START

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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 159250

~~Page 2 of 1~~

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	Geosciences	N/A
5. Proj./Prog./Dept./Div.:	6. Cog. Engr.:	7. Purchase Order No.:
81235 / R4CEE	B. A. Williams	N/A
8. Originator Remarks:		9. Equip./Component No.:
Approval/Release		N/A
		10. System/Bldg./Facility:
		216-U-12 Crib
11. Receiver Remarks:		12. Major Assm. Dwg. No.:
		N/A
		13. Permit/Permit Application No.:
		N/A
		14. Required Response Date:
		1/14/93

FEB 1993 RECEIVED EDMC

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Impact Level	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-EN-AP-108		0	Interim-Status Groundwater Quality Assessment Plan for the 216-U-12 Crib	3EQ	1	1	6

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
1, 2, 3, or 4 (see MRP 5.43)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Impact Level for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.
4/1	1	Cog.Eng. B. A. Williams 1/25/93 H6-06	R. J. Landon Roger J. Landon 1/27/93 H6-22	4/1	1
4/1	1	Cog. Mgr. R. L. Jackson Rljackson 1/27/93 H6-06	J. R. Kasper for 1/28/93 R2-50	4/1	1
4/1	1	QA S. T.Smith S T Smith 1/28/93 H4-25	~~S. W. Jackson~~ C. J. GEIER 1-28-93 H6-20	4/1	1
		Safety	C. J. Chou Chairman J. Chou 1/26/93 H6-06	4/1	1
		Env.			
4/1	1	E. A. Ruck, III 1/28/93 H6-23			

18. B. A. Williams 1/27/93
Signature of EDT Originator — Date

19. Rljackson for K. R. Fecht 1/27/93
Authorized Representative for Receiving Organization — Date

20. Rljackson R. L. Jackson 1/27/93
Cognizant/Project Engineer's Manager — Date

21. DOE APPROVAL (if required) Ltr. No. N/A
[ ] Approved
[ ] Approved w/comments
[ ] Disapproved w/comments

A-6400-073 (11/91) (EF) WEF124

BD-7400-172-1 (02/89)

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APPENDIX

DRILLING AND WELL CONSTRUCTION LOGS

Drilling logs for the wells listed in Table 5-1, Water Table Level Measuremnt Schedule for the 216-U-12 Crib, are included here. The following logs are provided:

216-U-12 Crib
299-W22-40
299-W22-41
299-W22-42
299-W22-43.

Additional wells for assessment program:

299-W22-22
299-W22-23.

9312905097 7

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: L. Watkins
Drilling Company: Kaiser Engineers Han
Date Started: 01Mar90

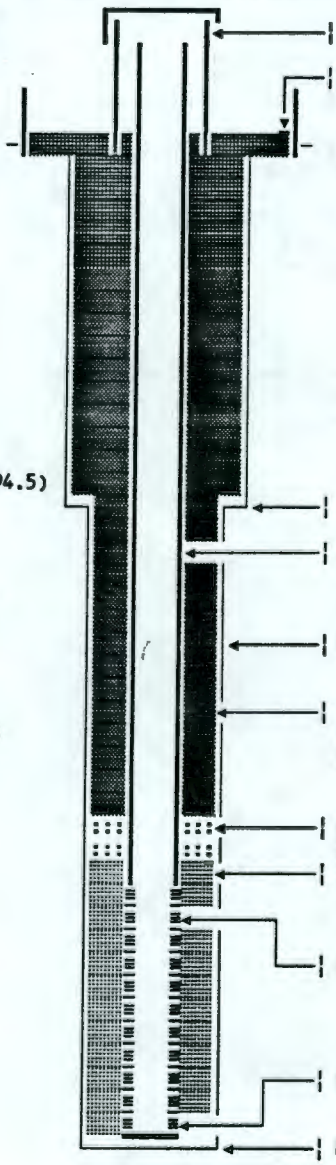
Sample Method: Drive barrel
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Richland, WA
Date Complete: 15May90

WELL NUMBER: 299-W22-40
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 36,242.3 E/W W 73,041.7
State NAD83 N 134,509.99m 567,634.57m
Coordinates: N 441,357 E 2,222,190
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 689.22 Brass cap

Depth to water: 228.1-ft Apr90
(Ground surface) 232.4-ft Sep92

GENERALIZED STRATIGRAPHY / Geologist's Log

5: SAND
10: Slightly gravelly, slightly muddy SAND
15: Slightly muddy SAND
20: Muddy SAND
25,30: Slighlty gravelly SAND
35,40: SAND
43: Muddy SAND
45,50,55: SAND
60: Slightly gravelly SAND
64: Slightly muddy SAND
65: Gravelly SAND
70,75,80,85: SAND
87: Slightly muddy SAND
90,95: SAND (Sl muddy 92-93, 94-94.5)
100: Muddy SAND
105: SAND
110,115: Slightly muddy SAND
120-155: SAND
160,165,170: Slightly muddy SAND
175: Muddy SAND
180: Slightly muddy SAND
185: Muddy SAND
190: Slightly gravelly, slightly muddy SAND
195: Slightly muddy gravelly SAND
200: Slightly muddy SAND
205: Slightly gravelly, slightly muddy SAND
210,215,220: Muddy SAND
225: Slightly muddy SAND
230: Muddy SAND
235,240,245: Muddy sandy GRAVEL



Elevation of reference point: [692.23-ft] (top of casing)
Height of reference point above ground surface [3.0-ft]
Depth of surface seal [0-20.5-ft]
Type of surface seal: 4-ft by 4-ft concrete surface pad. Cement grout to 20.5-ft.
10 3/4-in nominal hole to 143.5-ft.
I.D. of riser pipe: [4-in]
Type of riser pipe: Type 304 stainless steel
Diameter of borehole: [9-in nom] 143.5-245.0-ft
Type of filler, 20.5-211.1-ft: Bentonite crumbles 8-20 mesh
Bentonite pellets, 1/2-3/8-in 211.1-218.1-ft
Depth top of sand pack: [218.1-ft] 40 mesh silica sand to 243.2-ft
Depth top of screen: [224.1-ft] 4-in, #10-slot, Johnson type 304 stainless steel, wire wrapped, with bottom cap and channel pack
Depth bottom of screen: [244.5-ft]
Depth bottom of borehole: [245.0-ft]

Drawing By: RKL/2W22-40.ASB Date: 24Nov92

Reference: WHC-MR-0208, October 1990
KEH Survey Data Report, 18Jun90

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SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-40

WELL DESIGNATION	:	299-W22-40
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	216-U-12
HANFORD COORDINATES	:	N 36,242.3 W 73,041.7 [200W-18Jun90]
LAMBERT COORDINATES	:	N 441,357 E 2,222,190 [HANCONV]
		N 134,509.99m E 567,634.57m [NAD83-18Jun90]
DATE DRILLED	:	May90
DEPTH DRILLED (GS)	:	245.0-ft
MEASURED DEPTH (GS)	:	244.5-ft, 13May91
DEPTH TO WATER (GS)	:	228.1-ft, Apr90; 232.4-ft, 09Sep92
CASING DIAMETER	:	4-in, stainless steel, +ND-224.1-ft; 6-in, stainless steel, +3.0-~0.5-ft (not documented)
ELEV TOP CASING	:	692.23-ft, [200W-18Jun90]
ELEV GROUND SURFACE	:	689.22, Brass cap [200W-18Jun90]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	224.1-244.5-ft, #10-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, 20Jan92; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	U-12 crib Quarterly water level measurement, 20Nov90-09Sep92; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

9312905 0979

9312905019980

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: C. Wamsley
Drilling Company: Kaiser Engineers Han
Date Started: 07Feb90

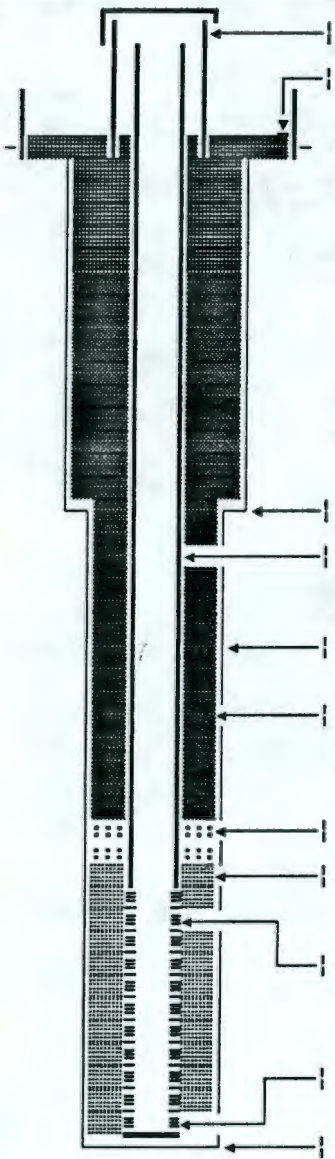
Sample Method: Hard tool
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Richland, WA
Date Complete: 15May90

WELL NUMBER: 299-W22-41
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 36,142.1 E/W W 73,033.8
State NAD83 N 134,479.46m E 567,637.04m
Coordinates: N 441,255 E 2,222,197
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 688.77 Brass cap

Depth to water: 228.0-ft Apr90
(Ground surface) 231.9-ft Sep92

GENERALIZED STRATIGRAPHY — Geologist's Log

5: Slightly muddy SAND
10-45: SAND
50: Slightly gravelly SAND
55-105: SAND (slightly cemented at 104 ft)
110: Muddy SAND
115-155: SAND
160: Muddy SAND
165-185: Sandy MUD
190-205: Muddy sandy GRAVEL
210-230: Sandy MUD
235-245: Muddy sandy GRAVEL



Elevation of reference point: [691.74-ft] (top of casing)
Height of reference point above ground surface [2.97-ft]
Depth of surface seal [0-18.4-ft]
Type of surface seal:
4-ft by 4-ft concrete pad
Cement grout to 18.4-ft
10 3/4-in nominal hole to 132.1-ft
I.D. of riser pipe: [4-in]
Type of riser pipe:
Type 304 stainless steel
Diameter of borehole: [9-in nom]
132.1-244.4-ft
Type of filler, 18.4-215.4-ft:
Bentonite crumbles
8-20 mesh
Bentonite pellets, 1/2-3/8-in 215.4-220.7-ft
Depth top of sand pack: [220.7-ft]
40-100 mesh silica sand to 243.7-ft
Depth top of screen: [224.1-ft]
4-in, #5-slot, Johnson type 304 stainless steel, wire wrapped, with bottom cap.
Depth bottom of screen: [245.3-ft]
Depth bottom of borehole: [245.3-ft]

Drawing By: RKL/2W22-41.ASB Date: 30Nov92

Reference: WHC-MR-0208, October 1990
KEH Survey Data Report, 18Jun90

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-41

WELL DESIGNATION	:	~~299~~-W22-41
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	216-U-12
HANFORD COORDINATES	:	N 36,142.1 W 73,033.8 [200W-18Jun90]
LAMBERT COORDINATES	:	N 441,255 E 2,222,197 [HANCONV]
		N 134,479.46m E 567,637.04m [NAD83-18Jun90
DATE DRILLED	:	May90
DEPTH DRILLED (GS)	:	245.3-ft
MEASURED DEPTH (GS)	:	245.6-ft, 13May91
DEPTH TO WATER (GS)	:	228.0-ft, Apr90; 231.9-ft, 09Sep92
CASING DIAMETER	:	4-in, stainless steel, +ND-224.1-ft; 6-in, stainless steel, +2.97-0.5-ft (not documented)
ELEV TOP CASING	:	691.74-ft, [200W-18Jun90]
ELEV GROUND SURFACE	:	688.77, Brass cap [200W-18Jun90
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	224.1-245.3-ft, #5-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, 13May91; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	U-12 Crib Quarterly water level measurement, 20Nov90-09Sep92; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

WELL CONSTRUCTION AND COMPLETION SUMMARY

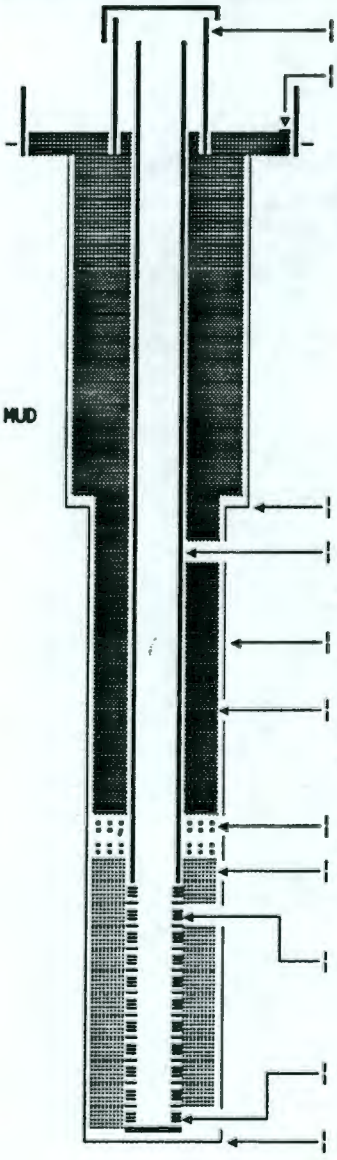
Drilling Method: Cable tool	Sample Method: Drive barrel
Drilling Fluid Used: Water	Additives Used: None
Driller's Name: G. Lydin	WA State Lic Nr: Not documented
Drilling Company: Kaiser Engineers Han	Location: Richland, WA
Date Started: 12Feb90	Date Complete: 15May90

WELL NUMBER: 299-W22-42	TEMPORARY WELL NO:
Hanford Coordinates: N/S N 36,052.7	E/W W 73,079.6
State NAD83 N 134,452.20m	E 567,623.16m
Coordinates: N 441,167	E 2,222,153
Start Card #: Not documented	T___ R___ S___
Elevation Ground surface (ft): 688.20 Brass cap	

Depth to water: 227.0-ft Apr90
(Ground surface) 231.4-ft Sep92

GENERALIZED STRATIGRAPHY — Geologist's Log

5-30: SAND
35: Slightly muddy SAND
40,45: SAND
50: Gravelly SAND
55-150: SAND
155: Slightly muddy SAND
160: Muddy SAND
165,170: Sandy MUD
175-185: Muddy SAND
190,195: Gravelly muddy SAND
200,205: Muddy SAND
210,215: Slightly gravelly sandy MUD
220,225: Sandy MUD
230: Muddy SAND
235-245: Muddy sandy GRAVEL



Elevation of reference point: [691.16-ft] (top of casing)
Height of reference point above ground surface [2.96-ft]
Depth of surface seal [18.8-ft]
Type of surface seal: Cement grout
10 3/4-in nominal hole to 137.7-ft.
I.D. of riser pipe: [4-in]
Type of riser pipe: Type 304 stainless steel
Diameter of borehole: [9-in nom] 137.7-243.4-ft
Type of filler, 18.8-215.2-ft: Bentonite crumbles 8-20 mesh
Bentonite pellets, 1/2-3/8-in 215.2-219.7-ft
Depth top of sand pack: [219.7-ft] 40-mesh silica sand to 243.2-ft
Depth top of screen: [223.1-ft] 4-in, #10-slot, Johnson type 304 stainless steel, wire wrapped, with bottom cap.
Depth bottom of screen: [243.4-ft]
Depth bottom of borehole: [243.4-ft]

Drawing By: RKL/2W22-42.ASB Date: 30Nov92

Reference: WHC-MR-0208, October 1990
KEH Survey Data Report 18Jun90

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SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-42

WELL DESIGNATION	:	299-W22-42
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	216-U-12
HANFORD COORDINATES	:	N 36,052.7 W 73,079.6 [200W-18Jun90]
LAMBERT COORDINATES	:	N 441,167 E 2,222,153 [HANCONV]
		N 134,452.20m E 567,623.16m [NAD83-18Jun90]
DATE DRILLED	:	May90
DEPTH DRILLED (GS)	:	243.4-ft
MEASURED DEPTH (GS)	:	244.3-ft, 13May91
DEPTH TO WATER (GS)	:	227.0-ft, Apr90; 231.4-ft, 09Sep92
CASING DIAMETER	:	4-in, stainless steel, ~+1.0~223.1-ft; 6-in stainless steel, +2.96~~0.5-ft (not documented)
ELEV TOP CASING	:	691.16-ft, [200W-18Jun90]
ELEV GROUND SURFACE	:	688.20, Brass cap [200W-18Jun90]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	223.1~243.4-ft, 10-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, 13May91; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	Water levels measured, 20Nov90~09Sep92 Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

9312905099 83

9312905 0984

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: D. Ludke
Drilling Company: Kaiser Engineers Han
Date Started: 22Feb90

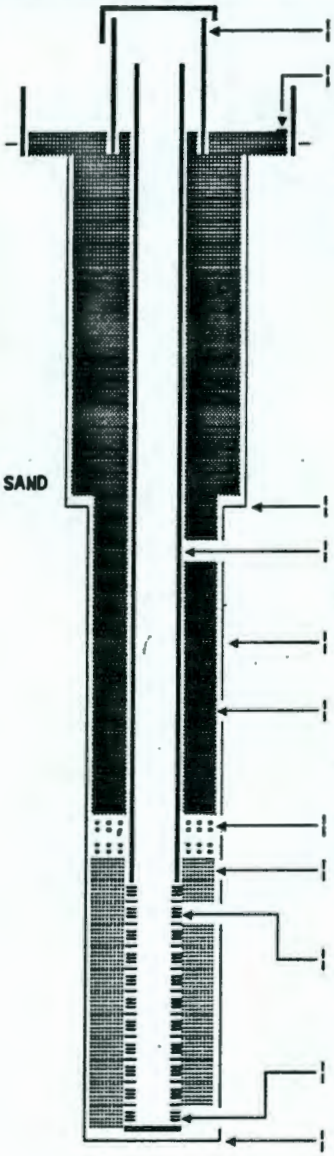
Sample Method: Hard tool
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Richland, WA
Date Complete: 15May90

WELL NUMBER: 299-W22-43
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 36,339.1 E/W W 73,376.5
State NAD83 N 134,539.24m E 567,532.48m
Coordinates: N 441,453 E 2,221,855
Start Card #: Not documented T R S
Elevation Ground surface (ft): 688.40 Brass cap

Depth to water: 226.2-ft Apr90
(Ground surface) 230.7-ft Sep92

GENERALIZED STRATIGRAPHY / Geologist's Log

5: Slightly muddy SAND
10: Slightly gravelly SAND
15-35: SAND
40: Slightly gravelly SAND
45: Gravelly SAND
50: Slightly gravelly SAND
55-95: SAND
100-110: Slightly muddy SAND
115-135: SAND
140,145: Slightly muddy SAND
150,155: Muddy SAND
160-180: Sandy MUD
185: Sandy MUD, caliche
190: Muddy sandy GRAVEL, caliche
195,200: Slightly gravelly muddy SAND
205-215: Sandy MUD
220-235: Muddy SAND
240: SAND
245: Muddy sandy GRAVEL



Elevation of reference point: [691.35-ft] (top of casing)
Height of reference point above ground surface [2.83-ft]
Depth of surface seal [0-18-ft]
Type of surface seal:
4-ft by 4-ft concrete pad
Cement grout to 18.0-ft
10 3/4-in nominal hole to 134.9-ft.
I.D. of riser pipe: [4-in]
Type of riser pipe:
Type 304 stainless steel
Diameter of borehole: [9-in nom]
134.9-244.0-ft
Type of filler, 18.0-216.0-ft:
Bentonite crunbles
8-20 mesh
Bentonite pellets, 1/2-3/8-in
216.0-219.4-ft
Depth top of sand pack: [219.4-ft]
40-mesh silica sand
to 242.9-ft
Depth top of screen: [223.7-ft]
4-in, #10-slot, Johnson type 304 stainless steel, wire wrapped, with bottom cap.
Depth bottom of screen: [244.0-ft]
Depth bottom of borehole: [244.0-ft]

Drawing By: RKL/2W22-43.ASB Date: 07Dec92

Reference: WHC-MR-0208, October 1990
KEH Survey Data Report 18Jun90

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-43

WELL DESIGNATION	:	2-W22-43
CERCLA UNIT	:	200 Aggregate Area Management Study
HANFORD COORDINATES	:	N 36,339.1 W 73,376.5 [200W-18Jun90]
LAMBERT COORDINATES	:	N 441,453 E 2,221,855 [HANCONV]
		N 134,539.24m E 567,532.48m [NAD83-18Jun90]
DATE DRILLED	:	May90
DEPTH DRILLED (GS)	:	244.0-ft
MEASURED DEPTH (GS)	:	244.9-ft, 13May91
DEPTH TO WATER (GS)	:	226.2-ft, Apr90; 230.7-ft, 09Sep92
CASING DIAMETER	:	4-in, stainless steel, +ND-223.7-ft; 6-in, stainless steel, +2.83-~0.5-ft (not documented)
ELEV TOP CASING	:	691.35-ft, [200W-18Jun90]
ELEV GROUND SURFACE	:	688.40-ft, Brass cap [200W-18Jun90]
PERFORATED INTERVAL	:	Not applicable
SCREENED INTERVAL	:	223.7-244.0-ft, #10-slot, stainless steel
COMMENTS	:	FIELD INSPECTION, 13May91; Stainless steel casing. 4-ft by 4-ft concrete pad, 4 posts, 1 removable capped and locked, brass cap in pad with well ID. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	U-12 Crib Quarterly water level measurement, 20Nov90-09Sep92; Not on water sample schedule
PUMP TYPE	:	Hydrostar
MAINTENANCE	:	

9312905098 5

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: McDonald
Drilling Company: Not documented
Date Started: 21Jun60

Sample Method: Drive barrel
Drilling Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 16Jul60

WELL NUMBER: 299-W22-22
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 36,094 E/W W 73,097
State NAD83 134,464.67m E 567,617.54m
Coordinates: N 441,208 E 2,222,135
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 688.42 Brass cap

Depth to water: 235-ft Jul60
(Ground surface) 230.8-ft Jun92

GENERALIZED STRATIGRAPHY / Driller's Log

5-18: Fine brown SAND w/10% SILT
18-20: GRAVEL
20-42: Fine brown SAND w/5% SILT & some GRAVEL (SILT lenses from 30 ft)
42-50: Brown SAND & SILT
50-58: Fine brown SAND & SILT
58-75: Fine brown SAND w/30% SILT
75-80: Fine brown SAND, SILT lenses
80-85: Fine brown SAND, 50% SILT
85-100: Fine brown SAND, w/70% SILT
100-115: Fine brown SAND, w/85% SILT
115-130: Fine brown SAND, 85% SILT, small GRAVEL
130-159: Fine brown SAND w/35% SILT
159-160: Fine brown SAND w/85% SILT
160-175: Light brown sandy CLAY
175-187: Light brown sandy CLAY w/GRAVEL
187-236: CALICHE, w/CLAY & GRAVEL
236-246: SILT & GRAVEL
246-253: Brown SAND & SILT w/some fine GRAVELS
253-275: SAND & small GRAVEL, SILT
275-301: SILT, SAND & fine GRAVEL

Elevation of reference point: [690.05-ft] (top of casing)
Height of reference point above ground surface [1.63-ft]
Depth of surface seal [ND]
Type of surface seal: None documented
I.D. of surface casing (If present) [ND]
I.D. of riser pipe: [8-in]
Type of riser pipe: Carbon steel
Diameter of borehole: [9-in nom]
Type of filler: Not documented
Elevation/depth top of seal
Type of seal: Not documented
Depth top of perforations: [225-ft]
Description of perforations: 225-300-ft, 6 cuts/rd/ft
Depth to bottom, 300.8-ft, 14Apr91
Depth bottom of perforations: [300-ft]
Depth bottom of casing: [301-ft]
Depth bottom of borehole: [301-ft]

Drawing By: RKL/2W22-22.ASB Date: 07Dec92
Reference: HANFORD WELLS

9312905098 6

SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-22

WELL DESIGNATION	:	299-W22-22
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	Not applicable
HANFORD COORDINATES	:	N 36,094 W 73,097 [200W-18Jun90]
LAMBERT COORDINATES	:	N 441,208 E 2,222,135 [HANCONV]
		N 134,464.67m E 567,617.54m [NAD83-18Jun90]
DATE DRILLED	:	Jul60
DEPTH DRILLED (GS)	:	301-ft
MEASURED DEPTH (GS)	:	300.8-ft, 14Apr91
DEPTH TO WATER (GS)	:	235-ft, Jul60; 230.8-ft, 11Jun92
CASING DIAMETER	:	8-in carbon steel, +1.63-301-ft
ELEV TOP CASING	:	690.05-ft, [200W-18Jun90]
ELEV GROUND SURFACE	:	688.42-ft, Brass cap [200W-18Jun90]
PERFORATED INTERVAL	:	225-300-ft
SCREENED INTERVAL	:	None documented
COMMENTS	:	FIELD INSPECTION, 14Apr91, 8-in carbon steel casing. 2-ft cement pad, no posts, capped and locked. No permanent identification. Not in radiation zone. OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	Separations area Semiannual water level measurement, 02May74-11JUn92; PNL Semiannual; WHC Quarterly water sample schedule
PUMP TYPE	:	Electric submersible
MAINTENANCE	:	

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WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: McDonald
Drilling Company: Not documented
Date Started: 28Jul60
Date Complete: 10Aug60

Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented

WELL NUMBER: 299-W22-23
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 36,030.2 E/W W 73,198.3
State NAD83 Coordinates: N 134,445.26m E 567,587.00m
N 441,144 E 2,222,034
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 688.6 Estimated

Depth to water: 224-ft Aug60
(Ground surface) 220.2-ft Dec78

GENERALIZED STRATIGRAPHY / Driller's Log

5-20: Fine brown SAND w/60% SILT
20-35: Fine SAND and small GRAVEL
35-40: Fine SAND & SILT
40-45: Fine SAND & SILT w/COBBLES
45-55: Fine brown SAND & 70% SILT
55-60: Fine brown SAND w/30% SILT
60-65: Coarse SAND w/10% GRAVEL
65-70: Coarse SAND w/COBBLES & SILT
70-90: Fine SAND & SILT
90-95: Hard-packed SILT
95-135: Fine brown SAND, w/85% SILT (SILT lenses evident 93-145-ft)
135-147: Fine brown sandy SILT
147-157: Fine brown SAND w/SILT lenses
157-175: Sandy brown CLAY
175-180: Hard brown CLAY and SILT
180-193: Brown CLAY
193-215: Brown CLAY and some GRAVEL and CALICHE?
215-230: Brown CLAY and SILT, no GRAVEL
230-235: Brown CLAY and SILT-some SAND
235-245: Fine brown SAND and SILT
245-247: Brown SAND & small GRAVEL, SILT
247-250: Clean GRAVEL (Added brown CLAY to drill)
250-300: SAND and GRAVEL

DRILLER'S NOTE:
Sand filled back to 242-ft after perforating.

Elevation of reference point: [690.70-ft] (top of casing)
Height of reference point above ground surface [2.1-ft]
Depth of surface seal [ND]
Type of surface seal: None documented
I.D. of surface casing (If present) [ND]
I.D. of riser pipe: [8-in]
Type of riser pipe: Carbon steel
Diameter of borehole: [9-in]
Type of filler: Not documented
Elevation/depth top of seal
Type of seal: Not documented
Depth top of perforations: [200-ft]
Description of perforations: 200-300-ft, 6 cuts/rd/ft
Depth to bottom, 229.2-ft, 19Apr91
Depth bottom of perforations: [300-ft]
Depth bottom of casing: [302-ft]
Depth bottom of borehole: [307-ft]

Drawing By: RKL/2W22-23.ASB Date: 23Nov92

Reference: HANFORD WELLS

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SUMMARY OF CONSTRUCTION DATA AND FIELD OBSERVATIONS
RESOURCE PROTECTION WELL - 299-W22-23

WELL DESIGNATION	:	299-W22-23
CERCLA UNIT	:	200 Aggregate Area Management Study
RCRA FACILITY	:	Not applicable
HANFORD COORDINATES	:	N 36,030.2 W 73,198.3 [200W-18Jun90]
LAMBERT COORDINATES	:	N 441,144 E 2,222,034 [HANCONV]
		N 134,445.26m E 567,587.00m [NAD83-18Jun90]
DATE DRILLED	:	Aug60
DEPTH DRILLED (GS)	:	307-ft
MEASURED DEPTH (GS)	:	229.2-ft, 19Apr91
DEPTH TO WATER (GS)	:	224-ft Aug60;
		220.2-ft, Dec78
CASING DIAMETER	:	8-in carbon steel, +2.1-302-ft
ELEV TOP CASING	:	690.70-ft [200W-18Jun90]
ELEV GROUND SURFACE	:	688.6-ft, Estimated
PERFORATED INTERVAL	:	200-300-ft
SCREENED INTERVAL	:	None documented
COMMENTS	:	FIELD INSPECTION, 19Apr91,
		8-in carbon steel casing.
		No pad, No posts, capped and locked.
		No permanent identification.
		Not in radiation zone.
		OTHER:
AVAILABLE LOGS	:	Driller
TV SCAN COMMENTS	:	Not applicable
DATE EVALUATED	:	Not applicable
EVAL RECOMMENDATION	:	Not applicable
LISTED USE	:	Water levels measured 08Jan75-01Dec78;
		Not on water sample schedule
PUMP TYPE	:	None documented
MAINTENANCE	:	

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G. T. Berlin	S5-15			
W. R. Brown	H6-21			
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W. G. Cox	H6-23			
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7. Abstract

The 216-U-12 Crib has received rad-chemical wastewater from the U Plant from April 1960 until February 1988, when it was permanently retired. The facility is operated by the Westinghouse Hanford Company for the DOE-RL. Groundwater under the 216-U-12 Crib is monitored under the RCRA of 1976 and under regulatory requirements of WAC. Data from wells around the 216-U-12 Crib indicate that specific conductance in downgradient wells 299-W22-41 and 299-W22-42 is greater than the background established for the parameter at the facility. This requires the development of a groundwater quality assessment plan. The groundwater quality assessment program will progress in phases. The objective of Phase 1 of the program, described in this report, will be to determine if elevated values of specific conductance in wells 299-W22-41 and 299-W22-42 indicates that contamination in the groundwater originates in the 216-U-12 Crib.

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1.0 INTRODUCTION

The 216-U-12 Crib (U-12 Crib) is a small, unlined percolation pit that was constructed as a replacement for the 216 U-8 Crib and received waste water from the 224-U Building (UO_3 Plant) in the 200 West Area from April 1960 until February 1988, when it was permanently retired and replaced by the 216-U-17 Crib. Waste water disposed of to the 216-U-12 Crib has contained dangerous waste and radioactive materials. The U-12 Crib, an interim status dangerous waste disposal unit, is operated by the Westinghouse Hanford Company (DOE 1988) for the U.S. Department of Energy (DOE), Richland Field Office (RL). The U-12 Crib is regulated under Washington Department of Ecology (Ecology) Dangerous Waste Regulations, Washington Administrative Code (WAC) 173-303 (Ecology 1991). Because the U-12 Crib is not expected to receive additional hazardous substances, RL has designated it for closure under the Resource Conservation and Recovery Act of 1976 (RCRA) regulations in accordance with the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1990).

Groundwater underlying the U-12 Crib is monitored following the requirements found in WAC 173-303-400, and by reference, requirements found in 40 CFR 265, Subparts F through R. Groundwater wells monitoring the U-12 Crib have been sampled quarterly for 1 year, and background values were established after the June 1992 sampling. The statistical analyses required by 40 CFR 265.93(b) have been completed for the September 1992 data collected at the U-12 Crib. Results from the September analysis indicated that the contamination indicator parameter-specific conductance in downgradient wells 299-W22-41 and 299-W22-42 were statistically greater than the background levels of this parameter in the initial evaluation and in follow-up verification (resample) analyses. Due to the increase in specific conductance in the groundwater, the development of a plan for a groundwater quality assessment program is required by 40 CFR 265.93(d)(2). This document contains the groundwater quality assessment plan addressing the requirements of 40 CFR 265.93 and 265.94.

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2.0 BACKGROUND INFORMATION

The following information on the U-12 Crib facility, its geology and hydrology has been condensed from the *Interim-Status Ground-Water Monitoring Plan for the 216-U-12 Crib* (WHC 1990). More detailed information and data tables are available in the aforementioned groundwater monitoring plan.

2.1 FACILITY INFORMATION

The 216-U-12 Crib is located approximately 610 m (2,000 ft) south of the U Plant in the 200 West Area (Figure 2-1). The crib is an unlined, gravel-bottom, percolation crib 3 by 30 m (10 by 100 ft), and 4 m (13 ft) deep. The crib has a plastic barrier cover and is backfilled with the original excavated soil. A vitrified clay distributor pipe, buried in the gravel, disperses the effluent across the bottom of the crib.

2.2 WASTE DISPOSAL PRACTICES

The waste stream was composed of effluent from UO_3 Plant and included 291-U-1 Stack drainage and process condensate from the 224-U Building. The 216-U-12 Crib received this waste stream from April 1960 until 1972, when it was deactivated. The 216-U-12 Crib was reactivated in November 1981, and received waste until it was permanently retired in February 1988. A yearly average of over 1.33×10^8 L (3.5×10^7 gal) of effluent was disposed to the U-12 Crib from 1960 through 1978 (Maxfield 1979).

The 216-U-12 Crib has received low-level radioactive wastes that are known to have included chemicals such as dilute nitric acid, as well as radioactive wastes of plutonium, strontium, ruthenium, and uranium. Since 1985, physical controls and operating procedures have been modified to avoid inadvertent discharge of hazardous chemicals to the waste water stream. Because the U-12 Crib was not expected to receive additional hazardous substances, RL proposed that the U-12 Crib be closed under RCRA interim status (DOE 1988).

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3.0 SITE DESCRIPTION

The Hanford Site lies within the Columbia Plateau, which is generally characterized by a thick sequence of tholeiitic basalt flows called the Columbia River Basalt Group (Swanson et al. 1979). These flows have been folded and faulted, creating broad structural and topographic basins separated by asymmetric anticlinal structures (i.e., ridges). The Hanford Site lies within one of these basins, the Pasco Basin (Figure 3-1).

3.1 GEOLOGY

The following sections describe the geology and hydrology beneath the 216-U-12 Crib, located within the 200 West Area. This information has been summarized from well log data collected during previous drilling and well installations at or around the U-12 Crib and as summarized by Connelly et al. (1992).

3.1.1 Surface Physiography

The U-12 Crib lies in an area of relatively low relief at an elevation of approximately 210 m (689 ft). The topography of this area is primarily the result of Pleistocene cataclysmic flooding and Holocene eolian activity. The U-12 Crib is situated within the Cold Creek bar, a broad topographic high that extends to the west and east that consists of sand and gravel deposited by cataclysmic flooding (Figure 3-2).

3.1.2 Stratigraphy

The generalized stratigraphy at the U-12 Crib consists of four primary stratigraphic units. They are, in ascending order, Saddle Mountains basalt (bedrock composed of basalt flows and sedimentary interbeds), Ringold Formation, Plio-Pleistocene Unit, and the Hanford formation.

3.1.2.1 Saddle Mountains Basalt. The Saddle Mountains Basalt is generally the uppermost formation of the Columbia River Basalt Group, consisting of the Pomona Member, Rattlesnake Ridge interbed, and the Elephant Mountain Member. The Elephant Mountain Member forms the bedrock surface beneath the U-12 Crib and acts as a confining layer separating the upper unconfined aquifer from the underlying Rattlesnake Rige interbed. This surface generally dips to the southwest and south as determined through various borehole investigations (Ford et al. 1992). In the vicinity of the U-12 Crib, basalt has been encountered in well 299-W22-24 at 38 m (125 ft) above mean sea level (172 m [565 ft) below the ground surface). This is the only deep well near the U-12] Crib.

3.1.2.2 Ringold Formation. The Ringold Formation is approximately 107 to 114 m (350 to 375 ft) thick beneath the U-12 Crib and overlies the Elephant Mountain basalt. This formation comprises the entire upper unconfined aquifer. The Ringold Formation in the vicinity of the U-12 Crib contains a wide variety of sediment types or lithofacies ranging from coarse sandy gravel to clay. Gravel facies dominate the Ringold Formation in this area.

3.1.2.3 Plio-Pleistocene Unit. The Plio-Pleistocene Unit consists of silty sand to gravelly silty sand with sufficient calcium carbonate and/or silica present in the matrix to partially cement the sediments into a semiconsolidated rocky mass that varies in thickness from 6 to 12 m (20 to 40 ft) below the U-12 Crib. This unit developed as a result of subaerial erosion of the upper Ringold Formation and has a significant effect on the downward migration of groundwater in the 200 West area. Above the Plio-Pleistocene unit is 8 to 11 m (25 to 35 ft) of early "Palouse" soil, an eolian sandy clay to clay sand unit that was probably derived from reworked upper Ringold and Plio-Pliestocene sediments.

3.1.2.4 Hanford Formation. The Hanford formation overlies the "Palouse" and consists primarily of two sedimentary facies. The Hanford Formation is 49 m (160 ft) thick with the lower 27 m (90 ft) consisting of clayey sand to sand that is thought to represent a transitional facies . The overlying facies is a sequence that alternates from clayey sand to gravelly sand. The ground surface adjacent to the U-12 Crib consists of 0.3- to 0.6-m (1- to 2-ft) thick eolian deposits of sand and clay. The ground surface has been reworked as a result of human activities around the U-12 Crib.

3.2 HYDROLOGY

Groundwater beneath the Hanford Site occurs under both unconfined and confined conditions. The unconfined aquifer is contained primarily within the middle unit of the Ringold Formation at the U-12 Crib. The source of natural recharge to the unconfined aquifer and some of the confined aquifers occurs from rainfall and runoff from the higher elevations and water infiltration from small ephemeral streams. A primary source of recharge to the unconfined aquifer is artificial recharge from liquid waste disposal areas which has been estimated as high as 10 times greater than natural recharge (Graham et al. 1981). Two groundwater mounds have formed in response to large volumes of discharge: (1) the B Pond System (in 200-East Area) and, (2) the U Pond (in 200 West Area). U Pond has been deactivated since 1984. The water table mound had risen more than 9 m (30 ft) from pre-Hanford water levels (pre-1943) beneath the B Pond System and more than 26 m (85 ft) beneath U Pond.

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Discharge from the unconfined aquifer is primarily to the Columbia River. The major hydrologic units beneath the U-12 Crib include the unsaturated zone, the suprabasalt aquifer system, and the basalt and interbed aquifer system. These elements are discussed briefly below.

3.2.1 Surface and Unsaturated Zone Water

Surface and unsatuarated zone water sources have varied in location around the U-12 Crib. This is because source facilities have come on and off stream at different times. These past and present sources include the U-12 Crib and surrounding area cribs: 216-S-23, 216-S-9, 216-U-8 and 216-U-16, 216-U-17 cribs, the 216-U-14 ditch, and the U Pond. Water from these liquid waste disposal facilities infiltrates into the ground and provides recharge to the suprabasalt aquifer.

3.2.2 Unsaturated Zone

The unsaturated (vadose) zone beneath the U-12 Crib is made up mainly of sand and gravel with some lenses of finer-grained material and ranges in thickness from 67 to 70 m (220 to 230 ft). This zone includes, in ascending order, the middle Ringold unit, the Plio-Pleistocene unit, the early "Palouse" soil, and the Hanford formation. Perched water within the unsaturated zone has not been documented beneath the U-12 Crib.

3.2.3 Suprabasalt Aquifer System (unconfined aquifer)

The suprabasalt aquifer below the U-12 Crib, the uppermost unconfined aquifer, consists primarily of coarse-grained, semiconsolidated sediments (sand and gravel) and discontinuous fine-grained sediments (silt and clay) of the upper and middle units of the Ringold Formation. The saturated thickness of the unconfined aquifer beneath the U-12 Crib is estimated to be approximately 104 m (340 ft). The base of the unconfined aquifer is considered to be the top of a fine-grained lower Ringold unit which reportedly acts as an aquitard separating the upper aquifer from an underlying aquifer. This underlying semiconfined aquifer is approximately 21 m (70 ft) thick and is defined from DOE (1988) as containing a coarse-grained facies of the basal Ringold unit.

3.2.4 Basalt Aquifer System

The uppermost aquifer beneath the U-12 Crib is unconfined and occurs within the Ringold Formation, while confined aquifers exist within the basalt. In the U-12 Crib area, the shallowest aquifers in the basalt system are believed to be the Elephant Mountain interflow zone and the Rattlesnake Ridge interbed.

3.2.5 Groundwater Flow System

The groundwater flow system in the vicinity of the U-12 Crib is dominated by diminishing recharge effects from the decommissioned U Pond located approximately 910 m (3,000 ft) to the west. The U Pond disposal facility had created a large potentiometric mound in the uppermost aquifer, which caused

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groundwater to flow radially outward. The water table in the unconfined aquifer beneath the U-12 Crib is approximately 139 m (457 ft) above mean sea level and declining. On the basis of information from existing wells in the U-12 Crib monitoring network, depth to the water table is from 71 to 72 m (233 to 235 ft) below land surface. The groundwater flow direction beneath the U-12 Crib is generally east-southeast. The June 1992 water table map (Figure 3-3) shows the configuration of the water table beneath the U-12 Crib and vicinity. The gradient in the upper most aquifer can be determined from head change along the groundwater flow path and is approximately 0.0022. There is also a downward vertical gradient, as measured in piezometers in borehole 299-W22-24. This is expected given the influence of the groundwater mound created by past discharges at U Pond. The total head decline measured at the U-12 Crib is over 2.7 m (9 ft) since the U Pond was deactivated in 1984.

The upper aquifer is primarily contained within the middle Ringold unit, which exhibits a variety of hydrologic characteristics ranging from locally confined to unconfined. Below the U-12 Crib, these lithologies exhibit unconfining conditions with variable hydrogeologic properties (created from compaction and partial cementation of this unit). Aquifer testing in offset wells (299-W21-1 and 699-32-77) reveals that transmissivity ranges from 418 to 5,295 m^2/d (4,500 to 57,000 ft^2/d) (WHC 1990). Likewise, hydraulic conductivity ranges from 6.4 to 79 m/d (21 to 260 ft/d).

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4.0 DESCRIPTION OF EXISTING GROUNDWATER MONITORING SYSTEM

This section contains a summary of the information collected under the detection monitoring program including the present monitoring well configuration and chemistry data.

4.1 MONITORING WELL NETWORK

The present detection level groundwater monitoring network for the U-12 Crib consists of one upgradient well (299-W22-43) and three downgradient wells (299-W22-40, 299-W22-41, 299-W22-42). Locations of the monitoring wells are shown in Figure 4-1. These wells are also used as part of the 200 Aggregate Area Management Study (AAMS). A summary of construction details for the four wells in the detection monitoring system is provided in Table 4-1.

4.2 GROUNDWATER QUALITY

Chemistry data gathered during the detection monitoring program indicate that specific conductance is elevated in wells 299-W22-41 and 299-W22-42 in relation to the other wells. The nitrate ion concentrations, technetium-99, and gross beta values, all have been consistently elevated in these wells and probably caused the elevated specific conductance. Groundwater in the uppermost aquifer near the U-12 Crib is characterized as a calcium bicarbonate or calcium/magnesium bicarbonate water. Groundwater chemistry may have been affected by artificial recharge from U Pond, which in turn reflects the chemistry of Columbia River water. Contamination may also have been contributed to

the groundwater from aforementioned upgradient waste cribs and ditch. In addition, the waste disposal line that connected the U-12 Crib appears to have leaked (Connelly et al. 1992). The results of the AAMS evaluation of water-chemistry data for the area indicate that technetium-99, uranium, and nitrate are the major contaminants of concern beneath the U-12 Crib and the nearby U-17 Crib. Technetium-99 and uranium are not regulated wastes under the RCRA.

4.3 GROUNDWATER SAMPLING AND ANALYSIS STATUS

The groundwater beneath the U-12 Crib has been monitored (under RCRA interim-status detection-level) since September 1991. As required by 40 CFR 265.92, the monitoring wells have been sampled every quarter for 1 year for contamination indicator parameters, groundwater quality parameters, and drinking water quality parameters. Sample analysis also includes site-specific parameters selected from published plume and waste stream data reports obtained from ongoing studies around the U-12 Crib. Four quarters of background monitoring were completed in June 1992.

After the first year, the network wells are sampled annually for groundwater quality parameters and semiannually for contamination indicator parameters. In addition, samples are analyzed for site-specific parameters semiannually and at least once for Appendix IX constituents (Ecology 1989). All available data results of the groundwater sampling and analysis have been reported in quarterly reports (DOE-RL, 1991a,b and 1992a-c).

4.4 STATISTICAL EVALUATION OF GROUNDWATER DATA

Initial groundwater samples were taken in September 1991 and approximately quarterly thereafter in: February, April, and June 1992. The samples taken in the second quarter were postponed until February 1992 due to finalization of the permanent laboratory contract. The June 1992 data completes the requirement to "establish initial background concentrations ... quarterly for one year" (40 CFR 265.92(c)(1)).

The background well for the 216-U-12 Crib is 299-W22-43. The required contamination indicator parameters are (40 CFR 265.92(b)(3)): field-specific conductance, field pH, total organic carbon (TOC), and total organic halogen (TOX). The regulations (40 CFR 265.92(c)(2)) require that "For each of the indicator parameters ... at least four replicate measurements must be obtained for each sample". This requirement was met. The method used to summarize the background data is based on Appendix B of the *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA 1986).

Table 4-2 gives the raw background data, Table 4-3 gives the replicate averages in the background, Table 4-4 gives the background summary statistics, and Table 4-5 lists background average, background standard deviation, and critical mean (or critical range, in the case of pH) for the indicator parameters except for TOX because of unsatisfactory audit findings of the DataChem Laboratories (DOE-RL 1992c, Section 1.2.4). The critical mean (or range, for pH) is the value above which (or above/below which in the case of pH) a compared value is determined to be statistically different from background.

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Table 4-6 lists the contamination indicator parameter data collected from the 216-U-12 Crib monitoring network in September 1992 and Table 4-7 gives the statistical summaries for the replicates. Comparison of the replicate averages from Table 4-7 against the critical means in Table 4-5 indicates that specific conductance in downgradient wells 2-W22-41 and 2-W22-42 is statistically higher than the background critical mean. A specific conductance versus time plot for the 216-U-12 Crib is presented in Figure 4-2. Note that TOX data listed in Table 4-6 are for the purpose of completeness only. They will not be used for the background/compliance well comparisons because of unsatisfactory audit findings (DOE-RL 1992c).

The regulations (40 CFR 265.93(c)(2)) require the owner/operator to resample a well to determine if the significant difference was a result of laboratory error. Wells 299-W22-41 and 299-W22-42 were resampled twice for specific conductance on December 10, 1992. Independent measurements by another sampling team was deemed not necessary because specific conductance levels have been consistently high since the first quarter of monitoring (September 1991). The resampling results are presented in Table 4-8 and the replicate averages are presented in Table 4-9.

Comparison of the replicate averages for the two sets of samples have verified that specific conductance in wells 299-W22-41 and 299-W22-42 exceed the critical mean and that the 216-U-12 Crib may be affecting the quality of the groundwater.

It has not been determined if the high specific conductance found in wells 299-W22-41 and 299-W22-42 is due to contamination from the U-12 Crib. Influence from other sources could exist (216-U-14 ditch, 216-S-23, 216-S-9, 216-U-16, and the waste disposal line to the U-12 Crib). The groundwater assessment program addresses the possible causes for the elevated specific conductance in downgradient wells 299-W22-41 and 299-W22-42.

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5.0 GROUNDWATER QUALITY ASSESSMENT PROGRAM

The intent of this groundwater quality assessment program is to determine whether dangerous waste from the U-12 Crib entered the groundwater, and, if so, determine the rate of movement, extent, and concentration of the dangerous waste or waste constituents in the groundwater. The approach of the initial phase (Phase I) of the groundwater quality assessment program described here is to first determine whether the source of the high specific conductance is from a waste site other than the U-12 Crib. If it is determined that waste constituents are from the U-12 Crib, the Phase II groundwater assessment plan will be prepared to address further data needs in the next phases of the program. The performance of work in this program will be controlled by the requirements of the *Environmental Compliance Manual* (WHC 1988) and the *Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities* (WHC 1992).

5.1 INVESTIGATORY APPROACH

The groundwater quality assessment program will progress in phases. The objective of Phase I of the program, described in this report, will be to determine if the elevated values of specific conductance in wells 299-W22-41 and 299-W22-42 are indicative of contamination in the groundwater from the U-12 Crib. The first phase of the program will address whether the statistical increase in specific conductance at wells 299-W22-41 and 299-W22-42 was caused by contaminants from another source (e.g., aforementioned nearby ditch, cribs, etc.). It involves: (1) evaluation of existing and future water level data from the U-12 Crib monitoring wells and other nearby wells to assess the groundwater flow directions; (2) evaluation of existing and future water quality data from the U-12 Crib and other nearby wells to identify the constituents causing the high specific conductance and define the potential source of the waste constituents; (3) evaluation of the potential effects of other facilities that may result in trends in background water quality; and (4) evaluation of laboratory quality control on data already collected and data from analyses to be performed to ensure valid analytical results are being obtained. In addition, characterization activites being performed by other U area interest groups (AAMS, CERCLA) will be integrated accordingly to compliment the assessment of the U-12 Crib.

This document describes the Phase I assessment program. If the results of this study indicate that the U-12 Crib did not impact the groundwater quality, then the detection level monitoring program will be reinstated upon concurrence with Ecology. If the Phase I evaluation confirms that the U-12 Crib is impacting the groundwater, then a Phase II investigation plan will be prepared. Information collection strategies in Phase II may include, but are not limited to, additional monitoring well installations and field testing, expansion of the chemical parameter list for sampling in existing and new well installations, groundwater flow and contaminant transport modeling, and statistical evaluation of chemical analyses.

5.2 GROUNDWATER QUALITY ASSESSMENT MONITORING NETWORK

As this first phase of the assessment monitoring program is designed primarily to provide a time trend of concentration changes, no new wells will need to be installed. If additional assessment is warranted after this preliminary investigation, the number and locations of any new wells that might be needed to fully assess the impact of the U-12 Crib on the groundwater will be evaluated.

5.3 WATER TABLE MEASUREMENT SCHEDULE

The water level monitoring network will be expanded by including more monitoring wells for Phase I. The expanded network and schedule are shown in Table 5-1. Locations of these wells are presented in Figure 4-1. Measurement frequencies for wells in the monitoring network have been increased to monthly for Phase I of assessment monitoring. Water table data from the AAMS and the surrounding CERCLA Operable Unit Groundwater Monitoring Program (UP-2) will be evaluated to provide additional information on the groundwater flow direction. These wells (not in the U-12 monitoring network) are measured quarterly. Well construction summary diagrams for the wells listed in Table 5-1 can be found in the Appendix.

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5.4 GROUNDWATER QUALITY ASSESSMENT SAMPLING SCHEDULE

In addition to the existing monitoring network of one upgradient and three downgradient wells, two older wells adjacent to the U-12 Crib (299-W22-22 and 299-W22-23) will be remediated, and if feasible, added to the sampling list and sampled quarterly for the contamination-indicator, groundwater, quality, and drinking water parameters. Any ion concentrations that are detected in the first sample round will be added to the site-specific list of constituents and analyzed for all wells during the remainder of Phase I of the assessment program. Historical and current U-Plant waste stream analytical data and discharge volumes will also be examined to determine the correlation, if any, between the stream discharge and chemistry changes recognized in the sampling results from the network wells. Table 5-2 contains the sample schedule and constituent list for Phase I of the assessment monitoring.

5.5 SCHEDULE OF IMPLEMENTATION

Phase I of the assessment monitoring program will be implemented during the next scheduled monitoring event and will end in September of 1993 (see Table 5-2).

5.6 SAMPLING AND ANALYSIS METHOD

The procedure for groundwater sample collection, water level measurements, and field measurements are contained in *Procedure for Groundwater Investigations* (PNL 1989a). The following list contains specific applicable procedures:

- FA-1, "Temperature Measurement Procedure"
- FA-2, "Calibration of Conductivity Meter and Measurement of Field Conductivity"
- FA-3, "Calibration of pH Meter and Measurement of Field pH"
- GC-1, "Groundwater Sample Collection Procedure"
- GC-2, "In-Line Sample Filtration Procedure"
- GC-3, "Disposal of Purge Water From Monitoring Wells"
- WL-1, "Water Level Measurement Procedure"
- WL-2, "Procedure of Standardizing Steel Tapes."

Chain-of-custody procedures are contained in procedure AD-2, *Groundwater Sample Chain-of-Custody Procedure* (PNL 1989a). The history of the custody of each sample is documented according to this procedure.

Preservation techniques, analytical methods used, and current detection levels of the constituents sampled for at the U-12 Crib are in accordance with the *Test Methods for Evaluating Solid Wastes* (EPA 1986b) or approved standard methods and listed in the quality assurance project plan (QAPP) for *RCRA Groundwater Monitoring Activities* (WHC 1992).

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6.0 QUALITY ASSURANCE PROGRAM

Overall quality assurance (QA) program requirements are defined in the *Quality Assurance Manual* (WHC 1988) and the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990, Article 30). The RCRA sampling and analysis program is being performed by Pacific Northwest Laboratory (PNL) in support of waste management activities conducted by Westinghouse Hanford Company for DOE. Sample collection and analysis activities are conducted under guidelines in the *Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities* (WHC 1992). The laboratory that analyses the RCRA samples for hazardous chemicals is currently Data Chem Laboratories, Inc. (DCL). The International Technology Analytical Services (ITAS) Richland, Washington, performs the radiochemical analysis. Both laboratories are subcontracted to the PNL. The quality control (QC) and quality assurance (QA) programs at ITAS and DCL are documented in a quality assurance manual and specific laboratory procedures based on *Testing Methods for Evaluating Solid Wastes* (EPA 1986b). These programs are designed to meet requirements of *Interim Guidelines and Specifications for Preparation of Quality Assurance Project Plans* (EPA 1983).

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6.1 INTERNAL QC OF PARTICIPANT CONTRACTOR OR SUBCONTRACTOR LABORATORY

Internal QC at the participant contractor, or subcontractor laboratories include general practices applicable to a wide range of analyses, as well as specific procedures stipulated for particular analyses as outlined in the QAPP (WHC 1992). Each laboratory generating data has the responsibility to implement minimum procedures that assure that precision, accuracy, completeness, and representativeness of its data are known and documented (EPA 1983). All laboratories shall have a written plan covering their analytical methods and internal QA/QC project manuals, including blanks, spiked samples, surrogate samples, calibration standards and devices, and reagent checks. The services of alternate analytical chemistry laboratories may be procured for split sample analyses.

6.2 EXTERNAL QC

The external QC will use both interlaboratory comparisons and blind, duplicate, and blank samples, to evaluate for accuracy, precision, and contamination of results from the participant contractor, or subcontractor laboratory. More specific requirements for external quality control can be found in the QAPP (WHC 1992). A summary of this evaluation is provided in the RCRA quarterly reports.

7.0 RECORD KEEPING AND REPORTING REQUIREMENTS

Phase I of the groundwater quality assessment program will be compiled during CY 1993 and early 1994. The results of this phase will be included in a report due to Ecology by July 1, 1994. The report will contain a discussion

of the Phase I results of the assessment program and provide a recommendation to either reinstate groundwater monitoring under detection requirements or proceed with additional phases of the groundwater quality assessment program. If additional phases of assessment program are warranted, a second phase of the assessment plan will be prepared and written to final status requirements for compliance monitoring. Record keeping requirements of 40 CFR 265.94 will be followed (EPA 1980).

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Figure 2-1. Location Map of the 216-U-12 Crib in the 200 West Area.

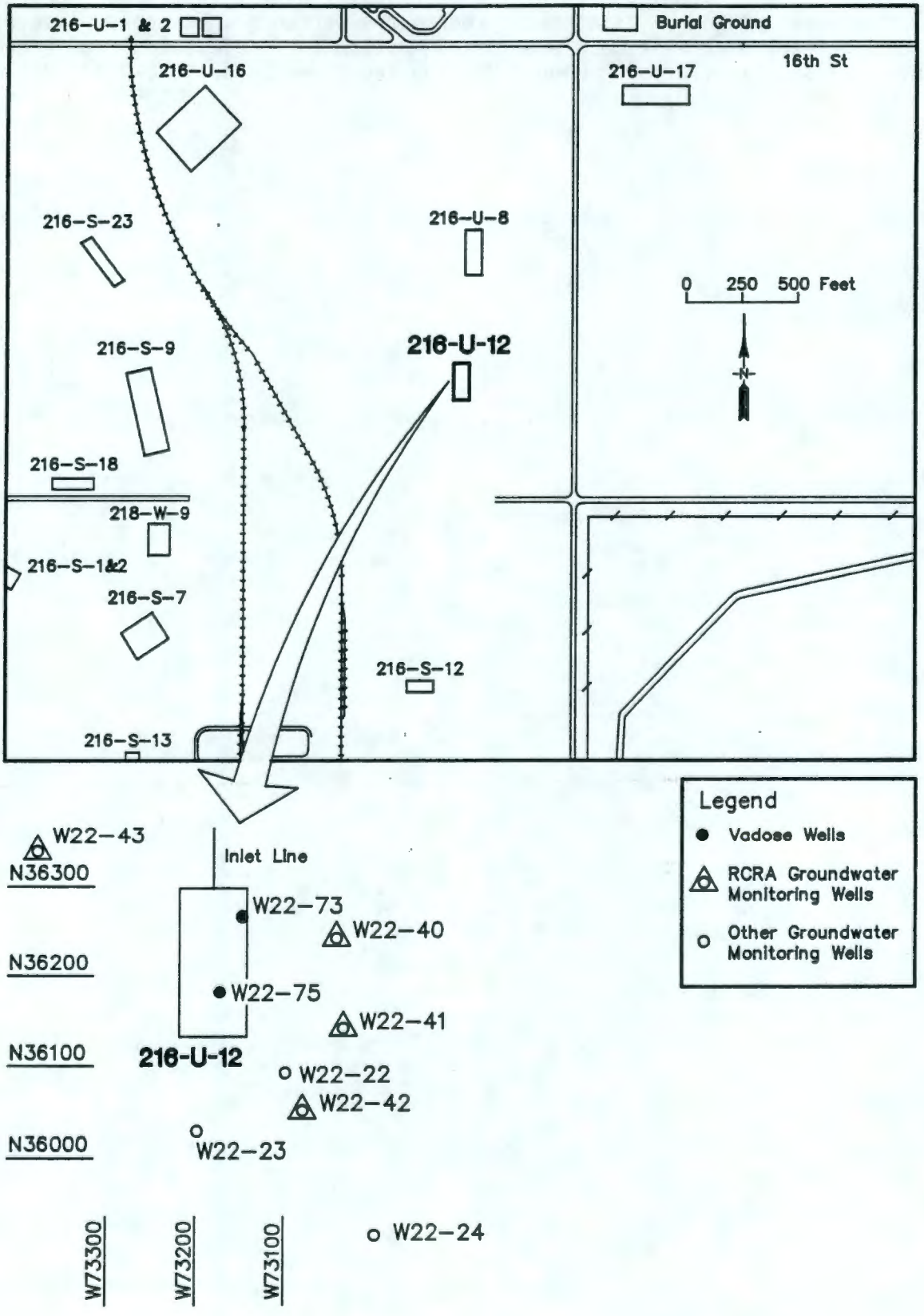

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Figure 3-1. Location Map of the Hanford Site.

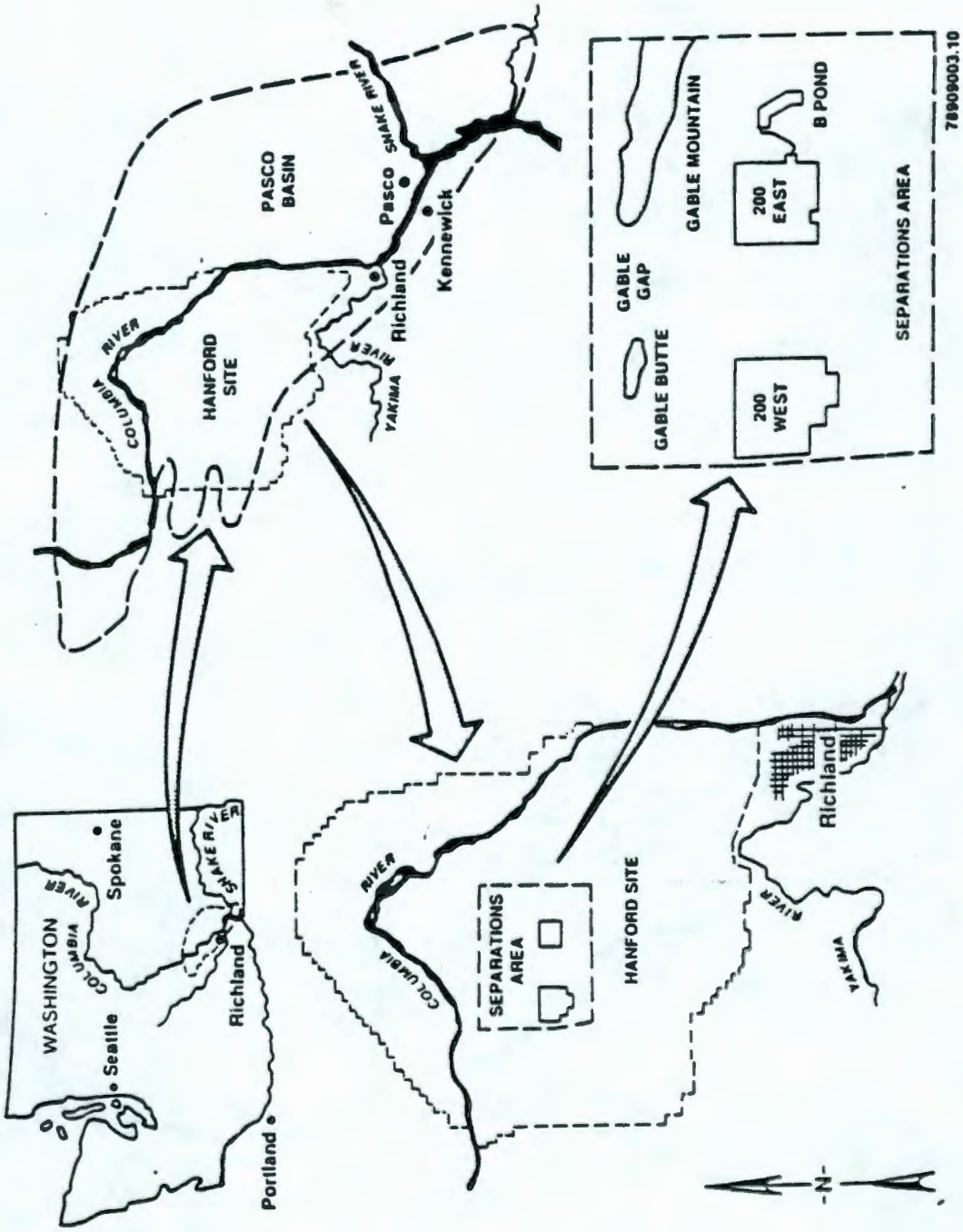

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Figure 3-2. Generalized Structural Features of the Pasco Basin, Washington.

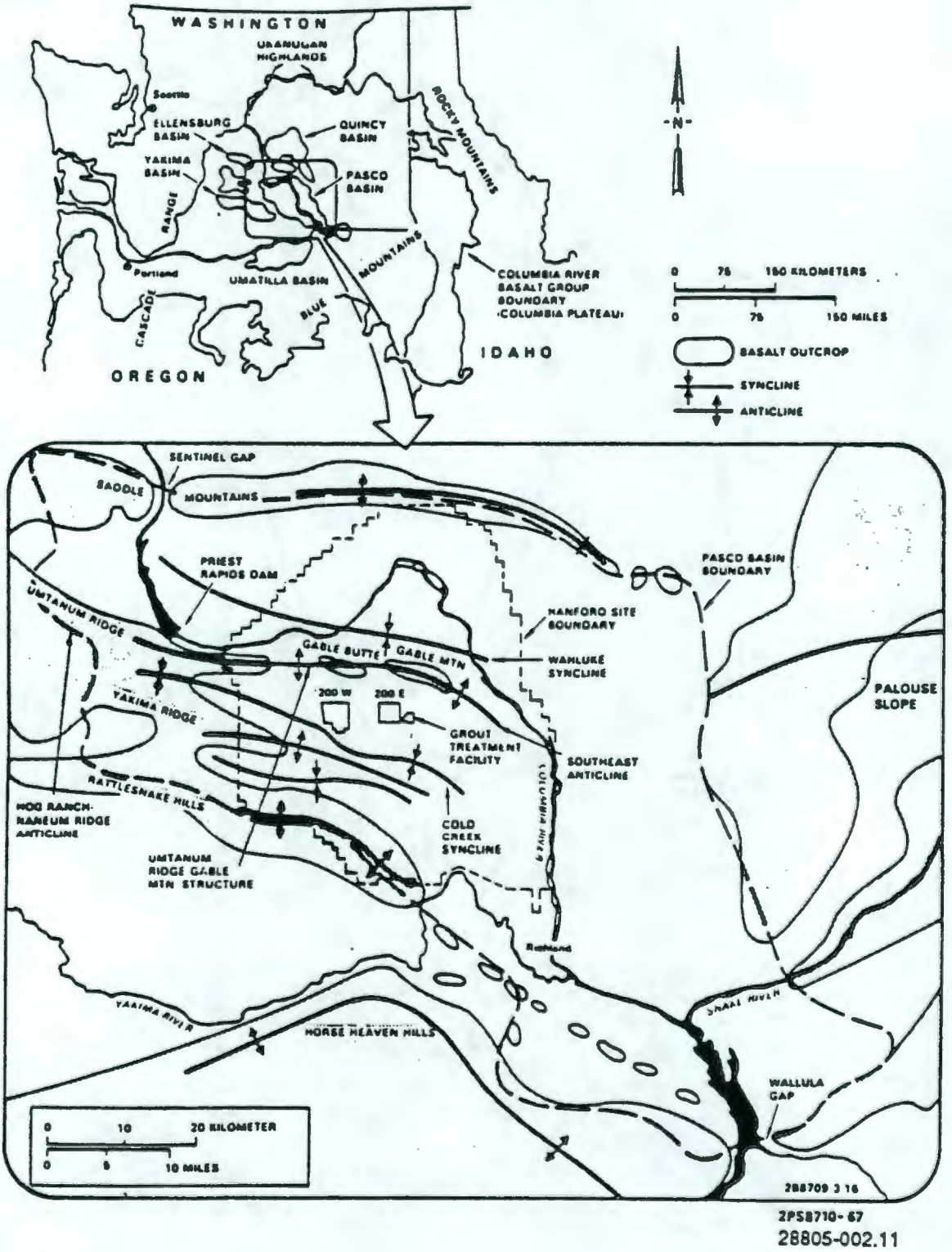

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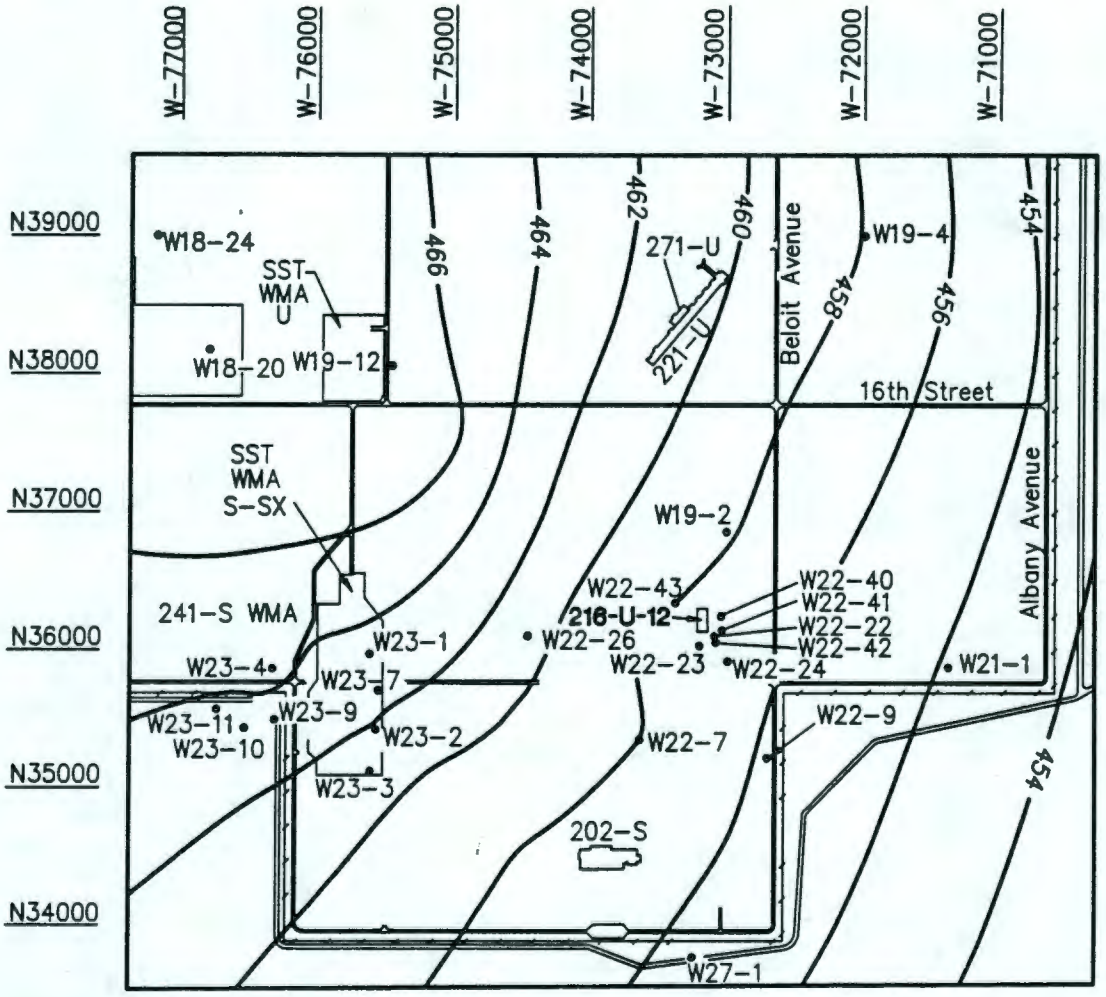
Figure 3-3. Water Level Elevations in Wells at the 216-U-12 Crib and a Water Table Map Indicating the General Direction of Groundwater Flow, September 1992.



Legend

- • Groundwater Monitoring Well
- W23-2 Well Used in Creating Water Table Map (Number Prefixed by 299-)
- —466— Water Table Contour, Feet Above Mean Sea Level
- LLWMA Low-Level Waste Management Area
- WMA Waste Management Area

-N-

0 1000 2000 Feet

0 500 Meters

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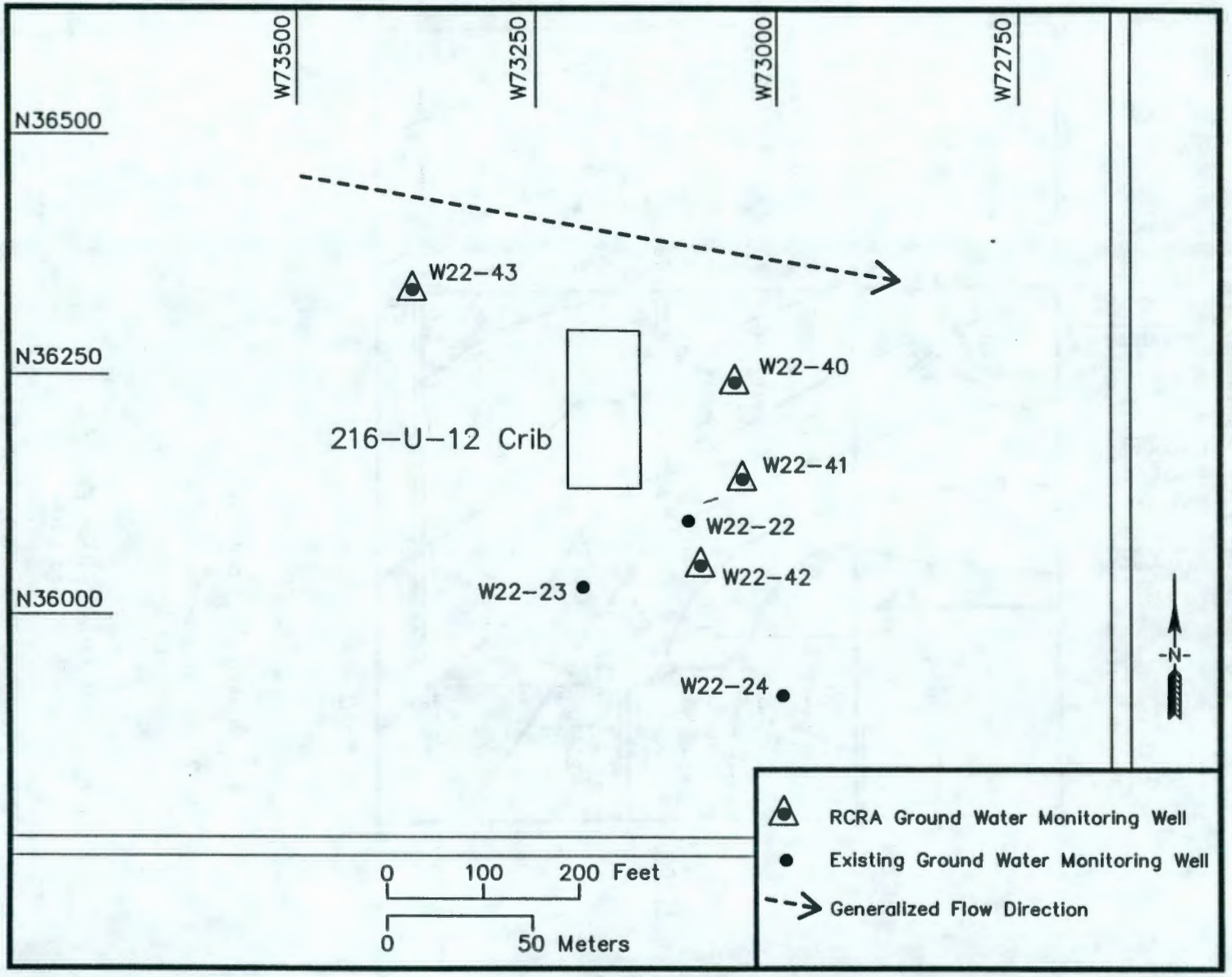

Figure 4-1. Monitoring Well Locations for the 216-U-12 Crib.

Figure 4-2. Specific Conductance Concentration Versus Time Plot for the 216-U-12 Crib.

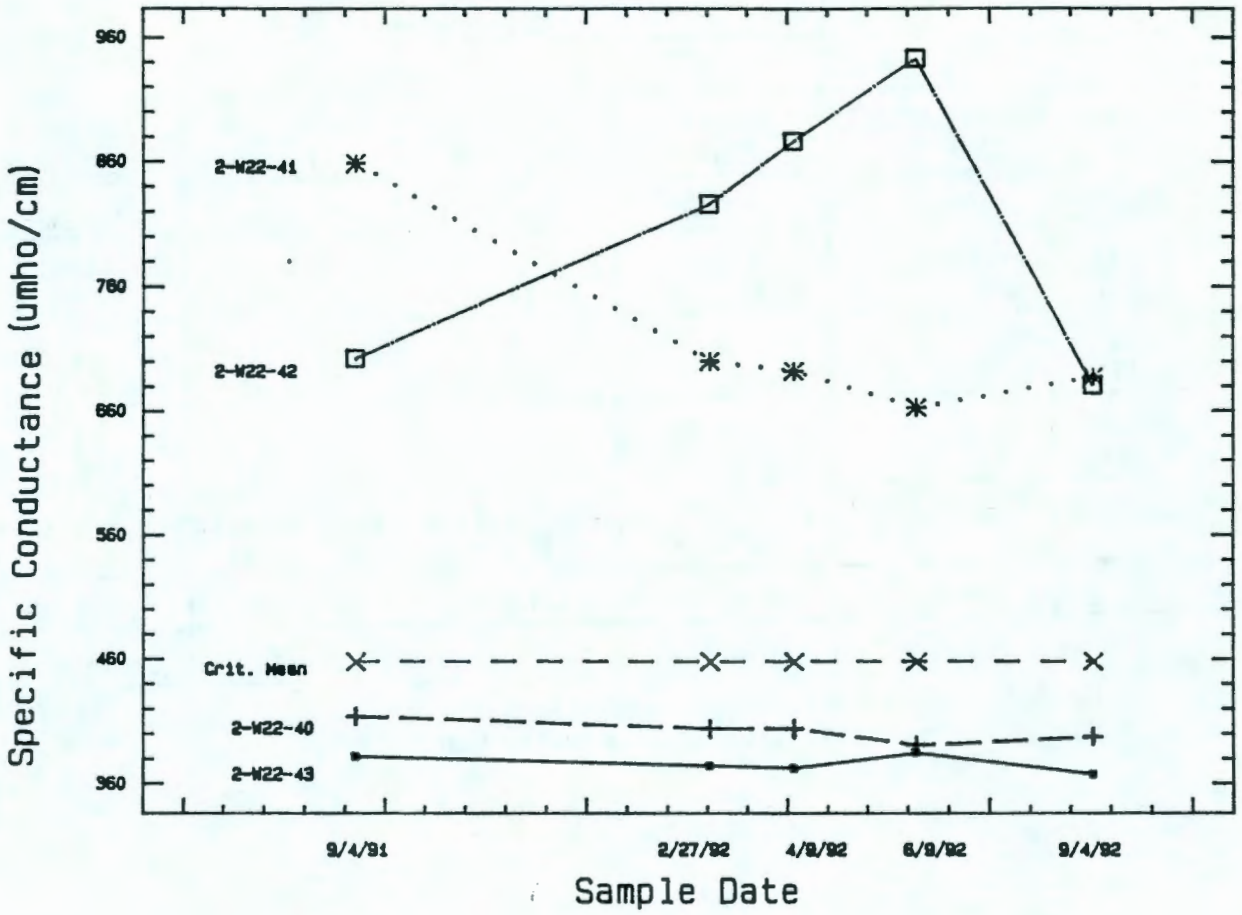

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Table 4-1. Construction Summary for Wells in the Groundwater Detection Monitoring Network.

Parameter	Well Number, 299-W22			
	-40	-41	-42	-43
Hanford coordinates	N36242/ W73042	N36142/ W73034	N36053/ W73080	N36339/ W73377
Primary purpose	DG/GWM	DG/GWM	DG/GWM	UG/GWM
Casing elevation, m (ft)	210.99 (692.23)	210.84 (691.74)	210.67 (691.16)	210.72 (691.35)
Total depth, m (ft)	74.7 (245.0)	74.6 (244.7)	74.4 (244.0)	74.37 (244.01)
Depth to water[a], m (ft)	71.66 (235.12)	71.53 (234.68)	71.37 (234.15)	71.06 (233.15)
Screened interval, m (ft)	68.3 - 74.4 (224 - 244)	68.3 - 74.4 (224 - 144)	68.0 - 74.1 (223 - 243)	68.3 - 74.4 (224 - 244)
Completion date	4/11/90	4/04/90	4/23/90	4/17/90
Drill method	Cable tool	Cable tool	Cable tool	Cable tool

UP/GWM = Upgradient well/groundwater monitoring.
DG/GWM = Downgradient well/groundwater monitoring.

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Table 4-2. Background Contamination Indicator Parameter Data for the 216-U-12 Crib. (Page 1 of 2)

Well name	Sample date	Dupicate Sample No.	Specific Conductance, µmho/cm (1/700w)	Field pH, 0.01/8.5s	TOC, ppb (1,000/.)	TOX, ppb (10/.)
299/W22-43	09/04/91	1	378	7.71	1,000[u]	25.0[h]
		2	381	7.71	1,000[u]	34.0[h]
		3	383	7.71	1,000[u]	29.0[h]
		4	384	7.71	1,000[u]	25.5[h]
	02/27/92	1	375	7.87	2,000	20.0[a]
		2	373	7.86	1,000[u]	10.0[a]
		3	374	7.84	1,000[u]	10.0[a]
		4	374	7.84	1,000[u]	10.0[a]
	04/09/92	1	372	7.85	1,000[u]	10.0[ua]
		2	371	7.85	1,000[u]	10.0[ua]
		3	374	7.84	1,000[u]	10.0[ua]
		4	371	7.84	1,000[u]	10.0[ua]
	06/09/92	1	386	8.38	1,000[u]	20.0[a]
		2	386	8.29	1,000[u]	20.0[a]
		3	385	8.24	1,000[u]	30.0[a]
		4	381	8.35	1,000[u]	30.0[a]
299/W22-40	09/03/91	1	414	7.69	1,000[u]	11.5[h]
		2	413	7.69	1,000[u]	12.5[h]
		3	414	7.69	1,000[u]	13.5[h]
		4	414	7.69	1,000[u]	14.0[h]
	02/27/92	1	406	7.70	1,000[u]	10.0[a]
		2	401	7.70	1,000[u]	20.0[a]
		3	403	7.69	1,000[u]	30.0[a]
		4	404	7.70	1,000[u]	10.0[a]
	04/09/92	1	408	7.88	1,000[u]	10.0[ua]
		2	402	7.88	1,000[u]	10.0[ua]
		3	401	7.88	1,000[u]	10.0[ua]
		4	403	7.88	1,000[u]	10.0[ua]
	06/09/92	1	390	7.77	1,000[u]	30.0[a]
		2	390	7.78	1,000[u]	20.0[a]
		3	390	7.77	1,000[u]	30.0[a]
		4	391	7.78	1,000[u]	20.0[a]
299/W22-41	09/03/91	1	858	6.90	1,000[u]	10.0[u]
		2	857	6.92	1,000[u]	11.0
		3	861	6.95	1,000[u]	12.5
		4	857	6.98	1,000[u]	10.0[h]
	02/27/92	1	701	7.76	1,000[u]	20.0[a]
		2	702	7.76	1,000[u]	20.0[a]
		3	701	7.76	1,000[u]	20.0[a]
		4	695	7.76	1,000[u]	20.0[a]
	04/09/92	1	687	7.86	1,000[u]	20.0[a]
		2	695	7.86	1,000[u]	10.0[ua]
		3	692	7.86	1,000[u]	10.0[ua]
		4	389[r]	7.85	1,000[u]	10.0[ua]
	06/09/92	1	663	8.07	1,000[u]	20.0[a]
		2	663	8.03	1,000[u]	10.0[ua]
		3	658	8.02	1,000[u]	10.0[a]
		4	664	8.00	1,000[u]	10.0[a]

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Table 4-2. Background Contamination Indicator Parameter Data for the 216-U-12 Crib. (Page 2 of 2)

Well name	Sample date	Dupicate Sample No.	Specific Conductance, µmho/cm (1/700w)	Field pH, 0.01/8.5s	TOC, ppb (1,000/.)	TOX, ppb (10/.)
299/W22-42	09/03/91	1	703	7.44	1,000[u]	10.0[u]
		2	705	7.46	1,000[u]	12.0[h]
		3	702	7.47	1,000[u]	17.0[h]
		4	698	7.49	1,000[u]	10.0[h]
	02/27/92	1	819	7.76	1,000[u]	10.0[a]
		2	836	7.74	1,000[u]	20.0[a]
		3	829	7.73	1,000[u]	10.0[ua]
		4	819	7.75	1,000[u]	10.0[a]
	04/09/92	1	868	7.79	1,000[u]	10.0[ua]
		2	874	7.78	1,000[u]	10.0[ua]
		3	880	7.78	1,000[u]	10.0[a]
		4	881	7.79	1,000[u]	10.0[ua]
	06/09/92	1	947	7.76		
		2	945	7.73		
		3	943	7.73		
		4	935	7.72		

The column headers consist of: Constituent Name; Analysis Units; and Contractual Required Quantitation Limit (CRQL)/Drinking Water Standard (suffix).

Suffix s = based on Secondard Maximum Contaminant Levels in 40 CFR 143, National Secondary Drinking Water Regulations.

w = based on additional Secondary Maximum Contaminant levels in WAC 248-54, Public Water Supplies.

Data flag:

u denotes that analyte concentration is below CRQL. Reported values were analytical labortories' CRQL.

A denotes unsatisfactory audit findings (DOE 1993).

H denotes that holding time was exceeded.

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Table 4-3. Average Replicate Statistics--Background Indicator Parameter Data for the 216-U-12 Crib (page 1 of 1)

Constituent (Unit)	Well Name	Sample Date	n	Average	Standard Deviation	C.V. (%)
Specific Conductance (μmho/cm)	2-W22-43	09/04/91	4	381.50	2.646	0.69
	2-W22-43	02/27/92	4	374.00	0.816	0.22
	2-W22-43	04/09/92	4	372.00	1.414	0.38
	2-W22-43	06/09/92	4	384.50	2.380	0.62
Field pH	2-W22-43	09/04/91	4	7.710	0	0
	2-W22-43	02/27/92	4	7.852	0.015	0.19
	2-W22-43	04/09/92	4	7.845	0.006	0.08
	2-W22-43	06/09/92	4	8.315	0.062	0.75
TOC[a] (ppb)	2-W22-43	09/04/91	4	500[U]	N.A.	N.A.
	2-W22-43	02/27/92	4	875[U]	750	85.7
	2-W22-43	04/09/92	4	500[U]	N.A.	N.A.
	2-W22-43	06/09/92	4	500[U]	N.A.	N.A.
TOX[a] (ppb)	2-W22-43	09/04/91	4	28.38	4.151	14.6
	2-W22-43	02/27/92[A]	4	N.C.	N.C.	N.C.
	2-W22-43	04/09/92[A]	4	N.C.	N.C.	N.C.
	2-W22-43	06/09/92[A]	4	N.C.	N.C.	N.C.

[a]Statistics were calculated by replacing not detected values with half of the respective CRQL.

[U]denotes calculated values are below the CRQL.

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[A]replicate averages are not calculated due to audit findings (DOE 1993).

N.A. = not available.C.V. = coefficient of variation.

N.C. = not calculated.

9 1 1 7 1 3 8 5 6

Table 4-4. Background Statistics[a]-Contamination Indicator Parameter Data for the 216-U-12 Crib

Constituent	Units	n	Background average	Background standard deviation	Background C.V. (%)
Specific conductance	µmhos/cm	4	378.000	5.958	1.6
Field pH		4	7.931	0.264	3.3
TOC	ppb	4	593.750	187.500	31.6
TOX[b]	ppb	N.C.	N.C.	N.C.	N.C.

[a]Background summary statistics for TOC were calculated using values below CRQL.

[b]Background summary statistics for TOX are not calculated due to audit findings of DataChem Laboratories (DOE 1993).

N.C. = not calculated.

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Table 4-5. Critical Means Table for 16 Comparisons--Background Contamination Indicator Parameter Data for the 216-U-12 Crib[a,b]

Constituent (Unit)	n	df	tc	Average background	Standard deviation	Critical mean
Specific Conductance (μmho/cm)	4	3	11.9838	378.000	5.958	457.8
Field pH	4	3	15.1451	7.931	0.264	[3.45, 12.41]
TOC[c] (ppb)	4	3	11.9838	593.75	187.500	3105.9
TOX[d] (ppb)	N.C.	N.C.	N.C.	N.C.	N.C.	N.C.

[a]Data collected from September 1991 to June 1992 for upgradient well 2-W22-43. Values calculated based on 16 comparisons.

[b]The following notations are used in this table:
df = degrees of freedom (n-1).
n = number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 16 comparisons.

[c]Critical mean was calculated from values reported below the CRQL.

[d]Critical mean is not calculated due to audit findings (DOE 1993).

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Table 4-6. September Contamination Indicator Parameter Evaluation Data for the 216-U-12 Crib

Well Name	Sample Date	Dupl. Sample Number	Specific Conductance µmho/cm 1/700w	Field pH 0.01/8.5s	TOC ppb 1000/.	TOX ppb 10/.
2-W22-43	09/08/92	1	368	7.90	1000[U]	20.0[HA]
		2	367	7.89	1000[U]	10.0[UA]
		3	367	7.88	1000[U]	20.0[HA]
		4	367	7.88	1000[U]	20.0[HA]
2-W22-40	09/04/92	1	399	7.90	1000[U]	20.0[HA]
		2	397	7.90	1000[U]	10.0[HA]
		3	397	7.89	1000[U]	10.0[UA]
		4	396	7.89	1000[U]	20.0[HA]
2-W22-41	09/04/92	1	697	7.85	1000[U]	10.0[UA]
		2	672	7.88	1000[U]	10.0[UA]
		3	688	7.87	1000[U]	10.0[HA]
		4	692	7.86	1000[U]	10.0[UA]
2-W22-42	09/04/92	1	680	7.79	1000[U]	10.0[UA]
		2	675	7.78	1000[U]	20.0[HA]
		3	685	7.78	1000[U]	40.0[HA]
		4	680	7.78	1000[U]	10.0[UA]

The column headers consist of: Constituent Name; Analysis Units; and Contractual Required Quantitation Limit (CRQL)/Drinking Water Standard (suffix)

Suffix s = based on Secondary Maximum Contaminant Levels in 40 CFR part 143, National Secondary Drinking Water Regulations
w = based on additional Secondary Maximum Contaminant Levels in WAC

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Data flag:

u denotes that analyte concentration is below CRQL. Reported values were analytical laboratories' CRQL.
A denotes unsatisfactory audit findings (DOE 1993).
H denotes that holding time was exceeded.

Table 4-7. September 1992 Contamination Indicator Parameter Replicate Averages for the 216-U-12 Crib

Constituent (Unit)	Well Name	Sample Date	n	Average	Standard Deviation	C.V. (%)
Specific Conductance (μmho/cm)	2-W22-43	09/08/92	4	367.25	0.500	0.14
	2-W22-40	09/04/92	4	397.25	1.258	0.32
	2-W22-41	09/04/92	4	687.25	10.813	1.57
	2-W22-42	09/04/92	4	680.00	4.083	0.60
Field pH	2-W22-43	09/08/92	4	7.888	0.010	0.12
	2-W22-40	09/04/92	4	7.895	0.006	0.07
	2-W22-41	09/04/92	4	7.865	0.013	0.16
	2-W22-42	09/04/92	4	7.783	0.005	0.06
TOC[a] (ppb)	2-W22-43	09/08/92	4	500[u]	N.A.	N.A.
	2-W22-40	09/04/92	4	500[u]	N.A.	N.A.
	2-W22-41	09/04/92	4	500[u]	N.A.	N.A.
	2-W22-42	09/04/92	4	500[u]	N.A.	N.A.
TOX[a] (ppb)	2-W22-43	09/08/92[A]	4	N.C.	N.C.	N.C.
	2-W22-40	09/04/92[A]	4	N.C.	N.C.	N.C.
	2-W22-41	09/04/92[A]	4	N.C.	N.C.	N.C.
	2-W22-42	09/04/92[A]	4	N.C.	N.C.	N.C.

[a]Statistics were calculated by replacing not detected values with half of the respective CRQL.

[u]denotes calculated values are below the CRQL.

[A]replicate averages are not calculated due to unsatisfactory audit findings (DOE 1993).

N.A. = not available.C.V. = coefficient of variation.
N.C. = not calculated.

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Table 4-8. Contamination Verification Sampling Results for the 216-U-12 Crib

Well Name	Sample Date	Replicate Sample Number	Specific Conductance #1	Specific Conductance #2
2-W22-41	12/10/92	1	647	685
		2	665	669
		3	690	663
		4	685	670
2-W22-42	12/10/92	1	551	556
		2	548	555
		3	542	562
		4	541	560

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Table 4-9. Average Replicate Statistics for Verification Samples for the 216-U-12 Crib

Well Name	Verification Sample	n	Average	Standard Deviation	Coefficient of Variation (%)
2-W22-41	#1	4	671.75	19.721	2.94
	#2	4	671.75	9.359	1.39
2-W22-42	#1	4	545.50	4.796	0.88
	#2	4	560.75	3.775	0.67

Table 5-1. Water Table Level Measurement Schedule for the 216-U-12 Crib

Well	Aquifer	Well Standards	Measurement Frequency
299-W22-40[90]	Top of unconfined	RCRA	Monthly
299-W22-41[90]	Top of unconifned	RCRA	Monthly
299-W22-42[90]	Top of unconfined	RCRA	Monthly
299-W22-43[90]	Top of unconfined	RCRA	Monthly
299-W22-22[60]	Top of unconfined		Monthly
299-W22-23[TB]	Top of unconfined		Monthly

Shading denotes upgradient wells.

Subscript following well number denotes the year of installation.

RCRA = well is constructed to RCRA specified standards.

Table 5-2. 1993 Phase I Groundwater Assessment Sampling Schedule for the 216-U-12 Crib

Well	1st Quarter, 93 (Jan, Feb, Mar)	2nd Quarter, 93 (Apr, may, June)	3rd Quarter, 93 (July, Aug, Sept)
299-W22-40	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS
299-W22-41	CIP,GWQ,DW,SS	CIP,GWQ,DW	CIP,GWQ,DW,SS
299-W22-42	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS
299-W22-43	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS
299-W22-22	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS
299-W22-23	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS	CIP,GWQ,DW,SS

CIP = Contamination-Indicator Parameters per 40 CFR 265.92 (EPA,1980):
pH Total Organic Carbon (TOC)
Specific Conductance Total Organic Halogen (TOX)
GWQ = Groundwater Quality Parameters per 40 CFR 265.92 (EPA, 1980):
Chloride Phenols
Iron Sodium
Manganese Sulfate
DW = Drinking Water Parameters per 40 CFR 265.92 (EPA, 1980):
Arsenic Nitrate 2,4-D
Barium Selenium 2,4,5-TP Silvex
Cadmium Silver Radium
Chromium Endrin Gross Alpha
Fluoride Lindane Gross Beta
Lead Methoxychlor Turbidity
Mercury Toxaphene Coliform Bacteria
SS = Site-Specific Parameters for the U-12 Crib:
Gamma scan Tritium
Uranium VOA
Technetium-99 Gross beta

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