WCH-326
Rev. 0

River Corridor
Closure Contract

100-K Target Analyte List Development for Soil

April 2010

For Public Release

Washington Closure Hanford

Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

STANDARD APPROVAL PAGE

Title: 100-K Target Analyte List Development for Soil

Author Name: R. W. Ovink, Integration Project Task Lead

Approval: J. A. Lerch, Mission Completion

Signature _____ Date 9/14/12

The approval signature on this page indicates that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

WCH-326
Rev. 0

River Corridor Closure Contract

100-K Target Analyte List Development for Soil

April 2010

Author:
R. W. Ovink

For Public Release

Washington Closure Hanford
Prepared for the U.S. Department of Energy, Richland Operations Office
Office of Assistant Manager for River Corridor

TABLE OF CONTENTS

TABLES

APPENDIX

1.0 PURPOSE

This report documents the process used to identify source area target analytes in support of the 100-K Area remedial investigation/feasibility study (RI/FS) addendum to the *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2008-46, Rev. 0). A "target analyte" is defined as a constituent suspected of being site-related that is carried into an investigation plan for characterization through sampling and analysis by approved laboratory methods. Target analytes identified for the 100 and 300 Areas must support RI/FS nature and extent characterization plus final remedial action decisions for source areas. This report also establishes the analyte exclusion criteria applicable for the 100 and 300 Area use and the analytical methods needed to analyze the refined target analytes.

2.0 APPROACH

The approach for the development of vadose zone soil target analytes is a multi-step process. In Steps 1 and 2, initial and master analytes lists were developed. The third step developed location-specific target analyte lists for waste sites where additional characterization is planned. Finally, the analyte list will receive regulatory review and input. This will result in final location-specific target analytes.

Step 1 – Prepare Initial Master Target Analyte

Characterization data for vadose zone soils are not available for addressing uncertainties associated with the nature and extent of contamination in the vadose zone. Therefore, remediation and characterization information (historic and current) is identified and reviewed to develop an initial list of target analytes to represent potential contamination in the vadose zone. The following types of reference documents and information sources are evaluated:

- Focused feasibility studies (FFS), limited field investigation (LFI) reports
- Interim action records of decision (IARODs)
- Cleanup verification documents (cleanup verification packages [CVPs], remaining sites verification packages [RSVPs])
- Technical baseline reports
- Databases containing analytical data resulting from these activities (i.e., characterization, remediation, waste management information)
- Other pertinent documents

Step 2 – Prepare Master Target Analyte List

After the initial target analyte list is compiled, the information undergoes additional review steps to remove analytes using generally-accepted exclusion criteria; a comparison of the soil target analyte list to the groundwater contaminants of potential concern (COPC) list is conducted, and the appropriate analytical methods and detection limits for the master target analyte list is identified.

At the conclusion of this step, the master target analyte list is established. The master target analyte list is comprehensive and includes all the analytes that have the potential to be present in the vadose zone and are important for waste site remediation within the area. The following steps are taken to prepare the master target analyte list.

- Apply the following generally accepted exclusion criteria to the initial set of target analytes.
  - Radionuclides with half-lives less than 3 years (and no significant "daughters")
  - Naturally occurring radionuclides associated with background radiation (e.g., K-40, Th-230, Th-232, and Ra-226)
  - Essential nutrients (minerals)
  - Analytes that have no toxicity values (based on the hierarchy of toxicity values recommended by the U.S. Environmental Protection Agency (EPA) in *Human Health Toxicity Values for Superfund Risk Assessments* [OSWER Directive 9285.7-53]).
- Compare the master target analyte list for vadose zone soil with the groundwater COPC list developed for the area. Groundwater COPCs not found on the master target analyte list are further evaluated to determine if there is a valid basis for their inclusion.
- Identify appropriate analytical methods for each analyte on the master target analyte list. Determine if the detection limits for each target analyte can achieve the remedial action goals for direct exposure, groundwater protection, and Columbia River protection.

Step 3 – Develop Location-Specific Target Analyte List

The master target analyte list represents all potential target analytes that could be present in the vadose zone for the waste site area. Location-specific target analytes will be identified from the master list using the following approach.

- Identify the contaminants of concern (COCs) for the specific waste sites where characterization is proposed from the applicable IAROD (which reflects information from LFI and technical baseline reports). If the characterization location is not at a waste site, evaluate information from waste sites in the vicinity (where available), and include these analytes on the location-specific target analyte list.
- Identify the COCs for the specific waste site locations from the verification documentation (CVPs or RSVPs). If the characterization location is not at a waste site, evaluate information

from waste sites in the vicinity (where available), and include these analytes on the location-specific target analyte list.

- Evaluate local groundwater monitoring well data (wells located within waste site "zones of influence"). Determine if groundwater COPCs have been analyzed for in these local wells.
  - If the groundwater COPCs have been analyzed for but not detected, then these analytes will not be included on the location-specific target analyte list.
  - If the groundwater COPCs have been analyzed for and have been detected, then these analytes will be included on the location-specific target analyte list.
  - If the groundwater COPCs have not been analyzed for, then an additional evaluation will be performed to determine if there is a data need. If there is a data need, these COPCs will be included on the waste-site specific target analyte list.

Step 4 – Agency Review of Locations and Location-Specific Target Analyte Lists

Following development of the location-specific target analyte list pursuant to Steps 1 through 3 above, the agencies will review the locations and the location-specific target analyte lists to determine whether adjustments/modifications are required to address information needs for the area. This review is intended to provide an opportunity to address any information requirements not identified in Steps 1 through 3. When additional information needs are identified, the agencies will modify the locations for additional characterization or the location-specific target analyte lists to reflect the additions/modifications needed for the area.

3.0 ASSUMPTIONS

- Historical resources (e.g., LFI, qualitative risk assessment, and CVP/RSVP documents) contain contaminant lists that are comprehensive with respect to characterizing environmental impacts from the 100 and 300 Area Hanford Site operations.
- Older analytical data (e.g., pre-*Comprehensive Environmental Response, Compensation, and Liability Act of 1980* [CERCLA]) reflect laboratory state-of-the-art procedures. Analytical methods have improved, resulting in lower detection limits for many analytes and better data quality assurance/quality control.
- Characterization activities implemented since initiating remediation under the IARODs may provide additional contaminant information that should be considered during pending RI/FS work processes.
- Post-remediation characterization and cleanup verification data reflect focused lists of analytes that are unique to each waste site and have been evaluated against IAROD cleanup requirements.
- Examining existing data and waste site process information will be useful in developing laboratory analytical needs for RI/FS characterization tasks.

- Universally accepted exclusion criteria may be applied to the initial target analyte list to develop a “refined” list.

- Additional exclusion criteria (e.g., statistical Hanford Site background comparisons, infrequently detected analytes, and analytes not detected at concentrations/activities exceeding required cleanup levels) may be applied during the RI/FS process as more data become available.

4.0 SOFTWARE CONSIDERATIONS

No statistical or algebraic calculations are performed for this activity. The evaluations conducted included analyte comparisons/sorting using Microsoft® Excel®.

5.0 SOIL TARGET ANALYTE LIST DEVELOPMENT

Master Target Analyte Identification

1. The documents listed in Table 1 were used to develop the 100-K target analyte list.

Table 1. Documents Used to Develop the 100-K Decision Unit Analyte List. (3 Pages)

Reference	Document Number	Document Type
1. Cleanup Status Report for the 116-KE-1 and 116-KW-1 Cribs	BHI-01737	BHI report
2. Cleanup Verification Package for the 100-K-55:1 and 100-K-56:1 Pipelines and the 116-KW-4 and 116-KE-5 Heat Recovery Stations	CVP-2005-00006	CVP
3. Cleanup Verification Package for the 116-KE-4 Retention Basin	CVP-2005-00002	CVP
4. Cleanup Verification Package for the 116-KW-3 Retention Basin	CVP-2004-00001	CVP
5. Cleanup Verification Package for the 116-K-1 Crib	CVP-2003-00024	CVP
6. Cleanup Verification Package for the 116-K-2 Effluent Trench	CVP-2006-00001	CVP

® Microsoft and Excel are registered trademarks of Microsoft Corporation in the United States and/or other countries.

Table 1. Documents Used to Develop the 100-K Decision Unit Analyte List. (3 Pages)

Reference	Document Number	Document Type
7. Remaining Sites Verification Package for 128-K-1, 100-K Burning Pit, Attachment to Waste Site Reclassification Form 2004-042	WSRF 2004-042	RSVP
8. Remaining Sites Verification Package for 100-K-29, 183-KE Sandblasting Site, Attachment to Waste Site Reclassification Form 2004-040	WSRF 2004-040	RSVP
9. Remaining Sites Verification Package for 100-K-30, 183-KE Sulfuric Acid Tank (West Tank), Attachment to Waste Site Reclassification Form 2003-036	WSRF 2003-036	RSVP
10. Remaining Sites Verification Package for 100-K-31, 183-KE Sulfuric Acid Tank (East Tank), Attachment to Waste Site Reclassification Form 2004-038	WSRF 2004-038	RSVP
11. Remaining Sites Verification Package for 100-K-32, 183-KW Sulfuric Acid Tank Bases (East Tank), Attachment to Waste Site Reclassification Form 2004-039	WSRF 2004-039	RSVP
12. Remaining Sites Verification Package for 100-K-33, 183-KW Sulfuric Acid Tank Bases (West Tank), Attachment to Waste Site Reclassification Form 2004-041	WSRF 2004-041	RSVP
13. 100 Area Source Operable Unit Focused Feasibility Study Report	DOE/RL-94-61	FFS
14. Sampling and Analysis Plan for Investigating Chromium Groundwater Contamination Near the 105-KW Reactor	DOE/RL-2008-33	SAP
15. Limited Field Investigation Report for the 100-KR-1 Operable Unit	DOE/RL-93-78	LFI
16. Radiological Characterization of the Retired 100 Areas	UNI-946 Dorian, J. J. and V. R. Richards	UNI report
17. Record of Decision for the 100-KR-2 Operable Unit, Hanford Site	EPA/ROD/R10-99/059	ROD
18. Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site (Remaining Sites ROD)	EPA/ROD/R10-99/039	IAROD
19. Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (Burial Grounds ROD)	EPA/ROD/R10-00/121	ROD

Table 1. Documents Used to Develop the 100-K Decision Unit Analyte List. (3 Pages)

Reference	Document Number	Document Type
20. Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Permit No. WA7 89000 8967, Closure Unit 16, 1706-KE Waste Treatment System	WA7 89000 8967	Dangerous waste permit application

BHI = Bechtel Hanford, Inc.
CVP = cleanup verification package
DOE/RL = U.S. Department of Energy, Richland Operations Office
EPA = U. S. Environmental Protection Agency
FFS = focused feasibility study
IAROD = interim action record of decision
LFI = limited field investigation
ROD = record of decision
RSVP = remaining sites verification package
SAP = sampling and analysis plan
UNI = United Nuclear Industries
WSRF = waste site reclassification form

2. The initial list of target analytes presented in Table 2 was created from the review and evaluation of the Table 1 documents.

Table 2. Summary of 100-K Initial Target Analytes and References. (2 Pages)

Analyte	Reference	Analyte	Reference
Radionuclides			
1. Americium-241	DOE/RL-94-61	13. Potassium-40	WSRF 2004-042
2. Carbon-14	DOE/RL-94-61	14. Radium-226	WSRF 2004-042
3. Cesium-134	DOE/RL-94-61	15. Sodium-22	DOE/RL-94-61
4. Cesium-137	CVP-2003-00024	16. Strontium-90	CVP-2003-00024
5. Cobalt-60	CVP-2003-00024	17. Technetium-99	DOE/RL-2008-33
6. Gross beta	DOE/RL-93-78	18. Thorium-228	WSRF 2004-042
7. Europium-152	CVP-2005-0006	19. Thorium-232	DOE/RL-94-61
8. Europium-154	CVP-2005-0006	20. Tritium	DOE/RL-2008-33
9. Europium-155	DOE/RL-94-61	21. Uranium-233/234	CVP-2004-00001
10. Nickel-63	CVP-2006-00001	22. Uranium-235	CVP-2004-00001
11. Plutonium-238	DOE/RL-94-61	23. Uranium-238	DOE/RL-2008-33
12. Plutonium-239/240	CVP-2004-00001		
Nonradionuclides			
1. 1, 1-Dichloroethene	HEIS/Groundwater	33. Dibenz[a,h]anthracene	WSRF 2004-042
2. Acenaphthene	DOE/RL-93-78	34. Di-n-butylphthalate	DOE/RL-93-78
3. Aluminum	DOE/RL-93-78	35. Ethylene glycol	CVP-2005-00006
4. Anthracene	WSRF 2004-042	36. Fluoranthene	WSRF 2004-042
5. Antimony	DOE/RL-94-61	37. Fluoride	DOE/RL-93-78
6. Aroclor-1016	WSRF 2004-04	38. Indeno(1,2,3-cd)pyrene	WSRF 2004-042
7. Aroclor-1221	WSRF 2004-04	39. Iron	DOE/RL-93-78
8. Aroclor-1232	WSRF 2004-04	40. Lead	CVP-2005-00006
9. Aroclor-1242	WSRF 2004-04	41. Magnesium	DOE/RL-93-78
10. Aroclor-1248	WSRF 2004-04	42. Manganese	DOE/RL-94-61
11. Aroclor-1254	WSRF 2004-04	43. Mercury	CVP-2005-00006
12. Aroclor-1260	WSRF 2004-04	44. Methylene chloride	DOE/RL-93-78
13. Arsenic	CVP-2005-0006	45. Nickel	DOE/RL-93-78
14. Barium	CVP-2005-0006	46. Nitrate-nitrite	DOE/RL-93-78

Table 2. Summary of 100-K Initial Target Analytes and References. (2 Pages)

Analyte	Reference	Analyte	Reference
15. *Benzene (GW COPC)*	HEIS/Groundwater	47. Pentachlorophenol	DOE/RL-94-61
16. Benzo(a)anthracene	WSRF 2004-042	48. Phenanthrene	WSRF 2004-042
17. Benzo(a)pyrene	WSRF 2004-042	49. Phosphate	DOE/RL-93-78
18. Benzo(b)fluoranthene	WSRF 2004-042	50. Potassium	DOE/RL-93-78
19. Benzo(ghi)perylene	WSRF 2004-042	51. Pyrene	WSRF 2004-042
20. Benzo(k)fluoranthene	WSRF 2004-042	52. Selenium	WSRF 2004-042
21. Beryllium	DOE/RL-93-78	53. Silver	WSRF 2004-042
22. Bis(2-ethylhexyl) phthalate	WSRF 2004-042	54. Sodium	DOE/RL-93-78
23. Cadmium	CVP-2005-00006	55. Sulfate	WSRF 2003-036
24. Calcium	DOE/RL-93-78	56. Tetrachloroethene	DOE/RL-93-78
25. Carbazole	WSRF 2004-042	57. Thallium	DOE/RL-93-78
26. *Carbon tetrachloride (GW COPC)*	HEIS/Groundwater	58. Toluene	DOE/RL-93-78
27. *Chloroform (GW COPC)*	HEIS/Groundwater	59. Total petroleum hydrocarbons	WSRF 2004-042
28. Chromium (hexavalent)	CVP-2003-00024	60. Trichloroethene	DOE/RL-2008-33
29. Chromium (total)	CVP-2003-00024	61. Vanadium	DOE/RL-93-78
30. Chrysene	WSRF 2004-042	62. Zinc	DOE/RL-94-61
31. Cobalt	DOE/RL-93-78		
32. Copper	DOE/RL-93-78		

NOTE: The primary references are listed for each analyte; most analytes were referenced in multiple documents.

CVP = cleanup verification package
DOE/RL = U.S. Department of Energy, Richland Operations Office
GW COPC = groundwater contaminant of potential concern
HEIS = Hanford Environmental Information System
WSRF = waste site reclassification form

3. The generally accepted exclusion criteria that follow were applied to the initial soil target analyte list to identify the excluded analytes listed in Table 3 and to develop the refined target analyte list presented in Table 4.

   - Radionuclides with half-lives less than 3 years (and no significant “daughters”)
   - Naturally occurring radionuclides associated with background radiation
   - Essential nutrients (minerals)
   - Analytes that have no toxicity values (per the most-current *Cleanup Levels and Risk Calculations Database* [CLARC] Table).

Table 3. 100-K Soil Analytes Excluded from Further Consideration.

Analyte	Exclusion Rationale	Daughters	Half-Life
Radionuclides			
Cerium-144	Half-life less than 3 years (284.6d)	Pr-144m (1.2m), Pr-144 (17.28m), and Nd-144 (stable)	NA
Cesium-134	Half-life less than 3 years (2.065y)	Ba-134 (stable)	NA
Cobalt-58	Half-life less than 3 years (70.88d)	Ni-58 (stable)	NA
Iron-59	Half-life less than 3 years (44.51d)	Co-59 (stable)	NA
Manganese-54	Half-life less than 3 years (612.2d)	Fe-54 (stable)	NA
Ruthenium-103	Half-life less than 3 years (39.27d)	Rh-103m (56.12m) and Rh-103 (stable)	NA
Ruthenium-106	Half-life less than 3 years (1.020y)	Rh-106 (29.9s) and Pd-106 (stable)	NA
Sodium-22	Half-life less than 3 years (2.605y)	Ne-22 (stable)	NA
Tin-113	Half-life less than 3 years (115.1d)	In-113m (1.658h) and In-113 (stable)	NA
Actinium-228	Decay daughter (Th-232/Ra-228); in equilibrium with parent	NA	6.15 hours
Lead-212	Decay daughter (Th-232/Ra-228); in equilibrium with parent	NA	10.6 hours
Lead-214	Decay daughter (Ra-226); in equilibrium with parent	NA	26.8 minutes
Potassium-40	Naturally occurring background radiation	NA	1.28 E9 years
Radium-224	Decay daughter (Th-232/Ra-228); in equilibrium with parent	NA	3.66 days
Radium-226	Only potential source from naturally-occurring background radiation (insufficient in-growth time for Hanford introduced U as decay daughter of U-234/Th-230)	NA	1.6 E3 years
Radium-228	Decay daughter (Th-232); in equilibrium with parent	NA	5.76 years
Thorium-228	Decay daughter (Th-232/Ra-228); in equilibrium with parent	NA	1.91 years
Thorium-230	Only potential source from naturally-occurring background radiation (insufficient in-growth time for Hanford introduced U as decay daughter of U-234)	NA	7.7 E4 years
Thorium-232	Naturally occurring background radiation	NA	1.4 E10 years
Thorium-234	Decay daughter of U-238; in equilibrium with parent	NA	2.41 days
Nonradionuclides			
Calcium	Essential nutrient	NA	NA
Iron	Essential nutrient	NA	NA
Magnesium	Essential nutrient	NA	NA
Phosphate	Essential nutrient	NA	NA
Potassium	Essential nutrient	NA	NA
Sodium	Essential nutrient	NA	NA
Sulfate	No soil toxicity information available	NA	NA

NA = not applicable

4. This step reconciles the refined soil target analytes with the groundwater COPCs developed for the area. Groundwater COPCs *not* found on the refined soils list are further evaluated. The default action is to include all groundwater COPCs on the refined soil target analyte list, unless there is a valid basis for their exclusion. The analytes added to Table 4 that are groundwater COPCs are presented in *italics.*

5. The appropriate analytical methods for the refined target analytes, taking into account action levels and detection limits, are presented in Table 4.

Table 4. Master 100-K Target Analyte List. (3 Pages)

Target Analyte	Practical Quantitation Limits [a]	Preliminary Cleanup Goals [a, b]			Analytical Methods
		Direct Exposure	Groundwater Protection	River Protection	
Radionuclides					
1. Cesium-137	0.1	6.2	NV [c]	NV [c]	1. Gamma energy analysis
2. Cobalt-60	0.05	1.4	NV [c]	NV [c]	
3. Europium-152	0.1	3.3	NV [c]	NV [c]	
4. Europium-154	0.1	3.0	NV [c]	NV [c]	
5. Europium-155	0.1	125	NV [c]	NV [c]	
6. Americium-241	1	31.1	NV [c]	NV [c]	
7. Plutonium-238	1	37.4	NV [c]	NV [c]	2. Isotopic-plutonium
8. Plutonium-239/240	1	33.9	NV [c]	NV [c]	
9. Strontium-90	1	4.5	NV [c]	NV [c]	3. Gas flow proportional counting
10. Uranium-233/234	1	1.1 [d]	1.1 [d]	1.1 [d]	4. Isotopic - uranium
11. Uranium-235	1	0.61	0.185 [e]	0.185 [e]	
12. Uranium-238	1	1.1 [d]	1.1 [d]	1.1 [d]	
13. Carbon-14	2	5.16	NV [c]	NV [c]	5. Liquid scintillation counter
14. Nickel-63	30	4,026	NV [c]	NV [c]	
15. Tritium	10	510	15.8	15.8	
16. Technetium-99	0.25	5.7	0.46	0.46	
Nonradionuclides					
17. Antimony	6	32	5.4 [e]	25.3	6. EPA 6010 (ICP metal)
18. Aluminum	5	80,000	480,000	960,000	
19. Arsenic	10	20 [f]	20 [f]	20 [f]	
20. Barium	2	16,000	1,650	3,300	
21. Beryllium	0.5	160	63.2	126	
22. Cadmium	0.5	80	0.69	0.25 [e]	
23. Chromium (total)	1	120,000	2,000	2,600	
24. Cobalt	2	24	15.7 [d]	NV [c]	
25. Copper	1	3,200	284	1,150	
26. Lead	5	250	3,000	840	7. EPA 6010 (ICP metal)
27. Manganese	5	3,760	512 [d]	512 [d]	
28. Nickel	4	1,600	130	357	
29. Selenium	10	400	5.2 [e]	1.04 [e]	
30. Silver	1	400	13.6	0.884 [e]	
31. Thallium	5	5.60	1.59 [e]	4.46 [e]	
32. Vanadium	2.5	560	2,240	NV [c]	
33. Zinc	1	24,000	5,970	226	

Table 4. Master 100-K Target Analyte List. (3 Pages)

Target Analyte	Practical Quantitation Limits [a]	Preliminary Cleanup Goals [a, b]			Analytical Methods
		Direct Exposure	Groundwater Protection	River Protection	
34. Chromium (hexavalent)	0.5	240	18.4	7.7	8. Cr VI 7196
35. Mercury	0.2	24	2.09	0.33 [d]	9. EPA 7471 (Hg cold vapor)
36. Aroclor-1016 (PCB)	0.017	0.5	0.0942	0.000447 [e]	10. EPA 8082 (PCB by GC)
37. Aroclor-1221 (PCB)	0.017	0.5	0.00920 [e]	0.0000437 [e]	
38. Aroclor-1232 (PCB)	0.017	0.5	0.00920 [e]	0.0000437 [e]	
39. Aroclor-1242 (PCB)	0.017	0.5	0.0394	0.000187 [e]	
40. Aroclor-1248 (PCB)	0.017	0.5	0.0386	0.000183 [e]	
41. Aroclor-1254 (PCB)	0.017	0.5	0.0664	0.000315 [e]	
42. Aroclor-1260 (PCB)	0.017	0.5	0.721	0.00342 [e]	
43. Fluoride	5	4,800	2,880	5,770	11. Anions by IC-300.0
44. Nitrate	2.5	128,000	40	80	
45. Nitrite	2.5	8,000	4	8	
46. Acenaphthene	0.1	4,800	97.9	131	12. EPA-8310 (PAH)
47. Anthracene	0.05	24,000	2,270	9,100	
48. Benzo(a)anthracene	0.015	1.37	0.856	0.04	
49. Benzo(a)pyrene	0.015	0.137	2.33	0.109	
50. Benzo(b) fluoranthene	0.015	1.37	2.95	0.138	
51. Benzo(ghi) perylene	0.03	2,400	25,700	7,070	
52. Benzo(k) fluoranthene	0.015	1.37	21.5	0.138	
53. Chrysene	0.1	13.7	9.56	0.0446 [e]	
54. Dibenz(a,h)anthracene	0.03	1.37	4.29	0.2	
55. Fluoranthene	0.05	3,200	631	178	
56. Indeno (1,2,3-cd) pyrene	0.03	1.37	8.33	0.389	13. EPA-8310 (PAH)
57. Phenanthrene	0.05	24,000	1,140	9,100	
58. Pyrene	0.05	2,400	655	2,620	
59. Ethylene glycol	5	160,000	64.3	NV [c]	14. EPA-8015 (Non-halogenated VOA)
60. *1,1-Dichloroethene*	0.01	1.67	0.0005	0.0008	15. EPA-8270 (Semi-volatiles)
61. Bis (2-ethylhexyl) phthalate	0.33	71.4	13.9	8.01	
62. Carbazole	0.33	50	0.314 [e]	NV [c]	
63. Di-n-butylphthalate	0.33	8,000	56.5	191	
64. Pentachlorophenol	0.33	8.33	0.0158 [e]	0.00887 [e]	
65. *Benzene* [g]	0.005	18.2	0.00448	0.014	16. EPA-8260 (Volatile organics)
66. *Carbon tetrachloride*	0.005	7.69	0.031	0.0046 [e]	
67. *Chloroform*	0.005	164	0.038	0.0607	
68. 1,4-Dichlorobenzene	0.005	41.7	0.03	0.160	
69. Methylene chloride	0.005	133	0.0218	0.0409	
70. Tetrachloroethene	0.005	1.85	0.00859	0.00832	
71. Toluene	0.005	6,400	4.65	99	
72. Trichloroethylene	0.005	11.2	0.00323 [e]	0.0355	

Table 4. Master 100-K Target Analyte List. (3 Pages)

Target Analyte	Practical Quantitation Limits [a]	Preliminary Cleanup Goals [a, b]			Analytical Methods
		Direct Exposure	Groundwater Protection	River Protection	
73. Total petroleum hydrocarbons	5	2,000	2,000	NV [c]	17. NWTPH-Dx, extended range

[a] Units are mg/kg (nonradionuclides) and pCi/g (radionuclides) unless otherwise noted.
[b] The initial cleanup goals presented here are from the most current CLARC table (updated April 22, 2009), calculated per *Model Toxics Control Act Statute and Regulation*, Publication No. 94-06, Washington State Department of Ecology, Olympia, Washington (WAC 173-340) (Ecology 2007) using input parameters stated in the CLARC table.
[c] The generic RESRAD modeling reported in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE/RL-96-17) predicts the contaminant will not reach groundwater within 1,000 years.
[d] Where cleanup levels are less than background, cleanup levels default to background as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL-96-17).
[e] Where cleanup levels are less than PQLs, cleanup levels default to PQLs as discussed in Sec. 2.1.2.1 of the 100 Area RDR/RAWP (DOE/RL-96-17). The PQLs will be used for working levels, and will be periodically reviewed to establish if lower detection limit capabilities have become available.
[f] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Sec. 2.1.2.1 of the 100 Area RDR/RAWP (DOE/RL-96-17).

CLARC = Cleanup Levels and Risk Calculation
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
GC = gas chromatograph
IC = ion chromatography
ICP = inductively coupled plasma
NV = no value
NWTPH-Dx = Northwest total petroleum hydrocarbons–diesel range
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
PQL = practical quantitation limit
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity
VOA = volatile organic analysis
WAC = *Washington Administrative Code*

Location-Specific Target Analyte Identification

Location-specific target analytes are identified from the master list using the following approach:

1. Identify the COCs for the specific waste sites where characterization is proposed from the applicable IAROD (which reflects information from LFI and technical baseline reports). If the characterization location is not at a waste site, evaluate information from waste sites in the vicinity (where available). Include these analytes on the location-specific target analyte list (Table 5).

2. Identify the COCs for the specific waste site locations from the verification documentation (CVPs or RSVPs). If the characterization location is not at a waste site, evaluate information from waste sites in the vicinity (where available). Include these analytes on the location-specific target analyte list (Table 5).

3. Evaluate local groundwater monitoring well data (wells located within waste site "zones of influence"). Determine if groundwater COPCs have been analyzed for in these wells. The groundwater data for 100-K is summarized in Appendix A.

    a. If the groundwater COPCs have been analyzed for but not detected, then these analytes will not be included on the location-specific target analyte list.

b. If the groundwater COPCs have been analyzed for and have been detected, then these analytes are included on the location-specific target analyte list.

c. If the groundwater COPCs have not been analyzed for, then an additional evaluation will be performed to determine if there is a data need. If there is a data need, these COPCs are included on the location-specific target analyte list.

4. The analytes from the 100-K location-specific list were considered by the lead agency and no additional analytes were requested.

Table 5. 100-K Location-Specific Target Analyte List. (2 Pages)

Target Analyte	Practical Quantitation Limits [a]	Preliminary Cleanup Goals [a, b]			Analytical Methods
		Direct Exposure	Groundwater Protection	River Protection	
Radionuclides					
1. Cesium-137 (CVP)	0.1	6.2	NV [c]	NV [c]	1. Gamma energy analysis
2. Co-60 (CVP/IAROD)	0.05	1.4	NV [c]	NV [c]	
3. Eu-152 (CVP/IAROD)	0.1	3.3	NV [c]	NV [c]	
4. Eu-154 (CVP/IAROD)	0.1	3.0	NV [c]	NV [c]	
5. Pu-239/240 (CVP/IAROD)	1	33.9	NV [c]	NV [c]	2. Isotopic-Pu
6. Sr-90 (CVP/IAROD)	1	4.5	NV [c]	NV [c]	3. Gas flow proportional counting
7. Carbon-14 (CVP)	2	5.16	NV [c]	NV [c]	4. Liquid scintillation counter
8. Nickel-63 (CVP)	30	4,026	NV [c]	NV [c]	
9. Tritium (GW)	10	510	15.8	15.8	
10. Tc-99 (GW)	0.25	5.7	0.46	0.46	
Nonradionuclides					
11. Antimony (GW)	6	32	5.4 [d]	25.3	5. EPA 6010 (ICP metal)
12. Arsenic (GW)	10	20 [e]	20 [e]	20 [e]	
13. Barium (GW)	2	16,000	1,650	3,300	
14. Beryllium (GW)	0.5	160	63.2	126	
15. Cadmium (GW)	0.5	80	0.69	0.25 [d]	
16. Chromium (total) (GW)	1	120,000	2,000	2,600	
17. Cobalt (GW)	2	24	15.7 [f]	NV [c]	
18. Copper (GW)	1	3,200	284	1,150	
19. Lead (GW)	5	250	3,000	840	
20. Manganese (GW)	5	3,760	512 [f]	512 [f]	
21. Nickel (GW)	4	1,600	130	357	
22. Selenium (GW)	10	400	5.2 [d]	1.04 [d]	
23. Silver (GW)	1	400	13.6	0.884 [d]	
24. Thallium (GW)	5	5.60	1.59 [d]	4.46 [d]	
25. Vanadium (GW)	2.5	560	2,240	NV [c]	
26. Zinc (GW)	1	24,000	5,970	226	
27. Chromium (hexavalent) (CVP/IAROD)	0.5	240	18.4	7.7	6. Cr-VI 7196

Table 5. 100-K Location-Specific Target Analyte List. (2 Pages)

Target Analyte	Practical Quantitation Limits [a]	Preliminary Cleanup Goals [a, b]			Analytical Methods
		Direct Exposure	Groundwater Protection	River Protection	
28. Mercury (GW/IAROD)	0.2	24	2.09	0.33 [f]	7. EPA 7471 (Hg cold vapor)
29. Fluoride (GW)	5	4,800	2,880	5,770	8. Anions by IC-300.0
30. Nitrate (GW)	2.5	128,000	40	80	
31. Nitrite (GW)	2.5	8,000	4	8	
32. Benzene (GW)	0.005	18.2	0.00448 [d]	0.014	9. EPA-8260 (Volatile organics)
33. Chloroform (GW)	0.005	164	0.0381	0.0607	

[a] Units are mg/kg (nonradionuclides) and pCi/g (radionuclides) unless otherwise noted.
[b] The initial cleanup goals presented here are from the most current CLARC table (updated April 22, 2009), calculated per *Model Toxics Control Act Statute and Regulation*, Publication No. 94-06, Washington State Department of Ecology, Olympia, Washington (WAC 173-340) (Ecology 2007) using input parameters stated in the CLARC table.
[c] The generic RESRAD modeling reported in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE/RL-96-17) predicts the contaminant will not reach groundwater within 1,000 years.
[d] Where cleanup levels are less than PQLs, cleanup levels default to PQLs as discussed in Sec. 2.1.2.1 of the 100 Area RDR/RAWP (DOE/RL-96-17). The PQLs will be used for working levels, and will be periodically reviewed to establish if lower detection limit capabilities have become available.
[e] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Sec. 2.1.2.1 of the 100 Area RDR/RAWP (DOE/RL-96-17).
[f] Where cleanup levels are less than background, cleanup levels default to background as discussed in Sec. 2.1.2.1 of the 100 Area RDR/RAWP (DOE/RL-96-17).

CLARC = Cleanup Levels and Risk Calculation
CVP = cleanup verification package
EPA = U. S. Environmental Protection Agency
GW = groundwater
IAROD = interim action record of decision
IC = ion exchange chromatography
ICP = inductively coupled plasma
NV = no value
PQL = practical quantitation limit
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity
WAC = *Washington Administrative Code*

6.0 CONCLUSIONS

This approach should be followed to identify target analytes for the other 100 and 300 Area RI/FS work plans under development.

The analytical methods in Tables 4 and 5, particularly those identified for radionuclides, should be verified and documented in the quality assurance project plan section of the sampling and analysis plan for the 100-K Area. As additional soil data become available, other suitable exclusion criteria should be considered and evaluated for use in the target analyte list development process.

7.0 REFERENCES

2003-036, 2004, Waste Site Reclassification Form 2003-036, and Attachment *Remaining Sites Verification Package for 100-K-30, 183-KE Sulfuric Acid Tank (West Tank)*, Rev. 0, Washington Closure Hanford, Richland, Washington.

2004-038, 2004, Waste Site Reclassification Form 2004-038, and Attachment *Remaining Sites Verification Package for 100-K-31, 183-KE Sulfuric Acid Tank (East Tank)*, Rev. 0, Washington Closure Hanford, Richland, Washington.

2004-039, 2004, Waste Site Reclassification Form 2004-039, and Attachment *Remaining Sites Verification Package for 100-K-32, 183-KW Sulfuric Acid Tank Bases (East Tank)*, Rev. 0, Washington Closure Hanford, Richland, Washington.

2004-040, 2004, Waste Site Reclassification Form 2004-040, and Attachment *Remaining Sites Verification Package for 100-K-29, 183-KE Sandblasting Site*, Rev. 0, Washington Closure Hanford, Richland, Washington.

2004-041, 2004, Waste Site Reclassification Form 2004-041, and Attachment *Remaining Sites Verification Package for 100-K-33, 183-KW Sulfuric Acid Tank Bases (West Tank)*, Rev. 0, Washington Closure Hanford, Richland, Washington.

2004-042, 2004, Waste Site Reclassification Form 2004-042, and Attachment *Remaining Sites Verification Package for 128-K-1, 100-K Burning Pit*, Rev. 0, Washington Closure Hanford, Richland, Washington.

BHI-01737, 2004, *Cleanup Status Report for the 116-KE-1 and 116-KW-1 Cribs*, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

CVP-2003-00024, 2003, *Cleanup Verification Package for the 116-K-1 Crib*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2004-00001, 2004, *Cleanup Verification Package for the 116-KW-3 Retention Basin*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2005-00002, 2005, *Cleanup Verification Package for the 116-KE-4 Retention Basin*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2005-00006, 2005, *Cleanup Verification Package for the 100-K-55:1 and 100-K-56:1 Pipelines and the 116-KW-4 and 116-KE-5 Heat Recovery Stations*, Rev. 0, Washington Closure Hanford, Richland, Washington.

CVP-2006-00001, 2006, *Cleanup Verification Package for the 116-K-2 Effluent Trench*, Rev. 0, Washington Closure Hanford, Richland, Washington.

DOE/RL-93-78, 1994, *Limited Field Investigation Report for the 100-KR-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-94-61,1995, *100 Area Source Operable Unit Focused Feasibility Study Report,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-96-17, 2009, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2008-33, 2008, *Sampling and Analysis Plan for Investigating Chromium Groundwater Contamination Near the 105-KW Reactor,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2008-46, 2010, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Dorian, J. J. and V. R. Richards, 1978, *Radiological Characterization of the Retired 100 Areas*, UNI-946, United Nuclear Industries, Inc., Richland, Washington.

Ecology, 1996, "Model Toxics Control Act – Cleanup," *Washington Administrative Code* (WAC) 173-340, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2007, *Model Toxics Control Act Statute and Regulation*, Publication No. 94-06, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2009, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc.CLARCHome.aspx>.

Ecology, 2009, *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Permit No. WA7 89000 8967, Closure Unit 16, 1706-KE Waste Treatment System, Washington State Department of Ecology, Olympia, Washington.

EPA/ROD/R10-00/121, 2000, *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site, Benton County, Washington,* U.S. Environmental Protection Agency, Washington, D.C.

EPA/ROD/R10-99/039, 1999, *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington,* U.S. Environmental Protection Agency, Washington, D.C.

EPA/ROD/R10-99/059, 1999, *Record of Decision for the 100-KR-2 Operable Unit, Hanford Site, Benton County, Washington,* U.S. Environmental Protection Agency, Washington, D.C.

OSWER Directive 9285.7-53, 2003, *Human Health Toxicity Values in Superfund Risk Assessments*, to Superfund National Policy Managers, Regions 1-10, from M.B. Cook (Director, Office of Superfund Remediation and Technology Innovation), U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., December 5.

WA7 89000 8967, 2009, *Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Permit No. WA7 89000 8967, Closure Unit 16, 1706-KE Waste Treatment System, Washington State Department of Ecology, Olympia, Washington.

APPENDIX A

100-K TARGET ANALYTE MEASLES CHART

Table A-1. 100-K Target Analyte Measles Chart. (2 Pages)

Constituent Name	Constituent Class	Soil Analytical Method	Waste Site	Groundwater Wells												
			116-K-2 Process Effluent Trench	199-K-117A	199-K-18	199-K-19	199-K-20	199-K-21	199-K-22	199-K-37	199-K-154	199-K-156	199-K-157	199-K-163	199-K-169	199-K-170
Antimony	Metal	6010 EPA	G	--	Detect	--	--	Detect	Detect	Detect	--	--	--	--	--	--
Arsenic	Metal		G	Detect	Detect	--	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Barium	Metal		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Beryllium	Metal		G	--	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Cadmium	Metal		G	--	Detect	--	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Chromium (total)	Metal		GX	Detect	--	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Cobalt	Metal		G	--	Detect	Detect	Detect	Detect	--	Detect	--	--	--	--	--	--
Copper	Metal		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Lead	Metal		G	--	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Manganese	Metal		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Nickel	Metal		G	--	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Selenium	Metal		G	--	--	Detect	Detect	--	--	--	--	--	--	--	--	--
Silver	Metal		--	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--	--
Thallium	Metal		G	--	Detect	--	--	--	--	--	--	--	--	--	--	--
Vanadium	Metal		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Zinc	Metal		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Chromium (hexavalent)	Metal	7196 EPA	CG	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect
Mercury	Metal	7471 EPA	X	--	Detect	--	--	--	Detect	--	--	--	--	--	--	--
Cesium-137	Radionuclide	Gamma energy analysis	CX	--	--	Detect	Detect	--	--	--	--	--	--	--	--	--
Cobalt-60	Radionuclide		CX	--	--	Detect	--	--	--	--	--	--	--	--	--	--
Europium-152	Radionuclide		CX	--	--	--	--	--	--	--	--	--	--	--	--	--
Europium-154	Radionuclide		CX	--	Detect	--	--	--	--	--	--	--	--	--	--	--
Europium-155	Radionuclide		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Strontium-90	Radionuclide	Gas flow proportional counting	CGX	Detect	--	--	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Plutonium-238	Radionuclide	Isotopic-Pu		--	--	--	--	--	--	--	--	--	--	--	--	--
Plutonium-239/240	Radionuclide		CX	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon-14	Radionuclide	Liquid scintillation counting	CG	--	Detect	Detect	Detect	Detect	Detect	Detect	--	Detect	Detect	--	Detect	Detect
Nickel-63	Radionuclide		C	--	--	--	--	--	--	--	--	--	--	--	--	--
Technetium-99	Radionuclide		--	--	Detect	Detect	--	Detect	Detect	--	--	--	Detect	--	--	--
Tritium	Radionuclide		G	Detect	Detect	Detect	--	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect	Detect

Table A-1. 100-K Target Analyte Measles Chart. (2 Pages)

Constituent Name	Constituent Class	Soil Analytical Method	Waste Site	Groundwater Wells												
			116-K-2 Process Effluent Trench	199-K-117A	199-K-18	199-K-19	199-K-20	199-K-21	199-K-22	199-K-37	199-K-154	199-K-156	199-K-157	199-K-163	199-K-169	199-K-170
1,1-Dichloroethene	VOC	8260 EPA	G	--	--	--	--	--	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	VOC		G	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene	VOC		G	--	Detect	--	--	Detect	Detect	--	--	--	--	--	--	--
Chloroform	VOC		G	--	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Carbon tetrachloride	VOC		G	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	VOC		G	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene	VOC		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene	VOC		G	--	--	--	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	VOC		G	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloride	Wet chem	9056 EPA	G	Detect	Detect	Detect	Detect	--	--	--	--	--	--	--	--	--
Fluoride	Wet chem		G	Detect	Detect	Detect	Detect	--	--	--	--	--	--	--	--	--
Nitrate (NO_3)	Wet chem		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--
Nitrite (NO_2)	Wet chem		G	Detect	Detect	Detect	--	--	--	--	--	--	--	--	--	--
Sulfate	Wet chem		G	Detect	Detect	Detect	Detect	Detect	Detect	Detect	--	--	--	--	--	--

-- = analyte was either not analyzed in groundwater or not detected in groundwater
C = identified in cleanup verification package
EPA = U.S. Environmental Protection Agency
G = identified as a groundwater contaminant of potential concern
VOC = volatile organic compound
X = identified as an interim record of decision contaminant of concern

DISTRIBUTION

U.S. Department of Energy
Richland Operations Office

J. P. Hanson	A5-11

Washington Closure Hanford

J. A. Lerch	H4-22
K. M. Singleton	H4-22
Document Control	H4-11
DOE-RL Public Reading Room	H2-53
Hanford Technical Library	P8-55