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THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

VOLUME 2 OF 2

REMEDIAL INVESTIGATION REPORT - PART 1

FINAL

CERCLA-8-99-12
Union Pacific Railroad
Ogden, Utah

Prepared for

UNION PACIFIC RAILROAD
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Prepared by

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APPENDIX C
BORING LOGS

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. STRAT B1

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN, UTAH		LOCATION:	
DRILLING CO.: LAYNE CHRISTENSEN		METHOD: HSA	
DATE START: 3-28-00	DATE COMP: 3-30-00	TIME:	TOTAL DEPTH: 42.5 FT
LOGGED BY: DAN DOWERS			DEPTH TO WATER: ~5 FT

WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
3/28/00	0		ML	0-2.5' Recovery 1.0', silt with fine sand, <1% gravel, mod sorting, dark yellow brown (10YR 4/2), no odor, dry.	40%		0.4	
			GW	2.5-5' Recovery 0.5', gravel and cobbles up to 3" diam, gray orange (10YR 7/4), round-subround, dry. (fine fraction lost?)	20%		0.0	
	5		GM	5-7.5' Recovery 1.0', gravel and sand, gravel up to 3" diam, sand med grained w/ silty matrix, poor sorting, no odor, wet @ 5'.	40%		0.0	
				7.5-10' No recovery, flowing sands and gravel, unable to reach bottom of boring due to slough in hole.	0%			
3/29/00	10		SW/SM	10-12.5' Recovery 1.2', sand, med-v.coarse, grades to gravel with 3" cobbles @ base, subround, poorly sorted, mod brown (5YR 4/4), wet.	48%		0.0	
			SP	12.5-15' Recovery 2.0', sand, coarse w/ gravel @ top (12.5-13'), mod sorting, 10-20 mm diam, yellow brown (10YR 5/4).	80%		0.0	
	15		SP	15-17.5' Recovery 2.5', sand, med-coarse, mod sorting, trace gravel, yellow brown (10YR 4/2), wet, no odor.	100%		0.0	
			SP	17.5-20' Recovery 1.0', sand as above, sli silty (<5%), yellow brown (10YR 4/2), moist-wet as above, trace (<5%) gravel.	40%		0.0	
	20		SM/SP	20-22.5' Recovery 1.9', as above.	76%		0.0	
		60 78 93 125 31 103		22.5-24.5' Moved hole 10' N, rotary to 22.5' (no sample), switched to different sampling system 3/30/00. Hammer driving spoon inside flush thread casing. Recovery 0.	0%			
Note: excessive blow counts due to large diam. "3" core sampler.	25			24.5-26.5' Recovery 0.	0%			

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. STRAT B1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION:
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 3-28-00 / DATE COMP: 3-30-00 / TIME:	TOTAL DEPTH: 42.5 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: ~5 FT

WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
1 1/2" core spoon below 28.5'	25	108 138 29						
		52 104 127		26.5-28.5' Recovery 0, silt/clay coating bottom of spoon. Recovery problem due to large spoon? Switched to 2" OD 1½" ID spoon @ 28.5'.	0%			
		48 23 23	SM	28.5-30.5' Recovery 1.2', sand, vf-med grained, slightly silty, poor sorting, brownish gray (5YR 4/1).	60%		0.0	
	30	24 17				Strat B1-30 @1600		VOC
		9 12 15	GP / CHs	30.5-32.5' Recovery 1.2', 0.2' gravel, well sorted, top of Alpine clay @ 31.5', lt green gray (5YR 6/1), silty, plastic, easily rolls into 3" long strands.	60%		0.0	
		15 9 11 16	CHs	32.5-34.5' Recovery 2', fat clay as above, w/ vf sand.	100%		0.0	
	35	5 7 11 15	CHs	34.5-36.5' Recovery 2', fat clay as above, w/ vf sand.	100%		0.0	
		5 7 14 20	CHs	36.5-38.5' Recovery 2', fat clay w/ vf sand as above.	100%		0.0	
		5 6 7 9	CHs	38.5-40.5' Recovery 1.9', fat clay w/ vf sand as above.	0%			
	40	6 36 101 33		40.5-42.5' Recovery 0. Driller said bottom was in sand; fine sand on spoon. Plugged w/ cement and bentonite.				
				TD @ 42.5'				
	45							
	50							

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. STRAT B2

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN, UTAH		LOCATION:	
DRILLING CO.: LAYNE CHRISTENSEN		METHOD: HSA	
DATE START: 3-31-00	DATE COMP: 4-1-00	TIME:	TOTAL DEPTH: 20 FT
LOGGED BY: DAN DOWERS			DEPTH TO WATER: ~5 FT

WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
2½" diam. core	0	3 6 8 15	ML	0-2' Recovery 1.8', 0-1.4' silt, brown-gray (5YR 4/1); 1.4-1.8' sand, fine-med, sli silty, yellow brown (10YR 5/4), no odor, mod-well sorting.	90%		0.0	
		5 6 7 9	SP	2-4' Recovery 1.6', sand as above with mottled limonite stain, soft, unconsol.	80%		0.0	
	5	4 5 5 7	SM	4-6' Recovery 1.4', sand, medium grained w/ silty matrix, pale yellow brown (10YR 6/2), poor-mod sorting, no odor, becomes wet @ ~5'.	70%		0.0	
Switch to smaller spoon @ 10' to improve recovery		40 24 26 25	SW	6-8' Recovery 0.5', sand and gravel with cobbles up to 2½" diam, subround, poor sorting, gray-orange (10YR 7/4), wet, no odor.	125%		0.0	
1½" diam. core		32 24 20 18	GW	8-10' Recovery 0.5', Gravel with ~5% coarse sand, sandy fraction apparently lost, gravel to 1" diam, subround, poorly sorted, no odor, wet.	25%		0.0	
	10	12 12 15 17	SW	10-12' Recovery 0.5', sand 50%, med-v.coarse, and gravel/ cobbles up to 2" diam, subround, poorly sorted, wet, no odor.	25%		0.1	
		22 11 22 26		12-14' No recovery, cobble in spoon.	0%		NA	
	15	6 13 12 12	CH/ML	14-16' Recovery 0.5', fat clay w/ silt and fine sand, 1 gravel clast @ top, pale yellow brown (10YR 6/2), rolls into +3" strings, high plastic, moist, no odor. Top Alpine clay @ 15.5', brown-gray (5YR 4/1).	25%	Strat B2-15.5 @1800	0.0	VOC
		3 6 10 14	CH	16-18' Recovery 2', fat clay as above (Alpine) w/ decreasing fine sand.	100%		0.0	
		4 6 7 11	CH	18-20' Recoverey 2', fat clay (Alpine) as above w/ minor fine sand and silt.	100%		0.0	
	20			Plugged boring w/ cement and bentonite @ 20'.				
				TD @ 20.0'				
	25							

JOB NUMBER: 792904

BORING 1-B1

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	5	2100	0	0	0
2-2	19	3100	0	0	0
3-6	23	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
CL	Silty clay: old HC residue on surface, decreases with depth, trace to weak diesel odor, dark brown-gray, moist
SC	Clay with scattered sand and gravel: dark brown-gray, weak diesel odor, wet below 6-7 feet.

Notes: Groundwater encountered at 6-8 feet
Water sample collected, no odor

BORING 1-B2

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	1	0
2-2	2	ND	0	0	0
3-4	3	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty and sandy fill: no HC odor
SC	Sandy clay and clayey sand - grades to fg sand: natural color, no stain or HC odor
SW	Sand and sandy gravel: no HC odor or stain, wet below 5 feet.

Notes: Groundwater encountered at 5-6 feet
No water sample collected

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 1-B1 AND 1-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 1-B3

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	1	0
2-2	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty and sandy fill: no HC odor
	SW	Sand: cg-vcg, natural color, no HC odor or stain, wet below 3.5 feet

Notes: Groundwater encountered at 3-4 feet
No water sample collected

BORING 1-B4

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	1	
3-6	1	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty and sandy fill: no HC odor
	SC	Clayey sand: sand fg, dark brown, underlies fill of coal and sandy gravel, no HC odor or stain
	SW	Sand: mg-cg, grades from silt-clayey sand above, trace HC odor, wet, no staining

Notes: Groundwater encountered at 6-8 feet
Water sample collected

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LOG OF BORINGS 1-B3 AND 1-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 8-B1

DATE DRILLED: 9/19/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	7.4	0		0
2-2	0	8.3	0		0
3-8	0	0	0		0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Sandy gravel fill: no HC odor or staining, natural color - dark brown to beige
SP	Sand: mg-cg, natural color, no HC odor or staining, wet

Notes: Groundwater encountered between 8 and 10 feet. No contamination observed at saturation zone.

BORING 8-B2

DATE DRILLED: 9/19/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	0	0		1
2-2	0	0	0		0
3-7	0	6.4	0		0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Sandy gravel fill: no HC odor or staining, natural color - dark brown to beige
CL	Clayey silt with fg-mg sand: natural color - dark brown, no HC odor or stain.
SW	Sandy gravel: common pebbles, natural color, no HC odor or staining, wet

Remarks: Groundwater encountered between 7 and 9 feet. No contamination observed at saturation zone.

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LOG OF BORINGS 8-B1 AND 8-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 8-B3

DATE DRILLED: 9/19/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	14	0		0
2-2	0	22	0		0
3-8	0	19	0		0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Asphalt and sandy gravel road base
	CL	Silty clay with scattered sand and pebbles: natural color, no HC odor or stain.
	SW	Sandy gravel: common pebbles, natural color - beige, no HC odor or staining, sand cg to vcg, wet

Remarks: Groundwater saturation encountered between 8 and 10 feet. No contamination observed at saturation zone.

BORING 9-B1

DATE DRILLED: 9/17/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	0	0	0	
2-2	5	210	0	0	
3-7	8	18	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill: no HC odor or staining.
	SP	Sand: fg-mg, grading to coarser with depth, well sorted, natural med. brown color, weak old diesel odor, no staining.
	SW	Sandy gravel: common pebbles, natural color - beige-brown, no HC od or staining, grades from sand above - fining upwards alluvium, wet at 7 to 8 feet.

Remarks: Groundwater saturation encountered at 7 to 8 feet. No hydrocarbon odor at saturation zone.

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LOG OF BORINGS 8-B3 AND 9-B1
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 9-B2

DATE DRILLED: 9/17-18/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES
	1-0	0	0	0	0		
	2-2	0	8.5	0	0		■
5							
	3-7	0	8.2	0	0		■
10							
15							

SYMBOLS	DESCRIPTION
SW	Sandy gravel: common pebbles, natural color - beige, no HC odor or staining, sand cg to vcg - sand predominant at 2 to 4 feet, wet at 7 to 9 feet.

Remarks: Groundwater saturation encountered at 7 to 8 feet.
No contamination observed at saturation zone.

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792904	LOG OF BORING 9-B2 Ogden Railyard Ogden, UT	GEOPROBE BORING

BORING 12-B1

DATE DRILLED: 9/17/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	0	
3-8	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sandy gravel: common pebbles and minor silt, no HC odor or sta[illegible] drill refusal at 9 feet before saturated conditions intersected, cobbles increasing at bottom of boring.

Remarks: Groundwater not encountered at bottom of boring. Drill refusal before saturated conditions are intersected.

BORING 12-B2

DATE DRILLED: 9/17/9[illegible]

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sandy gravel: common silt decreasing with depth, no HC odor or stain. drill refusal at 7 feet before saturated conditions intersected.

Remarks: Groundwater not encountered at bottom of boring - drill refusal prohibits advance to saturation.

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Proj. 792904

LOG OF BORINGS 12-B1 AND 12-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 12-B3

DATE DRILLED: 9/17/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sandy gravel: common silt decreasing with depth, no HC odor or stain, drill refusal at 3.5 feet before saturated conditions intersected.

Remarks: Groundwater not encountered; drill refusal on coarse fill material (??). Two additional offsets meet with refusal at approximately the same depth.

BORING 12-B4

DATE DRILLED: 9/19/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		9.0	0	0	
2-2		100	0	0	
3-8		410	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	Fill	Sandy gravel fill for railbed
	SW	Sandy gravel: common pebbles and minor clay, weak diesel odor, drill refusal at three different sites before subsaturated moisture reached at 9-9.5 ft.

Remarks: Groundwater encountered at bottom of boring; insufficient quantity for water sample collection.

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LOG OF BORINGS 12-B3 AND 12-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 12-B5

DATE DRILLED: 9/19/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		18	0	0	
2-2		0	0	1	
3-8		11	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill for railbed
	SW	Sandy gravel: scattered pebbles, sand cg-vcg, no HC odor or staining throughout, wet at 9 ft, clay layer at bottom of run.

Remarks: Groundwater saturation encountered at about 9 ft.

BORING 13-B1

DATE DRILLED: 9/18/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	1	12	0	0	0
2-4	12	8	0	0	0
3-8	0	5.8	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Concrete
		Sandy gravel fill: trace HC odor, small pockets of old HC staining
	SP	Sand: mg-cg, natural color, no HC odor or staining, wet at bottom.

Notes: Groundwater encountered between 9 and 10 feet. No contamination observed at saturation zone.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 12-B5 AND 13-B1
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 13-B4

DATE DRILLED: 9/20/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	0
2-2	0	ND	0	0	0
3-8	5	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sandy gravel fill: No HC odor
	SW	Sandy gravel with trace silt and clay: Dark brown, no HC odor.
	SW	Sand: mg-cg, trace clay, no HC stain, weak diesel odor, moist

Notes: Groundwater encountered below 9-10 feet. Weak to moderate diesel odor from water.
Water sample collected.

BORING 13-B5

DATE DRILLED: 9/20/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sandy gravel: Natural colors, no stain or odor, moist to wet, boring located on lower terrace.

Notes: Groundwater encountered at about 5-8 feet. Trace to weak diesel odor from water. No surface soil sample.
Water sample collected.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 13-B4 AND 13-B5
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 13-B2

DATE DRILLED: 9/18/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	7.1	0	0	0
2-4	0	5.1	0	0	0
3-8	1	0	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Concrete
SC	Sand with minor clay: No HC odor or stain.
CL	Silty clay with scattered sand and fine gravel: sand cg-vcg, patches natural organics, no HC stain or odor.
SW	Sand: cg-vcg, trace clay, dark gray, common natural organics, wet at 9-10 ft.

Notes: Groundwater encountered between 9 and 10 feet. No contamination observed at saturation zone.

BORING 13-B3

DATE DRILLED: 9/19/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	18	0	0	0
2-2	0	11	0	0	0
3-9	0	7.2	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill: No to trace HC odor, no HC staining
SP	Sand: mg-cg, gray-brown, no HC odor or stain, wet below 9 feet.

Notes: Groundwater encountered below 9.5 feet. No contamination observed at saturation zone.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 13-B2 AND 13-B3
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 13-B6

DATE DRILLED: 9/20/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sandy gravel: Natural colors, no stain or odor, moist to wet, boring located on lower terrace.
10									
15									

Notes: Groundwater encountered at about 5-6 feet. Trace old diesel odor from water. No soil samples
Water sample collected.

BORING 13-B7

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sandy gravel: No soil sample collected, boring located 5 feet west of western-most repair track
10									
15									

Notes: Groundwater encountered at about 6 feet.
Water has no odor, good return, cloudy gray-brown
Analysis for 8260, TPH, metals

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 13-B6 AND 13-B7
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 18-B1

DATE DRILLED: 10/15/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0		0		
2-2	0		0		
3-8	0		0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel: no HC odor, fill
CL	Silty clay: grades for sandy gravel fill above, no HC odor or stain
SW	Sandy gravel: wet, no HC odor or stain

Notes: Groundwater encountered at 6-8 feet
Water sample collected, no HC odor

BORING 19-B1

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0		0		
2-2	0		0		
3-7	0		0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sand and fine gravel with clay: road base, no HC odor
SW	Silt and vfg sand: no HC stain or odor, black natural organics
SW	Sand: fg-cg, well sorted, fining down, no HC odor or stain, wet at 8 feet

Notes: Groundwater encountered at about 8 feet.
No water sample collected

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 18-B1 AND 19-B1
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 19-B2

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0		0		
2-2	0		0		
3-7	0		0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy loam: no HC odor
	SW	Sand and fine gravel: no HC stain or odor, scattered coal
	SW	Sand grading to gravel: no HC odor or stain, wet at 8 feet

Notes: Groundwater encountered at about 8 feet.
No water sample collected

BORING 21-B1

DATE DRILLED: 10/9/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	150			4
2-2	0	ND			0
3-8	0	ND			0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sand and gravel with scattered gravel-size ore spillage: common CuOx ore, slag, fill and ballast material
	SW	Sand and fine gravel: natural color, no HC odor or staining, perched water about 3-4 feet, principal saturation below 6-7 feet

Notes: Groundwater encountered at about 7 feet.
Water has no odor or sheen.
Water sample collected

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 19-B2 AND 21-B1
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 21-B1A

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and gravel with scattered gravel-size ore spillage: common CuOx ore, slag, fill and ballast material
									Sand and fine gravel: natural color, no HC odor or staining, perched water about 3-4 feet, principal saturation below 6-7 feet
10									
15									

Notes: Groundwater encountered at about 7 feet.
Water has no odor or sheen, sample collected for 8260.
Twin of 21-B1 for water sample

BORING 21-B2

DATE DRILLED: 10/9/9

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
	1-0	0	ND			0		SP	Sand: fill, windblown, well sorted, fg-mg, clean
	2-2	0	ND			0			Sand: well sorted, fg-mg, no HC odor or staining, wet below 7 feet
5	3-6	0	ND			0			
10									
15									

Notes: Groundwater encountered at about 7 feet.
Water has no odor or sheen.
Water sample collected

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 21-B1A AND 21-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 21-B3

DATE DRILLED: 10/9/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND			1
2-2	0	ND			0
3-7	0	ND			0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Railroad gravel fill: ballast and gravel
	CL	Clay grading to fg sand at about 3.5 feet: brown, no odor or HC staining
	SW	Sand: increasing size fraction at depth, grades from above, natural color, no odor or HC stain
	SW	Sandy gravel: grades from finer sand above, natural color, no odor or HC stain, wet

Notes: Groundwater encountered at about 7-8 feet.
Water sample collected, no HC odor

BORING 21-B3A

DATE DRILLED: 5/19/98

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Railroad gravel fill: ballast and gravel
	CL	Clay grading to fg sand at about 3.5 feet: brown, no odor or HC staining
	SW	Sand: increasing size fraction at depth, grades from above, natural color, no odor or HC stain
	SW	Sandy gravel: grades from finer sand above, natural color, no odor or HC stain, wet

Notes: Groundwater encountered about 7-8 feet.
Water sample collected for 8260
Twin boring of 21-B3, drilled for water sample

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UPRR Ogden Railyard
Proj. 792804

LOG OF BORINGS 21-B3 AND 21-B3A
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 21-B4

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clayey matrix: logged solely from drilling characteristics, no soil samples collected
10									
15									

Notes: Groundwater encountered about 6-8 feet, slow recovery
Water sample collected for 8260
Water had no odor.

BORING 21-B6

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clayey matrix: logged solely from drilling characteristics, no soil samples collected
10									
15									

Notes: Groundwater encountered about 6-8 feet, good recovery
Water sample collected for 8260
Water had no odor.

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 21-B4 AND 21-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 21-B5D

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10		0				
15		0				
20		0				
25		0				
30		0				
35		0				
40		0				
45						
50						

SAMPLES

SYMBOLS		DESCRIPTION
		Sand and gravel mix: typical uppermost alluvial sequence, no samples
		Probable sand – lost sample: absence of sample in spoon indicates wet, well sorted sand
	SW	Sandy gravel: no HC odor, wet, no clay, natural colors, grades from well sorted mg-vcg sand to sandy gravel
	CL	Clay: medium brown, low to moderate plasticity, massive, moist trace silt, no HC odor
		Silty clay facies – limited vertical extent, gradational above and below

Notes: Strat hole only, no soil samples for analyses collected.
Groundwater encountered at about 7 feet.
Water sample collected with screen at 7 to 9 feet.
Lithologies logged from 2-foot split spoon samples collected at every 4-foot interval.

BORING 21-B7

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no soil samples collected

Notes: Groundwater encountered about 7-9 feet, good recovery
Water sample collected for 8260
Water had trace odor.

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792904	LOG OF BORING 21-B5D Ogden Railyard Ogden, UT	GEOPROBE BORING

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

BORING/WELL COMPLETION LOG

BORING NUMBER 21-B8

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD RI*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/14/01*	DATE COMP: *5/14/01*	GROUND ELEV:
TOTAL DEPTH: (FT) *8'*		
LOGGED BY: *T. Kish*	TOC ELEVATION:	DEPTH TO WATER: (FT) *7.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	SAMPLE ANALYSIS	SAMPLE ID & DEPTH
	0			FILL	FILL Black Granules of Coal Like Material With Medium-Grained Sand & Trace Gravels	4.0		Metals SVOC VOC METALS SVOC	21-B8-0 21-B8-2
	5			CL	CLAY Very Stiff, Light Brown, Medium Plasticity. Grades Downward To Highly Plastic At 7 Feet	4.0			
				SW	SAND Wet, Light Brown, Fine Grained, Well Sorted				
	10				Note: Ground Water Sample Collected From 8-12 Foot Interval.				
	15								
	20								21-B8

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BORING/WELL COMPLETION LOG

BORING NUMBER 21-B9

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD RI*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/14/01*	DATE COMP: *5/14/01*	GROUND ELEV:
TOTAL DEPTH: (FT) *10'*		
LOGGED BY: *T. Kish*	TOC ELEVATION:	DEPTH TO WATER: (FT) *9.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	SAMPLE ANALYSIS	SAMPLE ID & DEPTH
	0			FILL	FILL Crushed Gravel & FG Sand	4.0		Metals SVOC VOC METALS SVOC	21-B9-0 21-B9-2
				SW	SAND Fine Grained, Well Sorted, Moist, Light Brown, Trace Subgraded Gravels				
	5				(4-8 Foot Run - Limited Recovery, Core Barrel Blocked By Gravel)	1.8			
				CL	CLAY Silty, Dark Brown, Moist, Low Plasticity	2.0			
	10			SP	SAND Poorly Sorted, Coarse Grain With Gravels, Moderate Brown				
					Note: Ground Water Sample Collected From 10-14 Foot Interval.				
	15								
	20								

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BORING/WELL COMPLETION LOG

BORING NUMBER 21-B10

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD RI*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/14/01*	DATE COMP: *5/14/01*	GROUND ELEV:	TOTAL DEPTH: (FT) *8'*
LOGGED BY: *T. Kish*	TOC ELEVATION:	DEPTH TO WATER: (FT) *7'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	SAMPLE ANALYSIS	SAMPLE ID & DEPTH
	0			FILL	FILL Black Coal Like Material, Very Fine Grain	2.0		SVOC Metals VOC SVOC METALS	21-B10-0 21-B10-2
	5			SW	SAND Fine Grained, Well Sorted, Moist, Light Brown, Minor Well Rounded Gravels. Grades To Grayish Brown In The Last 3 Inches	2.8			
	10				Note: Ground Water Sample Collected From 8-12 Foot Interval.				
	15								
	20								

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BORING/WELL COMPLETION LOG

BORING NUMBER 21-B11

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD RI*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/14/01*	DATE COMP: *5/14/01*	GROUND ELEV:	TOTAL DEPTH: (FT) *8'*
LOGGED BY: *T. Kish*	TOC ELEVATION:	DEPTH TO WATER: (FT) *8'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	SAMPLE ANALYSIS	SAMPLE ID & DEPTH
	0			FILL	FILL Dark Brown FG Sand, Damp, Mnor Gravels	3.0		METALS SVOC VOC METALS SVOC	21-B11-0 21-B11-2
	5			SW	SAND Fine Grained, Well Sorted, Moist, Light Brown, Minor Fines	2.8			
	10				Note: Ground Water Sample Collected From 8-12 Foot Interval.				
	15								
	20								

BORING 22A-B1

DATE DRILLED: 10/13/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	1	0
2-2	0	ND	0	0	0
3-7	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill
CL	Clay with minor silt, grades to fg sand: probable fill, no HC odor or staining
SW	Sand: mg-cg, no HC odor or stain, wet at 7-8 feet

Notes: Groundwater encountered at 7-8 feet.
No water sample collected.

BORING 22A-B2

DATE DRILLED: 10/13/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	1
2-2	0	ND	0	0	0
3-7	1	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill, scattered coal
CL	Clay with minor silt: probable fill, no HC odor or staining
SW	Sand: mg-cg, no HC odor or stain, wet at 7-8 feet, fining both up and down in sample interval

Notes: Groundwater encountered at 7-8 feet.
No water sample collected

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LOG OF BORINGS 22A-B1 AND 22A-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22A-B3

DATE DRILLED: 10/13/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	15	0	0	1
2-2	0	0	0	0	0
3-7	0	0	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill, scattered coal
	CL	Clay with minor silt: probable fill, no HC odor or staining
	SW	Sand: mg-cg, no HC odor or stain, wet at 7-8 feet, fining both up and down in sample interval

Notes: Groundwater encountered at 7-8 feet.
No water sample collected

BORING 22A-B4

DATE DRILLED: 10/13/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	81	0	2	1
2-2	2	200	0	0	0
3-7	13	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill
	SW	Sand: mg-cg, pervasive old HC stain, trace HC odor
	CL	Silty clay: Trace-weak HC odor, wet, minor scattered staining

Notes: Groundwater encountered at 7-8 feet.
No water sample collected, free product present.
Piezometer constructed.

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LOG OF BORINGS 22A-B3 AND 22A-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22A-B5

DATE DRILLED: 10/13/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	6.9	0	0	0
2-2	43	980	0	0	1
3-6	28	380	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill
SW	Sandy gravel: pervasive product coating, black product may be perched on clay layer below
CL	Silty clay: moderate HC odor, wet, gray-brown

Notes: Groundwater encountered at 7-8 feet
No water sample collected, free product present.
Piezometer constructed.

BORING 22A-B6

DATE DRILLED: 3/16/98

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Sandy gravel or sand: No sample collected, soil log based solely on drilling characterisitcs

Notes: Groundwater encountered at 7-8 feet
Product encountered-diesel odor
No water sample, no piezometer constructed.

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Proj. 792904

LOG OF BORINGS 22A-B5 AND 22A-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22A-B7

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sandy gravel or sand: No sample collected, soil log based solely on drilling characterisitcs
10									
15									

Notes: Groundwater encountered at 7-8 feet
Product encountered-diesel odor, no water sample
Piezometer constructed, screened from 3-13 feet.

BORING 22A-B8

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sandy gravel or sand: No sample collected, soil log based solely on drilling characterisitcs
10									
15									

Notes: Groundwater encountered at 6-8 feet
Water sample collected, analyzed for 8260
Good water return, moderate odor, sheen

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Proj. 792904

LOG OF BORINGS 22A-B7 AND 22A-B8
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22A-B10

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS		DESCRIPTION
									SW	Sandy gravel or sand: No sample collected, soil log based solely on drilling characterisitcs
5										
10										
15										

Notes: Groundwater encountered at 6-8 feet
No water sample collected
Water has strong odor, sheen, no product

BORING 22A-B9

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS		DESCRIPTION
									SW	Sandy gravel or sand: No sample collected, soil log based solely on drilling characterisitcs
5										
10										
15										

Notes: Groundwater encountered at 6-8 feet
Water sample collected, analyzed for 8260
Good water return, strong odor, sheen

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LOG OF BORINGS 22A-B10 AND 22A-B9
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22A-B11

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS		DESCRIPTION
5									SW	Sandy gravel or sand: No sample collected, soil log based solely on drilling characterisitcs
10										
15										

Notes: Groundwater encountered at 6-8 feet
Abundant product blebs-diesel odor, no water sample
Piezometer constructed, screened from 3-13 feet.

BORING 22A-B12

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS		DESCRIPTION
5									SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10										
15										

Notes: Groundwater encountered at 7-9 feet
Water sample collected for 8260.
Good water return, no odor,

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LOG OF BORINGS 22A-B11 AND 22A-B12
Ogden Railyard
Ogden, UT

GEOPROBE BORING

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
22A - B13

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 2
PROJECT: *OGDEN VINYL CHLORIDE TRANSECT*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		

DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV:	TOTAL DEPTH: (FT) *24.0' bgs*
LOGGED BY: *T. Kish*	TOC ELEVATION:	DEPTH TO WATER: (FT) *~10.0' bgs*	

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0	N/A		FILL	FILL, Gravels to 1" and Sand. Sand is Medium-Grained with Little Fines (10%). Poorly Sorted.	75%	2.0'	0.0	N/A
				SP	SAND, Fine Grained. Moderatly Sorted. Black Layer from 2.0' - 2.5'. Moderate Fines (25%).				
	5	N/A		SC	CLAYEY SAND, Very Fine Grained. with Moderate Fines (25%). Light Brown. Wet.	75%	6.0'	0.0	N/A
					Grades to SILTY SAND @ 7.5' Medium Plasticity. Trace Gravels to .25".				
				SM	SILTY SAND, Very Fine Grained. Brown.	60%	10.0'	0.0	N/A
	10	N/A		SP	SAND, Medium Grained. Wet. Well Sorted. Light Brown. Moderate Fines (25%).				
				GM	SAND, Medium Grained. Poorly Sorted. Contains .5" gravels , Sub Rounded, Saturated, Moderate Fines (25%).				
		N/A		GM	SAND, Medium Grained. Saturated, Contains 1" - 1.5" Gravels. Poorly Sorted. with Moderate Fines (25%).	75%	14.0'	0.0	N/A
	15								
		N/A		GM	SAND, Medium Grained. Saturated, Contains 1" - 2" Gravels. Poorly Sorted. with Moderate Fines (25%). Sub Rounded.	75%	18.0'	0.0	N/A
				SW	SAND, Medium Grained. Sub Rounded to Rounded. Poorly Sorted. with Little Fines (10%).				
	20				Continued on next page.				

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ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
22A - B13

CLIENT: *UNION PACIFIC RAILROAD* | JOB NUMBER: *13290000* | SHEET 2 OF 2

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG	USCS CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
					Continued from previous page.				
	20			SW	SAND, Coarse Grained. Sub Rounded to Rounded. Poorly Sorted. Saturated. Little Fines (10%).				
		N/A		GP	RIVER GRAVELS, .25 - 2". Poorly Sorted. Sub Rounded to Rounded. Moderate Fines (25%).	90%	22.0'	0.0	N/A
					ALPINE FORMATION, Fat Clay - High Plasticity. Dense				
					End of Borehole Backfilled with Granular Bentonite				
	25								
	30								
	35								
	40								
	45								

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
22A - B16

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN VINYL CHLORIDE TRANSECT*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: / TOTAL DEPTH: (FT) *20.0' bgs*
LOGGED BY: *T. Kish*	TOC ELEVATION:	DEPTH TO WATER: (FT) *~9.0' bgs*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0	N/A	FILL	FILL, Angular Gravels and Sandy Soil Matrix.	60%	2.0'	0.0	N/A
			SP	SAND, Fine Grained, Well Sorted, Little Fines (10%), Moist, Light Brown.				
	5	N/A	ML	SANDY SILT, Moist, Low Plasticity.	65%	8.0'	90.0	N/A
			SP	Grades to SAND, Medium Grained, Well Sorted, Moist, Strong Diesel Odor.				
	10	N/A	ML	SANDY SILT, Very Fine Grained, Moist. Grades to Medium Grained SAND, Moist, Well Sorted, Moderate Fines (25%).	75%	10.0'	15.0	N/A
			GP?	RIVER GRAVELS, Poorly Sorted, .5" - 1.5" Rounded to Well Rounded, Wet. Contains Coarse Sand, Poorly Sorted. Moderate Fines.				
	15	N/A	ML	SANDY SILT, Very Fine Grained, Wet. Brown. (12' - 12.25' bgs)	100%	14.0'	0.0	N/A
			GP?	RIVER GRAVELS, (Starts @ 12.25' bgs) & Coarse Sand. Poorly Sorted, Sand is Medium to Coarse Grained, with Little Fines.				
		N/A	GP	RIVER GRAVELS, with Coarse Sand, Poorly Sorted, Fines @ ~20% Gravels Well Rounded, and Range from .25" - 2".	100%	18.0'	0.0	N/A
				ALPINE FORMATION 18.9' bgs				
	20			End of Borehole Backfilled with Granular Bentonite and Asphalt Patch.				22A - B16

BORING 22B-B1

DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		80	0	1	1
2-2		ND	0	0	0
3-6		24	0	1	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Road base gravel fill with minor clay/silt: no HC odor Sand: mg-cg, minor clay as matrix, possible fill next to building foundation, no HC odor but may host old HC staining.
SC	Clayey sand: old petroleum staining observed at saturated zone.

Notes: Groundwater encountered at about 7 feet.
Trace HC odor in water; no sheen.
Water sample collected, slow water recovery

BORING 22B-B2

DATE DRILLED: 9/24/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	33	0	0	1
2-2	1	55	0	0	1
3-6	0	47	0	0	1

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SC	Silty sand: Fill, black, no HC odor Clayey and silty sand: possible fill next to building foundation, no HC odor but may have HC staining.
CL	Silty clay grading to fg-mg sand: no odor or stain, wet
SC	

Notes: Groundwater encountered at about 7 feet.
Water has no odor or sheen.
Water sample collected

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 22B-B1 AND 22B-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B3

DATE DRILLED: 9/24/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	85	0	0	1
2-2	112	530	0	0	0
3-6	123	2500	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty sand with taconite pellet debris: Fill, overlies stained soil
SC	Silty clay: dark brown, moderate diesel odor
SW	Sandy gravel: diesel sheen on grains, wet, moderate to strong diesel odor, grades from silty sand above.

Notes: Groundwater encountered at about 7 feet.
Free diesel product at water table.
No water sample collected.
Piezometer constructed.

BORING 22B-B4

DATE DRILLED: 9/24/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	38	0	0	2
2-2	124	550	0	0	0
3-6	84	230	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Silty sand and gravel fill with scattered metal and wood debris
	Silty clay: grades from sand above, moderate to strong diesel odor.
SC	Silty clay continues to 8 feet, dark brown, wet, strong odor

Notes: Groundwater encountered at about 7 feet.
Water sample collected, weak to moderate odor and sheen

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LOG OF BORINGS 22B-B3 AND 22B-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B5

DATE DRILLED: 9/24/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		62	0	0	1
2-2		120	0	0	0
3-6		67	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty sand and gravel fill
SC	Sandy clay: weak HC odor
SM	Silty sand: wet, weak odor

Notes: Groundwater encountered at about 7 feet.
Water sample collected, weak HC odor, slight sheen
Slow water recovery

BORING 22B-B6

DATE DRILLED: 10/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	92	0	1	1
2-2	0	17	0	0	0
3-6	0	9.5	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty gravel fill: sooty, dark gray to black
SP	Sand: well sorted, mg-cg, no HC odor or stain, natural colors
SW	Sandy gravel: natural colors, no HC odor, moist to wet

Notes: Groundwater encountered at about 7 feet.
Water sample collected, no HC odor

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LOG OF BORINGS 22B-B5 AND 22B-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B7

DATE DRILLED: 10/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	2	1
2-2	120		0	1	0
3-6	478	ND	0	0	1

SAMPLES

DEPTH IN FEET: 5, 10, 15

SYMBOLS		DESCRIPTION
		Silty gravel fill
	GM	Sandy gravel with silt: moderate diesel odor, no staining
	SW	Sandy gravel: strong diesel odor, diesel sheen on grains

Notes: Groundwater encountered at about 6-7 feet.
Water sample collected, trace HC odor.

BORING 22-B8

DATE DRILLED: 3/11/98

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

SAMPLES

DEPTH IN FEET: 5, 10, 15

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel with possible clay: logged soley from drilling characterisitcs, no samples collected

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

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LOG OF BORINGS 22B-B7 AND 22B-B8
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B10

DATE DRILLED 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

BORING 22B-B9

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

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LOG OF BORINGS 22B-B10 AND 22B-B9
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B11

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

BORING 22B-B12

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

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LOG OF BORINGS 22B-B11 AND 22B-B12
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B13

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clay: logged solely from drilling characterisitcs, no samples collected
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride and 8260
Good water return; weak diesel odor

BORING 22B-B14

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 22B-B13 AND 22B-B14
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B15

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 8-9 feet, screen at 11-13 ft
Water sample collected for vinyl chloride only
Good water return

BORING 22B-B16

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 7-8 feet
Water analysis for vinyl chloride, 8260
Good water return, moderate odor, brown color

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 22B-B15 AND 22B-B16
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B17

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater/product encountered
No water analysis
Piezometer constructed, screened from 3-13 feet
Piezometer wellhead subsequently damaged by grader, ~~repaired on 5/20/98~~

BORING 22B-B18

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 8 feet
Water analysis for vinyl chloride only
Good water return, no odor

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 22B-B17 AND 22B-B18
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B19

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 6-7 feet
Water analysis for vinyl chloride only
Good water return, no odor

BORING 22B-B20

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 8 feet
Water analysis for vinyl chloride only
Good water return, no odor, light brown color

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 22B-B19 AND 22B-B20
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 22B-B21

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 8 feet
Water analysis for 8260
Good water return, no odor

BORING 22B-B22

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 6-7 feet
Water analysis for 8260
Good water return, trace to no odor

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 22B-B21 AND 22B-B22
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 26-B1

DATE DRILLED: 10/8/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	8.4	0	0	
2-2	33	370	0	3	
3-8	17	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty loam fill
	CL	Clayey silt and sand: pervasive black petroleum residue, weak HC odor
	SP	Sand: grades from above, mg-cg, pervasive aged petroleum coating, weak odor, wet

Notes: Groundwater encountered at about 5 feet.
Water sample collected, weak odor, sheen

BORING 26-B2

DATE DRILLED: 10/8/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	0	0	1	
2-2	48	780	0	0	
3-8	50	280	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty loam fill
	SW	Sandy gravel: abrupt change from uncontaminated earth to to pervisive petroleum coatings at 3.5 feet - upper sandy gravel is likely backfill, weak HC odor Staining dercreases to spotty at depth, weak to moderate odor, wet at about 5 feet

Notes: Groundwater encountered at about 5 feet.
Water sample collected, moderate odor, product blebs

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LOG OF BORINGS 26-B1 AND 26-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 26-B3

DATE DRILLED: 10/9/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	110	0	0	
2-2	0	120	0	1	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill
SM	Silty loam: dark brown to black, natural colors, no HC odor or staining, clean, wet below 3 feet

Notes: Groundwater encountered at about 3 feet.
Water sample collected, no HC odor

BORING 26-B4

DATE DRILLED: 10/9/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	50	0	0	
2-2	0	7.4	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty and clayey loam: black, no HC odor or staining, clean, forest soil
SW	Sandy gravel: natural alluvium, wet below 3 feet no HC odor or staining, clean

Notes: Groundwater encountered at about 3 feet.
Water sample collected, no HC odor

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 26-B3 AND 26-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 26-B5

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
								SW	Sand and sandy gravel, loamy soil: logged soley from drilling characterisitcs, no samples collected
5									Notes: Groundwater encountered at 3 feet Water sample collected for vinyl chloride only Good water return; trace HC odor
10									
15									

BORING 26-B6

DATE DRILLED: 3/11/9

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
								SW	Sand and sandy gravel, loamy soil: logged soley from drilling characterisitcs, no samples collected
5									Notes: Groundwater encountered at 3 feet Water sample collected for vinyl chloride only Good water return; trace HC odor, water medium gray
10									
15									

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Proj. 792904

LOG OF BORINGS 26-B5 AND 26-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B8

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4297.2*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *3'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			SM	SILT, Brown Silty Organics. 0" - 6"				
				OL	SILTY CLAY, Slightly Moist, Dark Brown. Dark Gray @ 1.5' & 2.8'.	3.5		0.0	26 - B8 3.5
				SP/SM	SAND, Fine to Coarse Grained. Moist. Odor @ 3'.				
	5			GM	GRAVEL, >1" with Intermittent Sand. Moist. Brownish Gray.	3.5		0.0	
	10			SP/SM	SAND, Fine to Coarse Grained. Moist. 1.5 ?	3.0		0.0	
	15								
	20								26 - B8

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B9

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4296.99*	TOTAL DEPTH: (FT) *8.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *1.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH	SILTY CLAY, Poorly Graded, Brown. Fine to Medium Sand with Organic Material Stratisfied. Med Dense				
				CL	CLAY SILT , Poorly Graded. Moist, Medium Plasticity. Homogenous. Dark Brown.	3.0		0.0	26 - B9-3
				GP	SAND, Poorly Graded. with Intermittent Coarse Gravels >1" with Medium Sand to Coarse Gravel and Cobble. Moist, Medium Density.				
	5			GP	SAND, Poorly Graded. with Intermittent Coarse Gravels >1" with Medium Sand to Coarse Gravel and Cobble. Moist, Medium Density.	3.5		0.0	
				CH	CLAY, Brown Inorganic. High Plasticity. No Odor. Homogenous. Possible ALPINE FORMATION.				
	10								
	15								
	20								

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B10

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4297.95*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *3'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH	SILTY CLAY, Organic Material				
				CL	SILTY CLAY, Poorly Graded. Slightly Moist, Medium Plasticity. Homogenous. Dark Brown.	2.5		0.8	26 - B10 - 3.5
				CL	SILTY CLAY, Dark Gray with Oil Substance *				
				CL	SILTY CLAY, Brown with Orange Cobbles				
	5			GP	SAND, Poorly Graded. with Intermittent Coarse Gravels >1" with Medium Sand to Coarse Gravel and Cobble. Moist, Medium Density.	4.0		0.3	
	10			GP	SAND, Poorly Graded. with Intermittent Coarse Gravels >1" with Medium Sand to Coarse Gravel and Cobble. Moist, Medium Density.	3.0			
	15				* Note: Tarry Oil Substance seemed to Contain an Oil Rag or Fiberous Material				
	20								26 - B10

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B11

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4297.25*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *2.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH	SILTY CLAY, Organic Material.				
				CL	SILTY CLAY, Poorly Graded. Slightly Moist. Medium Plasticity, Dark Brown. Homogenous. Poorly Graded Sand to Coarse Gravel.	4.0		4.0	26 - B11 - 3
	▼			GP	GRAVELS ?, Slightly Moist. Brown with White & Yellowish Lenses. Definite Odor of Product.				
				SM	SANDY SILT, with Coarse Gravel. Intermittent, Medium to Fine Sand. Moist. Dark Gray.				
	5			SM	SANDY SILT, with Coarse Gravel. Intermittent, Medium to Fine Sand. Moist. Dark Gray.	3.5		2.4	
				GP	GRAVELS, Poorly Graded. Moist. Red White Yellowish. Little Fines.				
	10			GP	GRAVELS, Poorly Graded. Moist. Red White Yellowish. Little Fines.	3.0		0.1	
	15								
	20								26 - B11

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B12

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4297.14*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *1.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			SM	SILTY SAND, Organic Material. 0-9"				
				OL	SILTY CLAY, with Black Organic Stripes, Orange Intermittent. Some Cobbles .5" 9"				
				CL	SILTY CLAY, Dark Gray 10".	2.8		0.0	26 - B12 - 1.5
				SP/SM	SAND, Coarse to Fine Grained Brown with Cobbles 8".				
	5			GM	GRAVEL, Intermittent gravels >1" diam.	3		0.0	
	10				GRAVEL - As above	3		0.0	
	15								
	20								26 - B12

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B13

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4299.66*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *1.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH CL	ORGANIC MATERIAL. SILTY CLAY, Organic Material. Poorly Graded. Slightly Moist. Medium Plasticity. Dark Brown.				
					Black Oil Like Fine Material that behaves like Break Dust. Moist. (Sludgelike Remnants) Diesel Odor.	4.0		0.3	26 - B13 - 4
	5			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Residual Hydrocarbon. Dark Gray. At bottom No Odor	4		0.1	
	10			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Residual Hydrocarbon. Dark Gray. At bottom No Odor	3		0.0	
	15				Note: High Residual Hydrocarbons, Potential Free Product in Ground Water about 1.5' into Table. Dark Brown Somewhat Viscous.				
	20								26 - B13

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B14

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4299.94*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *1.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH CL	ORGANIC MATERIAL. SILTY CLAY, Poorly Graded. Moist. Medium Plasticity. Dark Brown. Definate Free Product Odor.	4.0		7.8	26 - B14 - 3
					@ 3'-4" Lense of Dark Gray Product of Oil.				
	5			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Moist. Dark Gray.	4		0.0	
	10			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Moist. Dark Gray.	3		0.0	
	15								
	20								26 - B14

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B15

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4294.32*	TOTAL DEPTH: (FT) *7.5'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *2'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG	USCS CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH CL	ORGANIC MATERIAL. Silty Clay. SILTY CLAY, Poorly Graded. Moist. Medium Plasticity. Dark Gray/Brown.	4.0		0.0	26 - B15 - 2
				GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Dark Gray.				
	5			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Dark Gray.	3.5		0.0	
	10								
	15								
	20								26 - B15

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B16

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		

DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4300.30*	TOTAL DEPTH: (FT) *7.5'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *1.5'*	

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH CL	ORGANIC MATERIAL. Silty Clay. SILTY CLAY, Poorly Graded. Moist. Medium Plasticity. Dark S w/ Brown. Slight Odor.	4.0			26 - B16 - 3.5
	5			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Dark Gray.	3.5			
	10								
	15								
	20								26 - B16

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B17

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4299.58*	TOTAL DEPTH: (FT) *11.0'*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *1.2'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH	ORGANIC MATERIAL. Silty Clay.				
				CL	SILTY CLAY, Poorly Graded. Moist. Medium Plasticity. Dark Gray. Definate Free Product Sheen.	2.5		1.3	26 - B17 - 2
	5			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Moist. Dark Gray.	3.0		0.8	
	10			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Moist. Dark Gray.	3.0		0.3	
	15				NOTE: Strong Odor. Globules on Plastic Cylinder.				
	20								

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ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B18

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4297.88*	TOTAL DEPTH: (FT) *12*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *2.5'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			?	Black Oil Like Fine Material That Behaves Like Brake Dust. Slightly Moist Sludgelike Remnants. (Unknown)	3.5	ALL	4.3	26 - SG1 - 0.0 26 - B18 - 4.0
	5			CL	SILTY CLAY, Dark Gray with Oil Substance.				
				GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Dark Gray.	3.0		1.3	
	10			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Dark Gray.	3.5		0.0	
	15				NOTE: Strong Odor. Globules on Plastic Cylinder.				
	20								26 - B18

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ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
26 - B19

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *13290000*	SHEET 1 OF 1
PROJECT: *OGDEN RAILYARD AOI-26 EXCAVATION CONFIRMATION*	LOCATION: *OGDEN UTAH, OGDEN RAILYARD*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT: *GEOPROBE 5400*	
METHOD: *DIRECT PUSH / GEOPROBE*		
DATE START: *5/8/01*	DATE COMP: *5/8/01*	GROUND ELEV: *4299.50*	TOTAL DEPTH: (FT) *8*
LOGGED BY: *E. Sewell*	TOC ELEVATION:	DEPTH TO WATER: (FT) *2.0'*

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG	USCS CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0			OH	ORGANIC MATERIAL, Silty Clay.				
				CL	SILTY CLAY, Poorly Graded. Medium Plasticity. Slightly Moist. Homogenous. Dark Brown.	4.0		0.1	
					4" of Coarse Gravel whitish Yellow.				
				GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Moist. Dark Gray.				26 - B19 - 4
	5			GP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand. Moist. Dark Gray.	3.5		0.0	
	10								
	15								
	20								26 - B19

BORING 27-B1

DATE DRILLED: 9/22/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	39	0	0	1
2-2	0	39	0	1	0
3-6	0	5.8	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Sandy gravel: scattered sludge remnants as crusts of surface ooze, scattered old construction debris
SW	Sandy loam: minor silt and clay fractions, medium-dark brown, no HC odor
SW	Sand with scattered gravel sizes: no staining or HC odor, wet

Notes: Groundwater encountered at about 6-7 feet. Water sample collected, no odor or sheen.

BORING 27-B2

DATE DRILLED: 9/22/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	1	1300	0	1	1
2-2	3	1200	0	1	1
3-4	4	1900	0	1	1

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SM, SW	Sandy silt: sludge seep material abundant, sample is tarry
	Sandy soil: uncertain grainsize fractions, dark brown to black with abundant tarry sludge, very acidic, nearly pervasive throughout boring

Notes: No water sample collected because tarry material would foul water works.

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LOG OF BORINGS 27-B1 AND 27-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 27-B3

DATE DRILLED: 9/22/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		5.4	0	0	0
2-2		5.5	0	0	0
3-4		43	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty loam: no surface contamination, clean
SP	Sand: well sorted, no odor, scattered small clots of sludge similar to that in 27-B1
SM	Silty sand: sand vfg, fining downwards, old HC odor, no staining of visible petroleum HCs, wet

Notes: Water sample collected, moderate HC odor from water, no sheen.

BORING 27-B4

DATE DRILLED: 9/22/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		8.2	0	0	0
2-2		17	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty loam: no surface contamination, clean, no odor
SW	Sandy gravel: no stain or tarry clots, moderate to strong odor, wet below 3 feet

Notes: Water sample collected, moderate HC odor from water, trace sheen.

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LOG OF BORINGS 27-B3 AND 27-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 27-B5

DATE DRILLED: 9/22/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	0
2-2	0	5	0	0	0
3-4	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty loam: no surface sludge, no odor
		Silty and sandy loam: grades to mg-cg sand, clean, no odor
	SP	
	SM	Sandy gravel: no odor or visible HC contamination, wet

Notes: Water sample collected, weak HC odor from water, no sheen.

BORING 27-B6

DATE DRILLED: 9/22/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	27	0	1	1
2-2	0	69	0	0	0
3-4	0	42	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty loam: no surface sludge, no odor
	SP	Sand: fg-cg, well sorted, fractions from 4 to 8 feet are predominantly mg-cg, wet below 4 feet, no odor or staining

Notes: Water sample collected, no HC odor from water, no sheen.

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LOG OF BORINGS 27-B5 AND 27-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 27-B7

DATE DRILLED: 10/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	84	0	1	1
2-2	0	ND	0	0	0
3-8	0	5.1	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty loam: no surface sludge, no odor
SP	Sand: mg-cg, well sorted, no sludge or HC odor
SW	Sandy gravel: well sorted, no sludge or HC odor, wet

Notes: Water sample collected, no HC odor from water, no sheen.

BORING 30-B1

DATE DRILLED: 10/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	8.3	0	2	3
2-2	373	990	0	0	0
3-8	217	1700	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty gravel fill
CL	Silty clay: no HC staining, weak diesel-gasoline odor
SW	Sand: fg-mg, grades from above, diesel odor, no HC stain
SW	Sandy gravel: moderate-strong diesel odor, trace staining, wet

Notes: Groundwater encountered at about 7 feet. Water sample collected, strong HC odor, sheen

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LOG OF BORINGS 27-B7 AND 30-B1
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B2

DATE DRILLED: 10/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	20	0	3	2
2-2	47	310	0	0	1
3-8		99	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty gravel fill with old HC stain, common metal scrap
CL	Clayey silt: pervasive black stain - old petroleum residue
SW	Sand: fg-mg, grades from above, diesel odor, HC stain
SW	Sandy gravel: dripping petroleum product, wet

Notes: Groundwater encountered at about 7 feet.
No water sample collected, product present.
No piezometer constructed because of salvage yard activities.

BORING 30-B3

DATE DRILLED: 10/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	190	0	3	1
2-2	4	6.1	0	0	1
3-8	2	ND	0	0	1

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty gravel fill: common metal scrap
SP	Sand and scattered gravel: common coal and clinker
	Sandy gravel with silt: spotty oily coatings, HC very old, HC odor trace to none
GM	

Notes: Groundwater encountered at about 7 feet.
Water sample collected, moderate HC odor, sheen

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LOG OF BORINGS 30-B2 AND 30-B3
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B4

DATE DRILLED: 10/7/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		20	0	2	1
2-2		1800	0	0	1
3-6		280	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	ML	Sandy gravel fill: common metal scrap Silt with minor clay: moderate HC odor
	SW	Sandy gravel: Petrleum coatings, strong diesel (?) odor, wet

Notes: Groundwater encountered at about 7 feet.
Water sample collected, strong odor, sheen

BORING 30-B5

DATE DRILLED: 10/7/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		11	0	2	1
2-2		18	0	0	0
3-6		3700	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	ML	Sandy gravel fill: common metal scrap Silt with clay: trace HC odor
	ML	Silt and fg sand: moderate diesel odor, wet, trace sheen

Notes: Groundwater encountered at about 6-7 feet.
Water sample collected, strong odor, sheen

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LOG OF BORINGS 30-B4 AND 30-B5
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B6

DATE DRILLED: 10/7/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		120	0	4	1
2-2		1200	0	2	1
3-6		1300	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill: common metal scrap
	ML	Silt with clay: HC odor and staining, wood debris
	ML	Silt and fg sand: moderate diesel odor, wet,

Notes: Groundwater encountered at about 7 feet.
Water sample collected, strong odor, sheen

BORING 30-B7

DATE DRILLED: 10/7/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		95	0	2	1
2-2		690	0	0	1
3-6			0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill: common metal scrap
	GM	Silty sand and gravel: strong HC odor, petroleum coating at depth - possible product, wet below 7 feet

Notes: Groundwater encountered at about 7 feet.
No water sample collected, free product present

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LOG OF BORINGS 30-B6 AND 30-B7
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B8

DATE DRILLED: 10/7/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		170	0	1	2
2-2		44	0	0	0
3-8		3400	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy and clinker-debris fill: trace diesel odor
SW	Sandy gravel: product coating with weak odor

Notes: Groundwater encountered at about 7 feet.
No water sample collected, product present

BORING 30-B9

DATE DRILLED: 10/8/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Silty loam grading to underlying fill of sand, clinker, coal, other fine debris and gravel: no HC odor
SW	Sandy gravel: natural colors, no HC odor or staining, wet below 7.5 feet

Notes: Groundwater encountered below 7.5 feet.
Water sample collected, trace diesel odor.
This boring is located within AOI-20 at the north end of AOI-30.

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LOG OF BORINGS 30-B8 AND 30-B9
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B10

DATE DRILLED: 10/8/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	2	41	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS

DESCRIPTION

Silty loam grading to underlying fill of sand and gravel with clinker, coal: no HC odor

SW — Sandy gravel: natural colors, no HC odor or staining, wet below 7.5 feet

Notes: Groundwater encountered below 7.5 feet.
Water sample collected, trace diesel odor.
This boring is located within AOI-20 at the north end of AOI-30.

BORING 30-B11

DATE DRILLED: 10/8/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	0
2-2	2	72	0	0	1
3-8	145	2000	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS

DESCRIPTION

Silty loam grading to underlying fill of sand, clinker, and coal: no HC odor

SW — Sandy gravel: pervasive petroleum coating, strong diesel odor, wet below 7.5 feet

Notes: Groundwater encountered below 7.5 feet
Water sample collected, moderate diesel odor, trace sheen.
Slow water recovery.
This boring is located within AOI-20 at the north end of AOI-30.

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LOG OF BORINGS 30-B10 AND 30-B11
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B12

DATE DRILLED: 10/9/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	15	0	0	0
2-3	1	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy loam: brown, no HC odor or staining, clean, forest soil
	SW	Sand with scattered gravel: medium to dark gray, natural color and organic odor, wet

Notes: Groundwater encountered at about 2-3 feet.
Water sample collected, no HC odor

BORING 30-B13

DATE DRILLED: 10/9/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	0
2-1	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy-silty loam: no HC odor or staining, clean, roots, forest soil
	SW	Sand with scattered gravel: medium to dark gray, natural color and organic odor, wet

Notes: Groundwater encountered at about 2 feet.
Water sample collected, no HC odor

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LOG OF BORINGS 30-B12 AND 30-B13
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B14

DATE DRILLED: 3/11/98

DEPTH IN FEET

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel with sandy loam: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 3 feet.
Water sample collected for vinyl choride only
Good water return

BORING 30-B15

DATE DRILLED: 3/11/98

DEPTH IN FEET

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel fill and native: logged only from drilling characteristics, no samples collected

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LOG OF BORINGS 30-B14 AND 30-B15
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B16

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 8 feet.
No water sample collected, oily-aged free-phase product
Piezometer constructed, screen from 3-13 feet, stick-up wellhead

BORING 30-B17

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 8 feet.
Water sample collected, water has HC sheen and weak odor
Water for vinyl chloride and 8260 analysis

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 30-B16 AND 30-B17
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B18

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 6 feet.
Water sample collected, water has weak odor, gray color
Water for vinyl chloride only

BORING 30-B19

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 7 feet.
Water has good return, moderate odor, gray color
Analyses for vinyl chloride and 8260

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
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LOG OF BORINGS 30-B18 AND 30-B19
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B20

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 7 feet.
Water has good return, weak odor
Analyses for vinyl chloride only

BORING 30-B21

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 7 feet.
Water has moderate odor, light gray color, good return
Analyses for vinyl chloride only

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 30-B20 AND 30-B21
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B22

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 7 feet.
Water has good return, moderate odor
Analyses for vinyl chloride and 8260

BORING 30-B23

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 7 feet.
Water has moderate odor, sheen, good return
Analyses for vinyl chloride and 8260

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 30-B22 AND 30-B23
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B24

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 9 feet.
Water has strong odor, sheen, product blebs but no product layer, good water return
Analysis for vinyl chloride

BORING 30-B25

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 7-8 feet.
Water sample collected, water has weak, cloudy
Analyses for vinyl chloride

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LOG OF BORINGS 30-B24 AND 30-B25
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B26

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater/product encountered at about 7.5 feet.
No water sample collected.
Piezometer constructed, screen from 3-13 feet

BORING 30-B27

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 6 feet.
Water has weak odor, good return
Water analysis for 8280

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
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LOG OF BORINGS 30-B26 AND 30-B27
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B28

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 8 feet.
Water has trace odor, good return
Water analysis for vinyl chloride only

BORING 30-B29

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 7 feet.
Water has no odor, good return, medium brown color
Water analysis for vinyl chloride only

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UPRR Ogden Railyard
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LOG OF BORINGS 30-B28 AND 30-B29
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B30

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 8 feet.
Water sample collected, water has strong HC sheen and moderate HC odor
Water for vinyl chloride only

BORING 30-B31

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected

Notes: Groundwater encountered at about 8 feet.
Water sample collected, good recovery, trace odor
Water analysis for 8260

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 30-B30 AND 30-B31
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 30-B32

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Black product encountered at about 7.5 feet.
No water sample collected.
Piezometer constructed, screen from 3-13 feet

BORING 30-B33

DATE DRILLED: 5/20/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged only from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 8 feet.
Water had good recovery, moderate odor, product blebs and sheen, cloudy
Water analysis for 8260

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 30-B32 AND 30-B33
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 32-B1

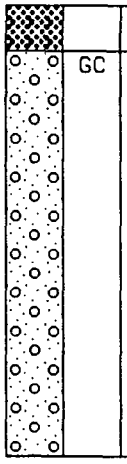
DATE DRILLED: 9/20/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	28	88	0	1	
3-8	12	14	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS



DESCRIPTION

Sandy gravel fill with clay matrix at depth: no HC odor or staining, dark brown to beige

Sandy gravel with minor clay: scattered pet. staining, weak HC odor, becoming wet below 8 feet, clay matrix may increase with depth.

Notes: Groundwater encountered at about 7-8 feet.
Diesel odor detected in groundwater.
Water sample collected, slow water return.

BORING 32-B2

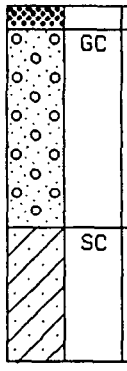
DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	1	
2-2	1	5.2	0	0	
3-6	13	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS



DESCRIPTION

Sandy gravel fill with minor clay/silt: no HC odor or staining, dark brown to beige

Sandy gravel with scattered clayey zones: possible fill, trace HC odor

Silty and clayey sand: weak old diesel odor, moist to wet

Notes: Groundwater encountered at about 6-8 feet.
Trace diesel odor detected in groundwater.
Water sample collected.

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LOG OF BORINGS 32-B1 AND 32-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 32-B3

DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	5.2	0	0	
2-2	0	870	0	0	
3-6	14	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	GC	Sandy gravel fill with minor clay/silt: no HC odor or staining, dark brown to beige
		Sandy gravel with scattered clayey zones: moderate diesel odor, diesel sheen on grains.
	SC	Silty clay with sand: fg sand, pervasive diesel odor, wet below 7 feet

Notes: Groundwater encountered at about 7-8 feet.
Weak diesel odor detected in groundwater, no sheen
Water sample collected.

BORING 32-B4

DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	19	0	1	
2-2	187	380	0	0	
3-6	291	77	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	GC	Sandy gravel fill with minor clay/silt: no HC odor or staining, dark brown to beige
		Sandy gravel with scattered clayey zones: pervasive old diesel odor and coatings.
	SW	Sandy gravel: no stain, weak to moderate diesel odor, wet

Notes: Groundwater encountered at about 7-8 feet.
Trace diesel odor detected in groundwater, no sheen
Water sample collected.

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LOG OF BORINGS 32-B3 AND 32-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 32-B5

DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		10	0	1	
2-2		240	0	0	
3-8		350	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Road base gravel fill with minor clay/silt: no HC odor
	SC	Silty clay with scattered gravel units: weak diesel odor.
	SW	Sandy gravel: no stain, moderate diesel odor, wet, grades from silty clay above.

Notes: Groundwater encountered at about 7-8 feet.
Weak to moderate diesel odor detected in groundwater
Water sample collected.
No PID results

BORING 32-B6

DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	22	0	0	
2-2	0	ND	0	0	
3-8	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Road base gravel fill: no HC odor
	SW	Sand with scattered gravel: no diesel odor or stain, sand cg-vcg.

Notes: Groundwater encountered at about 7-8 feet.
No water sample collected.

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LOG OF BORINGS 32-B5 AND 32-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 32-B7

DATE DRILLED: 9/23/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	16	0	0	
2-2	0	ND	0	0	
3-8	0	25	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS | DESCRIPTION

SW

Road base gravel fill with minor clay/silt: no HC odor

Sand: possible fill earth, no HC odor or visible contamination

Notes: Groundwater encountered at about 6-8 feet.
Moderate diesel odor in water; sheen is present.
Water sample collected.

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Proj. 792904

LOG OF BORING 32-B7
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 33-B1

DATE DRILLED: 11/5/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	0	
	0				
3-7	2	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
ML	Silty-sandy loam: clean, no HC odor or staining
	Silt: light to medium brown, no HC odor or stain, homogeneous, dry, vfg sand increasing at depth.
SW	Sand: grades from above to mg-cg sand to sand gravel at bottom of boring, gravel is wet, trace HC?? odor, possible trace HC?? staining

Notes: Groundwater encountered at 7-8 feet.
Water sample collected, possible trace HC odor.

BORING 33-B2

DATE DRILLED: 11/5/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
	0				
1-5	0	ND	0	0	
2-7	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Sandy loam: clean, no HC odor or staining
	Sand: mg-vcg, dry, no HC odor or stain
	Sand grading to sand gravel: gravel is wet, trace HC?? or musty odor

Notes: Groundwater encountered at about 8 feet.
Water sample collected, possible trace HC?? odor.
No surface soil sample - clean native soil

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UPRR Ogden Railyard
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LOG OF BORINGS 33-B1 AND 33-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 33-B3

DATE DRILLED: 11/5/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES
		0					
5	1-5	0	ND	0	0		■
10							
15							

SYMBOLS	DESCRIPTION
SW	Sandy loam: clean, no HC odor or staining
	Sandy gravel: gravel is wet below 5 feet, trace musty odor

Notes: Groundwater encountered at about 7 feet.
Water sample collected, trace musty odor.
No soil retrieval at 2 to 4 feet.
No surface soil sample – clean native soil

BORING 33-B4

DATE DRILLED: 11/5/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES
		0					
	1-4	0	ND	0	0		■
5							
	2-7	0	ND	0	0		■
10							
15							

SYMBOLS	DESCRIPTION
SW	Sandy loam: clean, no HC odor or staining
	Silty sand grading to sandy grave: sand grades from vfg to vcg, wet below 7 feet, no HC odor or staining

Notes: Groundwater encountered below 7 feet.
Water sample collected, trace musty odor.

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LOG OF BORINGS 33-B3 AND 33-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B1

DATE DRILLED: 11/3/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	0	ND	0	0	0
4-10	11	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill : clean, no HC odor
SM	Silt and vfg sand: no HC odor or stain, natural color
SW	Sand: no HC odor or stain, natural color, dry, grades to sandy gravel below
SW	Sandy gravel: trace HC odor, no stain, natural color, wet

Notes: Groundwater encountered at about 10 feet
Water sample collected, weak HC odor

BORING 34-B2

DATE DRILLED: 11/3/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	227	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy loam fill : clean, no HC odor
SW	Sand: fg-mg, natural color, no HC odor
SW	Sandy gravel: natural color at 6-7 feet, scattered HC coatings and weak HC odor at 8-10 feet, wet at 8-10 feet

Notes: Groundwater encountered at 8-10 feet
Water sample collected, weak HC odor, sheen

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LOG OF BORINGS 34-B1 AND 34-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B3

DATE DRILLED: 11/3/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	2	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Silty and clayey sand: Fill??, clay matrix, old black-brown HC residue, no HC odor
		Sand: fg-vfg, natural color, no HC odor or stain
	SW	Sandy gravel: natural color, no HC odor or stain, wet

Notes: Groundwater encountered at 8-10 feet
Water sample collected, no HC odor or sheen

BORING 34-B4

DATE DRILLED: 11/3/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sand: fg-mg, no HC odor
	ML	Clayey silt: dark brown, no HC odor or stain
	CL	Clayey sand: dark brown, no HC odor or stain, wet

Notes: Groundwater encountered at 8-10 feet
Water sample collected, trace HC odor

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LOG OF BORINGS 34-B3 AND 34-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B5

DATE DRILLED: 11/3/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	1
2-2	0	ND	0	0	0
3-8	78	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy loam fill : clean, no HC odor
SC	Sand and minor silt/clay: natural color, no HC odor or stain
SW	Sand: mg, grading to sandy gravel, wet at gravel level, moderate HC odor

Notes: Groundwater encountered at 8-10 feet
Water sample collected, moderate HC odor, sheen

BORING 34-B6

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	0
2-2	0	ND	0	0	1
3-8	23	300	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sand and silt: clean, no HC odor
SW	Sand: vfg-fg and grading to cg-vcg and sandy gravel, no HC odor or stain at 2-4 feet, HC increasing with depth to scattered HC staining and weak odor
SW	Sandy gravel: moderate HC odor, scattered staining, wet

Notes: Groundwater encountered at 9-11 feet
Water sample collected, weak HC odor

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LOG OF BORINGS 34-B5 AND 34-B6
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B7

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	0
2-2	0	ND	0	0	0
3-8	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS

DESCRIPTION

Sandy and silty loam: no HC odor

SW — Sand: fg-mg and grading to cg-vcg and sandy gravel, no HC odor or stain

SW — Sandy gravel: no HC odor or staining, wet

Notes: Groundwater encountered at 9-10 feet
Water sample collected, trace odor

BORING 34-B8

DATE DRILLED: 3/10/96

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS

DESCRIPTION

SW — Sand and sandy gravel alluvium with possible clayey matrix: No samples collected, logged solely from drilling characteristics.

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Slow water return

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LOG OF BORINGS 34-B7 AND 34-B8
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B10

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B9

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

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LOG OF BORINGS 34-B10 AND 34-B9
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B11

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium with possible clayey matrix at d logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Slow water return

BORING 34-B12

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B11 AND 34-B12
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B13

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B14

DATE DRILLED: 3/11/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-8 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B13 AND 34-B14
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B15

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B16

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B15 AND 34-B16
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B17

DATE DRILLED: 3/12/98

DEPTH IN FEET

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

5

10

15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B18

DATE DRILLED: 3/12/98

DEPTH IN FEET

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

5

10

15

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B17 AND 34-B18
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B19

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 9-10 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B20

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B19 AND 34-B20
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B21

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B22

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics, clayey zone below 7 feet.

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Slow water return

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792904	LOG OF BORINGS 34-B21 AND 34-B22 Ogden Railyard Ogden, UT	GEOPROBE BORING

BORING 34-B23

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics, clayey zone below 7-8 feet and likely extends to below 10 feet. Note: Very poor water return at 8-11 feet, good at 11-14 feet
10								CL	
15								SW	

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
~~Good water return below 11 feet~~

BORING 34-B24

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet, screen at 11-13 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B23 AND 34-B24
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B25

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 9-10 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B26

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B25 AND 34-B26
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B27

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B28

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B27 AND 34-B28
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B29

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 8 feet
Water sample collected for vinyl chloride only
Good water return

BORING 34-B30

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 7 feet
Water sample collected for vinyl chloride only
Good water return
Several probe refusals on boulders or concrete before successful boring.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B29 AND 34-B30
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B31

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics, possible clayey zone at depth

Notes: Groundwater encountered at 8-9 feet
Water sample collected for vinyl chloride only
Slow water return

BORING 34-B32

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 3-4 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B31 AND 34-B32
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B33

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 3-4 feet
Water sample collected for vinyl chloride and 8260
Good water return, weak HC odor and trace sheen, water medium green-gray

BORING 34-B34

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 3-4 feet
Water sample collected for vinyl chloride and 8260
Good water return, trace HC odor, no sheen, water light gray to near-clear

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B33 AND 34-B34
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B35

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 6-7 feet
Water sample collected for vinyl chloride only
Slow water return

BORING 34-B36

DATE DRILLED: 3/13/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics, possible clayey zone from 7 to 11 feet.

Notes: Groundwater encountered at 7-9 feet, screen at 11-13 ft
Water sample collected for vinyl chloride only
Good water return, weak HC odor, sheen
Good GW recovery is about 5 feet below level of nearby pond.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B35 AND 34-B36
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B37

DATE DRILLED: 3/14/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics, possible clayey matrix from 7 to 11 feet.
10									
15									

Notes: Groundwater encountered at 7-9 feet, screen at 11-13 ft
Water sample collected for vinyl chloride only
Good water return, no HC odor

BORING 34-B38

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-9 feet
Water sample collected for 8260.
Good water return, weak diesel odor, cloudy

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B37 AND 34-B38
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B39D

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10		0				
15		0				
20		0				
25		0				
30		0 0				
35		0				
40		0				
45		0				
50		0				

SAMPLES SYMBOLS		DESCRIPTION
		Sand and gravel mix: typical uppermost alluvial sequence, no samples, becomes water-saturated between 8 and 10 feet.
	SP	Sand and silt: sand fg-cg, well sorted, grades upward to silt and vfg sand, no hydrocarbon (HC) odor, wet, natural colors, no HC staining
	SW	
	SP	Sandy gravel: no HC odor, wet, no clay, natural colors
	SW	Sand: mg-vcg and fine gravel, wet, no HC odor, grades to coarse sandy gravel.
	CL	Clay: medium brown, low to moderate plasticity, massive, moist trace silt, no HC odor, grades sharply to lithology below
	CL	Silt and sand: sand vfg, well sorted, wet, no HC odor, grades to clay below
	CL	Clay: medium brown, moderate plasticity, soft, moist, massive, no HC odor, continues unchanged to bottom of boring.

Notes: Strat hole only, no samples for analyses collected.
Logged from 2-foot split spoon samples every 4 feet.

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792904	LOG OF BORING 34-B39D Ogden Railyard Ogden, UT	GEOPROBE BORING

BORING 34-B40

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-9 feet
Water sample collected for 8260.
Good water return, no odor,

BORING 34-B41

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-9 feet
Water sample collected for 8260.
Good water return, no odor,

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 782904

LOG OF BORINGS 34-B40 AND 34-B41
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 34-B42

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-9 feet
Water sample collected for 8260.
Good water return, no odor,

BORING 34-B43

DATE DRILLED: 5/19/9

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium: No samples collected, logged solely from drilling characteristics
10									
15									

Notes: Groundwater encountered at 7-9 feet
Water sample collected for 8260.
Good water return, no odor,

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 34-B42 AND 34-B43
Ogden Railyard
Ogden, UT

GEOPROBE BORING

PROJECT NUMBER	BORING NUMBER	34-B47	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4286.53906 NORTHING: 3607400.85 EASTING: 1506283.97

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 END DATE: 11/14/2001 LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
		75	ML		0-3 ft, clayey silt w/ gravels, dark brown, moist, black staining, heavy staining at 2-3 ft,strong tar/hydrocarbon odor	
5		100	CL		3-6.5 ft, sandy clay, moist soft, some staining @ 6-7 ft.	
		100	GW		6.5-8 ft. Gravel 8-12 ft, gravel w/sand 11-12 ft, diesel odor and brown-black staining, wet	Approximate ▽
10						
	Sample	25	SW	20.7 10.0	12-14 ft, coarse sand w/gravels, wet, hydrocarbon odor; Sample 34-B47-13 collected @ 12-13 ft. Sample 34-B47-13 collected @ 12-13 ft.	
15						
					Hit rock. End of boring at 16 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B48	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4284.354027 NORTHING: 3607420.92 — EASTING: 1506330.57

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 — END DATE: 11/14/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1 ft, no recovery	
		75	ML		1-4 ft, sandy silt w/gravel, brown, moist	
5					4-5 ft, no recovery	
		75		0.0	5-7 ft, clayey silt, brown, med. Dense, black staining at 3-3.5 ft, no odor or reading	
			SP		7-10.8 ft, poorly graded sand, light brown-brown, moist	
10		100				Approximate ▽
			GW	12.7	10.8-12 ft, gravel w/sand, v. moist-wet, blackish, diesel odor	
		10			12-15.7 ft, no recovery	
15			SW	1.2	15.7-16 ft, well graded sand w/gravel, gray-black, wet, strong diesel odor	
					TD = 16 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER 34-B49	
163851		SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4280.403908 NORTHING: 3607402.14 EASTING: 1506354.26

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 END DATE: 11/14/2001 LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS
		65	ML		1-1.5 ft, no recovery 1.5-3.5 ft; silt w/gravel, brown, moist, loose	
			SP		3.5-5 ft; poorly graded sand w/gravels, 15%, moist, light brown, loose	
5		100	CL		5-8 ft; silty clay, brown, moist, slight plasticity 7-8 ft; light black staining	
		75	SP		8-9 ft; no recovery 9-10 ft; poorly graded sand w/gravel and silt, brown, loose, moist	
10			CL		10-11 ft; silty clay, brown, wet, non-plastic	Approximate ▽
			SP		11-11.5 ft; poorly graded sand, SP, as above at 9-10 ft, wet	
		40	GW	0.0	11.5-12 ft; gravel, angular, well graded 12-14.5 ft; no recovery 14.5 16 ft; gravel, wet, slight odor	
15						
					TD = 16 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER 34-B50	
163851		SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4282.031199 NORTHING: 3607427.4 — EASTING: 1506270.23

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 — END DATE: 11/14/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
		90	GW	3.6	0.5-2.5 ft; gravel w/sand and silt, well graded, slightly moist, loose, brown, 0.5-1 ft, 1-2.5 ft; black	
			ML		2.5-4 ft; silt, med. Dense, black staining	
5		75			4-5 ft; no recovery	
			CL/ML		5-7 ft; silty clay, stiff, slight plasticity, moist, some black staining; Thin sand at 6.5 ft., grades into silt at 6.5-7 ft, wet	
	SAMPLE		SP	129.0	7-8 ft; poorly graded sand, SP, poorly graded medium sand w/gravels, sub-rounded, moist, v. strong odor	
10		65	GW		8-9.5 ft; no recovery; 9.5-12 ft; well graded gravel w/sand, medium sand, 50%, loose, moist, slight staining, wet near 12 ft	Approximate ▽
		35	SW	2.1	12-14.5 ft; no recover; 14.5-16 ft; coarse well graded sand and gravel, sand grades to gravel at 16 ft, wet, loose	
15			GW			
					TD = 16 ft; Note: Sample 34-B50-8 collected @ 1125. VOC collected 7-8 ft, remaining sample 8-12 ft; Dup A collected @ 1100	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B60	
163851			SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4283.37634 NORTHING: 3607251.23 EASTING: 1506284.83

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 END DATE: 11/14/2001 LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
		100			0-6.5 ft; silt, <5% gravels, dry, tan-light brown	
5		100	ML		6.5-8 ft; silt, 3-4 inch layer of dark brown silt, light brown silt w/ small amounts of staining, dry, med-high density	
10		100			8-12 ft; as above, 2 inch gravel	
		75	SP		12-12.8 ft; poorly graded sand, fine sand, dry, med-dense 12.8-14 ft; poorly graded sand, medium sand, sub-rounded gravel, dry, loose	
15			GW		14-15 ft; no recovery 15-16 ft; gravel, angular-subrounded up to 2 inches, coarse well graded sands, saturated	Approximate ▽
20					TD = 16 ft. Note: Sample 34-B60-11 collected @ 1400 at 11-16 ft.	
25						

PROJECT NUMBER	BORING NUMBER	34-B51	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4285.272659 NORTHING: 3607451.4 EASTING: 1506227.89

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 END DATE: 11/14/2001 LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
		100	ML		0-3 ft; silt, 10% gravels, slightly moist, med. Dense, brown-dark brown	
					3-5 ft; gravelly silt, angular, brown-gray	
5		100			5-7 ft; clayey silt, 5% gravel, dark brown, moist, some black staining	
					7-8 ft; silt, med. Dense, brown, v. moist	
		75			8-9 ft; no recovery	
			SW		9-9.6 ft; silt, med-dense, brown-dark brown, 3% small gravels	
10	Sample			26.8	9.6-12 ft; well graded sand, loose, angular-subrounded gravels, staining throughout	
		25			12-15 ft; no recovery	
15				71.2	15-16 ft; as 9.6-12 ft, wet at 15.5 ft	Approximate ▽
					TD = 16 ft.	
					Note: Sample 34-B51 collected @ 1230. VOC collected 11-12 ft, MS/MSD collected	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B61	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4285.082371 — NORTHING: 3607330.39 — EASTING: 1506288

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 — END DATE: 11/14/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
		75	ML		1-7 ft; silt, med-dense, dry, light brown, patchy dark staining	
5		100			7-7.5 ft; clayey silt, dense, dry	
			SP		7.5-8 ft; poorly graded sand, fine, med-dense, moist 8-9.5 ft; no recovery	
10		65				
			GW		9.5-15 ft; gravels with sand, 60% gravel, fine-coarse sand, med-dense, moist, staining throughout	
		100				
15			ML	0.0	15-16 ft; clayey silt, med-dense, brown-gray, wet at 15 ft, 4" layer of black soil at gravel silt interface, odor but no PID reading	Approximate ▽
		50	GW		16-18 ft; no recovery 18-20 ft; gravel, angular-subrounded, up to 2" dia., well graded sands 10-20%, dark brown, saturated, diesel odor	
20		0			20-24 ft; no recovery, cohesionless material. Driller pushed to 25 ft. and feels clay is at 22 ft.	
			CL		Note: Sample 34-B61-15 collected @ 1455 at 15-16 ft. Sample 34-B61-20 collected @ 1605.	
25					TD = 25 ft.	

PROJECT NUMBER	BORING NUMBER	34-B62	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4266.404606 NORTHING: 3607576.39 EASTING: 1506153.77

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/14/2001 END DATE: 11/14/2001 LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
		100	ML		0-6"; sludge material, clayey & silty, loose, moist, dark brown 6"-1.5 ft; Fat clay, stiff, med-plasticity, moist, fabric remnants? 1.5-5.5 ft; clayey silt, stiff, med-plasticity, moist, gray brown, slight staining and odor	
5		100	SP		5.5-5.9 ft; SP medium sand, v. moist-wet, med dense, light brown	Approximate ▽
			ML		5.9-7 ft; as 6"-5.5 ft, water saturated, clayey silt	
	Sample		SP		7-8 ft; poorly graded sand, fine, med-dense, wet, grayish brown *(sample 34-B62-7)*	
10		100			8-11 ft; poorly graded sand, fine-medium sand, med-dense, wet, brownish gray 11-12 ft; as above, very dense. 9-10 ft sand is loose and slightly flowing, sheen visible	
		100	SW		12-16 ft; well graded sand, angular-rounded, med-dense, wet, brownish gray	
15	Sample				*(sample 34-B62-14)*	
		100	CL		16-20 ft; lean clay, soft, med-plasticity, brown, thin interbedded layers of silt every 6" to 1 foot, wet	
20					TD = 20 ft. Note: Sample 34-B62-7 @ 1700 at 7-8 ft; Sample 34-B62-14 @ 1715 at 14-16 ft. Dup B collected @ 1800 14-16 ft.	
25						

PROJECT NUMBER	BORING NUMBER	34-B63	SHEET	OF
163851				

SOIL BORING LOG

PROJECT: Union Pacific Ogden SP Yard — DRILLING CONTRACTOR: Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4267.018121 — NORTHING: 3607537.7 — EASTING: 1506145.17

DRILLING METHOD AND EQUIPMENT USED: Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER: T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
	PCB	75	ML		1-1.6 ft; Sludge material,	
			SP		1.6-2.1 ft; SP sand, medium sand, med-dense, moist, light brown	
			CL			
			SP		2.1-3.3 ft; silty clay, slight plasticity, firm, moist, slight black staining	
					3.3-4 ft; SP sand, medium sand, med-dense, moist, light brown	
5		90		1.2	(4-4.7 No recovery). 4.7-6 ft; as sand above	
				3.6	6-6.8 ft; SP sand, coarse, med-dense, v. moist, ,brown-black	
			ML/CL	4.6	6.8-7.2 ft; sandy clayey silt. / 7.2-7.6 ft; gravel, 20% fines, black, strong odor.	
	Sample	65			7.6-8 ft; silty clay, soft, slight plasticity, v. moist, slight staining (*Sample 34-B63-8*)	Approximate ▽
			SW		8-9.5 ft; no recovery; 9.5-9.8 ft; SW sand w/ gravel, wet, subrounded, dense, gray-black.	
10	PCB		GW		9.8-10.5 ft; gravel w/ sand, subrounded, 20% sand, wet, loose, black, odor. 10.5-11.3 ft; silty clay, soft, slight plasticity, light brown, white flakes within clay, wet.	
			CL/GW		11.3-12 ft; gravel, wet, angular 2" dia.	
		75	GW			
	PCB		SW		12-13 ft; no recovery	
15			CL		13-13.5 ft; SW sand w/ gravel, 40% gravel, med-dense, weet, subrounded .5" gravels 13.6-16 ft; clay, lean, firm, wet	
					TD = 16 ft.	
					Note: Depths for PCB/TOC composite sample: 1) 1.3-1.9 ft 2) 10.7-11 ft. 3) 13.4-13.8 ft.	
					Sample 34-B63-8 @ 0915 at 8-10 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B66	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4269.754334 — NORTHING: 3607518.73 — EASTING: 1506316.84

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
	PCB	75	ML		1-1.6 ft; black sludge material intermixed w/ silty sand and gravel, loose, brown, moist	
				60.3	1.6-2.7 ft; clayey silt w/ gravel, soft, moist, anugular gravels, alternating browns. 2.7-3.3 ft; sand, fine-medium, dense, v. moist, gray-black, diesel odor.	
	Sample		CL	153.0	3.3-4 ft; silty clay, gravels 10-15%, firm, slight plasticity, v. moist, brownish gray black	(34-B66-3)
5		50			4-6 ft; no recovery	
	PCB		SW/SP	85.3	6-6.5 ft; SW sand w/ silt, 20% fines, 5% gravel, dense, v. moist, black, strong odor. 6.5-6.9 ft; sand very fine, dense, wet, black.	Approximate ▽
				54.8	6.9-8 ft; GW w/ sand, rounded, wet 2" dia., 20% sand	
		38	GW	42.0	8-10.5 ft; no recovery	
10						
					11.5 -12 ft; as gravel above	
		100	SP/SW		12-14.3 ft; fine poorly graded sand that grades into a well graded sand at 13.5 ft. and gravel at 14 ft, dense, saturated, angular-subrounded grains	
15			GW		14.3-15 ft; gravel, angular, 2" dia., little fines, saturated	
	PCB		CL		15-16 ft; clay, lean stiff, wet	
					TD = 16 ft.	
					Note: Sample 34-B66-3 @ 0950 at 3-4 ft. PCB composite depths: 1) 1.5-1.9 ft 2) 6-6.6 ft 3) 14.9-15.3 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B67	
163851			SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4278.3173 NORTHING: 3607544.53 — EASTING: 1506250.42

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-2.5 ft; no recovery	
		35	ML		2.5-3 ft; sludge material, silt, dark brown, loose, moist	
			SP		3-4 ft; SP, medium sand, dense, wet, angular-subrounded grains, light brown	
5					4-6 ft; no recovery	
		50	GW		6-6.3 ft; sand as above. 6.3-6.4 ft; thin clayey silt interface, dark brown, dense, moist	Approximate ▽
				8.4	6.4-8 Ft; GW, angular-rounded, 20% fines, wet, 2" dia., dark gray, loose	
10	[redacted]	100			8-12 ft; as above, **LNAPL present** *Sample 34-B67-8*	
		100			12-15.8 ft; as above, more sand - 40%	
15			CL		15.8-16 ft; clay	
					TD = 16 ft.	
					Note: Sample 34-B67-8 @ 1055 @ 8-12 ft.	
					PCB/TOC composite @1045: LAG-AE-PCB-1, LAG-AE-PCB-2, LAG-AE-PCB-3. Composite sample collected from locations 34B63, 66, 67.	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B68	
163851			SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4268.973496 NORTHING: 3607558.3 — EASTING: 1506298.06

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1 ft; no recovery	
		75	ML		1-1.5 ft; sludge material, silt mix, dark brown-light brown, moist	
			CL		1.5-2.8 ft; clay, stiff, moist, med-plasticity, gray-light brown, staining	
	Sample		ML		2.8-3.1 ft; silt, dense, light brown, v. moist. 3.1-3.4 ft; SW sand, med-dense, v. moist, brown; 3.4-4 ft; GW gravel w/ silts, 2"+ dia., 20% fines, black, odor; clayey silt at sand-gravel interface.	
5		75			4-5 No recovery — *Sample 34-B68-3*	
					5-7.9 ft; as above, 30% silts and sands	
			SP/SW		grading sands	Approximate ▽
			PT		7.9-9.1 ft; fibrous, pale yellow material, wet, crumbles (looks like balsa wood)	
10		100	SW		9.1-12 ft; sand w/ gravel, SW, wet, med-dense, dark gray	
			GP		12-13 ft; no recovery	
	Sample	75			13-14.5 ft; gravel, GP, angular-subrounded, .5" dia. — *Sample 34-B68-13*	
15			SP/GP		14.8-15.5 ft; silty sand, med-dense, gray-brown, wet	
					15.5-16 ft; gravel, GP, angular	
					TD = 16 ft.	
					Note: Sample 34-B68-3 @ 1200 @ 3-5 ft. Sample 34-B68-13 @ 1210 @ 13-15 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B69	
163851			SHEET OF

SOIL BORING LOG

PROJECT: Union Pacific Ogden SP Yard — DRILLING CONTRACTOR: Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4285.361242 NORTHING: 3607557.52 — EASTING: 1505970.91

DRILLING METHOD AND EQUIPMENT USED: Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER: T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1 ft; no recovery	
		75	ML		1-1.2 ft; sludge material 1.2-3.4 ft; fine silt, dense, dry, light brown, slight staining	
			SW		3.4-4 ft; sand w/ gravel, SW, 30-40 % gravel, angular-subrounded, med-dense sand, moist 4-5 ft; no recovery *Sample 34-B69-3*	
5		75	ML		5-5.8 ft; silt, dense, light-dark brown, slightly moist	
			SW/GW		5.8-7.3 ft; well graded sand and gravel, SW-GW, 50%, angular-subrounded, moist	Approximate ▽
			GW		7.3-8 ft; gravel w/ silt, 20%, black, wet, hydrocarbon odor *Sample 34-B69-8*	
10		38			8-10.4 ft; no recovery 10.4-12 ft; as gravel above	
		20			12-14 ft; no recovery	
			CL		13-13.5 ft; as above, sand interbeds	
15					13.5-clay, TD Note: Sample 34-B69-3 @ 1340 at 3-6 ft. Sample 34-B69-8 @ 1350 at 7.5-10 ft. PCB/TOC composite depths: 1) 1-1.5 2) 13.4-13.8.	
20						
25						

PROJECT NUMBER	BORING NUMBER 34-B70	
163851		SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4280.564668 NORTHING: 3607576.76 — EASTING: 1506031.01

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1 ft; no recovery	
		75	ML		1-1.2 ft; sludge material. 1.2-2.8 ft; silt, dense, dry, light brown	
			SW		2.8-4 ft; Gravelly sand, SW, 15-20% gravel, moist, light brown, .25" dia., subrounded	
5		100	SW		4-7 ft; as above, increasing gravels w/ depth. Staining near 7 ft.	Approximate ▽
			GW		7-8 ft; Well graded gravel, wet, gray-black, slight odor.	
10		50	GW		8-10 ft; no recovery	
			SW		10-11.2 ft; Gravelly sand, SW, 30-40% gravel, wet, angular-subrounded.	
			GW		11.2-12 ft; gravel, GW, 2" dia., subrounded, 10% fines, black silts, wet, odor	
		100	SW		12-15 ft; as above. At 12-13 ft SW, 80% sand, 20% gravel; At 13-15 ft; 80% gravel, blackish gray, odor, wet	
15	Sample		GW		*Sample 34-B70-14*	
			CL		15-16 ft; Alpine clay, lean	
					TD = 16 ft.	
					Note: Sample 34-B70-14 @ 1420 at 14-15.4 ft.	
20						
25						

PROJECT NUMBER	BORING NUMBER 34-B71	
163851		SHEET OF

SOIL BORING LOG

PROJECT: Union Pacific Ogden SP Yard — DRILLING CONTRACTOR: Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4273.57322 NORTHING: 3607542.75 — EASTING: 1506066.5

DRILLING METHOD AND EQUIPMENT USED: Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER: T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1.5 ft; no recovery	
		65	ML		1.5-1.7 ft; sludge; silt, dry, dark brown. 1.7-2.0 ft; silt gravel mix, tan-white, .5" dia., dry, loose.	
					2-2.7 ft; silt, dense, wet, brown-black, diesel odor	
			SP		2.7-4 ft; Gravelly sand, SP, 40 % gravel, med-dense, wet, light brown	
5		50			4-6 ft; no recovery — *Sample 34-B71-4*	
					6-7 ft; as above	Approximate ▽
			GW		7-8 ft; Well graded gravel, GW, angular-rounded, silty-coarse sand, wet at 7 ft.	
					8-9.5 ft; no recovery	
10		65			9.5-12 ft; well-graded Gravel	
					No log 12-16 ft.	
		100				
15					Clay at 15.3 ft	
					Note: Sample 34-B71-4 @ 1455 at 4-8 ft. MS/MSD collected	
					Composite PCB/TOC sample depths: 1) 1.5-2 FT 2) 14.8-15.3	
20					PCB/TOC sample LAG-AW-PCB-1 collected @ 1500.	
					PCB/TOC sample LAG-AW-PCB-2 collected @ 1505.	
					Composite samples from 34-B69, 71.	
25						

PROJECT NUMBER	BORING NUMBER	34-B72	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4270.138191 — NORTHING: 3607467.71 — EASTING: 1506010.43

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1.7 ft; no recovery	
		55	ML		1.7-2 ft; sludge; silt, dark brown, loose, moist	
					2-2.5 ft; silt, med-dense, moist, 10% gravel.	
			GW		2.5-4 ft; well graded gravel, GW, 40 % sand, gravel angular-subrounded, moist	
5					4-5 ft; no recovery	
		75	ML		5-6 ft; silt, dense, brown, moist, 5% gravel	
			GW	10.3	6-8 ft; gravel w/ sands, GW, 65% gravel, 2" dia., angular-subrounded, black, odor	Approximate ▽
					8-9 ft; no recovery *Sample 34-B72-9*	
10		75		10.8	9-10.7 ft; as above, varying % of gravel and sands, sheen visible, black, strong odor	
					10.7-12 ft; as above, not as contaminated, color change from black to brown	
					TD = 12 ft. at Clay	
					Note: Sample 34-B72-9 @ 1535 at 9-10 ft.	
15					PCB/TOC composite depth: 1) 1.7-2.1 ft 2) 11.8-12.1 ft	
20						
25						

PROJECT NUMBER	BORING NUMBER 34-B73	
163851		SHEET OF

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4282.539728 NORTHING: 3607440.88 EASTING: 1506072.36

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 END DATE: 11/15/2001 LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1.5 ft; no recovery	
		65	ML		1.5-2.1 ft; sludge material; silt, dark brown, moist, loose, gray clay chunks with white lines within.	
					2.1-4 ft; silt, dense, moist, some staining, 5% gravels	
5		65	SW/GW		4-5.5 ft; no recovery	
					5.5-8 ft; sand and gravel, 50% each, well graded, med-dense, moist, 1" gravels	
					8-10 ft; no recovery	Approximate ▽
10	Sample	50	GW		*Sample 34-B73-10*	
					10-12 ft; gravel w/ sand, GW, % gravels increase with depth, gray, 30% sand, 10% silt.	
					No odor	
					TD = 12 ft.	
					Note: Sample 34-B73-10 @ 1600 at 10-11 ft.	
15						
20						
25						

PROJECT NUMBER	BORING NUMBER	34-B74	SHEET	OF
163851				

SOIL BORING LOG

PROJECT : Union Pacific Ogden SP Yard — DRILLING CONTRACTOR : Earthprobe

AREA: AOI 34 — ELEVATION (ft): 4286.220819 NORTHING: 3607462.36 — EASTING: 1506062.36

DRILLING METHOD AND EQUIPMENT USED : Geoprobe

WATER LEVELS (date/time): — START DATE: 11/15/2001 — END DATE: 11/15/2001 — LOGGER : T. Isakson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL (FT)	RECOVERY (%)	USCS CODE	MAXIMUM PID READING (ppm)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DRILLING RATE, TESTS, AND INSTRUMENTATION.
					0-1.5 ft; no recovery	
		65	ML		1.5-2 ft; sludge; silt, moist, loose, dark brown	
					2-2.7 ft; clayey silt, stiff, nonplastic, black-brown	
			SP		2.7-4 ft; sand, SP, fine sand, dense, wet, brown	
5		65			4-5.5 ft; no recovery	
			GW		5.5-9.9 ft; gravel w/ sand, GW, SW, 60-70% gravel, angular-subrounded, staining throughout	
10		100			9.9-10.4 ft; clayey silt, stiff, wet, nonplastic, dark brown	Approximate ▽
			ML/GW		10.4-12 ft; gravel w/ silt, 30% silt, dense, wet, black below silt layer turning brown with depth	
			GW		*Sample 34-B74-10*	
		100			12-13 ft; gravel, GW, rounded-angular, gray-black, 5% fines	
			CL		13 ft; clay	
15					TD = 14 ft.	
					Note: Sample 34-B74-10 @ 1640 at 10-12 ft.	
					PCB/TOC sample LAG-BEW-PCB-1 @ 1630; Dup C collected @ 1615	
					PCB/TOC sample LAG-BEW-PCB-2 @ 1630; MS/MSD collected	
					Composite sample depths: 1) 1.5-2.2 ft. 2) 12.8-13.5 ft. Composite from 34-B72, 74	
20						
25						

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER
AOI-34 33-B80

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *792904-05-52*	SHEET 1 OF 1
PROJECT: *UPRR OGDEN PHASE II RI*	LOCATION: *AOI-34 WWTP*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT:	
METHOD: *GEOPROBE*		
DATE START: *6/15/00*	DATE COMP: *6/15/00*	GROUND ELEV: / TOTAL DEPTH: (FT) *16.0'*
LOGGED BY: *P. Cavender*	TOC ELEVATION:	DEPTH TO WATER: (FT)

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0		ML	SANDY SILT, Min??? Gravel & Wood, Dark Brown, Dry, Loose, Slight Petroleum Odor.	4		51.0	33 - B30 - 25 (8:40)
	5		ML	SANDY SILT, Sand 15% Very Fine Grained, Silt 85% Dry to 6.6, Moist at 6.0, Medium Petroleum Odor.	3		8.0	
			SP	SILTY SAND, Brown, Medium Petroleum Odor, Dry as Above.				
	10		SP	SANDY SILT, with Coarse Gravels Intermittent. Medium to Fine Sand, Moist, Dark Gray.	1.87		77.0	
			GM	SILTY Gravel with Sand, Grayish Brown, Moderate Petroleum Odor, Loose, Dry.				
	▼		GM	SILTY Gravel with Sand, Grayish Brown, Moderate Petroleum Odor, Wet @ Approx. 13', No Stain.			62.0	33 - B80 - 12 (9:00)
	15							
	20			NOTE: Hole plugged with Bentonite Crumbles. OVM reading taken directly off sampler tube. ▼ Depth to ground water.				33 - B80

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ENVIRONMENTAL MANAGEMENT & PLANNING

BORING/WELL COMPLETION LOG

MONITORING WELL NUMBER 33-B82
AOI-34

CLIENT: *UNION PACIFIC RAILROAD*	JOB NUMBER: *792904-05-52*	SHEET 1 OF 1
PROJECT: *UPRR OGDEN PHASE II RI*	LOCATION: *AOI-34 WWTP*	
DRILLING CO.: *EARTH PROBE*	EQUIPMENT:	
METHOD: *GEOPROBE*		
DATE START: *6/16/00*	DATE COMP: *6/16/00*	GROUND ELEV:	TOTAL DEPTH: (FT) *12.0'*
LOGGED BY: *P. Cavender*	TOC ELEVATION:	DEPTH TO WATER: (FT)

WELL COMPLETION	DEPTH	BLOWS	GRAPHIC LOG USCS	CODE	DESCRIPTION	FEET RECVRY	OVM SAMPLE DEPTH	OVM (ppm)	SAMPLE ID & DEPTH
	0				SILTY Gravel Fill, Yellowish Brown, No Odor or Stain, Loose, Dry.	2		0.0	33 - B82 - 2.0 (10:45)
	5			GM	No Recovery Hit Gravel	0.0		0.0	
	10			GM	SILTY Gravel, Grayish Brown, Slight Petroleum Odor at 10.0', Wet at 11.80-12.0 feet, Staining at 11.0', Loose.	0.0		8.0	33 - B82 - 12 (11:00)
	15				TD=12'				
	20				NOTE: Hole plugged with Bentonite Crumbles. OVM reading taken directly off sampler tube. ▼ Depth to ground water.				33 - B82

BORING 35-B1

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	0	
3-8	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy fill: no HC odor or staining.
SC	Sandy: fg-mg, grading from clayey sand above, moist, no HC odor
SW	Sand, grading to sandy gravel: no HC odor or stain, wet

Notes: Groundwater encountered at about 7-8 feet.
No water sample collected.

BORING 35-B2

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0	0	
2-2	0	ND	0	0	
3-7	0	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy loam: no HC odor or staining.
SM	Silty sand: natural brown color, no HC odor or staining
SW	Sand: mg-cg, grades from above, moist to wet, no HC stain or odor

Notes: Groundwater encountered at about 7-9 feet
No water sample collected.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 35-B1 AND 35-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 35-B3

DATE DRILLED: 11/4/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	9.7	0	0	
2-2	0	ND	0	0	
3-8	3	ND	0	0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty clay and sand: dark brown trona spillage stain
	SW	Sand: fg-mg, grading from silty caly with vfg sand above, No HC odor or stain
	SW	Sand, grading to sandy gravel, no HC odor or stain, wet

Notes: Groundwater encountered at about 7-8 feet.
Water sample collected, trace HC odor.
Boring located within stained soil from trona spillage - surface puddles and soil have reddish brown color and characteristic odor.

BORING 35-B4

DATE DRILLED: 11/6/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0				
2-2	0				
3-7	1				

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Silty and sandy loam: dark brown, no HC odor or staining
	SM	Silt and vfg sand: natural color, no HC odor or stain
	SW	Sandy gravel, no HC odor or stain, wet

Notes: Groundwater encountered at about 8 feet.
Water sample collected, trace HC odor

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LOG OF BORINGS 35-B3 AND 35-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 36-B1

DATE DRILLED: 11/5/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0		0		0
2-2	0	ND	0		0
3-7	0		0		2

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy gravel fill: scattered metal debris
	Sand and gravel with scattered asphalt: fill earth, possible coal and clinker
CL	Clay with minor silt and vfg sand: wet, no HC odor, natural brown

Notes: Groundwater encountered at about 8 feet.
No water sample collected

BORING 36-B2

DATE DRILLED: 11/5/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0		1
2-2	0	67	0		1
3-7	0	ND	0		0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Sandy loam with gravel: fill earth, no HC odor
	Silty sand with scattered debris: fill earth, bricks
CL	Clay with minor silt and vfg sand: wet, no HC odor, natural dark brown

Notes: Groundwater encountered at about 8 feet.
No water sample collected

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Proj. 792904

LOG OF BORINGS 36-B1 AND 36-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 36-B3

DATE DRILLED: 11/5/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0		1
2-2	0	ND	0		0
3-7	0	ND	0		0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel: fill, scattered metal debris
		Sand with scattered debris: fill earth, bricks, no HC odor or stain
	SW	Sandy gravel: grades from sand above, wet, no HC odor,

Notes: Groundwater encountered at about 8 feet.
No water sample collected

BORING 36-B4

DATE DRILLED: 11/5/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0		1
2-2	0	ND	0		0
3-7	0	ND	0		0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel: fill, scattered mixed debris
		Sand with brick debris: fill earth, bricks, no HC odor or stain
	SW	Sandy gravel: wet, no HC odor, natural color

Notes: Groundwater encountered at about 8 feet.
No water sample collected

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 36-B3 AND 36-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 37-B1

DATE DRILLED: 9/16/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	0		0	
2-2	0	28		0	
3-7	53	3000		0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill: no HC odor or staining, natural color - dark brown to beige
	SC	Clayey silt with vfg sand: no HC odor or staining. Sand increasing with depth. Part of soil may be pit fill from previous overexcavation - boring sited very near edge of pit.
	SW	Sandy gravel: grades from above - fining upwards alluvial sequence, old diesel odor with common gray-black HC staining on sand and gravel grains, wet at 8 feet.

Notes: Groundwater encountered at about 8 feet.
Diesel contamination observed at saturation zone.
Water sample has diesel odor.

BORING 37-B2

DATE DRILLED: 9/16/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	0		0	
2-4	78	1500		0	
3-8	85	880		0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill: no HC odor or staining, natural color - dark brown to beige
	SC	Clay with minor silt: weak diesel odor, no staining.
	SW	Sandy gravel: grades from above - fining upwards alluvial sequence, weak diesel odor, gray - possible minor HC coatings, wet below 9 feet.

Notes: Groundwater encountered at about 9 feet.
Diesel odor observed at saturation zone.
Water sample has weak diesel odor.

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Proj. 792904

LOG OF BORINGS 37-B1 AND 37-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 37-B3

DATE DRILLED: 9/17/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	0		0	
2-4	5	6.7		0	
3-8	117	1200		0	

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS: SC

DESCRIPTION

Sandy gravel fill: no HC odor or staining, natural color - dark brown to beige

Sand with fine gravel fraction - natural colors - beige, gray, no stain or HC odor until sample until core at 8 to 10 feet. WET at 8 to 10 feet, weak diesel odor at saturated zone.

Notes: Groundwater saturation encountered at about 8 feet.
Diesel odor observed at saturation zone.
Water sample has weak diesel odor.

BORING 38-B1

DATE DRILLED: 10/13/9

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-4	71	5100	0	0	1
2-7	87	910	0	0	1

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS: SW

DESCRIPTION

Concrete

Sandy gravel: common product saturation, black product, moderate diesel odor, voids from construction

Becomes sandy at depth, uncertain lithology, pervasive product coating

Notes: Groundwater encountered at about 7-8 feet
No water sample collected, free product present.
Piezometer constructed.

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 37-B3 AND 38-B1
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B2

DATE DRILLED: 10/13/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5	1-4		1500	0	0	0
10	2-6		1000	0	0	0
15						

SAMPLES

SYMBOLS	DESCRIPTION
	Concrete
CL	Silty clay: Strong HC odor
SW	Sandy gravel: moderate diesel odor, product coating

Notes: Groundwater encountered at about 7-8 feet
No water sample collected, free product present.

BORING 38-B3

DATE DRILLED: 10/13/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5	1-4	18	410	0	0	0
10	2-6	81	1500	0	0	0
15						

SAMPLES

SYMBOLS	DESCRIPTION
	Concrete
CL	Silty clay: moderate diesel odor
CL	Silty clay with vfg sand: strong diesel odor, product saturation

Notes: Groundwater encountered at about 7-8 feet
No water sample collected, free product present.
Piezometer constructed.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B2 AND 38-B3
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B4

DATE DRILLED: 10/13/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	37	300	0	0	1
2-6	75	710	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS | DESCRIPTION

SW — Concrete

Sandy gravel: pervasive old diesel coating, wet below 6 feet

Notes: Groundwater encountered at 6-8 feet
Water sample collected, moderate HC odor.

BORING 38-B5

DATE DRILLED: 10/14/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	28	870	0	0	0
2-6	54	1000	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS | DESCRIPTION

CL — Concrete

Clay with silt: brown, moderate diesel odor

SW — Sand: fg, grading to sandy gravel, wet, product coating

Notes: Groundwater encountered at 6-8 feet
Water sample collected, strong HC odor, product wisps and films.
Slow water recovery

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B4 AND 38-B5
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B6

DATE DRILLED: 10/14/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	26	3900	0	0	0
2-6	33	1800	0	0	3

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Concrete
SW	Sand: black petroleum coating, moderate diesel odor
CL	Clay: pervasive petroleum coating
SW	Sandy gravel: abrupt change from clay above, pervasive petroleum coating, scattered product blebs

Notes: Groundwater encountered at 6-8 feet
Water sample collected, strong HC odor, scattered product wisps and films, no product layer developed

BORING 38-B7

DATE DRILLED: 10/14/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	14	210	0	0	0
2-6	19	31	0	0	1

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Concrete
CL	Silty clay: weak-moderate diesel odor, no staining, underlies sandy gravel fill (?)
SW	Sandy gravel: weak diesel odor, no staining, natural colors, wet

Notes: Groundwater encountered at 6-8 feet
Water sample collected, weak HC odor, no product or sheen.

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B6 AND 38-B7
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B8

DATE DRILLED: 10/14/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	44	370	0	0	0
2-6	114	370	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Concrete
	CL	Silty clay: weak-moderate diesel odor, no staining, probable fill (?)
	SW	Sandy gravel: moderate diesel odor, no staining, natural colors, wet

Notes: Groundwater encountered at 6-8 feet
Water sample collected, trace odor,
no sheen.

BORING 38-B9

DATE DRILLED: 10/14/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	9		0	0	0
2-6	5	190	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Concrete
	CL	Sand: mg-vcg, trace HC odor, no staining,
	SW	Silty clay: dark brown-gray, wet, trace HC odor

Notes: Groundwater encountered at 6-8 feet
Water sample collected, trace odor,
dark gray color

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B8 AND 38-B9
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B10

DATE DRILLED: 10/14/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	0	ND	0	0	0
2-8	0	ND	0	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Track ballast and gravel
	SW	Sand: mg-cg, no HC odor or stain, well sorted
	SW	Sandy gravel: wet, no HC odor

Notes: Groundwater encountered at 6-8 feet
Water sample collected, trace odor,

BORING 38-B11

DATE DRILLED: 10/15/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0		280	0	0	0
2-2		4200	0	0	0
3-8		3200	1	0	0

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
	CL	Clayey gravel: black, possible old HC residue, no HC odor
		Silty clay: weak to moderate diesel odor, grades sand below
	SW	Sandy gravel: wet, product saturation

Notes: Groundwater encountered at 6-8 feet
No water sample collected, product present.
Piezometer constructed.

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B10 AND 38-B11
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B12

DATE DRILLED: 11/6/97

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
	1-7	178	2600	0	0	0
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill
	SW	Sand and fine gravel: moderate diesel odor, moist to wet, diesel product on cuttings

Notes: Groundwater encountered at 6-8 feet
No water sample collected, free product present.
Piezometer constructed - screen 4-14 feet.

BORING 38-B13

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: No samples collected, logged solely from drilling characteristics

Notes: Groundwater encountered at 6-8 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B12 AND 38-B13
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B14

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel with possible clay: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 6-8 feet
Water sample collected for vinyl chloride only
Slow water return

BORING 38-B15

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected

Notes: Groundwater encountered at 6-8 feet
Water sample collected for vinyl chloride only
Good water return

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792904	LOG OF BORINGS 38-B14 AND 38-B15 Ogden Railyard Ogden, UT	GEOPROBE BORING

BORING 38-B15

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 6-8 feet
Water sample collected for vinyl chloride only
Good water return

BORING 38-B17

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clay: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 6-8 feet
Water sample collected for vinyl chloride only
Slow water return; water has weak HC odor and dark gray-black color.

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B15 AND 38-B17
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B18

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clay: logged solely from drilling characteristics, no samples collected
10									
15									

BORING 38-B19

DATE DRILLED: 3/10/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clay: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 6-7 feet
Water sample collected for vinyl chloride and 8260
Good water return; water has moderate diesel odor

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UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B18 AND 38-B19
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B20

DATE DRILLED: 3/12/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clay: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 6-7 feet
Water sample collected for vinyl chloride, 8260, 8270, DRO.
Good water return; water has moderate diesel odor

BORING 38-B21

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at 5-7 feet
Water sample collected for vinyl chloride
Good water return; water has strong diesel odor, sheen and product blebs.
~~Piezometer constructed, screened from 3-13 feet.~~

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B20 AND 38-B21
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B22

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 4-5 feet
No water sample, product encountered-diesel odor.
Water has strong diesel odor and sheen, abundant product blebs.
~~Piezometer constructed, screened from 3-13 feet~~

BORING 38-B23

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 4 feet
No water sample, black product encountered, old diesel odor
Piezometer constructed, screened from 3-13 feet

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B22 AND 38-B23
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B24

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 4 feet
No water sample, product encountered-diesel odor,
Water has strong diesel odor and sheen, abundant product blebs.
~~Piezometer constructed, screened from 3-13 feet~~

BORING 38-B25

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 4-5 feet
No water sample, product layer encountered-diesel odor,
Water has strong diesel odor and sheen, abundant product blebs.
~~Piezometer constructed, screened from 3-13 feet~~

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B24 AND 38-B25
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B26

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel with possible clay: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 4-5 feet
No water sample, product layer encountered-diesel odor.
Water has strong diesel odor and sheen, abundant product blebs.
~~Water has very slow return rate.~~
Piezometer constructed, screened from 3-13 feet

BORING 38-B27

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel, minor clay: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 8 feet
Water sample collected for 8260
Good water return; water has sheen and weak product odor

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B26 AND 38-B27
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B28

DATE DRILLED: 3/16/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characteristics, no samples collected
10									
15									

Notes: Groundwater encountered at about 4-5 feet
No water sample, product layer encountered-diesel odor, Water has strong diesel odor and sheen, abundant product blebs.
~~Piezometer constructed, screened from 3-13 feet~~

BORING 38-B29

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel: logged solely from drilling characterisitcs, no samples collected
10									
15									

Notes: Groundwater encountered at about 5-6 feet
Water sample has moderate-strong odor, sheen, good return. Sampled for 8260

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B28 AND 38-B29
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B30

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characterisitcs, no samples collected

Notes: Groundwater encountered at about 6 feet
Water sample collected for 8260
Good water return; water has sheen and strong product odor

BORING 38-B31

DATE DRILLED: 3/17/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel: logged solely from drilling characterisitcs, no samples collected

Notes: Groundwater encountered at about 5-6 feet
Water sample collected for 8260 and vinyl chloride
Good water return; water has sheen and strong product odor

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B30 AND 38-B31
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B32

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium with possible clayey matrix above 10 feet, log derived solely from drilling characteristics

Notes: Poor recovery of groundwater until screen set at 12-14 feet, trace odor.
~~Water sample collected for 8260.~~

BORING 38-B33

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
5						
10						
15						

SAMPLES

SYMBOLS		DESCRIPTION
	SW	Sand and sandy gravel alluvium with possible clayey matrix above 10 feet, log derived solely from drilling characteristics

Notes: Good recovery of groundwater, screen set at 9-13 feet.
Water sample collected for 8260.
Good water return, no odor

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS 38-B32 AND 38-B33
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING 38-B34

DATE DRILLED: 5/19/98

DEPTH IN FEET	SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS	SAMPLES	SYMBOLS	DESCRIPTION
5								SW	Sand and sandy gravel alluvium with possible clayey matrix above 10 feet, log derived solely from drilling characteristics
10									
15									

Notes: Good recovery of groundwater, screen set at 9-13 feet.
Water sample collected for 8260.
Good water return, moderate diesel odor and sheen

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792804	LOG OF BORING 38-B34 Ogden Railyard Ogden, UT	GEOPROBE BORING

BORING SPRR3-B1

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	12	0		
2-2	211	15	0		
3-7	344	32	0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Sandy gravel fill: no HC odor or staining
	ML	Clayey silt and vfg sand: natural color, weak to moderate gasoline odor, perched water above thin clay seam
	SW	Sandy gravel: grades from finer sand above, natural color, moderate-strong gasoline odor, wet

Notes: Groundwater encountered at about 8 feet.
No water sample collected, gasoline product in boring.
Piezometer constructed.

BORING SPRR3-B2

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	3	8	0		
2-7	212	89	0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Asphalt pavement, no sample
	ML	Silt with natural organic stringers: brown to black, no HC odor or staining
	SW	Sandy gravel: probably gradational from above, no stain, moderate gasoline odor, wet at approx. 8 feet

Notes: Groundwater encountered at about 8 feet.
Water sample collected, moderate gasoline odor, sheen.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS SPRR3-B1 AND SPRR3-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING SPRR3-B3

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	14	69	0		
2-7	317	100	0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
	Asphalt pavement, no sample
ML	Silt: well sorted, trace gasoline odor
SW	Sandy gravel: probably gradational from above, no stain, moderate gasoline odor, wet at approx. 8 feet

Notes: Groundwater encountered at about 8 feet.
Water sample collected, moderate gasoline odor, sheen and scattered product wisps

BORING SPRR3-B4

DATE DRILLED: 3/17/98

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS	DESCRIPTION
SW	Sandy gravel and sand: probably similar alluvium as SPRR3-B3, log derived solely from drilling characteristics, no soil sample collected

Notes: Groundwater encountered at about 8 feet.
Water has strong gasoline odor, sheen, no measurable product layer when drilled
Water analyzed for 8260.

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS SPRR3-B3 AND SPRR3-B4
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING SPRR5-B1

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	ND	0		
2-2	2	ND	0		
3-7	1200	ND	0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Road gravel fill: gravel and sand
	ML	Silt, minor clay and vfg sand: natural color, no odor or HC staining
	SW	Sand: increasing size fraction at depth, grades from above, natural color, no odor or HC stain
	SW	Sandy gravel: grades from finer sand above, natural color, moderate-strong gasoline odor, wet

Notes: Groundwater encountered at about 8 feet.
Water sample collected, moderate gasoline odor

BORING SPRR5-B2

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-0	0	8.2	0		
2-2	53	710	0		
3-7	>2000	78	0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Road gravel fill: gravel and sand
	ML	Silt: natural color, moderate gasoline odor, no HC stain
	SW	Sand and silt: increasing size fraction at depth, grades from above, natural color, strong gasoline odor
	SW	Sandy gravel: grades from finer sand above, natural color, moderate-strong gasoline odor, wet

Notes: Groundwater encountered at about 8 feet.
Water sample collected, trace gasoline odor

LAIDLAW ENVIRONMENTAL SERVICES Inc.
UPRR Ogden Railyard
Proj. 792904

LOG OF BORINGS SPRR5-B1 AND SPRR5-B2
Ogden Railyard
Ogden, UT

GEOPROBE BORING

BORING SPRR5-B3

DATE DRILLED: 10/10/97

SAMPLE NUMBER	PID (ppm)	TPH (ppm)	VOCs	PAHs	METALS
1-2	9	7.5	0		
2-7	4	3.7	0		

DEPTH IN FEET: 5, 10, 15

SAMPLES

SYMBOLS		DESCRIPTION
		Road gravel fill: gravel and sand, no sample
	SW	Silt and vfg sand: trace gasoline odor, no HC stain, natural color
	SW	Silty sand grading to fg sand: no HC odor or stain, becomes wet about 8 feet

Notes: Groundwater encountered at about 8 feet.
Water sample collected, no gasoline odor

LAIDLAW ENVIRONMENTAL SERVICES Inc. UPRR Ogden Railyard Proj. 792904	LOG OF BORING SPRR5-B3 Ogden Railyard Ogden, UT	GEOPROBE BORING

APPENDIX D
MONITORING WELL COMPLETION LOGS

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 12-MW1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-6-00 / DATE COMP: 5-6-00 / TIME:	TOTAL DEPTH: 16 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 11 FT

WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0	30 40 25	GM (s)	0-2' Recovery 1.8'; silty gravel with sand; gravel 55%, small to med; sand 25% fine, med and coarse; silt 20%; brown (7.5YR 4/4), no odor, dry	90%	0.7		
		44 19 59 53	ML (s)	2-4' Recovery 1.8'; sandy silt with gravel; gravel 30%; sand 35%, med to coarse; silt 35%; brown (7.5YR 4/3), no odor, dry	90%	0.6		
	5	52 14 13 12	GM (s)	4-6' Recovery 1.1'; silty gravel with sand; gravel 50%, small to large; sand 25%, med to coarse; silt 25%; strong brown (7.5YR 4/6), no odor, dry	55%	0.5	12MW1-4 (10:25)	VOC, Metals Semivol PAH TPH,DRO
		28 16 36	GM (s)	6-8' Recovery 1.5'; sandy gravel with silt; gravel 50%; sand 40%, med to coarse; silt 10%; very pale brown (10YR 7/3), no odor, dry	75%	0.5		
		60 68 27 74	GM (s)	8-10' Recovery 1.7', sandy gravel with silt, gravel 45%, sand 45%, silt 10%, very pale brown (10YR 7/4), no odor, dry	85%	0.4		
	10	53 55 25	GM (s)	10-12' Recovery 1.7', 10-11.5' sandy gravel, as above, no odor, wet at 11', brown (10YR 5/3)	85%	0.3	12MW1-10 (11:10)	VOC Semivol PAH Metals TPH,DRO
		39	CH	11.5-12' Lean clay, dark grayish brown (10YR 4/2), no odor, moist				
		28 11 2	CH	12-14' Recovery 2', lean clay as above, dark brown (10YR 3/3), no odor, moist, minor silty stringers between 13-14', high plastic	100%	0.3		
	15	3 7 9 4	CH	14-16' Recovery 2', lean clay (possible alpine fm.), brown (10YR 3/3), no odor, moist, high plastic	100%			
		5 8 8		TD well @ 16' Due to proximity of Weber River 25' to the west, will leave 5' of screen dry to accommodate water level fluctuations Screen from 16-6' Filter sand from 16-4' Transition sand from 4-3.8' Bentonite from 3.8-1'				
	20							
	25							
	30							

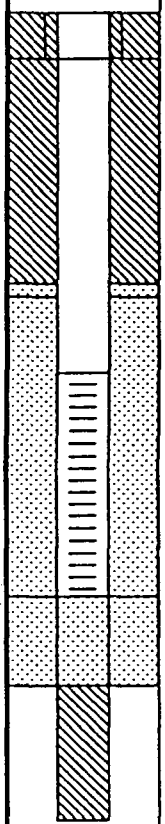
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 12-MW2D

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-5-00 / DATE COMP: 5-5-00 / TIME:	TOTAL DEPTH: 18 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 11 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	35, 45, 62	GM (s)	0-2', Recovery 1.1', silty gravel with sand, gravel 50%, sand 20% silt 30%, dark brown (7.5YR 3/3), slight pet odor, dry	55%	2.6		
	43, 19, 58, 55	GM (s)	2-4' Recovery 1', silty gravel with sand, as above, dark brown, mild pet odor, dry	80%	40.0	Geotech 12MW2D-2 (13:39)	
5	81, 60, *		*100 blow counts in 2", no recovery, drilled to 6'	0	NA	12MW2D-4 (13:48)	VOC,
	12, 30, 70	ML (g) / GM (s)	6-8' Recovery 1.5', 6-6.5' gravely silt, gravel 40%, silt 55%, 5% fine sand, very dark grayish brown (10YR 3/2) slight pet odor, moist	75%	1.6		
	91, 63, 109, 63	GM (s)	6.5-8' Gravely well graded, gravel 50%, sand 25%, silt 25% very dark grayish brown (10YR 3/2) slight pet odor, dry	85%	1.5	Geotech 12MW2D-9 (14:40)	
10	50, 43, 31, 28	GM (s)	8-10' Recovery 1.7', gravely sand, gravel 50%, sand med-coarse 30%, silt 20%, yellowish brown (10YR 5/4), no odor, dry	45%	11.3		
	21, 43	SP	10-12' Recovery 0.9', sandy gravel, gravel 55%, sand 20%, silt 15%, yellowish brown (10YR 5/6), mod pet odor, wet, sheen on water in sampler	45%		12MW2D-12 (15:14)	Fluor sudan 12MW2D -12
	1, 3, 16	CH	12-14' Recovery 2', 12-12.5' sand, poorly graded, 95% med-coarse sand, 5% fines, dark brown (10YR 3/3), no odor, wet	100%	4.8	Geotech 12MW2D-13 (15:17)	
15	10, 7, 7, 10, 10	CH	12.5-14' Fat clay, dark yellowish brown (10YR 4/4), no odor, moist 14-16' As above with 1-2" thick silty clay layers, no odor, moist	100%	3.9		
	7, 8, 11, 12	CH	16-18' As above, no odor, moist	100%	0.1		
20			TD well @ 18' Backfill from 18-15' with Bentonite chips Backfill from 15-13' with (20x40) sand-5 50# bags, 6 50# bags Set screen from 13-8' Place filter sand (20x40) from 13-6' Bentonite from 6-1'				
25							
30							

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 12-MW3

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-5-00 / DATE COMP: 5-5-00 / TIME:	TOTAL DEPTH: 20 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 12.5 FT

WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0		GP (s)	0-5' No recovery, augered up samples, sandy gravel, fill, dark brown (10YR 3/3), 80% gravel, 15% sand, med grained and 5% fines, mod pet. odor, dry		6.5	12MW3-4 (10:20)	VOC Metals Semivols PAH TPH,DRO
	5		GP (s)	5-8' Auger recovery, sandy gravel, small to medium rounded, 60% gravel, 40% med to coarse sand, dark brown (10YR 3/3), mild pet. odor, moist				
			GP (s)	8-9.5' As above				
	10			9.5-10' As above				
			GM (s)	10-12' Silty gravel with sand, 50% rounded gravel, 30% med to coarse sand, 20% fines, brown (10YR 4/3), weak pet. odor, moist		2.2	12MW3-11 (10:30)	VOC Metals Semivols PAH TPH,DRO
			GM (s)	12-13' As above				
	15		GP (s)	13-19' Poorly graded gravel with sand, gravel 80%, sand 20%, coarse to med, brown (10YR 4/3), slight pet. odor, moist to wet		1.2		
	20		CH	19-20' Fat clay (Alpine?), high plastic, dark yellowish brown (10YR 4/4), no odor, moist, off load auger		1.0		
	25			TD well @ 20' 19-9' 10' of 10-slot PVC screen 19-7' filter sand (20x40) 3.5 100# bags 7-6.8' fine transition sand 70 mesh 6.8-2' Bentonite hole plug 3 50# bags Flush mount completion				
	30							

JOB NUMBER: 792904

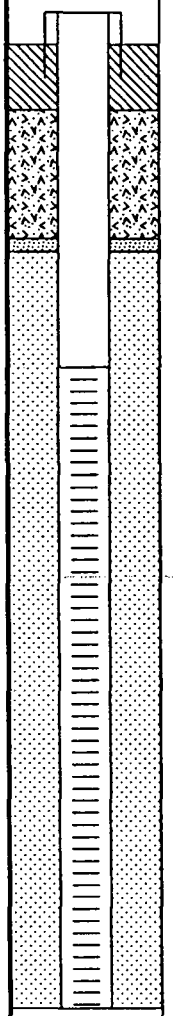
SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 18-MW1

WELL NO. 18-MW1

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN, UTAH		LOCATION:	
DRILLING CO.: LAYNE CHRISTENSEN		METHOD: HSA	
DATE START: 4-10-00	DATE COMP: 4-10-00	TIME: START 1500	TOTAL DEPTH: 15 FT
LOGGED BY: DAN DOWERS			DEPTH TO WATER: 6 FT



WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0	6, 8, 12, 18	Fill	0-2' Recovery 1.0' Fill, black coaly soil with brick frags, 20% silt, dry, dusky brown (5YR 2/2), hit buried metal pipeline @ 2' moved 50' north across road, pipeline parallels fence by chemical company.	50%		0.2	
		6, 9, 12, 12	Fill	2-4' Recovery 1.0', as above.	50%	18MW1 -2 @1530	0.2	2-4 VOC,PAH Metals
	5	6, 24, 15, 10	Fill	4-6' Recovery 1.0', as above, silty @ 5-6', damp.	50%	18MW1 -5 @1600	0.2	5-6 VOC,PAH Metals
		8, 5, 4, 2	SW (g)	6-8' Recovery 1.0', sand and gravel, mod yellow brown (10YR 5/4), wet, no odor, sand coarse-v.coarse, gravel to 1".	50%		0.2	
		2, 2, 30, 28	SW (g)	8-10' Recovery 1.0', as above, wet, no odor	50%		0.2	
	10	10, 42, 24, 20	SW/SM (g)	10-12' Recovery 2', sand, fine, silty to v.coarse, ~15% gravel, light brown (5YR 5/6), very wet, no odor.	100%		0.1	
		4, 9, 8, 8	SW/SM (g)	12-14' Recovery 1.0', sand with gravel as above.	50% / 100%		0.2	
		5, 22	SW/SM (g)	14-15' Recovery 1.0', sand with gravel as above.			0.2	
	15			TD well @ 15' Well Completion: Screen: 2" PVC, .010" slots @ 15-5' Blank: 2" PVC @ 5'- surface +2.5' Sand pack: 20/40 @ 15'-3', w/ 2" 70 mesh on top Bentonite seal: 3'-1' Cement: 1'-surface and 4x4' pad w/ 3 posts and a protective casing				
	20							

JOB NUMBER: 792904

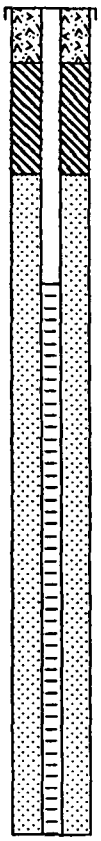
LOG

BORING NO.

WELL NO. 13-MW1

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/6/98	DATE COMP: 6/6/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 10.83

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Grade level completion - drive-over cap			
	10		SW	Sandy gravel: minor sporadic clay content, no HC odor or stain, becomes wet below 7-8 feet	0	13-MW1-8	ND DRO
	20						

▼ -DEPTH TO FREE PRODUCT

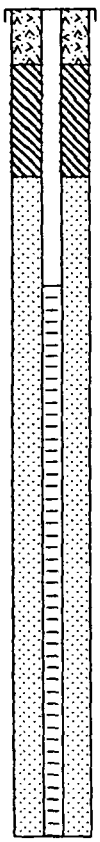
LOG

BORING NO.

WELL NO. 13-MW2

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/6/98	DATE COMP: 6/6/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 10.64

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level completion - drive-over cap			
	10	SW	Sandy gravel: minor sporadic clay content, no HC odor or stain, becomes wet below 7-8 feet	0	13-MW2-8	ND DRO
	20					

▼ -DEPTH TO FREE PRODUCT

WELL LOG

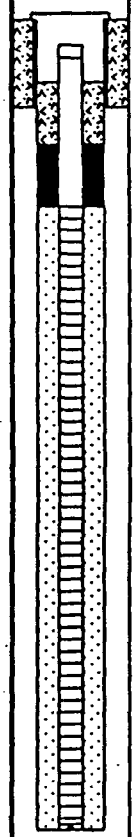
USPCI

Remedial Services

A01-13

BORING NO. RIV-MW-16

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 96120
PROJECT: RIVERDALE YARD		LOCATION: RIVERDALE UT.	
DRILLED BY: P. C. EXPLOR.	DRILLER: TRENT JENSEN		METHOD: HOLLOW-STEM AUGER
DATE START: 11/3/90	DATE COMP: 11/3/90	SURF. EL:4333.68 MSL	TD: 15.0' BGS
LOGGED BY: SCOTT SCHULEIN	APPROVED BY:		DEPTH TO WATER: 9.63



WELL COMP	DEPTH (ft)	DESCRIPTION	GRAPHIC LOG USCS CODE	OVM	SAMPLE NUMBER	TPH ppm
	0	0.0 to 0.5 ASPHALT.	AS	ND		
		0.5 TO 3.0 SANDY GRAVELS, BROWN, CLEAN FILL.				
		3.0 TO 10.0 SANDY GRAVEL, GRAY, MOIST.		ND		
	5		GM			
		DEPTH TO WATER 11/6/90		53		
	10	10.0 TO 15.0 SANDY GRAVEL, HYDROCARBON SCHEEN ON THE SAMPLES, WET, GRAY.			MW-16A	307
	15	THE COMPLETED DEPTH OF THIS WELL IS 13.0 FEET DUE TO THE FLOWING SANDS.		228		
	20					

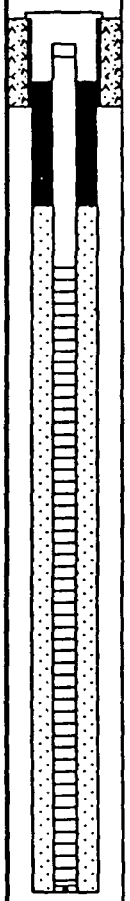
WELL LOG

USPCI
Remedial Services

A01-13

BORING NO. RIV-MW-17

CLIENT: UP RAILROAD			JOB NUMBER: 96120
PROJECT: RIVERDALE YARD		LOCATION: RIVERDALE UT.	
DRILLED BY: P. C. EXPLOR.	DRILLER: TRENT JENSEN		METHOD: HOLLOW-STEM AUGER
DATE START: 11/4/90	DATE COMP: 11/4/90	SURF. EL:4333.48 MSL	TD: 15.0' BGS
LOGGED BY: SCOTT SCHULEIN	APPROVED BY:		DEPTH TO WATER: 9.52

WELL COMP	DEPTH (ft)	DESCRIPTION	GRAPHIC LOG USCS CODE	OVM	SAMPLE NUMBER	TPH ppm
	0	0.0 to 0.5 ASPHALT.	AS			
		0.5 TO 6.5 SANDY GRAVELS, BROWN, CLEAN FILL.	SP	ND		
	5					
		6.5 TO 10.0 SANDY GRAVEL, SOME CLAY, POORLY SORTED, SLIGHT HYDROCARBON ODOR, GRAY.			MW-17A	67
		DEPTH TO WATER 11/6/90				
	10	10.0 TO 15.0 CLAYEY SAND, FINE GRAINED, STRONG HYDROCARBON ODOR, GRAY, SILTY CLAY.	OL	24	MW-17B COMPOSIT	66
	15	THE COMPLETED DEPTH OF THIS WELL IS 14.0 FEET DUE TO THE FLOWING SANDS.				
	20					

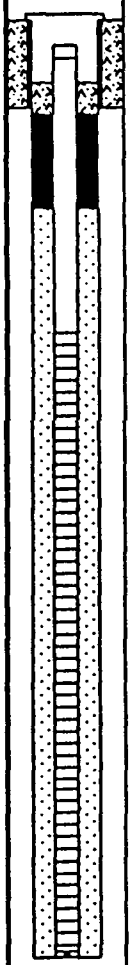
WELL LOG

USPCI
Remedial Services

A01-13

BORING NO. RIV-MW-18

CLIENT: UP RAILROAD			JOB NUMBER: 98120
PROJECT: RIVERDALE YARD		LOCATION: OGDEN/RIVERDALE, UT	
DRILLED BY: P. C. EXPLORATION	DRILLER: TRENT JENSEN		METHOD: HOLLOW-STEM AUGER
DATE START: 11/5/90	DATE COMP: 11/5/90	SURF. EL:4333.25 MSL	TD: 15.0' BGS
LOGGED BY: SCOTT SCHULEIN	APPROVED BY:		DEPTH TO WATER: 9.59



WELL COMP	DEPTH (ft)	DESCRIPTION	GRAPHIC LOG USCS CODE	OVM	SAMPLE NUMBER	TPH ppm
	0	0.0 to 0.5 ASPHALT.	AS			
		0.5 TO 2.0 SANDY GRAVELS, BROWN, CLEAN FILL.	SP			
		2.0 TO 4.5 SANDY GRAVEL, POORLY SORTED, GRAY, SLIGHT HYDROCARBON ODOR FROM 4.0 TO 4.5'.	GP			
	5	4.5 TO 12.0 SILTY CLAY SOME SAND, DARK GRAY, HYDROCARBON ODOR.	ML	41	MW-18A	<10
	10	DEPTH TO WATER 11/6/90				
		12.0 TO 15.0 SILTY CLAY, SAND LENSES, GRAY, WET, STRONG HYDROCARBON ODOR.		478	MW-18B	12
	15	THE COMPLETED DEPTH OF THIS WELL IS 15.0 FEET.				
	20					

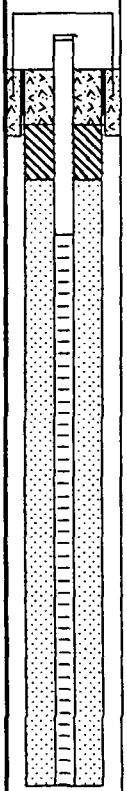
LOG

BORING NO.

WELL NO. 21-MW1

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/5/98	DATE COMP: 6/5/98	SURF. EL:	WELL TD: 13.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.19

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SC	Sand with partial minor clay matrix: sand fg-mg, no odor, natural colors – no staining, wet below 3.5 feet			
	10		SW	Sandy gravel: unconsolidated, natural colors, wet, no HC odor	0		
	20						

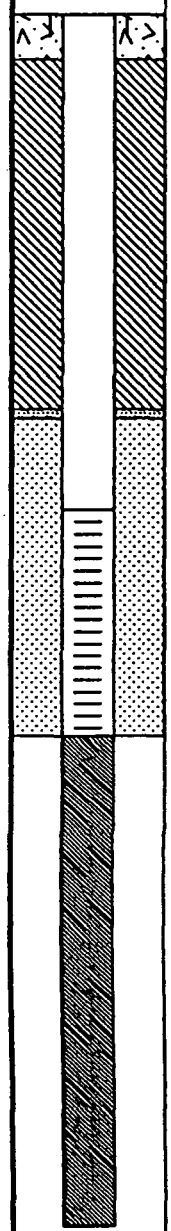
▼ -DEPTH TO FREE PRODUCT

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 19-MW1D

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-4-00 / DATE COMP: 5-4-00 / TIME:	TOTAL DEPTH: 27 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 7.5 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0		Cap	0-1' Asphalt and concrete				
	1 1 1	ML (s)	1-3' Recovery 1', sandy silt, sand 40% vfg, silt 60%, dark brown (10YR 3/3), no odor, dry	50%	0.4		
	2 1 2	SM	3-5' Recovery 1.8', silty sand, sand 60%, silt 40%, dark yellowish brown (10YR 4/4), no odor, dry	60%	1.0		geotech 19MW1D-3
5	3 4 1 1	ML (s)	5-7' Recovery 1.7', sandy silt, sand 35% vfg, silt 65%, yellowish brown (10YR 5/6), no odor, moist between 6-7'	85%	0.0		geotech 19MW1D-5
▼	3 3 2 3	SM	7-9' Recovery 1.3', silty sand, sand 65%, silt 35%, very dark gray (10YR 3/1) med pet. odor, wet	65%	118.0	19MW1D-7 (15:24)	geotech 19MW1D-8
10	10 35 25 20	GM (s)	9-11' Recovery 1.3', silty gravel with sand; 50% gravel, 30% silt, 20% sand, very dark gray (10YR 3/1), strong pet. odor (possibly gasoline), wet, sheen on H_2O in sampler	65%	41.0		
	21 17 14	GW (s)	11-13' Recovery 1.7', sandy gravel, gravel 45% well graded, sand 35% med to coarse, silt 20%, very dark gray (10YR 3/1), strong pet. odor, wet, sheen on H_2O in sampler	85%	32.0		
	9 8 4 5	SM (g)	13-15' Recovery 0.4', silty sand with gravel, gravel 40%, 45% sand, 15% silt, very dark grayish brown (10YR 3/2), faint pet. odor, wet	20%	7.0		
15	12 11 2	SM (g)	15-17' Recovery 1.5', as above, 15-15.5' SM (g)	75%	2.0	19MW1D-15 (15:35)	
		CH	15.5-16.5' Fat clay	75%	2.0		geotech 19MW1D-16
	0 1 0 5	ML/CL	16.5-17' Silty with lean clay, interfingering, dark gray brown (7.5YR 4/3), no odor, moist	75%	0.0		
	5 4	CL	17-19' Recovery 1.5', clay with silt and vf sand lenses, brown (7.5YR 5/2), no odor, moist				
20	8 15	CL	19-21' Recovery 2', clay with silt, as above, no odor, moist	100%	1.0		
	13 6 12	SM	20-21' Silty sand, sand 60% vfg, silt 40%, brown (7.5YR 5/2), no odor, moist				
	17 26 8 12	SM	21-23' Recovery 1.7', silty sand (SM), same as above, no odor, moist	85%	1.0		
25	20 25 9 18	SM/CL	23-25' Recovery 2', silty sand as above, with 2" to 4" clay lenses, clay has reddish brown striations, no odor, moist	100%	1.0		
		SM/CL	25-27' Recovery as above, recovery 1.5'	75%	0.5		
30	24 25		TD well @ 27' Back fill gorehole from 27-18' with bentonite (holeplug) fill in filter sand from 18-16' set 5' of PVC 10-slot screen from 16-11' place filter sand from 16-9' ~~place 2" of 70 mesh transition sand 9-8.8'~~ bentonite from 8.8-1'				

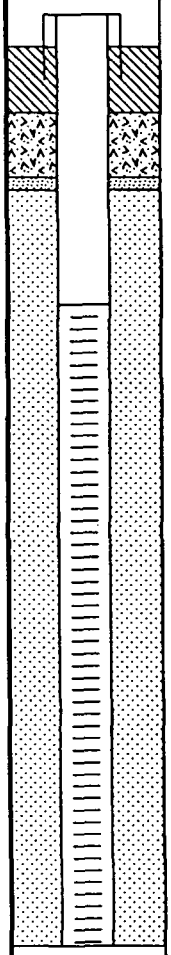
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 20-MW1
WELL NO. 20-MW1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION: AST AREA
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-10-00 / DATE COMP: 4-10-00	TIME: START 1100 AM / TOTAL DEPTH: 14 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: 5-6 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	27, 7, 6	Fill	0-2' Recovery 0.5' Fill, ~80% coal frags, 20% silt, cinders, sand, black-dark brown, no odor, dry.	25%		0.2	
	5, 4, 4, 3, 4	Fill	2-4' Recovery 0.5' Fill as above.	25%	20MW1 -2 @1130	0.1	VOC,PAH Metals
5	4, 13, 24, 30	GW/SW	4-6' Recovery 1.0', lt brown (5YR6/4), sand and gravel, 50% med-coarse sand, 50% gravel to 1" diam, wet, no odor, unconsol, poor sorting.	50%	20MW1 -5 @1145	0.1	VOC,PAH Metals @top of H_2O
	22, 51, 50	GW/SW	6-8' Recovery 1.25'- sand and gravel, as above, wet, no odor.	63%		0.0	
	92, 22, 16		8-10' Recovery 1.0', sand and gravel as above, brown-gray (5YR 4/1), wet, no odor.	50%		0.2	
10	19, 40	GW/SW					
	6, 52	SW (g)	10-12' Recovery 1.0', sand w/ 25% gravel, dark brown gray, med-v.coarse, gravel up to 1/2", wet, no odor.	50%		0.2	
	32, 21						
	19, 27		12-14' Recovery 1.0', sand and gravel as above, gravel up to 1" diam, wet, no odor.	50%		0.1	
	31, 34	SW (g)					
15			TD well @ 14' Well Completion: Screen: 2" PVC .010" slot @ 14'-4' Sand pack: 20/40 @ 14'-2' w/ 2" 70 mesh on top Bentonite seal: 2'-1' Concrete and pad: @ 1'-surface Blank: 2" PVC to surface +2.5' Above grade protective casing w/ 3 posts and 4x4' pad				
20							

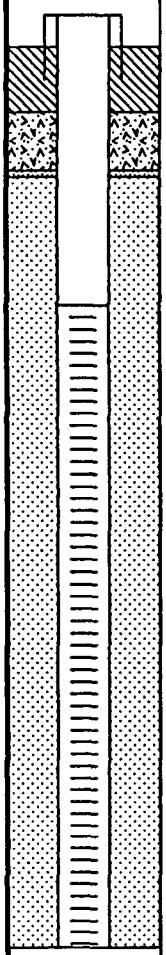
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 20-MW2
WELL NO. 20-MW2

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION: AST AREA
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-1-00 / DATE COMP: 4-1-00 / TIME:	TOTAL DEPTH: 14 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: ~5-6 FT



WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0	16, 55		0-2' No recovery, refusal on cobble in fill.	0%			
		12, 15, 9, 9		2-4' No recovery, probable fill.	0%			
	5	3, 3, 3, 4	Fill	4-6' Recovery 0.5', fill, coal frags w/ sand, fine-silty, gray-black (5GY 2/1), becoming damp, no odor.	25%		0	
		3, 16, 20, 34	SM	6-8' Recovery 1.0', silty sand, med-coarse w/ ~15% gravel, dark gray (5GY 4/1), mod HC odor, occ black HC (?) stain, moist-wet, H_2O @ ~6', poorly sorted.	50%	20MW2 -6 @1030	3.0	8 RCRA Metals, PAH,VOC
		24, 38, 45, 22	SM	8-10' Recovery 1.0', sand, med-v.coarse w/ gravel up to 2", occ silty, wet, slight HC odor (?), poorly sorted, olive gray (5Y 4/1).	50%		0.4	
	10	15, 17, 18, 7	SM	10-12' Recovery 0.5', sand, gravel as above, no odor.	25%		0.01	
		5, 5, 4, 5		12-14' No recovery - soft, unconsol, very wet sand on spoon (flowing sand).	0%			
	15			TD well @ 14' Well Completion: PVC screen: .010" slots @ 14-4' PVC blank: @ +2.5' to 4' 20/40 sand pack: 2-14' Fine sand: 1.9-2' (70 mesh) Bentonite: 1-2' Concrete: 0-1' Concrete pad w/ above grade prot. casing and 3 guard posts and locking lid.				
	20							

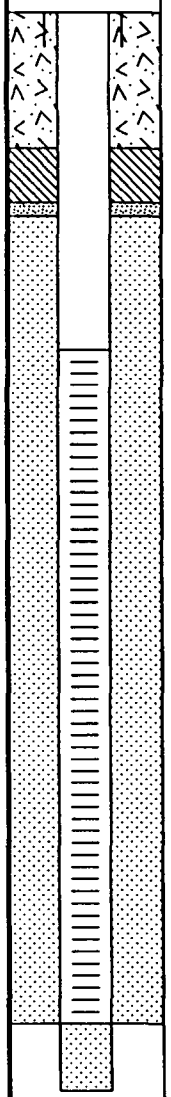
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 20-MW3D

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-7-00 / DATE COMP: 5-7-00 / TIME:	TOTAL DEPTH: 16 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 6 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	6 6 4 4	ML (s)	0-2' Recovery 1', silt w/ sand, silt 65%, sand 35%, v.fine to med grained, black (10YR 2/1), no odor, dry, pieces of fine broken rock w/ brick (fill).	50%	0.0		
	4 2 4 4	ML (s)	2-4' Recovery 1', sandy silt w/ gravel, gravel 15% rounded small med, sand 20%, silt 65%, black (10YR 2/1), no odor, dry, pieces of coal and brick (fill).	50%	0.0		
5	4 5 6 5	ML (s)	4-6' Recovery 1', sandy silt w/ gravel, as above, no odor, dry, moist last 2".	50%	0.0		
	12 20 41 43	GM (s)	6-8' Recovery 1', silty gravel w/ sand, gravel 55%, sand 20%, silt 25%, dark yellowish brown (10YR 4/6), no odor, wet.	50%	0.0		
	34 41 24 26	SP (g)	8-10' Recovery 1.3', gravely sand, gravel 40%, sand 55%, fines 5%, dark yellowish brown (10YR 4/6), no odor, wet.	65%	0.0		
10	20 18 17 16	SP (g)	10-12' Recovery 1.4', gravely sand, gravel 35%, sand 60%, fines 5%, dark yellowish brown (10YR 4/6), no odor, wet, last 1" had fat clay lens.	70%	0.0		
	16 22	SP	12-14' Recovery 1', poorly graded sand w/ silt, sand 90% vcg, 10% silt, yellowish brown (10YR 5/4), no odor, wet.	50%	0.0		
	13 11	GM (s)	13-14' Gravel w/ sand and silt, gravel 50%, sand 30%, silt 20%, yellowish brown (10YR 5/6), no odor, wet.				
15	4 7 13 19	CH	14-16' Recovery 2', fat clay (possible Alpine), dark yellowish brown (10YR 4/4), no odor, moist.	100%	0.0	20-MW3D 14 (10:15)	VOC
20			TD well @ 16' Well Completion: Screen: 15'-10', 10-slot Backfill borehole w/ (20x40) sand: 16'-15' Filter sand (20x40): 15'-8' Transition sand: 8'-7.8' Bentonite: 7.8'-2', 1 bag (50#) Cement: 2'-0				

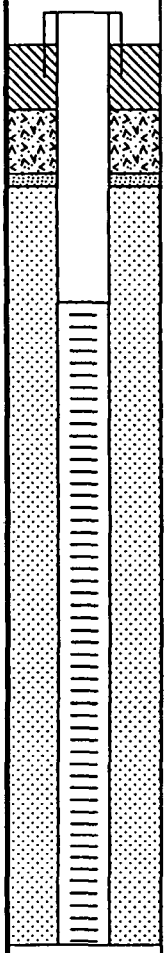
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 21-MW2
WELL NO. 21-MW2

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION:
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-11-00 / DATE COMP: 4-11-00 / TIME:	TOTAL DEPTH: 14 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: 6 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	14, 8, 16, 16	Fill	0-2' Recovery 1.0', fill to ~1', black, coaly silt and fine sand, 0.9-1' sand and gravel (~50% each), mod yellow brown (10YR 5/4), med-v.coarse, gravel to 1½", subangular-subround, poor sorting, dry, no odor.	50%		0.1	
	7, 11, 6, 6	SP/SM	2-4' Recovery 1.0', poorly graded sand with silt, sand is fine, silty mod well sorted, mod org pink, damp, no odor, gravel ~10%, max 1/2" diam, no odor.	50%	21MW2 -2 2-4' @1330	0.0	VOC,PAH Metals
						0.0	
	2, 2, 1, 0	SP/SM	4-6' Recovery 0.5', fine org pink sand as above, damper than above, no odor, void @ 5.5-6'?	25%			
5							
▼	2, 1, 23, 20	SP/SM	6-8' Recovery 0.4', wet, flowing sand as above.	20%	21MW2 -6 @1400	0.0	VOC,PAH Metals
	12, 18, 15, 17	SP (g)	8-10' Recovery 1.0', poorly graded sand w/ gravel, sand to 9', as above, pale yellow brown, gravel w/ sand, 30% gravel, poorly graded sand w/ gravel.	50%		0.0	
10	12, 17, 19, 14	SP (g)	10-12' Recovery 1.0', poorly graded sand w/ gravel, gravel increasing toward base, gravel @ ~40%, wet, no odor.	50%		0.0	
	9, 19, 30, 38	SP (g)	12-14' Recovery 1.0', poorly graded sand w/ gravel, gravel decreasing to 20%, brownish gray (5YR 4/1), wet, no odor.	50%		0.0	
15			TD well @ 14' Well Completion: Screen: 2" PVC .010" slots @ 14'-4' Sand pack: 20/40 sand @ 14'-2', 2" 70 mesh sand on top Bentonite seal: 2'-1' Concrete: 1'-surface and 4x4' pad w/ protective casing and 3 posts PVC blank: 4'-surface +2.5'				
20							

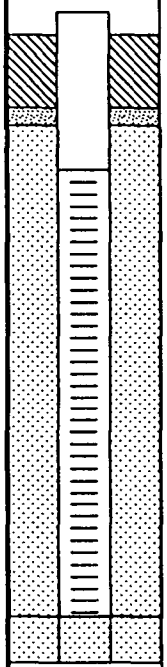
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 21-MW3

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-1-00 / DATE COMP: 5-1-00 / TIME:	TOTAL DEPTH: 14 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 5.5 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	22, 17, 23	Fill/GW	0-2' Recovery 1.6', gravel with silt and sand, fill material, 20% coal pieces, gravel angular 1.5" dia, black to dark brown (7.5YR N2), no odor, dry	80%	0.0		
	27, 12, 10, 12	ML/CL	2-4' Recovery 1', silt with clay, <10% fine sand, very dark brown (10YR 2/2), no odor, dry	50%	0.0		
5	16, 1, 1, 1	CL/ML	4-6' Recovery 2', clay with silt, med plastic, very dark brown (10YR 2/2), petroleum odor, moist, minor staining	100%	2.2	21MW3-4 (15:45)	VOC, Metals Semivol TPH,DRO
	2, 3	CL	6-7' Recovery 0.5', clay as above to approx 7', odor, wet, staining, floating petroleum globs on H_2O	50%	2.0		
	13, 27	GW	7-8' Recovery 0.5', gravel with silt, clay <10%, gravel 1.5" dia, dark brown (10YR 4/3), odor, wet, stain	50%	12.0	21MW3-8 (16:05)	VOC Metals Semivols TPH,DRO
	21, 21, 21	GW (s)	8-10' Recovery 1', gravel, sandy, <10% silt, gravel 1-2" dia, elongate, rounded, sand coarse dark grayish brown (10YR 3/2), odor, stain, wet	50%	9.0		
10	22, 21, 6	GW/SP	10-12' Recovery 1', sand with gravel, silt, sorting, gravel fine to med 1-2", sand 60% to 65% fine to med grain, subrounded to subangular, dark grayish brown (10YR 3/2), odor, wet, stain	35%	7.0		
	19, 28, 32, 12	GW/SP	12-14' Recovery 0.7', GW-SP as above, dark grayish brown (10YR 4/2), odor, stain, wet				
15	19, 5, 2		TD well @ 14' Well set at 13' bgs to allow 2.5' of screen dry and 7.5' wet, anticipate possible accumulation of floating petroleum product.				
20							
25							
30							

JOB NUMBER: 792904

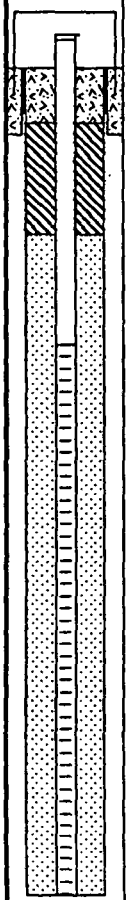
LOG

BORING NO.

WELL NO. 22A-MW1

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.86

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		SW	Sand & sandy gravel: Unconsolidated sandy alluvial sequences,			
			6-7.5 ft: sand mg-cg, trace HC staining, moderate diesel odor, scattered clayey lens', wet below 7.5 feet	23	MW1-6	ND DRO
	10	SW	Sandy gravel: medium brown, wet, grades to increasing sand at depth, moderate diesel odor,	17	MW1-10	76 DRO
	20					

▼ =DEPTH TO FREE PRODUCT

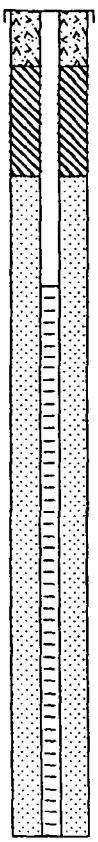
LOG

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

BORING NO.

WELL NO. 22A-MW2

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 10.10

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level completion - drive-over cap			
		CL	Silty clay: Dark brown, No HC odor, clat sticky, soft, moist 7-8.5 ft: Clayey sand and gravel, no odor, dark brown-gray, wet	0	MW2-7	ND DRO
	10	SC	Sandy gravel: Wet, no HC odor, grades from clayey alluvium above	0		
	20					

▼ =DEPTH TO FREE PRODUCT

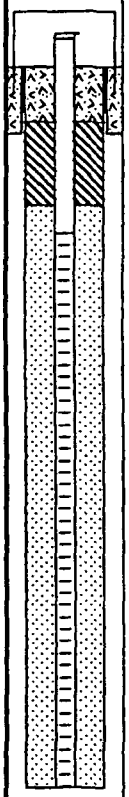
LOG

BORING NO.

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

WELL NO. 22A-MW3

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/3/98	DATE COMP: 6/3/98	SURF. EL:	WELL TD: 13.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 10.67

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		SC	Sand with minor clayey matrix and silt: pervasive diesel odor below 4 feet	76	MW3-5	430 DRO
	10	SW	Sandy gravel: dark brown, wet, pervasive diesel odor			
	20					

▼ -DEPTH TO FREE PRODUCT

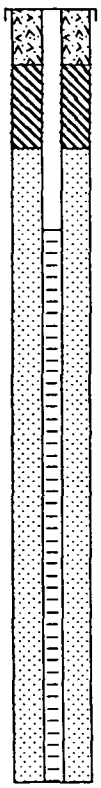
LOG

BORING NO.

WELL NO. 22A-MW4

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.	JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE
METHOD: AUGER/ODEX	
DATE START: 6/3/98	DATE COMP: 6/3/98
SURF. EL:	WELL TD: 14.0
LOGGED BY: ED ULLMER	PROD. DEPTH:
INITIAL SWD (MP): 7.18	

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level completion - drive-over cap			
		asph.	Sand with slight to moderate clay matrix: trace diesel odor			
		SC		5	MW4-5	220 DRO
	10	SW	Sandy gravel: Typical coarse alluvium, wet, no HC odor,			
	20					

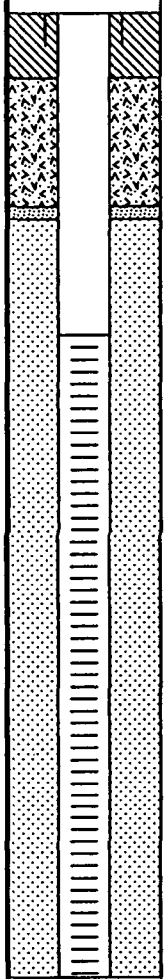
▼ =DEPTH TO FREE PRODUCT

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 22a-MW5
WELL NO. 22a-MW5

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION:
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-12-00 / DATE COMP: 4-13-00 / TIME:	TOTAL DEPTH: 15 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: 10 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	26, 15, 13, 14	Fill	0-2' Recovery 1.2', fill, olive gray (5Y4/1), mixed sand, silt and gravel, black color due to coal/cinders, dry, no odor.	60%		0.1	
	18, 22, 21, 22	Fill / SM (g)	2-4' Recovery 1.1', Fill as above, @ top 0.2', silty sand w/ gravel, 50% sand, 30% gravel, 20% fine silt, lt brown (5YR 6/4), dry, sli damp.	55%	22aMW 5-2 @1230	0.1	VOC,PAH SVOC,TPH Metals
5	5, 4, 3, 4	SM (g)	4-6' Recovery 0.4', silty sand w/ gravel, as above, damp, no odor.	20%		0.1	
	1, 3, 3, 4	CH	6-8' Recovery 1.6', fat clay, high plastic, <10% firm sand, moderate brown (5YR 3/4), damp.	80%		0.1	
	13, 30, 24, 27	CH / SP/SM (g)	8-10' Recovery 1.0', fat clay as above to ~8.5', 10% silt, 50% sand, 40% gravel @ 8.5-9'.	50%	22aMW 5-8 @1300	0.1	VOC,PAH SVOC,TPH Metals
10	27, 26, 28, 21	SP/SM (g)	10-12' Recovery 1.3', as above.	65%		0.0	
	17, 26, 28, 27	SP/SM / SP/SM (g)	12-14' Recovery 1.3', poorly graded sand w/ silt @ 12-12.5', wet, med brown (5YR/44). 12.5-13' Sand as above w/ gravel, wet, no odor.	65%		0.0	
	29, 16	SP/SM	14-15' Recovery 0.7', poorly graded sand w/ silt, wet, mod yellow brown (10YR 5/4), ~5% gravel as above, no odor.	70%		0.0	
15			TD well @ 15'				
20			Well Completion: Screen: 2" PVC, .010" slots @ 15'-5' Sand pack: 20/40 @ 15'-3' w/ 2" 70 mesh on top Bentonite seal: 3'-1' Concrete: 1'-surface w/ 4' diam concrete pad and flush mount Blank: 2" PVC @ 3'-surface				

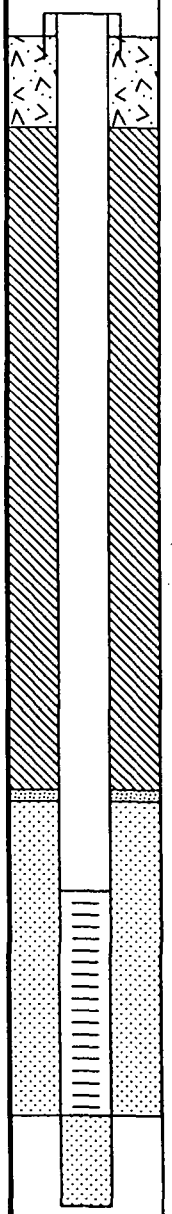
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 22a-MW6D

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-3-00 / DATE COMP: 5-3-00	TIME: / TOTAL DEPTH: 26 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 7 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	7, 8, 10, 22, 17, 15, 9, 8	Fill	0-2' Recovery 1.1', fill material, silt, cobbles, coal pieces, brick shards, black (2.5YR N2.5), no odor, dry	55%	0.0		
		ML (s)	1-2' Sandy silt w/ gravel, silt 65%, sand 25% med to fine, gravel 5-10% rounded, black (10YR 2/1), no odor, dry	25%	0.0		
		ML (s)	2-4' Recovery 0.5', sandy silt w/ gravel, as above, wood fragments and concrete pieces, fill, black (10YR 2/1), no odor, dry	85%	0.0		
5	1, 2, 2, 4, 8, 3	ML, CL, SM, SM	4-6' Recovery 1.7, 4-4.5' fill, black (2.5YR N2.5), no odor, dry, silt fill mv; 4.5-5.6' clay, med plastic, dark brown (10YR 3/3), no odor, moist; 5.5-6' silty sand, 60% sand fine to vf, 40% fines, brown (10YR 4/3), no odor, dry.	70%	0.0		
	2, 1, 1, 0	SM, CL	6-8' Recovery 1.4', 6-7' silty sand, sand 75% vf-fine, silt 25%; 7-8' silty sand, becoming siltier, 60% vf-fine sand, 40% silt, dark brown (10YR 3/3), no odor, wet @ 7'	100%	0.0		
10	1, 1, 1, 23, 24, 28, 23	CL, GM (s), GM (s)	8-10' Recovery 2', 8-8.5', same as above, moist; 8.5-9' clay, med plastic, black (10YR 2/1), no odor, moist	85%	0.0		
			10-10.5' Recovery 1.7', as above, clay as above, no odor, wet	70%	0.0		
			10.5-12' Silty gravel; gravel 45%, sand 35%, fines 25%		0.0		
			12-14' Recovery 1.4', silty gravel as above, no odor, wet				
15	38, 33, 48, 20	SP, GM (s)	14-16' Recovery 2', sand with silt, coarse to fine grained 90%, 10% fines, dark yellowish brown (10YR 4/4), no odor, wet	100%	2.0		
	19, 25, 43	GM (s)	15-16' Silty gravel with sand, gravel 55%, sand fine to coarse 35%, 10% fines, dark yellow brown (10YR 4/6), no odor, wet	70%	0.4		
			16-18' Recovery 1.4', silty gravel with sand, as above				
20	13, 25, 12, 13	GP (s)	18-20' Recovery 1', sandy gravel, poorly graded, sand 30%, gravel 60%, 10% fines, very dark gray (10YR 3/1), no odor, wet, micro-blebs of floating black petroleum	50%	2.0		
	15, 19, 11, 16	GP (s)	20-22' Recovery 1', sandy gravel, poorly graded, gravel 60%, sand medium to coarse 30%, 10% fines, dark gray (10YR 3/1), no odor, wet, micro-blebs of floating pet. on water in sampler	50%	2.0		
	1, 4, 24	SP, CL	22-24' Recovery 1.2', sand, sand 90%, silt 10%, dark brown (10YR 3/3), no odor, wet	60%	0.1	22aMW6D-22	VOC fluor scan
25	30, 6, 4, 6, 8	CL	23.5-24' Clay, high plastic, top of alpine	100%	0.0		
			24-26' Recovery 2', clay, high plastic, dark brown (10YR 3/3), no odor, moist				
30	2, 3, 4, 5		TD well @ 26' Backfill filter sand (20-40) 26-24' (2) set 5' of 10-slot screen at 24-19' (5) set filter sand from 24-17' .25 feet of 70 mesh transition sand to 16.75' 16.75-2' Bentonite hole plug cement from 2' to surface seal				

JOB NUMBER: 792904

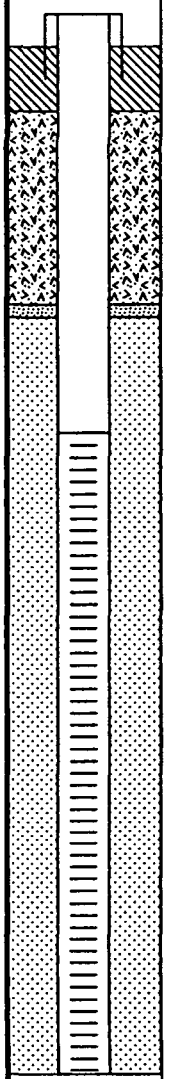
SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 22a-MW6

WELL NO. 22a-MW6

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN, UTAH		LOCATION:	
DRILLING CO.: LAYNE CHRISTENSEN		METHOD: HSA	
DATE START: 4-11-00	DATE COMP: 4-11-00	TIME:	TOTAL DEPTH: 16 FT
LOGGED BY: DAN DOWERS			DEPTH TO WATER: ~9 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	13, 18, 20	Fill	0-2' Recovery 1.0', fill, dark gray (N4), coaly material, silt and gravel mix, dry, no odor.	50%		0.1	
	31, 38, 32, 19	Fill	2-4' Recovery 0.2', slough? fill as above, no sample due to low volume of material.	0%		NA	
5	16, 2, 3, 4, 5	SM	4-6' Recovery 2.0', sand, med grained w/ 50% silty sand, dark yellow brown-med yellow brown (10YR 4/2-5/4), damp, no odor.	100%	22aMW 6-4 @900	0.1	VOC,PAH Metals
	5, 5, 5, 5	SM	6-8' Recovery 1.0', as above, damp, no odor, silty sand.	50%		0.1	
10	1, 1, 2, 2	CH	8-10' Recovery 2.0', fat clay, silty, high plastic, brown gray (5YR 4/1), damp, no odor.	100%	22aMW 6-9 @930	0.2	VOC,PAH Metals
	1, 16, 53, 54	SW/GW	10-12' Recovery 1.0', sand and gravel, dark gray, wet sand 50% med~v.coarse, subangular-subround, gravel 50%, subround, up to 2" diam.	50%		0.2	
	14, 30, 45, 50	SW/GW	12-14' Sand and gravel as above, wet, no odor, recovery 1.0'.	50%		0.1	
15	24, 24, 18, 15	SW/GW	14-16' Sand and gravel as above, wet, recovered 1.0'.	50%		0.2	
20			TD well @ 16' Well Completion: Screen: 2" PVC, @ 16'-6' .010" slots Sand pack: 20/40 sand pack @ 16'-4' 2" 70 mesh sand on 20/40 sand Blank: 2" PVC to surface +2.5' Above grade protector and 3 posts Bentonite seal @ 4'-1' Concrete & pad @ 1'-surface				

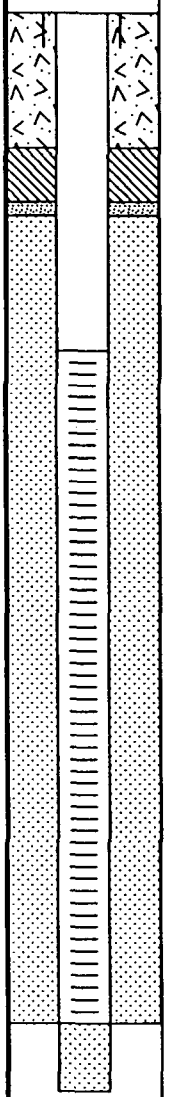
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 22B-MW1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-7-00 / DATE COMP: 5-7-00 / TIME:	TOTAL DEPTH: 16 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 7 FT



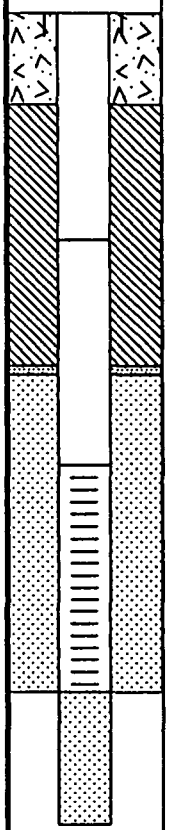
DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	12, 18	ML (s)	0-1' Recovery 1', sandy silt w/ gravel, gravel 20%, sand 35%, silt 45%, black (10YR 2/1), no odor, dry.	50%	0.0		
	22, 33	ML (g)	1-2' Sandy silt w/ gravel, gravel 35%, sand 25%, silt 40%, black (10YR 2/1), no odor, dry.		0.0		
	20, 12	ML (g)	2-4' Recovery 1.4', 2-3' sandy silt w/ gravel, as above.	70%	0.0		
	5, 6	CL	3-4' Clay, <5% vf sand, dark brown (10YR 3/3).		0.0		
	5, 9	CH	4-5' No recovery, off auger, fat clay with sand, sand 10% vfg to med, clay 90%, black (10YR 2/1), high plastic, no odor, moist.		0.0	22B-MW1 4 (11:50)	VOC,PAH Semi-Vol Metal, TPH,DRO
5	12, 10	ML (g)	5-6' Silt w/ sand, sand 20%, silt 80%, dark brown (10YR 3/3), no odor, moist,				
	6, 5, 3, 3	ML (s)	6-8' Recovery 1.8', sand silt, sand vfg to med grained 30%, silt 70%, dark grayish brown (10YR 4/2), mild pet odor, moist at 8', wet at 7', sheen on water in sampler.	90%	75.5	22B-MW1 7 (12:15)	VOC,PAH Semi-Vol Metals TPH,DRO
	2, 14	ML (s)	8-10' Recovery 1.7', sandy silt, as above, mod pet odor, wet 8-9'.	85%	145.5		
10	36, 38	GM (s)	9-10' Sandy gravel w/ silt, gravel 45%, sand 40%, silt 15%, yellowish brown (10YR 5/4), strong pet odor, wet, sheen on water in sampler.				
	22, 14, 16, 13	GM (s)	10-12' Recovery 1.8', sandy gravel w/ silt, gravel 45%, sand 30%, silt 25%, yellowish brown (10YR 5/4), mod pet odor, wet. Lower half (11-12') sand is 40% and silt is 15%.	90%	9.8		
	4, 9, 12, 17	GM (s)	*12-14' Recovery 1.2', sandy gravel, as above.* 12-13' gravel 45%, sand 45%, silt 10%. 13-14' gravel 45%, sand 30%, silt 25%, yellowish brown (10YR 5/4), slight pet odor, wet.	60%	23.5		
15	100, 80, 19, 20	GM (s)	14-16' Recovery 1.2', silty gravel w/ sand, gravel 40%, sand 25%, silt 35%, dark brown (10YR 3/3), no pet odor, wet.		3.4		
20			TD well @ 16' Well Completion: Screen: 15'-5', 10-slot Backfill w/ (20x40) filter sand: 16'-15' Filter sand (20x40): 15'-3' Transition sand: 3'-2.8' Bentonite: 2.8'-2', 1 bag (50#) Cement: 2'-0				

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 22B-MW2D

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-6-00 / DATE COMP: 5-6-00 / TIME:	TOTAL DEPTH: 18 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 10 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	15, 24, 20	ML, GM (s)	0-2' Recovery 1.8', silty gravel with sand, gravel 55%, sand med to coarse 20%, silt 25%, dark yellowish brown (10YR 4/6), slight pet. odor, dry, fill 0-6"-black silt with sand	90%	1.3		
	17, 16, 16, 16	GM (s)	2-4' Recovery 1', sandy gravel with silt, gravel 45%, sand 40%, silt 15%, dark yellowish brown (10YR 3/6), moderate odor, dry	50%	5.5		
5	14, 8, 5, 7	ML (s)	4-6' No recovery from sampler, augered up sample, sandy silt with gravel, gravel 20%, sand 10%, silt 70%, very dark gray (10YR 3/1), strong pet.			22BMW2D -5 (14:31)	VOC,PAV SEMIVOL METALS TPH,DRO
	6, 5	ML (s)	6-7' Recovery 1.6', sandy silt with gravel, strong pet. odor, dry	80%	78.8		
	6, 6, 5	SP, CL	7-8' Poorly graded sand, sand 80%, silt 20%, yellowish brown (10YR 5/4), strong pet. odor, moist	85%	80.3		
10	1, 1, 1	SP	8-10' Recovery 1.7', lean clay, clay (8.0-9.5), pet impact, minor silt stringers, very dark brown (10YR 2/2), strong pet. odor, moist	85%		22BMW2D -9	VOC
	15, 13, 16	GM (s)	9.5-10' Sand med coarse 90%, silt 10%, black (10YR 2/1), strong pet. odor, wet		28.9		
	14, 19, 13	GM (s)	10-12' Recovery 1.7', sandy gravel with silt, gravel 45%, sand med to coarse 40%, silt 15%, brown (10YR 4/3), strong pet. odor, sheen on water in sampler, wet	70%	13.7		
15	18, 22, 26	CH (s)	12-14' Recovery 1.4', sandy gravel with silt, gravel 50%, sand coarse to fine 30%, fines 20%, very dark brown (10YR 2/2), strong pet. odor, wet sheen on water in sampler	100%	2.2	22BMW2D -14 (15:08)	
	4, 3, 7, 10	CH	14-16' Recovery 2', fat clay with silt, clay fraction 85%, silt fraction 15%, weak pet. odor, moist	100%	0.9		
	4, 6, 11, 3		16-18' Recovery 2', fat clay, as above (possible alpine fm.)				
20			TD well @ 18'				
25			18-15' sand backfill screen 15-10' filler pack 15-8' bentonite from 7.8-2' 7.0 base (20x40) sand 50# 3.0 base bentonite 50# transition sand from 8-7.8'				
30							

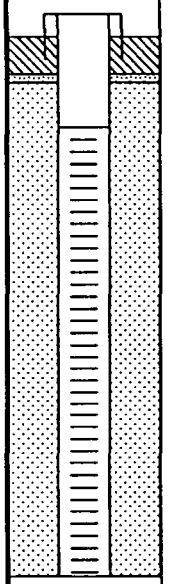
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 26-MW2

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-1-00 / DATE COMP: 5-1-00	TIME: / TOTAL DEPTH: 12 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 4 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	8 8 8 8	ML	0-2' Recovery 0.8', silt with fine sand, <1% gravel, mod sorting, very dark grayish brown (10YR 3/2), no odor, dry	40%	0.0		
	5 10 15	ML	2-4' Recovery 0.6', silt with fine sand, <1% med gravel, mod sorting, very dark brown (10YR 2/2), no odor, moist	30%	0.0		
5	11 4 3	GM	4-6' Recovery 1', gravel with silt, <10% fine sand, well sorted, very dark brown (10YR 2/2), no odor, wet	50%	0.0 5.0	26MW2-4 (12:18)	VOC,PAH Metals TPH,DRO
	13 20 11 18	GW	6-8' Recovery 1.5', gravel with sand, <10% silt, gravel up to 1.5", elongate to rounded, well sorted, no odor, dark brown (10YR 4/3), wet	75%	0.0		
	18 25	SP	8-9' Recovery 0.5', coarse sand, <10% silt, poorly sorted, subangular, very dark gray (10YR 3/1), wet	50%	0.0		
10	10 22 15 41	GW SP	9-10' Recovery 0.5', gravel with sand, <5% silt, well sorted, up to 1.5" dia., subrounded, very dark gray (10YR 3/1), no odor, wet	100%	0.0 2.0		
	11 15 41 67	GW	10-11.5' Recovery 2', sand coarse, <5% silt, poorly sorted, dark gray (10YR 4/1), no odor, wet		0.0		
			11.5-12' Recovery 6", gravel with sand, <5% silt, well sorted, 0.5-1.5" gravel, rounded, coarse sand (10YR 4/1), no odor, wet				
15			TD well @ 16'				
			Screen set at 12-2' Filter pack set from 12-1' transition sand from 1-0.8' Bentonite from 0.8' to surface				
20							
25							
30							

JOB NUMBER: 792904

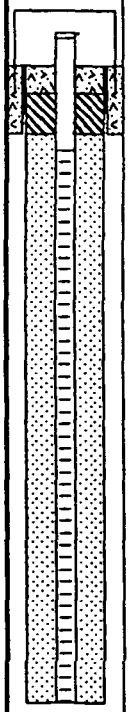
LOG

BORING NO.

WELL NO. 26-MW1

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/5/98	DATE COMP: 6/5/98	SURF. EL:	WELL TD: 11.5
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 6.83

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sandy gravel: unconsolidated, natural colors, wet below 2.5 feet, no HC odor or stain			
	10						
	20						

▼ -DEPTH TO FREE PRODUCT

USPCI

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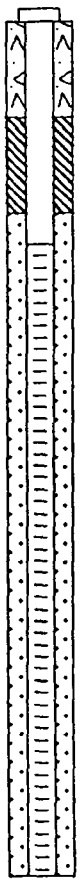
LOG

A01-26

WELL NO. STMW-1

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *HSA*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *13.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
						
		0'-3' Sandy silt, brown, moist, no odor	ML			
		3'-7' Clayey silt w/rock fragments, no odor Water @ 4'-5', sandy, silty	CL			
		No recovery	ML			
		9' Rocks, stream gravel, no odor, wet	GM			
		Total Depth 13.5'				

5 10 15 20

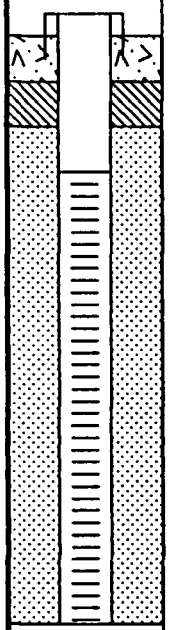
JOB NUMBER: 96437

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 27-MW1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-2-00 / DATE COMP: 5-2-00 / TIME:	TOTAL DEPTH: 14 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 5 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	3, 3, 4	ML	0-2' Recovery 1.4', sandy silt, sand 30-35%, dark yellowish brown (10YR 4/4), no odor, moist towards 2', dry in upper foot	70%	0.0		
	8, 8, 9	ML	2-4' Recovery 0.5', sandy silt as above, 30-35% sand, very fine to fine grained, <20% rounded to subangular gravel, dark yellowish brown (10YR 4/4), very slight pet. odor, moist	25%	1.0		
	14, 11, 4	ML		50%	0.0	27MW1-4 (14:15)	VOC,TPH Metals DRO Semivols
5	8, 27	GP (s)	4-6' Recovery 1', sandy silt, <30% sand, <2% gravel, dark yellowish brown (10YR 4/4), odor, moist		0.0		
	26, 27, 82	SW (g)	5-6' Gravel with sand, fine to coarse sand <30%, gravel rounded to angular, very dark brown (10YR 3/2), pet. odor, wet	50%	0.0	27MW1-6 14:23	VOC,TPH Metals DRO Semivols
	82, 40, 11	SM	6-8' Recovery 1', well graded sand with gravel, 40% gravel from large to small, rounded to subangular; sand 50%, poorly sorted, fine to coarse, 10% fines, very dark brown (10YR 3/2), slight pet. odor, wet	100%	0.0		
10	15, 17, 18	ML (s)	8-10' Recovery 2', silty sand, sand 60%, silt 35-40%, <10% fines, dark yellowish brown (10YR 4/4), slight pet. odor, wet, grades to sandy silt (ML) last 3 inches	45%	0.0		
	7, 8, 14	ML (s)	10-12' Recovery 0.9', sandy silt, sand very fine <35%, very dark gray (10YR 3/1), moderate pet. odor, wet	85%	0.0		
	15, 5	CL	12-13' Recovery 1.7', silt with sand, sand <20%, very fine sand, dark yellowish brown (10YR 3/2), odor, moist		0.0		
15	10, 11, 12		13-14' Recovery 1.7', lean clay, <15% silt, very dark gray (10YR 3/1), no odor, moist				
			TD well @ 14'				
			screen from 3-13' sand from 13-2' Bentonite to 1' concrete to surface				
20							
25							
30							

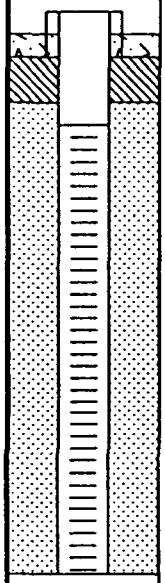
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 27-MW2

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-2-00 / DATE COMP: 5-2-00	TIME: / TOTAL DEPTH: 12 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 5 FT



WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0	3 6 11	ML (s)	0-2' Recovery 1.3', sandy silt, 35%-40%, fine sand, <2% small rounded gravel, dark yellowish brown (10YR 3/6), no odor, dry	65%	0.0		
		35 25 27 23	GM (s)	2-4' Recovery 0.8', graveley sand, 45% gravel, 35% fine to coarse sand, 20% fines, dark yellowish brown (10YR 4/6), no odor, dry	40%	0.0		
	5	21 11 15 12	GP (s)	4-6' Recovery 1.3', gravel with sand, sand <30%, gravel rounded to subangular, sand medium to coarse, fines <5%, very dark gray (10YR 3/1), strong pet. odor, wet, sheen on H_2O	65%	4.0	27MW2-4 (17:03) 27MW2-4-8 (17:50)	
		13 10 7	SP (g)	6-8' Recovery 0.7', sand with gravael, sand 60% med to coarse gravel 30% small to medium, 10% fines, very dark gray (10YR 3/1), pet. odor, wet, sheen on water in core barrel	35%	0.0		
		8 14 9 18	SP (g)	8-10' Recovery 0.9', sand with gravel as above	45%	0.0	27MW2-8-10 (17:54)	
	10	18 24 15 32	GM (s)	10-12' Recovery 1.5', silty gravel with sand, 50% gravel, 30% silt, 15% sand, fine to coarse, 5% fines, very dark gray (10YR 3/1), pet. odor, wet	75%	0.0	27MW2-10-12 (18:00)	
		15 7		TD well @ 12' Screen from 12-2' Filter sand from 12-1.5' Bentonite to 0.5'				
	15							
	20							
	25							
	30							

JOB NUMBER: 792904

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LOG

A01-27

WELL NO. OGP-1

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *HSA*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *18 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0'-2' Silty clay to clayey silt, no odor, rootlets, worms, moist River cobble in sample, 50% recovery	CL			
		2'-4' River sandy gravel to gravelly sand, coarse grained sand, no odor, no fines, moist	GW	0 ppm		
		4'-6' Poor recovery, river gravel		0 ppm	OGP-1 @ 3.5'	<100 mg/kg
	5	6'-8' Poor 50% recovery, river gravel 7' Sewer odor		5 ppm	OGP-1 @ 7'	<100 mg/kg
		8'-10' Very coarse grained sand w/pebbles, sewer odor, wet, minor fines	SP	3 ppm		
	10	10'-12' Sand w/gravel, sand fine to very coarse grained, gravel to 1"	GW			
		12'-18' No samples, river gravel becomes very large @ 16'-18'				
	15					
		Total Depth 18'				
	20					

JOB NUMBER: 96437

USPCI LOG A01-30

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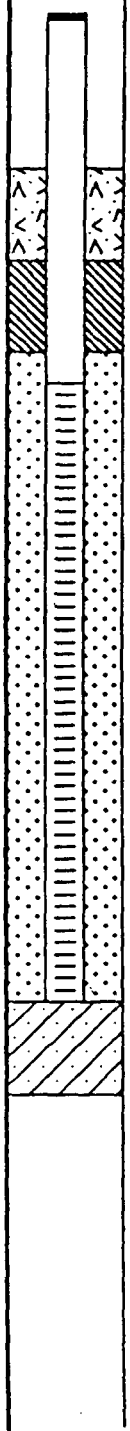
WELL NO. MW-1

CLIENT: *Union Pacific Railroad*			JOB NO.: *96120-077*
PROJECT: *Riverdale, Utah*		LOCATION: *T 8*	
DRILLED BY: *Layne*	DRILLER: *Jerry/Clint*	METHOD: *8" HSA*	
START DATE: *9-14-93*	COMP. DATE: *9-14-93*	SURF. EL.: *FT. est.*	TD: *15.0 FT. BGS*
LOGGED BY: *Ken Rose*			D. T. WATER: *8.0 FT. BGS*



WELL DIAGRAM	OPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH ppm
		Brown fine to coarse sand w/some gravel and metal debris, dry, no staining Brown, light brown fine to med. sand w/some coarse sand, trace gravel, damp, no odor Water encountered at ~8' Sample from 7' to 8.5' Brown, light brown med. to coarse sand, some fine sand and gravel, wet, no odor or sheen	GW		MW-1 8.0' 1600	
	5 10	Cobbles at 9' Brown sand and gravel w/some cobbles, wet, no odor Decreased cobbles at 12' Brown sand w/some gravel, trace cobbles, wet, no odor	GP			
	15 20	Boring completed to 15' Groundwater encountered at ~8' Monitor well installed to 13.5', 10' screen 2 bags of #10-20 silica 1 bag bentonite chips				

JOB NUMBER: 96120-077

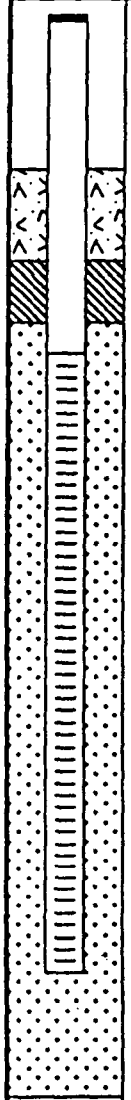
USPCI LOG

A01-30

A subsidiary of
Union Pacific Corporation

WELL NO. MW-2

CLIENT: *Union Pacific Railroad*			JOB NO.: *96120-077*
PROJECT: *Riverdale, Utah*		LOCATION: *T 8*	
DRILLED BY: *Layne*	DRILLER: *Jerry*		METHOD: *8" HSA (Mobil B-80)*
START DATE: *9-15-93*	COMP. DATE: *9-15-93*	SURF. EL.: *FT. est.*	TD: *15.0 FT. BGS*
LOGGED BY: *Ken Rose*			D. T. WATER: *7.0 FT. BGS*



WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH ppm
		Brown sand and gravel w/some metal debris, trace silt, dry, no odor or staining As above, increased sand at 2'	GW			
	5	Brownish gray (stained) gravel and cobbles w/some sand, v.moist, strong diesel odor (4.5')				
	▼	Encounter groundwater at ~7'				
		As above, wet, strong odor				
	10	Brownish gray gravel and cobbles w/trace sand, wet, slight odor (11') As above	GP			
	15	Boring completed to 15' Groundwater encountered at ~7' Monitor well installed to 13' 10' (0.020") screen 2.5 bags of #10-20 silica 1 bag of bentonite chips Above ground well				
	20					

JOB NUMBER: 96120-077

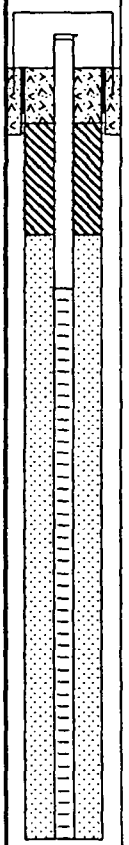
LOG

BORING NO.

WELL NO. 30-MW3

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/4/98	DATE COMP: 6/4/98	SURF. EL:	WELL TD: 14.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.8

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sand with minor gravel fraction: probable fill, no odor			
			SW	Sandy gravel and sand: unconsolidated sandy gravel and sandy alluvial sequences, pervasive black stain and product blebs below 7 feet. Gravel fraction increases with depth.	55	30-MW3-6	510 DRO
	10						
	20						

▼ -DEPTH TO FREE PRODUCT

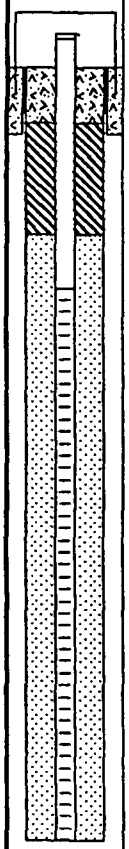
LOG

BORING NO.

WELL NO. 30-MW4

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/4/98	DATE COMP: 6/4/98	SURF. EL:	WELL TD: 14.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.14

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		SC	Sand with minor clay matrix: sand fg-mg, well sorted, homogeneous, medium brown, trace diesel odor, wet below 6 feet	11	30-MW4-6	ND DRO
	10					
		SW	Sandy gravel: unconsolidated, natural colors, wet, no HC odor			
	20					

▼ -DEPTH TO FREE PRODUCT

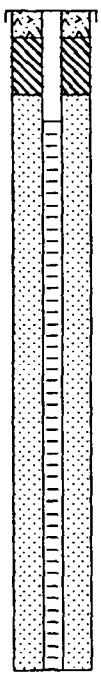
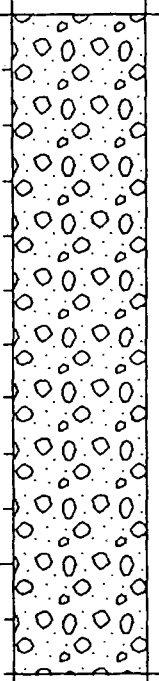
LOG

BORING NO.

WELL NO. 30-MW5

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.		JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE	METHOD: AUGER/ODEX
DATE START: 6/5/98	DATE COMP: 6/5/98	SURF. EL:	WELL TD: 12.0
LOGGED BY: ED ULLMER	PROD. DEPTH:	INITIAL SWD (MP): 7.95

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
	10		SW	Sandy gravel: unconsolidated, pervasive staining and coatings of old petroleum product below 5 feet	89		
	20						

▼ -DEPTH TO FREE PRODUCT

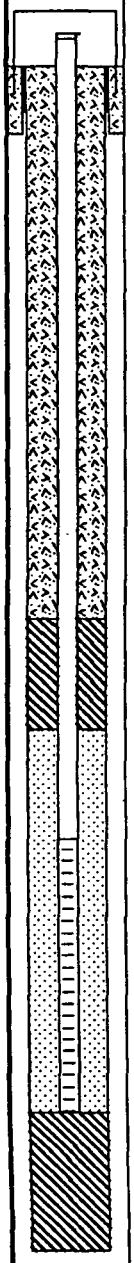
LOG

BORING NO. MW-30

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

WELL NO. 30-MW6D

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/5/98	DATE COMP: 6/5/98	SURF. EL:	WELL TD: 19.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 8.05

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		SW	Sandy gravel: unconsolidated, pervasive HC stain below 1-2 feet, moderate diesel odor			
		SP	Sand with minor gravel fraction: pervasive HC staining and product film, moist to wet with depth	56	MW6D-5	1500 DRO
				62		
	10	SW	▽ Sandy gravel: Pervasive product staining diminishing with depth, wet,			
			12 ft: sandy gravel - lower limit of staining or odor, none below 12 feet	0		
		SP	Sand: cg-vcg, no stain or odor, wet	2	MW6D-17	ND DRO
	20	CL	Clay: sharp upper contact, moderately stiff with good plasticity, minor vfg sand and silt content, moist, massive, gray-brown	0		
				0		

▼ =DEPTH TO FREE PRODUCT

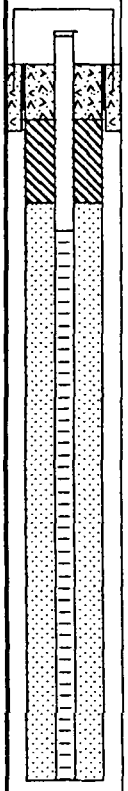
LOG

BORING NO.

WELL NO. 30-MW6

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/5/98	DATE COMP: 6/5/98	SURF. EL:	WELL TD: 13.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 8.81

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sandy gravel: unconsolidated, pervasive HC stain below 2 feet, This well adjacent to 30-MW6D – see MW6D log for further details			
	10						
	20						

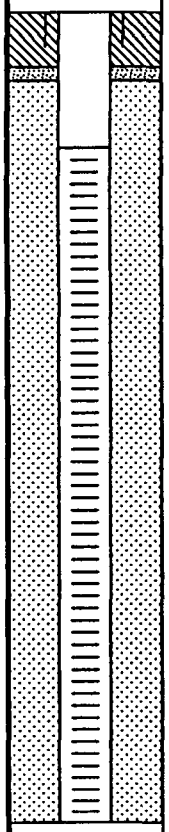
▼ =DEPTH TO FREE PRODUCT

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 30-MW7

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-7-00 / DATE COMP: 5-7-00 / TIME:	TOTAL DEPTH: 12 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 4 FT



WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0	3, 5, 2, 2	ML (g)	0-2' Recovery 1', gravely silt w/ sand, gravel 40%, sand vfg 20%, silt 40%, brown (10YR 4/3), no odor, moist.	50%	0.0		
		1, 1, 1, 2	ML (g)	2-4' Recovery 0.5', silt w/ gravel, gravel 30%, silt 60%, 10% vfg sand, brown (10YR 4/3), no odor, wet.	25%	0.0		
	▼	11, 30	ML (g)	4-6' Recovery 1.3', 4-5' silt w/ gravel, as above.	65%	0.0	30-MW7 4 (14:35)	
	5	49, 22		5-6' Sandy gravel w/ silt, gravel 50%, sand 30%, silt 20%, dark grayish brown (10YR 4/2), no odor, wet.		0.0		
		13, 13, 14, 20	GM (s)	6-8' Recovery 1', well graded gravel w/ sand, gravel 60%, sand fine to v.coarse 30%, silt 10%, brown (10YR 5/3), no odor, wet.	50%	0.2		
		15, 15, 20, 27	GM (s)	8-10' Recovery 0.8', well graded gravel w/ sand, as above, no odor, wet.	40%	0.2		
	10	29, 73, 65	GM (s)	10-12' Recovery 1.4', well graded gravel w/ sand, gravel 75%, sand fine to v.coarse 20%-5: fine, brown (10YR 5/3), no odor, wet.	70%	0.0		
				TD well @ 12' Well Completion: Screen: 12'-2', 10-slot Filter sand (20x40) silica sand: 12'-1' 0.2' of transition sand from 1' to 0.8' Bentonite hole plug: 0.8' to 0				
	15							
	20							

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 32-MW1

WELL NO. 32-MW1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION:
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-14-00 / DATE COMP: 4-14-00	TIME: / TOTAL DEPTH: 14 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: 7 FT

WELL COMP	DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
	0	30, 43, 26	Fill	0-2' Recovery 1.2', fill, mixed coal frags, silt and ~10% gravel, dark yellow brown (10YR 4/2), no odor.	60%		NA OVM NOT WORKING	
		30, 20, 14, 13, 18	ML (g)	2-4' Recovery 0.5', sandy silt w/ 15% gravel, dark yellow brown (10YR 4/2), no odor, damp.	25%	32MW1 -2 @915		VOC,PAH Metals 2-4'
	5	9, 13, 6, 6		4-6' No recovery.	0%			
		0, 0, 21, 15, 13	SM (g)	6-8' Recovery 0.6', 6-7.5' 55% sand, 40% silt, 5% gravel, silty sand, v.dark brown water @ 7' (moist), 7.5-8' 60% sand, 25% silt, 15% gravel, gray brown, no odor.	30%	32MW1 -6 @945		VOC,PAH Metals 6-8'
		19, 28, 33, 47	SM/GM	8-10' Recovery 1.2', 45% sand, 40% gravel, 15% silt, dark yellow brown (10YR 4/2), silty sand w/ gravel, no odor.	60%			
	10	37, 35, 56, 80	SM/GM	10-12' Recovery 1.2', as above.	60%			
		57, 44, 34, 15	SM	12-14' Recovery 1.2', 80% sand, 15% silt, 5% gravel, silty sand, no odor.	60%			
	15			TD well @ 14' Well Completion: Screen: 2" PVC, 0.10" slots @ 14'-4' Sand pack: 14'-2' 20/40 sand w/ 2" 70 mesh on top Blank: 2" PVC @ 4' to surface Bentonite seal: @ 2'-1' Concrete @ 1'-surface and 4' diam pad (round) Flush mount completion				
	20							

JOB NUMBER: 792904

WELL LOG

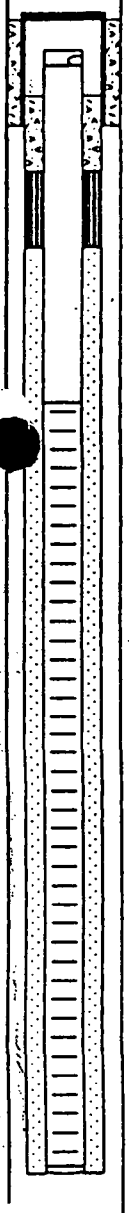
A01-32

USPCI

Remedial Services

BORING NO. RIV-MW-14

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 96120
PROJECT: RIVERDALE YARD		LOCATION: RIVERDALE UT.	
DRILLED BY: P. C. EXPLOR.	DRILLER: TRENT JENSEN		METHOD: HOLLOW-STEM AUGER
DATE START: 11/2/90	DATE COMP: 11/2/90	SURF. EL: 4323.19 MSL	TD: 15.0' BGS
LOGGED BY: SCOTT SCHULEIN	APPROVED BY:		DEPTH TO WATER: 8.84

WELL COMP	DEPTH (ft)	DESCRIPTION	GRAPHIC LOG USCS CODE	OVM	SAMPLE NUMBER	TPH ppm
	0	0.0 to 3.0 FILL, ROAD BASE GRAVELS.	AF	2		
		3.0 TO 5.0 CLAY, GRAY.	ML			
	5	5.0 TO 6.0 SAND, FINE GRAINED, BROWN.	SW	ND	MW-14A	<10
		6.0 TO 15.0 SANDY GRAVELS SOME CLAY, GRAY, WET. WATER LEVEL 11/6/90	GW	15	MW-14B	42
	10					
	15	THE COMPLETED DEPTH OF THIS WELL IS 15.0 FEET.				

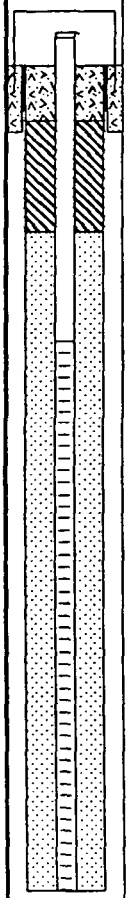
LOG

BORING NO.

WELL NO. 34-MW1

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/1/98	DATE COMP: 6/1/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.72

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sandy gravel: Entire boring is unconsolidated sandy gravel and sandy alluvial sequences, no odor or staining, natural colors, wet at 7-8 feet	0		
	10			▽			
	20						

▼ =DEPTH TO FREE PRODUCT

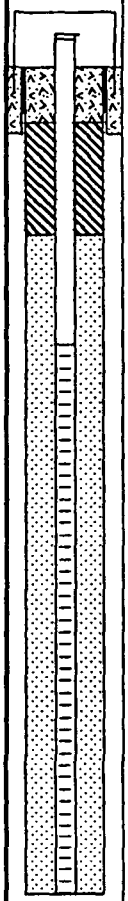
LOG

BORING NO.

WELL NO. 34-MW2

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/1/98	DATE COMP: 6/1/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 12.84

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		SW	Sandy gravel: Entire boring is unconsolidated sandy gravel and sandy alluvial sequences, no odor or staining, natural colors, wet below 8 feet.	0		
	10	ML	Sandy and silty clay: medium brown, wet, no odor			
	20					

▼ -DEPTH TO FREE PRODUCT

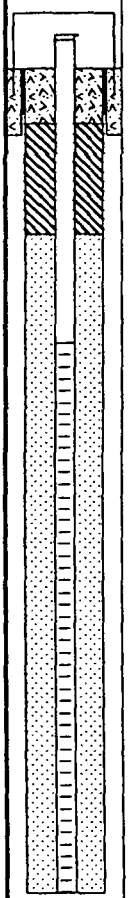
LOG

BORING NO.

WELL NO. 34-MW3

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/1/98	DATE COMP: 6/1/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.4

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sandy gravel: Entire boring is sand and sandy gravel - most of sandy gravel is washed fill installed along nearby sanitoary sewer, no HC odor or staining, all natural colors, wet below 7-8 feet.	0		
	10						
	20						

▼ -DEPTH TO FREE PRODUCT

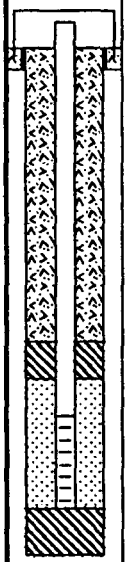
LOG

BORING NO.

WELL NO. 34-MW3D

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.		JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE	METHOD: AUGER/ODEX
DATE START: 6/1/98	DATE COMP: 6/1/98	SURF. EL:	TD: 25.0
LOGGED BY: ED ULLMER	APPROVED BY:	DEPTH TO WATER:

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
	10	SW	Sandy gravel: Alluvium – unconsolidated sand with gravel fractions ranging to pebbles and fine cobbles, becomes wet at 8 feet, no sample spoons above 10 feet. Cuttings have no odor or staining, natural colors, composition is mostly silica-base lithic clasts to quartzose grains, clay and silt fractions minor or none throughout sandy gravel sequences. Numerous gradational sequences. Alluvium typical of sequence previously drilled in railyard	0		
			10-11.5: sandy gravel grading down to mg-vcg sand, wet, no odor	0		
			15-18.5: coarse gravel fraction grades down to fine gravel fraction, pebbles subround to angular.	0		
	20			0		
		CL	Clayey sand grading down to silty clay: gradational from sandy gravel above. Clay medium brown, soft, wet, no odor	0	MW3D-24	NO EXC VOCS
		SP	Sand: well sorted gradational sequence ranging from vfg to cg, wet, no odor	0		
		CL	Clay: Sharply gradational from sandy unit above, medium-dark brown, moderate to good plasticity, moist but not wet, massive	0		
	30					
	40					
	50					
	60					
	70					

▼ =DEPTH TO FREE PRODUCT

LOG

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

BORING NO.

WELL NO. 34-MW4

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/1/98	DATE COMP: 6/1/98	SURF. EL:	WELL TD: 16.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 9.99

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Grade level well completion – drive-over cap			
			asph	Asphalt pavement			
			SW	Sand: Scattered gravel fractions, sand well sorted, fg-cg, becomes wet at 8 feet, no odor or stain	0		
	10						
			SP	Sandy gravel: Typical coarse alluvial deposit, natural colors, no odor or staining,			
			CL	Sandy clay: medium brown, wet, loose, no odor, sand vfg-fg			
	20						

▼ -DEPTH TO FREE PRODUCT

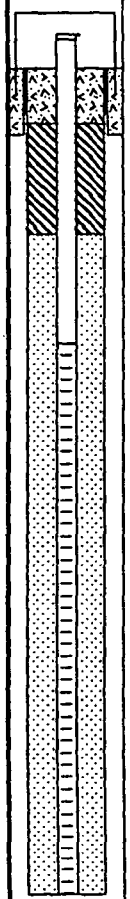
LOG

BORING NO.

WELL NO. 34-MW5

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.76

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		SW	Sandy gravel and sand: Typical sandy alluvial sequences, no odor or staining, natural colors, wet at 7.5 feet	0		
	10		7-7.5 ft: Sandy gravel,natural colors, wet, no odor			
	20					

▼ -DEPTH TO FREE PRODUCT

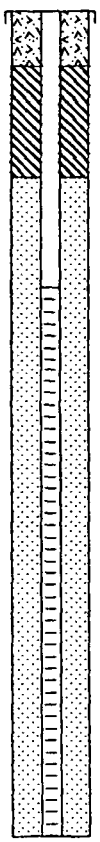
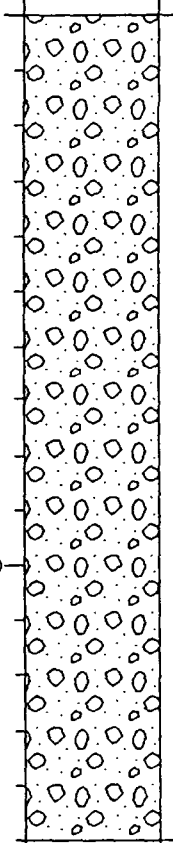
LOG

BORING NO.

WELL NO. 34-MW6

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 9.08

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Grade level well completion – drive-over cap			
			SW	Sandy gravel and sand: Typical coarse alluvial deposit, no odor or staining, natural colors, wet below 8 feet			
				6–7.5 ft: fg–mg sand, well sorted, moist, no odor or staining	0	34-MW6-6	ND DRO
	10						
	20						

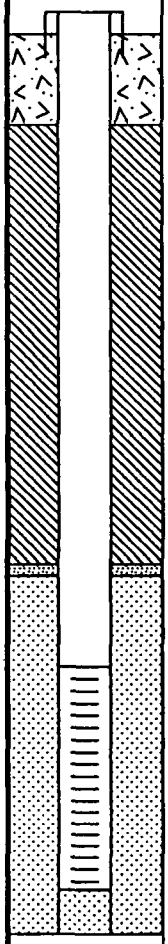
▼ -DEPTH TO FREE PRODUCT

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 34-MW7D

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI		LOCATION: OGDEN, UTAH	
DRILLING CO.: LAYNE CHRISTENSEN		METHOD: HSA, MOBILE B-61	
DATE START: 5-3-00	DATE COMP: 5-3-00	TIME:	TOTAL DEPTH: 20 FT
LOGGED BY: PHILIP CAVENDOR			DEPTH TO WATER: 10 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	3 4 5	ML (s)	0-2' Recovery 0.8', silt with sand, silt 75%, very fine sand 25%, dark brown (10YR 3/3), no odor, dry	40%	0.0		
	5 5 4 8	SP	2-4' Recovery 1.6', sand, 90% med to fine, yellowish brown (10YR 5/8), no odor, dry, 10% fines	80%	0.0		
	10 4	ML (s)	4-5' Recovery 1.5', silt with sand, silt 80%, very fine sand 20%, dark brown (10YR 3/3)	75%	0.0		
5	4 4	SP	5-6' Sand, well sorted, med to vf sand 95%, 5% fines, yellowish brown (10YR 5/8), no odor, dry	75%			
	8	ML (s)					
	9 21	GP (s)	6-6.5' Recovery 1.5', silt with sand, silt 75%, vf sand 25%, dark yellowish brown (10YR 3/6), no odor, dry				
	42 30 48	SP (g)	6.5-8' Sandy gravel, gravel 50%, sand med to fine 40%, 10% fines, yellowish brown (10YR 5/4), no odor, dry	25%	0.0		
10	32 19 12 15	SP (g)	8-10' Recovery 0.5', sand with gravel (gravely sand), sand 60% gravel 30%, 10% fines, dark yellowish brown (10YR 3/4), no odor, moist	35%	0.0		
	25 25 25 22	GM (s)	10-12' Recovery 0.7', sand with gravel, sand 50% med to coarse gravel 40%, 10% fines, dark yellowish brown (10YR 4/4), no odor, wet	50%	0.0		
15	40 33 30	GM (s)	12-14' Recovery 1', gravel with silt, poorly sorted, 50% gravel, 30% sand, 20% silt and fines, yellowish brown (10YR 5/4), hint of pet. odor, wet	40%	0.0		
	13 13		14-16' Recovery 0.8', as above, silty gravel with sand, no odor, wet	50%	0.0		
	30 30	GM (s)	16-18' Recovery 1', as above, silty gravel with sand, no odor, wet				
	2 13 21 27	SP CH	18-20' Recovery 2', 18-18.25' poorly graded sand, 65% coarse, 25% fine grained, 10% fines, dark brown (10YR 3/3); 18.25-20' fat clay, high plastic, dark brown (10YR 3/3), no odor, moist	100%	0.0	34MW7D-18 (10:45)	VOC
20	2 3 4 5		TD well @ 20'				
25							
30							

Filter sand from 20-12'
Screen 19-14'
Transition sand 12-11.75'
Bentonite 11.75-2'
Backfilled boring with filter sand from 20-19'

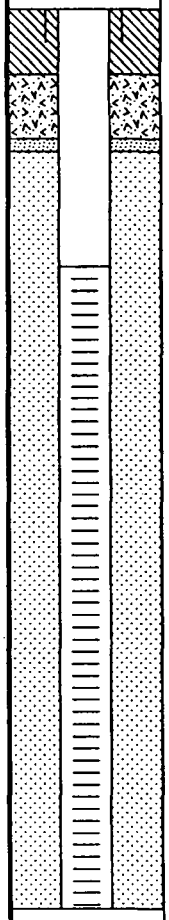
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 34-MW8
WELL NO. 34-MW8

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION:
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-12-00 / DATE COMP: 4-13-00	TIME: / TOTAL DEPTH: 14 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: 7 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	13, 7, 9, 20	Fill	0-2' Recovery 0.5', fill, brown black (5YR 2/1), mixed silt, sand and gravel.	25%		0.0	
	34, 70, 46, 20	SM (g)	2-4' Recovery 1.3', 55% poorly graded sand w/ 30% gravel, <15% fines (silty), gravel max 2" diam (broken), subangular-subround, no stain or odor, dry-damp.	65%	34MW8 -2 @910	0.0	SVOC,PAH Metals TPH
5	20, 27, 40, 41	SM (g)	4-6' Recovery 0.7', silty sand w/ gravel as above, mod yellow brown (10YR 5/4), no odor, damp.	35%	34MW8 -4 @930 @4-7'	0.0	SVOC,PAH Metals TPH
▼	40, 25, 23, 25	SM/GM	6-8' Recovery 0.7', as above w/ ~40% gravel, 40% sand, 20% silt, becomes wet @ 7', no odor.	35%		0.0	
	30, 37, 34, 37	SW/SM (g)	8-10' Recovery 0.8', well graded sand w/ silt and gravel, 75% sand, 15% gravel, 10% silt, dark yellow orange (10YR 6/6), no odor, wet.	40%		0.0	
10	26, 36, 27, 23	SP	10-12' Recovery 0.5', poorly graded sand w/ silt (~10%), wet, no odor, lt olive gray (5Y 6/1).	25%		0.0	
	5, 11, 21, 20	SW/SM (g)	12-14' Recovery 1.0', well graded sand w/ silt and gravel, 60% sand, 30% gravel, 10% silt, wet, no odor, lt olive gray (5Y 6/1).	50%		0.0	
15, 20			TD well @ 14' Well Completion: Screen: 2" PVC, .010" slots, 14'-4' Sand pack: 20/40 @ 14'-2' w/ 2" 70 mesh on top Bentonite seal: 2'-1' Concrete: 1'-surface, 4' round diam, concrete pad Blank: 2" PVC @ 4'-surface				

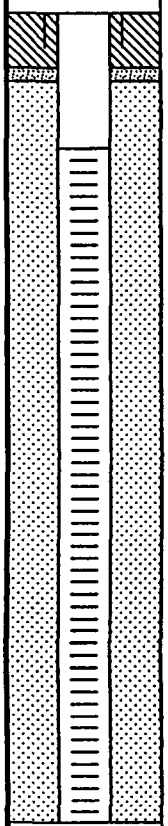
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 34-MW9

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-8-00 / DATE COMP: 5-8-00 / TIME:	TOTAL DEPTH: 12 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 5 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	5, 20, 54, 46	GM (s)	0-2' Recovery 1.2', silty gravel w/ sand, gravel small to med, rounded to subangular 45%, sand fine to coarse grained 25%, silt 30%, brown (10YR 4/3), no odor, dry.	60%	0.0		
	6, 20, 38, 36	GM (s)	2-4' Recovery 0.8', sandy gravel w/ silt, gravel 45%, sand med to coarse 40%, silt 15%, yellowish brown (10YR 5/4), no odor, dry.	40%	0.0		
5	11, 22, 34, 40	GM (s)	4-6' Recovery 1.3', sandy gravel w/ silt, as above, no odor, wet @ 5'.	65%	3.8	34-MW9 4 (13:15) 34-MW9 5 (13:30)	
	27, 23, 21, 31	SM	6-8' Recovery 0.5', silty sand, sand v.fine to med grained 70%, silt 30%, black (10YR 2/1), slight pet odor, wet. Sheen on water in sampler. 7-8' sand is coarse to v.coarse.	25%	3.5		
	27, 36	SM	8-9' Recovery 1.2', silty sand as above, black (10YR 2/1), mile pet odor, wet. Sheen on water in sampler.	60%	5.9		
	47, 51	GM (s)	9-10' Silty gravel w/ sand, gravel 45%, sand coarse 25%, silt 30%, mild pet odor, and sheen on water in sampler.				
10	9, 44, 48, 48	GM (s)	10-12' Recovery 0.5', sandy gravel w/ silt, gravel 45%, sand med coarse 35%, silt 20%, black (10YR 2/1), slighrt pet odor, wet. Sheen on water in sampler.	25%	1.7		
15			TD well @ 12' Well Completion: Screen: 12'-2' Backfill w/ (20x40) filter sand: 12'-1' 0.2' of transition sand from 1' to 0.8' Bentonite hole plug: 0.8' to 0				
20							

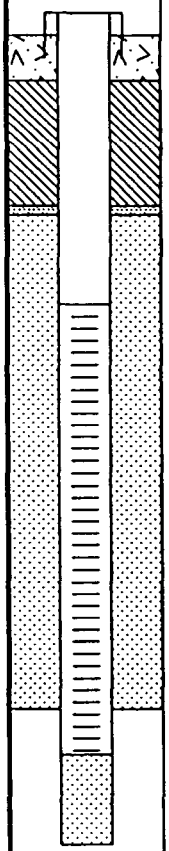
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

WELL NO. 35-MW1

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA, MOBILE B-61
DATE START: 5-2-00 / DATE COMP: 5-2-00 / TIME:	TOTAL DEPTH: 18 FT
LOGGED BY: PHILIP CAVENDOR	DEPTH TO WATER: 11 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	15, 19	SM	0-1' Fill material (silt and gravel), very dark brown (10YR 2/2), no odor, dry	55%	0.0		
	7, 11	SM	1-2' Recovery 1.2', silty sand with 30% fines, med grading, very dark gray brown (10YR 3/2), no odor, dry	75%	0.0 1.0		
	6, 6, 7	ML	2-4' Recovery 1.5', sandy silt, well sorted, ver fine sand <15%, dark brown (10YR 3/3), slight pet. odor, moist			35MW1-4 (10:50)	VOC Metals PAH TPH,DRO
5	14, 3, 2	ML	4-6' Recovery 0.5', sandy silt, very fine sand, 10% fines, <1% gravel pieces, very dark brown (10YR 2/2), no odor, dry	25%	0.0		
	2, 2, 3, 4	SP	6-8' Recovery 1', sand, silt <10%, poorly graded, dark yellowish brown (10YR 4/4), dry, no odor	80%	0.0		
	6, 8, 5	SP	8-9.5' Recovery 1.5', SP as above, dark yellow brown (10YR 4/4),	100%	0.0	35MW1-9 (1:10)	VOC
10	4	CL	9.5-10' Recovery 0.5', clay, with silt 15-20%, wet, no odor		0.0		
	2, 1, 1	SM	10-12' Recovery 1.4', silty sand (60% sand, 40% silt), mod sorting, dark yellowish brown, (10YR 3/4), no odor, wet @ 11'	70%	0.0		
	1, 2, 2, 8	GM	12-14' Recovery 1', silty gravel with sand, <15% sand fine to coarse, poorly sorted, dark yellowish brown (10YR 4/4),	50%	0.0		
15	12, 12	SM	14-15' Recovery 1.7', silty sand, silt 15-20%, dark brown (10YR 3/3), no odor, wet, blebs	85%	0.0		
	12	CL	15-16' Recovery as above, clay with <15% silt, dark grayish brown (10YR 4/2) as above, moist, high plastic	100%	0.0 0.0		
		CL	16'-18' As above, moist, high plastic		0.0		
20			TD well @ 16' Backfill with 20-40 sand from 16-18' Screen from 16-6' Filter sand to 4' Bentonite from 3.8 to 1' below surface 2" of 7030 sand				
25							
30							

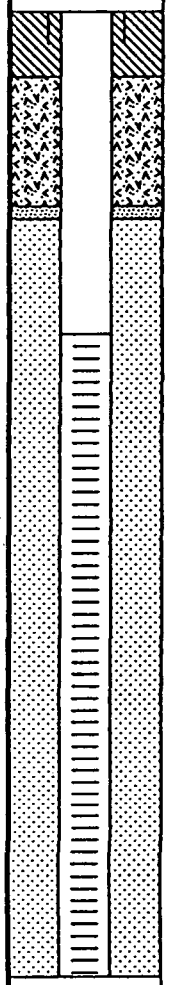
JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 35-MW2
WELL NO. 35-MW2

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN, UTAH		LOCATION:	
DRILLING CO.: LAYNE CHRISTENSEN		METHOD: HSA	
DATE START: 4-13-00	DATE COMP: 4-13-00	TIME: START 800 AM	TOTAL DEPTH: 15 FT
LOGGED BY: DAN DOWERS			DEPTH TO WATER: 10 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	34, 35, 31	Fill	0-2' Recovery 1.5', fill-silt-gravel, v.pale orange-yellow brown (10YR 8/2-6/2), dry, no odor.	75%		0.0	
	18, 10, 7	SM (g), ML	2-4' Recovery 1.2', .6' of silty sand w/ gravel, gravel 25%, sand 65%, .6' of sandy silt, mod yellow brown (10YR 5/4), dry, no odor.	60%	35MW2 -2 @915	0.0	VOC,PAH Metals 2-4'
	8, 12						
5	9, 15, 12	SP/SM (g)	4-6' Recovery 1.2', 4-5' poorly graded med grained sand, ~5% silt, 5-6' silty sand w/ gravel, 20% silt, 15% gravel, 65% sand, dark yellow orange (10YR 6/6), damp @ base.	60%		0.0	
	21, 20, 35	SM (g), GP/GM (s)	6-8' Recovery 1.3', 6-7' 35% gravel, sand as above, 7-8' 10% silt, 40% sand, 50% gravel, damp, no odor.	65%		0.0	
	37, 46, 40	GP/GM (s)	8-10' Recovery 0.5', as above with increasing gravel, poorly graded gravel with sand and silt, damp, no odor.	25%		0.0	
	80, 100, 110						
10	20, 31, 36	GM (s)	10-12' Recovery 0.9', gravel as above, max size +2", dark yellow brown (10YR 4/2), increasing silt to 15%, 40% sand, 45% gravel, wet, no odor.	45%	35MW2 -10 @1030	0.0	VOC,PAH Metals 10-11'
	22, 17, 17	SM (g)	12-14' Recovery 0.7', silty sand w/ gravel, sand 55%, silt 15%, gravel 30%, dark yellow brown (10YR 4/2), wet, no odor.	35%		0.0	
	7, 2, 20	GM/SM	14-15' Recovery 0.7', silty gravel with sand, 20% silt, 40% sand, 40% gravel, dark yellow brown (10YR 4/2), wet, no odor, very slight HC sheen on water in tube.	70%		0.0	
15	22						
20							

TD well @ 15'

Well Completion:
- Screen: 2" PVC, .010" slots @ 15'-5'
- Sand pack: 20/40 sand @ 15'-3' +2" 70 mesh
- Bentonite seal: 3'-1'
- Concrete: 1'-surface w/ 4' round pad flush mount @ surface
- Blank: 2" PVC @ 5' to surface

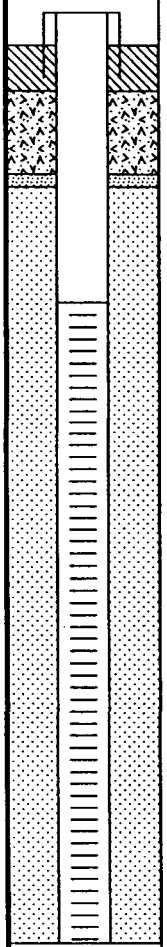
SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. 38-MW12

WELL NO. 38-MW12

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN, UTAH	LOCATION:
DRILLING CO.: LAYNE CHRISTENSEN	METHOD: HSA
DATE START: 4-12-00 / DATE COMP: 4-12-00 / TIME:	TOTAL DEPTH: 14 FT
LOGGED BY: DAN DOWERS	DEPTH TO WATER: 7 FT



DEPTH	BLOWS	GRAPHIC LOG USCS CODE	DESCRIPTION	% RECVRY	SAMPLE NO.	OVM (ppm)	SAMPLE ANAL.
0	9, 9, 11, 16	Fill	0-2' Recovery 1.4', fill, gravel @ top grading to silt @ base, dry, no odor.	70%		0.0	
	11, 12, 13, 16	ML	2-4' Recovery total 1.3', (slough @ top) 0.6' of recovery, silt w/ sand, pale brown (5YR 5/2), damp.	65%	38MW 12-2 @1545	0.1	VOC,PAH SVOC,TPH Metals
5	9, 15, 12, 9	SM	4-6' Recovery 1.5', silty sand, 30% silt, 5% gravel, 65% fine-med sand, dry-slightly damp.	75%		0.0	
▼	38, 50, 38, 50	SP/GP	6-8' Recovery 1.2', sand and gravel ~45% ea w/ 10% fines, w/ hydrocarbon sheen and saturation, HC is brown, w/ med-strong HC odor, water wet @ ~7', lt brown (5YR 6/1).	60%	38MW 12-6 @1400	0.4	VOC,PAH SVOC,TPH Metals
	16, 30, 38, 42	SP/GP	8-10' Recovery 1.0', as above w/ sheen and HC saturation.	50%		3.7	
10	17, 16, 16, 11	SP/SM (g)	10-12' Recovery 1.4', poorly graded sand w/ silt and gravel, 60% sand, 30% gravel, 10% silt, brown gray (5YR 4/1), sheen of HC on core brown, mod HC odor.	70%		2.4	
	6, 20, 30, 31	SP/SM (g)	12-14' Recovery 1.4, as above, sheen is probable contam from above, brownish gray (5YR 4/1).	70%		0.3	
15			TD well @ 14' Well Completion: Screen: 2" PVC, .010 slots @ 14'-4' Sand pack: 20/40 sand @ 14'-2' w/ 2" 70 mesh on top Bentonite seal: 2'-0.7' Concrete: @ 0.7' to surface, 4x4' concrete pad w/ protective casing and 3 posts PVC Blank: 4' to surface +2.5'				
20							

JOB NUMBER: 792904

A01-36

LOG OF TEST BORING NO. MW-1

PROJECT Ogden City Corp./Phase II E.A.
Ogden, Utah

JOB NO. E92-2119 DATE 04-09-92

RIG TYPE CME-75
BORING TYPE 4 1/4" I.D. Hollow Stem Auger
SURFACE ELEV.
DATUM

Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	HNU reading	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								SM	moist medium dense	SILTY SAND with some fine gravel at surface to 6"; fine sand, nonplastic, brown
5				C	19		0			
								SP	saturated loose	GRAVELLY SAND with trace silt; fine to coarse sand, subround, brown
10										
15										Stopped drilling at 13' Set 2" Schedule 40 PVC 0.020" slotted PVC pipe from 13' to 3' Set 2" Schedule 40 blank PVC pipe from 3' to surface 10-20 sand, 13' to 2' No. 8 Enviroplug bentonite 2' to 1' Sakrete 1' to surface
20										
25										

GROUNDWATER

DEPTH	HOUR	DATE
5.0		4-9-92

SAMPLE TYPE

A - Auger cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California split spoon sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS
PHOENIX - ALBUQUERQUE - SANTA FE
SALT LAKE CITY - EL PASO - TUCSON - RENO/SPARKS

A01-36

PROJECT Ogden City Corp./Phase II E.A.
Ogden, Utah

LOG OF TEST BORING NO. MW-2

JOB NO. E92-2119 DATE 04-09-92

RIG TYPE CME-75
BORING TYPE 4 1/4" I.D. Hollow Stem Auger
SURFACE ELEV.
DATUM

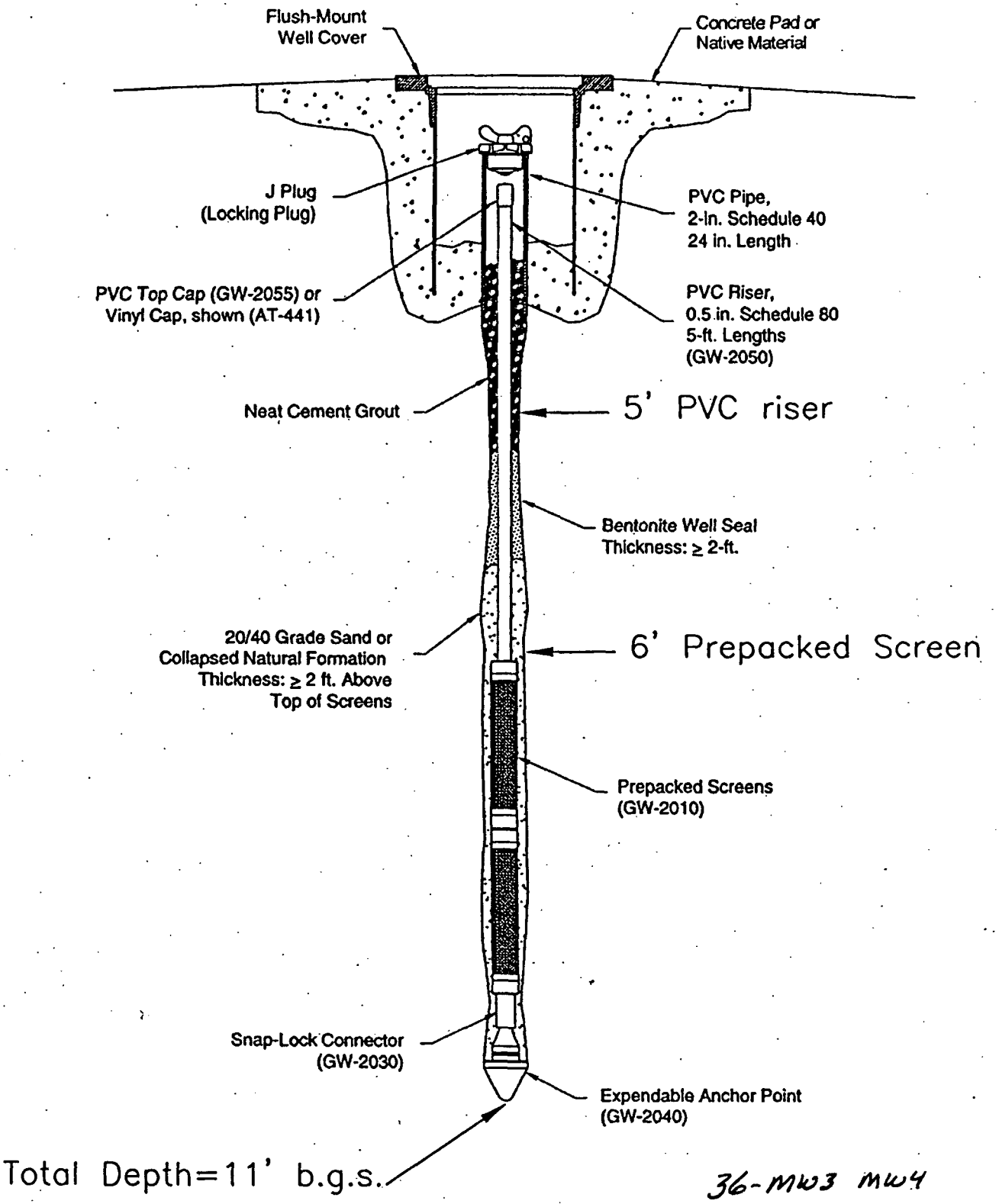
Depth in Feet	Continuous Penetration Resistance	Graphical Log	Sample	Sample Type	Blows/foot 140 lb. 30" free-fall drop hammer	Dry Density lbs. per cubic foot	HNU reading	Unified Soil Classification	REMARKS	VISUAL CLASSIFICATION
0								SM	moist medium dense	SILTY SAND with some fine gravel at surface to 6"; fine sand, nonplastic, coal dust at surface to approximately 3", brown
							0			
5				C	4					
								SP	moist loose	GRAVELLY SAND with trace silt; fine to coarse sand, brown
▽									saturated	
10							0			
15							0			
										Stopped drilling at 15'
										Set 2" Schedule 40 PVC 0.020" slotted PVC pipe from 15' to 5'
										Set 2" Schedule 40 blank PVC pipe from 5' to surface
20										10-20 sand, 15' to 4'
										No. 8 Enviroplug bentonite 4' to 2'
										Sakrete 2' to surface
25										

GROUNDWATER

	DEPTH	HOUR	DATE
▽	8.0		4-9-92
▼			

SAMPLE TYPE
A - Auger cuttings.
S - 2" O.D. 1.38" I.D. tube sample.
U - 3" O.D. 2.42" I.D. tube sample.
T - 3" O.D. thin-walled Shelby tube.
D - 3 1/4" O.D. 2.42" I.D. tube sample.
C - California split spoon sample

SERGENT, HAUSKINS & BECKWITH
CONSULTING GEOTECHNICAL ENGINEERS
PHOENIX - ALBUQUERQUE - SANTA FE
SALT LAKE CITY - EL PASO - TUCSON - RENO



36-MW3 MW4
MW5 MW7

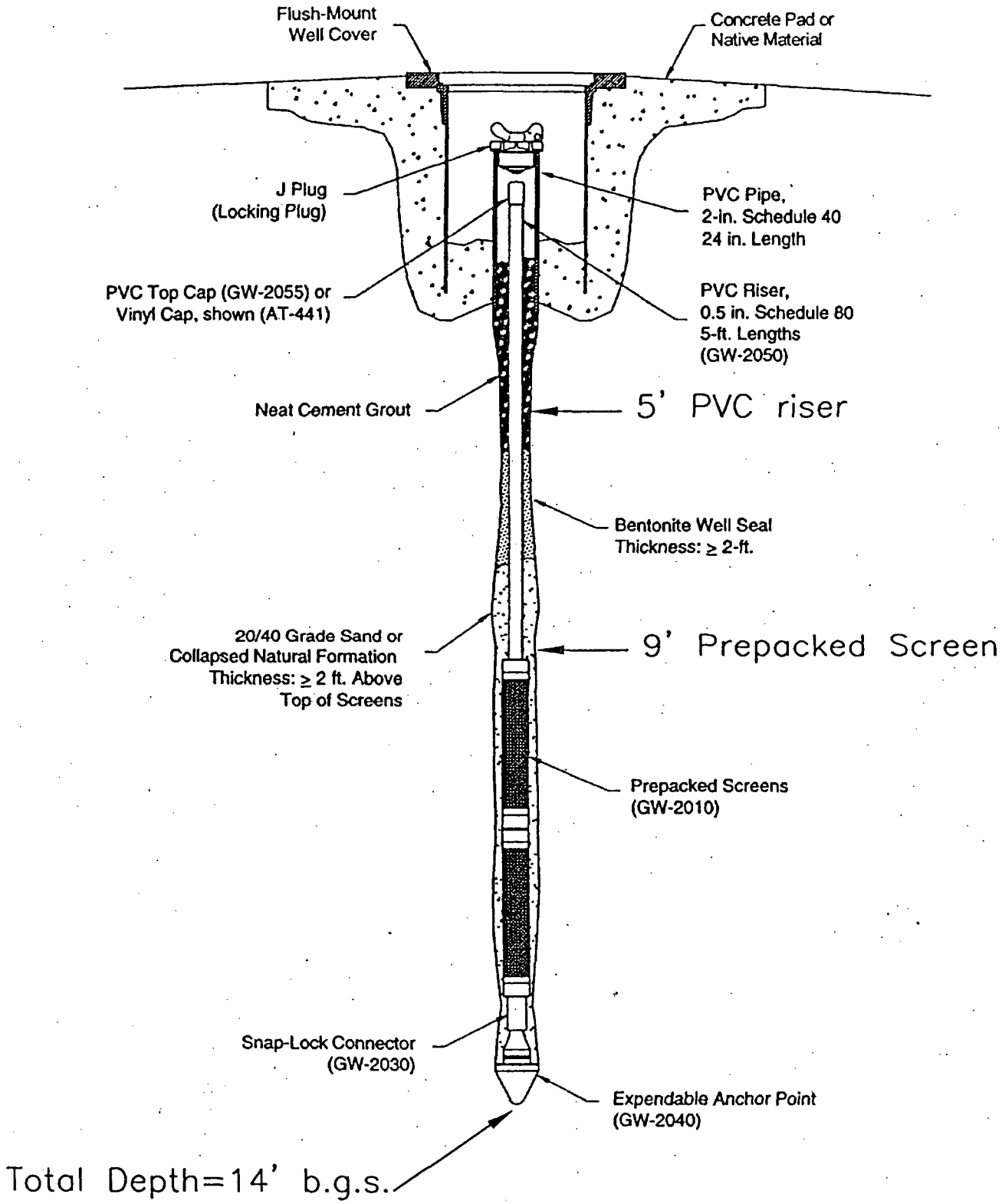
Analytical Results Report
UOS Job No. 75-70901

Weber County Transfer Station
Ogden, Utah

Well Construction – MW3,4,5&7
Figure 5

February 1998

URS OPERATING SERVICES



36-MW6

Analytical Results Report
UOS Job No. 75-70901

Weber County Transfer Station
Ogden, Utah

Well Construction – MW6
Figure 4

February 1998

URS OPERATING SERVICES

USPCI

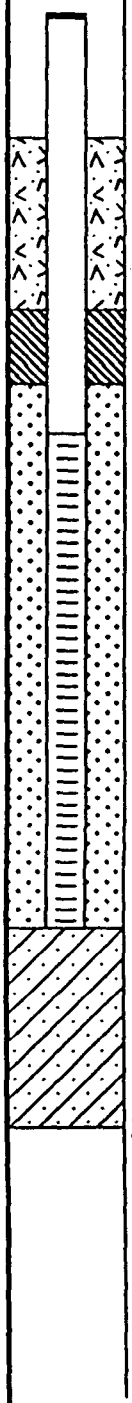
A subsidiary of
Union Pacific Corporation

LOG

A01-37

WELL NO. MW-1

CLIENT: *Union Pacific Railroad*			JOB NO.: *98120-077*
PROJECT: *Riverdale, Utah*		LOCATION: *T 6&9*	
DRILLED BY: *Layne*	DRILLER: *Jerry/Clint*	METHOD: *8" HSA*	
START DATE: *9-13-93*	COMP. DATE: *9-14-93*	SURF. EL.: *FT. est.*	TD: *20.0 FT. BGS*
LOGGED BY: *Ken Rose*			D. T. WATER: *9.0 FT. BGS*



WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH ppm
		Light gray gravel w/some sand and cobbles Dry, some metal debris Dark brown gravel w/coarse sand and gravel Some cobbles, damp, no odor	GW			
	5	As above, becomes moist at 6' Slight diesel odor at 7'				
		Wet at ~9', strong diesel odor, visible sheen				
	10	Cobbles from 9.5' to 11.5'	GP			
		Dark grayish brown gravel w/some coarse sand and cobbles, trace fine to med.sand, wet, slight odor	GW			
	15	As above, wet, slight odor				
	20	Boring completed to 20.0' BGS Groundwater encountered at ~9' Well installed to 18', 10' (0.02") screen 2.5 bags of #10-20 silica 1 bucket bentonite chips				
	25					

JOB NUMBER: 98120-077

USPCI

A subsidiary of
Union Pacific Corporation

LOG

A01-37

WELL NO. MW-2

CLIENT: *Union Pacific Railroad*			JOB NO.: *96120-077*
PROJECT: *Riverdale, Utah*		LOCATION: *T 6&9*	
DRILLED BY: *Layne*	DRILLER: *Jerry/Clint*	METHOD: *8" HSA*	
START DATE: *9-14-93*	COMP. DATE: *9-14-93*	SURF. EL.: *FT. est.*	TD: *20.0 FT. BGS*
LOGGED BY: *Ken Rose*			D. T. WATER: *8.5 FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH ppm
		Light gray gravel and cobbles, some wood and metal debris, dry, no staining				
		Brown coarse sandy gravel with some cobbles, moist, no odor				
	5					
		Increased cobbles encountered from 7.5' to 10'				
		Wet at 8.5', strong diesel odor				
	10	Dark grayish brown coarse sand and gravel w/some cobbles, wet, strong odor	GP			
	15	Gray med. to coarse sand w/some gravel, trace cobbles, wet, slight odor (15'-18')				
		Increased cobbles at 18', wet, slight odor				
		As above, wet, slight odor				
	20	Boring completed to 20' Groundwater encountered at ~8.5' Monitor well installed to 18' (0.020") Screen, 10', 3 bags of #10-20 silica sand 1 bag bentonite chips Well construction identical to MW-1				
	25					

JOB NUMBER: 96120-077

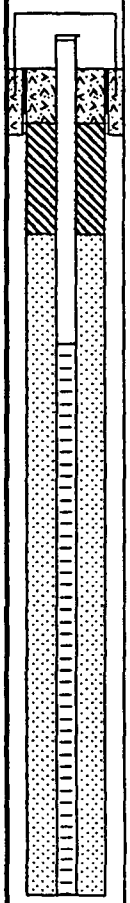
LOG

BORING NO.

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

WELL NO. 37-MW3

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/6/98	DATE COMP: 6/6/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 11.45

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sandy gravel: Entire boring is sand and sandy gravel, no HC odor or staining, all natural colors, wet below 7-8 feet.	0		
	10			▽			
	20			▼ =DEPTH TO FREE PRODUCT			

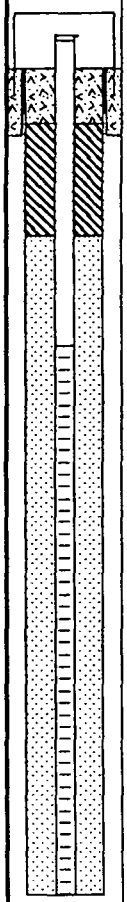
LOG

BORING NO. AC1-37

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

WELL NO. 37-MW4

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/6/98	DATE COMP: 6/6/98	SURF. EL:	WELL TD: 15.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 12.33

WELL COMP	DPT	GRAPHIC LOG USCS CODE		DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
				Above ground well completion			
			SW	Sand: Scattered gravel-rich beds, sand mg-vcg, no HC odor or staining, all natural colors, wet below 6-7 feet.	0		
	10			9 ft: gravel increases from 9-11 feet minor clay in matrix below 11 feet			
	20			▼ -DEPTH TO FREE PRODUCT			

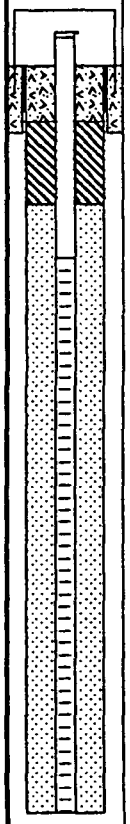
LOG

BORING NO.

WELL NO. 38-MW1

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 13.5
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP):

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Clayey sand			
		SP	Sand with fine gravel: dark brown, moderate diesel odor			
	10	SW	Sandy gravel: moderate to strong diesel odor, dark brown-gray coating, product blebs and sheen on soil and pebbles			
	20					

▼ =DEPTH TO FREE PRODUCT

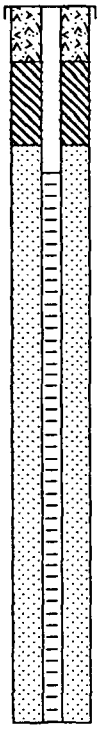
LOG

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

BORING NO.

WELL NO. 38-MW10

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/4/98	DATE COMP: 6/4/98	SURF. EL:	WELL TD: 13.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 6.53

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level wellhead with drive-over cap			
		asph	Aspalt			
		SC	Sand with minor, partial clay matrix: pervasive diesel odor	188	MW10-5	ND
	10	SW	Sandy gravel: wet, slight-moderate diesel odor			
	20					

▼ -DEPTH TO FREE PRODUCT

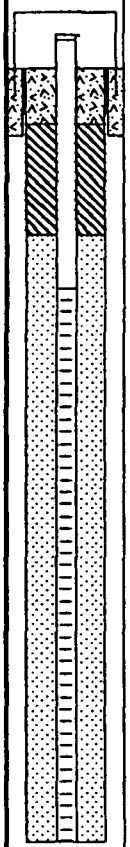
LOG

BORING NO.

WELL NO. 38-MW2

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 14.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 9.49

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Sandy clay and clay: medium brown, no HC odor, moist			
		SC	Sandy gravel: scattered minor clay, no HC odor, wet, natural colors with possible staining on fines	0		
	10			3	MW2-10	ND DRO
	20					

▼ =DEPTH TO FREE PRODUCT

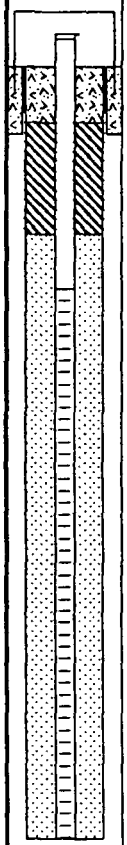
LOG

BORING NO.

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

WELL NO. 38-MW3

CLIENT: UNION PACIFIC RESOURCES CO.		JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE	METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 14.0
LOGGED BY: ED ULLMER	PROD. DEPTH:	INITIAL SWD (MP): 8.93

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
	10	CL	Silty clay and clay: scattered vfg sand, no HC odor, dark brown with black mottles, moist-wet at 7 feet	0	38-MW3-8	ND DRO
		SW	Sandy gravel: wet, no HC odor, natural colors, strong water flow below 11 feet			
	20					

▼ =DEPTH TO FREE PRODUCT

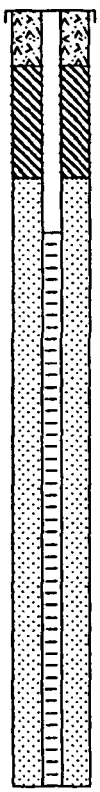
LOG

BORING NO.

WELL NO. 38-MW4

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 14.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 7.97

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level wellhead with drive-over cap			
		CL	Clay to sandy clay with gravel: no HC odor, medium brown			
	10	SW	Sandy gravel: wet, no HC odor, natural colors, strong water flow below 10 feet	0	MW4-10	ND DRO
	20					

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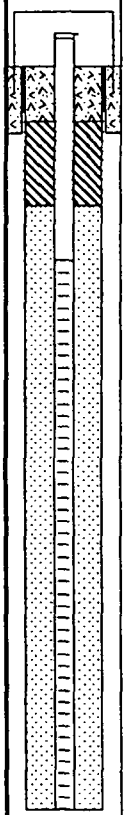
LOG

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

BORING NO.

WELL NO. 38-MW5

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 13.5
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 9.76

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Clayey sand and silty clay: trace HC odor, medium to dark brown, wet below 7-8 feet, no staining	4	38-MW5-7	ND DRO
	10	SW	Sandy gravel: wet, no HC odor, natural colors, minor partial clay in matrix			
	20					

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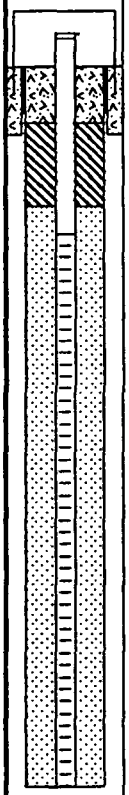
BORING NO.

WELL NO. 38-MW6

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP):

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Clayey sand and silty clay: brown to dark gray, moderate to strong diesel odor below 5 feet			
	10	SW	Sandy gravel: wet with diesel product blebs and sheen, running free product from soil, strong odor	187		
	20					

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Consulting Services

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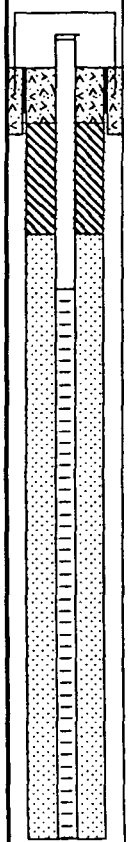
BORING NO.

WELL NO. 38-MW7

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 14
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 9.55

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Clayey and silty sand: scattered gravel clasts, dark gray, moderate to strong diesel odor			
	10	SW	Sandy gravel: wet, pervasive diesel coating, sheen, strong odor	206	38-MW7-7	62
	20					

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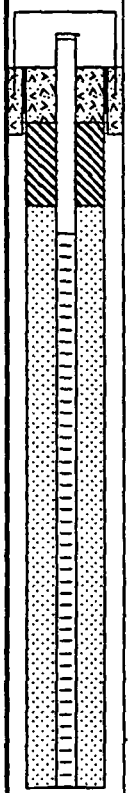
BORING NO.

WELL NO. 38-MW8

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/2/98	DATE COMP: 6/2/98	SURF. EL:	WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 9.27

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Clayey and silty sand and sand: strong diesel odor, loose when wet, sand mg-cg, well sorted			
	10	SW	Sandy gravel: partial diesel coatings, medium to dark gray, strong odor	260	38-MW8-8	160 DRO
	20					

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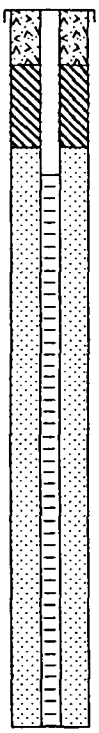
BORING NO.

LAIDLAW ENVIRONMENTAL SERVICES
Consulting Services

WELL NO. 38-MW9

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/3/98	DATE COMP: 6/3/98	SURF. EL:	WELL TD: 13.0
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 5.1

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level wellhead with drive-over cap			
		CL	Sand with loose cayey matrix: well sorted, medium brown, Slite HC odor - solvent type (?)	16	38-MW9-5	ND DRO
	10	SW	Sandy gravel: wet, no HC odor, natural colors			
	20					

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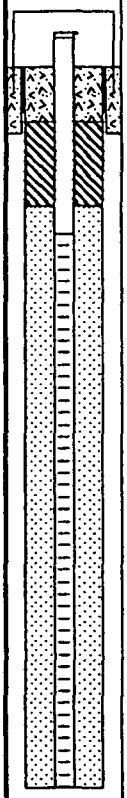
ENVIRONMENTAL DECISION GROUP, Inc.
a Safety-Kleen Company

BORING NO.

WELL NO. SPRR3-MW1

CLIENT: UNION PACIFIC RESOURCES CO.		JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE	METHOD: AUGER/ODEX
DATE START: 6/3/98	DATE COMP: 6/3/98	SURF. EL:4292.416 Ref / WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:	INITIAL SWD (MP): 9.64



WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground well completion			
		CL	Silty sand with clayey matrix: gray, pervasive gasoline odor below 4 feet, wet below 4 feet Top screen - 4287.04	392	MWI-6	150 GRO
	10	SW	Sand and gravel: trace to no clay, unconsolidated, permeable - stong water flow, typical coarse alluvium in railyard, moderate gasoline odor Bottom screen - 4277.04			
	20					

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BORING NO.

ENVIRONMENTAL DECISION GROUP, Inc.
a Safety-Kleen Company

WELL NO. SPRR3-MW2

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/3/98	DATE COMP: 6/3/98	SURF. EL:4290.168 Ref	WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 10.7

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level wellhead - drive-over cap			
		CL	Sand with silt and partial clayey matrix: pervasive gasoline odor below 4 feet, wet below 4 feet Top screen - 4287.17	670	MW2-5	49 GRO
	10	SW	Sand and gravel: trace to no clay, unconsolidated, permeable - stong water flow, typical coarse alluvium in railyard, moderate gasoline odor Bottom screen - 4277.17			
	20					

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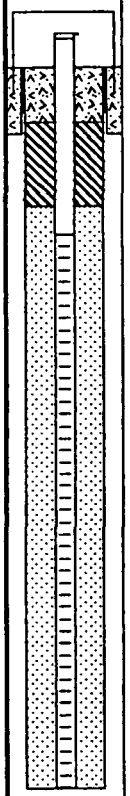
BORING NO.

WELL NO. SPRR3-MW3

ENVIRONMENTAL DECISION GROUP, Inc.
a Safety-Kleen Company

CLIENT: UNION PACIFIC RESOURCES CO.		JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE	METHOD: AUGER/ODEX
DATE START: 6/3/98	DATE COMP: 6/3/98	SURF. EL:4293.852 Ref WELL TD: 13.0
LOGGED BY: ED ULLMER	PROD. DEPTH:	INITIAL SWD (MP): 7.46

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Above ground completion			
		CL	Sand with silt and partial clayey matrix: pervasive odor of mostly diesel (?) below 3 feet, trace to no staining Top screen - 4288.29	47	MW3-5	48 GRO
	10	SW	Sand and gravel: Wet, typical railyard coarse alluvium, trace to no clay, permeable, slight diesel odor, no staining or coating Bottom screen - 4278.29			
	20					

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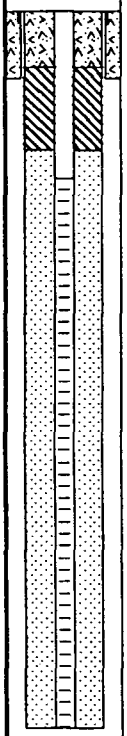
BORING NO.

ENVIRONMENTAL DECISION GROUP, Inc.
a Safety-Kleen Company

WELL NO. SPRR5-MW1

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/4/98	DATE COMP: 6/4/98	SURF. EL:4285.939	WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 8.03

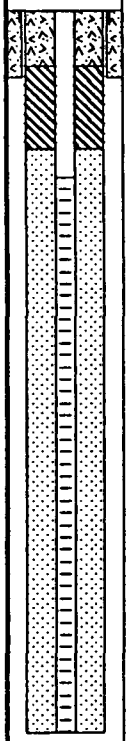
WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level wellhead, drive-over cap			
		SC	Sand with minor clay or silt in matrix: no HC odor or staining Top screen - 4282.94 ▽	2	MW1-8	ND GRO
	10	SW	Sand and gravel: wet, trace to no clay, unconsolidated, permeable - stong water flow, typical coarse alluvium in railyard, no gasoline odor Bottom screen - 4272.94			
	20		▼ =DEPTH TO FREE PRODUCT			

ENVIRONMENTAL DECISION GROUP, Inc.
a Safety-Kleen Company

BORING NO.

WELL NO. SPRR5-MW2

CLIENT: UNION PACIFIC RESOURCES CO.		JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD	LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE	METHOD: AUGER/ODEX
DATE START: 6/4/98	DATE COMP: 6/4/98	SURF. EL:4285.951 Ref / WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:	INITIAL SWD (MP): 7.85



WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
			Grade level wellhead, drive-over cap			
		SC	Sand with minor clay or silt in matrix: no HC odor or staining Top screen - 4282.95			
			▽	0	MW2-8	ND GRO
	10	SW	Sand and gravel: wet, unconsolidated, permeable - typical coarse alluvium in railyard, no odor or staining Bottom screen - 4272.95			
	20					

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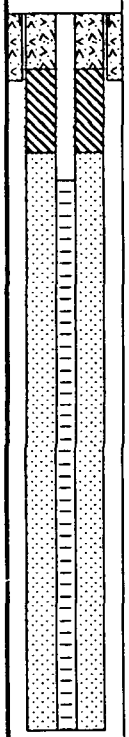
LOG

BORING NO.

ENVIRONMENTAL DECISION GROUP, Inc.
a Safety-Kleen Company

WELL NO. SPRR5-MW3

CLIENT: UNION PACIFIC RESOURCES CO.			JOB NUMBER: 792904
PROJECT: RI/FS OGDEN RAILYARD		LOCATION: OGDEN, UTAH	
DRILLED BY: EARTHCORE	DRILLER: KERN/NATTALE		METHOD: AUGER/ODEX
DATE START: 6/4/98	DATE COMP: 6/4/98	SURF. EL:4285.991	WELL TD: 13
LOGGED BY: ED ULLMER	PROD. DEPTH:		INITIAL SWD (MP): 7.84

WELL COMP	DPT	GRAPHIC LOG USCS CODE	DESCRIPTION	PID ppm	SAMPLE NUMBER	TPH mg/kg
		SC	Grade level wellhead, drive-over cap Sand with minor clay or silt in matrix: no HC odor or staining Top screen - 4282.99	0	MW3-8	ND GRO
	10	SW	Sand and gravel: wet, unconsolidated, permeable - typical coarse alluvium in railyard, no odor or staining Bottom screen - 4272.99			
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APPENDIX E
DATA QUALITY ASSESSMENT

Appendix E

Data Quality Assessment

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1 INTRODUCTION

All of the laboratory analytical data summarized in Appendices A and G, and as discussed or referenced in the text of the RI report have been reviewed and validated. This appendix presents a discussion of the usability of the data, and pertains to the Phase II analytical data collected and analyzed by the UPRR project team. Data usability is evaluated by two processes; data verification (reconciliation with DQOs) and data validation (overall data quality).

Data validation is an evaluation of the technical usability of the verified data, and is performed external to the data generator (laboratory) by applying a defined set of performance criteria to the body of the data. The data validation reviews for the Phase II data listed in the table below were conducted by Diane Short and Associates (DSA Inc., Golden, CO) according to the project Quality Assurance Project Plan (Safety-Kleen, 2000a), and following EPA Contract Laboratory Program National Functional Guidelines for Organic Review and Inorganic Data Review.

Data Validation Documents Previously Submitted	
Forrester Group, 2000b	Data validation report and comparison to site-specific screening levels for Phase II data collected through July 2000.
Forrester Group, 2001e	Data validation report and comparison to site-specific screening levels for Phase II data collected from August through December 2000.
Forrester Group, 2001f	Data validation report and comparison to site-specific screening levels for Phase II groundwater data collected January and February 2001.
Forrester Group, 2001g	Data validation report and comparison to site-specific screening levels for Phase II soil data collected May 2001.
Forrester Group, 2001h	Data validation report and comparison to site-specific screening levels for Phase II groundwater data collected May 2001.
Forrester Group, 2001i	Data validation report and comparison to site-specific screening levels for Phase II groundwater data collected September 2001.

2 DATA VERIFICATION

Data verification included a review of the findings of the following activities; assessment of field collection procedures, sample labeling methods, chain of custody procedures, and all assessments of analytical data collection, recording and reporting. The potential impact of any deviations on the reliability of the data is assessed.

2.1 SAMPLING METHODS

Groundwater and soil samples collected by UPRR, were collected according to the SOPs contained in Appendix A of the phase II Field sampling Plan (Safety Kleen, 2000b). There were no deviations from the identified sampling methods.

There was no specific SOP developed for the samples of LNAPL (22A-B4, 30-MW6, 38-MW1 38-MW6 38-CAISSON), and of the groundwater in wells from beneath the LNAPL layer, collected in June 2000. For the collection of the LNAPL samples, a peristaltic pump was used to withdraw the required volume of LNAPL from the well directly into the sample containers.

Collection of the groundwater samples from beneath the LNAPL layer was accomplished by lowering a telescoping length of PVC pipe (0.5 inch inside 1.0 inch) with a bottom cap through the LNAPL layer. The 0.5-inch diameter pipe was then used to knock the tethered bottom cap loose from the 1.0-inch diameter pipe, after which the 0.5-inch diameter pipe was further lowered in the well. The sample collection tube from the peristaltic pump was the filled with DI water and lowered through the 0.5-inch diameter pipe into the well. Sample collection procedures were then completed following the groundwater sample collection SOP. There was no evidence of any entrained LNAPL in the sample collection tube, thus the reliability of the data should not be affected.

The following parameters were measured on samples during monitoring well purging and sampling: temperature, specific conductance, pH, dissolved oxygen, and turbidity.

2.2 Sample Documentation

There were no deviations from the identified methods for sample documentation other than the following naming conventions.

1. The soil borings and associated soil samples collected from borings identified as 33-B80, 33-B81, and 33-B82, were actually completed and collected from AOI-34. The locations are correctly shown on the appropriate figures in the report.

2. After receipt of the analytical data, the identifications of surface soil sampling locations 17-SG1, 17-SG2, 18-SG1, and 18-SG2 were changed to 17-SG1-2001, 17-SG2-2001, 18-SG1-2001, and 18-SG2-2001, to distinguish them from earlier Phase I soil samples that had previously been assigned these sample identifiers.

2.3 Sample Custody, Handling, and Shipping

Procedures for handling samples in the field, packaging samples for shipment, shipment of samples to the laboratory, and maintenance and documentation of chain of custody (COC) were followed as described in the Field Sampling Plan. There were some occasional discrepancies between the sample chain-of-custody forms and the actual analysis requested. These discrepancies were resolved prior to the analyses and are discussed in the individual sections on data validation.

2.4 Laboratory Analyses

Table 1 presents a summary of the samples collected during the Phase II investigation and the analyses performed. The field and quality control samples submitted to the analytical laboratories were analyzed by the methods listed below. All soil and sediment samples contained in the report tables are reported on a dry weight basis.

Volatiles	SW-846 Method 8260B,
BTEX	EPA-600 Method 624
Semi-Volatiles	SW-846 Method 8270C

PCBs	SW-846 Method 8082, Method 8270 SIM
Diesel Range Organics	SW-846 Method 8015B-mod DRO
Light Hydrocarbons	EPA, RSK-175
Metals	SW-846 Method 6010B and series 7000
Wet Chemistry	MCAWW 300.0, 310.1, 353.2, 354.1
Total Organic Carbon	SW-846 Method 9060
Reactive CN and S	SW-846 Chapter 7

Soil, sediment, and sludge samples submitted for PCB analysis (8082) after the first week of November 2000, were subject to additional extraction-cleanup procedures prior to analysis, (SW-846 Methods 3550B, 3665A, 3660B). These additional cleanup steps were added by EPA following an audit of the analytical laboratory (Severn Trent), to achieve a lower PCB detection limit on soil, sediment, and sludge samples with elevated concentrations of PAHs. Typical detection limits for PCBs are <40 ug/kg. The soil PCB screening level is 2900 ug/kg.

3 DATA VALIDATION

The data validation process consisted of evaluation of individual samples collected and analyzed to determine if the results are within acceptable limits. Validation of the analytical data was completed by a subcontractor (Diane Short & Associates) using EPA Contract Laboratory Program National Functional Guidelines for Organic Review, 1994, SW-846 and MCAWW Methods, and the project Quality Assurance Project Plan (QAPP) as referenced by the reviewer to perform the data validation review. The EPA qualifiers have been expanded to include a descriptor code and value to define QC violations and their values, per the approval of the Project Manager and EPA-approval. Per the Scope of Work, the review includes validation of all QC referencing the above documents. A 10 percent full review of the raw data was performed on submitted chromatograms and mass spectra. The following data validation codes were used in these reviews. The codes also indicate the criteria that were reviewed.

The data validation qualifiers are as follows:

1. The EPA CLP data validation (SOP) qualifiers "U", "J", and "R":

"J" indicates data are estimated

"U" indicates that the data are considered to be undetected at the elevated detection limit due to blank contamination; data are usable as undetected values

"R" indicates rejected, unusable data

2. The following qualifier "descriptors" give further detail of the type and amount of qualification a given data point has received:

"H" indicates holding time or sample preservation violation

"E" indicates interference problems (like the serial dilution) or exceedence of instrument range

"I" indicates internal standard area exceedence or the ICS for metals

"D" indicates exceedence of duplicate or MSD RPD control limits

"*" indicates exceed duplicate ± CRDL limits for values less than 5 times CRDL

"S" indicates matrix spike, surrogate outside control limits

"C" indicates instrument calibration exceed limits

"L" indicates laboratory control standard outside control limits

"B" indicates positive blank contamination exceeding MDL

"K" indicates negative blank contamination exceeding 2 x MDL in metals

"N" indicates tentatively identified compound

"Q" indicates for reasons not stated above - see text of review

Because of the numerous sampling events and the time period over which the Phase II samples were collected, the laboratory analytical data was reviewed and validated on a batch basis. The full text of the data validation reports may be found in the documents referenced above in Section 1. The following subsections present a data validation summary of the individual sampling events. The validation of analytical data included a review of the following:

- Holding Times and Preservation
- Instrument Tuning
- Calibrations
- Blanks
- Surrogate Recoveries
- Internal Standard Criteria
- Matrix Spike/Matrix Spike Duplicates
- Blank Spikes (LCS)
- System Performance (full validation only)
- Overall Assessment of Data

3.1 Soil and Water Samples Collected March 2000

3.1.1 SW-846 8260B VOLATILES

SDG: 58779, 58782, 58781, 58826, 58828

SAMPLE NO.: See Attachment 42 waters and 32 soils

Data are fully usable after consideration of the qualifiers noted below.

Data Deliverables:

The following items do not affect data quality, but are deviations from the project requirements: The required response factor data were not included in the CCV reports, only % drift results based on calculated concentrations. Since the review includes a requirement to assess the magnitude of the RRF for each compound, this caused the reviewer to have to manually calculate these results from the raw data, adding to the time required to assess the data.

Initial and Continuing Calibrations:

The continuing calibration showed the same compounds failing to achieve the minimum response as did the initial calibrations. In addition, 2-hexanone failed to meet the 0.05 limit in several CCV's associated with water samples. This analyte is qualified as RC# when this occurs. The other low responding compounds were already qualified for the initial calibration behavior and were not additionally qualified.
A number of CCVs showed %D values outside the 20% limit specified in the QAPP. When associated with detected targets, this has resulted in qualification as JC#, where # is the % drift observed. Nondetected targets are not qualified for this unless the drift is particularly severe. There could be a variability to the data due to variability in the calibration factors.

Surrogate Recoveries:

Several instances of surrogate recoveries outside the contract limits were observed. It appears that when recoveries fall below the lower control limit, the laboratory has re-analyzed the sample. When recoveries fall above the upper control limit the laboratory has not always done so. Results associated with low recoveries have been qualified JS#, where # is the % recovery observed. Such results may be biased. When detected compounds are associated with high recoveries, the results are also qualified as JS#, but non-detects are not qualified for high recoveries.

MS/MSD Results:

The CLP list of analytes is used. On soil SDG 58826, the original MSD was out of limits due to poor IS recoveries (apparently a spiking error). A rerun gave a MSD that was within limits. The MS on this set had a recovery of 45% for 1,1-DCE, which is low, and an RPD of 43% for this analyte was observed because the MSD recovery was within limits. The associated sample is qualified as JS45 for this analyte, indicating that it could be biased low.

LCS Recoveries:

The LCS was spiked with all targets, and recoveries were reported for all targets. LCS duplicates were also run. For the majority of targets the LCS recoveries were well within the limits. There were occasional failures, in which recoveries fell either above or below the control window. In cases where the recoveries fell below the window, all targets are qualified as JL#. This indicates the possibility of low bias due to the low recovery. In the case of high recoveries, nondetected targets have not been qualified, and detected targets have been qualified as JL#, indicating the possibility of a high bias.

Method Blank Contamination:

In general, the method blanks are free of contaminants except for chloromethane, bromomethane, and some instances of methylene chloride contamination. All these targets were detected at levels below the reporting limits.

Positive detections in associated samples for these analytes are qualified as UB# when the sample result is less than 5x the method blank level (10X for methylene chloride).

The presence of chloromethane and bromomethane in method blanks is fairly unusual. This may be caused by laboratory surrogate or internal standard spike contamination. It is unlikely that container contamination would be so consistent, but this cannot be ruled out. In any event, the positive detections for these analytes in samples is clearly due to contamination and not to sample content.

Field QC:

Field blanks were present. These also contained the chloromethane and in some cases the bromomethane. The results were qualified as UB# due to method blank contamination.

Reporting Limits:

This project includes "screening level" concentrations, which are the goals for reporting limits. All the reporting limits for water samples were at least as low as the screening level limits. For soil samples, acrylonitrile, 1,2-dibromo-3-chloropropane, and vinyl chloride had screening limits that were below the reporting limits provided by the laboratory.

Given the nature of the compounds for which the limits were not met, it is unlikely that the laboratory could have achieved lower limits for these targets. The screening level cannot realistically be achieved in soil for these compounds. Some soil samples contained significant moisture. The reporting limits for specific samples can be higher than the screening level because of the moisture correction.

3.1.2 SW-846 8270B SEMI-VOLATILES

SDG: 58784, 58826, 58783

SAMPLE NO.: See Attachment 3 soils

The data are fully usable with consideration of the qualification defined below.

Data Deliverables:

The following items do not affect data quality, but are deficiencies in meeting the project deliverable criteria.

The data package was generally well done and well organized. However, there were deficiencies in some of the forms, as follows:

The response factor data, as required by the QAPP, were not included in the CCV reports, only % drift results based on calculated concentrations. Since the review includes a requirement to assess the magnitude of the RRF for each compound, the reviewer manually calculated these results from the raw data, adding to the time required to assess the data.
The QA manager is in communication with the laboratory to resolve these deficiencies before the next set of data deliverables are produced.

Calibrations:

The laboratory has chosen to use linear or non-linear regression curves when the %RSD exceeds 15. This has been done for pentachlorophenol, carbazole, and 3,3'-dichlorobenzidine. For calibrations associated with water samples, in the case of pentachlorophenol, the r2 value was 0.991, and in the case of carbazole was 0.986. These compounds are qualified as JC# when detected in samples on this basis, where # is the value of r2 observed.

Pentachlorophenol is a CCC, and is required only to have %RSD of 30% or less. The same data points provide a %RSD of the average response as 18.8%, well under the limit. Thus, as far as method requirements are concerned, the use of a regression line is not necessary for this compound and the data are not expected to be affected by the qualification.

In addition, the lower calibration level for pentachlorphenol is 5 ug/ml. This would correspond to 10 ug/L in water samples using the procedure reported by the laboratory. Thus the reporting limit used (2 ug/L) is not supported by the lowest calibration level achieved for this compound. Pentachlorophenol has a tendency to be lost to active sites in the chromatographic system at levels below 5 ug/ml or so, and for this reason the ability to reach low detection limits for this compound is limited.

For most of the other targets, the laboratory has been successful at calibrating from 0.5 ug/ml to 25 ug/ml. This is a somewhat lower calibration range than is normally used for 8270 analysis, but is achievable. It would be desirable to make sure that the laboratory mdls support this as well as the calibration curve.

In the case of the initial calibration associated with soil samples, the pentachlorophenol calibration showed an r2 value of 0.998, but still with only 5 data points. The carbazole was again done with a power curve and gave an r2 value of 0.990, and the 3,3'-dichlorobenzidine gave an r2 value of 0.992. Thus detections of carbazole and 3,3'-dichlorobenzidine are qualified as JC#.

Several of the targets had %D limits that exceeded the 20% requirement. Positive detections associated with such cases are qualified as JC#, where # is the %D observed. There could be a variability to the data qualified 'JC' due to variability in the calibration factors.

MS/MSD Results:

For SDG 58783 the matrix spike duplicate recovery for phenol was low, and the native sample has been qualified as JS#, where # is the phenol recovery observed in the spike. Data could be biased low due to matrix effects.

For SDG 58784, there were two MS/MSD sets, and several analytes were recovered high. Since no targets were detected in the native samples, no qualifiers were applied.

Reporting Limits:

The screening levels associated with this project are extremely low for a few analytes. The level for pentachlorophenol, for example, is 1 ug/L. The laboratory is reporting 2 ug/L, but a 10 ug/L limit is supported by the calibrations.

Five of the targets do not meet screening levels in water samples, including benzo(a)pyrene, dibenzo(a,h)anthracene, 2,6-dinitrotoluene, hexachlorobenzene, and pentachlorophenol. The screening levels for these targets cannot be met with full-scan 8270. Indeed, for pentachlorophenol, the screening level is difficult to achieve even with selected ion monitoring because of the behavior of this compound at low concentrations. During the November audit, the QA Officer reviewer the semi-volatile MDL study and associated spectra. The analytical chemist also went over the low-level identification process. It appears that the chemist running the low level Method 8270 analysis is able to identify the required low-level compounds at the required limit. Benzo(a) pyrene results were still in question and the chemist will be preparing an explanation of the review process.

For soils, all screening levels are nominally met. Some of the actual reporting limits are elevated in soils due to high percent moisture levels. This could raise a few targets above the screening levels, but most should still be below the screening level concentration.

3.1.3 METALS SW846 6010 (ICP) and 7470 (CVAA Hg)

SDG NUMBER: 58776, 58778, 58825 , 58826

SAMPLE NUMBER: 53 (water), 18 (sediment)

Calibration: Prep and Field Blanks

In the first submission, 18 of the 23 metals were either above the reporting limit or negative at 2 x RL. This indicates that the RLs were not achievable and all results at about 5 X RL were unusable. The QA manager worked with the lab and EPA project managers to determine what detection limits needed to be achieved and reported.

Data were re-processed and resubmitted. By the third submission only 2 of the water metals were qualified UB#, where # is the value of the blank. Sediment data (set 58826) were not resubmitted with updated detection limits and several metals were qualified.

Sediment data have been qualified for negative blanks whose absolute values are greater than (2 x blank). Data are qualified JK#, where # is the value of the negative blank. Data could be biased low and false undetected values could have been reported.

Analyte	SDG	Blank Value mg/kg
beryllium	58826	-.19
cadmium	58826	-.26
lead	58826	-.45

Field Blanks

Upon re-submission, water blanks were acceptable. Sediment data were qualified UB#, where # is the value of the blank.

Analyte	SDG	Blank Value mg/kg
antimony	58826	0.5
mercury	58826	0.04
silver	58826	0.20

Field blanks FBB1 and FBB2 were further qualified for cooper, potassium, sodium and zinc. The UB data are fully usable as undetected values at the elevated detection limits. All reported results for field blanks in the 3rd submission for water are undetected using the higher reporting limits. All data for the sediment field blanks have been qualified as UB and are considered to be undetected with the following exceptions:

Analyte	Value	Sample
aluminum	20.5	FBB1
beryllium	0.01U JK	FBB1
cadmium	0.02 JK	FBB1
calcium	43.1	FBB1
iron	261	FBB1
magnesium	9.8	FBB1
manganese	4.9	FBB1
aluminum	15.7	FBB2
beryllium	0.01U JK	FBB2
cadmium	0.02 JK	FBB2
calcium	22.8	FBB2
iron	197	FBB2
manganese	2.6	FBB2

No qualifiers have been added to the data by the validator. The project manager or field manager needs to assess which samples are affected by each blank and the extent of contamination.

Matrix Spikes

Data for potassium, silver and sodium for water and antimony, and copper for sediment are qualified JS#, where # is the value of the %R. When the %R is greater than 125%, the detected data for potassium and sodium may be biased high. When the %R is less than 75%, the data for silver, antimony and copper may be biased low. Undetected data for silver with a percent recovery of less than 30% are considered to be rejected and it is possible false negative data have been reported.

Matrix Duplicates

Data for iron in water and copper and lead for sediment are qualified JD# where # is the value of the RPD. Sediment data for arsenic and cadmium are qualified for J*#, where # is the difference between the duplicate values (low level precision). There could be variability to the data which increases as the # increases.

Field Duplicates

FD samples for water are identified as:
WR028B/D BC4B/D SC1B/D RD1B/D A0102B/D. All are within acceptable limits (20% RPD or ± RL for results < 5 x RL) with the following exceptions:
A0101B/D:

Analyte	Results	RPD	RL	Comment
aluminum	546/1080	66	500	
iron	1140/1890	50	400	
lead	20/35	55	15	within +/- RL
sodium	797000/1130000	35	2000	
zinc	150/206	31	30	

FD for sediment are SC1B/D and A0102B/D. All are within the limits applied for laboratory precision limits with the following exceptions:

A0102B/D

Analyte	Results	RPD	RL	Comment
beryllium	.355/ .063	136	.01	
mercury	0.047/0.074	44	.01	

SC1B/D

Analyte	Results	RPD	RL	Comment
cadmium	.204/ .306	40	.02	
mercury	.186/ .045	122	.01	

Data are not qualified for field duplicate precision.

Low Level, CRDL, standard

CRDLs were not required and they were reported. There is not established limit for the CRDL, which is a standard run at 2 x the lowest reporting standard. The CRDL standard gives an indication of the ability of the laboratory to meet the required detection limit. Recoveries for lead

were as low as 1%, for silver at 23%, selenium at 10%, beryllium at 10%, cadmium at 10% and thallium at 29%. The low level and undetected results for these metals may be questionable.

ICS

These samples were all run using ICP TRACE, except mercury. The metals that are usually analyzed by GFAA were not properly spiked nor acceptably recovered in the ICS. Per follow up with the laboratory and the attached memo, the low recoveries for the GFAA metals is due to insufficient spike level rather than major ion interference. For this reason, data have not been qualified for ICS recoveries although they are noted below. The problem of being able to reach the required low levels again, seems to be an issue. The lab has promised that the proper RLs will be in place for the next round of analysis.

Reporting levels

There were sufficient problems with ICS spikes and CRDL standards to question the ability of the laboratory to adequately perform ICP TRACE analysis at low levels for the GFAA metals: lead, thallium and selenium. The laboratory was definitely not able to achieve low levels for all metals as originally submitted. The re-submitted values adequately reflect the current sensitivity of the analyses.

3.2 Soil and Water Samples Collected May 2000

3.2.1 SW-846 8260B VOLATILES

SDG. 59848, 59787, 59621, 59090, 59546

SAMPLE NO.: See Attachment 50 soils

Data are fully usable after consideration of qualifiers as follows:

Chain of Custody and Sample Condition:

SDG 59787 was received at 24.5 deg C cooler temperature. The laboratory Case Narrative indicates that the client was contacted regarding this deviation. Because the temperature was so high, the results have been qualified as RT24.5 for nondetected targets and JT24.5 for detected targets. All other shipments were within acceptance limits for cooler temperature.

It is possible that results from samples received with temperatures outside guidance may be give results that are accurate. However, there is much greater uncertainty associated with such data. There are several phenomena that can contribute to inaccuracies when samples are subjected to temperatures higher than those recommended. Biodegradation is accelerated at higher temperatures, and can result in false negatives due to the removal of the targets by microbes. Transfer of contamination can occur between samples at higher rates due to the higher vapor pressure of the compounds in the samples, and higher rates of diffusion. Losses from the containers can be significant due to higher diffusion rates.

For this reason, such data should not be used without some additional information that will allow some assessment of how significant such processes are. For example, comparison with previous sampling sets can be helpful. There were some shipments that were received without any cooler seals, including 59787, 59621, and 59546. All other shipments were received with cooler seals but no sample seals.

Calibrations:

A number of targets gave low response factors consistently in the initial calibrations. A number of CCVs showed %D values outside the 20% limit specified in the QAPP. When associated with detected targets, this has resulted in qualification as JC#, where # is the % drift observed. Nondetected targets are not qualified for this unless the drift is particularly severe. There could be a variability to the data due to variability in the calibration factors.

Instrument Tunes:

One sample, MW52RE in set 59546 was run outside the 12-hour clock for tunes. This sample was a reanalysis done by the laboratory due to a low surrogate recovery. The reanalysis gave a low recovery of surrogate, but a different surrogate than in the original analysis. The question of whether this is due to matrix is not completely resolved by this result.

Internal Standard Areas:

There were a number of sets in which internal standard areas were high, and a few in which internal standard areas were low. When positive detections were associated with these outliers, the compounds associated with the internal standard outside of limits are qualified as JI#, where # is the %recovery of the internal standard.

Surrogate Recoveries:

Several instances of surrogate recoveries outside the contract limits were observed. It appears that when recoveries fall below the lower control limit, the laboratory has re-analyzed the sample. When recoveries fall above the upper control limit the laboratory has not always done so. Results associated with low recoveries have been qualified JS#, where # is the % recovery observed. Such results may be biased. When detected compounds are associated with high recoveries, the results are also qualified as JS#, but non-detects are not qualified for high recoveries.

MS/MSD Analyses:

Only one MS/MSD set was conducted for the 50 samples. There was a MS/MSD run in SDG 59787. No other MS/MSD results were present in the other SDG's. The results for the one QC sample were acceptable.

LCS Recoveries:

For the majority of targets the LCS recoveries were well within the limits. There were occasional failures, in which recoveries fell either above or below the control window. In cases where the recoveries fell below the window, all targets are qualified as JL#. This indicates the possibility of

low bias due to the low recovery. In the case of high recoveries, nondetected targets have not been qualified, and detected targets have been qualified as JL#, indicating the possibility of a high bias.

Method Blanks:

In general, the method blanks are free of contaminants except for methylene chloride, detected at levels below the reporting limits.

SDG.: 59869, 59853, 59852, 59868, 59795, 59847, 59867

SAMPLE NO.: See Attachment 27 waters, 60 soils

Data are fully usable after consideration of qualifiers.

Chain of Custody and Sample Condition:

SDG 59869 was received at 13.8 deg C cooler temperature. The laboratory Case Narrative presents this fact with no other amplification. Because the temperature was so high, the results have been qualified as RT13.8 for nondetected targets and JT13.8 for detected targets. All other shipments were within acceptance limits for cooler temperature.

There were some shipments that were received without any cooler seals, including 59795. All other shipments were received with cooler seals but no sample seals.

Calibrations:

A number of targets gave low response factors consistently in the initial calibrations. One sample 21SP10 was also qualified JC52 for acetone continuing calibration %D out of limits See the executive summary.

Internal Standard Areas:

Internal standard areas were low for the samples listed below. All data are qualified JI#, where # is the recovery of the IS compared to the daily standard area. When only 1 of the 4 IS's are out of limits and the reviewer has determined that the data are not affected, no qualification has been applied. If 2 or more of the IS's are out of limits and of nearly the same value, the average of the recoveries has been used.

RZ308ARE RZ308DRE RZ206ARE RZ209ARE RZ205ARE

Surrogate Recoveries:

Several instances of surrogate recoveries outside the contract limits were observed. These data could be biased high due to matrix effects.

RZ308DRE RZ308A RZ308D RZ205A RZ208A RZ209A
RZ209ARE RZ306A RZ306ARE

MS/MSD Analysis:

There were not 1 per 20 of these sets. Two MS/MSD pairs were present for soil and one for water. In soil set 59847, chlorobenzene was recovered low in both the MS and MSD (22 and 50%). Data are qualified JS22 in the parent sample only and the reported value could be biased low. In soil set 59847, the %RPD was 78% (limit is 10%). There is no qualification required for MSDs, but the possibility of matrix inhomogeneity is noted.

Method Blank Contamination:

In general, the method blanks are free of contaminants except for methylene chloride, detected at levels below the reporting limits in some method blanks. In SDG 59867, acetone was also detected in the blanks.

Field Duplicates:

Field duplicates met project criteria. Field duplicates included the following:

R2308D (soil)	BVP02AD (water)	21SP08D (water)
RZ202AD (soil)	BVP02AD (soil)	SPP06AD (soil)

3.2.2 SW-846 Method 8015 (TPH, DRO) and 8082 (PCB's)

SAMPLE DIGEST NUMBER: 59090, 59546, 59621, and 59787

NO. OF SAMPLES 28 (Soil)

The quality of the data is considered fully acceptable and usable with consideration of the following qualification.
The one MS/MSD sample for DRO had percent recoveries out of control. The particular sample that was chosen contained a high concentration of DRO and interfered with the recovery. No qualification was applied.

The surrogate in the DRO sample MW52 in SDG 59546 had a 144% recovery. The surrogate in DRO samples 2134, 3514, and 2714 (SDG59787) had recoveries of 151%, 148%, and 145% respectively. These samples were Qualified JS#, where # is the value of the percent recovery. Data are possibly biased high due to matrix effects. Many surrogates were diluted out. There is no qualification for this.

Screen level reporting limits could not be achieved for these samples due to high levels of hydrocarbons and other interferences. The samples were diluted in most cases or smaller amounts of sample used for the extraction.

3.2.3 SW-846 8270B SEMI-VOLATILES

SDG.: 59787, 59546, 59621, 59090, 59849, 59861, 59851

SAMPLE NO.: See Attachment 54 soils, 24 waters

Data are usable with the following exceptions and qualifications:

Chain of Custody and Sample Condition:

SDG 59787 was received at 24.5 deg C cooler temperature. The laboratory Case Narrative indicates that the client was contacted regarding this deviation. Because the temperature was so high, the results have been qualified as RT24.5 for nondetected targets and JT24.5 for detected targets. All other shipments were within acceptance limits for cooler temperature.

There were some shipments that were received without any cooler seals, including 59787, 59621, and 59546. All other shipments were received with cooler seals but no sample seals.

Calibrations:

The CCC %RSD requirment is met for soil calibrations. For the water samples, the laboratory has used a nonlinear regression for pentachlorophenol. While the use of such calibration strategies is acceptable by method, the method specifically requires the CCC %RSD to fall at 30% or below. In this case, the laboratory did not provide the average % RSD values but the reviewer calculated it as 47.3% for pentachlorophenol.

For most of the targets, the laboratory has been successful at calibrating from 0.5 ug/ml to 25 ug/ml. This is a somewhat lower calibration range than is normally used for 8270 analysis, but is achievable. It would be desirable to make sure that the laboratory mdls support this as well as the calibration curve.

Several of the targets had %D limits that exceeded the 20% requirement. Positive detections associated with such cases are qualified as JC#, where # is the %D observed. There is a possible variability to values qualified JC due to variability in the calibration factors.

Internal Standard Areas:

Internal standards were recovered high in several instances. In several others, internal standards were recovered low. In either case, when associated with detected targets the results are qualified as JI#, where # is the recovery observed. Such deviations can indicate a bias due to sample matrix. The laboratory has reanalyzed samples when this occurred. Original and re-analysis results are reported.

Surrogates:

The only surrogates to fall outside of the control windows were high, or were diluted out. If targets were detected associated with high recoveries, data are qualified as JS#, where # is the recovery observed. Reanalyses were conducted by the laboratory when appropriate. Data could be biased high due to matrix interferences.

MS/MSD Results:

MS/MSD samples had compounds out of limits, but none resulted in qualification. There were a sufficient number of MS/MSD analyses conducted.

LCS Recoveries:

For the LCS associated with water set 59851, 3,3'-dichlorobenzidine was not recovered in the LCS. This target is qualified as RL0 in the associated data. Also, 2,4-dimethylphenol was recovered at only 10% in this same set, and was also qualified as RL10. Soil LCS results were within limits.

Method Blanks:

The method blanks all reported detections of phthalate esters below the reporting limit.

SDG.: 59795, 59847, 59862, 59863

SAMPLE NO.: See Attachment 70 soils

The data are usable for project purposes with consideration of the following qualification.

Calibrations:

Several of the targets had %D limits that exceeded the 20% requirement. Positive detections associated with such cases are qualified as JC#, where # is the %D observed. There is a possible variability to values qualified JC due to variability in the calibration factors.

Internal Standards:

Internal standards were recovered high in one LCS and in ISP13A. QC samples are not qualified and only detected data are qualified for high IS. In all other exceedences, internal standards were

recovered low. When the IS is low, all compounds are qualified as JI#, where # is the recovery observed. Such deviations can indicate a bias due to sample matrix. The laboratory has reanalyzed samples when this occurred. When only one IS is out of limits, there is usually little impact on the data and the quantitation calculation incorporates the high or low bias into the equation. For this reason, data have not been qualified for undetected values when only one IS is out. When several ISs are out of limits and near the same recovery value, the average recovery has been applied to all qualifications. The following samples are JI qualified:

FB1 BVP01A SPP01A SPP02A SPP03A SPP06A SPP06ADUP SPP07A ISP12A ISP13ADL ISP14A ISP15A RZ303A

Surrogates:

Several surrogates were recovered out of limits, or were diluted out. If targets were detected associated with high recoveries, detected data are qualified as JS#, where # is the recovery observed. Samples showing low recoveries are qualified as JS#. Only sample 21SP06 was qualified. Reanalyses were conducted by the laboratory when appropriate. Samples with surrogates diluted out are not qualified.

LCS Recoveries:

A few analytes were recovered high. In those cases there were no associated detections in samples and qualifiers were not added.

2,4-dinitrophenol was recovered low (20%) in the LCS for set 49847. This resulted in qualification as JL20, indicating that this analyte may be biased low. No detections of the compound were noted. Pyrene was recovered high in the same set, and there were detected levels of this compound. These were qualified as JL148, where the recovery was 148%. This analyte may be biased high.

Method Blanks:

Some method blanks showed detections of phthalate esters below the reporting limit.

System Performance:

For soils, all screening levels are nominally met. Some of the actual reporting limits are elevated in soils due to high percent moisture levels. This could raise a few targets above the screening levels, but most should still be below. In addition, some samples required dilution due to high levels of target and nontarget compounds and in those samples reporting limits are consequently elevated.

3.2.4 ICP SW-846 Method 6010 Plus Cyanide

SAMPLE DIGEST NUMBER: 59090, 59546, 59621, and 59787

NUMBER OF SAMPLES: Soils 29 metals, 2 CN

The quality of the data is acceptable and usable with consideration of the following qualifications.

Blanks

Per the 10% review, one SDG (59546) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table.

CALIBRATION BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (mg/Kg)	Qualifier
59546	Barium	Prep	-1.17	JK1.2
	Cadmium	Prep/CCB	-0.095/-.16	JK.16
	Chromium	CCB	-0.12	JK.12
	Lead	CCB	-0.54	JK.54
	Mercury	Prep	-0.038	JK.04
	Silver	PrepCCB	0.162/.24	UB.24

Negative blank levels whose absolute value was greater than 2X the IDL that resulted in sample qualification were qualified JK-#, where # is the negative value of the blank. All data are considered to be biased low with the bias increasing as the blank value increases.

For preparation blanks, all positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the associated blank. Qualified data are fully usable as undetected values at the elevated reporting limit. Cadmium and silver are UB in SDG 59621. Silver is UB in SDG 59546.

Negative blank levels whose absolute value was greater than 2X the IDL that resulted in sample qualification were qualified JK-#, where # is the negative value of the blank. All data are considered to be biased low with the bias increasing as the blank value increases. Cadmium, mercury and lead are JK in SDG 5946. Lead is JK in SDG 59621. Silver is JK in SDG 59787.

Interference Check Sample

In SDG 59621 Lead had a final ICS percent recovery of 68%. The samples were qualified JI68. When the Spike recovery is below the QC limits, it is possible data are biased low or false negative data could be reported.

Matrix Spike

Barium in the MS in SDG 59546 had a percent recovery of 200.7%, while Mercury had a percent recovery of 68.6%. Barium in the MS in SDG 59787 had a percent recovery of 70.7%, while Lead had a percent recovery of 65.2%. The affected data were qualified JS#, where # is the value of the compound percent recovery. When the Spike recovery is above the QC limits, it is possible reported data are biased high. When the Spike recovery is below the QC limits, it is possible data are biased low or false negative data could be reported.

Matrix Duplicate

The duplicate percent recovery for Lead in SDG 59546 was 84.8%. The duplicate percent recoveries for Cadmium, Chromium, and Lead in SDG 59787 were 75.3%, 36.5%, and 56.6%, respectively. The samples were qualified JD#, where # is the value of the %D. There could be a variability in the reported data values due to sample inhomogeneity. It is possible the variability of the reported results increases as the RPD or difference between the values increases.

Laboratory Control Sample

Mercury in SDG 59621 LCS had a recovery of 75.9%. The affected data were qualified JL#, where # is the value of the compound percent recovery. When the Spike recovery is above the QC limits, it is possible reported data are biased high. When the Spike recovery is below the QC limits, it is possible data are biased low or false negative data could be reported.

Serial Dilution

Data for barium and lead in SDG 59787 were qualified due to the %D of the Serial dilution being above 10%. Data were qualified JE#, where # is the value of the percent difference. When the %D's are above the QC limits, it is possible reported data are biased high due to interference.

3.2.5 SW-846 6010B and CVAA Mercury

SAMPLE DIGEST NUMBER: 59795, 59847, 59859, 59860, 59864, 59865 and 59866

NUMBER OF SAMPLES: 68(Soil), 25(Water)

The quality of the data is acceptable and usable with consideration of the following qualification.

Blanks

Per the 10% review, one SDG (59795) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table.

BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (mg/Kg)	Qualifier
59795	Barium	Prep/CCB	-0.96/-1.1	JK-1.1
	Cadmium	CCB	0.08	UB.08
	Chromium	CCB	0.17	UB.17
	Mercury	Prep	-0.006	JK-.006
	Selenium	CCVB	1.79	UB1.8
	Silver	CCB	0.27	UB.27

Negative blank levels whose absolute value was greater than 2X the IDL that resulted in sample qualification were qualified JK#, where # is the negative value of the blank. All data are considered to be biased low with the bias increasing as the blank value increases.

All positive sample values that were less than 5X the preparation blank result for that analyte received qualification UB#, where # is the value of the associated blank. Qualified data are fully usable as undetected values at the elevated reporting limit.

Matrix Spike

Fourteen MS spike recoveries were outside acceptance limits in SDG 59847. Potassium in the MS in SDG 59854 had a percent recovery of 73.3%. Calcium in the MS in SDG 59860 had a percent recovery of 134%. Seven MS spike recoveries were outside acceptance limits in SDG 59864. Ten MS spike recoveries were outside acceptance limits in SDG 59865. The affected data were qualified JS#, where # is the value of the compound percent recovery. When the Spike recovery is above the QC limits, it is possible reported data are biased high. When the Spike recovery is below the QC limits, it is possible data are biased low or false negative data could be reported.

Matrix Duplicate

The duplicate RPD for Iron in SDG 59860 was 37.8%. The duplicate RPD for Barium and Lead in SDG 59865 were 36%, and 45%, respectively. The samples were qualified JD#, where # is the value of the %RPD. There could be a variability in the reported data values due to sample inhomogeneity. It is possible the variability of the reported results increases as the RPD or difference between the values increases.

Serial dilution

The associated affected data due to the %D of the Serial dilution being above 10% were qualified JE#, where # is the value of the percent difference. When the %D's are above the QC limits, it is possible reported data are biased high due to interference.

SDG	Analytes qualified
59847	aluminum, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, vanadium, zinc
59859	cadmium, manganese

SDG 59866 was also submitted as part of this set and reviewed per the report criteria. Full TAL metals were analyzed for this set rather than the RCRA short list. The following qualifiers have been applied due to out of limits QC.

Analyte	Qualifier
antimony	UB.43 (Values <2.15) JS36
cadmium	JK-.18
lead	JS71D45
magnesium	JS47
mercury	UB.046RS0 (Values < .23); JS0

Analyte	Qualifier
potassium	JS68
silver	UB.23 (Values < 1.15)
thallium	JS67
zinc	JS68
manganese	JS143

3.3 Soil and Water Samples Collected JUNE 2000 SAMPLING

3.3.1 SW-846 8270 SEMI-VOLATILES

SDG. 203744, 203999, 203752

SAMPLE NO. See Attachment 12 Soils, 14 Waters, 5 TCLP

Data are fully usable for project purposes with consideration of the following qualification.

Chain of Custody:

SDG 203752 and SDG 203744 were received at a temperature of 0.5 deg C. This should not be a problem as long as containers were not compromised. The indication is that no such problem was observed.

Calibrations:

For most of the other targets, the laboratory has been successful at calibrating from 0.5 ug/ml to 25 ug/ml. This is a somewhat lower calibration range than is normally used for 8270 analysis, but is achievable. It would be desirable to make sure that the laboratory mdls support this as well as the calibration curve.

In the case of the initial calibration associated with soil samples, the pentachlorophenol calibration showed an r2 value of 0.998, but still with only 5 data points. The carbazole was again done with a power curve and gave an r2 value of 0.990, and the 3,3'-dichlorobenzidine gave an r2 value of 0.992. Thus detections of carbazole and 3,3'-dichlorobenzidine are qualified as JC#.

Several of the targets had %D limits that exceeded the 20% requirement. Positive detections associated with such cases are qualified as JC#, where # is the %D observed. There could be a variability to the data qualified 'JC' due to variability in the calibration factors.

Internal Standards:

Internal standards were recovered high in samples LAW2 and LBE1, SDG 203752, soil analysis. This is clearly due to high concentrations of nontarget compounds in these samples, causing considerable interference. Associated detected targets are qualified as JI#, where # is the % recovery of the internal standard.

Internal standards were recovered low in samples 8025, 8012, 8117, and 8212 in SDG 203744. Associated targets have been qualified as JI#, where the # is the % recovery of the internal standard. Some of these samples were reanalyzed at dilution due to high levels of target and internal standards were recovered normally in those cases, indicating that this is due to matrix.

Surrogates:

Several surrogates were recovered out of limits, or were diluted out. If compounds were detected associated with high recoveries, detected data are qualified as JS#, where # is the recovery observed. Samples showing low recoveries are qualified as JS#. Samples with surrogates diluted out are not qualified. High recoveries could indicate high bias and low recoveries could indicate low bias to the data due to matrix effects. One surrogate is allowed to be out in each fraction before qualification is applied.

LCS Recoveries:

A few analytes were recovered high. In those cases there were no associated detections in samples and qualifiers were not added. 2,4-dimethyl phenol was recovered low (20%) in SDG 203999. Associated samples have been qualified as JL20 for this analyte.

Method Blanks:

Some method blanks showed detections of phthalate esters below the reporting limit.

Matrix Spikes and MS Duplicates

MS/MSD were not present for client samples for the water samples.

SDG. 204374, 204217, 204098, 204373, 204036, 204371, 204915, 204939, 205585

SAMPLE NO. See Attachment 111 WATERS

Data are fully usable for project purposes with consideration of the following qualification.

Calibrations:

The laboratory has chosen to use linear or non-linear regression curves when the %RSD exceeds 15. This has been done for several targets and criteria have been met in most cases. There are occasional targets for which r2 values fall below 0.995. These have not required qualification because they have not been detected in samples.

Several of the targets had %D limits that exceeded the 20% requirement. Positive detections associated with such cases are qualified as JC#, where # is the %D observed. There is a possible variability to values qualified JC due to variability in the calibration factors.

Internal Standards:

Internal standards were recovered low in several instances in set 204036 and 204371. In 204371, these samples also had extremely high dilutions due to high compound values. The results are qualified as JI#, where # is the recovery observed. Sample 30MW2 had undetected compounds rejected, RI due to extremely low IS recovery. Such deviations can indicate a bias due to sample matrix. The laboratory has reanalyzed samples when this occurred and such reanalyses have confirmed a matrix effect.

Surrogates:

Several surrogates were recovered out of limits, or were diluted out. If targets were detected associated with high recoveries, detected data are qualified as JS#, where # is the recovery observed. All samples are qualified JS# for low recoveries. Re-analyses were conducted by the laboratory when appropriate. Surrogates diluted out are not qualified.

LCS Recoveries:

A few analytes were recovered high in 204915 and 204939. In those cases there were no associated detections in samples and qualifiers were not added. Some analytes were recovered low and were qualified as JL#, where # is the recovery observed.

An unusually high number of compounds were recovered in the 40 – 50% range for SDG 204098 and 204217 samples run on 7/7/00 and in the 20 – 30% range for SDG 204939. Phenol, naphthalene, 3,3'-dichlorobenzidine were rejected RL# in set 204939 for LCS below 10%.

Method Blanks:

Some method blanks showed detections of phthalate esters below the reporting limit.

3.3.2 SW-846 8260B Volatiles

SDG. 204217, 204098, 204373, 204036, 204371, 204915, 204939, 205585

SAMPLE NO. See Attachment, 111 WATERS

Data are fully usable after consideration of qualifiers.

Chain of Custody and Sample Condition:

One SDG, 204217, was received as several sample kits. Two of the kits had cooler temperatures slightly above the upper limit of 6 deg C. Because of the laboratory system for recording this information, it is not possible to determine which samples are affected. There is no apparent relationship between the sample kit affected and the chain of custody.

Because the deviation is minor the results have not been qualified. However, the same SDG indicates that no seals were present on the coolers. This is a potentially serious deviation. Again, no qualifiers have been added, but project management are alerted for potential problems.

Initial and Continuing Calibrations:

A number of targets gave low response factors consistently in the initial calibrations. See executive summary.

Matrix Spikes:

There were no MS/MSD sets provided with these SDGs. This appears to be because insufficient sample has been provided to the laboratory.

Surrogates

One surrogate was out high at 150% for 34MW7D; detected data are qualified JS150 and there could be a slightly high bias to the data. One other surrogate was low, but it was in a diluted sample and no reported data are affected.

Laboratory Control Samples:

For the majority of targets the LCS recoveries were well within the limits. There were occasional failures, in which recoveries fell either above or below the control window. In cases where the recoveries fell below the window, non-detected targets are qualified as UJL# and detected targets as JL#. This indicates the possibility of low bias due to the low recovery. In the case of high recoveries, nondetected targets have not been qualified, and detected targets have been qualified as JL#, indicating the possibility of a high bias.

Method Blanks:

In general, the method blanks are free of contaminants except for methylene chloride, detected at levels below the reporting limits in some method blanks. See executive summary.

Detection Limits:

This project includes "screening level" concentrations, which are the goals for reporting limits. All the reporting limits for water samples were at least as low as the screening level limits, with the exception of benzene, which is reported with an RL of 5 ug/L. Results are reported below the RL, but the limit of this reporting is not provided by the laboratory.

SDG. 203744, 203999, 203752

SAMPLE NO. See Attachment 7 Soils, 9 Waters, 5 TCLP

The data are fully usable for project purposes with consideration of the following qualification.

Data Deliverables:

The following do not affect data quality, but are noted as deficiencies in the data deliverable. The MS/MSD samples analyzed with these sets are not reported. Although these are not client samples, the data are required for submittal to verify QC frequency criteria.

Chain of Custody and Sample Condition:

SDG 203752 and SDG 203744 were received at a temperature of 0.5 deg C. This should not be a problem as long as containers were not compromised. The indication is that no such problem was observed.

Initial and Continuing Calibrations:

A number of targets gave low response factors consistently in the initial calibrations. See executive summary.

Surrogates:

Sample 8112 and sample 8212 gave high recoveries for one surrogate. Positive detections in these samples are qualified as JS#, where # is the recovery observed.

Matrix Spikes:

There were no MS/MSD sets provided. No project-specific precision or accuracy could be determined.

LCS Recoveries:

For the majority of targets the LCS recoveries were well within the limits. However, there were some serious deviations on SDG 203744. Several targets were not recovered at all in two of the three applicable LCS runs, and several targets were recovered only very poorly. Targets which were not recovered are qualified as RL0 or RL#, where # is the very low recovery observed in these instances. This affects the following samples: TB, 39SL, 8012, 8025, 8112, 8117, 8120, and 822.

Targets with these low recoveries include bromomethane, trichlorofluoromethane, acrolein, acrylonitrile, vinyl acetate, 2-chloroethyl vinyl ether, 1,2-dibromoethane, 1,2-dibromo-3-chloropropane, 1,2,3-trichloropropane, acetonitrile, methacrylonitrile, isobutyl alcohol, 1,4-dioxane, and n-hexane.

Due to the late submittal of packages, all samples are well beyond holding times. The rejected data will be assessed during the data usability process. The laboratory only mentions in the Case Narrative that several of the LCS results are outside of control limits. These samples should have been re-analyzed, but no explanation is offered as to why this was not done.

Internal Standards:

Internal standards met recovery windows except for the fourth internal standard on sample 8212 (SDG 203744), which was recovered at 23%. Results associated with this internal standard are qualified as JI23. Quantitation may be biased high or low depending on the relative behavior of the internal standard and target in the purge.

3.3.3 ICP SW-846 Method 6010B, 200.7, CVAA MERCURY, and Wet Chemistry Methods

SAMPLE DIGEST NUMBER:204036, 204098, 204217, 204371, 204373, 204915, and 204939.

NUMBER OF SAMPLES: 86(RCRA), 18(200.7), 19(Wet Chem) and 1 Oil for RCI

The quality of the data is acceptable and usable as qualified. The following is noted:

Interference Check Sample:

In SDG 204939, Potassium had a percent recovery of 183% and Sodium had a percent recovery of 154%. Since this is a limited list of analytes, the presence of an interfering analyte cannot be determined. No qualification is added, but the possibility of interference is noted for these compounds.

Blanks:

Per the 10% review, one SDG (204939) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table.

BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (ug/L)	Qualifier
204939	Barium	CCB	0.54	UB1.2
	Cadmium	Prep	0.2	None
	Calcium	Prep/CCVB	60.8/144	None
	Chromium	ICVB	0.5	None
	Magnesium	Prep/CCB	48/149	None
	Manganese	Prep	0.74	None
	Mercury	ICV	0.1	None
	Potassium	Prep/ICV	18.8/43	None
	Selenium	Prep	2.7	UB4.8
		CCV	4.8	
	Sodium	Prep/CCB	-21.4/26	None

Negative blank levels were reported, but no data are affected.
Preparation blanks were reviewed for all samples. All positive sample values that were less than 5X the preparation blank result for that analyte received qualification UB#, where # is the value of the associated blank. Qualified data are fully usable as undetected values at the elevated reporting limit.

The following field blanks had contamination above 2X IDL: Mercury at 0.027 ug/L in SDG 20417; Mercury at 0.035 ug/L in RBE and at 0.024 ug/L in RBF in SDG 204098; and Chromium at 0.5 in FBC, at 0.45 ug/L in FBE, and at 0.47 ug/L in RBI in SDG 204373. Data will be reviewed by field personnel because the validator does not have the sample associations with the blanks.

Serial Dilution:

The associated affected data due to the %D of the Serial dilution being above 10% were qualified JE#, where # is the value of the percent difference. When the %D's are above the QC limits, it is possible reported data are biased high due to interference.

SDG	Analyte	%D
204217	Potassium	24%
204098	Sodium	93
204036	Potassium	28
	Sodium	10.4
204371	Barium	11.5

Matrix Spikes

Below is a table of the qualifications for the Metal MS's.

SDG No	SAMPLE	ANALYTE	% RECOVERY	QUALIFIER
204036	All samples	Potassium	169, 133%	JS169
204098	All samples	Potassium	137, 133%	JS137
204217	All Positive Hits	Arsenic	153, 153%	JS153

		Barium	144, 145%	JS145
		Cadmium	149, 148%	JS149
		Chromium	146, 148%	JS148
		Lead	147, 146%	JS147
		Manganese	144, 142%	JS144
		Potassium	216, 224%	JS224
		Selenium	153, 153%	JS153
		Silver	143, 139%	JS143

SDG No	SAMPLE	ANALYTE	% RECOVERY	QUALIFIER
204373	All Samples	Potassium	140%	JS140
204939	All Samples	Sodium	-16.5%	RS0

When the Spike recovery is above the QC limits, it is possible reported data are biased high. When the Spike recovery is below the QC limits, it is possible data are biased low or false negative data could be reported. The sodium spike 35MW2 was 10000 ug/kg and the sample result average was 36500. This is close to the 4 times limit for spike reliability.

Laboratory Control Samples

The LCS for reactive cyanide and sulfide for SDG 204915 were out of limits at 13% and 59%, respectively. Data for CN have been qualified RL13 and sulfide as JL59. Data could be biased low and the undetected CN data are considered to be rejected.

Detection Limits

The QAPP screen limit for arsenic is 4.5 ug/l. The reported IDL for arsenic for SDG 205585 is 5.2. All the 203 and 204xxx sets had acceptable limits. The laboratory will be contacted to correct the limits.

3.4 Groundwater Samples Collected September 2000

3.4.1 SW-846 METHOD 8260 Volatiles

SDG. 208482, 208256, 208489, 208381

SAMPLE NO. 66 waters

Data are fully usable after consideration of qualifiers.

Chain of Custody

SDG 208482 was received with some samples at a temperature of 1.6 deg C, slightly outside the range of 4 +/- 2. This should not be a problem as long as containers were not compromised. The indication is that no such problem was observed.

Surrogates

One sample on SDG 208482, and two samples gave high recoveries on SDG 208381. Positive detections were qualified as JS#, where # is the % recovery observed.

Other surrogate outliers were due to dilution and did not result in qualification.

Laboratory Control Samples

For the majority of targets the LCS recoveries were well within the limits. In the few cases where deviations occurred, positive results have been qualified as JL# for recoveries above the upper control limits, and all results qualified as JL# for recoveries below the lower control limit.

Field QC

Is SDG 208482, field blanks showed methylene chloride contamination below the reporting limit. These results were used to qualify associated samples as UB# for this analyte when it was detected.

SDG. 208351, 208570, 208725, 209018, 209832, 209686

SAMPLE NO. 68 water samples

Data are fully usable after consideration of qualifiers.

A summary of the findings follows.

Chain of Custody and Sample Condition:

Samples in SDG 208351 were received at 10.9 deg C cooler temperature. The laboratory Case Narrative presents this fact with no other explanation. Because the temperature was so high, the results have been qualified as RT11 for nondetected targets and JT11 for detected targets. All other shipments were within acceptance limits for cooler temperature except one kit in 209018 which was at 0.3 deg C. Vials were not frozen and there is no impact on the data.

A number of CCVs showed %D values outside the 20% limit specified in the QAPP. When associated with detected targets, this has resulted in qualification as JC#, where # is the % drift observed. Nondetected targets are not qualified for this unless the drift is particularly severe. In this group, only acetone has been qualified JC40

Surrogate Recoveries:

An instance of surrogate recoveries outside the contract limits was observed. The sample was reanalyzed as a dilution. Similar results were obtained. All results associated with high recoveries have been qualified as JS#, where # is the % recovery observed. When detected compounds are associated with high recoveries, the results are qualified as JS#, but non-detects are not qualified for high recoveries. These data could be biased high due to matrix effects.

Data qualified for surrogates include:

34B2W2 JS144

MS/MSD Analysis:

There were not 1 per 20 of these sets. No associated MS/MSD were analyzed except for SDG 209018. Matrix precision and accuracy cannot be determined for sample sets that lack an MS/MSD.

In sample ORSW09 1,1-dichloroethene was recovered low in both the MS and MSD (50 and 60%). Data for the parent sample have been qualified for JS50 and it is possible false undetected values are reported.

3.4.2 SEMI-VOLATILES ORGANICS SW-846 METHOD 8270

SDG. 208482, 208256, 208489, 208381

SAMPLE NO. 58 Waters

Chain of Custody

SDG 208482 was received with some samples at a temperature of 1.6 deg C, slightly outside the range of 4 +/- 2. This should not be a problem as long as containers were not compromised. The indication is that no such problem was observed.

Analytical Report Forms
A report form I was not provided for sample 38MW3 in SDG 208482, nor was any raw data provided for it.

Calibrations

Several of the targets had %D limits that exceeded the 20% requirement. Quantitated compounds associated with such cases are qualified as JC#, where # is the %D observed. There could be a variability to the reported values due to variability in the response factors.

Internal Standard Areas

All internal standards were recovered high for samples 36MW2, 22AMW2, FBB, FBC, FBD, FBE, FBH, and 38MW2, in LGN 208482.

These results are all qualified as JI#, where # has been chosen as the internal standard with the highest deviation. All internal standards were recovered at well over 200%, with some as high as 450%.

Since surrogate recoveries for these samples did not show severely repressed recoveries, it is unclear what has occurred. It appears that the laboratory spiked at the correct levels and concentrated the extract subsequently. This would result in data that are probably accurate since the relative amounts of internal standard to analyte would be normal. There is no Case Narrative and so if the laboratory discussed this, the discussion is not available.

Surrogates

Several surrogates were recovered out of limits, or were diluted out. If compounds were detected associated with high recoveries, detected data are qualified as JS#, where # is the recovery observed. Samples showing low recoveries are qualified as JS#. Samples with surrogates diluted out are not qualified. High recoveries could indicate high bias and low recoveries could indicate low bias to the data due to matrix effects. One surrogate is allowed to be out in each fraction before qualification is applied.

Laboratory Control Samples

The recoveries were severely repressed, at around 0-4%, for all analytes in several samples reported in SDG 208482 and in SDG 208489. All targets for these samples are qualified as RL<10, indicating very poor recoveries. For detected analytes, the results are qualified as JL#, where # is the recovery in the LCS observed for that analyte. The laboratory did not provide any explanations, but simply pointed out that the LCS did not meet criteria.

The laboratory re-extracted all of these samples out of holding time and with acceptable LCS recoveries. Results for these re-extracted analyses are qualified as JH#, where # is the number of days past the holding time. These data could be biased low for compounds most susceptible to degradation.

Field QC

Field blanks are those samples designated as RB or FB. These occasionally have low levels of detected targets, including phthalate esters and PAH targets. There associated samples are not identified, so they have not been used for further sample qualification. Project personnel will evaluate the potential effect of field blanks on sample results

Field duplicates have not been identified, or if identified, the sample with which they are associated is not clear.

SDG. 208351, 208570, 208725

SAMPLE NO. 46 Water

Holding Times

Hold Times were not met for samples 38MW9, 38MW4. These samples are flagged as JH5. Compounds susceptible to biodegradation could be biased low or false undetected values reported.

Calibrations

Several of the targets had %D limits that exceeded the 20% requirement. Quantitated compounds associated with such cases are qualified as JC#, where # is the %D observed. There could be a variability to the reported values due to variability in the response factors.

Internal Standards

Internal standards were recovered high in one LCS and in the samples listed below. QC samples are not qualified and only detected data are qualified for high IS. When several IS's are out of limits and near the same recovery value, the average recovery has been applied to all qualifications. Recoveries exceeding 200% were found in the above mentioned sample. The sample is qualified JI# for all undetected and detected analytes. Analytes could be considered for low bias and possible false negatives, although a general

repression of all compounds could have occurred. Further review of the chromatograms could be performed to verify the bias. It is possible the IS was double spiked for 340B16 since all IS's are out and over 200%. There are essentially no detected compounds in the sample and no indication of matrix interference in the sample chromatogram.

SDG	Sample	
208570 340B16	all IS's out high	
208351	38-MW9	IS5, 110%
38-MW4	IS5, 111%	

LCS Recoveries

A few analytes were recovered high. In those cases there were no associated detections in samples and qualifiers were not added. In control samples where recoveries were below the LCL the result is qualified as JL#, indicating that this analyte may be biased low. In instances where recoveries were high, and there were detected levels of this compound; qualification is JL#. This analyte may be biased high

3.4.3 Diesel Range Organic by SW 846/ 8015 M and light Hydrocarbons by RSK-175

SAMPLE DIGEST NUMBER: 208256, 208482, 208489, 208381

NO. OF SAMPLES Water - 25 for DRO, 10 for light hydrocarbons

The quality of the data is considered fully acceptable and usable. No data have been qualified.

SDG NO: 208351, 208570, 208725, 209608

NO. OF SAMPLES Water 15 DRO; 6 LT Hydrocarbons

The quality of the DRO data as qualified is considered fully acceptable and usable.

The quality of the Light Hydrocarbon data for SDG 208351 and 208570 has samples analyzed for Light Hydrocarbons also. The Hold Times were not met for samples in these groups. The samples have been qualified as JH12, JH4 and JH1 for all targeted analytes. All samples were reported Non-detect for all Light Hydrocarbon targeted analytes. It is possible for results obtained outside the hold time requirements to give inaccurate results, possibly false negatives. For this reason, such data should not be used without some additional information that will allow some assessment of how significant hold times for these analytes are.

3.4.4 METALS BY ICP SW-846 METHOD 6010B, METHOD 200.7, CVAA MERCURY, AND WET CHEMISTRY

SDG: 208256, 208351, 208381, 208482, 208489, 208570, 208703, and 208725.

SAMPLE MATRIX: 94 Waters SAMPLING DATE (Mo/Yr) 9/00

NUMBER OF SAMPLES: 90(RCRA), 20(200.7), 39(Wet Chem)

The quality of the data is acceptable and usable as qualified below. The following is noted:

Methods and Calibration

The method used for soils Total Organic Carbon (TOC) in set 209018 is not the method noted in the QAPP, nor the one submitted by the laboratory as part of the QAPP. The required method is SW-846 Method 9056, a titration method was used. The two methods must be compared by the laboratory to verify the reported results. TOC soils data have been qualified 'JQ' to indicate improper method.

There was no 3 point calibration for TOC soils as required by the method, only an ICV/LCS. All analyses were acceptable except for the 209018 TOC. The ICV was 111%. Data have been qualified JC111 and it is possible there is a variability to the data due to only having a one point curve.

Method and Calibration Blanks

Per the 10% review, one SDG (208256) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table. It is of concern that almost all of the data submitted are qualified for blank problems. This indicates that the Method Detection Limits are unrealistic and that results reported at the MDL are more apt to be due to instrument noise than to the presence of the analyte.

BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (ug/L)	Qualifier
208256	Arsenic	CCB	7.8	UB7.8
	Barium	Prep	1.9	UB1.9
		ICVB	1.8	
		CCVB	1.7	
	Cadmium	Prep	2.0	UB2.2
		ICVB	2.0	
		CCVB	2.2	
	Chromium	Prep	2.4	UB2.4
		ICVB	2.2	

		CCVB	2.3	
	Lead	Prep	2.4	UB2.9
		ICVB	1.3	
		CCVB	2.9	
	Mercury	CCVB	0.03	JK-.04
		CCVB	-0.04	
	Selenium	CCVB	16.5	UB17
	Silver	Prep	2.7	UB2.8
		ICVB	2.4	
		CCVB	2.8	

Negative blank levels whose absolute value was greater than 2X the IDL that resulted in sample qualification were qualified JK#, where # is the negative value of the blank. All data are considered to be biased low with the bias increasing as the blank value increases.

Field Blanks

The following field blank had contamination above 2X IDL: Barium at 13.4 ug/L in SDG 208256. The contamination in the remainder of field blanks was either canceled by the method blank, the ICV blank or the CCV blank contamination.

Matrix Spikes

The recovery for the TOC spike in set 209108 was 132% and data have been qualified JS132. Data for all samples for 208351 have been qualified JS145 for potassium and data could be biased high for these high spike recoveries. Data for mercury in set 208381 are qualified JS66 and data could be biased slightly low due to matrix spike recovery.

Serial dilution

The associated affected data due to the %D of the Serial dilution being above 10% were qualified JE#, where # is the value of the percent difference. When the %D's are above the QC limits, it is possible reported data are biased high due to interference.

Holding Times

Nitrite data for 208482 have been qualified JH#, where # is the 2 or 3 days over holding time. In set 208351, the nitrite holding time exceedences were 5 to 6 days and the reviewer has qualified data RH# to indicate the possibility of oxidation of the nitrite and the reporting of false undetected values.

3.5 Groundwater Samples Collected January-February, 2001

3.5.1 SW-846 Method 8260B - Volatiles

SDG: 213914, 213920, 214400

SAMPLE MATRIX: 55 Water SAMPLING DATE (Month/Year): 01/01

General Comment

Trip blanks were in the coolers, but not noted on the COC for analysis. Trip blanks, therefore, were not analyzed. There is no evidence of field contamination in any of the samples and the lack of trip blanks has not affected the QC for these samples.

Note that there are some BTEX-only samples in set 214400. Data are fully usable after consideration of qualifiers noted below.

Calibrations:

A number of targets gave low response factors consistently in the initial calibrations. Compounds affected include acrolein, acrylonitrile, 2-chloroethylvinyl ether, methacrylonitrile, 1,2-dibromo-3-propane, isobutyl alcohol and 1,4-dioxane. Among these, isobutyl alcohol and 1,4-dioxane gave the lowest response, with response factors of 0.004 or less.

Undetected compounds having response factors below 0.05 were qualified as RC#, where # is the value of the response factor observed in the associated initial calibration. Such target results may potentially result in false negatives due to poor response in the analysis. Data are considered to be rejected. Detected compounds are qualified JC#; the data are usable for project purposes. For most of these compounds, the LCS recoveries were acceptable indicating that the compounds can be accurately detected at mid-range levels.

Acetone is calibrated with an r^2 value of 0.994, positive results of this compound have been qualified JC0.994 to indicate a lack of linearity to the calibration. The limit is 0.995 and the affect on the data is not considered to be significant.

The same compounds gave low responses for the continuing calibration. No further qualification is applied.

LCS/LCSD Analysis:

For the majority of targets the LCS recoveries were well within the limits. There were occasional failures, in which recoveries fell above and below the control windows. In the case of high recoveries, non-detected targets have not been qualified. Low recoveries of compounds have been qualified JL# where # represents the recovery of the spiked analyte. There could be a slight low bias to the results due to low method accuracy.

Samples in SDGs 213914 and 213920 analyzed 01/29, 01/30, 01/31 and 02/02 have been qualified JL70 for chloromethane, dibromomethane (EDB), and cis-1,3-dichloropropene.

Data for 214400 have been qualified as follows:
LCS4L 2/20: vinyl acetate JL60; chloromethane JL70
LCS3L 2/16: isobutyl alcohol JL67

LCS E 2/16: 4-methyl-2-pentanone JL60; bromoform JL70; 2 hexanone JL60

In instances where undetected compounds have been qualified it is possible false undetected values have been reported. High recoveries of undetected compounds are not qualified.

Samples:

SDG 213914 samples 33MW4, DUPE A, 33MW4FP, 33MW6FP, DUPE C, 34B1W1 and 34B2W2 analyzed at dilution on 01/30, 01/31 and 02/03; are not qualified as the original analyses are within satisfactory calibration limits.

Field Blank

The Field Blank and both Equipment Rinses in SDG 213914 contain 0.9 ug/l methylene chloride. None of the data submitted with these blanks contained MC and no qualification has been applied.

SDG. 214031, 214399, 214382, 214254, 215319

SAMPLE MATRIX: 69 Water

Data are fully usable after consideration of qualifiers.

Chain of Custody

There were several coolers in which the temperature of receipt was below the lower limit of 2 deg C. The containers were intact and so no qualification is required.

Calibrations

A number of targets gave low response factors consistently in the initial calibrations.

Compounds affected include isobutyl alcohol, 1,4-dioxane, acrolein, DBCP, and 2-chloroethylvinyl ether. Among these, isobutyl alcohol and 1,4-dioxane gave the lowest response, with response factors of 0.0033 or less.

Undetected compounds having response factors below 0.05 are qualified as RC#, where # is the value of the response factor observed in the associated initial calibration. Such target results may potentially result in false negatives due to poor response in the analysis. Data are considered to be rejected.

These analytes appear in most cases seem to be recovered normally in the LCS and LCS duplicates associated with these calibrations indicating acceptable quantitation at mid-range concentrations. However, the data should not be considered as usable without further review.

A number of CCVs showed %D values outside the 25% limit specified in the QAPjP. In this group, no detected targets were associated with such calibrations so no qualifiers have been applied. Response

factors were acceptable indicating that the compounds would have been detected if they had been present.

Surrogates

Sample FLDDG in SDG 214382 had surrogates recovered low. This sample was reanalyzed by the laboratory with satisfactory recoveries. The original run has been qualified as JS64, where # is the recovery of the lowest-recovered surrogate. The re-analysis is recommended for use.

Sample MW6 in this SDG had a high recovery of BFB (127%) and detected targets in this sample have been qualified as JS127. There could be a slight high bias to the data due to matrix interferences.

Matrix Spikes

No MS/MSD was present for 214399. There were multiple MS/MSDs in set 214254, 214382 and the project frequency of 1/20 has been met.

One recovery was out of limits on the low side. Native sample was qualified as JS#, where # is the recovery observed, where this occurred. Undetected data are not qualified for high recoveries, which did occur in several samples.

Sample	Compound	Qualification
38MW9	1,1 dichloroethene	JS70

Laboratory Control Spikes

For the majority of targets the LCS recoveries were well within the limits. In the few cases where deviations occurred, positive results have been qualified as JL# for recoveries above the upper control limits, and all results qualified as JL# for recoveries below the lower control limit. Low recoveries are in the 60 - 70% range, indicating a slight low bias to the method accuracy. The impact on the data is not considered to be significant.

Method Blanks

A few method blanks showed methylene chloride contamination at levels at or below the reporting limit. The associated samples were qualified as UB# for this analyte. The data are fully usable as non-detects.

Field QC

Several of the rinse blanks and trip blanks contained levels of methylene chloride below the reporting limit. None of these were associated with samples that showed detections that had not been previously qualified for method blank contamination.

Holding Times

All original analyses were within holding times. For sample 33BMW2 a secondary dilution was conducted two days outside of holding times and the data for this reanalysis has been qualified as JH2.

3.5.2 Method 8270 - Semi-Volatiles, Low Detection Limit

SDG. 213914, 213920, 214031, 214254, 214382, 214399, 214400, 215319

SAMPLE MATRIX: 129 Water SAMPLING DATE (Month/Year): 01, 02 /01

Data are fully usable after consideration of qualifiers.

Internal Standards:

Internal standards were recovered low in analysis of SDG 213914 on 02/05. Two samples (33-MW6 and 33MW4FP) received qualifying codes JI#, where # is the %R observed. All other samples analyzed on 02/05 have been reanalyzed or the targets are not affected by the out of bounds IS.

One IS is at 5.6% in sample 30MW2. Data associated with this IS are qualified RI5.6 to indicate possible significant matrix effects. The sample was not re-analyzed. One IS is slightly low at 49% in the re-analysis of 34MW14. Data are qualified JI49. One IS is low in sample 37MW2 at 34%. Data associated with this IS are qualified JI34. The sample was not re-analyzed.

Surrogates:

Several samples had one surrogate recovered out of limits; this was usually a low phenol. Several surrogates were diluted out. Samples with surrogates diluted out are not qualified. High recoveries could indicate high bias and low recoveries could indicate low bias to the data due to matrix effects. One surrogate is allowed to be out in each fraction before qualification is applied.

All the surrogates were low in sample 34MW14. Data are qualified RS4. The sample was re-analyzed with acceptable results except for the one IS which is just under the 50% limit. The re-analysis is recommended for use.

LCS Recoveries:

Pentachlorophenol was low in most of the sets at 11 - 18%. Data have been qualified JL#, where # is the %R. Data for PCP could be biased low due to poor method accuracy. Sets affected include 214382/383, 214254, 214031/165, and 214400.

Matrix Spikes

MS/MSD were not present in set 214399, 214382. A Method Blank spike was used.

Method Blanks:

Some method blanks showed detections of phthalate esters at or below the reporting limit.

Positive detections of phthalate esters in samples associated with these method blanks have been qualified as UB#, where # is the associated blank level, unless the sample level is 10X that in the blank or higher. Data are fully usable as undetected values.

Field Blanks:

Most field blanks were free of contamination after qualification for method blanks. Equip10, Field Blank4, EQUIP5 had butyl benzyl phthalate at 0.55, 0.84, .13 ug/l respectively. Rinse Blank 6 had fluorene at 1.2 ug/l. Affected positive data have been qualified UB#, where # is the value of the blank.

Sample Identification

Per the 10% review. Spectral matches were good. The laboratory has correctly identified m detected compounds with the following observations. Note that there is very high interference with the higher molecular weight compounds like anthracene, fluorene, phenanthrene, pyrene.

In sample 34MW4, the reviewer does not concur that 2-methyl-4,6-dinitro phenol can be identified accurately away from the interferences. The value is already flagged 'J' by the lab and no further qualification is added.

3.5.3 EPA SW-846: Method 6010, Method 7470

SDG: 211502, 13914, 213920, 214031, 214254, 214382, 214399, 214400, 214310, 215319

NUMBER OF SAMPLES: 115 water,

General Comment on Deliverables

Three oil samples and 1 water sample were submitted for Bulk Density (Standard Methods 2710Fmo), Oil/Water tension (ASTM D971-82), Viscosity (ASTM D445-97), Specific Gravity (ASTM D1429C). There is no QC associated with these samples unless a sample duplicate is requested. There is no duplicate designated. Only holding times are reviewed and they were acceptable.

The quality of the data is acceptable and usable as qualified. The following is noted:

Blank Contamination

Per the 10% review, one SDG (214399) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table.

BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (ug/L)	Qualifier
214399 * 214400	Arsenic	Prep	-6.9	JK-11.2
		CCVB	-11.2	

	Barium	Prep	-1.8	None
		ICVB	-1.5	
		CCVB	-1.9	
	Cadmium	Prep	-2.0	JK-2
		ICVB	-2.0	
		CCVB	-2.2	
	Chromium	Prep	-8	JK-8.7
		ICVB	-8.5	
		CCVB	-8.7	
	Lead	Prep	-1.2	JK-2.4
		CCVB	-2.4	
	Selenium	CCVB	23.1	UB23
	Silver	Prep	1.3	UB1.9
		ICVB	1.9	
		CCVB	1.6	

* Prep blank only

Negative blank levels whose absolute value was greater than 2X the IDL that resulted in sample qualification were qualified JK#, where # is the negative value of the blank. All data are considered to be biased low with the bias increasing as the blank value increases.

Preparation Blanks

Contamination was found during review of the remaining preparation blanks. All positive sample values that were less than 5X the preparation blank result for that analyte received qualification UB#, where # is the value of the associated blank. Qualified data are fully usable as undetected values at the elevated reporting limit. A full list of qualified data are contained in the project database.

Field Blanks

Most of the contamination in the field blanks was canceled by the method blank contamination. The contamination that remained was used to qualify the affected samples that had values less than five times the blank contamination. The qualification was UB#, where # is the value of the associated blank.

Matrix Spikes

Metals were acceptable. One TOC sample PB11 was slightly high at 126%. Data for the set are qualified JS126 and there could be a slight high bias to the data.

In set 215319, Barium spike was 128%. The 2 samples in the set are qualified for barium JS128 and the reported values could be biased slightly high.

Matrix Duplicates

The duplicate RPD for Barium associated with samples 214006 in SDG 213914 had an RPD of 102%. The 214006 samples were qualified JD102. There could be variability to the reported data due to matrix variability.

Serial Dilution

The serial dilution for set 215319 for Barium was 26%. Data are qualified JE26. There could be a non-linear matrix effect.

Project Reporting Limits
The QAPP reporting limit for water arsenic is 4 ug/l. The laboratory has reported arsenic at 5.2 ug/l.

3.6 Soil Samples Collected May – June 2001

3.6.1 VOLATILE ORGANICS SW-846 METHOD 8260B

GENERAL COMMENTS
The following comments apply to all volatile analyses and are not repeated in the individual sections.

The laboratory has provided data that comply with the requested method. All unqualified and 'J' qualified data are considered to be fully usable with consideration of the qualification applied per the data validation process. Several data points have been rejected due to low calibration response factors, internal standard and surrogate recoveries. In most cases, the rejected data have been re-analyzed and usable data have been reported. The 'R' qualified data are considered to be rejected and not usable for decision-making purposes. In most cases, these are undetected values and it is possible false undetected values have been reported if the compound is suspected of being present at the site.

SDG. 218538, 218525, 218528, 218608, 218602, 218502

Number of Samples: 26 Soils

Surrogates:

A number of surrogate recoveries fell outside of limits. When these recoveries are repressed but above 10%, the undetected and detected results are qualified as JS#, where # is the recovery observed. When a recovery is less than 10%, the results are qualified as RS# and are considered to be rejected due to extreme matrix effects. Where this has occurred, the laboratory has re-analyzed the sample either at the same or at a different dilution, and in each case there exists data that can be used.

Calibrations:
A number of targets gave low response factors consistently in the initial calibrations. Compounds affected include isobutyl alcohol, 1,4-dioxane, 2-butanone, acrolein, acrylonitrile, 2-chloroethylvinyl

ether, DBCP, and methacrylonitrile. Among these, 1,4-dioxane gave the lowest response, with some response factors of 0.001 or less.

Compounds having response factors below 0.05 are qualified as RC#, where # is the value of the response factor observed in the associated initial calibration. Such target results may potentially result in false negatives due to poor response in the analysis. Data are considered to be rejected.

These analytes appear in some cases seem to be recovered normally in the LCS and LCS duplicates associated with these calibrations indicating acceptable quantitation at mid-range concentrations. However, the data should not be considered as usable without further review.

The laboratory has chosen to use a regression curve when the %RSD is greater than 15%. In most cases, a linear curve has been used, but in some a second-order curve has been used. The second order curve requires that 6 points be run (SW-846 and AFCEE), and this has also been done. In several instances, the r2 value falls below 0.995. No Positive detections from such results were observed; hence no qualifiers have been issued for these deviations.

The continuing calibration showed the same compounds failing to achieve the minimum response as occurred in the initial calibrations. In all cases, the low responding compounds were already qualified for the initial calibration behavior and were not additionally qualified. Data are considered to be rejected. It is possible false undetected values have been reported.

A number of CCVs showed %D values outside the 20% limit specified in the QAPP. When associated with detected targets, this has resulted in qualification as JC#, where # is the % drift observed. Non-detected targets are not qualified for this unless the drift is particularly severe. In this group, no detected targets were associated with such calibrations so no qualifiers have been applied.

Method Blanks:

Methylene chloride and toluene are detected in a number of the method blanks. When methylene chloride is detected with values less than (10 X blank value), the data are qualified UB#, where # is the value of the associated blank. No toluene data were reported. Data are fully usable as undetected values at the elevated detection limit.

Laboratory Control Sample

The LCS was spiked with all targets, and recoveries were reported for all targets. LCS duplicates were also run.

For the majority of targets the LCS recoveries were well within the limits. Bromomethane was recovered high in one case and low in another but was not detected. In the case where it was recovered low, the results are qualified as JL#, where # is the recovery.

SDG: 218575, 218580, 218754

Number of Samples: 16 Soil

Internal Standards:
SDG 218580 samples 26-18-4 and 26-19-4 have internal standards recoveries below 50%. Sample 26-18-4 has two internal standards low and sample 26-19-4 has four low. The qualified sample analytes have been associated to the next nearest internal standard. Qualifications of RI# are given to non-detected compounds with IS less than 10%. All other data are qualified JI# for detected compounds; where # is the recovery of the internal standard. Sample 26-19-4 re-analysis has been qualified as RI9, the average of the four internal standards. This average indicates a general ID repression evident in all the IS's. The form IS's for this sample provide the individual percent recoveries.

Sample 26-18-4 diluted re-analysis reports all internal standards within control criteria limits. Sample 26-18-4 has been reanalyzed with similar results indicating clear matrix interferences.

Surrogates:

Samples with detected compounds associated with high and low surrogates have been qualified JS#, where # is the percent recovery of the highest or lowest outlier. Matrix Spike/Spike Duplicates are not qualified for such outliers. Samples with high surrogates reported indicate there could be a slightly high bias to the data. Samples with low surrogates reported could possibly indicate low bias due to matrix effects.

Sample 26-B11-3 originally analyzed with one surrogate recovered high was re-analyzed at a dilution. The dilution is reported with all surrogates within acceptable limits.

Sample 26-B18-4 originally analyzed with one surrogate recovered low was re-analyzed at the same dilution with similar results indicating sample matrix interferences. Data could be biased low in proportion to the percent recovery.

Sample 21-B11-2 has one surrogate below criteria limits this sample was not re-analyzed. Although the sample has been qualified JS64, this is not a serious deviation. The sample is non-detect for all requested analytes and the surrogate percent recovery is not below reasonable recovery levels (i.e. 50-60%). It is believed the laboratory is within compliance for the analysis of this sample.

Matrix Spikes:

The client QC specific sample 21-B8-2 matrix spike is reported with low spike recoveries for all five spiked analytes the matrix spike duplicate has low recovery for one, chlorobenzene. The re-analysis of this spike set reports recoveries well in control limits. There is indication that matrix interference may be present; the original analysis of the MS/MSD report low surrogate recoveries. Additionally, the re-analysis provides recoveries within control limits and second and third sample QC sets have been included with the data. The re-analyses data are in the database and are considered to be usable with no qualification.

The data for SDG 218754 has only been qualified for RPD. It is believed the original analysis of this QC set does not represent the method accurately. The re-analysis of sample 21-B8-2 should be used for project purposes.

3.6.2 SEMIVOLATILE ORGANICS SW-846 METHOD 8270C

GENERAL COMMENTS

The following comments apply to all volatile analyses and are not repeated in the individual sections.

The laboratory has provided data that comply with the requested method with the exception of a sample that was not re-analyzed for internal standard exceedences. All unqualified and 'J' qualified data are considered to be fully usable with consideration of the qualification applied per the data validation process. Several data points have been rejected due to low aniline recovery in the LCS and for low surrogate recoveries. These data are considered to be rejected and not usable for decision-making purposes.

SDG NUMBER. 218528, 218525

Number of Samples: 26 soils

Surrogates:

For soil samples, there were a number of surrogates out of limits, primarily acid-fraction surrogates. In several of these cases, there were multiple surrogates recovered below 10% and results for the analytes in the affected fraction are qualified as RS#, where # is the recovery. Such results are rejected. However, in each case the laboratory was able to re-extract the sample within holding time and reanalyze. The problem was resolved so that usable data exists in each case. For one sample one acid surrogate was out of limits and the laboratory re-extracted the sample out of holding times. The original sample is usable since only one surrogate was out of limits and the re-extracted results have been qualified as JH1, indicating extraction one day out of hold.

Internal Standards

Several internal standards were out of limits on the high side in soil samples. This appears to be due to interference from high levels of non-target compounds evident from the chromatograms. Where this has occurred, targets have been qualified as JI#, where # is the % recovery of the internal standard. A quantitation bias may be present in these cases.

Calibration:

Because the laboratory has chosen to use linear and non-linear regression analysis, the reporting format used does not always include response factors. In these cases, the peak area is shown and the regression formula and the r2 value are provided. The reviewer has spot-checked these by calculating the response manually from raw data and in all cases checked, the response meets minimum criteria. Analytes handled in this way include, in various calibrations, pentachlorophenol, 4,6-dinitro-2-methylphenol, indeno(1,2,3-cd)Pyrene, and di-n-octylphthalate.

When the %RSD exceeds 15 linear and non-linear regressions are used. This has been done for several targets and criteria have been met in most cases. There are occasional targets for which r2 values fall below 0.995. These have not required qualification because they have not been detected in

samples and response factors were acceptable so that compounds would have been detected had they been present. The laboratory has complied with the method and the project QAPP.

Method Blanks:

Some method blanks showed detections of phthalate esters below the reporting limit. Positive detections of phthalate esters in samples associated with these method blanks have been qualified as UB#, where # is the associated blank level, unless the sample level is 10X that in the blank or higher. Data are fully usable as undetected values.

SDG NUMBER. 218536, 218539, 218571, 218575, 218580, 218754

Number of Samples: 42 soil samples

Hold Time:

SDG's 218539, 218571 and 218580 have samples qualified JH#, where # is the number of days exceeding the hold time from collection to sample extraction. In many instances the samples have been extracted and analyzed within the time allowed, however, due to quality control failures (low surrogate or internal standard recoveries) the samples have under gone additional extraction and analysis. This is not believed to have seriously impacted the sample data. Sample 9-B3-0 has been re-extracted seven days after the hold time allotted. The results are similar except a few heavier B/N (base/neutrals) have been reported below the practical quantitation in the re-extract/re-analysis.

Although the re-extraction is 7 days beyond the holding time, the reviewer recommends that the second extraction and analysis more correctly identify sample contaminate levels than the original. There were too many complications in the first extraction and analysis. The first extraction and analysis have high internal standard recoveries and low surrogate recoveries.

Internal Standards:

Internal standards were recovered low in SDG 218580. The results are qualified as JI#, where # is the recovery observed. Sample 26-B18-4 has two low internal standard recoveries just below the 50% criteria window. Low internal standard deviations can indicate a bias due to sample matrix. In this instance the sample has undergone sample cleanup (GPC). Evaluation of the chromatography indicates possible matrix effects correlated to low internal standards. The sample was not re-analyzed to confirm matrix interferences. Deviation from method criteria is not serious; however the sample has been qualified for associated failing internal standard recoveries. Sample target concentration and practical quantitation limits should be further reviewed where compounds have been qualified. For simplification of the database records, internal standard areas have been averaged to indicate a general repression of the IS's so that the # value is the average IS recovery.

Several SDG's have several samples with high internal standard recoveries. Only detected compounds are qualified as JI# for high IS recoveries, where # is the percent recovery observed. Detected compounds can have a suppressed bias toward quantitation where serious deviations have occurred. In most instances the deviations have not been serious.

Sample 21-B8-2 re-extract is observed with internal standard retention time of 6 +0.39 minutes from expected retention time. The associated compounds have been qualified JQ.09. The drift is not serious for analytical identification of target compounds. Identification is acceptable for affected compounds.

Surrogates:

Several acid surrogates were recovered out of limits, or were diluted out. If targets were detected associated with high recoveries, detected data are qualified as JS#, where # is the recovery observed. For recoveries that are low, but greater than 10%, all samples are qualified JS#. For recoveries below 10%, positive data are qualified JS# and undetected values, RS#, and data are considered to be rejected as possible false non-detected values. Low recoveries can indicate a low bias toward detected and non-detected results. Re-analyses were conducted by the laboratory when appropriate with similar results. Surrogates diluted out are not qualified.

Matrix Spike:

Where spike recoveries are observed out of criteria windows and detection has been observed, the samples have been qualified JS# where the # represents the value observed. Only parent samples have been qualified and then only the detected compounds. The laboratory has spiked with the EPA CLP short list of compounds for the matrix spike/spike duplicate.

SDG 218571 matrix spike %R fell outside the recovery limits set forth in the QAPP. The original extraction and analysis have some complications. Internal standards have been recovered out high for both the MS and MSD. The MSD recovery of the spike analytes is within criteria limits; the MS has observed values less than ten percent for spiked analytes. The sample and MSD surrogate recoveries are within criteria windows while the MS recoveries are below the criteria limits. With the above-mentioned complications the parent sample cannot be accurately qualified from the original analysis. It is not apparent whether complications from the matrix spike are caused by laboratory preparation and/or quantitation inaccuracies or pure matrix interferences. The matrix spike was re-extracted and the original spike replaced. All validation for matrix spike recoveries are from the re-extracted spike.

Laboratory Control Sample:

A few analytes were recovered high in the reported SDGs. In those cases there were no associated detections in samples and qualifiers were not added. Some analytes were recovered low and were qualified as JL#, where # is the recovery observed.

Aniline was recovered below 10% in LCS 05/22/01 associated with sample 21-B8-0, this analyte has been qualified RL7 for this sample. False undetected data may have been reported for aniline due to poor method accuracy.

3.6.3 DIESEL RANGE ORGANICS SW-846 METHOD 8015B

SDG NUMBER. 218575, 218580

Number of Samples : 11 soil samples

The laboratory has complied with the requested method. All data are considered to be fully usable. No qualifiers have been applied.

3.6.4 METAL BY EPA SW-846 METHOD 6010 AND 7470

The reported data comply with the requested method. Unqualified and 'J' qualified data are considered to be usable for project purposes with consideration of the qualification applied during the validation process. Several mercury data points are 'R' qualified as rejected due to low spike recoveries. These data are not considered to be usable for project decision-making purposes. These data are generally undetected values and false undetected data could be reported if these analytes are suspected of being present at the site.

SDG NUMBER: 218525, 218528, 218536, 218539, 218571, 218575, 218580, 218754

Number of Samples: 84 Soil samples

Calibration Blanks:

Per the 10% review, one SDG (218536) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table.

BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (ug/L)	Qualifier
218536	Arsenic	CCVB	2.8	None
	Barium	CCVB	4.2	None
	Cadmium	CCVB	3.1	UB.3
	Chromium	CCVB	2.7	UB.3
	Lead	CCVB	5.8	None
	Selenium	CCVB	2.7	UB.3
	Silver	CCVB	3.3	UB.33

Preparation Blanks:

All positive sample values that were less than 5X the preparation blank result for that analyte received qualification UB#, where # is the value of the associated blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The following analytes have been qualified.

SDG	Matrix	Analyte
218:525	S	cadmium, mercury
536	S	cadmium, mercury

539 S cadmium, mercury

Matrix Spikes

Note that a number of the soil SDGs had 2 MS's in the set. The preparation dates were the same and the analysis run logs did not clearly associate samples with either one of the MS's. Data have been qualified on the worst-case recovery even though the second MS was often within the acceptance limits. There is a significant amount of inhomogeneity to these samples as is evident from the number of qualifications for matrix precision.

SDG No	SAMPLE	ANALYTE	% RECOVERY	QUALIFIER
218525	All samples	Barium	26%	JS26
		Cadmium	73%	JS73
218528	All samples	Lead	548%	JS548
		Mercury	64%	JS64
218536	All samples	Barium	138%	JS138
218539	All samples	Arsenic	73%	JS73
		Barium	51%	JS51
		Cadmium	69%	JS69
		Chromium	72%	JS72
		Lead	24%	JS24
218571	All samples	Arsenic	58%	JS58
		Barium	50%	JS50
		Cadmium	58%	JS58
		Chromium	53%	JS53
		Lead	50%	JS50
		Mercury	53%	JS53
		Selenium	61%	JS61
		Silver	66%	JS66
218575	All samples	Barium	24%	JS24
		Mercury	68%	JS68
218580	All samples	Arsenic	62%	JS62
		Cadmium	59%	JS59
		Chromium	60%	JS60
		Lead	155%	JS155
		Mercury	222%	JS222
		Selenium	57%	JS57
		Silver	63%	JS63

218754	All samples	Lead	516%	JS516
		Mercury	-78%	RS0 (U). JS0
		Selenium	73%	JS73

Data have been qualified JS#, where # is the value of the spike %R. When the %R is over 125%, data could be biased high with the bias increasing as the %R increases. When the %R is less than 75 % data could be biased proportionately low. When the %R is less than 30%, undetected data are considered to be rejected and false undetected values could have been reported.

Matrix Duplicates

A high or low bias cannot be determined from precision data. As the RPD or difference increases, the variability to the data from matrix inhomogeneity increases. When there are two duplicates in the soil sets, data have been qualified on the highest RPD as noted for the spikes. Data are qualified JD#, where # is the RPD or J*# where # is the difference between the two low level values. Low-level values are less than 5 x Reporting Limit.

SDG	ANALYTE	%RPD	QUALIFICATION
218528	Arsenic	70%	JD70
	Barium	57%	JD57
	Lead	80%	JD80
	Cadmium	diff = 1.0	J*1.0
218571	Arsenic	36%	JD36
	Mercury	diff=0.08	J*.08
218575	Barium	40%	JD40
	Cadmium	diff=1.1	J*1.1
	Mercury	diff =.07	J*.07
218580	Barium	37%	JD37
	Mercury	136%	JD136
218754	Arsenic	diff = 5.9	J*5.9
	Barium	90%	JD90
	Cadmium	152%	JD152
	Chromium	155%	JD155
	Lead	150%	JD150
	Mercury	163%	JD163
	Silver	41%	JD41

Serial Dilution:

Data are qualified JE#, where # is the value of the serial dilution percent difference. Data could have in indeterminate bias due to non-linear matrix effects.

SDG	ANALYTE	%D	QUALIFICATION
218525	Barium	23%	JE25
	Chromium	13%	JE13
	Lead	27%	JE28
218571	Chromium	18%	JE18
	Lead	17%	JE18
218538	Barium	94%	JE94
218575	Chromium	17%	JE17
	Lead	14%	JE14
218580	Barium	237%	JE237
	Chromium	236%	JE236
	Lead	221%	JE221
218754	Arsenic	11%	JE11
	Cadmium	19%	JE19
	Chromium	16%	JE16
	Lead	15%	JE15

3.7 WATER SAMPLES COLLECTED MAY 2001

3.7.1 VOLATILE ORGANICS SW-846 METHOD 8260B

GENERAL COMMENTS

The following comments apply to all volatile analyses and are not repeated in the individual sections.

The laboratory is within method compliance. The unqualified and 'J' qualified data are fully usable after consideration of qualifiers applied during the validation process. Several compounds are consistently qualified 'R' as rejected for calibration response factors below acceptable limits. These data are not considered to be usable for project decision making. These data are undetected values and could be reported as false undetected values if the compounds are suspected of being present at the site.

Calibrations

A number of targets gave low response factors consistently in the initial calibrations. Compounds affected include isobutyl alcohol, 1,4-dioxane, 2-butanone, acrolein, DBCP, and methacrylonitrile. Among these, 1,4-dioxane gave the lowest response, with some response factors of 0.001 or less.

Compounds having response factors below 0.05 are qualified as RC#, where # is the value of the response factor observed in the associated initial calibration. Such target results may potentially result in false negatives due to poor response in the analysis. Data are considered to be rejected.

These analytes appear in some cases seem to be recovered normally in the LCS and LCS duplicates associated with these calibrations indicating acceptable quantitation at mid-range concentrations. However, the data should not be considered as usable without further review.

The continuing calibration showed the same compounds failing to achieve the minimum response as occurred in the initial calibrations. In all cases, the low responding compounds were already qualified for the initial calibration behavior and were not additionally qualified. Data are considered to be rejected. It is possible false undetected values have been reported.

The laboratory has chosen to use a regression curve when the %RSD is greater than 15%. In most cases, a linear curve has been used, but in some a second-order curve has been used. The second order curve requires that 6 points be run (SW-846 and AFCEE), and this has also been done. In several instances, the r2 value falls below 0.995. No Positive detections from such results were observed; hence no qualifiers have been issued for these deviations.

A number of CCVs showed %D values outside the 20% limit specified in the QAPP. When associated with detected targets, this has resulted in qualification as JC#, where # is the % drift observed. Non-detected targets are not qualified for this unless the drift is particularly severe. In this group, no detected targets were associated with such calibrations so no qualifiers have been applied.

Blanks

In general, the method blanks are free of contaminants except for methylene chloride and toluene which were detected at levels below the reporting limits in some method blanks.

Positive detections in associated samples for methylene chloride are qualified as UB# when the sample result is less than (10x the method blank level). No toluene data are present at concentrations less than (5 x blank) and no qualification has been applied. UB data are considered to be fully usable as undetected values.

SDG NUMBER. 218218, 218318, 218165, 218357, 218076, 218406

Number of Samples: 81 water samples

Surrogates

One sample on SDG 218076 had all surrogates recovered high. The sample contained high levels of targets and was reanalyzed at a higher dilution. The reanalysis had all surrogates within windows. The original run is qualified as JS#, where # is the highest surrogate recovery, for detected targets. Non-detects are not qualified. Data for this sample could be biased high due to matrix interference.

SDG 218406 had sample 34MD8DL with 1,2-dichloroethane-d4 recovered low. All targets in this analysis are qualified as JS61. Surrogates in the original run were all within limits.

Sample 34MW6 had a low recovery of dibromofluoromethane (74%). Dilution reruns of the sample were within limits. Analytes in the original sample are qualified as JS74. When surrogate recoveries are low, it is possible data are biased low due to matrix effects.

Matrix Spikes

Sample R5MW1 in SDG 218357 had a low matrix spike recovery for benzene (60%). The MSD recovery for this target was within normal limits. The native sample is qualified as JS60. Data could possibly be biased low for benzene due to matrix effects

Compound Identification

Per the 10% review, chromatography was satisfactory in all cases. The mass spectral match for 1,1,2-TCA identified in sample MW6FP did not meet acceptance criteria. The relative retention time of this target is 0.86 and the identified peak was 0.872. The mass spectrum is that of the toluene-d8 surrogate, which has a relative retention time of 0.87. The reviewer considers identification of this target in this sample to be incorrect. The compound has been qualified JQ to indicate this assessment.

SDG. 218538, 218608, 218602, 218502, 219841

Number of Samples: 56 Waters

Calibrations:

For the 218502, 218538 and 219841 sets, data for acrolein; acrylonitrile; 2-hexanone; 2-chloroethylvinyl ether; 1,2-dibromo-3-chloropropane; methacrylnitrile; isobutyl alcohol; 1,1,2-trichloroethane and 1,4-dioxane are qualified RC# where # is the response factor. Data are considered to be rejected and false undetected values could have been reported due to low instrument sensitivity. All of these compounds, except 1,1,2-TCA are poor responders and usually have low response factors from most laboratories. 1,1,2 TCA was acceptable for the June sample analyses. The LCS data were acceptable for these compounds indicating that mid-range concentrations can be detected and quantitated accurately.

Laboratory Control Sample (LCS)

The LCS's were low for bromomethane in the May samples. Data have been qualified JL70, where # is the %R. Data could be biased slightly low. Bromochloromethane was slightly high in the LCS for the June samples. The compound was not detected and no qualification is required.

Detection Limits

The laboratory has reported data from the lowest dilution possible. There are a number of samples that were diluted in order to bring compounds into the linear range of the instrument. Both analyses are reported in the hard copy data. The validator has put a light pencil mark through the lower dilution values that the lab has flagged as "E" for exceeding the linear range. The validator has then circled the diluted values to be used for project purposes in the diluted sample. These are the values that are in the project database. The June samples 33 MW1FP and MW2FP required dilutions to bring the data into the linear range of the instrument.

3.7.2 SEMI-VOLATILE ORGANICS SW-846 METHOD 8270

GENERAL COMMENTS

The following comments apply to all semi-volatile analyses and are not repeated in the individual sections.

The laboratory has complied with the method. Client MS/MSDs were not present with every SDG, but the laboratory has supplied blank spikes and duplicates to meet method criteria. Data are usable for project purposes with consideration of the following qualifiers that are applied during the data review process.

Method Blank

Some method blanks showed detections of phthalate esters below the reporting limit. In addition, detections below the reporting limit for naphthalene and 2-methylnaphthalene were noted in some method blanks.

Positive detections of phthalate esters, naphthalene, and 2-methylnaphthalene in samples associated with these method blanks have been qualified as UB#, where # is the associated blank level, unless the sample level is 5X that in the blank or higher (10x for phthalates). Data are fully usable as undetected values.

SDG. 218218, 218318, 218165, 218357, 218076, 218406

Number of Samples: 72 Water Samples

Surrogate

In SDG 218076, one dilution run for MW4FPDL had nitrobenzene-d5 recovered high, and a second dilution run had this surrogate recovered high plus 2-fluorobiphenyl. Dilution factors were 50 and 100 respectively, which are sufficient to cause the quantitation of the surrogate to be in a less reliable region of the curve. Since the recoveries are not extremely high and the recovery of the surrogate is normal in the original run, no qualification has been applied.

In SDG 218318, phenol-d6 was recovered low at 21% in sample 36MW5. There is no qualification for this since this is the only acid surrogate out of limits in this sample. In sample 36MW3, fluorophenol was recovered at 24% and phenol-d6 recovered at 17%. The acid compounds sample have been qualified as JS17, indicating that there may be a low bias for acid compounds in this sample. Neither sample appears to have been re-analyzed by the laboratory.

In SDG 218357, terphenyl-d14 was recovered high (130%) in sample 38MW3. No qualifiers were added because this is the only base-neutral surrogate recovered out of limits of the three spiked. In addition, high recoveries do not normally require qualification for undetected analytes.

Matrix Spike

The laboratory has analyzed matrix spikes on samples designated by the client, and in other cases has prepared and analyzed a blank spike and blank spike duplicate. Since the blank spike and blank spike duplicate do not reference a specific sample, these can only be used as additional LCS runs. There

were two SDGs in which client samples were spiked for MS/MSDs; SDG 218165, in which sample MW1 was spiked, and SDG 218406, in which sample 18MW1 was spiked. This means that there is not 1 MS/MSD per SDG. The project frequency of 20 samples may have been met when all QC samples are reviewed.

For sample 18MW1, the MS/MSD recoveries were within limits. For sample MW1, acenaphthene and pyrene were both recovered high in the MS and MSD. For acenaphthene, recoveries were 720 and 730%, respectively. For pyrene, recoveries were 170 and 190%, respectively. A closer review of the data shows that these recoveries appear to have been properly calculated, and they do not appear to be due to matrix interference or high sample levels. The laboratory makes no comment about the origin of the high recoveries, but it is not unreasonable that they could be due to an improperly-made spiking solution. Whatever the cause, the native sample does not contain detectable levels of these analytes and no qualifiers were added.

The RPDs for the MS/MSD pair related to sample 18MW1 were out of limits for 1,4-dichlorobenzene (31%) and 1,2,4-trichlorobenzene (22%). These are only slightly above the QAPP RPD limits. Per the validation guidance no qualifier has been added for duplicates alone, but it may indicate greater than normal variability for this sample.

SDG. 218502, 218602, 218538, 219841

Number of Samples: 40 waters

Surrogates:

In water samples the surrogates were recovered within limits except for terphenyl-d14 in SDG 218602. This surrogate was recovered high in several samples, but since the other surrogates in the base-neutral fraction were within limits no qualifiers were added.

Detection Limits

The laboratory has reported data from the lowest dilution possible. All analyses are reported in the hard copy data. The validator has put a light pencil mark through the lower dilution values that the lab has flagged as "E" for exceeding the linear range. The validator has then circled the diluted values to be used for project purposes in the diluted sample. These are the values that are in the project database. All of the June samples required dilutions to bring the data into the linear range of the instrument.

Matrix Spikes

Matrix spikes and MS duplicates were not analyzed for the June samples due to the high dilutions. Spikes in the normal range would have been diluted out. The laboratory is, therefore, in compliance with the method and QAPP.

3.7.3 DIESEL RANGE ORGANICS SW-846 METHOD 8015B

SDG NUMBERS. 218602, 218538, 218502

Number of Samples: 19 water samples

The laboratory is in compliance with the method. All data are considered to be fully usable. No qualifiers have been applied.

SDG NUMBERS:. 218406, 218557

Number of Samples: 3 water samples

The laboratory has complied with the requested method. All data are considered to be fully usable. No qualifiers have been applied.

3.7.4 METALS BY EPA METHOD 6010, AND SW-846 METHOD 7470

SDG NUMBERS: 218502, 281538, 218602, 218758 and 219841

Number of Samples: 39 water samples

The laboratory has provided data that comply with the requested method. All data are fully usable for project purposes with consideration of the following qualification.

Preparation Blanks:

Reportable levels of contamination were present in the method blanks. Data have been qualified UB#, where # is the value of the blank contamination. Data are fully usable as undetected values. Only positive data whose value is less than (5 x blank) are qualified.

SDG	Contamination
218502	barium, cadmium, lead
218538	barium, cadmium, chromium, lead, selenium, silver
219841	arsenic
218501	barium, cadmium, lead,
218758	cadmium, selenium
218602	cadmium, lead

Serial Dilution

Data are qualified JE#, where # is the % difference of the original and the serial diluted sample. Data could have an indeterminate bias due to non-linear matrix effects. Only barium in SDG 218758 is qualified JE28

Data for barium in SDG 218538 have been qualified JE94 to indicate a 94 % difference in the original and the diluted serial dilution samples. Barium data in 219841 are also qualified JE75. There appears to be a non-linear matrix interference that could cause an indeterminate bias to the data.

Matrix Spike

In SDG 219841, chromium has been qualified JS128 to indicate a possible slight high bias to the data due to matrix recovery of 128 % (limit 125%)

Matrix Duplicate

The arsenic duplicates for SDG 219841, sample 33 MW1FP were low level values, less than 5 x the reporting limit (RL). The RPD is not used in this case, the precision is measured by the difference between the two reported values. The difference was 7.1 ug/l and data have been qualified J*7.1 to indicate a difference of greater than ± the RL. This indicates possible sample inhomogeniety.

Detection Limits

The laboratory was able to achieve the required low level detection limits, particularly for arsenic.

SDG NUMBER:218076, 218165, 218218, 218318, 218357, 218406

Number of Samples: 73 water samples

The laboratory has complied with the requested method. The quality of the data is acceptable with consideration of the following qualification.

Blanks

Contamination affecting sample results was reported in the preparation blanks for the following metals:

SDG 218406: cadmium, chromium, lead, silver
SDG 218218: cadmium, lead, selenium
SDG 218165: barium, lead, selenium

Data with values less than (5x blank value) have been qualified UB#, where # is the value of the blank contamination. Data are fully usable as undetected values.

Per the 10% review, one SDG (218076) was reviewed for ICB and CCB results. All positive sample values that were less than 5X the blank result for that analyte received qualification UB#, where # is the value of the highest associated blank, including the preparation blank. Qualified data are fully usable as undetected values at the elevated reporting limit. The highest blank contamination is shown in the following table.

BLANK CONTAMINATION SUMMARY TABLE

SDG	Analyte	Blank Type	Amount (ug/L)	Qualifier
218076	Arsenic	CCVB	1.7	UB1.7
	Barium	CCVB	1.8	UB1.8
	Cadmium	CCVB	1.9	UB1.9

	Chromium	CCVB	1.8	UB1.8
	Lead	CCVB	1.6	UB1.6
	Mercury	CCVB	0.05	UB.05
	Selenium	CCVB	4.5	UB4.5

All positive sample values that were less than (5X the preparation blank result) for that analyte received qualification UB#, where # is the value of the associated blank. Qualified data are fully usable as undetected values at the elevated reporting limit.

Serial Dilution

Barium in SDG's 218318 and 218406 had serial dilution percent differences of 49% and 44%, respectively. The samples were qualified JE#, where # is the value of the difference. There could be a non-linear matrix interference to the reported results.

3.8 Soil Samples Collected November 2001

3.8.1 VOLATILE ORGANICS SW-846 METHOD 8260A

SDG Nos. 227106, 227107, 227152

Number of Samples : 25 Soil, 6 Water

The laboratory has provided data that are derived from full method compliance. All data are considered to be fully usable with consideration of the qualification applied per the data validation process noted below.

Chain of Custody and Sample Condition:

Samples in SDG 227152 had incorrect sample collection dates. The project manager informed the validation and laboratory personnel and the changes were made to the chain of custody forms by the validator.

There were several discrepancies, noted by the lab in the Case Narrative. For SDG 227106, the trip blank was not listed on the Chain of Custody. For SDG 227107, the trip blank was not listed on the Chain of Custody, and one soil container and one equipment blank container were broken. The laboratory gave no indication that the broken containers resulted in any negative impact on the analyses.

Initial Calibrations:

A number of targets gave low response factors consistently in the initial calibrations.

Compounds affected include isobutyl alcohol, DBCP, 1,4-dioxane, acetone, and acrolein. 1,4-dioxane gave the lowest response, with response factors of 0.001 or less.

Undetected compounds having response factors below 0.05 are qualified as RC#, where # is the value of the response factor observed in the associated initial calibration. Such target results may potentially result in false negatives due to poor response in the analysis. Data are considered to be rejected. Detected compounds with low response factors are qualified as JC#, where # is the response factor observed. Such results are considered to be biased, but are not rejected.

These analytes appear in some cases seem to be recovered normally in the LCS and LCS duplicates associated with these calibrations indicating acceptable quantitation at mid-range concentrations. However, the data should not be considered as usable without further review.

Continuing Calibrations:

The continuing calibration showed the same compounds failing to achieve the minimum response as occurred in the initial calibrations. In all cases, the low responding compounds were already qualified for the initial calibration behavior and were not additionally qualified. Data are considered to be rejected, RC#, if the compound is not detected and are considered biased, JC#, if detected. It is possible false undetected values have been reported.

Internal Standard Areas:

For SDG 227106, all internal standard areas were low in the analysis of sample 34B71. 1,4-DCB-d4 was recovered at 7%, and the others at 11%. Analytes associated with 1,4-DCB-d4 were qualified as RI7 when undetected and JI7 when detected.

A reanalysis at dilution was conducted on this sample and all internal standard were within limits except for 1,4-DCB-d4, which was recovered at 48%. Analytes associated with this internal standard were qualified as JI48. In addition, this internal standard was recovered low (23%) in sample 34B729 and associated analytes were qualified as JI23.

In SDG 227107, sample 34B51 had 1,4-DCB-d4 recovered at 23% and associated analytes were qualified as JI23.

Surrogate Recoveries:

Surrogate recoveries were not in control windows for the trip blank associated with SDG 227152, with toluene-d8 recovered low at 72%. The laboratory reanalyzed this sample and the same surrogate was recovered low again at 68%.

EB2 (an equipment blank) and the trip blank associated with SDG 227107 both gave low recoveries of BFB at 72 and 74%, respectively. The laboratory reanalyzed the samples and the BFB was recovered within windows, but in the reanalysis toluene-d8 was low at 72 and 66%, respectively.

Sample 34B51 gave a high recovery of BFB at 141%. This was not reproduced in the associated MS/MSD analyzed for this sample.

Sample 35B729 gave a low recovery of toluene-d8 and BFB, and on reanalysis these surrogates were still recovered low.

Sample 34B71 gave a high recovery of BFB at 155%. This was not reproduced in the MS/MSD.

Samples having low recoveries of surrogates were qualified as JS#, where # is the observed surrogate recovery, for all analytes whether detected or not. Samples having high recoveries of surrogates were qualified as JS# only for analytes that were detected.

Matrix Spike/Matrix Spike Duplicates:

Please note: The partial matrix spike list from SW-846 is used here.

For sample 34B51, the MSD gave low recoveries for 1,1-DCE, TCE, and toluene. These analytes were qualified as JS#, where # is the recovery observed, in the parent sample.

In the case of sample 34B51, the %RPD was out of limits for 1,1-DCE and toluene. This indicates that there may be some variability in sample homogeneity that affect the precision of the results for this sample.

LCS Recoveries:

For the majority of targets the LCS recoveries were well within the limits. A few analytes associated with undetected targets were recovered high, and no qualifiers were added. For one LCS in SDG 227106, 2-chloroethylvinyl ether was recovered at 38%, and associated samples were qualified as JL38, indicating a possible low bias for this analyte in those sample results.

3.8.2 SEMIVOLATILE ORGANICS SW-846 METHOD 8270C

SDG. 227106, 227107, 227152

Samples NO. 25 Soil/1 Water

The laboratory has complied with the requested method. Data are fully usable after consideration of qualification noted below. UB data are considered to be fully usable as undetected values.

Chains of Custody

The chain of custody for SDG 227152 was originally submitted with sampling dates one month prior to the actual sampling. The correct sampling date has been verified by the project manager and corrections issued to the laboratory and the validation representative.

Continuing Calibration

Several continuing calibrations have target compound %D recoveries that exceeded the 25% requirement. Only positive detection of these %D outliers is qualified. The detection of pyrene in SDG 227107 under the continuing calibration 11/26/01 has been reported and qualified JC29 for

high %D. The values should be considered estimated and accurate proportional to the percent deviation. This deviation is small and the impact is not considered to be significant.

Internal Standards

Sample 34-B72-9 is reported with three internal standards below the 50% lower limit. The recoveries of internal standards #4, 5 & 6 have been averaged for qualification. The associated target compounds have been qualified JI42 for low internal standard recovery.

Samples 34-B47-13, 34-B50-8, DUPA, DUPB, 34-51, 34-B61-15 and 34-B61-20 have several reported dilutions where associated compounds have been qualified for both low and high internal standard recoveries. Sample 34-B50-8 dilution 1X associated compounds are qualified RI2.4 for low internal standard #6 recovery. These results are rejected at the respective reporting limits.

Sample 34-B64-19 associated compounds have been qualified JI46 for low internal standard #6.

The quantitation of associated analytes can be biased high where internal standard recoveries have been suppressed and biased low where recoveries have been accentuated. No internal standard recovery is particularly severe with the acceptation of sample 34-B50-8. All qualifications for internal standard recoveries are estimated values.

Matrix Spike (MS) and MS Duplicate

Parent sample 34-B71-4 has been qualified JS# for low recovery of pentachlorophenol, where # represents the amount recovered. Pentachlorophenol is recovered at 211% in the matrix spike and at 0% in the MSD. The sample is reported non-detect for this compound in both the 1X and the 10X analyses. Matrix effects are severe for this sample and non-homogeneity is possible however other phenolic or chlorinated compounds are not present in any of the other samples. The sample is qualified JS0 rather than "R" for the lowest amount recovered. The sample has been further qualified for relative percent difference, (see VII.C. below).

Parent sample 34-B51has been qualified RS0 and RS6 for unacceptable recoveries of 2,4-DNT and pyrene respectively. These sample compound results should be considered rejected values at the reporting limits and possible false undetected values may have been reported.

The matrix spike/spike duplicate for 34-B71-4 report recoveries for 2,4-DNT are above 400%. The sample is non-detect for this compound and is not qualified for the high recoveries.

Acenaphthene and pyrene for parent sample 34-B71-4 are reported at concentrations greater than four times the spike amount. Acenaphthene for parent sample 34-B51 are also reported at concentrations greater than four time the spike amount. The spike recoveries for these compounds are not considered for qualification due to the sample concentrations reported.

The water sample EB-1 is field QC and does not require precision and accuracy information form the matrix for laboratory method performance. The laboratory has provided a blank spike/spike duplicate for some semblance of the laboratories procedures. The compound n-nitroso-di-n-propylamine is reported with high recovery in both the spike and the duplicate. The samples are non-detect for this compound and are not qualified for high recoveries.

The RPD is reported above the contractual requirements for pentachlorophenol in sample 34-B71-4 and pyrene is reported with high RPD in sample 34-B51. The samples have been qualified JD# where # represents the difference reported. The parent sample concentrations of these compounds should be considered to deviate around the result to the extent of the deviation qualified.

Blanks

Some soil method blanks show bis(2-ethylhexyl phthalate) and di-n-butyl phthlate contamination. Qualification of compounds is made only when sample detection is reported less than 5X the reported blank contamination. The affected compounds are qualified UB# where # represents the amount of associated blank contamination. UB data are considered to be fully usable as undetected values.

Field Blanks

One equipment blank, EB-1 has been identified. All data are either undetected as reported or qualified UB, as undetected.

3.8.3 Methods 8015B GRO/DRO and 8082 PCB, Wet Chemistry – Method ASA-9 90-3 (Walkley-Black) for TOC

SDG NOS. 227106, 227107 and 227152

Number of Samples per Method: GRO 2 Water/24 Soil, DRO 1 Water/24 Soil, PCB 1 Water/10 Soil and TOC 12 Soil

Continuing Calibration:

GRO Analysis – Samples in SDG 227107 analyzed 11/27/01, instrument GCVOA-07 have been qualified JC23 where detections for GRO have been reported. The recovery for the calibration check is above the %D criteria for the method performed. There could be a variability to the reported data due to variability in the calibration factor used in the quantitation calculation.

PCB Analysis – The PCB continuing calibration for 11/28/01 1959 hours is high at 17% difference on the primary quantitation column. The confirmational column is also high for this calibration check. The samples bracketed by this check are reported non-detect and are not qualified for this deviation. The remaining calibration checks are within criteria limits.

Surrogate:

Some surrogates for DRO and GRO have either been diluted out or are quantitated below the normal reporting limit (RL). There is no qualification for this process.

PCB Analysis – The indication for proper extraction technique of soil samples is that at least one surrogate is recovered within criteria limits. One surrogate is allowed outside criteria limits before qualification is made for surrogate recovery. The water analysis of EB-2 reports TCX recovery high

at 132%, and DCB recovery low at 20%. The sample is reported non-detect for PCBs and has been qualified JS20 for the low surrogate recovery. Surrogate recoveries for the Method Blank and the Laboratory Control Sample are within criteria limits indicating proper extraction techniques have been used. The recoveries from the sample indicate instrumentation fluctuation since matrix is not considered. There could be false undetected values reported for PCB data. This is an equipment blank and the environmental samples are not affected.

Matrix Spike/Spike Duplicate:

GRO Analysis – The soil Matrix Spike/Spike Duplicate samples for SDGs 227106 and 227107 require dilutions and the spike concentrations are quantitated at or below the practical quantitation limits. The spike set from SDG 227152 and other method QC sample recoveries are within control limits and provide precision and accuracy for the method preformed. There is no qualification for diluted spike recoveries.

PCB Analysis – The Blank Spike/Spike Duplicate performed for the water matrix of sample EB-2 recovers PCB 1260 high at a122 percent. The sample is non-detect no qualifications are made.

TOC Analysis – The Matrix spike for SDG 227152 is reported with recovery of TOC at 76%. The criteria window is 80-120 percent. Although not a serious bias the samples have been qualified JS76 for low spike recovery. This could possibly indicate a low bias proportional to the percent recovery due to matrix interference.

GRO Analysis – The RPD for matrix spike/spike duplicate set for SDG 227152 is at 59% RPD. The laboratory indicates matrix effects for the soil QC set. This is entirely possible given the adsorption and non-homogeneous nature of soil samples. The sample is non-detect for GRO; only detected values would be qualified for duplicate precision.

Blank:

GRO Analysis – Positive detections in associated samples for gasoline range organics are qualified as UB# , where # is the value of the associated blank. Data are qualified when the sample result is less than 5x the method blank level. UB data are considered to be fully usable as undetected values. Note that the value after the UB qualifier is corrected for the dilution of the sample.

3.9 Summary

Monitoring and field-sample collection work was conducted in accordance with project specifications and the Contractor's Field Sampling Plan. The conclusion of the data validation exercises is that the analytical data generated by the sampling programs are usable for making appropriate decisions regarding site characterization.

Data that have been determined to be rejected during the data validation process are not considered to be usable for project purposes and will be excluded from the decision process. The vast majority of data that have been rejected are not compounds of concern and the impact on the project is not considered to be significant. Data qualified by the reviewer as "J" are recommended for use with consideration of the biases indicated by the qualification code and value.

4 DETECTION LIMIT COMPARISON

Analytical detection limits or practical quantitation limits (PQLs) achieved by the analytical laboratory for the site data were compared to the site-specific screening level (SLV) concentrations in Table 2. Groundwater samples with detections limits above the water screening levels for certain parameters are listed in Table 3.

The information presented in Table 3 is according to the sample collection date. Groundwater data for the first quarterly sampling event (July 2000) shows the greatest number of analytes with detection limits above the SLV; most significantly vinyl chloride (DL = 10 ug/L) and benzene (DL = 5 ug/L). The number of analytes with elevated detection limits was reduced for the September 2000 event and further reduced for the subsequent events due to attempts by the laboratory to meet the target detection limits as specified for the VOC and SVOC parameters with SLVs below the standard method reporting limits. Even so, there remain several consistent parameters with method detection limits above the SLV, due to the assign low-level SLV concentrations. These parameters are; arsenic, three VOCs (1,2,3-trichloropropane, methacrylonitrile, 1,2-dibromoethane), six SVOCs (dibenzo(a,h)anthracene, benzo(a)pyrene, n-nitrosodi-n-propylamine, 2,6-dinitrotoluene, hexachlorobenzene, pentachlorophenol).

These chemicals have low aqueous maximum acceptable detection limits (MADLs) that are less than laboratory detection limits (EPA, 1999). As directed by EPA (1999) concentrations are estimated for these parameters by the laboratory if there is evidence of concentrations between the PQL and MADL, thus potential data gaps are minimized.

Soil samples with detections limits above the soil screening levels (Table 2) for certain parameters are listed in Table 4. All of the required soil detection limits were generally met for the soil samples. The few exceptions listed in Table 4 are from interferences caused by contaminant levels in the samples.

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TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

TABLE 1 Summary of Samples Collected and Analyses Performed
TABLE 2 Screening Level Concentrations for Analytes
TABLE 3 Groundwater Analytical Detection Limits Above Screening Levels
TABLE 4 Soil Analytical Detection Limits Above Screening Levels

Contact the Superfund Records Center to view available document.
(303) 312-6473

APPENDIX F

EPA FINAL FIELD SAMPLING REPORT (FEBRUARY 2001)

FINAL
FIELD SAMPLING REPORT
in SUPPORT of RISK ASSESSMENT at
OGDEN RAIL YARD
OGDEN, UTAH
FEBRUARY 2001

Prepared by

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LIST OF ACRONYMS

AAS	Atomic Absorption Spectroscopy
AET	Adverse Effects Threshold
ANOVA	Analysis of Variance
AOI	Area of Interest
As	Arsenic
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
AVS	Acid Volatile Sulfide
AWQC	Ambient Water Quality Criteria
BC	Burch Creek
bgs	Below Ground Surface
BTAG	Biological Technical Assistance Group
BVPP	Buena Ventura Park Pond
BW	Body Weight
°C	Degrees Centigrade
Cd	Cadmium
CEC	Cation Exchange Capacity
cfm	Cubic Feet per Minute
cfs	Cubic Feet per Second
cm	Centimeter
COC	Contaminant of Concern or Chain of Custody
COPC	Contaminant of Potential Concern
Cr	Chromium
Cu	Copper
CV	Coefficient of Variation
CV/AAS	Cold-Vapor Atomic Absorption Spectroscopy
CWA	Clean Water Act
d	day
DL	Detection Limit
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DQO	Data Quality Objectives
d.w.	Dry Weight
EA	Endangerment Assessment
e.g.	For Example (exampli gratia)
EPA	Environmental Protection Agency
EqP	Equilibrium Partitioning
ERA	Ecological Risk Assessment
ER-L	Effects Range - Low
ER-M	Effects Range - Median
ERTC	Environmental Response Team Center
et al.	And Others
etc.	And So Forth (et cetera)
FAAS	Flame Atomic Absorption Spectroscopy
FS	Feasibility Study
ft	Feet, Foot
g	Gram
GW	Ground Water
ha	Hectare

LIST OF ACRONYMS (cont'd)

HASP	Health and Safety Plan
HDPE	High Density Polyethylene
Hg	Mercury
HQ	Hazard Quotient
hr	Hour
Hwy	Highway
IC	Ion Chromatography
ICAP	Inductively Coupled Argon Plasma
ICP	Inductively Coupled Plasma
i.e.	That is (id est)
K_d	Dissociation Coefficient
kg	Kilogram
L	Liter
LC50	Lethal Concentration that Results in 50% Mortality
LD50	Lethal Dose that Results in 50% Mortality
LEL	Lowest Effect Level
LOAEL	Lowest Observable Adverse Effect Level
LOQ	Limit of Quantitation
LPL	Lower Prediction Limit
m	Meter
MAR	March
MDL	Method Detection Limit
μg/μL	Microgram/microliter
mg/mL	Milligram/milliliter
mL	Milliliter
mm	Millimeter
MQL	Method Quantitation Limit
MSL	Mean Sea Level
NA	Not Applicable
NC	No Criteria
ND	Not Detected
Ni	Nickel
NOAEL	No Observable Adverse Effect Level
NPDES	National Pollution Discharge Elimination System
NPL	National Priority List
NTU	Nephelometric Turbidity Units
OMOE	Ontario Ministry of the Environment
OR	Ogden River
ORY	Ogden Rail Yard
Pb	Lead
ppb	Parts per Billion
ppm	Parts per Million
PRP	Potentially Responsible Party
QA/QC	Quality Assurance/Quality Control
QAWP	Quality Assurance Work Plan
RD	Roundhouse Ditch
REAC	Response Engineering and Analytical Contract
ROD	Record of Decision
RPM	U.S. EPA Remedial Project Manager

LIST OF ACRONYMS (cont'd)

S	Soil
SC	Strongs Creek
Se	Selenium
SE	Standard Error
33SS	33rd Street Slough
SSC	Site Safety Coordinator
21SP	21st Street Pond
SW	Surface Water
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TF	Tissue Fish
TI	Tissue Invertebrate
TLm	Median Tolerance Level
TOC	Total Organic Carbon
TSS	Total Suspended Solids
U.S.	United States
USACOE	U.S. Army Corps of Engineers
USGS	United States Geological Survey
WA	Work Assignment
WAM	Work Assignment Manager
WP	Work Plan
WR	Weber River
w.w.	Wet Weight
Zn	Zinc

EXECUTIVE SUMMARY

The Ogden Rail Yard site is located in Weber County, UT, on the western edge of the city of Ogden. The rail yard is oriented in a north-south direction, consisting of a distance of approximately 5.5 kilometers (3.4 miles) along the east bank of the Weber River. The site is currently owned and operated by the Union Pacific Railroad . The Ogden Rail Yard Site was the location of a major maintenance area for the Union Pacific Railroad. The area uses included roundhouses, fuel storage, engine repair, and waste treatment facilities (U.S. EPA 1999).

The objective of this effort was to assist in the generation of site-specific ecological and contaminant data for the Ogden Rail Yard site; and to generate a technical data evaluation for the aquatic components of the site. Within this effort, field samples (abiotic and biotic) were collected to assist in filling data gaps initially for the completion of a screening risk assessment.

All sampling conducted within this investigation was conducted as described below; however, most of the soil, sediment and water samples were transferred under chain-of-custody to consultants of the Union Pacific Railroad for chemical analyses. Only approximately 10% of the abiotic samples were retained for independent analyses, as described below. All biotic samples (i.e. fish tissues), toxicity testing samples and biological survey samples were retained for evaluation. Sample analyses data and sampling location information were transferred to the consultants of the Union Pacific Railroad, with the understanding that they would compile all abiotic data and develop site maps.

Sampling locations were focused on the east bank of the Weber River, associated with the Ogden Rail Yard site; and a total of 9 samples were also collected from the Ogden River. There were 19 surface water and sediment samples collected from the Weber River, 15 from the 21st Street Pond, 3 from the Buena Ventura Park Pond, 3 from the Ogden River, 3 from the Roundhouse drainage ditch, 2 from Area of Interest 10, 3 from the 33rd Street Slough, and 4 from each of the remaining locations (Burch Creek and Strongs Creek).

At 7 of the surface water and sediment sampling locations a stream benthic macroinvertebrate survey was conducted as well as solid phase sediment laboratory toxicity tests utilizing two species: chironomids (*Chironomus tentans*) and amphipods (*Hyalella azteca*).

Because of the need for tissue analysis to evaluate the potential transfer of CPOCs to humans and piscivorous organisms, fish were collected from the 21st Street Pond. Prior to necropsy and filet collection, individual fish were examined for external parasites, lesions, and tumors. Samples of filets, carcasses, and livers of five species representative of the site (i.e. brook trout, rainbow trout, largemouth bass, common carp, and white sucker) were collected for analyses.

Sampling of surface soil chemistry was identified as a data need to support the ecological risk analyses for the Weber River riparian area. Samples were collected from most of the length of the riparian zone on the east side of the Weber River and the perimeter of the 21st Street Pond. The sampling design assumed that the perimeter of the 21st Street Pond was as one exposure unit, and the WR riparian area was divided into four exposure units. Ten randomly selected sampling locations were selected in each of the four exposure units along the Weber River. Additionally, there were 7 sampling locations from the 21st Street Pond perimeter exposure unit.

In addition, one sediment/soil sample, from a visible discharge of groundwater from the perimeter of the 21st Street Pond, was collected to assist in the chemical analysis of the sediments collected from the 21st Street Pond and Ogden River.

Surface waters collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, VOCs, Total Petroleum Hydrocarbons (TPH), hardness, TSS, and TOC.

Surface water contained detectable concentrations of aluminum, arsenic, barium, lead, and manganese; however, cadmium, chromium, cobalt, copper, mercury, nickel, selenium, and silver were not detected in surface water samples analyzed.

Surface water samples collected did not have detectable concentrations of BNAs and acetone was the only VOC found (also found in the blank) in surface water samples, with the exception of the water sample from the seep on the bank of the 21st Street Pond. That particular sample (A0119-0325) was found to contain: 120 μg/L benzene, 230 μg/L ethylbenzene, 59 μg/L p&m-xylene, 90 μg/L o-xylene, 12 μg/L isopropylbenzene, 63 μg/L 1,3,5-trimethylbenzene, 64 μg/L 1,2,4-trimethylbenzene, and 180 μg/L naphthalene.

The water samples analyzed were found to have no detectable TPH concentrations.

Sediments collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, pesticides/PCBs, VOCs, TPH, TOC, and grain size.

Aluminum concentrations ranged from 920 mg/kg (AOI 4A) to 15,000 mg/kg in sediments from the 21st Street Pond (21SP04). Sediment arsenic concentrations were greatest at AOI 4 (6.1 mg/kg) and least at the 21st Street Pond seep (1.4 mg/kg). Barium concentrations ranged from 49 mg/kg (33SS2A) to 400 mg/kg (AOI 4A). Cadmium was not detected in many of the locations and the maximum recorded was 1.0 mg/kg (AOI102A). Sediment chromium concentrations ranged from 4.4 mg/kg (AOI4A) to 31 mg/kg (SC1A). The maximum recorded cobalt concentration, 7.7 mg/kg, was from a sample from the 21st Street Pond (21SP04). A sediment sample from the 33rd Street Slough (33SS2A) contained the highest copper concentration, 130 mg/kg. Lead concentrations in sediment samples ranged from 6.8 mg/kg (BC3A) to 130 mg/kg (SC1A). The maximum recorded manganese concentration, 960 mg/kg, was from a sample from the 21st Street Pond (21SP04). The sediment mercury concentrations ranged from non-detected to 0.39 mg/kg (BVP03B). Nickel concentrations ranged from 3.6 mg/kg (WR021ADUP) to 20 mg/kg (21SP04B). The maximum detected sediment selenium and vanadium concentrations were 5.0 mg/kg (AOI4A) and 24 mg/kg (21SP04B), respectively. Sediment zinc concentrations were as low as 33 mg/kg (OR02B) and as high as 200 mg/kg (RD3A). Antimony and silver were not detected in sediment samples analyzed.

The following BNAs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, carbazole, fluoranthene, pyrene, bis)2-ethylhexyl)phthalate, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. A tentatively identified compound (TIC) was recorded for the sediment/soil sample from the seep at the 21st Street pond. It was identified as a biphenol (920 μg/kg). Bis(2-ethylhexyl)phthalate was also found in the sediment samples from the Ogden River, Buena Ventura Park Pond, and 21st Street Pond.

Two pesticides were identified in sediments from the area. Locations SC1A and 33SS2A were found to contain g-chlordane, while p,p'-DDE was measured in sediments from 21st Street Pond seep (12 μg/kg), 21st Street Pond (4.9 to 9.4 μg/kg), and the Weber River (WR019A, 7.3 μg/kg). Only one PCB congener was positively identified. Arochlor 1260 was found at concentrations of 340 μg/kg and 1,000 μg/kg from AOI 10-2 and OR02B, respectively.

The following VOCs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): methylene chloride, benzene, 2-butanone, 4-methyl-2-pentanone, toluene, p-isopropyltoluene, naphthalene, ethylbenzene, p&m-xylene, o-xylene, isopropylbenzene, n-propylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and sec-butylbenzene. Benzene (46 μg/kg) and related compounds were found in the sediment/soil (A0119-0324) from the seep at the 21st Street Pond.

Concentrations of TPH in sediments analyzed ranged from 170 mg/kg (BC3A) to 2,200 mg/kg (WR024A).

The results of the survival and growth effects on *H. azteca* and *C. tentans* observed in the site sediments suggest the absence of adverse effects associated the sediments from the Weber River, with the possible exception of one location which was the furthest downstream of the site. The sediment and water chemistry data for the location do not explain the mortality observed. While the results of these tests can not be discounted, it should be recognized that the observed effects were not large relative to the laboratory control.

The stream macrobenthic community evaluation conducted in the Weber River, and co-located with the toxicity testing, does not indicate any site specific impact on the stream community. These results are consistent with the findings of the toxicity testing conducted.

There were seven BNAs identified in the fish tissue samples, with the most BNA contaminants found in white sucker and common carp filets and carcasses.

There were 5 pesticides (g-chlordane, dieldrin, p,p'-DDE, p,p'-DDD, p,p'-DDT) and one PCB congener (Arochlor 1260) residues identified in the fish tissues from the 21st Street Pond .

Two common carp filets (5.3 μg/kg, 20 μg/kg, w.w.) and one carcass (40 μg/kg, w.w.) were found to contain g-chlordane. Dieldrin was only detected in the carcasses of two trout, a brook trout (3.1 μg/kg, w.w.) and a rainbow trout (2.6 μg/kg, w.w.).

The relatively high PCB concentrations found in the fish from the 21st Street Pond (up to 4 ug/g wet wt. in a carp carcass), combined with the low sediment PCB concentrations found in the sediment suggest that the source of the PCBs is outside of the 21st Street Pond.

Surface soils did not contain unusually high concentrations of any TAL metal, with most of the highest metal concentrations coming from the upstream riparian zone. Bis(2-ethylhexyl)phthalate, benzo(g,h,i)perylene, chrysin, and many unknown tentatively identified compounds (TICs) were the only BNAs found in surface soils; mostly found in samples from the riparian area between Interstate 79 and north of AOI 12 (RZ-1). Only the surface soil from location RZ106 was found to contain Arochlor 1260, at a concentration of 260 ug/kg. The only pesticide detected, p,p'-DDE(1.8 μg/kg) was found in the soil from location RZ407. Few of the surface soil samples were found to contain VOCs. However, acetone, chloroform, trichlorofluoromethane, and chlorodifluoromethane were detected a limited quantity in various samples.

1.0 INTRODUCTION

1.1 Objectives of this Study

The objective of this effort was to assist in the generation of site-specific ecological and contaminant data for the Ogden Rail Yard site, Ogden, Utah (UT); and to generate a technical data evaluation for the aquatic components of the site.

1.2 Site Background

The Ogden Rail Yard site is located in Weber County, UT, on the western edge of the city of Ogden. The rail yard is oriented in a north-south direction, consisting of a distance of approximately 5.5 kilometers (3.4 miles) along the east bank of the Weber River.

The site is currently owned and operated by the Union Pacific Railroad . The Ogden Rail Yard Site was the location of a major maintenance area for the Union Pacific Railroad. The area uses included roundhouses, fuel storage, engine repair, and waste treatment facilities. It is suspected that significant subsurface contamination exists and that several migration and release pathways may be present and affecting terrestrial areas as well as adjacent water bodies, including the Weber River (U.S. EPA 1999).

2.0 METHODOLOGY

Within this effort, field samples (abiotic and biotic) were collected to assist in filling data gaps initially for the completion of a screening risk assessment. Copies of chain of custody forms are found in Appendix A. Descriptions of site reconnaissance and field activities are found in Appendix B.

All sampling conducted within this investigation was conducted as described below; however, most of the soil, sediment and water samples were transferred under chain-of-custody to consultants of the Union Pacific Railroad for chemical analyses. Only approximately 10% of the abiotic samples were retained for independent analyses, as described below. All biotic samples (i.e. fish tissues), toxicity testing samples and biological survey samples were retained for evaluation.

Sample analyses data and sampling location information were transferred to the consultants of the Union Pacific Railroad, with the understanding that they would compile all abiotic data and develop site maps.

2.1 Technical Approach

2.1.1 Habitat Evaluation

The in stream and riparian habitat was evaluated at all sampling locations in the Weber River to support the biological survey per Environmental Response Team (ERTC)/Response Engineering and Analytical Contract (REAC) Standard Operating Procedure (SOP) #2032 *Benthic Macroinvertebrate Sampling* and EPA (1990b, 1997b). Habitat parameters pertinent to the assessment of biological quality include those that characterize the stream micro- and macro scale habitat and influence the structure of the biological community. These include epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles (or bends), bank stability, bank vegetative protection, and riparian vegetative zone width (Table 1). For every location, the procedure assigned a numeric value for each habitat parameter individually, with the highest scores awarded to locations with best quality habitat. The values were summed for total habitat score, with the highest scores awarded to locations

with best quality habitat. The total score for each location was compared to a reference location to provide a habitat comparability score; Weber River location WR09 was used as the reference location. The habitat comparability score is a ratio of the total score for a location to the total score for the reference. The comparability scores are associated with verbally descriptive assessment categories which include: "comparable to reference", "supporting", "partially supporting", and "non-supporting" (Table ~~1~~ 2).

2.1.2 Aquatic Sampling

2.1.2.1 Sampling Locations

To the maximum extent possible, sampling locations for surface water, sediment, and benthic macroinvertebrates were collocated to decrease costs and increase interpretive powers. The locations were situated in areas exhibiting similar habitat characteristics including substrate composition, riparian vegetation, topographic relief, channel morphology, flow velocity, watershed features, and land use. Sampling locations were focused on the east bank of the Weber River, associated with the Ogden Rail Yard site, to evaluate the site's potential for release of contamination to the Weber River. Samples were also collected from the Ogden River to evaluate the possibility of contaminant release at a total of 9 selected locations (See Figure 1):

- Weber River (WR) upstream, adjacent to, and downstream of the Ogden Rail Yard
- 21st Street Pond (21SP)
- Buena Ventura Park Pond (BVPP)
- Burch Creek (BC)
- Strongs Creek (SC)
- 33rd Street Slough (33SS)
- Area of Interest #10 (AOI 10)
- Roundhouse drainage ditch (RD)
- Ogden River (OR) upstream, adjacent to, and downstream of the 21st Street Pond

2.1.2.2 Surface Water Sampling

Surface water was collected at all sampling locations per ERTC/REAC SOP #2013, *Surface Water Sampling* directly into the appropriate container by hand. To avoid the incidental incorporation of suspended sediment into the sample, water was collected prior to other sampling activities that may disturb the sediment: in addition sampling began downstream and proceeded upstream. Water samples were collected at half the maximum depth at each sampling location. Those samples from the Weber River were collected approximately one meter (m) from the east bank, which was adjacent to the Ogden Rail Yard. Those samples from the Ogden River were collected approximately 1 m from the south bank, which was adjacent to the 21st Street Pond.

There were 19 surface water samples collected from the Weber River, 15 from the 21st

Street Pond, 3 from the Buena Ventura Park Pond, 3 from the Ogden River, 3 from the Roundhouse drainage ditch, 2 from Area of Interest 10, 3 from the 33rd Street Slough, and 4 from each of the remaining locations (Burch Creek and Strongs Creek).

2.1.2.3 Water Quality Measurements

Water quality parameters were measured using a Hydrolab Surveyor 4*a* Water Quality Management System™. The Hydrolab was used to measure temperature (degrees centigrade, °C), pH, dissolved oxygen (DO, mg/L), conductivity (microohms, μmhos), oxidation-reduction potential (volts, V), and turbidity (Nephelometric Turbidity Units, NTU). The Hydrolab was calibrated prior to data collection and after data collection was complete. The Hydrolab was used in accordance with the manufacturer's operating manual.

2.1.2.4 Sediment Sampling

Sediment was collected from 19 locations on the Weber River and collocated with surface water samples. Sampling locations were in identified depositional areas, determined to contain a volume of sediment sufficient to fulfill the analytical requirements. The collection area for any one sample did not exceed a 6 m reach of the river. Sediment was collected per ERTC/REAC SOP #2016, *Sediment Sampling*. Sediment samples were collected using a ponar or decontaminated trowels (as appropriate to reduce the loss of fine sediment particles). It was frequently necessary to composite sediment from several collocated grabs in a stainless steel bucket, to obtain sufficient material to meet analytical requirements. The bulk sample was covered and returned to a staging area. Prior to homogenization, aliquots for VOC analyses were dispensed into appropriate sample containers. After the sample was thoroughly mixed, aliquots for remaining laboratory analyses were dispensed into appropriate sample containers. All unused sample material was returned to the site.

There were 19 sediment samples collected from the Weber River, 15 from the 21st Street Pond, 3 from the Buena Ventura Park Pond, 3 from the Ogden River, 3 from the Roundhouse drainage ditch, 2 from area of interest 10, 3 from the 33rd Street Slough, and 4 from each of the remaining locations (Burch Creek and Strongs Creek).

2.1.2.5 Benthic Macroinvertebrate Sampling

A stream benthic macroinvertebrate survey was conducted at 7 sampling locations along the Weber River (WR09, WR011, WR012, WR014, WR019, WR024, WR028). These samples were taken as one method of evaluation of the ecological integrity of the Weber River. Rapid Bioassessment Protocols (RBP) were used to identify and evaluate the abundance and distribution of habitat and ecological communities (U.S. EPA 1990b, 1997b). Sampling locations were situated in areas that typify the drainage (i.e. representativeness) and were likely to yield representative specimens of benthic macroinvertebrates. In order to assure similarities of habitat among locations, the same personnel selected and sampled the sites. The survey followed draft ERTC/REAC SOP #2032 *Benthic Macroinvertebrate Sampling* and U.S. EPA protocols (1990b, 1997b).

Three replicate collections (2 minutes each) were made with a D-net, from the 7 locations on the Weber River (21 total samples). To facilitate comparisons, an equivalent level of effort was expended in riffle areas consisting of a heterogeneous assortment of gravel to cobble-sized particles. The stream bottom upstream of the net was disturbed to a depth of approximately 5 centimeters (cm). Organisms and debris thus dislodged were swept into

the net by the current. Following this, clean water was carefully poured or swept through the net to wash fine sediment particles from the contents. The samples were transferred from the net to a 500-milliliter (ml) polyethylene bottle and preserved with isopropyl alcohol.

Due to the large number of organisms present in each sample, sub-sampling was performed according to U.S. EPA methods (USEPA 1999). The alcohol was decanted from the sample and examined for organisms. If any were found, they were returned to the main sample. The sample was then placed into a plastic tray marked into even divisions, approximately 6 cm square. Each square was numbers sequentially. Water was added to the tray, and the detritus carefully distributed evenly throughout the tray. A random number table was used to select a sampling square. All detritus and organisms were removed from the selected square and placed into a glass tray underlit by a light source. Organisms in the sub-sample were then gently removed and placed into labeled glass vials containing 70% methanol. If fewer than 100 organisms were recovered from the square, additional squares were randomly selected until at least 100 organisms were recovered. The remaining detritus was replaced into the original sampling container along with the alcohol. This procedure was repeated for all 21 samples. All samples were returned to Lockheed Martin/REAC for archiving.

Organisms in each sample were identified to lowest practical taxon, genus in most cases, using commonly accepted taxonomic references (Wiggins 1996; Merrit and Cummins 1996; or Peckarsky 1990). Chironomid larvae and oligochaetes were counted but not identified further. Exuviae, empty shells, and pieces of larvae without heads were not included in counts. The number of each taxa found in each sample was noted on a bench sheet. Occasionally organisms were recovered that were damaged to the point that full identification was not possible. In this case, notes were provided on the benchsheets. Identified organisms were returned to vials and preserved in 70% ethanol. All vials were returned to Lockheed Martin/REAC for archiving.

The total number of organisms present and the number of distinct taxa identified are presented. The functional group of each taxa was determined by using the tables in Merritt and Cummins 1996 and U.S. EPA 1999. The number of scrapers and filterers were determined and used to evaluate the scraper:filterer ratio. Species diversity in each sample was evaluated using Shannon's H'. The number of organisms in the orders Plecoptera, Ephemeroptera, and Trichoptera were determined and compared to the numbers of organisms in the family Chironomidae to evaluate the EPT:Chironomid ratio. The percent contribution of the dominant taxon was calculated by dividing the number of organisms in the most abundant taxon by the total number of organisms collected. All calculations were performed using Microsoft Excel. Hilsenhoff's biotic index was conducted according to Hilsenhoff (1987) and Hilsenhoff (1988) with the modifications suggested by the U.S. EPA's Rapid Bioassessment Protocol (EPA 444/4-89/001 and EPA 841-B-99-002).

In order to determine the biological condition at each station, the metrics were averaged across the three replicates (or recalculated, depending on the metric) and the result tabulated for each of the seven stations. The condition score at each station was then compared to the score at the reference (Station 1, Location WR09) and evaluated using the criteria in U.S. EPA protocol (1989).

2.1.2.6 Fish Collection

Because of the need for tissue analysis to evaluate the potential transfer of CPOCs to humans and piscivorous organisms, fish were collected from the 21st Street Pond, using a boat-mounted electrofisher, with the assistance of the State of Utah's fisheries biologists. Stunned fish were collected with dip nets and placed into coolers containing site water until processing. Fish were collected from the entire pond area by making concentric passes around the pond, until the target number of specimens had been reached. The sampling crew taxonomically identified the fish and recorded the wet weight (whole body, carcass, and liver) and length (total, fork, and standard) of the fish, as per ERTC/REAC SOP #2039, *Fish Handling and Processing*. Prior to necropsy and filet collection, individual fish were examined for external parasites, lesions, and tumors. Filets, carcasses, and livers were wrapped in aluminum foil, placed in a plastic bag, and placed on wet ice for 16 hours prior to being frozen with dry ice. Five species representative of the site (i.e. brook trout, rainbow trout, largemouth bass, common carp, and white sucker) were collected for analyses, with the following total length ranges: brook trout (20-40 cm), rainbow trout (21-40 cm), largemouth bass (24-41 cm), common carp (47-59 cm), and white sucker (42-55 cm). There were 3 individuals each of brook trout and rainbow trout, 6 largemouth bass, and 5 each of common carp and white sucker collected. Each fish had a filet (skin on) removed for analyses. The remaining carcass was analyzed to obtain whole-body burden data. Livers from each fish of a species were composited for analyses. In addition, there were seven (whole-body) samples of a forage fish species (bluegill, perch, crappie, red-sided shiner, and juvenile largemouth bass) were collected for tissue residue analyses. Following inspection of the filets by a Union Pacific Railroad representative, tissues were shipped on dry ice, via overnight delivery to the analytical lab.

2.1.2.7 Toxicity Evaluations

Laboratory toxicity tests were conducted using site sediment with the following species, commonly utilized in sediment toxicity evaluations: chironomids (*Chironomus tentans*) and amphipods (*Hyalella azteca*).

Solid-phase sediment toxicity evaluations using *C. tentans* and *H. azteca* were employed to provide data concerning the availability and toxicity of contaminants present in the sediment as per ERTC/REAC SOP #2051, *Ten Day Renewal Test for Determining Acute Toxicity of Sediments To The Freshwater Amphipod Hyalella azteca and the Midge Chironomus tentans*. Sediment for the solid–phase toxicity evaluations were collected from seven of the Weber River sediment sampling locations (collocated with the benthic community survey locations). These organisms often comprise a significant proportion of the benthic biomass and are an important component of the aquatic community. In addition to being in intimate physical contact with the substrate, *C. tentans* and *H. azteca* feed on detrital matter and vegetative debris incorporated into the sediment. Each sediment toxicity test consisted of eight replicates per sample location using 100 percent site sediment (no dilutions were used), and a control. Overlying water for the tests were of a quality consistent with that of the mean site waters (i.e., alkalinity, hardness, pH, and Ca^{2+}:Mg^{2+} ratio). In addition, a concurrent standard reference toxicity test was conducted for each organism.

2.1.3 Terrestrial Sampling

2.1.3.1 Sampling Locations

Sampling of surface soil chemistry was identified as a data need to support the ecological risk analyses for the Weber River riparian area. Samples were collected from most of the

length of the riparian zone (RZ) on the east side of the Weber River and the perimeter of the 21st Street Pond. The sampling design assumed that the perimeter of the 21st Street Pond was as one exposure unit, and the WR riparian area was divided into four exposure units:

- RZ-1 (the portion south of Interstate 79 and north of AOI 12);
- RZ-2 (the area to the north of Interstate 79 and south of the 24th Street overpass);
- RZ-3 (the area to the north of the 24th Street overpass and south of the 21st Street overpass); and
- RZ-4 (background riparian area of the WR).

In RZ-1 and RZ-2, sampling in AOI 27 and AOI 34 was determined to be not needed as these two AOIs were anticipated to be investigated as part of other efforts.

Surface soil sampling was confined to the east side of the Weber River, since contaminant migration to the west side riparian zone soils was not expected. Ten randomly selected sampling locations were selected per exposure unit in RZ-1, RZ-2, RZ-3, and RZ-4. Additionally, there were 7 sampling locations from the 21st Street Pond perimeter exposure unit.

2.1.3.2 Surface Soil Collection

Surficial soil (0 to 15 centimeters below ground surface) was collected from the five exposure units (four Weber River riparian zones and the perimeter of 21st Street Pond) using a dedicated, appropriately decontaminated stainless steel trowel per Environmental Response Team (ERTC)/Response Engineering and Analytical Contract (REAC) Standard Operating Procedure (SOP) #2012, *Soil Sampling*. Individual grabs were placed into a stainless steel (SS) bucket and homogenized. For VOC analyses an alternate methodologies for collection of soil samples was employed, the EnCore® sampling device. Aliquots for remaining laboratory analyses were dispensed into appropriate sample containers and all unused sample material was returned to the site.

2.1.3.3 Seep Sediment/Groundwater Collection

One sediment/soil sample, from a visible discharge of groundwater from the perimeter of the 21st Street Pond, was collected (ERTC/REAC SOP #2012, *Soil Sampling*) to assess point source loading of contaminants to the 21st Street Pond and Ogden River. The results of the chemical analyses were utilized to focus the selection of analytes for the sediments of the 21st Street Pond.

2.2 Sampling Equipment Decontamination

The following sampling equipment decontamination procedure was employed prior and subsequent to sampling each location in the following numerical sequence:

1 physical removal
2 nonphosphate detergent wash (Liquinox)
3 potable water rinse
4 distilled/deionized water rinse
5 10% nitric acid rinse
6 solvent rinse (Acetone)
7 distilled water rinse

8 air dry

There were exceptions to this decontamination procedure. The ponar utilized in the collection of sediments from the 21st Street Pond and Buena Ventura Park Pond only underwent step one, physical removal, of the procedure. The ponar was completely decontaminated at the end of each sampling day and between the Buena Ventura Park Pond and 21st Street Pond sampling activities. The potential for cross sample contamination from the highly contaminated sediment locations was evaluated from the perspective of the sequence of sample collection. It was determined that the potential for cross contamination did not distort the evaluation of the contamination distribution in the sediments.

2.3 Standard Operating Procedures

2.3.1 Sample Documentation

Sample documentation was completed per the following ERTC/REAC SOPs:

- ERTC/REAC SOP #2002, *Sample Documentation*
- ERTC/REAC SOP #4005, *Chain of Custody Procedures*

2.3.2 Sample Packaging and Shipment

Sample packaging and shipment was conducted in accordance with the following ERTC/REAC SOP:

- ERTC/REAC SOP #2004, *Sample Packaging and Shipment*

2.3.3 Sampling Techniques

Field activities were conducted in accordance with the following SOPs:

- ERTC/REAC SOP #2013, *Surface Water Sampling.*
- ERTC/REAC SOP #2016, *Sediment Sampling.*
- ERTC/REAC SOP #2032 *Benthic Macroinvertebrate Sampling*
- ERTC/REAC SOP# 2041, *Operation of the Hydrolab Surveyor II Water Quality Management System*
- ERTC/REAC SOP # 2055, *10-Day Renewal Test for Determining Acute Toxicity of Sediments to the Freshwater Amphipod, Hyalella azteca and the Midge, Chironomus tentans.*

2.4 Waste Disposal

Investigative derived waste (i.e. PPE) was disposed of in accordance with all state and federal regulations. All of the treated and untreated samples will be maintained for 60 days after the issuance of this final report. If no additional testing has been requested at the end of the 60 days, with the approval of the Task Leader, arrangements will be made for disposal.

3.0 RESULTS

The abiotic (sediment, soil and water) chemical data presented herein constitute approximately 10% (U.S. EPA split portion) of all samples collected and analyzed. The chemistry data for the sediment samples which had laboratory toxicity testing also conducted are included, as well as the chemical analysis data for the tissue

samples collected. All abiotic chemistry data was compiled through the consultants for Union Pacific Railroad, these data may be found in the following reports:

Data Summary Report.
Samples Collected Through July 2000
Union Pacific Railroad Company
Ogden, Utah
December 19, 2000

and

Draft Interim Remedial Investigation report
AOI - 33, 21 Street Pond
Union Pacific Railroad Company
Ogden, Utah
December 19, 2000

Full analytical results, for the samples presented in this report, may be found in Appendix C, and toxicological evaluations in Appendix D. All toxicity test results are summarized in Tables 1-18. A brief summary of the analytical and toxicological results follows. For the purpose of graphical clarity, non-detected concentrations are presented as the associated analysis method detection limit.

All analytical results for water are reported as micrograms of contaminant per liter of water (μg/L). With the exception of grain size analyses, all analytical results for sediment are reported as milligrams of contaminant per kilogram of sediment (mg/kg). Results of the grain size analyses are reported as percent composition. All analytical results for tissue are reported as micrograms of contaminant per kilogram of tissue (μg/kg).

The analytical results generated from the analyses of sediment and tissue are reported by the laboratories on a dry weight (d.w.) basis. The percent solids determination for each sample is also included. [The hazard quotient (HQ) method in risk assessments commonly compares site-specific contaminant concentrations with effects levels from the literature that are reported on a wet weight (w.w.) basis.] Only the analytical results for fish tissue were converted to a wet weight basis for this evaluation. The dry weight concentrations in abiotic matrices are presented in their respective tables.

3.1 Results of the Habitat Evaluation

3.1.1 Habitat Evaluation

Location WR09 received an overall score of 169 (Table 2). Optimal scores were received for epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration, frequency of riffles, bank stability (left bank), bank vegetative protection (left bank), and riparian vegetation zone width (left bank); a suboptimal score was received for bank stability (right bank); and marginal scores were received for bank vegetative protection (right bank) and riparian vegetation zone width (right bank). With the exception of a dirt road parallel to the right bank, this location was situated in a relatively undisturbed area. The right bank was steep and covered with boulder rip-rap with some vegetation; the road was within 15-feet of the stream edge. The riparian vegetation had been reduced by the rip-rap and dirt road along the right bank, but the left bank was completely vegetated. The Weber River at this location was a relatively fast flowing stream dominated by riffle areas (Table 3). Pool and run areas were present, but only along the channel margins and small embayments. The substrate was composed primarily of cobble to boulder sized particles (Table 3) and the sediment was normal in appearance and odor. The Weber River at location 09 ranged to 2-feet in depth and was approximately 40-feet in width. The canopy cover was less than 5 percent. Some coarse particulate organic matter was present along

the upstream sides of rocks and other obstructions.

Location WR011 received an overall score of 165 (Table 2). Optimal scores were received for epifaunal substrate/available cover, embeddedness, velocity-depth regime, sediment deposition, channel flow status, channel alteration, and frequency of riffles, suboptimal scores were received for bank stability (both banks), bank vegetative protection (left bank), and riparian vegetation zone width (left bank); and marginal scores were received for bank vegetative protection (right bank) and riparian vegetation zone width (right bank). The dirt road present along the right bank continued to result in lower scores at this location and the stability of the right bank was compromised somewhat by the presence of a large disturbed area and piles of bare spoil and construction debris. The left bank was not disturbed and fully vegetated. The Weber River at this location was a relatively fast flowing stream dominated by riffle areas (Table 3). Pool and run areas were more common that at WR09, but were still present only along the channel margins. The substrate was composed primarily of cobble to boulder sized particles (Table 3) and the sediment was normal in appearance and odor. The Weber River at location 011 ranged to 3-feet in depth and was approximately 35-feet in width. The canopy cover was less than 5 percent. Some coarse particulate organic matter was present along the upstream sides of rocks and other obstructions.

Location WR012 received an overall score of 149 (Table 2). Optimal scores were received for epifaunal substrate/available cover, embeddedness, velocity-depth regime, channel flow status, channel alteration, and frequency of riffles; suboptimal scores were received for sediment deposition and bank stability (both banks); marginal scores were received for bank vegetative protection (both banks), and riparian vegetation zone width (both banks). At this location, the Weber River flows through a developed area; paved roads are present and the riparian area was dominated by mowed turf and ornamental plantings. The Weber River at this location was a relatively fast flowing stream but the riffle areas were reduced relative to areas further upstream (Table 3). Pool and run areas were more common, and were present in the channel as well as along the channel margins. The substrate was composed primarily of boulder sized particles but there was a greater proportion of gravel and sand sized particles at this location (Table 3). The sediment was normal in appearance and odor. The Weber River at location 012 ranged to 4-feet in depth and was approximately 35-feet in width. The canopy cover was less than 5 percent. Some coarse particulate organic matter was present along the upstream sides of rocks and other obstructions.

Location WR014 received an overall score of 136 (Table 2). Optimal scores were received for sediment deposition, channel flow status, channel alteration, bank stability (right bank), and bank vegetative protection (right bank); suboptimal scores were received for epifaunal substrate/available cover, embeddedness, frequency of riffles, bank stability (left bank), and riparian vegetative zone width (right bank); marginal scores were received for velocity-depth regime, bank vegetative protection (left bank), and riparian vegetative zone width (left bank). A paved road was present along the left bank and areas of bare soil and disturbed road shoulder were present in the riparian area. The right bank was forested and the canopy cover was 30 percent. The habitat at this location was dominated by run (Table 3) and extensive areas of fast laminar flow is present. The stream substrate was composed primarily of cobble-sized particles with substantial proportions of pebbles and coarse sand (Table 3). Coarse particulate organic matter was present in the stream. The Weber River at location 014 ranged to 4-feet in depth and was approximately 25 feet in width.

Location WR019 received an overall score of 143 (Table 2). Optimal scores were received for sediment deposition, channel alteration, frequency of riffles, and bank vegetative protection (left bank); suboptimal scores were received for epifaunal substrate/available cover, embeddedness, channel flow status, bank stability (both banks), bank vegetative protection (right bank), and riparian vegetation zone width (right bank); marginal scores were received for velocity depth regime and riparian vegetative zone width (right bank). At this location, the Weber River flows through a

park; a recreational field was present along the right bank and a picnic area was present along the left bank approximately 100-yards upstream of the sampling location. The left bank was forested, but exposed gravel bars were present along the inner portions of stream bends. The habitat at this location was dominated by riffle areas with some pools and run areas along the stream edge and in embayments (Table 3). The substrate was composed of gravel to cobble sized particles with some sand and finer particles in areas of slower flow (Table 3), and was normal in appearance and odor. The Weber River at location 019 ranged to 1.5-feet in depth and was approximately 25 feet in width. The canopy cover was less than ten percent, and very little coarse particulate organic matter was present in the stream.

Location WR024 received an overall score of 99 (Table 2). An optimal score was received for channel flow status; suboptimal scores were received for epifaunal substrate/available cover, embeddedness, and bank stability (right bank); marginal scores were received for velocity-depth regime, sediment deposition, channel alteration, frequency of riffles, bank stability (left bank), bank vegetative protection (right bank), and riparian vegetation zone width (right bank); poor scores were received for bank vegetative protection (left bank), and riparian vegetation zone width (left bank). At this location, the Weber River flows through the rail yard itself and was bordered by large areas of bare soil, dirt and paved roads, a chemical packaging facility, rail maintenance areas, and rail sidings. A narrow fringe of riparian vegetation is present along the right bank and the left bank is dominated by disturbance as noted above. The river filled the channel and stream banks were undercut in places. The habitat was primarily run with large areas of fast laminar flow (Table 3). Pools were present in embayments and a small riffle area was present approximately 20-yards upstream of the sampling location. The substrate was dominated by gravel and sand sized particles (Table 3) and was normal in appearance and odor. The canopy cover was less than 5 percent. The Weber River at location 024 ranged to 4-feet in depth and was approximately 25 feet in width. Although very little coarse particulate organic matter was present, areas of fine organic matter was present in the pools.

Location WR028 received overall score of 121 (Table 2). Optimal scores were received for epifaunal substrate/available cover, sediment deposition, and channel flow status; suboptimal scores were received for embeddedness, channel alteration, frequency of riffles, and bank stability (right bank); marginal scores were received for velocity-depth regime, bank stability (left bank), bank vegetative protection (right bank), and riparian vegetation zone width (right bank); poor scores were received for bank vegetative protection (left bank), and riparian vegetation zone width (left bank). With the exception of some sidings, this location was downstream of most active portions of the rail yard including maintenance area and lagoons and drainage ditches. The riparian area along both banks was somewhat disturbed but was vegetated with a scrub-shrub association and some scattered trees. The river flows through a well defined channel; the left stream bank was a relatively steep embankment approximately 8-feet above the waters surface whereas the right bank sloped gradually to the water surface. The habitat was primarily run with large areas of fast laminar flow (Table 3). Pools were present in embayments and backwater areas. Several riffle areas were present adjacent to gravel bars along the right bank and the inner portion of stream bends. The substrate was dominated by cobble and gravel and sand sized particles (Table 3) and was normal in appearance and odor. The canopy cover was less than 5 percent. The Weber River at location 028 ranged to 3-feet in depth and was approximately 30 feet in width. Some coarse particulate organic matter was present and fine organic matter was present in the pools.

3.1.2 Habitat Assessment

For each location, the evaluation procedure rated and then totaled the scores for individual habitat parameters (Table 2). The total score for each location was compared to the reference location to provide a habitat comparability score. When compared to upstream location WR09, the habitat at

locations WR011 was assigned to assessment category "comparable to reference", locations WR012, WR014 and WR019 were assigned to assessment category "supporting", location WR028 was assigned to assessment category "partially supporting", and location WR024 was assigned to assessment category "non-supporting". Relative to the upstream reference location, the habitat quality of the downstream locations can be ranked as follows: WR09>WR011>WR012>WR019>WR014>WR028>WR024.

3.2 Results of the *In situ* Surface Water Quality

Water quality parameters were measured (09 March 2000) using a Hydrolab Surveyor 4*a* Water Quality Management System™ at the following locations: Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, and Strongs Creek (Table 4). Surface water temperatures ranged from 1.0 °C (AOI 10-2) to 4.3 °C (Burch Creek-3). The dissolved oxygen concentrations in the surface waters only varied from a low of 10.2 mg/L (Roundhouse ditch-3) to 11.4 mg/L (AOI 10-2). There was minimal variation in pH among the locations, with all having a pH of 8.2 or 8.3 standard units. Surface water conductivity ranged from 451 μmhos (Strongs Creek-4) to 3,679 μmhos (AOI 10-2). Turbidity was greatest at location AOI 10-2 (1,000+ NTU) and lowest at Roundhouse ditch-3 (53 NTU).

3.3 Results of the Chemical Analyses of Surface Water

Surface waters collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, VOCs, Total Petroleum Hydrocarbons (TPH), hardness, TSS, and TOC (Appendix C).

Surface water concentrations of aluminum ranged from 57 μg/L (33SS1A) to 1,200 μg/L (BC3A and BVP03B). Arsenic concentrations ranged from non-detected to 5.0 μg/L (SC2A). Barium surface water concentrations ranged from 52 μg/L (OR02B) to 250 μg/L (BC3A). Surface water samples had lead concentrations ranging from non-detectable to 7.2 μg/L (BVP03A). Manganese concentration in surface water ranged from 30 μg/L (WR011A and WR012A) to 110 μg/L (33SS1A). Surface water samples were found to contain zinc at concentrations ranging from non-detectable to 21 μg/L (33SS1A). Cadmium, chromium, cobalt, copper, mercury, nickel, selenium, and silver were not detected in surface water samples analyzed.

Surface water samples collected did not have detectable concentrations of BNAs.

Acetone was the only VOC found (also found in the blank) in su.face water samples, with the exception of the water sample from the seep on the bank of the 21st Street Pond. That particular sample (A0119-0325) was found to contain: 120 μg/L benzene, 230 μg/L ethylbenzene, 59 μg/L p&m-xylene, 90 μg/L o-xylene, 12 μg/L isopropylbenzene, 63 μg/L 1,3,5-trimethylbenzene, 64 μg/L 1,2,4-trimethylbenzene, and 180 μg/L naphthalene.

The water samples analyzed were found to have no detectable TPH concentrations.

Surface water hardness, expressed as mg/L $CaCO_3$, ranged from 93 mg/L (BVP03B) to 392 mg/L (BC3A). Due in part to flow and substrate differences, TSS concentrations varied widely. At the 33rd Street Slough (33SS1A), TSS was below the method detection limit of 5 mg/L, in contrast to the 23 mg/L in Burch Creek (BC3A). Surface water from the Ogden River had the lowest concentration of TOC, 1.8 mg/L (OR02B), while the sample from BVPP (BVP03B) had the highest, 5.2 mg/L.

3.4 Results of the Chemical Analyses of Sediments

Sediments collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, pesticides/PCBs, VOCs, TPH, TOC, and grain size (Appendix C).

Aluminum concentrations ranged from 920 mg/kg (AOI 4A) to 15,000 mg/kg in sediments from the 21st Street Pond (21SP04). Sediment arsenic concentrations were greatest at AOI 4 (6.1 mg/kg) and least at the 21st Street Pond seep (1.4 mg/kg). Barium concentrations ranged from 49 mg/kg (33SS2A) to 400 mg/kg (AOI 4A). Cadmium was not detected in many of the locations and the maximum recorded was 1.0 mg/kg (AOI102A). Sediment chromium concentrations ranged from 4.4 mg/kg (AOI4A) to 31 mg/kg (SC1A). The maximum recorded cobalt concentration, 7.7 mg/kg, was from a sample from the 21st Street Pond (21SP04). A sediment sample from the 33rd Street Slough (33SS2A) contained the highest copper concentration, 130 mg/kg. Lead concentrations in sediment samples ranged from 6.8 mg/kg (BC3A) to 130 mg/kg (SC1A). The maximum recorded manganese concentration, 960 mg/kg, was from a sample from the 21st Street Pond (21SP04). The sediment mercury concentrations ranged from non-detected to 0.39 mg/kg (BVP03B). Nickel concentrations ranged from 3.6 mg/kg (WR021ADUP) to 20 mg/kg (21SP04B). The maximum detected sediment selenium and vanadium concentrations were 5.0 mg/kg (AOI4A) and 24 mg/kg (21SP04B), respectively. Sediment zinc concentrations were as low as 33 mg/kg (OR02B) and as high as 200 mg/kg (RD3A). Antimony and silver were not detected in sediment samples analyzed.

The following BNAs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): 4-methylphenol, naphthalene, 2-methylnaphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, carbazole, fluoranthene, pyrene, bis)2-ethylhexyl)phthalate, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. A tentatively identified compound (TIC) was recorded for the sediment/soil sample from the seep at the 21st Street pond. It was idenitified as a biphenol (920 μg/kg). Bis(2-ethylhexyl)phthalate was also found in the sediment samples from the Ogden River, Buena Ventura Park Pond, and 21st Street Pond.

Two pesticides were identified in sediments from the area. Locations SC1A and 33SS2A were found to contain g-chlordane, while p,p'-DDE was measured in sediments from 21st Street Pond seep (12 μg/kg), 21st Street Pond (4.9 to 9.4 μg/kg), and the Weber River (WR019A, 7.3 μg/kg). Only one PCB congener was positively identified. Arochlor 1260 was found at concentrations of 340 μg/kg and 1,000 μg/kg from AOI 10-2 and OR02B, respectively.

The following VOCs were found in sediment samples from the various drainages related to the rail yard (i.e., Burch Creek, AOI 10, 33rd Street Slough, Roundhouse ditch, Strongs Creek, and the Weber River): methylene chloride, benzene, 2-butanone, 4-methyl-2-pentanone, toluene, p-isopropyltoluene, naphthalene, ethylbenzene, p&m-xylene, o-xylene, isopropylbenzene, n-propylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, and sec-butylbenzene. Benzene (46 μg/kg) and related compounds were found in the sediment/soil (A0119-0324) from the seep at the 21st Street Pond.

Concentrations of TPH in sediments analyzed ranged from 170 mg/kg (BC3A) to 2,200 mg/kg (WR024A).

Sediment TOC (loss on ignition) ranged from 0.61 percent (%) (WR021A) to 5.1% (WR09A).

3.5 Results of the Solid-Phase Sediment Toxicity Evaluations

A summary of the *H. azteca* survival and growth during the 14 day subchronic exposure to site

sediments is presented in Table 4. The mean percent laboratory control survival was 93%. The mean percent survival in the sediment from location WR025A was 74%; the only sample to be statistically different compared to the survival of control organisms. The mean percent survival in all of the remaining samples evaluated ranged from 91 to 100%. The mean dry weight of amphipods in the laboratory control, at day 14, was 0.15 mg per amphipod. Based on the statistically significant reduction of survival in the sediment from location WR025, organism growth from this sample was excluded from statistical analysis. The mean dry weight of amphipods in all of the site sediments tested ranged from 0.24 to 0.40 mg per amphipod, greater than that of the laboratory control organisms.

A summary of the *C. tentans* survival and growth during the 10 day subchronic exposure to site sediments in presented in Table 5. The mean percent laboratory control survival was 93%. The mean percent survival in the sediment from location WR025A was 76%; the only sample to be statistically different compared to the survival of control organisms. The mean percent survival in all of the remaining samples evaluated ranged from 81 to 96%. The mean dry weight of midge in the laboratory control, at day 10, was 0.99 mg per midge. Based on the statistically significant reduction of survival in the sediment from location WR025, organism growth from this sample was excluded from statistical analysis. The mean dry weight of midge in all of the site sediments tested ranged from 1.91 to 3.51 mg per midge, greater than that of the laboratory control organisms.

3.6 Results of the Benthic Macroinvertebrate Community Survey

Examination of raw samples indicated very high counts for all samples. In most cases, subsampling only one square was required to achieve greater than 100 organisms. In no case was more than 2 squares necessary to obtain the required 100 organisms. It was apparent from casual observation that EPT taxa (Ephemoptera, Plecoptera, Tricoptera - mayflies, stoneflies, caddisfies respectively), particularly mayflies, were dominant in most samples. Counts of the subsamples ranged from 107 to 312, representing 12 to 22 taxa, often 50% or more being EPT taxa (Table 7). The most abundant organisms were EPT taxa, and chironomids were not overly abundant in most samples.

Community metrics were calculated according to EPA protocols and are summarized by station in Table 7. There were no apparent trends in abundance or richness in either total taxa or EPT taxa. Pollution tolerant organisms were present at all stations. However, Hilsenhoff indices were high, ranging from 4.4 to 5.3. The high values are likely due to the high numbers of Beatidae mayflies, which have a Biotic Index of 5. However, the presence of these organisms is as likely due to hydraulic conditions and the large amount of vegetative matter present in the samples as it would be due to xenobiotic input. It is possible that the stream is receiving nutrient input, this could be verified by surface water chemistry. There was no apparent trend in Biotic Index between stations, nor was there a trend in either EPT:chironomid or scraper:filterer ratios. Community structure did exhibit some trends, with the percent contribution of dominant taxa decreasing downstream from a high of 60 to a low of 25-30. Again, this is likely due to the very high number of Beatidae mayflies present at the upstream stations. Taxa diversity increased relatively consistently from the upstream to the downstream stations, from a low of 1.6 to a high of 2.2.

A bioassessment was performed following USEPA protocols and comparing stations objectively utilizing standard community metrics. There were no significant differences detected between the 7 stations (Table 7).

3.7 Results of the Chemical Analyses of Fish Tissues

The fish collected (Table 8) and processed were analyzed for tissue residues of BNAs and pesticides/PCBs. Samples were also analyzed for percent lipid content. Complete analytical reports

can be found in Appendix C.

There were seven BNAs identified in the fish tissue samples (Table 9). Three of the compounds commonly found were phthalates [i.e., diethylphthalate, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate], plasticizers and common laboratory contaminants (from latex gloves). The remaining detected BNAs were phenol, 4-methylphenol, bis(2-chloroethoxy)methane, and acenaphthene. Phenol (3,100 μg/kg, w.w.) was found only in the composite liver sample (0119-1230) from white suckers. Similarly, 4-methylphenol (580 μg/kg, w.w.) was only found in a single sample (0119-1239), a largemouth bass carcass. Bis(2-chloroethoxy)methane (530 μg/kg) was identified in only one sample as well (0119-1215), a common carp filet. Six samples were found to contain acenaphthene, one white sucker filet (0119-1220 = 560 μg/kg, w.w.), three white sucker carcasses (0119-1223 = 580 μg/kg, 0119-1225 = 910 μg/kg, 0119-1229 = 420 μg/kg, w.w.), and two common carp carcasses (0119-1210 = 780 μg/kg, 0119-1218 = 730 μg/kg, w.w.).

There were 5 pesticides (g-chlordane, dieldrin, p,p'-DDE, p,p'-DDD, p,p'-DDT) and one PCB congener (Arochlor 1260) residues identified in the fish tissues from the 21st Street Pond (Table 10). Two common carp filets (5.3 μg/kg, 20 μg/kg, w.w.) and one carcass (40 μg/kg, w.w.) were found to contain g-chlordane. Dieldrin was only detected in the carcasses of two trout, a brook trout (3.1 μg/kg, w.w.) and a rainbow trout (2.6 μg/kg, w.w.).

3.8 Results of the Chemical Analyses of Surface Soils

Surface soils collected from the Weber River, Ogden River, Burch Creek, Strongs Creek, 33rd Street Slough, AOI 10, Roundhouse ditch, Buena Ventura Park Pond, and the 21st Street Pond were analyzed for TAL metals, BNAs, pesticides/PCBs, and VOCs (Appendix C).

Concentrations of TAL metals were relatively nominal for surface soils analyzed from the riparian zones of the Ogden Rail Yard site. Arsenic concentrations ranged from 2.1 mg/kg (RZ106 and RZ304) to 22 mg/kg (RZ407). Cadmium concentrations ranged from non-detectable (RZ304) to 7.7 mg/kg (RZ407). Chromium ranged in concentration from 7.6 mg/kg (RZ105) to 19 mg/kg (RZ407). Copper concentrations in soils analyzed ranged from 12 mg/kg (RZ105) to 80 mg/kg (RZ407). Lead concentrations ranged from 29 mg/kg (RZ304) to 940 mg/kg (RZ407). Mercury concentrations ranged from 0.03 mg/kg (21SPP03) to 0.16 mg/kg (RZ109). Nickel concentrations in soil ranged from 6.3 mg/kg (RZ105) to 19 mg/kg (RZ407). Selenium was not detected in any of the surface soil samples analyzed. Silver concentrations ranged from non-detectable to 3.5 mg/kg (RZ407). Vanadium concentrations ranged from 10 mg/kg (RZ105 and RZ110) to 22 mg/kg (RZ407). Zinc concentrations ranged from 53 mg/kg (RZ304) to 940 mg/kg (RZ407).

Bis(2-Ethylhexyl)phthalate was found to be present in six soil samples. These estimated values ranged from 240 μg/kg (RZ208DUP) to 490 μg/kg (RZ106). Surface soil from location RZ106 was also found to contain an estimated 500 μg/kg benzo(g,h,i)perylene. The sample from RZ110 resulted in many unknown tentatively identified compounds (TICs) that ranged in concentration from 870 to 11,000 μg/kg. It also contained 4,400 μg/kg chrysin.

Surface soils analyzed were found to not have detectable concentrations of pesticides/PCBs, with the exception of two samples. The surface soil from location RZ106 was found to contain 260 μg/kg Arochlor 1260. The soil from location RZ407 contained an estimated 1.8 μg/kg p,p'-DDE.

Surface soils were found to have few detectable VOCs, which included acetone, chloroform, trichlorofluoromethane, and chlorodifluoromethane. Acetone was found in five samples ranging from 2 to 18 μg/kg. However, these values are to be considered estimated and acetone was also found in the blank. Soil from location RZ107 was found to contain an estimated concentration of

chloroform of 1.0 μg/kg. Trichlorofluoromethane was found at 2.2 μg/kg in the duplicate soil sample from RZ208. All samples analyzed were found to contain chlorodifluoromethane, except those from locations RZ106, RZ109, RZ208, and RZ304.

4.0 CONCLUSIONS

4.1 Aquatic Data

The results of the survival and growth effects on *H. azteca* and *C. tentans* observed in the site sediments suggest the absence of adverse effects associated these samples, with the exception of a significant reduction in amphipod and midge survival in those organisms exposed to sediment from location WR025A. Available sediment contaminant data for location WR025A do not explain the significant mortality observed. Also, data indicates that parameters affecting bioavailability are not different at location WR025A, compared to other locations. The observed mortality should not be considered aberrant test results, being that similar results were obtained with two species. Therefore, it must be concluded that some parameter not evaluated may be the source of the observed effects. However, it is also import to recognize that while the mortality effects are statistically significant, they are not large in magnitude. Mortality within the laboratory control samples are typically deemed acceptable, for the validity of the laboratory test, if the mortality is 20% or less (80% survival). Within the test results of station WR025A the survival was 74% and 76%, and these results are statistically significant because the control survivorship was 93%, for both species, with low replicate variability.

The most abundant organisms were EPT taxa, The abundance of mayflies and stoneflies typically being indicative of good water quality. The chironomids were not overly abundant in most samples , again suggestive of good water quality, as chironomids are viewed as contaminant insensitive and high numbers can be an indication of organic loading. There were no apparent trends in abundance or richness in either total taxa or EPT taxa between stations. Community structure did exhibit some trends, with the percent contribution of dominant taxa decreasing downstream from a high of 60 to a low of 25-30. There was also a relatively consistent increase in species diversity from the upstream to the downstream stations. None of these results point towards a site specific impact on benthic community integrity. Overall, it can be concluded that there were no biologically significant differences detected between the 7 stations.

There were seven BNAs identified in the fish tissue samples: three phthalates [i.e., diethylphthalate, di-n-butylphthalate, and bis(2-ethylhexyl)phthalate], phenol, 4-methylphenol, bis(2-chloroethoxy)methane, and acenaphthene. Most of the BNA contaminants were found in white sucker and common carp filets and carcasses. Concentrations of detected BNAs ranged from 420 μg/kg acenapthene (white sucker carcass) to Phenol (3,100 μg/kg, w.w.) was found only in the composite liver sample (0119-1230) from white suckers. Similarly, 4-methylphenol (580 μg/kg, w.w.) was only found in a single sample (0119-1239), a largemouth bass carcass. Bis(2-chloroethoxy)methane (530 μg/kg) was identified in only one sample as well (0119-1215), a common carp filet. Six samples were found to contain acenaphthene, one white sucker filet (0119-1220 = 560 μg/kg, w.w.), three white sucker carcasses (0119-1223 = 580 μg/kg, 0119-1225 = 910 μg/kg, 0119-1229 = 420 μg/kg, w.w.), and two common carp carcasses (0119-1210 = 780 μg/kg, 0119-1218 = 730 μg/kg, w.w.).

There were 5 pesticides (g-chlordane, dieldrin, p,p'-DDE, p,p'-DDD, p,p'-DDT) and one PCB congener (Arochlor 1260) residues identified in the fish tissues from the 21st Street Pond (Table 10). Two common carp filets (5.3 μg/kg, 20 μg/kg, w.w.) and one carcass (40 μg/kg, w.w.) were found to contain g-chlordane. Dieldrin was only detected in the carcasses of two trout, a brook trout (3.1 μg/kg, w.w.) and a rainbow trout (2.6 μg/kg, w.w.).

The relatively high PCB concentrations found in the fish from the 21st Street Pond (up to 4 ug/g wet wt. in a carp carcass), combined with the low sediment PCB concentrations found in the sediment suggest that the source of the PCBs is outside of the 21st Street Pond.

The lipid content of the fish filet, carcass and liver tissue was evaluated (Table 11). The lipid content of brook trout, rainbow trout, largemouth bass, white sucker, and common carp filet tissue ranged from 12 to 23 percent, 6 to 10 percent, 4 to 7 percent, 29 to 51 percent, and 6 to 22 percent, respectively. The lipid content of brook trout, rainbow trout, largemouth bass, white sucker, and common carp carcass ranged from 25 to 47 percent, 5 to 62 percent, 11 to 29 percent, 34 to 56 percent, and 13 to 31 percent, respectively. The lipid content of brook trout, largemouth bass, white sucker, and common carp liver tissue was 23, 55, 59, and 23 percent, respectively.

4.2 Terrestrial Data

Surface soils did not contain unusually high concentrations of any TAL metal, with most of the highest metal concentrations coming from the upstream riparian zone (RZ-4). Bis(2-ethylhexyl)phthalate, benzo(g,h,i)perylene, chrysin, and many unknown tentatively identified compounds (TICs) were the only BNAs found in surface soils. Most of these were recorded for samples from RZ-1. Only the surface soil from location RZ106 was found to contain 260 μg/kg Arochlor 1260. The only pesticide detected, p,p'-DDE(1.8 μg/kg) was found in the soil from location RZ407. Few of the surface soil samples were found to contain VOCs. However, acetone, chloroform, trichlorofluoromethane, and chlorodifluoromethane were detected a limited quantity in various samples.

5.0 REFERENCES

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Table 1. Summary of Bioassessment Protocol Habitat Scoring and Categories
Used for the Weber River
Ogden Rail Yard Site
Ogden, Utah

February 2001

Habitat/Parameter	Condition Rating			
	Optimal	Suboptimal	Marginal	Poor
Epifaunal Substrate/Available Cover	20 - 16	15 - 11	10 - 6	5 - 0
Embeddedness	20 - 16	15 - 11	10 - 6	5 - 0
Velocity-Depth Regime	20 - 16	15 - 11	10 - 6	5 - 0
Sediment Deposition	20 - 16	15 - 11	10 - 6	5 - 0
Channel Flow Status	20 - 16	15 - 11	10 - 6	5 - 0
Channel Alteration	20 - 16	15 - 11	10 - 6	5 - 0
Frequency of Riffles (or Bends)	20 - 16	15 - 11	10 - 6	5 - 0
Bank Stability	10 - 9	8 - 6	5 - 3	2 - 0
Bank Vegetative Protection	10 - 9	8 - 6	5 - 3	2 - 0
Riparian Vegetative Zone Width	10 - 9	8 - 6	5 - 3	2 - 0

Assessment Category	Percent of Comparability
Comparable to reference	> 90
Supporting	75-88
Partially Supporting	60-73
Non-supporting	< 58

Table 2. Summary of Bioassessment Protocol Habitat Scores for the Weber River
Ogden Rail Yard Site
Ogden, Utah

February 2001

Habitat Parameter		Sample Location						
		WR09	WR011	WR012	WR014	WR019	WR024	WR028
Epifaunal Substrate/Available Cover		18	18	17	15	13	15	16
Embeddedness		18	18	17	15	15	13	15
Velocity-Depth Regime		18	18	18	7	7	7	7
Sediment Deposition		18	18	14	16	16	10	16
Channel Flow Status		18	18	18	18	15	16	16
Channel Alteration		18	18	18	18	18	6	13
Frequency of Riffles (or Bends)		18	18	18	8	18	10	13
Bank Stability	left bank	9	8	6	6	8	5	5
	right bank	8	7	7	9	7	7	7
Bank Vegetative Protection	left bank	9	8	5	4	9	1	2
	right bank	5	5	5	9	6	5	5
Riparian Vegetative Zone Width	left bank	9	8	3	3	8	0	2
	right bank	3	3	3	8	3	4	4
Total Score		169	165	149	136	143	99	121
*Comparability to location WR09		NA	0.98	0.88	0.80	0.85	0.59	0.72

Assessment Category	*Comparability
Comparable to reference	> 90
Supporting	75-88
Partially Supporting	60-73
Non-supporting	< 58

Table 3. Summary of Instream Habitat
Ogden Rail Yard Site
Ogden, Utah

February 2001

Location	Habitat Present (%)			Substrate Composition (%)						
	Riffle	Pool	Run	Bedrock	Boulder	Cobble	Gravel	Sand	Silt	Clay
WR09*	75	10	15	10	50	20	10	5	5	0
WR011	60	20	20	5	40	20	15	10	10	0
WR012	40	25	35	5	40	15	15	15	10	0
WR014	35	15	50	5	15	35	25	10	10	0
WR019	70	15	15	5	5	25	40	15	10	0
WR024	5	20	75	0	5	15	45	20	15	0
WR028	20	20	60	0	10	30	45	10	5	0

*Reference

Table 4. Water Quality Data from Hydrolab Surveyor 4*a*
Ogden Rail Yard
Ogden, Utah

February 2001

Location	Date	Temperature (°C)	DO (mg/L)	pH	Conductivity (μmhos)	Turbidity (NTU)
Burch Creek - 3	03-09-00	4.3	10.4	8.2	594	166
AOI 10 - 2	03-09-00	1.0	11.4	8.3	3679	1000+
33rd Street Slough - 3	03-09-00	2.5	10.9	8.3	469	468
Roundhouse ditch - 3	03-09-00	3.8	10.2	8.2	528	53
Strongs Creek - 4	03-09-00	3.2	11.0	8.3	451	73

Table 5. Results of Sediment Toxicity Tests (*Hyalella azteca*, n = 8)
Ogden Rail Yard
Ogden, Utah

February 2001

Location	Exposure (Days)	Mean Survival, % (SD)	Mean Dry Weight, mg/organism (SD)
Laboratory Control	14	93 (12)	0.15 (0.03)
WR09A	14	96 (11)	0.30 (0.03)
WR011A	14	100 (0)	0.24 (0.03)
WR012A	14	99 (4)	0.40 (0.04)
WR014A	14	95 (9)	0.29 (0.09)
WR019A	14	91 (11)	0.35 (0.07)
WR021A	14	100 (0)	0.30 (0.03)
WR022A	14	99 (4)	0.30 (0.03)
WR024A	14	99 (4)	0.33 (0.06)
WR025A	14	74 (29)[ab]	0.25 (0.07)
WR028A	14	96 (5)	0.32 (0.03)

SD - Standard Deviation
a - Denotes value is statistically significantly different from laboratory control ($p \leq 0.05$).
b - Denotes value is statistically significantly different from WR09A ($p \leq 0.05$).

Table 6. Results of Sediment Toxicity Tests (*Chironomus tentans*, n = 8)
Ogden Rail Yard
Ogden, Utah

February 2001

Location	Exposure (Days)	Mean Survival, % (SD)	Mean Dry Weight, mg/organism (SD)
Laboratory Control	10	93 (7)	0.99 (0.08)
WR09A	10	89 (12)	2.86 (0.11)
WR011A	10	90 (9)	3.51 (0.59)
WR012A	10	93 (9)	2.97 (0.20)
WR014A	10	81 (10)	2.28 (0.32)
WR019A	10	96 (5)	2.73 (0.41)
WR021A	10	89 (16)	1.91 (0.37)
WR022A	10	94 (7)	1.99 (0.15)
WR024A	10	84 (11)	3.47 (1.13)
WR025A	10	76 (16)[ab]	2.05 (0.27)
WR028A	10	91 (8)	2.37 (0.26)

SD - Standard Deviation
a - Denotes value is statistically significantly different from laboratory control ($p \leq 0.05$).
b - Denotes value is statistically significantly different from WR09A ($p \leq 0.05$).

Table 7. Results of the Benthic Macroinvertebrate Community Assessment
Ogden Rail Yard
Ogden, Utah

February 2001

Metric	Location						
	WR09	WR011	WR012	WR014	WR019	WR024	WR028
Average Number of Organisms per Replicate (in sub-samples)	286	244	233	142	160	210	212
Number of Taxa per Location	23	20	24	20	18	22	25
Functional Feeding Groups							
Total Scrapers at Location (in sub-samples)	152	105	285	149	149	294	210
Total Filterers at Location (in sub-samples)	86	60	39	138	54	96	53
Average Scrapers:Filterers	1.8	1.8	7.3	0.7	2.8	3.1	4.0
EPT Abundance at Location (in sub-samples)	659	560	382	279	397	301	326
Chironomid Abundance at Location (in sub-samples)	115	79	267	80	56	251	170
Average EPT:Chironomid	5.7	7.1	1.4	3.5	7.1	1.2	1.9
Average % Contribution Dominant Taxon per Replicate (in sub-samples)	60	56	47	25	32	41	29
EPT Index at Location (in sub-samples)	14	11	14	12	12	13	14
H^1 Diversity at Location (average in sub-samples)	1.6	1.6	1.7	2.2	2.0	1.9	2.2
Hillsenhoff's Biotic Index at Location (average in sub-samples)	4.8	4.9	5.2	4.7	4.4	5.2	5.3

Table 7 (con't). Results of the Benthic Macroinvertebrate Community Assessment
Ogden Rail Yard
Ogden, Utah

February 2001

Metric	Location						
	WR09	WR011	WR012	WR014	WR019	WR024	WR028
Community Loss Index (Relative to WR09)	NA	0.30	0.20	0.25	0.44	0.27	0.20
Biological Condition Score (Relative to WR09)	NA	89	83	94	94	83	100
Biological Condition Category (Relative to WR09)	NA	Not Impacted	Not Impacted	Not Impacted	Not Impacted	Not Impacted	Not Impacted

NA = Comparisons were not made.

Table 8. Fish Collected from 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Total Weight (kg)	Filet Weight (g)	Liver Weight[a] (g)	Total Length (cm)	Standard Length (cm)	Fork Length (cm)
Brook Trout	119-1182,83,84	1	273.9	41.2	38.7	36.5	38.7
Brook Trout	119-1185,86	1.1	195.9		40	37.4	40
Brook Trout	119-1236,37	0.1	32.1		20.4	18.3	20.4
Rainbow Trout	119-1198,99	0.1	28.2		21.3	19.2	20.5
Rainbow Trout	119-1200,01	0.9	222.7		40.5	39.4	40.5
Rainbow Trout	119-1202,03	1.1	188.7		40.1	39.4	40.1
Largemouth Bass	119-1187,88,89	1.4	178.9	3.9	41	35.8	39.5
Largemouth Bass	119-1190,91	0.2	84.8		28.2	24.3	27.5
Largemouth Bass	119-1192,93	0.5	121.9		33.4	29.3	32
Largemouth Bass	119-1194,95	0.5	98.7		30	26.4	28.3
Largemouth Bass	119-1196,97	0.2	85.6		26.3	22.8	25.5
Largemouth Bass	119-1238,39	0.1	55.4		24.9	21.2	24.1
White Sucker	119-1220,21,30	2.5	218.7	16.8	55.3	49.3	52.7
White Sucker	119-1222,23	1.4	231.2		46.9	41.4	44.5
White Sucker	119-1224,25	0.9	128.8		42.2	37	39.8
White Sucker	119-1226,27	1	162.1		42	37	39.5
White Sucker	119-1228,29	0.9	166		42.7	26.6	40.4
Common Carp	119-1209,10,19	1.4	238.2	18.4	47.5	39	43.5
Common Carp	119-1211.12	1.6	132.1		50	41.5	45
Common Carp	119-1213,14	2.6	161.2		59	49.5	54
Common Carp	119-1215,16	2	135.1		52	42.3	45.5
Common Carp	119-1217,18	1.5	139		50	41.5	45

Table 8 (con't). Fish Collected from 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample	Total Weight (kg)	Filet Weight (g)	Liver Weight[a] (g)	Total Length (cm)	Standard Length (cm)	Fork Length (cm)
Bluegill (n=4)	119-1233	0.094					
Bluegill (n=4)	119-1234	0.118					
Bluegill (n=3)	119-1235	0.122					
Perch (n=1)	119-1207	0.04			15.6	13.2	15
White Crappie (n=1)	119-1208	0.037			13.8	11.2	13
Red-sided Shiner (n=4)	119-1231	0.046					
Largemouth Bass (n=9)	119-1232	0.092					

Table 9. Fish Tissue BNA Residues, from 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Phenol (µg/kg, w.w.)	4-Methylphenol (µg/kg, w.w.)	Bis(2-Chloroethoxy)methane (µg/kg, w.w.)	Acenaphthene (µg/kg, w.w.)	Diethylphthalate (µg/kg, w.w.)	Di-n-butylphthalate (µg/kg, w.w.)	Bis(2-Ethylhexyl)phthalate (µg/kg, w.w.)
Brook Trout								
filet	119-1182	U	U	U	U	U	U	2800
carcass	119-1183	U	U	U	U	U	U	U
liver (composite)	119-1184	U	U	U	U	U	U	1100
Brook Trout								
filet	119-1185	U	U	U	U	U	U	580
carcass	119-1186	U	U	U	U	U	U	730
Brook Trout								
filet	119-1236	U	U	U	U	U	U	1100
carcass	119-1237	U	U	U	U	U	U	1900
Rainbow Trout								
filet	119-1198	U	U	U	U	U	U	760
carcass	119-1199	U	U	U	U	U	U	1600
Rainbow Trout								
filet	119-1200	U	U	U	U	U	U	860
carcass	119-1201	U	U	U	U	U	U	1100
Rainbow Trout								
filet	119-1202	U	U	U	U	U	U	1700
carcass	119-1203	U	U	U	U	U	U	700

Table 9 (con't). Fish Tissue BNA Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Phenol (µg/kg, w.w.)	4-Methylphenol (µg/kg, w.w.)	Bis(2-Chloroethoxy)methane (µg/kg, w.w.)	Acenaphthene (µg/kg, w.w.)	Diethylphthalate (µg/kg, w.w.)	Di-n-butylphthalate (µg/kg, w.w.)	Bis(2-Ethylhexyl)phthalate (µg/kg, w.w.)
Largemouth Bass								
filet	119-1187	U	U	U	U	U	U	590
carcass	119-1188	U	U	U	U	U	U	2500
liver (composite)	119-1189	U	U	U	U	U	U	3000
Largemouth Bass								
filet	119-1190	U	U	U	U	U	U	1600
carcass	119-1191	U	U	U	U	460	U	1700
Largemouth Bass								
filet	119-1192	U	U	U	U	U	U	670
carcass	119-1193	U	U	U	U	U	U	1300
Largemouth Bass								
filet	119-1194	U	U	U	U	U	U	1300
carcass	119-1195	U	U	U	U	U	U	3800
Largemouth Bass								
filet	119-1196	U	U	U	U	U	U	1900
carcass	119-1197	U	U	U	U	U	U	2300
Largemouth Bass								
filet	119-1238	U	U	U	U	U	U	2400
carcass	119-1239	U	580	U	U	U	U	600

Table 9 (con't). Fish Tissue BNA Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Phenol (µg/kg, w.w.)	4-Methylphenol (µg/kg, w.w.)	Bis(2-Chloroethoxy)methane (µg/kg, w.w.)	Acenaphthene (µg/kg, w.w.)	Diethylphthalate (µg/kg, w.w.)	Di-n-butylphthalate (µg/kg, w.w.)	Bis(2-Ethylhexyl)phthalate (µg/kg, w.w.)
White Sucker								
filet	119-1220	U	U	U	560	U	U	U
carcass	119-1221	U	U	U	U	U	U	U
liver (composite)	119-1230	3100	U	U	U	U	U	4400
White Sucker								
filet	119-1222	U	U	U	U	U	U	U
carcass	119-1223	U	U	U	580	U	U	U
White Sucker								
filet	119-1224	U	U	U	U	U	U	U
carcass	119-1225	U	U	U	910	U	U	U
White Sucker								
filet	119-1226	U	U	U	U	1700	U	U
carcass	119-1227	U	U	U	U	U	U	U
White Sucker								
filet	119-1228	U	U	U	U	U	U	U
carcass	119-1229	U	U	U	420	U	U	U
Common Carp								
filet	119-1209	U	U	U	U	U	U	U
carcass	119-1210	U	U	U	780	U	U	1600
liver (composite)	119-1219	U	U	U	U	U	U	2900

Table 9 (con't). Fish Tissue BNA Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Phenol (μg/kg, w.w.)	4-Methylphenol (μg/kg, w.w.)	Bis(2-Chloroethoxy)methane (μg/kg, w.w.)	Acenaphthene (μg/kg, w.w.)	Diethylphthalate (μg/kg, w.w.)	Di-n-butylphthalate (μg/kg, w.w.)	Bis(2-Ethylhexyl)phthalate (μg/kg, w.w.)
Common Carp								
filet	119-1211	U	U	U	U	U	U	1400
carcass	119-1212	U	U	U	U	U	U	78
Common Carp								
filet	119-1213	U	U	U	U	U	U	560
carcass	119-1214	U	U	U	U	U	U	670
Common Carp								
filet	119-1215	U	U	530	U	U	U	1600
carcass	119-1216	U	U	U	U	U	U	450
Common Carp								
filet	119-1217	U	U	U	U	U	U	410
carcass	119-1218	U	U	U	730	1900	U	U
Bluegill								
(n = 4)	119-1233	U	U	U	U	U	U	1200
(n = 4)	119-1234	U	U	U	U	U	U	2800
(n = 3)	119-1235	U	U	U	U	U	U	1900

Table 9 (con't). Fish Tissue BNA Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Phenol (μg/kg, w.w.)	4-Methylphenol (μg/kg, w.w.)	Bis(2-Chloroethoxy)methane (μg/kg, w.w.)	Acenaphthene (μg/kg, w.w.)	Diethylphthalate (μg/kg, w.w.)	Di-n-butylphthalate (μg/kg, w.w.)	Bis(2-Ethylhexyl)phthalate (μg/kg, w.w.)
Perch *(n = 1)*	119-1207	U	U	U	U	U	U	650
White crappie *(n = 1)*	119-1208	U	U	U	U	U	U	830
Red-sided shiner *(n = 4)*	119-1231	U	U	U	U	U	1100	730
Largemouth bass *(n = 9)*	119-1232	U	U	U	U	U	U	U

Table 10. Fish Tissue Pesticide/PCBs Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	g-Chlordane (μg/kg, w.w.)	Dieldrin (μg/kg, w.w.)	p,p'-DDE (μg/kg, w.w.)	p,p'-DDD (μg/kg, w.w.)	p,p'-DDT (μg/kg, w.w.)	Arochlor 1260 (μg/kg, w.w.)
Brook Trout							
filet	119-1182	U	U	11	1.9	U	12
carcass	119-1183	U	U	28	4.7	U	30
liver (composite)	119-1184	NA	NA	NA	NA	NA	NA
Brook Trout							
filet	119-1185	U	U	9.7	1.5	U	14
carcass	119-1186	U	U	25	3.9	U	28
Brook Trout							
filet	119-1236	U	U	7.1	2.4	U	5.3
carcass	119-1237	U	3.1	21	7.5	1.8	14
Rainbow Trout							
filet	119-1198	U	U	1.9	U	U	U
carcass	119-1199	U	2.6	19	6.7	U	19
Rainbow Trout							
filet	119-1200	U	U	17	2.7	2.7	22
carcass	119-1201	U	U	25	4.1	4.1	32
Rainbow Trout							
filet	119-1202	U	U	16	1.9	U	19
carcass	119-1203	U	U	25	3.0	U	30
Largemouth Bass							
filet	119-1187	U	U	20	2.6	U	30
carcass	119-1188	U	U	210	30	U	300
liver (composite)	119-1189	NA	NA	NA	NA	NA	NA

U - Not detected
NA - Not analyzed due to insufficient mass

Table 10 (con't). Fish Tissue Pesticide/PCBs Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	g-Chlordane (μg/kg, w.w.)	Dieldrin (μg/kg, w.w.)	p,p'-DDE (μg/kg, w.w.)	p,p'-DDD (μg/kg, w.w.)	p,p'-DDT (μg/kg, w.w.)	Arochlor 1260 (μg/kg, w.w.)
Largemouth Bass							
filet	119-1190	U	U	19	2.2	U	36
carcass	119-1191	U	U	350	48	U	53
Largemouth Bass							
filet	119-1192	U	U	21	2.3	U	27
carcass	119-1193	U	U	250	27	U	280
Largemouth Bass							
filet	119-1194	U	U	17	1.8	U	36
carcass	119-1195	U	U	350	38	U	640
Largemouth Bass							
filet	119-1196	U	U	36	3.6	U	55
carcass	119-1197	U	U	430	60	U	690
Largemouth Bass							
filet	119-1238	U	U	30	2.6	U	52
carcass	119-1239	U	U	230	22	U	460
White Sucker							
filet	119-1220	U	U	480	U	U	760
carcass	119-1221	U	U	470	U	U	850
liver (composite)	119-1230	NA	NA	NA	NA	NA	NA
White Sucker							
filet	119-1222	U	U	590	U	U	910
carcass	119-1223	U	U	650	U	U	1300

U - Not detected
NA - Not analyzed due to insufficient mass

Table 10 (con't). Fish Tissue Pesticide/PCBs Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	g - Chlordane (µg/kg, w.w.)	Dieldrin (µg/kg, w.w.)	p,p' - DDE (µg/kg, w.w.)	p,p' - DDD (µg/kg, w.w.)	p,p' - DDT (µg/kg, w.w.)	Arochlor 1260 (µg/kg, w.w.)
White Sucker							
filet	119-1224	U	U	190	U	U	290
carcass	119-1225	U	U	280	U	U	420
White Sucker							
filet	119-1226	U	U	100	U	U	130
carcass	119-1227	U	U	260	U	U	370
White Sucker							
filet	119-1228	U	U	65	U	U	96
carcass	119-1229	U	U	150	U	U	170
Common Carp							
filet	119-1209	U	U	280	U	U	1900
carcass	119-1210	U	U	57	U	U	4000
liver (composite)	119-1219	NA	NA	NA	NA	NA	NA
Common Carp							
filet	119-1211	U	U	150	U	U	290
carcass	119-1212	U	U	480	U	U	1400
Common Carp							
filet	119-1213	5.3	U	120	U	U	200
carcass	119-1214	U	U	270	U	U	520
Common Carp							
filet	119-1215	20	U	570	U	U	1100
carcass	119-1216	U	U	790	U	U	1100

U - Not detected
NA - Not analyzed due to insufficient mass

Table 10 (con't). Fish Tissue Pesticide/PCBs Residues From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	g - Chlordane (μg/kg, w.w.)	Dieldrin (μg/kg, w.w.)	p,p' - DDE (μg/kg, w.w.)	p,p' - DDD (μg/kg, w.w.)	p,p' - DDT (μg/kg, w.w.)	Arochlor 1260 (μg/kg, w.w.)
Common Carp							
filet	119-1217	U	U	320	U	U	1100
carcass	119-1218	40	U	830	U	U	2300
Bluegill							
(n = 4)	119-1233	U	U	85	15	U	150
(n = 4)	119-1234	U	U	72	10	U	150
(n = 3)	119-1235	U	U	86	13	U	150
Perch							
(n = 1)	119-1207	U	U	57	13	U	170
White crappie							
(n = 1)	119-1208	U	U	79	16	U	130
Red-sided shiner							
(n = 4)	119-1231	U	U	77	16	U	240
Largemouth bass							
(n = 9)	119-1232	U	U	92	16	U	230

U - Not detected
NA - Not analyzed due to insufficient mass

Table 11. Fish Tissue Percent Lipid Content From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Percent (%) Lipid Content
Brook Trout		
filet	119-1182	13
carcass	119-1183	25
liver (composite)	119-1184	23
Brook Trout		
filet	119-1185	12
carcass	119-1186	25
Brook Trout		
filet	119-1236	23
carcass	119-1237	47
Rainbow Trout		
filet	119-1198	10
carcass	119-1199	62
Rainbow Trout		
filet	119-1200	10
carcass	119-1201	13
Rainbow Trout		
filet	119-1202	6
carcass	119-1203	5
Largemouth Bass		
filet	119-1187	7
carcass	119-1188	28
liver (composite)	119-1189	55
Largemouth Bass		
filet	119-1190	4
carcass	119-1191	17

Table 11 (con't). Fish Tissue Percent Lipid Content From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Percent (%) Lipid Content
Largemouth Bass		
filet	119-1192	6
carcass	119-1193	25
Largemouth Bass		
filet	119-1194	5
carcass	119-1195	29
Largemouth Bass		
filet	119-1196	4
carcass	119-1197	18
Largemouth Bass		
filet	119-1238	4
carcass	119-1239	11
White Sucker		
filet	119-1220	42
carcass	119-1221	34
liver (composite)	119-1230	59
White Sucker		
filet	119-1222	51
carcass	119-1223	53
White Sucker		
filet	119-1224	38
carcass	119-1225	56
White Sucker		
filet	119-1226	29
carcass	119-1227	56

Table 11. (con't). Fish Tissue Percent Lipid Content From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Percent (%) Lipid Content
White Sucker		
filet	119-1228	31
carcass	119-1229	44
Common Carp		
filet	119-1209	16
carcass	119-1210	26
liver (composite)	119-1219	23
Common Carp		
filet	119-1211	10
carcass	119-1212	18
Common Carp		
filet	119-1213	6
carcass	119-1214	13
Common Carp		
filet	119-1215	14
carcass	119-1216	19
Common Carp		
filet	119-1217	22
carcass	119-1218	31
Bluegill		
(n = 4)	119-1233	13
(n = 4)	119-1234	10
(n = 3)	119-1235	10

Table 11. (con't). Fish Tissue Percent Lipid Content From 21st Street Pond
Ogden Rail Yard
Ogden, Utah

February 2001

Species	Sample(s)	Percent (%) Lipid Content
Perch *(n = 1)*	119-1207	12
White crappie *(n = 1)*	119-1208	10
Red-sided shiner *(n = 4)*	119-1231	21
Largemouth bass *(n = 9)*	119-1232	11

APPENDIX G
SURFACE FLUX CHAMBER TESTING

CE Schmidt, Ph.D.
Environmental Consultant

TECHNICAL MEMORANDUM

Results of the Surface Flux Chamber Testing
at the Union Pacific Railyard (UPR) Site Located in
Ogden, Utah

REVISION 1
(revisions by The Forrester Group, in response to EPA comments)

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October, 2000
(Revised February, 2002)

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Attachments

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B- Chain of Custody
C- Lab Reports

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EXECUTIVE SUMMARY

Field measurements were conducted at the Union Pacific Railyard (UPR) site located in Ogden, Utah on June 21 and 22, 2000. The testing is part of a site Air Pathway Analysis (APA) conducted for project-specific volatile organic compounds (VOCs) conducted during the summer of 2000 by The Forrester Group. Union Pacific and The Forrester Group were interested in measuring the flux of selected VOCs on the Ogden railyard. Compounds were found in the groundwater in three unique areas of the site which include the areas known as: the North plume (AOIs 34 & 22a), the South plume (AOIs 30 & 22b), and the 21st Street Pond DNAPL zone. Testing was conducted in order to provide site characterization data assessing the potential surface emissions of selected VOCs in all three areas, including a limited amount of indoor and outdoor air from structures in these three test areas. The study compounds included: benzene, 1,1-dichloroethene, and vinyl chloride. The goal of the testing was to provide surface flux data that was representative of maximum "worst-case" air emissions per area (co-located with high groundwater concentrations), emissions into test structures (open soil testing along structure foundations), and representative plume air emissions in each test area (spatially distributed over groundwater plume). Further, a second goal was to collect outdoor and indoor air quality data (ambient concentration data) from test structures in each area for comparison to health standards and estimated concentrations using measured flux data. This survey data included at least one indoor and one outdoor integrated ambient air sample in test structures in each of the three study areas. Flux measurements were performed at a total of 28 locations in the three areas. The break-down of sample type per area is given below.

Test Area	*Max Plume*	*Structure*	*Spatial*	*Indoor/Outdoor*
North Plume	2	2	6	3
South Plume	2	2	6	3
DNAPL zone	0	2	6	2

Figures 1, 2, and 3 present the sampling locations for the North Plume, South Plume, and DNAPL zone, respectively.

A limited field program was conducted and flux measurements were made using the United States Environmental Protection Agency (US EPA) recommended surface flux chamber. The surface flux chamber testing was conducted at a total of 28 test locations plus 3 blank tests, 2 replicate tests, and 2 background tests(near yard and in the neighborhood). Flux measurements were performed following the US EPA flux chamber protocol and all surface flux samples were shipped off-site for detailed analysis following US EPA Method TO-14; gas chromatography

mass spectroscopy (GC/MS). Indoor and outdoor samples were also collected from test structures in all three study areas.

In general, the field data were low (less than 1 ug/m2, min-1) and similar to typical system blank and background flux levels for benzene. Vinyl chloride and 1,1-dichloroethene were infrequently detected, and when detected, these compounds were found near the method detection limit. The indoor and outdoor ambient air data sets for all study areas were unremarkable and did not indicate compounds originating from the subsurface sources.

Field quality control data indicate acceptable sampling method performance.

The flux data can be used to estimate exposure to subsurface contamination by two pathways of exposure: emissions to ambient air; and infiltration through building slab and emissions to indoor air. Outdoor flux can be multiplied by the surface area of the plume footprint to obtain a locale-specific emissions to ambient air. Indoor infiltration can be calculated by multiplying flux data by the surface area of the building footprint and multiplying the potential footprint emissions by an infiltration factor typical of slab construction as appropriate (i.e., 0.5%-to-2%, Schmidt, et al, June, 1998). This approach can also be used to estimate substructure vault and crawlspace air concentrations for evaluation regarding explosion potential.

CE Schmidt, Ph.D.
Environmental Consultant

I. INTRODUCTION

This technical memorandum describes the field testing that was conducted in order to assess the surface air emissions of selected VOCs subsurface groundwater plumes at the UPR site located in Ogden, Utah. Area source flux data were collected with the intention of using the flux data as input to a site-specific assessment. Testing was conducted by Dr. C.E. Schmidt on June 21 and 22, 2000 with a representative of The Forrester Group. Site preparation was managed by The Forrester Group. Other persons present on-site included representatives from various agencies involved in the site.

The objective of this study was to provide site characterization data representative of air emissions of selected VOCs from known groundwater subsurface sources. Sampling locations are described in Table 1. Surface flux chamber data are reported as flux values (micrograms per square meter per minute, mg/m^2, min^{-1}) for VOCs. The surface flux data can be used to assess the issue of emissions at the surface over these groundwater plumes to the open outdoor air, and emissions via infiltration into structures over the plume on-site.

This memorandum includes a discussion of the testing methodology, quality control procedures, results, discussion of the results, and summary statements.

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II. TEST METHODOLOGY

Testing for surface flux was conducted using the US EPA recommended Surface Isolation Flux Chamber (US EPA, 1986). Flux chamber sampling locations were selected using the historic groundwater isoconcentration data.

The operation of the surface flux chamber is given below:

1) Flux chamber, sweep air, sample collection equipment, and field documents were located on-site. Site test locations were identified and a thin layer of weathered asphalt was removed at all test locations.

2) The site information, location information, equipment information, date, and proposed time of testing were documented on the Emissions Measurement Field Data Sheet.

3) The exact test location was selected and placed about 1/4" into the land surface sealing the chamber. Thermocouples were placed in order to monitor surface/air temperatures outside of the chamber. At some locations of interest, ground cover including asphalt and cement were removed in order to access open soil for flux chamber testing.

4) The sweep air flow rate was initiated and the rotometer, which stabilizes the flow rate, was set at 5.0 liters per minute. A constant sweep air flow rate was maintained throughout the measurement for each sampling location.

5) Flux chamber data were recorded every residence interval (6 minutes) for five intervals, or 30 minutes.

6) At steady-state (assumed to be greater than 5 residence intervals), the sample collection was performed by interfacing a canister to the sample line and filling a canister with sample gas.

7) After sample collection, all field data were documented on the data sheet.

8) After sampling, the flux measurement was discontinued by shutting off the sweep air, removing the chamber, and securing the equipment.

9) Sampling locations were recorded on the field data sheet. The equipment was then relocated to the next test location and steps 1) through 8) were repeated.

III. QUALITY CONTROL

Control procedures that were used to assure that data of sufficient quality resulted from the flux chamber study are listed and described below. The application and frequency of these procedures were developed to meet the program data quality objectives as described in the project work plan (Schmidt, C.E., November, 1999).

Field Documentation -- A field notebook containing data forms, including sample chain-of-custody (COC) forms, was maintained for the testing program. Attachment A contains the Emission Measurement Data Sheets.

Chain-of-Custody -- COC forms were not used for field data collection. Field data were recorded on the Flux Chamber Data Forms provided in Attachment A.

GC/MS Selective Ion Mode (SIM) Analysis

Method Spike Recovery Analysis – Eight method spike samples were analyzed. All compounds in all analyses were recovered within the QC criteria of 70%-to-130% for all compounds. The recoveries ranged from 70%-to-122%. These data represent acceptable method performance.

Laboratory Replicate Analysis — Eight method spike recovery samples were analyzed in replicate and the precision of the method was reported as relative percent difference (RPD) per compound. The compound RPD for all samples was between 0 and 28. These data, as compared to the QC criteria of 30 RPD indicate acceptable method performance.

Laboratory Method Blank – Eight laboratory method blank samples were analyzed and no target list compounds were reported in any sample above MDL (vinyl chloride <0.004 ppbv, 1,1-dichloroethene <0.010 ppbv, and benzene <0.012 ppbv). These data indicate acceptable method performance.

Canister Blank – One canister blank sample was collected by filling a clean canister with ultrahigh purity air. Vinyl chloride and 1,1-dichloroethene were not detected above MDL, however, benzene was detected near the MDL at 0.043 ppbv or 0.005 ug/m2,min-1. These data indicate acceptable method performance and will be used to qualify the field data. Benzene SIM results less than 5 times the canister blank detected value (0.215 ppbv or 0.025 ug/m2,min-1) were qualified as nondetects.

Field System Blank — Two field blank sample were collected for the surface flux chamber testing

protocol; one per chamber. The surface flux blank sample was collected by placing the surface flux chamber on a sheet of Teflon and operating the chamber as per field testing protocol. The surface flux chamber blank was collected prior to initiation of testing. Vinyl chloride and 1,1-dichloroethene were not detected above MDL, however, benzene was detected near the MDL in both samples at 0.035 ppbv and 0.043 ppbv or 0.004 ug/m2,min-1 and 0.005 ug/m2,min-1. This level of system blank for these testing systems are typical and these field data indicate acceptable method performance. Benzene SIM results less than 5 times the maximum system blank detected value of 0.043 ppbv (0.215 ppbv or 0.025 ug/m2,min-1) were qualified as nondetects.

Field Replicate Sample —Two field replicate samples were collected for flux testing by sampling a second canister sample after sample collection. The QC criterion for field precision is 50 RPD. Replicates were collected at sample locations NF-01 (sample IDs 34A-012 and 34A-013) and DF-06 (sample IDs 33A-213 and 33A-214). The RPD for the replicate sample compounds ranged from 0 to 24. As such, these data represent acceptable method performance.

GC/MS Full Scan Mode Analysis

Method Spike Recovery Analysis – Eight method spike samples were analyzed. All compounds in all analyses were recovered within the QC criteria of 70%-to-130% for all compounds. The recoveries ranged from 70%-to-122%. These data represent acceptable method performance.

Laboratory Replicate Analysis — Eight method spike recovery samples were analyzed in replicate and the precision of the method was reported as relative percent difference (RPD) per compound. The compound RPD for all samples was between 0 and 28. These data, as compared to the QC criteria of 30 RPD indicate acceptable method performance.

Laboratory Method Blank – Three laboratory method blank samples were analyzed and no compounds were detected in 2 of the 3 blanks above MDL and 6 compounds were detected in one of the 3 blank samples. In all cases, these compounds were found at less than 0.2 ppbv. The full scan sample in the impacted QC batch is SF-07. Detections below 5 times the values detected in the blank were qualified as nondetects. These data indicate acceptable method performance.

IV. RESULTS AND DISCUSSIONS

All field data for the surface flux chamber and ambient air testing are presented in Tables 2 through 8. Flux chamber results for the North Plume area are presented in flux units (ug/m^2, min-1) in Table 2. The ambient air survey data collected for the structure in the North plume area are presented in concentration units (ppbv) in Table 3. Flux chamber results for the DNAPL zone are presented in flux units (ug/m^2, min-1) in Table 4. The ambient air survey data collected for the structure in the 33 plume area are presented in concentration units (ppbv) in Table 5. Flux chamber results for the South Plume area are presented in flux units (ug/m^2, min-1) in Table 6. The ambient air survey data collected for the structure in the South plume area are presented in concentration units (ppbv) in Table 8. And finally, the GC/MS full scan data for flux samples collected in all three areas and the background locations are presented in flux units (ug/m2, min-1) in Table 8.

Surface flux data are calculated using measured target compound concentrations and flux chamber operating parameter data (sweep air flow rate of 5.0 liters per minute [L/min], surface area of 0.13 square meters [m^2]). The site emissions can be calculated by multiplying the flux by the surface area of the source. The flux is calculated from the sweep air flow rate Q (cubic meters per minute [m^3/min]), the species concentration Yi (micrograms per cubic meter [mg/m^3)], and exposure to the chamber surface area A (square meters [m^2]), as follows:

$$Fi = \frac{Q \cdot Yi}{A}$$

The flux SIM data for the **North plume area** (AOIs 34 & 22a) are provided in Table 2 and are summarized below. Data summarized are reported above system blank and background levels or are believed to be related to the subsurface plumes. Where appropriate, locations of highest flux measurements are noted.

Plume Mapping Locations

Compounds (ug/m2,min-1)	***Lowest Flux (ug/m2, min-1)***	***Highest Flux***	***Frequency***
Vinyl Chloride	<0.0010	**0.0010 (NF-03)**	***1 of 6***
1,1-Dichloroethene	<0.0020	**0.0030 (NF-05)**	***1 of 6***
Benzene	<0.0070	<0.0070	***0 of 6***

Near Structure Locations

Compounds (ug/m2,min-1)	*Lowest Flux (ug/m2, min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	<0.0010	*0 of 2*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 2*
Benzene	<0.006	**0.052 (NF-09)**	*1 of 2*

Worst Case Locations

Compounds (ug/m2, min-1)	*Lowest Flux (ug/m2, min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	<0.0010	*0 of 2*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 2*
Benzene	<0.0070	**0.040 (NF-07)**	*1 of 2*

Vinyl chloride and 1,1-dichloroethene were each detected at one of the plume mapping locations (NF-03 and NF-05, respectively) and not the "near structure" or "worst case" test locations. Benzene was not detected in any of the plume locations. The highest flux was detected at a "near structure" and not the "worst case" test location.

Full scan analysis (see Table 8) of two samples with the highest levels of the target compound showed collectively six additional compounds with the highest flux recorded for tetrachloroethene at 1.3 ug/m2,min-1 (NF-07, North plume worst case location).

Ambient air data collected in two locations in the test structure in the North plume area and outdoor of the structure did not detect vinyl chloride or 1,1-dichloroethene above MDL but did detect benzene. Benzene was detected in all ambient samples and was found indoors at levels approximately 73 times the level detected outside (16 ppbv to 19 ppbv inside and 0.22 ppbv to 0.26 ppbv outside). These levels are consistent with indoor ambient levels, especially for indoor air quality with cigarette smokers (note- indoor cigarette smoking was observed by office worker).

The flux SIM data for the **DNAPL zone** (AOI 33 & 21st Street Pond vicinity) area are provided in Table 3 and are summarized below. Data summarized are reported above system blank and background levels or are believed to be related to the subsurface plumes. Where appropriate, locations of highest flux measurements are noted.

Plume Mapping Locations

Compounds (ug/m2,min-1)	*Lowest Flux (ug/m2,min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	<0.0010	*0 of 6*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 6*
Benzene	<0.007	<0.007	*0 of 6*

Near Structure Locations

Compounds (ug/m2,min-1	*Lowest Flux (ug/m2,min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	**0.0030 (DF-07)**	*1 of 2*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 2*
Benzene	<0.0020	**0.044 (DF-07)**	*1 of 2*

Worst Case Locations

Compounds (ug/m2,min-1)	*Lowest Flux (ug/m2,min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	NA	NA	*0 of 0*
1,1-Dichloroethene	NA	NA	*0 of 0*
Benzene	NA	NA	*0 of 0*

Vinyl chloride was detected at one location near the structure (DF-07). 1,1-Dichloroethene was not detected at any location. Benzene was detected at one near structure location (DF-07).

Full scan analysis (see Table 8) of samples from DF-03 and DF-07 showed collectively five additional compounds with the highest flux recorded for toluene at 1.0 ug/m2, min-1 (DF-03).

Ambient air data collected in one locations in the test structure in the DNAPL zone and outdoor of the structure did not detect vinyl chloride or 1,1-dichloroethene above MDL, but did detect benzene. Benzene was detected in both indoor and outdoor ambient samples and was found indoors at approximately the same levels detected outside (0.52 ppbv inside and 0.47 ppbv outside). These levels are consistent with indoor and outdoor ambient levels, especially for indoor air quality with cigarette smokers (note- indoor cigarette by office workers was observed).

The flux SIM data for the **South plume area** (AOIs 30 & 22b) are provided in Table 6 and are

summarized below. Data summarized are reported above system blank and background levels or are believed to be related to the subsurface plumes. Where appropriate, locations of highest flux measurements are noted.

Plume Mapping Locations

Compounds (ug/m2,min-1)	*Lowest Flux (ug/m2,min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	**0.0010 (SF-02)**	*1 of 6*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 6*
Benzene	<0.007	**0.59 (SF-01)**	*2 of 6*

Near Structure Locations

Compounds (ug/m2,min-1)	*Lowest Flux (ug/m2,min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	<0.0010	*0 of 2*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 2*
Benzene	<0.007	<0.007	*0 of 2*

Worst Case Locations

Compounds (ug/m2,min-1)	*Lowest Flux (ug/m2,min-1)*	*Highest Flux*	*Frequency*
Vinyl Chloride	<0.0010	<0.0010	*0 of 2*
1,1-Dichloroethene	<0.0020	<0.0020	*0 of 2*
Benzene	**0.045**	**0.048 (SF-07)**	*2 of 2*

Vinyl chloride was detected at one plume mapping location (SF-02) and 1,1-dichloroethene was not detected at any location. Benzene was detected at 4 locations above blank or background levels. The highest flux was detected at a plume mapping location and not the "near structure" or "worst case" test location.

Full scan analysis (see Table 8) of two samples with the highest levels of the target compound (SF-01 and SF-07) showed collectively 14 additional compounds with the highest flux recorded for m,p-xylene at 0.19 ug/m2,min-1 (SF-01).

Ambient air data collected in two locations in the test structure in the South plume area and outdoor of the structure did not detect vinyl chloride or 1,1-dichloroethene above MDL but did detect

benzene. Benzene was detected in all ambient samples and was found indoors at levels approximately one-half the level detected outside (0.19 ppbv to 0.36 ppbv inside and 0.62 ppbv outside). Theses levels are consistent with indoor and outdoor ambient levels, especially for indoor air quality without cigarette smokers (note- indoor cigarette smoking was not observed by office workers).

Outdoor flux data can be used to estimate the emissions of study compounds from the subsurface to the ambient outdoor air and into structures via migration through cracks in cement slabs. Outdoor emissions per study area is calculated by multiplying the groundwater plume (source) surface area by the representative flux per area. A dispersion model or box model is used to estimate the concentration resulting from the flux and source surface area. Indoor emissions is per test structure in a study area is calculated by multiplying a representative area or amount of crack per slab by the flux at the structure (or highest flux per compound per study area). Indoor concentrations are calculated by using a box model, the estimated emissions through cracks in the slab, and representative building ventilation.

V. SUMMARY

Surface flux measurements were made at multiple locations in three areas on the Union Pacific railyard for the purpose of obtaining data of sufficient quality to assess the air emissions potential of study compounds from the subsurface sources. The following is a summary of activities and results associated with this objective:

Surface flux measurements of study compounds were measured at 28 test locations in three study areas on the site using the US EPA recommended surface flux chamber technology. This technology quantitatively measures vapor fluxes at the land surface due to the presence of subsurface volatile compounds.

- Field quality control data indicate acceptable sampling method performance.

- In general, the field flux data were low (<1 ug/m2, min-1) and similar system blank and background flux levels.

- The highest flux of the study compounds was detected in the South plume area in the sample from location SF-01. Benzene was detected at 0.059 ug/m2, min-1.

- Full scan analysis was performed on two samples in each of the three study areas. The samples analyzed were selected as the highest combined concentration in each of the samples per each area. Full scan speciation data indicate other compounds present along with the target study compounds.

- Ambient air collected in and around test structures in all three study areas did not indicate an occurrence of study compounds related to the subsurface sources. Benzene was elevated in the North plume structure; however, the source of benzene in this structure may be related to cigarette smoking.

- The flux data can be used to estimate exposure to subsurface contamination by two pathways of exposure: emissions to ambient air; and infiltration through building slab and emissions to indoor air. Outdoor flux can be multiplied by the surface area of the plume footprint to obtain a locale-specific emissions to ambient air. Indoor infiltration can be calculated by multiplying flux data by the surface area of the building footprint and multiplying the potential footprint emissions by an infiltration factor typical of slab construction as appropriate (i.e., 0.5%-to-2%, Schmidt, et al, June, 1998).

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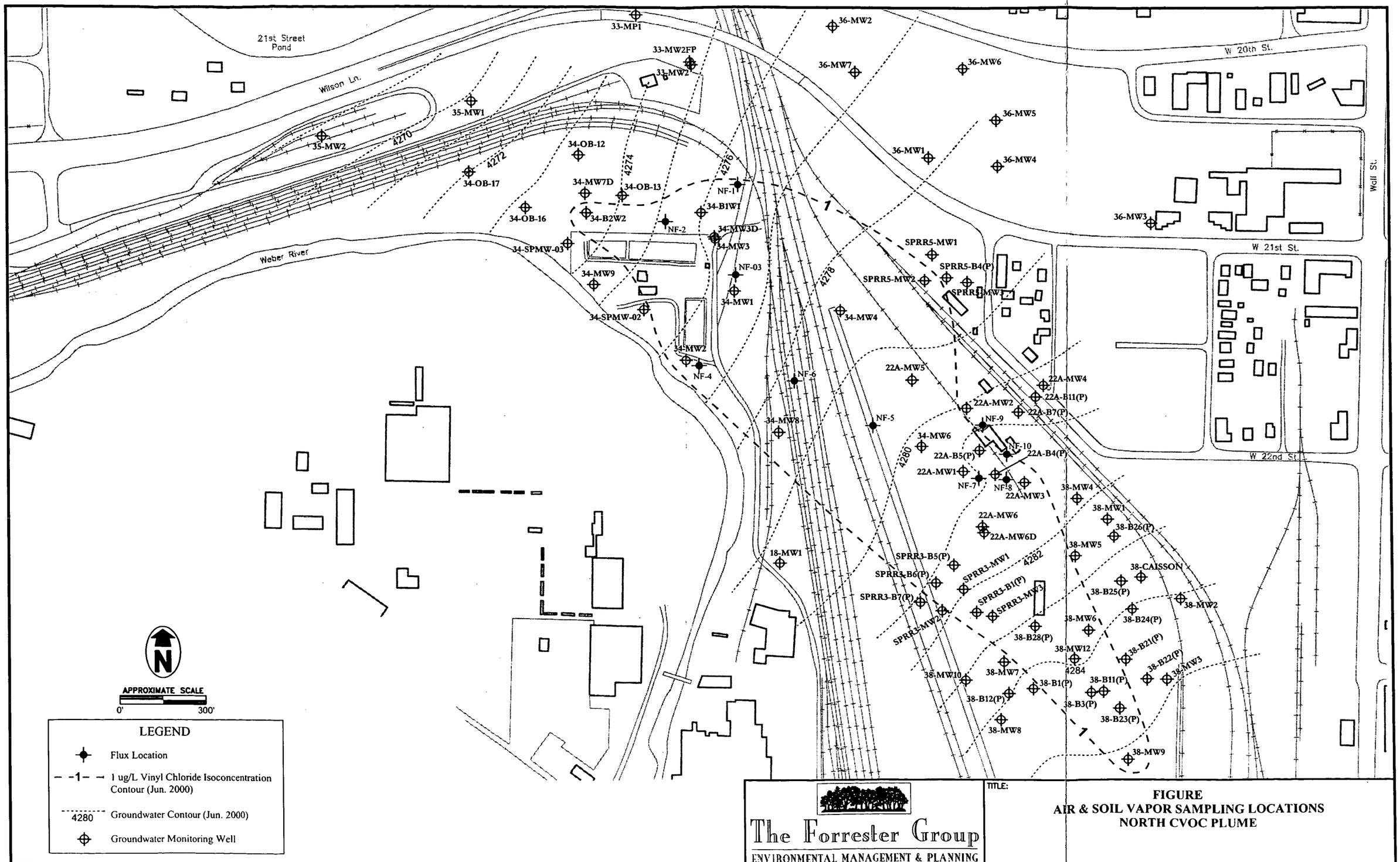
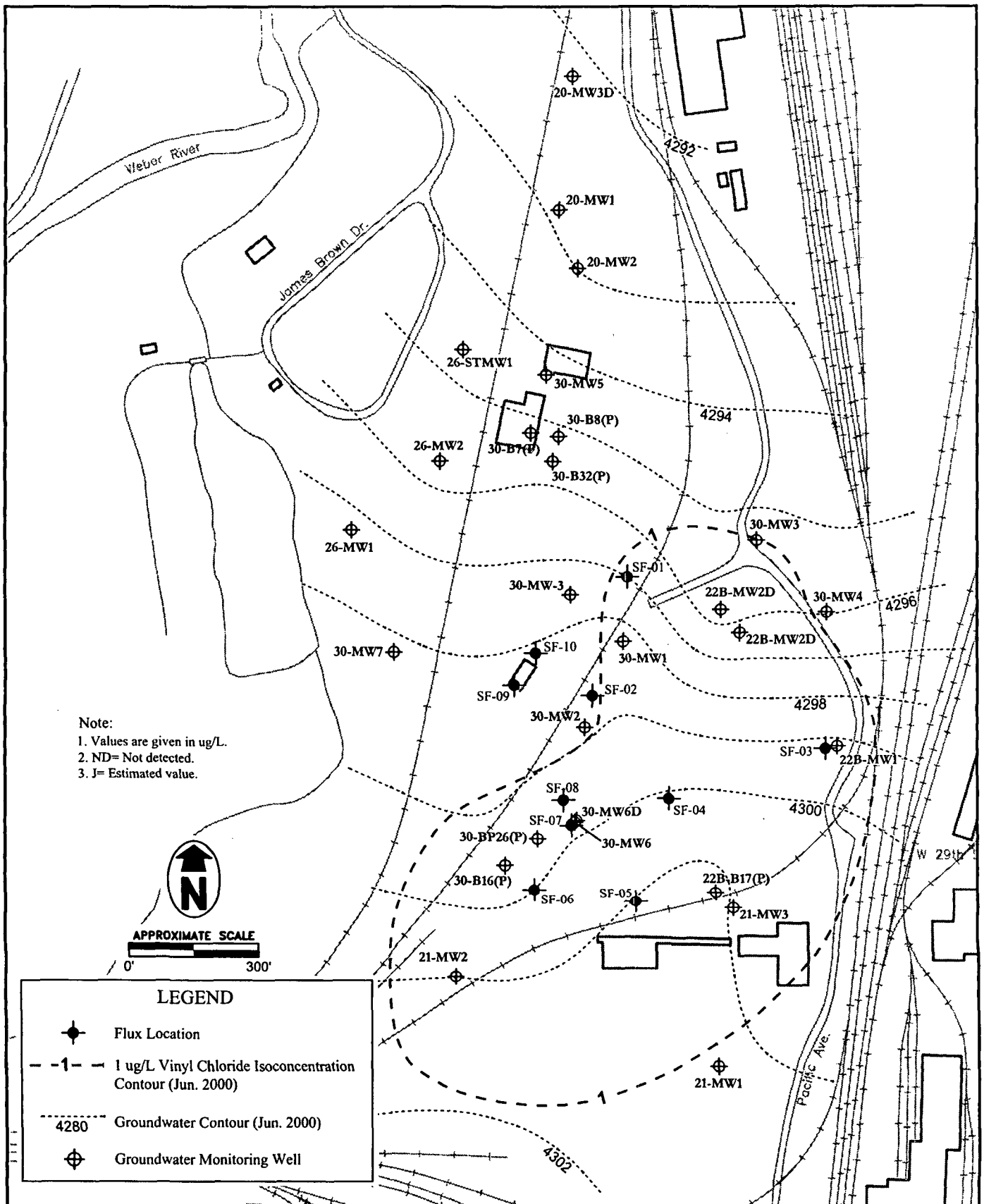
US EPA. 1986. "Measurement of Gaseous Emission Rates From Land Surfaces Using an Emission Isolation Flux Chamber, Users Guide." EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada, EPA Contract No. 68-02-3889, Work Assignment No. 18, February 1986.

Schmidt, C.E. Work Plan for Surface Flux Chamber Testing at the Union Pacific Railyard Site Located in Ogden, UT, November, 1999.


21st Street Pond
Wilson Ln.
Weber River
W 20th St.
W 21st St.
W 22nd St.
Wall St.
33-MP1
33-MW2FP
33-MW2
35-MW1
35-MW2
34-OB-12
34-OB-17
34-MW7D
34-OB-13
34-OB-16
34-B2W2
34-SPMW-03
34-MW9
34-SPMW-02
34-B1W1
34-MW3D-
34-MW3
34-MW1
34-MW2
34-MW4
34-MW8
34-MW6
36-MW2
36-MW7
36-MW6
36-MW5
36-MW1
36-MW4
36-MW3
NF-1
NF-2
NF-03
NF-4
NF-6
NF-5
NF-9
NF-10
NF-7
NF-8
SPRR5-MW1
SPRR5-B4(P)
SPRR5-MW2
SPRR5-MW3
22A-MW5
22A-MW4
22A-B11(P)
22A-MW2
22A-B7(P)
22A-B5(P)
22A-B4(P)
22A-MW1
22A-MW3
22A-MW6
22A-MW6D
18-MW1
SPRR3-B5(P)
SPRR3-B6(P)
SPRR3-B7(P)
SPRR3-MW1
SPRR3-B1(P)
SPRR3-MW3
SPRR3-MW2
38-MW4
38-MW1
38-B26(P)
38-MW5
38-CAISSON
38-B25(P)
38-MW2
38-MW6
38-B24(P)
38-B28(P)
38-MW12
38-B21(P)
38-B22(P)
38-MW3
38-MW10
38-MW7
38-B1(P)
38-B11(P)
38-B12(P)
38-B3(P)
38-B23(P)
38-MW8
38-MW9
4270
4272
4274
4276
4278
4280
4282
4284
1
N
APPROXIMATE SCALE
0'
300'
LEGEND
Flux Location
1 ug/L Vinyl Chloride Isoconcentration Contour (Jun. 2000)
4280 Groundwater Contour (Jun. 2000)
Groundwater Monitoring Well
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE
AIR & SOIL VAPOR SAMPLING LOCATIONS
NORTH CVOC PLUME

1330-00



The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

FIGURE
AIR AND SOIL VAPOR SAMPLING LOCATIONS
SOUTH CVOC PLUME

1330-00

Table 1. Summary of Field Sample Collection Information.

DATE	TIME	SAMPLE ID	CAN ID	TEST AREA	LOCATION/COMMENT
6/21/2000	836	34A-001	220	QC	Teflon- Blank, Chamber F
6/21/2000	837	34A-002	300	QC	Teflon- Blank, Chamber H
6/21/2000	1015	34A-003*	328	North Plume Structure, 1 of 2	NF-09
6/21/2000	1023	34A-004	313	North Plume Structure, 2 of 2	NF-10
6/21/2000	1124	34A-005	362	North Plume Worst Case, 1 of 2	NF-08
6/21/2000	1139	34A-006*	309	North Plume Worst Case 2 of 2	NF-07
6/21/2000	1242	34A-007	823	North Plume Mapping; Spatial	NF-06
6/21/2000	1251	34A-008	367	North Plume Mapping; Spatial	NF-05
6/21/2000	1412	34A-009	329	North Plume Mapping; Spatial	NF-04
6/21/2000	1424	34A-010	336	North Plume Mapping; Spatial	NF-03
6/21/2000	1514	34A-011	764	North Plume Mapping; Spatial	NF-02
6/21/2000	1530	34A-012	694	North Plume Mapping; Spatial	NF-01
6/21/2000	1530	34A-013	663	North Plume Mapping; Spatial	NF-01 Replicate
6/21/2000	1654	33A-001	631	DNAPL Zone Mapping; Spatial	DF-01
6/21/2000	1702	33A-002*	726	DNAPL Zone Mapping; Spatial	DF-03
6/21/2000	1825	33A-003	651	DNAPL Zone Mapping; Spatial	DF-05
6/21/2000	1833	33A-004	685	DNAPL Zone Mapping; Spatial	DF-04
6/21/2000	1942	BKGD-1*	610	QC	BKGD-01 (near tracks)
6/22/2000	906	30A-201	389	South Plume Structure, 1 of 2	SF-09
6/22/2000	916	30A-202	358	South Plume Structure, 2 of 2	SF-10
6/22/2000	1003	30A-203	379	South Plume Mapping; Spatial	SF-02
6/22/2000	1016	30A-204*	305	South Plume Mapping; Spatial	SF-01
6/22/2000	1114	30A-205*	361	South Plume Worst Case, 1 of 2	SF-07
6/22/2000	1122	30A-206	423	South Plume Worst Case, 2 of 2	SF-08
6/22/2000	1220	30A-207	386	South Plume Mapping; Spatial	SF-06
6/22/2000	1230	30A-208	308	South Plume Mapping; Spatial	SF-05
6/22/2000	1314	30A-209	340	South Plume Mapping; Spatial	SF-04
6/22/2000	1325	30A-210	415	South Plume Mapping; Spatial	SF-03
6/22/2000	1430	33A-211*	327	DNAPL Zone Structure; 1 of 2	DF-07
6/22/2000	1438	33A-212	338	DNAPL Zone Structure; 2 of 2	DF-08
6/22/2000	1556	33A-213	326	DNAPL Zone Mapping; Spatial	DF-06
6/22/2000	1556	33A-214	347	DNAPL Zone Mapping; Spatial	DF-06 Replicate
6/22/2000	1533	33A-215	318	QC	Canister Blank
6/22/2000	1653	33A-216	304	DNAPL Zone Mapping; Spatial	DF-02
6/22/2000	1808	BKGD-2*	738	QC	BKGD-02 (residential)
INDOOR AND OUTDOOR AIR					
6/21/2000	918	34AA-001	697	North Plume Structure; office	Integrated- 8' 15"
6/21/2000	920	34AA-002	817	North Plume Structure; office	Integrated- 8' 14"
6/21/2000	930	34AA-003	789	North Plume Structure; Outdoor	Integrated- 8' 07"
6/21/2000	932	34AA-004	677	Replicate Sample	Integrated- 8' 06"
6/22/2000	910	33AA-201	910	DNAPL Zone Structure; Office	Integrated- 8' 50"
6/22/2000	756	33AA-202	772	DNAPL Zone Structure; Outdoor	Integrated- 8' 39"
6/22/2000	812	30AA-203	702	South Plume Structure; Office	Integrated- 8' 09"
6/22/2020	820	30AA-204	608	South Plume Structure; Office	Integrated- 8' 03"
6/22/2000	823	30AA-205	645	South Plume Structure; Outdoor	Integrated- 8' 03"

*- Notes those samples that, by highest levels of SIM compound level, were selected and analyzed full scan.

Table 2. Summary of Flux Data for the North Plume, ug/m2,min-1.

	QC	QC	QC			NF-09	NF-10	NF-08	NF-07
	33A-215	**34A-001**	**34A-002**	**BKGD-1**	**BKGD-2**	**34A-003**	**34A-004**	**34A-005**	**34A-006**
COMPOUNDS	**Can Blk**	**Blank**	**Blank**	**Rail Yard**	**Town**	**NP Struc**	**NP Struc**	**NP WC**	**NP WC**
Vinyl Chloride	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	0.0050	0.0060	0.0040	0.0070	0.0080	**0.052**	<0.007	<0.007	**0.040**

NP Struc- North plume test location near the test structure.
NP WC- North plume worst-case test location.
NP Plu- Plume test location in the north plume.
Can Blk- Canister blank test.
Blank- System blank test, both chambers used in testing.
BKGD-1- Background test conducted on the edge of the rail yard; not over the plume(s).
BKGD-2- Background test conducted in town near the rail yard; not over the plume(s).

Table 2. Summary of Flux Data for the North Plume, ug/m2,min-1.

	NF-06	**NF-05**	**NF-04**	**NF-03**	**NF-02**	**NF-01**	**NF-01**
	34A-007	**34A-008**	**34A-009**	**34A-010**	**34A-011**	**34A-012**	**34A-013**
COMPOUNDS	**NP Plu**	**NP Plu**	**NP Plu**	**NP Plu**	**NP Plu**	**NP Plu**	**Repl**
Vinyl Chloride	<0.001	<0.001	<0.001	**0.0010**	<0.001	<0.001	<0.001
1,1-Dichloroethene	<0.002	**0.0030**	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007

NP Struc- North plume test location near the test structure.
NP WC- North plume worst-case test location.
NP Plu- Plume test location in the north plume.
Can Blk- Canister blank test.
Blank- System blank test, both chambers used in testing.
BKGD-1- Background test conducted on the edge of the rail yard; not over the plume(s).
BKGD-2- Background test conducted in town near the rail yard; not over the plume(s).

Table 3. Summary of North Plume Study Structure Ambient Air Data (ppbv).

	33A-215	34AA-001	34AA-002	34AA-003	34AA-004
COMPOUNDS	**Can Blk**	**Indoor**	**Indoor**	**Upwind**	**Replicate**
Vinyl Chloride	<0.006	<0.20	<0.18	<0.008	<0.008
1,1-Dichloroethene	<0.015	<0.50	<0.45	<0.021	<0.021
Benzene	0.043	**16**	**19**	**0.26**	**0.22**

Can Blk- Canister filled with pure air.
Indoor- Integrated indoor air sample in the test structure.
Upwind- Integrated outdoor air sample positioned upwind of the test structure.
Replicate- Co-located replicate sample.

Table 4. DNAPL Zone Flux Data, ug/m2,min-1.

	QC	QC	QC			DF-01	DF-03	DF-05	DF-04
	33A-215	34A-001	34A-002	BKGD-1	BKGD-2	33A-001	33A-002	33A-003	33A-004
COMPOUNDS	Can Blk	Blank	Blank	Rail Yard	Town	DNP Plu	DNP Plu	DNP Plu	DNP Plu
Vinyl Chloride	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	0.0050	0.0060	0.0040	0.0070	0.0080	<0.007	<0.007	<0.007	<0.007

DNP Struc- 33 Plume test location near the test structure.
DNP Plu- Plume test location in the 33 plume.
Can Blk- Canister blank test.
Blank- System blank test, both chambers used in testing.
BKGD-1- Background test conducted on the edge of the rail yard; not over the plume(s).
BKGD-2- Background test conducted in town near the rail yard; not over the plume(s).

Table 4. DNAPL Zone Flux Data, ug/m2,min-1.

	DF-07	DF-08	DF-06	DF-06	DF-02
	33A-211	33A-212	33A-213	33A-214	33A-216
COMPOUNDS	DNP Struc	DNP Struc	DNP Plu	Repl.	DNP Plu
Vinyl Chloride	**0.0030**	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	**0.044**	<0.002	<0.007	<0.007	<0.007

DNP Struc- 33 Plume test location near the test structure.
DNP Plu- Plume test location in the 33 plume.
Can Blk- Canister blank test.
Blank- System blank test, both chambers used in testing.
BKGD-1- Background test conducted on the edge of the rail yard; not over the plume(s).
BKGD-2- Background test conducted in town near the rail yard; not over the plume(s).

Table 5. Summary of Plume 33 Structure Ambient Air Data, ppbv.

	33A-215	33AA-201	33AA-202
COMPOUNDS	**Can Blk**	**Indoor**	**Upwind**
Vinyl Chloride	<0.006	<0.007	<0.007
1,1-Dichloroethene	<0.015	<0.017	<0.019
Benzene	0.043	**0.52**	**0.47**

Can Blk- Canister filled with pure air.
Indoor- Integrated indoor air sample in the test structure.
Upwind- Integrated outdoor air sample positioned upwind of the test structure.

Table 6. Summary of Flux Data for the South Plume, ug/m2,min-1.

	QC	QC	QC			SF-09	SF-10	SF-02	SF-01
	33A-215	34A-001	34A-002	BKGD-1	BKGD-2	30A-201	30A-202	30A-203	30A-204
COMPOUNDS	**Can Blk**	**Blank**	**Blank**	**Rail Yard**	**Town**	**SP Struc**	**SP Struc**	**SP Plu**	**SP Plu**
Vinyl Chloride	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0010**	<0.001
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	0.0050	0.0060	0.0040	0.0070	0.0080	<0.007	<0.007	**0.035**	**0.059**

SP Struc- South plume test location near the test structure.
SP WC- South plume worst-case test location.
SP Plu- Plume test location in the south plume.
Can Blk- Canister blank.
Blank- System blank test, both chambers used in testing.
BKGD-1- Background test conducted on the edge of the rail yard; not over the plume(s).
BKGD-2- Background test conducted in town near the rail yard; not over the plume(s).

Table 6. Summary of Flux Data for the South Plume, ug/m2,min-1.

	SF-07	SF-08	SF-06	SF-05	SF-04	SF-03
	30A-205	30A-206	30A-207	30A-208	30A-209	30A-210
COMPOUNDS	**SP WC**	**SP WC**	**SP Plu**	**SP Plu**	**SP Plu**	**SP Plu**
Vinyl Chloride	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	**0.048**	**0.045**	<0.007	<0.007	<0.007	<0.007

SP Struc- South plume test location near the test structure.
SP WC- South plume worst-case test location.
SP Plu- Plume test location in the south plume.
Can Blk- Canister blank.
Blank- System blank test, both chambers used in testing.
BKGD-1- Background test conducted on the edge of the rail yard; not over the plume(s).
BKGD-2- Background test conducted in town near the rail yard; not over the plume(s).

Table 7. Summary of South Plume Structure Ambient Air Data, ppbv.

	33A-215	**30AA-203**	**30AA-204**	**30AA-205**
COMPOUNDS	**Can Blk**	**Indoor**	**Indoor**	**Upwind**
Vinyl Chloride	<0.006	<0.008	<0.008	<0.007
1,1-Dichloroethene	<0.015	<0.019	<0.019	<0.018
Benzene	0.043	<0.059	**0.36**	**0.62**

30AA-204 and 30AA-205 mislabled on COC
Can Blk- Canister filled with pure air.
Indoor- Integrated indoor air sample in the test structure.
Upwind- Integrated outdoor air sample positioned upwind of the test structure.

Table 8. Summary of Full Scan VOC Flux Data for Selected Locations in All Areas (ug/m2,min-1).

			NF-09	NF-07	DF-03	DF-07	SF-01	SF-07
	BKGD-1	BKGD-2	34A-003	34A-006	33A-002	33A-211	30A-204	30A-205
COMPOUNDS	Rail yard	Town	NP Struc	NP WC	DNP Plu	DNP Struc	SP Plu	SP WC
Chloromethane	ND	ND	0.019	ND	0.015	0.042	ND	0.081
Chloroethane	ND	ND	ND	ND	ND	ND	ND	0.046
Trichlorofluoromethane	ND	0.051	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND	0.023	ND	ND
Benzene	ND	ND	0.058	ND	0.024	0.046	0.037	0.030
Toluene	0.024	0.11	0.41	0.21	1.0	0.37	0.16	0.15
Tetrachloroethene	ND	ND	ND	1.3	0.095	ND	0.058	ND
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ND	ND	0.040	ND	ND	ND	0.052	ND
m,p-Xylene	ND	0.033	0.19	0.14	0.062	0.051	0.19	ND
o-Xylene	ND	ND	0.067	ND	ND	ND	0.080	0.058
4-Ethyltoluene	ND	ND	ND	ND	ND	ND	0.038	0.073
1,2,4-Trimethylbenzene	ND	ND	ND	ND	ND	ND	0.048	0.046
1,3-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	0.073
Benzyl Chloride	ND	ND	ND	ND	ND	ND	ND	0.13
1,4-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	0.069
1,2-Dichlorobenzene	ND	ND	ND	ND	ND	ND	ND	0.058
1,2,4-Trichlorobenzene	ND	ND	ND	ND	ND	ND	ND	0.12

BKGD-1- Background location on the rail yard property.
BKGD-2- Background location in town near the rail yard property.
NP Struc- Location near test structure in the north plume area.
NP WC- "Worst-case location in the north plume area.
DNP Plu- Plume location in the DNAPL zone
DNP Struc- Location near the test structure in the DNAPL zone.
SP Plu- Plume location in the south plume area.
SP WC- "Worst-case location in the south plume area.

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX G Attachments A through C (See Table of Contents)

Contact the Superfund Records Center to view available document.
(303) 312-6473

APPENDIX H
AOI-27 TEST LOGS

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 1

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *6.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Trench ~ 12' long Sparse vegetation				
		Fill, tar, tar paper, brick Strong odor - methane/heavy oil Appears to be roofing debris?	Fill	3ppm		
		2.5' Black gravel zone, rounded, well sorted, saturated w/tar? Some free product, more paper, some rafts of gravel-tar This zone extends laterally only above 8' grades into black clay w/tar odor.	GW	17ppm		
	5	4' Native soil, grayish brown sandy clay w/minor gravels Strong HC odor, weather diesel? some orange staining	CL			
		Gray river cobbles			418.1 @ 6'	800 mg/kg
		Groundwater flowing into trench from bottom, has dark orange/black sheen, weathered diesel odor				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 2

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *6 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	OPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Native soil, med brown sandy clay, minor gravels, no stain or odor				
		15' laterally in trench Bunker 'C' solidified in chunks @ surface				
		Black sandy clay, strong methane odor, some HC odor				
		Top of contm varies laterally from 1.5 to 3' bgs			2'	156000
		Solid 5' deep solid tar from surface at east end of trench	CL			
		Strong diesel (weathered), odor, orange/black odor sheen				
	5	Black hard coal-like solid tar layer just above water Water level drops to 6' only 5' laterally in trench Gray cobbles, poorly sorted, strong diesel odor				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 3

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *3 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Trench 5' long Only 5' east of Trench 2				
		At ~3' black solid tar mixed w/soil and gravel w/strong acrid odor on stockpile Headspace 337 ppm Sample of plastic black odiferous material	Fill	300 ppm		392000
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 4

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *6 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Trench ~6' long Trench 4 btw 1 and 3				
		Native sandy clay, med brown Black sandy clay, strong HC odor (not acrid) Some debris - paper, canvas No groundwater	CL			
	5	BOT				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 5

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/13/94*	COMP. DATE: *12/13/94*	SURF. EL.: *FT.*	TD: *6 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Dark brown to black sandy clay, concrete debris No HC odor, maybe some minor HC contamination	CL			
		Sample just above water			Grab @ 2.5'	800
		Perch water seeping into hole				
	5	River cobble @ water table, no odor				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 6

CLIENT: *Union Pacific Railroad*			JOB NO.: *98437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Silty clay w/debris and rounded clasts	CL			
		Perched water entering hole (lots)				
					418.1 @ 3'	25,500
		5' down very tarey w/branches roofing felt and concrete				
	5	5.5' deep, ~10' long, lots of odor			418.1 @ 5'	35,800
	10					

JOB NUMBER: 98437

USPCI LOG

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Union Pacific Corporation

TRENCH NO. 7

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *4 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		4'x10' - 2-1/2 top feet				
		Black tar, acrid HC odor coarse grained sand beneath Water entering hole from below w/product very thick sheen, greenish brown	SP		418.1 @ 3.5'	171,000
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 8

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		Southern area				
		0-1' Topsoil, dk brown, lots of roots	Topsoil			
		Horizontally stratified sands, fine grained to very coarse grained to 5'	SP			
	5	River gravel @ 5', becomes large at 5.5' No odor, looks clean, sample just above water, no odor	GW		@5	<100
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 9

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *6 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		West side of pond				
		0-1' Brown silty sand, roots, no odor	SM			
		1'-3.5' Silty sand to clay, no odor, moist, brown w/clasts	SC			
		3.5'-5' Gray sand coarse grained to fine grained, no odor	SP		4181 @ 4.5'	400 mg/kg
	5	5'-5.5' River gravel, water Total depth 6', lots of water, minor sheen	GW			
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 10

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		8' x 5' deep				
		0-6" Topsoil w/roots Silty sand becomes more sandy and coarser w/depth	SP			
		River gravel @ 5', no odor Sample just above water collected	GW		418.1 @ 4.5'	<100 mg/kg
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 11

CLIENT: *Union Pacific Railroad*		JOB NO.: *96437*	
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:	METHOD: *Backhoe*	
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *4 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*	D. T. WATER: *FT. BGS*	

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		8' x 4' deep				
		0-6" Topsoil silty sand	SM			
		Boulder conglomerate, clast supported, lots of big clasts and water matrix is coarse grained sand	SP			
		Total Depth = 4'			418.1 @ 4'	<100 mg/kg
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 12

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *4 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	OPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-6" Topsoil silty sand Silty sand continues down to 2'	SM			
		Pebbly sand followed by conglomerate (cobble) Lots of water No odor, no HC evidence	SP		418.1 @ 2'	<100 mg/kg
		Total Depth = 4'				
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 13

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *3 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		2-1/2' deep x 5' long				
		No odor, no sheen 1' Clayey silty sand (topsoil) roots	SC			
		Coarse grained gravelly sand to 3', coarsens w/depth No odor	SP		91821 @ 2.5	<100
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 14

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-6" Silty sandy topsoil, no odor				
		Silty fine grained sand to 5', no odor	SM		4181 @ 4.5'	<100 mg/kg
	5	5'-5.5' River gravel, no odor Water, no sheen	GW			
		Total Depth = 5.5'				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 15

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-6" Silty sandy topsoil, no odor 6"-2.5' Silty fine grained sand, no odor	SM			
		2.5'-3' Gravel layer	GW			
		3'-4.5' Silty sand, no odor	SM		418.1 @ 4'	<100 mg/kg
	5	4.5'-5.5' Gravel Water, no sheen	GW			
		Total Depth = 5.5'				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 16

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:	METHOD: *Backhoe*	
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*	D. T. WATER: *FT. BGS*	

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-2.5' Topsoil, dk black w/roots and debris, no odor	Topsoil			
		2.5'-4.5' Silty sand, dk brown mottled w/clasts and debris, no odor	SM		418.1 @ 4'	<10 mg/kg
	5	4.5'-5.5' River gravel, cobble conglomerate, no odor Water, no sheen	GW			
		Total Depth = 5.5'				
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 17

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *4 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-6" Topsoil 6"-2' Black silty sand, minor debris, strong odor	SM			
		2'-4' Fine grained sand, moderate odor Water, has oily layer	SW			
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 18

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
	▼	0-6" Topsoil, roots, dk brown silty sand	Topsoil			
		6"-2.5' Fill--clasts, debris, wood, bricks, no odor, dk brown-black			4B1 B2	200 mg/kg
		2.5'-5' Fine grained silty sand, no odor, tan Water, no sheen	SM			
	5					
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 19

CLIENT: *Union Pacific Railroad*		JOB NO.: *96437*	
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:	METHOD: *Backhoe*	
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *6.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*	D. T. WATER: *FT. BGS*	

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-6" Topsoil, roots and debris,	Topsoil			
		6"-2.5' Fill w/tar chunks (roofing) w/bricks, wood, debris, brown Veins of solid tar, slight odor			418 @ 2'	3,900 mg/kg
	5	2.5'-6.5' Clastic silty sand, brown w/river cobbles, no odor Water, sheen	SM/GW			
	10					

JOB NUMBER: 96437

USPCI LOG

A subsidiary of
Union Pacific Corporation

TRENCH NO. 20

CLIENT: *Union Pacific Railroad*			JOB NO.: *96437*
PROJECT: *Ogden Ponds*		LOCATION: *Ogden, Utah*	
DRILLED BY:	DRILLER:		METHOD: *Backhoe*
START DATE: *12/14/94*	COMP. DATE: *12/14/94*	SURF. EL.: *FT.*	TD: *5.5 FT. BGS*
LOGGED BY: *Steve Brinkman*	MEAS. PT. EL.: *FT.*		D. T. WATER: *FT. BGS*

WELL DIAGRAM	DPT	DESCRIPTION	GRAPHIC LOG USCS CODE	OVA ppm	SAMPLE NUMBER	TPH mg/kg
		0-6" Topsoil, tan silty sand 6"-2.5' Fill w/roofing material and tar stringers perched water, no sheen apparent	Topsoil			
		2.5'-5.5' Gray-brown silty sand, cobble conglomerate matrix supported	SM		418.1 @ 2.5' 418.1 @ 5'	38,300 mg/kg
	5					
		Total Depth = 5.5'				
	10					

JOB NUMBER: 96437

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T21

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 5.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 5.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	gp	0-0.5' Gravely loam with vegetation. No odor, dry. Minor bricks.		
	sp	0.5-3.5' River sand with abundant gravel up to 6". Well rounded, coarse grained, poorly sorted. No odor.		
5	sw	3.5-5.5' Fine sand with moderate gravel. Water flowing into hole at 5.0'. Moderate hydrcarbon odor, minor sheen.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T22

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 7.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 6 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sp	0-1.5' Sandy soil with minor gravel up to 2". No odor. Abundant roots		
	sp	1.5-3.2' Poorly sorted, brown sand, coarse grained with moderate river cobbles up to 2.5". Cobbles are well rounded		
5	sm	3.2-5.5' Sand is brownish-gray with silt. Moderate sewer odor		
▼	sm	5.5-7.0' As above, no silt. Water at 6'. No sheen.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T23

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 7.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 6.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sp	0.0-0.5' Sandy loam soil, brown.		
	sp	0.5-1.0' Sand with minor cobbles up to 1.5". Brown, medium to coarse grained, poorly sorted. No odor		
	fill	1.0-2.0' Black sandy fill with abundant black tar paper and coal at 1.5-2.0'. No odor, no fluid, some glass.		
	fill	2.0-5.0' Fill, coarse sand, poorly sorted with moderate gravel up to 3". Cobbles are well rounded. Glass, bricks, wood, some minor tar paper. Minor organic smell (reduced.) Brownish-gray concrete waste at 5.0'.		
5	fill	5.0-7.0' Dark gray sandy fill with silt. Wood, coal, glass. Moderate organic odor, reduced. Poorly sorted with silt. Water at 6.5'. No diesel or hydrocarbon odor.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T24

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 5.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 5.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	SW	0.0-0.5' Sandy loam soil, brown, rooted, no odor.		
	fill	0.5-1.5' Fill, medium to fine sand with minor gravel (1.5".) Abundant coal and tar paper, dry, hard tar fractures.		
	SW	1.5-3.0' Sand, medium with moderate gravel up to 3", rounded, damp. Minor organic odor. No hydrocarbon odor. Some debris, bricks, wood, glass.		
5	SW	3.0-5.5' Sand, dark gray, medium to fine grain, reduced, occasional greenish-gray. No hydrocarbon odor. No sheen. Moderate septic odor. Water flowing into hole at 5.0'.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T25

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 5.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 4.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sw	0.0-0.5' Sandy loam, brown.		
	sm	0.5-4.0' Medium sand with silt, dark gray to black, strong hydrocarbon odor, abundant hard tar with concoidal fracture. Minor gravel to 2", rounded. Product at 3.5 feet, tary and minor oil.		
▼	sm	4.0-5.0' Sand as above, dark gray. Moderate hydrocarbon odor. Water at 4.5 feet. Strong sheen on water. Sample taken.		
5				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T26

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 5.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 5.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sw	0.0-1.0' Brown sandy loam soil, no odor.		
	sp	1.0-4.0' Sand, fine to medium grain, poorly sorted, abundant cobbles up to 3", well rounded, no odor.		
5	sm	4.0-5.5' Sand, fine grain, minor cobbles. Gray to dark gray. Sand has minor silt. No sheen. Septic odor. No hydrocarbon odor. Damp at 4.0', water at 5.0'.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T27

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 4.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 3.5 FT

DEPTH	GRAPHIC LOG	USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0		SW	0.0-.25' Sandy loam soil.		
		gp	.25-4.5' Gravel, sandy, very coarse to coarse grain. Abundant river cobbles up to 10", moderate to well rounded. No odor, no sheen. Water in trench at 3.5'.		
5					
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T28

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 6.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 5.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	SW	0.0-0.3' Sandy soil, no roots.		
	sludge	0.3-1.0' Black sludge, moderate firm, moderate odor.		
	SW	1.0-1.5' Sand, fine to medium grain, no gravel, no cobbles, brown.		
	SW	1.5-1.9' As above. Dark gray, strong hydrocarbon odor, no sludge. Sample taken at 1.6'.		
	SW	1.9-5.5' Greenish-gray as above. Wet at 4.0', but no water. Difficult digging to 5.5'		
5	SW	5.5-6.0' Greenish-gray sand, fine to medium grain, minor gravel with cobbles to 4" (well rounded.) Water at 5.5'. Minor sheen.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T29

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 2.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 2.5 FT

DEPTH	GRAPHIC LOG	USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0		sw	0.0-0.3' Sandy loam		
		gp	0.3-2.5' (dug to 4.0' - caving/SAA) Sandy gravel, brown. Sand is coarse grain to very coarse. *Abundant large cobbles up to 8", rounded. Water at 2.5'* No odor.		
5					
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T30

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 6.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 4.5 FT

DEPTH	GRAPHIC LOG USCS CODE		DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0					
		sw	0.0-0.8' Brown, sandy loam.		
		sp	0.8-2.5' Black, sand with tar and asphalt. Medium grain, minor gravel. Strong hydrocarbon odor.		
		sp	2.5-6.0' Dark gray sand, medium to fine grain. Strong hydrocarbon odor. Water at 4.5'. Sheen on water.		
5					
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T31

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 3.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 3.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-.17' Sand with silt, light brown.		
	sp	.17-3.5' Sand, mud to coarse grain, poorly sorted with abundant gravel, cobbled to 6", rounded. Water at 3.0'. No odor, no sheen.		
5				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T32

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 5.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 4.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-5.5' Silt with fine grained sand. Light brown, dry, no odor, minor cobbles up to 3". Water at 4.0' Minor sloughing at 4.5'		
5				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T33

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 4.8 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 4.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	SW	0.0-0.8' Sandy loam.		
	SM	0.8-4.8' Silt, brown with fine to very fine sand. Water at 4'. No odor. No sheen.		
5				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T34

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 7.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 6.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-5.5' Brown, silt with fine sand. No odor, minor cobbles.		
5	sm	5.5-6.8' Dark gray to black. Hydrocarbon odor. Sandy silt with decayed wood. No sludge. Water at 6.0'.		
	sm	6.8-7.5' Brown, same silt as above, minor cobbles to 6".		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T35

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 6.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 5.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-4.0' Silt with fine sand, tan. Dry, no odor.		
5 ▼	sp	4.0-6.5' Medium to coarse sand at base, abundant cobbles up to 6". Moist at 5.0'. Water at 5.5'.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T36

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 6.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 6.0 FT

DEPTH	GRAPHIC LOG	USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0		sm	0.0-4.0' Silt with fine sand, tan.		
			0.0-3.0' Hard, no odor, dry.		
		sm	4.0-5.0' Fine sand with silt, tan. Damp, no odor.		
5		sw	5.0-6.5' Medium sand, tan to orange-tan with iron staining. Moderate cobbles up to 6". Rounded. Wet at 6.0' Water does not flow into trench. No odor.		
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T37

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI		LOCATION: OGDEN, UTAH	
DRILLING CO.: PACIFIC WEST		METHOD: BACK-HOE	
DATE START: 6-14-00	DATE COMP: 6-14-00	TIME:	TOTAL DEPTH: 5.5 FT
LOGGED BY: TED PETRANOFF			DEPTH TO WATER: 5.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-3.0' Silt with fine sand, no odor, dry.		
	sw	3.0-4.5' Fine to medium sand, moderately well sorted at base. Tan, damp, no odor.		
5	sp	4.5-5.5' Sand, medium, poorly sorted with abundant gravel. Cobbles to 4". Wet at 5.0, water at 5.5. No odor, no sheen.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T38

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-14-00 / DATE COMP: 6-14-00 / TIME:	TOTAL DEPTH: 6.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 6.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-4.0' Silt with fine sand, tan. No odor, dry. on East wall-North, minor dry sludge.		
	sm	4.0-5.0' Sand with fine to medium grained at base, silty at top Moderate sorting at base, tan, no odor, damp.		
5	sp	5.0-6.0' Sand, medium grained, tan. Moderate gravel, rounded to 4". Wet at 5.5, water at 6.0		
▼				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T39

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-15-00 / DATE COMP: 6-15-00 / TIME:	TOTAL DEPTH: 5.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sludge	0.0-0.8' Black sludge with silt, sandy, moderate odor. Sludge appears laid out on surface. Sample taken.		
	sm	0.8-4.0' Silt, tan, sandy, dry. Sharp contact with sludge above. No odor. Sample taken		
5	sp	4.0-5.0' Sand with medium to fine grains, moderate sorting. Tan, damp at base and gravel at base. Trench terminated to prevent contact with groundwater.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T40

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI		LOCATION: OGDEN, UTAH	
DRILLING CO.: PACIFIC WEST		METHOD: BACK-HOE	
DATE START: 6-15-00	DATE COMP: 6-15-00	TIME:	TOTAL DEPTH: 3.5 FT
LOGGED BY: TED PETRANOFF			DEPTH TO WATER: 3.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sp	0.0-1.0' Sand with abundant gravel, medium grain, clasts to 2" rounded, poorly sorted, tan, dry, no odor.		
	sm	1.0-1.5' Silt, tan, sandy, dry, no odor.		
	sp	1.5-3.0' Sand, medium grain, moderate sorting, tan, damp, no odor.		
▼	sp	3.0-3.5' As above with gravel, water at 3.0'.		
5				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T41

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-15-00 / DATE COMP: 6-15-00 / TIME:	TOTAL DEPTH: 3.5 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 3.0 FT

DEPTH	GRAPHIC LOG	USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0		sw	0.0-0.8' Sand, fine grain with abundant gravel, tan, dry, no odor.		
		sp	0.8-3.0' Sand, tan, moderate grain, moderate sorting, minor iron staining, no odor, damp at base.		
▼		sp	3.0-3.5' As above with abundant gravel up to 8", well rounded. water at 3.0', no sheen.		
5					
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T42

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI		LOCATION: OGDEN, UTAH	
DRILLING CO.: PACIFIC WEST		METHOD: BACK-HOE	
DATE START: 6-15-00	DATE COMP: 6-15-00	TIME:	TOTAL DEPTH: 7.0 FT
LOGGED BY: TED PETRANOFF			DEPTH TO WATER: 6.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sm	0.0-3.0' Silt, fine sand, tan, no odor, dry to damp.		
5	sw	3.0-5.5' Sand, tan, very fine grain to fine grain, no cobbles, damp, no odor, minor silt.		
▼	sm	5.5-7.0' Silt, tan to brown-gray. >30% very fine sand, damp to wet. Water at 6.5'. No odor		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T43

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-15-00 / DATE COMP: 6-15-00 / TIME:	TOTAL DEPTH: 5.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 4.5 FT

DEPTH	GRAPHIC LOG USCS CODE		DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0		sp	0.0–0.6' Sandy loam, soil, tan, root penetrated, dry, no odor.		
		sp	0.6–2.0' Sand, tan, very silty, damp, no odor.		
		sp	2.0–5.0' Sand, tan to brown, moderate to very coarse grain, poorly sorted. Water at 4.5'.		
5					
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE
WELL NO. T44

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-15-00 / DATE COMP: 6-15-00 / TIME:	TOTAL DEPTH: 4.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 3.5 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sp	0.0-1.0' Sandy loam with gravel, tan, no odor.		
	sp	1.0-3.0' Sand, tan to rusty tan, medium to very coarse grained, poorly sorted. Abundant gravel to 6", rounded. No odor, damp at base.		
	SP	3.0-3.5' As above with clast stained black with minor hydrocarbon (tar) coating. Very faint odor, no sludge.		
▼	SP	3.5-4.0' Sand, tan to rusty tan, medium to very coarse grained, poorly sorted. Abundant gravel to 6", rounded. Water at 3.5'. Water is orange, no odor, no sheen, cobbles not stained.		
5				
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T45

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE

DATE START: 6-15-00	DATE COMP: 6-15-00	TIME: 5.5	TOTAL DEPTH: FT
LOGGED BY: TED PETRANOFF			DEPTH TO WATER: 5.0 FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sw	0.0-0.8' Sandy loam, soil.		
	sw	0.8-2.0' Silt, very fine sand, tan. Dry to damp, no odor.		
	sp	2.0-4.0' Sand, tan, silty at top, medium to coarse at base. Moderate sorting at base. damp, no odor.		
5	sp	4.0-5.5' As above with abundant cobbles to 3". Water at 5.0, caving.		
10				

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T46

CLIENT: UNION PACIFIC RAILROAD	JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI	LOCATION: OGDEN, UTAH
DRILLING CO.: PACIFIC WEST	METHOD: BACK-HOE
DATE START: 6-15-00 / DATE COMP: 6-15-00 / TIME:	TOTAL DEPTH: 6.0 FT
LOGGED BY: TED PETRANOFF	DEPTH TO WATER: 5.5 FT

DEPTH	GRAPHIC LOG	USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	grease / oil		0.0-0.5' Black, dried oil, faint odor, journal grease.		
		sm	0.5-1.2' Silt, tan, hard, sandy, dry, no odor, no contamination.		
		sm	1.2-2.5' Sand, very fine to fine grain, tan, silty, moderate sorting. Dry, no odor.		
		sp	2.5-3.0' Sand, medium grain, tan, moderate sorting, damp, no odor.		
		sp	3.0-3.3' Black cobbles, appears hydrocarbon related, no odor. Clean below 3.3.		
5		sp	3.3-6.0' Sand, medium to coarse grained, tan to rusty-tan. Abundant gravel clasts to 6", rounded. Water at 5.5', water slightly muddy, no orange, no odor.		
10					

JOB NUMBER: 792904

SAFETY-KLEEN CONSULTING

SOIL BORING/WELL LOG

BORING NO. UPRR-OGDE

WELL NO. T47

CLIENT: UNION PACIFIC RAILROAD			JOB NUMBER: 792904
PROJECT: OGDEN RAILYARD, PHASE II RI		LOCATION: OGDEN, UTAH	
DRILLING CO.: PACIFIC WEST		METHOD: BACK-HOE	
DATE START: 6-15-00	DATE COMP: 6-15-00	TIME:	TOTAL DEPTH: 6.0 FT
LOGGED BY: TED PETRANOFF			DEPTH TO WATER: FT

DEPTH	GRAPHIC LOG USCS CODE	DESCRIPTION	SAMPLE NO.	SAMPLE ANAL.
0	sw	0.0-0.3' Dark brown soil with sand, root penetrated.		
	sm	0.3-1.5' Silt, hard, tan, very fine sand, no odor.		
	sp	1.5-3.0' Sand, tan, fine grain, moderate sorting, dry to damp. Subangular, no odor.		
5	sp	3.0-6.0' Sand, tan, medium grained, poorly sorted, no cobbles, damp, no odor, no hydrocarbon stain.		
10				

JOB NUMBER: 792904

APPENDIX I
SPRR LOCOMOTIVE MACHINE SHOP DEMOLITION DOCUMENTATION

AMI GROUP
Environmental Services

October 18, 1999

Mr. Gary Hill
Union Pacific Railroad
1416 Dodge Street
Omaha, NE 68179

RE: Ogden, Utah (Locomotive Shop)

Dear Gary:

Per your request, I have attached some documentation from the demolition project for the Locomotive Shop in Ogden, Utah. If you should need originals of these documents, please let me know and I will contact, the contractor, Jeff Loebner with Spirco or if you would like to contact him directly, his phone number is 800-462-7743.

If you have any questions or desire additional information, please feel free to contact me at (402) 397-5001.

Respectfully Submitted,

Larry J. Owens
Senior Project Manager

704 South 75th Street • Omaha, NE 68114
Phone 402-397-5001 • Fax 402-397-3313 • E mail info@amigroupinc.com

01

02

Poor Quality Source Document

The following document images have been scanned from the best available source copy.

To view the actual hard copy, contact the Superfund Records Center at (303) 312-6473.

Fee Received: $	Date Received:	Initials:
Check Number:		
Date Paid:	Postmark Date:	10-Wkg-Dyg:

NOTIFICATION OF DEMOLITION AND RENOVATION

and Asbestos Removal

PLEASE COMPLETE ALL 20 SECTIONS!

I. Type of Notification: [X] Original [ ] Revised [ ] Canceled

II. A. Type of Operation:
[X] Demolition [ ] Ordered Demo
[ ] Renovation [ ] Emergency Reno
[ ] Courtesy Notification

II. B. Fee Class
[ ] $500 | NESHAP >5000 sq./lin. ft.
[X] $200 | NESHAP <5000 sq./lin. ft.
[ ] $50 | Non-NESHAP Residential
[ ] $0 | Courtesy Notifications

III. Facility Description: Please Complete Fully!

A. Building Name: Union Pacific Rail Yard

B. Street Address: Union Pacific Loco Motive Shop City: Ogden State: UT Zip:
County: Weber Telephone Number: (801)none

C. Site Description: (Floor or Room or Component, Area of Facility)
Throughout Facility

D. Building Size: 120,000 sq.ft. # of Floors: 2 Age of Bldg: 45 yrs

E. Present Use: Vacant Prior Use: Loco motive repair shop

IV. Facility Owner and Contractor Information:

A. Facility Owner Name: Union Pacific

B. Street Address: 1416 Dodge St.
City: Omaha State: NE Zip: 68179

C. Contact Person: Gary Hill Telephone Number: (402)271-5971

D. Asbestos Contractor: Rocky Mountain Asbestos Abatement TDH: 241

E. Street Address: 1710 West 8760 South
City: West Jordan State: Utah Zip: 84088

F. Contact Person: Ron Samford Telephone Number: (801)562-5488

G. Demolition Contractor (if applicable):

H. Street Address:
City: State: Zip:

I. Contact Person: Telephone Number:

V. Scheduled Dates of Asbestos Removal (Date ACM will be disturbed)

A. Prep: 5-3-99 Start: 5-3-99 Complete: 5-17-99

B. Days of Week Working (Monday thru Friday)

C. Hours of the Day: 8 a.m. To 6 p.m.

VI. Scheduled Dates of Demolition/Renovation:

Start: Complete

VII. Person Trained in Provisions of NESHAP Regulations who will Supervise Project (List Certification No. or Attach Copy of Certificate of Accreditation)

A. Name: Ron Samford Soc. Sec. Num: 518-88-3093

B. Course Provider Name: NEPA

C. Date of Accreditation: 6-12-98 Utah Cert. Number: 1207

VIII Asbestos Inspection (Including Appropriate Analytical Method Used to Detect Asbestos Containing Material):

A. Bulk Sampling, PLM and Dispersion Staining analytical methods. Date Inspected (10-11-97)

B. Is Asbestos Present? (X) Yes ( ) No

C. What Consulting Company Conducted the Inspection? AMI Group

D. Who Conducted the Inspection? Dan Taylor

E. Inspector's Utah Certification #: [illegible]

IX. Approximate Amount of Asbestos Containing Material (ACM) to be Removed:

A. Regulated ACM (RACM) to be Removed:

1. Pipes 361 lf 4" pipe 324 6" pipe 290 10" pipe (Linear Feet)	2. Surface Area: (Square Feet)	3. Vol. ACM Off Facility Component: (Cubic Feet)

B. Category I ACM that will not Become RACM, to be Removed:

1. Surface Area 4700 sq. ft. linoleum (Square Feet)	2. Vol. ACM Off Facility Component: (Cu. Ft.)	3. Other:

C. Category II ACM that will not Become RACM, to be Removed:

1. Pipes (Ln. Ft.)	2. Surface Area: (Sq. Ft.)	3. Vol. ACM Off Facility Component: (Cu. Ft.)

X. Complete for Demolition Only. ACM Not to be Removed

A. Category I ACM (packings, gaskets, resilient floor coverings, asphalt roofing products):

1. Surface Area (Sq. Ft.)	2. Vol. ACM Off Facility Component: (Cu. Ft.)	3. Other: Roofing material

B. Category II ACM (all other nonfriable ACM not in category I):

1. Pipes (Ln. Ft.)	2. Surface Area: (Sq. Ft.)	3. Vol. ACM Off Facility Component: (Cu. Ft.)

XI. Detailed Description of Planned Demolition or Renovation Work, and Method(s) to be Used (Actual Demolition or Renovation Techniques or Methods to be Used, Description of Asbestos Materials and Facility Components Affected):

Project involves the removal of TSI piping throughout structure will follow State demolition asbestos removal requirements. Erect critical barriers, build five stage decon unit and glove bag ACM.

XII. Detailed Description of Work Practices and Engineering controls to be Used to Prevent Emissions of Asbestos at the Demolition and Renovation Site:

There will be deviations from Rocky Mountain Asbestos Abatements standard work practices.

XIII Waste Transporter I (removal site to storage area or removal site to disposal area):

A. Name: Rocky Mountain Asbestos Abatement

B. Street Address: 1730 West 8760 South
City: West Jordan State: Utah Zip: 84088

C. Contact Person: Ron Samford Phone Number: (801) 562 5488

XIV. Waste Transporter II (storage area to disposal site, if applicable)

A. Name:

B. Street Address:
City: State: Zip:

C. Contact Person: Phone Number:

XV. Waste Disposal Site:

A. Name: Waste Control Management

B. Street Address: 8000 West 1300 South
City: Magna State: Utah Zip:

XVI. Name of Waste Generator Receiving Signed Copy of Waste Shipment Record:
Union Pacific

XVII If Demolition Ordered by a Government Agency, Please Identify the Agency Below: (Attach Copy of Order)

A. Name:

B. Title:

C. Authority:

D. Date Ordered:
Date Order to Begin:

XVIII. For Emergency Renovation:

A. Date and Hour of Emergency:

B. Detailed Description of the Unforeseen Event:

C. Explanation of How the Event Caused Unsafe Conditions or Would Cause Equipment Damage or an Unreasonable Financial Burden to the Facility Owner:

XIX. Description of Procedures to be Followed in the Event that Unexpected Asbestos is Found or Previously Nonfriable Asbestos Material Becomes Crumbled, Pulverized, or Reduced to Powder:

Immediately demarcate area with Asbestos Danger tape, wet material and install critical poly barriers prior to shoveling all visible debris.

XX. I Certify that the Above Information is Correct.

Ron Samford for /Ron Samford 4-15-99
(Signature of Owner/Operator) (Date)

OFFICE USE ONLY:

	Date Rejected:	
NESHAP Review	Date Approved:	ACTS #:

6/8/95

704 South 75th Street
Omaha, NE 68114
Phone (402)397-5001
FAX (402)397-3313

CERTIFICATE OF FINAL INSPECTION

PROJECT NAME: UPRR Locomotive Shop DATE: 7/16/99

PROJECT LOCATION: UP/SP Ogden Yard, 22nd & Wall Ave. Ogden, UT PHASE: Project Closeout

In accordance with the Removal and Disposal Plan, I hereby certify that I have visually inspected the designated work area(s) and that all surfaces have been found to be clean of visual dust, debris, or residue. The area(s) is designated by the scope of work on file with the appropriate State or Local Governmental Regulatory Agency.

AMI Project Number: N15 Building Owner: UPRR

Building Owner Point of Contact: Gary Hill

Building Owner Representative

Signature: Tim Andersen Date: 7-16-99

Printed Name: Tim Andersen Title: Project Manager

Company Representing: AMI Group, Inc.

Remediation Company's Designated Person/Representative

Signature: Jeff DeCaney Date: 7-16-99

Printed Name: JEFF DeCaney Title: Project Supervisor

Company Representing: Spirco Services

Building Owner's Point of Contact/Representative

Signature: John E Dodge Date: 7-16-1999

Printed Name: JOHN E Dodge Title: Sheet Metal worker water Semi L-D

Company Representing:

Specifics or Limitations to Inspection:

704 South 75th Street
Omaha, NE 68114
Phone (402)397-5001
FAX (402)397-3313

CERTIFICATE OF FINAL INSPECTION

PROJECT NAME: UPRR Water Resevior DATE: July 14, 1999

PROJECT LOCATION: 1562 25th St., Ogden, UT PHASE: Project Closeout

In accordance with the Removal and Disposal Plan, I hereby certify that I have visually inspected the designated work area(s) and that all surfaces have been found to be clean of visual dust, debris, or residue. The area(s) is designated by the scope of work on file with the appropriate State or Local Governmental Regulatory Agency.

AMI Project Number: N14 Building Owner: Union Pacific Railroad

Building Owner Point of Contact: Gary Hill

Building Owner Representative

[signature] Date: 7/14/99
Signature

Tim Anderson Title: Project Manager
Printed Name

Company Representing: AMI Group, Inc.

Remediation Company's Designated Person/Representative

[signature] Date: 7-14-99
Signature

Jeff DeCaney Title: Project Supervisor
Printed Name

Company Representing: SPirco Services

Building Owner's Point of Contact/Representative

[signature] Date: 7-14-1999
Signature

John E Dodge Title: Street Maintenance water Service
Printed Name

Company Representing: U.P.R.R

Specifics or Limitations to Inspection: Contractor is liable and has full responsibility for the watering of the entire resevior area until the contract term has expired.

REYNOLDS BROTHERS

REYNOLDS BROS. INC.
4730 South 200 West
SALT LAKE CITY, UTAH 84107 Phone 266-0451

JOB # 7:15 - 4:30 DATE 6-15-99

JOB SITE AHRENS CONS BILL TO AHRENS CONS
UNIL ST 22ND ST

TERMS: NET 30 DAYS A FINANCE CHARGE IN THE AMOUNT OF 2% PER MONTH (24% per Annum) WILL BE CHARGED ON ALL PAST DUE ACCOUNTS.

PAYABLE TO REYNOLDS BROTHERS INC. ON THE 10th DAY OF THE MONTH FOLLOWING DATE OF INVOICE IN THE EVENT OF THIS CLAIM NOT PAID WITHIN 30 DAYS AFTER DUE DATE, I OR WE AGREE TO PAY REASONABLE ATTORNEY FEES WITH OR WITHOUT SUIT, TOGETHER WITH INTEREST UNTIL PAID, BOTH BEFORE AND AFTER JUDGMENT THIS ORDER. TERMS AND CONDITIONS ARE ACCEPTED.
NOTICE: OUR DRIVERS AND OPERATORS WILL MAKE EVERY EFFORT TO DO WHATEVER THE CUSTOMER OR HIS AGENT DESIGNATES, BUT WE ASSUME NO RESPONSIBILITY FOR DAMAGES INSIDE CURBS OR PROPERTY LINES AGENT DESIGNATES.

NO.	TIME LOADED	MATERIAL	NET WEIGHT	LOADED AT	DELIVERED
1.	9:00	Demo	Export	Union pacific	mouldings
2.	9:30	"	"	yard, 22nd	"
3.	10:30	"	"	" "	"
4.	11:30	"	"	" "	"
5.	1:00	"	"	" "	"
6.	2:00	Demo	"	" "	"
7.	2:45	"	"	" "	"
8.	3:15	"	"	" "	"
9.		"	"	" "	"
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					

Customer Signature [signature]

Hrs [illegible]

Operator Kevin

Machine No. TIC

TOTAL

WHITE - OFFICE CANARY - FILE PINK - CUSTOMER

* General Debris went to Mouldings & Sons landfill.

...UNT #

INVOICE

48481

REYNOLDS BROS. INC.

4730 South 200 West

SALT LAKE CITY, UTAH 84107 Phone 266-0451

JOB # 7:15-12:00 12:30-5:00 DATE 6 16 99

JOB SITE AHRENS BILL TO: AHRENS

22 ST [illegible]

TERMS: NET 30 DAYS A FINANCE CHARGE IN THE AMOUNT OF 2% PER MONTH. (24% per Annum) WILL BE CHARGED ON ALL PAST DUE ACCOUNTS.

PAYABLE TO REYNOLDS BROTHERS INC. ON THE 10th DAY OF THE MONTH FOLLOWING DATE OF INVOICE IN THE EVENT OF THIS CLAIM NOT PAID WITHIN 30 DAYS AFTER DUE DATE, I OR WE AGREE TO PAY REASONABLE ATTORNEY FEES WITH OR WITHOUT SUIT, TOGETHER WITH INTEREST UNTIL PAID, BOTH BEFORE AND AFTER JUDGMENT THIS ORDER, TERMS AND CONDITIONS ARE ACCEPTED.
NOTICE: OUR DRIVERS AND OPERATORS WILL MAKE EVERY EFFORT TO DO WHATEVER THE CUSTOMER OR HIS AGENT DESIGNATES, BUT WE ASSUME NO RESPONSIBILITY FOR DAMAGES INSIDE CURBS OR PROPERTY LINES AGENT DESIGNATES.

NO.	TIME LOADED	MATERIAL	NET WEIGHT	LOADED [illegible]	[illegible]
1.	8:15	Demo	EXPORT	union pacific	mouldings
2.	9:15	"	"	"	"
3.	10:15	"	"	"	"
4.	10:45	"	"	"	"
5.	11:45	"	"	"	"
6.	1:00	RD BASE	35 Ton	mouldings	union pacific
7.	1:30	Demo	EXPORT	union pacific	mouldings
8.	1:45	RD BASE		mouldings	union pacific
9.	2:15	Demo	EXPORT	union pacific	mouldings
10.	2:45	RD BASE		mouldings	union pacific
11.	3:30	Demo	EXPORT	union pacific	mouldings
12.	4:00	RD BASE		mouldings	union pacific
13.	4:30	Demo	EXPORT	union pacific	mouldings
14.					
15.					
16.					
17.					
18.					

Customer Signature [signature]

Operator

Machine No. T12

Hrs	9 1/4	
TOTAL		

WHITE - OFFICE CANARY - FILE PINK - CUSTOMER

ACCOUNT #

INVOICE No. 48485

REYNOLDS BROS. INC.

4730 South 200 West
SALT LAKE CITY, UTAH 84107 Phone 266-0451

JOB # 6-30-12:00-5 DATE 6-18-99

JOB SITE AHRENS 12:30 - 4:00 3½ BILL TO: AHRENS

(Order Pat Yates)

TERMS: NET 30 DAYS A FINANCE CHARGE IN THE AMOUNT OF 2% PER MONTH, (24% per Annum) WILL BE CHARGED ON ALL PAST DUE ACCOUNTS.

PAYABLE TO REYNOLDS BROTHERS INC ON THE 10th DAY OF THE MONTH FOLLOWING DATE OF INVOICE IN THE EVENT OF THIS CLAIM NOT PAID WITHIN 30 DAYS AFTER DUE DATE, I OR WE AGREE TO PAY REASONABLE ATTORNEY FEES WITH OR WITHOUT SUIT, TOGETHER WITH INTEREST UNTIL PAID, BOTH BEFORE AND AFTER JUDGMENT THIS ORDER. TERMS AND CONDITIONS ARE ACCEPTED.
NOTICE: OUR DRIVERS AND OPERATORS WILL MAKE EVERY EFFORT TO DO WHATEVER THE CUSTOMER OR HIS AGENT DESIGNATES, BUT WE ASSUME NO RESPONSIBILITY FOR DAMAGES INSIDE CURBS OR PROPERTY LINES AGENT DESIGNATES.

No.	Time Loaded	Material	Weight			
1.	7:45	Demo	exit	union	pacific	matchings
2.	8:30	"	"	"	"	"
3.	9:15	"	"	"	"	"
4.	9:45	"	"	"	"	"
5.	11:30	"	"	"	"	"
6.	11:15	"	"	"	"	"
7.	1:15	"	"	"	"	"
8.	2:30	"	"	"	"	"
9.	5:30	"	"	"	"	"
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						

Customer Signature

Hrs 9

Operator

Machine No. T12

TOTAL

WHITE - OFFICE CANARY - FILE PINK - CUSTOMER

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: Rail Road From 2750.

ADDRESS:

JOB LOCATION: 22nd Below Wall Ave.

DESCRIPTION OF WORK PERFORMED:

JOB NO.: DATE 6-21-99

EQUIP. #	MATERIAL	LOAD	HOURS
B-16	Fill Dirt	25	8
S-17	Fill Dirt	29	9.5
Perkins	Fill Dirt	31	9
B-17	Fill Dirt	30	9.5
unitedS+G	Fill Dirt	16	8
B-14	Fill Dirt	15	5
B-11	Fill Dirt	12	5

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: AHRENS Contracting Inc.

ADDRESS:

JOB LOCATION:

DESCRIPTION OF WORK PERFORMED:

JOB NO. DATE 6-22-99

EQUIP. #	MATERIAL	LOAD	HOURS
LA 1		10	4.5
DS6		11	14
B-17		25	8.5
Peckens		23	8
		64	2 ad

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

Busenbark Construction, Inc.

51 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: T J AHRENS

ADDRESS:

JOB LOCATION: RAIL ROAD

DESCRIPTION OF WORK PERFORMED:

JOB NO. DATE 4-24-99

EQUIP. #	MATERIAL	LOAD	HOURS
B-17	FILL ON SITE	39	7
S-17	" " "	38	7
PERKINS			
PER 1	2750 TO RR FILL DIRT	20	7.5

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE [signature]

704 South 75th Street
Omaha, NE 68114
Phone (402)397-5001
FAX (402)397-3313

RECIEPT OF DISPOSAL

PROJECT NAME: Locomotive Shop DATE: 6/22/99

PROJECT LOCATION: Southern Pacific Ogden Yard, Ogden, UT PHASE: Demolition

AMI Project Number: N15 Building Owner: UPRR

Building Owner Point of Contact: _____

This reciept is to certify that 1 truck loads

of lead containing brick

approved by EPA standards and state regulations were disposed

of at said location of: Weber County Solid Waste

2599 A Ave. Ogden, UT

Signed this day, OK'd by Karlene

Kelli Miller 6/22/99
(Landholder) Date

X (AMI Group, Inc.) 6/22/99
Date

704 South 75th Street
Omaha, NE 68114
Phone (402)397-5001
FAX (402)397-3313

RECIEPT OF DISPOSAL

PROJECT NAME: Locomotive Shop DATE: 6/22/99
PROJECT LOCATION: Southern Pacific Ogden Yard, Ogden, UT PHASE: Demolition

AMI Project Number: N15 Building Owner: UPRR

Building Owner Point of Contact: _____

This reciept is to certify that 1 truck loads

of lead containing brick

approved by EPA standards and state regulations were disposed

of at said location of: Weber County Solid Waste

2599 A Ave. Ogden UT

Signed this day, OK'd by Karlene

Kellie Miller 6/22/99
(Landholder) Date

X (AMI Group, Inc.) 6/22/99
Date

WEBER COUNTY TRANSFER STATION

2599 "A" AVENUE
OGDEN, UTAH 84401

BILL TO: 0
CASH CUSTOMER

Vehicle ID: 46
Reference:

DATE IN: 06/22/1999 TIME IN: 14:12
DATE OUT: 06/22/1999 TIME OUT: 14:19

INBOUND TICKET Number: 02-005204

SCALE GROSS WEIGHT	37380	LB
SCALE TARE WEIGHT	24940	LB
NET WEIGHT	12440	LB

Qty	Description	Amount
6.22	DEMOLITION	183.49

AMOUNT DUE: 183.49

CHECK #

x Containd lead Brick

RECIEPT OF DISPOSAL

Omaha, NE 68114
Phone (402)397-5001
FAX (402)397-3313

PROJECT NAME: Locomotive Shop DATE: 6/30/99

PROJECT LOCATION: Southern Pacific Ogden Yard, Ogden, UT PHASE: Demolition

AMI Project Number: N15 Building Owner: UPRR

Building Owner Point of Contact: Gary Hill

This reciept is to certify that 4 truck loads

of creasolt contaminated railroad ties / utility poles

approved by EPA standards and state regulations were disposed

of at said location of: 910 West 21st Westhaven

Utah 84404 Moulding's Landfill

Signed this day.

Shelley Faddis (Landholder) 6-30-99 Date

(AMI Group, Inc.) 6/30/99 Date

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: Thomas Coast

ADDRESS:

JOB LOCATION: 1550 E 25-15

DESCRIPTION OF WORK PERFORMED:

JOB NO.: DATE: 6-25-99

EQUIP. #	MATERIAL	LOAD	HOURS
Perkins		7	6
Fox		3	
B-13		1	
B-16		9	
B-18		9	
		26	

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: Ahrens Carl

ADDRESS:

JOB LOCATION: 22ND PR

DESCRIPTION OF WORK PERFORMED:

JOB NO.: DATE: 6-28-89

EQUIP. #	MATERIAL	LOAD	HOURS
Perkins		7	
B-13		10	
B-14		2	
B-16		9	
B-18		10	
		38	

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

C.E. BUTTERS
CONSTRUCTION INC.
782-2088

LICENSED CONTRACTOR

KENT BUTTERS
PRESIDENT

760 N. HARRISVILLE ROAD
OGDEN, UTAH 84404

- BASEMENTS
- SITE PREPARATION
- SEWER LINES
- TOP SOIL
- SUBDIVISIONS
- HAULING
- ROADS
- SNOW REMOVAL

SAND • GRAVEL • FILL • ETC.

Date 6-28 1999 Time

Sales Person

Blue Stake Ref. No.

Blue Stake Completion Date

Load Origin 25th Fillmore

Sold to IT-AHZENS Const (BART BUSZKI)

Driver BLARS - #Ed107

Billing Address

Job Name PA Road Water Restrict

Town & Zip Code

Address 25th Fillmore

Phone 314-265-7799

Town & Zip Code Ogden UT

P.O.# (Acct)

Phone

QUAN.	DATE	ARTICLES OR DESCRIPTION	PRICE	AMOUNT
	6-28	Endump Lease	65 x	552.50
8.5 HR	6-28	(8:00-12:00)+(12:30-5:00)		
11	6-28	Dump FEE	80.00 x 9	720.00
11	6-28			
9				
		SUB. TTL.		1292.50
			TAX	
			TTL.	

SALES CONTRACT TERMS

Due by the 15th day of the following month after purchase. In the event payment is not made when due, I or we agree to pay reasonable collection fees, lien fees, and attorney fees with or without suit, together with 1 1/2% per month SERVICE CHARGE, which is an annual rate of 18% until paid. Signature by owner of agent constitutes acceptance of above.

NOTICE: Our drivers will make every effort to place material where customer designates, but the Company assumes no responsibility for damages inside curb or property line. Claims for shortage or complaints about material delivered will not be allowed unless made at time of delivery.

Received By: [signature]

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: Ahrens Const

ADDRESS:

JOB LOCATION: 2nd RR

DESCRIPTION OF WORK PERFORMED:

JOB NO.: DATE 6-29-99

EQUIP. #	MATERIAL	LOAD	HOURS
B-41		2	
B-13		3	2½
B-16		3	2½
B-18		5	5
Kenny		2	1½
Lance C. II		2	1½
		18	

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE Pat

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: Athens Corp

ADDRESS:

JOB LOCATION: 1550 F 25th

DESCRIPTION OF WORK PERFORMED:

JOB NO.: DATE 6-29-99

EQUIP. #	MATERIAL	LOAD	HOURS
B-13		13	8
D-16		13	7½
B-18		12	7
Kenny		13	8
S-17		3	2
Lake Cll		13	8
Perkins		~~5~~	3
		~~70~~	
		67	

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

C.E. BUTTERS
CONSTRUCTION INC.
782-2088

LICENSED CONTRACTOR

KENT BUTTERS
PRESIDENT

760 N. HARRISVILLE ROAD
OGDEN, UTAH 84404

- BASEMENTS
- SITE PREPARATION
- SEWER LINES
- TOP SOIL
- SUBDIVISIONS
- HAULING
- ROADS
- SNOW REMOVAL

SAND • GRAVEL • FILL • ETC.

Date 6-29 19 99 Time

Sales Person

Blue Stake Ref. No.

Blue Stake Completion Date

Load Origin Rail Yard Ogden

Sold to FJ Ahrens Const

Driver B Larsen #107 Ed 1

Billing Address

Job Name Rail Yard

Town & Zip Code

Address 1500 West Ogden

Phone 314-265-7799

Town & Zip Code Ogden UT

P.O.# Acct ?

Phone

QUAN	DATE	ARTICLES OR DESCRIPTION	PRICE	AMOUNT
450	6-29	Endump Case	65	
375	6-29	(11:30-12:00) / (12:30-4:15)		
1111	6-29	Dump Fee -	80 00	320 00
4				
		(Debris Haul from Rail Yard)		
		SUB. TTL.		
			TAX	
			TTL.	

SALES CONTRACT TERMS

Due by the 15th day of the following month after purchase. In the event payment is not made when due, I or we agree to pay reasonable collection fees, lien fees, and attorney fees with or without suit, together with 1 1/2% per month SERVICE CHARGE, which is an annual rate of 18% until paid. Signature by owner of agent constitutes acceptance of above.

NOTICE: Our drivers will make every effort to place material where customer designates, but the Company assumes no responsibility for damages inside curb or property line. Claims for shortage or complaints about material delivered will not be allowed unless made at time of delivery.

Received By: Randy Richard

C.E. BUTTERS
CONSTRUCTION INC.
782-2088

LICENSED CONTRACTOR

KENT BUTTERS
PRESIDENT

760 N. HARRISVILLE ROAD
OGDEN, UTAH 84404

- BASEMENTS
- SITE PREPARATION
- SEWER LINES
- TOP SOIL
- SUBDIVISIONS
- HAULING
- ROADS
- SNOW REMOVAL

SAND • GRAVEL • FILL • ETC.

Date 6-29 19 99 Time

Sales Person

Blue Stake Ref. No.

Blue Stake Completion Date

Load Origin 25th Fillmore

Driver BL - Ed #107

Job Name Air Road Water Loop

Address 25th Fillmore

Town & Zip Code Ogden UT

Phone

Sold to FJ Ahrens Const
(Bari Zubulaki)

Billing Address

Town & Zip Code

Phone 314 265-7799

P.O.# Acct

QUAN.	DATE	ARTICLES OR DESCRIPTION	PRICE	AMOUNT
	6-29	Endump Lease	$65.00	$308.75
4.75	6-29	(0645 - 11:30)		
5	6-29	Dump Fee per	$80.00	$400.00
		(Debris Haul From Rail Road Water Res		
		SUB. TTL.		$708.75
			TAX	
			TTL.	

SALES CONTRACT TERMS

Due by the 15th day of the following month after purchase. In the event payment is not made when due, I or we agree to pay reasonable collection fees, lien fees, and attorney fees with or without suit, together with 1 1/2% per month SERVICE CHARGE, which is an annual rate of 18% until paid. Signature by owner of agent constitutes acceptance of above.

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Received By: [signature]

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: T.J. Ahrens Const

ADDRESS:

JOB LOCATION: 22ND KR YARD

DESCRIPTION OF WORK PERFORMED: U.H.C.U

JOB NO.: DATE 6-30-99

EQUIP. #	MATERIAL	LOAD	HOURS
Perkins		13	

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: T.J. Arrons

ADDRESS:

JOB LOCATION: 1550 25th

DESCRIPTION OF WORK PERFORMED: Haul fill material

JOB NO.: DATE June 30 1999

EQUIP. #	MATERIAL	LOAD	HOURS
B-13	Fill	13	7.5
B-16	"	14	8.5
B-18	"	15	9
S-17	"	13	8.5
D+L 68	"	12	7
APC 12	"	5	3.5
Nesson W-11	"	15	9
		87	

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days.

SIGNATURE

C.E. BUTTERS
CONSTRUCTION INC.
782-2088

LICENSED CONTRACTOR

KENT BUTTERS
PRESIDENT

760 N. HARRISVILLE ROAD
OGDEN, UTAH 84404

- BASEMENTS
- SITE PREPARATION
- SEWER LINES
- TOP SOIL
- SUBDIVISIONS
- HAULING
- ROADS
- SNOW REMOVAL

SAND • GRAVEL • FILL • ETC.

Sold to Bart Baselaki

Billing Address

Town & Zip Code

Phone

P.O.#

Date 6-30 1999 Time

Sales Person

Blue Stake Ref. No.

Blue Stake Completion Date

Load Origin Ranch

Driver Brian

Job Name TJ Ahrens Const

Address 25th above harrison (park)

Town & Zip Code

Phone

QUAN.	DATE	ARTICLES OR DESCRIPTION	PRICE	AMOUNT
7 Loads		Fill	[redacted]	
			55 EA	
		$55.00 per load		
		SUB. TTL.		
			TAX	
			TTL	

SALES CONTRACT TERMS

Due by the 15th day of the following month after purchase. In the event payment is not made when due, I or we agree to pay reasonable collection fees, lien fees, and attorney fees with or without suit, together with 1 1/2% per month SERVICE CHARGE, which is an annual rate of 18% until paid. Signature by owner or agent constitutes acceptance of above.

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Received By: [signature]

Busenbark Construction, Inc.

451 WEST SECOND STREET
P.O. BOX 12442
OGDEN, UTAH 84414
PHONE (801) 621-4557 — FAX 621-4647

NAME: T.J. AHrens Const

ADDRESS:

JOB LOCATION: 1550 25th

DESCRIPTION OF WORK PERFORMED: Haul Fill-Mat

JOB NO.: DATE: 1 July 1999

EQUIP. #	MATERIAL	LOAD	HOURS
B-13	Fill	16	9
B-16	Fill	14	8
B-18	Fill	16	9
Nesson	Fill	16	9.5
D+L Cole	Fill	17	9.5
Sims	Fill	13	7.5

NET 15 DAYS Finance charge of 2% per month (24% per year) will be added to the unpaid balance if not paid after 15 days

SIGNATURE

AMI GROUP, INC.
704 South 75th Street
Omaha, NE 68114
Phone (402)397-5001
FAX (402)397-3313

SAFETY TRAINING DOCUMENTATION FORM

PROJECT NAME: Ogden, UT Locomotive Shop/Reservior
DATE: 6/10/99
PROJECT LOCATION: Ogden, UT
PHASE: P3 - Demolition

CLASS TITLE: Safety Review, UPRR
START TIME:

INSTRUCTOR: Tim Andersen
END TIME:

BREAKS:

NAME (PRINTED)	NAME (SIGNATURE)	SOCIAL SECURITY NUMBER	COMPANY	EXAM PASS/FAIL
Randy Kirkwood	Randy Kirkwood	[redacted]	AHRENS	
Ray Henerfauth	Ray Henerfauth	[redacted]	Ahrens	
John Romero	John Romero	[redacted]	Ahrens	
Jeff DeCaney	[illegible]	[redacted]	Spires	
Bart Buselaki	Bart Buselaki	[redacted]	AHRENS	
James Gutierrez	[illegible]	[redacted]	Atlas Steel	
José Segura	[illegible]	[redacted]	Atlas Steel	
22 Ken Troutman	Ken Troutman	[redacted]	Ahrens	
22 Pro BERTO CRUZ	AD 2	[redacted]	Ahrens DA	
ROBERT COMAS	Robert Comas	[redacted]	TJ AHRENS	
Santiago Garcia		[redacted]	AHRENS	

AMI Group, Inc.'s Verification: The individuals listed above have completed the attendance and testing requirements for the course offered by AMI Group, Inc.

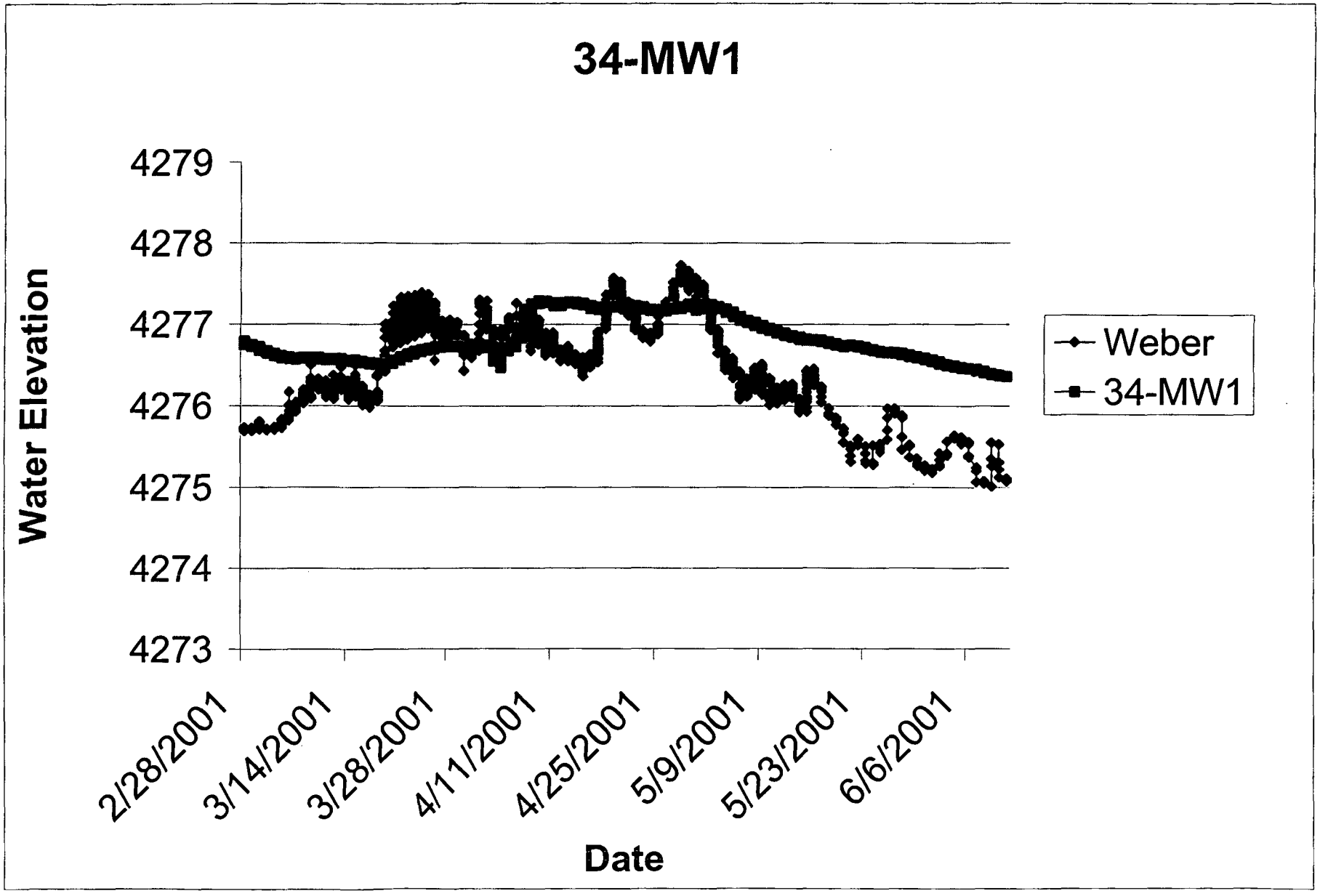
Tim Andersen
AMI Group Inc. Instructor

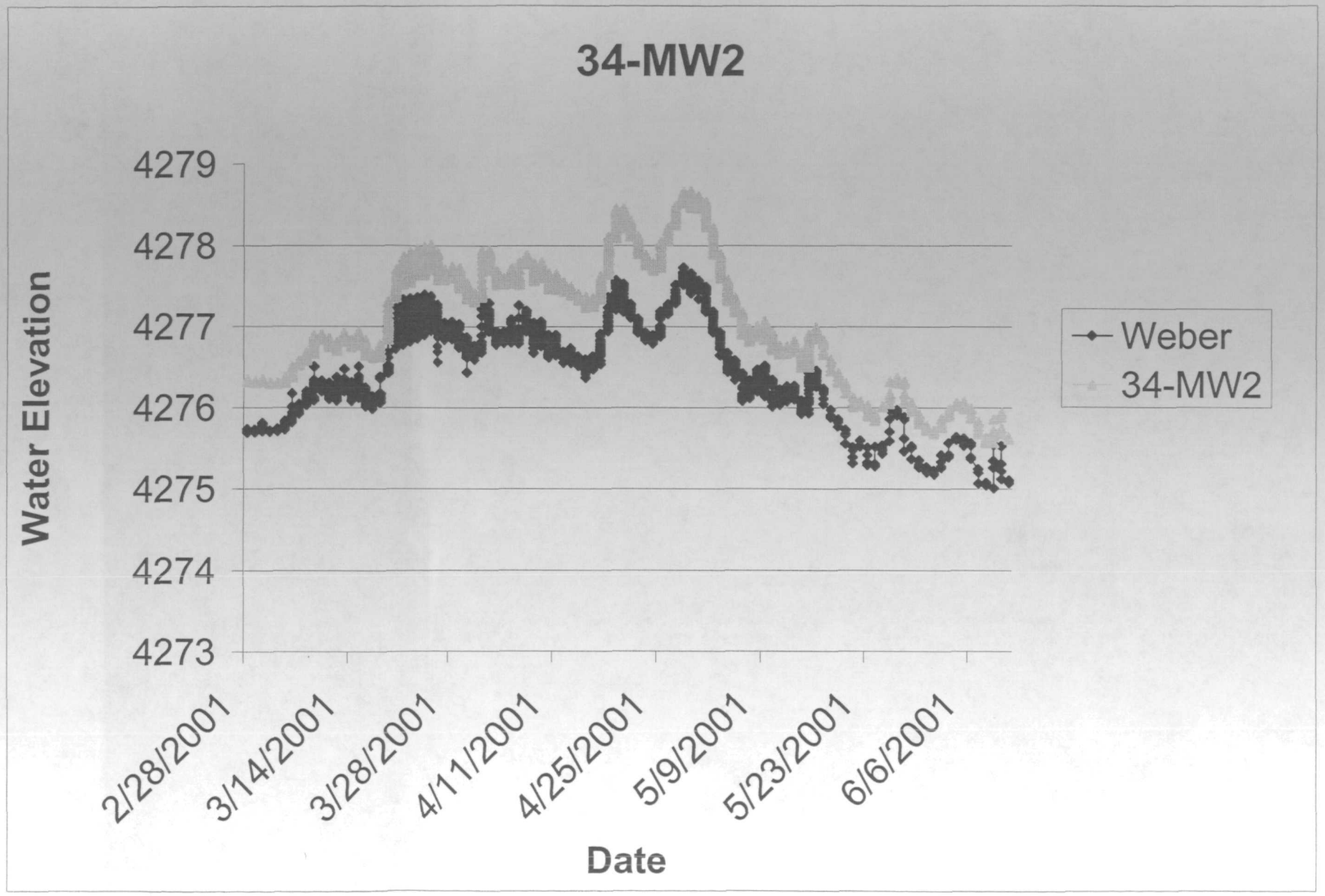
6/10/99
Date

Signature of Notary

Date

APPENDIX J
WATER LEVEL TRANSDUCER DATA


34-MW1
Water Elevation
4279
4278
4277
4276
4275
4274
4273
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Weber
34-MW1


34-MW2
Water Elevation
4279
4278
4277
4276
4275
4274
4273
2/28/2001
3/14/2001
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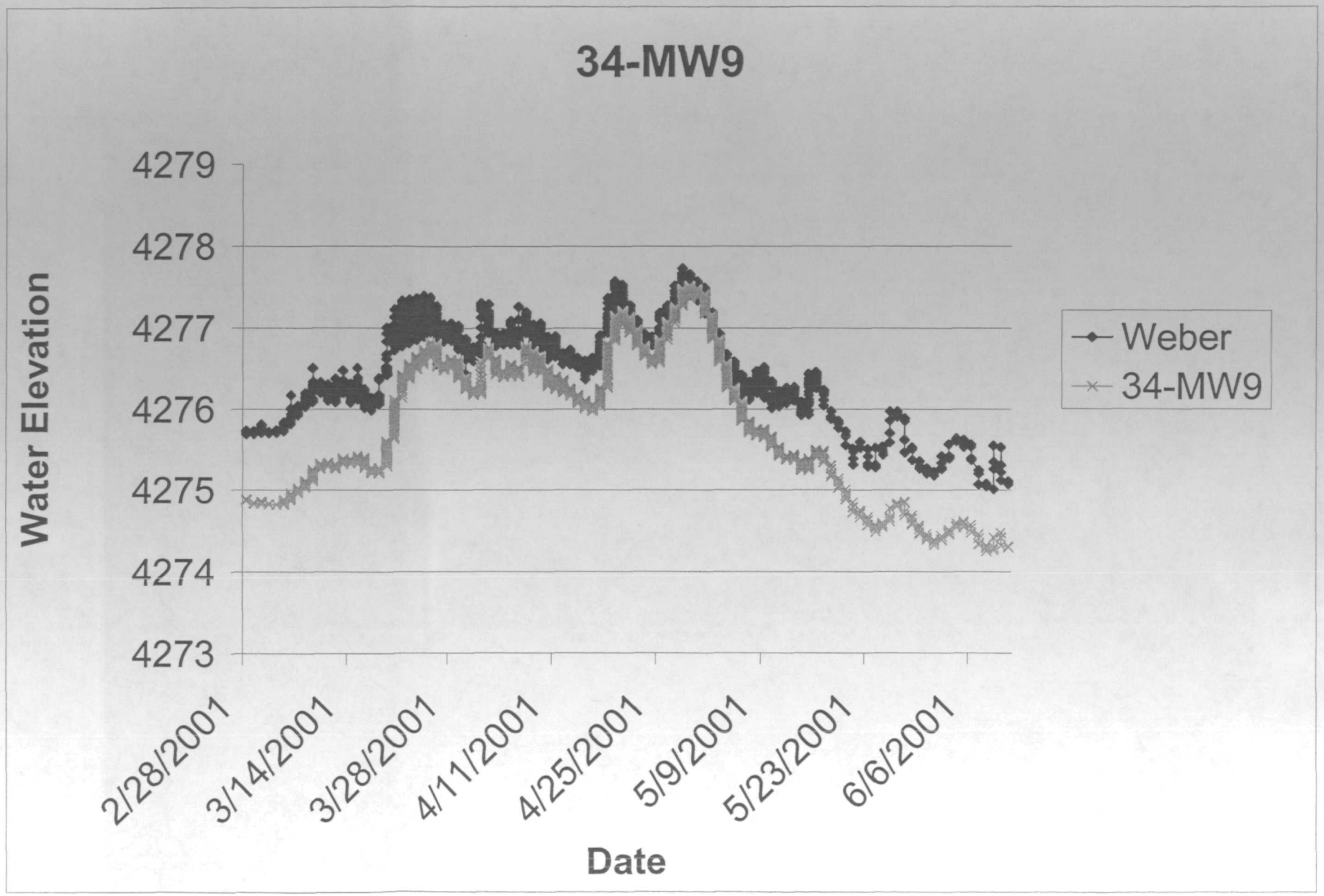
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Weber
34-MW2


34-MW9
Water Elevation
4279
4278
4277
4276
4275
4274
4273
2/28/2001
3/14/2001
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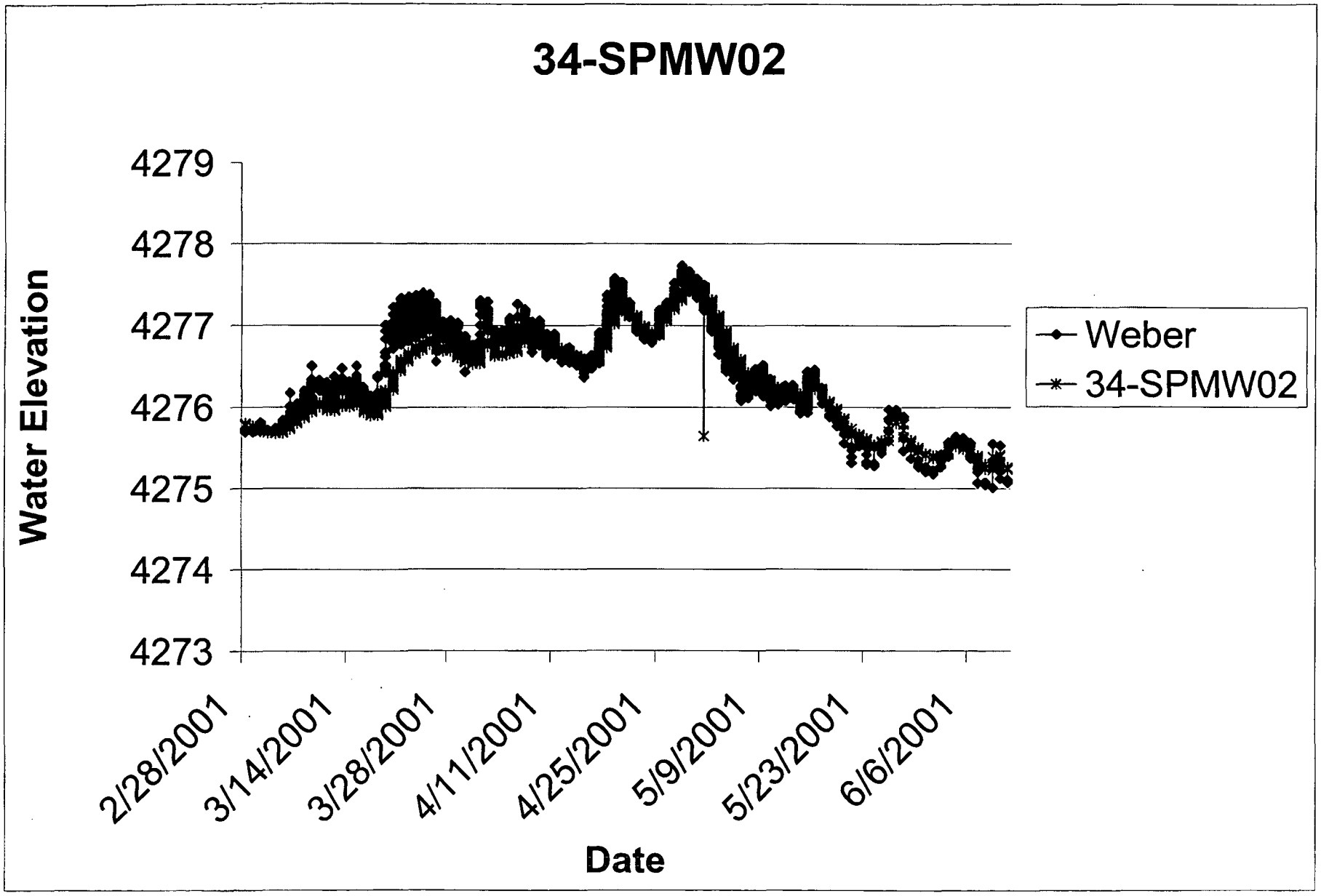
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Weber
34-MW9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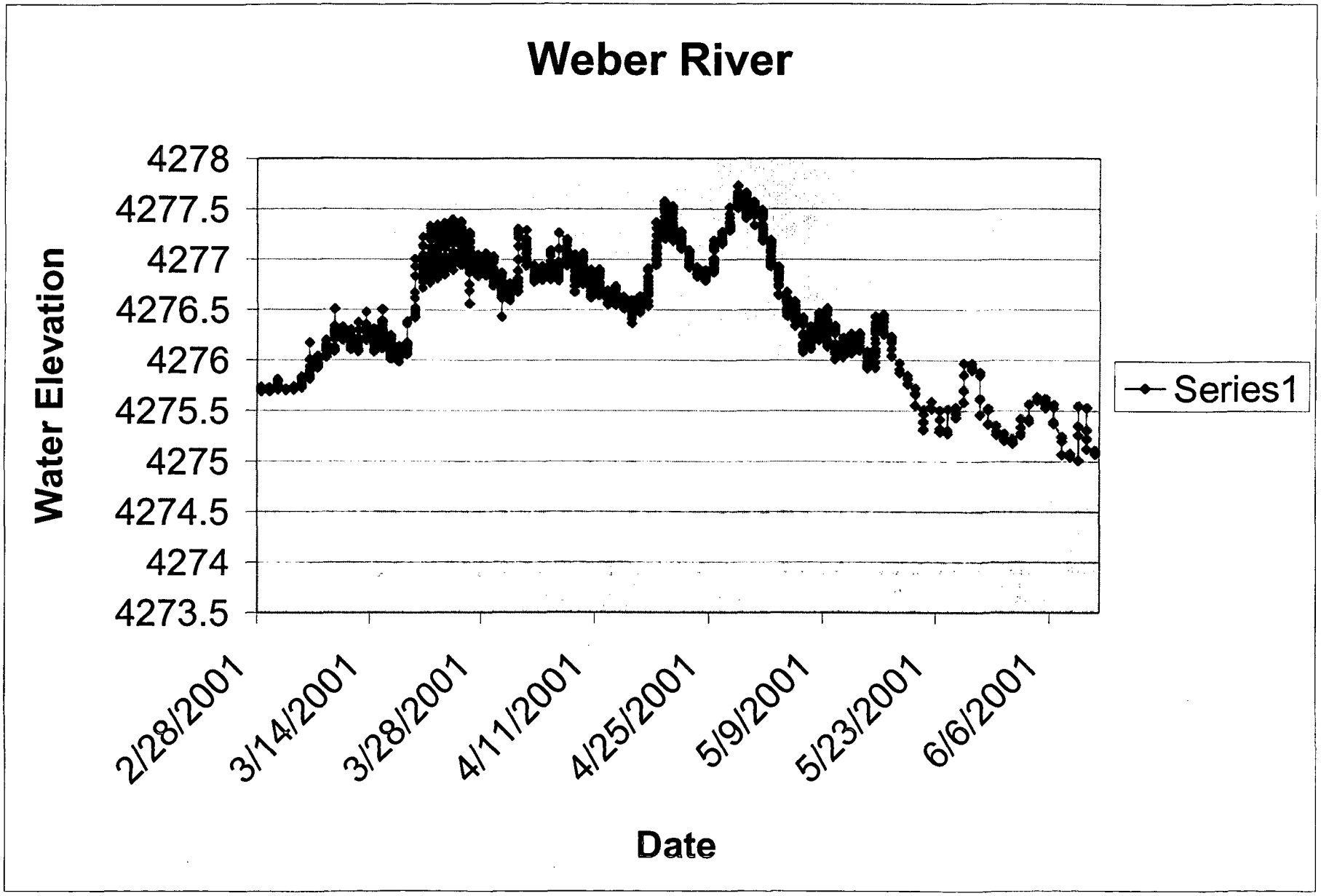
Water Elevation
4279
4278
4277
4276
4275
4274
4273
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Weber
34-SPMW02


Weber River
Water Elevation
4278
4277.5
4277
4276.5
4276
4275.5
4275
4274.5
4274
4273.5
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Series1

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

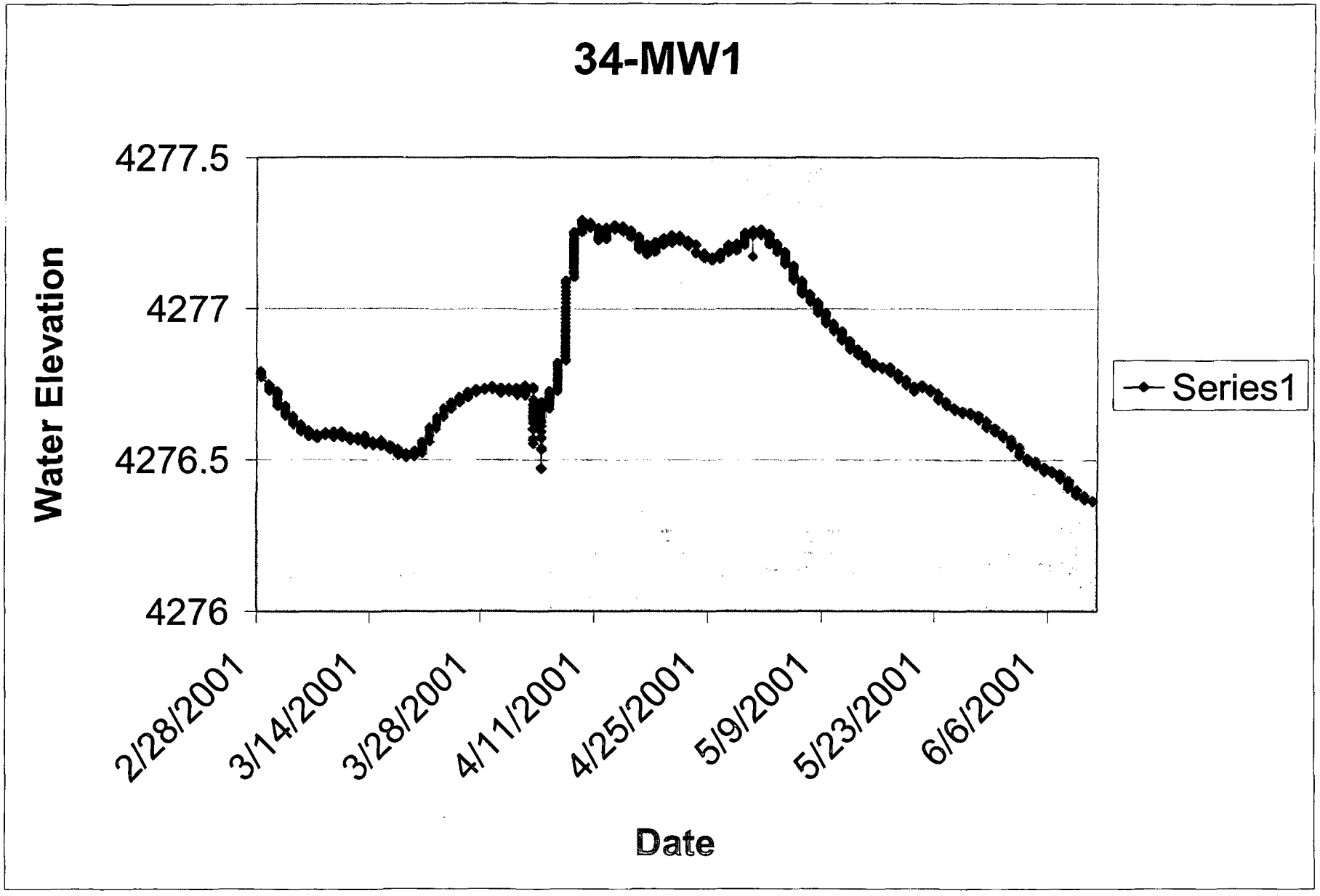
Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX J Data gathered using Linear testing (Weber River)

Contact the Superfund Records Center to view available document.
(303) 312-6473


34-MW1
Water Elevation
4277.5
4277
4276.5
4276
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Series1

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

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- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX J Data gathered using Linear testing (34-MW1)

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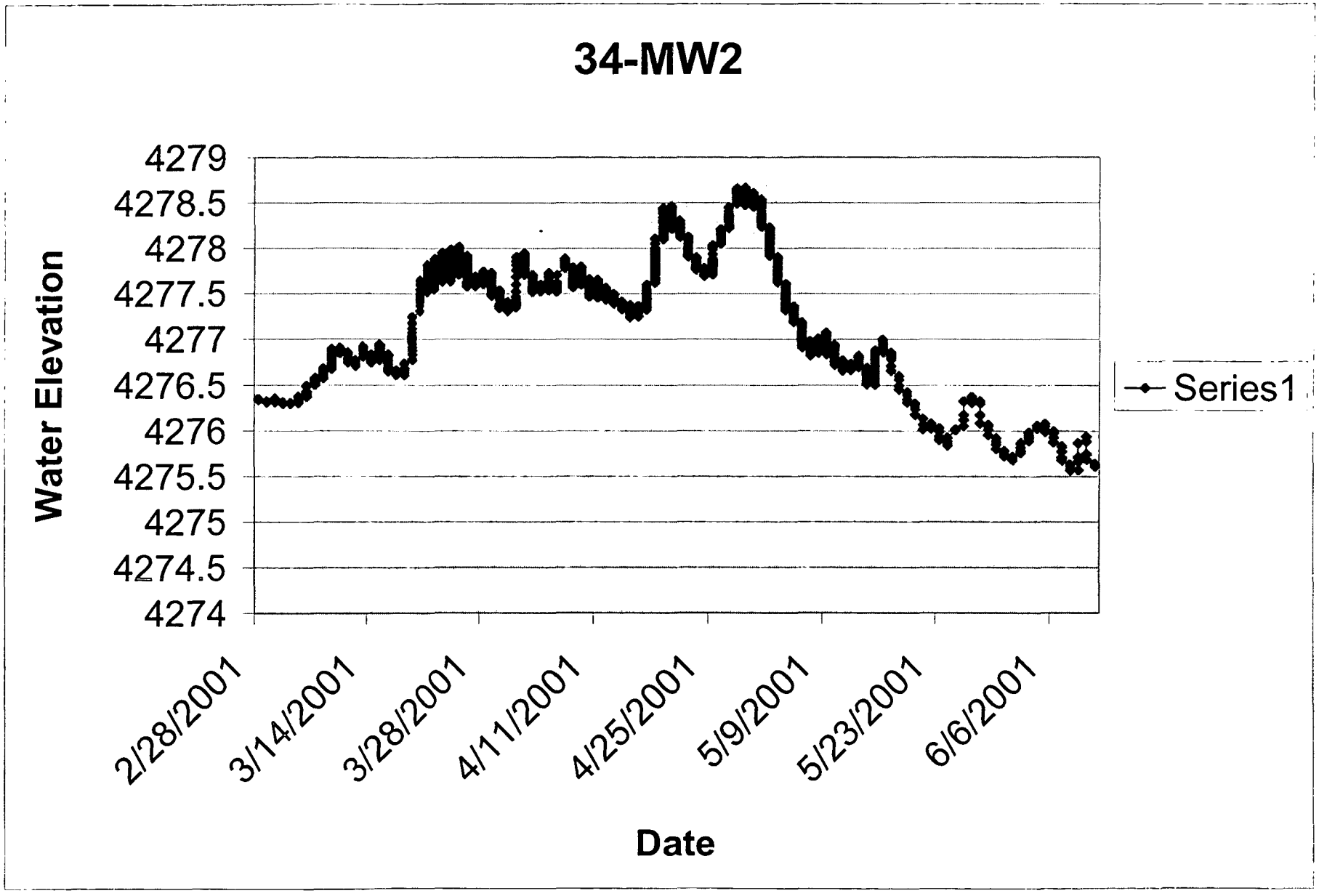
(303) 312-6473


34-MW2
Water Elevation
4279
4278.5
4278
4277.5
4277
4276.5
4276
4275.5
4275
4274.5
4274
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Series1

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX J Data gathered using Linear testing (34-MW2)

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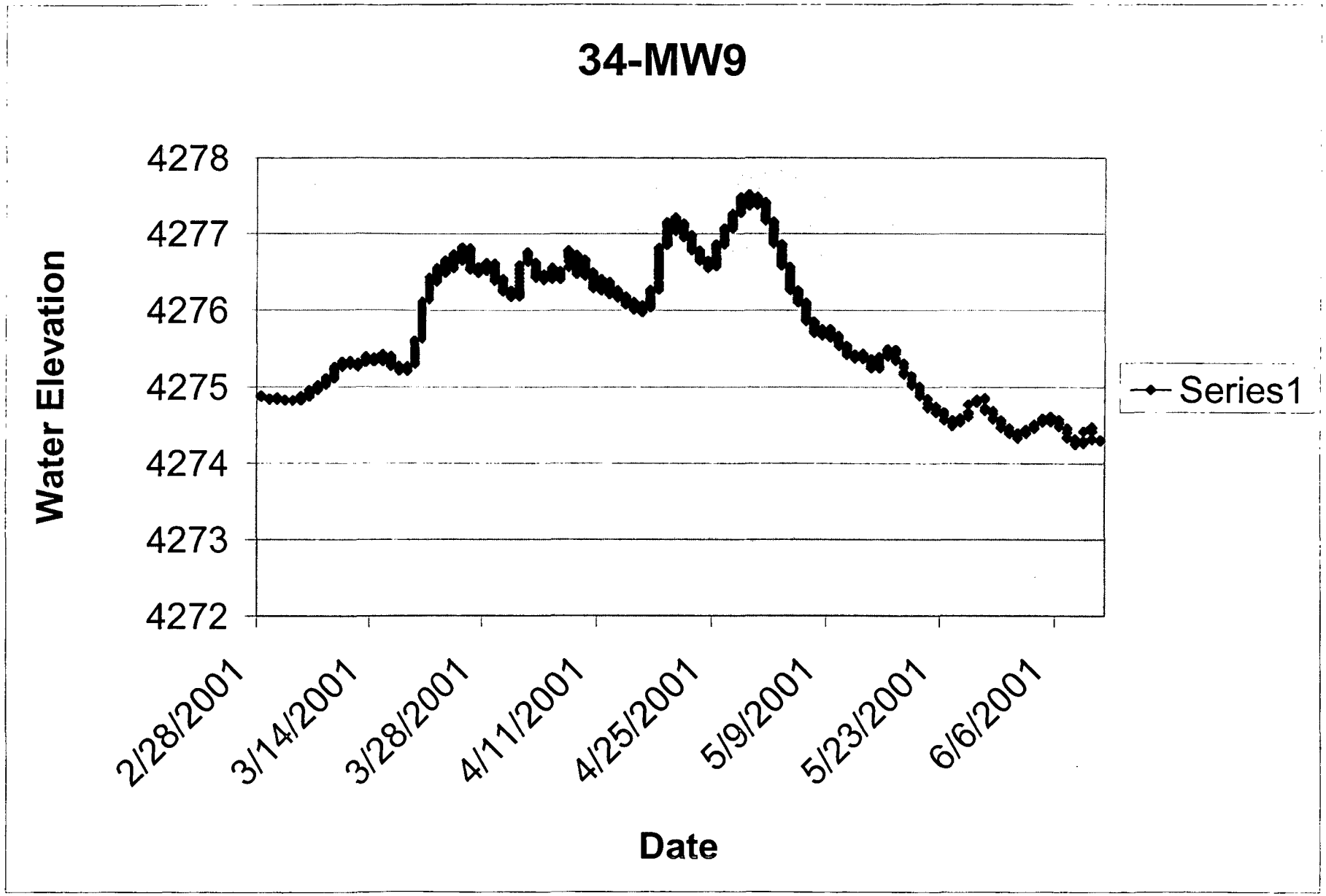
(303) 312-6473


34-MW9
Water Elevation
4278
4277
4276
4275
4274
4273
4272
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Series1

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

- ☐ PHOTOGRAPHS
- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
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- ☐ PERMANENTLY BOUND DOCUMENTS
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  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX J Data gathered using Linear testing (34-MW9)

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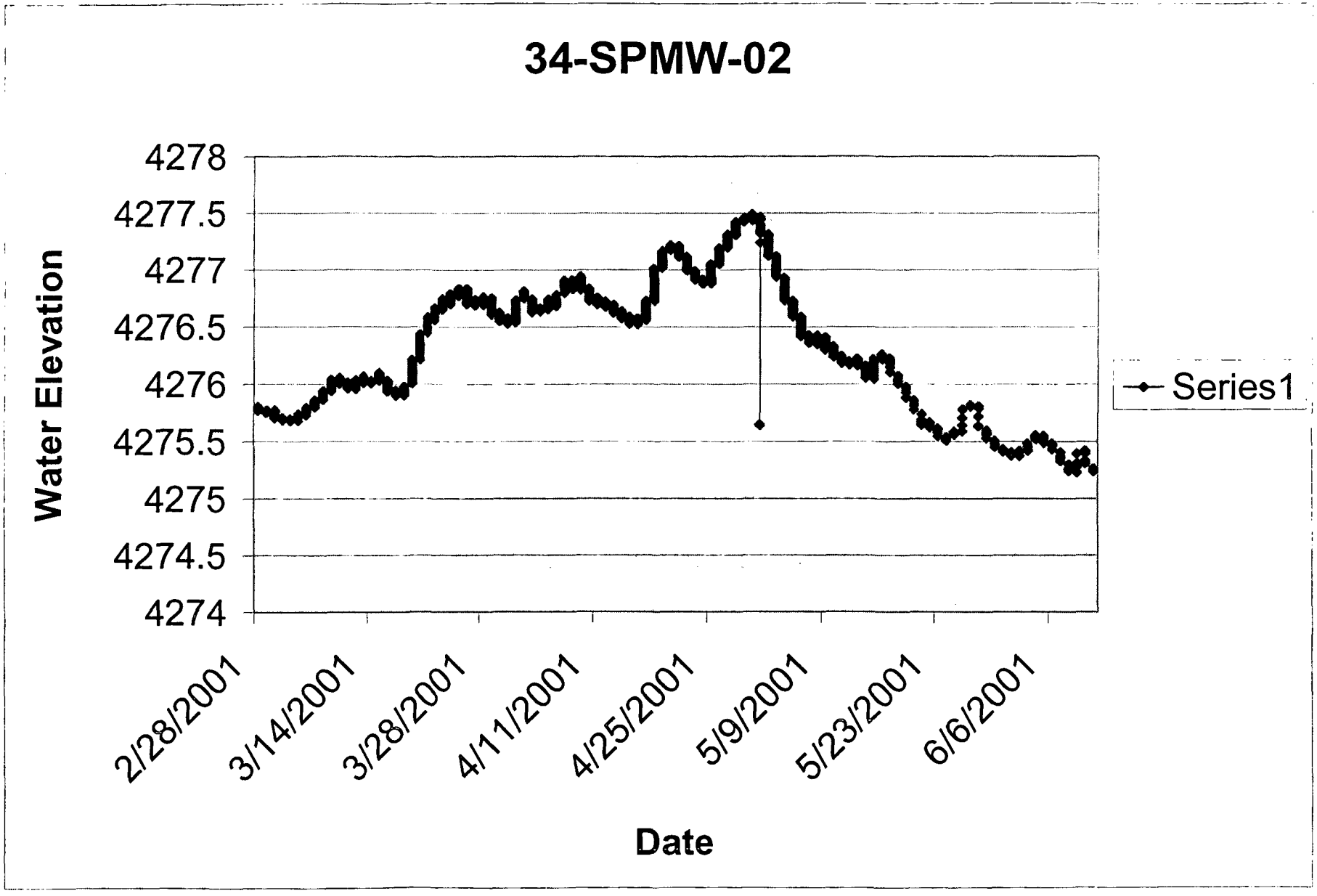
(303) 312-6473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Water Elevation
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4277.5
4277
4276.5
4276
4275.5
4275
4274.5
4274
2/28/2001
3/14/2001
3/28/2001
4/11/2001
4/25/2001
5/9/2001
5/23/2001
6/6/2001
Date
Series1

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

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- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
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- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX J Data gathered using Linear testing (34-SPMW-02)

Contact the Superfund Records Center to view available document.
(303) 312-6473

TARGET SHEET

EPA REGION VIII

SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 2011804

SITE NAME: OGDEN RAILROAD YARD

DOCUMENT DATE: 09/01/2003

DOCUMENT NOT SCANNED

Due to one of the following reasons:

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- ☐ 3-DIMENSIONAL
- ☐ OVERSIZED
- ☐ AUDIO/VISUAL
- ☐ PERMANENTLY BOUND DOCUMENTS
- ☐ POOR LEGIBILITY
- ☐ OTHER
- ☐ NOT AVAILABLE
- ☑ TYPES OF DOCUMENTS NOT TO BE SCANNED
  (Data Packages, Data Validation, Sampling Data, CBI, Chain of Custody)

DOCUMENT DESCRIPTION:

APPENDIX K Geotechnical Testing Results
APPENDIX L Monitoring Well Hydrographs

Contact the Superfund Records Center to view available document.
(303) 312-6473

APPENDIX M
LNAPL BAILDOWN EVALUATION AND PARTITIONING ANALYSIS

Hydrocarbon Baildown/Recharge Test Calculations

(From Huntley, D, 2000, "Analytic Determination of Hydrocarbon Transmissivity From Baildown Tests", Groundwater, Jan-Feb,Vol. 38, No. 1, p. 46-52)

Hydrocarbon transmissivity can be found using the following equation:

$$T = \frac{2.3 r_c^2 \left(\frac{1}{1-\rho_r} \right)}{2t} \ln\left(\frac{r_0}{r_w} \right) \log\left(\frac{s_0}{s} \right)$$

where:

- T = hydrocarbon transmissivity
- r_c = radius of casing
- r_w = radius of well boring
- r_0 = radius of influence
- ρ_r = relative hydrocarbon density
- t = any chosen time from the regression line
- s = drawdown from the regression line corresponding to chosen t value
- s_0 = y-intercept of regression line

Analytical Method:

In order for method to be valid, the potentiometric surface must remain constant throughout hydrocarbon recovery period. This is verified by plotting hydrocarbon surface elevation (oil/air interface), potentiometric surface elevation, and groundwater surface elevation (oil/water interface). Hydrocarbon and water elevations are measured in the field during the recovery period. Potentiometric surface is calculated by the equation:

$$Z_p = Z_w + \rho_r (Z_o - Z_w)$$

where:

- Z_p = potentiometric surface elevation
- Z_o = oil/air interface elevation
- Z_w = oil/water interface elevation
- ρ_r = relative hydrocarbon density

Graphical variables in the transmissivity equation (t, s, s_0) are obtained by plotting the log of hydrocarbon drawdown versus elapsed time during recovery. Hydrocarbon drawdown is the difference between the original hydrocarbon elevation and the hydrocarbon elevation during the recovery period. A straight (regression) line is drawn through the data. Note that because the data is plotted on a semi-log graph, the equation for the regression line will be logarithmic. The variables t and s are the coordinates of any random point on the regression line. The variable s_0 is the y-intercept of the regression line.

30-MW3

The potentiometric surface is constant for recovery period as shown on accompanying graph. The recovery period ends when the oil/air interface reaches the same elevation it was at before the LNAPL was removed. A plot of hydrocarbon drawdown versus elapsed time was also constructed with a regression line.

Calculate transmissivity:

r_c = 1 inch (0.0833 feet)
r_w = 3.25 inches (0.271 feet)
r_0 = 5 feet (assumed)
ρ_r = 0.87 (estimated)
t = 30 minutes (0.0208 days)
s = 0.039 feet
s_0 = 0.067 feet

$$T = \frac{2.3 * 0.0833^2 \left(\frac{1}{1-0.87}\right)}{2 * 0.021} \ln\left(\frac{5}{0..271}\right) \log\left(\frac{0..067}{0.039}\right) = \mathbf{2.0 \frac{ft^2}{day} = 2.1 \times 10^{-2} \frac{cm^2}{s}}$$

Calculate hydraulic conductivity:

Saturated hydrocarbon thickness, b, is approximately 0.66 feet at 30-MW3. Therefore, hydraulic conductivity, K_o, with respect to hydrocarbon, is:

$$K_o = \frac{T}{b} = \frac{2.0}{0.66} = \mathbf{3.0 \frac{ft}{day} = 1.1 \times 10^{-3} \frac{cm}{s}}$$

38-B11

The potentiometric surface is constant for recovery period as shown on accompanying graph. A plot of hydrocarbon drawdown versus elapsed time was also constructed with a regression line. Because product drawdown becomes negative (i.e. the oil/air interface recovers to an elevation that is higher than before the LNAPL was bailed), a final data point was artificially added to the data set that represents the time at which LNAPL drawdown is 0.001 feet (complete recovery). Zero complete recovery cannot be used because the drawdown plot is semi-logarithmic, making a data point of zero unplotable.

Calculate transmissivity:

r_c = 0.5 inch (0.0417 feet)
r_w = 1 inch (0.0833 feet)
r_0 = 5 feet (assumed)
ρ_r = 0.87 (estimated)
t = 30 minutes (0.0208 days)
s = 0.0048 feet
s_0 = 0.0605 feet

$$T = \frac{2.3 * 0.0417^2 \left(\frac{1}{1-0.87}\right)}{2 * 0.0208} \ln\left(\frac{5}{0.0833}\right) \log\left(\frac{0.0605}{0.0048}\right) = \mathbf{1.5 \frac{ft^2}{day} = 1.6 \times 10^{-2} \frac{cm^2}{s}}$$

Calculate hydraulic conductivity:

Saturated hydrocarbon thickness, b, is approximately 0.24 feet at 38-B11. Therefore, hydraulic conductivity, K_o, with respect to hydrocarbon, is:

$$K_o = \frac{T}{b} = \frac{1.5}{0.24} = \mathbf{6.3}\frac{\mathbf{ft}}{\mathbf{day}} = \mathbf{2.2 \times 10^{-3}}\frac{\mathbf{cm}}{\mathbf{s}}$$

38-MW6

The potentiometric surface is constant for recovery period as shown on accompanying graph. A plot of hydrocarbon drawdown versus elapsed time was also constructed with a regression line. Because product drawdown becomes negative (i.e. the oil/air interface recovers to an elevation that is higher than before the LNAPL was bailed), a final data point was artificially added to the data set that represents the time at which LNAPL drawdown is 0.001 feet (complete recovery). Zero complete recovery cannot be used because the drawdown plot is semi-logarithmic, making a data point of zero unplotable.

Calculate transmissivity:

r_c = 1 inch (0.0833 feet)
r_w = 3.25 inch (0.271 feet)
r_0 = 5 feet (assumed)
ρ_r = 0.87 (estimated)
t = 30 minutes (0.0208 days)
s = 0.0103 feet
s_0 = 0.1697 feet

$$T = \frac{2.3 * 0.0833^2\left(\frac{1}{1-0.87}\right)}{2 * 0.0208}\ln\left(\frac{5}{0.271}\right)\log\left(\frac{0.1697}{0.0103}\right) = \mathbf{10.5}\frac{\mathbf{ft^2}}{\mathbf{day}} = \mathbf{1.1 \times 10^{-1}}\frac{\mathbf{cm^2}}{\mathbf{s}}$$

Calculate hydraulic conductivity:

Saturated hydrocarbon thickness, b, is approximately 1.60 feet at 38-MW6. Therefore, hydraulic conductivity, K_o, with respect to hydrocarbon, is:

$$K_o = \frac{T}{b} = \frac{10.5}{1.60} = \mathbf{6.6}\frac{\mathbf{ft}}{\mathbf{day}} = \mathbf{2.3 \times 10^{-3}}\frac{\mathbf{cm}}{\mathbf{s}}$$

Radius of Influence Sensitivity Analysis

In the above analysis, the radius of influence of each location for LNAPL was assumed. This assumption is based on what is reasonable for this type of analysis. To determine the affect of this assumption on the calculated transmissivity values, radii of influence between 1 foot and 1000 feet was used and transmissivity values were calculated,

representing a three order of magnitude range of radius of influence. For each location, results are as follows:

Radius of Influence	Transmissivity (feet/day) 30-MW3	38-B11	38-MW6
1 foot	0.9	0.1	4.7
5 feet	2.0	1.5	10.5
10 feet	2.5	2.0	13.0
30 feet	3.2	2.9	16.9
100 feet	4.1	3.9	21.2
1000 feet	5.6	5.8	29.5

This sensitivity analysis shows that the Huntley method is relatively insensitive to the choice of radius of influence. While the radius of influence varies three orders of magnitude, the change in transmissivity for two of the locations (30-MW3 and 38-MW6) only changes by less than one order of magnitude (0.8). Transmissivity varies for the third location, 38-B11, by less than two orders of magnitude (1.8). Additionally, because the values for each location are relatively low, the range of values for each location does not vary significantly. Choosing five feet per day for the radius of influence for these locations is therefore a reasonable assumption that does not significantly alter the outcome or usefulness of the analysis.

LNAPL Baildown/Recharge Tests
Field Data
UPRR Ogden Railyard
Ogden, Utah

Well 30-MW3

Relative Hydrocarbon Density: 0.87
Well Elevation: 4303.34
Initial Product Thickness: 0.66

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	9:53	11.02	11.68	Static	4292.32	4291.66	4292.23	0.00	0.66	
12/07/00	16:35	11.10	11.18	0	4292.24	4292.16	4292.23	0.08	0.08	12%
12/07/00	16:40	11.07	11.19	5	4292.27	4292.15	4292.25	0.05	0.12	18%
12/07/00	17:43	11.04	11.31	68	4292.3	4292.03	4292.26	0.02	0.27	41%
12/08/00	11:30	11.02	11.53	1135	4292.32	4291.81	4292.25	0.00	0.51	77%
12/15/00	15:20	10.89	11.35	11445	4292.45	4291.99	4292.39	-0.13	0.46	70%
01/20/01	12:00	10.96	11.55	18445	4292.38	4291.79	4292.30	-0.06	0.59	89%
02/21/01	12:00	10.60	10.60	22765	4292.741	4292.74	4292.74	-0.42	0.00	0.2%

Well 38B-11

Relative Hydrocarbon Density: 0.87
Well Elevation: 4290.49
Initial Product Thickness: 0.24

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	8:52	6.71	6.95	Static	4283.78	4283.54	4283.75	0.00	0.24	
12/07/00	11:40	6.77	7.15	0	4283.72	4283.34	4283.67	0.06	0.38	158%
12/07/00	11:45	6.75	7.42	5	4283.74	4283.07	4283.65	0.04	0.67	279%
				48.5				0.001		
12/07/00	13:12	6.68	7.81	92	4283.81	4282.68	4283.66	-0.03	1.13	471%
12/08/00	10:07	6.69	7.99	1347	4283.80	4282.50	4283.63	-0.02	1.30	542%
12/15/00	14:30	6.65	8.00	11690	4283.84	4282.49	4283.66	-0.06	1.35	562%
01/20/01	12:00	6.72	8.03	18740	4283.77	4282.46	4283.60	0.01	1.31	546%
02/22/02	12:00	7.02	7.68	24500	4283.47	4282.81	4283.38	0.31	0.66	275%

Well 38MW-6

Relative Hydrocarbon Density: 0.87
Well Elevation: 4293.34
Initial Product Thickness: 1.60

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	7:50	10.00	11.60	Static	4283.34	4281.74	4283.13	0.00	1.60	
12/07/00	13:27	10.22	10.29	0	4283.12	4283.05	4283.11	0.22	0.07	4%
12/07/00	13:32	10.08	10.27	5	4283.26	4283.07	4283.24	0.08	0.19	12%
				55.3				0.001		
12/07/00	14:35	9.99	10.97	68	4283.35	4282.37	4283.22	-0.01	0.98	61%
12/08/00	10:37	9.97	11.42	1270	4283.37	4281.92	4283.18	-0.03	1.45	91%
12/15/00	14:25	9.92	11.44	11578	4283.42	4281.90	4283.22	-0.08	1.52	95%
01/20/01	12:00	10.00	11.40	18633	4283.34	4281.94	4283.16	0.00	1.40	88%
02/22/02	12:00	9.47	11.62	24393	4283.87	4281.72	4283.59	-0.53	2.15	134%

Well 30-MW6

Relative Hydrocarbon Density: 0.87
Well Elevation: 4308.59
Initial Product Thickness: 0.53

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	10:24	8.62	9.15	Static	4299.97	4299.44	4299.90	0.00	0.53	
12/07/00	16:52	8.71	8.75	0	4299.88	4299.84	4299.87	0.09	0.04	8%
12/07/00	16:57	8.62	8.65	5	4299.97	4299.94	4299.97	0.00	0.03	6%
12/07/00	17:52	8.61	8.80	60	4299.98	4299.79	4299.96	-0.01	0.19	36%
12/08/00	11:20	8.60	8.88	1108	4299.99	4299.71	4299.95	-0.02	0.28	53%
12/15/00	15:30	8.51	8.77	11438	4300.08	4299.82	4300.05	-0.11	0.26	49%
01/20/01	12:00	8.73	9.77	18428	4299.86	4298.82	4299.72	0.11	1.04	196%
02/21/01	12:00	8.10	8.50	22748	4300.49	4300.09	4300.44	-0.52	0.40	75%

Well 38B-3

Relative Hydrocarbon Density: 0.87
Well Elevation: 4290.54
Initial Product Thickness: 1.28

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	8:45	6.78	8.06	Static	4283.76	4282.48	4283.59	0.00	1.28	
12/07/00	11:08	6.78	7.87	0	4283.76	4282.67	4283.62	0.00	1.09	85%
12/07/00	11:13	6.75	9.11	5	4283.79	4281.43	4283.48	-0.03	2.36	184%
12/07/00	12:10	6.71	8.24	62	4283.83	4282.30	4283.63	-0.07	1.53	120%
12/08/00	10:58	6.73	8.21	1430	4283.81	4282.33	4283.62	-0.05	1.48	116%
12/15/00	14:35	6.71	8.25	11727	4283.83	4282.29	4283.63	-0.07	1.54	120%
01/20/01	12:00	6.83	8.19	18772	4283.71	4282.35	4283.53	0.05	1.36	106%
02/22/02	12:00	6.35	7.86	24532	4284.19	4282.68	4283.99	-0.43	1.51	118%

LNAPL Baildown/Recharge Tests
Field Data
UPRR Ogden Railyard
Ogden, Utah

Well 38B-22

Relative Hydrocarbon Density: 0.87
Well Elevation: 4291.57
Initial Product Thickness: 0.19

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	9:02	7.58	7.77	Static	4283.99	4283.80	4283.97	0.00	0.19	
12/07/00	11:58	7.46	7.47	0	4284.11	4284.10	4284.11	-0.12	0.01	5%
12/07/00	12:03	7.47	7.48	5	4284.10	4284.09	4284.10	-0.11	0.01	5%
12/07/00	13:20	7.47	7.51	82	4284.10	4284.06	4284.09	-0.11	0.04	21%
12/08/00	10:05	7.48	7.57	1327	4284.09	4284.00	4284.08	-0.10	0.09	47%
12/15/00	14:40	7.44	7.51	11682	4284.13	4284.06	4284.12	-0.14	0.07	37%
01/20/01	12:00	7.52	7.68	18722	4284.05	4283.89	4284.03	-0.06	0.16	84%
02/22/02	12:00	7.25	7.35	24482	4284.32	4284.22	4284.31	-0.33	0.10	53%

Well 38B-25

Relative Hydrocarbon Density: 0.87
Well Elevation: 4289.79
Initial Product Thickness: 1.58

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	8:15	6.50	8.08	Static	4283.29	4281.71	4283.08	0.00	1.58	
12/07/00	15:00	6.60	6.77	0	4283.19	4283.02	4283.17	0.10	0.17	11%
12/07/00	15:05	6.59	6.85	5	4283.20	4282.94	4283.17	0.09	0.26	16%
12/07/00	15:57	6.55	6.82	57	4283.24	4282.97	4283.20	0.05	0.27	17%
12/08/00	10:50	6.59	6.87	1190	4283.20	4282.92	4283.16	0.09	0.28	18%
12/15/00	14:50	6.50	7.02	11510	4283.29	4282.77	4283.22	0.00	0.52	33%
01/20/01	12:00	6.69	7.83	18540	4283.10	4281.96	4282.95	0.19	1.14	72%
02/22/02	12:00	6.14	7.29	24300	4283.65	4282.50	4283.50	-0.36	1.15	73%

Well 38B-26

Relative Hydrocarbon Density: 0.87
Well Elevation: 4290.21
Initial Product Thickness: 0.18

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	8:20	7.58	7.86	Static	4282.63	4282.35	4282.59	0.00	0.28	
12/07/00	15:14	7.50	7.68	0	4282.71	4282.53	4282.69	-0.08	0.18	64%
12/07/00	15:19	7.67	7.69	5	4282.54	4282.52	4282.54	0.09	0.02	7%
12/07/00	16:09	7.67	7.74	55	4282.54	4282.47	4282.53	0.09	0.07	25%
12/08/00	10:57	7.69	7.70	1183	4282.52	4282.51	4282.52	0.11	0.01	4%
12/15/00	15:00	7.60	7.71	11506	4282.61	4282.50	4282.60	0.02	0.11	39%
01/20/01	12:00	7.90	8.15	18526	4282.31	4282.06	4282.28	0.32	0.25	89%
02/22/02	12:00	7.20	7.25	24286	4283.01	4282.96	4283.00	-0.38	0.05	18%

Well 38B-28

Relative Hydrocarbon Density: 0.87
Well Elevation: 4290.84
Initial Product Thickness: 1.00

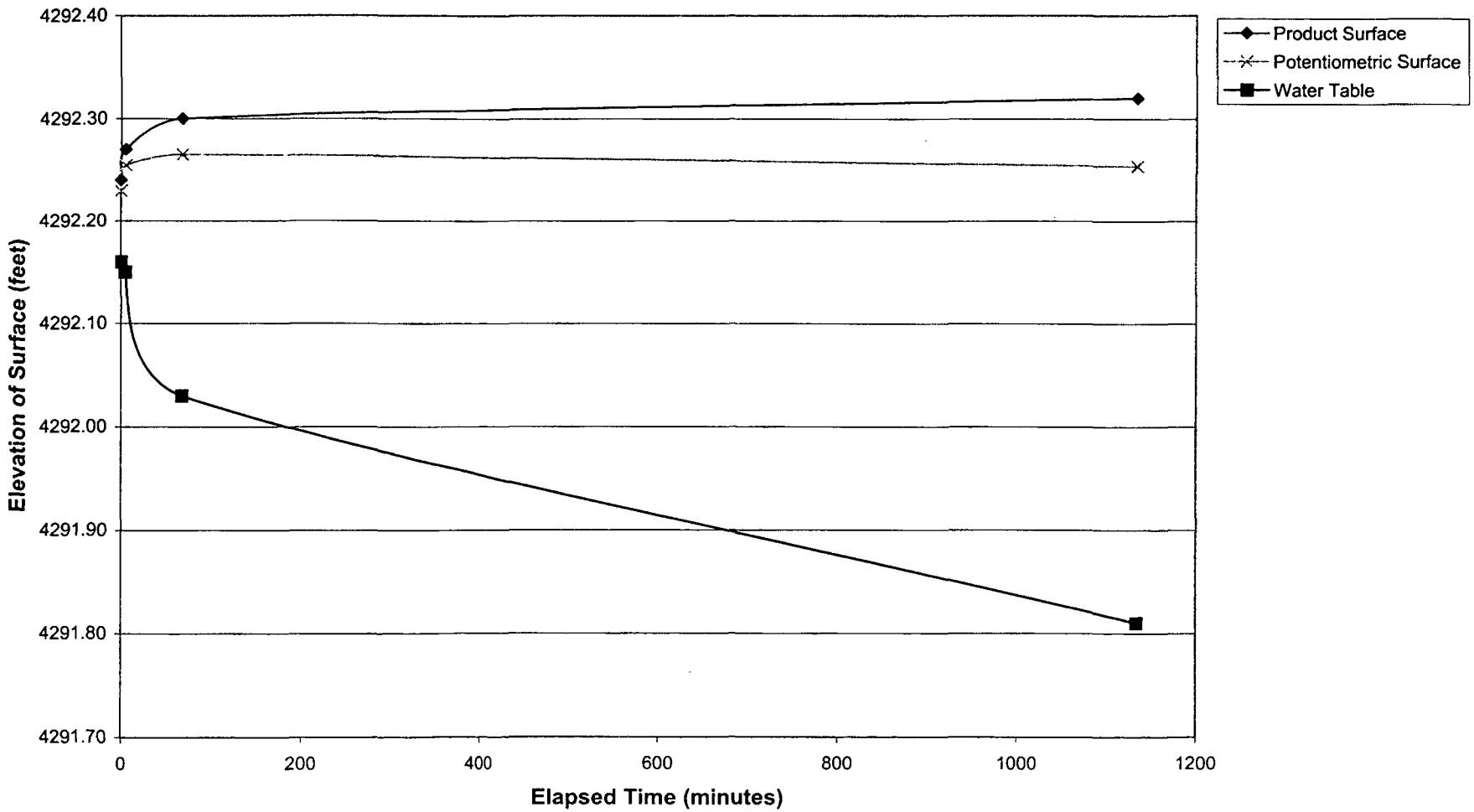
Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	9:20	8.08	9.08	Static	4282.76	4281.76	4282.63	0.00	1.00	
12/07/00	14:47	8.13	8.37	0	4282.71	4282.47	4282.68	0.05	0.24	24%
12/07/00	14:52	8.10	8.52	5	4282.74	4282.32	4282.69	0.02	0.42	42%
12/07/00	15:49	8.06	8.61	62	4282.78	4282.23	4282.71	-0.02	0.55	55%
12/08/00	10:44	8.50	9.51	1197	4282.34	4281.33	4282.21	0.42	1.01	101%
12/15/00	14:15	7.99	9.01	11488	4282.85	4281.83	4282.72	-0.09	1.02	102%
01/20/01	12:00	8.16	9.40	18553	4282.68	4281.44	4282.52	0.08	1.24	124%

Well 38MW-1

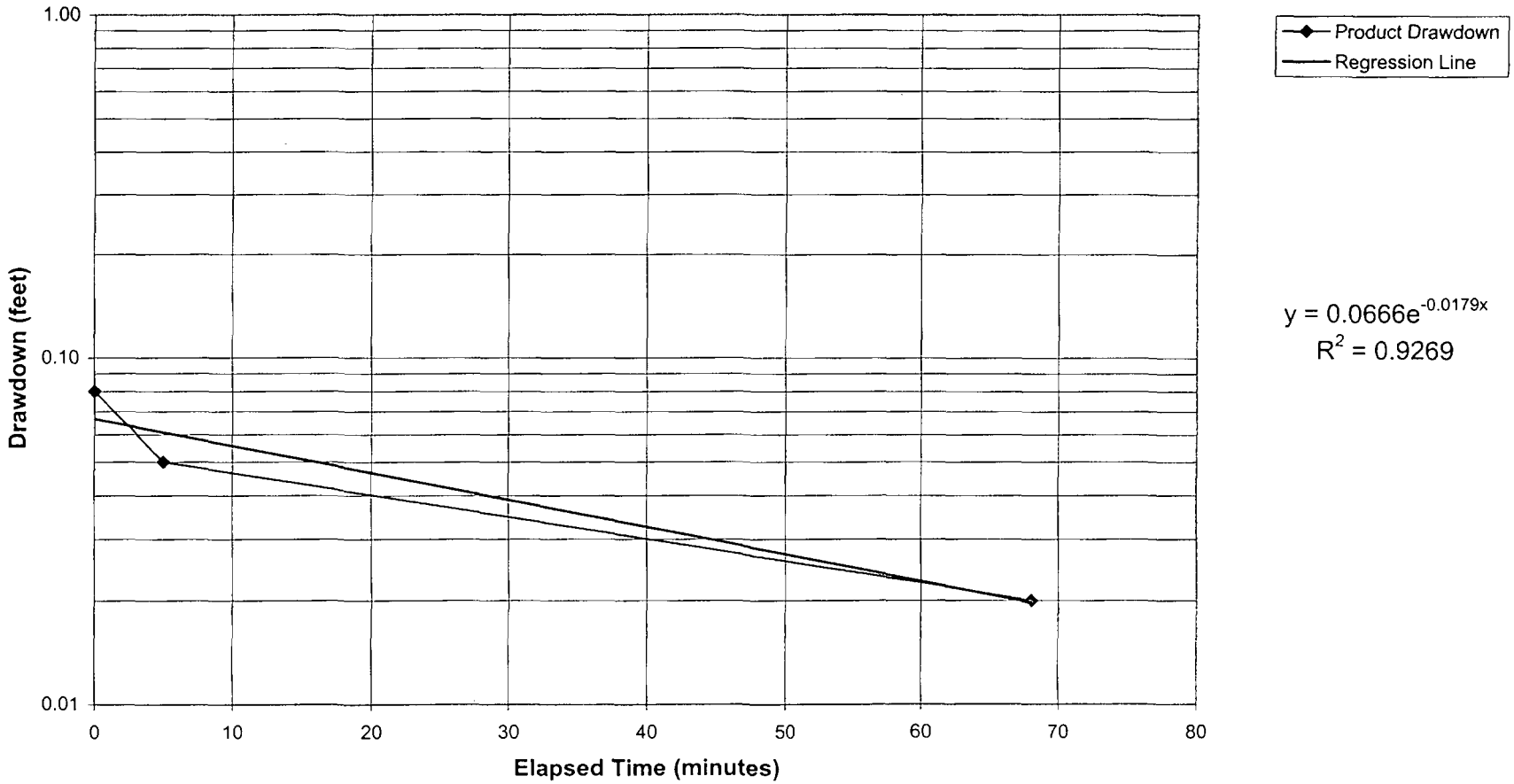
Relative Hydrocarbon Density: 0.87
Well Elevation: 4293.10
Initial Product Thickness: 0.70

Date	Time	Depth to Product	Depth To Water	Elapsed Minutes	Product Elevation	Water Elevation	Potentiometric Surface	Product Drawdown	Product Thickness	Percent Recovery
12/06/00	8:27	11.11	11.81	Static	4281.99	4281.29	4281.90	0.00	0.70	
12/07/00	15:28	11.11	11.39	0	4281.99	4281.71	4281.95	0.00	0.28	40%
12/07/00	15:33	11.12	11.13	5	4281.98	4281.97	4281.98	0.01	0.01	1%
12/07/00	16:12	11.05	11.11	44	4282.05	4281.99	4282.04	-0.06	0.06	9%
12/08/00	11:04	11.08	11.10	1176	4282.02	4282.00	4282.02	-0.03	0.02	3%
12/15/00	15:10	10.98	11.30	11502	4282.12	4281.80	4282.08	-0.13	0.32	46%
01/20/01	12:00	10.32	12.09	18512	4282.78	4281.01	4282.55	-0.79	1.77	253%
02/22/02	12:00	10.45	12.82	24272	4282.65	4280.28	4282.34	-0.66	2.37	339%

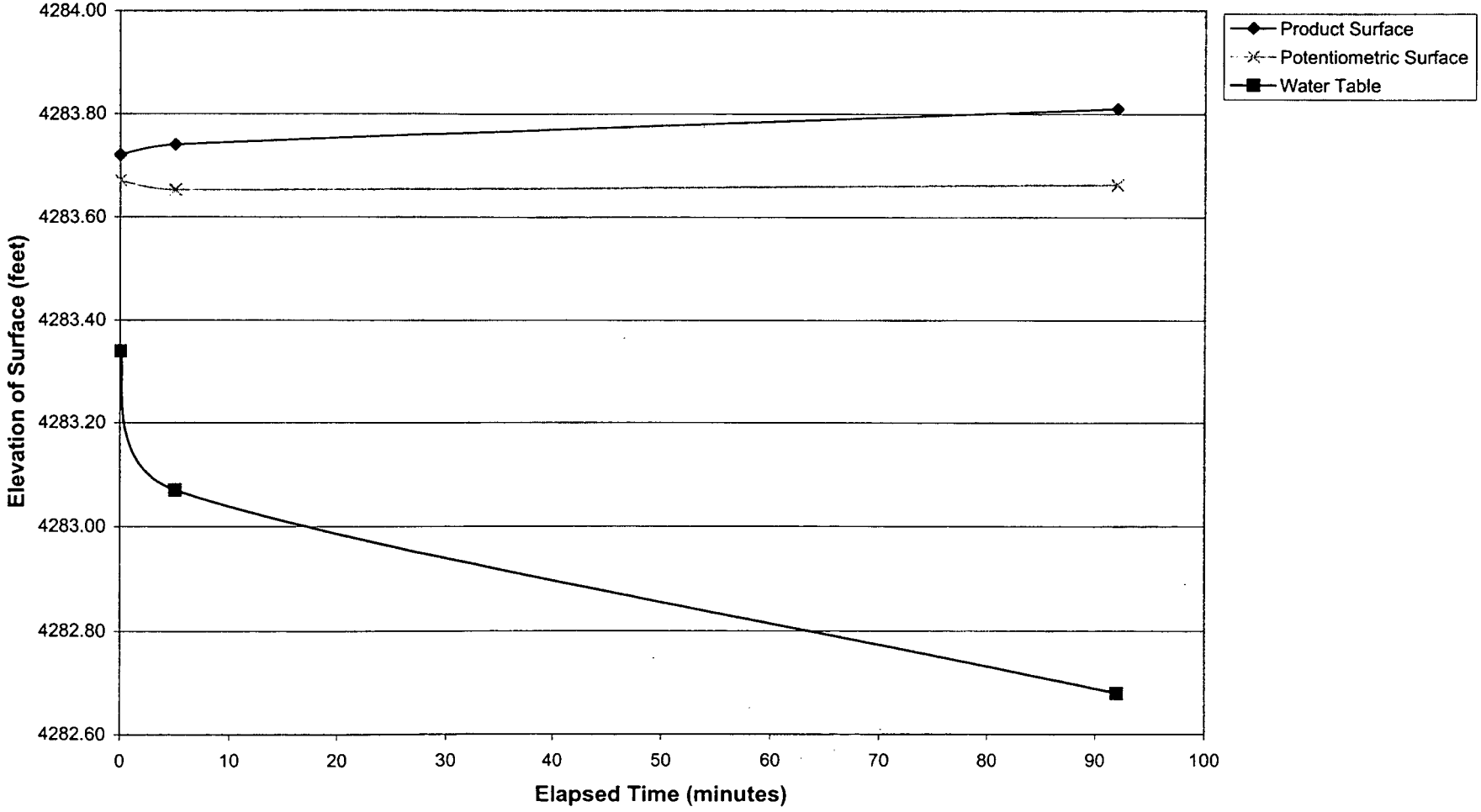
30-MW3 Surface Elevations
UPRR Ogden Railyard
Ogden, Utah



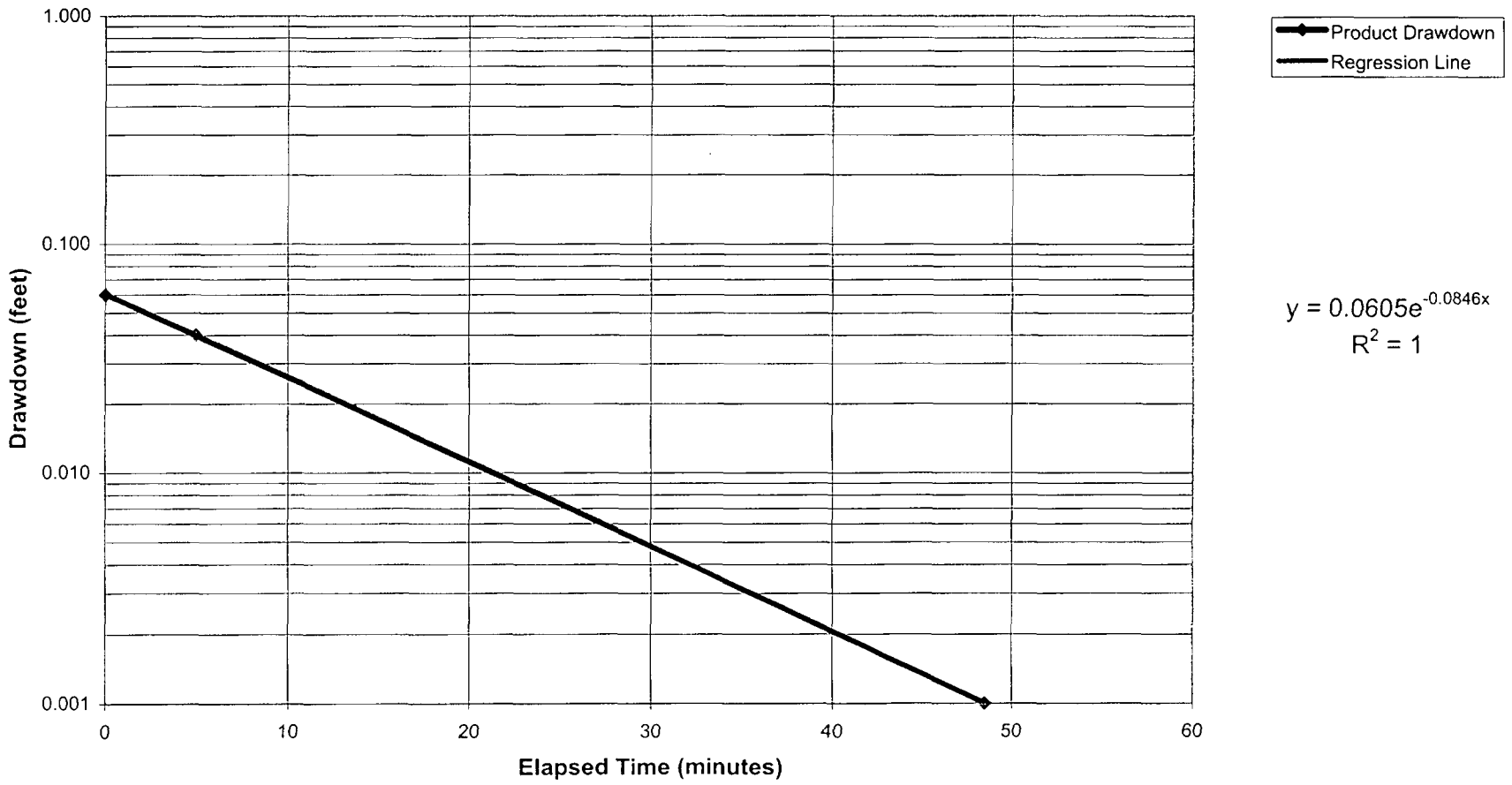
30-MW3 Drawdown
UPRR Ogden Railyard
Ogden, Utah



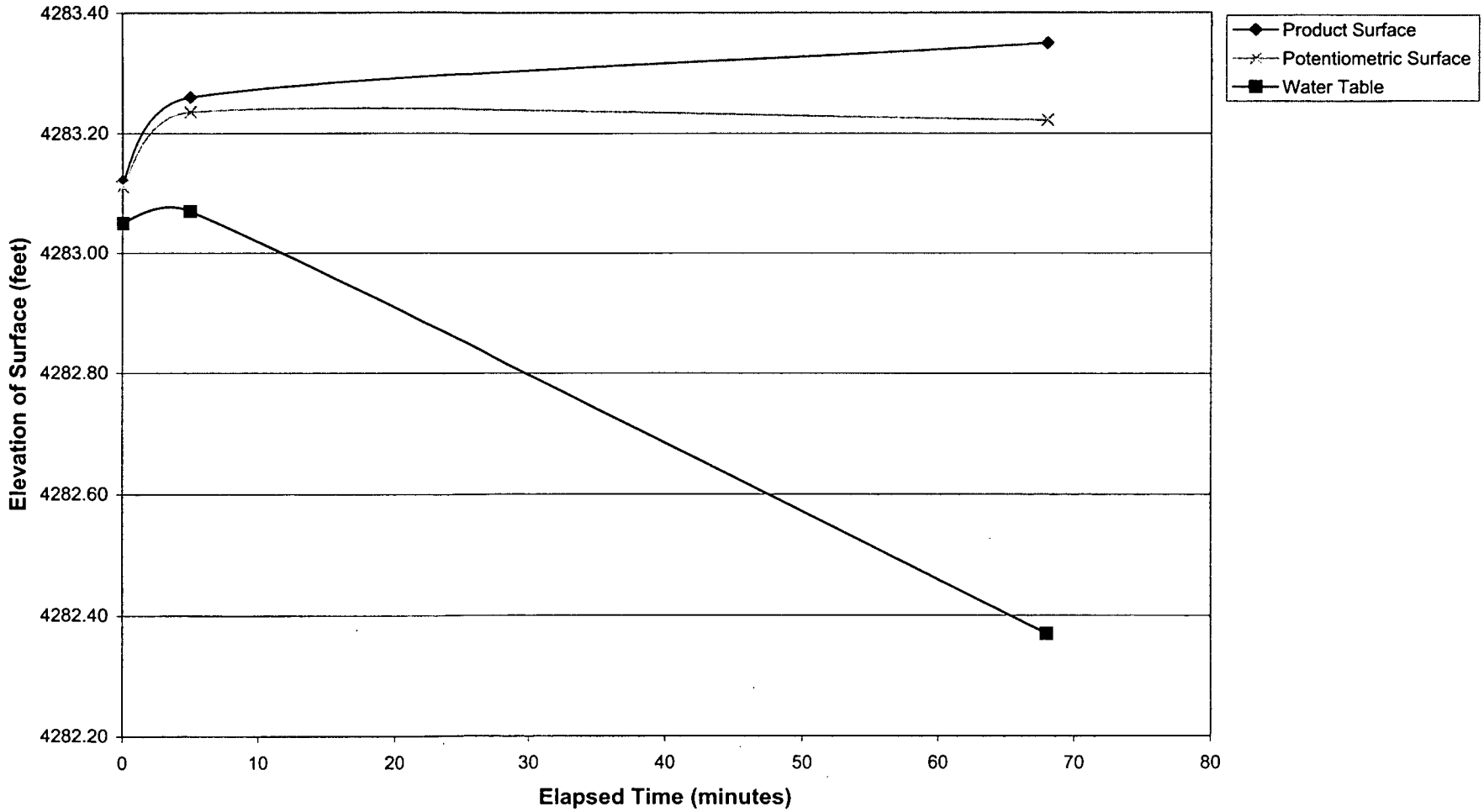
38B-11 Surface Elevations
UPRR Ogden Railyard
Ogden, Utah



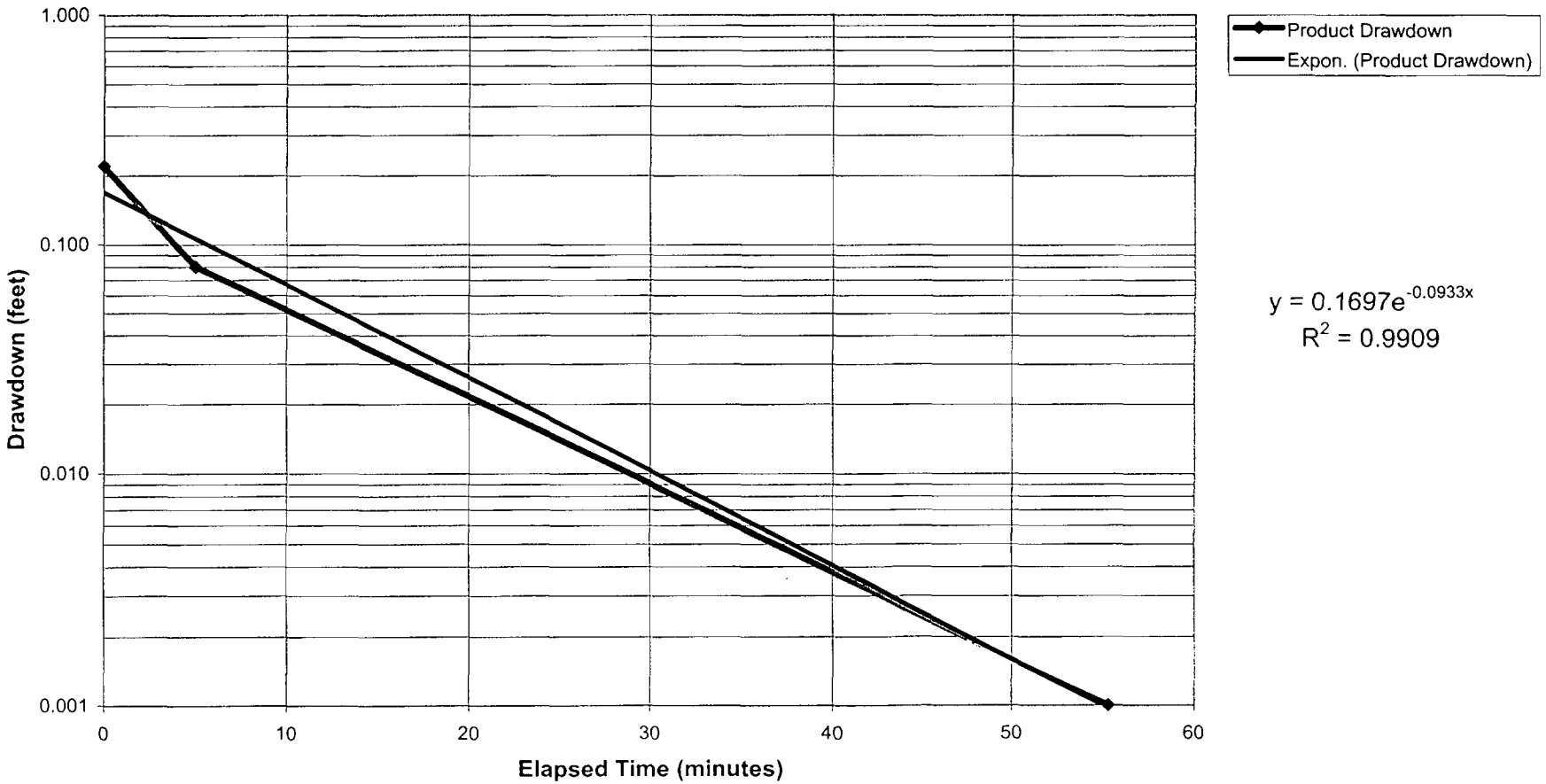
38B-11 Drawdown
UPRR Ogden Railyard
Ogden, Utah



38-MW6 Surface Elevations
UPRR Ogden Railyard
Ogden, Utah



38-MW6 Drawdown
UPRR Ogden Railyard
Ogden, Utah



Pumping Test Data - UPRR Ogden

Page 1 of ___

Well 38B-26
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL ___ Elevation ___
Pump On Date ___ Time ___
Pump Off Date ___ Time ___
Comment 1" ID Completion

Data Collected By ___

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	08:20	7.86	~~6.58~~ 7.58	- Yes -
12-7	1514	7.68	7.50	START BAIL @ 1511
12-7	1519	7.69	7.67	
12-7	1609	7.74	7.67	
12-8	1057	7.70	7.69	
12/11	15:00	7.71	7.60	[illegible] by John W.H/ERM [illegible]
1-20-01		8.15	7.90	
2-22-01		7.20	7.25	

Pumping Test Data - UPRR Ogden

Page 1 of ___

Well: 38 MW-1
Type of Data: Baildown
Pumped Well Number: ___
Pumping Rates: ___
How Q was Measured: ___
How WLs Measured: ___
Dist. from Pumped We: ___

M.P for WL: ___ Elevation: ___
Pump On Date: ___ Time: ___
Pump Off Date: ___ Time: ___
Comment: 2" ID Well Completion

Data Collected By: ___

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	08:27	11.81	11.11'	- Yes -
12-7	1528	~~11.11~~ 11.39	~~11.15~~ 11.11	START BAIL @ 1528
12-7	1533	11.13	11.12	
12-7	1612	11.05	11.11	
12-8	1104	11.08	11.10	
12/16	15:10	11.30	10.98	taken by John W. H/TERM from Well
1-20-01		12.09	10.32	
2-22-01		12.82	10.45	

Pumping Test Data - UPRR Ogden

Page 1 of ___

Well: 30-MW3
Type of Data: Baildown
Pumped Well Number: ___
Pumping Rates: ___
How Q was Measured: ___
How WLs Measured: ___
Dist. from Pumped We: ___

M.P for WL: TOC Elevation: ___
Pump On Date: ___ Time: ___
Pump Off Date: ___ Time: ___
Comment: 2" ID Well Completion

Data Collected By: ___

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	09:53	11.68	11.02'	Yes
12-7	1635	11.18	11.10	START BAILING @ 1631
12-7	1640	11.19	11.07	
12-7	1743	11.31	11.04	
12-8	1130	11.53	11.03	
12-15	15:20	11.35	10.89	taken by Schnitt/ERM transcribed DSha
1-20-01		11.55	10.96	
2-21-01		10.60		

Pumping Test Data - UPRR Ogden

Page 1 of ___

Well 30MW6
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL TOC Elevation
Pump On Date Time
Pump Off Date Time
Comment

Data Collected By

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	10:24	9.15	8.62	- Yes -
12-7	1652	~~8.65~~ 8.75	8.71	START BAIL @ 1649
12-7	1657	8.62	8.65	
12-7	1752	8.80	8.61	
12-8	1120	8.88	8.60	
12/15	15:30	8.77	8.61	taken by John Witt/ERM transcribed by [illegible]
1-20-01		9.77	8.73	
2-21-01		8.50	8.10	

Pumping Test Data - UPRR Ogden

Page __ of __

Well 38 B-~~24~~ 25 TS (P)
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL _____ Elevation _____
Pump On Date _____ Time _____
Pump Off Date _____ Time _____
Comment (1" ID Well Completion)

Data Collected By _____

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	08:15	8.08	6.50	- Yes -
12-7	1500	6.77	~~[illegible]~~ 6.60	START BAIL @ 1458
12-7	1505	6.85	6.59	
12-7	1557	6.82	6.55	
12-8	1050	6.87	6.59	
12/16	14:60	7.02	6.60	taken by John W.H / ERM by [illegible]
1-20-01		7.83	6.69	
2-22-01		7.29	6.14	

Pumping Test Data - UPRR Ogden

Page 1 of ___

Well 38 B-28
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL TOC Elevation
Pump On Date Time
Pump Off Date Time
Comment 1" Well Completion (ID)

Data Collected By

	Date	Time	Depth to water	Depth to LNAPL	Remarks
	12/6	09:20	9.08	8.08	-Yes-
1 Mills	12-7	1447	8.37	8.13	Start Bail @ 1445
5 Mills	12-7	1452	8.52	8.10	
1 HR	12-7	1549	8.61	8.04	
1 Day	12-8	1044	9.51	8.50	
	12/15	14:16	9.01	7.99	Taken by John Witt/ERM by [signature]
	1-20-01		9.40	8.16	

Pumping Test Data - UPRR Ogden

Page __ of ___

Well 38 MW 6
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL TOC Elevation
Pump On Date Time
Pump Off Date Time
Comment 2" Completion

Data Collected By

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	7:50	11.60'	10.0'	-Yes- Check Measurements
12-7	1327	10.29	10.22	START BUZZ @ 1320
12-7	1332	10.27	10.08	
12-7	1435	10.97	9.99	
12-8	1037	11.42	9.97	
12/15	14:25	11.44	9.92	Taken by John W. H/ERM by [illegible]
1-20-01		11.40	10.-	
2-22-01		11.62	9.47	

B-28 8.08 - Yes B-1 Dry Hole
9.08 @ 09:20

B 25 8.31 - B.12 - No

Pumping Test Data - UPRR Ogden

Page 1 of ___

Well #38 B-22
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL TOC Elevation
Pump On Date Time
Pump Off Date Time
Comment 1" Well Completion (ID)

Data Collected By

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	09:02	7.77	7.58	Maybe
12-7	1168	7.47	7.46	Start Bail @ 1150
12-7	1203	7.48	7.47	
12-7	1320	7.51	7.47	
12-8	1010.5	7.57	7.48	
12/15	14:40	7.61	7.44	taken by John Witt/EKM
1-20-01		7.68	7.52	
2-22-02		7.35	7.25	

Pumping Test Data - UPRR Ogden

Page __ of __

Well 38-B11
Type of Data Baildown
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL TOC Elevation
Pump On Date Time
Pump Off Date Time
Comment 1" ID Well Completion

Data Collected By

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	8:52	6.95	6.71	- Poor O/W Interface (Maybe)
12-7	1140	7.15	6.77	
12-7	1145	7.42	6.75	
12-7	1312	7.81	6.68	Start Bail @ 1137
12-8	10:02	7.99	6.69	
12/8	14:30	8.00	6.65	Data by Sohn W. H/ERM by [illegible]
1-20-01		8.03	6.72	
2-22-01		7.68	7.02	

Pumping Test Data - UPRR Ogden

Page 1 of __

Well 38B-3
Type of Data
Pumped Well Number
Pumping Rates
How Q was Measured
How WLs Measured
Dist. from Pumped We

M.P for WL TOC Elevation
Pump On Date Time
Pump Off Date Time
Comment 1" ID Completion

Data Collected By Tom Sale & Tim Gutshall

Date	Time	Depth to water	Depth to LNAPL	Remarks
12/6	8:45	8.06'	6.78	- Yes -
12-7	1108	7.87	6.78	
12-7	1113	9.11 BTC	6.75	BAILE START 1105
12-7	1210	8.24	6.71	
12-8	1058	8.21	6.73	
12/15	14:36	8.25	6.71	[illegible] Schuwitt / ERM [illegible]
1-20-01		8.19	6.83	
2-22-01		7.86	6.35	

MEMORANDUM

February 3, 2003

To: File

From: Jay Hoskins

Subject: UPRR Ogden Railroad
LNAPL Partitioning

This memorandum presents an analysis of TCE, 1,1,1-TCA, and vinyl chloride partitioning. Because these compounds were not detected in the LNAPL samples taken from the site, the method detection limit concentrations of these compounds are used as input parameters. The analysis is intended to yield insight into whether the LNAPL is a likely source of the chlorinated organic compounds that were detected in groundwater. It is not intended as a definitive environmental partitioning analysis or specification of required detection limits.

Input parameters

- The detection limit concentrations for 1,1,1-TCA, TCE, and vinyl chloride, assumed to be the maximum fraction of each component (X_i)in the LNAPL, are as follows:

  1,1,1-TCA: 6.2 mg/kg (ppm)

  TCE: 6.2 mg/kg (ppm)

  Vinyl Chloride: 12 mg/kg (ppm)

- The solubility (S_i) of 1,1,1-TCA, TCE, and vinyl chloride are as follows (Source: Remediation Engineering, Suthersan, S.S., 1997.):

  1,1,1-TCA: 950 mg/L

  TCE: 1,100 mg/L

  Vinyl Chloride: 1,100 mg/L

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CHESTERFIELD, MISSOURI 63017

- The highest measured groundwater concentrations ($C_{M,water}$) are as follows:

  1,1,1-TCA: 4.1 mg/L

  TCE: 0.43 mg/L

  Vinyl Chloride: 3.1 mg/L

If the water was in equilibrium with the LNAPL, what aqueous concentration of 1,1,1-TCA, TCE, and vinyl chloride would result from their LNAPL detection limit concentrations?

Calculated Concentration in Water ($C_{C,water}$) = X_i x S_i (Source: Estimating Potential for Occurrence of DNAPL at Superfund Sites, USEPA, 1992.)

As a rough approximation, concentration will be used in place of mole fraction (X_i). In order to determine the mole fraction of the diesel LNAPL, it is necessary to know the molecular weight of the diesel. Diesel fuel is a composite of several compounds, and in order exactly to determine the molecular weight of a diesel, it would be necessary to identify and quantify all the individual components. Identification of each component is not practical nor warranted given that the three chlorinated ethenes were not detected. In addition, approximations of the molecular weight of the diesel may not improve this calculation's accuracy. Therefore, using concentration in place of mole fraction is a reasonable approximation for the purpose of this work.

1,1,1-TCA: $C_{C,water} = 6.2/10^6 \times 950$ mg/L = 0.00589 mg/L

TCE: $C_{C,water} = 6.2/10^6 \times 1{,}100$ mg/L = 0.00682 mg/L

Vinyl Chloride: $C_{C,water} = 12/10^6 \times 1{,}100$ mg/L = 0.0132 mg/L

These concentrations should be theoretical maximum concentrations because 1) they do not account for attenuation mechanisms such as sorption to soil or dilution and 2) they assume that the concentration in the LNAPL is the detection limit concentration when in actuality the detection limit concentration may be greater than the concentration in the LNAPL.

What is the ratio of the highest measured groundwater concentrations to the calculated concentrations?

Ratio (R) = $C_{M,water} / C_{C,water}$

1,1,1-TCA: R = 4.1 mg/L / 0.00589 mg/L = 696

TCE: R = 0.43 mg/L / 0.00682 mg/L = 63

Vinyl Chloride: R = 3.1 mg/L / 0.0132 mg/L = 235

APPENDIX N
NAPL FIELD TEST DOCUMENTATION

Table I-1
Ogden Rail Yard
Coring Field Inspection Data Summary

Soil Boring or Well Coring	Depth to Top of Alpine Clay (ft.)	OVA Head Space (ppm)	Florescence	Sudan IV
Strat-B1	29.5-32	1.0	NA	NA
Strat-B2	15.5	1.0	NA	NA
12-MW2D	12	4.0	very slight	Neg.
19-MW1D	8	133.0	Weak	Neg.
19-MW1D	17	5.0	ND	Neg.
20-MW3D	14	0.0	ND	Neg.
22a-MW6D	22	0.0	ND	Neg.
22b-MW2D	14	5.0	weak	Neg.
34-MW7D	18-18.25	0.0	ND	Neg.

NA=Not Available
ND=Not Detected

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

UPRR Ogden Railyard	NAPL Screening			
Date : 5/5/00				
Boring: 12 - MW2D				
Logger: Phil Carendor				
Interval	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
12 feet	4.0	very slight cut	Neg	no odor

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

19-MW1D

UPRR Ogden Railyard		NAPL Screening		
Date: 5/4/00				
Boring: 19-MW1D				
Logger: Philip Cavendon				
Interval	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
19-MW1D-8	133.0	weak Cut	neg	pad Pet odor
19-MW1D-17	5.0	neg.	neg	

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

20-MW3D

UPRR Ogden Railyard		NAPL Screening		
Date : 5/7/00				
Boring: 20-MW30				
Logger: Phil Cavendor				
Interval	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
14.0	0.0	Neg	Neg	No odor

22a-MW6D

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

UPRR Ogden Railyard		NAPL Screening		
Date: 5/3/00				
Boring: 22a-MW6D				
Logger: Phil Cavender				
Interval	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
22.0'	0.0 (19:50)	neg (19:52)	neg (19:55)	no odor

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

22B-MW2D

UPRR Ogden Railyard	NAPL Screening			
Date : 5/6/00				
Boring: 22B-MW2D				
Logger: Ph. / Cavendor				
Interval	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
14.0'	5.0	weak cut	Neg	mod odor

Well: 34-MW70

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

UPRR Ogden Railyard		NAPL Screening		
Date: 5/3/00				
Boring: 34-MW70				
Logger: Phil Cavendor				
Interval	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
18.0-18.25'	0.0 (11:10)	Negative (11:20)	Negative (11:30)	No odor

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

UPRR Ogden Railyard	NAPL Screening			
Date: 3-30-00				
Boring: Strat-B1				
Logger: Dowers				
Interval ~~29.5-32~~	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
29.5 - 32	1.0 ppm	NA	NA	no stain
				no odor -
				0.0 ppm
				OVM off
				chart

Ogden Railyard Remedial Investigation (RI)
Standard Operating Procedure (SOP) 102
Deep Soil Sampling and Logging

UPRR Ogden Railyard		NAPL Screening		
Date : 3-31-00				
Boring: Strat. B2				
Logger: TDown				
Interval 15.5'	OVA Head Space (ppm)	Florescence	Sudan IV	Comments
15.5'	1.0	—	—	No odor
				or stain

APPENDIX O
VINYL CHLORIDE FATE AND TRANSPORT ASSESSMENT CALCULATIONS

MEMORANDUM

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

Date: August 28, 2003

To: File

From: Jay Hoskins

Subject: Ogden North VC Plume Modeling

One "line of evidence" of a natural attenuation assessment is an evaluation of the rate of which attenuation processes will reduce contaminant concentrations (USEPA, 1999). This memo provides the methodology, results, and discussion of the degradation rate modeling and sensitivity analysis that was performed in support of the natural attenuation assessment of the northern VC plume.

BACKGROUND

The northern VC plume is found in an unconfined aquifer that is within a silty-gravel deposit. This layer of silty-gravel is believed to be continuous throughout the site. Additionally, the Weber River in the vicinity of the plume is a losing stream.

The *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998) suggests two methods for determining first-order rate constants. The first method uses a conservative tracer (e.g. trimethylbenzene isomers, chloride, methane, and total organic carbon) to normalize contaminant concentrations for dispersion, diffusion, and sorption, and then assumes a first-order decay model to determine the decay rate. The other method is based on a one-dimensional steady-state model proposed by Buscheck and Alcantar (1995). The *Technical Protocol* states that if the data are available, the tracer method should be used; if tracer data are not available, the method of Buscheck and Alcantar can be used.

The tracer method was examined, but was not used because suitable tracer data were not available. This conclusion was based on the following.

- Trimethylbenzene data are not available for this site.
- Multiple degradation chains (i.e. TCA→1,1-DCE→VC→Cl^- and TCE→cis-1,2-DCE→VC→Cl^-) are likely attributing to VC degradation and chloride production. The collected data are not sufficient to determine the total amount of chloride in the multiple degradation pathways.
- Methane was not detected in any monitoring wells. This may be due to the elevated detection limits of the analytical method previously used.
- Total organic carbon data is available; however it is difficult to apply the data to the site in a meaningful way. This may be because multiple sources of organic carbon (e.g. diesel LNAPL and/or sewer pipe sludge) are masking effects of dispersion, dilution, and sorption.

The Buscheck and Alacantar model is appropriate for plumes where contaminant concentrations are in dynamic equilibrium between plume formation at the source and plume attenuation downgradient (USEPA, 1998). The first step in applying this model is to confirm that the plume has reached a steady state configuration. This was done by analyzing Figures O-1 through O-4 to make sure that the plume is not migrating downgradient and that contaminant concentrations are not changing significantly through time. In addition, VC data from north plume monitoring wells approximately located along the plume centerline (see Figures O-1 through O-4) were examined for changes in concentration through time (Chart O-1).

The downgradient extent of the plume is defined by the 1 ug/L isoconcentration contour line. Figure O-1 shows the plume extending to near 34-MW7D, and VC was detected further downgradient at an estimated concentration of 0.6J ug/L in 35-MW1. Figures O-2 through O-4 show the plume extending to 35-MW1. Additionally, the measured VC concentration at 35-MW1 was 2 ug/L in three of four sampling events, suggesting concentrations at the plume edge are not substantially increasing. Thus, it appears that the plume is not likely migrating downgradient of 35-MW1.

The plume shape is generally one where higher concentrations (100-1000 ug/L) exist between 38-MW12 and 34-MW3. In general, the 10 ug/L isoconcentration line extends downgradient to 34-MW7D, and the 1 ug/L line extends to 35-MW1. The shape of the isoconcentration contour lines appears to be generally similar through time. Also, concentrations in the north plume monitoring wells generally varied within an order of magnitude (Table O-1 and Chart O-1). Therefore, it may be concluded that VC concentrations in the plume are not significantly changing over time.

Based on the above considerations, it was concluded that Buscheck and Alcantar model is appropriate for this site. The 1-D steady-state model that was developed by Buscheck and Alcantar to calculate a first-order degradation rate is the following:

$$\lambda = \left(\frac{v_c}{4\alpha_x}\right)\left(\left[1 + 2\alpha_x\left(\frac{k}{v_x}\right)\right]^2 - 1\right)$$

where:

λ : Decay rate (day^{-1})

v_c : Contaminant velocity (ft./day)

α_x : Longitudinal dispersivity (ft.)

$\frac{k}{v_x}$: Reciprocal of attenuation distance ($ft.^{-1}$).

The model output (i.e., decay rate) is a function of contaminant velocity, dispersivity, and the attenuation distance. A sensitivity analysis was performed by varying these variables over several runs and recording the resulting decay rate. The basis for how each variable was changed is described below.

Contaminant Velocity

Contaminant velocity was calculated from the equation,

$$v_c = \frac{K_H i}{n_e R}$$

where:

v_c : Contaminant velocity (ft./day)

K_H : Hydraulic conductivity (ft/day)

i : Hydraulic gradient (ft./ft.)

n_e : Effective porosity

R : Retardation factor

As shown above, the range of velocities that could be used is dependent upon how hydraulic conductivity, effective porosity, hydraulic gradient, and retardation factor vary at the site.

Based on low-flow pumping tests conducted in the Northern Area Operable Unit, the hydraulic conductivity of the silty gravel deposit at the site is estimated to be 10^{-1} cm/s. This estimate is in-line with values reported by Freeze and Cherry (1979), who reported the hydraulic conductivity of gravels to range from 10^{-1}-10^{2} cm/s. Freeze and Cherry also provide values for silty sand, which range from 10^{-5}-10^{-1} cm/s. These values, while rough, illustrate hydraulic conductivity may vary orders of magnitude within the body of the plume. Based on the soil type (gravel with a significant fraction of fines), it is our judgment that the actual hydraulic conductivity, if varied from the pump test, would likely be lower. Therefore, we have included an order of magnitude difference sensitivity analysis ranging from 10^{-1} to 10^{-2} cm/s (280 and 28 ft/day, respectively).

The Draft RI Report reports the overall hydraulic gradient for the northern portion of the yard to be 0.004 ft./ft. Additionally, groundwater contour lines shown in the northwest end of the plume (see Figures O-1 to O-4) suggest that the hydraulic gradient may increase to 0.007 ft./ft.

The effective porosity (specific yield) of the shallow aquifer was determined to be 0.2. Based on field observations, the degree of silt content could reduce effective porosity. Accordingly, the sensitivity analysis will reflect effective porosity values of 0.1 and 0.2.

Adsorption has little effect on retarding VC transport because VC does not strongly adsorb to organic material. Therefore it will be assumed that VC migrates at the same rate as the groundwater, and the retardation factor will be 1 for all analyses.

A north plume groundwater velocity of 5.6 ft./day was calculated in the Draft RI Report. In addition, two contaminant transport velocities were used as reasonable high and low ranges. The velocities used in the sensitivity analysis are shown below.

Parameter	High Range	Draft RI Report	Low Range
Hydraulic Conductivity (cm/s)	10^{-1}	10^{-1}	10^{-2}
Hydraulic Conductivity (ft/day)	280	280	28
Hydraulic Gradient (ft./ft.)	0.007	0.004	0.004
Effective Porosity	0.1	0.2	0.2
Retardation Factor	1	1	1
Velocity (ft/day)	**19.6**	**5.6**	**0.55**

Longitudinal Dispersivity

To assess the uncertainty associated with longitudinal dispersivity, values of 1/10 and 1/100 of the total length of the plume were used. The Draft RI Report states that plume length is approximately 2800 ft. (based on Figures O-1 to O-4). Based on these factors, dispersivity values of 280 ft. and 28 ft. were used in the modeling.

Reciprocal of Attenuation Distance

Two objectives of the sensitivity analysis performed on the reciprocal of the attenuation distance are

- To assess how variability in the monitoring data impacts the derived rate and
- To assess how variability in the interpretation of concentration vs. distance for a given monitoring event impacts the derived rate.

The reciprocal of the attenuation distance was determined by performing linear regression analyses to determine the slope of the regression line between log-concentration and distance. The relationship between log-concentration and distance was determined from the VC isoconcentration contours shown in Figures O-1 to O-4. The input and results of the linear regression analysis are shown in Tables O-3 through O-6. The procedure used was as follows:

- For Figures O-1 through O-3, a line was drawn perpendicular to the isoconcentration contours at the downgradient end of the plume. This line is assumed to lie along the plume centerline. The regression analysis was performed two ways, using three and four data points.
- Figure O-4 was used to perform a sensitivity analysis on how deflecting the line approximately 30 degrees from the assumed plume centerline affects the model output. Two lines are shown in Figure O-4.
- Concentration data were taken from the isoconcentration contour lines, and the distance between the contour lines was determined from the figure's scale.
- A linear regression analysis of log-concentration vs. distance was performed, and the slope of the regression line was used as the input for reciprocal of attenuation distance (k/v_x).

SENSITIVITY ANALYSIS

A sensitivity analysis was performed to determine which variables had the greatest affect on model output. 11 sets of input were tested and labeled as Scenarios A-K. Table O-2 summarizes the inputs into the Buscheck and Alcantar model, the output decay rate, and the associated half-life.

Variability in Monitoring Data: Changes in Rate over Time

Scenarios A-F were designed to look how the decay rate change over time. All of these scenarios assume a contaminant velocity of 5.6 ft./day and a longitudinal dispersivity of 280 ft. As part of this analysis, the effect of the number of data points used in the regression analysis was also examined. Analyses based on 3-points used a 100-1 ug/L change in concentration to determine the reciprocal of attenuation distance. Analyses based on 4-points used a 1000-1 ug/L change in concentration to determine the reciprocal of attenuation distance.

The output from Scenarios A and B is based on data collected in June 2000 (Figure O-1), and the regression analysis is shown in Table O-3. The output from Scenarios C and D is dependent upon data collected in September 2000 (Figure O-2), and the regression analysis is shown in Table O-4. Scenario E and F are dependent upon data collected in January 2001 (Figure O-3), and the regression analysis is shown in Table O-5. Scenario G is dependent upon data collected in May 2001 (Figure O-4), and the regression analysis is shown in Table O-6. Model results from Scenarios A-G are summarized in Table O-7 and Chart O-2.

For analyses performed with 3-data points, rates varied from 2.1×10^{-2} to 7.6×10^{-2} day^{-1} (half-life 9-42 days), a difference of approximately 4 times. Analyses performed with 4-data points varied from 1.1×10^{-2} to 3.0×10^{-2} day^{-1} (half-life 23-62 days), a difference of approximately 3 times. This indicates variability in the data may affect the model output by a factor of 3-4 times.

The largest range of decay rates was about 7 times (1.1×10^{-2} to 7.6×10^{-2} day^{-1}), which is based on the difference in Scenarios A and B. Scenarios A and B both use June 2000 data to calculate the decay rate but use 4 and 3 data points, respectively, in the regression analysis. The large variability between Scenarios A and B is likely due to the interpretation of the 1 ug/L isoconcentration line. As shown in Figure O-1, VC was detected in 35-MW1, and the plume edge is shown short of this point. Extending the plume edge to near 35-MW1 would cause the calculated decay rate to decrease, and therefore the range of rates would also decrease. In comparison other sampling dates, the rates calculated in Scenarios C and D (September 2000) and Scenarios E and F (January 2001) only varied by about 1.5 times, supporting the argument that using 3 vs. 4 data points has a relatively small effect on the range of decay rates.

Variability in Interpretation of Concentration vs. Distance: Deflected Plume Centerline

Scenarios G and H were compared to examine the effect of deflecting the plume centerline (Table O-2). For both scenarios, the contaminant velocity was 5.6 ft./day and longitudinal dispersivity was 280 ft. The deflected plume centerline resulted in an increase in the reciprocal of attenuation distance (Table O-8). The model decay rate for Scenario G and H were 1.7×10^{-2} and 2.2×10^{-2} day^{-1} (half-lives 42 and 31

days) respectively. Based on this comparison, it appears that deflecting the plume centerline could increase the model decay rate by approximately 1.25 times.

Longitudinal Dispersivity

Scenarios G and I were compared to determine the effect of the longitudinal dispersivity on model output (Table O-2). Both of these scenarios assume the contaminant velocity to be 5.6 ft./day and the reciprocal of attenuation distance to be 1.9×10^{-3} ft^{-1}. For these conditions, Chart O-2 and Table O-9 depict how the decay rate and half-life change over the range of longitudinal dispersivity values. As shown, the model decay rate increases approximately 1.5 times for an order of magnitude increase in longitudinal dispersivity.

Contaminant Velocity

Scenarios J and K were designed to examine the effect of contaminant velocity on model decay rate and half-life. Each of these scenarios assumes the longitudinal dispersivity to be 280 ft. and the reciprocal of attenuation distance to be 1.9×10^{-3} ft^{-1}. Chart O-3 and Table O-10 show the relationship between decay rate vs. contaminant velocity and half-life vs. contaminant velocity for the range of velocities tested (0.55-19.6 ft./day). The decay rate varied from 1.6×10^{-3} to 5.8×10^{-2} day^{-1}, a difference of approximately 35 times.

The equation of Buscheck and Alcantar model state that decay rate is directly proportional to contaminant velocity. Therefore, for an order of magnitude change in velocity, the model decay rate and half-life also vary by an order of magnitude, as shown. Compared to other factors, the model decay rate is most sensitive to the contaminant velocity used.

The contaminant velocity was calculated based on a hydraulic conductivity, hydraulic gradient, effective porosity, and retardation factor representative of site conditions. Of these parameters, the range of hydraulic conductivity values varies the most and has the greatest affect on contaminant velocity. Additional pump tests to determine hydraulic conductivity from the northern VC plume could be valuable if hydraulic conductivity values could be refined. However, individual hydraulic conductivity tests in alluvial deposits may vary 2-3 orders of magnitude (Freeze and Cherry, 1977). Therefore, there is limited benefit in additional testing because refinement of contaminant velocity (and decay rate) is not likely possible.

COMPARISON OF MODEL RATES TO LITERATURE

Based on the sensitivity analysis, the high and low degradation rates were 7.6×10^{-2} day^{-1} and 1.6×10^{-3} day^{-1} (half-lives 9 days and 423 days), respectively. All other rates ranged from 1.1×10^{-2} to 5.8×10^{-2} day^{-1} (12-62 days).

Wiedemeier et. al (1999) reports that biodegradation rate coefficients for chlorinated ethenes were generally 10^{-4} to 10^{-2} day^{-1}, without any discernable trend in the biodegradation rate coefficients among the different chlorinated compounds. Aronson and Howard (1997) provide mean and recommended anaerobic biodegradation first-order rate coefficients for selected chlorinated solvents, including VC. The

average VC first-order rate coefficient that Aronson and Howard cite is 7.9 x 10^{-3} day^{-1}, and the recommended range is 3.3 x 10^{-4} to 7.2 x 10^{-3} day^{-1}. For many of the chlorinated solvents, Aronson and Howard defined the low-end rate as the lowest measured field value and the high-end value as the average rate coefficient for all the field/in situ microcosm studies. (However, some minor discrepancies exist between the reported high-end rates and the mean values, as shown for the VC degradation rates.)

The range of calculated decay rates is reflective of all the VC degradation pathways. The model decay rates (1.6 x 10^{-3} to 7.6 x 10^{-2} day^{-1}) were of the same order-of-magnitude of the general range (10^{-4} to 10^{-2} day^{-1}) reported by Weidemeir et al. Only the lowest calculated decay rate (1.6 x 10^{-3} day^{-1}) was within the recommended range (3.3 x 10^{-4} to 7.2 x 10^{-3} day^{-1}) of anaerobic decay rates reported by Aronson and Howard. All other model decay rates were faster than the recommended range, but generally within an order of magnitude. Given that the precision of the site's decay rate is more than an order of magnitude and that the model rates and literature anaerobic rates generally agree within an order of magnitude, the range of model output is likely valid.

VC is believed to be more quickly biodegraded in aerobic conditions, as reflected by the faster aerobic degradation rates (2.5 x 10^{-2} to 3.9 x 10^{-3} day^{-1}) reported by Howard et. al. (1991) Aerobic river water that is "lost" to the shallow aquifer may provide a flux of oxygen and other nutrients that assist in biodegrading VC. The flux of clean water may also dilute plume concentrations. In reality, vinyl chloride removal is probably a combination of aerobic and anaerobic biodegradation, as well as abiotic mechanisms (i.e., dilution).

CONCLUSIONS

- The Buscheck and Alcantar model is appropriate for this site. The plume appears to have reached a steady state configuration given that the plume is not migrating downgradient and that concentrations are not significantly changing through time.

- Output from the Buscheck and Alcantar model is a function of contaminant velocity, dispersivity, and the attenuation distance. Of these factors, the model decay rate is most sensitive to contaminant velocity. The precision of the site's decay rate is believed to be more than an order of magnitude.

- The range of contaminant velocities that were calculated for the site is most sensitive to the measured and estimated hydraulic conductivity values used. There is limited benefit in additional hydraulic conductivity testing because test results may vary 2-3 orders of magnitude, and therefore the precision of the calculated rate may not improve.

- Given that model and literature decay rates generally agree within an order of magnitude, the range of model output is likely valid. In reality, vinyl chloride removal is probably a combination of aerobic and anaerobic biodegradation, as well as abiotic mechanisms (i.e., dilution).

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UPRR Ogden Railyard
Table O-1
Monitoring Well Concentrations vs. Time
2/11/2003

Well Location	Units	June 2001	September 2000	January 2001	May 2001
22A-MW6	ug/L	1300	870	2300	940
22A-MW1	ug/L	430	730	670	620
34-MW6	ug/L	530	--	1100	540
22A-MW5	ug/L	300	210	43	1
34-MW1	ug/L	400	260	240	160
34-MW3	ug/L	150	3100	270	94
34-B1W1	ug/L	170	140	84	37
34-OB-13	ug/L	5	13	36	34
34-B2W2	ug/L	3	15	44	15
34-MW7D	ug/L	0.5	7	20	22
34-OB-12	ug/L	5	3	8	8
35-MW1	ug/L	0.6 J	2	2	2

Notes:
1. If field duplicate data were available, then the higher of the two readings is shown in Chart 1
2. Estimated concentrations are shown in Chart 1

UPRR Ogden Rail Yard
Table O-2
Summary Table of Degradation Rate Modeling
2/11/2003

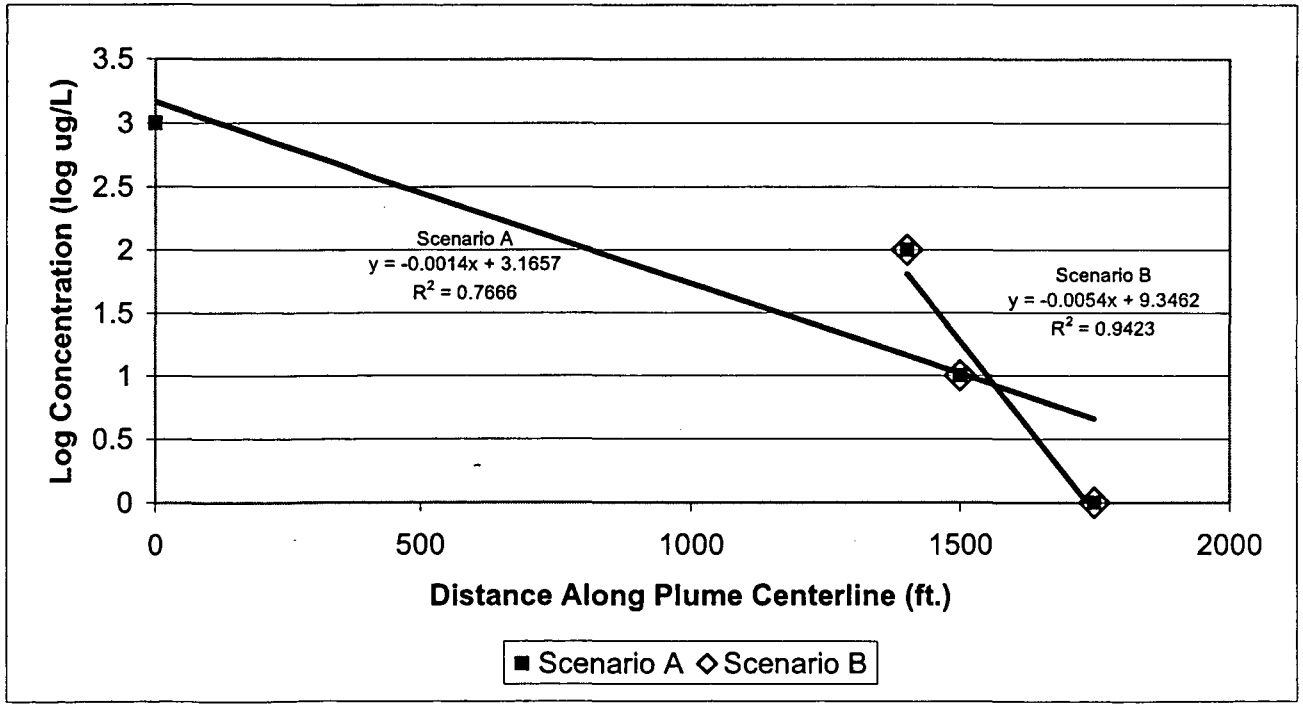
Scenario	Contaminant Velocity (ft./day)	Longitudinal Dispersivity (ft.)	Reciprocal of Attenuation Distance ($ft.^{-1}$)	Decay Rate (day^{-1})	Half Life (days)
A	5.6	280	0.0014	1.1E-02	62
B	5.6	280	0.0054	7.6E-02	9
C	5.6	280	0.0029	3.0E-02	23
D	5.6	280	0.0023	2.1E-02	33
E	5.6	280	0.0015	1.2E-02	56
F	5.6	280	0.0021	1.8E-02	38
G	5.6	280	0.0019	1.7E-02	42
H	5.6	280	0.0024	2.2E-02	31
I	5.6	28	0.0019	1.1E-02	61
J	0.55	280	0.0019	1.6E-03	423
K	19.6	280	0.0019	5.8E-02	12

Notes:
Half life was calculated as Ln(2)/Decay Rate.

UPRR Ogden Rail Yard
Table O-3
Scenario A and B Inputs for Determination
of the Reciprocal of Attenuation Distance
2/11/2003

Parameter	Isoconcentration Line 1000	Isoconcentration Line 100	Isoconcentration Line 10	Isoconcentration Line 1
Concentration	1000	100	10	1
Log Concentration	3	2	1	0
Distance Along Plume Centerline	0	1400	1500	1750

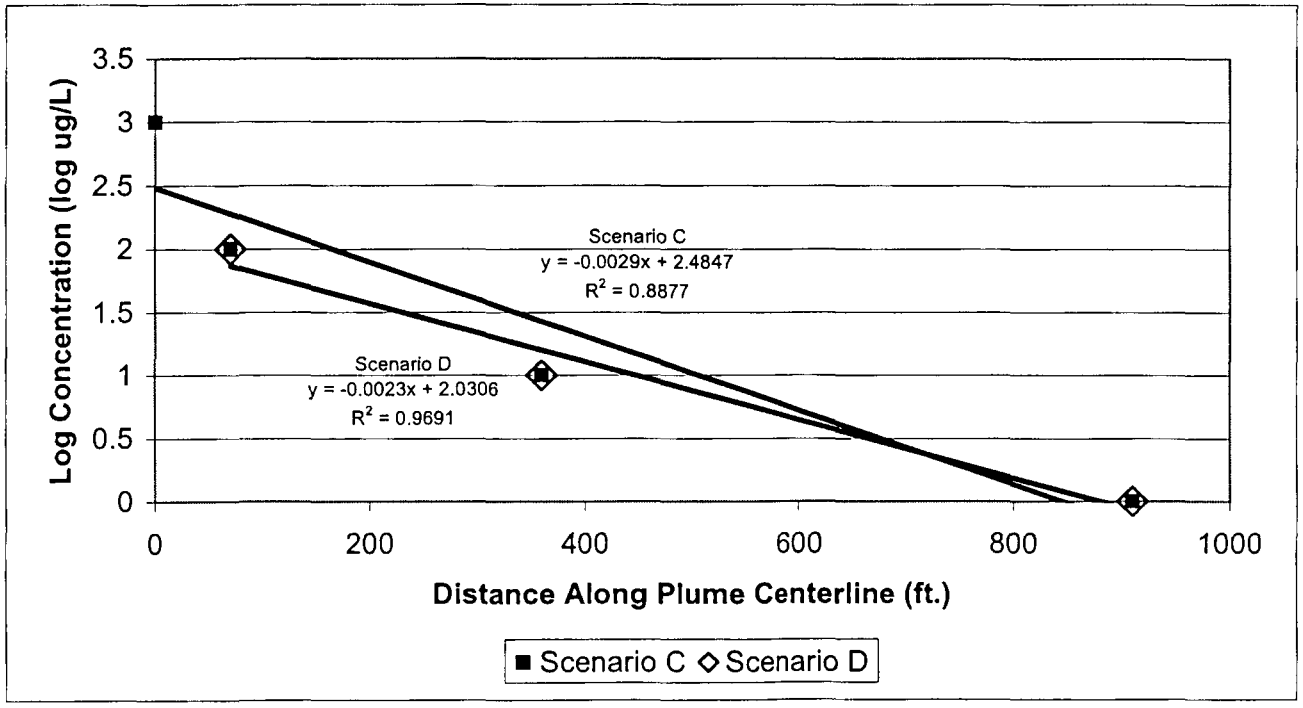
	Scenario A	Scenario B
Range of Isoconconcentration Lines	1-1000 ug/L	1-100 ug/L
k/v_x	**0.0014**	**0.0054**



UPRR Ogden Rail Yard
Table O-4
Scenario C and D Inputs for Determination
of the Reciprocal of Attenuation Distance
2/11/2003

Parameter	Isoconcentration Line 1000	Isoconcentration Line 100	Isoconcentration Line 10	Isoconcentration Line 1
Concentration	1000	100	10	1
Log Concentration	3	2	1	0
Distance Along Plume Centerline	0	70	360	910

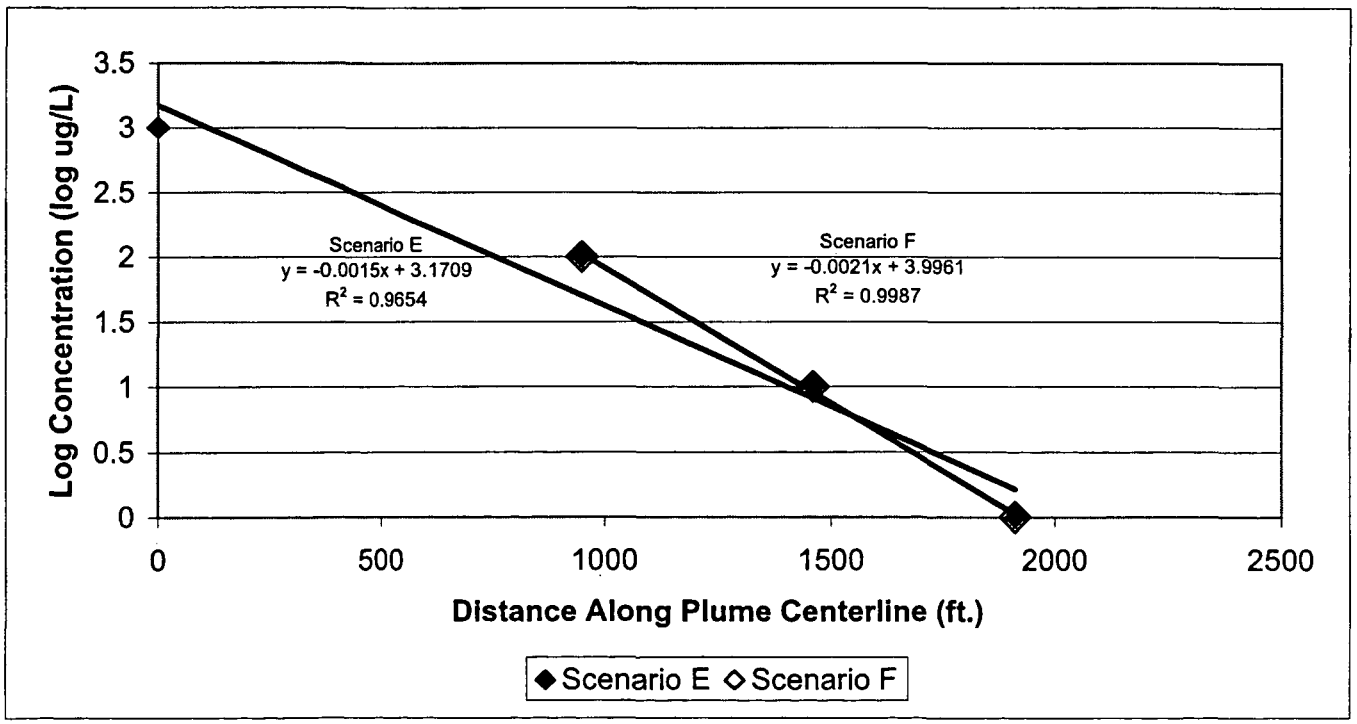
	Scenario C	Scenario D
Range of Isoconconcentration Lines	1-1000 ug/L	1-100 ug/L
k/v_x	**0.0029**	**0.0023**



UPRR Ogden Rail Yard
Table O-5
Scenario E and F Inputs for the Determination
of the Reciprocal of Attenuation Distance
2/11/2003

Parameter	Isoconcentration Line 1000	Isoconcentration Line 100	Isoconcentration Line 10	Isoconcentration Line 1
Concentration	1000	100	10	1
Log Concentration	3	2	1	0
Distance Along Plume Centerline	0	950	1460	1910

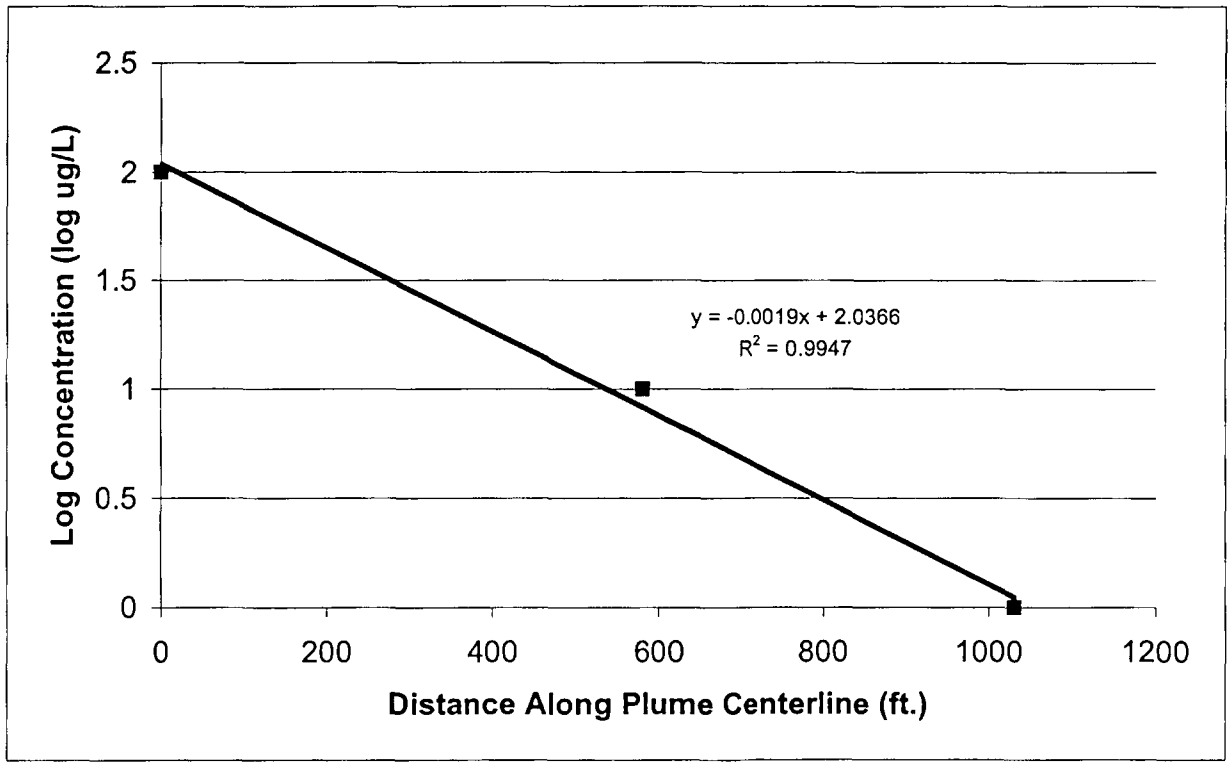
	Scenario E	Scenario F
Range of Isoconconcentration Lines	1-1000 ug/L	1-100 ug/L
k/v_x	**0.0015**	**0.0021**



UPRR Ogden Rail Yard
Table O-6
Scenario G, I, J, K Inputs for Determination
of the Reciprocal of Attenuation Distance
2/11/2003

Parameter	Isoconcentration Line 100	Isoconcentration Line 10	Isoconcentration Line 1
Concentration	100	10	1
Log Concentration	2	1	0
Distance Along Plume Centerline	0	580	1030

	Scenario G, I, J, & K
k/v_x	0.0019



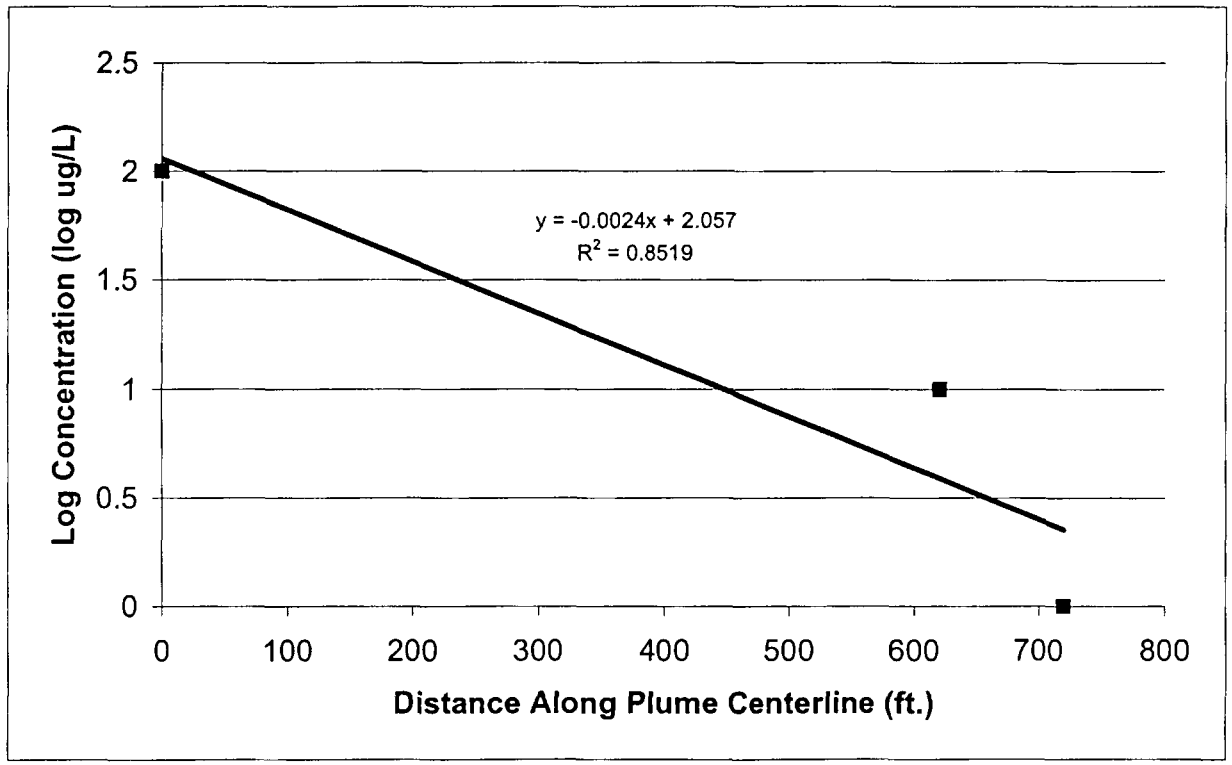
UPRR Ogden Rail Yard
Table O-7
Summary Table of Degradation Rate Modeling
Variability in Data over Time
2/11/2003

Scenario	Contaminant Velocity (ft./day)	Longitudinal Dispersivity (ft.)	Number of Data Points	Date of Sampling Data	Reciprocal of Attenuation Distance ($ft.^{-1}$)	Decay Rate (day^{-1})	Half Life (days)
A	5.6	280	4	Jun-00	0.0014	1.1E-02	62
B	5.6	280	3	Jun-00	0.0054	7.6E-02	9
C	5.6	280	4	Sep-00	0.0029	3.0E-02	23
D	5.6	280	3	Sep-00	0.0023	2.1E-02	33
E	5.6	280	4	Jan-01	0.0015	1.2E-02	56
F	5.6	280	3	Jan-01	0.0021	1.8E-02	38
G	5.6	280	3	May-01	0.0019	1.7E-02	42

UPRR Ogden Rail Yard
Table O-8
Scenario H Input for Determination
of the Reciprocal of Attenuation Distance
2/11/2003

Parameter	Isoconcentration Line 100	Isoconcentration Line 10	Isoconcentration Line 1
Concentration	100	10	1
Log Concentration	2	1	0
Distance Along Plume Centerline	0	620	720

	Scenario H
k/v_x	0.0024



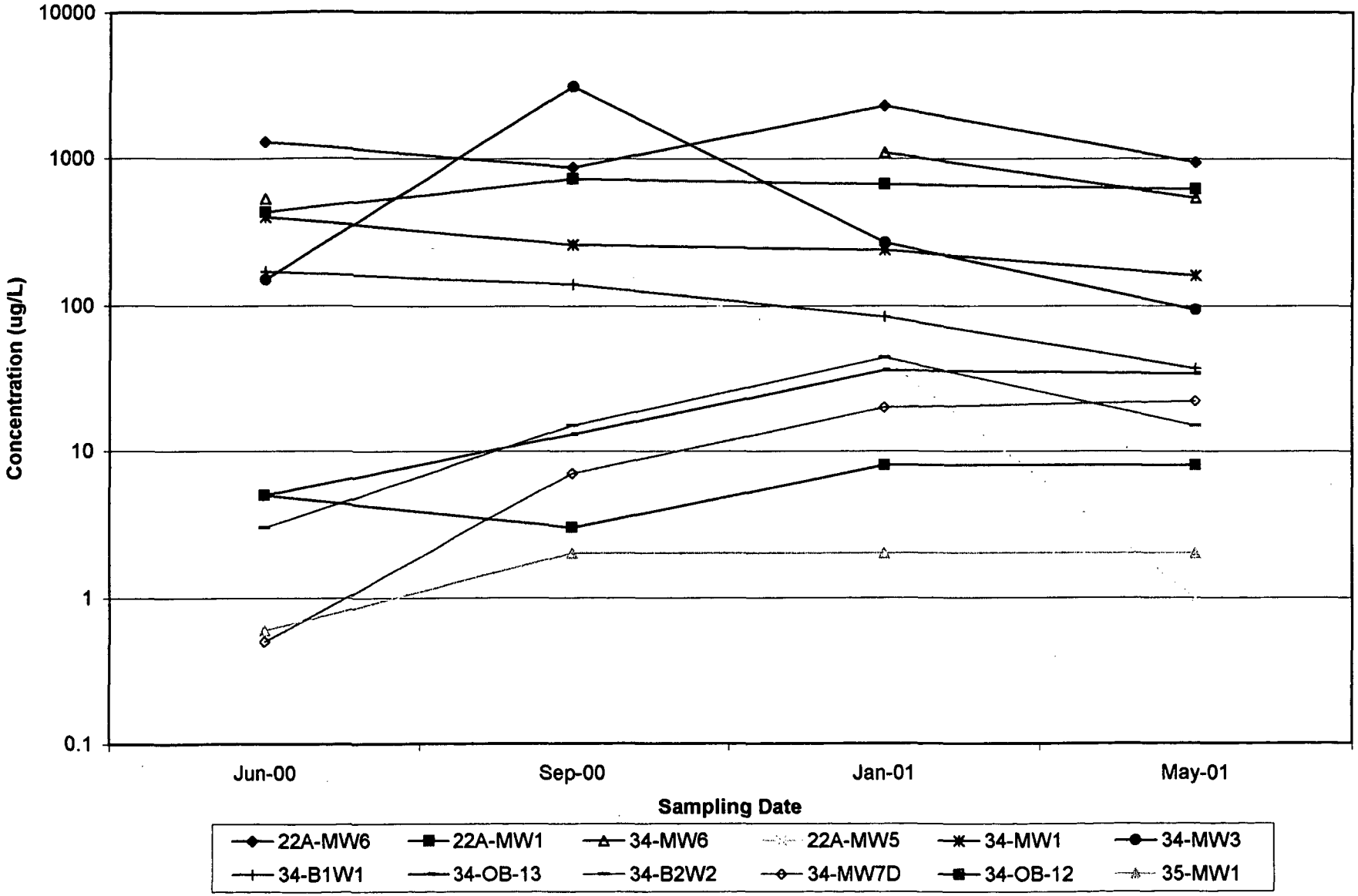
UPRR Ogden Rail Yard
Table O-9
Summary Table of Degradation Rate Modeling
Longitudinal Dispersivity vs. Decay Rate and Half-Life
2/11/2003

Scenario	Contaminant Velocity (ft./day)	Longitudinal Dispersivity (ft.)	Reciprocal of Attenuation Distance ($ft.^{-1}$)	Decay Rate (day^{-1})	Half Life (days)
I	5.6	28	0.0019	1.1E-02	61
--	5.6	56	0.0019	1.2E-02	58
--	5.6	84	0.0019	1.3E-02	55
--	5.6	112	0.0019	1.3E-02	53
--	5.6	140	0.0019	1.4E-02	50
--	5.6	168	0.0019	1.4E-02	48
--	5.6	196	0.0019	1.5E-02	46
--	5.6	224	0.0019	1.5E-02	45
--	5.6	252	0.0019	1.6E-02	43
G	5.6	280	0.0019	1.7E-02	42

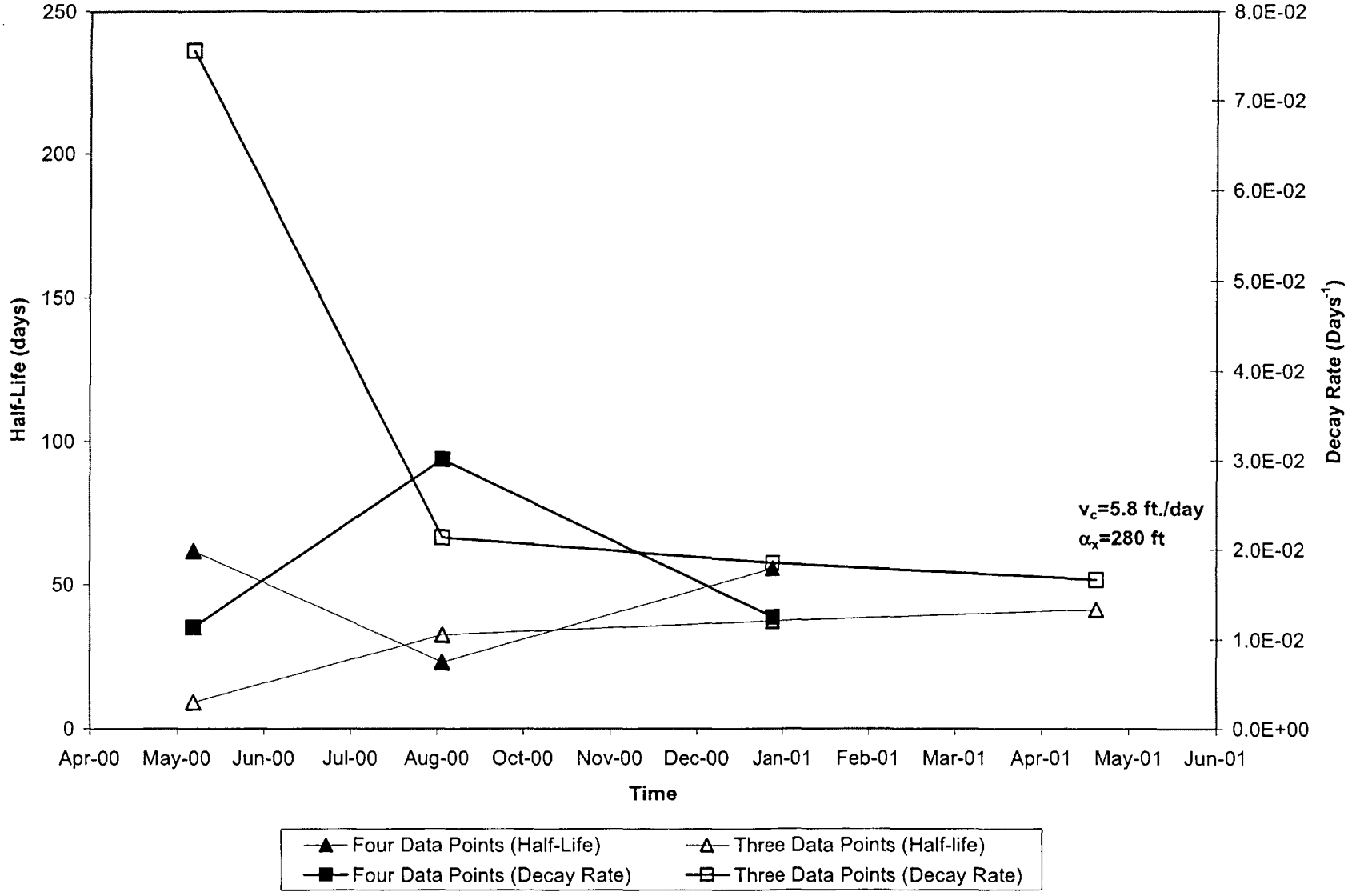
UPRR Ogden Rail Yard
Table O-10
Summary Table of Degradation Rate Modeling
Contaminant Velocity vs. Decay Rate and Half-Life
2/11/2003

Scenario	Contaminant Velocity (ft./day)	Longitudinal Dispersivity (ft.)	Reciprocal of Attenuation Distance ($ft.^{-1}$)	Decay Rate (day^{-1})	Half Life (days)
J	0.55	280	0.0019	1.6E-03	423
--	2	280	0.0019	6.0E-03	116
--	4	280	0.0019	1.2E-02	58
--	6	280	0.0019	1.8E-02	39
--	8	280	0.0019	2.4E-02	29
--	10	280	0.0019	3.0E-02	23
--	12	280	0.0019	3.6E-02	19
--	14	280	0.0019	4.2E-02	17
--	16	280	0.0019	4.8E-02	15
K	19.6	280	0.0019	5.8E-02	12

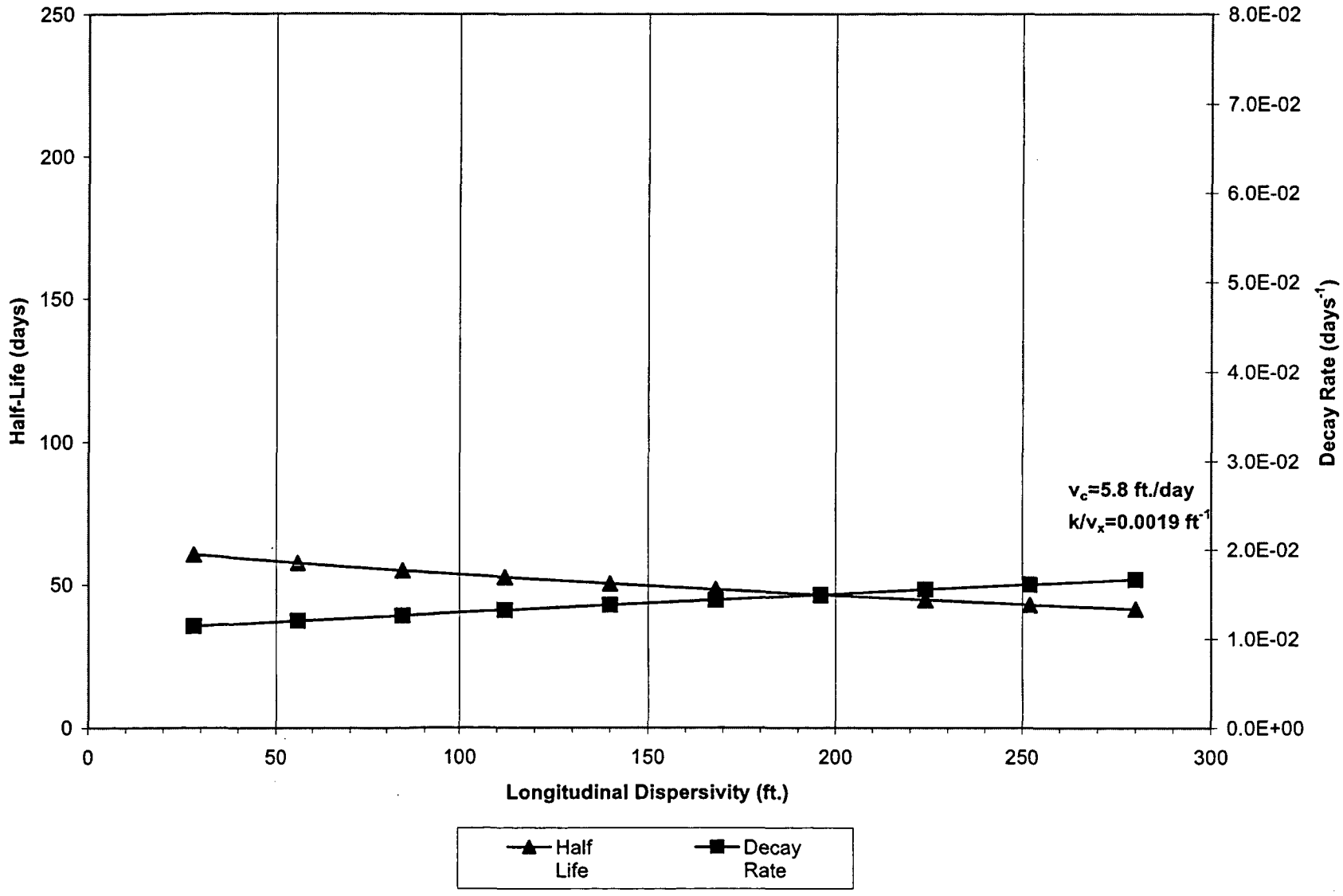
UPRR Ogden Rail Yard
Chart O-1
North Plume Monitoring Wells
Concentration vs. Time
8/28/2003



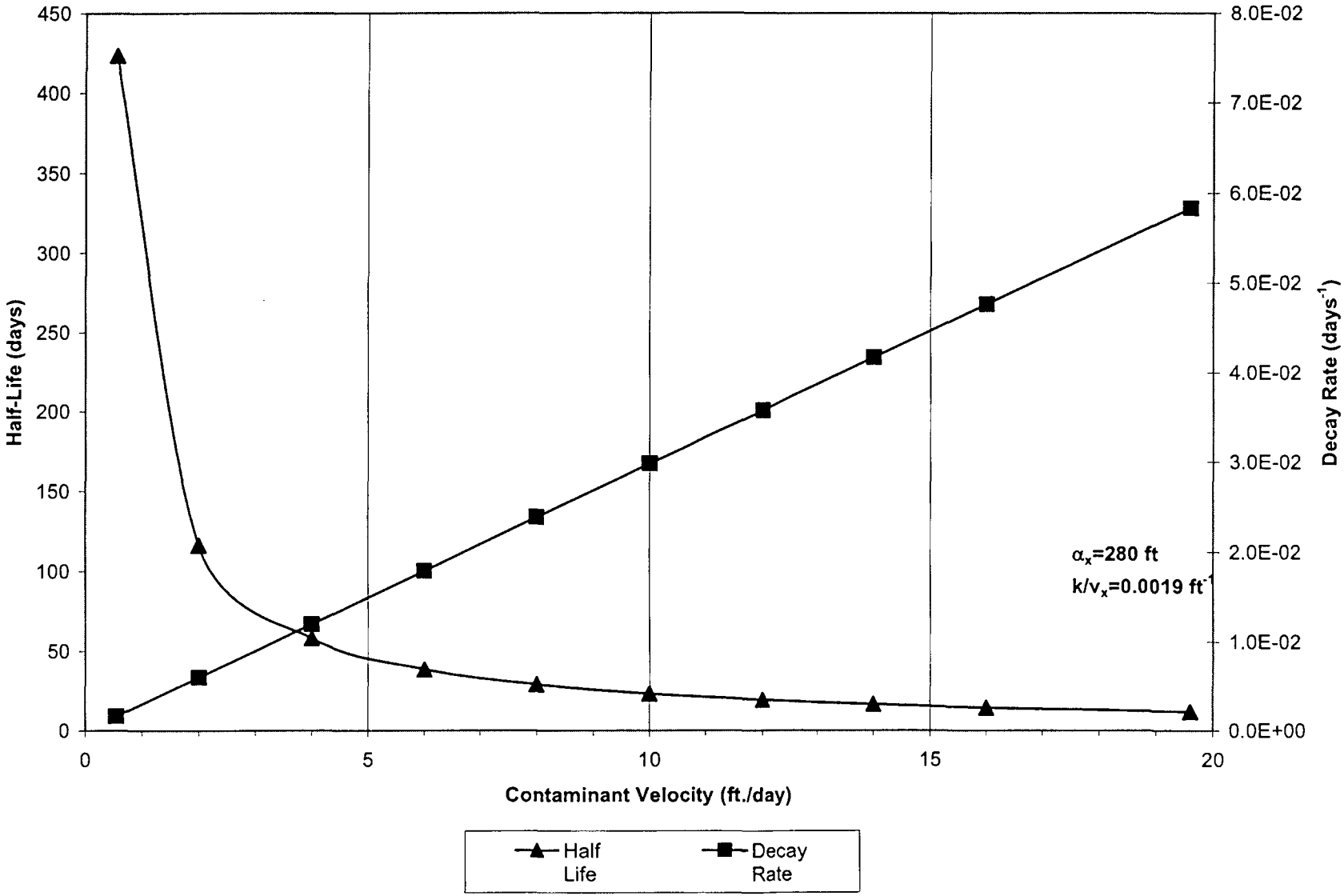
UPRR Ogden Rail Yard
Chart O-2
Model Decay Rate and Half-life Over Time
2/11/2003

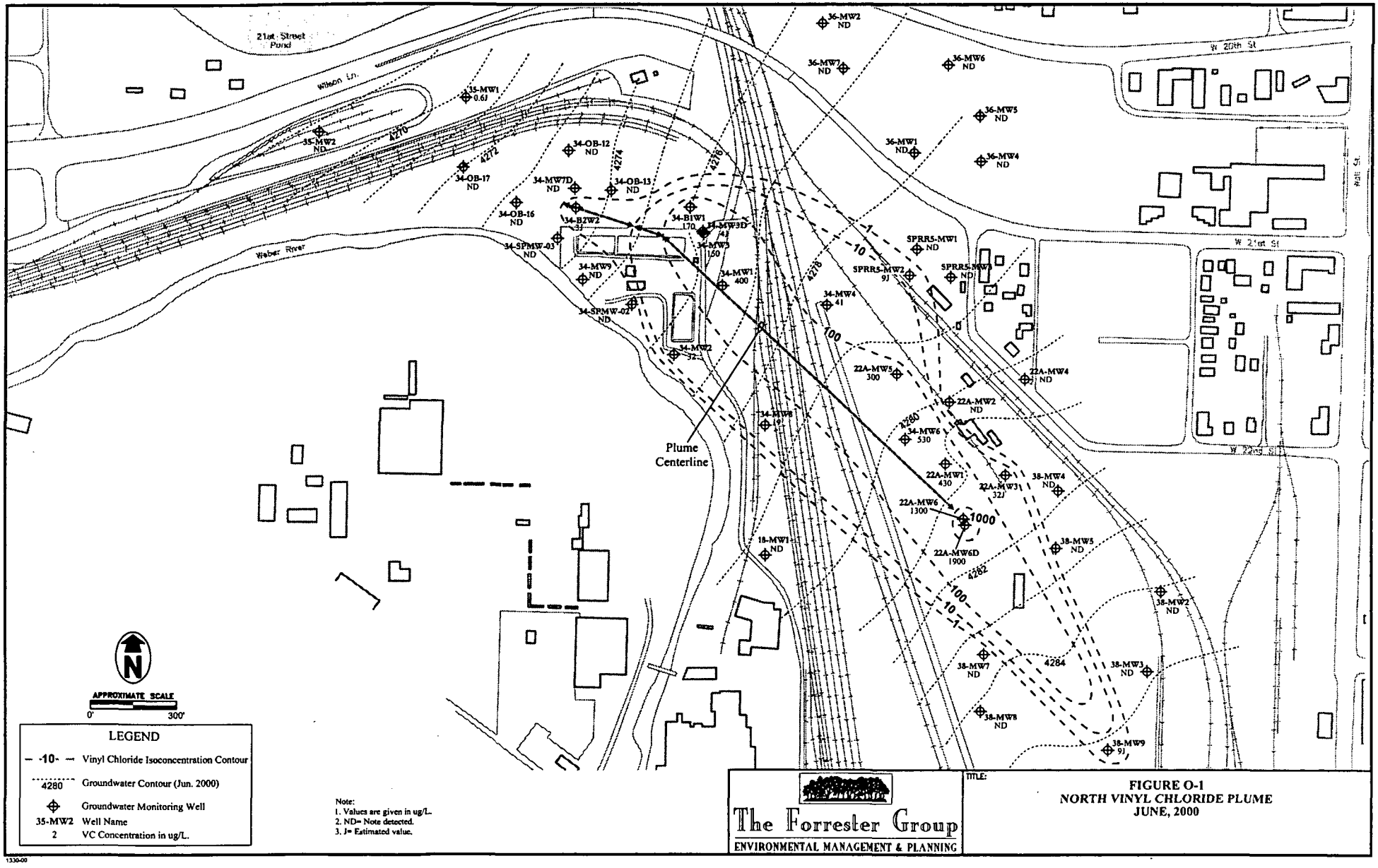


UPRR Ogden Rail Yard
Chart O-3
Model Half-life and Decay-rate vs. Longitudinal Dispersivity
2/11/2003

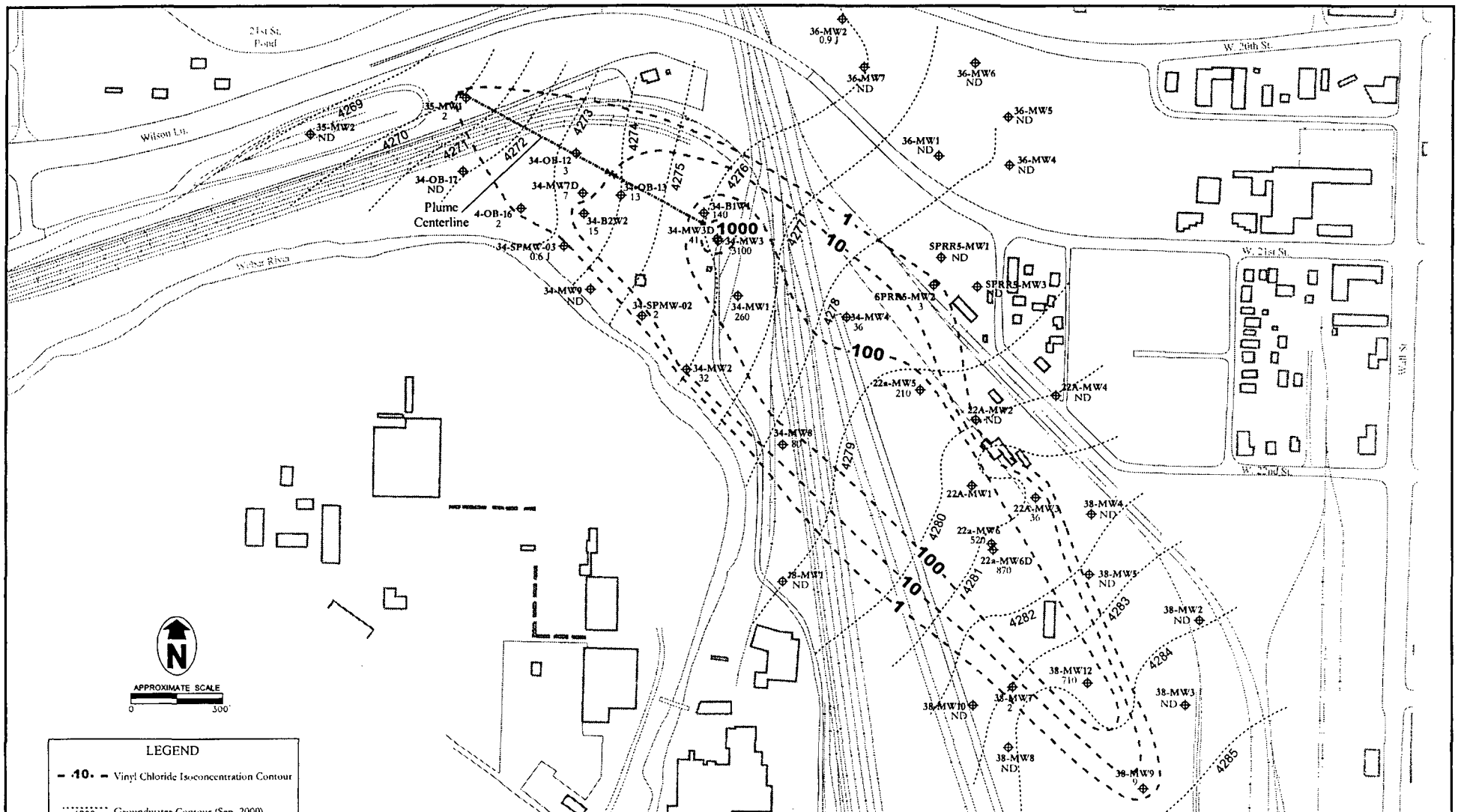


UPRR Ogden Rail Yard
Chart O-4
Model Half-life and Decay-rate vs. Contaminant Velocity
2/11/2003




21st Street Pond
Wilson Ln.
Weber River
W 20th St
W 21st St
W 22nd St
Hall St.
35-MW1 0.6J
35-MW2 ND
34-OB-17 ND
34-OB-12 ND
34-OB-13 ND
34-OB-16 ND
34-MW7D ND
34-BZW2 33
34-SPMW-03 ND
34-MW9 ND
34-SPMW-02 ND
34-MW2 32
34-BIW1 170
34-MW3D 41
34-MW3 150
34-MW1 400
34-MW4 41
34-MW8 19
18-MW1 ND
36-MW2 ND
36-MW7 ND
36-MW6 ND
36-MW5 ND
36-MW1 ND
36-MW4 ND
SPRR5-MW1 ND
SPRR5-MW2 9J
SPRR5-MW3 ND
22A-MW5 300
22A-MW4 ND
22A-MW2 ND
34-MW6 530
22A-MW1 430
22A-MW3 32J
38-MW4 ND
22A-MW6 1300
22A-MW6D 1900
38-MW5 ND
38-MW2 ND
38-MW7 ND
38-MW3 ND
38-MW8 ND
38-MW9 9J
4270
4272
4274
4276
4278
4280
4282
4284
Plume Centerline
10
100
1000
N
APPROXIMATE SCALE
0'
300'
LEGEND
-10- Vinyl Chloride Isoconcentration Contour
4280 Groundwater Contour (Jun. 2000)
Groundwater Monitoring Well
35-MW2 Well Name
2 VC Concentration in ug/L.
Note:
1. Values are given in ug/L.
2. ND= Note detected.
3. J= Estimated value.
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE O-1
NORTH VINYL CHLORIDE PLUME
JUNE, 2000

1330-00



LEGEND

- 10 - Vinyl Chloride Isoconcentration Contour

4280 Groundwater Contour (Sep. 2000)

Groundwater Monitoring Well

35-MW2 Well Name

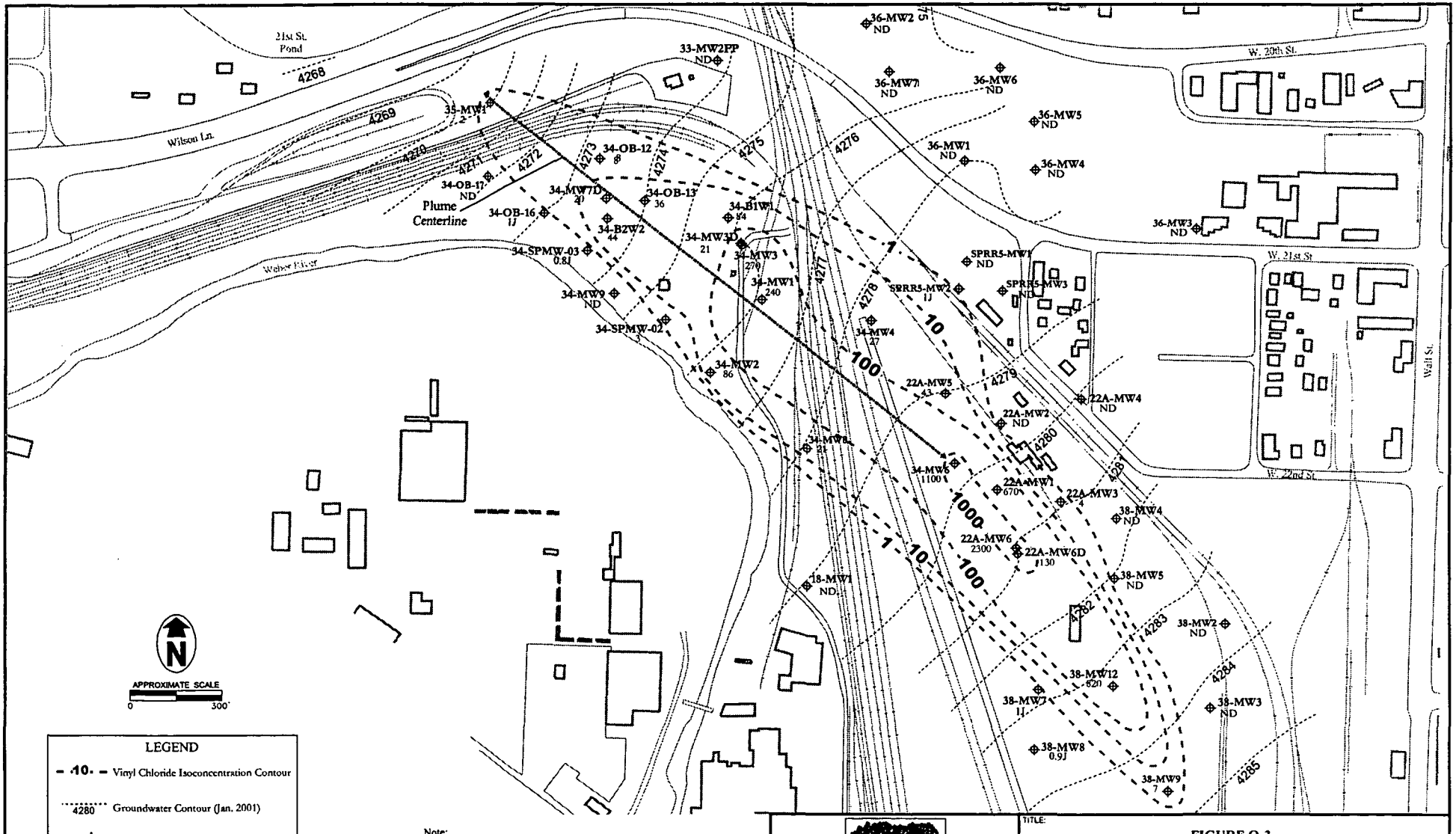
2 VC Concentration in ug/L

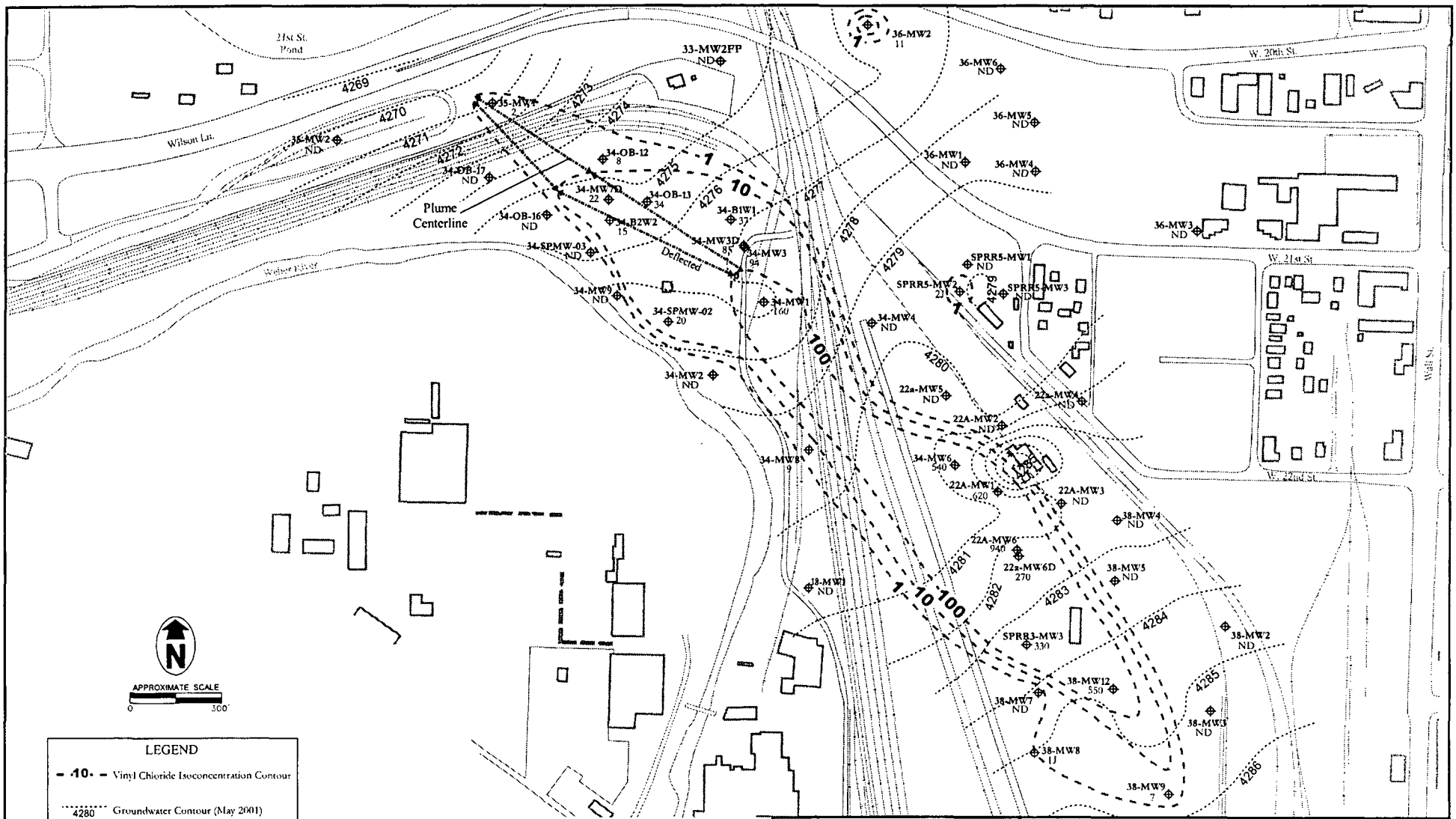
Note:
1. Values are given in ug/L.
2. ND= Not detected.
3. J= Estiimated value.

The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING

TITLE:

FIGURE O-2
NORTH VINYL CHLORIDE PLUME
SEPTEMBER, 2000


21st St. Pond
Wilson Ln.
Weber River
W. 20th St.
W. 21st St.
W. 22nd St.
Wall St.
Plume Centerline
33-MW2FP ND
35-MW1 2
34-OB-12 8
34-OB-17 ND
34-MW7D 40
34-OB-13 36
34-OB-16 1J
34-B1W1 94
34-B2W2 44
34-MW3D 21
34-MW3 270
34-MW1 240
34-SPMW-03 0.8J
34-MW9 ND
34-SPMW-02 5
34-MW2 86
34-MW4 27
34-MW8 21
34-MW6 1100
18-MW1 ND
36-MW2 ND
36-MW7 ND
36-MW6 ND
36-MW5 ND
36-MW1 ND
36-MW4 ND
36-MW3 ND
SPRR5-MW1 ND
SPRR5-MW2 1J
SPRR5-MW3 ND
22A-MW5 43
22A-MW2 ND
22A-MW4 ND
22A-MW1 670
22A-MW3 4
38-MW4 ND
22A-MW6 2300
22A-MW6D 1130
38-MW5 ND
38-MW2 ND
38-MW12 820
38-MW7 1J
38-MW3 ND
38-MW8 0.9J
38-MW9 7
4268
4269
4270
4271
4272
4273
4274
4275
4276
4277
4278
4279
4280
4281
4282
4283
4284
4285
1
10
100
1000
N
APPROXIMATE SCALE
0
300'
LEGEND
10 Vinyl Chloride Isoconcentration Contour
4280 Groundwater Contour (Jan. 2001)
Groundwater Monitoring Well
35-MW2 Well Name
2 VC Concentration in ug/L
Note:
1. Values are given in ug/L.
2. ND= Not detected.
3. J= Estiimated value.
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE O-3
NORTH VINYL CHLORIDE PLUME
JANUARY, 2001


21st St. Pond
Wilson Ln.
Walnut River
W. 20th St.
W. 21st St.
W. 22nd St.
Plume Centerline
Deflected
33-MW2PP ND
36-MW2 11
36-MW6 ND
36-MW5 ND
36-MW1 ND
36-MW4 ND
36-MW3 ND
35-MW2 ND
35-MW1 2
34-OB-12 8
34-OB-17 ND
34-MW7D 22
34-OB-13 34
34-OB-16 ND
34-B2W2 15
34-B1W1 37
34-MW3D 85
34-MW3 94
34-SPMW-03 ND
34-MW9 11 ND
34-SPMW-02 20
34-MW1 160
34-MW4 ND
34-MW2 ND
34-MW8 9
SPRR5-MW1 ND
SPRR5-MW2 21
SPRR5-MW3 ND
22a-MW5 ND
22a-MW4 ND
22A-MW2 ND
34-MW6 540
22A-MW1 620
22A-MW3 ND
38-MW4 ND
22A-MW6 940
22a-MW6D 270
38-MW5 ND
18-MW1 ND
SPRR3-MW3 330
38-MW2 ND
38-MW12 550
38-MW7 ND
38-MW3 ND
38-MW8 11
38-MW9 7
4269
4270
4271
4272
4273
4274
4275
4276
4277
4278
4279
4280
4281
4282
4283
4284
4285
4286
1
10
100
N
APPROXIMATE SCALE
0
300'
LEGEND
10 Vinyl Chloride Isoconcentration Contour
4280 Groundwater Contour (May 2001)
Groundwater Monitoring Well
35-MW2 Well Name
2 VC Concentration in ug/L
Note:
1. Values are given in ug/L.
2. ND= Not detected.
3. J= Estiimated value.
The Forrester Group
ENVIRONMENTAL MANAGEMENT & PLANNING
TITLE:
FIGURE O-4
NORTH VINYL CHLORIDE PLUME
MAY, 2001

MEMORANDUM

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

Date: February 11, 2003

To: File

From: Jay Hoskins

Subject: Natural Attenuation Screening Protocol
Ogden Rail Yard North CVOC Plume

The Natural Attenuation Screening Protocol (the "Screening Protocol") was applied to the north CVOC plume at the Ogden Rail Yard. The purpose of this exercise was

- To estimate the potential for natural attenuation of chlorinated solvents based on existing data and
- To evaluate the need for additional data collection for demonstrating natural attenuation.

The biodegradation modeling program BIOCHLOR contains a convenient tool that was used to execute the Screening Protocol. The *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA, 1998) was used as a reference during the screening process.

EVALUATION OF EXISTING DATA

The Screening Protocol was used to evaluate data collected from the "most contaminated zone" (USEPA, 1998) at the site and score the data to test the likelihood that biodegradation is occurring. For this plume, the area that appears to be impacted greatest is generally located between 38-MW12 and the well pair 22a-MW6/6D, where a machine shop historically operated. This is an area where 1,1,1-TCA, TCE, 1,1-DCE, and VC have all been detected at relatively high concentrations (see Figure 6-3 of the Draft RI Report). Data collected from 38-MW12 and the well pair 22a-MW6/6D were used as representative data.

Data were taken from the Draft RI Report, Data Summary Reports, and field data sheets. The data used in the analysis are summarized in Table O-11. For each of the wells, parameters in Table O-11 were compared to the Screening Protocol's criteria. If the comparison required comparison to a background well, data from 38-MW2 were used because this well is generally upgradient of 22a-MW6/6D and CVOCs have not been detected. A decision was answered affirmatively only if at least two of the wells met the Screening Protocol's criteria. If data were not available to satisfy a criterion, then a decision on that criterion was not made.

The attached table from BIOCHLOR (Table O-12) shows the inputs that went into the site score. The site score was 19, which can be interpreted as there is adequate evidence for anaerobic biodegradation of chlorinated organics. The *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* recommends proceeding to the next step of the natural attenuation screening evaluation for scores of 15 or higher. Some decision inputs may warrant special discussion, as provided below.

- Dissolved oxygen (DO) measurements were taken using DO probe (i.e. meter) and with a testing kit. For a given monitoring event, the measured concentrations varying as much as 6 times between the

two methods, with kit measurements generally higher than probe measurements. Additionally, for two of the wells, a larger variation occurred between the two kit measurements (varying by factor of 2 at 38-MW12 and 22a-MW6D). Given the variability in kit method data, only the probe (meter) measurements were used in the screening protocol. Based on the probe (meter) measurements, it was determined that the DO concentration in the most contaminated zone was less than 0.5 mg/L. This conclusion is supported by the kit measurements at 22a-MW6, where DO concentrations were consistent and only slightly above the 0.5 mg/L criteria (0.55 and 0.61 mg/L, respectively).

- Corrected Eh records were available for only one sampling event. The final Eh measurement from each well was below 50 mV, therefore 1 point was awarded. With or without this 1 point, the site score is adequate for determining that adequate evidence for anaerobic degradation exists.

- Benzene, toluene, ethyl benzene, and xylenes (BTEX) were detected in groundwater measurements, and the BTEX concentration was calculated as the sum of the individual constituent concentrations. If a constituent was not detected, its assumed concentration was 0. BTEX concentrations at the site were below the 0.1 mg/L criterion, and therefore no points were awarded.

  One main purpose of the BTEX criterion is for determining if sufficient carbon is available to drive the reductive dechlorination process. Diesel, which has a chemical makeup containing little BTEX, is likely providing other forms of organic carbon (e.g. PAHs) for reducing the chlorinated ethenes. However, the Screening Protocol does not factor these other constituents.

- TCE was detected in all three wells, however based on the available information, it cannot be determined if the detected TCE is a daughter product and/or was released at the site. Low levels of PCE were detected at 38-MW12 and 22a-MW6, and this indicates that PCE could be a parent compound of TCE. However, TCE was possibly used in industrial activities at the site.

ADDITIONAL DATA COLLECTION

Seven parameters were determined to not have enough data to accurately interpret them in the Screening Protocol. The parameters were the following:

- Sulfide
- Methane
- Carbon dioxide
- Hydrogen
- Volatile Fatty Acids (VFAs)
- TCE (Material released or daughter product of PCE dechlorination)

- Ethene/Ethane

Additional data collection on these parameters is not necessary to complete the Screening Protocol because the site score is adequate for determining that biodegradation is occurring. Because of this, any additional data collection should refine the site conceptual model and/or help evaluate remedial alternatives for the site. Sulfide, carbon dioxide, hydrogen, and VFA measurements are helpful for determining if the conditions are right for biodegradation of chlorinated ethenes. However, these parameters provide little value in improving the understanding of what pathways are transforming the chlorinated ethenes. In addition, whether TCE is a product of biotransformation or was released makes little difference because TCE is well attenuated downgradient of the "most contaminated area".

VC is the constituent of greatest concern in groundwater because of its wide distribution and its high concentration relative to its screening level. Detectable levels of methane, ethane, and ethene would indicate that VC is being biodegraded. The analytical method previously used to evaluate methane, ethane, and ethene was not able to detect these compounds, and this was likely due to the elevated analytical limits that were used. Testing additional samples with an analytical method that has lower methane, ethene, ethane detection limits will be performed.

UPRR Ogden Rail Yard
Table O-11
Summary Table of Data Evaluated in Natural Attenuation Protocol
2/11/2003

Parameter	Units	38-MW12	22a-MW6	22a-MW6D	38-MW2	Notes
Oxygen (meter)	mg/L	0.2-0.3	0.2-0.3	0.2-0.7	--	Based on two sampling events
Nitrate	mg/L	0.15U	0.15U	0.15U	--	Based on two sampling events
Iron II	mg/L	8.8	6.95-7.2	3.4-3.5	--	Based on two sampling events
Sulfate	mg/L	79.4-105	49.6-56.3	17.1-18.7	--	Based on two sampling events
Corrected Eh	mV	-85	-61	-108	--	Based on one sampling event
pH	--	6.8-7	6.5-7.8	6.5-7.4	--	
TOC	mg/L	18.2	16-20.4	15-25	--	Based on two sampling events
Temperature	°C	11-22.6	10-18.8	10-18.4	--	
Alkalinity	mg/L	477-520	579-585	567-599	386-467	Based on two sampling events
Chloride	mg/L	79.2-108	128-164	282-411	71.8-79.2	Based on two sampling events
Benzene	ug/L	2-3	4-8	2-3	--	
Toluene	ug/L	3-7	1-3	1U-1	--	
Ethylbenzene	ug/L	6-8	2-5	0.5J-2	--	
Xylenes (Total)	ug/L	18-20	3J-7	1-2	--	
BTEX (Total)	ug/L	29-38	10-23	4.5-8	--	
PCE	ug/L	5-7	0.7-1U	1U	--	
cis 1,2-DCE	ug/L	3500	2000-3700	540-870	--	
trans 1,2-DCE	ug/L	14J	10J-37	2-13	--	
1,2-DCE (total)	ug/L	3000-5300	800-3700	42-870	--	
VC	ug/L	550-710	870-1300	130-1900	--	
1,1,1-TCA	ug/L	2200-4100	180-580	3-76	--	
1,1-DCA	ug/L	870-1200	28-66	170-810	--	
Chloroethane	ug/L	160-190	43-160	49-120	--	

Notes:
Unless stated otherwise, ranges for 22a-MW6/6D are based on four sampling events and ranges for 38-MW12 are based on three sampling events.
Cis-1,2-DCE and trans-1,2-DCE ranges are based on two sampling events, except for 38-MW12.

UPRR Ogden Rail Yard
Table O-12
Natural Attenuation Screening Protocol Results
2/11/2003

Natural Attenuation Screening Protocol	Interpretation	Score	
The following is taken from the USEPA protocol (USEPA, 1998). The results of this scoring process have no regulatory significance.	Inadequate evidence for anaerobic biodegradation* of chlorinated organics	0 to 5	Score: 19
	Limited evidence for anaerobic biodegradation* of chlorinated organics	6 to 14	
	Adequate evidence for anaerobic biodegradation* of chlorinated organics	15 to 20	
	Strong evidence for anaerobic biodegradation* of chlorinated organics	>20	Scroll to End of Table

* reductive dechlorination

Analysis	Concentration in Most Contam. Zone	Interpretation	Yes	No	Points Awarded
Oxygen*	<0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations	●	○	3
	>5mg/L	Not tolerated; however, VC may be oxidized aerobically	○	●	0
Nitrate*	<1 mg/L	At higher concentrations may compete with reductive pathway	●	○	2
Iron II*	>1 mg/L	Reductive pathway possible; VC may be oxidized under Fe(III)-reducing conditions	●	○	3
Sulfate*	<20 mg/L	At higher concentrations may compete with reductive pathway	○	●	0
Sulfide*	>1 mg/L	Reductive pathway possible	○	○	0
Methane*	<0.5 mg/L	VC oxidizes	○	○	0
	>0.5 mg/L	Ultimate reductive daughter product, VC Accumulates	○	○	0
Oxidation Reduction Potential* (ORP)	<50 millivolts (mV)	Reductive pathway possible	●	○	1
	<-100mV	Reductive pathway likely	○	●	0
pH*	5 < pH < 9	Optimal range for reductive pathway	●	○	0
	5 > pH >9	Outside optimal range for reductive pathway	○	●	0
TOC	>20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	○	●	0
Temperature*	>20°C	At T >20°C biochemical process is accelerated	○	●	0
Carbon Dioxide	>2x background	Ultimate oxidative daughter product	○	○	0
Alkalinity	>2x background	Results from interaction of carbon dioxide with aquifer minerals	○	●	0
Chloride*	>2x background	Daughter product of organic chlorine	●	○	2
Hydrogen	>1 nM	Reductive pathway possible, VC may accumulate	○	○	0
	<1 nM	VC oxidized	○	○	0
Volatile Fatty Acids	>0.1 mg/L	Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source	○	○	0
BTEX*	>0.1 mg/L	Carbon and energy source; drives dechlorination	○	●	0
PCE*		Material released	●	○	0
TCE*		Material released	○	○	0
		Daughter product of PCE a/	○	○	0
DCE*		Material released	○	●	0
		Daughter product of TCE. If cis is greater than 80% of total DCE it is likely a daughter product of TCE a/; 1,1-DCE can be a chem. reaction product of TCA	●	○	2
VC*		Material released	○	●	0
		Daughter product of DCE a/	●	○	2
1,1,1-Trichloroethane*		Material released	●	○	0
DCA		Daughter product of TCA under reducing conditions	●	○	2
Carbon Tetrachloride		Material released	○	●	0
Chloroethane*		Daughter product of DCA or VC under reducing conditions	●	○	2
Ethene/Ethane	>0.01 mg/L	Daughter product of VC/ethene	○	○	0
	>0.1 mg/L	Daughter product of VC/ethene	○	○	0
Chloroform		Material released	○	●	0
		Daughter product of Carbon Tetrachloride	○	●	0
Dichloromethane		Material released	○	●	0
		Daughter product of Chloroform	○	●	0

* required analysis.
a/ Points awarded only if it can be shown that the compound is a daughter product (i.e., not a constituent of the source NAPL).

SCORE Reset

End of Form

MEMORANDUM

THE FORRESTER GROUP
INSIGHTFUL ENVIRONMENTAL SOLUTIONS™

Date: March 6, 2003

To: File

From: Jay Hoskins

Subject: UPRR Ogden Railroad
Southern Vinyl Chloride Plume

This memorandum presents support information for evidence presented in Section 5.2.2. It is not intended as a definitive environmental analysis or specification of required detection limits. The analysis of the vinyl chloride source and soil partitioning coefficient for the northern plume applies to the southern plume. The analysis consists of two parts listed below.

- Groundwater flow velocity
- Steady state plume analysis

GROUNDWATER FLOW VELOCITY

Input Parameters

Hydraulic Conductivity = K = 0.1 cm/s = 3.28×10^{-3} ft/s (Source: Section 3.6.2)

Hydraulic Gradient = i = 0.008 ft/ft (Source: Section 3.6.2)

Effective Porosity = n = 0.2 (Source: Section 3.6.2)

Based on Darcy's Law, what is the velocity of groundwater that is flowing through the soil pore space?

Darcy's Flux = $v_d = K \times i$ (Source: Hazardous Waste Management, La Grega et al., 1999)

$v_d = 3.28 \times 10^{-3}$ ft/s x 0.008 ft/ft = 2.62×10^{-5} ft/s = 2.3 ft/day

Velocity = $v = v_d / n$ (Source: Hazardous Waste Management, La Grega et al., 1999)

v = 2.3 ft/day / 0.2 = 11.3 ft/day

STEADY STATE PLUME ANALYSIS

Vinyl chloride concentration data from monitoring wells in the vicinity of the south plume (AOIs -30, -21, -22b, -26, and -30) were examined to determine if the plume is at steady state, expanding, or shrinking. Table O-13 provides the data that were considered. Vinyl chloride was

detected in 12 monitoring wells located in the south plume AOIs. Of these 12, only 7 of these wells had detections of VC in at least 3 of the 4 monitoring events.

Vinyl chloride data from these 7 wells were plotted on Chart O-5 and O-6 to graphically show how concentrations in the plume varied over time. A trend analysis was performed for each of these wells to help illustrate concentration changes in time. The steeper the slope, the stronger the indication that that concentrations are changing. Declining or increasing concentrations in monitoring wells are an indication that the plume is shrinking or expanding, respectively. Flat slopes indicate that concentrations are not changing over time. This analysis was not used to determine the exact nature of the relationship between concentration and time, but rather to learn the general relationship (i.e., increasing, decreasing, or unchanging).

Chart O-5 shows groundwater concentration data that was collected from June 2000 to May 2001. In the first monitoring event, vinyl chloride was not detected in either 26-MW2 or 26-STMW1. This may have been due to the higher detection limit (10 ug/L), as vinyl chloride was measured in these wells in other monitoring events at levels below 10 ug/L. As shown by the trend lines in Chart O-5, no definite trend was observed for wells 22b-MW2D, 30-MW1, and 21-MW2, suggesting concentrations in these wells were unchanging. Trend lines for wells 30-MW6D, 22b-MW1, 26-MW2, and 26-STMW-1 illustrate decreasing concentrations over time.

Chart O-6 shows groundwater concentration data that was collected in the last 3 sampling events (September 2000 to May 2001). For each of the 7 wells, the trend lines illustrate decreasing concentrations over time. Based on the data from the most recent sampling events, it appears that the plume is shrinking. Additional sampling over time is needed to confirm this as it may also be a function of seasonal fluctuation.

Sampling results at 30-MW6D were fit to an exponential trend line and the equation of the trend line was determined. This well was chosen because of all the south plume wells, the detected concentrations in this well were highest and the concentration change was greatest (2000-310 ug/L). Concentrations consistently decreased over time, and the data fits well to the exponential regression analysis (as indicated by an R^2=0.95 and the proximity of all the data points to the line). Shrinking plumes generally follow an exponential regression trend. Therefore, it is reasonable to concluded that concentrations in 30-MW6D are decreasing over time.

From September 2000 to May 2001, the VC concentrations at 26-MW2 and 26-STMW-1 consistently decreased from 4 to 1 ug/L and 3 to 1 ug/L, respectively. Based on the present trend and the low levels of vinyl chloride detected in these wells, one could anticipate that additional sampling may not detect VC above the site screening level. Additional sampling will be performed to determine if vinyl chloride levels are below screening levels and if levels have continued to decrease.

Conclusion

The trend analysis indicates that plume concentrations are likely decreasing over time. Concentrations decreased in the last three monitoring event for seven plume monitoring wells;

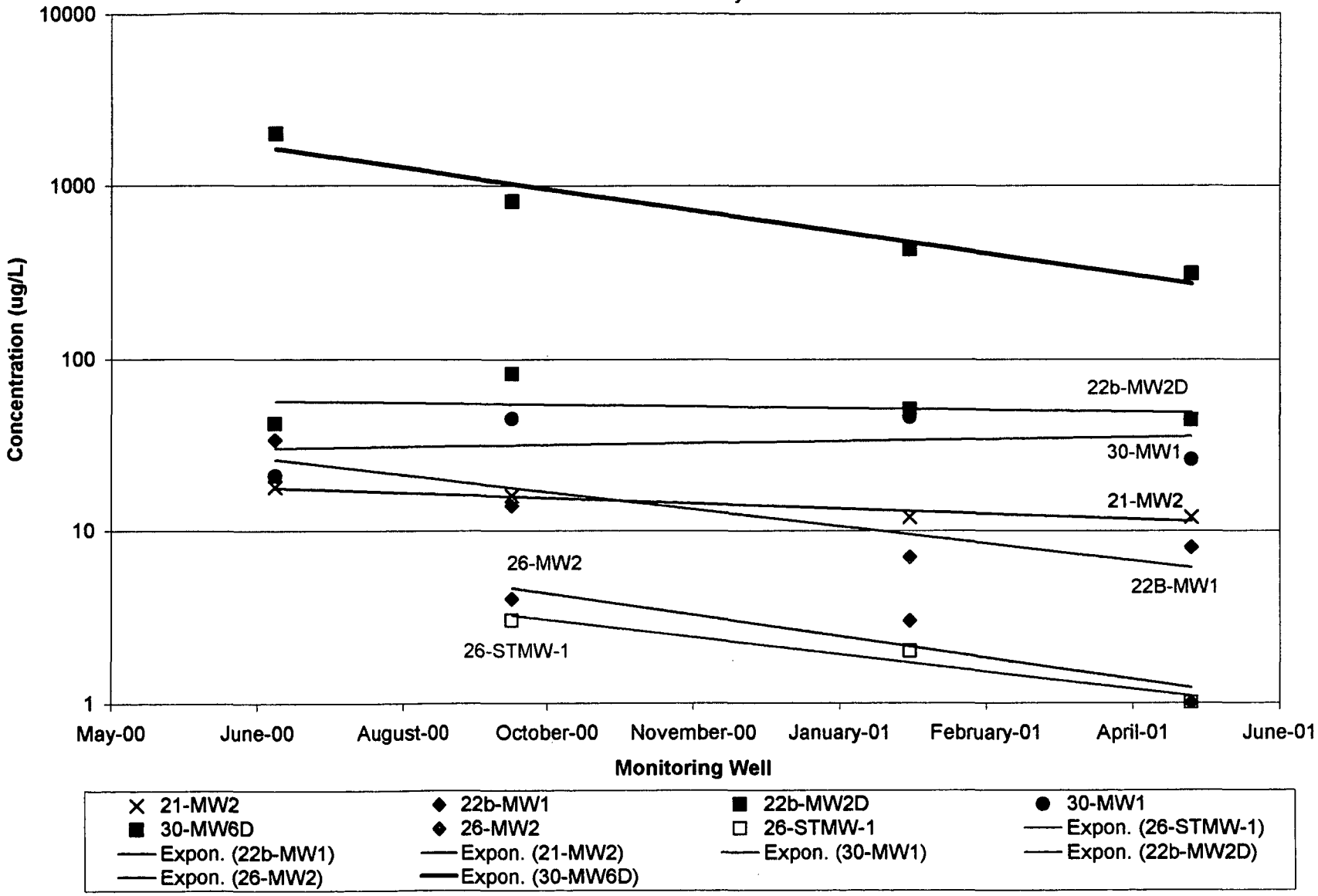
some of these wells show decreasing trends over all four monitoring events. This conclusion is especially supported by data at 30-MW6D, where sampling results decreased exponentially over time. Additional monitoring data will be collected from south plume monitoring wells to confirm that concentrations are continuing to decrease and that the plume is shrinking.

UPRR Ogden Rail Yard
Table O-13
South Plume Monitoring Wells
VC Concentration vs. Time

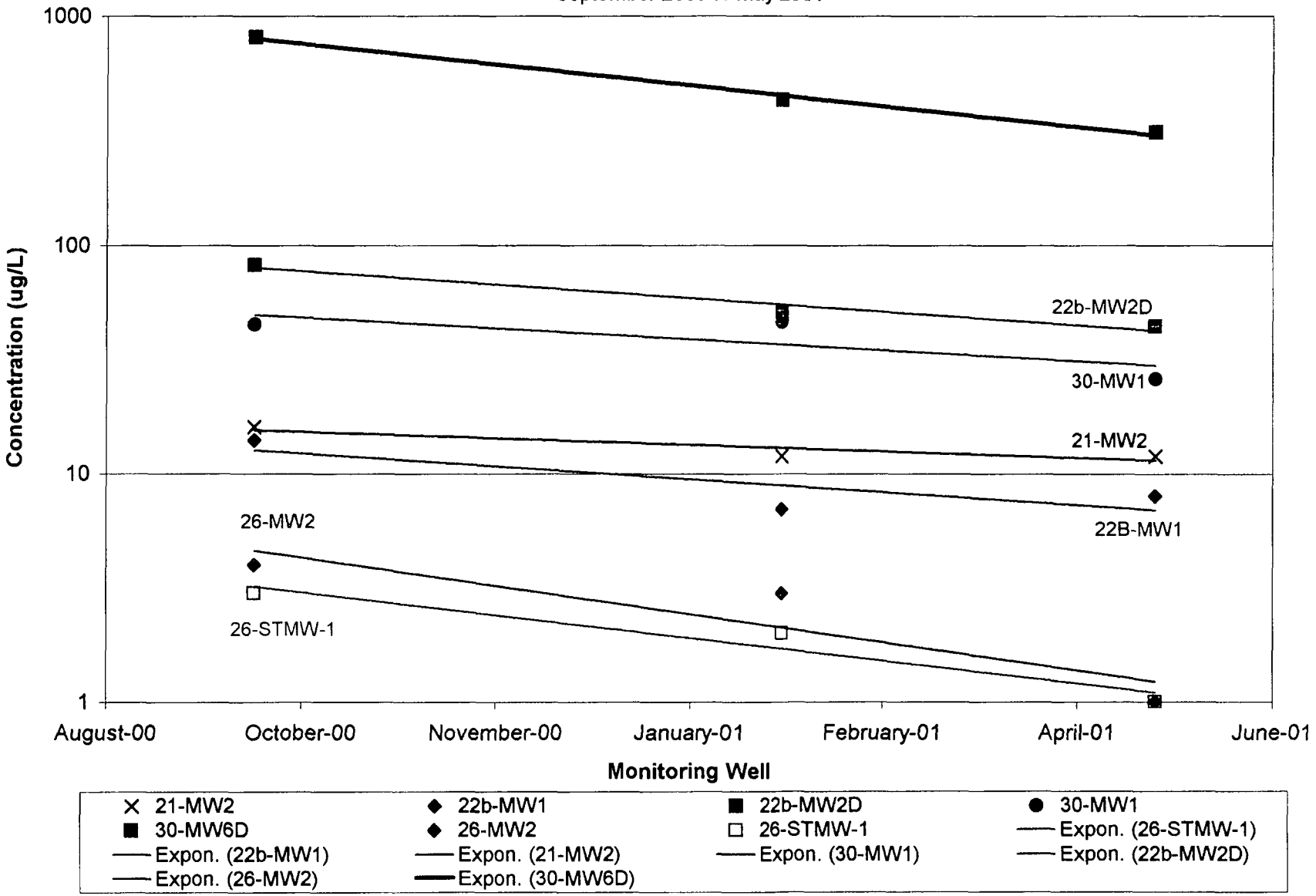
Monitoring Well	Units	June 2000	September 2000	February 2001	May 2001
20-MW1	ug/L	< 10	< 1	< 2	< 2
20-MW2	ug/L	< 10	< 1	< 2	< 2
20-MW3D	ug/L	< 10	< 1	< 2	0.6 J
21-MW1	ug/L	< 10	< 1	< 2	< 2
21-MW2	ug/L	18	16	12	12
21-MW3	ug/L	NA	41	8	NA
22b-MW1	ug/L	34	14	7	8
22b-MW2D	ug/L	42	82	51	44
26-MW1	ug/L	< 10 J	0.5 J	< 2	0.5 J
26-MW2	ug/L	< 10	4	3	1
26-STMW-1	ug/L	< 10 J	3	2	1
30-MW1	ug/L	21	45	46	26
30-MW2	ug/L	< 10 J	< 1	< 2	0.5 J
30-MW4	ug/L	< 10 J	< 1	0.7 J	< 2
30-MW-3	ug/L	< 10 J	< 1	< 2	< 2
30-MW6D	ug/L	2000	810	430	310
30-MW7	ug/L	< 10	< 1	2 J	3

Notes:
NA: Data not available

UPRR Ogden Rail Yard
Chart O-5
South Plume Monitoring Wells
VC Concentration vs. Time
June 2000 to May 2001



UPRR Ogden Rail Yard
Chart O-6
South Plume Monitoring Wells
Vinyl Chloride Concentration vs. Time
September 2000 to May 2001



United States Environmental Protection Agency
R.S. Kerr Environmental Research Laboratory
Office of Solid Waste and Emergency Response
Publication: 9355.4-07FS
January 1992

EPA

Estimating Potential for Occurrence of DNAPL at Superfund Sites

Office of Emergency and Remedial Response
Hazardous Site Control Division (OS-220W)

Quick Reference Fact Sheet

GOALS

The presence of Dense Nonaqueous Phase Liquids (DNAPL) in soils and aquifers can control the ultimate success or failure of remediation at a hazardous waste site. Because of the complex nature of DNAPL transport and fate, however, DNAPL may often be undetected by direct methods, leading to incomplete site assessments and inadequate remedial designs. Sites affected by DNAPL may require a different "paradigm," or conceptual framework, to develop effective characterization and remedial actions (2).

To help site personnel determine if DNAPL-based characterization strategies should be employed at a particular site, a guide for estimating the potential for DNAPL occurrence was developed. The approach, described in this fact sheet, requires application of two types of existing site information:

- **Historical Site Use Information**
- **Site Characterization Data**

By using available data, site decision makers can enter a system of two flowcharts and a classification matrix for estimating the potential for DNAPL occurrence at a site. If the potential for DNAPL occurrence is low, then conventional site assessment and remedial actions may be sufficient. If the potential for DNAPL is moderate or high, however, a different conceptual approach may be required to account for problems associated with DNAPL in the subsurface.

BACKGROUND

DNAPLs are separate-phase hydrocarbon liquids that are denser than water, such as chlorinated solvents (either as a single component or as mixtures of solvents), wood preservative wastes, coal tar wastes, and pesticides. Until recently, standard operating practice in a variety of industries resulted in the release of large quantities of DNAPL to the subsurface. Most DNAPLs undergo only limited degradation in the subsurface, and persist for long periods while slowly releasing soluble organic constituents to ground water through dissolution. Even with a moderate DNAPL release, dissolution may continue for hundreds of years or longer under natural conditions before all the DNAPL is dissipated and concentrations of soluble organics in ground water return to background levels.

DNAPL exists in the soil/aquifer matrix as free-phase DNAPL and residual DNAPL. When released at the surface, free-phase DNAPL moves downward through the soil matrix under the force of gravity or laterally along the surface of sloping fine-grained stratigraphic units. As the free-phase DNAPL moves, blobs or ganglia are trapped in pores and/or fractures by capillary forces (7). The amount of the trapped DNAPL, known as residual saturation, is a function of the physical properties of the DNAPL and the hydrogeologic characteristics of the soil/aquifer medium and typically ranges from 5% to 50% of total pore volume. At many sites, however, DNAPL migrates preferentially through small-scale fractures and heterogeneities in the soil, permitting the DNAPL to penetrate much deeper than would be predicted from application of typical residual saturation values (16).

Once in the subsurface, it is difficult or impossible to recover all of the trapped residual DNAPL. The conventional aquifer remediation approach, ground water pump-and-treat, usually removes only a small fraction of trapped residual DNAPL (11, 21, 26). Although many DNAPL removal technologies are currently being tested, to date there have been no field demonstrations where sufficient DNAPL has been successfully recovered from the subsurface to return the aquifer to drinking water quality. The DNAPL that remains trapped in the soil/aquifer matrix acts as a continuing source of dissolved contaminants to ground water, preventing the restoration of DNAPL-affected aquifers for many years.

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DNAPL TRANSPORT AND FATE - CONCEPTUAL APPROACHES

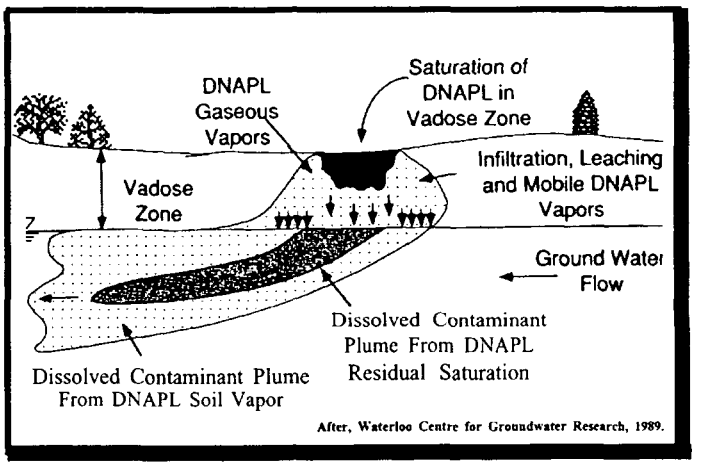
The major factors controlling DNAPL migration in the subsurface include the following (5):

- the volume of DNAPL released;
- the area of infiltration at the DNAPL entry point to the subsurface;
- the duration of release;
- properties of the DNAPL, such as density, viscosity, and interracial tension;
- properties of the soil/aquifer media, such as pore size and permeability;
- general stratigraphy, such as the location and topography of low-permeability units;
- micro-stratigraphic features, such as root holes, small fractures, and slickensides found in silt/clay layers.

To describe the general transport and fate properties of DNAPL in the subsurface, a series of conceptual models (24) are presented in the following figures:

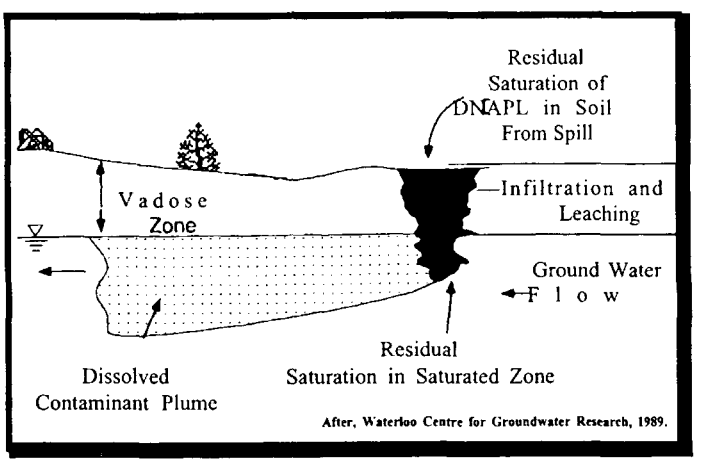
Case 1: DNAPL Release to Vadose Zone Only

After release on the surface, DNAPL moves vertically downward under the force of gravity and soil capillarity. Because only a small amount of DNAPL was released, all of the mobile DNAPL is eventually trapped in pores and fractures in the unsaturated zone. Infiltration through the DNAPL zone dissolves some of the soluble organic constituents in the DNAPL, carrying organics to the water table and forming a dissolved organic plume in the aquifer. Migration of gaseous vapors can also act as a source of dissolved organics to ground water (13).



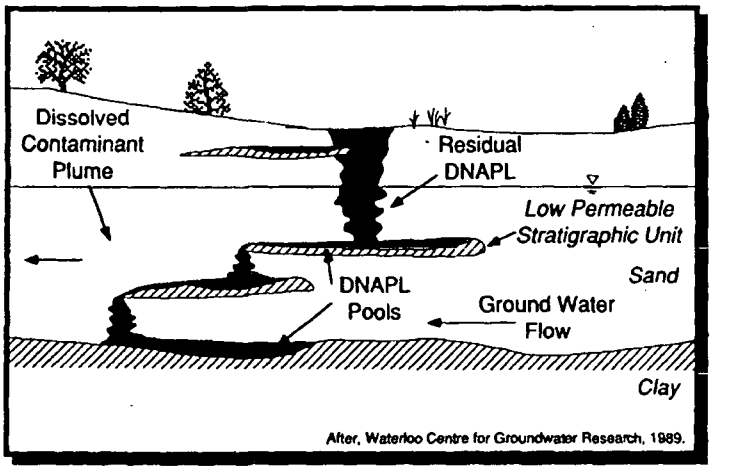
Case 2: DNAPL Release to Unsaturated and Saturated Zones

If enough DNAPL is released at the surface, it can migrate all the way through the unsaturated zone and reach a water-bearing unit. Because the specific gravity of DNAPL is greater than water, it continues downward until the mobile DNAPL is exhausted and is trapped as a residual hydrocarbon in the porous media. Ground water flowing past the trapped residual DNAPL dissolves soluble components of the DNAPL, forming a dissolved plume downgradient of the DNAPL zone. As with Case 1, water infiltrating down from the source zone also carries dissolved constituents to the aquifer and contributes further to the dissolved plume.



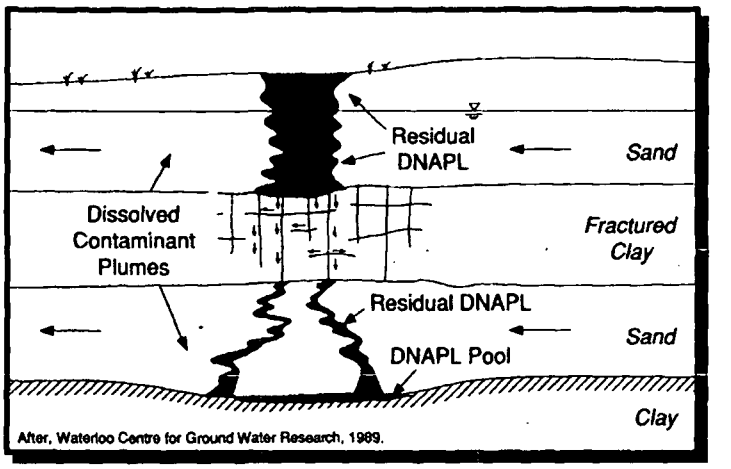
Case 3: DNAPL Pools and Effect of Low-Permeability Units

Mobile DNAPL will continue vertical migration until it is trapped as a residual hydrocarbon (Case 1 and Case 2) or until low-permeability stratigraphic units are encountered which create DNAPL "pools" in the soil/aquifer matrix. In this figure, a perched DNAPL pool fills up and then spills over the lip of the low-permeability stratigraphic unit. The spill-over point (or points) can be some distance away from the original source, greatly complicating the process of tracking the DNAPL migration.



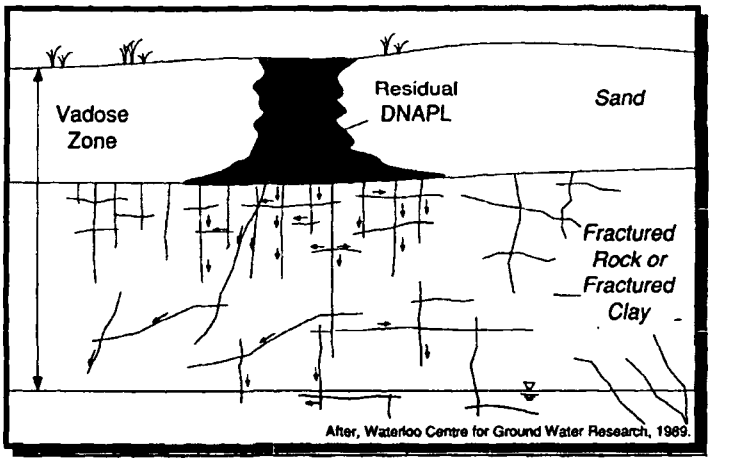
Case *4:* Composite Site

In this case, mobile DNAPL migrates vertically downward through the unsaturated zone and the first saturated zone, producing a dissolved constituent plume in the upper aquifer. Although a DNAPL pool is formed on the fractured clay unit, the fractures are large enough to permit vertical migration downward to the deeper aquifer (see Case 5, below). DNAPL pools in a topographic low in the underlying impermeable unit and a second dissolved constituent plume is formed.



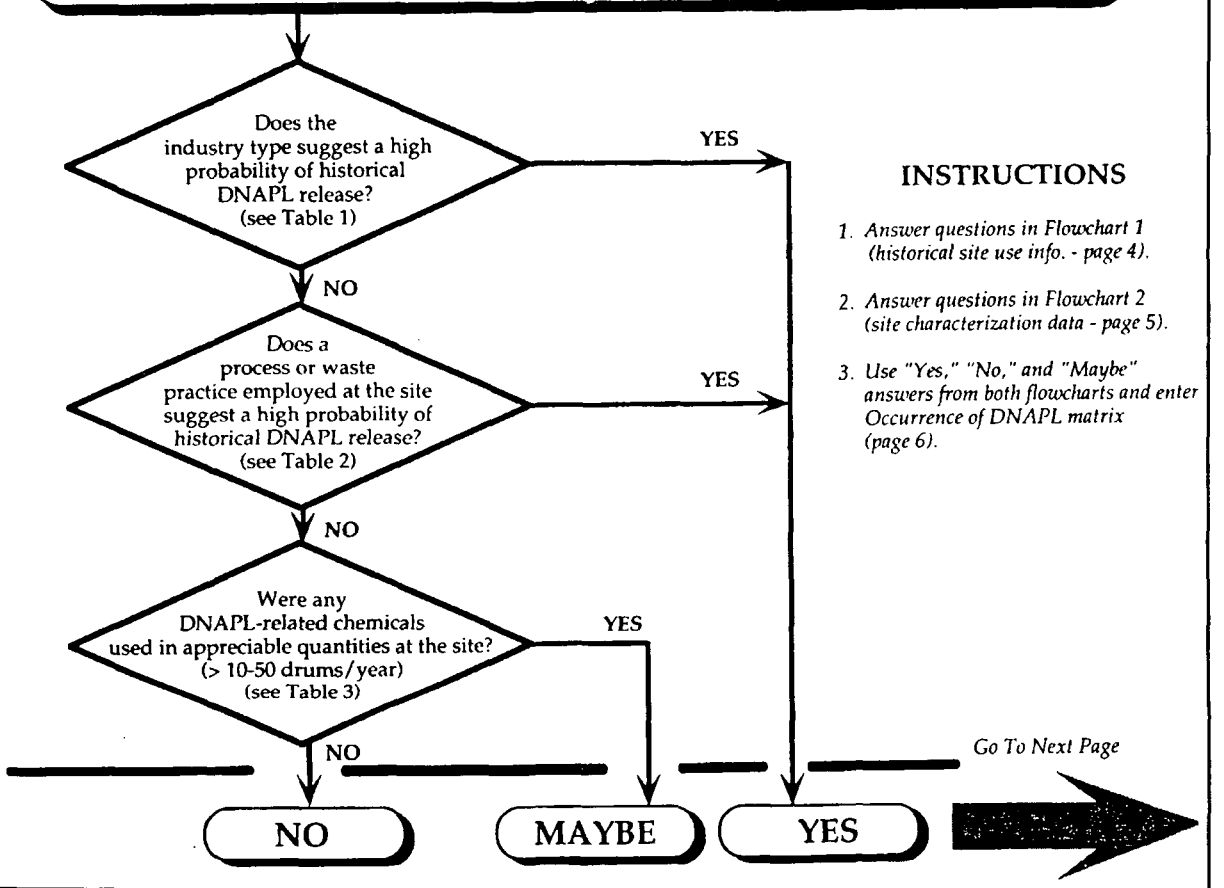
Case *5:* Fractured Rock or Fractured Clay System

DNAPL introduced into a fractured rock or fractured clay system follows a complex pathway based on the distribution of fractures in the original matrix. The number, density, size, and direction of the fractures usually cannot be determined due to the extreme heterogeneity of a fractured system and the lack of economical aquifer characterization technologies. Relatively small volumes of DNAPL can penetrate deeply into fractured systems due to the low retention capacity of the fractures and the ability of some DNAPLs to migrate through very small (< 20 microns) fractures. Many clay units, once considered to be relatively impermeable to DNAPL migration, often act as fractured media with preferential pathways for vertical and horizontal DNAPL migration.



Occurrence of DNAPL - Decision Chart 1

Does Historical Site Use Information Indicate Presence of DNAPL?



INSTRUCTIONS

1. *Answer questions in Flowchart 1 (historical site use info. - page 4).*
2. *Answer questions in Flowchart 2 (site characterization data - page 5).*
3. *Use "Yes," "No," and "Maybe" answers from both flowcharts and enter Occurrence of DNAPL matrix (page 6).*

TABLE 1

Industries with high probability of historical DNAPL release:

- Wood preservation (creosote)
- Old coal gas plants (mid-1800s to mid-1900s)
- Electronics manufacturing
- Solvent production
- Pesticide manufacturing
- Herbicide manufacturing
- Airplane maintenance
- Commercial dry cleaning
- Instrument manufacturing
- Transformer oil production
- Transformer reprocessing
- Steel industry coking operations (coal tar)
- Pipeline compressor stations

TABLE 2

Industrial processes or waste disposal practices with high probability of historical DNAPL release:

- Metal cleaning/decreasing
- Metal machining
- Tool-and-die operations
- Paint removing/stripping
- Storage of solvents in underground storage tanks
- Storage of drummed solvents in uncontained storage areas
- Solvent loading and unloading
- Disposal of mixed chemical wastes in landfills
- Treatment of mixed chemical wastes in lagoons or ponds

TABLE 3 DNAPL-Related Chemicals (20):

Halogenated Volatiles

Chlorobenzene
1,2-Dichloropropane
1,1-Dichloroethane
1,1-Dichloroethylene
1,2-Dichloroethane
Trans-1,2-Dichloroethylene
Cis-1,2-Dichloroethylene
1,1,1-Trichloroethane
Methylene Chloride
1,1,2-Trichloroethane
Trichloroethylene
Chloroform
Carbon Tetrachloride
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
Ethylene Dibromide

Halogenated Semi-Volatiles

1,4-Dichlorobenzene
1,2-Dichlorobenzene
Aroclor 1242, 1254, 1260
Chlordane
Dieldrin
2,3,4,6-Tetrachlorophenol
Pentachlorophenol

Non-Halogenated Semi-Volatiles

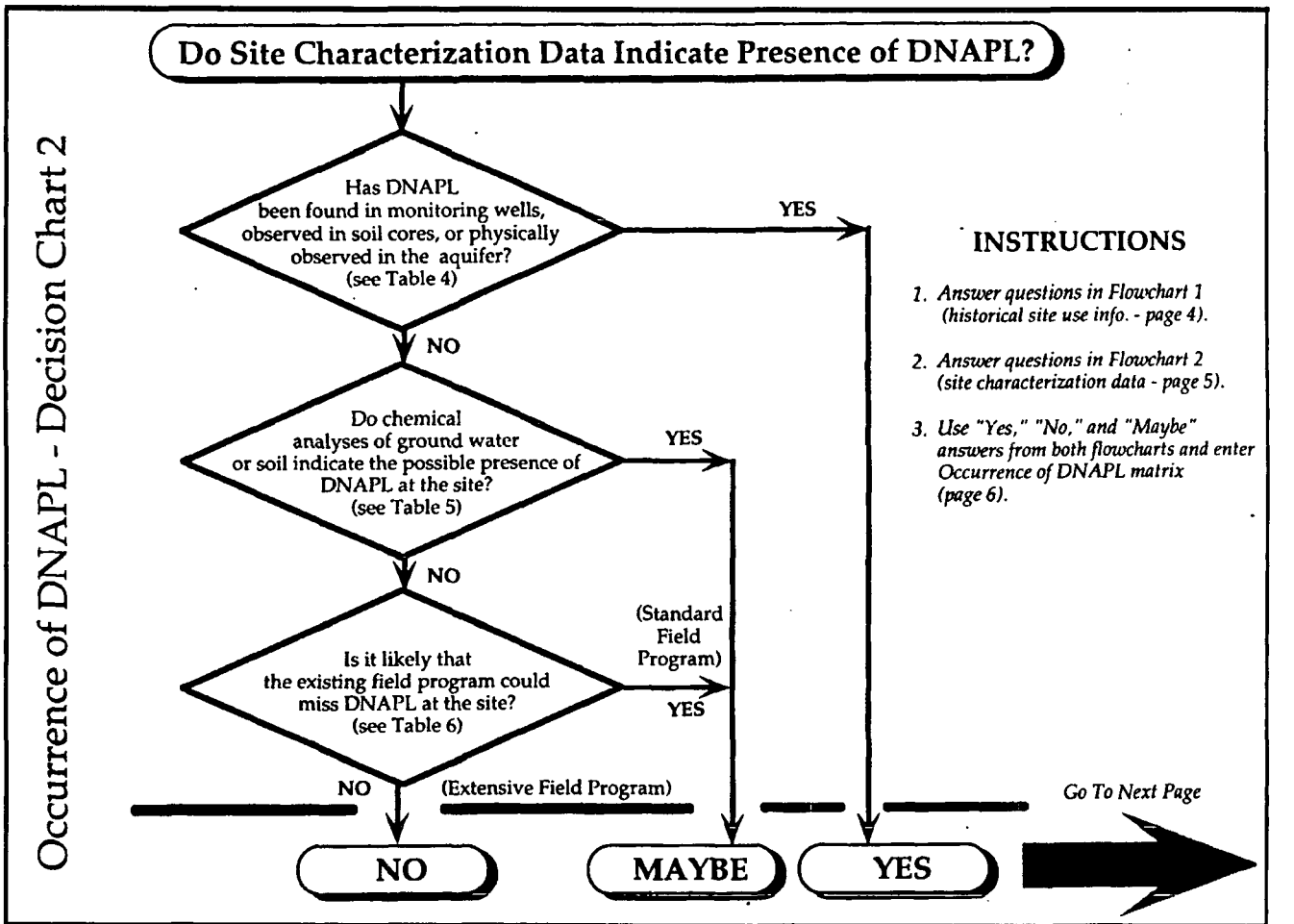
2-Methyl Napthalene
o-Cresol
p-Cresol
2,4-Dimethylphenol
m-Cresol
Phenol
Naphthalene
Benzo(a)Anthracene
Fluorene
Acenaphthene
Anthracene
Dibenzo(a,h)Anthracene
Fluoranthene
Pyrene
Chrysene
2,4-Dinitrophenol

Miscellaneous

Coal Tar
Creosote

Note: Many of these chemicals are found mixed with other chemicals or carrier oils.

Note:
The potential for DNAPL release increases with the size and active period of operation for a facility, industrial process, or waste disposal practice.



INSTRUCTIONS

1. *Answer questions in Flowchart 1 (historical site use info. - page 4).*
2. *Answer questions in Flowchart 2 (site characterization data - page 5).*
3. *Use "Yes," "No," and "Maybe" answers from both flowcharts and enter Occurrence of DNAPL matrix (page 6).*

TABLE 4

Methods to confirm DNAPL in wells:

- NAPL/water interface probes that signal a change in conductivity of the borehole fluid
- Weighted cotton string lowered down well
- Pumping and inspecting recovered fluid
- Transparent bottom-loading bailers
- Mechanical discrete-depth samplers.

In general, the depth of DNAPL accumulation does not provide quantitative information regarding the amount of DNAPL present (24).

Methods to confirm DNAPL in soil samples

Visual examination of cores or cuttings may not be effective for confirming the presence of DNAPL except in cases of gross DNAPL contamination. Methods for enhancing visual inspection of soil samples for DNAPL include:

- Shaking soil samples in a jar with water to separate the DNAPL from the soil (14).
- Performing a paint filter test, in which soil is placed in a filter funnel, water is added, and the filter is examined for separate phases (20).

TABLE 5

Conditions that indicate potential for DNAPL at site based on laboratory data:

Condition 1:
Concentrations of DNAPL-related chemicals (see pg. 3) in ground water are> 1% of pure phase volubility or effective volubility, (defined in Worksheet 1, pg. 7) (25).

Condition 2:
Concentrations of DNAPL-related chemicals on soils are >10,000 mg/kg (equal to 1 % of soil mass) (6).

Condition 3:
Concentrations of DNAPL-related chemicals in ground water calculated from water/soil partitioning relationships and soil samples are > pure phase volubility or effective solubility(see Worksheet 2, pg. 7).

Condition 4
Concentrations of DNAPL-related chemicals in ground water **increase** with depth or appear in **anomalous** up gradient / across gradient locations (25).

TABLE 6

Characteristics of extensive field programs that can help indicate the presence or absence of DNAPL (if several are present, select "NO"):

- Numerous monitoring wells, with wells screened in topographic lows on the surface of fine-grained, relatively impermeable units.
- Multi-level sampling capability.
- Numerous organic chemical analyses of soil samples at different depths using GC or GC/MS methods.
- Well-defined site stratigraphy, using numerous soil borings, a cone penetrometer survey, or geophysics.
- Data from pilot tests or "early action" projects that indicate the site responds as predicted by conventional solute transport relationships, rather than responding as if additional sources of dissolved contaminants are present in the aquifer (11, 25).

Note: *This procedure is designed primarily for hydrogeologic settings comprised of gravel, sand, silt, or clay and may not be be applicable to karst or fractured rock settings.*

Potential for Occurrence of DNAPL at Superfund Sites

DNAPL Category

Does Historical Use Indicate Presence of DNAPL? (Chart 1)	Do Characterization Data Indicate Presence of DNAPL? (Chart 2): Yes	Maybe	No
Yes	I	I - II	II
Maybe	I	II	II - III
No	I	II	III

Category	Implications for Site Assessment
high potential for DNAPL at site.	• The risk of spreading contaminants increases with the proximity to a potential DNAPL zone. Special precautions should be taken to ensure that drilling does not create pathways for continued vertical migration of free-phase DNAPLs. In DNAPL zones, drilling should be suspended when a low-permeability unit or DNAPL is first encountered. Wells should be installed with short screens (< 10 feet). If required, deeper drilling through known DNAPL zones should be conducted only by using double or triple-cased wells to prevent downward migration of DNAPL. As some DNAPLs can penetrate fractures as narrow as 10 microns, special care must be taken during all grouting, cementing, and well sealing activities conducted in DNAPL zones. • In some hydrogeologic settings, such as fractured crystalline rock, it is impossible to drill through DNAPL with existing technology without causing vertical migration of the DNAPL down the borehole, even when double or triple casing is employed (2). • The subsurface DNAPL distribution is difficult to delineate accurately at some sites. DNAPL migrates preferentially through selected pathways (fractures, sand layers, etc.) and is affected by small-scale changes in the stratigraphy of an aquifer. Therefore, the ultimate path taken by DNAPL can be very difficult to characterize and predict. • In most cases, fine-grained aquitards (such as clay or silt units) should be assumed to permit downward migration of DNAPL through fractures unless proven otherwise in the field. At some sites it can be exceptionally difficult to prove otherwise even with intensive site investigations (2). • Drilling in areas known to be DNAPL-free should be performed before drilling in DNAPL zones in order to form a reliable conceptual model of site hydrogeology, stratigraphy, and potential DNAPL pathways. In areas where it is difficult to form a reliable conceptual model, an "outside-in" strategy may be appropriate: drilling in DNAPL zones is avoided or minimized in favor of delineating the outside dissolved-phase plume (2). Many fractured rock settings may require this approach to avoid opening further pathways for DNAPL migration during site-assessment.
[I Moderate potential for DNAPL at site.	I Due to the potential risk for exacerbating ground-water contamination problems during drilling through DNAPL zones, the precautions described for Category I should be considered during site assessment. Further work should focus on determining if the site is a "DNAPL site."
III Low potential for DNAPL at site.	I DNAPL is not likely to be a problem during site characterization, and special DNAPL precautions are probably not needed. Floating free-phase organics (LNAPLs), sorption, and other factors can complicate site assessment and remediation activities, however.

Worksheet 1: Calculation of Effective Volubility (from Shiu, 1988; Feenstra, Mackay, & Cherry, 1991)

For a single-component DNAPL, the pure-phase volubility of the organic constituent can be used to estimate the theoretical upper-level concentration of organics in aquifers or for performing dissolution calculations. For DNAPLs comprised of a mixture of chemicals, however, the **effective volubility** concept should be employed:

$$S_i^e = X_i S_i$$

Where

S_i^e = the effective volubility (the theoretical upper-level dissolved-phase concentration of a constituent in ground water in equilibrium with a mixed DNAPL; in mg/l)

X_i = the mole fraction of component i in the DNAPL mixture (obtained from a lab analysis of a DNAPL sample or estimated from waste characterization data)

S_i = the pure-phase volubility of compound i in mg/l (usually obtained from literature sources)

For example, if a laboratory analysis indicates that the mole fraction of trichloroethylene (TCE) in DNAPL is 0.10, then the effective solubility would be 110 mg/l [pure phase solubility of TCE times mole fraction TCE: (1100 mg/l) * (0.10) = 110 mg/l]. Effective solubilities can be calculated for all components in a DNAPL mixture. Insoluble organics in the mixture (such as long-chained alkanes) will reduce the mole fraction and effective volubility of more soluble organics but will not contribute dissolved-phase organics to ground water. *Please* note *that this relationship is approximate and does not account for non-ideal behavior* of *mixtures, such as co-solvency, etc.*

Worksheet 2: Method for Assessing Residual NAPL Based on Organic Chemical Concentrations in Soil Samples (From Feenstra, Mackay, and Cherry, 1991)

To estimate if NAPLs are present, a partitioning calculation based on chemical and physical analyses of soil samples from **the saturated zone** (from cores, excavations, etc.) can be applied. This method tests the assumption that all of the organics in the subsurface are either dissolved in ground water or adsorbed to soil (assuming dissolved-phase sorption, not the presence of NAPL). By using the concentration of organics on the soil and the partitioning calculation, a theoretical pore-water concentration of organics in ground water is determined. If the theoretical pore-water concentration is greater than the estimated volubility of the organic constituent of interest, then NAPL may be present at the site. A worksheet for performing this calculation is presented below; see Feenstra, Mackay, and Cherry (1991) for the complete methodology.

Step 1: Calculate S_i^e, the effective volubility of organic constituent of interest. See Worksheet 1, above.

Step 2: Determine **Koc,** the organic carbon-water partition coefficient from one of the following:
A) Literature sources (such as 22) or
B) From empirical relationships based on **Kow,** the octanol-water partition coefficient, which is also found in the literature (22). For example, **Koc** can be estimated from Kow using the following expression developed for polyaromatic hydrocarbons (8):

$$\text{Log Koc} = 1.0 * \text{Log Kow} - 0.21$$

Other empirical relationships between Koc and Kow are presented in refs. 4 and 15.

Step 3: Determine **foc,** the fraction of organic carbon on the soil, from a laboratory analysis of clean soils from the site. Values for **foc** typically range from 0.03 to 0.00017 mg/mg (4). Convert values reported in percent to mg/mg.

Step 4: Determine or estimate **ρb,** the dry bulk density of the soil, from a soils analysis. Typical values range from 1.8 to 2.1 g/ml (kg/l). Determine or estimate **φw,** the water-filled porosity.

Step 5: Determine **Kd,** the partition (or distribution) coefficient between the pore water (ground water) and the soil solids:

$$Kd = Koc * foc$$

Step 6 Using **Ct,** the measured cone. of the organic compound in saturated soil in mg/kg, calculate the theoretical pore water cone. assuming no DNAPL (i.e., Cw in mg/l):

$$Cw = \frac{(Ct * \rho b)}{(Kd * \rho b + \varphi w)}$$

Step 7 Compare **Cw** and S_i^e (from Step 1):

$Cw > S_i^e$ suggests possible **presence** of DNAPL

$Cw < S_i^e$ suggests possible **absence** of DNAPL

GLOSSARY (adapted from Cherry, 1991):

DNAPL: A Dense Nonaqueous Phase Liquid. A DNAPL can be either a single-component DNAPL (comprised of only one chemical) or a mixed DNAPL (comprised of several chemicals). DNAPL exists in the subsurface as free-phase DNAPL or as residual DNAPL (see following definitions). DNAPL does not refer to chemicals that are dissolved in groundwater.

DNAPL ENTRY LOCATION: The area where DNAPL has entered the subsurface, such as a spill location or waste pond.

DNAPL SITE: A site where DNAPL has been released and is now present in the subsurface as an immiscible phase.

DNAPL ZONE: The portion of a site affected by free-phase or residual DNAPL in the subsurface (either the unsaturated zone or saturated zone). The DNAPL zone has organics in the vapor phase (unsaturated zone), dissolved phase (both unsaturated and saturated zone), and DNAPL phase (both unsaturated and saturated zone).

DISSOLUTION: The process by which soluble organic components from DNAPL dissolve in ground water or dissolve in infiltration water and form a ground-water contaminant plume. The duration of remediation measures (either clean-up or long-term containment) is determined by 1) the rate of dissolution that can be achieved in the field, and 2) the mass of soluble components in the residual DNAPL trapped in the aquifer.

EFFECTIVE SOLUBILITY: The theoretical aqueous volubility of an organic constituent in ground water that is in chemical equilibrium with a mixed DNAPL (a DNAPL containing several organic chemicals). The effective volubility of a particular organic chemical can be estimated by multiplying its mole fraction in the DNAPL mixture by its pure phase volubility (see Worksheet 1, page 7).

FREE-PHASE DNAPL: Immiscible liquid existing in the subsurface with a positive pressure such that it can flow into a well. If not trapped in a pool, free-phase DNAPL will flow vertically through an aquifer or laterally down sloping fine-grained stratigraphic units. Also called mobile DNAPL or continuous-phase DNAPL.

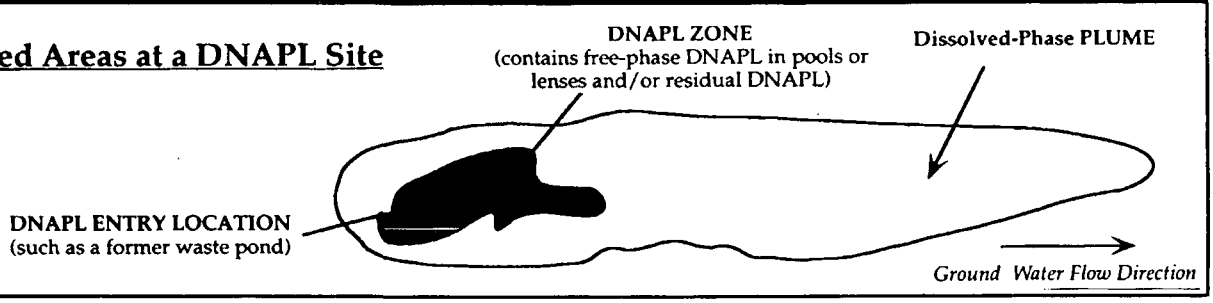
PLUME: The zone of contamination containing organics in the dissolved phase. The plume usually will originate from the DNAPL zone and extend downgradient for some distance depending on site hydrogeologic and chemical conditions. To avoid confusion, the term "DNAPL plume" should not be used to describe a DNAPL pool; "plume" should be used only to refer to dissolved-phase organics.

POOL and LENS: A pool is a zone of free-phase DNAPL at the bottom of an aquifer. A lens is a pool that rests on a fine-grained stratigraphic unit of limited areal extent. DNAPL can be recovered from a pool or lens if a well is placed in the right location.

RESIDUAL DNAPL: DNAPL held in soil pore spaces or fractures by capillary forces (negative pressure on DNAPL). Residual will remain trapped within the pores of the porous media unless the viscous forces (caused by the dynamic force of water against the DNAPL) are greater than the capillary forces holding the DNAPL in the pore. At most sites the hydraulic gradient required to mobilize all of the residual trapped in an aquifer is usually many times greater than the gradient that can be produced by wells or trenches (26).

RESIDUAL SATURATION: The saturation (the fraction of total pore space containing DNAPL) at which DNAPL becomes discontinuous and is immobilized by capillary forces (14). In unsaturated soils, residual saturation typically ranges from 5% to 20% of total pore volume, while in the saturated zone the residual saturation is higher, with typical values ranging from 15% to 50% of total pore volume (14,17). At many sites, however, DNAPL migrates preferentially through small-scale fractures and heterogeneities in the soil, permitting the DNAPL to penetrate much deeper than would be predicted from application of typical residual saturation values (16).

Defined Areas at a DNAPL Site



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