown in a garden contribute minimally to the dose. Consumption of water from a well placed on the resident's property has no contribution to the dose.

2.3 RESRAD Input Parameters

2.3.1 General Basis for the Dose Modeling Assessment

The following general assumptions formed the basis for the dose modeling assessments:

- The resident gardener scenario is applicable to soils at the Site.
- The DCGL for soil was derived based on a review of site surveys, sampling and prior remediation.
- Site-specific values, where available, were used as input to the RESRAD code. In lieu of site-specific values, NRC values, principally from NUREG/CR-5512, Volume 3 (NRC 1999a), NUREG/CR-5512, Volume 4 (NRC 1999b), and NUREG/CR-6697 (NRC 2000b); EPA *Soil Screening Guidance for Radionuclides: User's Guide* (EPA 2000); RESRAD default values; or information contained in the RESRAD manual (Yu 2001) were used to determine the selected inputs to the code.
- Each parameter and user input selection was evaluated individually and collectively for its appropriateness to the Site. As an example, distribution coefficients for specific elements of interest were ultimately determined based on the soil type comprising the contaminated zone. This was determined to be primarily silty clay loam (with some areas predominantly clay) (USDA 2006a). Corresponding values provided in Table 32.1 of the *RESRAD Data Collection Handbook To Support Modeling Impacts of Radioactive Material In Soil* (Yu 1993) were selected for this type of soil matrix. This same matrix and coefficient value was used for the unsaturated and saturated zones.
- The most recent version of RESRAD (Version 6.3) was used for this assessment.
- Where appropriate, parameter values were selected or determined using values provided by the EPA (EPA 2000).

2.3.2 Specific Justification for Parameter Selection

All parameters utilized in the RESRAD evaluations for natural thorium are listed with justifications for their selection in Appendix A.

The following parameters, taken from Appendix A, were specifically selected for further discussion.

2.3.2.1 *Pathway Selection*

Pathways applicable to the resident gardener scenario were selected. These included direct exposure from external sources, inhalation of dust, plant ingestion, water ingestion and soil ingestion. The meat, milk and aquatic food pathways were suppressed. Additionally, the radon pathway was suppressed for reasons previously discussed.

2.3.2.2 *Source Term*

Thorium-232 (^{232}Th), thorium-228 (^{238}Th) and radium-228 (^{228}Ra) constitute the principal radionuclides for the thorium decay chain. Secular equilibrium between the parent and decay products was assumed.

2.3.2.3 *Radionuclide Concentrations*

Unit concentrations of one picocurie per gram (1 pCi/g) for each of the Site radionuclides of concern were used. This approach provided dose-to-source ratios (DSRs), i.e., dose per unit concentration (mrem/y per pCi/g) which when divided into the primary dose limit resulted in a DCGL for that radionuclide in units of pCi/g.

2.3.2.4 *Area of Contamination Zone*

The contaminated zone is an area in which radionuclides are present in above background concentrations. The contaminated zone was modeled with no cover depth under the assumptions that contaminated silty clay loam existed to a depth of one meter. The primary case assumed a contaminated area of 10,000 square meters. Additional, smaller areas were then evaluated by reducing the contaminated area and length parallel to the aquifer while keeping all other parameters constant (in all cases the length parallel to the aquifer was assumed to be equal to the square root of the contaminated area).

2.3.2.5 *Thickness of Contaminated Zone*

Contamination was assumed to extent to a depth of 0.46 meters (one and a half feet). This was based on previous remediation requirements and results in a conservative approach since soil contamination in most remaining areas is expected to be found within the top 6 inches of soil (15 centimeters).

2.3.2.6 *Cover Depth*

The cover depth corresponds to the distance to the uppermost contaminated soil. No cover depth was assumed overlying the contaminated area for conservatism in the model.

2.3.2.7 *Soil Density*

The U.S. Department of Agriculture, Natural Resources Conservation Service, measured the density of soil samples obtained from many locations at the Site (USDA 2006b). For silty clay loam, which covers much of the Site, the soil density had a range of 1.2 to 1.7 grams per cubic centimeter (g/cc). This was obtained from samples from 0 to 60 inches below ground surface. Therefore, the RESRAD default of 1.5 g/cc was determined appropriate.

2.3.2.8 *Elemental Distribution (partition) Coefficients (K_d)*

This parameter is one of the most important to understand as it relates to contaminant migration and retardation in soil. Site-specific values for this parameter were not determined based on actual sample analysis, but were obtained from “look-up” values in Table 32.1 in the *RESRAD Data Collection Handbook To Support Modeling Impacts of Radioactive Material In Soil* (Yu 1993). Partition coefficients for elements in this table are provided for four different soil types; sand, loam, clay and organic. The following table provides the K_d values for the elements of concern at the Site for loam and clay soil types.

TABLE 2-1: ELEMENT PARTITION COEFFICIENTS (K_d)

Element	Loam K_d (cm^3/g)	Clay K_d (cm^3/g)
Thorium (Th)	3,300	5,800
Radium (Ra)	36,000	9,100

As indicated in the above Table, the K_d values for the two soil types are considerably different. However, the corresponding dose from the RESRAD model using natural thorium (and decay products) as the contaminant with K_d values for loam versus K_d values for clay do not differ. Therefore, K_d is not a sensitive parameter for natural thorium in soil at the Site.

2.3.2.9 *Contaminated Zone Hydraulic Conductivity*

The hydraulic conductivity, in meters per year (m/yr), for the contaminated zone (and unsaturated zone) were assumed to be a factor of 10 less than the saturated zone hydraulic conductivity for silty clay loam in Table 5.2 of the *RESRAD Data Collection Handbook To Support Modeling Impacts of Radioactive Material In Soil* (Yu 1993) or 5.36 m/yr.

2.3.2.10 Saturated Zone “b” Parameter

The soil specific exponential “b” parameter (unitless) is one of several hydrological parameters used to calculate the radionuclide leaching rate of the contaminated zone. The “b” parameters used in the Site model for the contaminated, unsaturated and saturated zones are 7.75 for silty clay loam and 11.40 for clay (Yu 1993).

2.3.2.11 Unsaturated Zone Thickness

The unsaturated zone thickness is the thickness of soil between the bottom of the contaminated zone and the water table. The unsaturated zone thickness used for the Site model is 1.54 meters. This value is derived by subtracting the contaminated zone thickness (0.46 meters) from the distance below ground surface to the water table, which for the Site is assumed to be 2 meters.

2.3.2.12 Groundwater Concentrations and Solubility Constants

The lack of site-specific groundwater and solubility data precluded the input of groundwater concentrations. The groundwater (water dependent) pathway for thorium was an “active” pathway for conservative dose modeling purposes. However, given the relatively immobile nature of thorium, groundwater contamination is not considered viable.

2.3.2.13 External Gamma Radiation Pathway

The external gamma pathway is the predominant, most significant pathway in the DCGL determination for thorium at the Site. Appendix A cites the input values selected for shielding factors and the fraction of time spent indoors/outdoors. For the resident gardener exposure scenario, these three values were obtained from the EPA (EPA 2000).

2.3.2.14 Ingestion Pathway

The significance of the dietary and non-dietary parameters on the DCGL determination is minimal for natural thorium. For the resident gardener exposure scenario, the parameter input values for the ingestion pathways were obtained from the EPA *Soil Screening Guidance for Radionuclides: User’s Guide* (EPA 2000).

2.3.2.15 Radon Parameters

As noted previously, this pathway was “suppressed” in the evaluation.

3.0 RESULTS

Previous sections of this report have detailed the approach and methodology for determining the DCGL for natural thorium. This section utilizes the preceding information to provide the results of the dose assessments for natural thorium in soil at the Site.

3.1 Site-Specific DCGL

3.1.1 Radiological Parameter Inputs to the RESRAD Code

The following inputs and approach were applied to the RESRAD DCGL determination:

- Principal radionuclides and decay products are in secular equilibrium
 - natural thorium
- A normalized (unit) concentration of 1 pCi/g per radionuclide was applied.
- Doses were calculated (by radionuclide) as a function of time, up to 1,000 years.
- The peak dose over the 1,000 year time period was determined (per unit activity of the parent radionuclide).
- Resulting dose-to-source ratios (DSRs) were compared to the NRC regulatory exposure limit of 25 mrem per year, resulting in a DCGL (pCi/g), using the following equation:

$$\text{DCGL (pCi/g)} = 25 \text{ mrem} / \text{DSR (mrem per pCi/g)}$$

3.1.2 RESRAD Results

3.1.2.1 Natural Thorium

Because natural thorium (^{232}Th and decay products) is the Site contaminant in soil within the areas of concern, this radionuclide, with decay products in secular equilibrium, was used in the model to investigate environmental transport and resulting exposure.

Dose Contribution from All Pathways

For the analysis of natural thorium in Site soil, the maximum (summed) dose of 6.21 mrem is delivered at time (t) = "0" years. This dose assumes a maximum contaminated area of 10,000 square meters, with a depth of contaminants in soil of 0.46 meters. Numerous additional evaluations were performed with reduced contaminated areas. As expected, the maximum (summed) dose delivered is reduced as the area is reduced. One important aspect of the evaluation is that the maximum delivered dose does not vary considerably when the contaminated area is 1,000 square meters or greater (up to the maximum of 10,000 square meters).

Significant Pathways

The external dose pathway for this model is the greatest contributor to the total dose delivered. As expected, the parameters associated with this pathway have the most significant impact on the total dose. These parameters include:

- Gamma shielding factor
- Fraction of time spent indoors (on an annual basis)
- Fraction of time spent outdoors (on an annual basis)

Natural Thorium Site-Specific DCGL

The maximum DSR for natural thorium (^{232}Th and decay products) in soil at the Site was determined to be:

$$5.61 \text{ mrem/yr per pCi/g}$$

Using the equation in Section 3.1.1, the site-specific DCGL for natural thorium, determined by dividing the annual dose limit by the DSR, is:

$$\text{Site-Specific DCGL} = 25 \text{ mrem} / 5.61 \text{ mrem/yr per pCi/g} = 4.46 \text{ pCi/g}$$

As a conservative measure and in keeping with the ALARA requirement in 10 CFR 20, this has been rounded down to 4.0 pCi/g. Therefore, the final site-specific DCGL which can be applied to any portion of the Site is **4.0 pCi/g**.

This site-specific DCGL is applicable to ^{232}Th and each decay product under the assumption that all decay products are in secular equilibrium with the parent and possess radiological half-lives greater than 180 days (RESRAD recommended half-life cutoff for dose calculations). Therefore, if the ^{232}Th activity in Site soil does not exceed 4.0 pCi/g, the total dose to a future resident gardener will not exceed 25 mrem per year TEDE.

3.2 Area Factors

An area factor (A_m) is defined in NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000a), as follows:

A factor used to adjust $DCGL_w$ to estimate $DCGL_{EMC}$ and the minimum detectable concentration for scanning surveys in Class 1 survey units--- $DCGL_{EMC} = DCGL_w \times A_m$. A_m is the magnitude by which the residual radioactivity in a small area of elevated activity can exceed the $DCGL_w$ while maintaining compliance with the release criterion.

Area factors were generated for natural thorium in Site soil. To accomplish this, the RESRAD parameter for contaminated area size and length of contaminated area parallel to the aquifer (assumed to be equal to the square root of the contaminated area size) were adjusted while keeping all other parameters constant. The area factors were then computed by taking the ratio of the dose per unit concentration generated by RESRAD for the 10,000 square meter area to that generated for the smaller area. If the DCGL for residual radioactivity distributed over 10,000 square meters is multiplied by the area factor (for the appropriate contaminated area size), the resulting concentration distributed over the smaller area delivers the same calculated dose. Area factors for the Site are provided in Table 3-1.

TABLE 3-1: SITE AREA FACTORS

Nuclide	Area Factor								
	1 m ²	5 m ²	10 m ²	50 m ²	100 m ²	300 m ²	1000 m ²	3000 m ²	10000 m ²
Th-nat	10.3	3.6	2.5	1.5	1.4	1.2	1.0	1.0	1.0

An example of the use of the area factors is provided below:

Assume that an area of interest at the Site is identified and the size of the contaminated area is 100 square meters. The adjusted natural thorium site-specific DCGL for this area is:

$$4.0 \text{ pCi/g} \times 1.4 = 5.6 \text{ pCi/g}$$

If the $DCGL_{EMC}$ is used, a final evaluation will be necessary to verify residual radioactivity within the survey unit results in a total effective dose equivalent not greater than 25 mrem year using MARSSIM Equation 8-2.

4.0 SUMMARY AND CONCLUSIONS

A site-specific DCGL for natural thorium in soil has been generated for use in remediation planning and/or verification that applicable regulatory dose requirements have been achieved at the Naval Station Great Lakes. In determining the DCGL several conservative and reasonable factors were utilized in the dose modeling assessments. These included:

- Selection of a resident gardener scenario as the conceptual site model and critical population group. Although it can't be ruled out, very few residents in urban areas actually use gardens for any significant amount of their dietary needs. Also, portions of the Site will most likely remain as industrial areas. However, the assessments performed assume the industrial area is used at some time in the future for urban residential expansion.
- No credit was taken for the potential dilution of contaminated soil with clean soil which will occur in the process of gardening, area renovations, landscaping and new construction.
- The depth of contamination in soil at the Site was assumed to be 0.46 meters. This was based on remediation performed in some areas of the Site.

Many other input parameters to the dose modeling code were used with justification for the use of all input parameters provided.

A unit concentration of 1 pCi/g for the Site radionuclides of concern (natural thorium with decay products in secular equilibrium) were used in the RESRAD evaluations. This approach provided dose-to-source ratios (DSRs) in units of mrem/yr per pCi/g, calculated for exposed individuals over a 1000 year time period. The DSRs represent the maximum dose to a member of the critical population group (resident gardener) over the 1000 year time period. A DCGL (pCi/g) for the radionuclide of concern in Site soil was determined by dividing the DSR into the primary dose limit of 25 mrem per year.

As a result of the RESRAD analysis, the site-specific DCGL for natural thorium in Site soil using resident gardener input parameters was determined to be **4.0 pCi/g**.

The site-specific DCGL represent the amount of soil contamination above background that would result in a total effective dose equivalent (TEDE) of 25 mrem to a member of the critical group in an area of 10,000 square meters uniformly contaminated with natural thorium to a depth of 0.46 meters. This DCGL is applicable to the parent, as well as each of the individual decay products associated with natural thorium.

5.0 REFERENCES

- (EPA 2000) EPA/540-R-00-0007, *Soil Screening Guidance for Radionuclides: User's Guide*, U.S. Environmental Protection Agency, October 2000.
- (NRC 1994) Federal Register Notice, Volume 59, Number 161, *Comments from Workshops: Radon*, U.S. Nuclear Regulatory Commission, August 22, 1994.
- (NRC 1999a) NUREG/CR-5512, Vol. 3, *Residual Radioactive Contamination from Decommissioning, Parameter Analysis, Draft Report for Comment*, U.S. Nuclear Regulatory Commission, August 1999.
- (NRC 1999b) NUREG/CR-5512, Vol. 4, *Comparison of the Models and Assumptions used in the DandD 1.0, RESRAD 5.61, and RESRAD-Build 1.50 Computer Codes with Respect to the Residential Farmer and Industrial Occupant Scenarios Provided in NUREG/CR-5512, Draft Report for Comment*, U.S. Nuclear Regulatory Commission, August 1999.
- (NRC 2000a) NUREG-1575, Revision 1, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*, U.S. Nuclear Regulatory Commission, August 2000 with June 2001 updates.
- (NRC 2000b) NUREG/CR-6697, *Development of Probabilistic RESRAD 6.0 and RESRAD-Build 3.0 Computer Models*, U.S. Nuclear Regulatory Commission, November 2000.
- (USDA 2006a) *Web Soil Survey*, U.S. Department of Agriculture, National Resources Conservation Service, available at <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx>, obtained November, 2006
- (USDA 2006b) *Physical Soil Properties, Lake County, Illinois*, Tabular Data, U.S. Department of Agriculture, National Resources Conservation Service, obtained November, 2006
- (Yu 1993) EAIS-8, *Data Collection Handbook to Support Modeling Impacts of Radioactive Material in Soil*, Argonne National Laboratory, C. Yu, et. al., April 1993.
- (Yu 2001) ANL/EAD-4, *User's Manual for RESRAD Version 6*, Argonne National Laboratory, C. Yu, et. al., July 2001.
- (Yu 2005) *RESRAD for Windows*, Version 6.3, Computer Code, Argonne National Laboratory, Environmental Assessment Division, C. Yu, et. al., August 25, 2005.

NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
PATHWAY SELECTIONS						
External Gamma	N/A	Active	Active	N/A	N/A	N/A
Inhalation (without radon)	N/A	Active	Active	N/A	N/A	N/A
Plant Ingestion	N/A	Active	Active	N/A	N/A	N/A
Meat Ingestion	N/A	Active	Inactive	N/A	Not applicable for resident gardener	N/A
Milk Ingestion	N/A	Active	Inactive	N/A	Not applicable for resident gardener	N/A
Aquatic Foods	N/A	Active	Inactive	N/A	Not applicable for resident gardener	N/A
Drinking Water	N/A	Active	Active	N/A	N/A	N/A
Soil Ingestion	N/A	Active	Active	N/A	N/A	N/A
Radon	N/A	Inactive	Inactive	N/A	Not applicable per Federal Register, 1994, p. 43210	NRC 1994
CONTAMINATED ZONE PARAMETERS						
Area of contaminated zone	AREA	10,000	10,000	m ²	The RESRAD default is used as the base case for natural thorium.	Yu 1993 (Section 30)
Thickness of contaminated zone	THICK0	2	0.46	m	A conservative approach was selected to define this parameter. The thickness was determined based on previous remediation history at portions of the facility.	Yu 1993 (Section 39)
Length parallel to the aquifer	LCZPAQ	100	100	m	For all cases, the length parallel to the aquifer was calculated as the square root of the contaminated zone area.	Yu 1993 (Section 16)
Times for calculations	TI	1, 3, 10, 30, 100, 300, 1000	1, 3, 10, 30, 100, 300, 1000	yr	RESRAD defaults for calculation times.	Yu 2001
COVER AND CONTAMINATED ZONE HYDROLOGICAL DATA						
Cover depth	COVER)	0	0	m	As a conservative approach for dose modeling, no cover depth was assumed.	Yu 1993 (Section 31)
Density of cover material	DENSCV	1.5	N/A	g/cm ³	Lack of cover depth precludes an assigned value for this parameter.	Yu 1993 (Section 2)
Cover erosion rate	VCV	0.001	N/A	m/yr	Lack of cover depth precludes an assigned value for this parameter.	Yu 1993 (Section 14)

NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Density of contaminated zone	DENSCZ	1.5	1.5	g/cm ³	Soil density range from samples obtained by USDA at the site was 1.2 to 1.7. The RESRAD default was chosen as a reasonable average.	USDA 2006b Yu 1993 (Section 2)
Contaminated zone erosion rate	VCZ	0.001	0.001	m/yr	RESRAD default used.	Yu 1993 (Section 14)
Contaminated zone total porosity	TPCZ	0.4	0.4	unitless	RESRAD default used as an estimate of the total porosity	Yu 1993 (Section 3)
Contaminated zone field capacity	FCCZ	0.2	0.2	unitless	RESRAD default used as an estimate of field capacity	Yu 2001
Contaminated zone hydraulic conductivity	HCCZ	10	5.36	m/yr	Assumed to be a factor of 10 less than the saturated zone hydraulic conductivity for silty clay loam from Table 5.2 of the reference.	Yu 1993 (Section 5)
Contaminated zone b parameter	BCZ	5.3	7.75	unitless	The contaminated zone b parameter was selected from Table 13.1 of the reference for silty clay loam.	Yu 1993 (Section 13)
Humidity in air	HUMID	8	N/A	g/m ³	Humidity input is only required in RESRAD when tritium is a radionuclide of concern.	Yu 2001
Evapotranspiration coefficient	EVAPTR	0.5	0.5	unitless	No site-specific data available. RESRAD default used.	Yu 1993 (Section 12)
Wind speed	WIND	2	4.65	m/sec	Per city-data.com, the wind speed for the Chicgao, IL area averages 10.4 miles per hour (4.65 m/sec).	Yu 1993 (Section 21) Internet search
Precipitation	PRECIP	1	0.91	m/yr	Site-specific value based on reported 35.82 inches per year (0.91 m/yr)	Yu 1993 (Section 9) Internet search
Irrigation	RI	0.2	0.2	m/yr	No site-specific data available. RESRAD default used.	Yu 1993 (Section 11)
Irrigation mode	IDITCH	Overhead	Overhead	unitless	The "Overhead" and "Ditch" designations are independent of the depth of contaminated zone and have no significant impact on the RESRAD evaluation. The RESRAD default designation was selected.	Yu 2001
Runoff coefficient	RUNOFF	0.2	0.2	unitless	The RESRAD default value was selected based on reference value for intermediate combinations of clay and loam.	Yu 1993 (Section 10)

NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Watershed area for nearby stream or pond	WAREA	1.00E6	1.00E6	m ²	RESRAD default used.	Yu 1993 (Section 17)
Accuracy for water/soil computations	EPS	0.001	0.001	unitless	RESRAD default used.	Yu 2001
SATURATED ZONE HYDROLOGICAL DATA						
Density of saturated zone	DENSAQ	1.5	1.5	g/cm ³	Soil density range from samples obtained by USDA at the site was 1.2 to 1.7. The RESRAD default was chosen as a reasonable average.	USDA 2006b Yu 1993 (Section 2)
Saturated zone total porosity	TPSZ	0.4	0.4	unitless	RESRAD default used. Equivalent to contaminated zone total porosity.	Yu 1993 (Section 3)
Saturated zone effective porosity	EPSZ	0.2	0.2	unitless	RESRAD default used.	Yu 1993 (Section 4)
Saturated zone field capacity	FCSZ	0.2	0.2	unitless	RESRAD default used.	Yu 2001
Saturated zone hydraulic conductivity	HCSZ	100	53.6	m/yr	Saturated zone hydraulic conductivity for silty clay loam taken from Table 5.2 of the reference.	Yu 1993 (Section 5)
Saturated zone hydraulic gradient	HGWT	0.02	0.02	unitless	RESRAD default used. Potable water at the Site is obtained via public water supply. Groundwater contamination is not considered a significant exposure pathway, though this parameter is "active" for conservatism.	Yu 1993 (Section 15)
Saturated zone b parameter	BSZ	5.3	7.75	unitless	The contaminated zone b parameter was selected from Table 13.1 of the reference for silty clay loam.	Yu 1993 (Section 13)
Water table drop rate	VWT	0.001	0.001	m/yr	RESRAD default used. Groundwater contamination is not considered a significant exposure pathway, though this parameter is "active" for conservatism.	Yu 1993 (Section 18)
Well pump intake depth (meters below water table)	DWIBWT	10	10	m	RESRAD default used. Groundwater contamination is not considered a significant exposure pathway, though this parameter is "active" for conservatism.	Yu 1993 (Section 19)
Model for Water Transport Parameters [Non-dispersion (ND) or Mass-Balance (MB)]	MODEL	ND	MB	unitless	Per NRC guidance, the MB model is an acceptable approach and provides a potentially more conservative dose estimate relative to the ND model. The MB model assumes a well is located at the center of the site rather than on the down gradient side of the Site boundary.	NUREG-1757, Vo. 2, App. I, page I-40

**NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS**

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
					In addition, all radionuclides released from the contaminated zone are withdrawn through the well. Groundwater contamination is not considered a significant exposure pathway, though this parameter is "active" for conservatism.	NRC 1999b
Well pumping rate	UW	250	250	m ³ /yr	RESRAD default used. Groundwater contamination is not considered a significant exposure pathway, though this parameter is "active" for conservatism.	Yu 2001
UNCONTAMINATED UNSATURATED ZONE PARAMETERS						
Number of unsaturated zone strata	NS	1	1	unitless	RESRAD default used.	Yu 1993 (Section 25)
Unsaturated zone thickness	H(1)	4	1.54	m	Determined by subtracting the contaminated zone thickness (0.46 m) from the assumed saturated zone depth below ground surface (2 m).	Yu 1993 (Section 25)
Unsaturated zone soil density	DENSUZ(1)	1.5	1.5	g/cm ³	Soil density range from samples obtained by USDA at the site was 1.2 to 1.7. The RESRAD default was chosen as a reasonable average.	USDA 2006b Yu 1993 (Section 2)
Unsaturated zone total porosity	TPUZ(1)	0.4	0.4	unitless	RESRAD default used (equivalent to saturated and contaminated zone total porosity inputs).	Yu 1993 (Section 3)
Unsaturated zone effective porosity	EPUZ(1)	0.2	0.2	unitless	RESRAD default used.	Yu 1993 (Section 4)
Unsaturated zone field capacity	FCUZ(1)	0.2	0.2	unitless	RESRAD default used.	Yu 2001
Unsaturated zone hydraulic conductivity	HCUZ(1)	100	5.36	m/yr	Assumed to be a factor of 10 less than the saturated zone hydraulic conductivity for silty clay loam from Table 5.2 of the reference.	Yu 1993 (Section 5)
Unsaturated zone b parameter	BUZ	5.3	7.75	unitless	The unsaturated zone b parameter was selected from Table 13.1 of the reference for silty clay loam.	Yu 1993 (Section 13)
NATURAL THORIUM						
ELEMENTAL DISTRIBUTION (PARTITION) COEFFICIENTS AND LEACH RATES: THORIUM						
Contaminated zone	DCNUCC(2 & 3)	60,000	3,300	cm ³ /g	Site is predominantly silty clay loam. Value from Table 32.1 of the reference for loam selected as the input. However, for thorium, the value selected has no impact on the DCGL determination.	Yu 1993 (Section 32)

NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Unsaturated zone	DCNUCU(2 & 3,1)	60,000	3,300	cm ³ /g	Site is predominantly silty clay loam. Value from Table 32.1 of the reference for loam selected as the input. However, for thorium, the value selected has no impact on the DCGL determination.	Yu 1993 (Section 32)
Saturated zone	DCNUCS(2 & 3)	60,000	3,300	cm ³ /g	Site is predominantly silty clay loam. Value from Table 32.1 of the reference for loam selected as the input. However, for thorium, the value selected has no impact on the DCGL determination.	Yu 1993 (Section 32)
Leach rate	ALEACH(2 & 3)	0	0	y ⁻¹	RESRAD default used.	Yu 2001
Solubility constant	SOLUBK(2 & 3)	0	0	unitless	RESRAD default used.	Yu 2001
ELEMENTAL DISTRIBUTION (PARTITION) COEFFICIENTS AND LEACH RATES: RADIUM						
Contaminated zone	DCNUCC(1)	70	36,000	cm ³ /g	Site is predominantly silty clay loam. Value from Table 32.1 of the reference for loam selected as the input.	Yu 1993 (Section 32)
Unsaturated zone	DCNUCU(1,1)	70	36,000	cm ³ /g	Site is predominantly silty clay loam. Value from Table 32.1 of the reference for loam selected as the input.	Yu 1993 (Section 32)
Saturated zone	DCNUCS(1)	70	36,000	cm ³ /g	Site is predominantly silty clay loam. Value from Table 32.1 of the reference for loam selected as the input.	Yu 1993 (Section 32)
Leach rate	ALEACH(1)	0	0	y ⁻¹	RESRAD default used.	Yu 2001
Solubility constant	SOLUBK(1)	0	0	unitless	RESRAD default used.	Yu 2001
OCCUPANCY, INHALATION AND EXTERNAL GAMMA DATA						
Inhalation rate	INHALR	8,400	8,400	m ³ /y	RESRAD default used.	Yu 1993 (Section 43)
Mass loading for inhalation	MLINH	0.0001	0.0001	g/m ³	RESRAD default used.	Yu 1993 (Section 35)
Exposure duration	ED	30	30	yr	RESRAD default used. DCGL calculations not influenced by exposure duration.	Yu 2001
Inhalation shielding factor	SHF3	0.4	0.4	unitless	RESRAD default used.	Yu 1993 (Section 36)
External gamma shielding factor	SHF1	0.7	0.4	unitless	EPA value from Equation 4 in reference used.	EPA 2000

NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Indoor time fraction	FIND	0.5	0.683	unitless	EPA value from Equation 4 in reference used.	EPA 2000
Outdoor time fraction	FOTD	0.25	0.073	unitless	EPA value from Equation 4 in reference used.	EPA 2000
Shape of the contaminated zone (circular or non-circular)	FS	Circular	Circular	unitless	RESRAD default used.	Yu 1993 (Section 50)
INGESTION PATHWAY (DIETARY DATA)						
Fruits, vegetables and grain consumption	DIET(1)	160	42.7	kg/yr	EPA value from Equation 5 in reference used.	EPA 2000
Leafy vegetable consumption	DIET(2)	14	4.66	kg/yr	EPA value from Equation 5 in reference used	EPA 2000
Milk consumption	DIET(3)	92	N/A	L/yr	Pathway not active	N/A
Meat and poultry consumption	DIET(4)	63	N/A	kg/yr	Pathway not active	N/A
Fish consumption	DIET(5)	5.4	N/A	kg/yr	Pathway not active	N/A
Other seafood consumption	DIET(6)	0.9	N/A	kg/yr	Pathway not active	N/A
Soil ingestion rate	SOIL	36.5	43.8	g/yr	EPA value from Equation 1 in reference used.	EPA 2000
Drinking water intake	DWI	510	730	L/yr	EPA value from Attachment D (paragraph D.2) in reference used.	EPA 2000
Contamination fraction of drinking water	FDW	1	1	unitless	Maximum NRC value used.	NRC 1999b Yu 2001
Contamination fraction of household water	FHHW	1	NA	unitless	Radon pathway is not selected; hence this parameter is not applicable	N/A
Contamination fraction of livestock water	FLW	1	N/A	unitless	Pathway not active.	N/A
Contamination fraction of irrigation water	FIRW	1	1	unitless	Maximum NRC value used.	NRC 1999b
Contamination fraction of aquatic food	FR9	0.5	N/A	unitless	Pathway not active.	N/A
Contaminated fraction of plant food	FPLANT	-1	0.1	unitless	0.1 chosen to more accurately represent the limited available residential garden area and much shorter growing period in this region.	EPA 2000
Contaminated fraction of meat	FMEAT	-1	N/A	unitless	Pathway not active	N/A

**NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS**

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Contaminated fraction of milk	FMILK	-1	N/A	unitless	Pathway not active	N/A
INGESTION PATHWAY (NON-DIETARY DATA)						
Livestock fodder intake for meat	LP15	68	N/A	kg/day	Pathway not active	N/A
Livestock fodder intake for milk	LP16	55	N/A	kg/day	Pathway not active	N/A
Livestock water intake for meat	LW15	50	N/A	L/day	Pathway not active	N/A
Livestock water intake for milk	LW15	160	N/A	L/day	Pathway not active	N/A
Livestock intake of soil	LS1	0.5	N/A	kg/day	Pathway not active	N/A
Mass loading for foliar deposition	MLFD	0.0001	0.0001	g/m ³	RESRAD default used.	Yu 1993
Depth of soil mixing layer	DM	0.15	0.15	m	RESRAD default used.	Yu 1993 (Section 35)
Depth of roots	DROOT	0.9	0.9	m	RESRAD default used.	Yu 1993 (Section 37)
Groundwater fractional usage: Drinking water	FGWDW	1	1	unitless	RESRAD default used.	Yu 1993
Groundwater fractional usage: Household water	FGWHH	1	N/A	unitless	Radon pathway not active	N/A
Groundwater fractional usage: Livestock water	FGWLW	1	N/A	unitless	Pathway not active	N/A
Groundwater fractional usage: Irrigation water	FGWIR	1	1	unitless	RESRAD default used.	Yu 1993
PLANT TRANSPORT FACTORS						
Wet weight crop yield: non-leafy vegetables	YV(1)	0.7	0.7	kg/m ²	RESRAD default used.	Yu 1993 NRC 2000b
Wet weight crop yield: leafy vegetables	YV(2)	1.5	1.5	kg/m ²	RESRAD default used.	Yu 1993 NRC 2000b

**NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS**

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Wet weight crop yield: fodder	YV(3)	1.1	N/A	kg/m ²	Pathway not active.	N/A
Length of growing season: non-leafy vegetables	TE(1)	0.17	0.17	years	RESRAD default used.	Yu 1993 NRC 2000b
Length of growing season: leafy vegetables	TE(2)	0.25	0.25	years	RESRAD default used.	Yu 1993 NRC 2000b
Length of growing season: fodder	TE(3)	0.08	N/A	years	Pathway not active	N/A
Translocation factor: non-leafy vegetables	TIV(1)	0.1	0.1	unitless	RESRAD default used.	Yu 1993 NRC 2000b
Translocation factor: leafy vegetables	TIV(2)	1	1	unitless	RESRAD default used.	Yu 1993 NRC 2000b
Translocation factor: fodder	TIV(3)	1	N/A	unitless	Pathway not active	N/A
Weathering removal constant	WLAM	20	20	y ⁻¹	RESRAD default used.	Yu 1993 NRC 2000b
Wet foliar interception fraction: non-leafy vegetables	RWET(1)	0.25	0.25	unitless	RESRAD default used.	Yu 1993 NRC 2000b
Wet foliar interception fraction: leafy vegetables	RWET(2)	0.25	0.25	unitless	RESRAD default used.	Yu 1993 NRC 2000b
Wet foliar interception fraction: fodder	RWET(3)	0.25	N/A	unitless	Pathway not active.	N/A
Dry foliar interception fraction: non-leafy vegetables	RDRY(1)	0.25	0.25	unitless	RESRAD default used.	Yu 1993 NRC 2000b
Dry foliar interception fraction: leafy vegetables	RDRY(2)	0.25	0.25	unitless	RESRAD default used.	Yu 1993 NRC 2000b
Dry foliar interception fraction: fodder	RDRY(3)	0.25	N/A	unitless	Pathway not active.	N/A
STORAGE TIMES BEFORE USE						
Fruits, non-leafy vegetables and grain	STOR_T(1)	14	14	days	RESRAD default used.	Yu 2001 Yu 1993

**NAVAL STATION GREAT LAKES
DEFAULT AND RECOMMENDED VALUES FOR RESRAD INPUT PARAMETERS**

RESRAD Version 6.3					Parameter Justification	
Parameter	Code	Default Value	User Input Value	Units	Comments	Reference
Leafy vegetables	STOR_T(2)	1	1	days	RESRAD default used.	Yu 2001 Yu 1993
Milk	STOR_T(3)	1	N/A	days	Pathway not active.	N/A
Meat	STOR_T(4)	20	N/A	days	Pathway not active.	N/A
Fish	STOR_T(5)	7	N/A	days	Pathway not active.	N/A
Crustacea and mollusks	STOR_T(6)	7	N/A	days	Pathway not active.	N/A
Well water	STOR_T(7)	1	1	days	RESRAD default used.	Yu 2001 Yu 1993
Surface water	STOR_T(8)	1	1	days	RESRAD default used.	Yu 2001 Yu 1993
Livestock fodder	STOR_T(9)	45	N/A	days	Pathway not active.	N/A