ENVIRONMENTAL CALCULATION COVER PAGE

SECTION 1 - Completed by the Responsible Manager

Project:
200-EA-1 RFI/CMS/RI/FS

Date: 07/03/2019

Calculation Title and Description:
Pore Volume Calculation - 200-EA-1 Operable Unit Liquid Waste Disposal Sites

RELEASE / ISSUE

DATE:
Jul 15, 2019
HANFORD RELEASE

Qualifications Summary

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Calculation Number: ECF-200EA1-17-0066 | Revision Number: 1

Revision History

Revision No.	Description	Date	Affected Pages
1	Includes all 200-EA-1 OU waste sites; revise porosity section & references.	11/19/2017	All

APPROVED
By Lynn M. Ayers at 11:37 am, Jul 15, 2019

Approved for Public Release;
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ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

SECTION 3 - Completed by the Responsible Manager

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SECTION 4 - Document Review and Approval

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SECTION 5 - Applicable if Calculation is a Risk Assessment or Uses an Environmental Model

Prior to Initiating Modeling:

Required training for modelers completed:
Integration Lead:

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Calculation Approved:
Risk/Modeling Integration Manager:

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Table 2. 200-EA-1 OU Waste Sites Receiving >0.5 Pore Volumes of Liquid Waste 4

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1 Purpose

The purpose of this calculation is to estimate the liquid pore volumes discharged to the soil column underlying 200-EA-1 Operable Unit (OU) waste sites.[1] This calculation is one of several lines of evidence used to support the 200-EA-1 OU waste site initial evaluations. Specifically, the results support the evaluation of the relative depth of potential vadose zone contamination and the potential for groundwater impacts.

2 Background

The 200-EA-1 OU consists of many waste sites, including liquid waste disposal and handling sites (e.g., cribs, ditches and trenches) and unplanned release (UPR) sites resulting from known or suspected liquid releases (hereinafter called liquid UPR sites). SGW-60540, *200-EA-1 Operable Unit Scoping*, (hereinafter called the 200-EA-1 scoping document) describes the 200-EA-1 OU waste sites in detail.

3 Methodology

Liquid pore volumes discharged to a waste site are calculated as follows:

1) Identify which 200-EA-1 OU waste sites are liquid sites (i.e., liquid waste disposal and handling sites and liquid UPR sites). Stop here for sites that are not liquid sites.

2) Determine whether liquid sites discharged liquid waste to the soil column.[2] If so, identify the volume of liquid waste discharged. For consistency, convert all volumes to ft^3 using the following equations:

$$Volume\ (m^3) \times \frac{35.31 ft^3}{m^3} = Volume\ (ft^3)$$

$$Volume\ (ML) \times \frac{1{,}000{,}000 L}{ML} \times \frac{0.03531 ft^3}{L} = Volume\ (ft^3)$$

   Stop here for sites that did not discharge liquid to the soil column or where the volume discharged is unknown.

3) Calculate the waste site bottom footprint for each site and, if needed, determine the adjusted footprint.

   a) Calculate the waste site bottom footprint using one of the following equations:

      i) For rectangular footprints: $Length(ft) \times Width(ft) = Calculated\ footprint(ft^2)$

      ii) For circular footprints: $\pi r^2 = Calculated\ footprint(ft^2)$, where r = radius of a circle in feet = diameter of a circle in feet ÷ 2

      Stop here for sites where a waste site bottom footprint cannot be calculated.

   b) Determine the adjusted footprint for each waste site as follows:

      i) If the calculated footprint is <2.3 m^2 (25 ft^2), then assume an adjusted footprint of 2.3 m^2 (25 ft^2).

[1] For purposes of this calculation, one pore volume is the calculated pore volume of the soil column between the waste site bottom and groundwater.

[2] Some liquid waste disposal and handling sites (e.g., pipelines and some retention basins) handled liquid waste but did not discharge it to the soil column.

ii) If the calculated footprint is ≥2.3 m^2 (25 ft^2), then retain the calculated footprint.

4) Identify the waste site bottom depth for each site.

5) Calculate the distance from the waste site bottom to groundwater using the following equation (convert the depth to groundwater from meters to feet by multiplying by 3.281 ft/m):

$$Distance\ from\ waste\ site\ bottom\ to\ groundwater\ (ft) = Depth\ to\ groundwater\ (ft) - Waste\ site\ bottom\ depth\ (ft)$$

6) Calculate the soil column pore volume using the following equation:

$$Soil\ column\ pore\ volume\ (ft^3) = Footprint\ (ft^2) \times Distance\ from\ waste\ site\ bottom\ to\ groundwater\ (ft) \times\ Effective\ porosity\ (unitless)^*$$

*Appendix B estimates the effective porosity.

7) Calculate the pore volume(s) disposed to each waste site rounded to the nearest 0.1 pore volume using the following equation:

$$Pore\ volume(s)\ disposed\ to\ waste\ site\ = \frac{Volume\ discharged\ (ft^3)}{Soil\ column\ pore\ volume\ (ft^3)}$$

4 Assumptions and Inputs

The following are assumptions to the pore volume calculation (numbers align with Chapter 3 calculation steps):

1) No assumptions.

2) Total liquid discharged is distributed uniformly over the waste site.

3) The assumptions include:

   a) The calculated waste site bottom footprints for ditches and trenches are assumed rectangular. Actual footprints for ditches and trenches are irregular, introducing uncertainty in the footprint area. For sites where the source document provides multiple waste site dimensions, use the dimensions that result in the smallest calculated waste site bottom footprint.

   b) There is a minimum adjusted waste site bottom footprint of 2.3 m^2 (25 ft^2) to correct for the improbably narrow soil column for small footprint waste sites (i.e., french drains and injection/reverse wells).

4) For sites where the source document provides a range of waste site bottom depths, use the greatest depth.

5) Water level data provided in the source document are representative of current conditions.

6) See Appendix B for assumptions used when estimating effective porosity.

7) The assumptions include:

   a) Liquid discharged to the soil column occurred only through the bottom of the waste site.

   b) Infiltrating liquid migrates vertically downward and does not spread laterally.

c) Physical, chemical, and/or hydrogeological processes that enhance or limit infiltration depth are not present.

The following are inputs to the pore volume calculation (numbers align with Chapter 3 calculation steps):

1) The 200-EA-1 scoping document (SGW-60540) provides information to identify the liquid waste disposal and handling sites and liquid UPR sites.

2) Table A5-21 of RPP-26744, *Hanford Soil Inventory, Rev. 1* (hereinafter called the Hanford Soil Inventory) and Table 2-2 of DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report*, provide the volume discharged and served as primary sources of volume data for SGW-60540. The Hanford Soil Inventory provides uncertainty estimates ranging from 10 to 50 percent for volumes discharged to cribs, injection/reverse wells, french drains, and trenches. The uncertainty associated with the volume discharged to ditches is unknown, and values provided are estimates based on periodic measurements taken during operations (DOE/RL-92-19).

3) The 200-EA-1 scoping document (SGW-60540) provides the waste site bottom footprint. Uncertainty in waste site footprints for irregularly shaped sites (e.g. ditches and trenches) is present.

4) The 200-EA-1 scoping document (SGW-60540) provides the waste site bottom depth.

5) Figure 3-1 and Table A-1 of SGW-58828, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*, provide the depth to groundwater. Data from the monitoring well nearest to the associated 200-EA-1 OU waste site were used. Water level data from SGW-58828 were selected to reduce the temporal variability in depth to groundwater and to reduce the influence of pressure head on water level measurements from monitoring wells with variable perforated intervals.

6) See Appendix B for inputs used when estimating effective porosity.

7) No additional inputs.

5 Software Applications

Microsoft® Excel® was used to document information and perform the calculations (Hanford Information System Inventory ID 1915). This software is an appropriate and applicable tool for these uses.

6 Calculation

Appendix A executes the calculation steps described in the Chapter 3 methodology.

7 Results/Conclusions

Tables 1 and 2 provides the estimated liquid pore volumes discharged to the soil column for the 200-EA-1 OU waste sites with sufficient information to support pore volume calculations. These waste sites were sorted into those receiving <0.5 pore volumes of liquid waste (Table 1) and those receiving >0.5 pore volumes of liquid waste (Table 2). Table A-1 (Appendix A) identifies all the 200-EA-1 OU waste sites, including the liquid waste disposal and handling sites and liquid UPR sites that either did not discharge liquid waste to the soil column or did not have sufficient data to support pore volume calculations.

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Results presented in this section support other lines of evidence indicating the potential depth of vadose zone contamination at a waste site, but due to the multiple uncertainties described in Chapter 4, they should not be used as the only line of evidence.

Table 1. 200-EA-1 OU Waste Sites Receiving <0.5 Pore Volumes of Liquid Waste

Waste Site	Pore Volumes Received
200-E-4 french drain	0.3
216-A-1 Crib	0.1
216-A-18 Trench	0.0
216-A-38-1 Crib	0.0
216-B-10B Crib	0.1
216-A-41 Crib	0.0
216-B-51 french drain	0.0
216-B-59 Trench	0.0
216-C-4 Crib	0.4
216-C-5 Crib	0.1
216-C-7 Crib	0.1

Table 2. 200-EA-1 OU Waste Sites Receiving >0.5 Pore Volumes of Liquid Waste

Waste Site	Pore Volumes Received
200-E PD Ditch	2.7
200-E-25 french drain	1.2
216-A-3 Crib	3.0
216-A-6 Crib	137.4
216-A-9 Crib	49.9
216-A-10 Crib	109.5
216-A-19 Trench	0.9
216-A-20 Trench	0.8
216-A-27 Crib	4.5
216-A-29 Ditch	204.5
216-A-30 Crib	240.1
216-A-36A Crib	0.6
216-A-36B Crib	22.6

Table 2. 200-EA-1 OU Waste Sites Receiving >0.5 Pore Volumes of Liquid Waste

Waste Site	Pore Volumes Received
216-A-37-1 Crib	23.0
216-A-37-2 Crib	34.9
216-A-45 Crib	2.3
216-B-2-1 Ditch	1,361.8
216-B-2-2 Ditch	2.3
216-B-10A Crib	28.2
216-B-12 Crib	28.3
216-B-55 Crib	67.1
216-B-62 Crib	23.7
216-B-63 Ditch	317.9
216-C-1 Crib	53.7
216-C-2 injection/reverse well	58.9
216-C-3 Crib	4.2
216-C-6 Crib	1.1
216-C-10 Crib	2.3

8 References

DOE/RL-92-19, 1993, *200 East Groundwater Aggregate Area Management Study Report*, Rev. 0, U.S Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/D196136029. https://pdw.hanford.gov/document/D196136305.

RPP-26744, 2005, *Hanford Soil Inventory, Rev. 1*, Rev. 0, U.S Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/document/0081114H.

SGW-58828, 2015, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/document/0079727H.

SGW-60540, 2017, *200-EA-1 Operable Unit Scoping*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/document/0068822H.

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Appendix A

200-EA-1 OU Waste Site Pore Volume Calculation

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Contents

A1 Calculation.....A-1

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Table A-1 200-EA-1 OU Waste Site Pore Volume Calculation……..A-3

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A 200-EA-1 OU Waste Site Pore Volume Calculation

Table A-1 in this appendix executes the calculation steps described in the Chapter 3 methodology of the main text and was compiled using the methodology, assumptions, and inputs identified in Chapters 3 and 4 of the main text.

A1 Calculation

The following describes the columns contained in Table A-1 (numbers align with Chapter 3 calculation steps).

1. Identified the 200-EA-1 operable unit (OU) liquid sites:
   - Column A: Waste site identification (ID) – Identifies the 200-EA-1 OU waste site.
   - Column B: Site type – Identifies the waste site type.
   - Column C: Identifies if the 200-EA-1 OU waste site is a liquid waste disposal and handling site or liquid UPR site.
     - **Stop here** if a waste site is not a liquid site.
2. Identified volume discharged to soil column:
   - Column D: Volume (ML) – Contains the volume of waste discharged in millions of liters to the waste site over its operating life, if known.
   - Column E: Volume (m^3) – Contains the volume of waste discharged in cubic meters to the waste site over its operating life, if known.
     - **Stop here** for sites that did not discharge liquid to the soil column or if the volume discharged to the waste site is unknown.
   - Column F: Volume (ft^3) – Converts the volume provided in columns D or E to cubic feet.
   - Column G: Volume source document – Identifies the source document for liquid waste volumes recorded in columns D or E.
3. Calculated waste site bottom footprint and, if needed, determined the adjusted footprint:
   - Column H: Calculated waste site bottom footprint: (ft^2) – Contains the available dimensions and calculated area of the bottom of the waste site, if known.
     - **Stop here** if the waste site bottom footprint is unknown.
   - Column I: Calculated/adjusted waste site bottom footprint (ft^2) – Contains the calculated or adjusted area of the bottom of the waste site, as appropriate.
4. Identified waste site bottom depth: (Column J; ft below ground surface [bgs]) – Contains the depth of the bottom of the waste site.
5. Calculated distance from the waste site bottom to groundwater:
   - Column K: Groundwater monitoring well – Identifies the monitoring well used to measure the depth to groundwater in column L.

- Column L: Depth to groundwater (m bgs) – Contains the depth to groundwater in meters below ground surface at the groundwater monitoring well identified in column K.
- Column M: Depth to groundwater (ft bgs) – Converts the depth to groundwater provided in column L to feet below ground surface.
- Column N: Calculated distance from waste site bottom to groundwater (ft) – Calculates this distance by subtracting column J from column M.

6. Calculated soil column pore volume: (Column O; ft^3) – Contains the pore volume within the column of soil beneath the waste site calculated by multiplying columns I and N by effective porosity.
7. Calculated pore volume(s) disposed to waste site: (Column P) – Contains the number of pore volumes discharged to the soil column beneath the waste site calculated by dividing column F by column O.

A2 References

DOE/RL-92-19, 1993, *200 East Groundwater Aggregate Area Management Study Report*, Rev. 0, U.S Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/D196136029. https://pdw.hanford.gov/document/D196136305.

RPP-26744, 2005, *Hanford Soil Inventory, Rev. 1*, Rev. 0, U.S Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/document/0081114H.

SGW-58828, 2015, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/document/0079727H.

SGW-60540, 2017, *200-EA-1 Operable Unit Scoping*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington. Available at: http://pdw.hanford.gov/document/0068822H.

Table A-1. 200-EA-1 OU Waste Site Pore Volume Calculation

Step 1			Step 2				Step 3		Step 4	Step 5				Step 6	Step 7
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Waste Site ID[d]	Site Type	Liquid Waste Disposal and Handling Site or Liquid UPR (Yes/No)	Volume of Waste Discharged (ML)	Volume of Waste Discharged (m^3)	Volume of Waste Discharged (ft^3)	Volume Source Document	Calculated Waste Site Bottom Footprint (ft^2)	Calculated / Adjusted Waste Site Bottom Footprint (ft^2)	Waste Site Bottom Depth (ft bgs)	Groundwater Monitoring Well[a]	Depth to Groundwater[a] (m bgs)	Depth to Groundwater[b] (ft bgs)	Calculated Distance from Waste Site Bottom to Groundwater (ft)	Calculated Soil Column Pore Volume (ft^3)	Calculated Pore Volume(s) Disposed to Waste Site
200-E BP	Burn Pit	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E PD	Ditch	Yes	--	2.47E+05	8.72E+06	DOE/RL-92-19, Rev. 0 Table 2-2	1921 ft x 20 ft (38,420 ft^2)	38,420	11.5	299-E24-25	88.9	292	280	3,229,365	2.7
200-E-4	French Drain	Yes	1.75E-02	--	6.18E+02	RPP-26744, Rev.1, Table A5-21	4 ft diameter circle (12.6 ft^2)	25	8	299-E24-25	88.9	292	284	2,128	0.3
200-E-13	Dumping Area	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-25	French Drain	Yes	7.39E-02	--	2.61E+03	RPP-26744, Rev.1, Table A5-21	2 ft diameter circle (3.1 ft^2)	25	20	299-E28-17	94.4	310	290	2,173	1.2
200-E-26	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
200-E-27	Dumping Area	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-41	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-43	Storage Area	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-53	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-56	UPR-liquid	Yes	7.55E-02	--	2.67E+03	RPP-26744, Rev.1, Table A5-21	Unknown	--	--	--	--	--	--	--	--
200-E-57	UPR-liquid	Yes	1.13E-01	--	3.99E+03	RPP-26744, Rev.1, Table A5-21	Unknown	--	--	--	--	--	--	--	--
200-E-109	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-115	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-117	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-121	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-123	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-124	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
200-E-125	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-129	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--

Table A-1. 200-EA-1 OU Waste Site Pore Volume Calculation

Step 1			Step 2				Step 3		Step 4	Step 5				Step 6	Step 7
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Waste Site ID[d]	Site Type	Liquid Waste Disposal and Handling Site or Liquid UPR (Yes/No)	Volume of Waste Discharged (ML)	Volume of Waste Discharged (m^3)	Volume of Waste Discharged (ft^3)	Volume Source Document	Calculated Waste Site Bottom Footprint (ft^2)	Calculated / Adjusted Waste Site Bottom Footprint (ft^2)	Waste Site Bottom Depth (ft bgs)	Groundwater Monitoring Well[a]	Depth to Groundwater[a] (m bgs)	Depth to Groundwater[b] (ft bgs)	Calculated Distance from Waste Site Bottom to Groundwater (ft)	Calculated Soil Column Pore Volume (ft^3)	Calculated Pore Volume(s) Disposed to Waste Site
200-E-130	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-139	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-142	Depression	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
200-E-209-PL	Pipeline	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
200-E-249-PL	Pipeline	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
200-E-251-PL	Pipeline	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
200-E-252-PL	Pipeline	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
200-E-262-PL	Pipeline	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
200-E-276-PL	Pipeline	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
200-E-287	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-292	Dumping Area	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-293	Foundation	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-294	Foundation	No	--	--	--	--	--	--	--	--	--	--	--	--	--
200-E-297	Dumping Area	No	--	--	--	--	--	--	--	--	--	--	--	--	--
201-C	Process Unit	No	--	--	--	--	--	--	--	--	--	--	--	--	--
207-A-NORTH	Retention Basin	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
207-A-SOUTH	Retention Basin	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
207-B	Retention Basin	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
209-E-WS-2	French Drain	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
216-A-1	Crib	Yes	9.84E-02	--	3.47E+03	RPP-26744, Rev.1, Table A5-21	30 ft x 30 ft (900 ft^2)	900	15	299-E26-4	76.2	250	235	63,453	0.1

Table A-1. 200-EA-1 OU Waste Site Pore Volume Calculation

Step 1			Step 2				Step 3		Step 4	Step 5				Step 6	Step 7
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Waste Site ID[d]	Site Type	Liquid Waste Disposal and Handling Site or Liquid UPR (Yes/No)	Volume of Waste Discharged (ML)	Volume of Waste Discharged (m^3)	Volume of Waste Discharged (ft^3)	Volume Source Document	Calculated Waste Site Bottom Footprint (ft^2)	Calculated / Adjusted Waste Site Bottom Footprint (ft^2)	Waste Site Bottom Depth (ft bgs)	Groundwater Monitoring Well[a]	Depth to Groundwater[a] (m bgs)	Depth to Groundwater[b] (ft bgs)	Calculated Distance from Waste Site Bottom to Groundwater (ft)	Calculated Soil Column Pore Volume (ft^3)	Calculated Pore Volume(s) Disposed to Waste Site
216-A-3	Crib	Yes	3.05E+00	--	1.08E+05	RPP-26744, Rev.1, Table A5-21	20 ft x 20 ft (400 ft^2)	400	15	299-E24-21	96.1	315	300	36,036	3.0
216-A-6	Crib	Yes	3.36E+03	--	1.19E+08	RPP-26744, Rev.1, Table A5-21	100 ft x 100 ft (10,000 ft^2)	10,000	21	299-E25-36	94.1	309	288	863,226	137.4
216-A-9	Crib	Yes	9.80E+02	--	3.46E+07	RPP-26744, Rev.1, Table A5-21	420 ft x 20 ft (8,400 ft^2)	8,400	13	299-E24-22	87.9	288	275	694,008	49.9
216-A-10	Crib	Yes	3.16E+03	--	1.12E+08	RPP-26744, Rev.1, Table A5-21	275 ft x 45 ft[e] (12,375 ft^2)	12,375	45	299-E24-16	97.4	320	275	1,019,339	109.5
216-A-18	Trench	Yes	4.88E-01	--	1.72E+04	RPP-26744, Rev.1, Table A5-21	80 ft x 80 ft (6,400 ft^2)	6400	15	299-E26-4	76.2	250	235	451,223	0.0
216-A-19	Trench	Yes	1.10E+00	--	3.88E+04	RPP-26744, Rev.1, Table A5-21	25 ft x 25 ft (625 ft^2)	625	15	299-E26-4	76.2	250	235	44,065	0.9
216-A-20	Trench	Yes	9.61E-01	--	3.39E+04	RPP-26744, Rev.1, Table A5-21	25 ft x 25 ft (625 ft^2)	625	15	299-E26-4	76.2	250	235	44,065	0.8
216-A-27	Crib	Yes	2.32E+01	--	8.19E+05	RPP-26744, Rev.1, Table A5-21	200 ft x 10 ft (2,000 ft^2)	2,000	15	299-E24-16	97.4	320	305	182,742	4.5
216-A-29	Ditch	Yes	--	1.04E+07	3.67E+08	DOE/RL-92-19, Rev. 0 Table 2-2	4,000 ft x 6 ft (24,000 ft^2)	24,000	15	299-E25-34	80.6	264	249	1,796,030	204.5
216-A-30	Crib	Yes	7.64E+03	--	2.70E+08	RPP-26744, Rev.1, Table A5-21	1,400 ft x 10 ft (14,000 ft^2)	14,000	12	299-E25-19	85.2	280	268	1,123,673	240.1
216-A-34	Ditch	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
216-A-36A	Crib	Yes	1.07E+00	--	3.78E+04	RPP-26744, Rev.1, Table A5-21	100 ft x 7.5 ft (750 ft^2)	750	22	299-E24-16	97.4	320	298	66,953	0.6
216-A-36B	Crib	Yes	3.15E+02	--	1.11E+07	RPP-26744, Rev.1, Table A5-21	500 ft x 11 ft (5,500 ft^2)	5,500	24	299-E17-18	98.1	322	298	491,479	22.6
216-A-37-1	Crib	Yes	3.68E+02	--	1.30E+07	RPP-26744, Rev.1, Table A5-21	700 ft x 10 ft (7,000 ft^2)	7,000	11	299-E25-19	85.2	280	269	563,937	23.0
216-A-37-2	Crib	Yes	1.10E+03	--	3.88E+07	RPP-26744, Rev.1, Table A5-21	1,400 ft x 10 ft (14,000 ft^2)	14,000	16	299-E25-24	85.7	281	265	1,113,763	34.9
216-A-38-1	Crib	Yes	0.00E+00	--	0.00E+00	SGW-60540, Rev. 0	15 ft x 520 ft (7,800 ft^2)	7800	37	299-E24-16	97.4	320	283	661,212	0.0
216-A-40	Retention Basin	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
216-A-41	Crib	Yes	1.00E-02	--	3.53E+02	RPP-26744, Rev.1, Table A5-21	10 ft x 10 ft (100 ft^2)	100	6.5	299-E24-22	87.9	288	282	8,457	0.0
216-A-42	Retention Basin	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
216-A-45	Crib	Yes	1.03E+02	--	3.64E+06	RPP-26744, Rev.1, Table A5-21	310 ft x 60 ft (18,600 ft^2)	18,600	44.5	299-E17-22	98.9	324	280	1,562,349	2.3

Table A-1. 200-EA-1 OU Waste Site Pore Volume Calculation

Step 1			Step 2				Step 3		Step 4	Step 5				Step 6	Step 7
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Waste Site ID[d]	Site Type	Liquid Waste Disposal and Handling Site or Liquid UPR (Yes/No)	Volume of Waste Discharged (ML)	Volume of Waste Discharged (m^3)	Volume of Waste Discharged (ft^3)	Volume Source Document	Calculated Waste Site Bottom Footprint (ft^2)	Calculated / Adjusted Waste Site Bottom Footprint (ft^2)	Waste Site Bottom Depth (ft bgs)	Groundwater Monitoring Well[a]	Depth to Groundwater[a] (m bgs)	Depth to Groundwater[b] (ft bgs)	Calculated Distance from Waste Site Bottom to Groundwater (ft)	Calculated Soil Column Pore Volume (ft^3)	Calculated Pore Volume(s) Disposed to Waste Site
216-B-2-1	Ditch	Yes	--	1.49E+08	5.26E+09	DOE/RL-92-19, Rev. 0 Table 2-2	3,500 ft x 15 ft (52,500 ft^2)	52,500	6	299-E27-18	76.6	251	245	3,863,862	1,361.8
216-B-2-2	Ditch	Yes	--	4.97E+04	1.76E+06	DOE/RL-92-19, Rev. 0 Table 2-2	3,500 ft x 3 ft (10,500 ft^2)	10,500	8	299-E27-18	76.6	251	243	766,472	2.3
216-B-2-3	Ditch	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
216-B-10A	Crib	Yes	9.98E+00	--	3.52E+05	RPP-26744, Rev.1, Table A5-21	12 ft x 12 ft (144 ft^2)	144	20	299-E28-17	94.4	310	290	12,516	28.2
216-B-10B	Crib	Yes	2.80E-02	--	9.89E+02	RPP-26744, Rev.1, Table A5-21	12 ft x 12 ft (144 ft^2)	144	20	299-E28-17	94.4	310	290	12,516	0.1
216-B-12	Crib	Yes	5.20E+02	--	1.84E+07	RPP-26744, Rev.1, Table A5-21	161 ft x 51 ft (8,211 ft^2)	8,211	30	299-E28-18	89.5	294	264	649,448	28.3
216-B-51	French Drain	Yes	1.00E-03	--	3.53E+01	RPP-26744, Rev.1, Table A5-21	5 ft diameter circle (19.6 ft^2)	25	14	299-E33-14	68.1	223	209	1,571	0.0
216-B-55	Crib	Yes	1.20E+03	--	4.24E+07	RPP-26744, Rev.1, Table A5-21	750 ft x 10 ft (7,500 ft^2)	7,500	13	299-E28-18	89.5	294	281	631,461	67.1
216-B-59	Trench	Yes	4.77E-01	--	1.68E+04	RPP-26744, Rev.1, Table A5-21	400 ft x 20 ft (8,000 ft^2)	8000	14	299-E28-1	87.6	287	273	656,197	0.0
216-B-59B	Retention Basin	Yes	NA[c]	NA[c]	--	--	--	--	--	--	--	--	--	--	--
216-B-62	Crib	Yes	2.80E+02	--	9.89E+06	RPP-26744, Rev.1, Table A5-21	500 ft x 10 ft (5,000 ft^2)	5,000	15	299-E28-18	89.5	294	279	417,974	23.7
216-B-63	Ditch	Yes	7.98E+03	--	2.82E+08	RPP-26744, Rev.1, Table A5-21	1,600 ft x 8 ft (12,800 ft^2)	12,800	10	299-E34-10	73.4	241	231	886,370	317.9
216-C-1	Crib	Yes	2.34E+01	--	8.26E+05	RPP-26744, Rev.1, Table A5-21	23 ft x 8 ft (184 ft^2)	184	13	299-E24-25	88.9	292	279	15,383	53.7
216-C-2	Injection/ Reverse Well	Yes	3.15E+00	--	1.11E+05	RPP-26744, Rev.1, Table A5-21	12 in diameter circle (0.79 ft^2)	25	40	299-E24-25	88.9	292	252	1,888	58.9
216-C-3	Crib	Yes	5.00E+00	--	1.77E+05	RPP-26744, Rev.1, Table A5-21	50 ft x 10 ft (500 ft^2)	500	10	299-E24-25	88.9	292	282	42,252	4.2
216-C-4	Crib	Yes	1.70E-01	--	6.00E+03	RPP-26744, Rev.1, Table A5-21	10 ft x 20 ft (200 ft^2)	200	16	299-E24-25	88.9	292	276	16,541	0.4
216-C-5	Crib	Yes	3.89E-02	--	1.37E+03	RPP-26744, Rev.1, Table A5-21	10 ft x 20 ft (200 ft^2)	200	16	299-E24-25	88.9	292	276	16,541	0.1
216-C-6	Crib	Yes	5.31E-01	--	1.87E+04	RPP-26744, Rev.1, Table A5-21	10 ft x 20 ft (200 ft^2)	200	16	299-E24-25	88.9	292	276	16,541	1.1
216-C-7	Crib	Yes	5.99E-02	--	2.12E+03	RPP-26744, Rev.1, Table A5-21	20 ft x 20 ft (400 ft^2)	400	10	299-E24-25	88.9	292	282	33,802	0.1
216-C-10	Crib	Yes	8.97E-01	--	3.17E+04	RPP-26744, Rev.1, Table A5-21	32.5 ft x 5 ft (162.5 ft^2)	162.5	7	299-E24-25	88.9	292	285	13,878	2.3

Table A-1. 200-EA-1 OU Waste Site Pore Volume Calculation

Step 1			Step 2				Step 3		Step 4	Step 5				Step 6	Step 7
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Waste Site ID[d]	Site Type	Liquid Waste Disposal and Handling Site or Liquid UPR (Yes/No)	Volume of Waste Discharged (ML)	Volume of Waste Discharged (m^3)	Volume of Waste Discharged (ft^3)	Volume Source Document	Calculated Waste Site Bottom Footprint (ft^2)	Calculated / Adjusted Waste Site Bottom Footprint (ft^2)	Waste Site Bottom Depth (ft bgs)	Groundwater Monitoring Well[a]	Depth to Groundwater[a] (m bgs)	Depth to Groundwater[b] (ft bgs)	Calculated Distance from Waste Site Bottom to Groundwater (ft)	Calculated Soil Column Pore Volume (ft^3)	Calculated Pore Volume(s) Disposed to Waste Site
218-E-7	Burial Vault	No	--	--	--	--	--	--	--	--	--	--	--	--	--
2607-E3	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-E5	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-E6	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-E7A	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-E7B	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-E9	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-E12	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-EA	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
2607-EF	Septic System	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
291-C	Process Unit	No	--	--	--	--	--	--	--	--	--	--	--	--	--
291-C-1	Burial Ground	No	--	--	--	--	--	--	--	--	--	--	--	--	--
HSVP	Valve Pit	Yes	NA	NA	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-10	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-11	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-12	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-20	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-21	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-29	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-33	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--

Table A-1. 200-EA-1 OU Waste Site Pore Volume Calculation

Step 1			Step 2				Step 3		Step 4	Step 5				Step 6	Step 7
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Waste Site ID[d]	Site Type	Liquid Waste Disposal and Handling Site or Liquid UPR (Yes/No)	Volume of Waste Discharged (ML)	Volume of Waste Discharged (m^3)	Volume of Waste Discharged (ft^3)	Volume Source Document	Calculated Waste Site Bottom Footprint (ft^2)	Calculated / Adjusted Waste Site Bottom Footprint (ft^2)	Waste Site Bottom Depth (ft bgs)	Groundwater Monitoring Well[a]	Depth to Groundwater[a] (m bgs)	Depth to Groundwater[b] (ft bgs)	Calculated Distance from Waste Site Bottom to Groundwater (ft)	Calculated Soil Column Pore Volume (ft^3)	Calculated Pore Volume(s) Disposed to Waste Site
UPR-200-E-37	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-43	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-50	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-64	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-66	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-69	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-88	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-89	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-95	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-98	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-99	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-112	UPR-liquid	Yes	Unknown	Unknown	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-143	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--
UPR-200-E-144	UPR-solid	No	--	--	--	--	--	--	--	--	--	--	--	--	--

Sources:
DOE/RL-92-19, *200 East Groundwater Aggregate Area Management Study Report* (Table 2-2).
RPP-26744, *Hanford Soil Inventory , Rev. 1* (Table A5-21).
SGW-58828, *Water Table Maps for the Hanford Site 200 East Area, 2013 and 2014* (Figure 3-1 and Table A-1).
SGW-60540, *200-EA-1 Operable Unit Scoping.*

Notes:
a. Depth to water selected from well located nearest to waste site based on SGW-58828, Rev 0, Figure 3-1 and Table A-1.
b. Depth to water in feet = depth to water in meters x 3.281.
c. Pipeline or lined retention basin - no discharge to the soil column.
d. Five waste sites (200-E-99, 200-E-100, 200-E-301, 216-B-64, and UPR-200-E-101) were removed from the 200-EA-1 OU scope after publication of SGW-60540 and are not included in this evaluation.
e. 216-A-10 Crib is a "V" shaped trench (waste site bottom width = 0 ft). So that the calculation could be completed, the width of a transect through and perpendicular to the crib distribuiton pipe and intersecting the crib side walls (45 feet) was used as the bottom width.

bgs = below ground surface
NA = not applicable
OU = operable unit
UPR = unplanned release

Appendix B

Estimating Effective Porosity for use in the 200-EA-1 OU Waste Site Pore Volume Calculation

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B Estimating Effective Porosity for use in the 200-EA-1 OU Waste Site Pore Volume Calculation

This appendix shows how effective porosity was estimated for use in the 200-EA-1 operable unit (OU) waste site pore volume calculation.

B1 Methodology

Effective porosity is estimated as follows:

1) Identify hydrostratigraphic profiles representative of 200 East Area subsurface conditions underlying 200-EA-1 OU liquid sites. Complete steps 2-8 for each representative hydrostratigraphic profile.
2) Identify the geologic units, geologic unit depths, and soil types.
3) Calculate the thickness of each soil type using the following equation:

   Thickness of Soil Type B (ft) = Depth of Soil Type B (ft) – Depth of Soil Type A (ft),

   where 'Soil Type B' directly underlies 'Soil Type A.'

4) Identify effective porosity for each soil type.
5) Calculate the percent composition of each soil type as follows:

$$Soil\ Type\ Percent\ Composition\ = \frac{Soil Type\ Thickness\ (ft)}{Hydrostraigraphic\ Profile Total\ Thickness\ (ft)} \times 100,$$

   where the Hyrdostratigraphic Profile Total Thickness = Water Table Depth

6) Calculate the weighted effective porosity of each soil type as follows:

$$Soil\ Type\ Weighted\ Effective\ Porosity = Soil\ Type\ Percent\ Composition \times Soil\ Type\ Effective\ Porosity$$

7) Calculate the hydrostratigraphic profile's effective porosity as follows:

$$Hydrostratigraphic\ Profile\ Effective\ Porosity = \sum_{i=1}^{n} (Soil\ Type\ Weighted\ Effective\ Porositiy)_n$$

8) Calculate the average effective porosity for the hydrostratigraphic profiles relevant to the 200-EA-1 OU.

$$Average\ Effective\ Porosity\ for\ Hydrostratigraphic\ Profiles = \frac{1}{n}\sum_{i=1}^{n} (Hydrostratigraphic\ Profile\ Effective\ Porosity)_n$$

B2 Assumptions and Inputs

Table B-1 presents this calculation's assumptions and inputs. Numbers in Table B-1 align with Section B1 calculation steps.

Table B-1. Effective Porosity Calculation Assumptions and Inputs

Step	Assumptions	Inputs
1	None	DOE/RL-2011-50, Table 4-2
2	To account for large scale variability in the hydrostratigraphy across the Hanford Site, the hydrogeologic profiles were assumed to have similar hydrogeologic structure and properties (e.g. 4 to 6 horizontal layers, homogeneous, isotropic).[a]	DOE/RL-2011-50, Table 4-2
3	None	No additional inputs.
4	Effective porosity is assumed to be equal to the saturated moisture content, Θ_s.[b]	DOE/RL-2011-50, Table 4-4
5	None	No additional inputs.
6	None	No additional inputs.
7	None	No additional inputs.
8	None	No additional inputs.

Sources: DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection*.

PNNL-14702, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*

a. Reference PNNL-14702, Section 2.4.1.

b. Reference PNNL-14702, Section 4.2.

B3 Software Applications

Microsoft® Excel® was used to document information and perform the calculations (Hanford Information System Inventory ID 1915). This software is an appropriate and applicable tool for these uses.

B4 Calculation

Table B-2 executes the calculation steps described in Section B1 methodology. The following describes the columns contained in Table B-2 (numbers align with Section B1 calculation steps).

1. Identified hydrostratigraphic profiles representative of 200 East Area subsurface conditions underlying 200-EA-1 OU liquid sites.

   - Column A: Rows 1, 9, 17, 19, 21, 28, 35, and 37 list the 200 East Area hydrostratigraphic profiles identified in DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection*, and considered in this calculation.

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- **Stop here** for hydrostratigraphic profiles that are not relevant to the 200-EA-1 OU.

2. Identified the geologic units, geologic unit depths, and soil types.
   - Column B: Depth (ft) – Contains the depth in feet from ground surface to the geologic unit.
   - Column C – Contains the geologic unit name.
   - Column D – Contains the soil type (code) comprising the geologic unit.
3. Calculated the thickness of each soil type: (Column E; ft).
4. Identified effective porosity for each soil type: (Column F; percent).
5. Calculated the percent composition of each soil type (Column G; percent).
6. Calculated the weighted effective porosity of each soil type: (Column H; percent).
7. Calculated the effective porosity of the hydrostratigraphic profile: (Column I; percent).
8. Calculated the average effective porosity for the hydrostratigraphic profiles relevant to the 200-EA-1 OU (Row 39; percent).

B5 Results/Conclusions

As shown in Table B-2, the calculated average effective porosity for the four hydrostratigraphic profiles relevant to the 200-EA-1 OU is 31%. This value implies a higher degree of accuracy than actually exists in this calculation. For example, there is great variability in the 200 East Area hydrostratigraphy for which this calculation does not account (see step 2 assumption in Table B-1 [Section B2]). Therefore, recommend using an effective porosity of 30% in the 200-EA-1 OU waste site pore volume calculation.

B6 References

DOE/RL-2011-50, 2012, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/document/0093361.

PNNL-14702, 2006, *Vadose Zone Hydrogeology Data Package for Hanford Assessments*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://pdw.hanford.gov/document/0911300343.

Table B-2. Estimating Effective Porosity for use in the 200-EA-1 OU Waste Site Pore Volume Calculation

Step	Step 2			Step 3	Step 4	Step 5	Step 6	Step 7
Column	B	C	D	E	F	G	H	I
Row	Depth (ft)	Geologic Unit	Soil Type[a]	Soil Type Thickness (ft)	Soil Type Effective Porosity	Soil Type Percent Composition (%)	Soil Type Weighted Effective Porosity (%)	Hydrostratigraphic Profile Effective Porosity (%)
1	**Template 200A-x for Surface Disposal Sites (e.g., Ponds)[b]**							**32**
2	0	Surface	N/A	N/A	N/A	N/A	N/A	--
3	15	Eolian	Hss	15	0.445	4.9	2.2	--
4	30	Hanford Gravel	Hg	15	0.167	4.9	0.82	--
5	233	South 200 East Sand	Hfs	203	0.379	67	25	--
6	295	Hanford Gravel	Hg	62	0.167	20	3.4	--
7	305	Ringold Unit E	Rg	10	0.177	3.3	0.58	--
8	305	Water Table	N/A	N/A	N/A	N/A	N/A	--
9	**Template 216A-x for Shallow Disposal Sites (e.g., Cribs, Burial Grounds)[b]**							**31**
10	0	Surface	N/A	N/A	N/A	N/A	N/A	--
11	15	Backfill	B	15	0.262	4.9	1.3	--
12	30	Hanford Gravel	Hg	15	0.167	4.9	0.82	--
13	233	South 200 East Sand	Hfs	203	0.379	67	25	--
14	295	Hanford Gravel	Hg	62	0.167	20.	3.4	--
15	305	Ringold Unit E	Rg	10	0.177	3.3	0.58	--
16	305	Water Table	N/A	N/A	N/A	N/A	N/A	--

Table B-2. Estimating Effective Porosity for use in the 200-EA-1 OU Waste Site Pore Volume Calculation

Step	Step 2			Step 3	Step 4	Step 5	Step 6	Step 7
Column	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Row	**Depth (ft)**	**Geologic Unit**	**Soil Type[a]**	**Soil Type Thickness (ft)**	**Soil Type Effective Porosity**	**Soil Type Percent Composition (%)**	**Soil Type Weighted Effective Porosity (%)**	**Hydrostratigraphic Profile Effective Porosity (%)**
17	**Template 216A_BC_E-X for the Eastern Corner of the BC Crib Area Based on 299-E-13-1 (N 134404.512, E573655.723)**							**N/A**
18	Template not used to estimate effective porosity. South and east of the 200-EA-1 OU, and not proximal to 200-EA-1 OU waste sites.							
19	**Template 216A_BCT_S-X for the Southwestern Portion of the BC Trench Area Based on 299-E13-12 (N 134146.593, E573188.669)**							**N/A**
20	Template not used to estimate effective porosity. South and west of the 200-EA-1 OU, and not proximal to 200-EA-1 OU waste sites.							
21	**Template 200B-X for Surface Disposal Sites (e.g., Buildings, Ponds, Ditches, Unplanned Releases)[c]**							**30.**
22	0	Surface	N/A	N/A	N/A	N/A	N/A	--
23	2	Eolian	Hss	2	0.445	0.77	0.34	--
24	66	Hanford Gravel	Hg	64	0.167	25	4.1	--
25	249	North 200 East Hanford Sand	Hcs	183	0.349	70.	25	--
26	260	Undifferentiated Hanford/Plio-Pleistocene	Hg	11	0.167	4.2	0.71	--
27	260	Water Table	N/A	N/A	N/A	N/A	N/A	--
28	**Template 216B-X for Shallow Disposal Sites (e.g., Cribs, Burial Grounds)[c]**							**30.**
29	0	Surface	N/A	N/A	N/A	N/A	N/A	--
30	15	Backfill	B	15	0.262	5.8	1.5	--
31	66	Hanford Gravel	Hg	51	0.167	20.	3.3	--

Table B-2. Estimating Effective Porosity for use in the 200-EA-1 OU Waste Site Pore Volume Calculation

Step	Step 2			Step 3	Step 4	Step 5	Step 6	Step 7
Column	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Row	**Depth (ft)**	**Geologic Unit**	**Soil Type[a]**	**Soil Type Thickness (ft)**	**Soil Type Effective Porosity**	**Soil Type Percent Composition (%)**	**Soil Type Weighted Effective Porosity (%)**	**Hydrostratigraphic Profile Effective Porosity (%)**
32	249	North 200 East Hanford Sand	Hcs	183	0.349	70.	25	--
33	260	Undifferentiated Hanford/Plio-Pleistocene	Hg	11	0.167	4.2	0.71	--
34	260	Water Table	N/A	N/A	N/A	N/A	N/A	--
35	**Template 216E-X for Surface Disposal Sites (e.g. Ponds)**							**N/A**
36	Template not used to estimate effective porosity. North and east of the 200-EA-1 OU, and not proximal to 200-EA-1 OU waste sites.							
37	**Template 216E-X for Shallow Disposal Sites (i.e., Cribs, Tranches, Burial Grounds, Sand Filter, Septic Systems)**							**N/A**
38	Template not used to estimate effective porosity. North and east of the 200-EA-1 OU, and not proximal to 200-EA-1 OU waste sites.							
39	**Step 8: Average Effective Porosity for Hydrostratigraphic Profiles Relevant to the 200-EA-1 OU**							**31**

Source: DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection* (Tables 4-2 and 4-4).

Notes:

a. Table 4-1 in DOE/RL-2011-50 provides descriptions of each soil type.

b. Hydrostratigraphic profile in the southern 200 East Area (near the Plutonium Uranium Extraction [PUREX] Plant, Hot Semiworks, and A, AN, AP, AW, AX, AY, AZ, and C Tank Farms).

c. Hydrostratigraphic profile in the northwestern 200 East Area (near B Plant and the B, BX, BY Tank Farms).

N/A = not applicable

OU = operable unit