FINAL
QUARTERLY RESPIROMETER TEST 1 OF 5

BUILDING 986 POL LABORATORY

SOIL VAPOR EXTRACTION AND BIO-VENTING OPERATIONS AND MAINTENANCE

FORT RICHARDSON, ALASKA
CONTRACT NO. DACA85-01-P-0080

Prepared for:

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Project #200110

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OPERATIONAL MONITORING

AGVIQ, Inc. inspected the soil vapor extraction (VE) and bio-venting system for proper operational parameters. The system appeared to be operating normally, as designed and was tested as initially configured. No alternative data was available at the time of testing to change the configuration. Power indicators and alarms were operational. The system's air flow was free-flowing, did not have excessive vacuum, the lower explosive limits (LEL) concentrations were low and the condensate tank was empty and unobstructed.

RESPIROMETER TESTING

On January 30, 2002 the initial respiration testing of this yearly sequence of O & M activities was performed for a period of eight (8) days. Prior to shutting off the blower for the respirometer test, the VE system was configured to extract air from VE wells 1 and 2, an initial effluent sample was collected, and initial soil vapor readings were collected from three (3) monitoring points. VE well 3 was left closed. Readings using a Combustible Gas Indicator (CGI) were collected from each of the monitoring points (MP-1, MP-2 and MP-3) at half hour intervals for the first four (4) hours after shut down on January 30, 2002. Readings were also collected daily over the next seven (7) days and the blower was restarted on February 6, 2002.

ANALYTICAL SAMPLING PROGRAM

Effluent Sampling

Effluent samples were collected from the VE system exhaust stack, prior to shutdown, to estimate hydrocarbon-mass removal rates as configured. The samples were collected from the exhaust stack using laboratory-prepared 1-liter stainless steel canisters. The samples were sent to CT&E of Anchorage, Alaska. The effluent samples were analyzed for the following parameters:

- Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) by EPA 8021B
- Gasoline Range Organics (GRO) by AK 101; and
- Methane, carbon dioxide, oxygen and nitrogen by ASTM 1945M

FINDINGS

Effluent Sampling

At the time of sample collection, all of the GRO and BTEX constituents had undetectable levels except for P & M Xylene (Table 1). The air sample analytical results indicate that the percent levels of oxygen and nitrogen are similar to the concentrations found in the

atmosphere. All of the analytical results from the effluent air samples collected during the respirometer sampling event are presented in Appendix A.

Monitoring Events

The CGI results from the monitoring events are presented in Appendix B. The readings at MP-1 suggest biological activity due to the decrease in oxygen and the increase in carbon dioxide, during the extent of the monitoring period. This trend is greater at 20 ft bgs than at 10 ft bgs. This implies that biological activity is occurring in the vicinity of MP-1 and a significantly higher amount of activity is taking place at the greater depth. MP-1 is located in the vicinity of the former dry well (Appendix C).

The readings from MP-2 also exhibited evidence of biological activity. However, there was less evidence of biological activity seen at 10 ft bgs, than was exhibited at the same depth at MP-1. Evidence of a considerably higher amount of microbial activity is seen at the 20 ft bgs depth at this location.

MP-3 is located outside of the main contaminated area at the former dry well area. Very little activity was observed at both depths in this location.

To assist in assessing the VE system performance, the air flow rates (CFM) and vacuum (inches of H_2O) were measured from each vent well and concentrations of volatiles (ppm) were measured with a calibrated photo-ionization detector (PID) from each vent well at the exhaust stack. The air flow rates measured at the VE blower ranged between 13 and 39 CFM and the applied vacuum levels at the VE blower ranged between 16 and 24 inches of H_2O. The concentration of volatiles ranged between 1.5 and 9.2 ppm. The air flow, vacuum and concentration of volatiles results are listed in Table 2.

CONCLUSION

Review of the monitoring and analytical data indicates that the VE system is actively remediating the subsurface soils in the vicinity of the former dry well located at Building 986. The observations indicate that the remediation is progressing by two processes: bioremediation through the utilization of oxygen in the soil gas and, to a lesser degree, physical removal of hydrocarbon vapors. The physical removal is diminished due to the age of the system and remedial process.

Evidence of bioremediation and physical removal is obtained through sampling and analysis of the extracted soil gas. Analysis of the VE system effluent for petroleum hydrocarbons indicates that the VE system is successfully extracting contaminants. The presence of elevated CO_2 concentrations in the soil gas analyzed from the VE system exhaust stack may be an indication of hydrocarbon biodegradation in the site soils. In addition, atmospheric oxygen concentrations in the soil gas indicate that the oxygen is not currently limiting hydrocarbon biodegradation. Similarly, the data collected from the three soil gas monitoring points also indicate by the increase in CO_2 concentrations and significant decrease in O_2 concentrations that biodegradation is occurring in the soils at the site where contamination was found.

TABLE 1

AIR SAMPLE ANALYTICAL RESULTS

	---------- PARAMETERS ----------										
SAMPLE ID	**GRO** mg/Kg	**BTEX** mg/Kg	**Benzene** mg/Kg	**Toluene** mg/Kg	**Ethylbenzene** mg/Kg	**P & M-Xylene** mg/Kg	**O-Xylene** mg/Kg	**Oxygen** %	**Nitrogen** %	**Methane** %	**Carbon Dioxide** %
Exhaust 02FRA001AG	U	0.830	U	U	U	0.830	U	N/A	N/A	N/A	N/A
Exhaust 02FRA002AG	N/A	N/A	N/A	N/A	N/A	N/A	N/A	17.1790	82.2050	U	0.616000

Note:
GRO = Gasoline Range Organics
BTEX = Benzene, Toluene, Ethylbenzene and Total Xylenes
U = Undetectable as listed in the analytical report
N/A = Not Applicable as listed in the analytical report
mg/Kg = milligram per kilogram
% = percent by volume

TABLE 2

SOIL VAPOR EXTRACTION & BIO-VENTING SYSTEM OPERATIONAL DATA

---------- PARAMETERS ----------

LOCATION	AIR FLOW (CFM)	VACUUM (inches of H2O)	CONCENTRATION OF VOLATILES (ppm)	% WELLS OPEN
VE - 1	13 (max)	24	2.5	100 %
VE - 2	44	20	1.5	100 %
VE – 3	39	16	9.2	Approx. 10 %
EXHAUST STACK	27	6	4.6	N/A

Note:
CFM = Cubic Feet per Minute
ppm = Parts Per Million
N/A = Not applicable

Appendix A

Laboratory Analytical Results

CT&E Environmental Services Inc.

CT&E Ref.#	1020552001	**Client PO#**	
Client Name	AGVIQ Inc.	**Printed Date/Time**	02/21/2002 8:36
Project Name/#	Bldg 986 FRA BVS System Ex.	**Collected Date/Time**	01/30/2002 14:00
Client Sample ID	Exhaust 02FRA001AG	**Received Date/Time**	01/31/2002 5:57
Matrix	Gas & Air	**Technical Director**	Stephen C. Ede
Ordered By		**Released By**	

Sample Remarks:

Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Volatile Fuels Department								
Gasoline Range Organics	20.0 U	20.0	ppm	CTE 8015M/8021B		02/04/02	02/04/02	DAR
Benzene	0.780 U	0.780	ppm	CTE 8015M/8021B		02/04/02	02/04/02	DAR
Toluene	0.660 U	0.660	ppm	CTE 8015M/8021B		02/04/02	02/04/02	DAR
Ethylbenzene	0.580 U	0.580	ppm	CTE 8015M/8021B		02/04/02	02/04/02	DAR
P & M -Xylene	0.830	0.580	ppm	CTE 8015M/8021B		02/04/02	02/04/02	DAR
o-Xylene	0.580 U	0.580	ppm	CTE 8015M/8021B		02/04/02	02/04/02	DAR
Surrogates								
1,4-Difluorobenzene <Surr>	96.4		%	CTE 8015M/8021B	60-120	02/04/02	02/04/02	DAR
4-Bromofluorobenzene <Surr>	78.6		%	CTE 8015M/8021B	50-150	02/04/02	02/04/02	DAR

CT&E Environmental Services Inc.

CT&E Ref.#	1020552002	**Client PO#**	
Client Name	AGVIQ Inc.	**Printed Date/Time**	02/21/2002 8:36
Project Name/#	Bldg 986 FRA BVS System Ex.	**Collected Date/Time**	01/30/2002 14:00
Client Sample ID	Exhaust 02FRA002AG	**Received Date/Time**	01/31/2002 5:57
Matrix	Gas & Air	**Technical Director**	**Stephen C. Ede**
Ordered By		**Released By**	Michael Kirk

Sample Remarks:

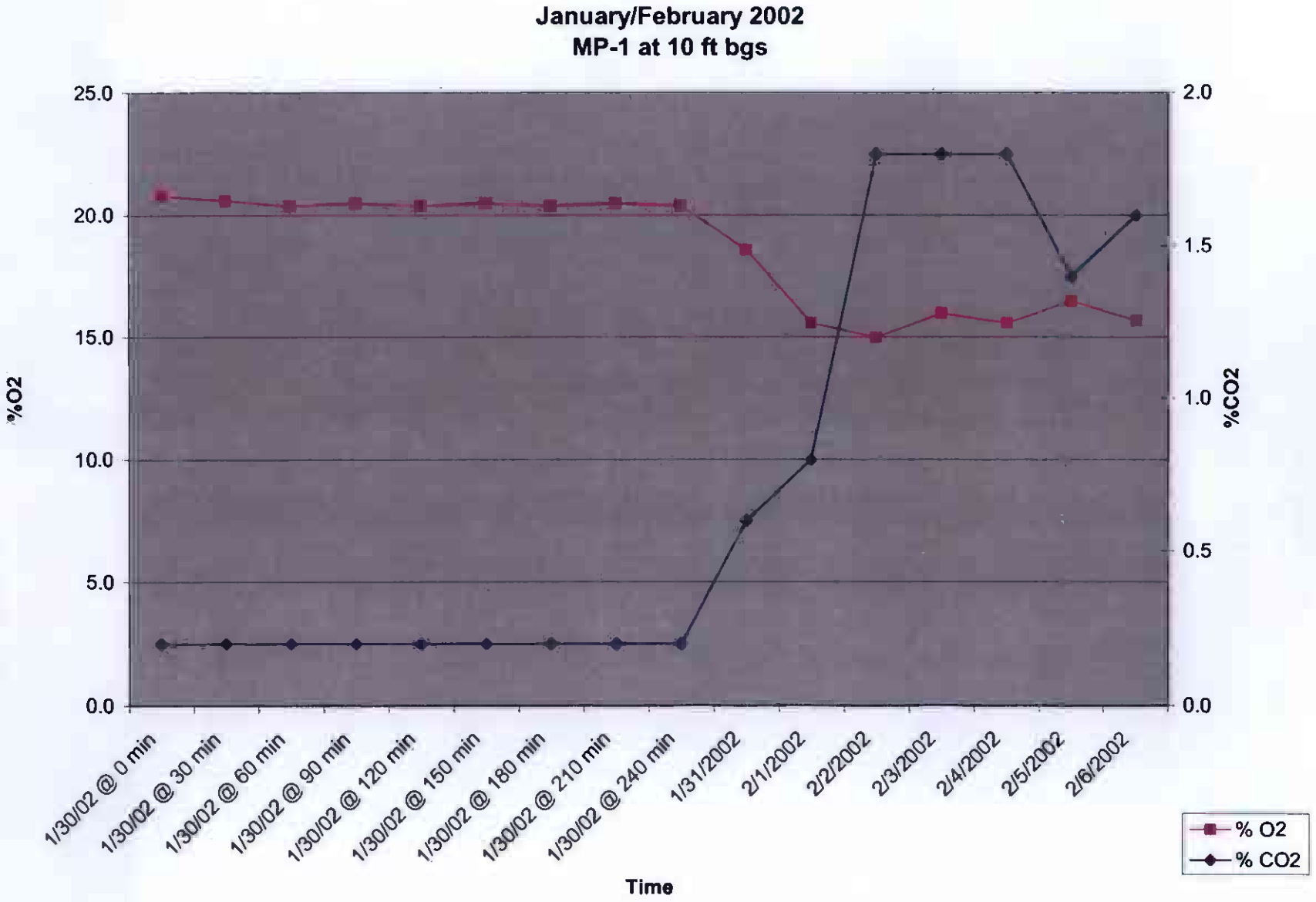
Parameter	Results	PQL	Units	Method	Allowable Limits	Prep Date	Analysis Date	Init
Oxygen	17.1790	0.00200	%	ASTM D-1945			02/04/02	KWM
Nitrogen	82.2050	0.00200	%	ASTM D-1945			02/04/02	KWM
Methane	0.00200 U	0.00200	%	ASTM D-1945			02/04/02	KWM
Carbon Dioxide	0.616000	0.00200	%	ASTM D-1945			02/04/02	KWM

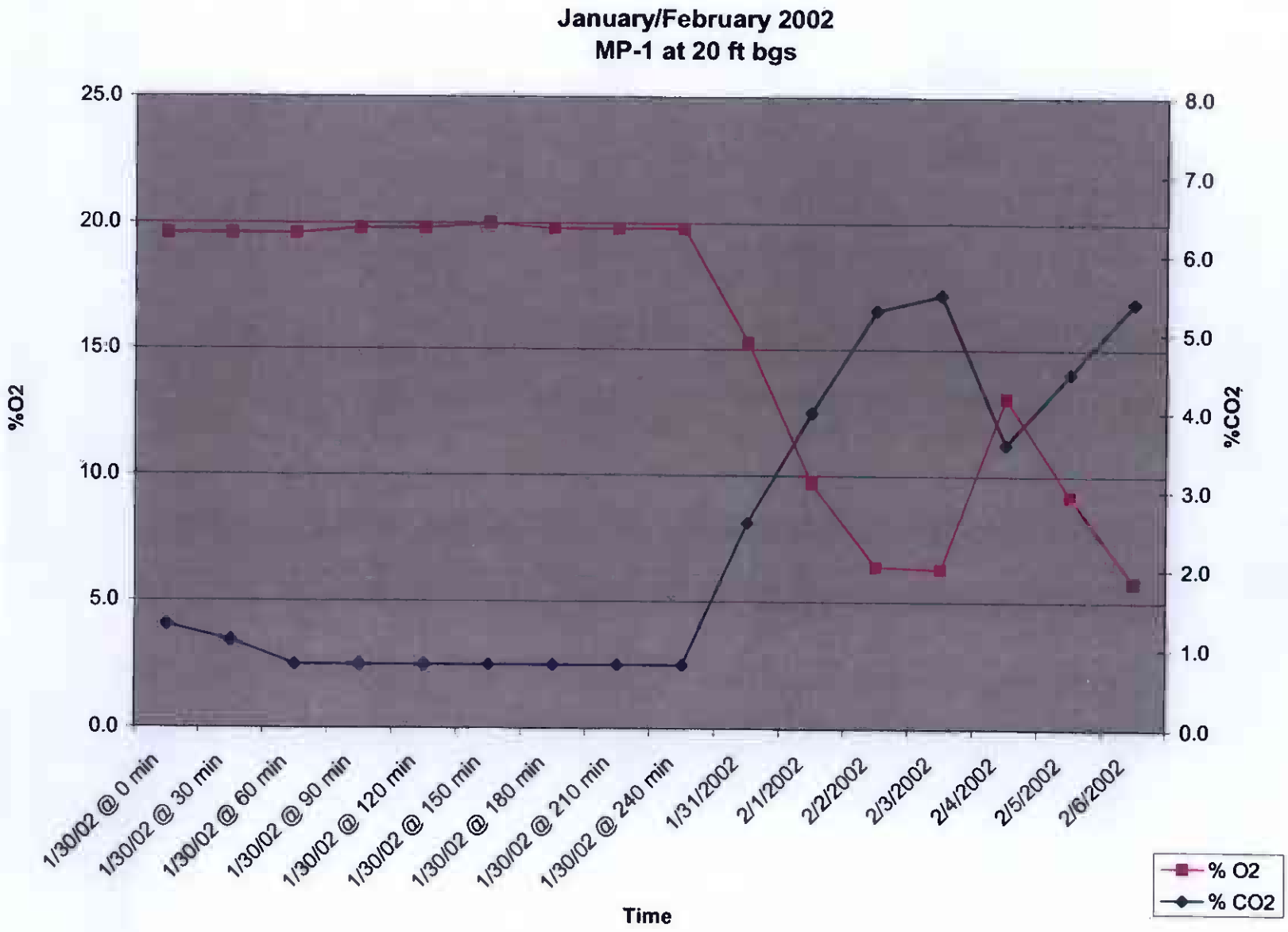
Appendix B

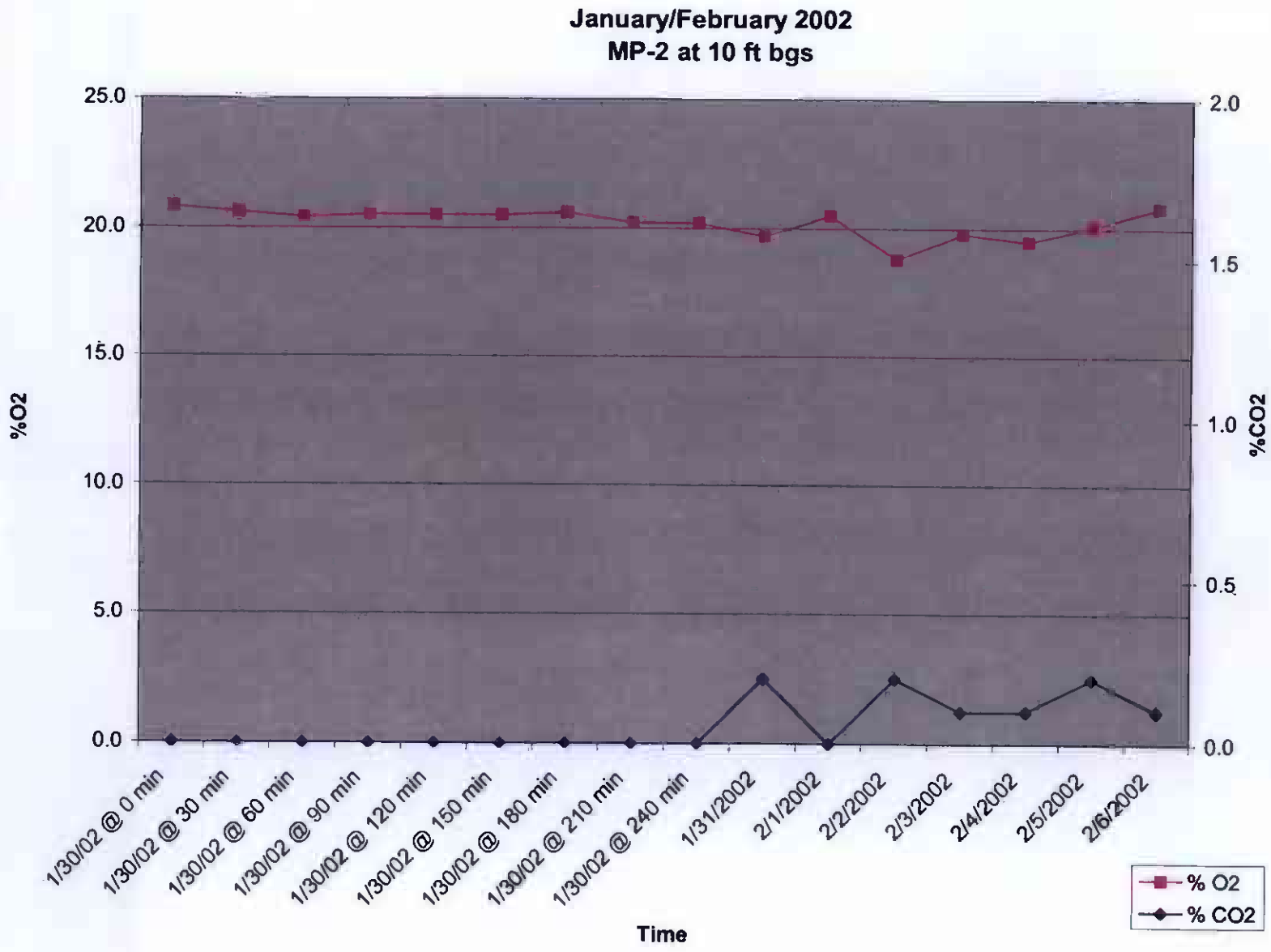
Combustible Gas Indicator Results From Quarterly Respirometer Test 1 of 5

	MP - 1				MP - 2				MP - 3			
DATE	10 ft bgs (Blue)		20 ft bgs (Green)		10 ft bgs (Blue)		20 ft bgs (Green)		10 ft bgs (Blue)		20 ft bgs (Green)	
	% CO_2	% O_2	% CO_2	% O_2	% CO_2	% O_2	% CO_2	% O_2	% CO_2	% O_2	% CO_2	% O_2
1/30/02 @ 0 min	0.2	20.8	1.3	19.6	0.0	20.8	0.6	20.2	0.0	20.9	0.1	20.9
1/30/02 @ 30 min	0.2	20.6	1.1	19.6	0.0	20.6	0.6	20.1	0.0	20.7	0.0	20.7
1/30/02 @ 60 min	0.2	20.4	0.8	19.6	0.0	20.4	0.6	19.8	0.0	20.7	0.0	20.6
1/30/02 @ 90 min	0.2	20.5	0.8	19.8	0.0	20.5	0.8	19.7	0.0	20.8	0.2	20.7
1/30/02 @ 120 min	0.2	20.4	0.8	19.8	0.0	20.5	0.8	19.5	0.0	20.8	0.1	20.7
1/30/02 @ 150 min	0.2	20.5	0.8	20.0	0.0	20.5	0.8	19.3	0.0	20.8	0.1	20.7
1/30/02 @ 180 min	0.2	20.4	0.8	19.8	0.0	20.6	1.0	19.2	0.0	20.8	0.1	20.7
1/30/02 @ 210 min	0.2	20.5	0.8	19.8	0.0	20.2	1.2	18.9	0.0	20.9	0.2	20.6
1/30/02 @ 240 min	0.2	20.4	0.8	19.8	0.0	20.2	1.4	18.4	0.0	20.7	0.2	20.5
1/31/2002	0.6	18.6	2.6	15.3	0.2	19.7	3.0	13.5	0.2	20.9	0.2	20.9
2/1/2002	0.8	15.6	4.0	9.7	0.0	20.5	3.6	9.0	0.0	20.2	0.2	18.9
2/2/2002	1.8	15.0	5.3	6.4	0.2	18.8	3.7	7.2	0.0	19.6	0.4	19.8
2/3/2002	1.8	16.0	5.5	6.3	0.1	19.8	4.8	6.2	0.0	20.9	0.4	20.7
2/4/2002	1.8	15.6	3.6	13.1	0.1	19.5	5.0	9.0	0.2	20.3	0.5	19.7
2/5/2002	1.4	16.5	4.5	9.2	0.2	20.1	5.6	8.2	0.1	20.4	0.4	19.3
2/6/2002	1.6	15.7	5.4	5.8	0.1	20.8	6.8	5.4	0.2	20.9	0.4	20.4

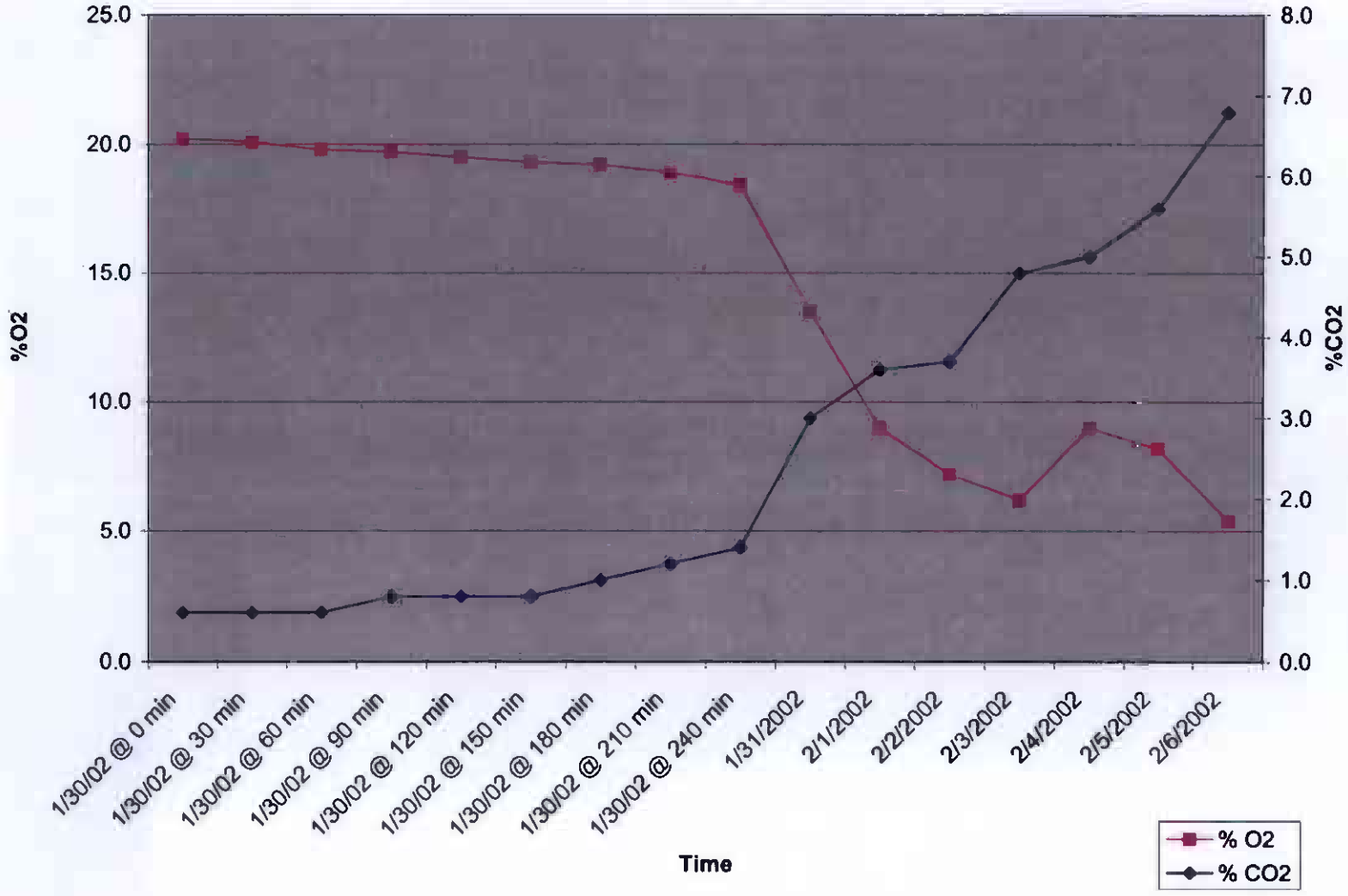
Note:
MP = monitoring point
ft = feet
bgs = below ground surface

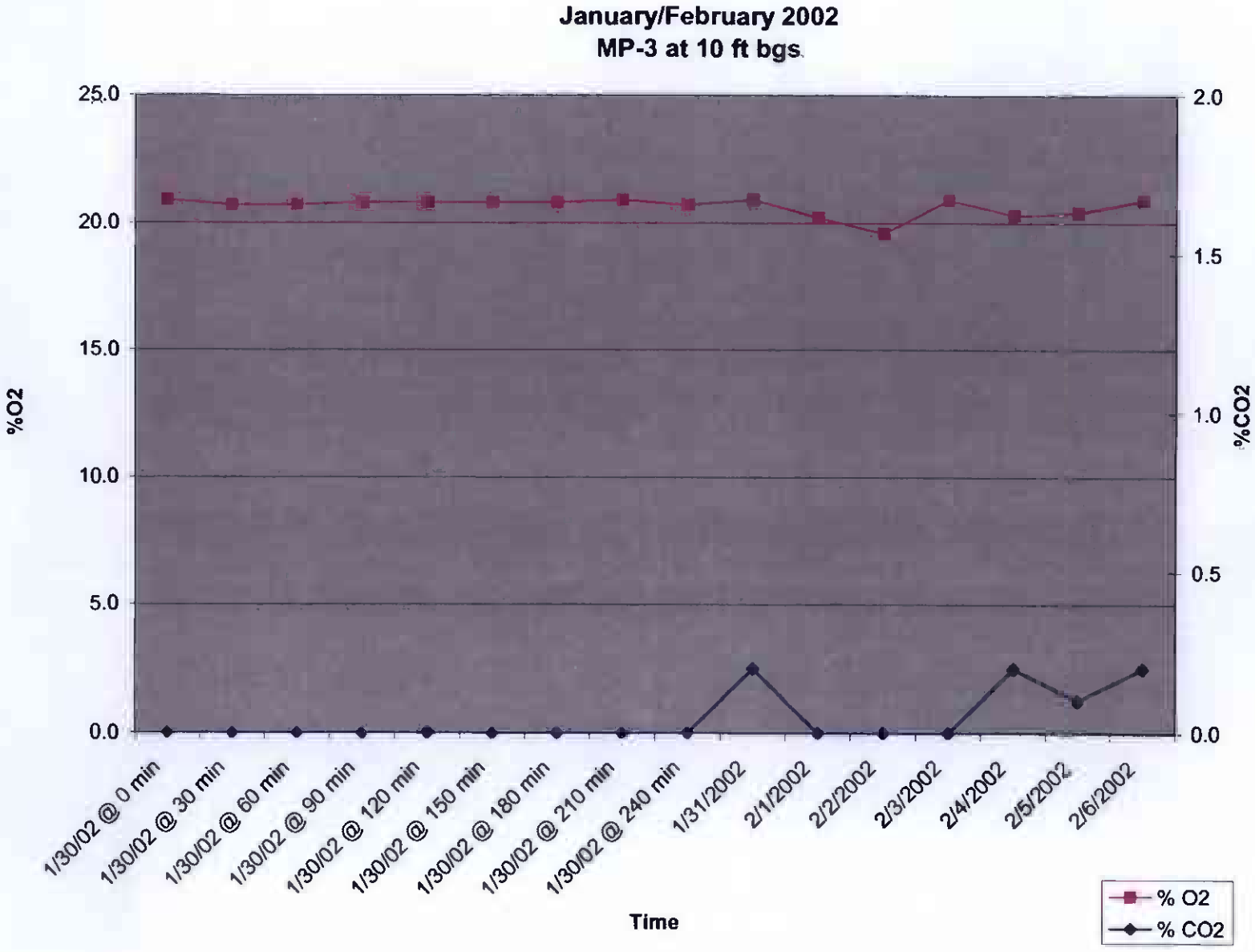

January/February 2002
MP-1 at 10 ft bgs
%O2
%CO2
25.0
20.0
15.0
10.0
5.0
0.0
2.0
1.5
1.0
0.5
0.0
1/30/02 @ 0 min
1/30/02 @ 30 min
1/30/02 @ 60 min
1/30/02 @ 90 min
1/30/02 @ 120 min
1/30/02 @ 150 min
1/30/02 @ 180 min
1/30/02 @ 210 min
1/30/02 @ 240 min
1/31/2002
2/1/2002
2/2/2002
2/3/2002
2/4/2002
2/5/2002
2/6/2002
Time
% O2
% CO2

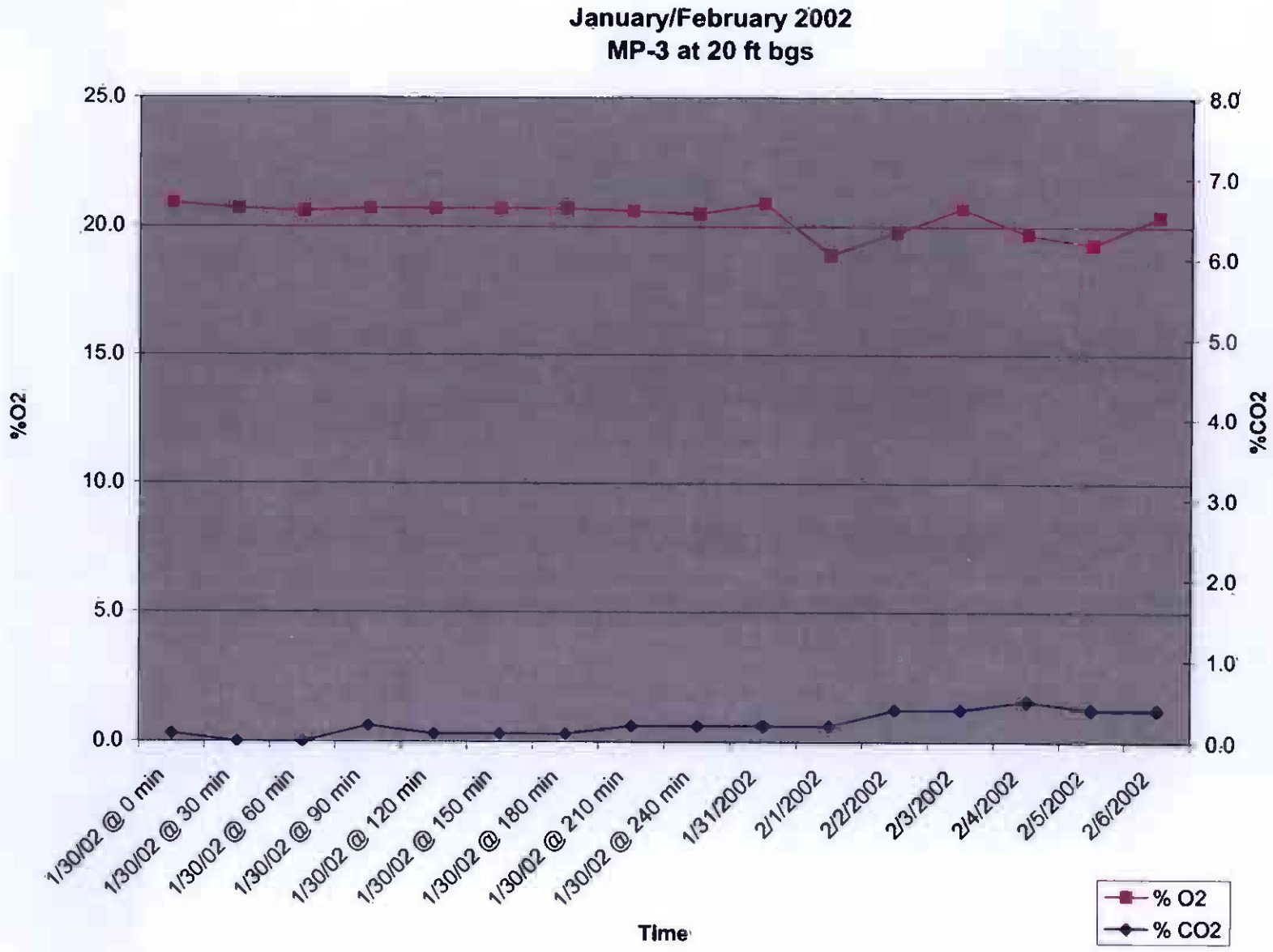

January/February 2002
MP-1 at 20 ft bgs
%O2
%CO2
25.0
20.0
15.0
10.0
5.0
0.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1/30/02 @ 0 min
1/30/02 @ 30 min
1/30/02 @ 60 min
1/30/02 @ 90 min
1/30/02 @ 120 min
1/30/02 @ 150 min
1/30/02 @ 180 min
1/30/02 @ 210 min
1/30/02 @ 240 min
1/31/2002
2/1/2002
2/2/2002
2/3/2002
2/4/2002
2/5/2002
2/6/2002
Time
% O2
% CO2


January/February 2002
MP-2 at 10 ft bgs
25.0
20.0
15.0
10.0
5.0
0.0
%O2
2.0
1.5
1.0
0.5
0.0
%CO2
1/30/02 @ 0 min
1/30/02 @ 30 min
1/30/02 @ 60 min
1/30/02 @ 90 min
1/30/02 @ 120 min
1/30/02 @ 150 min
1/30/02 @ 180 min
1/30/02 @ 210 min
1/30/02 @ 240 min
1/31/2002
2/1/2002
2/2/2002
2/3/2002
2/4/2002
2/5/2002
2/6/2002
Time
% O2
% CO2

January/February 2002
MP-2 at 20 ft bgs

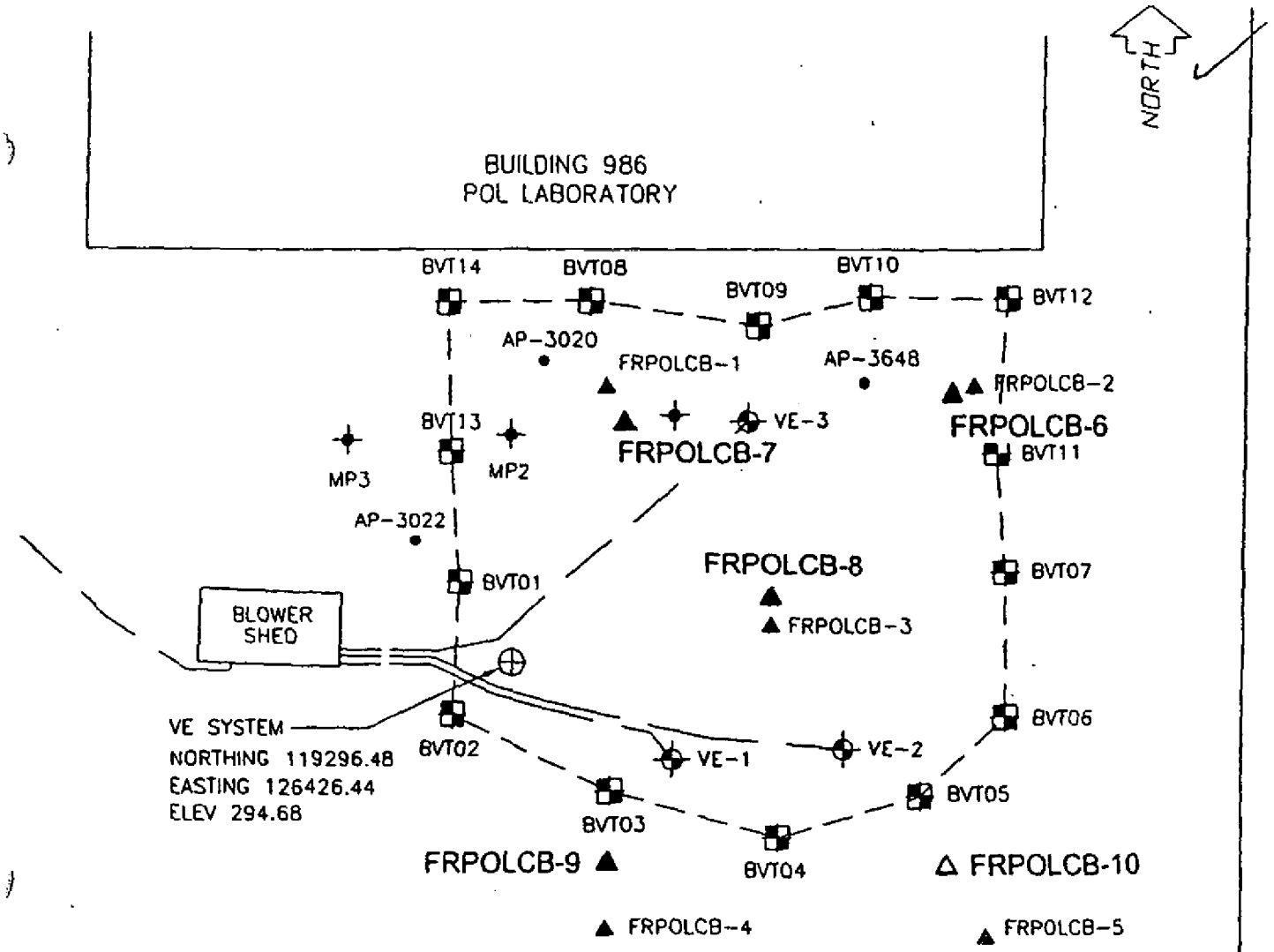



January/February 2002
MP-3 at 10 ft bgs
%O2
%CO2
25.0
20.0
15.0
10.0
5.0
0.0
2.0
1.5
1.0
0.5
0.0
1/30/02 @ 0 min
1/30/02 @ 30 min
1/30/02 @ 60 min
1/30/02 @ 90 min
1/30/02 @ 120 min
1/30/02 @ 150 min
1/30/02 @ 180 min
1/30/02 @ 210 min
1/30/02 @ 240 min
1/31/2002
2/1/2002
2/2/2002
2/3/2002
2/4/2002
2/5/2002
2/6/2002
Time
% O2
% CO2


January/February 2002
MP-3 at 20 ft bgs
%O2
%CO2
25.0
20.0
15.0
10.0
5.0
0.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1/30/02 @ 0 min
1/30/02 @ 30 min
1/30/02 @ 60 min
1/30/02 @ 90 min
1/30/02 @ 120 min
1/30/02 @ 150 min
1/30/02 @ 180 min
1/30/02 @ 210 min
1/30/02 @ 240 min
1/31/2002
2/1/2002
2/2/2002
2/3/2002
2/4/2002
2/5/2002
2/6/2002
Time
% O2
% CO2

Appendix C

Site map



NOTE:

CONTROL IS BASED ON COORDINATES PROVIDED BY COE SURVEY SECTION IN LOCAL FORT RICHARDSON GRID SYSTEM. ELEVATIONS ARE TO MEAN SEA LEVEL DATUM. UG LINES SHOWN CONNECTING THE VE WELLS TO THE BLOWER ARE AS DESCRIBED BY EMCON STAFF AND LOCATED BY STAKES PLACED AT ANGLE POINTS ON GROUND SURFACE. MONUMENT "VE SYSTEM" IS A STANDARD COE DISK MONUMENT SET AS PER EM 1110-1-1002 WITH FINNED ROD SECTION, DRIVEN TO A 4' REFUSAL DEPTH.

0 7.5 15 22.5 30
APPROX. SCALE IN FEET

LEGEND

MP1	SOIL GAS MONITORING POINTS
VE-1	VAPOR EXTRACTION WELL
AP-3020	MONITORING WELL
FRPOLCB-4	CONFIRMATION BORING LOCATION
BVT01	BIOVENTING WELLS
⊕	MONUMENT
— —	SUBSURFACE PIPE

△ FRPOLCB-6 2000 CONFIRMATION BORING LOCATION

\\PROJECTS\01TRA\01600800

AME: 99FTRF2.DWG

emcon Alaska, Inc.

DATE	DEC. 1997
DWN.	99ftrf2.dwg
CKD.	L. RAYMORE
REV.	OCT. 1999
PROJECT No.	

FORT RICHARDSON
BUILDING 986 REMEDIAL ACTION
Anchorage, Alaska

SITE LAYOUT

FIGURE
3