N61165.AR.003803
CNC CHARLESTON
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MONITORED NATURAL ATTENUATION FOR INTERIM MEASURES FIRST ROUND SAMPLING EVENT CNC CHARLESTON SC
6/9/1998
ENSAFE

MONITORED NATURAL ATTENUATION
FIRST ROUND SAMPLING EVENT

NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

CONTRACT N62467-89-D-0318
CTO-029

Prepared for:

Comprehensive Long-Term Environmental Action Navy
(CLEAN)
Charleston Naval Shipyard
Charleston, South Carolina

Post Decision Documents
Scan

Prepared by:

EnSafe Inc.
935 Houston Northcutt Boulevard
Suite 113
Mt. Pleasant, South Carolina 29464
(843) 884-0029

June 9, 1998

MONITORED NATURAL ATTENUATION
FIRST ROUND SAMPLING EVENT

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June 9, 1998

To: NAVBASE Charleston Project Team
From: Todd Kafka and Charlie Vernoy
Subject: Monitored Natural Attenuation Analytical Results at NAVBASE
Date: June 9, 1997

The results of the first round of monitored natural attenuation have been compiled and are summarized for ten separate sites at NAVBASE that have histories of chlorinated solvent and/or petroleum hydrocarbon contamination. Five of these sites are SWMU 39 (Zone A), SWMU 9 (Zone H), SWMU 17 (Zone H), AOC 607 (Zone F), and SWMU 166 (Zone K). The other five sites are located in Zone E and were grouped into areas of VOC contamination due to the close proximity of SWMUs and AOCs within the zone. Wells in neighboring AOCs and SWMUs were queried for VOC contamination to produce the sampling event plots. The five major areas in Zone E are SWMU 65, AOC 551 area, SWMU 172 & AOC 576, AOC 569 & 570 area, and SWMU 25 & 70. As with the SWMU 39 data package provided during the April Project Team Meeting, this data package includes:

- Arcview data plots of groundwater VOC results from each sampling event
- The first round of MNA groundwater VOC results
- Preliminary MNA screening using the EPA ranking system (*Draft EPA Region 4 Suggested Practices for Evaluation of a Site for Natural Attenuation [Biological Degradation] of Chlorinated Solvents*).
- Groundwater flow maps for shallow, deep, and intermediate wells (when appropriate) for each site.

Steps 1 and 2 of the MNA process at each site (reviewing site data, developing a conceptual model, and conducting an initial assessment of site potential for MNA) have been completed. The next steps to be taken are to refine the conceptual model using additional site characterization data and a 2nd round of MNA groundwater data. Several action items have been identified to meet these tasks:

- The 2nd round of MNA sampling is tentatively slated for August-September 1998 when groundwater levels expected to be at lower levels than those during the 1st MNA event, which coincided with our anomalously wet winter.

- At each site, data gaps will be addressed in the 2nd MNA sampling event by adding appropriate well locations. Similarly, redundancy in data will be addressed by removing appropriate wells from the next event.

- Methyl terbutyl ether (MTBE) will be added to the volatile organic list to enhance evaluation of BTEX plumes.

- Carbon dioxide, an end product to reductive dechlorination, will be added to the gas analyses performed in the field.

- Sulfide and total iron will be added to MNA parameters at each well location to better evaluate redox conditions in the aquifer. Total nitrogen will be analyzed at each site at 2-3 locations within the plume as an indicator of microbial activity.

- Chloride will be removed from the MNA parameters due to high variance in background locations, which does not assist in determining if MNA is occurring.

- Well locations with only BTEX contamination will be removed from the screening evaluation since no chlorinated solvent contamination is present.

- Mutually coincident groundwater flow maps to be generated with each subsequent MNA sampling event.

- Consideration of natural influences on MNA parameters; for instance, methane is produced naturally in many settings on base and should not be interpreted solely as methane production via natural degradation of chlorinated solvents.

- Calculation of aquifer capacity to degrade BTEX for those sites with BTEX contamination.

- Add heterotrophic microbial counts to groundwater analyses at certain sites with BTEX contamination to ensure that microbial populations are present.

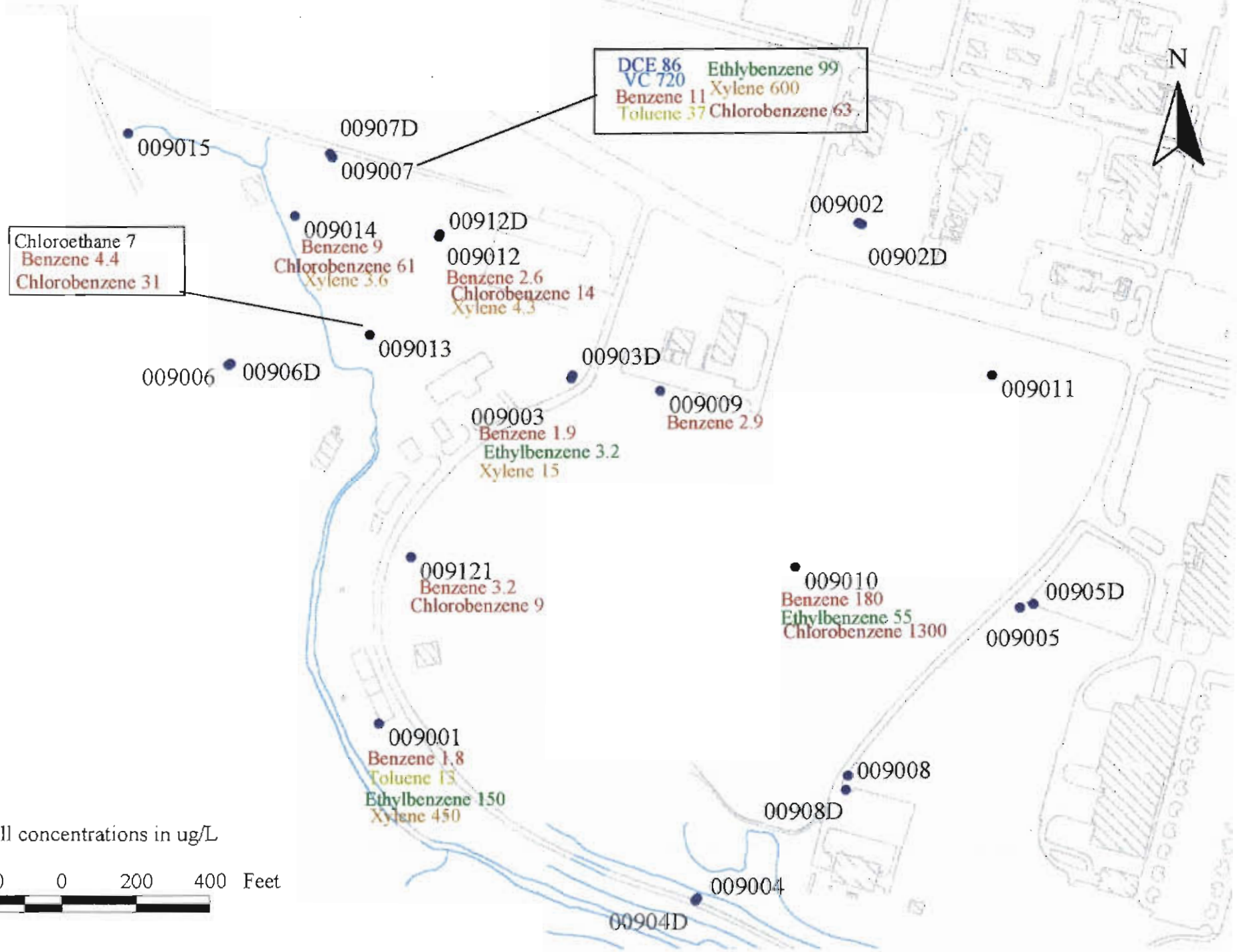
Technical Notes:

1 The 1st round of MNA data included three wells in Zone G (NBCG636001, NBCG637001 and NBCGGDG001). Two of these, 637001 and GDG001, lie within close proximity to SWMU 9, but were inadvertantly left off the SWMU 9 MNA Groundwater VOCs plot. Results from 637001 were: Benzene = 8 ppb; Toluene = 9 ppb; Ethylbenzene = 120 ppb; Xylenes = 1500 ppb; and Chlorobenzene = 42 ppb. Results from GDG001 were: TCE = 5 ppb and Xylenes = 3 ppb.

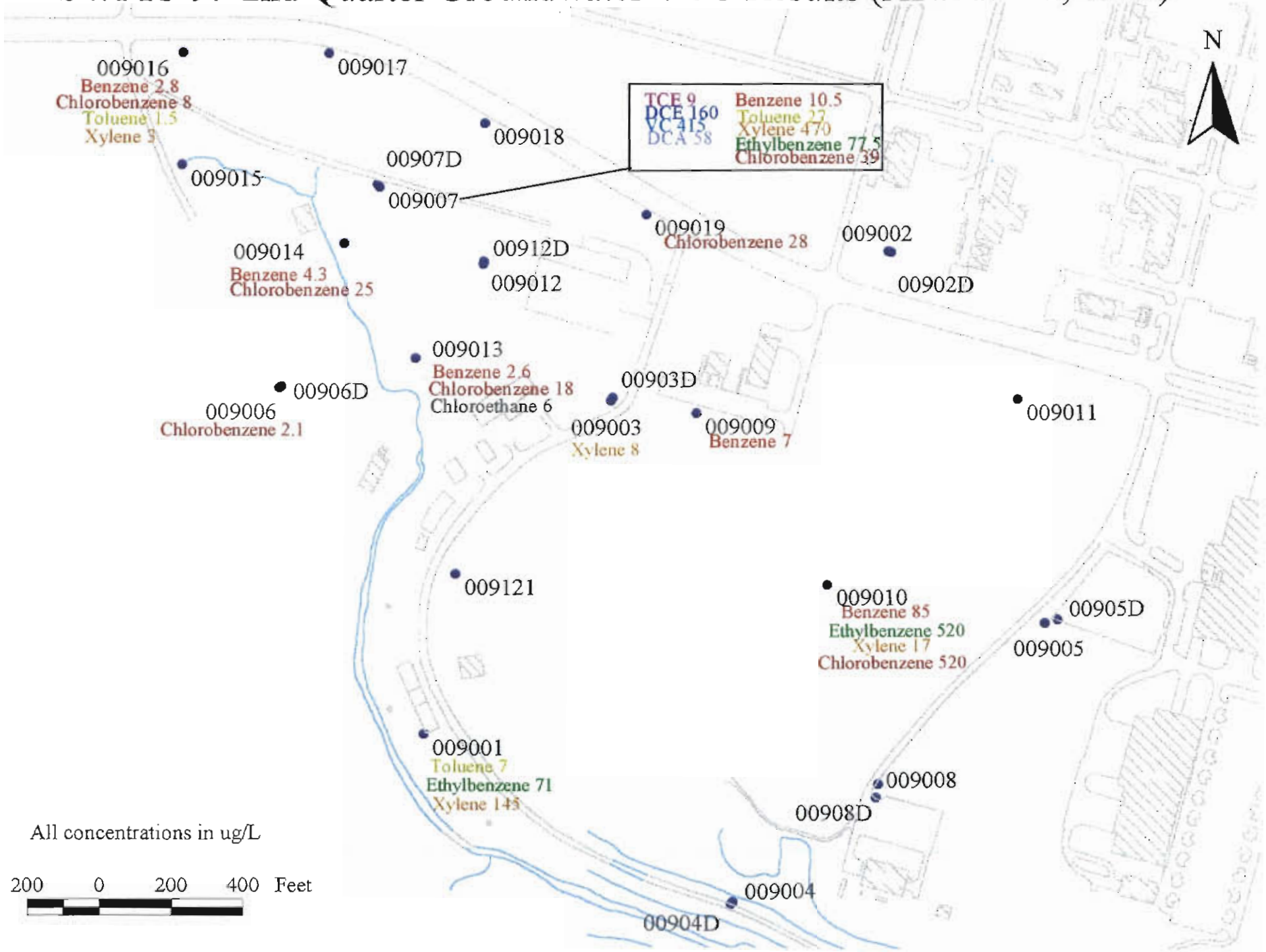
2 Only 7 shallow wells in SWMU 9 were sampled during the 1st round MNA event: 009001, 009007, 009009, 009010, 009011, 009014, and 009016. All other wells were included in SWMU 9 MNA Groundwater VOCs plot due to the large scale of site and to assist in evaluation of the MNA data.

ZONE	SITE
H	SWMU 9 SWMU 17
K	SWMU 166
F	AOC 607
E	SWMU 25 & 70 AREA SWMU 65 SWMU 172 & AOC 576 AREA AOC 551 AREA AOC 569 & 570 AREA

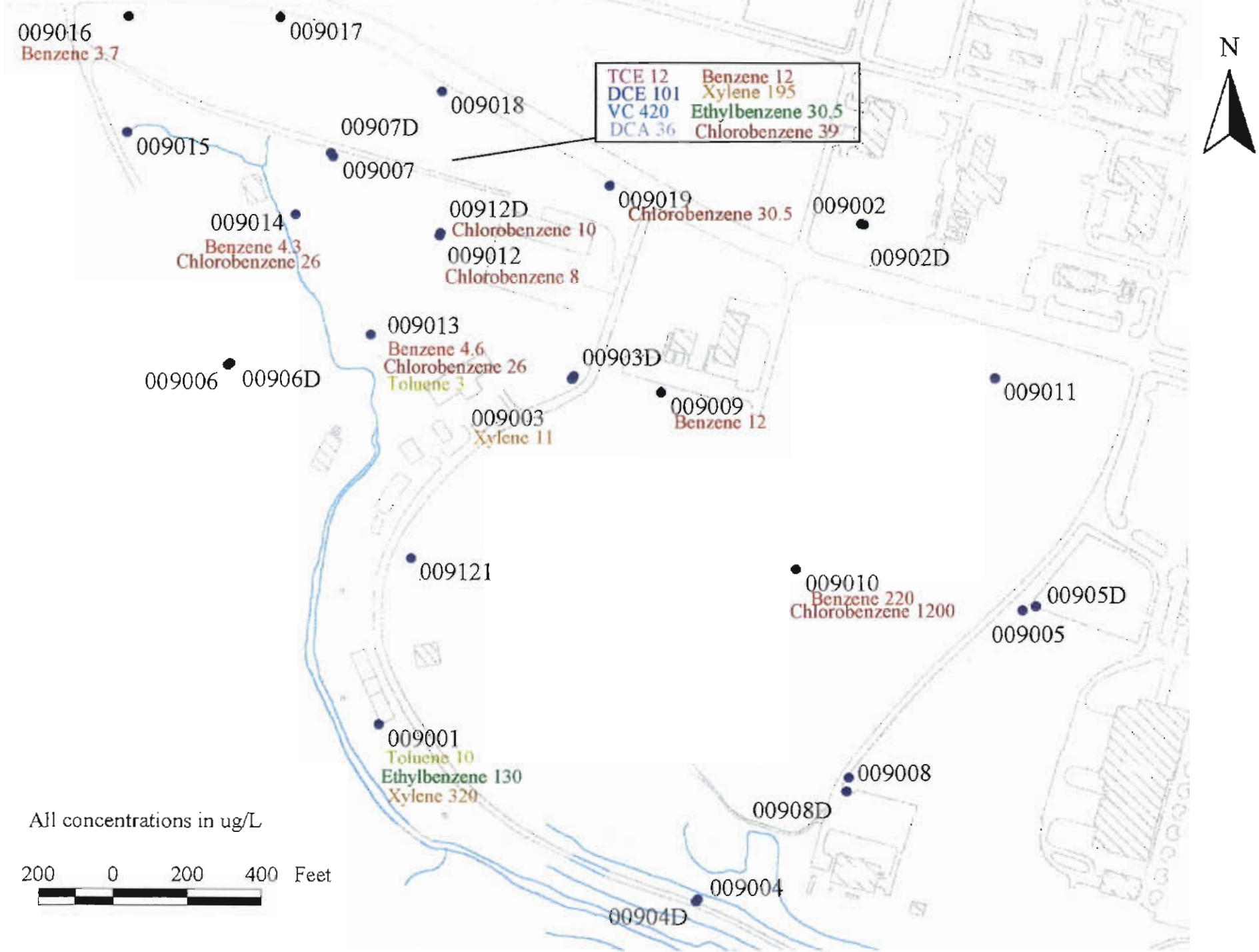
SWMU 9: 1st Quarter Groundwater VOC Results (NOV 2-28, 1994)



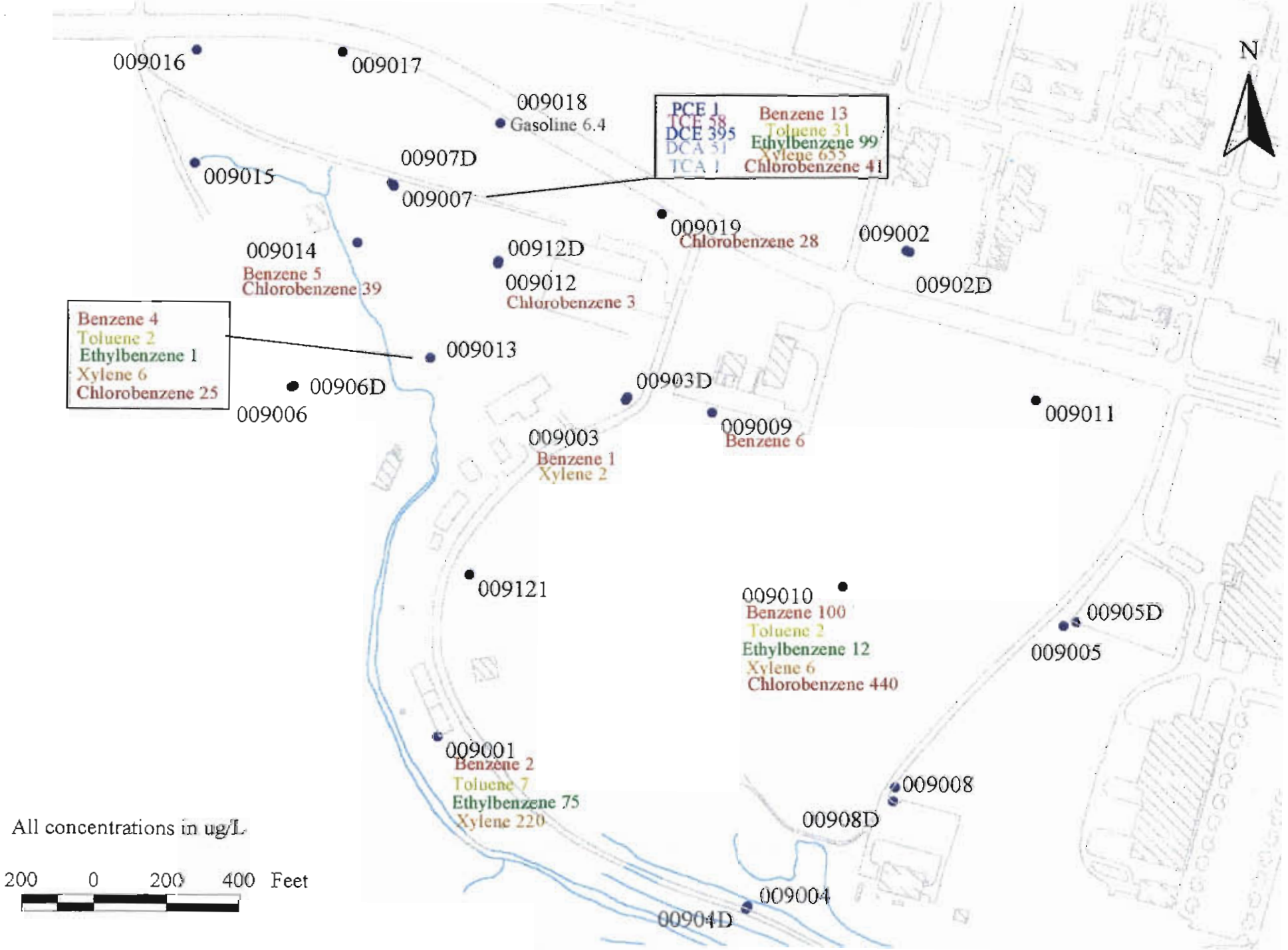
SWMU 9: 2nd Quarter Groundwater VOC Results (APR 13-25, 1999)



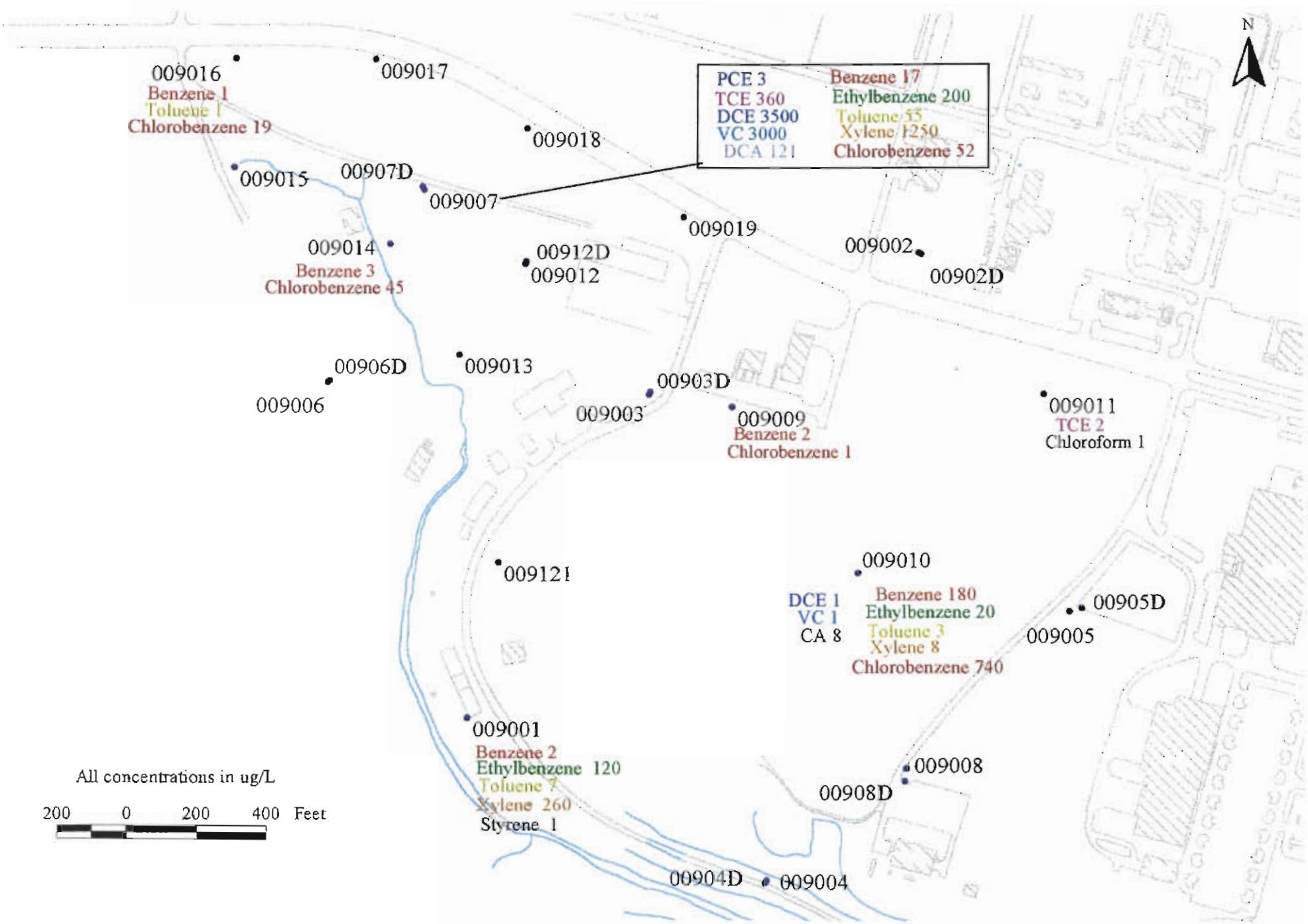
SWMU 9: 3rd Quarter Groundwater VOC Results (SEP 14-OCT 11, 1995)



SWMU 9: 4th Quarter Groundwater VOC Results (MAR 19-APR 16, 1996)



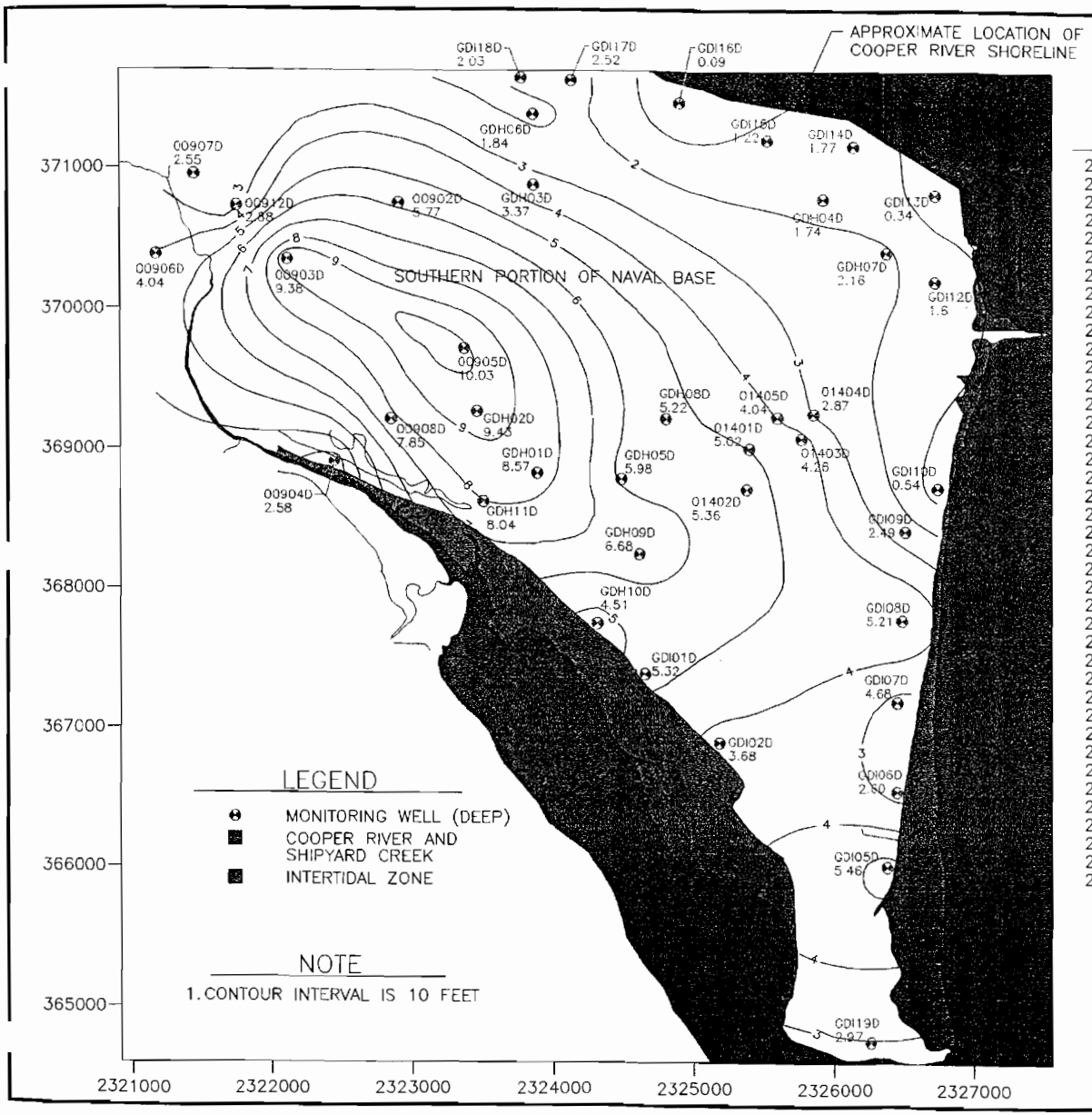
SWMU 9: 1st Rd MNA Groundwater VOC Results, MAR 11-16, 1998



SWMU 9 MONITORING NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	009001	009007	009009	009010	009011	009014	009016
VOCs	PCE	ug/l		3					
	TCE	ug/l		360			2		
	1,1-DCA	ug/l		121					
	1,1-DCE	ug/l							
	1,2-DCE tot	ug/l		3500		1			
	VC	ug/l		3000		1			
	Benz	ug/l	2	17	2	180		3	1
	Ethylbnz	ug/l	120	200		20			
	Tol	ug/l	7	65		3			1
	Xyl tot	ug/l	260	1250		8			
Natural Attenuation Parameters	Alk	ppm	42	96	55	73	72	55	83
	Sp Cond	mmho/cm	1.928	15	0.21	1.85	1.3	4.58	6.93
	Ethane	ng/l	3	1600	227	632.5	3	283.11	277.78
	Ethene	ng/l	3	1600	3	245	3	3	3
	H_2 (gas)	nm/l	5.44	1.21	0.16	0.25	0.29	0.28	5.65
	Fe^{2+}	mg/l	0.5	19.9	26	16.8	16.3	13.2	10
	CH_4	mg/l	172610	128202	36052	22126	74151	27231	21692
	DO	mg/l	0.12	0.12	0.11	0.25	0.28	0.22	0.11
	ORP	mV	133	-84	-85	-307	-125	-138	-191
	Temp	°C	16.5	16.6	18.6	16.9	17.2	17.0	15.8
	pH		9.14	8.29	6.26	7.18	6.30	7.95	8.99
	Cl	mg/l	554	5830	71	3700	450	2180	2480
	SO_4	mg/l	0.27	ND	2.7	45	ND	ND	1
	TOC	mg/l	13.2	60.0	19.2	14.2	18.5	14.8	17.4
	NO_3 as N	mg/l	ND	14.9	ND	ND	ND	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS	3	3	3	3	3	3	3
	NO_3		2	0	2	2	2	2	2
	Fe II		0	3	3	3	3	3	3
	SO_4		2	2	2	0	2	2	2
	CH_4		3	3	3	3	3	3	3
	Redox		0	1	1	2	2	2	2
	pH		-2	0	0	0	0	0	0
	TOC		0	2	0	0	0	0	0
	Temp		0	0	0	0	0	0	0
	CO_2*		0	0	0	0	0	0	0
	Alk*		0	0	0	0	0	0	0
	Cl*		2	2	0	2	2	2	2
	H_2		3	3	0	0	0	0	3
	VFA		0	0	0	0	0	0	0
	BTEX		2	2	2	2	0	2	2
	TCE		0	2	0	0	2	0	0
	DCE		0	2	0	2	0	0	0
	VC		0	2	0	2	0	0	0
	Ethane		0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0
	DCA		0	2	0	0	0	0	0
	CA		0	0	0	0	0	0	0
	Tot Pts		**15**	**29**	**16**	**21**	**19**	**19**	**22**
	NA evidence?		**A**	**S**	**A**	**S**	**A**	**A**	**S**

Notes:	*= parameters must exceed 2X background						
	"Background" locations:	Avg of results from "background" locations					
Shallow wells:	GDH003	Cl =	208	mg/l			
	GDH004	Alk =	420	ppm	(only available at GDH006)		
	GDH006	CO_2 =	no values				
	GDH007						
	GDH008						
Closest gridwells not influenced by surface water or upward gradients.							
RANKING RESULTS:							
N=	No evidence						
I=	Inadequate evidence						
L=	Limited evidence						
A=	Adequate evidence						
S=	Strong evidence						



Coordinates X	Coordinates Y	Well	Top of casing Elevations	Depth to Groundwater	Groundwater Elevations
2322898	370759.8	00902D	10.80	5.03	5.77
2322112	370341.4	00903D	9.88	0.5	9.38
2322451	368919.5	00904D	7.19	4.61	2.58
2323331	369705.6	00905D	10.83	0.8	10.03
2321174	370378.8	00906D	13.20	9.16	4.04
2321459	370945.9	00907D	7.73	5.18	2.55
2322861	369251.5	00908D	7.85	0.00	7.85
2321753	370727.7	00912D	9.42	6.54	2.88
2325395	369001.7	01401D	12.58	7.56	5.02
2325376	368713.4	01402D	12.87	7.51	5.36
2325767	369076.1	01403D	11.24	6.98	4.26
2325851	369251.7	01404D	9.38	6.51	2.87
2325602	369226.0	01405D	11.65	7.61	4.04
2323892	368830.3	GDH01D	13.06	4.49	8.57
2323451	369263.4	GDH02D	9.83	0.4	9.43
2323850	370885.1	GDH03D	12.85	9.48	3.37
2325925	370792.6	GDH04D	11.72	9.98	1.74
2324482	368776.0	GDH05D	14.35	8.37	5.98
2323874	371402.2	GDH06D	7.70	5.86	1.84
2326380	370412.3	GDH07D	11.85	9.69	2.16
2324798	369229.0	GDH08D	13.10	7.88	5.22
2324656	368258.4	GDH09D	13.29	6.61	6.68
2324284	367779.6	GDH10D	9.59	5.08	4.51
2323490	368617.6	GDH11D	9.55	1.51	8.04
2324651	367396.1	GDI01D	8.78	3.46	5.32
2325176	366908.0	GDI02D	11.88	8.20	3.68
2326383	365995.3	GDI05D	6.67	1.21	5.46
2326454	366555.0	GDI06D	7.45	4.85	2.60
2326455	367181.4	GDI07D	10.49	7.81	2.68
2326482	367772.1	GDI08D	11.42	6.21	5.21
2326505	368418.0	GDI09D	11.36	8.87	2.49
2326745	368728.6	GDI10D	8.00	7.46	0.54
2326722	370205.1	GDI12D	10.86	9.21	1.65
2326723	370828.2	GDI13D	11.84	11.50	0.34
2326133	371166.9	GDI14D	8.58	6.81	1.77
2325533	371205.4	GDI15D	10.83	9.61	1.22
2324905	371480.0	GDI16D	6.00	5.91	0.09
2324116	371633.4	GDI17D	10.26	7.74	2.52
2323773	371635.9	GDI18D	7.11	5.08	2.03
2326255	364744.5	GDI19D	9.13	6.16	2.97

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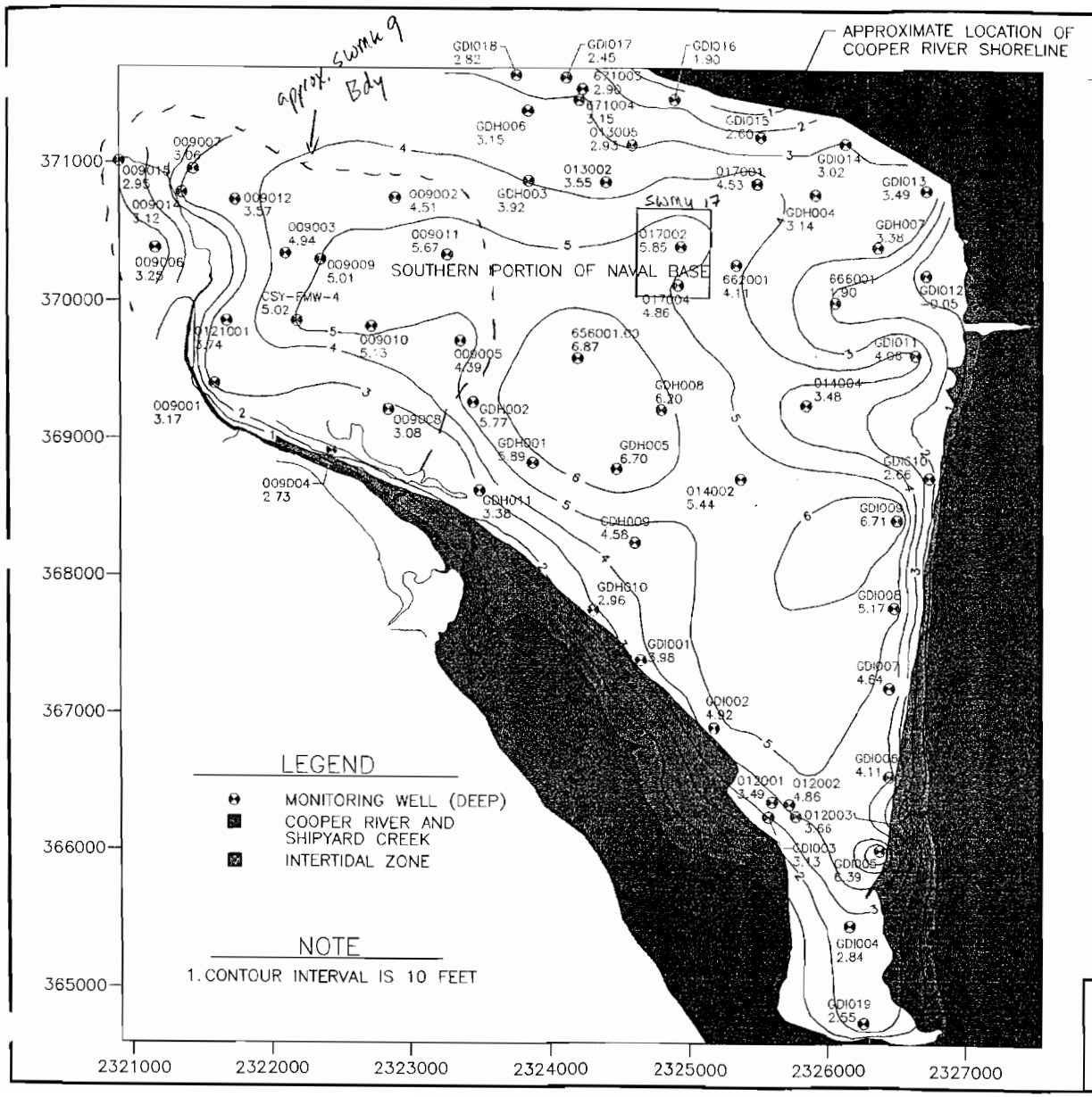
ZONE H
FINAL RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

FIGURE 3.7
POTENTIOMETRIC MAP OF
LOWER ZONE/SHALLOW AQUIFER
(5/11/95)

DWG DATE: 12/07/95 | DWG NAME: 29CHZH36



Coordinates X	Coordinates Y	Well	Top of Casing Elevation	Depth to Groundwater (5/11/95)	Groundwater Elevation
2322180	369859.1	CSY-FMW-4	8.05	3.03	5.02
2321585	369398.0	009001	9.68	6.51	3.17
2322898	370759.8	009002	10.89	6.38	4.51
2322112	370341.4	009003	10.42	5.48	4.94
2322451	368919.5	009004	7.10	4.37	2.73
2323331	369705.6	009005	9.16	4.77	4.39
2321174	370378.8	009006	12.61	9.36	3.25
2321459	370945.9	009007	7.91	4.85	3.06
2322861	369251.5	009008	8.44	5.36	3.08
2322353	370304.8	009009	14.27	9.26	5.01
2322720	369818.8	009010	11.25	6.12	5.13
2323258	370342.3	009011	13.77	8.10	5.67
2321753	370727.7	009012	9.62	6.05	3.57
2321358	370786.1	009014	8.84	5.72	3.12
2320901	371010.5	009015	10.72	7.77	2.95
2324390	370867.0	013002	9.12	5.57	3.55
2324579	371139.1	013005	11.47	8.54	2.93
2325378	368702.7	014002	13.23	7.79	5.44
2325851	369243.5	014004	9.72	6.24	3.48
2324931	370399.3	017002	10.47	4.62	5.85
2324907	370122.1	017004	9.80	4.94	4.86
2321674	369851.8	121001	9.15	5.41	3.74
2325481	370865.9	178001	12.23	7.70	4.53
2324188	369586.2	656001	11.23	4.36	6.87
2325329	370272.2	662001	8.62	4.51	4.11
2326044	370000.4	666001	10.59	8.69	1.90
2323892	368830.3	GDH001	13.01	7.12	5.89
2323451	369263.4	GDH002	9.82	4.05	5.77
2323850	370885.1	GDH003	13.20	9.28	3.92
2325925	370792.6	GDH004	11.83	8.69	3.14
2324482	368776.0	GDH005	14.73	8.03	6.70
2323874	371402.2	GDH006	7.59	4.44	3.15
2326380	370412.3	GDH007	12.22	8.84	3.38
2324798	369229.0	GDH008	12.94	6.74	6.20
2324656	368258.4	GDH009	12.78	8.20	4.58
2324284	367779.6	GDH010	9.26	6.30	2.96
2323490	368617.6	GDH011	9.60	6.22	3.38
2325584	366357.8	012001	8.14	4.65	3.49
2325709	366344.0	012002	9.08	4.22	4.86
2325755	366254.8	012003	8.45	4.79	3.66
2324229	371547.5	671003	8.78	5.88	2.90
2324202	371468.5	671004	8.85	5.70	3.15
2324651	367396.1	GDI001	8.73	4.75	3.98
2325176	366908.0	GDI002	11.76	6.84	4.92
2325570	366259.5	GDI003	9.05	5.92	3.13
2326156	365451.3	GDI004	8.65	5.81	2.84
2326383	365995.3	GDI005	9.98	3.59	6.39
2326454	366555.0	GDI006	7.74	3.63	4.11
2326455	367181.4	GDI007	10.31	5.67	4.64
2326482	367772.1	GDI008	11.48	6.31	5.17
2326505	368418.0	GDI009	11.29	4.58	6.71
2326745	368728.6	GDI010	8.05	5.39	2.66
2326636	369618.2	GDI011	8.79	4.73	4.06
2326722	370205.1	GDI012	11.01	11.06	−0.05
2326723	370828.2	GDI013	11.90	8.41	3.49
2326133	371166.9	GDI014	8.75	5.73	3.02
2325533	371205.4	GDI015	11.12	8.52	2.60
2324905	371480.0	GDI016	6.02	4.12	1.90
2324116	371633.4	GDI017	10.25	7.80	2.45
2323773	371635.9	GDI018	7.15	4.33	2.82
2326255	364744.5	GDI019	8.79	6.24	2.55

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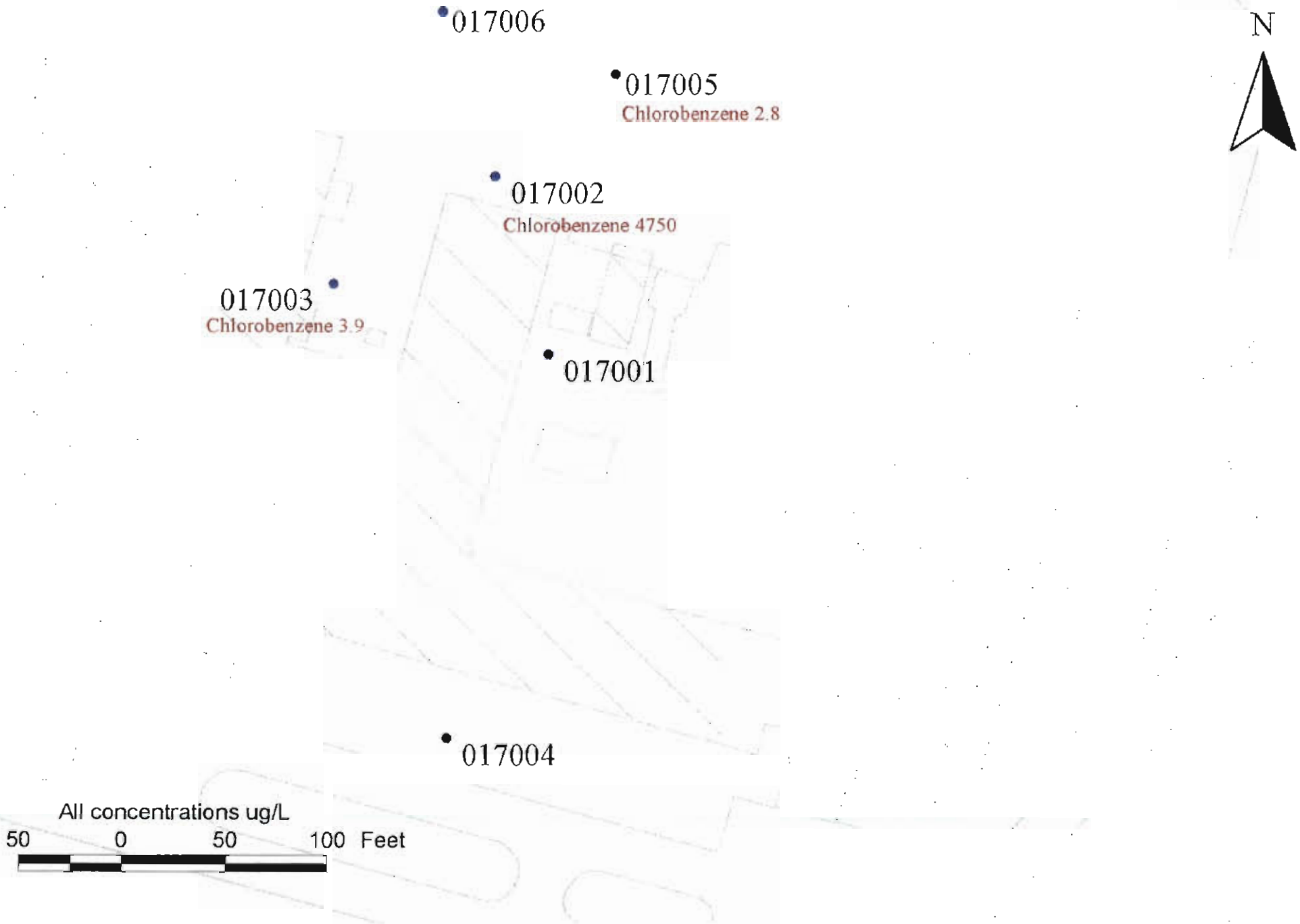
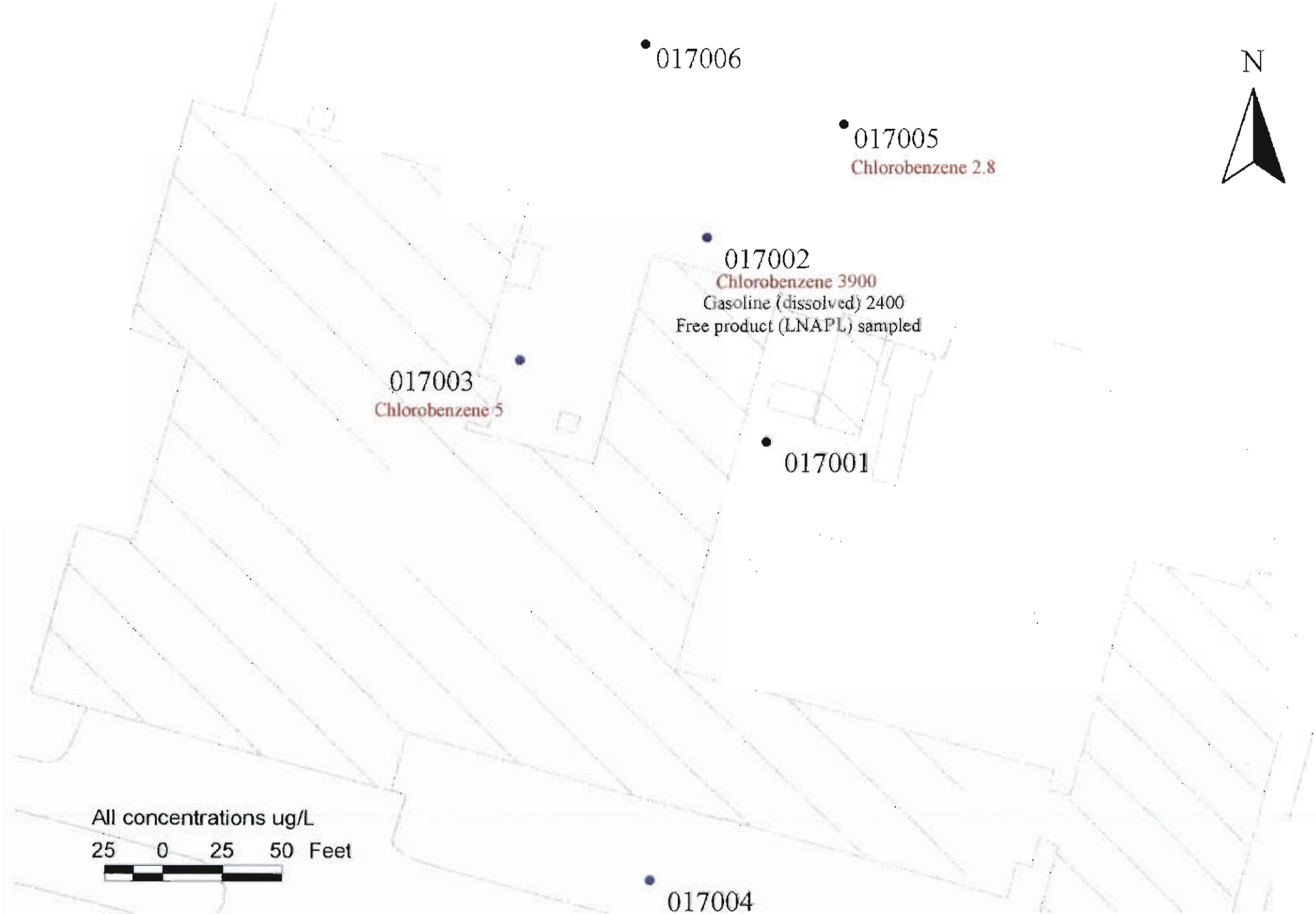
FIGURE 3.6
POTENTIOMETRIC MAP OF
UPPER ZONE/SHALLOW AQUIFER
(5/11/95)

DWG DATE: 12/07/95 | DWG NAME: 29CHZH34

SWMU 17: 2nd Quarter Groundwater VOC Results (MAR 29-APR 18, 1995)

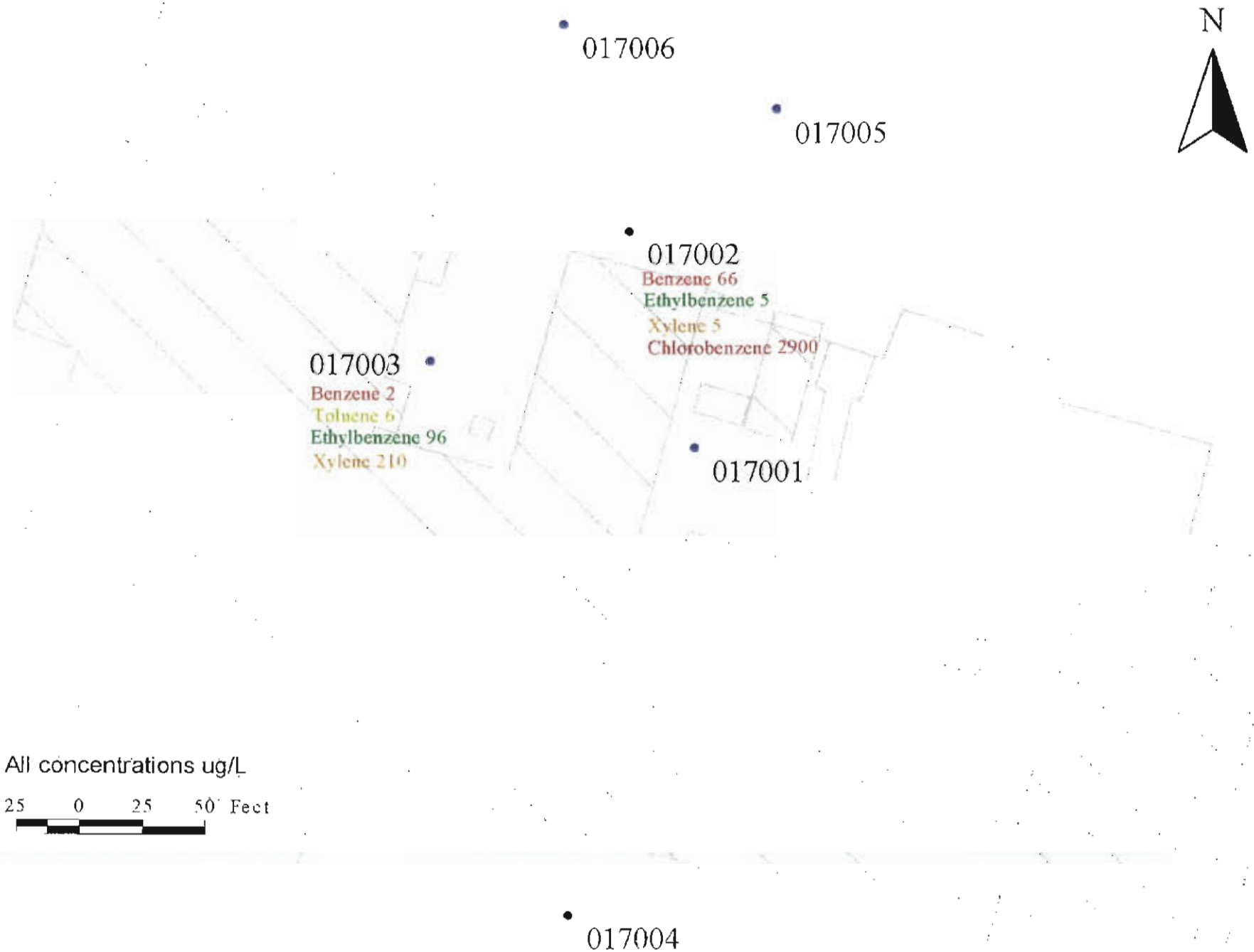


SWMU 17: 3rd Quarter Groundwater VOC Results (SEP 19-20, 1995)



SWMU 17: 4th Quarter Groundwater VOC Results (MAR 22-APR 17, 1996)

SWMU 17: Groundwater VOCs Results, MNA Event, March 10-11, 1998



SWMU 17 MONITORING NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	017001	017002	017003	017004	017005	017006
VOCs	PCE	ug/l						
	TCE	ug/l						
	1,1-DCA	ug/l						
	1,1-DCE	ug/l						
	1,2-DCE tot	ug/l						
	VC	ug/l						
	Benz	ug/l		66	2			
	Ethylbnz	ug/l		5	6			
	Tol	ug/l		5	96			
	Xyl tot	ug/l			210			
Natural Attenuation Parameters	Alk	ppm		51	48	70	94	72
	Sp Cond	mmho/cm		1.09	0.959	0.989	6.29	4.5
	Ethane	ng/l		108.2	96.85	3	3	3
	Ethene	ng/l		3	3	3	3	3
	H_2 (gas)	nm/l		0.08	0.40	0.04	0.38	0.16
	Fe^{2+}	mg/l		5.45	0.5	0.882	0.5	1.82
	CH_4	mg/l		19651	1177	3008	51606	35914
	DO	mg/l		0.13	0.50	0.19	0.18	0.18
	ORP	mV		-156	-75	-92	-296	-131
	Temp	°C		18.4	18.0	19.5	18.8	19.0
	pH			7.55	7.59	6.80	6.93	7.05
	Cl	mg/l		ND	50.5	69	1320	1420
	SO_4	mg/l		37	375	87	56	3
	TOC	mg/l		13.3	7.7	10.2	21.1	28.5
	NO_3 as N	mg/l		ND	0.17	ND	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS		3	3	3	3	3
	NO_3			2	2	2	2	2
	Fe II			3	0	0	0	3
	SO_4			0	0	0	0	2
	CH_4			3	3	3	3	3
	Redox			2	1	1	2	2
	pH			0	0	0	0	0
	TOC			0	0	0	2	2
	Temp			0	0	0	0	0
	CO_2*			0	0	0	0	0
	Alk*			0	0	0	0	0
	Cl*			0	0	0	2	2
	H_2			0	0	0	0	0
	VFA			0	0	0	0	0
	BTEX			2	2	0	0	0
	TCE			0	0	0	0	0
	DCE			0	0	0	0	0
	VC			0	0	0	0	0
	Ethane			0	0	0	0	0
	Ethene			0	0	0	0	0
	DCA			0	0	0	0	0
	CA			0	0	0	0	0
	Tot Pts			15	11	9	14	19
	NA evidence?			A	L	L	L	A

017001 NOT SAMPLED DUE TO FREE PRODUCT IN WELL

Notes: * = parameters must exceed 2X background

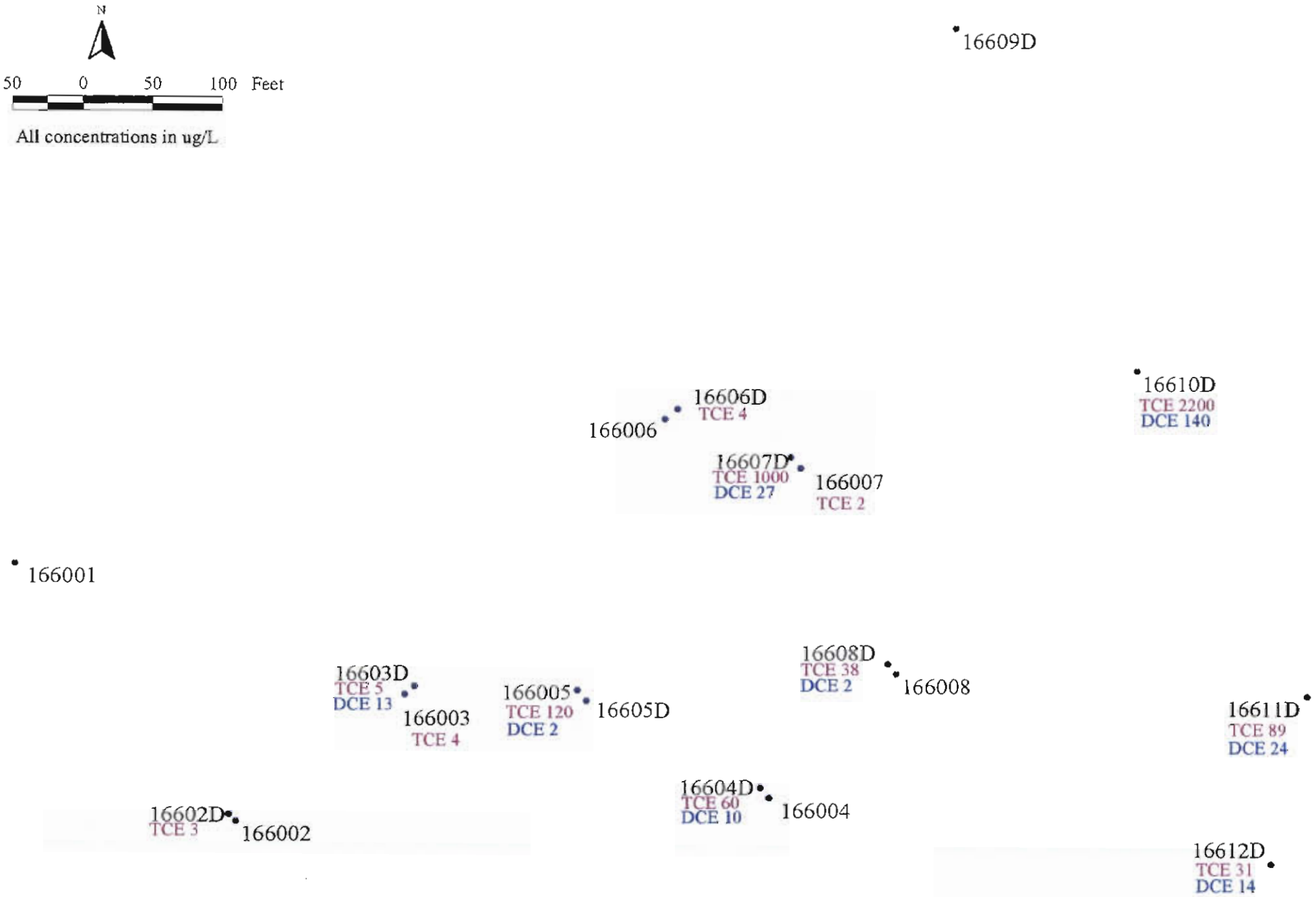
	"Background" locations:	Avg of results from "background" locations			
Shallow wells:	GDH003	Cl =	208	mg/l	
	GDH004	Alk =	420	ppm	(only available at GDH006)
	GDH006	CO_2 =	no values		
	GDH007				
	GDH008				

Closest gridwells not influenced by surface water or upward gradients.

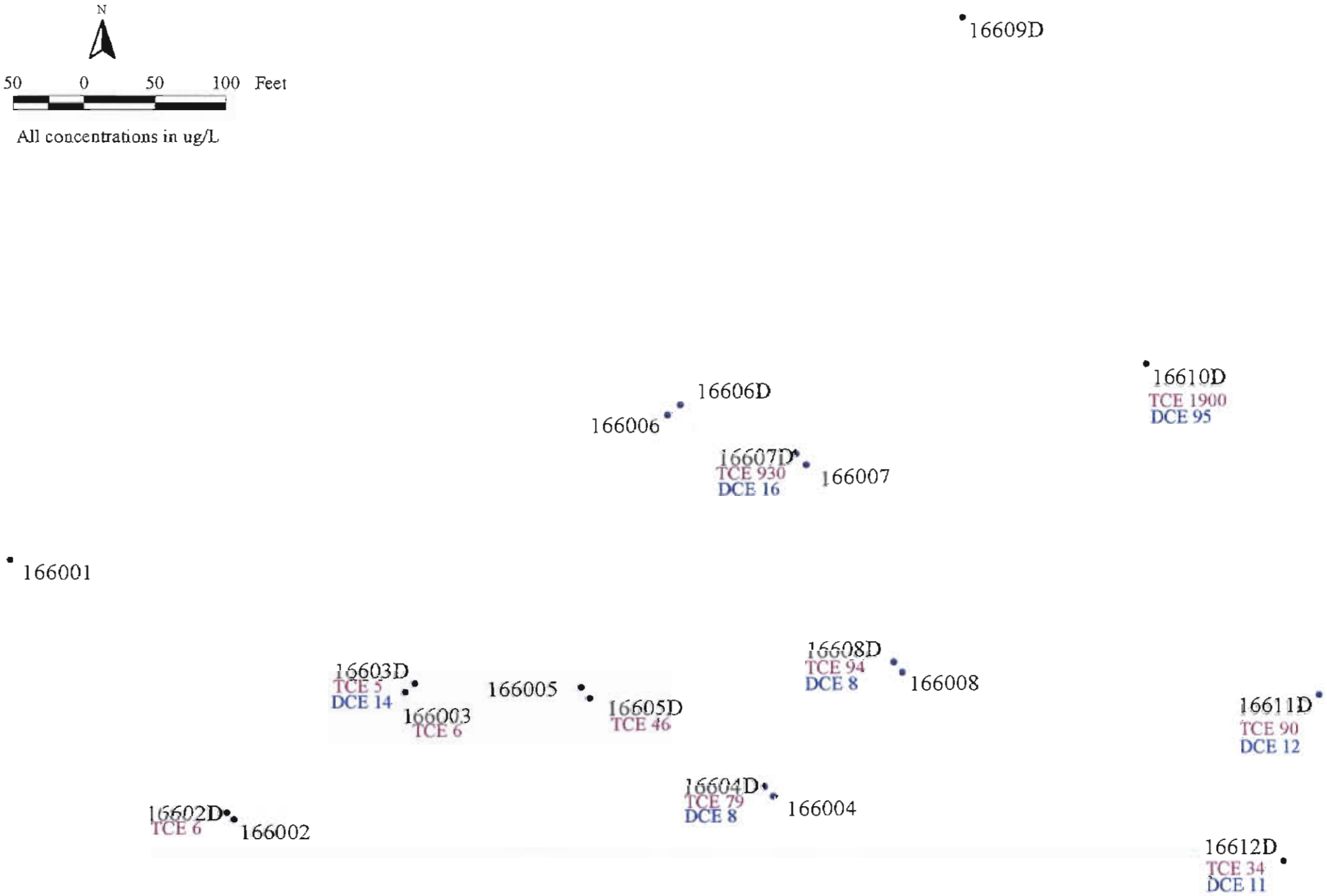
RANKING RESULTS:

N=	No evidence
I=	Inadequate evidence
L=	Limited evidence
A=	Adequate evidence
S=	Strong evidence

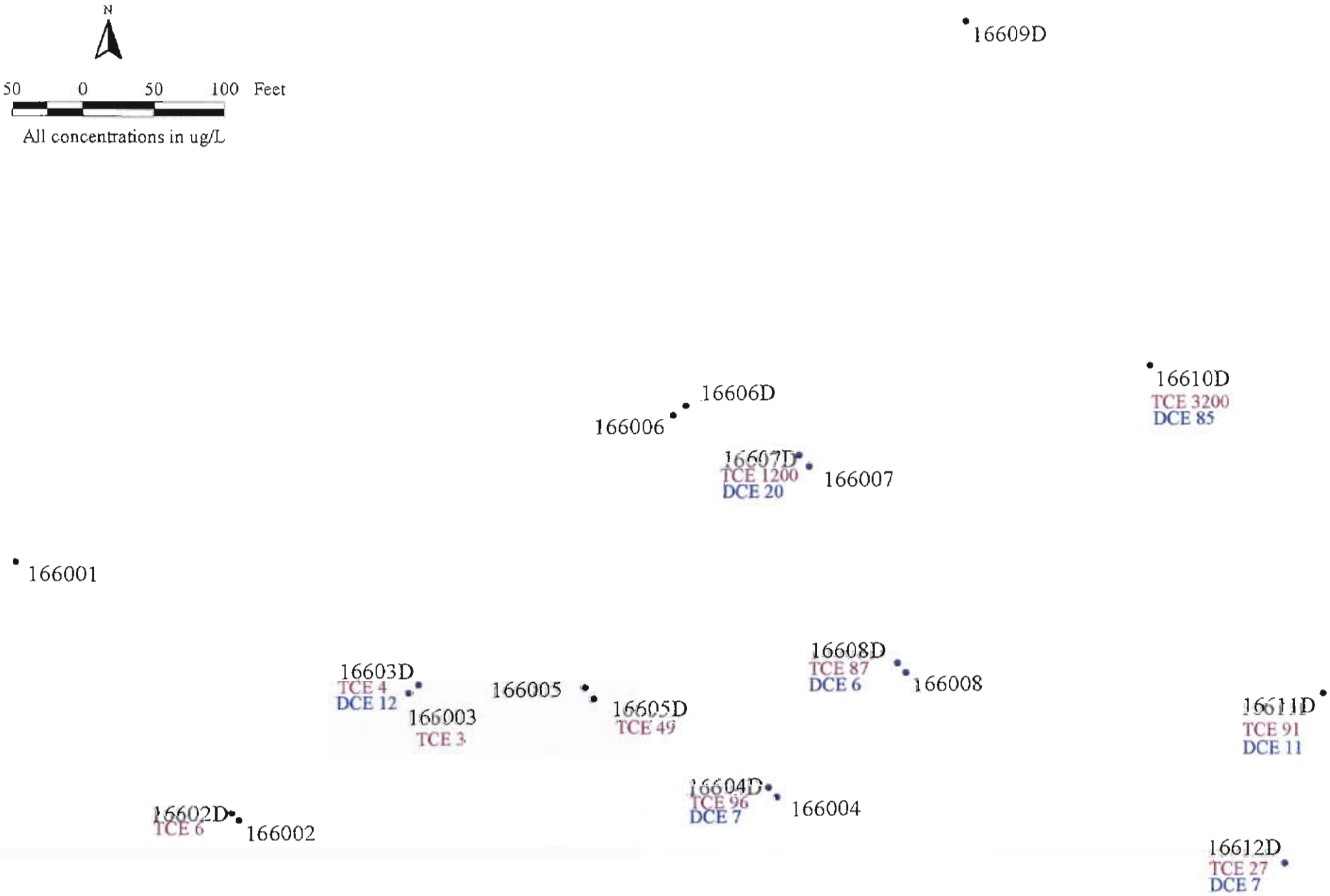
SWMU 166: 1st Quarter Groundwater VOC Results, May 22-23, 1997



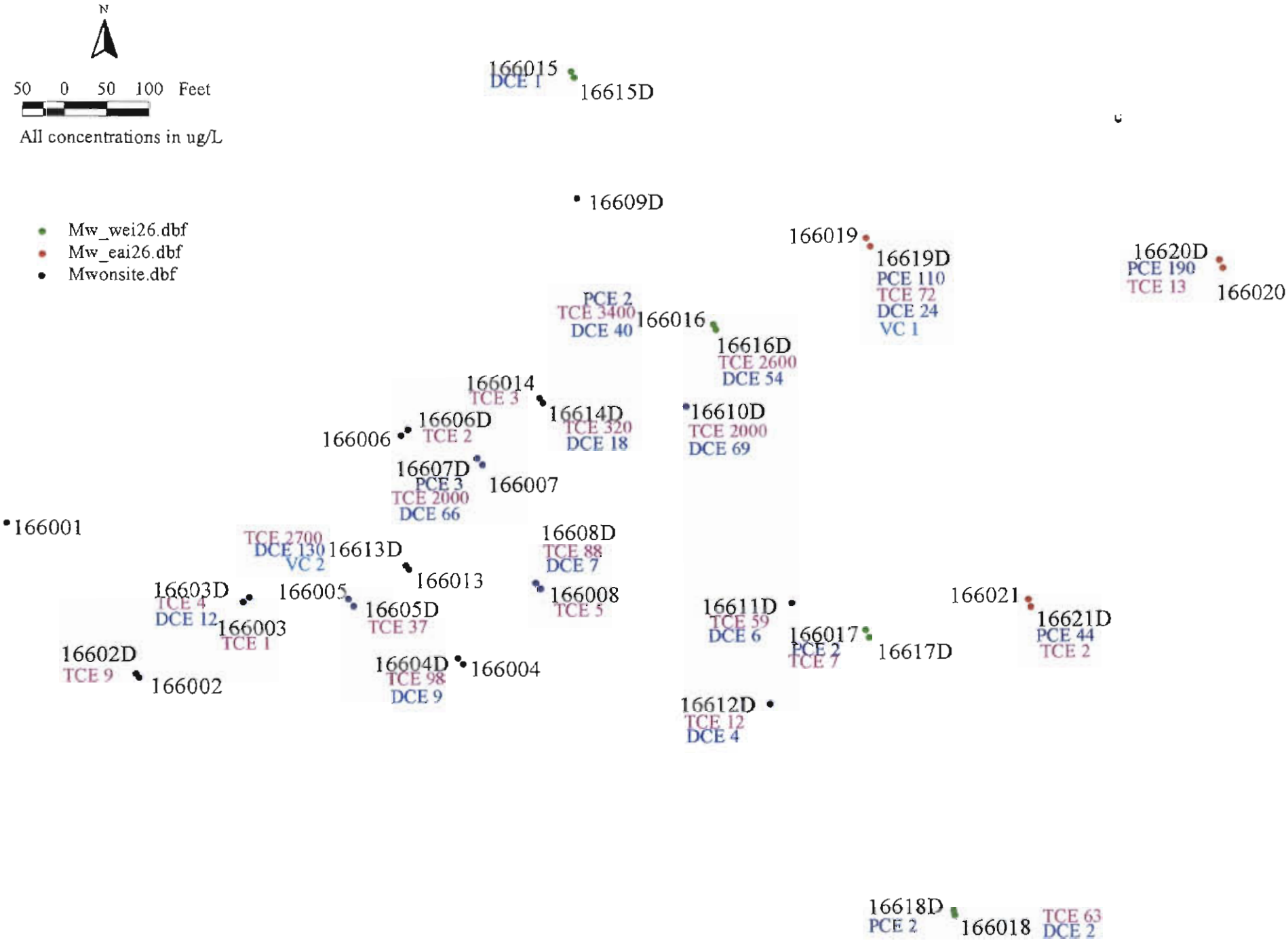
SWMU 166: 2nd Quarter Groundwater VOC Results, Jy 24-30, 1997



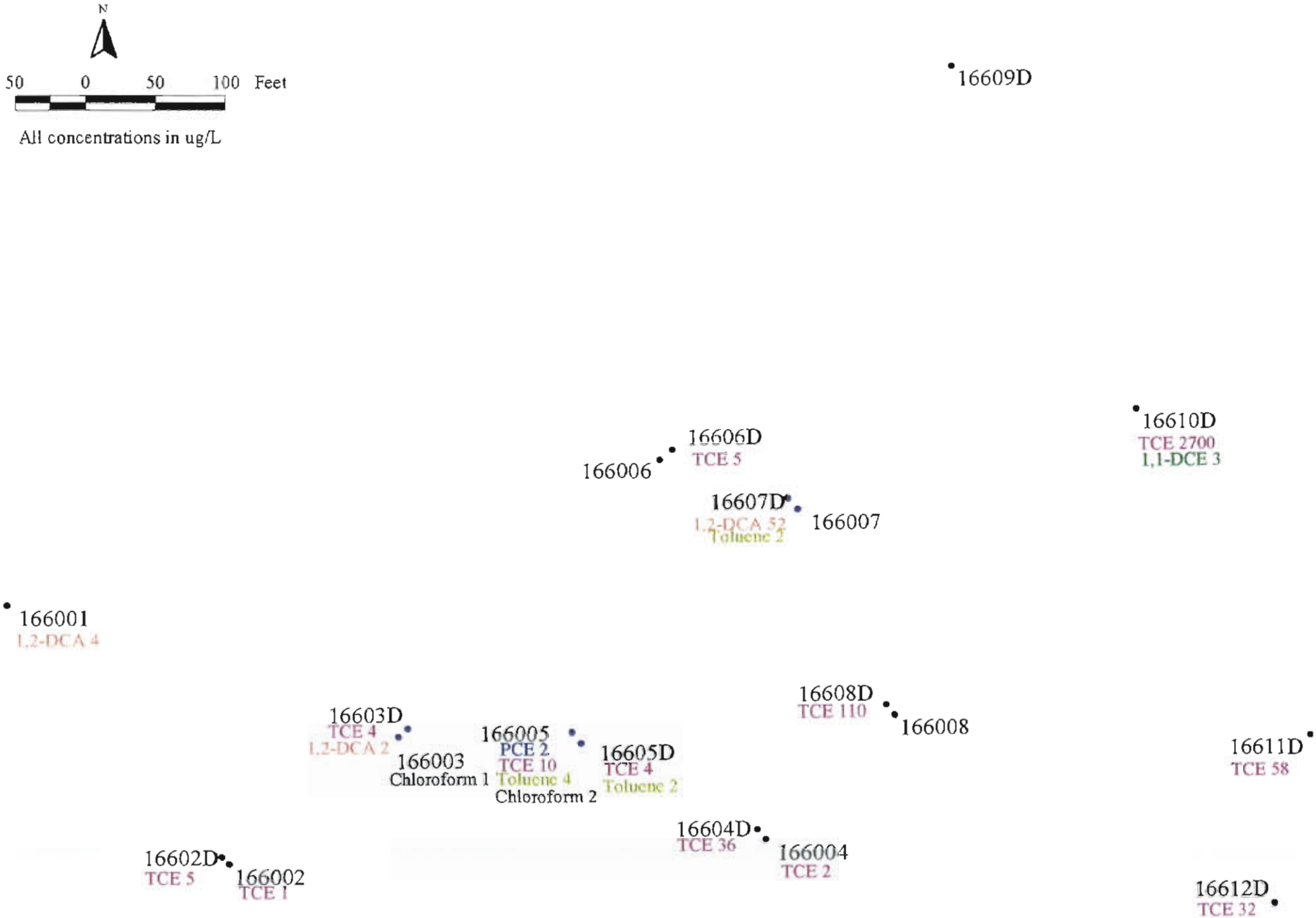
SWMU 166: 3rd Quarter Groundwater VOC Results, OCT 14-17, 1997



SWMU 166: 4th Quarter Groundwater VOC Results, JAN 21-29, 1998



SWMU 166: 1st Rd MNA Groundwater VOC Results, MAR 12-13, 199[illegible]

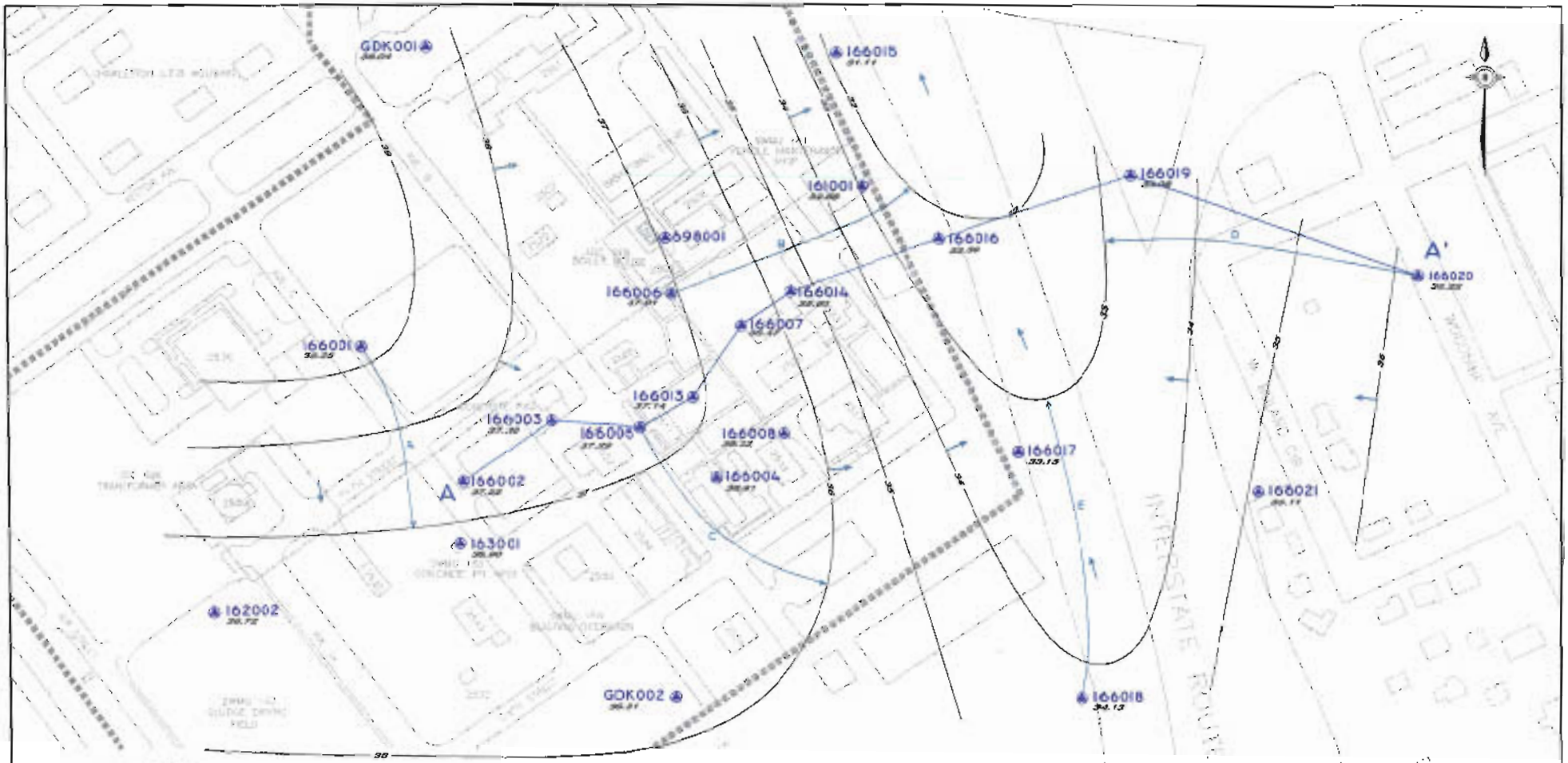


SWMU 166 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

	A e	units	166001	166002	166003	166004	166005	166006	166007	166	16602D	16603D	16604D	16605D	16606D	16607D	16608D	16609D	16610D	1D	16612D
VOCs	PCE	ug/l					2														
	TCE	ug/l		1		2	10				5	4	36	4	5		110		2700	58	32
	1,2-DCA	ug/l	4									2				52					
	1,1-DCE	ug/l																	3		
	1,2-DCE tot	ug/l																			
	VC	ug/l																			
	Benz	ug/l																			
	Ethylbnz	ug/l																			
	Tol	ug/l					4							2		2					
	Xyl tot	ug/l																			
Natural Attenuation Parameters	Alk	ppm	11	28	23	12	10	12	10	14	16	22	20	12	10	10	18	17	15	11	13
	Sp Cond	mmho/cm	0.020	0.200	0.201	0.026	0.110	0.063	0.067	0.085	0.044	0.173	0.040	0.208	0.015	0.056	0.122	0.172	0.084	0.062	0.080
	Ethane	ng/l	3.00	3.00	3.00	3.24	5.74	3.00	3.00	3.00	14.09	52.60	104.50	33.57	10.50	90.79	35.83	37.75	43.82	26.91	34.70
	Ethene	ng/l	5.04	5.51	6.90	11.23	9.82	5.89	5.43	6.58	5.40	19.99	153.70	19.26	7.47	60.06	38.22	34.22	421.44	19.37	18.98
	H_2 (gas)	nm/l	0.08	0.190	0.250	0.440	0.2	0.350	0.220	0.290	0.160	0.240	0.210	0.290	0.400	0.480	1.160	0.380	0.300	0.068	0.250
	Fe^{2+}	mg/l	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.89	1.6	1.42	10.8	2.13	1.05	0.722	1.55	2	2.32	2.11
	CH_4	mg/l	0.001	0.005	0.001	0.001	0.001	0.0010	0.001	0	0.01	678.00	0.016	0.01	0.01	401	373.30	0.020	360.210	0.003	0.006
	DO	mg/l	0.9	1.0	2.6	1.1	1.7	5.1	2.0	3.3	0.6	0.8	0.4	0.6	0.6	0.4	0.9	0.6	0.6	0.4	0.4
	pH		5.96	7.20	NT	5.96	5.31	6.52	4.35	NT	6.62	NT	6.77	5.94	6.55	5.18	NT	6.37	6.89	5.46	6.46
	ORP	mV	204	-73	55	199	168	121	250	97	-41	-39	-51	-22	96	163	-86	-50	-8	43	15
	Temp	°C	18.4	17.6	17.9	18.5	19.2	17.6	17.1	18.3	20.4	21.1	21.6	22.2	20.5	20.3	21.0	20.4	20.9	19.7	20.9
	Cl	mg/l	1.8	1.5	1.0	1.8	1.8	1.7	5.6	2.0	3.2	4.7	4.0	3.0	2.6	3.2	4.2	3.7	3.6	10.0	4.9
	SO_4	mg/l	10.6	12.8	8.4	18.7	15.3	9.3	22.1	9.1	10.8	9.8	25.8	108.0	11.9	13.7	5.7	4.0	10.4	14.9	12.9
	TOC	mg/l	ND	5.9	3.3	ND	ND	5.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	NO_3 as N	mg/l	0.1	ND	ND	0.2	1.0	ND	ND	3.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS	0	0	-3	-3	-3	-3	-3	-3	0	0	3	0	0	3	0	0	0	3	3
	NO_3		2	2	2	2	0	2	2	0	2	2	2	2	2	2	2	2	2	2	2
	Fe II		0	0	0	0	0	0	0	0	3	3	3	3	3	3	0	3	3	3	3
	SO_4		2	2	2	2	2	2	0	2	2	2	0	0	2	2	2	2	2	2	2
	CH_4		0	0	0	0	0	0	0	0	0	3	0	0	0	3	3	0	3	0	0
	Redox		1	1	0	1	1	1	1	0	1	0	1	1	1	1	0	1	1	1	1
	pH		0	0	0	0	0	0	-2	0	0	-2	0	0	0	0	-2	0	0	0	0
	TOC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Temp		1	0	1	1	1	1	1	1	0	0	0	0	1	1	0	0	0	1	0
	CO_2*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Alk*		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cl*		0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0
	H_2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0
	VFA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BTEX		0	0	0	0	2	0	0	0	0	0	0	2	0	2	0	0	0	0	0
	TCE		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DCE		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ethane		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DCA		2	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0
	CA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tot Pts		**8**	**6**	**2**	**3**	**3**	**3**	**1**	**0**	**8**	**10**	**9**	**8**	**9**	**19**	**8**	**8**	**11**	**14**	**11**
	NA evidence?		**L**	**L**	**I**	**I**	**I**	**I**	**I**	**N**	**L**	**L**	**L**	**L**	**L**	**A**	**L**	**L**	**L**	**L**	**L**

SWMU 166 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

Notes:		rameters must exceed 2X background								RANKING		JLTS:										
	"background" locations:		Avg of results from "background" locations							N =	No evidence											
Shallow wells:	166001		Cl =	1.8	mg/l					I=	Inadequate evidence											
	166006		Alk =	11.7	ppm					L=	Limited evidence											
	166004		CO_2 =	no values						A=	Adequate evidence											
These are clean wells surrounding solvent contamination at site; used data above because										S=	Strong evidence											
only one set of quarterly Cl and Alk data.																						
Deep wells:	16609D		Cl =	3.7	mg/l																	
			Alk =	17	ppm																	
			CO_2 =	no values																		
This is only clean deep well on site, no quarterly data available; used data above.																						



LEGEND:

- 162001 — SHALLOW MONITORING WELL W/ I.D. NUMBER
- 37.22 — GROUNDWATER ELEVATION
- NAVAL ANNEX BOUNDARY
- GROUNDWATER FLOW DIRECTION
- FLOWPATH AS DISCUSSED IN TEXT
- A——A' PROFILE LINE

COMPOSITE SITE PLAN

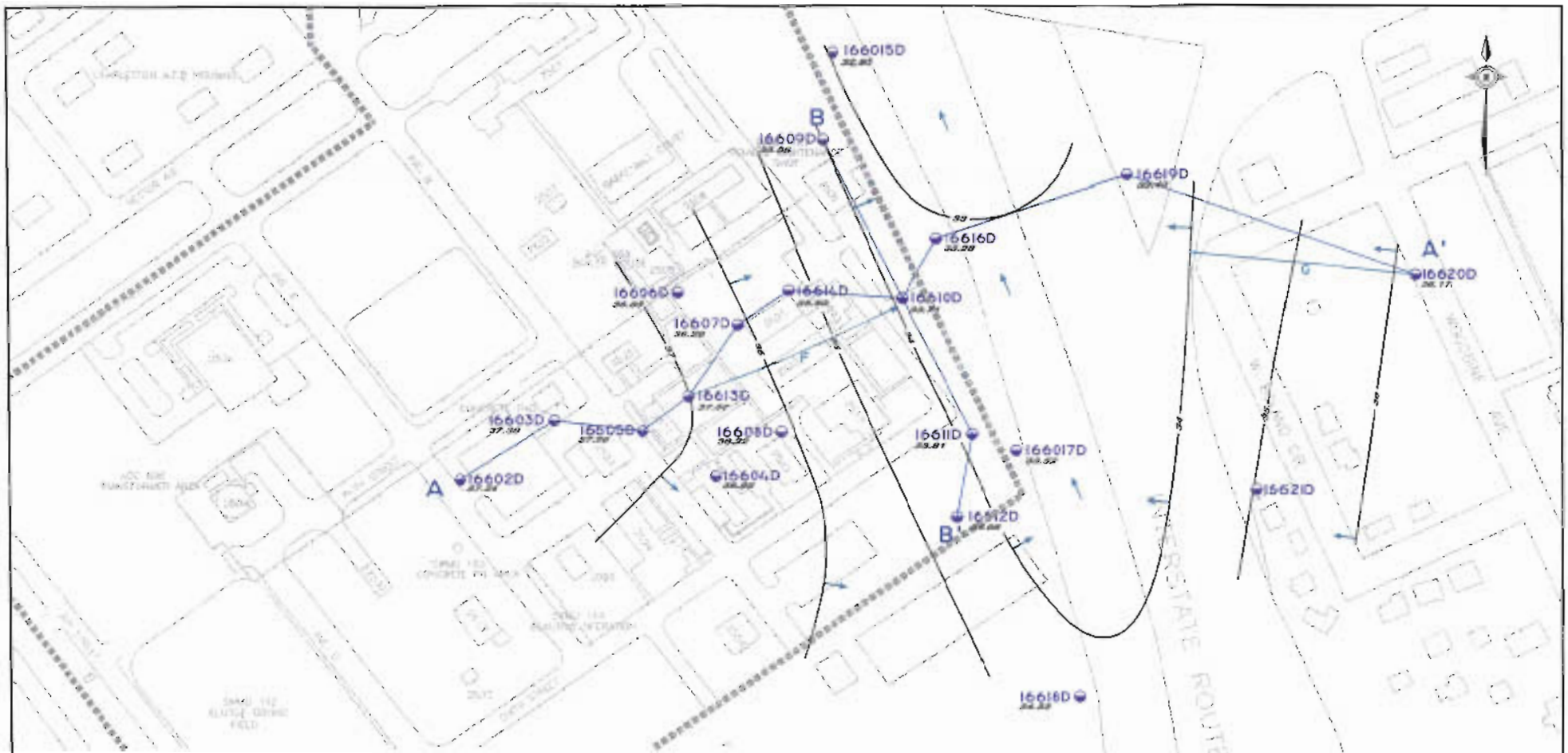
SCALE: 1" = 150'

ALL SAMPLE LOCATIONS ARE APPROXIMATE

ZONE K
DRAFT RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2.7
SHALLOW (5-15' BGS) POTENTIOMETRIC CONTOURS 3/6/98

Dr. by: ERODGERS | Dwg Name: 2911N010



LEGEND:

- 166002D — DEEP MONITORING WELL W/ I.D. NUMBER
- 37.24 — GROUNDWATER ELEVATION
- NAVAL ANNEX BOUNDARY
- GROUNDWATER FLOW DIRECTION
- G — FLOWPATH AS DISCUSSED IN TEXT
- A——A' — PROFILE LINE

COMPOSITE SITE PLAN

SCALE: 1" = 150'

ALL SAMPLE LOCATIONS ARE APPROXIMATE

ZONE K
DRAFT RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

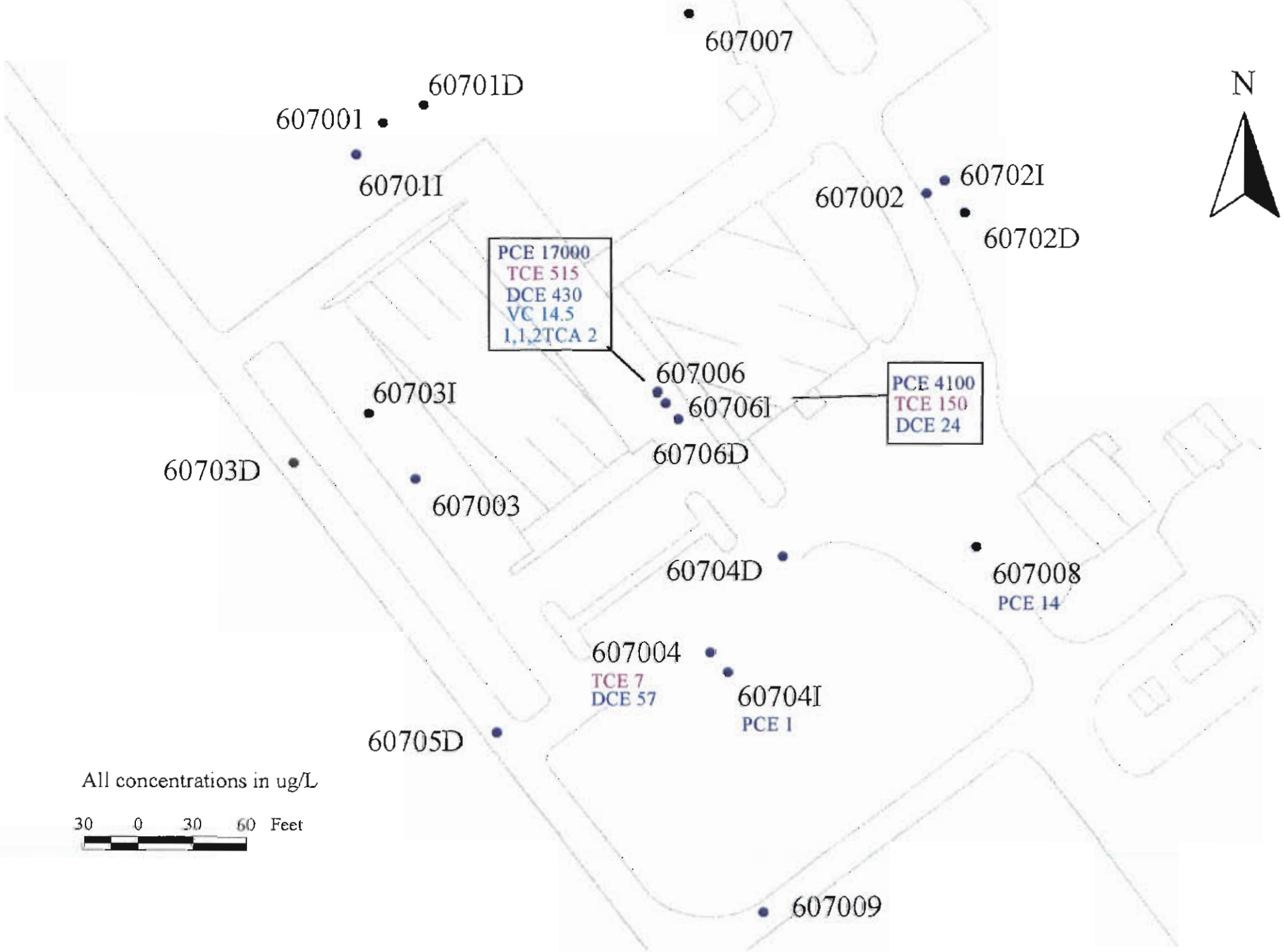
FIGURE 2.8
DEEP (20-30' BGS) POTENTIOMETRIC CONTOURS 3/6/98

Dr by: E ROGERS

Dwg name: 291INO1

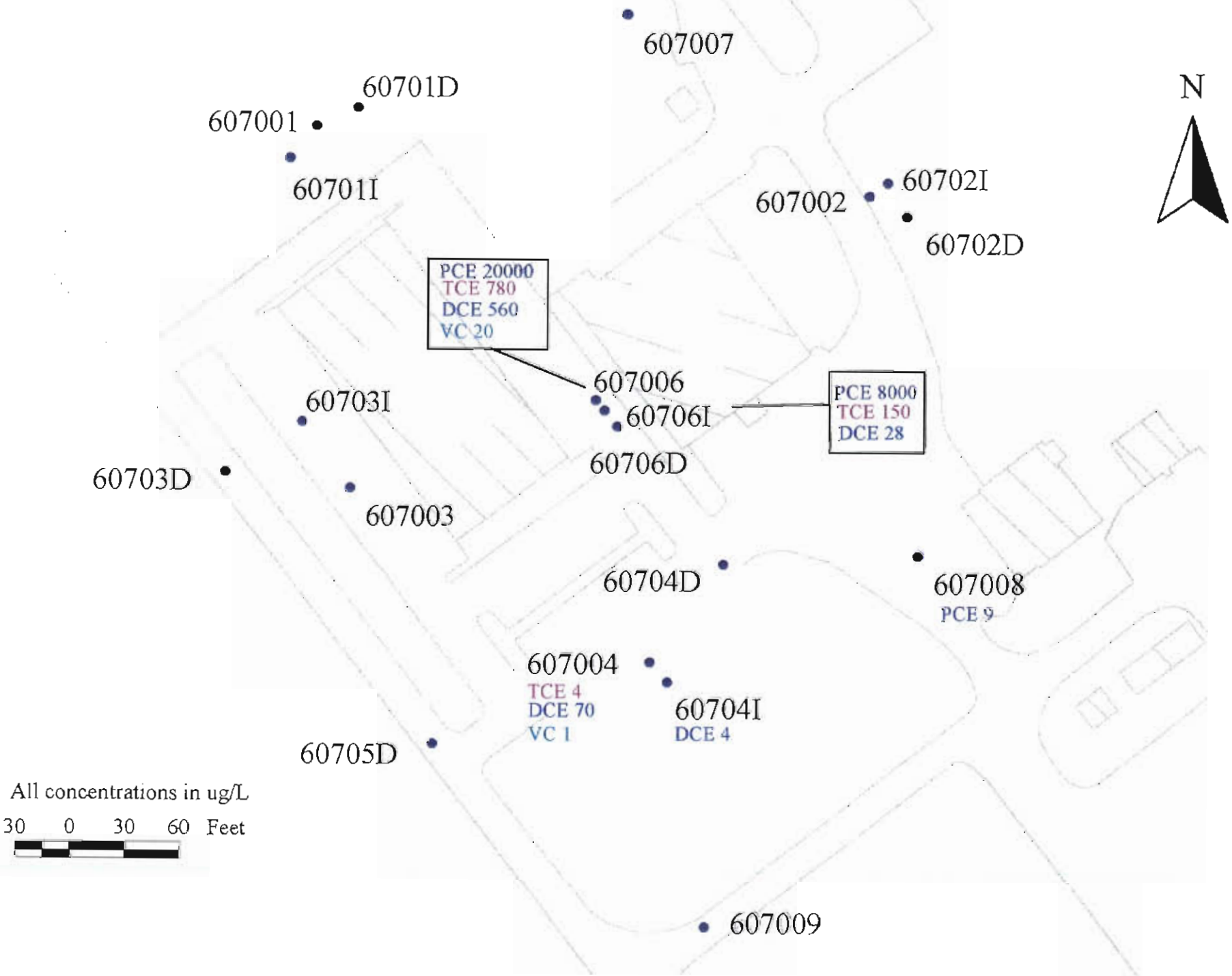
AOC 607: 1st Quarter Groundwater VOC Results, NOV 19-21, 1996

AOC 607: 2nd Quarter Groundwater VOC Results, APR 24-MAY 7, 1997

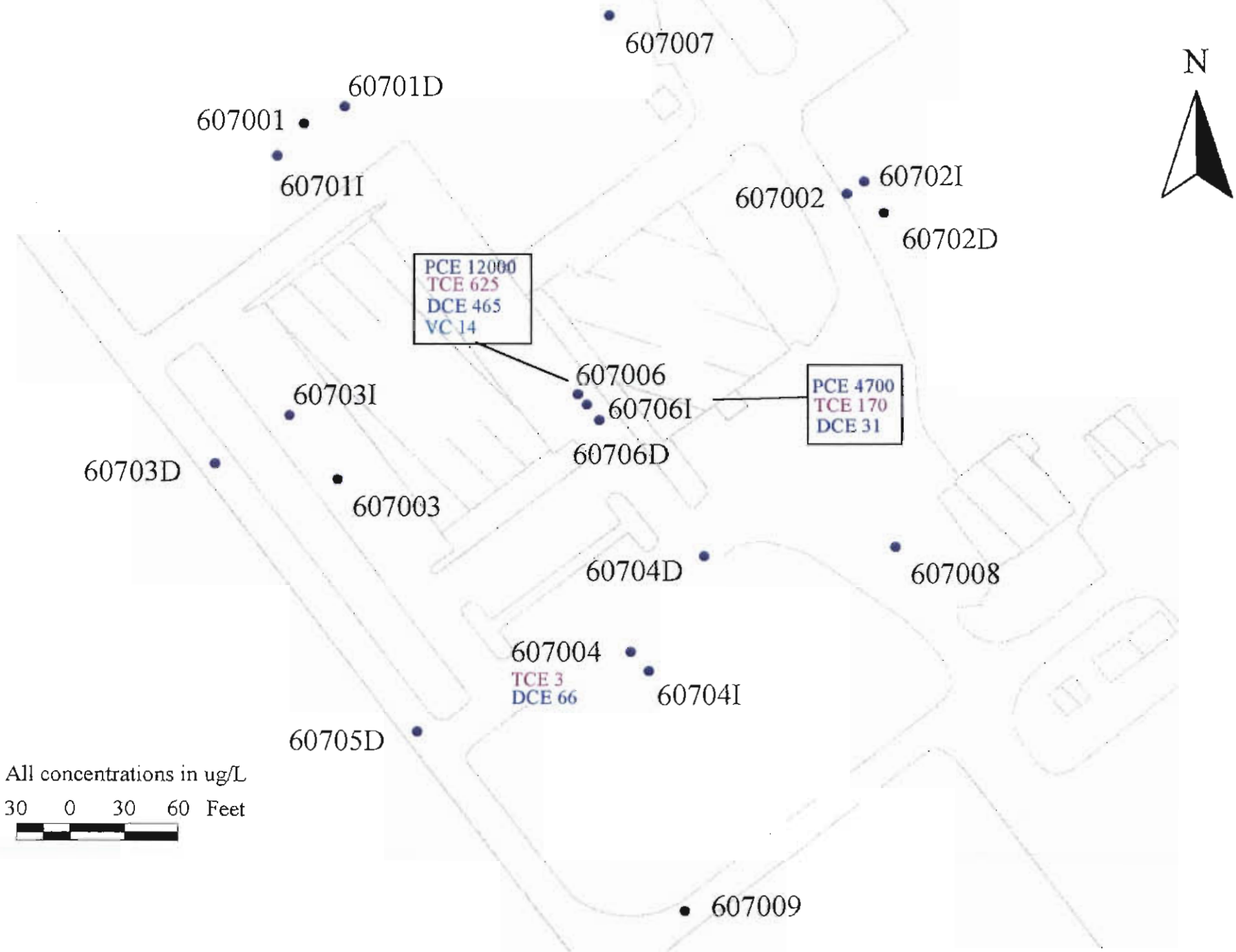


AOC 607: JUN 5-6, 1997 Groundwater VOC Results at 006/06I/06D & 008

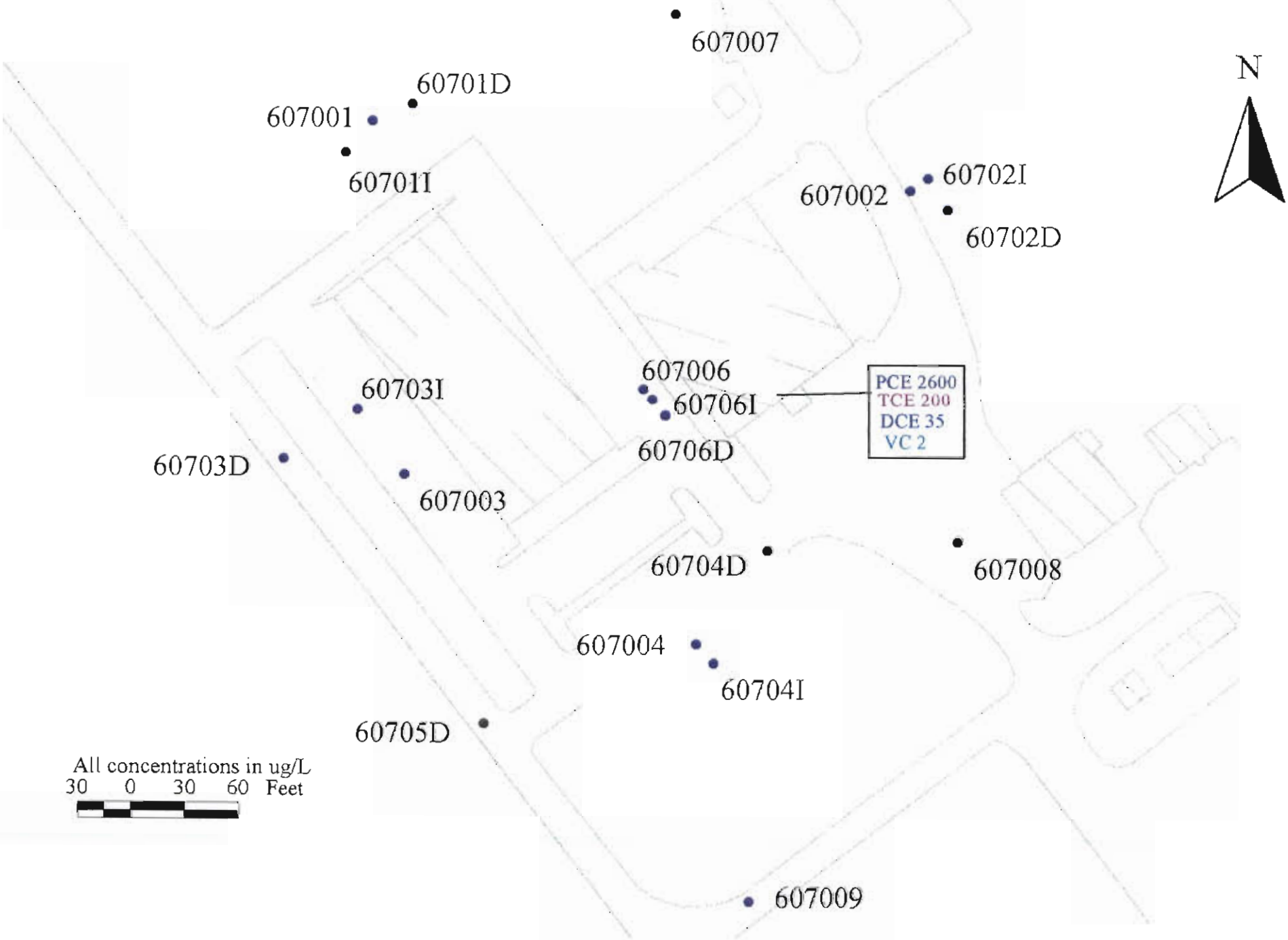
AOC 607: 3rd Quarter Groundwater VOC Results, AUG 12-SEP 4, 1997



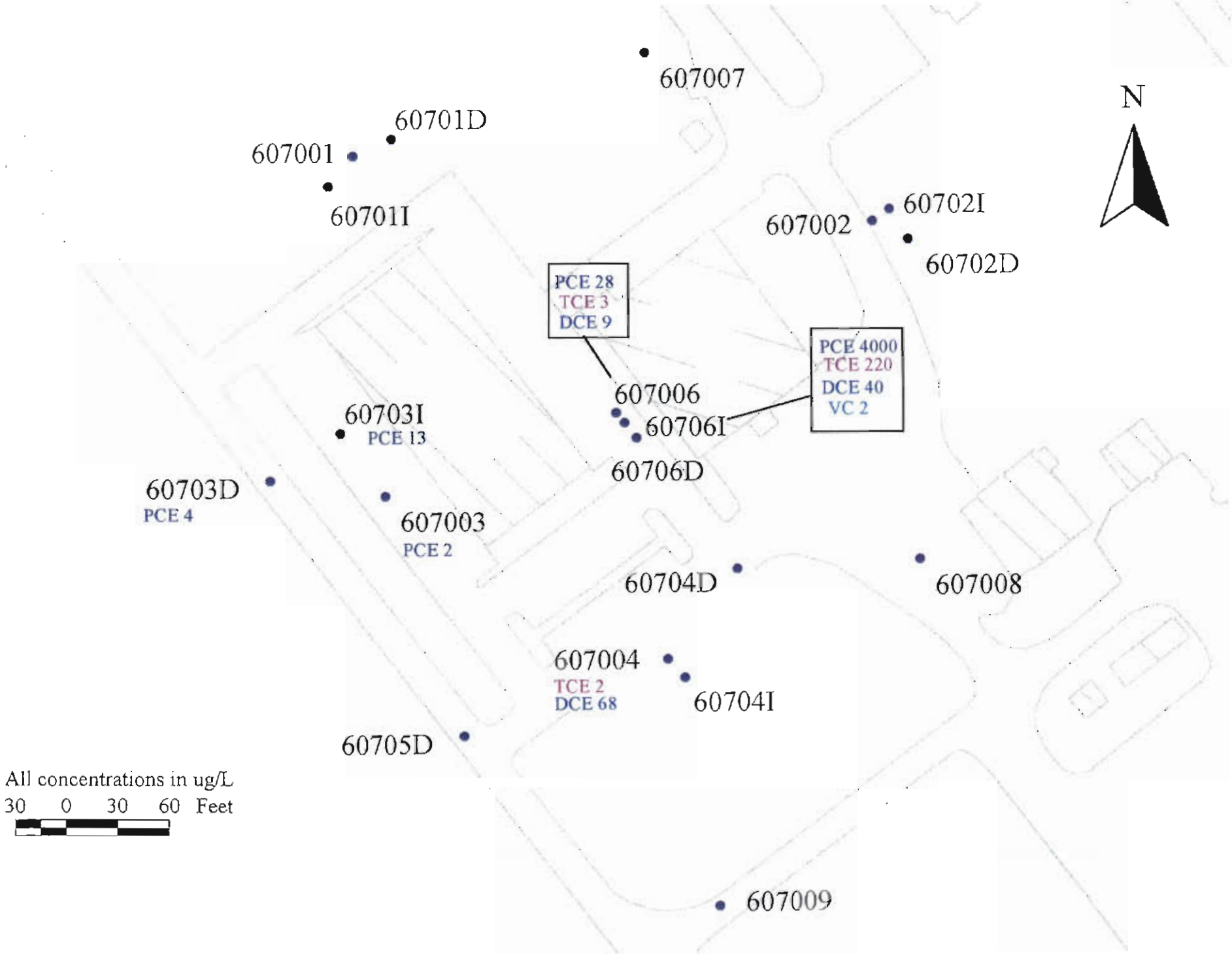
AOC 607: 4th Quarter Groundwater VOC Results, OCT 29-NOV 6, 1997



AOC 607: FEB 9-11, 1998 Groundwater VOC Results at 06I/06D, 008, & 009



AOC 607: 1st Round MNA Groundwater VOC Results, MAR 10-11, 1998

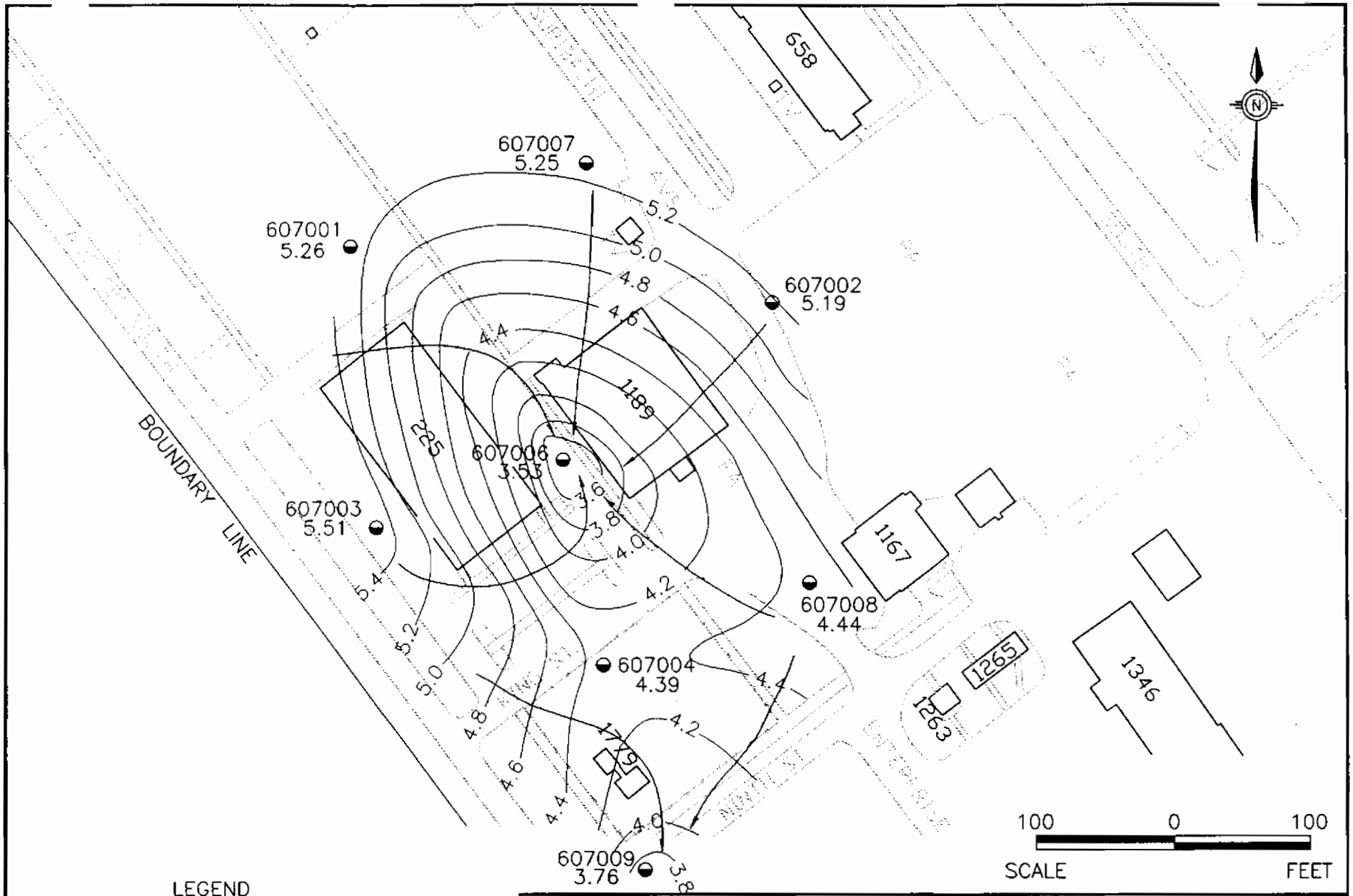


AOC 607 MONITORING NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	607001	60701I	60701D	607002	607021	60702D	607003	607(	60703D	607004	60704I	60704D	60705D	607006	607061	60706D	60700	7008	607009
VOCs	PCE	ug/l							2	2	4					28	4000				
	TCE	ug/l										2				3	220				
	1,1-DCA	ug/l																			
	1,1-DCE	ug/l																			
	1,2-DCE tot	ug/l										68				9	40				
	VC	ug/l															2				
	Benz	ug/l																			
	Ethylbnz	ug/l																			
	Tol	ug/l																			
	Xyl tot	ug/l																			
Natural Attenuation Parameters	Alk	ppm	54	36	29	10	50	44	13	33	53	42	24	36	37	10	60	25	22	10	280
	Sp Cond	mmho/cm	0.083	0.359	2.45	0.274	650	1.92	0.089	0.655	1.35	0.372	0.598	1.56	1.5	0.208	0.821	1.45	1.94	0.217	1.94
	Ethane	ng/l	3.06	36.94	ND	5.58	7.32	ND	3.03	56.08	ND	8.77	4.84	ND	ND	778.2	33.86	ND	9.58	9.59	ND
	Ethene	ng/l	11.32	4.39	ND	4.49	10.16	ND	4.95	5.41	ND	48.1	3.64	ND	ND	1336.1	340.34	ND	4.9	4.91	ND
	H_2 (gas)	nm/l	0.439	0.149	ND	0.155	0.0	ND	0.128	0.215	ND	0.082	0.105	ND	ND	0.100	0.134	ND	0.122	0.125	ND
	Fe^{2+}	mg/l	0.5	0.5	0.5	0.5	4.3	0.5	0.5	0.5	0.5	22.4	0.5	0.5	0.5	1.27	1.44	0.5	0.5	0.5	12.2
	CH_4	mg/l	0.001	0.009	0.01	0.017	0.003	0.0100	0.001	5336	0.02	0.01	343.9	0.01	0.01	308	0.01	0.001	0.017	0.020	4.36
	DO	mg/l	1.25	0.5	1.9	0.4	0.3	5.9	0.3	1.0	6.4	0.207	0.247	5.9	7.1	0.236	0.403	1.9	13.1	13.1	0.82
	ORP	mV	39	-85	31	210	-49	23	113	-114	51	-50	-47	109	94	83	-46	51	78	228	-147
	Temp	°C	16.3	20.0	19.9	20.7	21.5	23.4	17.4	21.3	20.4	17.0	19.5	22.1	21.0	18.6	21.3	22.3	16.5	19.7	18.5
	pH		6.54	7.08	7.26	4.81	6.82	6.83	5.45	6.57	7.58	6.39	7.36	6.95	7.27	4.79	6.31	7.21	5.87	4.72	6.67
	Cl	mg/l	2.9	341.0	3.6	7.6	800.0	498.0	25.6	59.5	224.0	235.0	170.0	430.0	361.0	174.0	654.0	546.0	567.0	34.2	266.0
	SO_4	mg/l	32	43	32	81	228	91	112	ND	103	264	20	106	120	196	258	92	76	102	2
	TOC	mg/l	2.7	ND	7.8	2.3	ND	ND	ND	2.9	ND	8.4	ND	ND	3.8	ND	ND	ND	19.7	2.4	122.0
	NO_3 as N	mg/l	0.28	ND	0.28	ND	ND	0.2	ND	ND	ND	ND	0.12	ND	0.31	ND	ND	ND	0.5	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS	-3	3	-3	3	3	-3	3	-3	-3	3	3	-3	-3	3	3	-3	-3	-3	0
	NO_3		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Fe II		0	0	0	0	3	0	0	0	0	3	0	0	0	3	3	0	0	0	3
	SO_4		0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
	CH_4		0	0	0	0	0	0	0	3	0	0	3	0	0	3	0	0	0	0	3
	Redox		1	1	1	0	1	1	0	2	0	1	1	0	0	0	1	0	0	0	2
	pH		0	0	0	-2	0	0	0	0	0	0	0	0	0	-2	0	0	0	-2	0
	TOC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	Temp		0	0	0	1	1	1	0	1	1	0	0	1	1	0	1	1	0	0	0
	CO_2*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Alk*		1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1
	Cl*		0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	2	0	2
	H_2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VFA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BTEX		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TCE		0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0
	DCE		0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0
	VC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
	Ethane		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DCA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tot Pts		1	6	0	4	10	1	5	7	0	16	9	0	0	15	16	0	2	-3	17
	NA evidence?		I	L	N	I	L	I	I	L	N	A	L	N	N	A	A	N	I	N	A

AOC 607 MONITORING NATURAL ATTENUATION PRELIMINARY RANKING

Notes:	*= par		rs must exceed 2X background						RANKING R			LTS:								
	"Background" locations:		Avg of results from "background" locations						N=	No evidence										
Shallow	607002		Cl =	21	mg/l				I=	Inadequate evidence										
	607008		Alk =	10	ppm				L=	Limited evidence										
			CO_2 =	no values					A=	Adequate evidence										
These are clean wells surrounding solvent contamination at site that are upgradient.									S=	Strong evidence										
Int. wells	60702I		Cl =	571	mg/l															
	60701I		Alk =	43	ppm															
			CO_2 =	no values																
These are clean wells surrounding solvent contamination at site that are upgradient.																				
Deep wel	60704D		Cl =	464	mg/l															
	60702D		Alk =	40	ppm															
			CO_2 =	no values																
These are clean wells surrounding solvent contamination at site.																				



LEGEND

◒ – SHALLOW MONITORING WELL

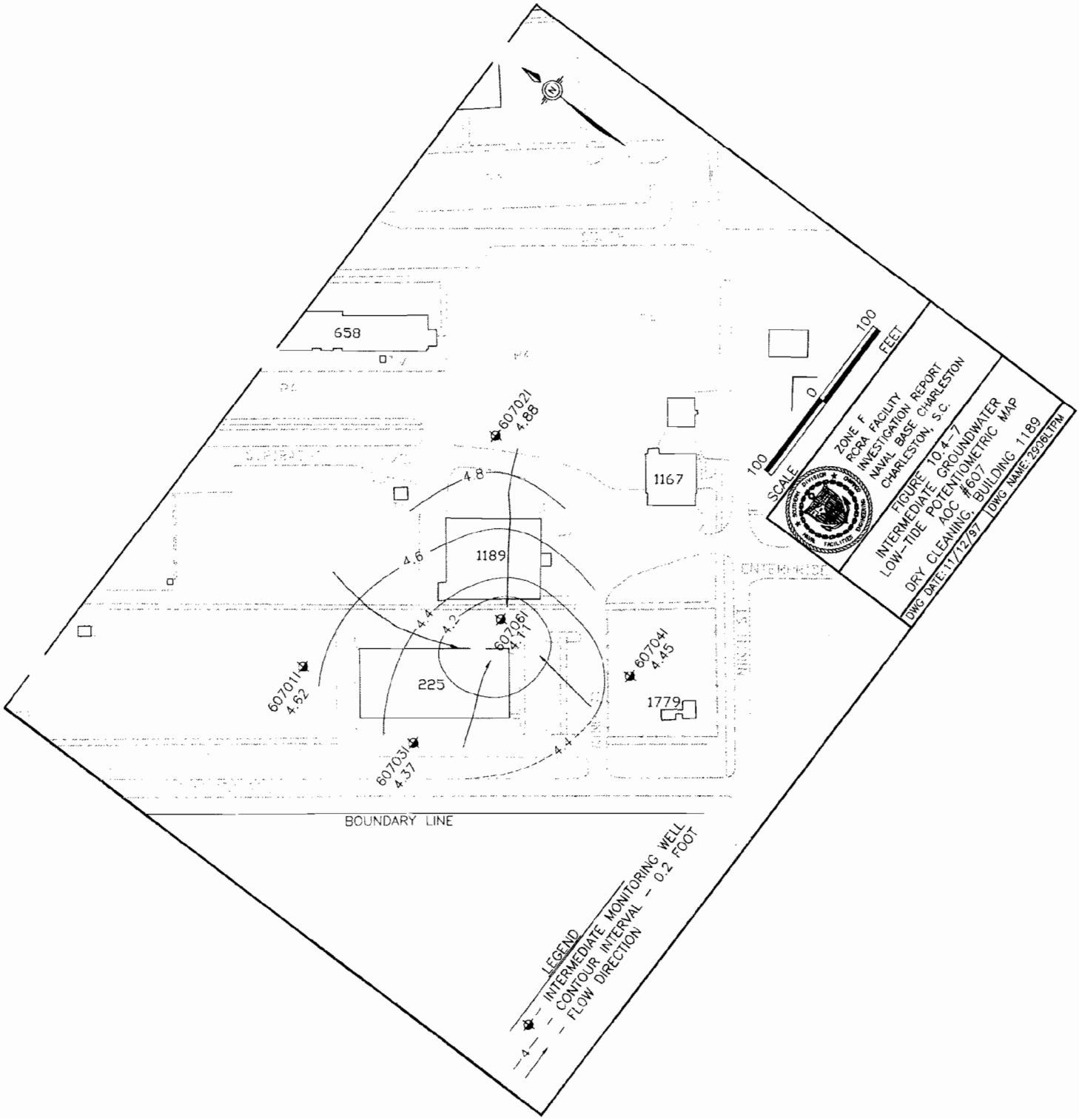
—4— – CONTOUR INTERVAL – 0.2 FOOT

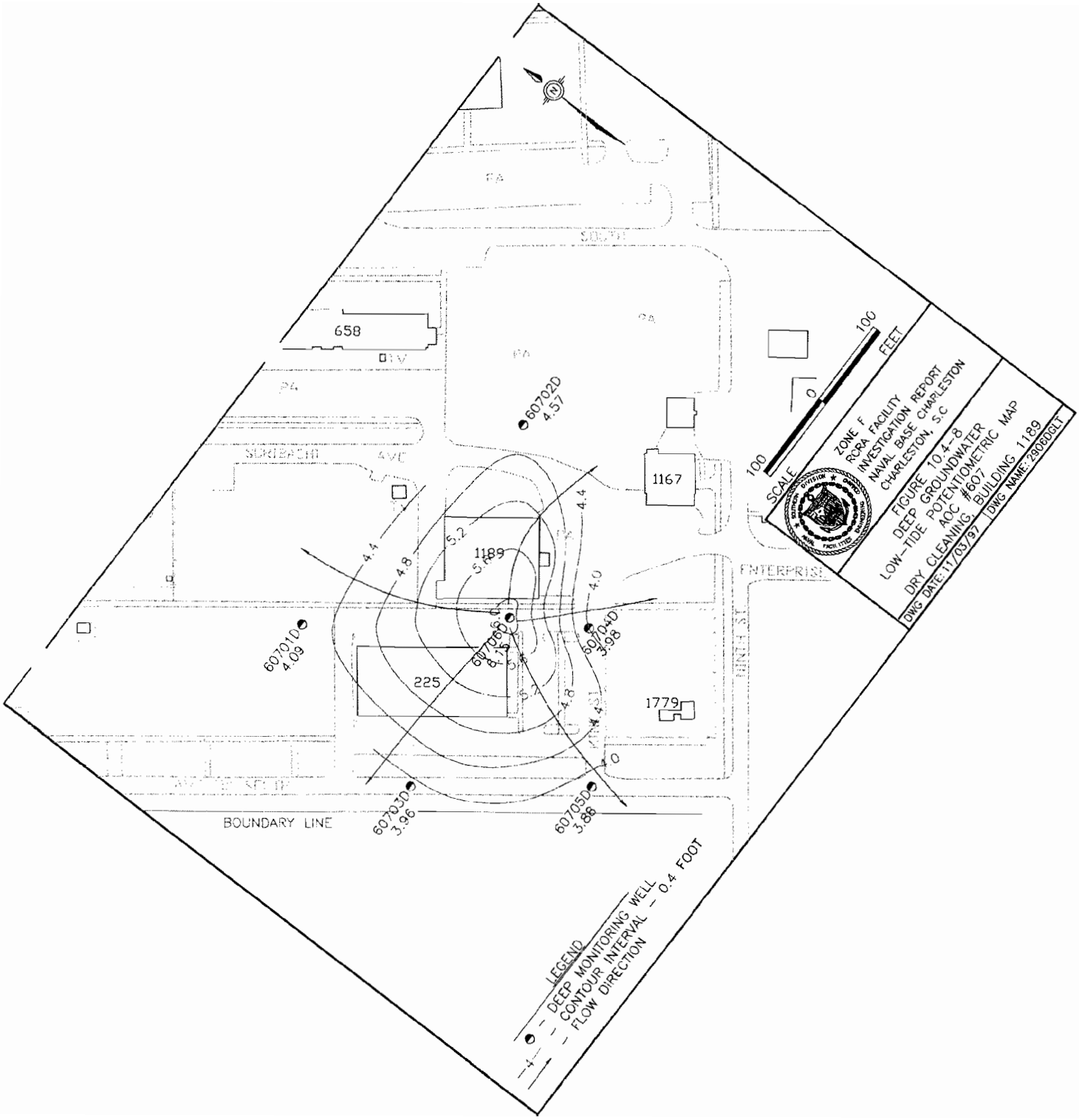
⟶ – FLOW DIRECTION

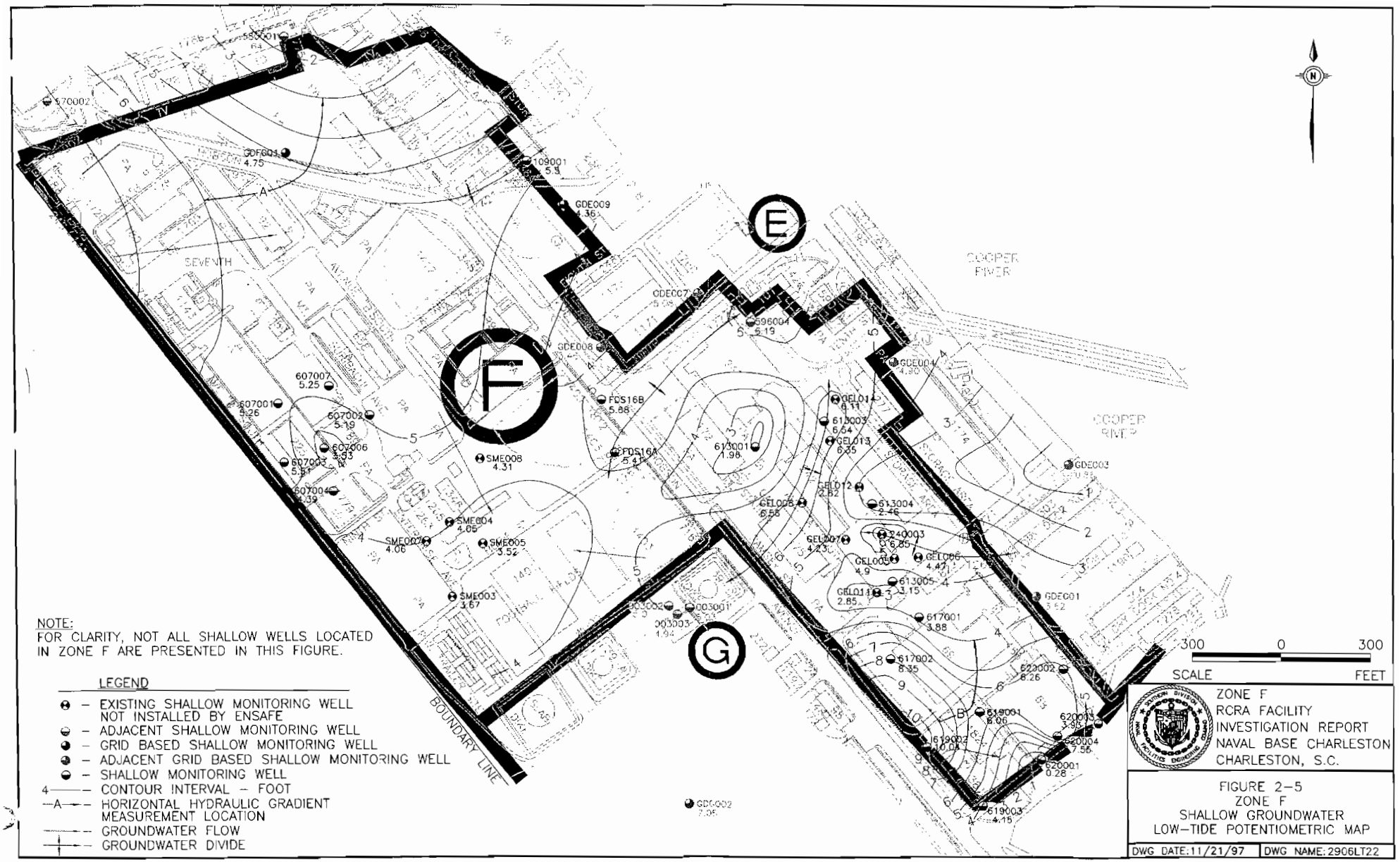
ZONE F
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

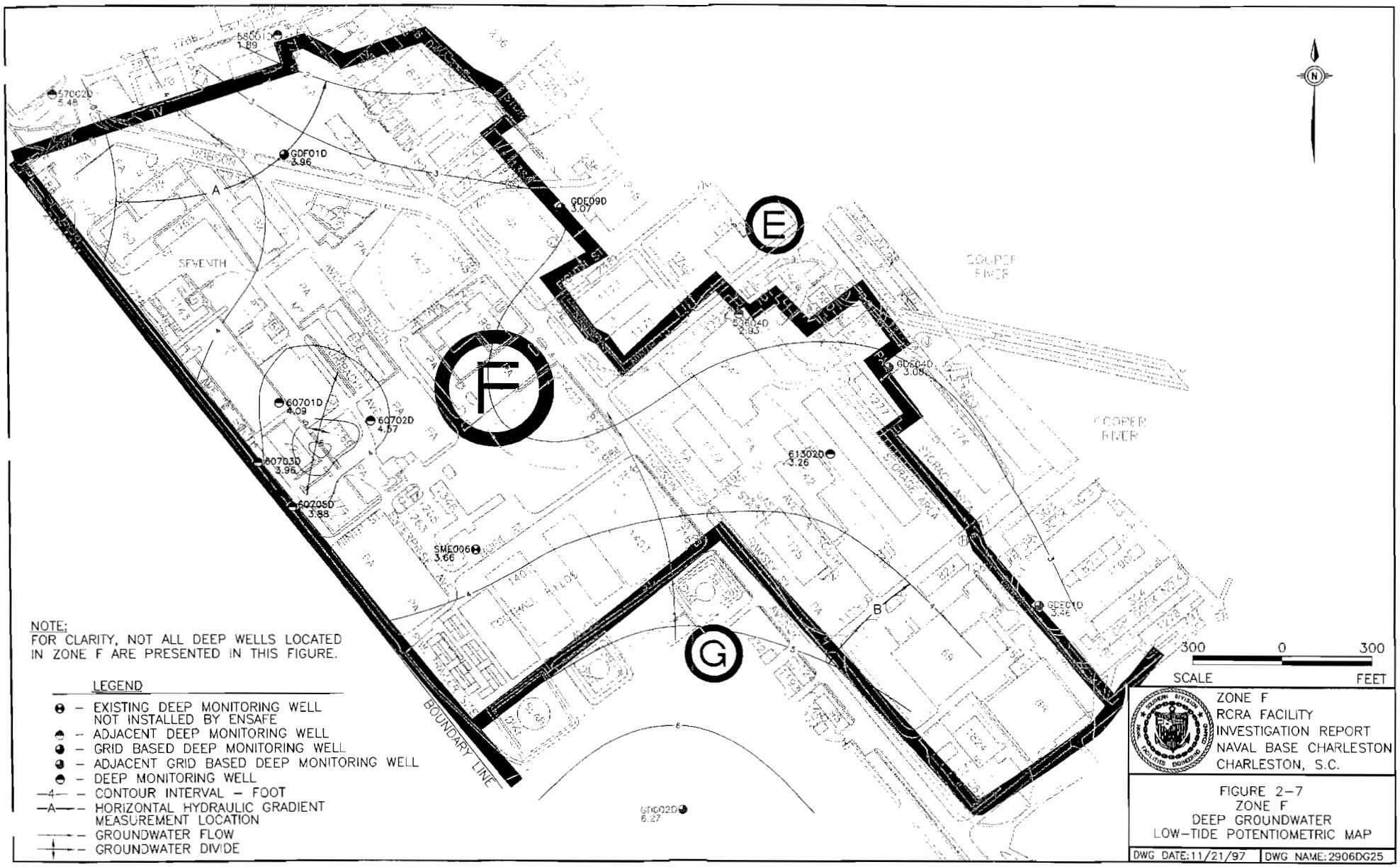
FIGURE 10.4–5
SHALLOW GROUNDWATER
LOW–TIDE POTENTIOMETRIC MAP
AOC #607
DRY CLEANING, BLDG 1189

DWG DATE: 11/12/97 | DWG NAME: 2906SGLT


658
607021
4.88
4.8
1167
4.6
1189
4.4
4.2
607061
4.11
607011
4.62
225
607041
4.45
1779
607031
4.37
4.4
BOUNDARY LINE
LEGEND
INTERMEDIATE MONITORING WELL
CONTOUR INTERVAL - 0.2 FOOT
FLOW DIRECTION
SCALE
100
0
100
FEET
ZONE F
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 10.4-7
INTERMEDIATE GROUNDWATER
LOW-TIDE POTENTIOMETRIC MAP
DRY CLEANING, AOC #607
BUILDING 1189
DWG DATE: 11/12/97
DWG NAME: 2906LTPM

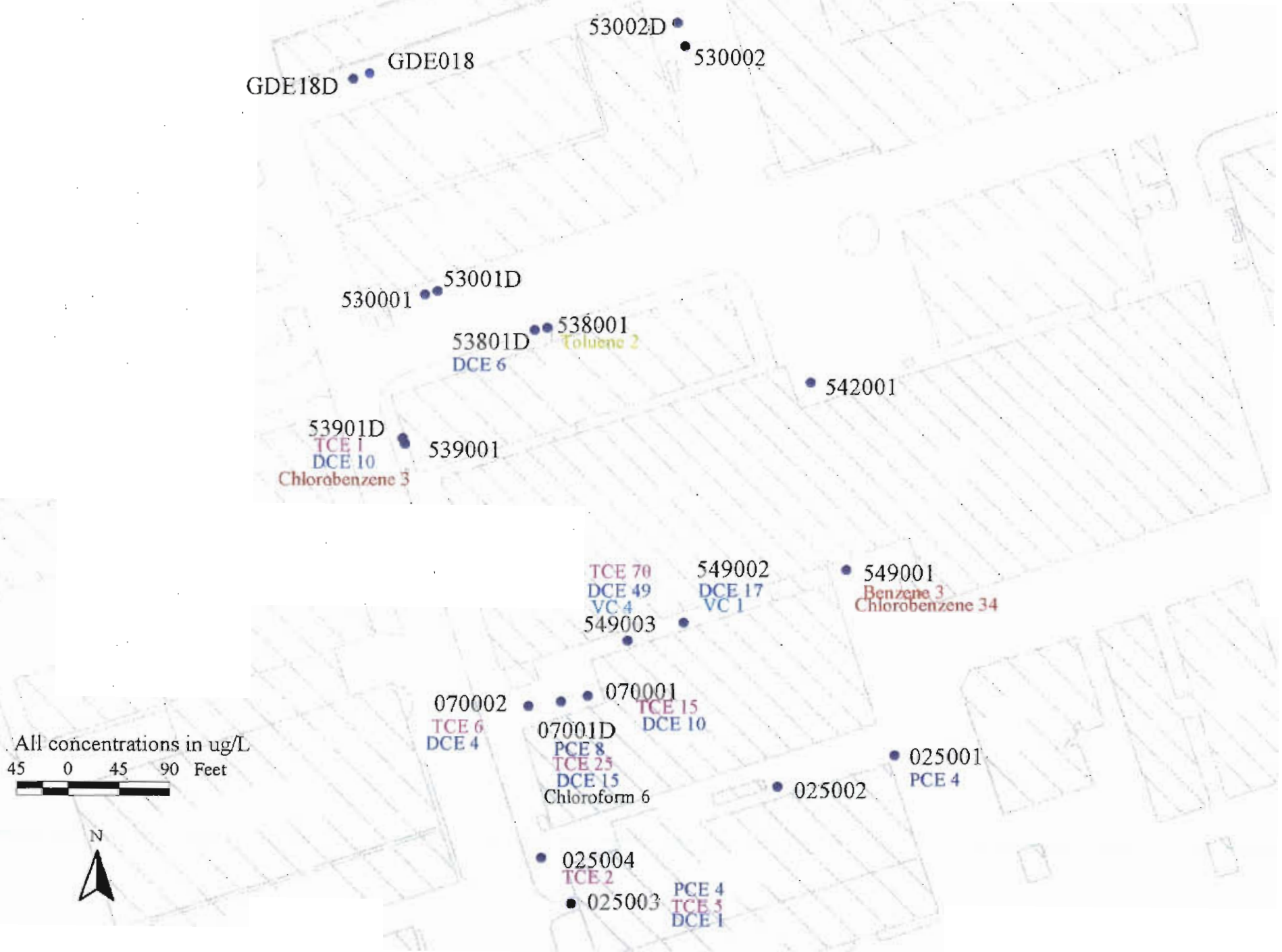

658
1167
1189
225
1779
60702D
4.57
60701D
4.09
60706D
8.15
60704D
3.98
60703D
3.96
60705D
3.88
4.4
4.8
5.2
5.6
4.0
BOUNDARY LINE
ENTERPRISE
SCALE
100
0
100
FEET
ZONE F
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C
FIGURE 10.4-8
DEEP GROUNDWATER
LOW-TIDE POTENTIOMETRIC MAP
AOC #607
DRY CLEANING BUILDING 1189
DWG DATE: 11/03/97 DWG NAME: 2906DGLT
LEGEND
- DEEP MONITORING WELL
- CONTOUR INTERVAL - 0.4 FOOT
- FLOW DIRECTION


NOTE:
FOR CLARITY, NOT ALL SHALLOW WELLS LOCATED IN ZONE F ARE PRESENTED IN THIS FIGURE.
LEGEND
EXISTING SHALLOW MONITORING WELL NOT INSTALLED BY ENSAFE
ADJACENT SHALLOW MONITORING WELL
GRID BASED SHALLOW MONITORING WELL
ADJACENT GRID BASED SHALLOW MONITORING WELL
SHALLOW MONITORING WELL
CONTOUR INTERVAL – FOOT
HORIZONTAL HYDRAULIC GRADIENT MEASUREMENT LOCATION
GROUNDWATER FLOW
GROUNDWATER DIVIDE
BOUNDARY LINE
COOPER RIVER
SEVENTH
F
E
G
300 0 300
SCALE FEET
ZONE F
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2–5
ZONE F
SHALLOW GROUNDWATER
LOW–TIDE POTENTIOMETRIC MAP
DWG DATE: 11/21/97
DWG NAME: 2906LT22


N
F
E
G
A
B
GDF01D 3.96
GDE09D 3.07
60701D 4.09
60702D 4.57
60703D 3.96
60705D 3.88
SME006 3.66
GDE04D 3.08
GDE01D 3.46
GRG02D 6.27
SEVENTH
COOPER RIVER
BOUNDARY LINE
300 0 300
SCALE FEET
NOTE:
FOR CLARITY, NOT ALL DEEP WELLS LOCATED IN ZONE F ARE PRESENTED IN THIS FIGURE.
LEGEND
EXISTING DEEP MONITORING WELL NOT INSTALLED BY ENSAFE
ADJACENT DEEP MONITORING WELL
GRID BASED DEEP MONITORING WELL
ADJACENT GRID BASED DEEP MONITORING WELL
DEEP MONITORING WELL
CONTOUR INTERVAL – FOOT
HORIZONTAL HYDRAULIC GRADIENT MEASUREMENT LOCATION
GROUNDWATER FLOW
GROUNDWATER DIVIDE
ZONE F
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-7
ZONE F
DEEP GROUNDWATER
LOW-TIDE POTENTIOMETRIC MAP
DWG DATE: 11/21/97
DWG NAME: 2906DG25

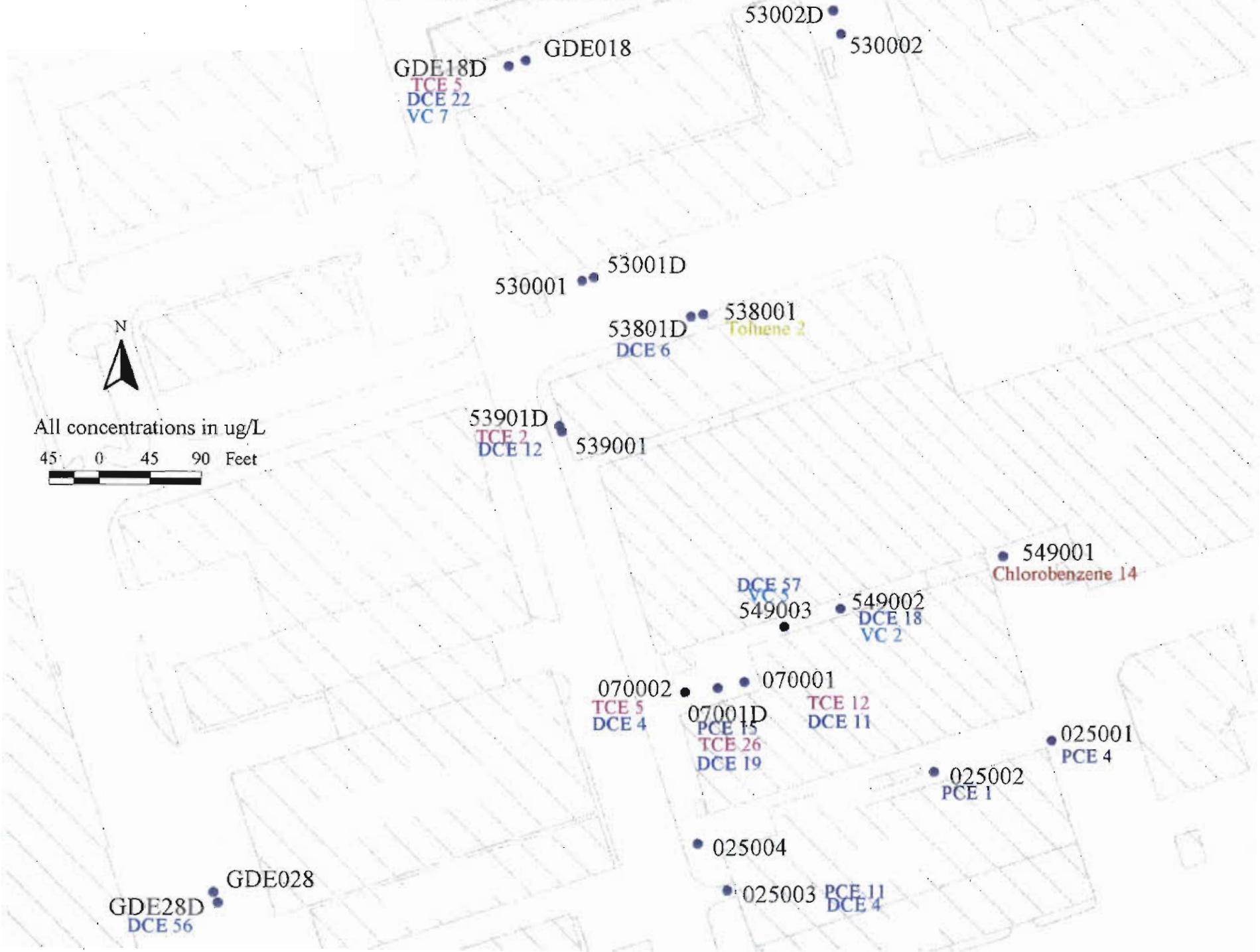
SWMUs 25 and 70 Area: 1st Qtr Groundwater VOC Results, APR 25-MY 2, 1996

SWMUs 25 and 70 Area: 2nd Qtr Groundwater VOC Results, JLY 25-AUG 6, 1996

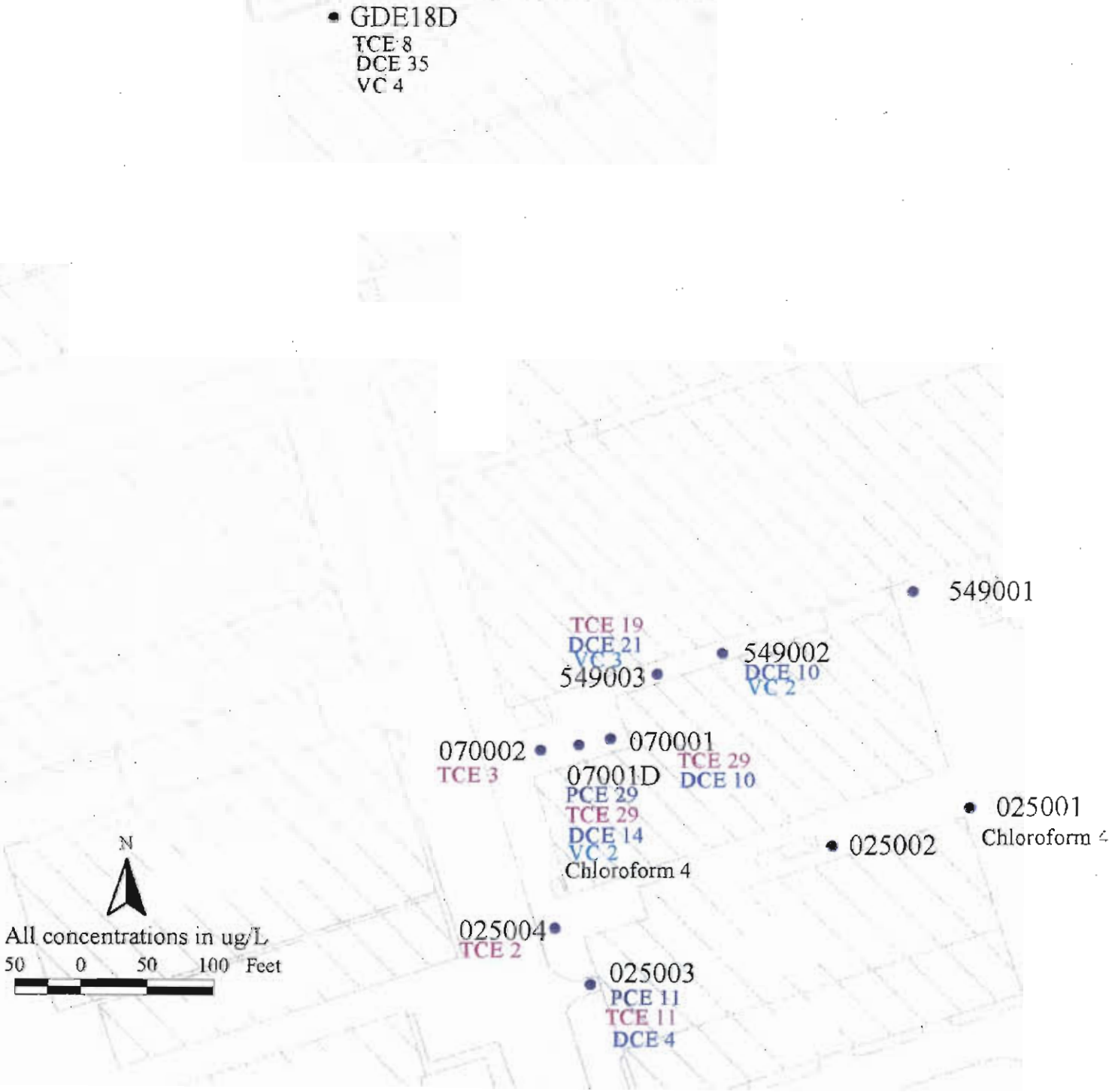


SWMUs 25 and 70 Area: 3rd Qtr Groundwater VOC Results, NOV 15-DEC 13, 1996

SWMUs 25 and 70 Area: 4th Qtr Groundwater VOC Results, FEB 13-MAR 5, 1996



SWMU 25 and 70 Area: 1st Rd MNA Groundwater Results, MAR 2-3, 1998



SWMU 25, 70 AOC 549 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	025001	025002	025003	025004	070001	070002	07001D	549001	549002	549003
VOCs	PCE	ug/l			11				29			
	TCE	ug/l			11	4	29	3	29			19
	1,1-DCA	ug/l										
	1,1-DCE	ug/l										
	1,2-DCE tot	ug/l			4		10		14		10	21
	VC	ug/l							2		2	3
	Benz	ug/l										
	Ethylbnz	ug/l										
	Tol	ug/l										
	Xyl tot	ug/l										
Natural Attenuation Parameters	Alk	ppm	10.00	30.00	31.00	23.00	16.00	11.00	16.00	20.00	33.00	33.00
	Sp Cond	mmho/cm	0.02	0.05	0.21	0.11	0.10	0.02	0.12	0.07	0.06	0.24
	Ethane	ng/l	3.00	3.00	62.73	1.57	3.00	3.00	3.00	3.00	11.10	5.63
	Ethene	ng/l	3.77	6.90	19.52	4.68	3.00	3.00	48.75	3.00	117.83	97.08
	H_2 (gas)	nm/l	0.09	0.10	0.37	0.17	0.15	0.12	1.54	0.18	0.25	0.13
	Fe^{2+}	mg/l	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	2.65	0.50
	CH_4	mg/l	0.00	0.00	0.02	0.00	1310.95	0.01	2294.52	0.00	324.21	0.01
	DO	mg/l	2.47	0.39	0.91	2.17	1.31	0.18	0.24	0.37	1.03	1.46
	ORP	mV	333.00	90.00	178.00	34.00	77.00	148.00	285.00	-5.00	9.00	104.00
	Temp	°C	18.20	18.10	20.00	18.50	17.70	18.30	21.60	25.00	19.20	19.50
	pH		3.65	5.96	5.98	6.95	5.95	5.92	5.06	6.42	6.19	5.56
	Cl	mg/l	5.80	2.90	28.40	3.40	2.90	8.20	22.2	1.5	6.9	10.0
	SO_4	mg/l	20.90	10.90	31.40	5664.00	25.20	12.90	198	2	20	59
	TOC	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	NO_3 as N	mg/l	0.94	4.00	0.45	0.43	0.78	0.46	0.24	0.13	0.32	3.7
Preliminary Screening Points & Ranking	DO	POINTS	-3	3	0	-3	-3	3	3	3	-3	-3
	NO_3		2	0	2	2	2	2	2	2	2	0
	Fe II		0	0	0	0	0	0	0	0	3	0
	SO_4		0	2	0	0	0	2	0	2	0	0
	CH_4		0	0	0	0	3	0	3	0	3	0
	Redox		0	0	0	1	0	0	0	1	1	0
	pH		-2	0	0	0	0	0	0	0	0	0
	TOC		0	0	0	0	0	0	0	0	0	0
	Temp		0	0	0	0	0	0	1	1	0	0
	CO_2*		0	0	0	0	0	0	0	0	0	0
	Alk*		0	0	0	0	0	0	0	0	0	0
	Cl*		0	0	2	0	0	0	0	0	0	0
	H_2		0	0	0	0	0	0	3	0	0	0
	VFA		0	0	0	0	0	0	0	0	0	0
	BTEX		0	0	0	0	0	0	0	0	0	0
	TCE		0	0	2	2	2	2	2	0	0	2
	DCE		0	0	2	0	2	0	2	0	2	2
	VC		0	0	0	0	0	0	2	0	2	2
	Ethane		0	0	0	0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0	0	0	0
	DCA		0	0	0	0	0	0	0	0	0	0
	CA		0	0	0	0	0	0	0	0	0	0
	Tot Pts		-3	5	8	2	6	9	18	9	10	3
	NA evidence?		N	I	L	I	L	L	A	L	L	I

Notes: *= parameters must exceed 2X background

	"Background" location		Avg of results from "background" locations		
Shallow wells:	542003	538001	Cl =	11.6	mg/l
	067001		Alk =	no values	
	GDE028		CO_2 =	no values	
	GDE015				

These are clean wells surrounding solvent contamination at site that are upgradient and downgradient.

Deep wells:	53801D		Cl =	62	mg/l
	GDE15D		Alk =	no values	
	02301D		CO_2 =	no values	
	GDE28D				

These are clean wells surrounding solvent contamination at site that are upgradient and downgradient.

RANKING RESULTS:

N=	No evidence (0 pts)
I=	Inadequate evidence (0-5 pts)
L=	Limited evidence (6-14 pts)
A=	Adequate evidence (15-20 pts)
S=	Strong evidence (> 20 pts)

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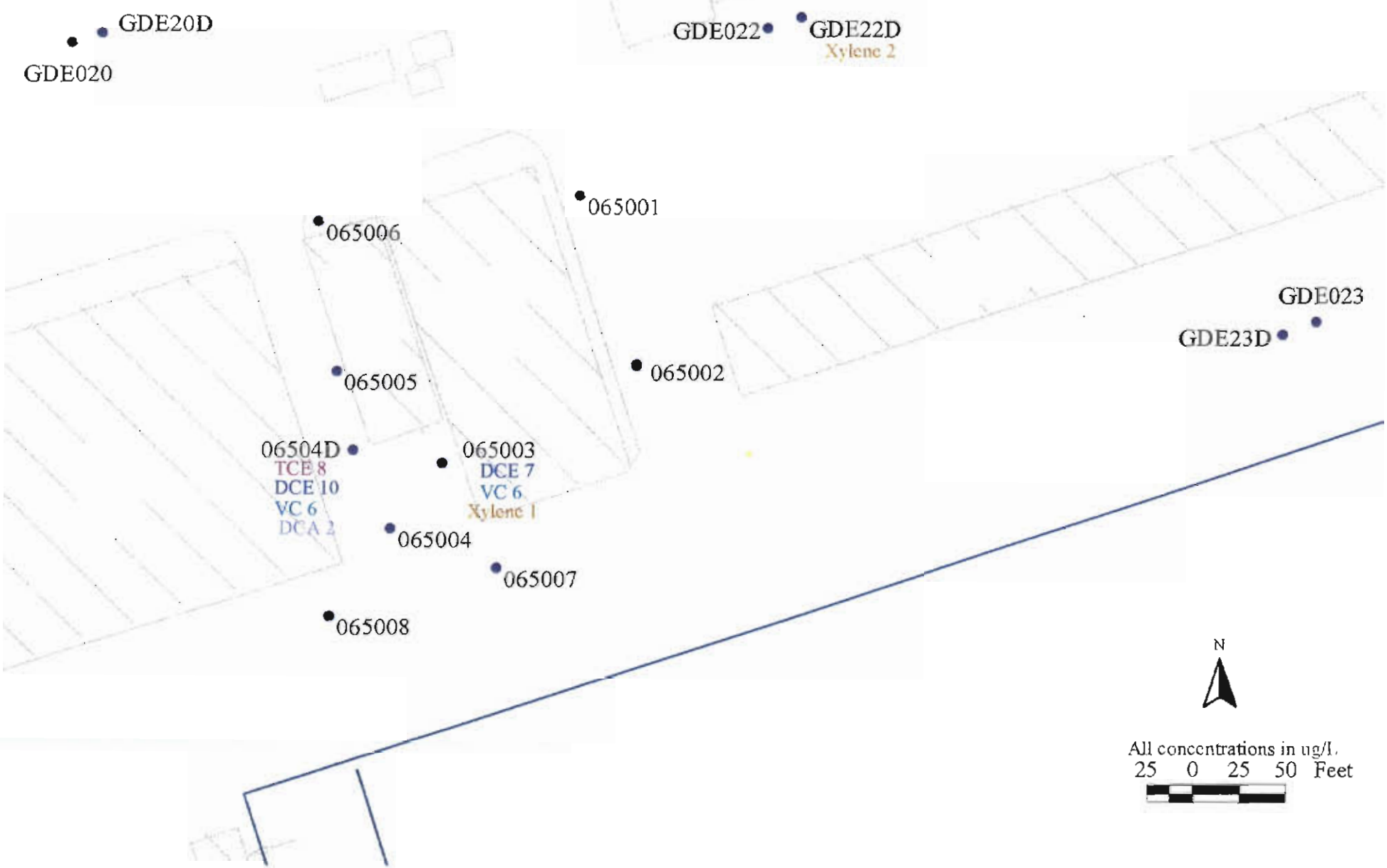
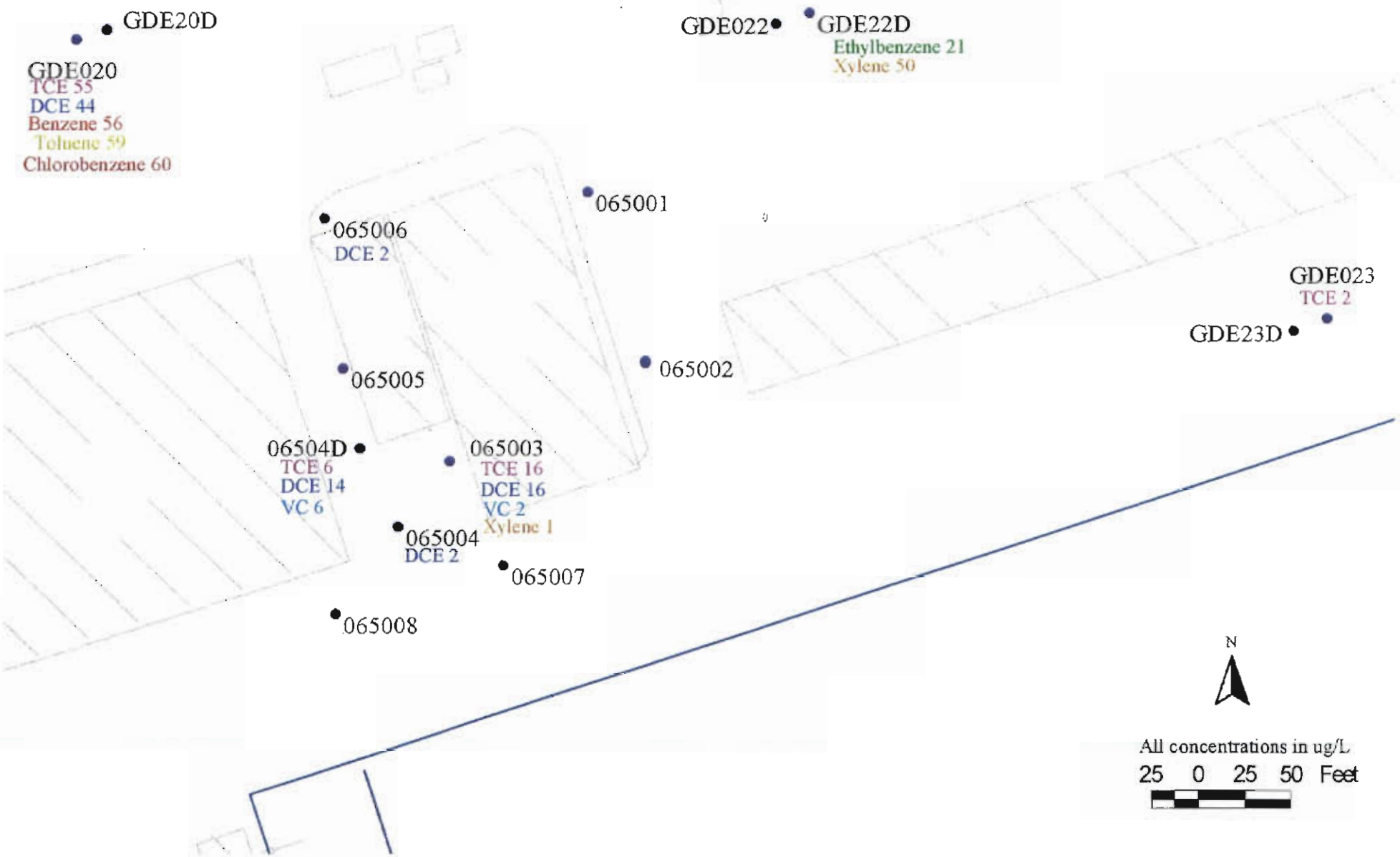
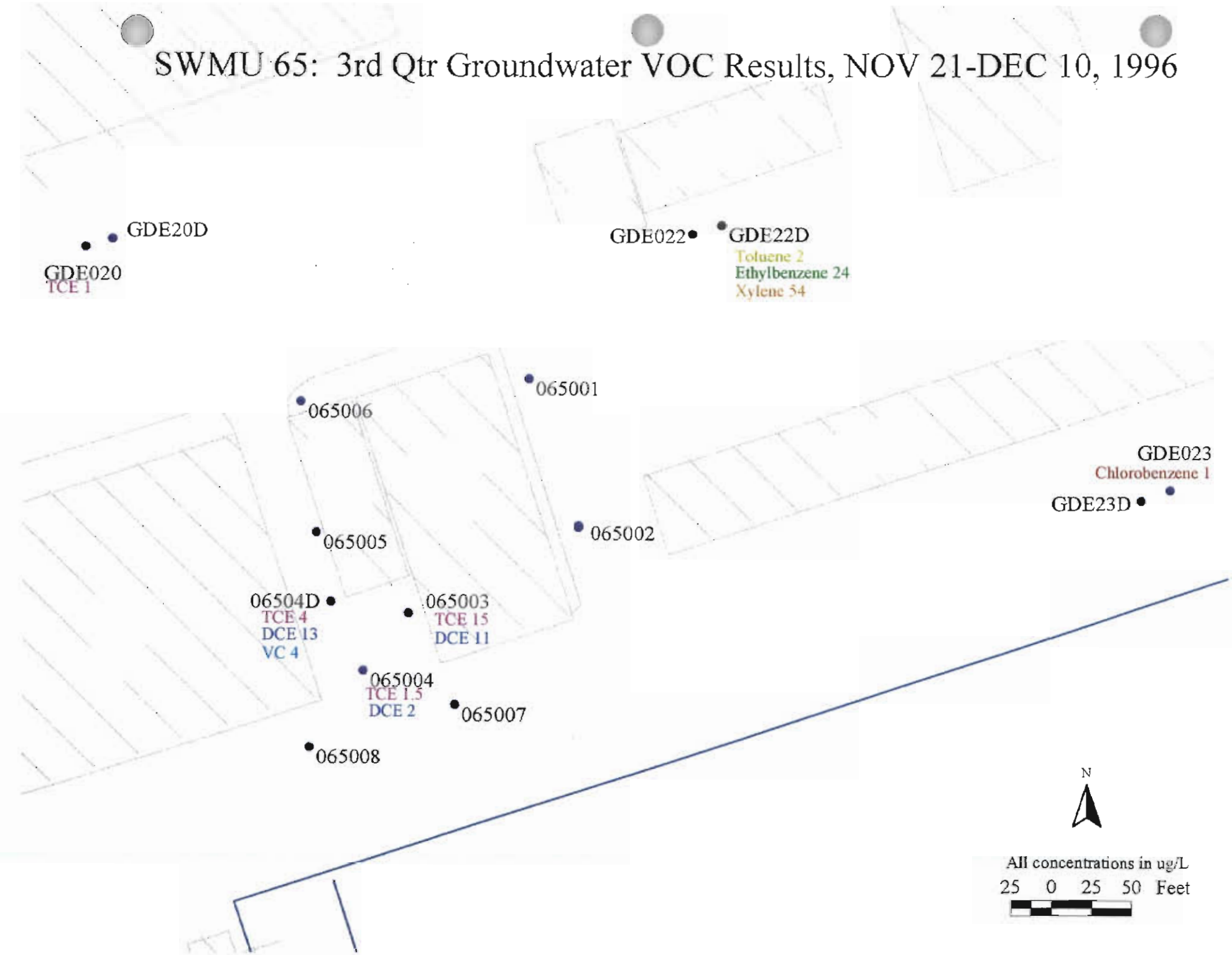
SWMU 65: 1st Qtr Groundwater VOC Results, APR 12-19, 1996



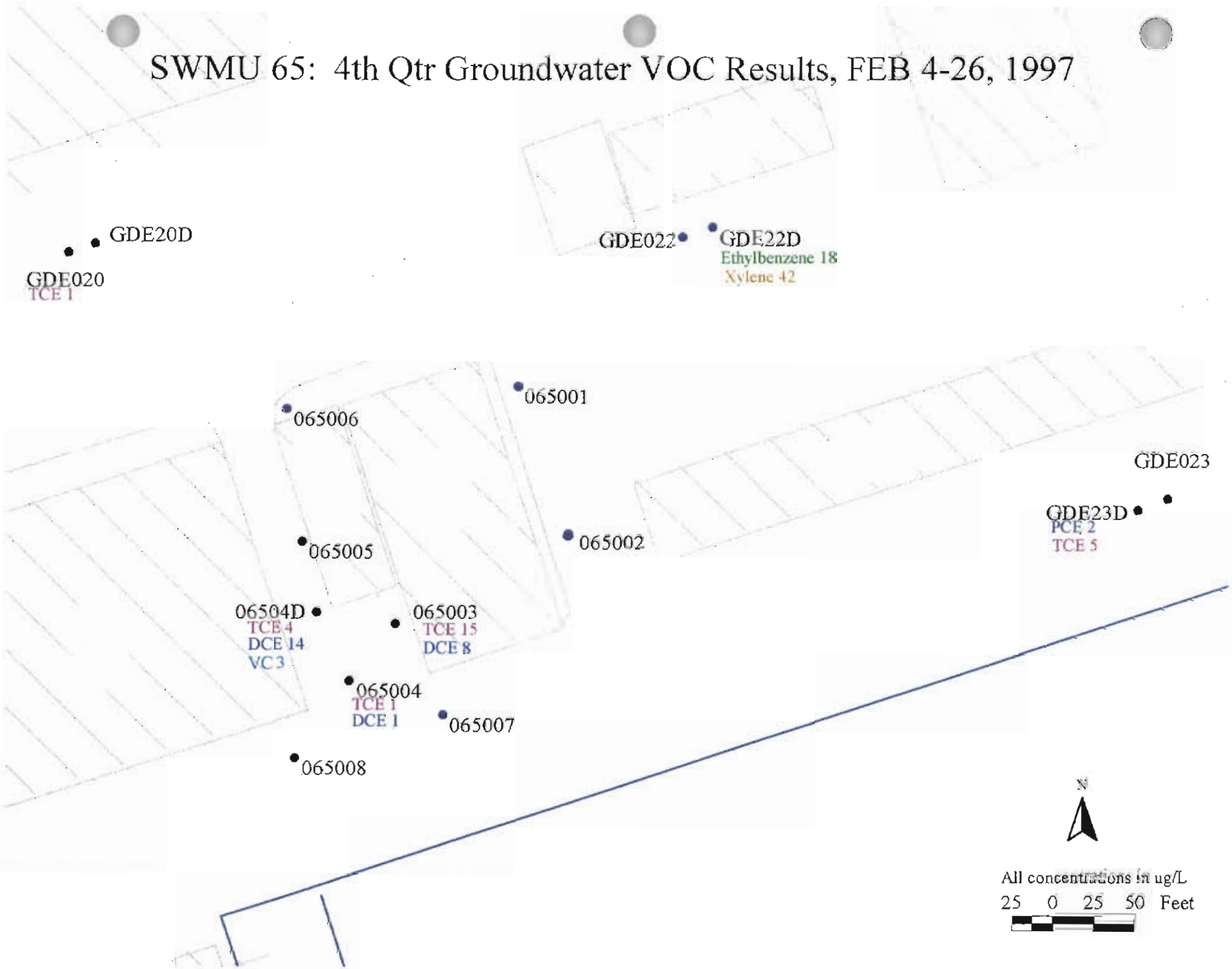
SWMU 65: 2nd Qtr Groundwater VOC Results, AUG 1-15, 1996



SWMU 65: 3rd Qtr Groundwater VOC Results, NOV 21-DEC 10, 1996



SWMU 65: 4th Qtr Groundwater VOC Results, FEB 4-26, 1997



SWMU 65: 1st Rd MNA Groundwater VOC Results, FEB 23-25, 1998

SWMU 65 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	065001	065002	065003	065004	065005	065006	065007	065008	06504D	GDE020	GDE023	GDE20D	GDE23D	550001
VOCs	PCE	*ug/l*														
	TCE	*ug/l*			9						5					
	1,1-DCA	*ug/l*														
	1,1-DCE	*ug/l*														
	1,2-DCE tot	*ug/l*														
	VC	*ug/l*			2											
	Benz	*ug/l*														
	Ethylbnz	*ug/l*														
	Tol	*ug/l*														
	Xyl tot	*ug/l*														
Natural Attenuation Parameters	Alk	*ppm*	98	30	52	67	54	32	88	50	57	10	78	48	120	83
	Sp Cond	*mmho/cm*	0.17	0.236	0.086	0.07	0.146	0.058	0.11	0.096	0.249	0.026	4.02	0.332	17.26	0.3
	Ethane	*ng/l*	3	3	431.94	36.23	3	ND	3	3	101.63	3	3	5.73	3	3
	Ethene	*ng/l*	3	3	250.72	45.14	3	ND	3	3	82.27	3	3	15.05	3	3
	H_2 (gas)	*nm/l*	0.400	0.610	0.340	1.130	0.2	ND	0.497	0.580	0.310	0.090	0.375	0.160	1.820	0.320
	Fe^{2+}	*mg/l*	1.35	0.5	0.5	0.5	11.8	5.4	2.14	7.49	6.58	0.5	0.5	0.5	0.5	16.9
	CH_4	*mg/l*	14670.63	4146.670	3375.18	499.74	4400.31	2.42	6990.8	11236	6472.39	0.001	20591.57	568.14	99027.61	7304
	DO	*mg/l*	0.39	1.8	0.4	0.4	0.5	0.8	1.8	0.4	0.2	3.64	0.11	0.3	0.1	0.56
	ORP	*mV*	-180	-228	-271	-52	-143	-79	-145	-135	-114	108	-290	-60	-352	-131
	Temp	*° C*	18.1	17.9	18.3	17.0	16.3	16.6	15.9	18.9	22.6	19.4	18.9	22.4	21.6	18.9
	pH		7.01	7.49	10.06	7.30	6.91	6.56	7.28	6.93	6.75	6.12	6.69	7.27	5.95	6.65
	Cl	*mg/l*	102.0	24.6	120.0	6.8	8.5	5.6	53.7	45.4	410.0	1.9	985.0	7770.0	ND	ND
	SO_4	*mg/l*	1	34	15	25	77	3	7	49	5580	4	12	8	ND	ND
	TOC	*mg/l*	10.0	2.5	32.9	ND	4.2	4.6	9.0	5.5	7.5	ND	9.5	14.4	ND	ND
	NO_3 as N	*mg/l*	ND	ND	ND	ND	ND	ND	0.13	ND	ND	0.59	ND	ND	ND	ND
Preliminary Screening Points & Ranking	DO	*POINTS*	3	-3	3	3	0	0	-3	3	3	-3	3	3	3	0
	NO_3		2	2	2	2	2	2	2	2	2	2	2	2	2	2
	Fe II		3	0	0	0	3	3	3	3	3	0	0	0	0	3
	SO_4		2	0	2	0	0	2	2	0	0	2	2	2	2	2
	CH_4		3	3	3	3	3	3	3	3	3	0	3	3	3	3
	Redox		2	2	2	1	2	1	2	2	2	0	2	1	2	2
	pH		0	0	-2	0	0	0	0	0	0	0	0	0	0	0
	TOC		0	0	2	0	0	0	0	0	0	0	0	0	0	0
	Temp		0	0	0	0	0	0	0	0	1	0	0	1	1	0
	CO_2*		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Alk*		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cl*		2	2	2	0	0	0	2	2	2	0	2	2	0	0
	H_2		0	0	0	3	0	0	0	0	0	0	0	0	3	0
	VFA		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BTEX		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	TCE		0	0	2	0	0	0	0	0	2	0	0	0	0	0
	DCE		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	VC		0	0	2	0	0	0	0	0	0	0	0	0	0	0
	Ethane		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	DCA		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	CA		0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tot Pts		17	6	18	12	10	11	11	15	18	1	14	14	16	12
	NA evidence?		A	L	A	L	L	L	L	A	A	I	L	L	A	L

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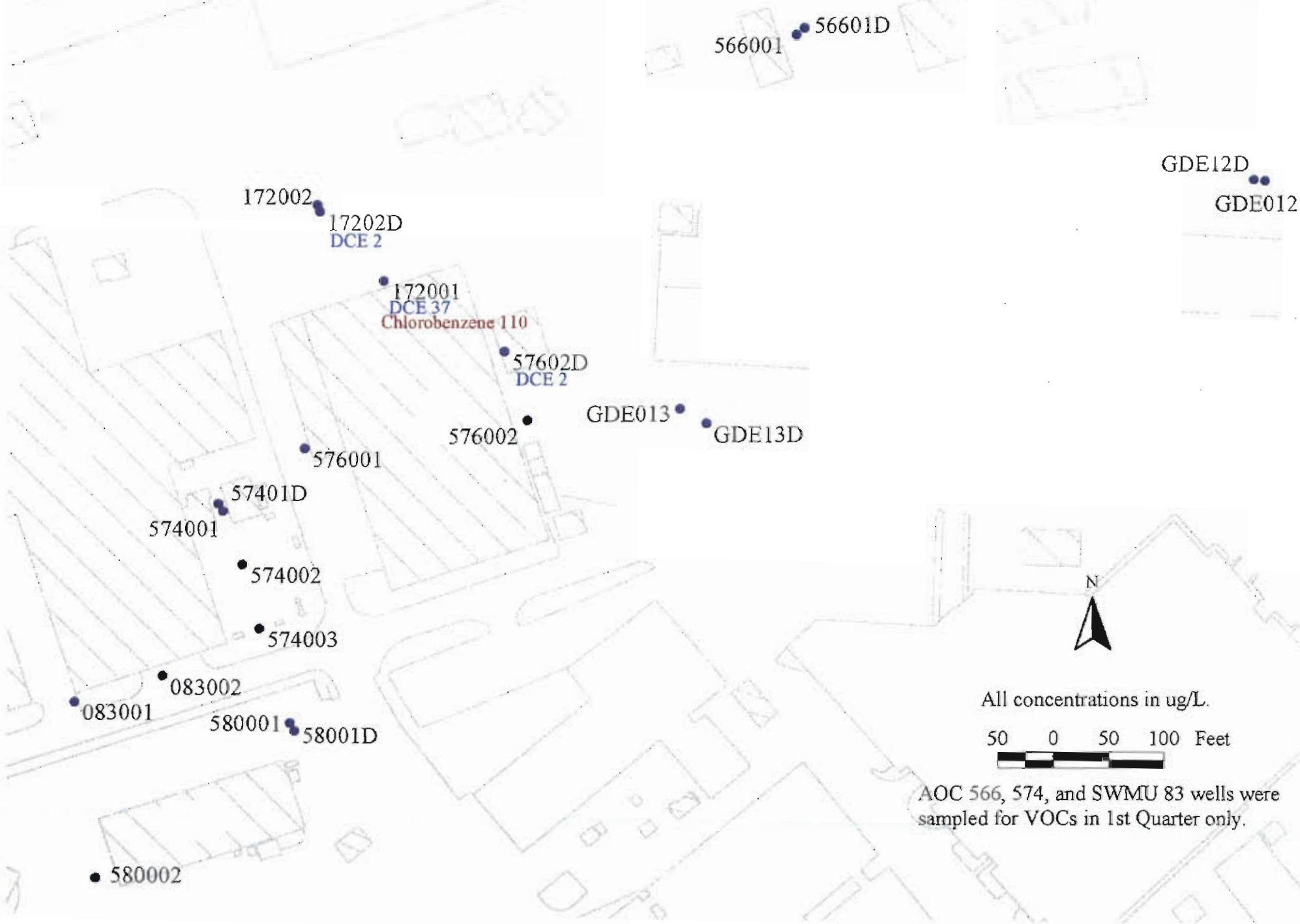
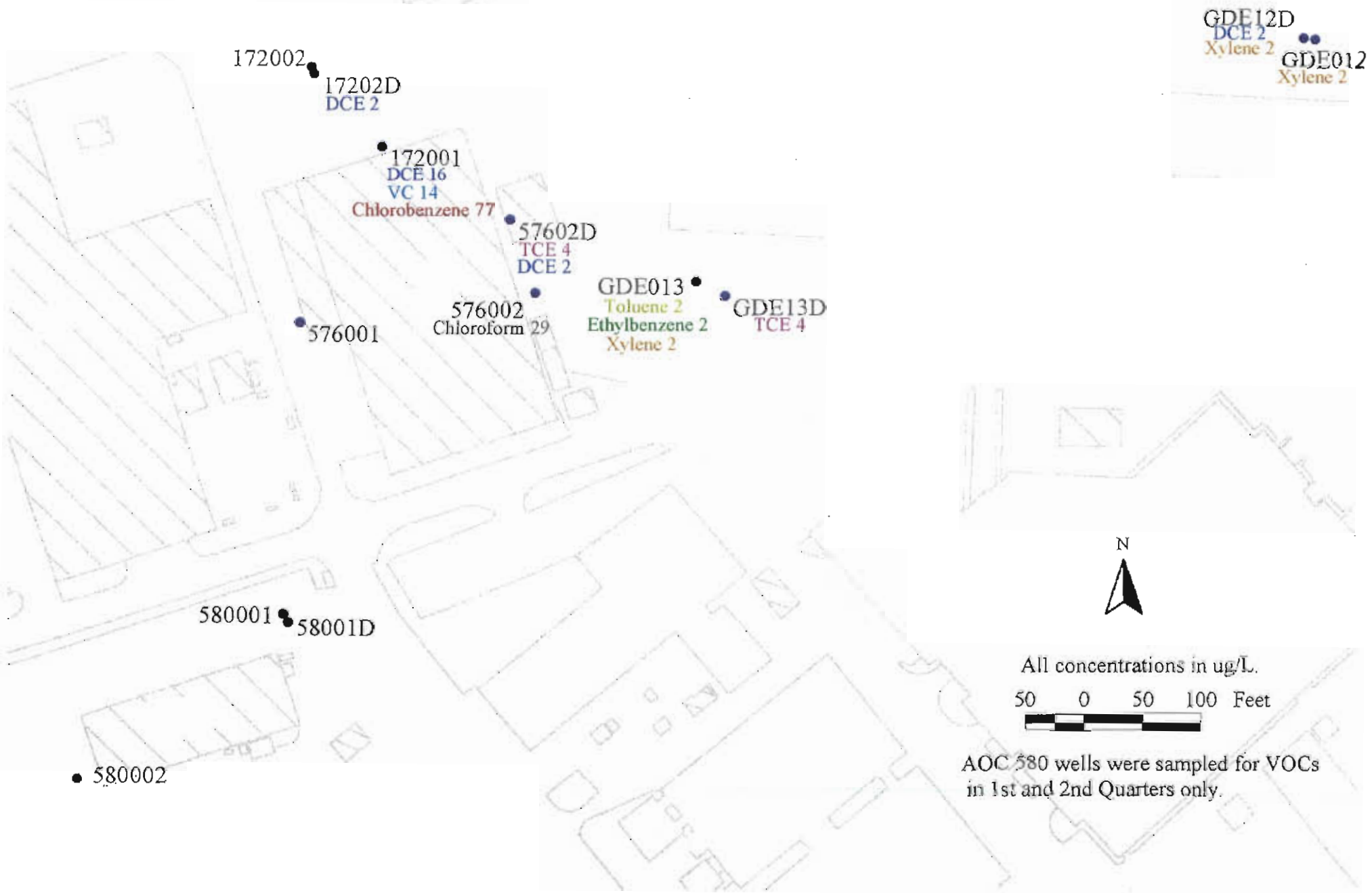
SWMU 65 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

Notes:	*= parameters must exceed 2X background									**RANKING RESULTS:**						
	"Background" location		Avg of results from "background" locations							N=	No evidence (0 pts)					
Shallow wells:	067002		Cl =	24	mg/l					I=	Inadequate evidence (0-5 pts)					
	GDE021		Alk =	no values						L=	Limited evidence (6-14 pts)					
			CO_2 =	no values						A=	Adequate evidence (15-20 pts)					
These are clean wells surrounding solvent contamination at site that are downgradient.										S=	Strong evidence (> 20 pts)					
Deep wells:	02301D		Cl =	363	mg/l											
	GDE21D		Alk =	no values												
			CO_2 =	no values												
These are clean wells surrounding solvent contamination at site that are upgradient or sidegradient.																

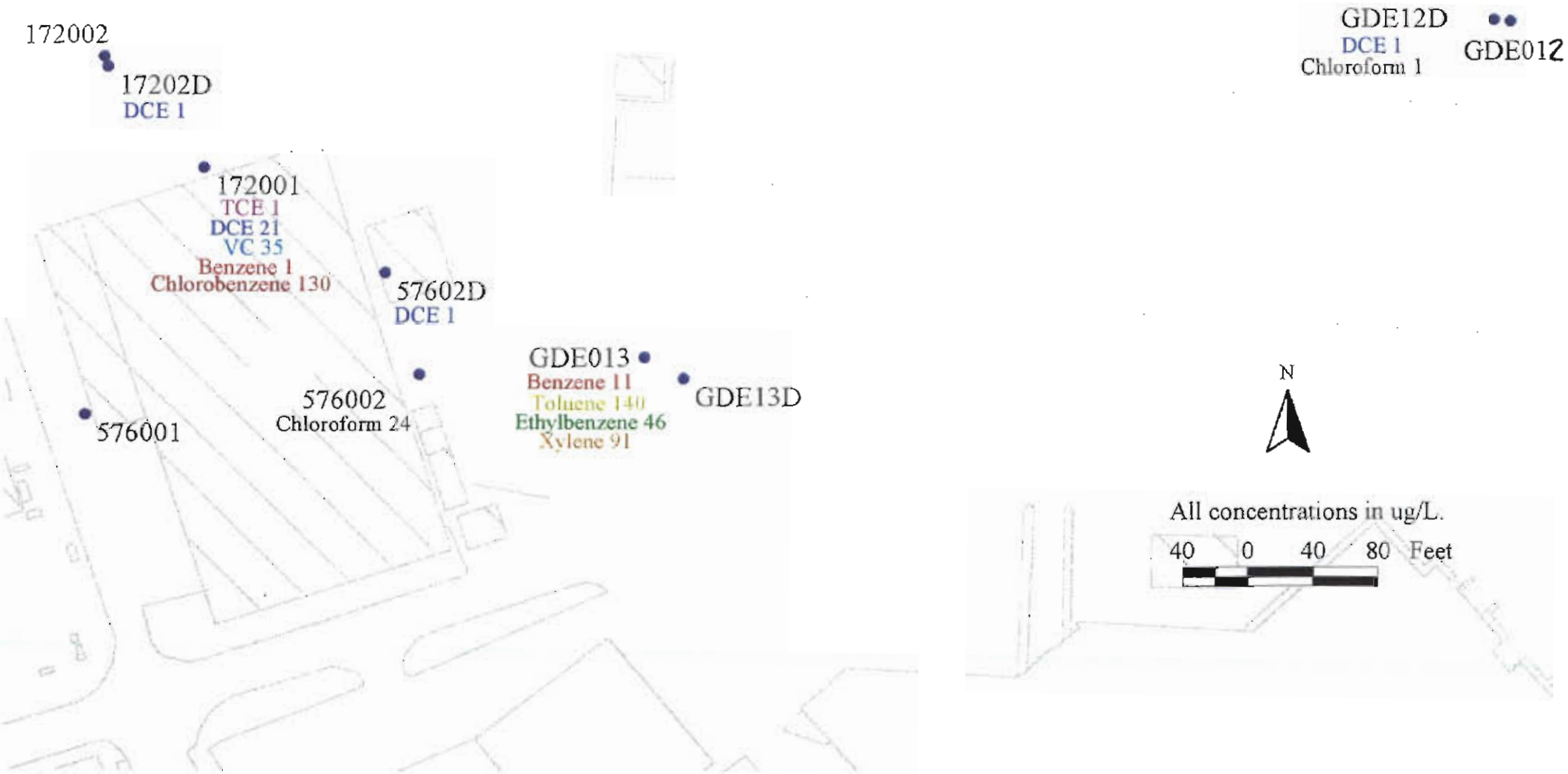
SWMU 172 and AOC 576 Area: 1st Quarter Groundwater VOC Results, APR 1-11, 1996



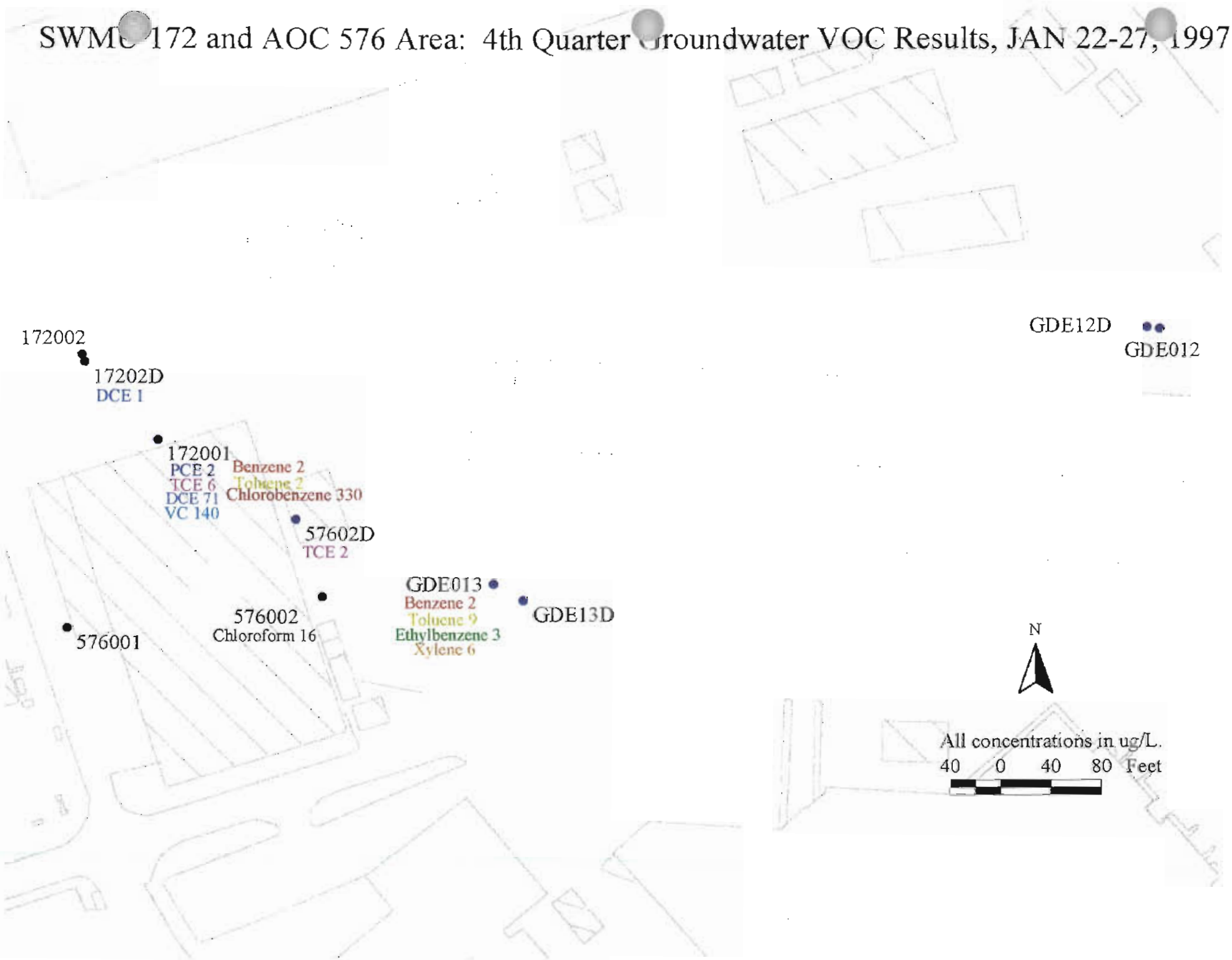
SWMU 172 and AOC 576 Area: 2nd Quarter Groundwater VOC Results, JY 16-24, 1996



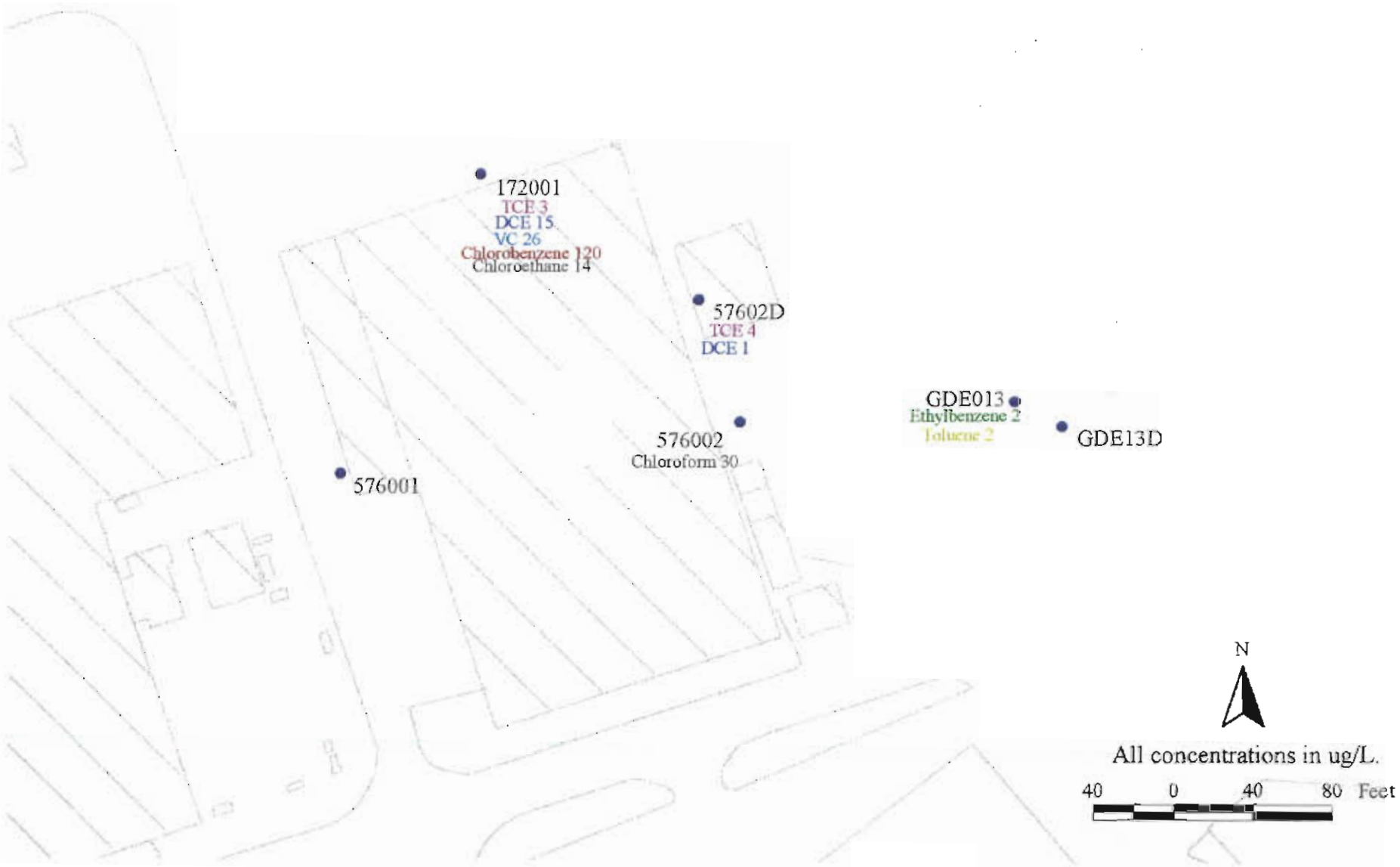
SWMU 172 and AOC 576 Area: 3rd Quarter Groundwater VOC Results, NOV 12-14, 1996



SWMU 172 and AOC 576 Area: 4th Quarter Groundwater VOC Results, JAN 22-27, 1997



SWMU 172 and AOC 576 Area: 1st Rd MNA Groundwater VOC Results, MAR 5-6, 1998

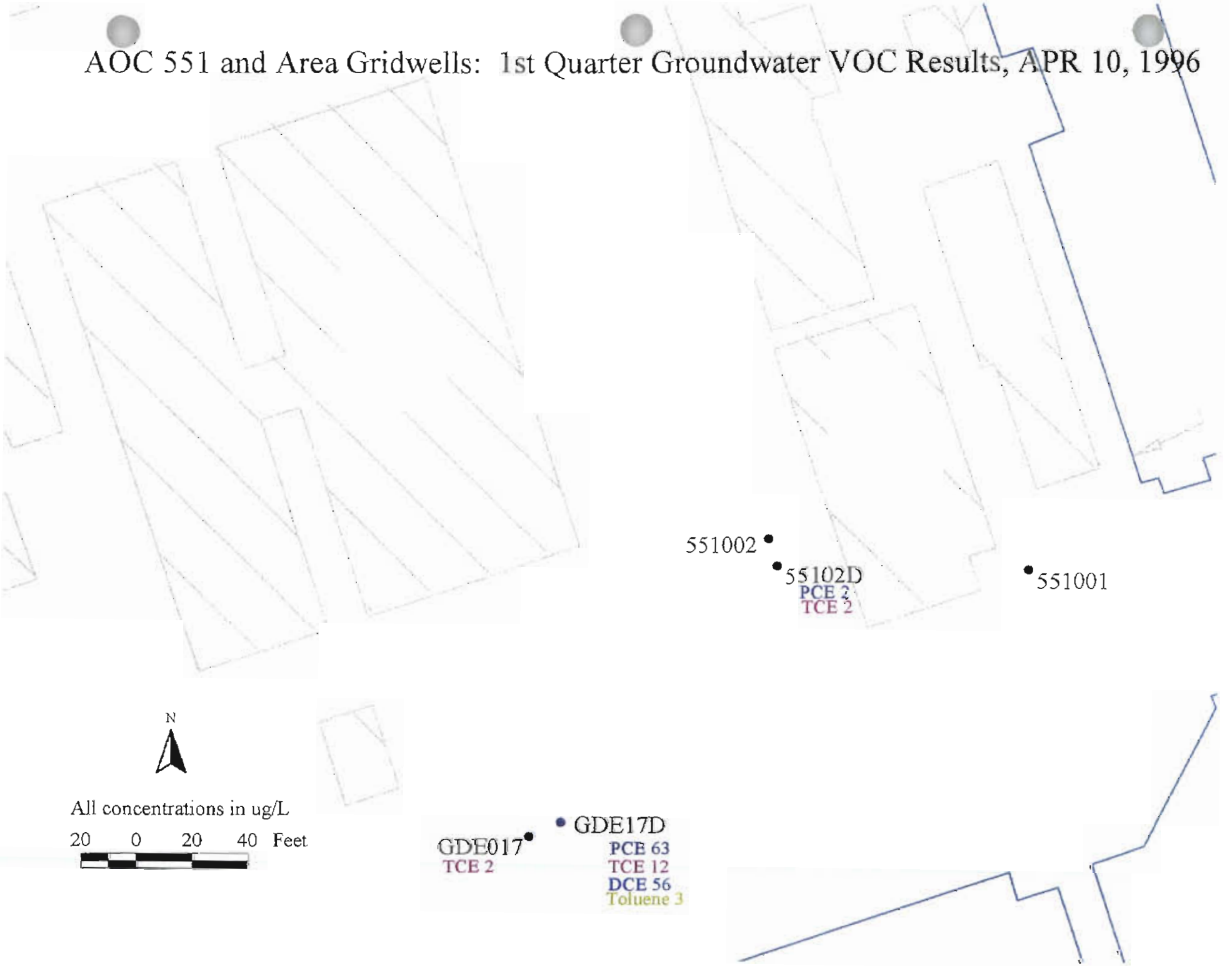


SWMU 172 AND AOC 576 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

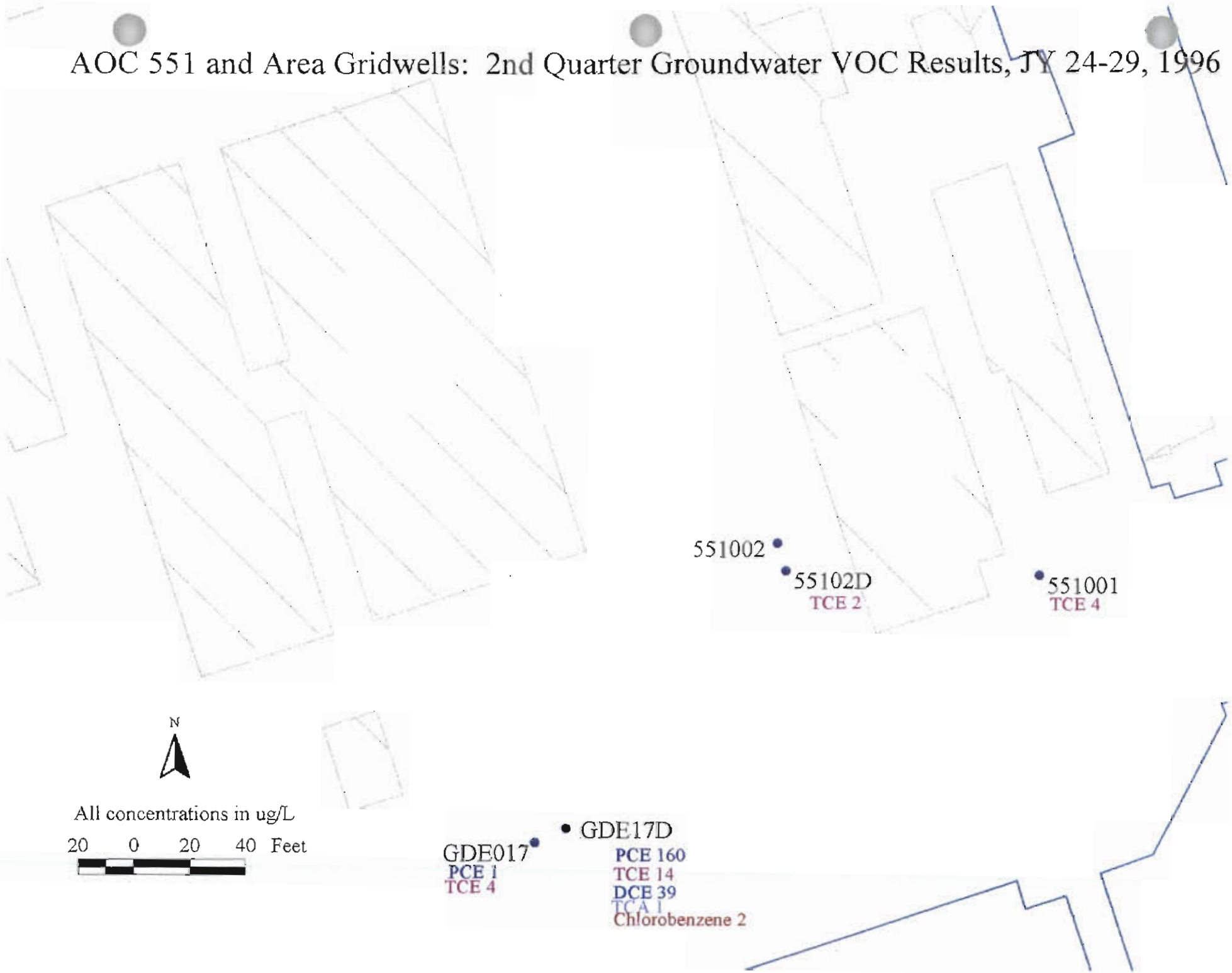
	Analyte	units	172001	576001	576002	57602D	GDE013	GDE13D
VOCs	PCE	ug/l						
	TCE	ug/l	3			4		
	1,1-DCA	ug/l						
	1,1-DCE	ug/l						
	1,2-DCE tot	ug/l	15			1		
	VC	ug/l						
	Benz	ug/l						
	Ethylbnz	ug/l					2	
	Tol	ug/l					2	
	Xyl tot	ug/l						
Natural Attenuation Parameters	Alk	ppm	64.00	10.00	10.00	72.00	53.00	76.00
	Sp Cond	mmho/cm	0.24	3.29	0.04	1.78	0.13	1.78
	Ethane	ng/l	3.00	32.26	1.05	120.28	727.36	190.05
	Ethene	ng/l	38.89	7.69	4.18	32.31	23.57	102.43
	H_2 (gas)	nm/l	0.15	0.27	0.00	0.03	0.29	0.36
	Fe^{2+}	mg/l	9.99	41.47	0.50	2.40	0.50	6.67
	CH_4	mg/l	1087.20	155.65	0.01	0.02	7493.05	2553.72
	DO	mg/l	0.11	0.80	0.22	0.33	0.28	0.93
	ORP	mV	-6.00	113.00	152.00	-24.00	-86.00	-58.00
	Temp	°C	16.70	19.70	16.20	20.80	19.20	22.30
	pH		5.97	4.23	3.72	6.19	7.10	6.10
	Cl	mg/l	19.60	1870.00	16.30	298.00	257.00	867.00
	SO_4	mg/l	79.00	166.00	71.00	259.00	107.00	82.60
	TOC	mg/l	8.60	ND	ND	ND	12.80	4.20
	NO_3 as N	mg/l	ND	ND	1.40	ND	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS	3	0	3	3	3	0
	NO_3		2	2	0	2	2	2
	Fe II		3	3	0	3	0	3
	SO_4		0	0	0	0	0	0
	CH_4		3	3	0	0	3	3
	Redox		1	0	0	1	1	1
	pH		0	-2	-2	0	0	0
	TOC		0	0	0	0	0	0
	Temp		0	0	0	1	0	1
	CO_2*		0	0	0	0	0	0
	Alk*		0	0	0	0	0	0
	Cl*		0	2	0	0	2	0
	H_2		0	0	0	0	0	0
	VFA		0	0	0	0	0	0
	BTEX		0	0	0	0	2	0
	TCE		2	0	0	2	0	0
	DCE		2	0	0	2	0	0
	VC		0	0	0	0	0	0
	Ethane		0	0	0	0	0	0
	Ethene		0	0	0	0	0	0
	DCA		0	0	0	0	0	0
	CA		0	0	0	0	0	0
	Tot Pts		16	8	1	14	13	10
	NA evidence?		A	L	I	L	L	L

Notes:	*= parameters must exceed 2X background							RANKING RESULTS:
	"Background" locations:		Avg of results from "background" locations					N= No evidence
Shallow wells:	145003		Cl =	49.4	mg/l			I= Inadequate evidence
	574001		Alk =	no values				L= Limited evidence
	574002		CO_2 =	no values				A= Adequate evidence
	574003							S= Strong evidence
These are clean wells surrounding solvent contamination at site that are upgradient.								
Deep wells:	14501D		Cl =	1569	mg/l			
	57401D		Alk =	no values				
	58001D		CO_2 =	no values				
These are clean wells surrounding solvent contamination at site that are upgradient.								

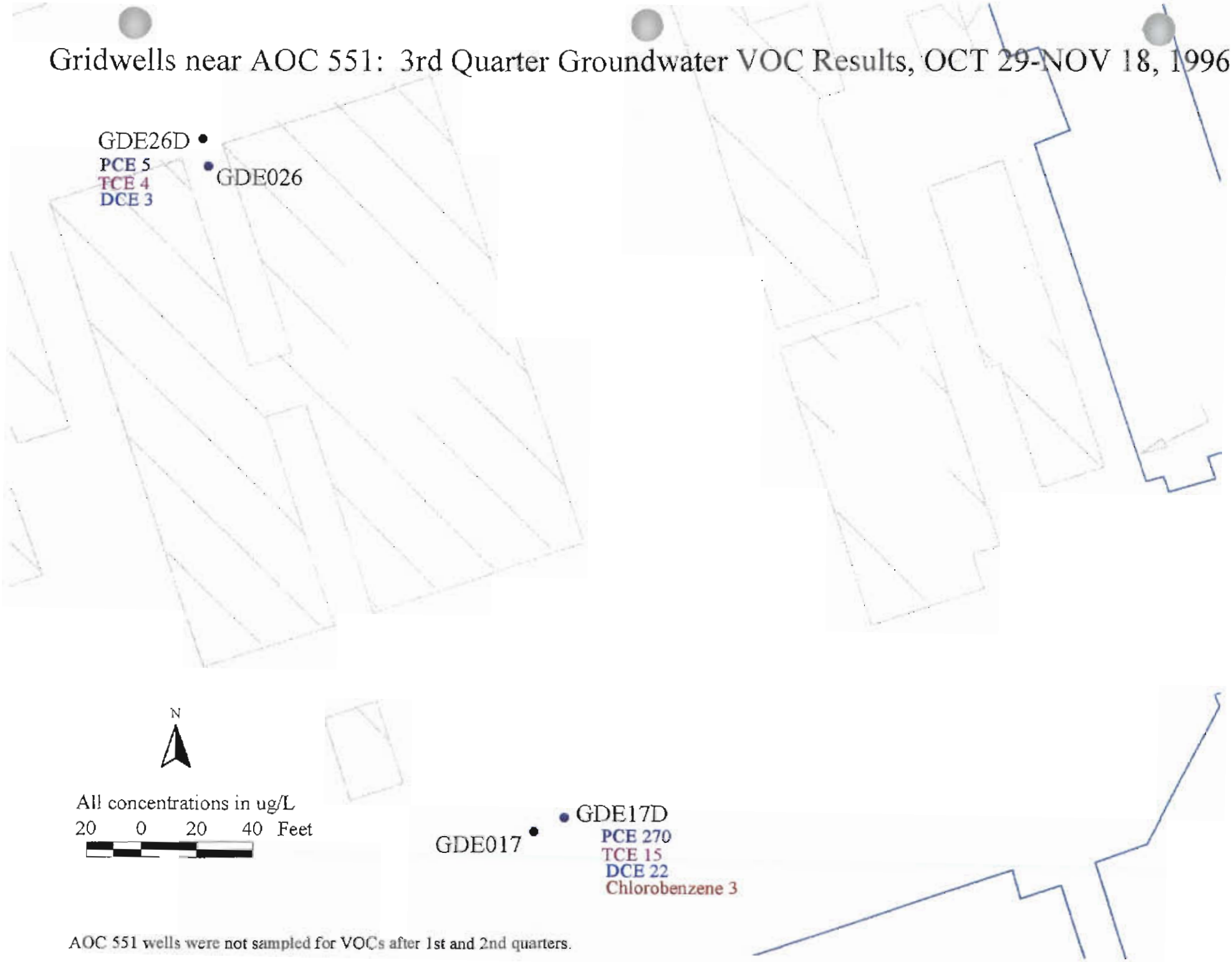
AOC 551 and Area Gridwells: 1st Quarter Groundwater VOC Results, APR 10, 1996



AOC 551 and Area Gridwells: 2nd Quarter Groundwater VOC Results, JY 24-29, 1996

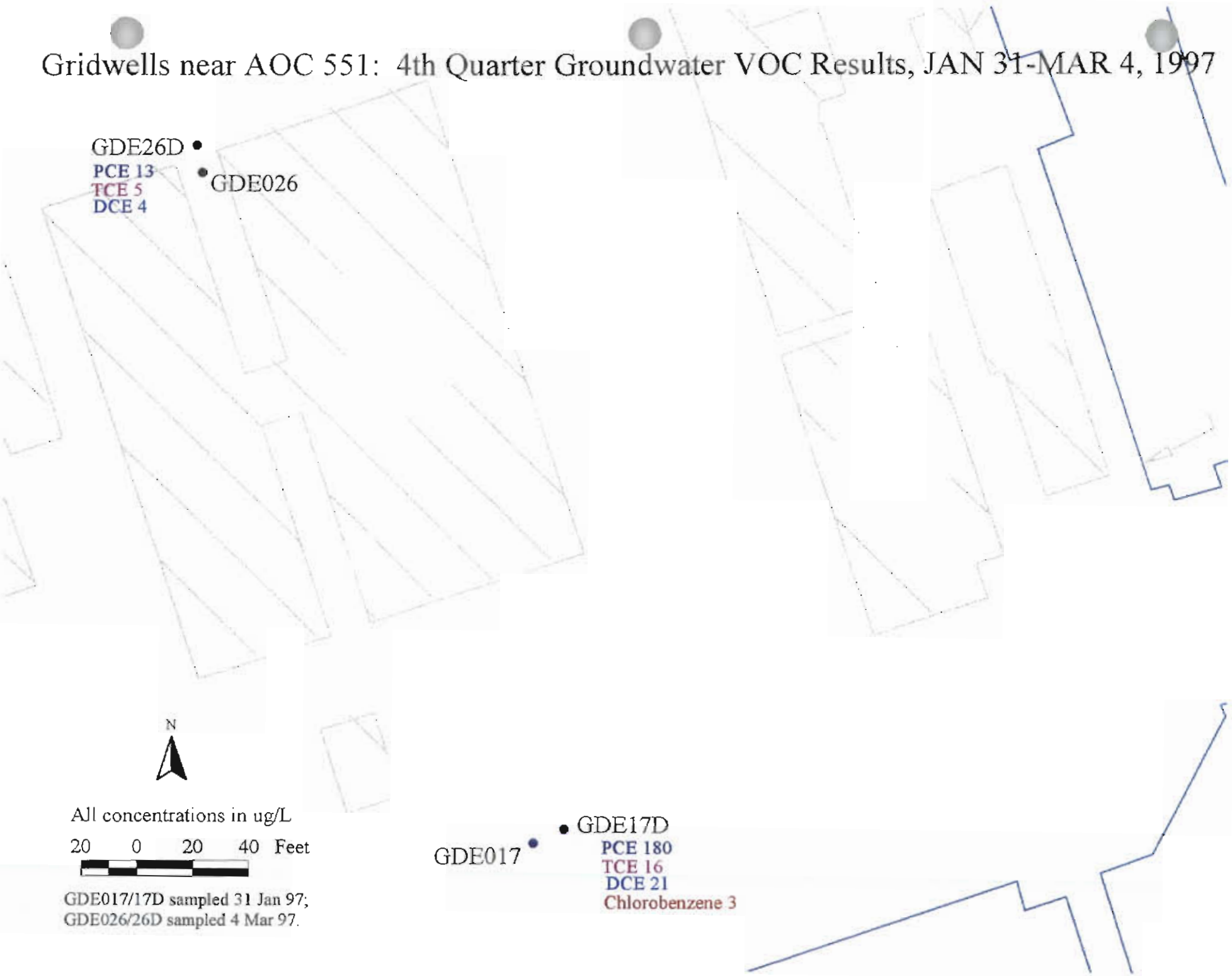


Gridwells near AOC 551: 3rd Quarter Groundwater VOC Results, OCT 29-NOV 18, 1996

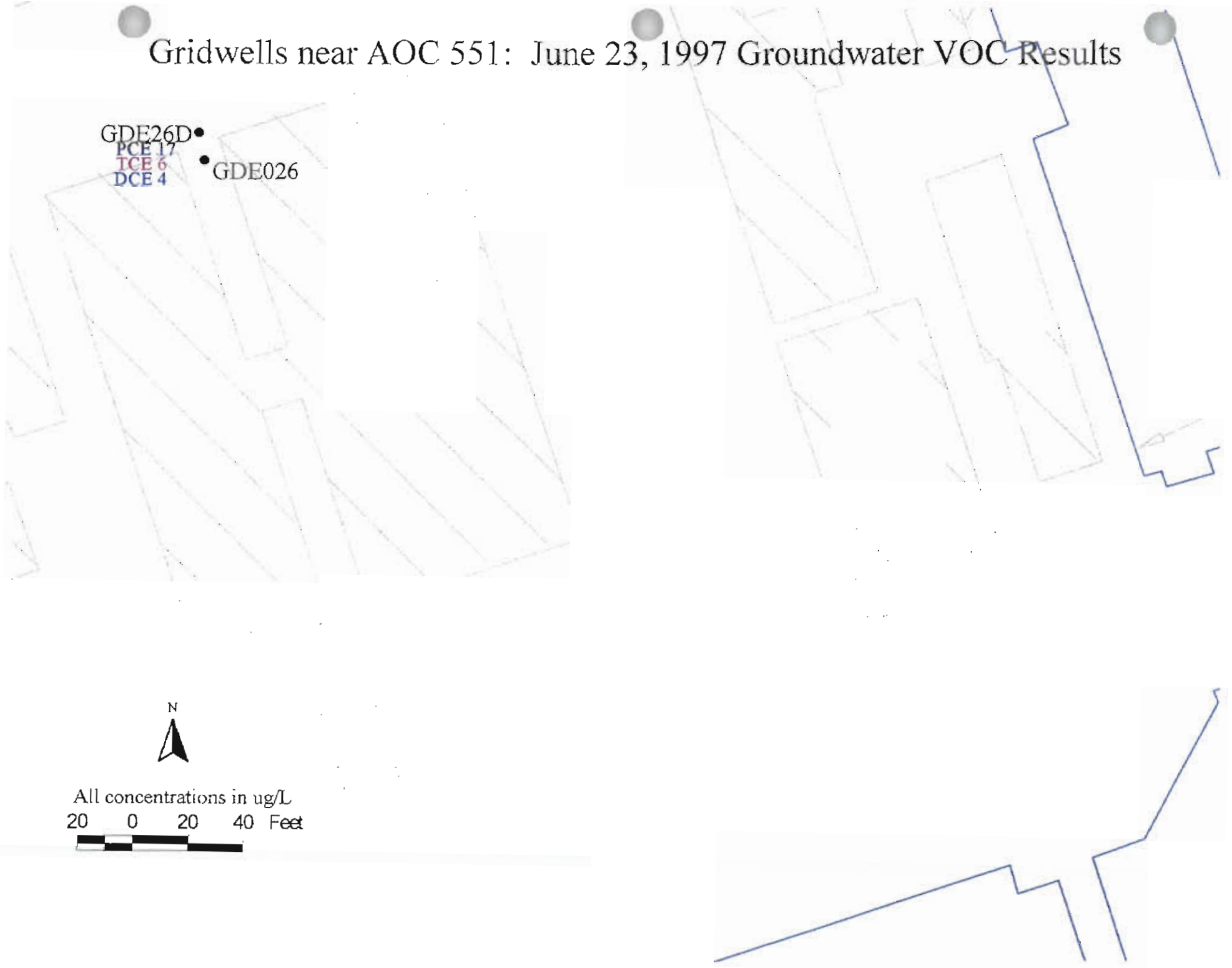


AOC 551 wells were not sampled for VOCs after 1st and 2nd quarters.

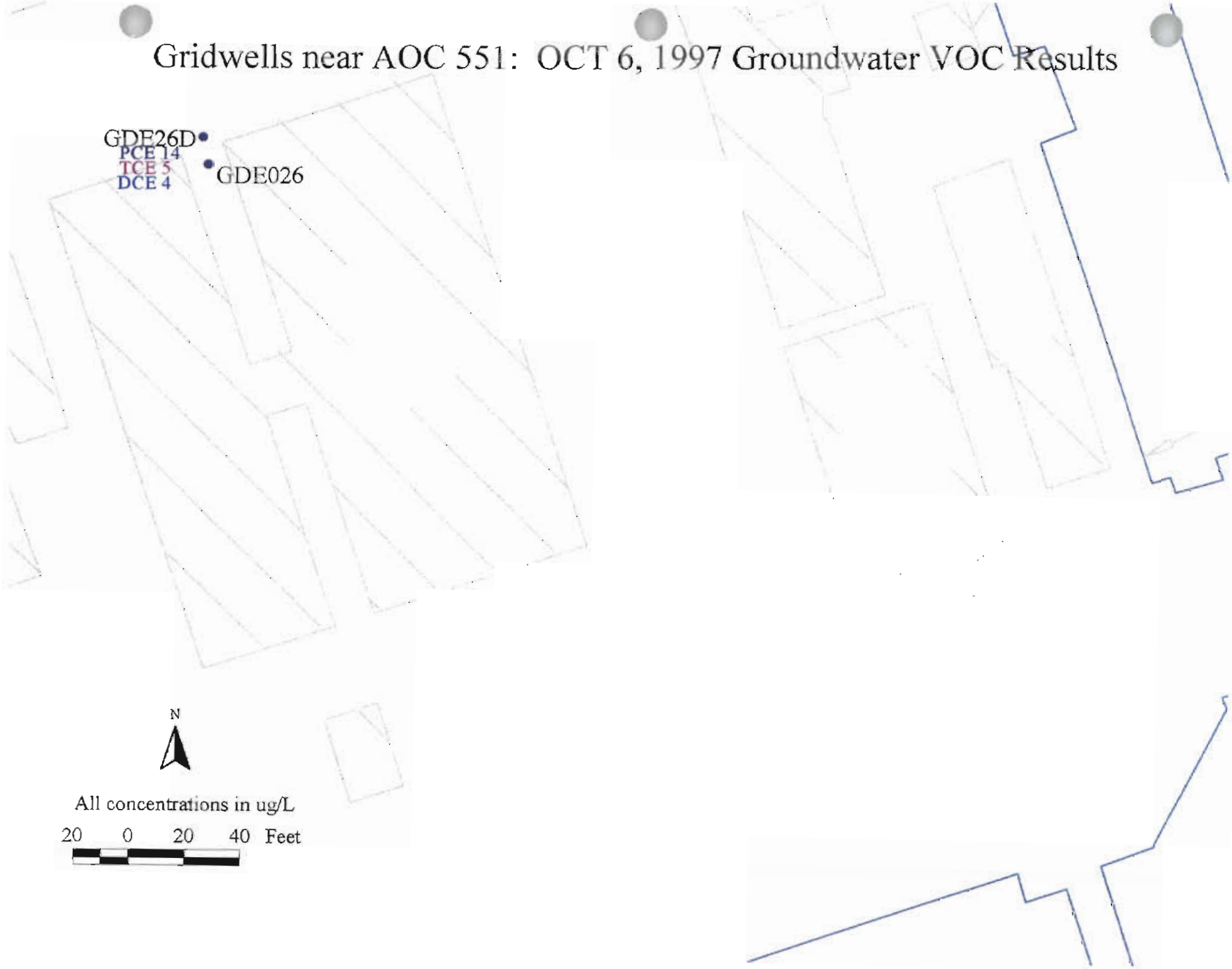
Gridwells near AOC 551: 4th Quarter Groundwater VOC Results, JAN 31-MAR 4, 1997



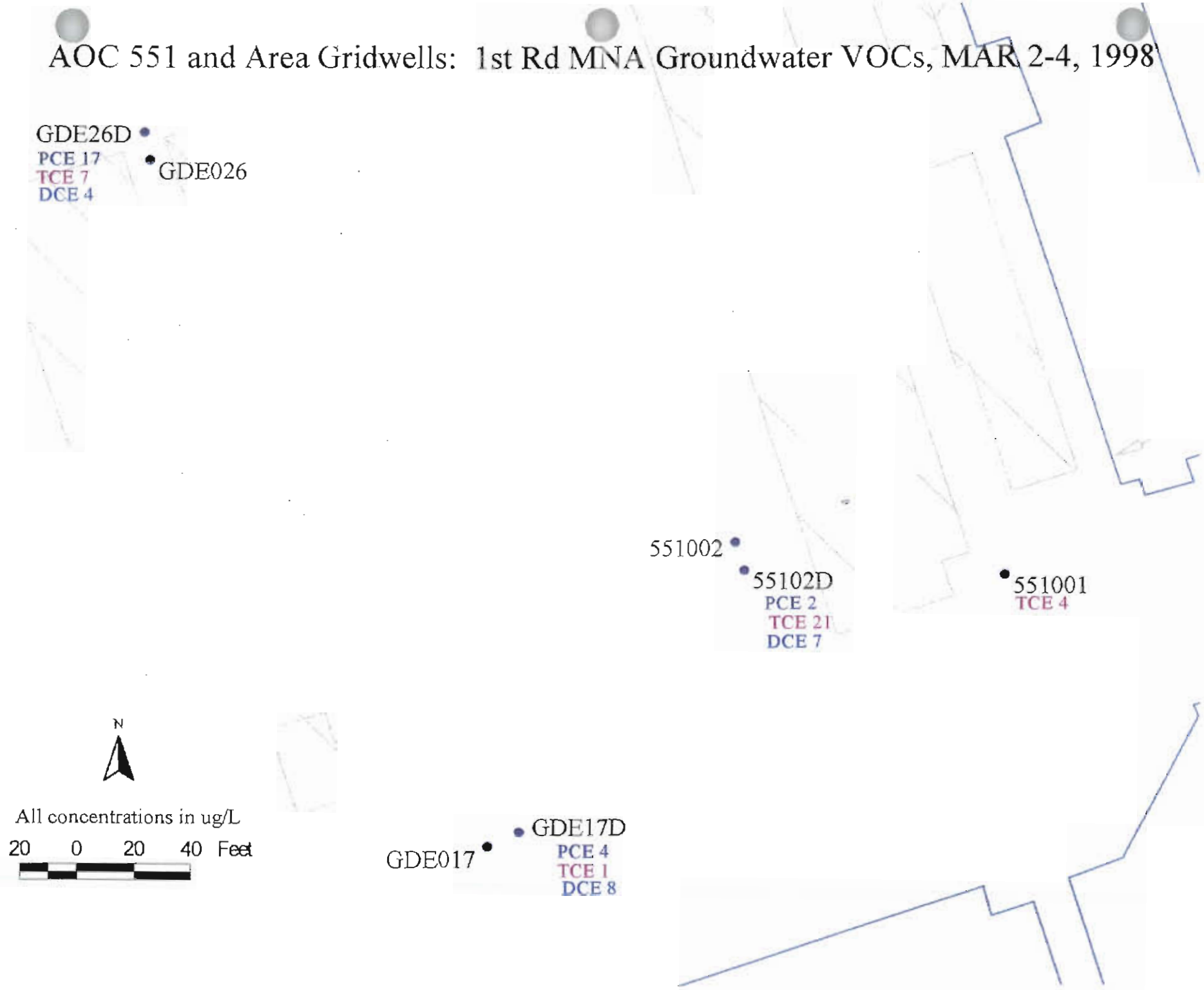
Gridwells near AOC 551: June 23, 1997 Groundwater VOC Results



Gridwells near AOC 551: OCT 6, 1997 Groundwater VOC Results



AOC 551 and Area Gridwells: 1st Rd MNA Groundwater VOCs, MAR 2-4, 1998



AOC 551 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	551001	551002	55102D	GDE017	GDE026	GDE17D	GDE26D
VOCs	PCE	ug/l						7	17
	TCE	ug/l	4					1	7
	1,1-DCA	ug/l							
	1,1-DCE	ug/l							
	1,2-DCE tot	ug/l						8	4
	VC	ug/l							
	Benz	ug/l							
	Ethylbnz	ug/l							
	Tol	ug/l							
	Xyl tot	ug/l							
Natural Attenuation Parameters	Alk	ppm	71	88	80	69	10	64	44
	Sp Cond	mmho/cm	0.09	0.19	0.36	0.57	0.10	0.36	0.11
	Ethane	ng/l	3.00	3.00	10.20	79.30	3.00	59.96	3.00
	Ethene	ng/l	3.00	3.00	23.52	20.71	3.00	66.63	3.00
	H_2 (gas)	nm/l	0.38	0.40	0.46	0.45	0.18	0.70	0.24
	Fe^{2+}	mg/l	0.50	5.42	0.50	0.50	0.50	0.50	0.50
	CH_4	mg/l	41414.74	14291.31	340.80	1669.20	0.001	952.69	0.001
	DO	mg/l	0.21	0.79	1.11	0.46	0.40	0.70	0.50
	ORP	mV	-253	-125	-71	-152	334	-7	22
	Temp	°C	17.80	19.40	23.30	17.50	18.00	23.40	21.70
	pH		6.84	7.24	6.72	7.34	4.28	6.54	7.50
	Cl	mg/l	37.60	161.00	16.20	20.50	5.30	24.30	56.00
	SO_4	mg/l	8.90	7.30	13.70	30.80	37.80	39.20	50.10
	TOC	mg/l	2.60	11.40	ND	ND	ND	ND	9.80
	NO_3 as N	mg/l	ND	ND	ND	ND	1.20	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS	3	0	-3	3	3	0	0
	NO_3		2	2	2	2	0	2	2
	Fe II		0	3	0	0	0	0	0
	SO_4		2	2	2	0	0	0	0
	CH_4		3	3	3	3	0	3	0
	Redox		2	2	1	2	0	1	1
	pH		0	0	0	0	-2	0	0
	TOC		0	0	0	0	0	0	0
	Temp		0	0	1	0	0	1	1
	CO_2*		0	0	0	0	0	0	0
	Alk*		0	0	0	0	0	0	0
	Cl*		2	2	0	2	0	0	0
	H_2		0	0	0	0	0	0	0
	VFA		0	0	0	0	0	0	0
	BTEX		0	0	0	0	0	0	0
	TCE		2	0	0	0	0	2	2
	DCE		0	0	0	0	0	2	2
	VC		0	0	0	0	0	0	0
	Ethane		0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0
	DCA		0	0	0	0	0	0	0
	CA		0	0	0	0	0	0	0
	Tot Pts		**16**	**14**	**6**	**12**	**1**	**11**	**8**
	NA evidence?		**A**	**L**	**L**	**L**	**I**	**L**	**L**

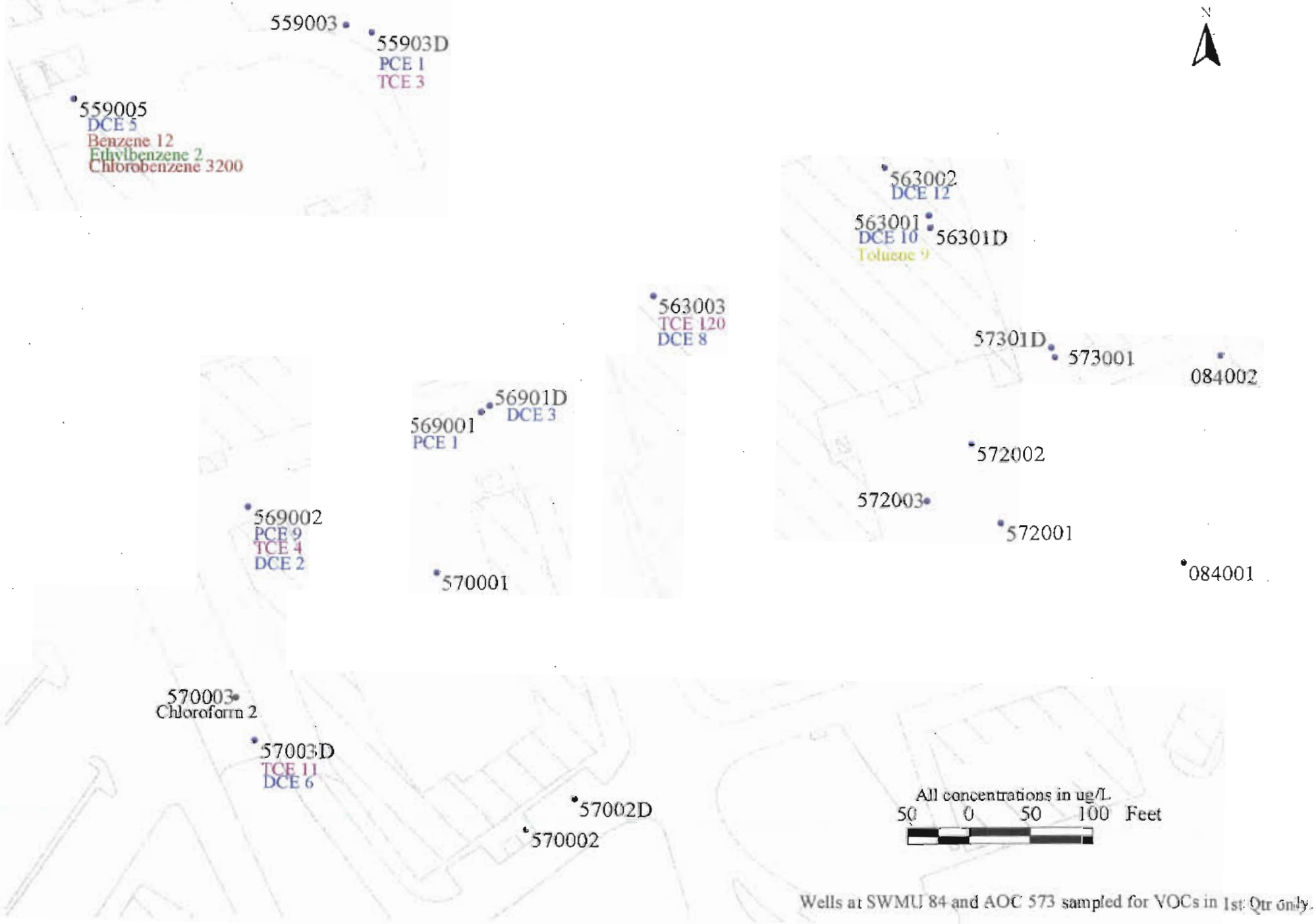
Notes: *= parameters must exceed 2X background

	"Background" locations	Avg of results from "background" locations				
Shallow wells:	025001	Cl =	6.8	mg/l		
	GDE026	Alk =	no values			
		CO_2 =	no values			
These are clean wells surrounding solvent contamination at site that are upgradient.						
Deep wells:	02301D	Cl =	363	mg/l		
	GDE21D	Alk =	no values			
		CO_2 =	no values			
These are the nearest deep wells free of chlorinated solvent contamination.						

RANKING RESULTS:

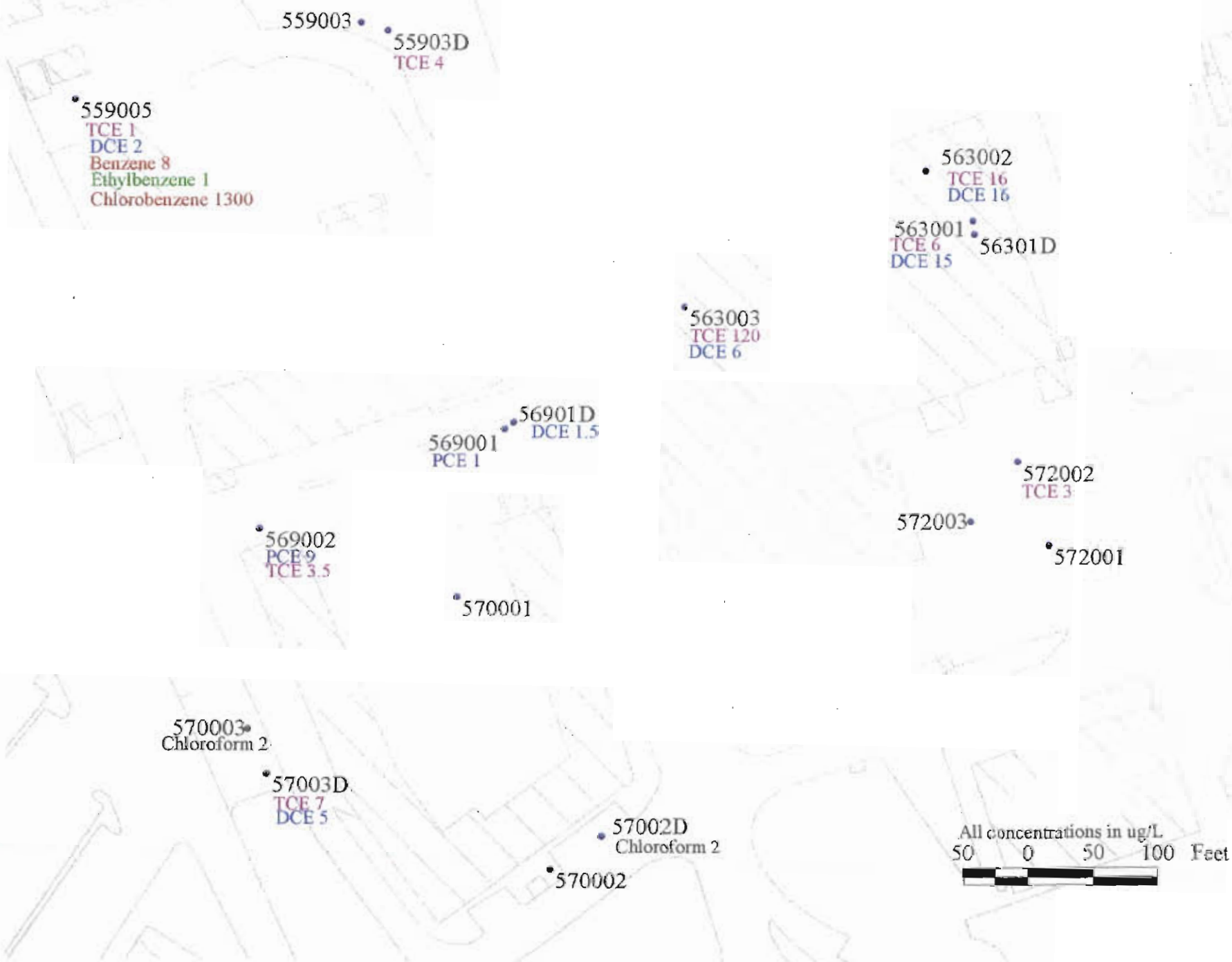
N=	No evidence (0 pts)
I=	Inadequate evidence (0-5 pts)
L=	Limited evidence (6-14 pts)
A=	Adequate evidence (15-20 pts)
S=	Strong evidence (>20 pts)

AOC 569 Area: 1st Quarter Groundwater VOC Results, MAR 28-MAY 10, 1996

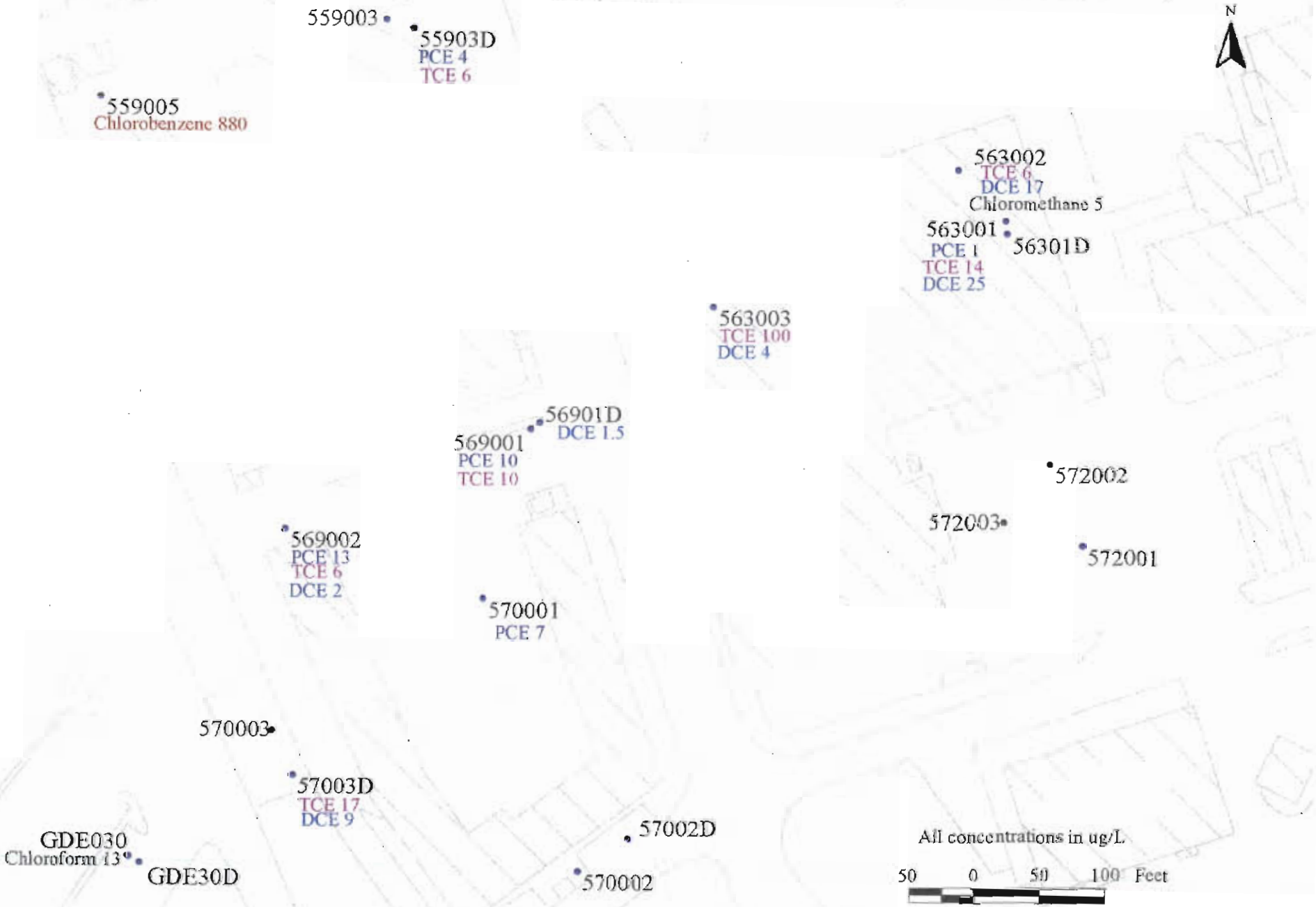


Wells at SWMU 84 and AOC 573 sampled for VOCs in 1st Qtr only.

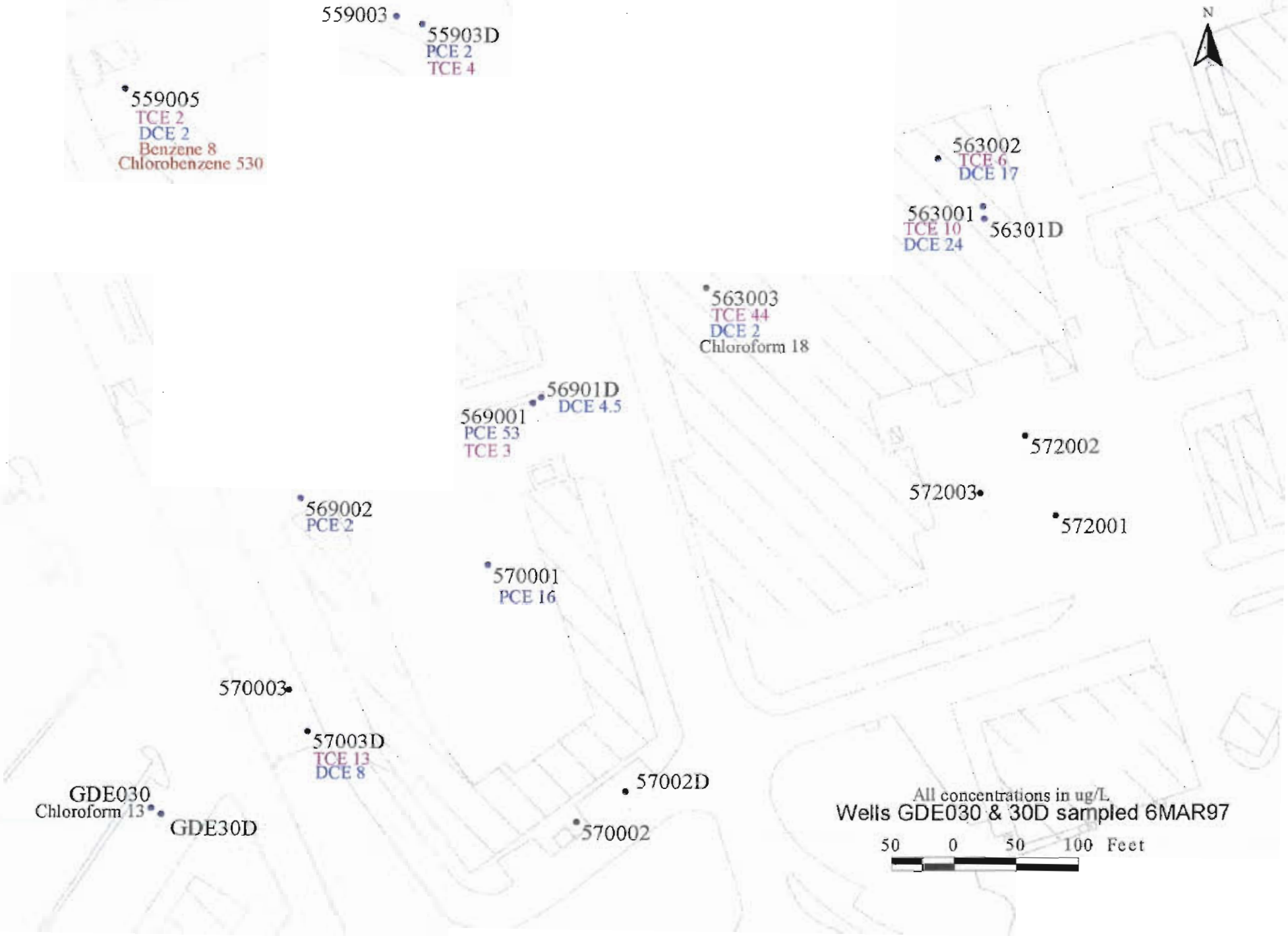
AOC 569 Area: 2nd Quarter Groundwater VOC Results, JY 22-31, 1996



AOC 569 Area: 3rd Quarter Groundwater VOC Results, OCT 31-NOV 25, 1996



AOC 569 Area: 4th Quarter Groundwater VOC Results, JAN 31-FEB 12, 1997



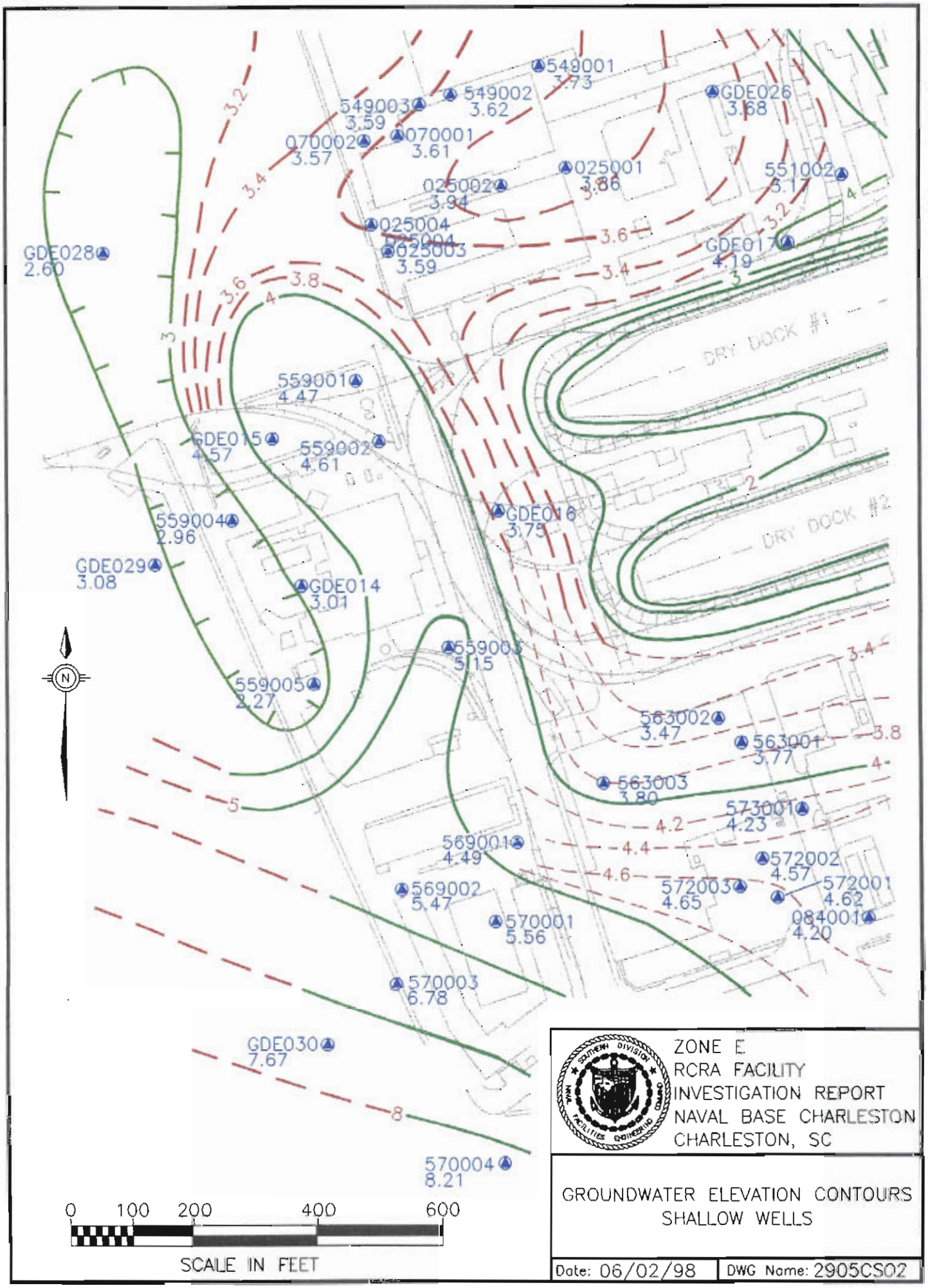
AOC 569 Area: 1st Rd MNA Groundwater VOC Results, MAR 6-10, 1998

AOCS 559, 563, 569, 570 572 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

	Analyte	units	55905	55903D	563001	563002	563003	56301D	569001	569002	56901D	570001	570003	57003D	572002
VOCs	PCE	ug/l					37		29	4		58			
	TCE	ug/l		5	5	3	12		2			1		10	
	1,1-DCA	ug/l													
	1,1-DCE	ug/l									6				
	1,2-DCE tot	ug/l			8										
	VC	ug/l													
	Benz	ug/l													
	Ethylbnz	ug/l													
	Tol	ug/l													
	Xyl tot	ug/l													
Natural Attenuation Parameters	Alk	ppm	27	40	18	17	10	ND	10	10	51	10	10	63	31
	Sp Cond	mmho/cm	0.121	0.208	0.28	0.88	0.165	0.112	0.125	0.09	0.336	0.189	0.106	0.382	0.205
	Ethane	ng/l	3	57.63	7.75	5.44	4.8	24.2	2.12	2.53	18.03	3	2.5	14.77	4.87
	Ethene	ng/l	4.16	14.07	7.78	8.68	2.58	3	3.36	5.15	18.34	5.9	16.44	34.56	6.21
	H_2 (gas)	nm/l	0.110	0.360	0.160	0.740	0.1	0.120	0.190	0.270	0.320	0.512	0.430	0.287	0.260
	Fe^{2+}	mg/l	0.5	0.5	0.5	4.52	0.5	4.69	0.582	0.5	0.5	0.748	0.5	0.5	0.81
	CH_4	mg/l	0.006	0.007	350.83	0.006	0.004	1003.52	0.001	903	0.00	0.00	0.001	0.00	1680.88
	DO	mg/l	0.54	0.4	1.0	0.4	0.7	0.3	1.0	0.4	0.3	0.275	0.339	0.9	0.3
	ORP	mV	76	-35	6	-15	93	-70	347	72	-81	316	181	-99	-83
	Temp	°C	19.1	22.6	20.2	19.6	20.7	23.0	20.0	21.0	23.5	16.6	19.3	22.2	22.2
	pH		5.78	7.12	6.52	6.28	4.68	7.40	3.87	5.11	7.40	3.82	5.25	7.25	6.20
	Cl	mg/l	5.0	107.0	13.7	12.4	38.0	120.0	51.7	63.4	41.2	14.1	14.5	29.1	6.4
	SO_4	mg/l	9	81	31	22	42	37	73	49	73	80	77	45	20
	TOC	mg/l	ND	ND	2.5	2.2	ND	ND	ND	ND	ND	ND	ND	ND	2.4
	NO_3 as N	mg/l	ND	ND	0.1	ND	1.3	ND	0.8	0.58	ND	1.6	1.6	ND	ND
Preliminary Screening Points & Ranking	DO	POINTS	0	3	-3	3	0	3	0	3	3	3	3	0	3
	NO_3		2	2	2	2	0	2	2	2	2	0	0	2	2
	Fe II		0	0	0	3	0	3	0	0	0	0	0	0	0
	SO_4		2	0	0	0	0	0	0	0	0	0	0	0	2
	CH_4		0	0	3	0	0	3	0	3	0	0	0	0	3
	Redox		0	1	1	1	0	1	0	0	1	0	0	1	1
	pH		0	0	0	0	-2	0	-2	0	0	-2	0	0	0
	TOC		0	0	0	0	0	0	0	0	0	0	0	0	0
	Temp		0	1	1	0	1	1	0	1	1	0	0	1	1
	CO_2*		0	0	0	0	0	0	0	0	0	0	0	0	0
	Alk*		0	0	0	0	0	0	0	0	0	0	0	0	0
	Cl*		0	2	0	0	2	2	2	2	0	0	0	0	0
	H_2		0	0	0	0	0	0	0	0	0	0	0	0	0
	VFA		0	0	0	0	0	0	0	0	0	0	0	0	0
	BTEX		0	0	0	0	0	0	0	0	0	0	0	0	0
	TCE		0	2	2	2	2	0	2	0	0	2	0	2	0
	DCE		0	0	2	0	0	0	0	0	0	0	0	0	0
	VC		0	0	0	0	0	0	0	0	0	0	0	0	0
	Ethane		0	0	0	0	0	0	0	0	0	0	0	0	0
	Ethene		0	0	0	0	0	0	0	0	0	0	0	0	0
	DCA		0	0	0	0	0	0	0	0	0	0	0	0	0
	CA		0	0	0	0	0	0	0	0	0	0	0	0	0
	Tot Pts		**4**	**11**	**8**	**11**	**3**	**15**	**4**	**11**	**7**	**3**	**3**	**6**	**12**
	NA evidence?		**I**	**L**	**L**	**L**	**I**	**A**	**I**	**L**	**L**	**I**	**I**	**L**	**L**

AOCS 559, 563, 569, 570 572 MONITORED NATURAL ATTENUATION PRELIMINARY RANKING

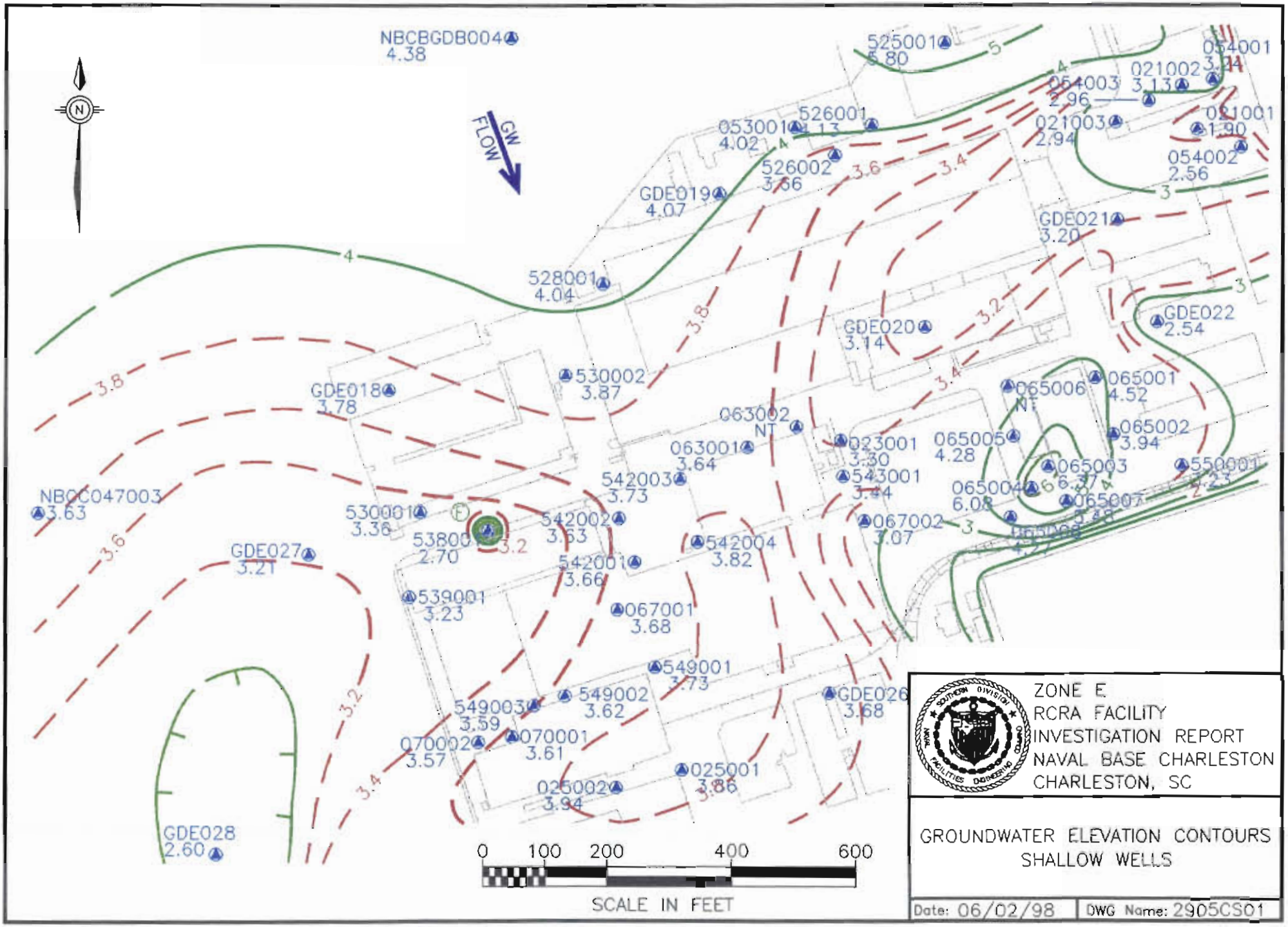
Notes:	* = parameters must exceed 2X background									RANKING RESULTS:					
	"Background" locations:		Avg of results from "background" locations							N =	No evidence (0 pts)				
Shallow wells:	570002		Cl =	8.8	mg/l					I =	Inadequate evidence (0-5 pts)				
	GDE030		Alk =	no values						L =	Limited evidence (6-14 pts)				
			CO_2 =	no values						A =	Adequate evidence (15-20 pts)				
These are clean wells surrounding solvent contamination at site that are upgradient.										S =	Strong evidence (> 20 pts)				
Deep wells:	57002D		Cl =	36.2	mg/l										
	GDE30D		Alk =	no values											
			CO_2 =	no values											
These are clean wells surrounding solvent contamination at site that are upgradient.															



ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, SC

GROUNDWATER ELEVATION CONTOURS
SHALLOW WELLS

Date: 06/02/98 | DWG Name: 2905CS02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GW FLOW
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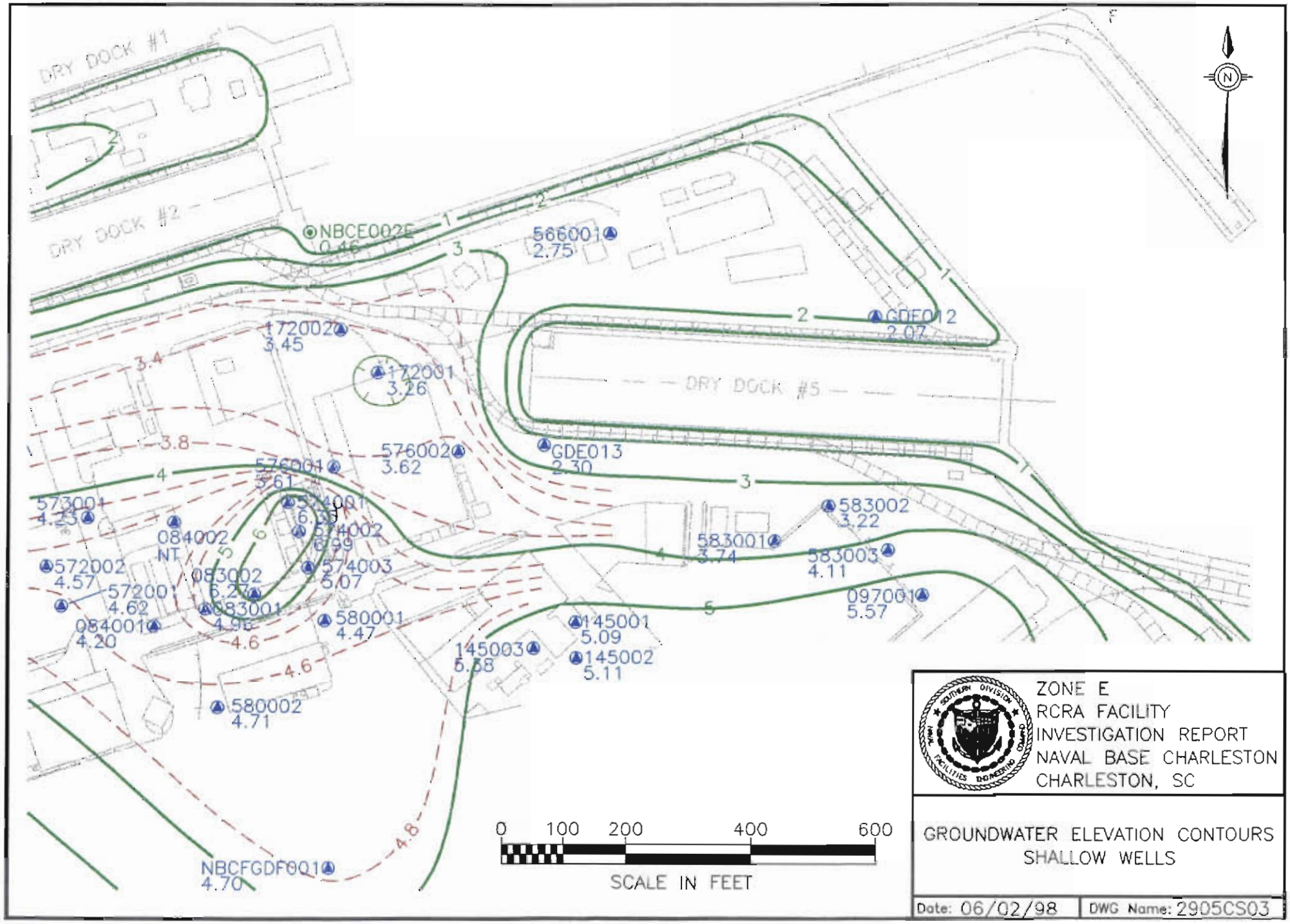
ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, SC
GROUNDWATER ELEVATION CONTOURS
SHALLOW WELLS
Date: 06/02/98
DWG Name: 2905CS01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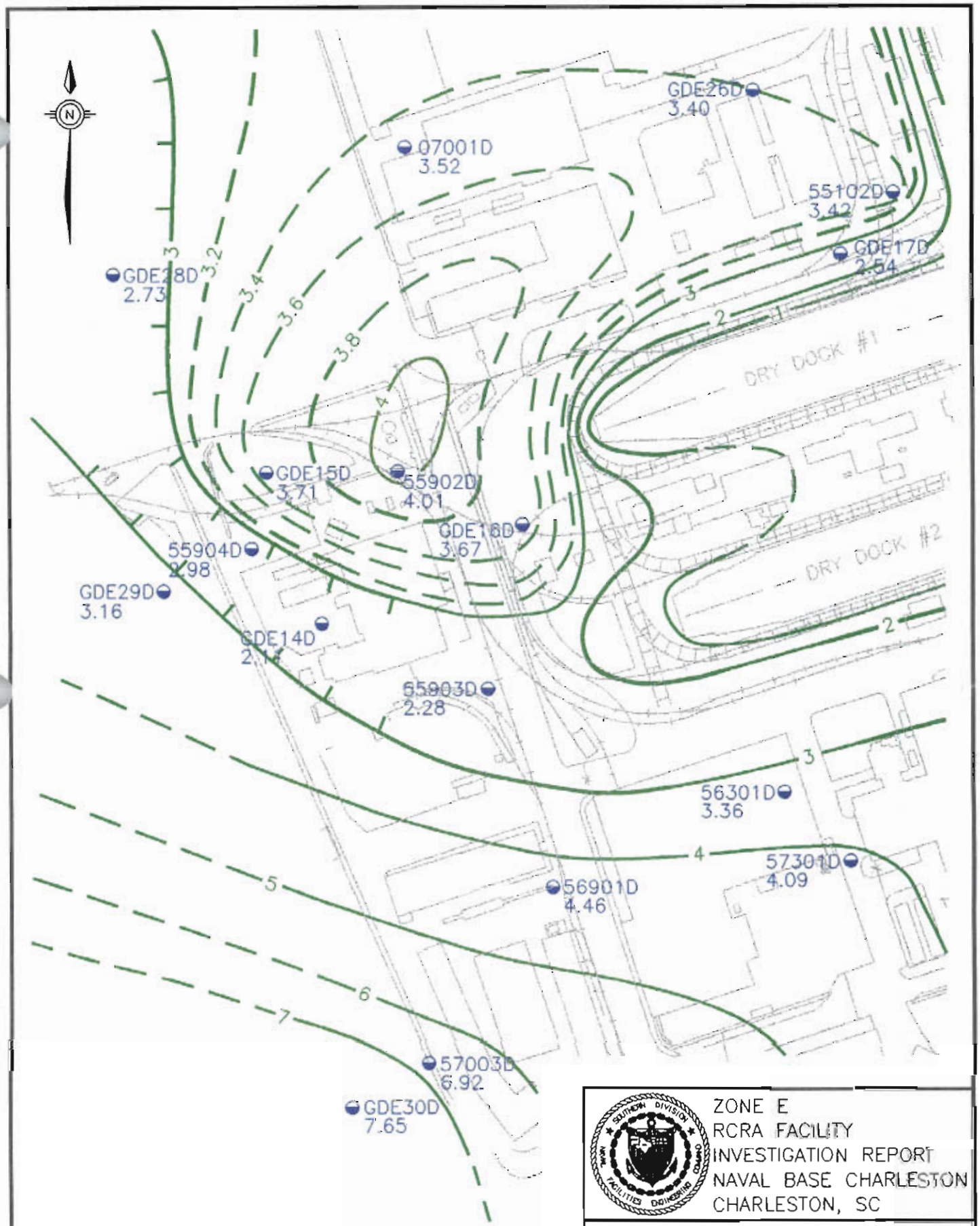
SCALE IN FEET
ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, SC
GROUNDWATER ELEVATION CONTOURS
SHALLOW WELLS
Date: 06/02/98
DWG Name: 2905CS03



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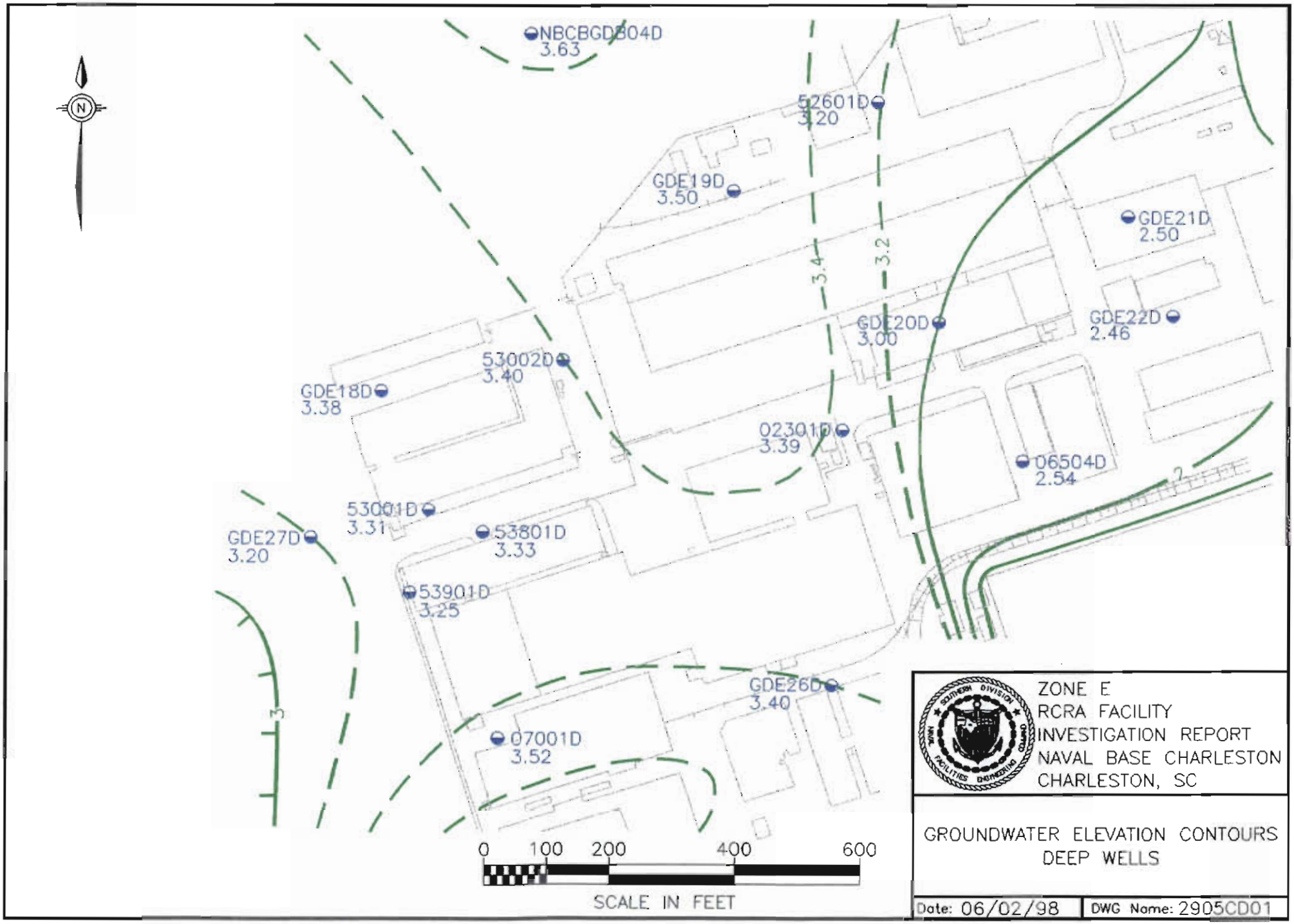
SCALE IN FEET

ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, SC

GROUNDWATER ELEVATION CONTOURS
DEEP WELLS

Date: 06/02/98 | DWG Name: 2905CD02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07001D
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SCALE IN FEET
ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
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GROUNDWATER ELEVATION CONTOURS
DEEP WELLS
Date: 06/02/98
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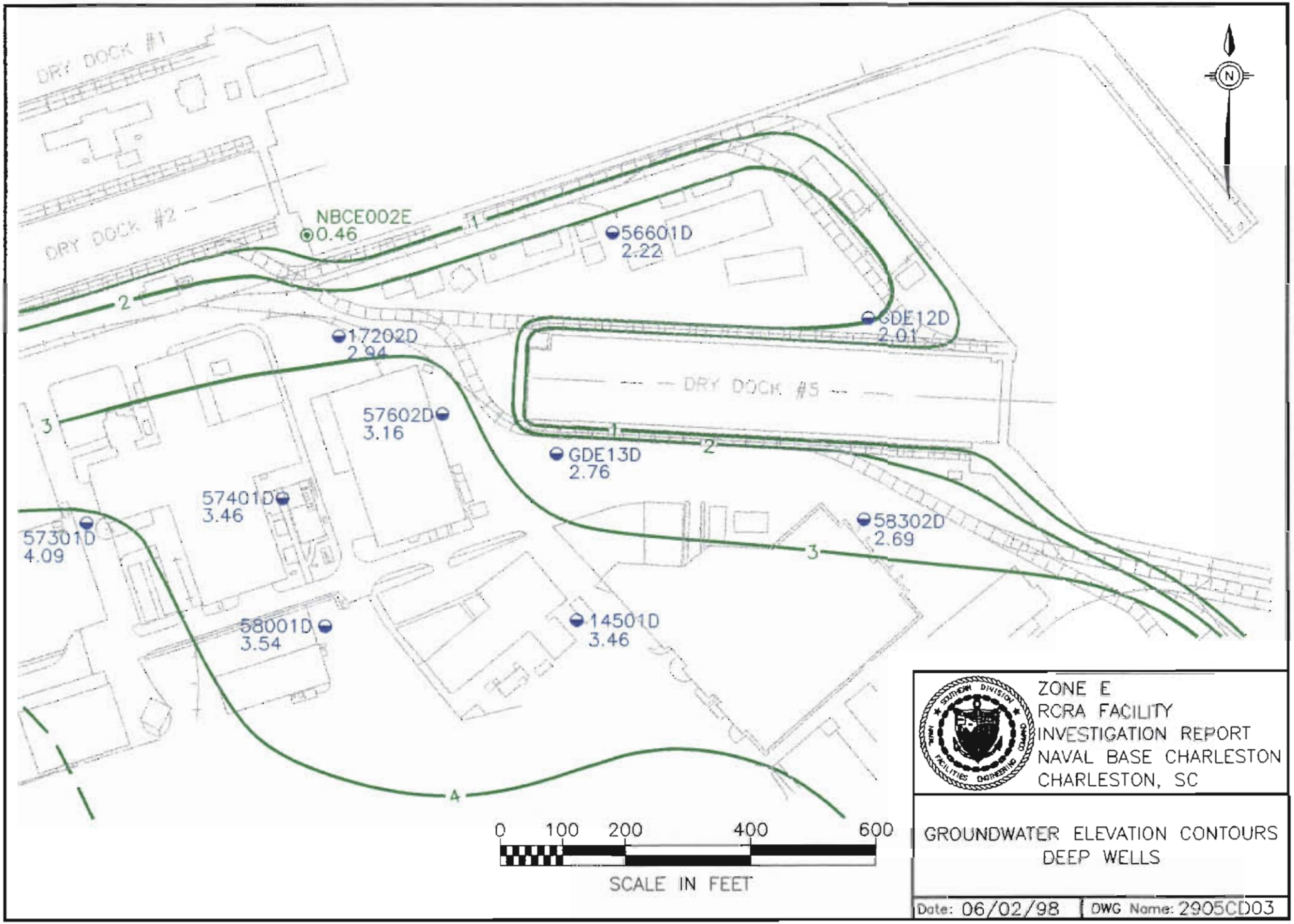
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SCALE IN FEET
ZONE E
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, SC
GROUNDWATER ELEVATION CONTOURS
DEEP WELLS
Date: 06/02/98
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