Genesee Park Landfill Gas Test System and Monitoring Network Installation Work Plan

Genesee Park Landfill
Seattle, Washington

DRAFT

WORKING COPY

Prepared for

Seattle Public Utilities and
City of Seattle Department of Parks and Recreation

Prepared by

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ACRONYMS

City	City of Seattle
DPD	Seattle Department of Planning and Development
MFS	Minimum functional standards
msl	mean sea level
PSCAA	Puget Sound Clean Air Agency
Site	Genesee Park Landfill Site

1. INTRODUCTION

This report presents a work plan for the Genesee Park Landfill Gas Test System and Monitoring Network Installation Project at the Genesee Park Landfill Site (Site) in Seattle, Washington. Parametrix has been retained by the City of Seattle (City) because of methane data collected by the City in the vicinity of the Site at levels above regulatory standards. The objectives of this project are listed below:

- Install 9 landfill gas monitoring probes around the property boundary to collect repeatable, reliable subsurface landfill gas data.
- Install a landfill gas control test system to remove and properly dispose of subsurface gas from the vicinity of parcel 4430.
- Assess the effectiveness of the test system as a possible model for additional gas controls should monitoring reveal the need for them.
- Assess the need for additional gas control measures by monitoring the newly installed probes over an initial two month time interval.

2. SITE BACKGROUND INFORMATION

2.1 PHYSICAL SETTING

2.1.1 Location

The Site is located in the Mt. Baker-Seward Park community of Seattle, Washington (Figure 1). The Site is approximately 56 acres in size and is bordered by Lake Washington Blvd to the north, South Snoqualmie Street and South Alaska Street to the south, 43rd Avenue South and 42nd Avenue South to the west, and 45th Avenue South and 46th Avenue South to the east.

2.1.2 Topography

The Site was the former location of an embayment and small stream valley. Topography at the Site varies from about 75 to 90 ft mean sea level (msl) in the southern portion of the Site to about 25 to 30 ft msl at the northern end of the Site near Lake Washington Blvd.

2.1.3 Site Hydrogeology

The Site is covered by approximately 4 to 7 feet of low-permeable fill material that grades from sandy silt to silty sand (Jongejan 1976). Below this cover lies about 15 to 30 feet of refuse. The refuse consists of cans, bottles, paper, tires, wood, clay, ash, and other types of municipal waste. Beneath the refuse is a low-permeable lacustrine deposit consisting of clay, silt, sand, and peat. The deposits around the boundary of the landfill consist of glacial till on the east side, recessional outwash deposits on the west, and bedrock (massive to bedded sandstone to siltstone) to the south. Cross-sections depicting subsurface conditions are shown on Figures 2 through 5. The location of the section lines is presented in Figure 6. Depth to first encountered groundwater varies greatly across the site from 3 feet below grade to 30 feet below grade. Groundwater may flow to the north or northeast (EDR 2006).

2.2 HISTORY

Before Lake Washington was lowered 9 feet in 1917, the Site was known as Wetmore Slough and extended westward from Lake Washington to Rainier Avenue and the small town of Columbia City. The western end of the slough was completely filled in about 1920. In 1947, when the City of Seattle purchased the property, the City began a "sanitary fill" between South Genesee Street and Lake Washington Boulevard. Placement of the fill (composed mostly of garbage) continued for almost two decades. The refuse disposal area, which became known as the Genesee Landfill, was closed and reclaimed as Genesee Park in the late 1960s. The Site contains a community center, network of asphalt paths, picnic areas, open grass and soccer fields, and parking areas.

2.3 DOCUMENTED AND OBSERVED CONDITIONS

Bar-hole monitoring for landfill gas was conducted by City of Seattle in 1993, 2001, and 2004 at locations shown on Figure 6. In 1993, methane and oxygen readings were measured at various locations (vaults, manholes, etc.) around the perimeter of the Site (see Figures 7A, 7B, 7C, 7D, 7E and Tables 1 and 2). Fifteen locations around the Site had methane readings that ranged from 5 percent to 72 percent. In 2001 and 2004, methane readings were measured at 26 different locations in the southern portion of the Site. At 11 of the locations the methane

readings ranged from 5 percent to 50 percent by volume. These 11 locations appear to be in the vicinity of utility trenches that could be acting as migration conduits for the gas. Combustible gas was also detected adjacent to a house on parcel 4430 (see Figure 6). Several utilities are located near parcel 4430, including a large storm water line believed to be the deepest utility that crosses the site. If subsurface landfill gas is currently migrating offsite, or has previously migrated and persists in offsite soils, the utility trenches and surrounding soils near parcel 4430 may be the likeliest place to detect it.

The gas detected during the bar-hole monitoring program could have one or more sources. The gas may be due to the refuse in the landfill, natural peat deposits beneath the landfill, or natural gas migrating along utility corridors. At the present time there is no way to differentiate what sources are contributing to the gas detected during the monitoring program.

On January 6, 2006, a meeting was held between the City, Parametrix, the Health Department, and Ecology concerning the Site. The Health Department stated that they felt the City was out of compliance with Title 10, Board of Health Solid Waste Regulations (10.09.040 and 10.09.050) due to bar-hole data in excess of the lower explosive limit for methane at or near the Site boundary. The Health Department requested that the City evaluate compliance in the vicinity of Parcel 4430 and at the property boundary around the perimeter of the Site.

Table 1. Detected Methane Concentrations in Bar-Hole Monitoring Points Located on the Site, Genesee Park Landfill, Seattle, WA

Date	Test Point	Methane (%)	Methane (ppm)
02/18/93	A1/BH #1 (55)		1,300
02/18/93	A1/BH #2 (New)		720
02/18/93	A1/BH #3 (56)		260
02/18/93	A1/BH #4 (57)		1,470
02/18/93	A1/BH #5 (new)		800
02/18/93	A1/BH #6 (58)		1,020
02/18/93	A1/BH #7		260
02/08/93	A1/BH #53		440
02/08/93	A1/BH #54	5.0%	
02/08/93	A1/BH #55		370
02/08/93	A1/BH #56	75.0%	
02/08/93	A1/BH #56	78.0%	
02/08/93	A1/BH #57		280
02/08/93	A1/BH #58	57.0%	
02/08/93	A1/BH #58	51.0%	
02/08/93	A1/BH #59	1.0%	
02/08/93	A1/BH #59 (MAN)		110
02/08/93	A1/BH #60		410
02/18/93	A2/BH #1		2,000
02/03/93	A2/BH #14		410
02/03/93	A2/BH #15		1,000
02/03/93	A2/BH #16	46.0%	
02/05/93	A2/BH #16	39.0%	
02/05/93	A2/BH #16	43.6%	
02/18/93	A2/BH #16	45.0%	
02/03/93	A2/BH #16B		480
02/03/93	A2/BH #16C	20.0%	
02/03/93	A2/BH #16D	32.0%	
02/03/93	A2/BH #16E	48.0%	
02/03/93	A2/BH #17		510
02/04/93	A2/BH #19		2,000
02/04/93	A2/BH #20	3.0%	
02/04/93	A3/BH #30		8,500
02/04/93	A3/BH #31	7.0%	
02/04/93	A4/BH #32	2.2%	
02/04/93	A4/BH #33		190
02/04/93	A4/BH #34	72.0%	
02/05/93	A4/BH #35		480
02/26/93	A5/BH #7		120
02/05/93	A5/BH #36	3.0%	
02/05/93	A5/BH #36A		60
02/05/93	A5/BH #36B		200
02/05/93	A5/BH #37	5.0%	
02/05/93	A5/BH #38	5.0%	
02/05/93	A5/BH #39		660
02/05/93	A5/BH #39 (MAN)		70
02/05/93	A5/BH #40		600
02/05/93	A5/BH #41		650
02/05/93	A6/BH #42		1,420
02/05/93	A6/BH #42 (MAN)		110
02/05/93	A6/BH #43		11,500
02/05/93	A6/BH #44		430
02/05/93	A6/BH #45	34.0%	
02/05/93	A6/BH #45	32.0%	
02/26/93	A6/BH #45	26.0%	
02/26/93	A6/BH #45A		570
02/05/93	A6/BH #46		5,500
02/05/93	A6/BH #47		1,220

Table 1. Detected Methane Concentrations in Bar-Hole Monitoring Points Located on the Site, Genesee Park Landfill, Seattle, WA

Date	Test Point	Methane (%)	Methane (ppm)
02/05/93	A6/BH #47	0.1%	
02/05/93	A6/BH #48	3.0%	
02/26/93	A7/BH #2A		870
02/26/93	A7/BH #5A	27.0%	
02/05/93	A7/BH #49		490
02/05/93	A7/BH #49 (MAN)		40
02/05/93	A7/BH #50		150
02/05/93	A7/BH #51	20.0%	
02/08/93	A7/BH #67		460
02/08/93	A7/BH #68		4,000
02/26/93	A8/BH #4A		790
02/26/93	A8/BH #4B		980
02/08/93	A8/BH #61		1,990
02/08/93	A8/BH #62		170
02/08/93	A8/BH #63		310
02/08/93	A8/BH #63 (MAN)		20
02/08/93	A8/BH #64		1,120
02/08/93	A8/BH #64 (MAN)		130
02/08/93	A8/BH #65	64.0%	
02/08/93	A8/BH #65	62.0%	
02/08/93	A8/BH #65 (MAN)		2,000
02/08/93	A8/BH #66		520
02/08/93	A8/BH #66 (MAN 1)		270
02/08/93	A8/BH #66 (MAN 2)		570
02/04/93	A9/BH #26	18.0%	
02/08/93	A9/BH #52		630
02/26/93	A9/BH #54A		360
02/26/93	A9/BH #54B		370
02/03/93	A10/BH #7		620
02/03/93	A10/BH #8	59.0%	
02/26/93	A10/BH #8	52.0%	
02/26/93	A10/BH #8A		330
02/03/93	A10/BH #9	22.0%	
02/03/93	A10/BH #10	16.0%	
02/26/93	A10/BH #10A		330
02/03/93	A10/BH #11		340
02/03/93	A10/BH #12		470
02/03/93	A10/BH #13		1,210
02/04/93	A10/BH #21	2.5%	
02/04/93	A10/BH #22		900
02/04/93	A10/BH #23		930
02/04/93	A10/BH #24		150
02/04/93	A10/BH #25		470
02/05/93	A11/BH #1A	30.0%	
02/05/93	A11/BH #1B		170
02/03/93	A11/BH#1	65.0%	
02/03/93	A11/BH #2	7.0%	
02/03/93	A11/BH #3	3-20.0% (V)	
02/03/93	A11/BH #4	31.0%	
02/03/93	A11/BH #5		40
02/03/93	A11/BH #6		1,830
02/03/93	A11/BH #18	7.0%	
02/04/93	A11/BH #27		810
02/04/93	A11/BH #28		290
02/04/93	NA/BH #29		390
06/21/01	BH #1	20.4%	
06/21/01	BH #2	49.0%	
06/21/01	BH #3	12.0%	

Table 1. Detected Methane Concentrations in Bar-Hole Monitoring Points Located on the Site, Genesee Park Landfill, Seattle, WA

Date	Test Point	Methane (%)	Methane (ppm)
06/21/01	BH #4		0
06/21/01	BH #5		140
06/21/01	BH #6	47.0%	
06/21/01	BH #7	50.0%	
06/21/01	BH #8		0
06/21/01	BH #9		0
06/21/01	BH #10		120
06/21/01	BH #11		300
06/21/01	BH #12	6.0%	
06/21/01	BH #20		1,500
06/21/01	BH #21	2.9%	
06/21/01	BH #22	1.2%	
06/21/01	BH #23	13.0%	
06/21/01	BH #24	5.0%	
06/21/01	BH #25	22.0%	
06/21/01	BH #26	40.0%	
10/04/04	BH #1	18.6%	
10/04/04	BH #2	38.8%	
10/04/04	BH #3	23.5%	
10/04/04	BH #4		0
10/04/04	BH #5		1,200
10/04/04	BH #6	12.8%	
10/04/04	BH #7	8.2%	
10/04/04	BH #8		0
10/04/04	BH #9		0
10/04/04	BH #10		220
10/04/04	BH #11		560
10/04/04	BH #12		60
10/04/04	BH #20		5,000
10/04/04	BH #21	28.2%	
10/04/04	BH #22		240
10/04/04	BH #23	14.0%	
10/04/04	BH #24	5.0%	
10/04/04	BH #25	49.8%	
10/04/04	BH #26	32.4%	

Bold - Methane concentration exceeds 5% regulatory standard
(Title 10, Board of Heath Solid Waste Regulations [10.09.040 & 10.09.050])

Table 2. Detected Methane Concentrations in Off-Site Structures, Genesee Park Landfill, Seattle, WA

Date	Area/No.	Methane (%)	Methane (ppm)
02/18/93	A1/MH #1		20
02/18/93	A1/MH #2		80
02/18/93	A1/MH #2 (Bedding)		460
02/18/93	A1/MH #3		2,500
02/18/93	A1/Vault 1		0
02/18/93	A1/Vault 1 (a)		250
02/18/93	A1/Vault 1 (b)		0
02/18/93	A1/Vault 2		50
02/18/93	A1/Vault 2 (a)		50
02/18/93	A1/Vault 2 (b)		0
02/08/93	A1/Vent #1		1,000
02/08/93	A1/Vent #2	45.0%	
02/18/93	A2/MH #1		7,500
02/18/93	A2/MH #2		720
02/18/93	A2/MH #3		330
02/18/93	A2/MH #4		410
02/18/93	A2/MH #5		370
02/18/93	A2/MH #6		0
02/18/93	A2/MH #7		300
02/18/93	A2/MH #8		50
02/18/93	A2/MH #9		380
02/18/93	A2/MH #10		120
02/18/93	A2/MH #11		0
02/18/93	A2/MH #12		160
02/18/93	A2/MH #13		2,000
02/18/93	A2/MH #14		0
02/18/93	A2/MH #15		2,500
02/18/93	A2/MH #16		1,840
02/18/93	A2/MH #17		840
02/18/93	A2/Vault 1		90
02/18/93	A2/Vault 1 (a)		90
02/18/93	A2/Vault 1 (b)		50
02/18/93	A2/Vault 2		50
02/18/93	A2/Vault 2 (a)		40
02/18/93	A2/Vault 2 (b)		150
02/18/93	A2/Vault 3		110
02/18/93	A2/Vault 3 (a)		40
02/18/93	A2/Vault 3 (b)		50
02/18/93	A2/Vault 4		20
02/18/93	A2/Vault 4 (a)		740
02/19/93	A3/MH #1		410
02/19/93	A3/MH #2		50
02/19/93	A3/MH #3		0
02/19/93	A3/MH #4		640
02/19/93	A3/MH #5		0
02/19/93	A3/MH #6		610
02/19/93	A3/Vault 1		40
02/19/93	A3/Vault 1 (a)		20
02/19/93	A3/Vault 1 (b)		140 *
02/19/93	A3/Vault 2		50
02/19/93	A3/Vault 2 (a)		0
02/19/93	A3/Vault 2 (b)		10
02/19/93	A3/Vault 3		120
02/19/93	A3/Vault 3 (a)		0
02/19/93	A3/Vault 3 (b)		230
02/19/93	A3/Vault 4		40
02/19/93	A3/Vault 4 (a)		50

Table 2. Detected Methane Concentrations in Off-Site Structures, Genesee Park Landfill, Seattle, WA

Date	Area/No.	Methane (%)	Methane (ppm)
02/19/93	A3/Vault 4 (b)		80
02/19/93	A3/Vault 5		20
02/19/93	A3/Vault 5 (a)		10
02/19/93	A3/Vault 5 (b)		50
02/19/93	A3/Vault 6		0
02/19/93	A3/Vault 6 (a)		0
02/19/93	A3/Vault 6 (b)		0
02/19/93	A4/MH #1		300
02/19/93	A4/Vault 1		190
02/19/93	A4/Vault 1 (a)		1,990
02/19/93	A4/Vault 1 (b)		310
02/19/93	A4/Vault 2		110
02/19/93	A4/Vault 2 (a)		50
02/19/93	A4/Vault 2 (b)		0
02/19/93	A4/Vault 3		0
02/19/93	A4/Vault 3 (a)		710
02/19/93	A4/Vault 3 (b)		50
02/19/93	A4/Vault 4		170
02/19/93	A4/Vault 4 (a)		590
02/18/93	A4/Vault 4 (b)		660
02/18/93	A4/Vault 5		10
02/18/93	A4/Vault 5 (a)		50
02/18/93	A4/Vault 5 (b)		270
02/26/93	A5/CB #3		70
02/26/93	A5/CB #6		0
02/26/93	A5/CB #8		20
02/26/93	A5/MH #1		100
02/26/93	A5/MH #2		60
02/26/93	A5/MH #4		870
02/26/93	A5/MH #4A		1,340
02/26/93	A5/MH #5		2,500
02/26/93	A5/MH #9		100
02/26/93	A5/MH #10		70
02/26/93	A5/MH #11		180
02/26/93	A5/Vault 12		20
02/26/93	A6/MH #1		0
02/26/93	A6/MH #2		40
02/26/93	A6/MH #3		40
02/26/93	A6/MH #4		120
02/26/93	A6/MH #5		80
02/26/93	A6/Vault 1		20
02/26/93	A6/Vault 2		0
02/26/93	A6/Vault 3		0
02/26/93	A6/Vault 3 (a)		50
02/26/93	A6/Vault 4		0
02/26/93	A6/Vault 5		20
02/26/93	A6/Vault 6		50
02/26/93	A6/Vault 7		20
02/26/93	A6/Vault 7 (a)		20
02/26/93	A6/Vault 8		20
02/26/93	A6/Vault 8 (a)		190
02/26/93	A6/Vault 8 (b)		70
02/26/93	A7/MH #1		No data
02/26/93	A7/MH #2		40
02/26/93	A7/MH #3		20
02/26/93	A7/MH #3A		900
02/26/93	A7/MH #5		180

Table 2. Detected Methane Concentrations in Off-Site Structures, Genesee Park Landfill, Seattle, WA

Date	Area/No.	Methane (%)	Methane (ppm)
02/26/93	A7/SWU 51	5.0%	
02/26/93	A7/SWU 51A		70
02/26/93	A7/SWU 51B		1,290
02/26/93	A7/SWU 51C	2.5%	
02/26/93	A7/Vault 4		60
02/26/93	A8/CB #5		60
02/26/93	A8/CB #6		No data
02/26/93	A8/CB #10		20
02/26/93	A8/MH #2		80
02/26/93	A8/MH #3		220
02/26/93	A8/MH #3A		520
02/26/93	A8/MH #7		770
02/26/93	A8/MH #8		1,890
02/26/93	A8/MH #9		140
02/26/93	A8/MH #11		2,500
02/26/93	A8/MH #12		120
02/26/93	A8/SWU 65	46.0%	
02/26/93	A8/Vault 1		100
02/26/93	A8/Vault 1A		240
02/26/93	A8/Vault 1B		890
02/26/93	A8/Vault 1C		900
02/26/93	A8/Vault 4		130
02/26/93	A10/MH #1		0
02/26/93	A10/MH #2		0
02/26/93	A10/MH #3		50
02/26/93	A10/SWU 54	4.0%	
02/26/93	A10/Vault 1		0
02/26/93	A10/Vault 1 (a)		310
02/26/93	A10/Vault 1 (a)		80
02/26/93	A10/Vault 1 (b)		470
02/26/93	A10/Vault 2		70
02/26/93	A10/Vault 2 (b)		50
02/26/93	A10/Vault 3		50
02/26/93	A10/Vault 3 (a)		3,000
02/26/93	A10/Vault 3 (b)		0
02/26/93	A10/Vault 4		20
02/26/93	A10/Vault 4 (a)		40
02/26/93	A10/Vault 4 (b)		40
02/26/93	A10/Vault 5		20
02/26/93	A10/Vault 5 (a)		160
02/26/93	A10/Vault 5 (b)		430
02/26/93	A10/Vault 6		0
02/26/93	A10/Vault 6 (a)		90
02/26/93	A10/Vault 6 (b)		260
02/26/93	A10/Vault 7		10
02/26/93	A10/Vault 7 (a)		220
02/26/93	A10/Vault 7 (b)		90
02/26/93	A11/CB #18		0
02/26/93	A11/CB #19		70
02/26/93	A11/MH #17		160
02/26/93	A11/MH #20		90
02/26/93	A11/MH #21		90
02/26/93	A11/MH #22		60
02/26/93	A11/Vault 1		280
02/26/93	A11/Vault 1 (a)		320
02/26/93	A11/Vault 1(b)		70
02/26/93	A11/Vault 2		180

Table 2. Detected Methane Concentrations in Off-Site Structures, Genesee Park Landfill, Seattle, WA

Date	Area/No.	Methane (%)	Methane (ppm)
02/26/93	A11/Vault 2 (a)		2,000
02/26/93	A11/Vault 2 (b)		30
02/26/93	A11/Vault 3		1,930
02/26/93	A11/Vault 3 (a)		400
02/26/93	A11/Vault 3 (b)	2.8%	
02/26/93	A11/Vault 3 (b)		8,500
02/26/93	A11/Vault 3 (c)	3.0%	
02/26/93	A11/Vault 4		130
02/26/93	A11/Vault 4 (a)		310
02/26/93	A11/Vault 4 (b)		240
02/26/93	A11/Vault 5		70
02/26/93	A11/Vault 5 (a)		350
02/26/93	A11/Vault 5 (b)		120
02/26/93	A11/Vault 6		0
02/26/93	A11/Vault 7		250
02/26/93	A11/Vault 8	2.0%	
02/26/93	A11/Vault 8 (a)	30.0%	
02/26/93	A11/Vault 8 (b)	0.0%	
02/26/93	A11/Vault 9		0
02/26/93	A11/Vault 9 (a)		1,090
02/26/93	A11/Vault 9 (b)		890
02/26/93	A11/Vault 10		110
02/26/93	A11/Vault 11		140
02/26/93	A11/Vault 11 (a)		WATER
02/26/93	A11/Vault 11 (b)		WATER
02/26/93	A11/Vault 12		230
02/26/93	A11/Vault 12 (a)		240
02/26/93	A11/Vault 12 (b)		3,500
02/26/93	A11/Vault 13		450
02/26/93	A11/Vault 13 (a)	3.5%	
02/26/93	A11/Vault 13 (b)		1,980
02/26/93	A11/Vault 14		80
02/26/93	A11/Vault 14 (a)		WATER
02/26/93	A11/Vault 14 (b)		WATER
02/26/93	A11/Vault 15		30
02/26/93	A11/Vault 15 (a)		190
02/26/93	A11/Vault 15 (b)		240
02/26/93	A11/Vault 16		0
02/26/93	A11/Vault 16 (a)		80
20/26/93	A11/Vault 16 (b)		60
02/08/93	BH/MH near S. Genesee		2,500
02/08/93	V/Vent #3	4.0%	

Bold = Methane concentration exceeds 100 ppm concentration in off-site structures
(Title 10, Board of Health Solid Waste Regulations [10.09.04 & 10.09.050]

3. GAS TEST SYSTEM CONCEPTUAL DESIGN

3.1 GENERAL APPROACH

The gas collection test system will be designed and, through the use of subcontractors, installed by Parametrix. Plans and specifications will be developed as further discussed under Section 4.1.2, Gas Test Design Completion, to the level of completion needed to deliver the project.

Based on the age of the landfill (closed for over 30 years) and the plan to install wells in soil rather than refuse, using a carbon filter to dispose of collected gas rather than a flare is appropriate. Carbon filters are effectively controlling odor and non-methane volatile compounds at other historic Seattle landfills. Although flaring is not anticipated to be needed, it is a fallback gas disposal option as discussed in Section 5, Alternatives Analysis.

3.2 SYSTEM LAYOUT

Figure 8 provides a conceptual layout of the gas collection test system. The system will include two collection wells, a blower and activated carbon filter within a masonry/chain link surround, and associated piping, electrical service and controls. The wells will be installed along the south boundary of parcel 4430, close to but avoiding utilities. Exact drilling locations will need to be determined in the field based on survey, utility location, and final assimilation of any other site and utility data. The intent is to install wells on City property outside the refuse.

Noise abatement is a concern since the system will stay in operation continuously. The blower and filter will produce some mechanical noise and acoustic resonance. Possible noise impacts will be reduced by installing a masonry wall at least seven feet high around the blower station. The wall will need to be laid out in a labyrinth configuration rather than fully surrounding the blower station in order to reduce the likelihood of gas accumulation in the event of a mechanical or piping failure. Another noise reduction option to consider would a blower discharge silencer or silencing-type filter.

Security is also a concern since the system will be installed in a publicly accessible area of Genesee Park. The well completions (valve, access cap, monitoring port) will be housed in vaults flush with the surrounding terrain. Gas pipe will be buried. The blower station enclosure will have a chain link 'roof' and locked chain link 'doors'.

Basic electrical improvements will include supply and entrance equipment and blower controls. Lighting and telemetry are optional improvements the City might also want to consider. Area classification will likely be Class 1, Division 2, Group D. Electrical enclosures will need to carry a NEMA 4 or higher weatherproof rating.

4. TASKS

4.1 PRE-FIELD ACTIVITIES

4.1.1 Locating

The City will survey the property boundary around the entire perimeter of the Site. The boundary will be marked by stakes with flagging and/or spray paint.

After the property boundary has been established, a meeting will be held with City personnel, and a Parametrix representative at the Site. The purpose of this meeting is to locate and mark drilling locations, identify underground obstructions, discuss health and safety issues, and identify areas for staging of drilling equipment and decontamination area.

4.1.2 Gas Test System Design Completion

As mentioned, the gas test system plans and specifications will be developed to the extent needed to (1) satisfy Washington law pertaining to sealing engineering plans and specifications, (2) support permit applications, (3) provide for City and agency review, (4) support material and equipment procurement, (5) obtain firm pricing information from subcontractor(s), and (6) otherwise deliver the project on a turn-key basis. Appendix A shows plan sheet mock-ups. The mock-ups should provide a general sense of what the sheets will eventually need to include. Further process mechanical and electrical engineering are needed to complete the gas system design.

The gas collection test system is essentially exploratory and field adjustments will be needed, although anticipated to effectively collect and properly dispose of subsurface gas in the vicinity of parcel 4430. It is therefore necessary for Parametrix to have both direct control of the subcontractor(s) and the latitude to make adjustments during system construction. This approach and the associated uncertainties make it unfeasible to implement the project through a design-bid-build approach. To save costs, plans and specifications will only be developed to the level of completion and detail needed to deliver the project on a turn-key basis.

4.1.3 Subcontracting

Parametrix will subcontract with a private utility locate firm, a driller and a general contractor. Either the general contractor or Parametrix will retain specialty subcontractors such as electrical. Subcontractors will need to participate in planning and competitively pricing the gas collection test system and probes. Contingent subcontracts will need to be established in order to bring subcontractors into the planning process prior to overall project authorization by the City. Subcontracts will take effect if the City awards the project to Parametrix.

4.1.4 Permitting

Parametrix will ascertain which permits are needed for the project and prepare applications on behalf of the City. Anticipated permits are (1) Puget Sound Clean Air Agency (PSCAA) Notice of Construction, (2) SEPA Checklist submitted to PSCAA as lead agency (3) electrical permits from the Seattle Department of Planning and Development (DPD) and (4) a street-use permit for some of the drilling. The need for electrical plan review is anticipated.

4.1.5 Public Notification

The City will notify the public prior to initiation of field activities. The notification requirements will be as prescribed by the City of Seattle Department of Parks and Recreation.

4.2 DRILLING AND WELL/PROBE INSTALLATION

All work will be performed under an appropriate Health and Safety Plan (HSP) for the protection of workers in accordance with OSHA and WISHA requirements. Health and safety training in compliance with 29CFR 1910.120 and Chapter 296-62-300 is required for all personnel for this job. Field work will be initiated under Level D protection and upgraded to Level C if necessary. The safety level will depend upon the requirements in the HSP and Site conditions. Parametrix will have an extra health and safety officer onsite during drilling of borings in refuse. A copy of the HSP is included in Appendix B.

Mobilization will entail moving equipment, temporary facilities and materials to work and staging areas onsite and securing the staging areas for several weeks during the construction activities. Staging in the Park Departmnet SE District Headquarters is anticipated. A temporary chain link fence will surround the staging area. Rolling equipment, materials, a roll-off bin or drums for tailings, and similar items would be stored within the fenced area. No staging area surface improvements are planned. Lawn and turf damaged by staging and construction activities will be repaired by leveling with topsoil and seeding. Other improvements damaged by staging or construction activities will be repaired or replaced.

Nine gas monitoring probes and two gas extraction wells are proposed for installation at the Site (Figure 1). The probes will be installed outside of the waste boundary and will be used to monitor gas. The extraction wells will be installed near parcel 4430 and will connect to the proposed test system. The rationale for each is listed in Table 3.

Prior to starting work, the drilling contractor will obtain the required start cards from the Department of Ecology. The drilling contractor will mobilize all material as described above. A decontamination area will be set-up in the staging area established by the City. The drilling and installation work will be accomplished with a hollow-stem auger drilling rig. Soil samples for geologic classification by the Unified Soil Classification System (USCS) will be collected by a split-spoon sampler through the hollow stem of the augers at approximately 5-foot intervals to the total depth explored. Additional samples may be collected based on change in lithology or at the discretion of the geologist.

The gas probes and gas extraction wells will be installed in 6-inch diameter and 12-inch diameter boreholes, respectively. The Parametrix geologist and gas engineer will determine the screened interval and total depth of each borehole. Table 3 shows the approximate depth of each gas probe and extraction well. The gas probes and extraction wells will be constructed as detailed in Figure 9 and 10. The City will survey the probes and wells after construction is complete. A map with survey coordinates will be provided to Parametrix.

Table 3. Proposed Probe Location and Depth Table

Proposed Boring	Location	Proposed Depth (feet)	Purpose
GP-1	Northwest corner of 42nd Ave S and South Oregon St	25	Monitor effectiveness of extraction system
GP-2	West side of 43rd Ave S three parcels north of S Adams St	16	Monitor potential landfill gas along 43rd Ave. S.
GP-3	West side of 43rd Ave S first parcel north of S Bradford St	15	Monitor potential landfill gas along 43rd Ave. S.
GP-4	Southeast corner of northern section of 45thAve S off of Lake Washington Blvd	25	Monitor potential landfill gas on eastern side of site near high bar-hole reading
GP-5	Northeast corner of maintenance yard off of 45th Ave S	20	Monitor potential landfill gas along eastern side of site
GP-6	Southwest corner of dead end of S. Snoqualmie St	35	Monitor potential landfill gas on southern boundary of the site where high bar-hole readings have been measured
GP-7	Northwest corner of S Alaska ST and 41st Ave S	36	Monitor potential landfill gas on southwestern boundary of the Site where high bar-hole reading was measured
GP-8	Southeast corner of S. Conover and 39th Ave S.	25	Monitor potential landfill gas on southwestern boundary of Site
GP-9	Between Parcel 4430 and landfill gas test system	10	Monitor effectiveness of extraction system
GE-1	Southwest corner of Genesee parking lot at end of driveway for parcel 4430	25	Extract landfill gas near parcel 4430
GE-2	East side of 42nd Ave S, south of the end of driveway for parcel 4430	25	Extract landfill gas near parcel 4430

Drilling decontamination procedures are as follows:

- All large drilling equipment (rods, bits, etc.) will be decontaminated between each use with a high-pressure washer prior to drilling each extraction well or gas probe borehole.
- Smaller equipment (hammers, samplers, etc.) will be decontaminated between each use with a tap-water rinse, followed by a detergent wash (Alconox) and a second tap-water rinse.
- All decontamination rinsate will be contained in labeled drums.

Investigation derived waste will be handled as follows:

- Drill cuttings (soil and refuse) will be placed in roll-off bins. Soil cuttings will be segregated from refuse cuttings in the roll-off bins.
- All decontamination rinsate will be stored in 55-gallon drums.
- Disposable health and safety gear (gloves, etc.) will be stored in 55-gallon drums.

- Drill cuttings and rinsate will be sampled and tested for disposal as described in the Sampling and Analysis Plan included in Appendix C.

Detailed standard operating procedures (SOPs) on exploratory boring log preparation, probe/well construction, and decontamination procedures are provided in Appendix D.

4.3 GAS TEST SYSTEM INSTALLATION

Gas test system construction should take about four to eight weeks, although activities will be intermittent during that time interval. The construction sequence will generally be as follows:

1. Mobilization, staging.
2. Gas extraction wells.
3. Probes (floating schedule, but likely following extraction well installation).
4. Well completions and buried gas pipe.
5. Blower area foundation, slab.
6. CMU wall.
7. Blower, filter.
8. Electrical.
9. Chain link roof and doors.
10. Startup.
11. Site clean-up, restoration.
12. Punch list.
13. Demobilization.
14. Close-out.

4.4 MONITORING

Gas collection test system and probes will be monitored bi-weekly for two months, monthly thereafter. The test system and probe adjacent to parcel 4430 will need to be monitored for at least one year to evaluate test system effectiveness in controlling subsurface gas that might have migrated beyond the property boundary in that area.

4.4.1 Test System

The following collection test system parameters will be monitored at the blower inlet piping and recorded:

- Combustible gas (as CH_4).
- CO_2.
- O_2.
- Gas temperature.
- Velocity (from which flow can be calculated).
- Vacuum.

4.4.2 Probes

The following parameters will be monitored at all probes and recorded:

- Combustible gas (as CH_4).
- CO_2.
- O_2.
- Pressure.

4.4.3 Triggers

The key regulatory compliance points with respect to gas at Genesee Park are:

- WAC 173-304-407 Minimum functional standards (MFS) for solid waste handling.
- Title 10, King County Board Of Health Solid Waste Regulations (Title 10).

MFS requires that all closed landfills must control, minimize or eliminate threats to human health and the environment. WAC 173-351-010 (2)(b) says that closure and post-closure requirements under MFS are applicable to municipal solid waste landfills which stopped receiving waste before October 9, 1991.

Title 10 provides that the regulation is to be liberally construed to apply to old landfills as needed to protect the public peace, health, safety and welfare (10.02.020). Under Title 10, Health can require a post closure stabilization period of 30 years or more (10.09.030) and require methane monitoring and control to protect the public health and the environment (10.09.040). Methane concentrations over 5 percent by volume in soil, 100 ppm in structures at or beyond the property boundary, and 1.25 percent in facility structures are not allowed (10.09.050). Construction restrictions apply within 1,000 feet of sites documented by Health to be generating methane at or above 5 percent by volume (10.09.060).

Although other regulations might apply, Title 10 and MFS are the most stringent. Since the gas probes will be installed on or near the property boundary, methane concentrations of 5 percent by volume or higher would be considered out-of-compliance with Title 10 and imply the need for further action. Lower levels of methane could be construed to indicate a potential threat; therefore, responses based on subsurface methane concentrations under 5 percent by volume at the property boundary also seem appropriate.

Structure monitoring is proposed as a temporary response should probe methane concentration above 3 percent by volume be detected. Although Title 10 sets methane limits of 100 ppm and 1.25 percent by volume for off-site and on-site structures, respectively, structure monitoring is generally considered to be less repeatable and reliable than probe monitoring.

For locations other than the vicinity of parcel 4430, Table 4 summarizes planned responses to methane concentrations above certain threshold (trigger) concentrations. The gas collection test system represents the initial response to known subsurface gas in the vicinity of parcel 4430. The effects of gas collection test system operation may need to be monitored for up to a year to assess the long-term efficiency of wells in soil adjacent to refuse.

Table 4. Gas Probe Methane Concentration and Pressure Thresholds and Response[a, b]

Threshold	Response Timeline	Action
CH_4>3% Volume	Immediate	Notify Health
		Increase probe monitoring frequency
-OR-	First 4 weeks	Monitor probes weekly
		Report to Health at the end of week 4 or sooner if warranted
CH_4>2% and Pressure>1 in. wg	After 4 weeks	If threshold exceedances are stable or diminishing, revert to ordinary monitoring frequency
		If threshold exceedances are worsening, discuss possible further actions with Health
	Immediate	Notify Health
		Increase probe monitoring frequency
CH_4>5% Volume		Start additional monitoring if requested by Health
	First 4 weeks	Monitor probes weekly
		Monitor off-site and on-site utility structures if directed by Health
		Monitor off-site buildings if directed by Health
		Monitor on-site buildings if directed by Health
		Report to Health at the end of week 4 or sooner if warranted
	Within 8 weeks	If threshold continues to be exceeded for 4 weeks, prepare response plan and implementation schedule for Health review and approval
		Continue weekly monitoring pending response plan implementation
	Per response plan	Implement Health-approved response plan

a Excludes probes in the vicinity of parcel 4430 since the gas control test system is being there.

b Response is anticipated to include but is not limited to the actions listed. The City will implement additional or different response actions if warranted. The City acknowledges Health's authority to direct additional or different response actions if warranted.

4.5 DOCUMENTATION/REPORTING

Parametrix will keep daily records of materials used and time spent on each activity. Parametrix will also keep a record of environmental monitoring. Workspace and borehole readings will be recorded at the beginning and end of each workday and any changes throughout the day. A daily inspection report will be completed for each day of work.

A summary report will be completed after eight weeks of bi-monthly monitoring. The report will include the following:

- Summary of field activities.
- Boring logs and probe/well construction details.
- Cross-sections depicting subsurface conditions.
- Summary of gas collection test system construction.
- Summary of monitoring data.
- Conclusions and recommendations for future actions, if any.

5. ALTERNATIVE ANALYSIS

Gas collection test system improvement or expansion or the design and installation of additional landfill gas controls might be needed if probe and structure monitoring indicate continued exceedances of methane threshold values at or beyond the property boundary. Although premature at this time to presume that additional controls will be needed near parcel 4430 or elsewhere, basic control schemes that might be considered include gas collection trenches and wells connected to passive venting or active (i.e.-blower) collection systems. The following table summarizes key features of active and passive systems based on trenches and wells:

Table 5. Key Features of Alternative Options

System/ Feature	Advantages	Disadvantages
Active Extraction System	• Induced vacuum, extracts gas from soil • Potential to reverse subsurface gas migration	• Consumes power • Generates noise • Higher capital, operations costs • Potential to start subsurface fires • Potentially higher gas volumes, can require flaring
Passive Venting System	• Inhibit migration by relieving subsurface gas pressure • Quiet, simple, no mechanical components • Relatively low capital, operations costs • Unlikely to start subsurface fires	• Limited zone of influence • Unable to extract subsurface gas • Unable to reverse subsurface gas migration
Trenches	• Direct influence along a trench line (i.e.-property boundary) • Installed with ordinary construction equipment	• Primarily effective on shallow gas • Installation causes greater disturbance • Installation in refuse generates substantial waste requiring disposal
Wells	• Installation minimizes surface disturbance • Potential to influence deep subsurface gas • Can operate at higher vacuum than trenches	• Installation requires specialized equipment, specially licensed and qualified personnel • Potential to breach stratigraphic units

6. SCHEDULE

A Landfill Gas Control Test System and Monitoring Network Schedule is included in Appendix E.

7. REFERENCES

Jongejan. 1976. Jongejan Gerard and Associates. Genesee Park and Playfield Master Plan. July 6, 1976.

EDR. 2006. Environmental Data Resources. Genesee Park, EDR Radius Map and Geocheck Report. January 12, 2006.

FIGURES

Parametrix Genesee Park 555-1550-041/02(071) 2/05 (B)

Orthophoto source:
Triathlon, July 1999
Map date: December 15, 2004

Legend

- Parcel Boundary
- DWU Lateral
- DWU Mainline
- Water Mainline
- Water services
- Pavement edge

Probes

- Proposed gas monitoring probe
- Proposed gas extraction well
- Bar hole
- Utility hole
- Vault ambient

Contours

- 10' contour
- 2' contour

Approximate Location of Passive Vent System

N

Figure 1
Genesee Park Landfill
Proposed Gas Monitoring and Extraction Wells
Seattle, Washington

North
A

South
A'

80
70
60
50
40
30
20
10
0

Park Boundary

Genesee Ave S

3854
B-2

2/95

8104
13

3/76

202

3/69

260

5/69

8104
11

3/76

3768
B1

8104-3

Parametrix City of Seattle 555-1550-052/02(072) 2/06 (B)

▽ Water Level

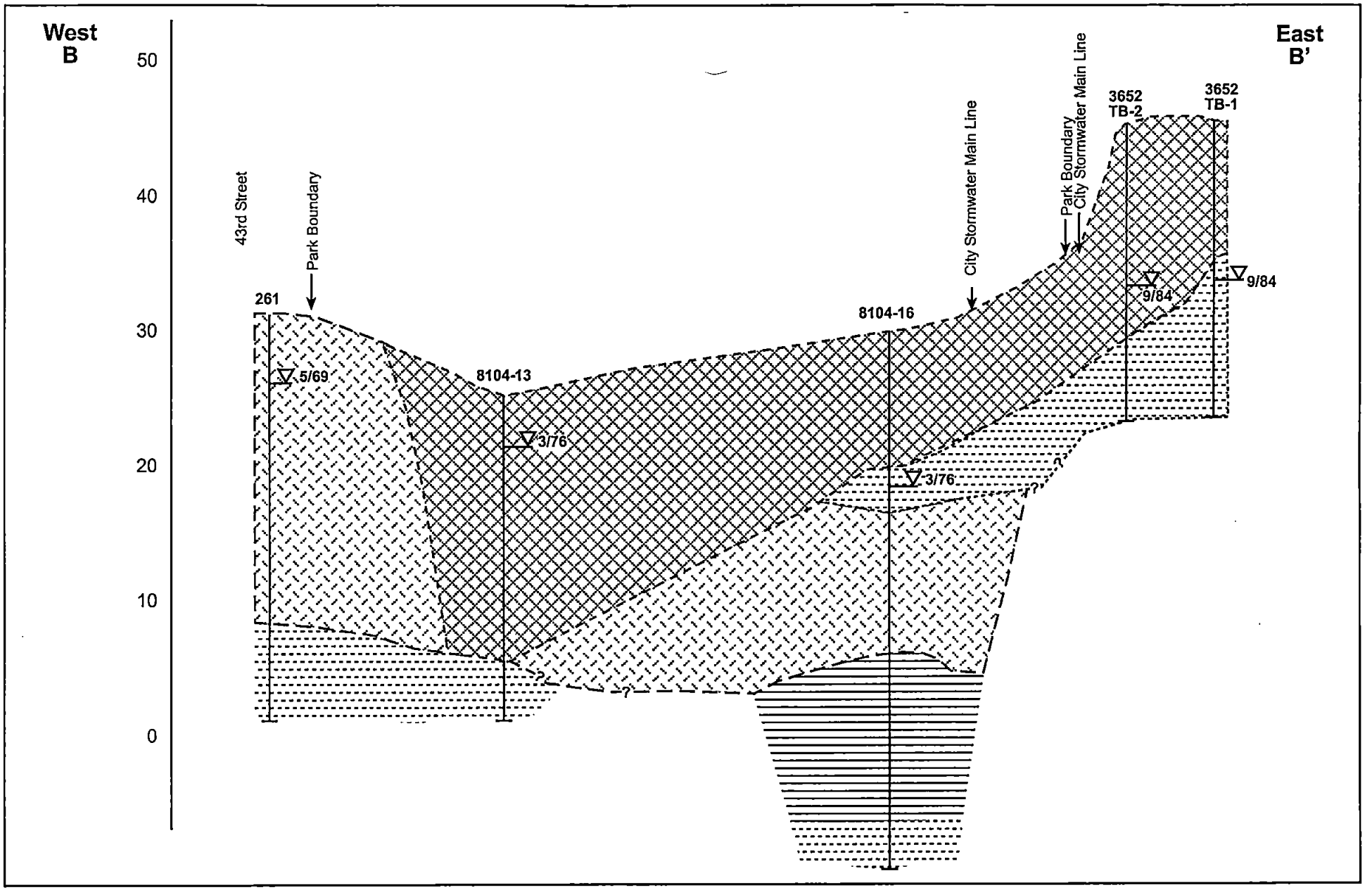
Horizontal 1" = 300'
Vertical 1" = 10'

Peat
Clay
Sand
Refuse, Fill
Silt, Sandy Silt, Clayey Silt

202 Boring Designation

Boring

Figure 2
Cross-section A-A'
Genesee Landfill
Seattle, Washington



Parametrix City of Seattle 555-1550-052/02(072) 2/06 (B)

▽ Water Level

Horizontal 1" = 100'
Vertical 1" = 10'

Peat

Clay

Refuse, Fill

Silt, Sandy Silt, Clayey Silt

202 Boring Designation

Boring

Figure 3
Cross-section B-B'
Genesee Landfill
Seattle, Washington

West
C

East
C'

70
60
50
40
30
20
10
0

39th Ave S (DWU Mainline)
Water Mains (11)
Park Boundary (26)

2 City Stormwater Maine Lines
42nd Ave S
Water Main

8104-1
8104-2
8104-3
8104-4
8104-5

3768
B3

City Stormwater
Main Line

Park Boundary

3/76
3/76

Parametrix City of Seattle 555-1550-052/02(072) 2/06 (B)

Water Level

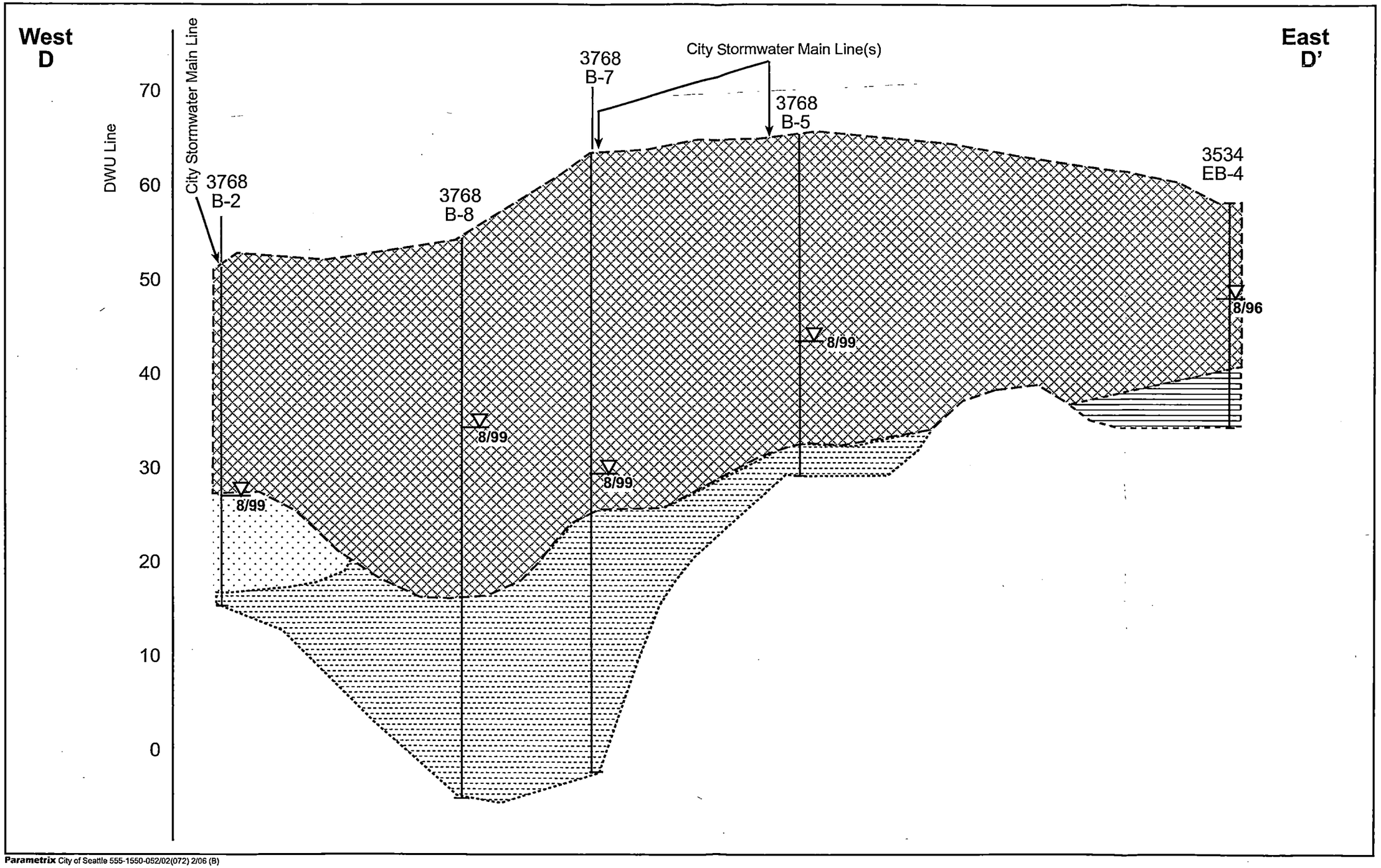
Horizontal 1" = 300'
Vertical 1" = 10'

202 Boring Designation

Boring

Peat
Clay
Refuse, Fill
Silt, Sandy Silt, Clayey Silt

Figure 4
Cross-section C-C'
Genesee Landfill
Seattle, Washington



Parametrix City of Seattle 555-1550-052/02(072) 2/06 (B)

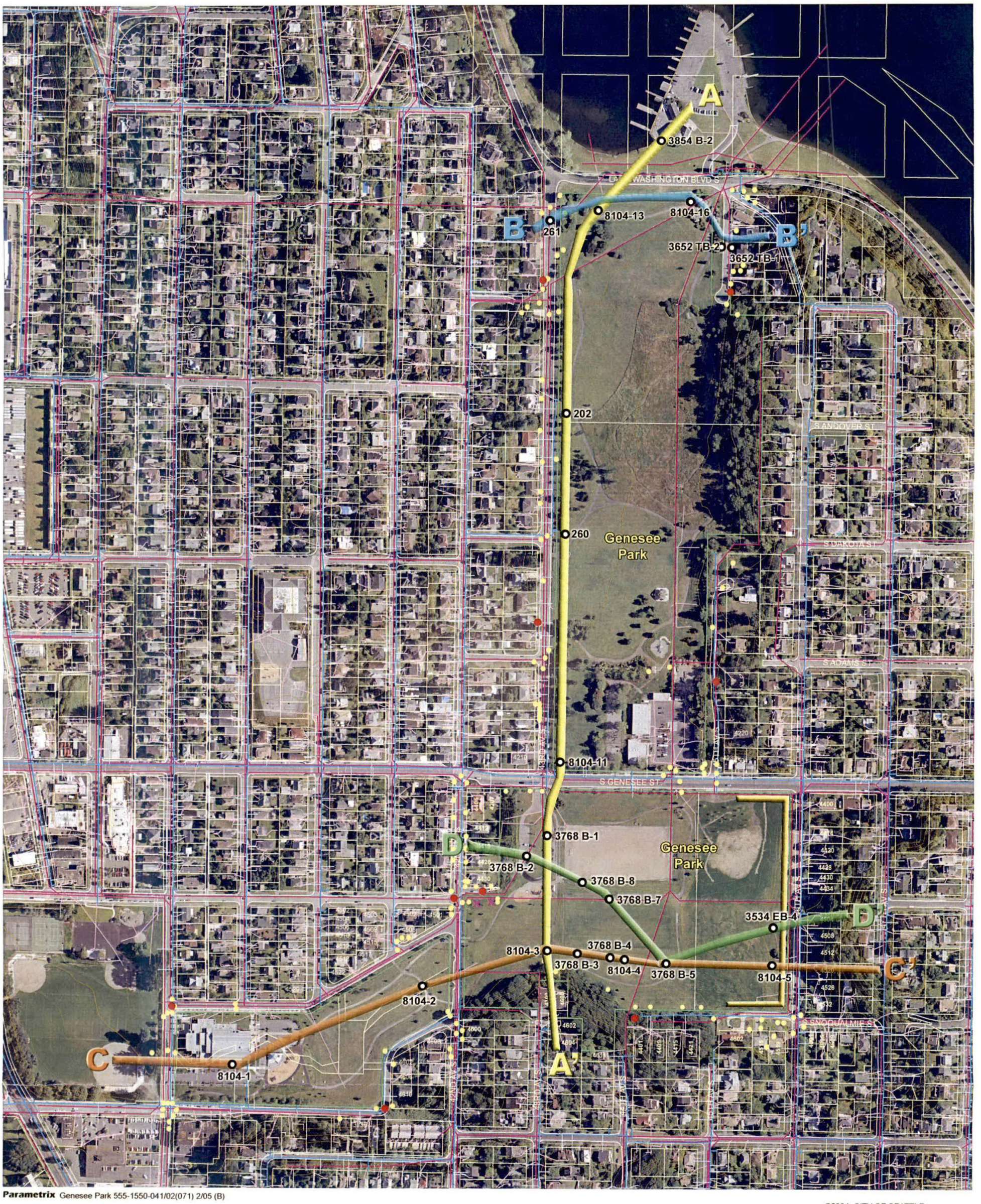
▽ Water Level

Horizontal 1" = 100'
Vertical 1" = 10'

Peat
Clay
Sand
Refuse, Fill
Silt, Sandy Silt, Clayey Silt

202 Boring Designation
Boring

Figure 5
Cross-section D-D'
Genesee Landfill
Seattle, Washington



Parametrix Genesee Park 555-1550-041/02(071) 2/05 (B)

Orthophoto source:
Triathlon, July 1999
Map date: December 15, 2004

Legend

- Parcel Boundary
- DWU Lateral
- DWU Mainline
- Water Mainline
- Water services
- Pavement edge

Probes

- Proposed gas monitoring probe
- Proposed gas extraction well
- Bar hole
- Utility hole
- Vault ambient

Contours

- 10' contour
- 2' contour

Approximate Location of Passive Vent System

N

Figure 6
Genesee Park Landfill
Cross-Section Locations
Seattle, Washington

Parametrix City of Seattle 555-1550-052/02(072) 2/06 (B)

N

February 1993 Methane Measurement Locations
- Structures (vaults, manholes, basements)
- Bar-holes

- Methane readings recorded by the City of Seattle
- Methane regulatory standard (Title 10, Board of Health Solid Waste Regulations [10.09.040 & 10.09.050])
  - 100 ppm methane in off-site structures
  - 5% methane at property boundary
- A5/MH9: Location of methane reading
- A : Area of site • CB : Catch basin
- MH : Man-hole • BH : Bar-hole • V = Vault
- Location of all site features are approximate

Figure 7A
Methane Concentrations Above Regulatory Standards
Northern Portion of Site
Genesee Park Landfill
Seattle, Washington

Parametrix City of Seattle 555-1550-052/02(072) 2/06 (B)

- Methane readings recorded by the City of Seattle
- Methane regulatory standard (Title 10, Board of Health Solid Waste Regulations [10.09.040 & 10.09.050])
  - 100 ppm methane in off-site structures
  - 5% methane at property boundary
- A5/MH9: Location of methane reading
- A : Area of site • CB : Catch basin
- MH : Man-hole • BH : Bar-hole • V = Vault
- Location of all site features are approximate

N

February 1993 Methane Measurement Locations

- Structures (vaults, manholes, basements)
- Bar-holes

Figure 7B
Methane Concentrations Above Regulated Standards
Central Portion of Site
Genesee Park Landfill
Seattle, Washington

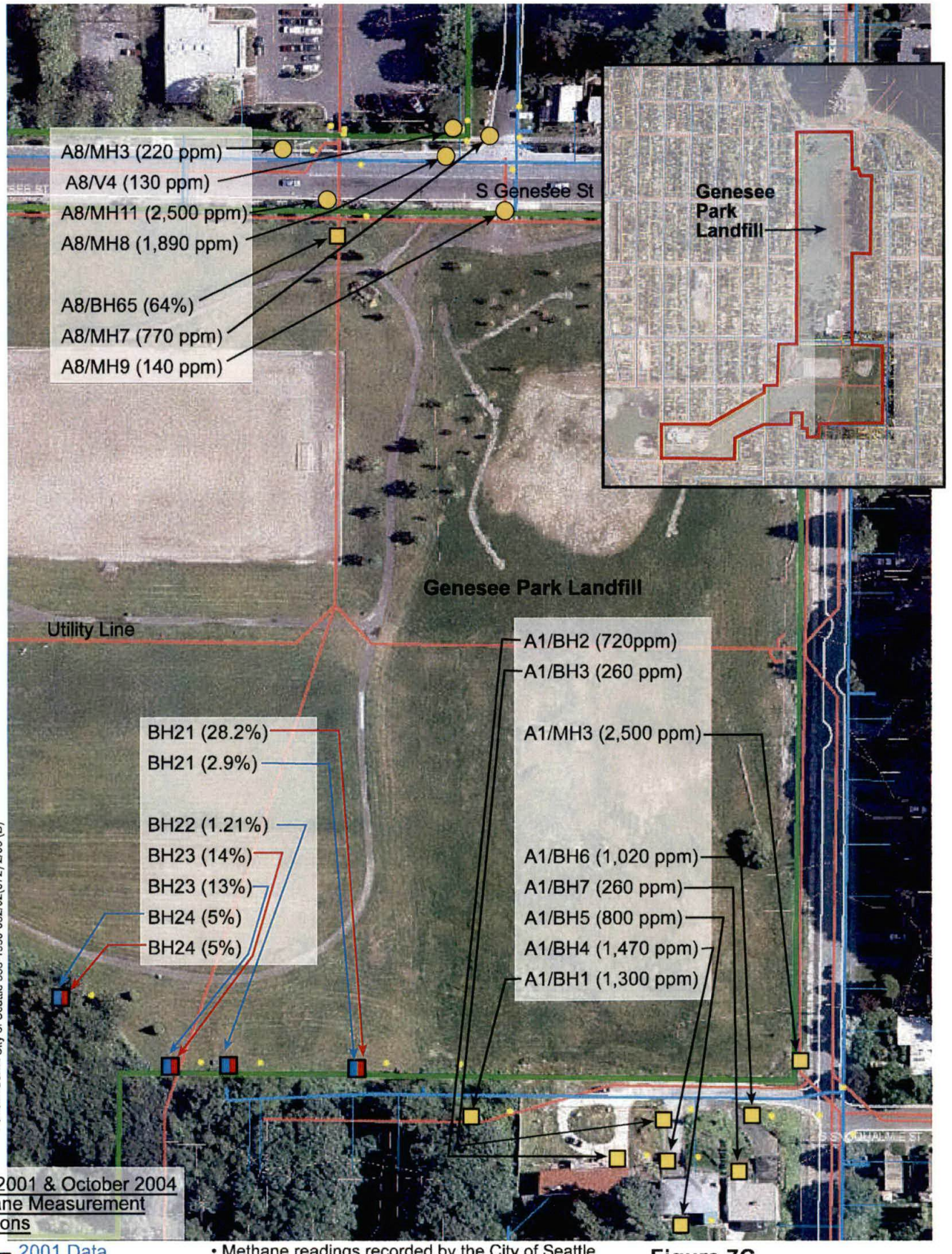
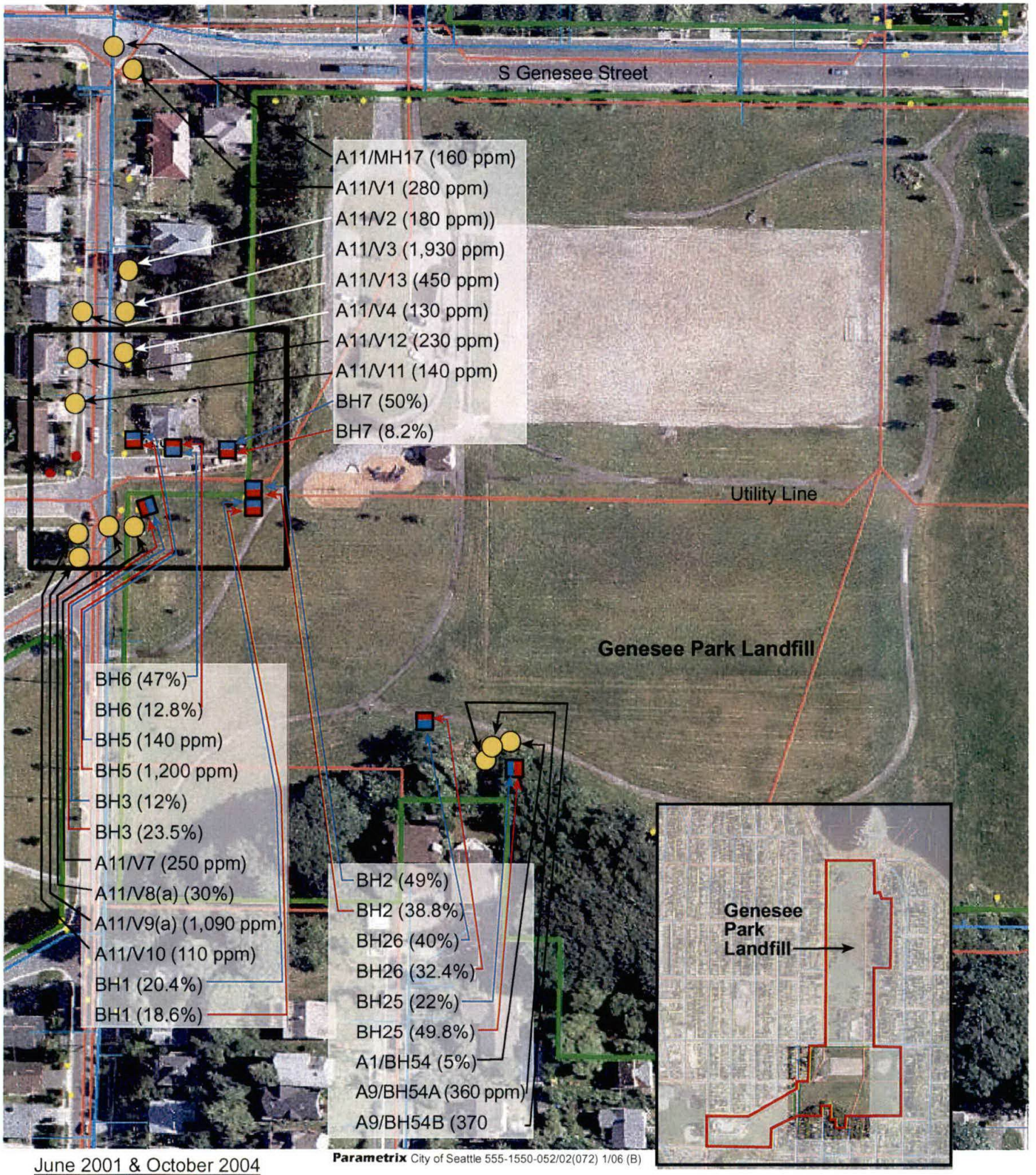


Figure 7C
Methane Concentrations Above Regulated Standards
Southeastern Portion of Site
Genesee Park Landfill
Seattle, Washington



Parametrix City of Seattle 555-1550-052/02(072) 1/06 (B)

June 2001 & October 2004 Methane Measurement Locations

2001 Data
2004 Data

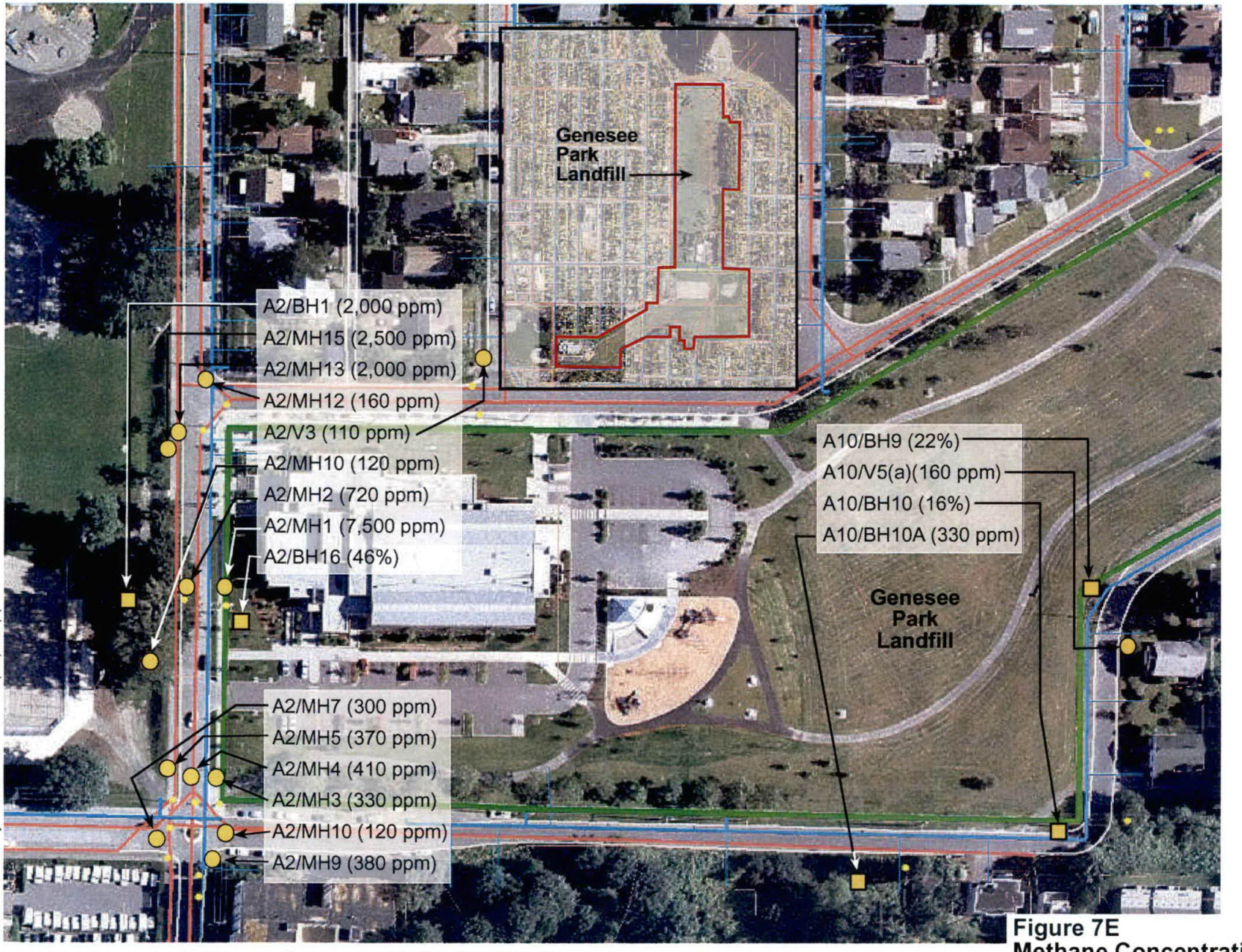
February 1993 Methane Measurement Locations

Structures (vaults, manholes, basements)
Bar-holes

N

- Methane readings recorded by the City of Seattle
- Methane regulatory standard (Title 10, Board of Health Solid Waste Regulations [10.09.040 & 10.09.050])
  - 100 ppm methane in off-site structures
  - 5% methane at property boundary
- A5/MH9: Location of methane reading
- A : Area of site • CB : Catch basin
- MH : Man-hole • BH : Bar-hole • V = Vault
- Location of all site features are approximate

Figure 7D
Methane Concentrations Above Regulated Standards
South Central Portion of Site
Genesee Park Landfill
Seattle, Washington



February 1993 Methane Measurement Locations

- Structures (vaults, manholes, basements)
- Bar-holes

- Methane readings recorded by the City of Seattle
- Methane regulatory standard (Title 10, Board of Health Solid Waste Regulations [10.09.040 & 10.09.050])
  - 100 ppm methane in off-site structures
  - 5% methane at property boundary
- A5/MH9: Location of methane reading • A : Area of site • CB : Catch basin
- MH : Man-hole • BH : Bar-hole • V = Vault • Location of all site features are approximate

Figure 7E
Methane Concentrations Above Regulated Standards
Genesee Park Landfill
Southwestern Portion of Site
Seattle, Washington

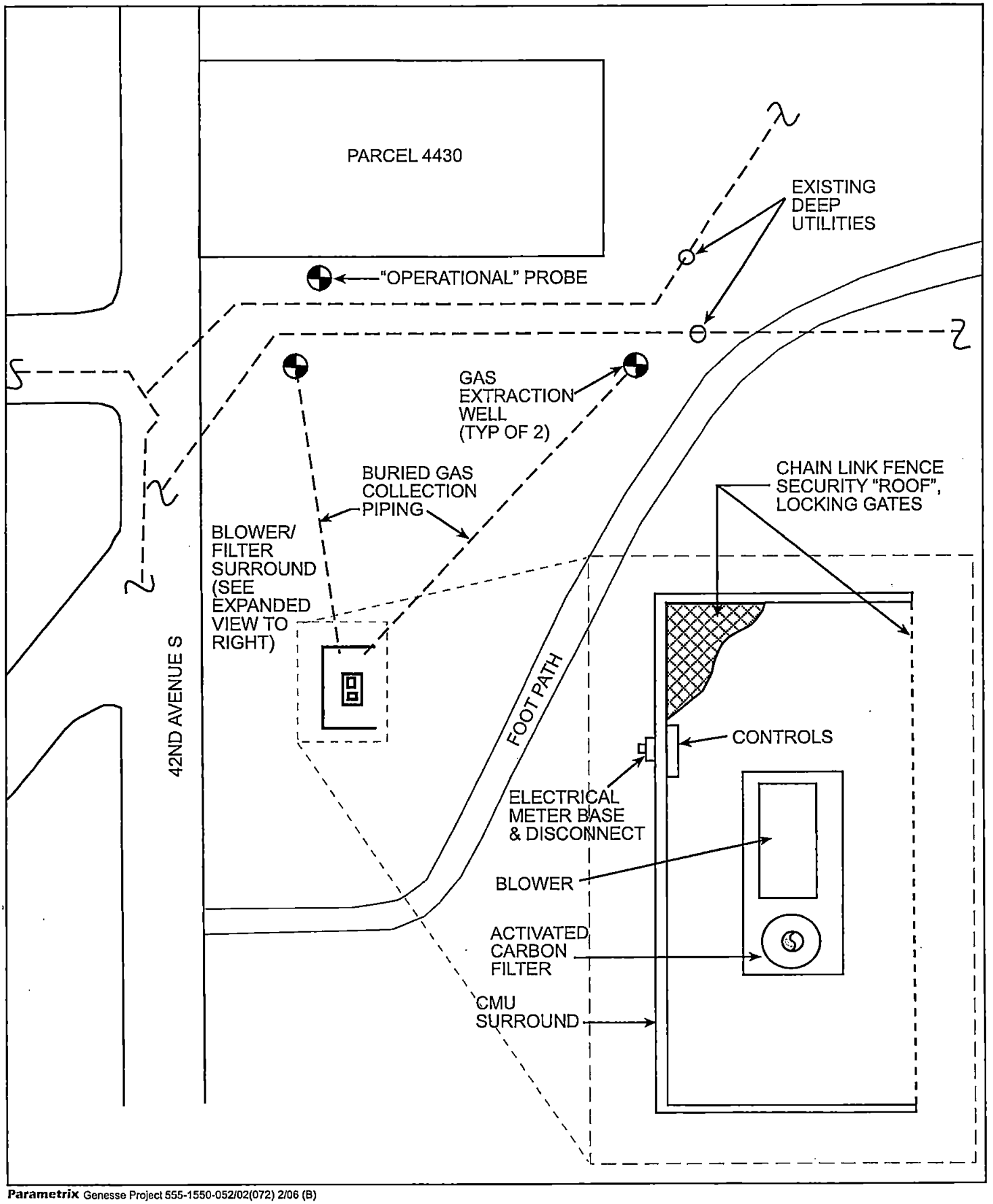
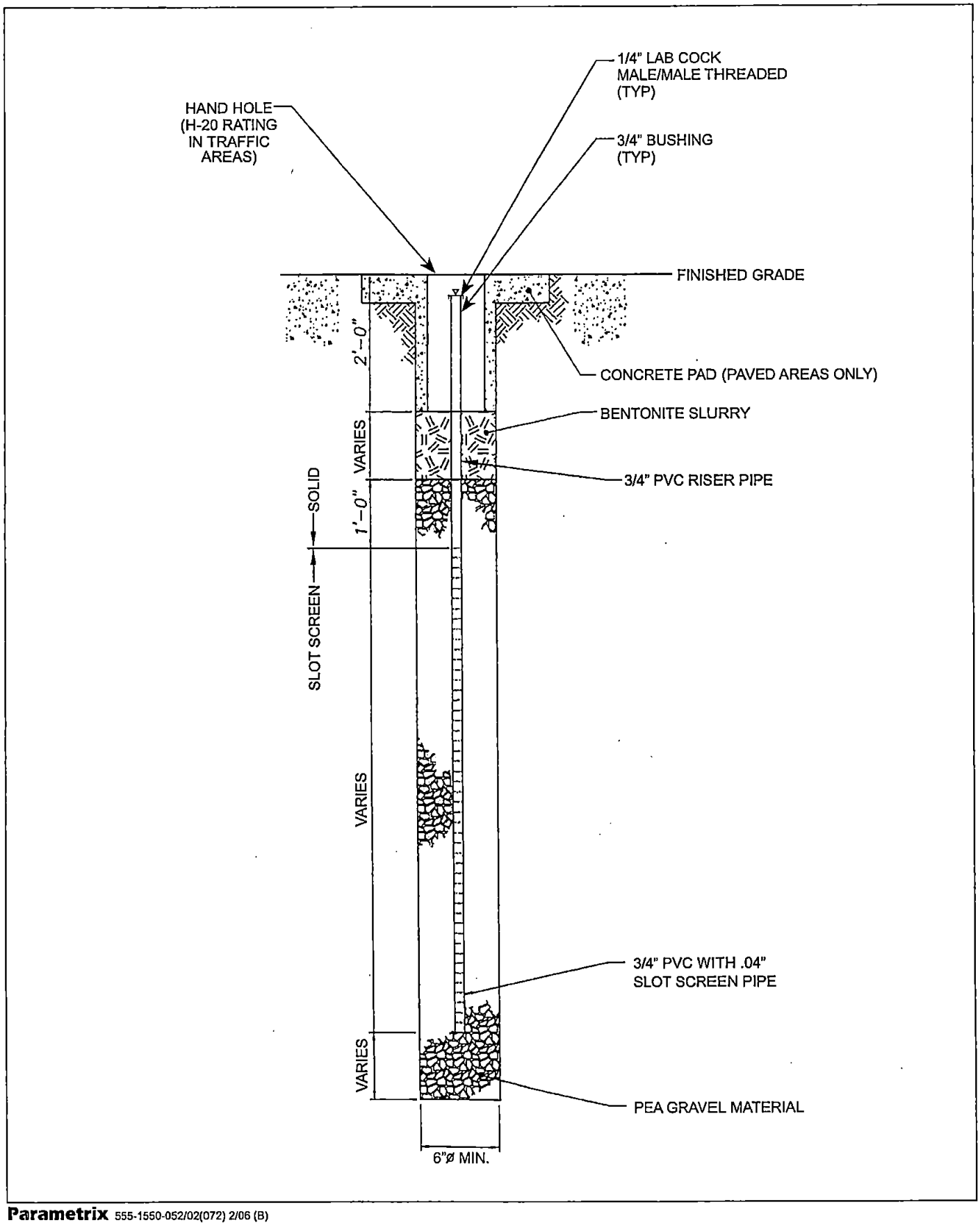


Figure 8
Genesee Gas Collection Test System Conceptual Layout



Parametrix 555-1550-052/02(072) 2/06 (B)

Figure 9
Gas Probe Schematic
Genesee Park
Seattle, Washinton

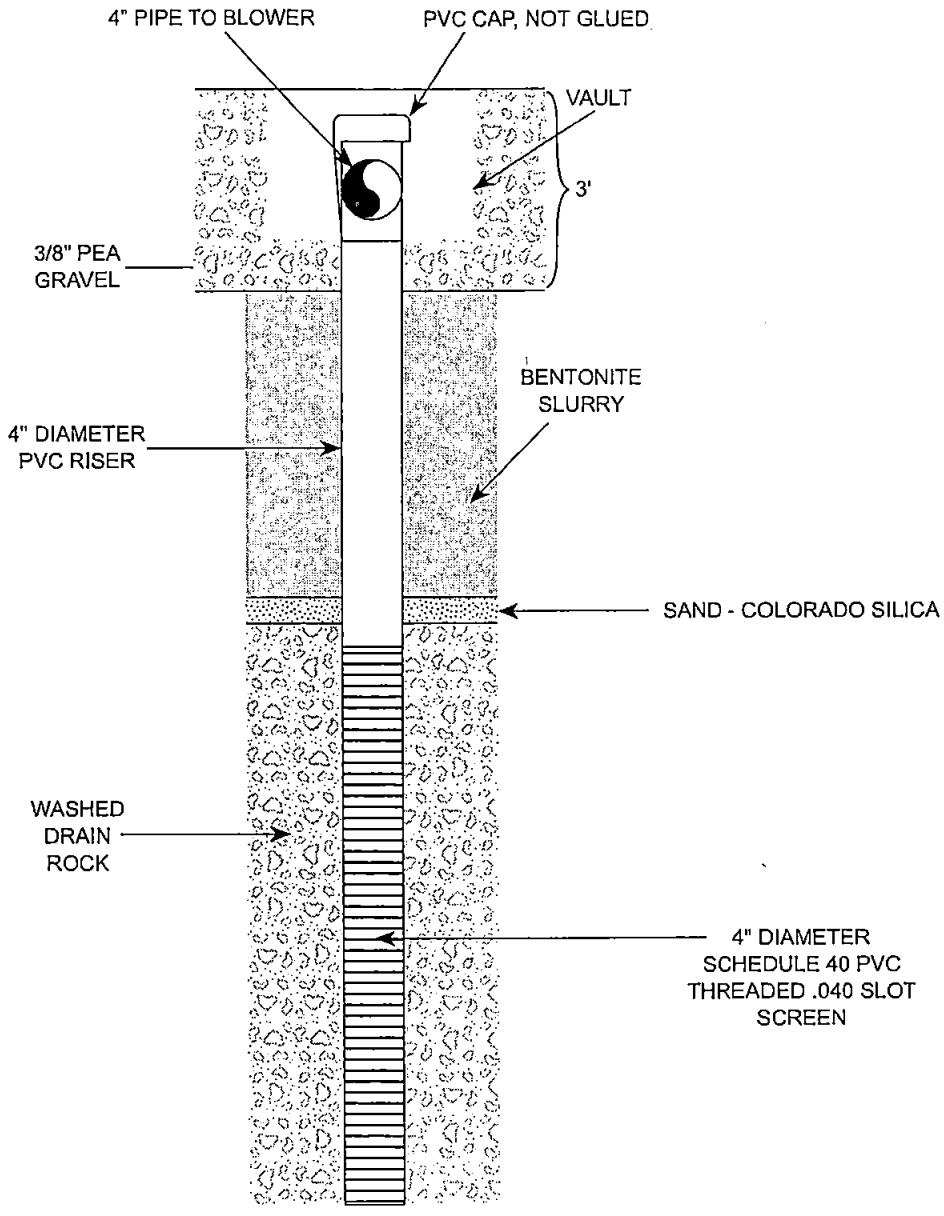


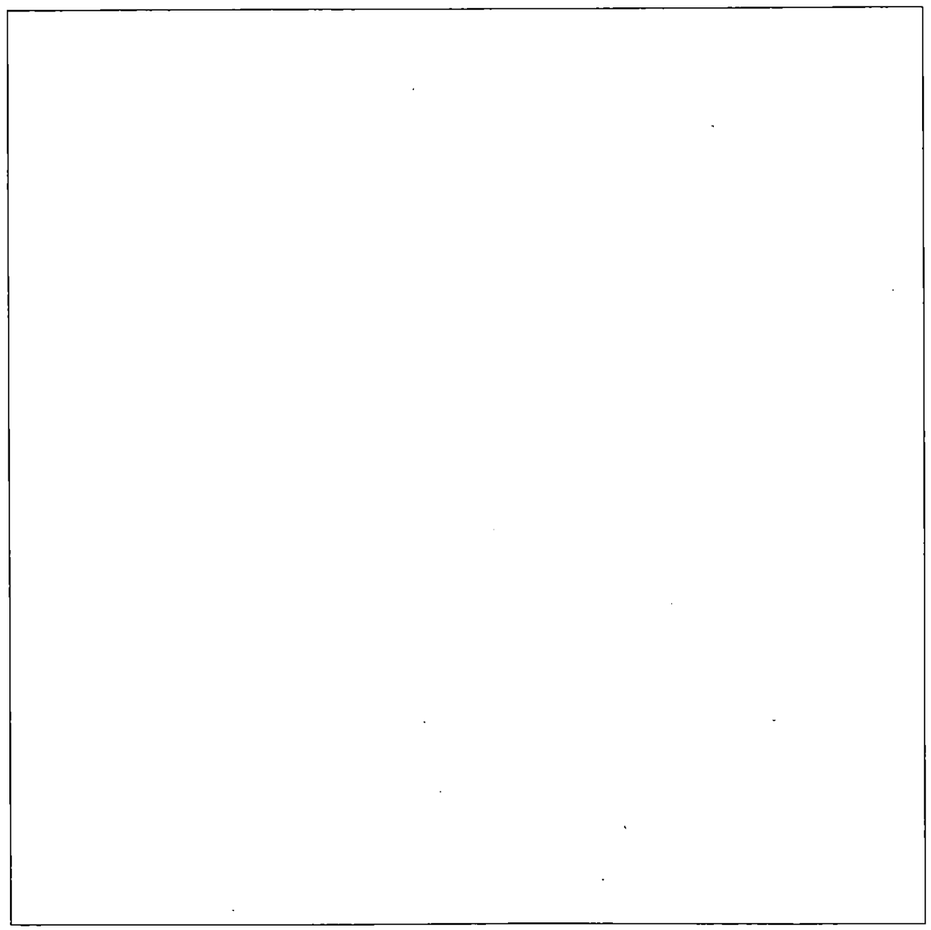
Figure 10
Gas Extraction Well Schematic
Genesee Park
Seattle, Washinton

APPENDIX A

Sheet Mock-ups Genesee Gas Collection Test System

GENESEE GAS COLLECTION TEST SYSTEM

SEATTLE, WASHINGTON



VICINITY MAP
PLAN
NO SCALE

LEGEND
XX

ABBREVIATIONS
XX

SHEET TITLE

1 MAP, LEGEND, ABBREVIATION
2 COLLECTION PLAN, BLOWER STATION PLAN
3 SECTIONS AND DETAILS
4 ELECTRICAL
5 DETAILS AND ELECTRICAL

IMAGES:
XREFS: XBL1550052P021072-1B

DATE: Feb 15, 2006 - 1:04pm PLOTTED BY: curtisj

△	REVISIONS	DATE	BY

DESIGNED
DRAWN J. CURTIS
CADD CHECKED
CHECKED
APPROVED

ONE INCH AT FULL SCALE.
IF NOT, SCALE ACCORDINGLY
FILE NAME BL1550052P01T072C-01
JOB No. 555-1550-052
DATE XX

DRAFT

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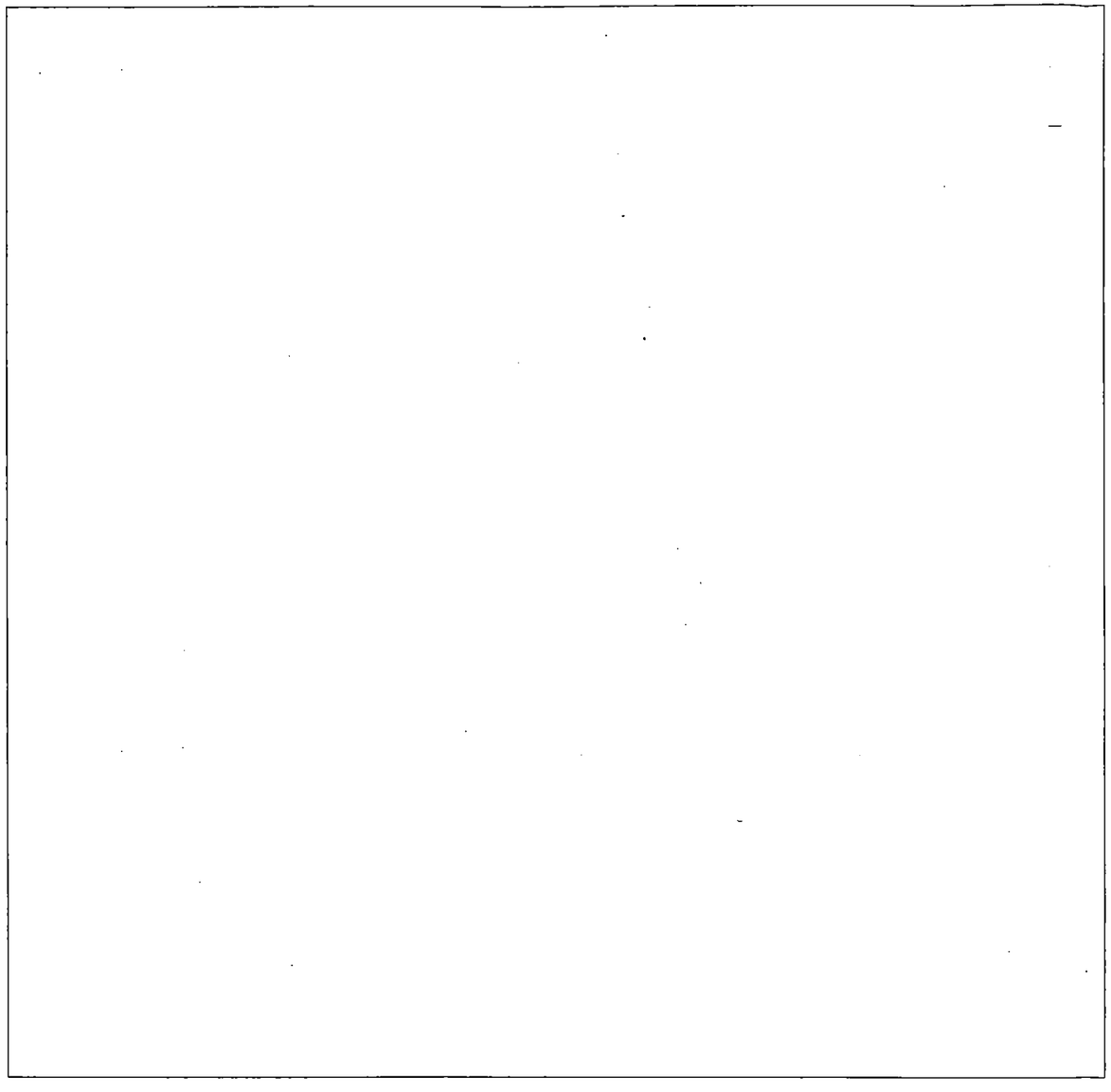
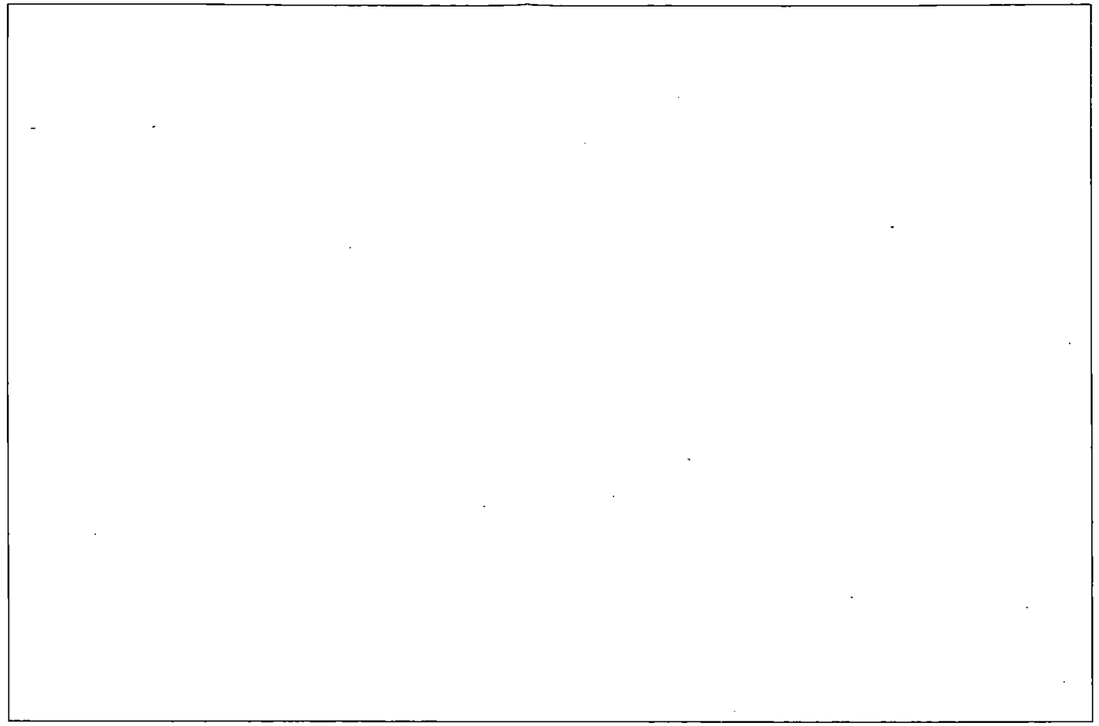
PROJECT NAME
GENESEE GAS COLLECTION TEST SYSTEM
SEATTLE, WA

MAP, LEGEND, AND ABBREVIATIONS

DRAWING NO.
OF XX
1



COLLECTION SYSTEM
PLAN
NO SCALE



BLOWER SYSTEM
PLAN
1/2"=1'-0"

NOTES:

1. XX

IMAGES:
XREFS: XBL1550052P021072-TB

DATE: Feb 15, 2008 - 1:04pm PLOTTED BY: curtisj

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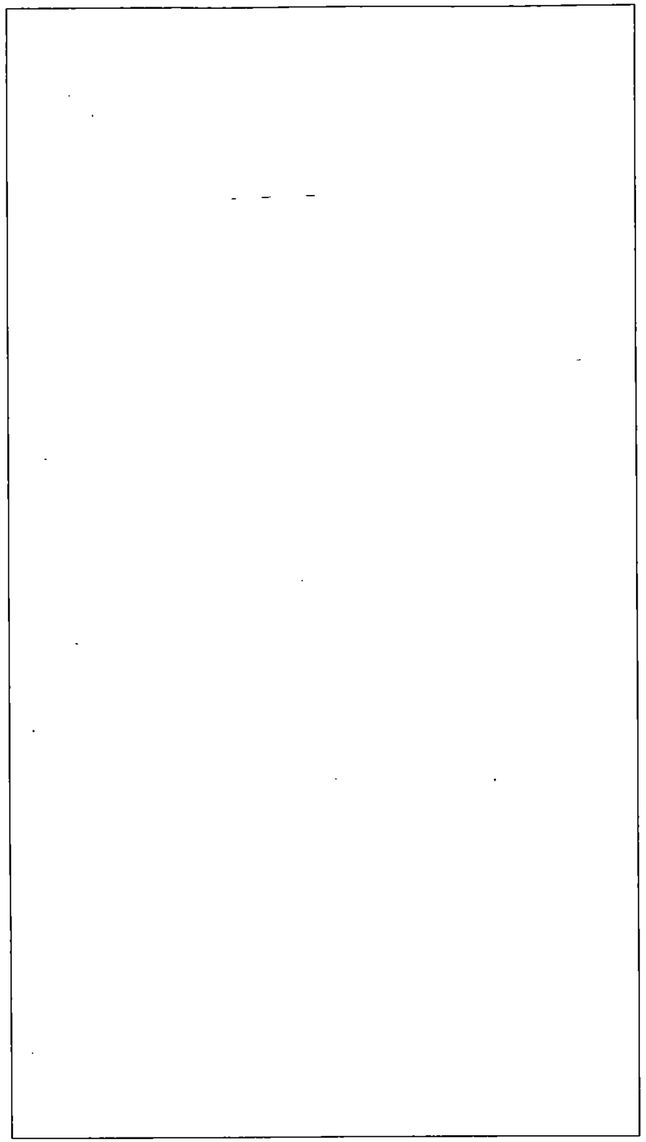
PROJECT NAME
GENESEE GAS COLLECTION
TEST SYSTEM

SEATTLE, WA

COLLECTION SYSTEM, BLOWER SURROUND PLAN

DRAWING NO.
OF XX
2



COLLECTION WELL
PLAN
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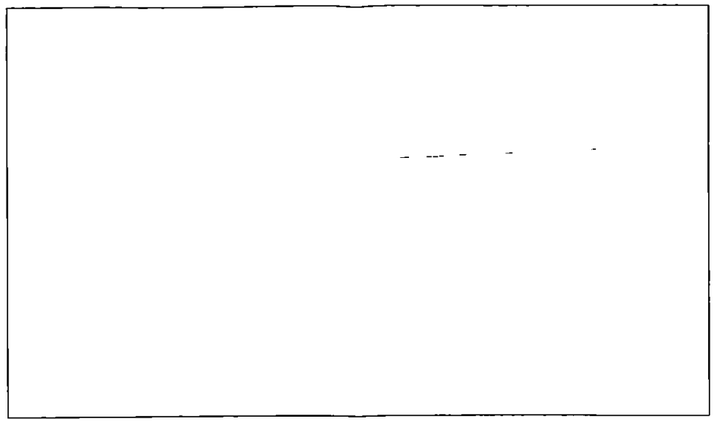

WELL COMPLETION VAULT
PLAN
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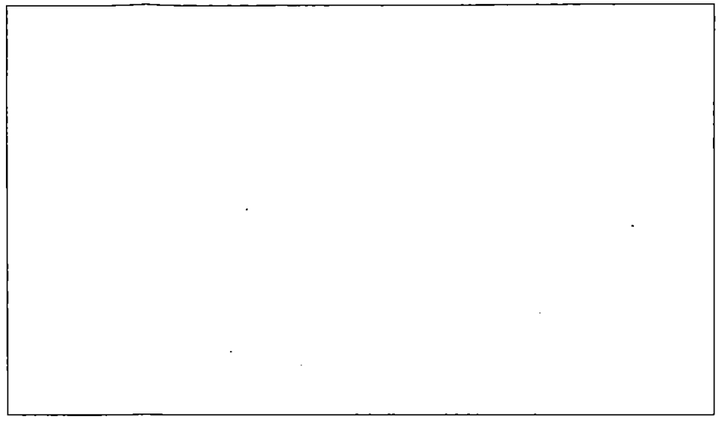
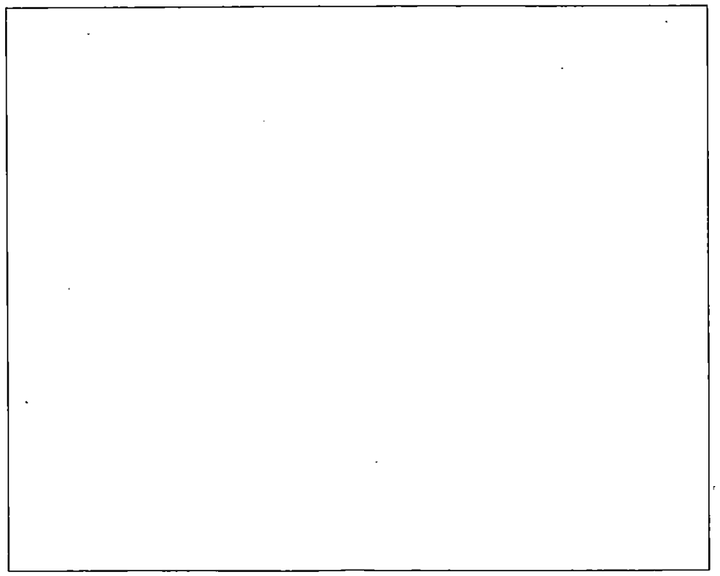


BLOWER STATION
SECTION A
NO SCALE



SLAB REINFORCEMENT
PLAN
NO SCALE

NOTES:

1. XX

IMAGES:
XREFS: BL1550052P01T072C-TB
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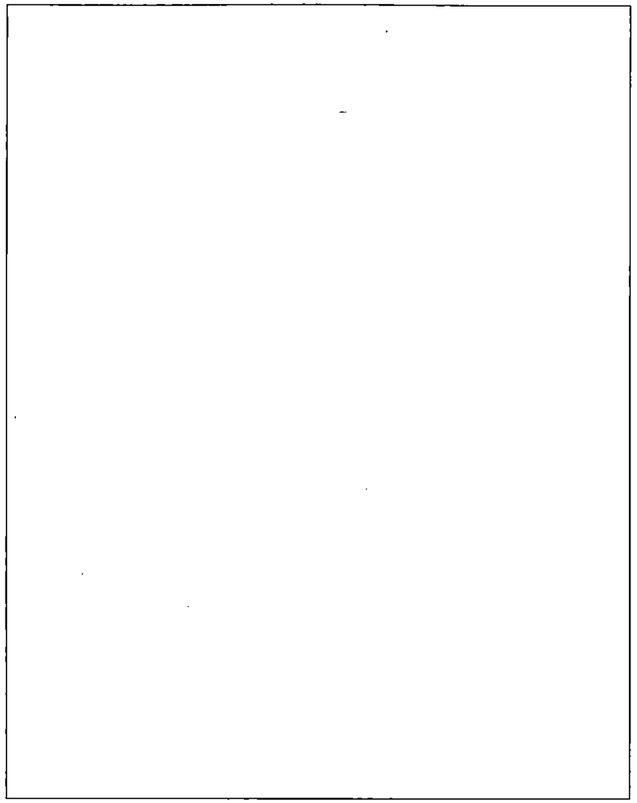
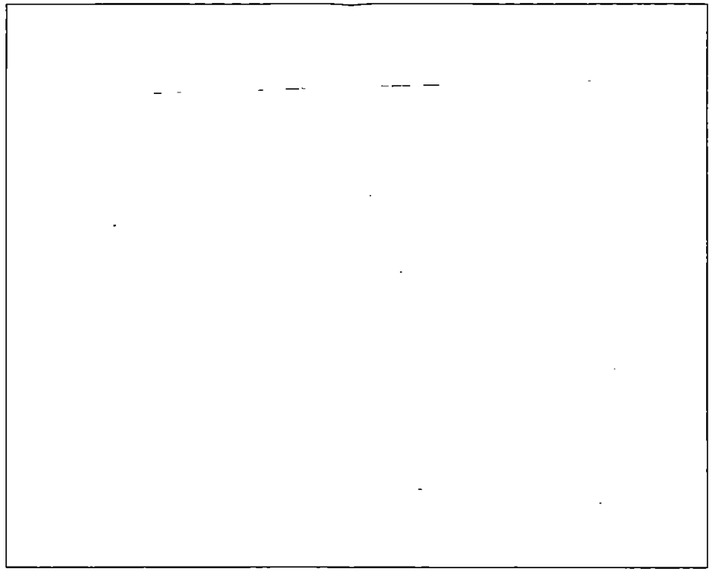
PROJECT NAME
GENESEE GAS COLLECTION
TEST SYSTEM
SEATTLE, WA

SECTIONS AND DETAILS

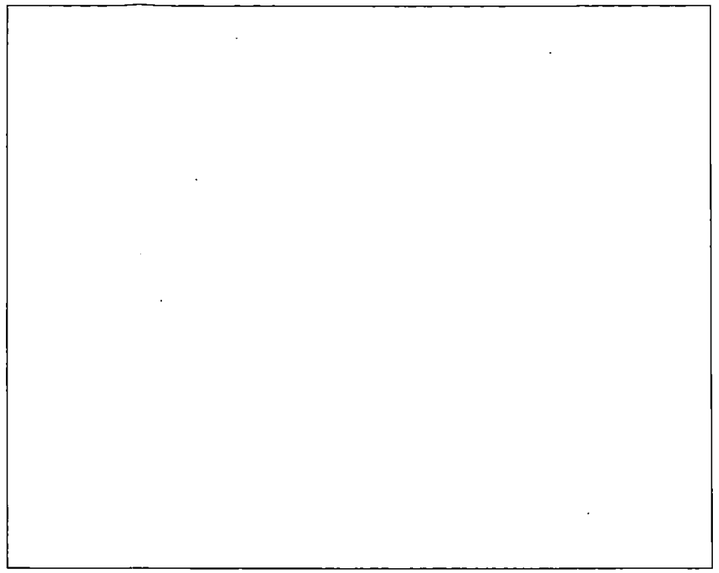
DRAWING NO.
OF XX
3



ELECTRICAL
PLAN
NO SCALE



ELEMENTARY
PLAN
NO SCALE



PANEL
PLAN
NO SCALE

NOTES:

1. XX

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JOB No. 555-1550-052
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PROJECT NAME
GENESEE GAS COLLECTION
TEST SYSTEM
SEATTLE, WA

ELECTRICAL

DRAWING NO.
OF XX
4

DATE: Feb 15, 2006 - 1:04pm PLOTTED BY: curtijer
IMAGES:
XREFS: XBL1550052P02T072-TB

APPENDIX B

Sampling and Analysis Plan

Sampling and Analysis Plan

Genesee Park Landfill Gas Monitoring Network and Collection Test System

Prepared for

Seattle Public Utilities and
City of Seattle Department of Parks and Recreation

Prepared by

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February 2006 | 555-1550-052 (02/072)

CITATION

Parametrix. 2006. Sampling and Analysis Plan
Genesee Park Landfill Gas Monitoring Network and Collection Test System.
Prepared by Parametrix, Bellevue, Washington. February 2006.

TABLE OF CONTENTS

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ACRONYMS

APHA-AWWA-WPCF	American Public Health Association-American Water Works Association-Water Pollution Control Federation
DQOs	Data Quality Objectives
Ecology	Washington State Department of Ecology
EOX	Total Halogen
EPA	United States Environmental Protection Agency
GC/ECD	Gas chromatography/electron capture detector
GC/FID	Gas chromatography/flame ionization detector
GC/MS	Gas chromatography/mass spectroscopy
ICP	Inductively coupled plasma
LCS	Laboratory Control Sample
LCS	laboratory control standard
MS	matrix spike
PAH	Interim TPH
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated Biphenyl
PID	photoionization detector
QA/QC	quality assurance/quality control
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SVOCs	emi-volatile organic compounds
VOCs	volatile organic compounds

1. INTRODUCTION

This Sampling and Analysis Plan (SAP) was developed for soil and water sampling associated with drilling activities at the Genesee Landfill in Seattle, Washington. This SAP outlines sampling methods and analytical methods and includes a Quality Assurance Project Plan (QAPP) addressing quality assurance objectives, analytical methods, quality control, and data validation and reporting.

1.1 PROJECT BACKGROUND

Genesee Park is constructed over the site of a closed landfill called known as the Genesee Landfill (Figure 1). The landfill primarily contains residential refuse and was part of a reclamation effort to develop the landfill into a park in the late 1960s.

Bar-hole monitoring for landfill gas was conducted by City of Seattle in 1993, 2001, and 2004 at locations shown on Figure 1. In 1993, methane and oxygen readings were measured at various locations (vaults, manholes, etc.) around the perimeter of the Site. Fifteen locations around the Site had methane readings that ranged form 5 percent to 72 percent. In 2001 and 2004, methane readings ere measured at 26 different locations in the southern portion of the Site. At 11 of the locations, the methane readings ranged form 5 percent to 50 percent by volume. These 11 locations appear to be in the vicinity of utility trenches that could be acting as migration conduits for the gas. Methane was also detected in a basement of a house on parcel 4430 (see Figure 1), although at much lower concentrations. Several utilities are located near parcel 4430, including a large storm water line believed to be the deepest utility that crosses the site. If subsurface landfill gas is currently migrating offsite, or has previously migrated and persists in offsite soils, the utility trenches and surrounding soils near parcel 4430 may be the likeliest place to detect it.

On January 6, 2006, a meeting was held between the City, Parametrix, the Health Department, and Ecology concerning the Site. The Health Department stated that they felt the City was out of compliance with Title 10, Board of Health Solid Waste Regulations (10.09.040 and 10.09.050) due to bar-hole data in excess of the lower explosive limit for methane at or near the Site boundary. The Health Department requested that he City evaluate compliance in the vicinity of Parcel 4430 and at the property boundary around the perimeter of the Site.

1.2 OBJECTIVES

The objectives of the sampling plan are as follows:

- Install 8 landfill gas monitoring wells around the property boundary to collect repeatable, reliable subsurface landfill gas data.
- Install a landfill gas control test system to remove and properly dispose of subsurface gas from the vicinity of parcel 4430.
- Assess the effectiveness of the test system as possible model for additional gas controls should monitoring reveal the need for them.
- Assess the need for additional gas control measures by monitoring the newly installed wells over an initial one month time interval.

Parametrix Genesee Park 555-1550-041/02(071) 2/05 (B)

Orthophoto source:
Triathlon, July 1999
Map date: December 15, 2004

Legend

- Parcel Boundary
- DWU Lateral
- DWU Mainline
- Water Mainline
- Water services
- Pavement edge

Probes

- Proposed gas monitoring probe
- Proposed gas extraction well
- Bar hole
- Utility hole
- Vault ambient

Contours

- 10' contour
- 2' contour

Approximate Location of Passive Vent System

N

Figure 1
Genesee Park Landfill
Proposed Gas Monitoring and Extraction Wells
Seattle, Washington

2. FIELD SAMPLING

2.1 SAMPLING OBJECTIVES

The objectives of the sampling program are as follows:

- Collect soil samples of drill cuttings for characterization and disposal purposes.
- Collect water samples from decontamination operations for characterization and disposal purposes.

2.2 SITE DESCRIPTION

The Genesee Landfill is located adjacent to Lake Washington in the southeastern portion of the City of Seattle. The Site is currently used as a city park and provides a community center, network of asphalt paths, picnic areas, and open grass and soccer fields. The ground surface of the Site is typically underlain by about 7 to8 feet of low-permeable fill material that grades from silty sand to sandy silt. Below this cover layer lies about 15 to 25 feet of refuse. The refuse consists of rubble, wood, clay, burned ash, paper, and other materials. Beneath the refuse is native material, consisting of recessional lacustrine deposits.

2.3 SOIL SAMPLING

2.3.1 Sampling Frequency and Sample Type

The number and types of samples to be collected are listed below:

- Soil cuttings from the drilling of gas probe and extraction well borings will be placed in roll-off bins in a designated staging area. The number of samples collected will be based upon the volume of material produced. If less than 100 cubic yards of material are produced, three soil samples will be collected for analysis. Additional soil samples will need to be collected if more than 100 cubic yards are produced.
- Rinse water from decontamination activities will be placed in 55-gallon drums and consolidated in the staging area. One water sample will be collected form each drum for chemical analysis.
- Two rinsate blanks and two field duplicates will be collect3ed during sampling activities for quality assurance/quality control (QA/QC) purposes.

2.3.2 Sampling Methods

2.3.2.1 Soil Samples

- A decontaminated trowel or shovel will be used to collect the soil sample. The soil sample will be collected from a depth of 6 to 12 inches below the soil surface.
- Sample material will be placed directly into labeled sample containers provided by the analytical laboratory for chemical analysis.
- Samples will be packed in ice and shipped via a commercial carrier, under chain-of-custody procedures, to the analytical laboratory.

- Additional sample material will be placed in a self-sealing plastic bag for in-field headspace analysis.
- Headspace samples will be allowed to warm in the sun for at least 20 minutes. Headspace analysis will be performed on bagged samples by placing the tip of a photoionization detector (PID) into the bag and recording the highest reading in the field notebook. The PID will be calibrated daily to an isobutylene standard.

2.3.2.2 Water Sampling

- Sample material will be placed directly into labeled sampled containers. The analytical laboratory will provide the necessary sample containers for analysis.
- Analytical samples will be packed in ice and shipped via commercial carrier, under chain-of-custody procedures, to the analytical laboratory.

2.3.3 Quality Assurance/Quality Control Procedures

Two field duplicate samples and two field rinsate blanks will be collected and analyzed as a quality control check.

2.4 SAMPLE ANALYSIS

2.4.1 Sample Handling and Documentation

Sample chain-of-custody will begin when the sample is collected and will be maintained until final disposal of the sample. Chain-of-custody procedures will be used to maintain and document sample possession. The principal documents are:

- Sample labels
- Field sampling records
- Chain-of-custody forms

Each sample container will be identified with printed labels and a unique and appropriate sample number. Sample labels will include the following information:

- Project identification
- Sample identification
- Analysis request
- Date and time of collection
- Initials of collector

Sample identifications will include sample location. All sampling locations will be recorded in the field notebook. Indelible ink will be used to prepare labels, chain-of-custody forms, and field notes.

2.4.2 Sample Analyses

Analytical methods and detection limits are discussed in Section 3. The soil and water samples will be analyzed and tested for the following:

- Resource Conservation and Recovery Act (RCRA) metals

- polychlorinated Biphenyl (PCBs)
- volatile organic compounds (VOCs)
- semi-volatile organic compounds (SVOCs)

2.5 DATA REPORTING

A data report will be provided within 30 days of the receipt of final sample results from the laboratory.

3. QUALITY ASSURANCE PROJECT PLAN

This QAPP establishes the quality assurance (QA) objectives for the WSU scrap metal yard IRA. It also establishes the QA organization and procedures to meet the project objectives. This QAPP also presents the procedures for sample handling, sample chain-of-custody, instrument/equipment performance criteria, analytical methods for sample analysis, internal quality control, audits, corrective actions, and data assessment.

The QA procedures described in this section are developed to assure the project specified Data Quality Objectives (DQOs) are met and that data generated are representative of the actual conditions found at the site. The goal of the QA plan is to assure a reasonable degree of confidence in data generated. QA plans do this through the establishment of a rigorous system of quality and performance checks on data collection, analysis, and reporting activities. In addition, QA plans strengthen the quality of data by requiring appropriate and timely corrective action to document and assure compliance with established performance and quality criteria.

3.1 PROJECT OBJECTIVES

The following are the objectives of the sampling programs outlined in Section2:

- Collect soil samples of drill cuttings for characterization and disposal purposes.
- Collect water samples from decontamination operations for characterization and disposal purposes.

3.2 PROGRAM QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITY

Specific program QA responsibilities are described in Table 3-1.

Table 3-1. Quality Assurance Responsibilities

Personnel	Responsibilities
Kurt Easthouse Project Manager Parametrix	Oversee technical team performance to ensure successful accomplishment of the technical and QA project objectives; review QA needs and approve QA corrective action where necessary.
Sandra Matthews Project Field Coordinator Parametrix	Ensure that all field sampling and handling procedures are followed and documented and field QA objectives are met; will coordinate and participate in the field sampling activities.
Sandra Matthews Project QA Officer Parametrix	Direct implementation of QAPP, provide technical QA assistance, evaluate laboratory data and perform QA/QC.
Laboratory QA Officer	Ensure that all laboratory QA objectives are met and data deliverables from the laboratory are correctly documented and reported.

3.3 QUALITY ASSURANCE OBJECTIVES FOR PARCC PARAMETERS

The purpose of this section is to describe quality assurance objectives for precision, accuracy, representativeness, completeness, and comparability (PARCC) of the project data. Documentation from the laboratory will be used to determine if PARCC requirements are being met. This documentation may include reports on sample results, surrogate recoveries, spike recoveries, and laboratory instrument calibrations. The documentation of PARCC allows validation of results and identifies data uses and/or limitations prior to the actual use of the data.

Specific requirements for sample handling, sample custody, calibration, analytical procedures, data reporting, internal quality control, audits, preventative maintenance, and corrective actions will be discussed in other sections of this QAPP.

3.3.1 Precision and Accuracy

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed similar conditions. It is expressed in terms of the standard deviation or relative percent difference (RPD). Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property), X, with either an accepted reference or true value, T. Accuracy can be expressed as the difference between two values, X-T, or the difference as a percentage of the reference or true value, 100 (X-T)/T, or as a ratio, X/T. Accuracy is a measure of the bias in a system and will be expressed as the percent recovery of the samples.

Accuracy and precision are determined through quality control parameters such as surrogate recoveries, matrix spikes, quality control (QC) check samples, and blind field duplicates.

A blind field duplicate sample will be analyzed as a QC sample for verification of precision and accuracy. If results of the blind field duplicate are outside the control limits, corrective action and/or data qualification will be determined after review by the quality assurance officer or his or her designee. Blind field duplication can be of poor quality because of sample heterogeneity. Therefore, corrective action will be determined by the quality assurance officer.

3.3.2 Representativeness

Representativeness expresses the degree to which sampling data accurately and precisely represent a characteristic of a population. Sample locations and field sampling procedures have been chosen to maximize representativeness. Representativeness will be assessed from review of sampling records of field activities.

3.3.3 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the total data collected. The QA objective for completeness during this project is 90 percent.

3.3.4 Comparability

Comparability expresses the confidence with which one data set can be compared to another. All measurements will be made so that results are comparable with other measurement data for similar samples and sample conditions and with relevant action levels, criteria, or standards. The samples will be collected and analyzed using standard techniques and reporting analytical results in units consistent with EPA guidelines. Method detection limits and units to be reported are described in Section 3.7.

3.4 SAMPLING PROCEDURES AND HANDLING

3.4.1 Sample Collection and Analyses

Soil and water samples will be collected at the site. Selection of sampling locations and objectives is discussed in Section 1. Procedures for field sample location, collection of samples and types of lab analyses to be performed is presented in Section 2. A summary of QC samples is shown in Table 3-2. A summary of specifications for containers, holding times, preservation and handling is shown in Table 3-3.

Table 3-2. Guidelines for Minimum QA/QC Samples for Field Sampling and Laboratory Analysis[1]

	Blind Field Duplicate	Field Rinsate Blank[2]	Method Blank	LCS[3]	Matrix Spike
Solid	1 in 20[4]	1 in 20	1 in 20	1 in 20	1 in 20
Aqueous	1 in 20[4]	1 in 20	1 in 20	1 in 20	1 in 20

1 EPA 1988.
2 Field rinsate blanks are not required for dedicated equipment.
3 LCS = Laboratory Control Sample.
4 All frequencies of 1 in 20 indicate 1 per batch, when the batch is less than 20.

Table 3-3. Sample Containers, Preparation, Preservatives and Holding Times

	Sample Container	Preservation and Handling	Holding Times[1, 2, 3]
Bottle Code: Soil			
PCB	8-oz WMG[4]	Keep on ice (4 degrees C)	14 days
Total metals	4-oz WMG	Keep on ice (4 degrees C)	6 months
SVOC	4-oz WMG	Keep on ice (4 degrees C)	14 days
VOC	4-oz WMG	Keep on ice (4 degrees C)	14 days
Bottle Code: Water			
PCB	1000 ml AG[6]	Keep on ice (4 degrees C)	14 days
Total metals	500 ml HDPE	HNO3 to pH <2 Keep on ice (4 degrees C)	6 months
SVOC	1000 ml AG4	Keep on ice (4 degrees C)	7 days until extraction
VOC	40ml vial[7] x 3	Keep on ice (4 degrees C)	7 days; 14 days if preserved

1 APHA-AWWA-WPCF 1989.
2 Methods for Chemical Analysis of Water and Wastes (EPA 1983).
3 Test Methods for Evaluating Solid Waste (SW-846), 3rd Edition (EPA 1986).
4 WMG = wide mouth glass
5 No headspace
6 AG=Amber glass with Teflon-lined lid
7 Glass vial; Teflon-lined-silicon septum cap No headspace

3.4.2 Documentation

Sample documents will be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents are summarized in Table 3-4 and will include:

- Field notebook
- Sample labels
- Chain-of-custody records

Table 3-4. Sampling and Sample Handling Records

Record	Use	Responsibility/Requirements
Field Notebook	Record significant events, observations, and appropriate measurements.	Maintained by field sampler/geologist; all entries must be factual, detailed, objective; entries must be signed and dated.
Sample Label	Accompanies sample; contains specific sample identification information	Completed and attached to sample container by sampler.
Chain-of-Custody Record	Documents chain of custody (responsibility/accountability) for sample handing	Documented by sample number. Original accompanies sample. A copy is retained by QAO.

Project sampling and sample handling will be documented through the use of a field notebook. A field notebook must be maintained to provide daily records of significant events, observations, and appropriate measurements collected during field investigations. All entries are to be made in waterproof ink, signed, and dated. Corrections will be made according to the procedures given at the end of this section.

Field notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during projects and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. The field notebook entries should be factual, detailed, and objective. All field notes will be retained by the program field coordinator and secured in a safe place.

As with any data logbooks, no pages are to be removed, destroyed, or thrown away. If a correction is to be made, these will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction will be initialed and dated. Most corrected errors will require a footnote explaining the correction.

If an error is made on a document assigned to one person, that individual may make corrections simply by crossing out the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered in a document should be corrected by the person who made the entry.

3.5 SAMPLE CUSTODY

3.5.1 Custody Procedures

This section describes standard operating procedures for sample custody and the chain-of-custody procedures to be used for this project. These procedures ensure the quality and integrity of the samples are maintained during their collection, transportation, storage, and analysis.

3.5.1.1 Chain-of-Custody

The chain-of-custody procedures used for this program provide an accurate written or computerized record that can be used to trace the possession of each sample from the time each is collected until completion of all required analyses. A sample is in custody if it is in any of the following places:

- Someone's physical possession
- Someone's view
- A secured container
- A designated secure area.

3.5.1.2 Field Custody Procedures

The following field custody procedures will be followed:

- As few people as possible will handle the samples.
- The sample collector will be responsible for the care and custody of the samples collected until the samples are transferred or dispatched properly.
- The sample collector will record sample data on the sample collection form.
- The field coordinator will determine whether proper custody procedures were followed during the field work and will decide if additional samples are required.

3.5.1.3 Laboratory Custody Procedures

A designated sample custodian will accept custody of the shipped samples and verify that the information on the sample labels matches the chain-of-custody records. Pertinent information on shipment, pickup, courier, and condition of the samples is entered in the "Remarks" section of the chain-of-custody form. The custodian then enters the sample identification number data into a bound logbook of the chain-of-custody forms, which is arranged by project code and station number.

The laboratory custodian uses the sample identification number or assigns a unique laboratory number to each sample, transfers the samples to the proper analyst, or stores them in the appropriate secure area. Sample control and custody at the laboratory through sample disposal will be conducted in accordance with standard laboratory procedures that maintain the sample integrity and security.

3.5.2 Transfer of Custody and Shipment

When samples are transferred, the person relinquishing the samples will sign the chain-of-custody record and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Program documentation of sample custody will be verified by the quality assurance officer during regular review of the data package.

The following transfer of custody and shipment procedures will be followed:

- The coolers in which samples are packed must be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the chain-of-custody record to document sample custody transfer.
- Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the chain-of-custody record and traffic report.
- All shipments will be accompanied by the chain-of-custody record identifying their contents. The original record will accompany the shipment. The other copies will be distributed as appropriate to the quality assurance officer and program manager.

3.5.3 Sample Identification

Each sample will be labeled and sealed immediately after collection. The labels will be filled out using waterproof ink and will be firmly affixed to the sample containers and protected with clear, water-resistant tape.

The following information will be given on each sample label:

- Name of sampler
- Date, time, and location of collection
- Sample number
- Analysis required
- Preservative, if any.

3.5.4 Sample Packaging and Shipping

The samples will be transported and handled in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of the samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are issued and enforced by the United States Department of Transportation (DOT) in the 49 C.F.R. 172 through 177. Samples will be packed in plastic bubble wrap, placed on ice in a sealed cooler, and shipped, via a commercial carrier to the analytical laboratory.

3.6 CALIBRATION PROCEDURES AND FREQUENCY

3.6.1 Laboratory Instruments

All instruments and equipment used during analysis will be operated, calibrated, and maintained according to manufacturer's guidelines and recommendations, and in accordance with procedures in the EPA method cited. Properly trained personnel will operate, calibrate, and maintain laboratory instruments. Calibration blanks and check standards will be analyzed daily for each parameter to verify instrument performance and calibration before beginning sample analysis.

All calibration procedures will meet or exceed EPA SW-846 protocols as described in the SW-846 for all metals analyses. Any variations from these procedures must be approved by the quality assurance officer before beginning sample analysis.

After the instruments are calibrated and standardized within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. Acceptable performance of the QC check sample verifies the instrument performance on a daily basis. Analysis of a QC check standard demonstrates good laboratory practices. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check samples will be analyzed and evaluated according to the EPA method criteria.

Instrument performance check standards and calibration blank results will be recorded in a laboratory instrument log book, which will also contain evaluation parameters, benchmark criteria, and maintenance information. If the instrument log book does not provide maintenance information, a separate maintenance log book must be maintained for the instrument.

3.6.2 Field Instruments

Field instruments to be used during the performance of sampling activities will be calibrated in accordance with manufacturers guidelines.

3.7 ANALYTICAL PROCEDURES

General methods and method quantitation limits for possible analyses are summarized in Table 3-5. Quality control checks and decision criteria for determining if an analysis is within quality control requirements will follow the Quality Control procedures and guidelines listed in SW-846.

Where appropriate, based on anticipated data uses and with recognition of validation requirements, these procedures may be modified to incorporate techniques familiar to the project laboratory. The laboratory will notify the project Quality Assurance Officer (QAO) of any proposed procedural changes and document these changes in the cover letter with the data reports.

Due to the potential sample heterogeneity, matrix interferences may make achievement of the desired detection limits and associated quality control criteria impossible. In such instances, the laboratory must report to the QAO the reason for noncompliance with quality control criteria or elevated detection limits.

Where appropriate, based on anticipated data uses and with recognition of validation requirements, these procedures may be modified to incorporate techniques familiar to the project laboratory. The laboratory will notify the project QAO of any proposed procedural changes and document these changes in the cover letter with the data reports.

Due to the potential sample heterogeneity, matrix interferences may make achievement of the desired detection limits and associated quality control criteria impossible. In such instances, the laboratory must report to the QAO the reason for noncompliance with quality control criteria or elevated detection limits.

Table 3-5. Methods and Quantitation Limits for Analysis of Soil

Analyte	Analytical Technique	Analytical Methods[a]	Quantitation Limit—Soil
PCBs	GC/ECD	EPA 8081	1.0 mg/kg
Metals	ICP-MS/CVAA (Hg)	EPA 6010	1.0 mg/kg
VOC	GC/MS	EPA 8240	5.0 µg/kg
SVOC	GC/MS	EPA 8270	0.01 mg/kg

GC/FID = Gas chromatography/flame ionization detector
GC/ECD = Gas chromatography/electron capture detector
ICP = Inductively coupled plasma
GC/MS = Gas chromatography/mass spectroscopy
NA = Not Applicable
NOTE: Quantitation limits are affected by sample size, extractability, and matrix interference.

3.8 DATA REDUCTION, VALIDATION, AND REPORTING

All analyses performed for this project must reference quality control results to enable reviewers to validate (or determine the quality of) the data. Sample analysis data, when reported by the laboratory, will include quality control results but not the backup documentation. The project QAO is responsible for conducting checks for internal consistency, transmittal errors, laboratory protocols, and for complete adherence to the quality control elements specified in the QAPP.

A verification level validation will be performed on all field documentation and analytical data reports. The data validation process will be used to verify the data quality. The SAP will be used as the primary document guiding the data validation effort. When this is not possible, methods-specific QA requirements (typically listed in the SOP for the analytical methods), and professional judgement will be used to guide the data validation effort.

The following QC elements will be reviewed, as appropriate:

- Analytical holding times
- Preparation blank contamination
- Check standard precision
- Analytical accuracy (blank and matrix spike recoveries and laboratory control sample recoveries)
- Analytical precision (comparison of replicate sample results, expressed as relative percent differences)

Each data package will be assessed to determine whether the required documentation is of known and verifiable quality. This includes the following items:

- Field chain-of-custody record is present, complete, and signed
- Certified analytical report
- QA/QC sample results

3.9 INTERNAL QUALITY CONTROL

Quality control checks will consist of measurements performed in the field and laboratory. The analytical methods referenced in Section 3.7 specify routine methods required to evaluate data precision and accuracy, and whether the data are within the quality control limits.

3.9.1 Field and Intralaboratory Methods

The following quality control samples will be evaluated to verify accuracy and precision of laboratory results for this project. The frequency of quality control sample evaluation is also indicated by sample type, but may be adjusted when the final sampling schedule is determined. The frequencies of quality control sample evaluation described here should be considered a minimum and will be adjusted accordingly.

3.9.1.1 Field Rinsate Blank

One field rinsate blank will be analyzed.

Field rinsate blanks will consist of deionized water poured over and/or through the sampling equipment after decontamination. Surfaces and materials exposed during actual sampling will be rinsed to evaluate the effectiveness of sampling equipment decontamination procedures and the potential for sample field cross-contamination.

3.9.1.2 Blind Field Duplicate

One blind field duplicate sample will be analyzed to verify the precision of laboratory and/or sampling methodology. The blind field duplicate will consist of split samples from a larger, homogenized sample. The samples will be coded so the laboratory cannot discern which samples are field duplicates.

3.9.1.3 Laboratory Method Blank

A minimum of one laboratory method blank will be analyzed per 20 samples or one per batch (whichever is greater) to assess possible laboratory contamination. Method blanks will contain all reagents and undergo all procedural steps used for analysis.

3.9.1.4 Laboratory Control Sample

A minimum of one laboratory control standard (LCS) will be analyzed per 20 samples or one per sampling event (whichever is greater) to verify precision of laboratory equipment. The LCS will be a concentration within the calibration range. LCS analysis will follow EPA LCS guidelines established in SW-846.

3.9.1.5 Laboratory Matrix Spike

A minimum of one laboratory matrix spike (MS) will be analyzed per 20 samples or one per sampling event (whichever is greater) to monitor recoveries and assure that extraction and concentration levels are at acceptable levels. The laboratory matrix spike will follow the matrix spike guidelines specified in the SW-846 SOWs.

3.9.1.6 Laboratory Matrix Duplicate

A minimum of one laboratory matrix duplicate will be analyzed per 20 samples or one per sampling batch (whichever is greater), to provide information on the precision of chemical analysis. The laboratory duplicate will follow EPA duplicate guidelines specified in the SW-846.

3.10 PREVENTATIVE MAINTENANCE

3.10.1 Field Instruments

Field instruments and maintenance procedures will be in accordance with manufacturers guidelines.

3.10.2 Laboratory Instruments

The analytical laboratory manager is ultimately responsible for the care of the laboratory instruments. He or she may delegate the responsibility to the senior supervising chemists or technician qualified to perform routine maintenance after demonstrating that personnel are trained in maintenance procedures for that laboratory section (wet chemistry, metals, and organic). Training of laboratory personnel on the routine care of laboratory equipment should be provided, at a minimum, during the initial installation of the equipment and, for new analysts, before initial use of the equipment.

Maintenance and other appropriate details should be documented in daily maintenance logbooks. The individual performing the maintenance procedures will date and sign each entry. At a minimum, the preventative maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

3.11 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

Analytical data will be reviewed to assure that the QA/QC objectives for precision, accuracy, and completeness are met. These reviews will identify the occurrence of deficiencies in time to take corrective action. This section describes routine procedures for assessing project data.

3.11.1 Assessment of Data Precision

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Field duplicate samples will be used to measure precision. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), which is calculated as follows:

The RPDs between the primary sample and the duplicate sample will be calculated and compared with quality assurance objectives.

3.11.2 Assessment of Accuracy

Accuracy is assessed using the results of standard reference material, continuing calibration, and matrix spike analyses. It is routinely expressed as a percent recovery, which is calculated as follows:

The percent recovery will be routinely calculated and checked against quality assurance objectives.

3.11.3 Assessment of Completeness

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be calculated and compared with the data quality objectives.

3.11.4 Assessment of Representativeness

Sample locations and sampling procedures will have been chosen to maximize representativeness. A qualitative assessment (based on professional experience and judgment) will be made of sample data representativeness based on review of sampling records and QA audit of field activities.

3.12 CORRECTIVE ACTIONS

Corrective actions may be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements established in the SAP or QAPP
- Equipment or analytical malfunctions.

During field operations and sampling procedures, the project field coordinator will be responsible for taking and reporting required corrective action. A description of any such action taken will be entered in the field notebook. If field conditions are such that conformance with the SAP or QAPP is not possible, the QAO will be consulted immediately. Any corrective action or field condition resulting in a major revision of the QAPP or SAP will be communicated to the project manager for review and concurrence. This communication will be made before changes in the field activities whenever possible.

During laboratory analysis, the laboratory QAO will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in the QAPP, corrective action will follow the guidelines in SW-846. This includes, at a minimum, the following considerations:

- Calibration check compounds must be within performance criteria specified in SW 846 or corrective action must be taken before sample analysis begins.
- Before processing any samples, the analyst should demonstrate by analysis of a reagent blank that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.
- Spike analysis must be within the contract required recovery limits or corrective action must be taken and documented.

If analytical conditions do not conform with this QAPP, the QAO will be notified as soon as possible so that any additional corrective actions can be taken.

Corrective Action Reports will be provided by the analytical laboratory to document response to any reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities. Corrective Action Reports will be reviewed for appropriateness of recommendations and actions by the QAO for QA matters, and the program manager for matters of technical approach.

3.13 QUALITY ASSURANCE REPORTS TO MANAGEMENT

A QC summary report from the analytical laboratory will accompany all data files. This QC report will summarize all relevant data quality information. The QAO will be responsible for data quality assessments and associated QA reports.

4. REFERENCES

APHA-AWWA-WPCF (American Public Health Association-American Water Works Association-Water Pollution Control Federation). 1989. Standard methods for the examination of waste and wastewater, 17th edition.

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Ecology and Environment. 1990. Site Assessment Report for WSU Salvage Yard. Unpublished report prepared for Washington State University.

EPA (United States Environmental Protection Agency). 1983. Methods for chemical analyses for water and wastes. U.S. EPA, Washington, D.C.

EPA (United States Environmental Protection Agency). 1986. Test methods for evaluating solid waste (SW-846), 3rd edition. U.S. EPA, Washington, D.C.

EPA (United States Environmental Protection Agency). 1988. Laboratory data validation functional guidelines for evaluating inorganics analyses. Hazardous Site Evaluation Division, U.S. EPA, Washington, D.C.

APPENDIX C

Health and Safety Plan

Health and Safety Plan
Genesee Park Landfill Site

Prepared for

Parametrix, Inc.

Prepared by

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CITATION

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ATTACHMENTS

ACRONYMS

amsl	above mean sea level
CH_4	Methane
CPR	cardiopulmonary resuscitation
H_2S	Hydrogen sulfide
LEL	lower explosive limit
OSHA	Occupational Safety and Health Administration
PELs	Permissible Exposure Limits
PID	photoionization detector
PPE	Personal Protective Equipment
ppm	parts per million
RH	Relative humidity
SOPs	standard operating procedures
VOCs	volatile organic compounds
WDLI	Washington Department of Labor and Industries

1. INTRODUCTION

This health and safety plan is designed for the installation of landfill gas monitoring probes to be performed by Parametrix, Inc. at the Genesee Park in Seattle, Washington. Activities at the site include:

- Install eight new gas monitoring probes.
- Install two gas extraction wells.
- Install a gas extraction test system.

1.1 REGULATORY GUIDANCE

This Health and Safety Plan has been prepared according to the following regulations and guidelines:

- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA March 6, 1989), Hazardous Waste Operations and Emergency Response; Final Rule, 29 CFR Part 1910.120.
- Washington Department of Labor and Industries (WISHA December 15, 1989, plus addenda), Hazardous Waste Operations, WAC 296-62-300 (Part P).
- NIOSH/OSHA/USCG/EPA (October 1985), Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities.
- U.S. Environmental Protection Agency (U.S. EPA November 1984; updated July 1988), Standard Operating Safety Guides.

Text taken verbatim from applicable regulations is shown in italics; for other text, citations to specific applicable regulations follow the text of this Plan, and are also provided in italics (example: OSHA, 29 CFR Part 1910.120; WAC 296-62-300).

1.2 APPLICABILITY

NOTE: This Health and Safety Plan applies only to authorized employees of Parametrix, Inc. ("employer"). It will be available for review by other site personnel including, but not limited to, the client, regulatory officials, and subcontractors.

Federal (OSHA, 29 CFR Part 1910.120[b][1][iv] and [v]) and State of Washington (WAC 296-62-3010[1][d] and [e]) regulations require that the employer provide relevant health and safety information, including but not limited to this Health and Safety Plan, to contractors, subcontractors, or their representatives, and OSHA, U.S. EPA, Washington Department of Labor and Industries, and Washington Department of Ecology personnel.

Recent State of Washington regulations (WAC 296-62-3180[1]) state:

The [occupational safety and health] program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have its own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor.

Therefore, any party other than Parametrix remains responsible for providing its own site-specific Health and Safety Plan that addresses its own site-specific activities, which may

differ from those addressed in this Plan for Parametrix staff. Hence, Parametrix, Inc. assumes no responsibility or liability for the use or misuse of its Health and Safety Plan by such other party, its employees, agents, or subcontractors. Such other party must develop and implement its own Health and Safety Plan, and further ensure that the provisions and implementation of its Health and Safety Plan will smoothly interface with other Plans in effect at the site.

2. KEY PARAMETRIX PERSONNEL

2.1 HEALTH AND SAFETY PERSONNEL

Site Safety Officer: Sandra Matthews

2.2 PROJECT PERSONNEL

Project Manager: Kurt Easthouse

2.3 CLIENT CONTACT

Client: Seattle Engineering Department
Solid Waste Utility

Jeff Neuner (primary contact)
(206) 684-7693

See Section 10, Table 3 for emergency contacts.

3. HAZARD ANALYSIS

This hazard analysis is focused on safety and health parameters associated with installation of gas probes. It is assumed that these activities represent a worst-case scenario of risk. Standard operating procedures for specific activities are presented in Section 8.0.

3.1 LOCATION AND DESCRIPTION OF SITE

Site Name: Genesee Park, former Genesee Landfill

Address: 42nd Ave S and Oregon Street
Seattle, Washington

Location: The site is located within the city of Seattle, at the southwest corner of the Genesee Park playfields at the intersection of Oregon Street S and 42nd Ave S.

Site location maps are provided in the workplan.

3.2 DESCRIPTION OF PLANNED FIELD ACTIVITIES

The field activities to be conducted by Parametrix staff are described in the scope of work and work plan for the specific planned field activities.

Planned activities currently include:

- Install eight new gas monitoring probes.
- Install two gas extraction wells.
- Install a gas extraction test system.
- Sample the probe for methane

3.3 DURATION OF FIELD ACTIVITIES

The City monitors the historic landfill periodically though bar hole studies and existing gas probes around the site. Field activities are ongoing, and will continue for a period as long as is determined necessary from the monitoring results.

3.4 SITE TOPOGRAPHY

The Genesee Landfill is located on the south side of Seattle, south of Lake Washington Boulevard between 42nd and 47th Avenues South. The site, is in a residential neighborhood adjacent to Lake Washington in a low area that was a slough. Elevations from approximately 28ft above mean sea level (amsl) to 70 ft amsl are found at the site. The site topography is mainly flat and slopes to the north in the northern section. The southern portion of the park is flat in the middle and has a steep slope to the south and west edge of the park.

3.5 SITE ACCESSIBILITY

Accessibility by Roads

Access to the site is an open public park. The location for the probe installation is a public right of way sidewalk around the perimeter of the park.

3.6 SAFETY AND HEALTH HAZARDS EXPECTED AT THE SITE

Safety and health hazards related to on-site landfilled wastes are currently controlled by an onsite venting system. The landfill is unlined. The soil top cover is of variable thickness. General types of safety and health hazards potentially present at the site during specific field activities include:

- Physical hazards associated with drilling, site topography and anticipated working conditions.
- Chemical hazards associated with potential exposure of personnel to subsurface site contaminants that may be encountered during certain field activities (e.g., operations and maintenance work on the landfill gas control system, monitoring and sampling of wells and surface water, and drilling).

More specific information on physical and chemical hazards is provided in Section 3.7 (Hazardous Substances and Health Hazards), Table 2 (Hazard Evaluation of Selected Chemicals), and the NIOSH Pocket Guide to Chemical Hazards .

3.6.1 Pathways For Hazardous Substances Dispersion

Potential pathways for hazardous substance dispersion at the site include:

- Airborne transport of gases and/or vapors, primarily from release of subsurface landfill gas during certain field activities (e.g., opening of well caps to allow sampling of landfill gas, leachate, or groundwater; routine operations and maintenance of landfill gas control system).
- Airborne release of volatile organic compounds (VOCs) during drilling and monitoring activities.
- Airborne transport of dust during drilling activities and vehicle use.
- Physical transport of contaminants by personnel, equipment, or vehicles that have come into contact with potentially contaminated subsurface materials (e.g., landfilled wastes).

The following pathways are not considered to be potential pathways for hazardous substances dispersion under normal conditions at this landfill, for the reasons stated:

- Airborne transport of hazardous gases or vapors potentially escaping through the landfill surface is not considered to be a potential pathway because of the presence of the landfill gas control system, which captures subsurface gases and vapors and routes them to the on-site landfill gas flare system, and the final cover.
- With the exception of drilling activities, airborne transport of hazardous dusts, including windborne dispersion of contaminated surface soils, is not considered to be a potential pathway because of the presence of a cover of clean fill overlying the landfilled wastes.
- Surface water transport, including storm water runoff, is not considered to be a potential pathway because of the presence of the cover and consequent isolation of surface water from the landfilled wastes.

3.7 HAZARDOUS SUBSTANCES AND HEALTH HAZARDS

The following sections describe specific physical and chemical hazards known or suspected to be present at the site.

3.7.1 General Waste Characteristics

3.7.1.1 Physical State

- Solid
- Semi-solid (e.g., sludge or slurry)
- Liquid
- Gas and/or vapor

3.7.1.2 Known/Suspected Categories of Constituents

The Genesee Landfill was created to primarily accept general municipal waste from City of Seattle. Typically, much of the material in municipal waste is of a putrescible nature. Putrescible wastes decompose and include such materials as food scraps from household and restaurant garbage. The following also may be present:

- Demolition debris
- Residential solid waste
- Landfill gases (methane and hydrogen sulfide)
- Volatile organics (vinyl chloride)
- Metals (manganese)

3.7.2 Physical Hazards

Physical hazards potentially present at the site include:

- Potential for explosion or fire from landfill gases.
- Heat stress hazards (especially for fieldwork to be conducted using chemical protective clothing and respiratory protection, particularly during summer).
- Safety hazards associated with heavy equipment (for example, physical injury from drilling equipment (See Attachment F)).
- Flying debris and noise hazards during drilling activities.
- Slip, trip, fall hazards from steep slopes associated with embankments on the Genesee Park Landfill property boundary.
- Heavy growth of nuisance shrubs in some locations on or near the site.
- Safety hazards associated with the permanent landfill gas flare facility.

3.7.3 Known or Suspected Chemical Hazards

The following sections list potentially hazardous chemical substances known or suspected to be present at the site. A summary of general types of hazards associated with the compounds at this site is provided in Section 3.7.4 (Summary of Site Hazards). More detailed information on the hazards associated with the specific chemical compounds is provided in Table 2 and the NIOSH Pocket Guide to Chemical Hazards .

3.7.3.1 Gases

Toxic and/or hazardous gases known to be present at the Genesee Landfill site include methane and hydrogen sulfide.

Methane

Methane (CH_4) is primarily of concern because of its combustibility and therefore the potential for fire or explosion. The lower explosive limit (LEL) for methane is approximately 5 percent methane in air (therefore, 10 percent of the LEL = 0.5 percent methane in air). Methane is non-toxic but at high concentrations may act as a simple asphyxiant by displacing oxygen from the air.

Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a common byproduct of the decomposition of landfilled wastes. Hydrogen sulfide is a colorless gas with a strong odor of rotten eggs possibly noticeable for an instant. The odor of this gas should not be used as a warning, since its presence may deaden the sense of smell. Additionally, the presence of other odor-causing substances in Genesee Park Landfill gas may mask the characteristic rotten-egg odor of hydrogen sulfide.

Hydrogen sulfide is acutely toxic and highly irritating. It can affect the body if it is inhaled or if it comes in contact with the eyes, skin, nose or throat. Inhalation of high concentrations of hydrogen sulfide may cause loss of consciousness and death. Inhalation of lower concentrations may cause headache, dizziness, and upset stomach. Exposure to hydrogen sulfide can cause temporary loss of the sense of smell, and irritation of the eyes, nose, or throat. The effects of long-term exposure to hydrogen sulfide are not known.

3.7.3.2 Volatile Organic Compounds

In the vapor phase, these compounds potentially present an inhalation toxicity hazard. They are most likely to be encountered in the phase during subsurface operations removing a cap or soil cover to expose field personnel to landfill gas (examples: operation and maintenance of the landfill gas control system; venting of gases from leachate or groundwater wells during sampling or hydrogeological studies, and drilling activities).

Vinyl chloride is a known human carcinogen. Exposure to carcinogenic contaminants should be controlled by administrative and engineering controls (extra ventilation or moving upwind from excavation areas), air monitoring, and personal protective equipment. The Site Safety Officer will oversee and implement these controls, as needed.

3.7.3.3 Metals

Ingestion or skin contact hazards from manganese may be present when handling excavated solid wastes or contaminated liquids such as landfill leachate.

3.7.4 Summary of Hazards Present at the Site

3.7.4.1 Overall Site Hazard

The overall site hazard posed by the Genesee Landfill site to field personnel and other site visitors under normal operating conditions is considered to be LOW. This assessment is based on the current level of engineered controls that prevent exposure of on-site personnel to potentially hazardous substances (e.g., landfilled wastes, subsurface landfill gas or landfill leachate). Such engineered controls include the landfill cover materials and the on-site landfill gas control system.

The overall hazard posed by the site to authorized Parametrix field personnel conducting specific field activities that may involve exposure to potentially hazardous substances such as landfilled wastes, landfill gas, or landfill leachate is considered to be LOW. This assessment is based on the ability to identify the presence of combustible and other gases, volatile organic compounds and metals as well as the ability to mitigate those hazards via ventilation, location, care in subsurface activities, and decontamination.

Acute Exposure Hazards

From an acute exposure standpoint, the most immediate hazards posed by the site are the physical hazards of working with heavy equipment and those hazards associated with potential exposures to landfill gases. Landfill gas is known to contain methane and other combustible gases, with the consequent potential for fire and explosion. Exposure to hydrogen sulfide gas may also lead to acute toxic effects, including (in order of increasing exposure concentrations): irritation of the eyes and respiratory tract, headache, dizziness, nausea, diarrhea, tremors, weakness, numbness of extremities, coma (with or without convulsions), or death (Sittig 1985).

Chronic Exposure Hazards

From a chronic exposure standpoint, vinyl chloride has a known carcinogenic potential and has been identified in groundwater. Exposure to carcinogenic contaminants should be controlled to the maximum extent feasible.

In addition to potential carcinogenic effects, vinyl chloride may cause other chronic toxic effects after repeated or prolonged exposure (see Table 2 and NIOSH Pocket Guide to Chemical Hazards).

3.7.4.2 Special Considerations Regarding Site Hazards

Special considerations related to on-site facilities include:

- The on-site landfill gas control system should only be operated or maintained by authorized field personnel responsible for these activities, and only in accordance with written standard operating procedures (SOPs).

4. HEALTH AND SAFETY TRAINING FOR SITE INVESTIGATIONS

Per Parametrix, Inc. policy, all field team members have received health and safety training, according to the regulations listed below:

- Minimum of 40 hours training or acceptable equivalent. WAC 296-62-3040(2).
- A minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor. WAC 296-62-3040(2).
- On-site management and supervisors directly responsible for or who supervise employees engaged in hazardous waste operations have completed at least eight hours of additional specialized training beyond that listed above. WAC 296-62-3040(3).
- All employees covered by the above receive eight hours of refresher training annually on the items specified in WAC 296-62-3040(1) and other relevant topics. WAC 296-62-3040(8).
- All field team members are currently certified in first aid and cardiopulmonary resuscitation (CPR) through the American Red Cross or equivalent program. (Parametrix, Inc. policy.)

4.1 HEALTH AND SAFETY MONITORING EQUIPMENT COMPETENCE

All field team members will receive formal training or attain competence in the proper usage and interpretation of readings from the equipment required in Section 7 (Air Monitoring) of this Health and Safety Plan.

4.2 DAILY SITE SAFETY MEETINGS

Site safety meetings (pre-entry briefings) will be held before initiating any site activity (that is, before each day's fieldwork), and at such other times as necessary, to ensure that employees are familiar with the provisions of this Health and Safety Plan.

4.3 REVIEW OF TRAINING RECORDS

A review of Parametrix site personnel training records will take place before site activities commence. A record of this review will be entered into the log provided in Attachment D. This log will be updated as necessary based upon staffing activities.

5. PERSONAL PROTECTIVE EQUIPMENT, ENGINEERING CONTROLS, AND WORK PRACTICES

5.1 ENGINEERING CONTROL AND PERSONAL PROTECTIVE EQUIPMENT SELECTION PROTOCOL

In general, engineering controls and work practices designed to prevent exposure to hazardous materials are preferred over use of Personal Protective Equipment (PPE). Where engineering controls and work practices have been determined not to be feasible, the appropriate level of PPE shall be determined based on data gathered during the preliminary site evaluation. The PPE selected will provide protection to a level of exposure below established Permissible Exposure Limits (PELs) or other appropriate guideline. The Site Safety Officer will be responsible for determining the type of PPE.

5.2 ENGINEERING CONTROLS AND WORK PRACTICES

Below are engineering controls and/or work practices that may be used to reduce or prevent exposures, thereby reducing the need for personal protection equipment:

- Upon site arrival, conduct air monitoring upwind of sampling or drilling site in clean air to determine contaminant background concentrations. Calibrate airmonitoring instruments and ensure their proper operation.
- During the approach to areas of concern, use a photoionization detector or equivalent to monitor levels of air contaminants.
- Periodically monitor during field activities. Allow gases to vent from wells prior to sampling.
- Eliminate or relocate any potential sources of sparks, heat, or ignition; no open flames (e.g., no smoking, no smudge pots)
- Intrinsically-safe "brush fan" (i.e., equipped with non-sparking sealed motor) may be used to provide ventilation and rapid dilution of gases and vapors

5.3 PERSONAL PROTECTIVE EQUIPMENT

5.3.1 General Construction Safety PPE

Must comply with requirements of Washington Department of Labor and Industries, Safety Standards for Construction Work, WAC 296-155]

- Hard hat. (All persons on any construction site must wear protective helmets, per WAC 296-155-205(1).)
- Hearing protection
  - Ear plugs required during drilling or other operations near heavy equipment
  - Ear muffs or other additional protection beyond ear plugs are optional
- Foot protection
  - Steel-toed neoprene or rubber boots are required where there is any possibility of contact with contaminated materials
- Eye protection

- Goggles that completely surround the eyes must be worn if there is any possibility of splashing liquids into the eyes.
- Safety glasses may be worn where flying particles may be present but there is no danger of splashing liquids into the eyes. A full face-shield on the hard hat will provide additional protection.

5.3.2 Hazardous Materials PPE

Concentration of contaminants is expected to be low. Elevated concentration of VOCs and/or other landfill gases may necessitate upgrading to Level C.

- Respiratory protection
  - Level D PPE is acceptable during drilling, with the contingency for Level C respiratory protection. Level C respiratory protection includes full-facepiece respirators with combination organic vapor and HEPA (P-100) filter cartridges.
  - Level D PPE may be appropriate during soil sampling once site contaminants have been characterized.
- Skin protection
  - Where there is little likelihood of contact with excavated materials, work clothing (e.g. cloth or uncoated Tyvek coveralls) is considered sufficient.
  - Where there is any possibility of skin contact with contaminated materials, the following shall be worn:
    - Liner gloves (PVC or latex)
    - Outer gloves (Edmont Sol-Vextm or equivalent), preferably taped to the sleeves of the coveralls
    - Chemical-resistant coveralls (polycoated Tyvek, Saranex, or PVC, as appropriate)

6. MEDICAL SURVEILLANCE REQUIREMENTS

Per Parametrix, Inc. policy, all employees conducting on-site field activities must participate in a medical surveillance program designed to determine their fitness for working in hazardous environments. Records of each employee's medical testing are reviewed by the Corporate Health and Safety Officer and filed in the employee's individual personnel file. The frequency of medical exams will be determined by the Corporate Health and Safety Officer in consultation with Virginia Mason Occupational Medicine Clinics and in accordance with guidelines provided in *29 C.F.R. 1910.120(f)* and *WAC 296-62-3050*.

7. AIR MONITORING, PERSONNEL MONITORING, AND SUPPLEMENTAL SAMPLING PROCEDURES

7.1 MONITORING PROCEDURES AND ACTION LEVELS

7.1.1 Initial Site Entry

OSHA, 29 CFR Part 1910.120(h)(2); WAC 296-62-3070(2)

Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits, or other dangerous condition such as the presence of flammable atmospheres, oxygen-deficient environments, or other site hazards.

Air monitoring data are to be recorded using the form provided in Attachment B (Air Monitoring Report Form).

7.1.2 Monitoring Equipment

Standard monitoring instruments for field operations at this site will include:

- Organic vapor monitoring instrumentation, for example:
  - A photoionization detector (PID), such as an HNu Systems PI-101 with 10.2 eV probe (or equivalent, such as Photovac TIP II with 10.6 eV probe).
- Gastech, and/or equivalent instruments:
  - Combustible gas concentration, measured as percent of Lower Explosive Limit, or LEL, in air
  - Oxygen concentration, measured as percent O_2 by volume.
  - Hydrogen sulfide concentration, measured as parts per million (ppm) by volume in air.
  - Carbon monoxide concentration measured as ppm by volume in air.

7.1.3 Calibration of Monitoring Equipment

Specify procedures to be used for calibration of monitoring equipment:

- All equipment used for health and safety monitoring purposes will be calibrated and serviced in accordance with the manufacturer's instructions.

7.1.4 Limitations of Monitoring Equipment

Detailed technical specifications for standard air monitoring equipment are provided in the instructions for the specific equipment. These technical specifications include for each make/model of instrument:

- Parameters measured, and normal operating ranges.
- Minimum detection limits of the instrument.
- Calibration gas recommended by the manufacturer. Note that, in general, the instrument is assumed to require calibration at the interval suggested by the manufacturer.

- Relative humidity (RH) control limits (minimum and maximum RH).
- Temperature control limits (minimum and maximum ambient temperatures for acceptable instrument reliability).
- Potential interferences (e.g., chemical interferents that may cause inaccurate instrument response such as false negative, false positive, and quantitatively or qualitatively erroneous instrument response).
- Factors that reduce instrument lifespan (e.g., conditions that may damage sensors or render the instrument inoperable).

Note that in general, air monitoring equipment may perform poorly under conditions including high humidity (RH greater than 90%, including fog and rain), extreme temperatures (lower than approximately 14°F or greater than 104°F; Foxboro OVA 128 Flame Ionization Detector may perform poorly below 59°F), and in the presence of certain chemical interferences.

Any further questions regarding the limitations of any specific monitoring instrument should be discussed with the Parametrix Corporate Health and Safety Officer. The Corporate Health and Safety Officer will coordinate requests for technical information from specific manufacturers of monitoring equipment.

7.2 PERSONAL MONITORING

- Under most circumstances (for example, where exposures are anticipated to remain below detection limits), the air monitoring procedures described in Table 1 (Health and Safety Action Levels) will be used to document that personnel are working below the published exposure levels or permissible levels with time-weighted averages.

7.2.1 Action Levels

Refer to Table 1 and Section 3 of Health and Safety Plan and NIOSH Pocket Guide to Chemical Hazards.

Table 1. Health and Safety Action Levels for Field Activities Based on Monitoring Device Measurements

Standard Air Monitoring Protocol

Required Monitoring Device	Monitoring Parameter	Monitoring Frequency	Action Level (Measured in Breathing Zone)	Action to be Taken
ORGANIC VAPORS				
Photoionization Detector (PID) (HNu ISPI-101, Photovac MicroTIP, Thermo Environmental Instruments OVM 580B, or equivalent)	Total non-methane volatile organic compounds	Periodic monitoring; frequency and location of monitoring to be determined by Parametrix Site Safety Officer, based on current stage of field activities.	For readings sustained for > 5 minutes:	
			Background to < 5 ppm above background	No action required; continue monitoring.
			≥ 5 ppm to ≤ 10 ppm above background **NOTE:** If so equipped, monitoring device alarm should be set to indicate readings above the lower bound of this range.	**OPTIONS:** 1. Use brush fan to ventilate to below action level. 2. If the contaminant is NOT vinyl chloride (as determined by colorimetric tubes or other means) upgrade to Level C respiratory protection. Mandatory use of "buddy system."
			>10 ppm sustained	Cease activities & determine possible causes, Resume slowly sampling continuously. If levels cannot be controlled contact the PM or Safety Manager to discuss using different equipment or work activities.
METHANE/HYDROGEN SULFIDE				
Gastech	Methane	Periodic monitoring; frequency and location of monitoring to be determined by Parametrix Site Safety Officer, based on current stage of field activities.	< 10 % LEL Regulations require personnel to leave the area at 10% or more LEL. If the sample is collected in the borehole the site safety officer with consensus from the equipment operators, may choose to continue working to a slightly higher level	No action required; continue monitoring.
			≥ 10 % LEL to < 25 % LEL in the borehole NOT in the breathing zone	Determine causes and possibly continue to work with continuous monitoring unless levels are rising rapidly.
			≥ 25 % LEL	Cease activities and withdraw from site. Determine causes and course of action. Resume work when levels have subsided, but only with caution and continuous monitoring.

Table 1. Health and Safety Action Levels for Field Activities Based on Monitoring Device Measurements (continued)

Standard Air Monitoring Protocol

Required Monitoring Device	Monitoring Parameter	Monitoring Frequency	Action Level (Measured in Breathing Zone)	Action to be Taken
METHANE/HYDROGEN SULFIDE (continued)				
Gastech (continued)	Hydrogen Sulfide	Periodic monitoring; frequency and location of monitoring to be determined by Parametrix Site Safety Officer, based on current stage of field activities.	Background to < 5 ppm above background	No action required; continue monitoring.
			≥ 5 ppm to ≤ 10 ppm above background in the breathing zone **NOTE:** If so equipped, monitoring device alarm should be set to indicate readings above the lower bound of this range.	**OPTIONS:** 1. Use brush fan to ventilate to below action level. 2. 10 ppm is a not to exceed ceiling limit for H2S If the sustained level is greater than 20 ppm, but less than 50 ppm, personnel may continue for no more than 10 minutes without an upgrade to appropriate respiratory protection (supplied air) Mandatory use of "buddy system."
			50 ppm sustained for 5 minutes (100 ppm is IDLH)	Cease activities, determine causes and course of action with the PM or Safety and Health Manager

NOTES:

"Buddy system" = A system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency. Use of the buddy system is mandatory whenever respiratory protection must be used.

LEL = Lower Explosive Limit in air (usually expressed in % by volume).

Level C respiratory protection = Full-facepiece air-purifying respirator (see Health and Safety Plan text for site-specific and activity-specific cartridge and/or canister specifications).

NIOSH = National Institute for Occupational Safety and Health.

ppm = Parts per million. For gases and vapors in air, typically refers to volume/volume. For solid and liquid phase contaminants, typically refers to mass/mass (e.g., mg/kg for solids, mg/L for liquids).

SCBA = Self-contained breathing apparatus.

Table 2. Hazard Evaluation of Selected Chemicals

Substance	Exposure Limit (PEL)	IDLH	Health Effects
Methane	Simple Asphyxiant	Simple Asphyxiant	Simple Asphyxiant
Vinyl chloride	TWA = 1 ppm STEL = 5 ppm	**Carcinogen**	Weakness; abdominal pain; liver damage; **carcinogen**
Hydrogen sulfide	Ceiling = 10 ppm	**100 ppm,**	Respiratory hazards, irritating, apnea, coma, convulsions, dizziness, fatigue

Notes

TWA = Time-Weighted Average for a normal 8-hour work day and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

STEL = Short-Term Exposure Limit is the concentration to which workers can be exposed continuously for a short period of time without suffering from 1) irritation, 2) chronic or irreversible damage, or 3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TWA is not exceeded. A STEL is defined as a 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour TWA is within the TWA limits. Exposures above the TWA up to the STEL should not be longer than 15 minutes and should not occur more than four times per day.

IDLH = Immediately Dangerous to Life or Health are concentrations which represent the maximum concentration from which, in the event of respiratory failure, one could escape within 30 minutes without a respirator and without experiencing any escape impairing (e.g., severe eye irritation) or irreversible health effects.

8. STANDARD OPERATING PROCEDURES

8.1 SITE CONTROL WORK ZONES

Work zones will be established during the initial site reconnaissance. Secure site from general public or other unauthorized personnel.

8.2 STANDARD OPERATING PROCEDURES FOR GROUNDWATER, SURFACE WATER, AND GAS MONITORING

8.2.1 Activity Description

- Periodic monitoring of groundwater on-site wells, surface water at the perimeter of the landfill disposal area, and landfill gas.

8.2.2 Potential Hazards

- Potential eye damage from potentially contaminated ground or surface water.
- Potential skin contact with potentially contaminated ground and surface water.
- Potential inhalation of landfill gases.

8.2.3 Monitoring Procedures

- Periodically monitor breathing zone for VOCs using PID.
- Periodically monitor breathing zone for methane/hydrogen sulfide using MSA 361 or equivalent multigas meter

8.2.4 Engineering Controls

- Air-driven submersible pumps will be used, when possible.
- Intrinsically safe brush fan.

8.2.5 Personal Protective Equipment

- Level D for soil and water sampling (see Section 5.3).
- Level C for landfill gas monitoring after initial monitoring for confined space entry (if applicable; see Sections 5.3 and 11). Supplied air may be necessary with sustained levels of Hydrogen sulfide, Vinyl chloride, or other gases. Appropriate respiratory protection **MUST** be used.

8.3 STANDARD OPERATING PROCEDURES COMMON TO ALL DRILLING METHODS

- Standard operating procedures (SOPs) may vary depending on the drilling method.
- Monitoring of air quality during drilling activities will be performed at regular intervals. The frequency of periodic air monitoring will be determined by the pace of the drilling activities. The following procedures constitute SOPs common to all of the drilling methods:

- Conduct air monitoring upwind of drilling site in clean air to determine background concentrations of contaminants, zero air monitoring instruments, etc.
- Approach drill site from upwind, whenever possible
- Cordon off drilling area to minimize risk of personnel falling into holes (26" diameter).
- Since PMX staff are not directly involved in the actual drilling activities, PMX staff should be alert to the activities of the drilling subcontractor(s) to avoid any possible safety hazards
- Conduct periodic air monitoring of the breathing zone around and downwind of the immediate work area. Compare these readings with levels at the bore hole or excavation.
- Conduct periodic air monitoring during well construction activities
- Conduct air monitoring of geologic samples (e.g., when soil core from Shelly tube is cut to expose fresh soil surface)
- Conduct additional air monitoring at all other times when air quality is in question
- Air monitoring results will be recorded on the forms provided in the Health and Safety Plan for that purpose (or transcribed to these forms from other appropriate field notes as soon as possible)
- Decontaminate personnel, vehicles, and equipment in accordance with the site-specific decontamination procedures described in Section 9 of the Health and Safety Plan.
- Additional information regarding Drill Rig Safety may be found in Attachment F.

8.4 SITE COMMUNICATIONS

- Field team members will be within voice communication and/or visual range under normal circumstances and/or will use walkie-talkies or other electronic devices to maintain adequate site communications, when appropriate.
- A standard telephone will be available on-site and accessible to Parametrix field team members.

9. DECONTAMINATION PROCEDURES

All decontamination procedures will be monitored by the Site Safety Officer. The procedures for decontaminating site personnel, vehicles, and equipment are as follows:

9.1 PERSONNEL

Personnel will generally be using disposable protective clothing that will not require decontamination. If non-disposable clothing is worn, laboratory detergent (e.g. Alconox) followed by a tap water rinse will be used for decontamination and the laundring personnel will be apprised in writing (with a receipt of information) of the potential contaminants and hazards.

9.2 VEHICLES

Vehicles will not require decontamination unless they have been in contact with site-related wastes. Decontamination procedures would then be dependent on the nature of the wastes contacted.

9.3 EQUIPMENT

All large drilling equipment (rods, bits, drill rig, etc.) will be steam cleaned with a high pressure washer prior to drilling each extractor well or gas probe. The are designated for steam cleaning activities will be located by the City.

Smaller equipment (hammers, samplers, water level probes, etc.) will be decontaminated between each use with a tap-water rise, followed by a detergent wash (Liquinox or Alconox) and a second tap-water rise. All decontamination rinsate will be contained in labeled drums provided by the Contractor.

9.4 DISPOSAL OF WASTES GENERATED DURING DECONTAMINATION

The Contractor will handle investigation-derived waste as follows:

- Drill cuttings (soil and refuse) will be placed in roll-off bins.
- All decontamination rinsate will be stored in 55-gallon drums.
- Disposable health and safety gear (gloves, tyvek cartridges) will be stored in 55-gallon drums.
- The Contractor will label and stage the drums at a location determined by the City.

Upon completion of all drilling activities the City will then be responsible for disposal of the waste.

10. EMERGENCY ACTION PLAN

10.1 EMERGENCY ROUTES

A map showing the route to the nearest hospital or medical clinic is provided in Attachment A.

10.2 RESCUE AND MEDICAL DUTIES

In the event of an emergency, the Site Manager is responsible for establishing and coordinating procedures for evacuation of all on-site personnel, including non-Parametrix personnel.

- Field personnel shall assemble at a designated area, upwind at the perimeter of the site.
- Rescue, including emergency decontamination, where required, will be conducted according to the specialized health and safety training as described by Section 4.0.
- Field team members will provide first aid and/or CPR within the limits of their training, as described in Section 4.0.

The following equipment will be available on site.

- First-Aid Kit
- Emergency eye wash
- Fire extinguisher (ABC).

10.3 1REPORTING FIRES AND OTHER EMERGENCIES

- Fires and other emergencies will be reported by the Site Health and Safety Officer.
- All emergencies will be reported to the Site Manager by field personnel.

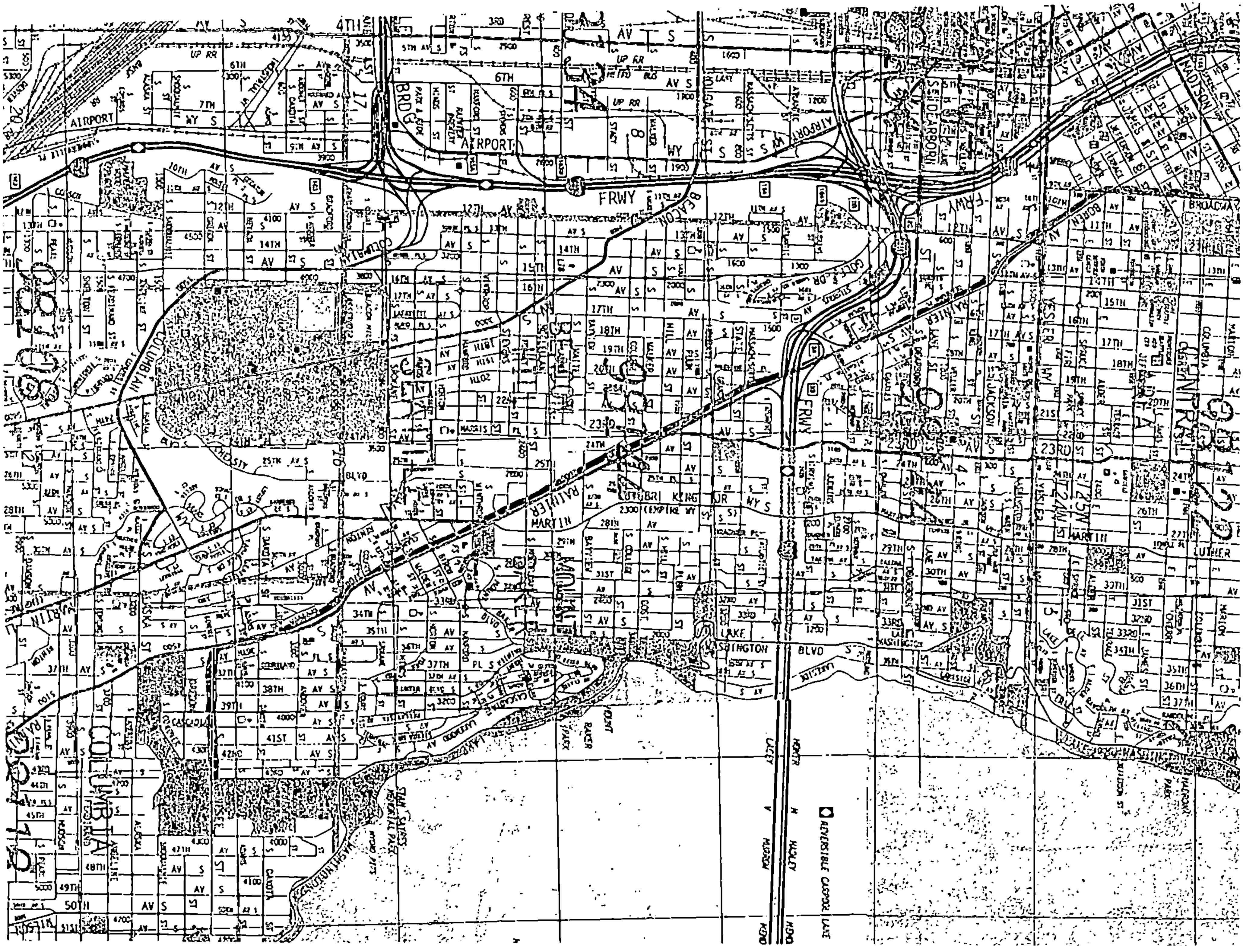
Note: In the unlikely event of a fuel spill into water, the Seattle Fire Marshall's Office will be notified and/or a 9-1-1 call will be made to comply with City codes.

Table 3. List of Emergency Contacts

Emergency Contact	Name	Telephone
Genesee Park	Marrel Livesay	(206) 684-7133
Genesee Landfill Project Office	Jeff Neuner City of Seattle 8100 Second Avenue South Seattle, WA 98108	(206) 684-7693
Ambulance:	Ambulance	911
Fire Department:	Seattle Fire Department	911
Hospital:	Swedish Providence Medical Ctr: 500 17th Ave/Seattle, WA 98122, US	(206)-320-2000
National Emergency Response Center		(800) 424-8802
Poison Control Center:		(206) 272-1281
Police:	Seattle Police Department 3001 S. Myrtle Seattle, WA 98108	911 or (206)386-1850
	Washington State Patrol	(206) 593-2424
Project Manager WA DOE	Kurt Easthouse	(425) 822-8880
Client Contact:	Seattle Engineering Department Jeff Neuner	(206) 684-7693

ATTACHMENT A

Hospital Route Map


AIRPORT WY S
FRWY
BEACON AV S
RAINIER AV S
MARTIN LUTHER KING JR WY S
23RD AV S
BROADWAY
LAKE WASHINGTON BLVD S
REVERSIBLE CARPOOL LANE
MADISON
BOREN AV
JACKSON ST
DEARBORN
COLUMBIA
UP RR

ATTACHMENT B

Air Monitoring Report Form

PARAMETRIX HEALTH AND SAFETY AIR MONITORING REPORT

PMX Project Name _____ Equipment ID Serial # _____

PMX Project #: 55-1550-37-(8) Equipment ID Serial # _____

Date: _____

Personnel present: _____ Other ser. #/describe: _____

Time (24-hr)	Monitoring Location Well or Boring # Sample Location #	PPE Level Used (B,C,D)	HNu or Microtip VOCs (ppm)	4 Gas Meter				Observations / Comments
				% LEL	O_2	CO	H_2S	

Site Health & Safety Officer's signature: _____

ATTACHMENT C

Health and Safety Plan Consent Agreement

PARAMETRIX, INC.
SITE HEALTH AND SAFETY PLAN CONSENT AGREEMENT

I have reviewed the safety plan prepared for Parametrix, and dated January 6, 2006, for the site fieldwork. I understand the purpose of the plan and I consent to adhere to its policies, procedures, and guidelines while an employee of Parametrix or its subcontractors.

Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date
Employee signature	Firm	Date

ATTACHMENT D

Training Records Review Log

PARAMETRIX, INC.

TRAINING RECORDS REVIEW LOG

I have reviewed the training records for Parametrix personnel conducting site fieldwork. The training of the listed personnel meet the minimum requirements outlined in Section 4 of this Health and Safety Plan.

Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date
Employee	Project Manager Signature	Date

ATTACHMENT E

Drill Rig Safety Instructions

ATTACHMENT E

DRILL RIG SAFETY INSTRUCTIONS

- Standard operating procedures (SOPs) may vary depending on the drilling method.
- Monitoring of air quality during drilling activities will be performed at regular intervals. The frequency of periodic air monitoring will be determined by the pace of the drilling activities. The following procedures constitute SOPs common to all of the drilling methods:
- Conduct air monitoring upwind of drilling site in clean air to determine background concentrations of contaminants, zero air monitoring instruments, etc.
- Approach drill site from upwind, whenever possible
- Cordon off drilling area to minimize risk of personnel falling into holes (26" diameter).
- Since PMX staff are not directly involved in the actual drilling activities, PMX staff should be alert to the activities of the drilling subcontractor(s) to avoid any possible safety hazards
- Conduct periodic air monitoring of the breathing zone around and downwind of the immediate work area
- Conduct periodic air monitoring during well construction activities
- Conduct air monitoring of geologic samples (e.g., when soil core from Shelly tube is cut to expose fresh soil surface)
- Conduct additional air monitoring at all other times when air quality is in question
- Air monitoring results will be recorded on the forms provided in the Health and Safety Plan for that purpose (or transcribed to these forms from other appropriate field notes as soon as possible)
- Decontaminate personnel, vehicles, and equipment in accordance with the site-specific decontamination procedures described in Section 9 of the Health and Safety Plan.

APPENDIX D

Standard Operating Procedures

STANDARD OPERATING PROCEDURES
GAS PROBE CONSTRUCTION

OBJECTIVE

The objective of this document is to establish proper procedure for gas probe installation. All gas probes will be constructed in accordance with WAC 173-160 Minimum Standards for Construction and Maintenance of Wells. The purpose of the probe is to monitor possible gas accumulations in unsaturated, permeable layers in the subsurface.

MATERIALS

- 3/4-inch schedule 40 PVC, solid and machine slotted 0.040
- 1/4-inch lab cook, male-male threaded
- Weighted tape
- Health and safety equipment
- Drill rig and necessary materials for probe construction

PROCEDURE

The following steps will be taken during the installation of gas monitoring probes:

1. Located and mark the location to install the gas-monitoring probe.
2. Verify the location for probe; obtain property access; mark subsurface utilities.
3. Verify drilling equipment to be used is the proper type and size.
4. Verify that all downhole equipment has been steam cleaned.
5. Measure the length of all downhole equipment (bit, drive casing, tremie pipe, etc.) prior to entering the borehole.
6. Drill boring as specific in the work plan.
7. Collect samples to identify stratigraphic units and water bearing zones.
8. An exploratory boring log must be completed for each gas probe to record all basic information for each probe including geologic descriptions, total depth, screened interval, driller, probe number, date, etc. (see SOP Exploratory Boring Log Preparation).
9. Install screen in the permeable, unsaturated zone designated in the work plan. Gas monitoring probes will be constructed using new, commercially manufactured, 3/4-inch inside diameter, flush-threaded, Schedule 40 PVC screen and casing. Screens will have

0.040-inch wide machine-cut horizontal slots. Each gas probe will be topped with a 1.4-inch, male-male threaded lab cock.

10. Backfill around the screened interval with gravel designated in the work plan. An artificial filter pack of 3/8-inch pea gravel or equivalent will be placed in the annular space between the borehole and the well screen from the bottom of the screened interval to 1 foot above the top of the screened interval.

11. A minimum of 2 feet of hydrated bentonite chips will be placed directly above the gravel pack. Clean water will be added to hydrate the bentonite.

12. If the zone above the screen is not saturated, bentonite chops will be used to seal the remaining annular space between the monitoring well and the borehole wall. If groundwater is present above the top of the screened section, a bentonite slurry with a weight of between 11 and 13 lbs./gal, will be pumped into place with a tremie pipe to seal the saturated portion of the annular space.

13. Each gas probe will be completed using a 5-foot long, 6-inch diameter lockable steel surface casing. The protective casing will be placed with a minimum of 2 feet of concrete embedded in concrete below ground surface.

14. Three 6-foot long, 3-inch diameter steel protective traffic posts will be placed around each well. The traffic posts will be installed with 3 feet embedded in concrete below ground surface.

15. Coordinate with the drilling contractor to submit his report to Ecology per WAC 173-160.

STANDARD OPERATING PROCEDURES
GAS EXTRACTION WELL CONSTRUCTION

OBJECTIVE

The objective of this document is to establish proper procedure for gas probe installation. All gas probes will be constructed in accordance with WAC 173-160 Minimum Standards for Construction and Maintenance of Wells. The purpose of the probe is to monitor possible gas accumulations in unsaturated, permeable layers in the subsurface.

MATERIALS

- 4-inch schedule 40 PVC, solid and machine slotted 0.040
- Weighted tape
- Health and safety equipment
- Drill rig and necessary materials for probe construction

PROCEDURE

The following steps will be taken during the installation of gas monitoring well

1. Locate and mark the location to install the gas extraction well.
2. Verify the location for well; obtain property access; mark subsurface utilities.
3. Verify drilling equipment to be used is the proper type and size.
4. Verify that all downhole equipment has been steam cleaned.
5. Measure the length of all downhole equipment (bit, drive casing, tremie pipe, etc.) prior to entering the borehole.
6. Drill boring as specific in the work plan.
7. Collect samples to identify stratigraphic units and water bearing zones.
8. An exploratory boring log must be completed for each gas probe to record all basic information for each probe including geologic descriptions, total depth, screened interval, drilled, well number, date, etc. (see SOP Exploratory Boring Log Preparation).
9. Install screen in the permeable, unsaturated zone designated in the work plan. Gas extraction wells will be constructed using new, commercially manufactured, 4-inch inside diameter, flush-threaded, Schedule 40 PVC well screen and well casing. Well screens will have 0.040-inch machine-cut horizontal slots.

10. An artificial filter pack of 3/8 pa gravel or equivalent will be placed in the annular space between the borehole and the well screen from the bottom of the screened interval to 1 feet above the top of the screened interval.

11. A minimum of 1 foot of fine-grained sand will be placed above the filter pack to prevent slurry infiltration.

12. A minimum of 2 feet of bentonite chips will be placed directly above the fine sand. Clean water will be added to hydrate the bentonite chips.

13. If the zone above the screen is not saturated, bentonite chips will be used to seal the remaining annular space between the monitoring well and the borehole wall. If groundwater is present above the top of the screen section, a bentonite slurry with a weight of between 11 and 13 lbs./gal, will be pumped into place with a tremie pipe to seal the saturated portion of the annular space.

14. Each gas extraction well will be completed using a slip cap and a hand hole box cover.

15. Two feet below surface the area around the borehole will be filled with gravel for drainage in the hand hole and the City will later connect the wells to the extraction system.

16. Coordinate with the drilling contractor to submit his report to Ecology per WAC 173-160.

STANDARD OPERATING PROCEDURE
EXPLORATORY SOIL BORING LOG PREPARATION

OBJECTIVE

The objective of this document is to describe a method for the preparation of an Exploratory Soil Boring Log. This log documents the subsurface information at the time of drilling. The level of detail required for soil classification will be based on project-specific considerations; however, the boring log procedures and required information described in the following sections will be the minimum.

The exploratory borings will be drilled by a subcontractor using hollow stem auger drilling equipment. Soil sampling intervals will be based on project-specific considerations. Soil samples will be collected by the drilling subcontractor using a split-barrel sampler. The sampler will be driven 18 inches into the undisturbed soil with a downhole slide hammer attached to a wire cable.

MATERIALS

- Exploratory Soil Boring Log
- USCS visual-manual soil identification flow chart
- Munsell color chart
- Hand lens
- Health and safety equipment

PROCEDURE

During drilling, the site geologist will log all pertinent information on a standard soil boring log form. Two general types of information will be collected:

1. Stratigraphic information. A continuous log of subsurface materials encountered during drilling will be recorded. The site geologist will classify the soil in accordance with the Unified Soil Classification System (USCS) and note all significant stratigraphic contacts and geologic features. The site geologist will also note the color, plasticity, moisture content, density/compaction, and other project-specific information.

2. Hydrogeologic information. A continuous log of soil moisture and/or saturated conditions will be recorded during drilling. The primary purpose is to obtain information that is only available during drilling regarding zones of saturation. In addition, a static water level will be collected at the beginning and end of each working day.

The Exploratory Soil Boring Log will include, at a minimum, the following items:

- Project name and number
- Boring or well number
- Boring location
- Date and time started/finished
- Name of drilling contractor

- Geologist's name
- Ground surface elevation (estimated)
- Drilling method and equipment
- Hole diameter
- Casing size
- Soil sampling method
- Depth of soil sample below grade
- Soil sample interval
- Soil sample type
- Percentage of soil sample recovered
- Geologic observations—soil description and classification
- Graphic soil symbols
- Graphic representation of stratigraphic contracts
- Blow counts/advance rate
- Total depth of boring
- Headspace reading, if applicable
- Observations on groundwater: Degree of saturation, drill stem wet or dry, etc.
- Static water level, time of observation, total depth of boring and drive casing at time of observation.
- Well installation data (reported on separate Monitoring Well Field Installation Log)
- Borehole abandonment information, if applicable

NOTES

All drilling activities and other pertinent site information will be recorded in the field notebook. Field notes will include, at a minimum, the following:

- Project name and number
- Date
- Weather conditions
- Personnel on-site
- Any problems or corrective actions
- Any other information that will allow reconstruction of pertinent field activities without relying on personal memory

Soil samples will be retained for verification purposes until the boring log is finalized. If sampling for chemical analysis is required, sample collection and handling procedures will be determined prior to drilling activities. Drilling and logging activities will be performed under appropriate health and safety procedures.

STANDARD OPERATING PROCEDURE

DECONTAMINATION

OBJECTIVE

The objective of this document is to describe decontamination procedures to be followed during the performance of field activities.

MATERIALS

The following materials are required for performance of equipment decontamination:

- Scrub brush
- Alconox or equivalent soap
- Tap water
- De-ionized water
- Water tubs
- Health and safety equipment

PROCEDURES

The following steps will be taken during decontamination of equipment and materials which may affect sample quality:

1. Scrub with non-phosphate detergent
2. Rinse with tap water
3. Rinse thoroughly with deionized water

NOTES

- Decontamination wastes will be disposed of according to project-specific considerations.

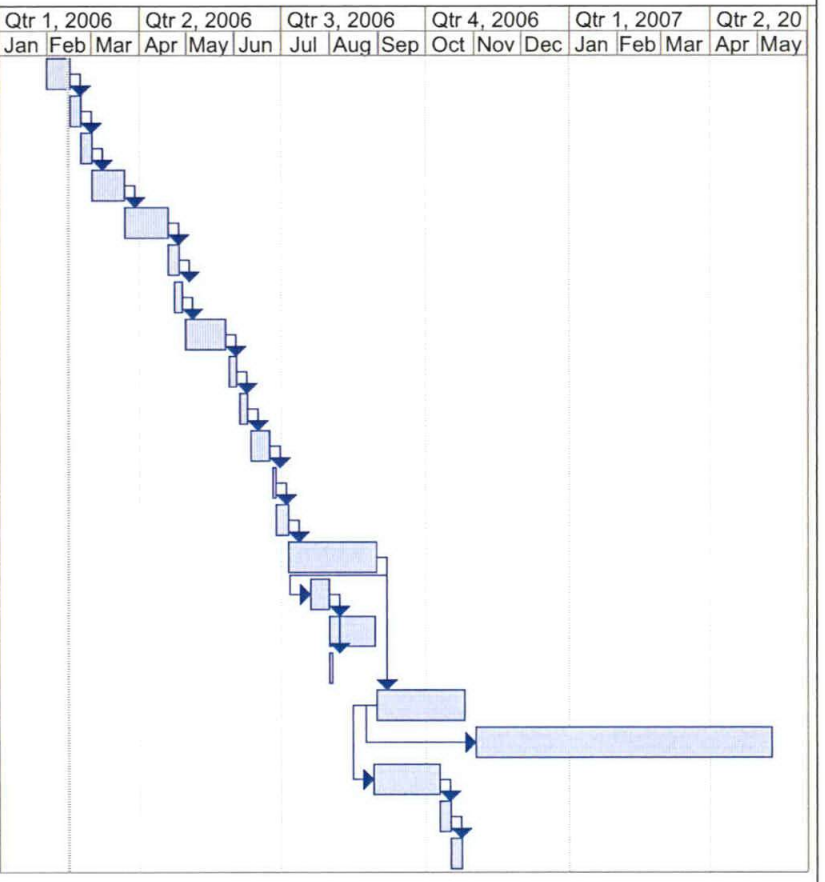
- Decontamination will be performed under level D health and safety procedures. Site-specific conditions may require additional health and safety precautions.

APPENDIX E

Project Schedule

Genesee Park Landfill Gas Control Test System and Monitoring Network Schedule
Genesee Landfill, Seattle Washington

ID	Task Name	Duration	Start	Finish
1	Prepare draft workplan	11 days	Wed 2/1/06	Wed 2/15/06
2	Receive regulatory comments	5 days	Thu 2/16/06	Wed 2/22/06
3	Prepare final work plan	5 days	Thu 2/23/06	Wed 3/1/06
4	Scoping, contingent subcontracts	15 days	Thu 3/2/06	Wed 3/22/06
5	City approvals, contract amendment	20 days	Thu 3/23/06	Wed 4/19/06
6	Set-up subcontracts	5 days	Thu 4/20/06	Wed 4/26/06
7	Public notification	5 days	Mon 4/24/06	Fri 4/28/06
8	Gas test system design completion, 50% submittal	20 days	Mon 5/1/06	Fri 5/26/06
9	City review	5 days	Mon 5/29/06	Fri 6/2/06
10	Final changes	5 days	Mon 6/5/06	Fri 6/9/06
11	Notice to proceed to subcontractors	10 days	Mon 6/12/06	Fri 6/23/06
12	Property boundary/utility locate meeting	2 days	Mon 6/26/06	Tue 6/27/06
13	Mobilization	5 days	Wed 6/28/06	Wed 7/5/06
14	Test system construction	40 days	Thu 7/6/06	Wed 8/30/06
15	Gas probe installation	8 days	Thu 7/20/06	Mon 7/31/06
16	Waste disposal	21 days	Tue 8/1/06	Tue 8/29/06
17	Demobilize	2 days	Tue 8/1/06	Wed 8/2/06
18	Bi-weekly monitoring	40 days	Thu 8/31/06	Wed 10/25/06
19	Monthly monitoring	135 days	Thu 11/2/06	Wed 5/9/07
20	Draft report preparation	30 days	Tue 8/29/06	Mon 10/9/06
21	Receive regulatory comments	5 days	Tue 10/10/06	Mon 10/16/06
22	Final report preparation	5 days	Tue 10/17/06	Mon 10/23/06



Project: Genesee Park Landfill
Date: Tue 2/14/06

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline