US EPA RECORDS CENTER REGION 5
1001003

Clean Harbors Services, Inc.
11800 S. Stony Island Ave.
Chicago, IL 60617

EPA ID No. ILD000608471

RCRA Part B License
Request for Permit
April 19, 2003

Volume 9
Appendices
Section E

APPENDIX 1

Boring Logs and Groundwater Monitoring Well Construction Summaries

BORING LOG G-120

SHEET 1 OF 1

SURFACE ELEV. 12.4 Feet — PROJECT SCA Incinerator, Chicago, Illinois

DATUM Chicago City Datum — DATE STARTED 10/11 (P) & 23 (S) — DATE COMPLETED 10/11 (P) & 23

DRILL RIG Mobile B-61 — DRILLING METHOD Hollow Stem Auger (3¼" ID, 7" OD)

ELEV. / DEPTH	DESCRIPTION	UNIFIED CLASS	BLOWS/FOOT	SAMPLES NUMBER	TYPE	HAMMER BLOWS PER 6 IN.	REC./ATT. (in.)	REMARKS
2, 4	Firm to stiff, brown, silty clay FILL mixed with misc. debris (wood, brick, steel, concrete) (CL)							Boring G-120 P initially augered to 13 ft, refusal on concrete, drilled new hole ± 10 ft south of original location. Boring G-120 S is located ± 3 ft north of G-120 P, no sampling was performed. See text for well completion procedures. See Figures 9 and 10 for well completion details.
6			16	1	SS	6-10-refusal	9/12	
8			7	2	SS	1-2-5	16/18	
10								
12			24	3	SS	7-6-18	14/18	
14	Stiff, black, silty clay FILL mixed with misc. debris (CL)		11	4	SS	2-3-8	2/18	
16	Soft, black, silty clay FILL, wet (CL)		4	5	SS	1-1-3	2/18	
18	Stiff, gray, silty CLAY, trace of sand and fine gravel (CL-CH)		10	6	SS	2-4-6	12/18	
20	Boring G-120 P completed at 19 ft 6 in. BGS on 10/11/85. Augers advanced to 19 ft 3 in. BGS to install PVC well casing. Boring G-120 S completed at 18 ft 7 in. BGS on 10/23/85. Ground water encountered at ± 15 ft BGS, but stabilized to ± 8 ft BGS upon completion of each well.							

Job No 853-2054

Scale 1" = 4'

Golder Associates

Drawn DLD

Checked

BORING LOG G-121

SHEET 1 OF 1

SURFACE ELEV. 12.4 Feet | PROJECT SCA Incinerator, Chicago, Illinois

DATUM Chicago City Datum | DATE STARTED 10/14 (P) & 24 (S) | DATE COMPLETED 10/15 (P) & 24 (S

DRILL RIG Mobile B-61 | DRILLING METHOD Hollow Stem Auger (3¼" ID, 7" OD)

ELEV. / DEPTH	DESCRIPTION	UNIFIED CLASS.	BLOWS/FOOT	SAMPLES NUMBER	TYPE	HAMMER BLOWS PER 6 IN.	REC./ATT. (in.)	REMARKS
2, 4, 6	Medium dense, black, misc. FILL (asphalt, brick, concrete, gravel, etc.)		19	1	SS	9-9-10	8/18	Both borings (P and S) were augered without difficulty. G-120 S was drilled ± 3 ft east of G-120 P. No sampling was performed for G-120 S. See text for well completion procedures. See Figures 11 and 12 for well completion details.
8, 10	Soft, black, oily sludge and misc. FILL, wet		24	2	SS	2-3-21	8/18	
			3	3	SS	1-1-2	14/18	
12	Soft, brown and gray, silty clay FILL (CL-CH)		5	4	SS	2-3-2	14/18	
	Soft, black, oily sludge FILL		10	5	SS	3-6-4	14/18	
16, 18	Firm, gray, silty CLAY, trace of sand and fine gravel (CL-CH)							
20	Boring G-121 P completed at 17 ft BGS on 10/15/85. Boring G-121 S completed at 18 ft 6 in. BGS on 10/24/85. Ground water encountered at ± 7 ft BGS in both borings.							

Job No 853-2054 | Scale 1" = 4'

Golder Associates

Drawn DLO | Checked

BORING LOG G-122 (P and S)

SHEET 1 OF 1

SURFACE ELEV. 12.6 Feet
PROJECT SCA Incinerator, Chicago, Illinois
DATUM Chicago City Datum
DATE STARTED 10/14 (P) & 24 (S) DATE COMPLETED 10/14 (P) & 24(S)
DRILL RIG Mobile B-61
DRILLING METHOD Hollow Stem Auger (3¼" ID, 7" OD)

ELEV. DEPTH	DESCRIPTION	UNIFIED CLASS	BLOWS/FOOT	SAMPLES NUMBER	TYPE	HAMMER BLOWS PER 6 IN.	REC./ATT. (in.)	REMARKS
2	Loose to medium dense, black, sandy FILL mixed with misc. debris (wood, brick, concrete, etc.)							Both borings (P and S) were augered without refusal. G-122 S was drilled + 3 ft east of G-122 P. No sampling was performed for G-122 S. See text for well completion procedures. See Figures 13 and 14 for well completion details. No sample at 9.5 ft, augered through concrete.
4			12	1	SS	12-6-6	8/18	
6								
8	Warm water encountered at 8 ft BGS		6	2	SS	2-2-4	9/18	
10								
12	Very soft to soft, black, silty clay FILL, wet (CL-CH)		1	3	SS	0-1-0	10/18	
14								
16			3	4	SS	1-1-2	14/18	
	Stiff, gray, silty CLAY							
18			14	5	SS	2-6-8	18/18	
20	Boring G-122 P completed at 18 ft 6 in. BGS on 10/14/85. Augers advanced to 17 ft 9 in. BGS to install PVC well casing. Boring G-120 S completed at 18 ft 6 in. on 10/24/85. Ground water encountered at ± 8 ft BGS in both borings.							

Job No. 853-2054
Scale 1" = 4'

Golder Associates

Drawn DLO
Checked

BORING LOG C-123 S

SHEET 1 OF 1

SURFACE ELEV. 12.4 Feet
PROJECT SCA Incinerator, Chicago, Illinois
DATUM Chicago City Datum
DATE STARTED 10/16/85
DATE COMPLETED 10/17/85
DRILL RIG Mobile B-61
DRILLING METHOD Hollow Stem Auger (3¼" ID, 7" OD)

ELEV. / DEPTH	DESCRIPTION	UNIFIED CLASS.	BLOWS/FOOT	SAMPLES NUMBER	TYPE	HAMMER BLOWS PER 6 IN.	REC./ATT. (in.)	REMARKS
2	Firm to very stiff, black, misc. FILL (brick, concrete, sand, clay, etc.)							Initial boring was augered to refusal at 10 ft depth. Augered new hole 10 ft west of original location without any difficulty to a depth of 18 ft 3 in. See text for well completion procedures. See Figure 15 for well completion details
4								
6			26	1	SS	7-11-15	8/18	
8	Wet at 8 ft depth		7	2	SS	5-3-4	8/18	
10								
12	Firm, gray, gravelly clay FILL		6	3	SS	2-2-4	10/18	
14	Stiff, gray and black, silty clay FILL, wet		14	4	SS	6-6-6	18/18	
16	Grading soft at 16 ft		5	5	SS	2-3-2	18/18	
18	Soft, gray, silty CLAY, trace sand and fine gravel (CL-CH)							
20	Boring completed at 18 ft 3 in. BGS on 10/17/85. Ground water encountered at ± 8 ft BGS, but stabilized at + 4 ft BGS upon completion of well.							

Job No. 853-2054
Scale 1" = 4'

Golder Associates

Drawn DLD
Checked

BORING LOG G-124 S

SHEET 1 OF 1

SURFACE ELEV. 11.9 Feet | PROJECT SCA Incinerator, Chicago, Illinois

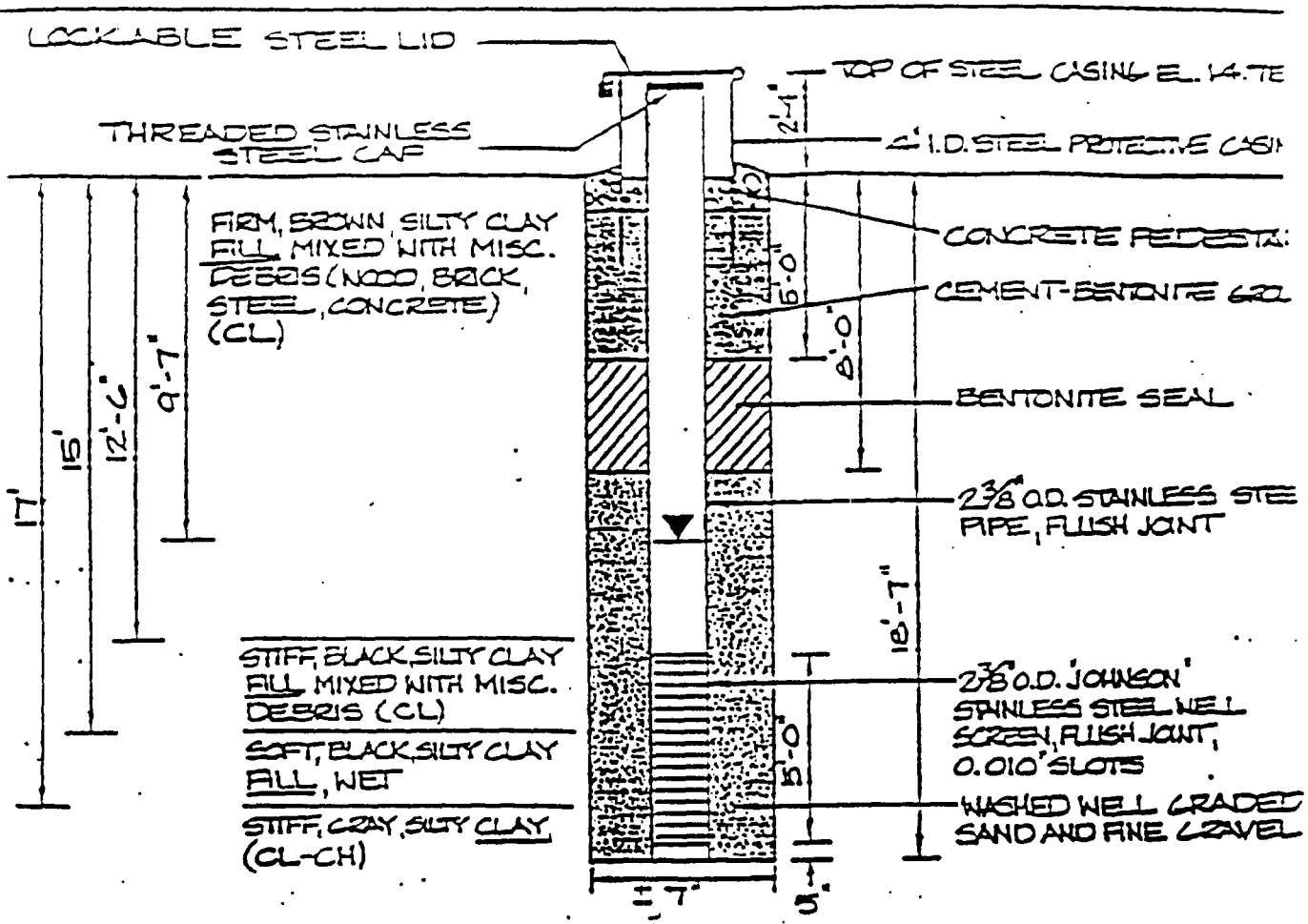
DATUM Chicago City Datum | DATE STARTED 10/22/85 | DATE COMPLETED 10/22/85

DRILL RIG Mobile B-61 | DRILLING METHOD Hollow Stem Auger (3½" ID, 7" OD)

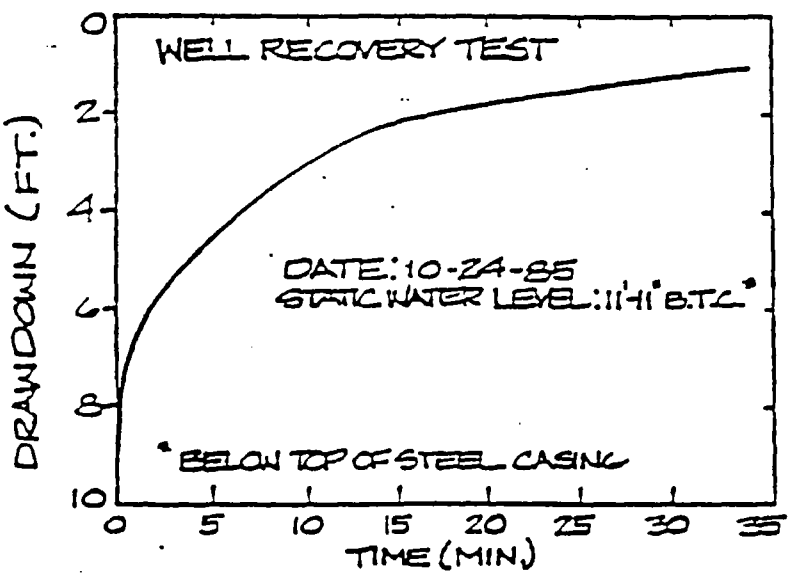
ELEV. / DEPTH	DESCRIPTION	UNIFIED CLASS	BLOWS/FOOT	SAMPLES NUMBER	TYPE	HAMMER BLOWS PER 6 IN.	REC./ATT. (in.)	REMARKS
2, 4	Firm to stiff, black, sand, silty, clay and gravel FILL							Boring was augered to full depth without any difficulty. See text for well completion procedures. See Figure 16 for well completion details.
6			6	1	SS	4-2-4	8/18	
	Warm water at 7.5 ft depth							
9			9	2	SS	7-4-5	10/18	
10								
	Soft to firm, brown and gray, silty clay FILL (CL-CH), moist		4	3	SS	2-2-2	18/18	
12								
			5	4	SS	1-2-3	18/18	
14	Grading gravelly at base of fill (wet)							
			51	5	SS	6-38-13	6/18	
16	Stiff, gray, silty CLAY, trace sand and fine gravel (CL-CH)							
18			15	6	SS	3-6-9	18/18	
20	Boring completed at 19 ft BGS on 10/22/85. Augers advanced to only 18 ft 8 in. BGS to install well casing. Ground water encountered at ± 7.5 ft BGS, but stabilized at ± 6 ft BGS upon completion of well.							

Job No. 853-2054 | Scale 1" = 4' | Golder Associates | Drawn DLO | Checked [illegible]

COMPLETION DETAIL
WELL G-120S



SCALE: VERT. 1" = 5'
HORIZ. N.T.S.

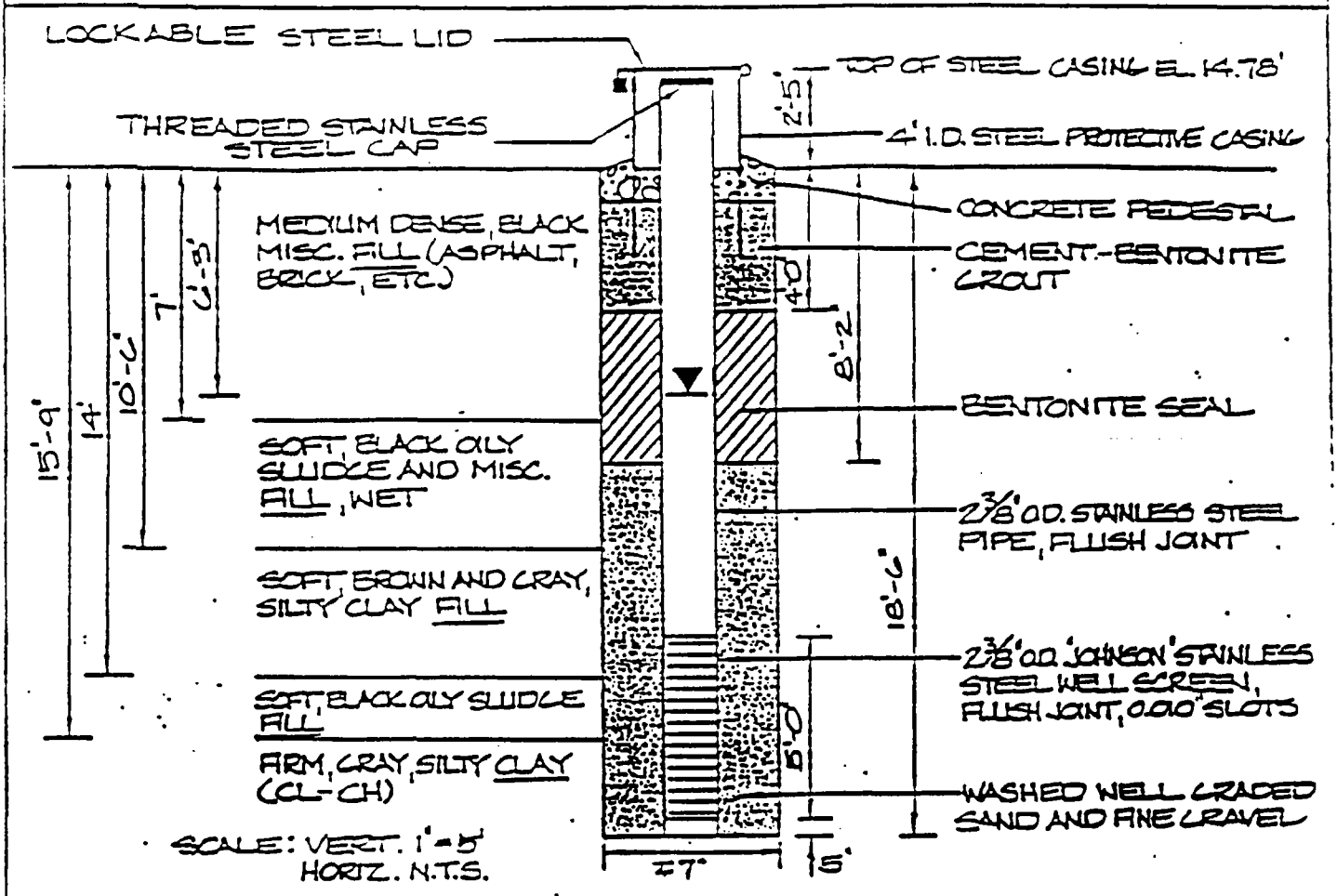


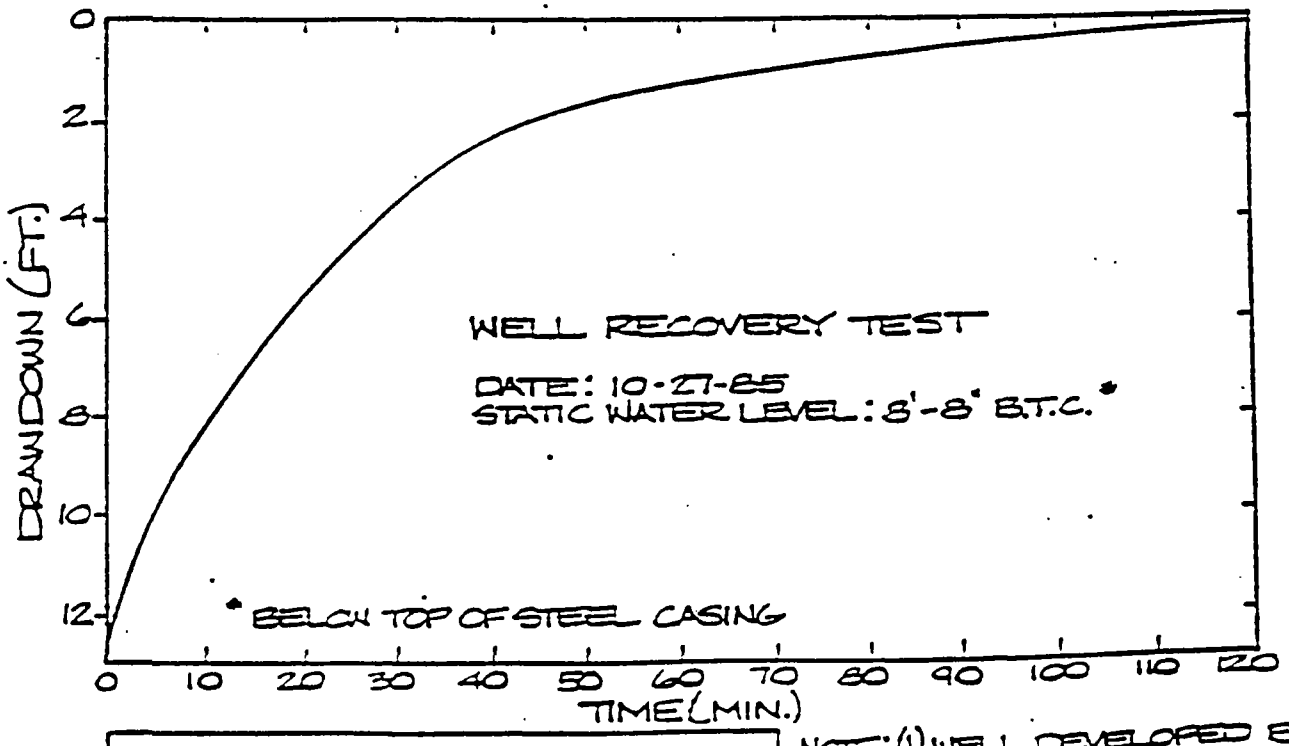
NOTES: WELL DEVELOPED BY BAILING WITH A STAINLESS STEEL BAILER ON OCT. 24, 25, 26 AND 27. TOTAL VOLUME OF WATER REMOVED = 18 GALLONS

GROUND WATER QUALITY DATA

DATE: 10-25-85
TEMPERATURE: 16°C
CONDUCTIVITY: 1250 μmhos/cm

COMPLETION DETAIL
WELL G-121S



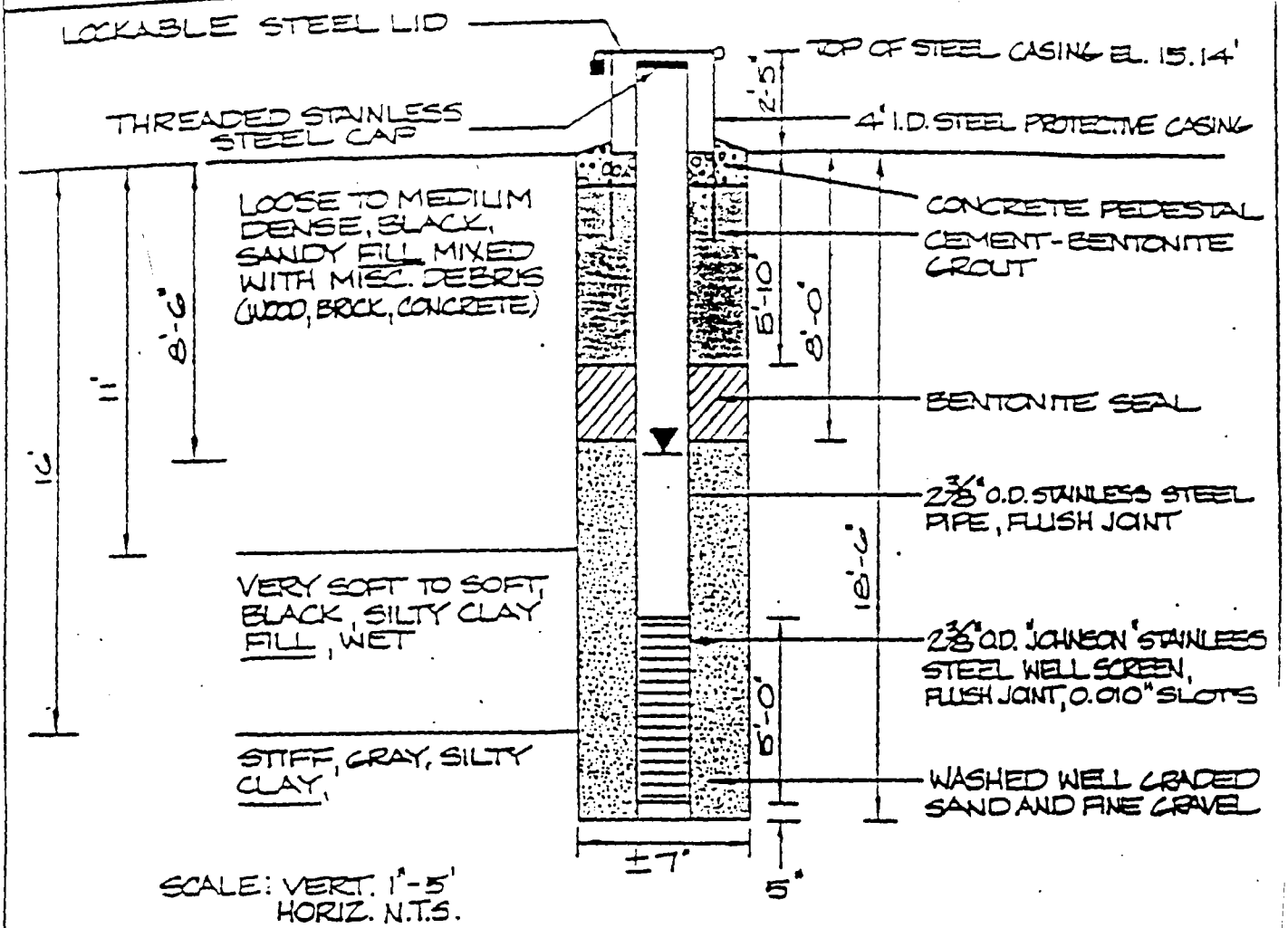


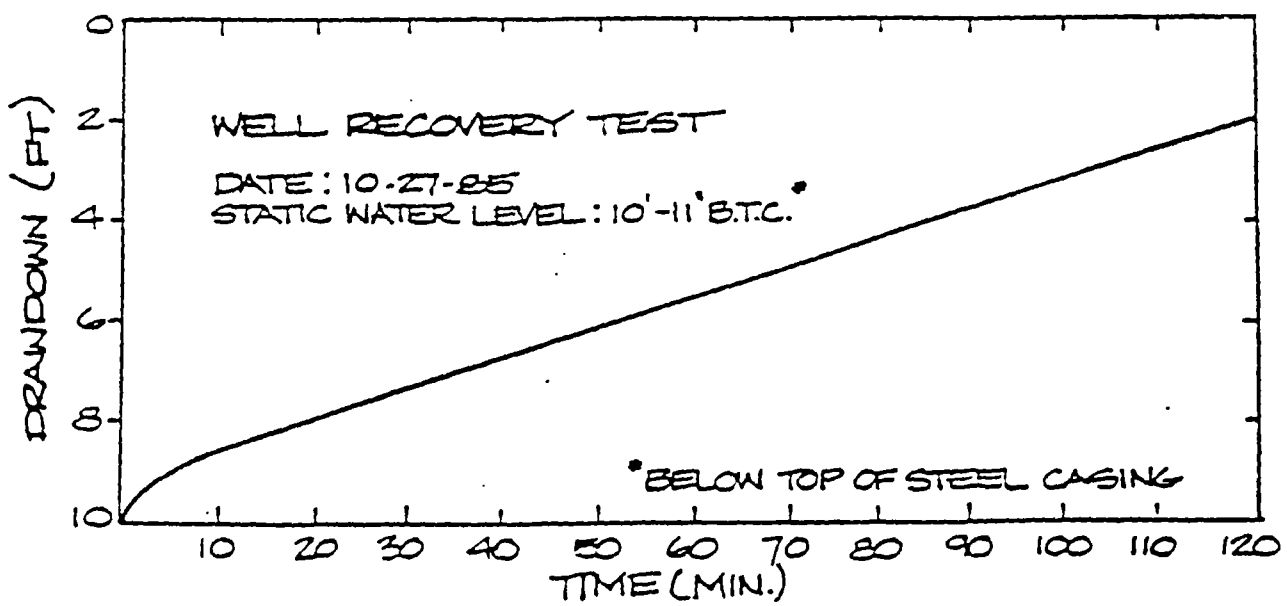
GROUND WATER QUALITY
DATE: 10-25-85
TEMPERATURE: 16°C
CONDUCTIVITY: 15,500 μmhos/cm

NOTE: (1) WELL DEVELOPED BY BAILING ON OCTOBER 25, 26 AND 27, TOTAL VOLUME REMOVED = 18 GALLONS

Proj. No. 853-2054 Eng. DO Date 10-31-85

COMPLETION DETAIL
WELL G-122S



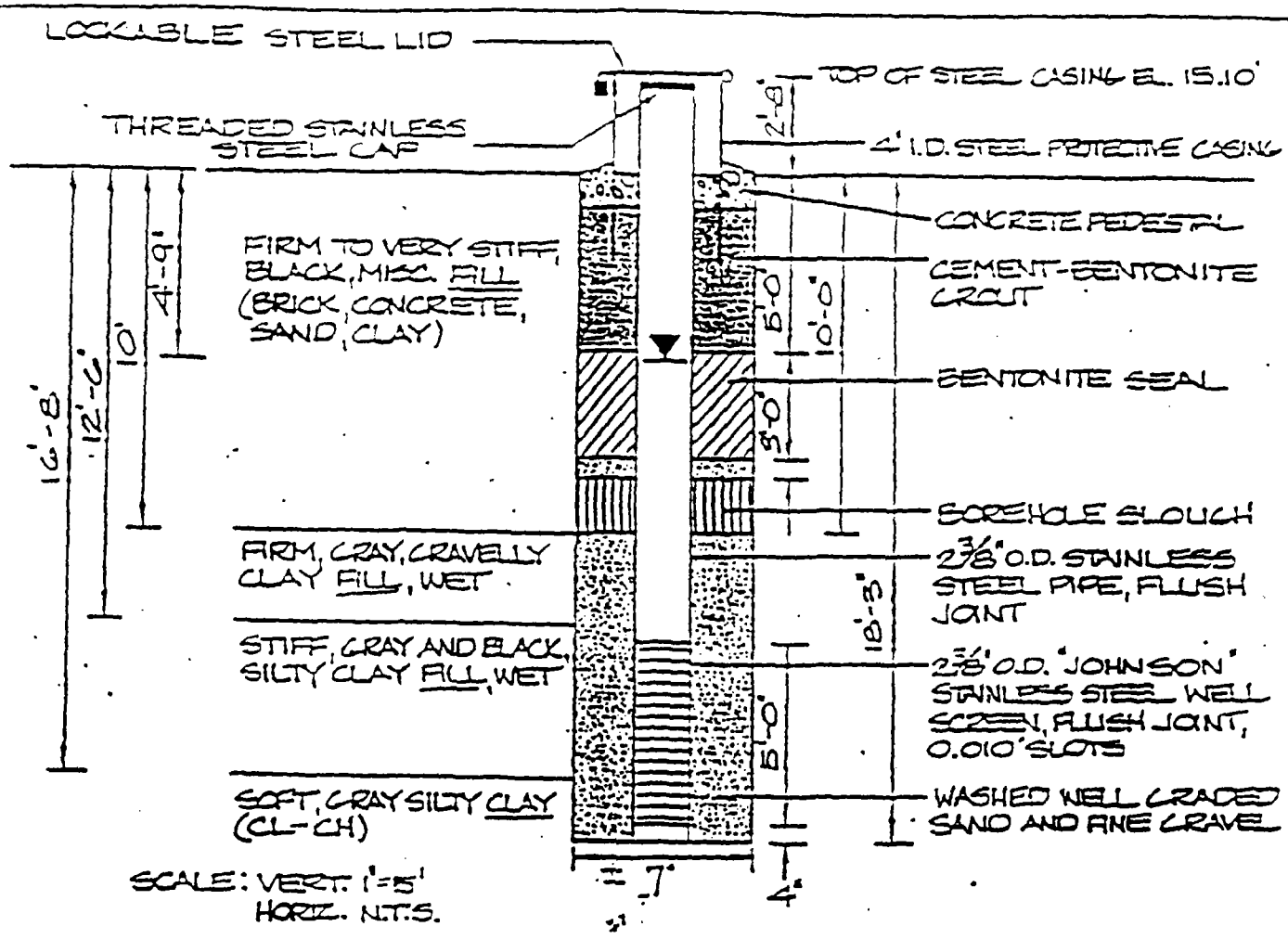


GROUND WATER QUALITY

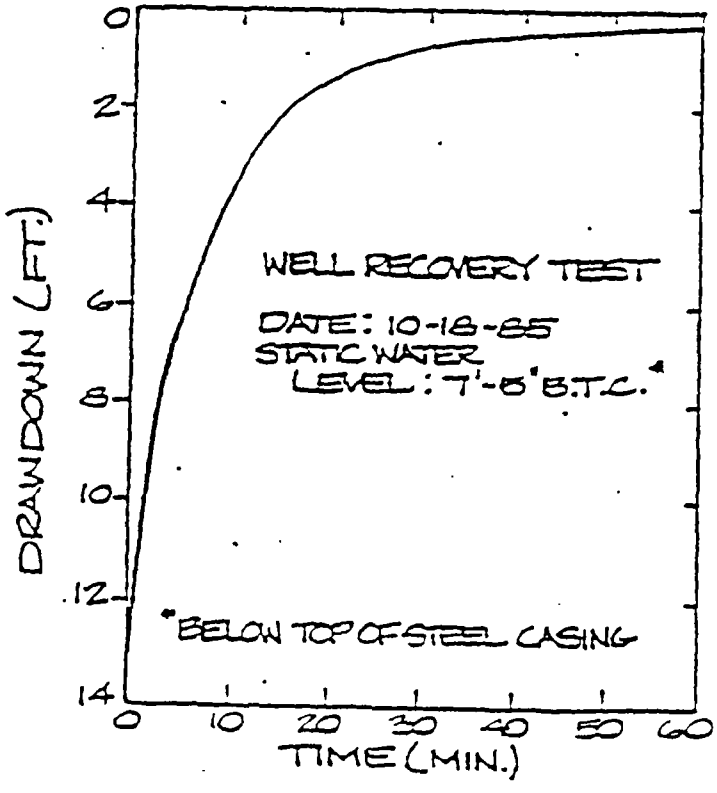
DATE: 10-25-85
TEMPERATURE: 24°C
CONDUCTIVITY: 11,000 μmhos/cm

NOTES: (1) WELL DEVELOPED BY BAILING WITH A STAINLESS STEEL BAILER ON OCT. 25, 26 AND 27. TOTAL VOLUME OF WATER REMOVED = 18 GALLONS.

COMPLETION DETAIL
WELL G-123S



SCALE: VERT. 1"=5'
HORIZ. N.T.S.

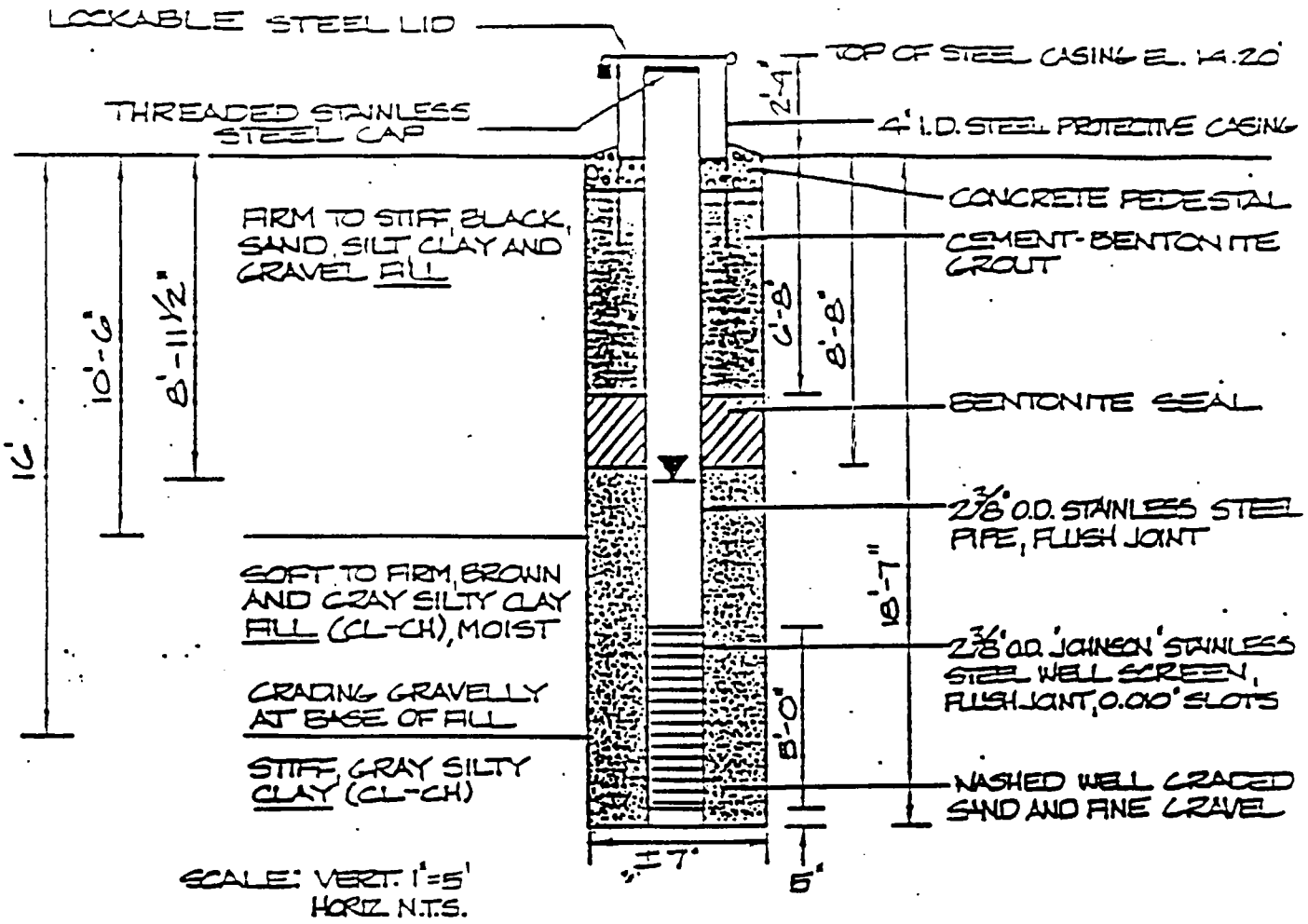


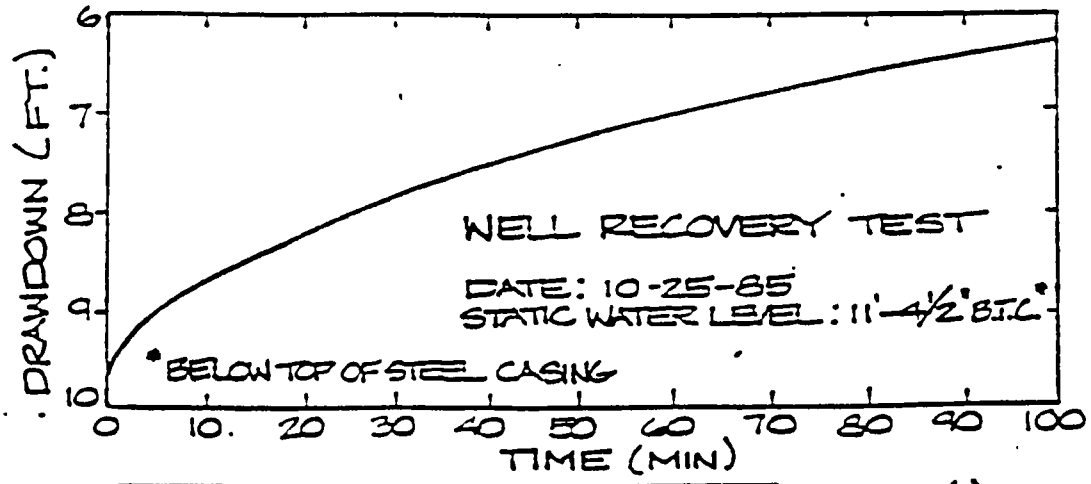
GROUND WATER QUALITY

DATE: 10-22-85
TEMPERATURE: 19°C
CONDUCTIVITY: 5,100 μmhos/cm

NOTE: WELL DEVELOPED BY BAILING ON OCTOBER 18, 21 AND 22. TOTAL VOLUME REMOVED = 107 GALLONS

COMPLETION DETAIL
WELL G-124S





GROUND WATER QUALITY

DATE: 10-25-85
TEMPERATURE: 24°C
CONDUCTIVITY: 1,700 μmhos/cm

NOTE: (1) WELL DEVELOPED BY BAILING ON OCTOBER 23, 24, 25, 26 AND 27. TOTAL VOLUME REMOVED = 27 GALLONS.

SOIL BOREHOLE LOG

SITE NAME AND LOCATION CWM Incinerator Chicago, IL	DRILLING METHOD: 8" OD Hollow Stem Auger	BORING NO. B-G307	
		SHEET 1 OF 1	
	SAMPLING METHOD: 2" Split-spoon (SS) 3" Split-spoon (SS)	DRILLING	
		START	FINISH
	WATER LEVEL	TIME	TIME
	TIME	1010	1315
	DATE	DATE	DATE
DATUM Chicago City ELEVATION 8.4'	CASING DEPTH	9/20/89	9/20/89

DRILL RIG Mobile B-57 ATV

ANGLE vertical BEARING

SAMPLE HAMMER TORQUE FT.-LBS

SURFACE CONDITIONS: Gravel/weeds

DEPTH IN FEET (ELEVATION)	BLOWS/6 IN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS: WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS
2	4,3, 2,4 (54%)		gray to black silty GRAVEL (fill); some sand and clay; moist; hard (GM)	2" SS	No casing used						
4	8,8, 7,6 (67%)		Light gray sandy GRAVEL (fill); dry; poorly graded; some brick and organic matter (GP)	2" SS							
6	2,1, 1,0 (33%)		Gray to black silty SAND (fill); wet at 6.5 feet; loose to very loose; some organic matter (SM)	2" SS							
8	1,1, 1,8 (62%)			2" SS							
10	7,4, 4,3 (79%)			3" SS							
12	2,1, 5,7 (83%)			2" SS							
14	4,8, 12,13 (100%)			3" SS							
			Light gray CLAY; moist; plastic (CL)								
			Bottom of boring at 14 feet.								

ATEC

DRILLING CONTR

LOGGED BY T. Hariu

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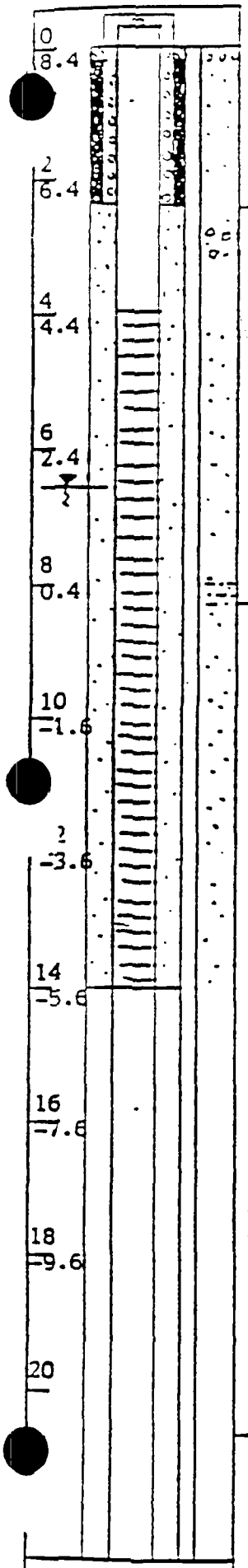


Well No. G-307

Boring No. X-Ref:

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords:

Elevation Ground Level 8.4'

Top of Casing 10.76'

Drilling Summary:

Total Depth 14'0"

Borehole Diameter 8" auger (OD) → 9"

Casing Stick-up Height: 2.36'

Driller D. Cass - Atec

Rig Mobile B-57

Bit(s) Hollow Stem Auger

Drilling Fluid None

Protective Casing Steel

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	9/20	1015	9/20	1315
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:	11/9	0925	11/9	1500

Well Design & Specifications

Basis: Geologic Log X Geophysical Log ___

Casing String (s): C = Casing S = Screen.

Depth		String(s)	Elevation	
+2.4'	4.0'	C1	10.76'	4.4'
4.0'	14.0'	S1	4.4'	5.6'

Casing: C1 2" dia PVC

C2

Screen: S1 2" dia PVC (4.0' -14.0' depth) 10 slot

S2

Filter Pack: (2-14' depth) Sand retained on #20, uniformly graded between 10 and 20

Grout Seal: Grout at surface Portland type 2 cement

Bentonite Seal: (0-2' depth) Aquagel Gold seal bentonite

Well Development:

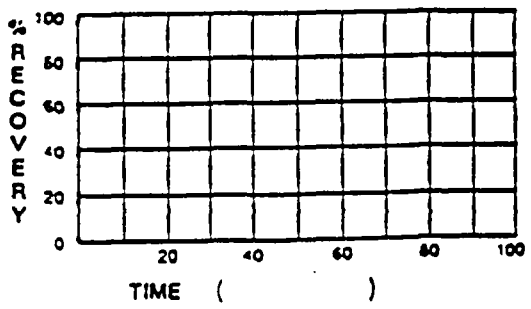
1 Well Volume = 32.7 gals (Calculated using 9" dia and height of wter column) ~ 41 gals pumped 5.75 hrs developed using nitrogen lift

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
5.75	7.82	1460	7.5

Recovery Data:

Q= S_o=



Comments: Dry bentonite pellets inside procover, capped with sand

Well installation overseen by D. Trainor (first well installed in project)

*Grout only at surface due to shallow depth of water table

CWM

SITE NAME

SUPERVISED BY Tina Hartu 9/20/89

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TABLE 1.4-14

TABLE 7

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : TANK FARM (page 1)

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

ESTIM DATE : 09-Jun-92
SHEET NO : 08 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	INVENTORY REMOVAL													
G1000	Verify inventory	*	1	2.00	2	28.10	56	0.00	0	0.00	0	0.00	0	56
G1100	Transport haz. waste liquids (178,950 gal, 200 mi)	TRKLD	36	2.00	72	34.35	2,473	0.00	0	0.00	0	750	27,000	29,473
G1200	Incinerate haz. waste liquids (9 lb/gal) (RCRA incinerator)	GAL	178,950	0.00	0		0	0.00	0	0.00	0	2.80	495,460	495,460
G1300	Transport fuel to fuel blender (24,000 gal, < 25 mi)	TRKLD	8	2.00	10	34.35	344	0.00	0	0.00	0	90	450	794
	SUB-TOTAL:	-	-	-	84	-	2,873	-	0	-	0	-	522,910	525,783
	DECONTAMINATION													
G2000	Decontaminate 13 haz. waste tanks (34,200 gal solvent)	*	1	95.00	95	28.10	2,670	32,045	32,045	630.00	630	0	0	35,345
G2100	Decontaminate 13 haz. waste tanks (34,200 gal water)	*	1	95.00	95	28.10	2,670	0.00	0	630.00	630	0	0	3,300
G2200	Visually inspect haz. waste tanks	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
G2300	Decontaminate 2 fuel tanks (5,000 gal water)	*	1	15.00	15	28.10	422	0.00	0	105.00	105	0	0	527
G2400	Visually inspect fuel tanks	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
G2500	Decontaminate secondary containment (brush/vacuum)	*	1	10.00	10	28.10	281	0.00	0	0.00	0	0	0	281
G2550	Decontaminate secondary containment (5,000 gal solvent)	*	1	10.00	10	28.10	281	0.00	0	0.00	0	0	0	281
G2600	Decontaminate secondary containment (20,000 gal water)	*	1	25.00	25	28.10	703	0.00	0	210.00	210	0	0	913
G2700	Visually inspect secondary containment	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
G2800	Inspect secondary containment with ground penetrating radar	*	1	0.00	0		0	0.00	0	0.00	0	8,135	8,135	8,135
	SUB-TOTAL:	-	-	-	253	-	7,109	-	32,045	-	1,575	-	8,135	48,864
	TRANSPORT AND DISPOSAL OF DECON. RESIDUALS													
G3000	Transport decon. solvent (41,700 gal, 750 mi)	TRKLD	9	2.0	18	34.35	618	0.00	0	0.00	0	2,815	25,335	25,953
G3100	Off-site incineration of solvent (TSCA incinerator)	GAL	41,700	0.0	0		0	0.00	0	0.00	0	3.65	152,205	152,205
G3200	Transport decon. rinsewaters (59,200 gal, 300 mi)	TRKLD	12	2.0	24	34.35	824	0.00	0	0.00	0	1,125	13,500	14,324
G3300	Off-site treatment of rinsewaters	GAL	59,200	0.0	0		0	0.00	0	0.00	0	0.55	32,560	32,560
	SUB-TOTAL:	-	-	-	42	-	1,443	-	0	-	0	-	223,600	225,043
	SUB-TOTAL THIS PAGE---------->			**********	379	**********	11,425	**********	32,045	**********	1,575	**********	754,845	799,890

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: TANKFARM

TABLE I.4-14

TABLE 7 (continued)

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : TANK FARM (page 2)

ESTIM DATE : 09-Jun-92
SHEET NO : 09 of 24

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	SAMPLING AND ANALYSIS													
G4000	Decon. solvent (from 3rd rinse; one sample per haz. waste tank)	SAMPL	13	0.5	6.5	28.10	183	0.00	0	0.00	0	200	2,600	2,783
G4100	Decon. rinsewater (from 3rd rinse; one sample for each tank)	SAMPL	15	0.5	7.5	28.10	211	0.00	0	0.00	0	350	5,250	5,461
G4200	Decon. rinsewater (from 3rd rinse of secondary containment; 1 sample per 5,000 sq ft)	SAMPL	2	0.5	1.0	28.10	28	0.00	0	0.00	0	350	700	728
G4300	PCB wipe (one sample per haz. waste tank)	SAMPL	13	0.5	6.5	28.10	183	0.00	0	0.00	0	95	1,235	1,418
G4400	PCB wipe (sec contain; area = 8,000 sq ft; 1 samp./2,500 sq ft)	SAMPL	8	0.5	4.0	28.10	112	0.00	0	0.00	0	85	680	872
	SUB-TOTAL:	-	-	-	26	-	717	-	0	-	0	-	10,545	11,262
	CLOSURE OF TANK TRUCK UNLOADING AREA													
G5000	Decontaminate unloading area (brush/vacuum)	*	1	5.00	5	28.10	141	0.00	0	0.00	0	0	0	141
G5050	Decontaminate unloading area (2,500 gal solvent)	*	1	5.00	5	28.10	141	0.00	0	0.00	0	0	0	141
G5100	Decontaminate unloading area (10,080 gal water)	*	1	13.00	13	28.10	365	0.00	0	210.00	210	0	0	575
G5200	Visually inspect unloading area	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
G5300	Inspect unloading area with ground penetrating radar	*	1	0.00	0		0	0.00	0	0.00	0	5,645	5,645	5,645
G5350	Transport and incineration of solvent included in G3000/G3100	*		0.00	0		0	0.00	0	0.00	0	5,645	0	0
G5400	Transport decon. rinsewaters (10,080 gal, 300 mi)	TRKLD	3	2.00	6	34.35	206	0.00	0	0.00	0	1,125	3,375	3,581
G5500	Off-site treatment of decon. rinsewaters	GAL	10,080	0.00	0		0	0.00	0	0.00	0	0.55	5,544	5,544
G5600	Sampling and analysis of decon. rinsewater (from 3rd rinse)	SAMPL	1	0.50	1	28.10	14	0.00	0	0.00	0	350	350	364
G5700	Sampling and analysis of PCB wipe (area = 2,520 sq ft)	SAMPL	4	0.50	2	28.10	56	0.00	0	0.00	0	1,635	6,540	6,596
	SUB-TOTAL:	-	-	-	33	-	951	-	0	-	210	-	21,454	22,615
	SUB-TOTAL THIS PAGE ----->				58		1,667		0		210		31,999	33,876
	TOTAL THIS ACTIVITY ----->				437		13,092		32,046		1,785		786,644	833,568

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: TANKFARM

TABLE 14-15

TABLE 8

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : PROPOSED SLUDGE FUEL TANK AND UNLOADING AREA

ESTIM DATE : 19-Aug-92
SHEET NO : 10 of 24

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	INVENTORY REMOVAL													
H1000	Verify inventory	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0.00	0	28
H1100	Transport waste liquids (12,000 gal, 200 mi)	TRKLD	3	2.00	6	34.35	206	0.00	0	0.00	0	750	2,250	2,456
H1200	Incinerate waste liquids (9 lb/gal) (RCRA incinerator)	GAL	12,000	0.00	0		0	0.00	0	0.00	0	2.80	33,600	33,600
	SUB-TOTAL:	-	-	-	7	-	234	-	0	-	0	-	35,850	36,084
	DECONTAMINATION													
H2000	Decontaminate sludge tank (2,160 gal solvent)	*	1	7.00	7	28.10	197	2,250	2,250	105.00	105	0	0	2,552
H2100	Decontaminate sludge tank (2,160 gal water)	*	1	7.00	7	28.10	197	0.00	0	105.00	105	0	0	302
H2200	Decontaminate secondary containment (brush/vacuum)	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
H2250	Decontaminate secondary containment (2,665 gal solvent)	*	1	6.00	6	28.10	169	2,665.00	2,665	0.00	0	0	0	2,834
H2300	Decontaminate secondary containment (10,500 gal water)	*	1	18.00	18	28.10	506	0.00	0	500.00	500	0	0	1,006
H2400	Visually inspect sludge tank and secondary containment	*	1	2.00	2	28.10	56	0.00	0	0.00	0	0	0	56
H2500	Inspect secondary containment with ground penetrating radar	*	1	0.00	0		0	0.00	0	0.00	0	3,135	3,135	3,135
	SUB-TOTAL:	-	-	-	41	-	1,152	-	4,915	-	710	-	3,135	9,912
	TRANSPORT AND DISPOSAL OF DECON. RESIDUALS													
H3000	Transport decon. solvent (4,825 gal, 750 mi)	TRKLD	1	2.00	2	34.35	69	0.00	0	0.00	0	2,815	2,815	2,884
H3100	Off-site incineration of solvent (7 lb/gal, TSCA incinerator)	GAL	2,660	0.00	0		0	0.00	0	0.00	0	3.65	9,709	9,709
H3200	Transport decon. rinsewaters (12,660 gal, 300 mi)	TRKLD	3	2.00	6	34.35	206	0.00	0	0.00	0	1,125	3,375	3,581
H3300	Off-site treatment of rinsewaters	GAL	12,660	0.00	0		0	0.00	0	0.00	0	0.55	6,963	6,963
	SUB-TOTAL:	-	-	-	8	-	275	-	0	-	0	-	22,862	23,137
	SAMPLING AND ANALYSIS													
H4000	Decon. solvent (from 3rd rinse of tank)	SAMPL	1	0.50	0.5	34.35	17	0.00	0	0.00	0	200	200	217
H4100	Decon. rinsewater (from 3rd rinse of tank)	SAMPL	1	0.50	0.5	34.35	17	0.00	0	0.00	0	935	330	347
H4200	Decon. rinsewater (from 3rd rinse of secondary containment)	SAMPL	1	0.50	0.5	34.35	17	0.00	0	0.00	0	935	330	347
H4300	PCB wipe (one sample from tank)	SAMPL	4	0.50	2.0	34.35	69	0.00	0	0.00	0	95	380	449
H4400	PCB wipe (sec contain; area = 2,665 sq ft; 1 sample/2,500 sq ft)	SAMPL	2	0.50	1.0	34.35	34	0.00	0	0.00	0	95	190	224
	SUB-TOTAL:	-	-	-	5	-	155	-	0	-	0	-	1,430	1,585
	SUB-TOTAL THIS PAGE---------->			********	61	********	1,816	********	4,915	********	710	********	63,277	70,718

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: SLUDGETK

Revision Ha
August 21, 1992

TABLE I 4-18

ICF KAISER ENGINEERS, INC.
8300 LEE HIGHWAY
FAIRFAX, VIRGINIA 22031-3000
DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 30 OCT 91

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : INCINERATOR (Page 1)

ESTIM BY : A MUHR
ESTIM TYPE : FINAL
ESTIM DATE : 10-Jun-92
SHEET NO : 12 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	REMOVAL OF REFRACTORY AND OTHER INTERNAL ELEMENTS													
J1000	Remove refractory brick	CU YD	200	0.40	80	28.10	2,248	0.00	0	0.00	0	0	0	2,248
J1100	Transport refractory brick (200 cu yd, 1,750 mi by rail)	TON	200	0.03	7	34.35	229	0.00	0	0.00	0	115	23,000	23,229
J1200	Remove scrubber tower packing	CU YD	92	0.40	37	28.10	1,034	0.00	0	0.00	0	0	0	1,034
J1300	Transport scrubber tower packing (92 cu yd, 1,750 mi by rail)	TON	2	1.53	3	34.35	105	0.00	0	0.00	0	115	230	335
J1400	Remove ionizing plates	CU YD	20	0.40	8	28.10	225	0.00	0	0.00	0	0	0	225
J1500	Transport ionizing plates (20 cu yd, 1,750 mi by rail)	TON	20	0.03	1	34.35	23	0.00	0	0.00	0	115	2,300	2,323
J1600	Remove demisters	CU YD	20	0.40	8	28.10	225	0.00	0	0.00	0	0	0	225
J1700	Transport demisters (20 cu yd, 1,750 mi by rail)	TON	20	0.03	1	34.35	23	0.00	0	0.00	0	115	2,300	2,323
J1800	Dispose of refractory brick, tower packing, ionizing plates, demisters (TSCA landfill)	TON	242	0.00	0		0	0.00	0	0.00	0	115	27,830	27,830
	SUB-TOTAL:	-	-	-	144	-	4,111	-	0	-	0	-	55,660	59,771
	DECONTAMINATION													
J2000	Decon. internal surfaces (59,500 gal water)	*	1	74.00	74	28.10	2,079	0.00	0	520.00	520	0	0	2,599
J2100	Visually inspect internal surfaces	*	1	18.00	18	28.10	450	0.00	0	0.00	0	0	0	450
J2200	Decon. external surfaces and equipment (1,000 gal solvent)	*	1	40.00	40	28.10	1,124	940.00	940	420.00	420	0	0	2,484
J2300	Decon. external surfaces and equipment (1,000 gal water)	*	1	40.00	40	28.10	1,124	0.00	0	420.00	420	0	0	1,544
J2400	Visually inspect external surfaces and equipment	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
J2500	Decon. secondary containment (brush/vacuum)	*	1	10.00	10	28.10	281	0.00	0	0.00	0	0	0	281
J2550	Decon. secondary containment (5,000 gal water)	*	1	25.00	25	28.10	703	0.00	0	315.00	315	0	0	1,018
J2600	Decon. secondary containment (20,000 gal water)	*	1	25.00	25	28.10	703	0.00	0	315.00	315	0	0	1,018
J2700	Visually inspect secondary containment	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
J2800	Inspect secondary containment with ground penetrating radar	*	1	0.00	0		0	0.00	0	0.00	0	8,150	8,150	8,150
	SUB-TOTAL:	-	-	-	232	-	6,519	-	940	-	1,990	-	8,150	17,599
	SUB-TOTAL THIS PAGE ---------->			*********	376	*********	10,631	*********	940	*********	1,990	*********	63,810	77,371

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME INCINERA

TABLE I.4-18 (continued)

ICF KAISER ENGINEERS, INC.
8300 LEE HIGHWAY
FAIRFAX, VIRGINIA 22031-3000
DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 30 OCT 91

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : INCINERATOR (page 2)

ESTIM BY : A MURR
ESTIM TYPE : FINAL
ESTIM DATE : 10-Jun-92
SHEET NO : 13 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	TREATMENT OF DECON. RESIDUALS													
J3000	Transport decon. solvent (1,000 gal, 750 mi)	TRKLD	2	2.00	4	34.38	137	0.00	0	0.00	0	2,815	5,630	5,767
J3100	Off-site incineration of solvent (TSCA incinerator)	GAL	8,000	0.00	0		0	0.00	0	0.00	0	3.85	21,900	21,900
J3200	Transport decon. rinsewaters (80,500 gal, 300 mi)	TRKLD	17	2.00	34	34.35	1,168	0.00	0	0.00	0	1,125	19,125	20,293
J3300	Off-site treatment of rinsewaters	GAL	80,500	0.00	0		0	0.00	0	0.00	0	0.55	44,278	44,278
	SUB-TOTAL:	-	-	-	38	-	1,305	-	0	-	0	-	90,930	92,235
	SAMPLING AND ANALYSIS													
J4000	Decon. rinsewater (3rd rinse of int. surf's; 1 samp/8,000 gal)	SAMPL	4	0.50	2.0	28.10	56	0.00	0	0.00	0	350	1,400	1,456
J4100	PCB wipe (int. surf's; area = 14,872 sq ft; 1 samp./2,500 sq ft)	SAMPL	6	0.50	3.0	28.10	84	0.00	0	0.00	0	95	570	654
J4200	Decon. solvent (from 3rd rinse of ext. surfaces and equipment)	SAMPL	1	0.50	0.5	28.10	14	0.00	0	0.00	0	200	200	214
J4300	Decon. rinsewater (3rd rinse of ext. surfaces and equipment)	SAMPL	1	0.50	0.5	28.10	14	0.00	0	0.00	0	350	350	364
J4400	Decon. rinsewater (3rd rinse of sec. cont.; 1 sample/8,000 gal)	SAMPL	2	0.50	1.0	28.10	28	0.00	0	0.00	0	350	700	728
J4500	PCB wipe (sec contain; area = 5,000 sq ft; 1 samp./2,500 sq ft)	SAMPL	4	0.50	2.0	28.10	56	0.00	0	0.00	0	95	380	436
	SUB-TOTAL:	-	-	-	9	-	253	-	0	-	0	-	3,600	3,853
	SUB-TOTAL THIS PAGE ----->			----------	47	----------	1,558	----------	0	----------	0	----------	94,530	96,088
	TOTAL THIS ACTIVITY ----->				423		12,188		940		1,990		158,340	173,458

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: INCINERA

TABLE I 4-17

TABLE 8

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : DRUM CRUSHERS

ESTIM DATE : 09-Jun-92
SHEET NO : 07 of 24

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	EQUIPMENT DISPOSAL													
F1000	Visually inspect equipment	*	1	4.0	4	28.10	112	0.00	0	0.00	0	0	0	112
F1100	Dismantle equipment	*	1	16.0	16	28.10	450	0.00	0	0.00	0	0	0	450
F1200	Transport dismantled equipment (8 cu yd + 4 cu yd, 10 ton, 1,750 mi by rail)	TON	10	0.03	0.33	28.10	9	0.00	0	0.00	0	115	1,150	1,159
F1300	Dispose dismantled equipment (TSCA landfill)	TON	10	0.00	0		0	0.00	0	0.00	0	115	1,150	1,150
	SUB-TOTAL	-	-	-	20	-	571	-	0	-	0	-	2,300	2,871
	DECONTAMINATION													
F2000	Decontaminate secondary containment*	*	1	0.0	0		0	0.00	0	0.00	0	0	0	0
	SUB-TOTAL	-	-	-	0	-	0	-	0	-	0	-	0	0
	*Secondary containment for the drum crushers is shared with the shredder, Table 5 shredder, costs for this item appear in Table 8													
	SUB-TOTAL THIS PAGE---------->			*********	20	*********	571	*********	0	*********	0	*********	2,300	2,871

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME DRMCRUSH

TABLE I.4-18

TABLE 16

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : LABORATORY

ESTIM DATE : 09-Jun-92
SHEET NO : 19 of 24

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	INVENTORY REMOVAL													
N1000	Verify inventory and pack waste chemicals into lab packs	*	1	40.00	40	28.10	1,124	0.00	0	0.00	0	0	0	1,124
N1100	Transport waste in lab packs (20 drums, 200 mi)	TRKLD	1	3.00	3	34.35	103	0.00	0	0.00	0	750	750	853
N1200	Incinerate waste chemicals (RCRA incinerator)	DRM	20	0.00	0		0	0.00	0	0.00	0	520	10,400	10,400
	SUB-TOTAL:	-	-	-	43	-	1,227	-	0	-	0	-	11,150	12,377
	DECONTAMINATION													
N2000	Decontaminate laboratory (brush/vacuum)	*	1	3.00	3	28.10	84	0.00	0	105.00	105	0	0	189
N2050	Decontaminate laboratory (1,500 gal solvent)	*	1	7.00	7	28.10	197	0.00	0	210.00	210	0	0	407
N2100	Decontaminate laboratory (5,400 gal water)	*	1	7.00	7	28.10	197	0.00	0	210.00	210	0	0	407
N2200	Visually inspect laboratory	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
	SUB-TOTAL:	-	-	-	18	-	506	-	0	-	525	-	0	1,031
	TRANSPORT AND DISPOSAL OF DECON. RESIDUALS													
N3000	Transport decon. rinsewaters (5,400 gal, 300 mi)	TRKLD	2	2.00	4	34.35	137	0.00	0	0.00	0	1,125	2,250	2,387
N3100	Off-site treatment of decon. rinsewaters	GAL	5,400	0.00	0		0	0.00	0	0.00	0	0.55	2,970	2,970
N3200	Transport decon. solvent (1,500 gal, 750 mi)	TRKLD	1	2.00	2	34.35	69	0.00	0	0.00	0	2,815	2,815	2,884
N3300	Off-site incineration of decon. solvent (7 lb/gal, TSCA incinerator)	GAL	1,500	0.00	0		0	0.00	0	0.00	0	6.65	9,975	9,975
	SUB-TOTAL:	-	-	-	6	-	206	-	0	-	0	-	18,010	18,216
	SAMPLING AND ANALYSIS													
N4000	Decon. rinsewater (from 3rd rinse)	SAMPL	1	0.50	0.5	28.10	14	0.00	0	0.00	0	350	350	364
N4100	PCB wipe	SAMPL	4	0.50	2.0	28.10	56	0.00	0	0.00	0	95	380	436
	SUB-TOTAL:	-	-	-	2	-	56	-	0	-	0	-	380	436
	SUB-TOTAL THIS PAGE---------->			----------	69	----------	1,995	----------	0	----------	525	----------	29,540	32,060

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: LABORATO

TABLE I.4-19

TABLE 17

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : MISCELLANEOUS PAGE 1

ESTIM DATE : 09-Jun-92
SHEET NO : 20 of 24

DETAIL ESTIMATE BREAKDOWN - COSTS UDATED 14-NOV-91

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	ASH HOPPER STAGING AREA (A.H.S.A.): INVENTORY REMOVAL													
O1000	Verify inventory (20 ash hoppers)	*	1	1.00	1	15.65	16	0.00	0	0.00	0	0.00	0	16
O1100	Load railcars and transport ash by rail (1,750 mi)	TON	60	0.25	15	20.00	300	0.00	0	0.00	0	115	6,900	7,200
O1300	Dispose of ash (TSCA landfill)	CUYD	60	0.00	0		0	0.00	0	0.00	0	115	6,900	6,900
	SUB-TOTAL:	-	-	-	16	-	316	-	0	-	0	-	13,800	14,116
	A.H.S.A.: DECONTAMINATION													
O2000	Decontaminate empty hopper (1,050 gal water each)	HOPPI	20	1.50	30	15.65	470	0.00	0	10.50	210	0	0	680
O2100	Decontaminate staging area (brush/vacuum)	*	1	1.00	1	15.65	16	0.00	0	0.00	0	0	0	16
O2200	Visually inspect hoppers and staging area	*	1	6.00	6	15.65	94	0.00	0	0.00	0	0	0	94
	SUB-TOTAL:	-	-	-	37	-	579	-	0	-	210	-	0	789
	A.H.S.A.: TRANSPORT & DISPOSAL OF DECON. RESIDUALS													
O3000	Transport decon. rinsewaters (21,600 gal, 300 mi)	TRKLD	6	2.00	10	15.65	157	0.00	0	0.00	0	1,125	6,625	6,782
O3100	Off-site treatment of decon. rinsewaters	GAL	21,600	0.00	0		0	0.00	0	0.00	0	0.55	11,880	11,880
	SUB-TOTAL:	-	-	-	10	-	157	-	0	-	0	-	17,505	17,662
	A.H.S.A.: SAMPLING AND ANALYSIS													
O4000	Decon. rinsewater (from 3rd rinse; one sample from each hopper)	SAMPL	20	0.50	10.0	15.65	157	0.00	0	0.00	0	350	7,000	7,157
O4100	Sampling and analysis of core sample from staging area	SAMPL	1	1.00	1.0	15.65	16	0.00	0	15.65	16	1635	1,635	1,668
	SUB-TOTAL:	-	-	-	11	-	172	-	0	-	16	-	8,635	8,823
	SUB-TOTAL THIS PAGE---------->				74		1,223		0		226		39,940	41,389

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: MISC-1

TABLE 1.4-19 (continued)

TABLE 18

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : MISCELLANEOUS PAGE 2

ESTIM DATE : 09-Jun-92
SHEET NO : 21 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	DECONTAMINATION OF PAVED ROADS													
O5000	Collection of soils & dust by brush/vacuum	*	1	100 00	100	15 65	1,565	0.00	0	0 00	0	0 00	0	1,565
O5100	Sampling and analysis of asphalt core samples	SAMPL	20	1.00	20	15 65	313	0.00	0	15 65	313	1,635	32,700	33,326
	SUB-TOTAL:	-	-	-	120	-	1,878	-	0	-	313	-	32,700	34,891
	LANDSCAPED AREA: SOIL ANALYSIS													
O6000	Sampling and analysis of soil in landscaped area	SAMPL	2	1.50	3	15 65	47	0 00	0	0 00	0	1,635	3,270	3,317
	GENERAL UTILITIES													
O7000	Utility usage during closure	DAY	270	0.00	0		0	137.00	36,990	0 00	0	0 00	0	36,990
	DECONTAMINATION OF SEWERS													
O8000	Decontaminate sewer lines (38,600 gal water)	*	1	45.00	45	15 65	704	0 00	0	315 00	315	0	0	1,019
O8100	Inspect sewer lines with video camera	*	1	0 00	0		0	0 00	0	0 00	0	19,675	19,675	19,675
O8200	Samp & anal of decon. rinsewaters (3rd rinse; 1 samp/5,000 gal)	SAMPL	3	0 50	2	15.65	23	0 00	0	0.00	0	350	1,050	1,073
O8300	On-site carbon adsorption treatment of decon. rinsewaters**	MGAL	0	0.00	0		0	0 00	0	0 00	0	0.00	0	0
	SUB-TOTAL:	-	-	-	47	-	728	-	0	-	315	-	20,725	21,768
	DECONTAMINATION OF STORM & PROCESS WATER TANKS													
O9000	On-site carbon adsorption treatment of inventory**	MGAL	0	0 00	0		0	0 00	0	0	0	0	0	0
O9100	Decontaminate 4 storage tanks (184,800 gal water)	*	1	231 00	231	15.65	3,615	0.00	0	1,565	1,565	0	0	5,180
O9200	On-site carbon adsorption treatment of decon. rinsewaters	MGAL	2 2204	24 00	53	20.00	1,066	0 00	0	0	0	32,275	32,275	33,341
O9300	Discharge treated water to POTW	MGAL	2.2204	0 00	0		0	0 00	0	0	0	146	324	324
O9400	Sampling and analysis of discharge to MSD (2,220,400 gal; 1 sample per day = 1 sample per 360,000 gal)	SAMPL	7	0.50	4	15 65	55	0 00	0	0	0	525	3,675	3,730
	SUB-TOTAL:	-	-	-	288	-	4,736	-	0	-	1,565	-	36,274	42,575
	** Note: Costs included with Item O9200													
	SUB-TOTAL THIS PAGE ----------->			********	457	********	7,388	********	36,990	********	2,193	********	92,969	139,541

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: MISC-2

TABLE 1.4-19 (continued)

TABLE 19

DETAIL ESTIMATE BREAKDOWN – COSTS UPDATED 14-NOV-91

PROJECT TITLE : RCRA PART B – CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : MISCELLANEOUS PAGE 4

ESTIM DATE : 09-Jun-92
SHEET NO : 22 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	DECONTAMINATION OF EQUIPMENT USED FOR CLOSURE ACTIVITIES													
P1000	Decontaminate equipment (3,600 gal solvent)	*	1	36.00	36	28.10	1,012	880.00	880	105.00	105	0	0	2,097
P1100	Decontaminate equipment (3,600 gal water)	*	1	36.00	36	28.10	1,012	880.00	880	105.00	105	0	0	2,097
P1200	Visually inspect equipment	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0	0	28
P1300	Transport decon. solvent (3,600 gal, 750 mi)	TRKLD	1	2.00	2	34.35	69	0.00	0	0.00	0	2,815	2,815	2,884
P1400	Off-site incineration of solvent (TSCA incinerator)	GAL	3,600	0.00	0		0	0.00	0	0.00	0	3.65	13,140	13,140
P1500	Transport decon. rinsewaters (3,600 gal, 300 mi)	TRKLD	1	2.00	2	34.35	69	0.00	0	0.00	0	1,125	1,125	1,194
P1600	Off-site treatment of rinsewaters	GAL	3,600	0.00	0		0	0.00	0	0.00	0	0.55	1,980	1,980
P1700	Sampling and analysis of decon. solvent (from 3rd rinse)	SAMPL	1	0.50	0.5	28.10	14	0.00	0	0.00	0	200	200	214
P1800	Sampling and analysis of decon. rinsewater (from 3rd rinse)	SAMPL	1	0.50	0.5	28.10	14	0.00	0	0.00	0	930	930	944
	SUB-TOTAL:	–	–	–	78	–	2,217	–	1,960	–	210	–	20,190	24,577
	TRANSPORTATION & DISPOSAL OF SWEEPINGS													
P2000	Transport sweepings from all areas/roads (1,750 mi by rail)	TON	4	0.03	0.13	28.10	4	0.00	0	0.00	0	115	460	464
	(200,000 sq ft of areas; approximately 4 cu yd of sweepings)													
P2100	Dispose of sweepings (TSCA landfill)	TON	4	0.00	0		0	0.00	0	0.00	0	115	460	460
	SUB-TOTAL:	–	–	–	0	–	4	–	0	–	0	–	920	924
	PERSONAL PROTECTIVE EQUIPMENT													
P3000	Purchase PPE (3 sets per laborer per day @ $75 per 3 sets)	L-DAY	12,150	0.00	0		0	80.00	972,000	0.00	0	0	0	972,000
P3100	Purchase Level B PPE (3 sets/laborer/day @ $150 per 3 sets)	L-DAY	2,700	0.00	0		0	158.50	428,600	0.00	0	0	0	428,600
P3200	Load & transport used PPE (120 sets/drum, 124 drums, 1,750 mi)	TRKLD	2	1.00	2	28.10	56	0.00	0	0.00	0	6,565	13,130	13,186
P3300	Dispose of PPE (TSCA landfill)	DRM	124	0.00	0		0	0.00	0	0.00	0	120	14,880	14,880
	SUB-TOTAL:	–	–	–	2	–	56	–	1,398,600	–	0	–	28,010	1,428,666
	SUB-TOTAL THIS PAGE---------->			*********	80	*********	2,277	*********	1,400,560	*********	210	*********	49,120	1,452,167

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: MISC-3

TABLE I.4-10 (continued)

TABLE 20

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : MISCELLANEOUS PAGE 3

ESTIM DATE : 10-Jun-92
SHEET NO : 23 of 24

DETAIL ESTIMATE BREAKDOWN - COSTS UPDATED 14-NOV-91

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	SEWER PRETREATMENT FILTRATION SYSTEM													
	On-site carbon adsorption treatment of inventory (30,000 gallons)	MGAL	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0
	On-site treatment of inventory through a mobile filtration unit (28,000 gallons)	MGAL	0.01	0.00	28	20.00	500	0.00	0	0.00	0	31,000	31,000	31,500
	Discharge treated inventory to POTW	MGAL	0.01	0.00	0	0.00	0	0.00	0	0.00	0	146	8	8
	Sampling & Analysis of discharge to MSC (1 sample/tank = 2 samples)	SMPL	2	0.50	1	32.30	32	0.00	0	0.00	0	525	1,050	1,082
	Off-site disposal of solids & filtration media	YD3	100	0.00	0	0.00	0	0.00	0	0.00	0	50	5,000	5,000
	Transportation to landfill	TRKLD	4	2.00	8	34.35	275	0.00	0	0.00	0	563	2,252	2,527
	Decontaminate 3 storage tanks (solvent)	*	3	8.00	24	28.10	674	2,465.00	7,395	50.00	150	0	0	8,219
	Decontaminant 3 storage tanks (water)	*	3	8.00	24	28.10	674	0.00	0	50.00	150	0	0	824
	Visually inspect storage tanks	*	3	1.00	3	28.10	84	0.00	0	0.00	0	0	0	84
	Off-site incineration of decon. solvent (TSCA incinerator)	GAL	5,500	0.00	0	0.00	0	0.00	0	0.00	0	3.65	20,075	20,075
	Transport decon. solvent	TRKLD	1	9.00	9	34.35	309	0.00	0	0.00	0	2,813	2,813	3,122
	On-site carbon adsoprtion of decon. rinsewaters	MGAL	0.01	0.00	5	20.00	100	0.00	0	0.00	0	31,000	31,000	31,100
	Sampling & analysis of discharge to MSD (1 sample/tank = 3 samples)	SMPL	3	0.50	1.50	32.30	48	0.00	0	0.00	0	525	1,575	1,623
	Discharge decon. rinsewaters to POTW	MGAL	0.01	0.00	0	0.00	0	0.00	0	0.00	0	146	1	1
	SUB-TOTAL				100.50		2997.05		7395.00		300.00		94773.80	105165.55
	SUB-TOTAL THIS PAGE---------->			*********	100.50	*********	2997.05	*********	7395.00	*********	300.00	*********	94773.80	105165.55

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: MISC-5

TABLE I 4-19 (continued)

TABLE 20

DETAIL ESTIMATE BREAKDOWN ~ COSTS UPDATED 14-NOV-91

PROJECT TITLE : RCRA PART B - CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : MISCELLANEOUS PAGE 5

ESTIM DATE : 20-Aug-92
SHEET NO : 23 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	PROPOSED ASH & FILTER CAKE PAD--ASPHALT PORTION:													
	INVENTORY REMOVAL													
P4000	Verify inventory (46 roll-offs & 50 hoppers)	*	1	1.00	1	28.10	28	0.00	0	0.00	0	0.00	0	28
P4100	Load railcars and transport ash by rail (1,750 mi)	TON	1,530	0.03	51	34.35	1,750	0.00	0	0.00	0	115	175,950	177,700
P4200	Dispose of ash (TSCA landfill)	TON	1,530	0.00	0		0	0.00	0	0.00	0	115	175,950	175,950
	SUB-TOTAL:	-	-	-	52	-	1,778	-	0	-	0	-	351,900	353,678
	ASPHALT PORTION: DECONTAMINATION													
P5000	Decontaminate empty hoppers (1,080 gal water each)	HOPPI	30	1.50	45	28.10	1,265	0.00	0	10.50	315	0	0	1,580
P5100	Decontaminate storage area (brush/vacuum)	*	1	169.00	169	28.10	4,749	0.00	0	0.00	0	0	0	4,749
P5200	Visually inspect empty hoppers and storage area	*	1	9.00	9	28.10	253	0.00	0	0.00	0	0	0	253
	SUB-TOTAL:	-	-	-	223	-	6,266	-	0	-	315	-	0	6,581
	ASPHALT PORTION: TRANSPORT & DISPOSAL OF DECON. RESIDUALS													
P6000	Transport decon. rinsewaters (32,400 gal, 300 mi)	TRKLD	7	2.00	14	34.35	481	0.00	0	0.00	0	1,125	7,875	8,356
P6100	Off-site treatment of decon. rinsewaters	GAL	32,400	0.00	0		0	0.00	0	0.00	0	0.55	17,820	17,820
	SUB-TOTAL:	-	-	-	14	-	481	-	0	-	0	-	25,695	26,176
	ASPHALT PORTION: SAMPLING AND ANALYSIS													
P7000	Decon. rinsewater (from 3rd rinse; 1 sample from each hopper)	SAMPI	30	0.50	15	28.10	422	0.00	0	0.00	0	350	10,500	10,922
P7100	Core samples from staging area (area = 84,065 sq ft; 1 core per 2,200 sq ft)	SAMPI	38	1.00	38	28.10	1,068	0.00	0	15.65	595	1635	62,130	63,793
	SUB-TOTAL:	-	-	-	53	-	1,489	-	0	-	595	-	72,630	74,714
	EQUIPMENT REMOVAL													
P8000	Disposal of vacuum truck, front end loader forklift and assorted pumps and hoses	TON	110	2	220	28.1	6,182		0	31	3,410	150	16,500	26,092
	SUB-TOTAL:				220		6182		0		3410		16500	26092
	SUB-TOTAL THIS PAGE---------->			*********	562	*********	16,197	*********	0	*********	4,320	*********	466,725	487,241

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: MISC-4

Revision Ha
August 21, 1992

TABLE 1.4-20

TABLE 21

DETAIL ESTIMATE BREAKDOWN – COSTS UPDATED 14-NOV-91

PROJECT TITLE : RCRA PART B – CLOSURE COST ESTIMATE
PROJECT OWNER : CHEMICAL WASTE MANAGEMENT, INC.
PROJ LOCATION : CHICAGO INCINERATOR, CHICAGO, IL
AREA : CERTIFICATION & SUPERVISION

ESTIM DATE : 09-Jun-92
SHEET NO : 24 of 24

NO	ACTIVITY DESCRIPTION	UNIT	QUANTITY	LABOR MANHOURS UNIT	LABOR MANHOURS TOTAL	LABOR DOLLARS RATE	LABOR DOLLARS TOTAL $	MATERIAL DOLLARS UNIT	MATERIAL DOLLARS TOTAL $	EQUIPMENT USAGE UNIT	EQUIPMENT USAGE TOTAL $	SUB-CONTRACTS UNIT	SUB-CONTRACTS TOTAL $	TOTAL COST
	CERTIFICATION COSTS													
Q1000	Clerical labor	*	1	1,440	1,440	20.00	28,800	0	0	0	0	0	0	28,800
Q1100	Independent, professional engineer	*	1	720	720	100.00	72,000	0	0	0	0	0	0	72,000
	SUB-TOTAL:	–	–	–	2,160	–	100,800	–	0	–	0	–	0	100,800
	SUPERVISION													
Q2000	Supervision of closure activities	*	1	1,318	1,318	32.30	42,571	0	0	0	0	0	0	42,571
	SUB-TOTAL THIS PAGE---------->			********	3,478	********	143,371	********	0	********	0	********	0	143,371

FOR SUMMARY OF COSTS SEE TABLE 1

FILENAME: CERT

Project Title: RCRA Part B Post-Closure Cost Estimate
Project Owner: CWM Chemical Services, Inc.
Project Location: Chicago Incinerator, Chicago, IL
6/15/92

TABLE I.6-1
POST-CLOSURE COST ESTIMATE
(OVER 30 YEARS)

NO.	ACTIVITY DESCRIPTION	UNITS	ESTIMATED UNITS	ESTIMATED UNIT COST	TOTAL COST
1000	Inspection of Capped Area				
1005	Year 1 - Monthly	$/period	12	$400	$4,800
1010	Year 2 - Quarterly	$/period	4	$400	$1,600
1015	Years 3 to 5 - Semi-Annually	$/period	6	$400	$2,400
1020	Years 6 to 30 - Annually	$/period	25	$400	$10,000
2000	Routine Maintenance of Vegetated Areas	$/period	60	$670	$40,200
2100	Topsoil Replacement	$/10 yrs	3	$675	$2,025
2200	Revegetation	$/10 yrs	3	$7,958	$23,874
3000	Surveying	$/10 yrs	3	$3,400	$10,200
4000	Fence Replacement	$/30 yrs	1	$44,500	$44,500
5000	Monitoring Well Replacement	$/30 yrs	3	$15,000	$45,000
5100	Groundwater Monitoring	$/year	30	$134,945	$4,048,350
6000	Annual Certification	$/year	30	$3,000	$90,000
7000	30 Year Post-Closure Report	$/30 yrs	1	$15,000	$15,000
					$4,337,949
8000	Contingency @ 15%		1		$650,692
	TOTAL				$4,988,641

Project Title: RCRA Part B Post-Closure Cost Estimate
Project Owner: CWM Chemical Services, Inc.
Project Location: Chicago Incinerator, Chicago, IL
6/15/92

TABLE I.6-2
POST CLOSURE UNIT COSTS

ACTIVITY DESCRIPTION	SOURCE	RATE INCLUDES	RATE	NUMBER OF UNITS	UNIT PRICE ESTIMATE
Inspection by Professional Engineer	SEC Donohue	Labor	$100/hr	4	$400
Mowing / Fertilizing	Means Data, 1991	T & M	5.13/1000 sq	130.7	$670
Topsoil Replacement	Lindall Excavating	T&M	$25/cy	27	$675
Revegetation	Means Data, 1991	T&M	0.89/1000 sq	130.7	$7,958
Surveying	National Survey	T&M	$3400/survey	1	$3,400
Fence Replacement	Fence Masters	T&M	$8.9/ft	5000	$44,500
Monitoring Well Replacement	ATEC	T&M	$15,000/well	1	$15,000
Annual Certification	SEC Donohue	Labor	$3,000	1	$3,000
30-Year Post-Closure Report	SEC Donohue	Labor	$15,000	1	$15,000

Project Title: RCRA Part B Post–Closure Cost Estimate
Project Owner: CWM Chemical Services, Inc.
Project Location: Chicago Incinerator, Chicago, IL
3/16/92

TABLE I.6-2 (Con't)
POST–CLOSURE UNIT COSTS
GROUNDWATER MONITORNG PROGRAM

Activity	Cost Per Unit ($)	# Units	Subtotal ($)
Year 1			
Groundwater Sampling Compliance Parameters (8 wells sampled 3 times each yr)	1769 /well	24	42456
*QC Sample for compliance parameters	3059 /well	3	9177
Appendix I Parameters (8 wells sampled 1 time per year)	3428 /well	8	27424
*QC Samples for Appendix I parameters	4718 /well	1	4718
Compliance Parameters not included in Appendix I list (8 wells samples 1 time per yr)	1000 /well	8	8000
Sampling Labor (4 events per each yr)	72 /hr	160	11520
Miscellaneous (Expenses & oversight)	400 /per sample event	4	1600
Statistical Analysis	7500 analysis/first year	1	7500
Result Reporting	3000 /report	4	12000
Annual Report prep.	12000 /report	1	12000
TOTAL FOR YEAR 1			136395

* Additional QC Samples [illegible]

Project Title: RCRA Part B Post–Closure Cost Estimate
Project Owner: CWM Chemical Services, Inc.
Project Location: Chicago Incinerator, Chicago, IL
3/16/92

TABLE I.6-2 (Con't)
POST–CLOSURE UNIT COSTS
GROUNDWATER MONITORING PROGRAM

Years 2 through 30

Item	Cost Per Unit ($)	# Units (years)	Sub–Total ($)	Total ($)
Groundwater Sampling				
*Compliance Parameters (8 wells x 3 events per year)	51633 /yr	29	1497357	
*Appendix I (8 wells x 1 event per year)	32142 /yr	29	932118	
Compliance Parameters not included in Appendix I list	8000 /yr	29	232000	
Sampling Labor ($72/hr x 160 hrs)	11520 /yr	29	334080	
Miscellaneous (expenses & oversight) ($400 per event x 4 events)	1600 /yr	29	46400	
Statistical analysis–quarterly	6000 /yr	29	174000	
Result Report – quarterly	12000 /yr	29	348000	
Annual Report	12000 /yr	29	348000	
TOTAL for 29 years				3911955

*Includes QC samples

Federal Express # 0995257012

CWM Chemical Services, Inc.

Chicago Incinerator
11700 S. Stony Island Ave.
Chicago, IL 60617
312-646-5700

January 14, 1992

Mr. Harry Chappel, Manager
Compliance Section
Division of Land Pollution Control
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, IL 62706

RE: **CWM Chicago Incinerator, Groundwater Assessment Program Fourth Quarter 1991 Report**

Dear Mr. Chappel:

Please find attached, the Fourth Quarter 1991 Groundwater Assessment Report for Wells G120S, G121S, G123S, G124S, G307 and the surface impoundments at the CWM Chemical Services, Inc. Chicago Incinerator facility. The assessment wells and surface impoundments were sampled on October 2, 1991.

All analyses were conducted by the WMI Environmental Monitoring Laboratories, Inc. (EML).

If you have any questions on this report, or if any additional information is needed, please contact me at (312) 646-5700.

Sincerely,
CWM Chemical Services, Inc.

Lisa Grassl

Lisa Grassl
Environmental Engineer

LG/nad

Attachment

cc: Kurt Frey
Ed Kenney
Bob LaBoube
Jim Doyle

bcc: Patrick Craig
CF: 11.8.3.4.3

CWM Chemical Services, Inc.
Chicago Incinerator

CWM CHEMICAL SERVICES, INC.
Chicago Incinerator

Quarterly Groundwater Assessment Report

Fourth Quarter 1991

I. General Description

This report is the sixteenth quarterly report of CWMCS's continuing groundwater assessment plan from samples collected on October 2, 1991. The program is based upon the initial program design as determined on January 7, 1988, and in our letter to the IEPA dated January 21, 1988. This program was subsequently modified by the IEPA as described in a letter to SCA dated March 25, 1988 and in a meeting with Geordie Smith of the IEPA on September 26, 1990. See Figures 1 and 2 for sample locations.

II. Overview

The fourth quarter assessment data for all parameters including field data, at all sampling locations, is summarized in Attachment A. Client reports with associated field information forms and chain-of-custody records are included in Attachment B. Historical data for each sampling location is included in Attachment C. A table of historical groundwater elevations for the assessment wells and state wells is included with a potentiometric surface map of the impoundment area in Attachment D. The analyses of the sludge sample collected for the fourth quarter 1991 are included in Attachment E.

III. Data Review

A. Rate and Extent of Migration of Hazardous Waste or Hazardous Waste Constituents

Upon review of the October 2, 1991 data, and comparison with the data from the two previous groundwater assessments and the past quarterly reports, there appears to be no release of hazardous waste constituents from the surface impoundments.

The rate of migration through the fill materials at the site has been defined by our consultants (Golder Associates) as approximately two (2) feet per year. In conjunction with Phase II of the ongoing RCRA Facility Investigation (RFI) at the site, the rate of migration will be reevaluated to determine any changes in this rate through more thorough tests on the groundwater movement.

The extent of contamination, noted in downgradient well G121S, appears to be relatively consistent with the historical data. The levels of constituents present in G121S have remained relatively consistent over time, while the other downgradient wells (G120S and G124S) have been consistently reported with little to no organic contaminants. The increase in barium and iron reported in G121S this quarter, does not correspond to the upgradient wells, the impoundment or the other downgradient wells.

No additional investigation into the extent of the contamination, noted in well G121S, was conducted during the fourth quarter of 1991. CWMCS will continue to monitor the levels of constituents reported in G121S.

In response to the Amended Consent Decree, CWMCS met with representatives of the IEPA and AGO on July 29, 1991 to discuss additional groundwater monitoring requirements for the assessment program, to further define the extent of contamination downgradient of well G121S. CWMCS submitted a Work Plan to the IEPA on August 27, 1991, which was revised on October 24 and November 6, 1991 and approved by the IEPA on December 4, 1991. The activities required by this Work Plan will begin during the first quarter of 1992. The First Quarter 1992 Groundwater Assessment Report will address the activities conducted and analytical results obtained.

B. Data Summary

In addition to the surface impoundments, groundwater monitoring was conducted at monitoring well G120S, G121S, G123S, G124S and G307. Monitoring wells G123S and G307 are the upgradient wells. The reported levels of both organics and inorganics in the downgradient monitoring wells are, in general, very similar to those values reported historically. 1,4-Dioxane was, once again, reported in both upgradient and downgradient wells, with levels increasing in some wells and decreasing in others. No definitive trends can be seen, although the levels reported are considerably higher in the upgradient wells than in the downgradient wells.

The analytical results reported for upgradient well G123S, continue to indicate decreasing levels of certain organic and inorganic constituents when compared with recent historical data. These levels, are however, generally higher than those reported in January of 1989.

The analytical results from well G307, the additional upgradient well, do not indicate the extent of contaminants noted in well G123S. Only one organic constituent (1,4-Dioxane) was reported in this well. Sodium and chloride values were reported at somewhat higher levels than in the past.

The analytical results reported for G307 and G123S confirm CWM's previous statements that, "The potential sources for this contamination [in well G123S] are upgradient waste management units from prior site activities". Phase I of the RFI supports these sources as the likely cause of contamination. Additional information on these sources and their flow paths will be determined in Phase II of the RFI.

A number of constituents were reported in the surface impoundment at levels higher than in the past. It is uncertain why these levels have increased as only rain water has entered the impoundment. These increased levels do not correspond to the values found in the monitoring wells, as the constituents which have increased in the impoundment have either decreased or have not been detected in the downgradient monitoring wells.

C. Groundwater Potentiometric Surface

The groundwater potentiometric surface for the fourth quarter of 1991, as shown in Attachment D, is relatively consistent with previous data. Groundwater at the facility flows generally from the east to the west-southwest. Additional work being conducted for Phase II of the RFI, should provide a more accurate groundwater potentiometric surface map, as groundwater elevations from the entire facility are being obtained.

Apparent anomalies in the reported groundwater elevations, may be partially attributed to the non-homogenous nature of the fill material from which the pier was constructed and from prior activities at the site. These types of anomalies, such as the higher than expected groundwater elevation in Well G110, have been noted in the past and during the RFI work done to date.

D. Sludge Analyses

The surface impoundments have not been active (receiving waste) since November 7, 1988. As a result, the chemical and physical characteristics of the accumulated sludges have not changed substantially since the Fourth Quarter 1988 sampling event. Analytical results for the fourth quarter 1991 sample are included in Attachment E.

IV. Conclusions:

Based upon the quarterly groundwater and surface impoundment analytical results, CWM believes that the surface impoundments are not the source of organic and inorganic constituents found in the groundwater assessment monitoring wells. In addition, the RCRA Facility Investigation (RFI) is designed to provide additional information regarding the source of contaminants at the facility, through a comprehensive study of soil, groundwater, and surface water. The RFI Phase I data appears to confirm that the surface impoundments are not the source of the contamination, and that prior activities at the site, by previous owners, are the likely source of contamination, both upgradient and downgradient of the impoundments. Phase II of the RFI should provide additional data to further confirm contamination source(s). Field activities for Phase II are almost complete.

The data continues to indicate the following:

1. The surface impoundments are not the source of organics impacting the groundwater.

2. The concentration of organics and inorganics in groundwater is relatively consistent over the last four years, with the exception of well G123S as indicated below.

3. The change in organic and inorganic constituents noted in well G123S may be attributed to upgradient sources and the subsequent movement of these constituents. This is supported by the results of Phase I of the RFI and should be confirmed by Phase II of the RFI.

4. The results from this sampling event do not appear to definitively indicate a release from the impoundments of hazardous waste or hazardous waste constituents to groundwater.

5. Relative groundwater elevations in the assessment are consistent with previous data.

V. Certification

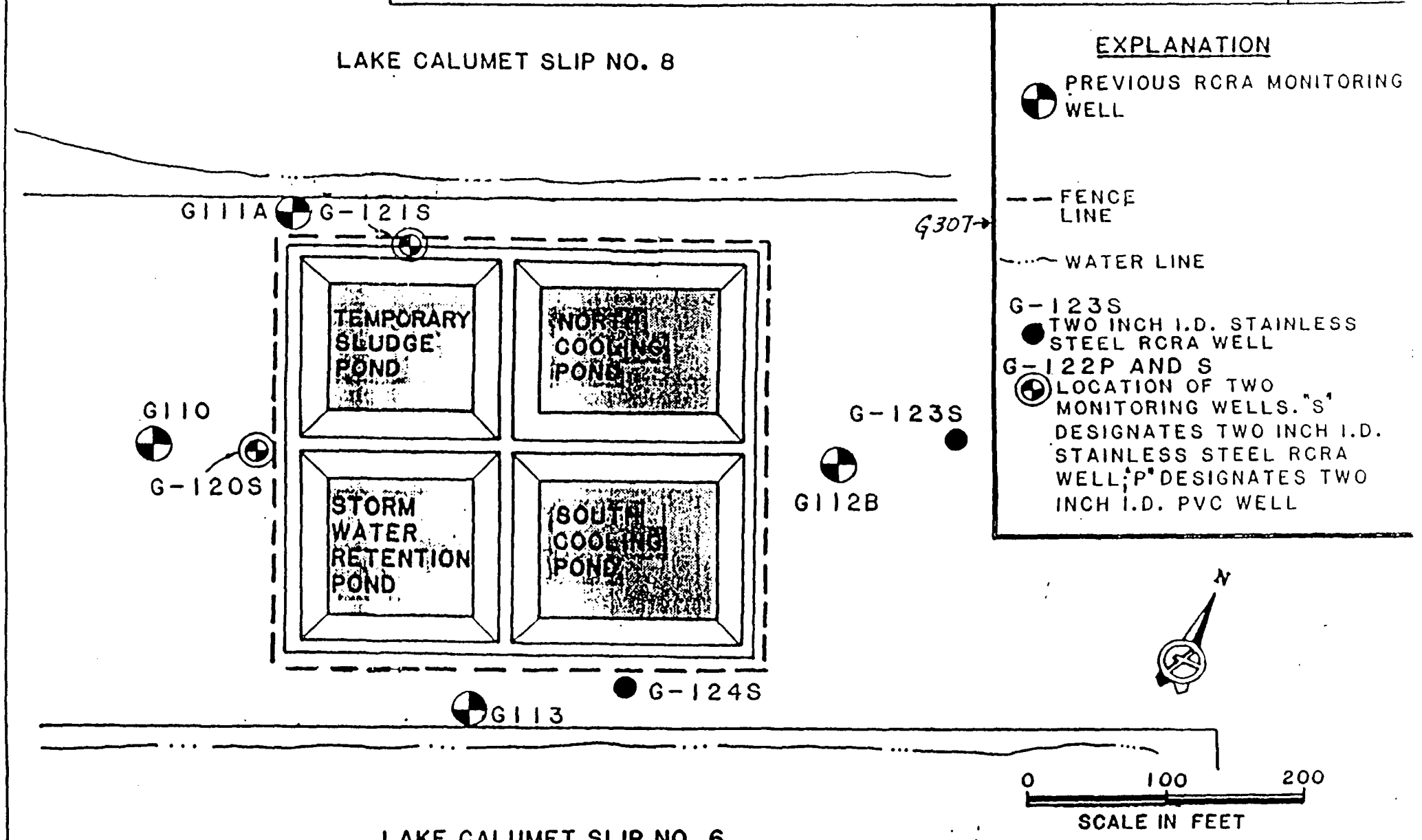
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Kurt R. Frey, General Manager

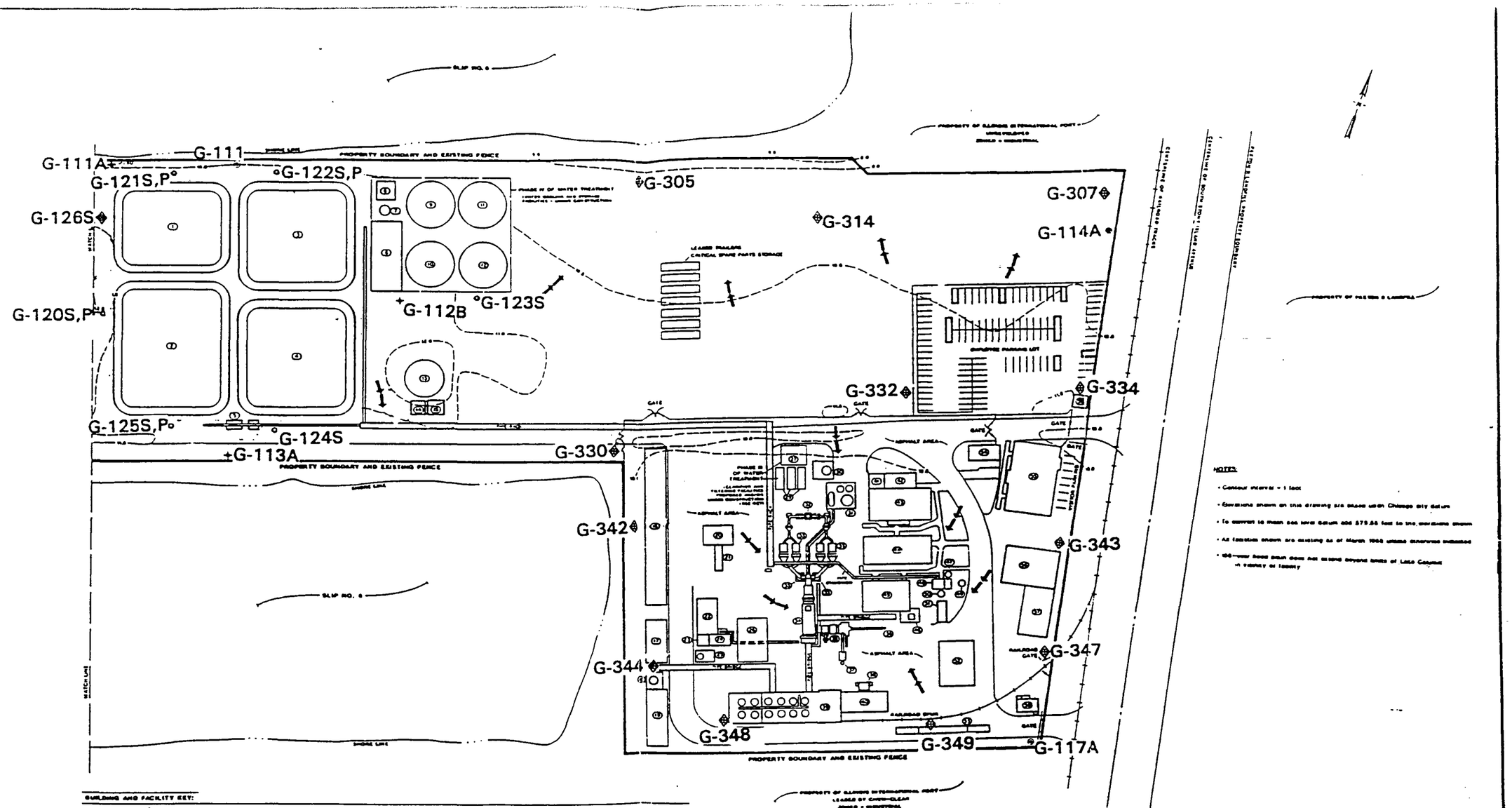
Proj. No. 1-2054 Eng. D.L.O. Date 11-1-85

MONITOR WELL LOCATION MAP

FIGURE 1



Golder Associates


G-111A
G-111
G-121S,P
G-122S,P
G-305
G-307
G-126S
G-314
G-114A
G-120S,P
G-112B
G-123S
G-332
G-334
G-125S,P
G-124S
G-113A
G-330
G-342
G-343
G-347
G-344
G-348
G-349
G-117A
PROPERTY BOUNDARY AND EXISTING FENCE
SHORE LINE
SLIP NO. 6
NOTES:
LEGEND:
DIRECTION OF SURFACE WATER DRAINAGE
G-123S
ASSESSMENT WELLS INSTALLED IN 1985 WELL LOCATIONS CONSIST OF ONE STAINLESS STEEL AND ONE PVC WELL INSTALLED SIDE BY SIDE
G-113A
RCRA MONITORING WELLS INSTALLED IN 1981
G-117A
OTHER MONITORING WELLS INSTALLED IN 1981
PHASE I INVESTIGATION - LEGEND:
G-334
SOIL SAMPLING POINT CONVERTED INTO GROUNDWATER MONITORING WELL
CHEMICAL WASTE MANAGEMENT, INC.
SCA CHEMICAL SERVICES
Figure 2
Dames & Moore

CWM Chemical Services, Inc.
Chicago Incinerator

ATTACHMENT A

EVENT SUMMARY REPORT

WMI ENVIRONMENTAL MON NG LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11943
MPS Number : 705911
Rev / Task : 00 / 02
Sample Type : WELL
Reported : 23-OCT-1991

Analyte	705-G120S 2-OCT-1991	EMLRL	705-G121S 2-OCT-1991	EMLRL	705-G123S 2-OCT-1991	EMLRL	Units
CHLORIDE	276	2.500	7840	50.000	1450	12.500	MG/L
FLUORIDE	.47	0.050	2.42	0.050	.24	0.050	MG/L
PH FIELD	6.94		7.68		7.56		PH UNITS
PH FIELD	6.94		7.69		7.55		PH UNITS
PH FIELD	6.94		7.71		7.55		PH UNITS
PH FIELD	6.94		7.72		7.54		PH UNITS
SPECIFIC CONDUCTANCE FIELD	2850.		15100.		4860.		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	2860.		15000.		4860.		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	2860.		15100.		4860.		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	2870.		15100.		4870.		UMHOS/CM
DEPTH TO WATER FROM TOP OF CASING	7.63		9.60		8.48		FT
GROUNDWATER ELEV.	586.21		584.29		585.65		FT MSL
WELL DEPTH TOTAL	20.77		20.70		21.77		FT
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	2.11		1.72		2.42		FT
WATER TEMPERATURE IN DEGREES CELSIUS	17.4		20.0		20.3		DEGREES C
ARSENIC-DISSOLVED	60.5	35.000	ND	35.000	ND	35.000	UG/L
LEAD-DISSOLVED	ND	25.000	ND	25.000	ND	25.000	UG/L
ARSENIC-TOTAL	116	14.000	22.6	10.000	11.6	10.000	UG/L
LEAD-TOTAL	25.3	5.000	ND	15.000	ND	15.000	UG/L
ALUMINUM-DISSOLVED	ND	200.000	ND	200.000	ND	200.000	UG/L
BARIUM-DISSOLVED	888	200.000	301	200.000	1100	200.000	UG/L
IRON-DISSOLVED	14500	100.000	3030	100.000	187	100.000	UG/L
SODIUM-DISSOLVED	112000	5000.000	4090000	40000.000	467000	5000.000	UG/L
ZINC-DISSOLVED	ND	20.000	ND	20.000	ND	20.000	UG/L
ALUMINUM-TOTAL	3060	1000.000	479	200.000	297	200.000	UG/L
BARIUM-TOTAL	1240	200.000	343	200.000	1360	200.000	UG/L
IRON-TOTAL	26600	1000.000	7130	1000.000	869	100.000	UG/L
SODIUM-TOTAL	138000	40000.000	3940000	40000.000	550000	40000.000	UG/L

NA - Not Analyzed ND - Not Detected TBK - Trip Blank s - EML Subcontract Data

WMI ENVIRONMENTAL M[illegible]ING LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11943
MPS Number : 705911
Rev / Task : 00 / 02
Sample Type : WELL
Reported : 23-OCT-1991

Analyte	705-G120S 2-OCT-1991	EMLRL	705-G121S 2-OCT-1991	EMLRL	705-G123S 2-OCT-1991	EMLRL	Units
ZINC-TOTAL	82.0	20.000	ND	20.000	ND	20.000	UG/L
4,4'-DDE	ND	0.100	ND	0.100	ND	0.100	UG/L
4,4'-DDT	ND	0.100	ND	0.100	ND	0.100	UG/L
1,2-DICHLOROBENZENE	ND	10.000	ND	10.000	ND	10.000	UG/L
2,4-DICHLOROPHENOL	ND	10.000	ND	10.000	ND	10.000	UG/L
2,4-DIMETHYLPHENOL	ND	10.000	12.	10.000	ND	10.000	UG/L
2,6-DICHLOROPHENOL	ND	10.000	ND	10.000	ND	10.000	UG/L
2-CHLOROPHENOL	ND	10.000	ND	10.000	ND	10.000	UG/L
3-METHYLPHENOL	ND	10.000	ND	10.000	30.	10.000	UG/L
4-CHLOROANILINE	ND	10.000	220.	10.000	ND	10.000	UG/L
4-METHYLPHENOL	ND	10.000	ND	10.000	30.	10.000	UG/L
ANILINE	ND	10.000	ND	10.000	ND	10.000	UG/L
ANTHRACENE	ND	10.000	ND	10.000	ND	10.000	UG/L
NAPHTHALENE	ND	10.000	ND	10.000	ND	10.000	UG/L
PHENOL	ND	10.000	ND	10.000	2500.	10.000	UG/L
(M and P)-XYLENE	ND	25.000	ND	50.000	ND	62.500	UG/L
1,1-DICHLOROETHENE	ND	25.000	ND	50.000	ND	62.500	UG/L
ACETONE	ND	170.000	ND	340.000	ND	425.000	UG/L
BENZENE	ND	5.000	210.	10.000	320.	12.500	UG/L
CHLOROBENZENE	ND	25.000	ND	50.000	ND	62.500	UG/L
DICHLORODIFLUOROMETHANE	ND	50.000	ND	100.000	ND	125.000	UG/L
ETHYLBENZENE	ND	25.000	ND	50.000	ND	62.500	UG/L
METHYLENE CHLORIDE	ND	25.000	ND	50.000	ND	62.500	UG/L
O-XYLENE	ND	25.000	ND	50.000	ND	62.500	UG/L
TOLUENE	ND	25.000	ND	50.000	ND	62.500	UG/L
VINYL CHLORIDE	ND	50.000	ND	100.000	ND	125.000	UG/L
P-DIOXANE	ND	10.000	69.	10.000	300.	10.000	UG/L

NA - Not Analyzed ND - Not Detected TBK - Trip Blank s - EML Subcontract Data

WMI ENVIRONMENTAL M ING LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11943
MPS Number : 705911
Rev / Task : 00 / 02
Sample Type : WELL
Reported : 23-OCT-1991

Analyte	705-G124S 2-OCT-1991	EMLRL	705-G307 2-OCT-1991	EMLRL	TBK-G120S 2-OCT-1991	EMLRL	Units
CHLORIDE	1100	12.500	210	2.500			MG/L
FLUORIDE	.34	0.050	.59	0.050			MG/L
PH FIELD	7.53		7.35				PH UNITS
PH FIELD	7.53		7.33				PH UNITS
PH FIELD	7.54		7.33				PH UNITS
PH FIELD	7.53		7.28				PH UNITS
SPECIFIC CONDUCTANCE FIELD	3710.		2250.				UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	3710.		2260.				UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	3720.		2260.				UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	3720.		2270.				UMHOS/CM
DEPTH TO WATER FROM TOP OF CASING	9.73		7.82				FT
GROUNDWATER ELEV.	583.55		582.89				FT MSL
WELL DEPTH TOTAL	20.80		16.91				FT
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	1.75		2.48				FT
WATER TEMPERATURE IN DEGREES CELSIUS	19.2		16.1				DEGREES C
ARSENIC-DISSOLVED	ND	35.000	ND	35.000			UG/L
LEAD-DISSOLVED	ND	25.000	ND	25.000			UG/L
ARSENIC-TOTAL	ND	10.000	36.8	10.000			UG/L
LEAD-TOTAL	ND	15.000	178	15.000			UG/L
ALUMINUM-DISSOLVED	ND	200.000	ND	200.000			UG/L
BARIUM-DISSOLVED	ND	200.000	ND	200.000			UG/L
IRON-DISSOLVED	3360	100.000	ND	100.000			UG/L
SODIUM-DISSOLVED	267000	5000.000	223000	5000.000			UG/L
ZINC-DISSOLVED	ND	20.000	ND	20.000			UG/L
ALUMINUM-TOTAL	365	200.000	34200	4000.000			UG/L
BARIUM-TOTAL	ND	200.000	486	200.000			UG/L
IRON-TOTAL	3090	100.000	85100	1000.000			UG/L
SODIUM-TOTAL	275000	40000.000	214000	40000.000			UG/L

NA - Not Analyzed ND - Not Detected TBK - Trip Blank s - EML Subcontract Data

WMI ENVIRONMENTAL MO[illegible]G LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11943
MPS Number : 705911
Rev / Task : 00 / 02
Sample Type : WELL
Reported : 23-OCT-1991

Analyte	705-G124S 2-OCT-1991	EMLRL	705-G307 2-OCT-1991	EMLRL	TBK-G120S 2-OCT-1991	EMLRL	Units
ZINC-TOTAL	ND	20.000	325	20.000			UG/L
4,4'-DDE	ND	0.100	ND	0.100			UG/L
4,4'-DDT	ND	0.100	ND	0.100			UG/L
1,2-DICHLOROBENZENE	ND	10.000	ND	10.000			UG/L
2,4-DICHLOROPHENOL	ND	10.000	ND	10.000			UG/L
2,4-DIMETHYLPHENOL	ND	10.000	ND	10.000			UG/L
2,6-DICHLOROPHENOL	ND	10.000	ND	10.000			UG/L
2-CHLOROPHENOL	ND	10.000	ND	10.000			UG/L
3-METHYLPHENOL	ND	10.000	ND	10.000			UG/L
4-CHLOROANILINE	ND	10.000	ND	10.000			UG/L
4-METHYLPHENOL	ND	10.000	ND	10.000			UG/L
ANILINE	ND	10.000	ND	10.000			UG/L
ANTHRACENE	ND	10.000	ND	10.000			UG/L
NAPHTHALENE	ND	10.000	ND	10.000			UG/L
PHENOL	ND	10.000	ND	10.000			UG/L
(M and P)-XYLENE	ND	10.000	ND	10.000	ND	10.000	UG/L
1,1-DICHLOROETHENE	ND	5.000	ND	10.000	ND	5.000	UG/L
ACETONE	ND	34.000	ND	68.000	ND	34.000	UG/L
BENZENE	ND	5.000	ND	5.000	ND	5.000	UG/L
CHLOROBENZENE	ND	5.000	ND	10.000	ND	5.000	UG/L
DICHLORODIFLUOROMETHANE	ND	10.000	ND	20.000	ND	10.000	UG/L
ETHYLBENZENE	ND	5.000	ND	10.000	ND	5.000	UG/L
METHYLENE CHLORIDE	ND	5.000	ND	10.000	ND	5.000	UG/L
O-XYLENE	ND	10.000	ND	10.000	ND	10.000	UG/L
TOLUENE	ND	5.000	ND	10.000	ND	5.000	UG/L
VINYL CHLORIDE	ND	10.000	ND	20.000	ND	10.000	UG/L
P-DIOXANE	19.	10.000	270.	10.000			UG/L

NA - Not Analyzed ND - Not Detected TBK - Trip Blank s - EML Subcontract Data

WMI ENVIRONMENTAL M ING LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11945
MPS Number : 705911
Rev / Task : 00 / 03
Sample Type : IMPOUND
Reported : 23-OCT-1991

Analyte	705-IMPDE 2-OCT-1991	EMLRL		EMLRL		EMLRL	Units
CHLORIDE	3670	25.000					MG/L
FLUORIDE	15.8	0.150					MG/L
PH FIELD	9.89						PH UNITS
PH FIELD	9.88						PH UNITS
PH FIELD	9.87						PH UNITS
PH FIELD	9.85						PH UNITS
SPECIFIC CONDUCTANCE FIELD	11300.						UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	11200.						UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	11200.						UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	11200.						UMHOS/CM
WATER TEMPERATURE IN DEGREES CELSIUS	20.0						DEGREES C
ARSENIC-DISSOLVED	41.0	35.000					UG/L
LEAD-DISSOLVED	ND	25.000					UG/L
ARSENIC-TOTAL	ND	70.000					UG/L
LEAD-TOTAL	122	15.000					UG/L
ALUMINUM-DISSOLVED	ND	200.000					UG/L
BARIUM-DISSOLVED	ND	200.000					UG/L
IRON-DISSOLVED	ND	100.000					UG/L
SODIUM-DISSOLVED	2900000	40000.000					UG/L
ZINC-DISSOLVED	71.9	20.000					UG/L
ALUMINUM-TOTAL	ND	200.000					UG/L
BARIUM-TOTAL	ND	200.000					UG/L
IRON-TOTAL	202	100.000					UG/L
SODIUM-TOTAL	2980000	40000.000					UG/L
ZINC-TOTAL	279	20.000					UG/L
4,4'-DDE	ND	0.100					UG/L
4,4'-DDT	0.117	0.100					UG/L
1,2-DICHLOROBENZENE	ND	10.000					UG/L
2,4-DICHLOROPHENOL	ND	10.000					UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMI ENVIRONMENTAL MON NG LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11945
MPS Number : 705911
Rev / Task : 00 / 03
Sample Type : IMPOUND
Reported : 23-OCT-1991

Analyte	705-IMPDE 2-OCT-1991	EMLRL		EMLRL		EMLRL	Units
2,4-DIMETHYLPHENOL	ND	10.000					UG/L
2,6-DICHLOROPHENOL	ND	10.000					UG/L
2-CHLOROPHENOL	ND	10.000					UG/L
3-METHYLPHENOL	ND	10.000					UG/L
4-CHLOROANILINE	ND	10.000					UG/L
4-METHYLPHENOL	ND	10.000					UG/L
ANILINE	ND	10.000					UG/L
ANTHRACENE	ND	10.000					UG/L
NAPHTHALENE	ND	10.000					UG/L
PHENOL	ND	10.000					UG/L
(M and P)-XYLENE	ND	25.000					UG/L
1,1-DICHLOROETHENE	ND	25.000					UG/L
ACETONE	ND	170.000					UG/L
BENZENE	ND	5.000					UG/L
CHLOROBENZENE	ND	25.000					UG/L
DICHLORODIFLUOROMETHANE	ND	50.000					UG/L
ETHYLBENZENE	ND	25.000					UG/L
METHYLENE CHLORIDE	ND	25.000					UG/L
O-XYLENE	ND	25.000					UG/L
TOLUENE	ND	25.000					UG/L
VINYL CHLORIDE	ND	50.000					UG/L
P-DIOXANE	ND	10.000					UG/L

NA - Not Analyzed ND - Not Detected TBK - Trip Blank s - EML Subcontract Data

WMI ENVIRONMENTAL MO[illegible]NG LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site ID : 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS Number : 91-11944
MPS Number : 705911
Rev / Task : 00 / 02
Sample Type : WELL
Reported : 22-OCT-1991

Analyte	705-02FB 2-OCT-1991	EMLRL		EMLRL		EMLRL	Units
(M and P)-XYLENE	ND	10.000					UG/L
1,1-DICHLOROETHENE	ND	5.000					UG/L
ACETONE	ND	34.000					UG/L
BENZENE	ND	5.000					UG/L
CHLOROBENZENE	ND	5.000					UG/L
DICHLORODIFLUOROMETHANE	ND	10.000					UG/L
ETHYLBENZENE	ND	5.000					UG/L
METHYLENE CHLORIDE	ND	5.000					UG/L
O-XYLENE	ND	10.000					UG/L
TOLUENE	ND	5.000					UG/L
VINYL CHLORIDE	ND	10.000					UG/L
P-DIOXANE	ND	10.000					UG/L

NA - Not Analyzed ND - Not Detected TBK - Trip Blank s - EML Subcontract Data

CWM Chemical Services, Inc.
Chicago Incinerator

ATTACHMENT B

CLIENT REPORTS AND ASSOCIATED FIELD INFORMATION FORMS/ CHAIN OF CUSTODY RECORDS

CWM Chemical Services, Inc.
Chicago Incinerator

SAMPLE BOTTLE PARAMETERS

IDENTIFICATION KEY

The following KEY has been provided to assist in interpreting the correlation between the sample I.D. and the Analytes/Lab Groups as listed on the Field Chain of Custody Records.

This KEY applies to the following samples:

G120S (AD7193)	G124S (AD7195)
G121S (AD7197)	G307 (AD7196)
G123S (AD7194)	IMPDE (AD7199)

KEY: Sample I.D.	Analytes/Lab Groups
A	Chloride Fluoride
B	Dissolved Metals (AA)
C	Total Metals (AA)
D	Dissolved Metals (ICP)
E	Total Metals (ICP)
F	Pesticides (DDE, DDT)
G	Semi-volatiles (A/B/N extractables)
H	Pesticides lab duplicate
I	Semi-volatiles lab duplicate
J	Volatile organics
K	Volatile organics - trip blank
L	p-Dioxane
M	p-Dioxane - trip blank

This KEY applies to the following samples:

02FB (AD7198)

KEY: Sample I.D.	Analytes/Lab Groups
A	Volatile organics
B	Volatile organics - trip blank
C	p-Dioxane

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

ce: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G120S
Type: WELL
Sample No: AD7193
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
CRCHLORI01:				
CHLORIDE	276	2.500	MG/L	DL
CRFLPOTO01:				
FLUORIDE	.47	0.050	MG/L	
FDPHQUAD01:				
PH FIELD	6.94		PH UNITS	
PH FIELD	6.94		PH UNITS	
PH FIELD	6.94		PH UNITS	
PH FIELD	6.94		PH UNITS	
FDSPCOND04:				
SPECIFIC CONDUCTANCE FIELD	2850.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	2860.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	2860.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	2870.		UMHOS/CM	
FDWDTWTC01:				
DEPTH TO WATER FROM TOP OF CASING	7.63		FT	
FDWGWELWDT:				
GROUNDWATER ELEV.	586.21		FT MSL	
WELL DEPTH TOTAL	20.77		FT	
FDWSTKUP01:				
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	2.11		FT	
FDXTEMPC01:				
WATER TEMPERATURE IN DEGREES CELSIUS	17.4		DEGREES C	
INGFAADIAS:				
ARSENIC-DISSOLVED	60.5	35.000	UG/L	DL
INGFAADIPB:				
LEAD-DISSOLVED	ND	25.000	UG/L	DL
INGFAATOAS:				
ARSENIC-TOTAL	116	14.000	UG/L	DL
INGFAATOPB:				
LEAD-TOTAL	25.3	5.000	UG/L	
ICPDISAL:				
ALUMINUM-DISSOLVED	ND	200.000	UG/L	
INICPDISBA:				
BARIUM-DISSOLVED	888	200.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G120S
Type: WELL
Sample No: AD7193
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
INICPDISFE:				
IRON-DISSOLVED	14500	100.000	UG/L	
INICPDISNA:				
SODIUM-DISSOLVED	112000	5000.000	UG/L	
INICPDISZN:				
ZINC-DISSOLVED	ND	20.000	UG/L	
INICPTOTAL:				
ALUMINUM-TOTAL	3060	1000.000	UG/L	DL
INICPTOTBA:				
BARIUM-TOTAL	1240	200.000	UG/L	DL
ICPTOTFE:				
RON-TOTAL	26600	1000.000	UG/L	DL
INICPTOTNA:				
SODIUM-TOTAL	138000	40000.000	UG/L	DL
INICPTOTZN:				
ZINC-TOTAL	82.0	20.000	UG/L	
SVGC1OCP06:				
4,4'-DDE	ND	0.100	UG/L	
4,4'-DDT	ND	0.100	UG/L	
SVMS1BNA03:				
1,2-DICHLOROBENZENE	ND	10.000	UG/L	
2,4-DICHLOROPHENOL	ND	10.000	UG/L	
2,4-DIMETHYLPHENOL	ND	10.000	UG/L	
2,6-DICHLOROPHENOL	ND	10.000	UG/L	
2-CHLOROPHENOL	ND	10.000	UG/L	
3-METHYLPHENOL	ND	10.000	UG/L	
4-CHLOROANILINE	ND	10.000	UG/L	
4-METHYLPHENOL	ND	10.000	UG/L	
ANILINE	ND	10.000	UG/L	
ANTHRACENE	ND	10.000	UG/L	
NAPHTHALENE	ND	10.000	UG/L	
PHENOL	ND	10.000	UG/L	
MSBA0105:				
(M and P)-XYLENE	ND	25.000	UG/L	DL
1,1-DICHLOROETHENE	ND	25.000	UG/L	DL
ACETONE	ND	170.000	UG/L	DL

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G120S
Type: WELL
Sample No: AD7193
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
BENZENE	ND	5.000	UG/L	DL
CHLOROBENZENE	ND	25.000	UG/L	DL
DICHLORODIFLUOROMETHANE	ND	50.000	UG/L	DL
ETHYLBENZENE	ND	25.000	UG/L	DL
METHYLENE CHLORIDE	ND	25.000	UG/L	DL
O-XYLENE	ND	25.000	UG/L	DL
TOLUENE	ND	25.000	UG/L	DL
VINYL CHLORIDE	ND	50.000	UG/L	DL
VOMSDCC103:				
P-DIOXANE	ND	10.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 17
Date Sealed 91 09 30 (YY / MM / DD)
Seal # 4489
By: EP 9-30-91

SITE/FACILITY # 7d5 SITE NAME: CWM Chemical Services

Sample Point: VG1205 (Source Code)

SAMPLE DATE: 911002 (YY / MM / DD)

SAMPLE TIME: 13:57 (2400 HR) MATRIX CODE: W

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes:

Well ..... (W) Leachate System .. (C) Pretreatment Facility ... (P) River/Stream/Brook .. (R) Soil ..... (S) Generation Pt. .... (G)
Dewatering/Pressure Relief .... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Noise ..... (N) Specify _____

ENS # 91-11942

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AD7193-A	01	P	NONE/COOL 4 DEG C	CR	Y N		
AD7193-B	01	P	HNO3	IN	Y N		
AD7193-C	01	P	HNO3	IN	Y N		
AD7193-D	01	P	HNO3	IN	Y N		
AD7193-E	01	P	HNO3	IN	Y N		MS
AD7193-F	2	G	NONE/COOL 4 DEG C	SV	Y N		
AD7193-G	2	G	NONE/COOL 4 DEG C	SV	Y N		
AD7193-H	2	G	NONE/COOL 4 DEG C	SV	Y N		
AD7193-I	2	G	NONE/COOL 4 DEG C	SV	Y N		
7193-J	4	G	HCL	VO	Y N		
7193-K	01	G	HCL	VO	Y N	No Sub Pl 10-1-91 Tiki	TB 9-30-91 EP
AD7193-L	4	G	NONE/COOL 4 DEG C	VO	Y N		
~~AD7193-M~~	~~01~~	~~G~~	~~NONE/COOL 4 DEG C~~	~~VO~~	Y N		CANCEL 9-30-91
					Y N		
					Y N		
					Y N		

Temp Blank Temp = 42°C
Tommy H. Witt

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Tommy H. Witt Date: 10/1/91 Time: 10:50 (2400 HR.)
Signature: Tommy H. Witt Seal #: 4489 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: Tommy H. Witt (Print) Date: 10/2/91 Time: 17:42 (2400 HR.)
Signature: Tommy H. Witt Seal #: 12051 Intact: yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 10/3/91 Time: 15:40 (2400 HR.)
AquaPak™/Sub. Contr. # 17 Temp.°C 4 Seal # 12051 Intact: Y

REGION

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD7193

Sample Point: WG1205 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL. IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
911002	1345	02	21	65

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated (Y) (N) (circle one) Sampling Equipment ..... Dedicated (Y) (N) (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- Polypropylene (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 1591.814 (ft/msl)	Land Surface Elevation	1591.73 (ft/msl)
Depth to water From top of well casing	17.63 (ft)	Depth to water From land surface	15.92 (ft)
Groundwater Elevation	1581.621 (ft/msl)	Groundwater Elevation	1581.621 (ft/msl)
Well Depth	21.77 (ft)	Stickup	2.11 (ft)

	ph		spec. cond.		Sample Temp.	(other parameter)	value	units
1st	6.94 (STD)	1st	2870	μm/cm at 25° C	14	Well DIAM	2.0	IN
2nd	6.94 (STD)	2nd	2860	μm/cm at 25° C				
3rd	6.94 (STD)	3rd	2860	μm/cm at 25° C				
4th	6.94 (STD)	4th	2850	μm/cm at 25° C				

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: STRONG Color: DARKISH GREEN Turbidity: HIGH

Weather Conditions: Wind Speed ~20 MPH Direction WEST Precipitation Y/N Outlook CLOUDY, 70°F

Specific Comments: * REFERANCE MEASUREMENT M.P. = INNER CASING

CASING VOL – 20.77 – 7.63 = 13.14 X 0.163 = 2.14 X 3 = 6.42

WATER LEVEL TAKEN WITH BAILER IN THE WATER.

READINGS PH – 6.93, 6.92, 6.92 AND 6.92 S.C. = 2880, 2870, 2870 AND 2870, TEMP = 16.7°C

NOTE – BIRD REMAINS OF 3 SEPERATE BIRDS WERE FOUND WITHIN 5 + 10 FT. OF THIS WELL.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/2/91 (Date) Tommy H. Watt (Signature) Employer: VESTON / GCL

FF-2A 4/90

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

.e: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G121S
Type: WELL
Sample No: AD7197
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
CRCHLORI01:				
CHLORIDE	7840	50.000	MG/L	DL
CRFLPOTO01:				
FLUORIDE	2.42	0.050	MG/L	
FDPHQUAD01:				
PH FIELD	7.68		PH UNITS	
PH FIELD	7.69		PH UNITS	
PH FIELD	7.71		PH UNITS	
PH FIELD	7.72		PH UNITS	
FDSPCOND04:				
SPECIFIC CONDUCTANCE FIELD	15100.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	15000.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	15100.		UMHOS/CM	
ECIFIC CONDUCTANCE FIELD	15100.		UMHOS/CM	
WDTWTC01:				
DEPTH TO WATER FROM TOP OF CASING	9.60		FT	
FDWGWELWDT:				
GROUNDWATER ELEV.	584.29		FT MSL	
WELL DEPTH TOTAL	20.70		FT	
FDWSTKUP01:				
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	1.72		FT	
FDXTEMPC01:				
WATER TEMPERATURE IN DEGREES CELSIUS	20.0		DEGREES C	
INGFAADIAS:				
ARSENIC-DISSOLVED	ND	35.000	UG/L	DL
INGFAADIPB:				
LEAD-DISSOLVED	ND	25.000	UG/L	DL
INGFAATOAS:				
ARSENIC-TOTAL	22.6	10.000	UG/L	
INGFAATOPB:				
LEAD-TOTAL	ND	15.000	UG/L	DL
CPDISAL:				
UMINUM-DISSOLVED	ND	200.000	UG/L	
INICPDISBA:				
BARIUM-DISSOLVED	301	200.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

...ce: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G121S
Type: WELL
Sample No: AD7197
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
INICPDISFE:				
IRON-DISSOLVED	3030	100.000	UG/L	
INICPDISNA:				
SODIUM-DISSOLVED	4090000	40000.000	UG/L	DL
INICPDISZN:				
ZINC-DISSOLVED	ND	20.000	UG/L	
INICPTOTAL:				
ALUMINUM-TOTAL	479	200.000	UG/L	
INICPTOTBA:				
BARIUM-TOTAL	343	200.000	UG/L	
...ICPTOTFE:				
IRON-TOTAL	7130	1000.000	UG/L	DL
INICPTOTNA:				
SODIUM-TOTAL	3940000	40000.000	UG/L	DL
INICPTOTZN:				
ZINC-TOTAL	ND	20.000	UG/L	
SVGC1OCP06:				
4,4'-DDE	ND	0.100	UG/L	
4,4'-DDT	ND	0.100	UG/L	
SVMS1BNA03:				
1,2-DICHLOROBENZENE	ND	10.000	UG/L	
2,4-DICHLOROPHENOL	ND	10.000	UG/L	
2,4-DIMETHYLPHENOL	12.	10.000	UG/L	
2,6-DICHLOROPHENOL	ND	10.000	UG/L	
2-CHLOROPHENOL	ND	10.000	UG/L	
3-METHYLPHENOL	ND	10.000	UG/L	
4-CHLOROANILINE	220.	10.000	UG/L	
4-METHYLPHENOL	ND	10.000	UG/L	
ANILINE	ND	10.000	UG/L	
ANTHRACENE	ND	10.000	UG/L	
NAPHTHALENE	ND	10.000	UG/L	
...HENOL	ND	10.000	UG/L	
...MSBAO105:				
(M and P)-XYLENE	ND	50.000	UG/L	DL
1,1-DICHLOROETHENE	ND	50.000	UG/L	DL
ACETONE	ND	340.000	UG/L	DL

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

ɪe: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G121S
Type: WELL
Sample No: AD7197
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
BENZENE	210.	10.000	UG/L	DL
CHLOROBENZENE	ND	50.000	UG/L	DL
DICHLORODIFLUOROMETHANE	ND	100.000	UG/L	DL
ETHYLBENZENE	ND	50.000	UG/L	DL
METHYLENE CHLORIDE	ND	50.000	UG/L	DL
O-XYLENE	ND	50.000	UG/L	DL
TOLUENE	ND	50.000	UG/L	DL
VINYL CHLORIDE	ND	100.000	UG/L	DL
VOMSDCC103:				
P-DIOXANE	69.	10.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 319
Date Sealed 91/10/30 (YY / MM / DD)
Seal # 4730
By: EP 9-30-91

SITE/FACILITY # 7d5 SITE NAME: CWM Chemical Services

Sample Point: W G 1 2 1 5 (Source Code)

SAMPLE DATE: 91/10/02 (YY / MM / DD)

SAMPLE TIME: 11:55 (2400 HR)

MATRIX CODE: W

Water (W) Leachate (C) Soil (S) Other (X)

Source Codes:

Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream/Brook (R) Soil (S) Generation Pt. (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # [illegible]

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS		FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AD7197-A	01	P	NONE/COOL 4	DEG C	CR	Y N		
AD7197-B	01	P	HNO3		IN	Y N		
AD7197-C	01	P	HNO3		IN	Y N		
AD7197-D	01	P	HNO3		IN	Y N		
AD7197-E	01	P	HNO3		IN	Y N		
AD7197-F	2	G	NONE/COOL 4	DEG C	SV	Y N		
AD7197-G	2	G	NONE/COOL 4	DEG C	SV	Y N		
AD7197-J	4	G	HCL		VO	Y N		
AD7197-K	01	G	HCL		VO	Y N	NO BUFFER [illegible]	TB 9-30-91 EP
AD7197-L	4	G	NONE/COOL 4	DEG C	VO	Y N		
~~7197-M~~	~~01~~	~~G~~	~~NONE/COOL 4~~	~~DEG C~~	~~VO~~	Y N		CANCEL 9-30-91
						Y N		
						Y N		
						Y N		
						Y N		
						Y N		

TEMP BLANK Temp = 03.5°C
Tommy Griffith

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Tommy H. Griffith Date: 10/1/91 Time: 12:00 (2400 HR.)
Signature: Tommy H. Griffith Seal #: 4730 Intact: YES

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: Tommy H Griffith (Print) Date: 10/2/91 Time: 18:10 (2400 HR.)
Signature: Tommy H. Griffith Seal #: 11616 Intact: YES

LAB USE ONLY
Opened By: (Signature) [illegible] Date: 10/3/91 Time: 15:70 (2400 HR.)
AquaPak™/Sub. Contr. # 319 Temp.°C 4 Seal # 11616 Intact: Y
REGION

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD7197

Sample Point: W G 1215 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
911001	2.02	0.1	1.8	2.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated (Y) N (circle one) Sampling Equipment ..... Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- Polypropylene (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.89 (ft/msl)	Land Surface Elevation	592.17 (ft/msl)
Depth to water From top of well casing	9.60 (ft)	Depth to water From land surface	7.88 (ft)
Groundwater Elevation	584.29 (ft/msl)	Groundwater Elevation	590.45 (ft/msl)
Well Depth	20.70 (ft)	Stickup	1.72 (ft)

	ph		spec. cond		
1st	7.72 (STD)	1st	15100 μm/cm at 25° C	Sample Temp.	20.0 (° C)
2nd	7.71 (STD)	2nd	15100 μm/cm at 25° C	Well DIAM (other parameter)	2.0 (value) IN (units)
3rd	7.69 (STD)	3rd	15100 μm/cm at 25° C	(other parameter)	(value) (units)
4th	7.68 (STD)	4th	15100 μm/cm at 25° C	(other parameter)	(value) (units)

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: STRONG Color: BROWN Turbidity: MODERATE

Weather Conditions: Wind Speed 0-5 MPH Direction S.W. Precipitation Y/N Outlook SUNNY. 70°F

Specific Comments: * REFERENCE MEASUREMENT M.P. = INNER CASING

CASING VOL - 20.70 - 9.60 = 11.10 X 0.163 = 1.80 (1) X 3 = 5.42 (3)

WATER LEVEL TAKEN WITH BAILER IN THE WATER.

SAMPLE WEATHER - OVERCAST, 70°F, WINDS - WEST ~ 30 MPH.

WELL PURGED DRY AT 1206 HRS ON 10-1-91.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/1/91 (Date) Tommy H. Smith (Signature) Employer: WESTON / GCL

FF-2A 4/90

REGION

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G123S
Type: WELL
Sample No: AD7194
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result.	EMLRL	Units	
CRCHLORI01:				
CHLORIDE	1450	12.500	MG/L	DL
CRFLPOTO01:				
FLUORIDE	.24	0.050	MG/L	
FDPHQUAD01:				
PH FIELD	7.56		PH UNITS	
PH FIELD	7.55		PH UNITS	
PH FIELD	7.55		PH UNITS	
PH FIELD	7.54		PH UNITS	
FDSPCOND04:				
SPECIFIC CONDUCTANCE FIELD	4860.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	4860.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	4860.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	4870.		UMHOS/CM	
WDTWTC01:				
DEPTH TO WATER FROM TOP OF CASING	8.48		FT	
FDWGWELWDT:				
GROUNDWATER ELEV.	585.65		FT MSL	
WELL DEPTH TOTAL	21.77		FT	
FDWSTKUP01:				
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	2.42		FT	
FDXTEMPC01:				
WATER TEMPERATURE IN DEGREES CELSIUS	20.3		DEGREES C	
INGFAADIAS:				
ARSENIC-DISSOLVED	ND	35.000	UG/L	DL
INGFAADIPB:				
LEAD-DISSOLVED	ND	25.000	UG/L	DL
INGFAATOAS:				
ARSENIC-TOTAL	11.6	10.000	UG/L	
INGFAATOPB:				
LEAD-TOTAL	ND	15.000	UG/L	DL
ICPDISAL:				
LUMINUM-DISSOLVED	ND	200.000	UG/L	
INICPDISBA:				
BARIUM-DISSOLVED	1100	200.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G123S
Type: WELL
Sample No: AD7194
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
INICPDISFE:				
IRON-DISSOLVED	187	100.000	UG/L	
INICPDISNA:				
SODIUM-DISSOLVED	467000	5000.000	UG/L	
INICPDISZN:				
ZINC-DISSOLVED	ND	20.000	UG/L	
INICPTOTAL:				
ALUMINUM-TOTAL	297	200.000	UG/L	
INICPTOTBA:				
BARIUM-TOTAL	1360	200.000	UG/L	DL
INICPTOTFE:				
IRON-TOTAL	869	100.000	UG/L	
INICPTOTNA:				
SODIUM-TOTAL	550000	40000.000	UG/L	DL
INICPTOTZN:				
ZINC-TOTAL	ND	20.000	UG/L	
SVGC1OCP06:				
4,4'-DDE	ND	0.100	UG/L	
4,4'-DDT	ND	0.100	UG/L	
SVMS1BNA03:				
1,2-DICHLOROBENZENE	ND	10.000	UG/L	
2,4-DICHLOROPHENOL	ND	10.000	UG/L	
2,4-DIMETHYLPHENOL	ND	10.000	UG/L	
2,6-DICHLOROPHENOL	ND	10.000	UG/L	
2-CHLOROPHENOL	ND	10.000	UG/L	
3-METHYLPHENOL	30.	10.000	UG/L	
4-CHLOROANILINE	ND	10.000	UG/L	
4-METHYLPHENOL	30.	10.000	UG/L	
ANILINE	ND	10.000	UG/L	
ANTHRACENE	ND	10.000	UG/L	
NAPHTHALENE	ND	10.000	UG/L	
PHENOL	2500.	10.000	UG/L	
MSBA0105:				
(M and P)-XYLENE	ND	62.500	UG/L	DL
1,1-DICHLOROETHENE	ND	62.500	UG/L	DL
ACETONE	ND	425.000	UG/L	DL

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

ce: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G123S
Type: WELL
Sample No: AD7194
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
BENZENE	320.	12.500	UG/L	DL
CHLOROBENZENE	ND	62.500	UG/L	DL
DICHLORODIFLUOROMETHANE	ND	125.000	UG/L	DL
ETHYLBENZENE	ND	62.500	UG/L	DL
METHYLENE CHLORIDE	ND	62.500	UG/L	DL
O-XYLENE	ND	62.500	UG/L	DL
TOLUENE	ND	62.500	UG/L	DL
VINYL CHLORIDE	ND	125.000	UG/L	DL
VOMSDCC103:				
P-DIOXANE	300.	10.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract to: _____

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 73
Date Sealed 91 / 10 / 30 (YY / MM / DD)
Seal # 45563
By: EP 9-30-91

FACILITY # 705 9 SITE NAME: CWM Chemical Services

Sample Point: W G 1 2 3 5 (Source Code)

SAMPLE DATE: 91 / 10 / 02 (YY / MM / DD)

SAMPLE TIME: 12:25 (2400 HR)

MATRIX CODE: W

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes:

Well ..... (W) Leachate System ... (C) Pretreatment Facility ... (P) River/Stream/Brook ... (R) Soil ..... (S) Generation Pt. ..... (G)
Dewatering/Pressure Relief .... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Noise ..... (N) Specify _____

ENS # [illegible]

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AD7194-A	01	P	NONE/COOL 4	DEG C CR	Y N		
AD7194-B	01	P	HNO3	IN	Y N		
AD7194-C	01	P	HNO3	IN	Y N		
AD7194-D	01	P	HNO3	IN	Y N		
AD7194-E	01	P	HNO3	IN	Y N		
AD7194-F	2	G	NONE/COOL 4	DEG C SV	Y N		
AD7194-G	2	G	NONE/COOL 4	DEG C SV	Y N		
AD7194-J	4	G	HCL	VO	Y N		
AD7194-K	01	G	HCL	VO	Y N	[illegible]	TB 9-30-91
AD7194-L	4	G	NONE/COOL 4	DEG C VO	Y N		
~~7194-M~~	~~01~~	~~G~~	~~NONE/COOL 4~~	~~DEG C VO~~	Y N		CANCEL 9-30-91
					Y N		
		Temp Blank	Temp ~ 03.7°C		Y N		
			Tommy H. Witt		Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) TOMMY Date: 10/1/91 Time: 10:30 (2400 HR.)
Signature: Tommy H. Witt Seal #: 45563 Intact: YES

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: Tommy H. Witt (Print) Date: 10/2/91 T.W. Time: 17:48 (2400 HR.)
Signature: Tommy H. Witt Seal #: 8271 Intact: YES

LAB USE ONLY
Opened By: (Signature) [illegible] Date: 10/3/91 Time: 15:45 (2400 HR.)
AquaPak™/Sub. Contr. # 73 Temp.°C 0 Seal # 8271 Intact: Y

REGION

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD7194

Sample Point: WG123S (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL. IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
911001	12:26	0.1	2.2	2.5

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated (Y) (circle one) | N | Sampling Equipment ..... Dedicated (Y) (circle one) | N |

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- Polypropylene (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 594.13 (ft/msl)	Land Surface Elevation	591.71 (ft/msl)
Depth to water From top of well casing	8.48 (ft)	Depth to water From land surface	6.06 (ft)
Groundwater Elevation	585.65 (ft/msl)	Groundwater Elevation	585.65 (ft/msl)
Well Depth	21.77 (ft)	Stickup	2.42 (ft)

	ph		spec. cond				
1st	7.54 (STD)	1st	4870 μm/cm at 25° C	Sample Temp.	20.3 (° C)		
2nd	7.55 (STD)	2nd	4860 μm/cm at 25° C	Well Diam (other parameter)	2.0 (value)	IN (units)	
3rd	7.55 (STD)	3rd	4860 μm/cm at 25° C	(other parameter)	(value)	(units)	
4th	7.56 (STD)	4th	4860 μm/cm at 25° C	(other parameter)	(value)	(units)	

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: ~~Black~~ T.W. 10-1-91 Strong Color: Black Turbidity: Moderate

Weather Conditions: Wind Speed 0-5 Direction S.W. Precipitation Y/N Outlook Sunny, 70°F

Specific Comments: * Reference Measurement M.P. = Inner Casing

Casing Vol - 21.77 - 8.48 = 13.29 x 0.163 = 2.16 (1) x 3 = 6.49 (3)

Water Level Taken with Bailer in the Water.

Well Purged Dry at 1231 hrs on 10-1-91.

Sample Weather - Overcast, 70°F, Winds - West ~ 30mph.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/1/91 (Date) Tommy H. Wall (Signature) Employer: Weston / GCL

IL FF-2A 4/90

REGION

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

:e: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G124S
Type: WELL
Sample No: AD7195
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
CRCHLORI01:				
CHLORIDE	1100	12.500	MG/L	DL
CRFLPOTO01:				
FLUORIDE	.34	0.050	MG/L	
FDPHQUAD01:				
PH FIELD	7.53		PH UNITS	
PH FIELD	7.53		PH UNITS	
PH FIELD	7.54		PH UNITS	
PH FIELD	7.53		PH UNITS	
FDSPCOND04:				
SPECIFIC CONDUCTANCE FIELD	3710.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	3710.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	3720.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	3720.		UMHOS/CM	
VDTWTC01:				
DEPTH TO WATER FROM TOP OF CASING	9.73		FT	
FDWGWELWDT:				
GROUNDWATER ELEV.	583.55		FT MSL	
WELL DEPTH TOTAL	20.80		FT	
FDWSTKUP01:				
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	1.75		FT	
FDXTEMPC01:				
WATER TEMPERATURE IN DEGREES CELSIUS	19.2		DEGREES C	
INGFAADIAS:				
ARSENIC-DISSOLVED	ND	35.000	UG/L	DL
INGFAADIPB:				
LEAD-DISSOLVED	ND	25.000	UG/L	DL
INGFAATOAS:				
ARSENIC-TOTAL	ND	10.000	UG/L	
INGFAATOPB:				
LEAD-TOTAL	ND	15.000	UG/L	DL
ICPDISAL:				
LUMINUM-DISSOLVED	ND	200.000	UG/L	
INICPDISBA:				
BARIUM-DISSOLVED	ND	200.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

.te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G124S
Type: WELL
Sample No: AD7195
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
INICPDISFE:				
IRON-DISSOLVED	3360	100.000	UG/L	
INICPDISNA:				
SODIUM-DISSOLVED	267000	5000.000	UG/L	
INICPDISZN:				
ZINC-DISSOLVED	ND	20.000	UG/L	
INICPTOTAL:				
ALUMINUM-TOTAL	365	200.000	UG/L	
INICPTOTBA:				
BARIUM-TOTAL	ND	200.000	UG/L	
ICPTOTFE:				
IRON-TOTAL	3090	100.000	UG/L	
INICPTOTNA:				
SODIUM-TOTAL	275000	40000.000	UG/L	DL
INICPTOTZN:				
ZINC-TOTAL	ND	20.000	UG/L	
SVGC10CP06:				
4,4'-DDE	ND	0.100	UG/L	
4,4'-DDT	ND	0.100	UG/L	
SVMS1BNA03:				
1,2-DICHLOROBENZENE	ND	10.000	UG/L	
2,4-DICHLOROPHENOL	ND	10.000	UG/L	
2,4-DIMETHYLPHENOL	ND	10.000	UG/L	
2,6-DICHLOROPHENOL	ND	10.000	UG/L	
2-CHLOROPHENOL	ND	10.000	UG/L	
3-METHYLPHENOL	ND	10.000	UG/L	
4-CHLOROANILINE	ND	10.000	UG/L	
4-METHYLPHENOL	ND	10.000	UG/L	
ANILINE	ND	10.000	UG/L	
ANTHRACENE	ND	10.000	UG/L	
NAPHTHALENE	ND	10.000	UG/L	
PHENOL	ND	10.000	UG/L	
MSBA0105:				
(M and P)-XYLENE	ND	10.000	UG/L	
1,1-DICHLOROETHENE	ND	5.000	UG/L	
ACETONE	ND	34.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

.e: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G124S
Type: WELL
Sample No: AD7195
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units
BENZENE	ND	5.000	UG/L
CHLOROBENZENE	ND	5.000	UG/L
DICHLORODIFLUOROMETHANE	ND	10.000	UG/L
ETHYLBENZENE	ND	5.000	UG/L
METHYLENE CHLORIDE	ND	5.000	UG/L
O-XYLENE	ND	10.000	UG/L
TOLUENE	ND	5.000	UG/L
VINYL CHLORIDE	ND	10.000	UG/L
VOMSDCC103:			
P-DIOXANE	19.	10.000	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

VV IVII Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ # 63
Date Sealed 91 / 09 / 30 (YY / MM / DD)
Seal # 5010
By: EP 9-30-91

FACILITY # 705 SITE NAME: CWM Chemical Services

Sample Point: W G 1 2 4 S (Source Code)

SAMPLE DATE: 91 / 10 / 02 (YY / MM / DD)

SAMPLE TIME: 12 : 50 (2400 HR)

MATRIX CODE: W

ENVIRONMENTAL MONITORING LABORATORIES, INC
SAMPLE POINT LABEL
Sample Team: Attach this label to CC form when sampling begins at the Sample Point specified.
#705-G124S #

Source Codes

Well . . . . . (W)	Leachate System . . (C)	Pretreatment Facility . . . (P)	River/Stream/Brook . . (R)	Soil . . . . . (S)	Generation Pt . . . . (G)
Stormwater/Pressure Relief . . . . (D)	Gas Condensate . . . (M)	Influent . . . . . (U)	Lake or Ocean . . . . . (L)	Bottom Sediment . . . (B)	Other . . . . . (X)
Surface Water Impoundment . . . (I)	Air . . . . . (A)	Effluent . . . . . (T)	Outfall . . . . . (O)	Noise . . . . . (N)	Specify _____

INS # 91-11743

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS		FILTER Y — N	FIELD COMMENTS	E.M.L COMMENTS
4D7195-A	D1	P	NONE/COOL 4	DEG C	CR	Y N	* PER DOR	DALE RECD
4D7195-B	D1	P	HNO3		IN	Y N	10/3/91	PER DD OP
4D7195-C	D1	P	HNO3		IN	Y N	MS 11-11-91	
4D7195-D	D1	P	HNO3		IN	Y N		
4D7195-E	D1	P	HNO3		IN	Y N		
4D7195-F	2	G	NONE/COOL 4	DEG C	SV	Y N		
4D7195-G	2	G	NONE/COOL 4	DEG C	SV	Y N		
4D7195-J	4	G	HCL		VO	Y N		
4D7195-K	D1	G	HCL		VO	Y N	NO BUBBLE 10-1-91 TM	TB 9-30-91 EP
4D7195-L	4	G	NONE/COOL 4	DEG C	VO	Y N		
~~4D7195-M~~	~~D1~~	~~G~~	~~NONE/COOL 4~~	~~DEG C~~	~~VO~~	Y N		CANCEL 9-30-91
						Y N		
						Y N		
						Y N		
						Y N		
						Y N		

TEMP BLANK = 03.8°C.
Tommy H. Witt

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Tommy H. Witt Date: 10/1/91 Time: 12:50 (2400 HR.)
Signature: Tommy H. Witt Seal #: 5010 Intact: YES

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: Tommy H. Witt (Print) Date: 10/2/91 Time: 17:20 (2400 HR.)
Signature: Tommy H. Witt Seal #: 11814 Intact: YES

LAB USE ONLY
Opened By: (Signature) [signature] Date: ~~10/3/91~~ 10/3/91 Time: 15:15 (2400 HR.)
AquaPak™/Sub. Contr. # 63 Temp.°C 2 Seal # 11814 Intact. Y

ORIGINAL LAB

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD71905

Sample Point: W G 1 2 4 5 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL. IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
9 1 10 1	1253	1	18	20

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated | Y | N | (circle one) Sampling Equipment ..... Dedicated | Y | N | (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- Polypropylene (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 5913.28 (ft/msl)	Land Surface Elevation	5911.53 (ft/msl)
Depth to water From top of well casing	9.73 (ft)	Depth to water From land surface	7.98 (ft)
Groundwater Elevation	5813.55 (ft/msl)	Groundwater Elevation	5813.55 (ft/msl)
Well Depth	20.80 (ft)	Stickup	1.75 (ft)

	ph		spec. cond (μm/cm at 25° C)		Sample Temp.	(other parameter)	value	units
1st	7.53 (STD)	1st	3720		19.2 (° C)	Well DIAM	2.0	IN
2nd	7.54 (STD)	2nd	3720					
3rd	7.53 (STD)	3rd	3710					
4th	7.53 (STD)	4th	3710					

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: Slight Color: Tan Turbidity: Slight

Weather Conditions: Wind Speed 0-5 MPH Direction S.W. Precipitation Y/N Outlook Sunny 70°F.

Specific Comments: * Reference Measurement MP = Inner Casing

Casing Vol - 20.80 - 9.73 = 11.07 x 0.163 = 1.80 (1) x 3 = 5.41 (3)

Well Purged Dry at 1256 hrs on 10-1-91.

Sample Weather - Partly Sunny, 70°s, Winds - West - 25-30 MPH.

A Field Blank for VOA's was Done at this Well.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/1/91 (Date) Jimmy H. Hill (Signature) Employer: Weston/GEL

AL FF-2A 4/90

REGION

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

.te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G307
Type: WELL
Sample No: AD7196
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
CRCHLORI01:				
CHLORIDE	210	2.500	MG/L	DL
CRFLPOTO01:				
FLUORIDE	.59	0.050	MG/L	
FDPHQUAD01:				
PH FIELD	7.35		PH UNITS	
PH FIELD	7.33		PH UNITS	
PH FIELD	7.33		PH UNITS	
PH FIELD	7.28		PH UNITS	
FDSPCOND04:				
SPECIFIC CONDUCTANCE FIELD	2250.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	2260.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	2260.		UMHOS/CM	
⌐PECIFIC CONDUCTANCE FIELD	2270.		UMHOS/CM	
⌐WDTWTC01:				
DEPTH TO WATER FROM TOP OF CASING	7.82		FT	
FDWGWELWDT:				
GROUNDWATER ELEV.	582.89		FT MSL	
WELL DEPTH TOTAL	16.91		FT	
FDWSTKUP01:				
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	2.48		FT	
FDXTEMPC01:				
WATER TEMPERATURE IN DEGREES CELSIUS	16.1		DEGREES C	
INGFAADIAS:				
ARSENIC-DISSOLVED	ND	35.000	UG/L	DL
INGFAADIPB:				
LEAD-DISSOLVED	ND	25.000	UG/L	DL
INGFAATOAS:				
ARSENIC-TOTAL	36.8	10.000	UG/L	
INGFAATOPB:				
LEAD-TOTAL	178	15.000	UG/L	DL
:CPDISAL:				
LUMINUM-DISSOLVED	ND	200.000	UG/L	
INICPDISBA:				
BARIUM-DISSOLVED	ND	200.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G307
Type: WELL
Sample No: AD7196
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
INICPDISFE:				
IRON-DISSOLVED	ND	100.000	UG/L	
INICPDISNA:				
SODIUM-DISSOLVED	223000	5000.000	UG/L	
INICPDISZN:				
ZINC-DISSOLVED	ND	20.000	UG/L	
INICPTOTAL:				
ALUMINUM-TOTAL	34200	4000.000	UG/L	DL
INICPTOTBA:				
BARIUM-TOTAL	486	200.000	UG/L	
ICPTOTFE:				
RON-TOTAL	85100	1000.000	UG/L	DL
INICPTOTNA:				
SODIUM-TOTAL	214000	40000.000	UG/L	DL
INICPTOTZN:				
ZINC-TOTAL	325	20.000	UG/L	
SVGC10CP06:				
4,4'-DDE	ND	0.100	UG/L	
4,4'-DDT	ND	0.100	UG/L	
SVMS1BNA03:				
1,2-DICHLOROBENZENE	ND	10.000	UG/L	
2,4-DICHLOROPHENOL	ND	10.000	UG/L	
2,4-DIMETHYLPHENOL	ND	10.000	UG/L	
2,6-DICHLOROPHENOL	ND	10.000	UG/L	
2-CHLOROPHENOL	ND	10.000	UG/L	
3-METHYLPHENOL	ND	10.000	UG/L	
4-CHLOROANILINE	ND	10.000	UG/L	
4-METHYLPHENOL	ND	10.000	UG/L	
ANILINE	ND	10.000	UG/L	
ANTHRACENE	ND	10.000	UG/L	
NAPHTHALENE	ND	10.000	UG/L	
PHENOL	ND	10.000	UG/L	
1SBA0105:				
(M and P)-XYLENE	ND	10.000	UG/L	DL
1,1-DICHLOROETHENE	ND	10.000	UG/L	DL
ACETONE	ND	68.000	UG/L	DL

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

.te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: G307
Type: WELL
Sample No: AD7196
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
BENZENE	ND	5.000	UG/L	DL
CHLOROBENZENE	ND	10.000	UG/L	DL
DICHLORODIFLUOROMETHANE	ND	20.000	UG/L	DL
ETHYLBENZENE	ND	10.000	UG/L	DL
METHYLENE CHLORIDE	ND	10.000	UG/L	DL
O-XYLENE	ND	10.000	UG/L	DL
TOLUENE	ND	10.000	UG/L	DL
VINYL CHLORIDE	ND	20.000	UG/L	DL
VOMSDCC103:				
P-DIOXANE	270.	10.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

:e: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11943 MP: 705911 REV: 00

Sample Point: TBK-G120S
Type: WELL
Sample No: AD7193
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units
VOMSBAO105:			
(M and P)-XYLENE	ND	10.000	UG/L
1,1-DICHLOROETHENE	ND	5.000	UG/L
ACETONE	ND	34.000	UG/L
BENZENE	ND	5.000	UG/L
CHLOROBENZENE	ND	5.000	UG/L
DICHLORODIFLUOROMETHANE	ND	10.000	UG/L
ETHYLBENZENE	ND	5.000	UG/L
METHYLENE CHLORIDE	ND	5.000	UG/L
O-XYLENE	ND	10.000	UG/L
TOLUENE	ND	5.000	UG/L
VINYL CHLORIDE	ND	10.000	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 187
Date Sealed 9 1 0 9 3 0
YY / MM / DD
Seal # 4748
By: ER 9-30-91

/FACILITY # 705 SITE NAME: CWM Chemical Services

Sample Point: W G 3 0 7
Source Code

SAMPLE DATE: - 9 1 1 0 0 2
YY / MM / DD

SAMPLE TIME: 15:40 (2400 HR) MATRIX CODE: W

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes:
Well ..... (W) Leachate System ... (C) Pretreatment Facility ... (P) River/Stream/Brook ... (R) Soil ..... (S) Generation Pt. .... (G)
Dewatering/Pressure Relief .... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Noise ..... (N) Specify _____

ENS # 91-11947

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AD7196-A	01	P	NONE/COOL 4	DEG C CR	Y N		[illegible]
AD7196-B	01	P	HNO3	IN	Y N		[illegible]
AD7196-C	01	P	HNO3	IN	Y N		[illegible]
AD7196-D	01	P	HNO3	IN	Y N		[illegible]
AD7196-E	01	P	HNO3	IN	Y N		[illegible]
AD7196-F	2	G	NONE/COOL 4	DEG C SV	Y N		[illegible]
AD7196-G	2	G	NONE/COOL 4	DEG C SV	Y N		[illegible]
AD7196-J	4	G	HCL	VO	Y N		[illegible]
AD7196-K	01	G	HCL	VO	Y N		[illegible] 9-30-91 ER
7196-L	4	G	NONE/COOL 4	DEG C VO	Y N		[illegible]
~~7196-M~~	~~01~~	~~G~~	~~NONE/COOL 4~~	~~DEG C VO~~	Y N		[illegible] 9-30-91
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

Temp Blank Temp - 04.1°C
Tommy H. Witt

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Tommy H. Witt Date: 10/2/91 Time: 15:15 2400 HR.
Signature: Tommy H. Witt Seal #: 4748 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : 2400 HR. Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : 2400 HR. Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: Tommy H. Witt (Print) Date: 10/2/91 Time: 18:05 2400 HR.
Signature: Tommy H. Witt Seal #: 8379 Intact: yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 10/3/91 Time: 15:30 2400 HR.
AquaPak™/Sub. Contr. # 187 Temp.°C 2 Seal # 8379 Intact: Y

REGION

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD7196

Sample Point: N G307 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
911002	15.20	0.2	1.5	4.5

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated (Y) N (circle one) Sampling Equipment ..... Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	D	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	D	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- Poly Propylene (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 590.71 (ft/msl)	Land Surface Elevation	588.23 (ft/msl)
Depth to water From top of well casing	7.82 (ft)	Depth to water From land surface	5.34 (ft)
Groundwater Elevation	582.89 (ft/msl)	Groundwater Elevation	582.89 (ft/msl)
Well Depth	16.91 (ft)	Stickup	2.48 (ft)

	ph		spec cond				
1st	7.08 (STD) 2 T.W. 10-2-91	1st	2270 μm/cm at 25° C	Sample Temp.	16.1 (° C)		
2nd	7.33 (STD) T.W.	2nd	2260 μm/cm at 25° C	Well Diam (other parameter)	2.0 (value)	(units)	
3rd	7.33 (STD)	3rd	2260 μm/cm at 25° C	(other parameter)	(value)	(units)	
4th	7.35 (STD)	4th	2250 μm/cm at 25° C	(other parameter)	(value)	(units)	

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: Slight Color: Brown Turbidity: High

Weather Conditions: Wind Speed ~20 MPH Direction N.W. Precipitation (Y)/N Outlook Cloudy, 70°F

Specific Comments: * Reference Measurement M.P. = Inner Casing

Casing Vol – 16.91 – 7.82 = 9.09 x 0.163 = 1.48 (1) x 3 = 4.44 (3)

Water Level Taken with Bailer in the Water.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/2/91 (Date) Tommy H. Watt (Signature) Employer: Weston/GCL

EML FF-2A 4/90

REGION

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11945 MP: 705911 REV: 00

Sample Point: IMPDE
Type: IMPOUND
Sample No: AD7199
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
CRCHLORI01:				
CHLORIDE	3670	25.000	MG/L	DL
CRFLPOTO01:				
FLUORIDE	15.8	0.150	MG/L	DL
FDPHQUAD01:				
PH FIELD	9.89		PH UNITS	
PH FIELD	9.88		PH UNITS	
PH FIELD	9.87		PH UNITS	
PH FIELD	9.85		PH UNITS	
FDSPCOND04:				
SPECIFIC CONDUCTANCE FIELD	11300.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	11200.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	11200.		UMHOS/CM	
SPECIFIC CONDUCTANCE FIELD	11200.		UMHOS/CM	
XTEMPC01:				
WATER TEMPERATURE IN DEGREES CELSIUS	20.0		DEGREES C	
INGFAADIAS:				
ARSENIC-DISSOLVED	41.0	35.000	UG/L	DL
INGFAADIPB:				
LEAD-DISSOLVED	ND	25.000	UG/L	DL
INGFAATOAS:				
ARSENIC-TOTAL	ND	70.000	UG/L	DL
INGFAATOPB:				
LEAD-TOTAL	122	15.000	UG/L	DL
INICPDISAL:				
ALUMINUM-DISSOLVED	ND	200.000	UG/L	
INICPDISBA:				
BARIUM-DISSOLVED	ND	200.000	UG/L	
INICPDISFE:				
IRON-DISSOLVED	ND	100.000	UG/L	
NICPDISNA:				
DIUM-DISSOLVED	2900000	40000.000	UG/L	DL
ICPDISZN:				
ZINC-DISSOLVED	71.9	20.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

.te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11945 MP: 705911 REV: 00

Sample Point: IMPDE
Type: IMPOUND
Sample No: AD7199
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 23-OCT-1991

Analyte	Result	EMLRL	Units	
INICPTOTAL:				
ALUMINUM-TOTAL	ND	200.000	UG/L	
INICPTOTBA:				
BARIUM-TOTAL	ND	200.000	UG/L	
INICPTOTFE:				
IRON-TOTAL	202	100.000	UG/L	
INICPTOTNA:				
SODIUM-TOTAL	2980000	40000.000	UG/L	DL
INICPTOTZN:				
ZINC-TOTAL	279	20.000	UG/L	
SVGC1OCP06:				
',4'-DDE	ND	0.100	UG/L	
,4'-DDT	0.117	0.100	UG/L	
SVMS1BNA03:				
1,2-DICHLOROBENZENE	ND	10.000	UG/L	
2,4-DICHLOROPHENOL	ND	10.000	UG/L	
2,4-DIMETHYLPHENOL	ND	10.000	UG/L	
2,6-DICHLOROPHENOL	ND	10.000	UG/L	
2-CHLOROPHENOL	ND	10.000	UG/L	
3-METHYLPHENOL	ND	10.000	UG/L	
4-CHLOROANILINE	ND	10.000	UG/L	
4-METHYLPHENOL	ND	10.000	UG/L	
ANILINE	ND	10.000	UG/L	
ANTHRACENE	ND	10.000	UG/L	
NAPHTHALENE	ND	10.000	UG/L	
PHENOL	ND	10.000	UG/L	
VOMSBAO105:				
(M and P)-XYLENE	ND	25.000	UG/L	DL
1,1-DICHLOROETHENE	ND	25.000	UG/L	DL
ACETONE	ND	170.000	UG/L	DL
BENZENE	ND	5.000	UG/L	DL
CHLOROBENZENE	ND	25.000	UG/L	DL
DICHLORODIFLUOROMETHANE	ND	50.000	UG/L	DL
ETHYLBENZENE	ND	25.000	UG/L	DL
METHYLENE CHLORIDE	ND	25.000	UG/L	DL
O-XYLENE	ND	25.000	UG/L	DL
OLUENE	ND	25.000	UG/L	DL
INYL CHLORIDE	ND	50.000	UG/L	DL
VOMSDCC103:				
P-DIOXANE	ND	10.000	UG/L	

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD7199

FIELD INFORMATION FORM

Sample Point: IIMPDE (Source Code)

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated | Y | | N | (circle one) Sampling Equipment ..... Dedicated | Y | | N | (circle one)

Purging Device	—	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	F	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	—	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	—	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	—	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	—	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	(ft/msl)	Land Surface Elevation	(ft/msl)
Depth to water From top of well casing	(ft)	Depth to water From land surface	(ft)
Groundwater Elevation	(ft/msl)	Groundwater Elevation	(ft/msl)
Well Depth	(ft)	Stickup	(ft)

	ph		spec. cond				
1st	9.85 (STD)	1st	1200	μm/cm at 25° C	Sample Temp.	20.0	(° C)
2nd	9.87 (STD)	2nd	1200	μm/cm at 25° C	(other parameter)	value	units
3rd	9.88 (STD)	3rd	1200	μm/cm at 25° C	(other parameter)	value	units
4th	9.89 (STD)	4th	1300	μm/cm at 25° C	(other parameter)	value	units

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: Moderate Color: Brown Turbidity: Moderate

Weather Conditions: Wind Speed ~20 mph Direction N.W. Precipitation Y/N Outlook Cloudy, 70°F

Specific Comments: Sample taken from the northeast impoundment pond. Sample was taken from the southwest corner of this pond. Bottles were submerged to obtain sample.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/21/91 (Date) Tommy H. Watt (Signature) Employer: Weston/GCL

FF-2A 4/90

Subcontract To: _____

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 106
Date Sealed 91/10/30 (YY / MM / DD)
Seal # 4836
By: EE 9-27-91

TE/FACILITY # 035 SITE NAME: CWM Chemical Services

Sample Point: H I M D D E (Source Code)

SAMPLE DATE: 91/10/02 (YY / MM / DD)

SAMPLE TIME: 14:32 (2400 HR)

MATRIX CODE: W

Water (W) Leachate (C)
Soil (S) Other (X)

Source Codes:
Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream/Brook (R) Soil (S) Generation Pt. (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # 91-11545

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y—N	FIELD COMMENTS	LAB COMMENTS
AD7199-A	01	P	NONE/COOL 4	DEG C CR	Y N		
AD7199-B	01	P	HNO3	IN	Y N		
AD7199-C	01	P	HNO3	IN	Y N		
AD7199-D	01	P	HNO3	IN	Y N		
AD7199-E	01	P	HNO3	IN	Y N		
AD7199-F	2	G	NONE/COOL 4	DEG C SV	Y N		
AD7199-G	2	G	NONE/COOL 4	DEG C SV	Y N		
AD7199-H	2	G	NONE/COOL 4	DEG C SV	Y N		
AD7199-I	2	G	NONE/COOL 4	DEG C SV	Y N		
AD7199-J	4	G	HCL	VO	Y N		
AD7199-K	01	G	HCL	VO	Y N	MATCH HEAD SIZE	10-9-91
AD7199-L	4	G	NONE/COOL 4	DEG C VO	Y N		
~~AD7199-M~~	~~01~~	~~G~~	~~NONE/COOL 4~~	~~DEG C VO~~	Y N		9-30-91
	TEMP BLANK TEMP = 03.9°C				Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Tommy H. Witt Date: 10/2/91 Time: 14:25 (2400 HR.)
Signature: Tommy H. Witt Seal #: 4836 Intact: YES

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: (Print) Tommy H. Witt Date: 10/2/91 Time: 17:59 (2400 HR.)
Signature: Tommy H. Witt Seal #: 11558 Intact: YES

LAB USE ONLY
Opened By: (Signature) [illegible] Date: 10/3/91 Time: 15:10 (2400 HR.)
AquaPak™/Sub. Contr. # 106 Temp.°C 3 Seal # 11558 Intact: Y

WMI ENVIRONMENTAL MONITORING LABORATORIES INC

CLIENT REPORT

te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 91-11944 MP: 705911 REV: 00

Sample Point: 02FB
Type: WELL
Sample No: AD7198
Sampled: 2-OCT-1991
Received: 3-OCT-1991
Reported: 22-OCT-1991

Analyte	Result	EMLRL	Units
VOMSBA0105:			
(M and P)-XYLENE	ND	10.000	UG/L
1,1-DICHLOROETHENE	ND	5.000	UG/L
ACETONE	ND	34.000	UG/L
BENZENE	ND	5.000	UG/L
CHLOROBENZENE	ND	5.000	UG/L
DICHLORODIFLUOROMETHANE	ND	10.000	UG/L
ETHYLBENZENE	ND	5.000	UG/L
METHYLENE CHLORIDE	ND	5.000	UG/L
O-XYLENE	ND	10.000	UG/L
TOLUENE	ND	5.000	UG/L
VINYL CHLORIDE	ND	10.000	UG/L
VOMSDCC103:			
P-DIOXANE	ND	10.000	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 480
Date Sealed 9 1 0 9 3 0 (YY / MM / DD)
Seal # 4755
By: EP 9-30-91

SITE/FACILITY # 7 0 5 SITE NAME: CWM Chemical Services

Sample Point: X 0 2 F B (Source Code)

SAMPLE DATE: 9 1 1 0 0 2 (YY / MM / DD)

SAMPLE TIME: 1 3 : 3 0 (2400 HR.)

MATRIX CODE: W

Water (W) Soil (S) Leachate (C) Other (X)

Source Codes:
Well (W) Dewatering/Pressure Relief (D) Surface Water Impoundment (I) Leachate System (C) Gas Condensate (M) Air (A) Pretreatment Facility (P) Influent (U) Effluent (T) River/Stream/Brook (R) Lake or Ocean (L) Outfall (O) Soil (S) Bottom Sediment (B) Noise (N) Generation Pt (G) Other (X) Specify _____

ENS # [illegible]

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y-N	FIELD COMMENTS	E.M.L. COMMENTS
AD7198-A	4	G	HCL	VU	Y (N)		[illegible]
AD7198-B	01	G	HCL	VU	Y N	No Bubble T.V.	↑
AD7198-C	4	G	NONE/COOL	DEG C VU	Y (N)		B 9-30-91
~~AD7198-D~~	~~01~~	~~G~~	~~NONE/COOL~~	~~DEG~~ ~~VU~~	Y N		
					Y N		ANEL 9-30-91
					Y N		
	Temp Blank Temp = 03.6°C				Y N		
				Tommy H. Witt	Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Tommy H. Witt Date: 10/2/91 Time: 13:03 (2400 HR.)
Signature: Tommy H. Witt Seal #: 4755 Intact: YES

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

AquaPak™/Sub Contr. # _____ Sealed By: Tommy H. Witt (Print) Date: 10/2/91 Time: 17:53 (2400 HR.)
Signature: Tommy H. Witt Seal #: 5401 Intact: YES

LAB USE ONLY
Opened By: (Signature) [illegible] Date: 10/3/91 Time: 9:45 (2400 HR.)
AquaPak™/Sub. Contr. # 480 Temp.°C 4 Seal # 5411 Intact. Y

WMI Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AD7198

FIELD INFORMATION FORM

Sample Point: X 02FB (Source Code)

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated | Y | | N | (circle one) Sampling Equipment ..... Dedicated | Y | | N | (circle one)

Purging Device	—	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	F	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	—	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	X	B-Stainless Steel	D-PVC		X- GLASS SAMPLING OTHER (SPECIFY)
Tubing-Purging	—	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	—	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- (SPECIFY)			
Filtering Devices 0.45 μ:	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	(ft/msl)	Land Surface Elevation	(ft/msl)
Depth to water From top of well casing	(ft)	Depth to water From land surface	(ft)
Groundwater Elevation	(ft/msl)	Groundwater Elevation	(ft/msl)
Well Depth	(ft)	Stickup	(ft)

1st	(STD) ph	1st	μm/cm at 25° C spec cond	Sample Temp.	(° C)
2nd	(STD) ph	2nd	μm/cm at 25° C spec cond	(other parameter)	value / units
3rd	(STD) ph	3rd	μm/cm at 25° C spec. cond	(other parameter)	value / units
4th	(STD) ph	4th	μm/cm at 25° C spec cond	(other parameter)	value / units

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: _____ Color: _____ Turbidity: _____

Weather Conditions: Wind Speed 25 MPH Direction West Precipitation Y/N Outlook Partly Sunny 70°F

Specific Comments:

Field Blank was poured in front of well G124 S. Field Blank water was supplied by EML. Due to insufficient volume of Field Blank water, PH, SC and Temp (field parameters) were not taken.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

10/2/91 (Date) Tommy H. Witt (Signature) Employer: Weston/GCL

CWM Chemical Services, Inc.
Chicago Incinerator

ATTACHMENT C

HISTORICAL DATA BY SAMPLING LOCATION

G120S

		10/2/91
Acetone	ug/l	<170
Dichlorodifluoro-methane	ug/l	<50
Methylene chloride	ug/l	<25
Naphthalene	ug/l	<10
4,4'-DDE	ug/l	<.1
Aluminum	ug/l	<200
Arsenic	ug/l	60.5
Barium	ug/l	888
Iron	ug/l	14500
Lead	ug/l	<25
Sodium	ug/l	112000
Zinc	ug/l	<20
Chloride	mg/l	276
Fluoride	mg/l	0.47

		7/2/91	4/3/91	1/4/91	10/24/90	7/23/90	4/26/90	1/22/90	10/24/89	7/25/89	4/24/89	1/30/89
Acetone	ug/l	<170	<34	<170	<170	<34	<170	<34	<34	<34	<10	22.1
Dichlorodifluoro-methane	ug/l	<50	<10	<50	<50	<10	<50	23	18	14	<10	<10
Methylene chloride	ug/l	<25	<5	<25	<25	<5	<25	<5	<5	<5	<5	5.28
Naphthalene	ug/l	<10	<10	<10	<10	<10	<10	12	14	23	20	18.9
4,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.10
Aluminum	ug/l	<200	<200	<200	<200	<200	<200	783	<200	549	<200	
Arsenic	ug/l	<60	<30	32.2	45.6	50.2	32.0	50.5	52.5	73	40.3	38
Barium	ug/l	981	930	1090	991	906	907	1060	812	1060	964	939
Iron	ug/l	12300	14300	15200	15400	14000	15400	17400	13000	12500	15600	13600
Lead	ug/l	<5	<5	<5	<5	<5	<5	<50	<25	<5	<5	90
Sodium	ug/l	132000	130000	153000	126000	143000	136000	148000	128000	131000	158000	131000
Zinc	ug/l	<20	<20	<20	83.8	<20	<20	21.7	<20	<20	<20	126
Chloride	mg/l	269	270	300	309	306	309	306	212	273	258	200
Fluoride	mg/l	0.44	0.46	0.47	0.50	0.44	0.45	0.51	0.46	<.05	.47	.4

G120S

		10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	59.3	23.4	<10	<10	10.7	NT
Dichlorodifluoro-methane	ug/l	77.8	33.6	64.6	24.3	43.8	NT
Methylene chloride	ug/l	5.79	13.4	<2.8	5.70	<2.8	8.20
Naphthalene	ug/l	21.4	8.3	23.0	29.0	4.08	<1.6
4,4'-DDE	ug/l	<.1	<.1	<.20	NT	.98	NT
Aluminum	ug/l						
Arsenic	ug/l	48	51	34	50	58	18
Barium	ug/l	1090	930	865	846	781	NT
Iron	ug/l	16700	16100	15400	14200	15500	1620
Lead	ug/l	<10	<4	<8	<4	<4	<4
Sodium	ug/l	137000	127000	117000	126000	115000	114000
Zinc	ug/l	10	360	<10	<10	107000	NT
Chloride	mg/l	300	260	460	250	NT	240
Fluoride	mg/l	.7	.6	.8	.5	.44	NT

NT-Not Tested

G121S

		10/2/91
Acetone	ug/l	<340
Benzene	ug/l	210
Chlorobenzene	ug/l	<50
Ethylbenzene	ug/l	<50
Toluene	ug/l	<50
Methylene Chloride	ug/l	<50
2-Chlorophenol	ug/l	<10
2,4-Dichlorophenol	ug/l	<10
2,4-Dimethylphenol	ug/l	12
Phenol	ug/l	<10
1,2-Dichlorobenzene	ug/l	<10
Anthracene	ug/l	<10
Naphthalene	ug/l	<10
Aniline	ug/l	<10
4-Chloroaniline	ug/l	220
m+p-Cresols	ug/l	<10
1,4-Dioxane	mg/l	69
Xylene, m	ug/l	<50
Xylene, o+p	ug/l	<50
4,4'-DDT	ug/l	<.1
2,6-Dichlorophenol	ug/l	<10
Aluminum	ug/l	<200
Arsenic	ug/l	<35
Barium	ug/l	301
Iron	ug/l	3030
Lead	ug/l	<25
Sodium	ug/l	4090000
Zinc	ug/l	<20
Chloride	mg/l	7840
Fluoride	mg/l	2.42

G121S

		7/2/91	4/3/91	1/4/91	10/24/90	7/24/90	4/26/90	1/22/90	10/24/89	7/26/89	4/24/89	1/31/89
Acetone	ug/l	<340	<340	<340	<340	<340	<310	<340	<340	<34	<10	4.1
Benzene	ug/l	230	200	190	240	230	260	200	230	250	260	178
Chlorobenzene	ug/l	<50	51	<50	51	51	59	<50	56	63	61	64.8
Ethylbenzene	ug/l	<50	<50	<50	<50	<50	<46	<50	<50	15	17	14.4
Toluene	ug/l	<50	<50	<50	<50	<50	<46	<50	<50	11	<5	9.95
Methylene Chloride	ug/l	<50	<50	<50	<50	<50	<46	<50	<50	6.2	7.5	5.84
2-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	5.45
2,4-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<2.9
2,4-Dimethylphenol	ug/l	19	19	19	<10	26	26	26	32	40	32	25.3
Phenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	23	<1.6
1,2-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	6.17
Anthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<2.0
Naphthalene	ug/l	<10	12	13	17	<10	16	15	21	28	<10	18.1
Aniline	ug/l	<10	<10	<10	<10	<10	<10	<10	10	13	<10	<11
4-Chloroaniline	ug/l	230	150	160	220	180	170	160	200	240	57	220
m+p-Cresols	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<11
1,4-Dioxane	mg/l	100	120	90	51	54	<50	<50	<50	<50	<50	<13
Xylene, m	ug/l	<50	<50	<50	<50	<50	<46	<50	<50	<10	11	<10
Xylene, o+p	ug/l	<50	<50	<50	<50	<50	<46	<50	<50	10	12	14.9
4,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	.1	<.1	<.1	<13
2,6-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<11
Aluminum	ug/l	<200	<200	<200	<200	<200	<200	<1000	<200	373	320	
Arsenic	ug/l	<30	<30	19.3	20.2	31.9	44.6	<10	18	35.9	45.6	10
Barium	ug/l	228	<200	210	<200	<200	<200	<200	<200	<200	206	47
Iron	ug/l	1860	736	688	602	683	227	990	564	142	610	230
Lead	ug/l	<25	<25	<25	<50	<10	<5	<5	<5	<5	<5	<4
Sodium	ug/l	3560000	3560000	4290000	4260000	4670000	5110000	4720000	600000	5110000	4260000	5130000
Zinc	ug/l	<20	<20	<20	<20	<20	<20	<50	<20	<20	26	<10
Chloride	mg/l	7210	6630	9840	8350	7610	80900	747	7070	8790	8170	9000
Fluoride	mg/l	2.5	2.9	2.7	2.9	3.1	3.2	3.4	4.4	5.7	3.9	1.1

G1215

		10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	<50	11.9	<10	<10	22.2	NT
Benzene	ug/l	285	<4.4	264	<4.4	371	270
Chlorobenzene	ug/l	65.9	22.0	79.4	33.4	93.4	59.4
Ethylbenzene	ug/l	<36	11.2	17.3	17.8	19.8	NT
Toluene	ug/l	<30	<6.0	34.5	18.3	59.5	67.1
Methylene Chloride	ug/l	560	7.28	<2.8	<2.8	<2.8	7.10
2-Chlorophenol	ug/l	9.53	7.09	11.6	13.3	24.7	25.0
2,4-Dichlorophenol	ug/l	<2.9	3.32	<2.8	4.02	16.8	<2.7
2,4-Dimethylphenol	ug/l	32.2	17.9	32.0	32.5	54.6	30.3
Phenol	ug/l	<1.6	1.61	<1.5	4.83	17.1	47.0
1,2-Dichlorobenzene	ug/l	9.76	5.07	5.64	6.63	6.93	3.29
Anthracene	ug/l	<2.0	<4.3	<1.9	<2.0	2.07	NT
Naphthalene	ug/l	20.3	<3.6	15.6	19.5	214	113
Aniline	ug/l	<11	<23	16.1	26.9	38.5	491
4-Chloroaniline	ug/l	198	<23	109	109	466	NT
m+p-Cresols	ug/l	<11	<10	11.9	<10	30.4	25.7
1,4-Dioxane	mg/l	<13	<13	<13	<13	57.2	NT
Xylene, m	ug/l	<50	<10	13.8	12.2	16.5	NT
Xylene, o+p	ug/l	<50	13.4	20.3	20.9	24.0	NT
4,4'-DDT	ug/l	<.1	<.1	<.21	NT	.475	NT
2,6-Dichlorophenol	ug/l	<11	<11	<10	<10	17.0	
Aluminum	ug/l						
Arsenic	ug/l	21	21	23	20	16	32
Barium	ug/l	192	174	163	210	203	NT
Iron	ug/l	232	343	97	141	140	<30
Lead	ug/l	<10	<4	<4	4	6	6
Sodium	ug/l	6550000	5400000	5710000	5020000	5340000	6220000
Zinc	ug/l	<10	10	<10	<10	837	NT
Chloride	mg/l	9700	9000	8900	9000	NT	11000
Fluoride	mg/l	5.7	6.9	15	3.4	2.6	NT

NT - Not Tested

G123S

		10/2/91
Acetone	ug/l	<425
Benzene	ug/l	320
1,1-Dichloroethylene	ug/l	<62.5
Methylene Chloride	ug/l	<62.5
Vinyl Chloride	ug/l	<125
Toluene	ug/l	<62.5
2-Chlorophenol	ug/l	<10
2,4-Dichlorophenol	ug/l	<10
2,4-Dimethylphenol	ug/l	<10
2,6-Dichlorophenol	ug/l	<10
m&p-Cresols	ug/l	30
4-Chloroaniline	ug/l	<10
Phenol	ug/l	2500
Naphthalene	ug/l	<10
Aniline	ug/l	<10
4,4'-DDT	ug/l	<.1
1,4-Dioxane	ug/l	300
Aluminum	ug/l	<200
Arsenic	ug/l	<35
Barium	ug/l	1100
Iron	ug/l	187
Lead	ug/l	<25
Sodium	ug/l	467000
Zinc	ug/l	<20
Chloride	mg/l	1450
Fluoride	mg/l	0.24

		7/1/91	4/3/91	1/4/91	10/24/90	7/24/90	4/26/90	1/22/90	10/24/89	7/25/89	4/25/89	1/30/89
Acetone	ug/l	<340	620	<1360	<3400	<340000	<68000	<34	<6800	<34	10	428
Benzene	ug/l	290	390	420	790	<10000	<2000	550	330	600	370	66.3
1,1-Dichloroethylene	ug/l	<50	56	398	2900	<50000	20000	5500	2400	4400	4100	167
Methylene Chloride	ug/l	<50	<50	<200	3200	<50000	30000	16000	5400	14000	23000	1440
Vinyl Chloride	ug/l	<100	310	800	<1000	<100000	<20000	<10	<2000	620	400	41.9
Toluene	ug/l	<50	71	<200	<500	<50000	<10000	130	<1000	<5	<5	25.3
2-Chlorophenol	ug/l	<10	<1000	<1000	<2000	<2000	<1000	120	65	96	97	32.2
2,4-Dichlorophenol	ug/l	<10	<1000	<1000	<2000	<2000	1600	700	250	400	180	18.7
2,4-Dimethylphenol	ug/l	<10	<1000	<1000	<2000	<2000	<1000	<10	12	13	14	<2.8
2,6-Dichlorophenol	ug/l	<10	<1000	<1000	<2000	<2000	<1000	160	79	100	68	20.9
m&p-Cresols	ug/l	68	<1000	<1000	<2000	<2000	<1000	132	240	280	188	36.0
4-Chloroaniline	ug/l	27	<1000	<1000	<2000	<2000	<4500	130	97	140	73	12.3
Phenol	ug/l	2292	7900	21000	29000	78000	70000	45000	32000	28000	16000	4250
Naphthalene	ug/l	<10	<1000	<1000	<2000	<2000	<1000	158	23	27	29	11.8
Aniline	ug/l	18	<1000	<1000	<2000	<2000	<1000	180	120	120	160	48.1
4,4'-DDT	ug/l	<.1	<.1	<.1	<1.0	<.1	NA	<.1	<.1	<.1	<.1	<.10
1,4-Dioxane	ug/l	270	610	710	300	870	510	650	<50	300	<50	
Aluminum	ug/l	<200	<200	<200	<200	<200	<200	<1000	<200	407	348	
Arsenic	ug/l	<30	<30	19.0	<30	17.1	<10	<10	15.7	16.1	17.2	<4
Barium	ug/l	1250	1600	1980	1620	1570	1620	1590	836	910	1060	615
Iron	ug/l	289	1530	1230	1800	893	748	630	156	172	179	90
Lead	ug/l	<25	<25	<25	<25	<10	<5	<50	<5	<5.0	48.7	<4
Sodium	ug/l	535000	697000	730000	608000	689000	762000	716000	783000	674000	959000	820000
Zinc	ug/l	<20	<20	<20	<20	<20	<20	24.0	<20	<20	<20	<10
Chloride	mg/l	1750	2410	2530	1980	2750	25600	238	1500	1840	2090	200
Fluoride	mg/l	0.34	0.32	0.32	0.37	0.28	0.25	.28	.35	.32	.26	.3

NA - Not Analyzed

G123S

		10/28/88	7/29/88	4/28/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	92.6	72.1	165	13.9	20.0	NT
Benzene	ug/l	13.6	20.0	19.5	<4.4	6.4	32.0
1,1-Dichloroethylene	ug/l	2.90	48.8	24.4	<2.8	18.5	144
Methylene Chloride	ug/l	16.3	15.5	680	<2.8	5.27	<2.8
Vinyl Chloride	ug/l	<10	NT	<10	<10	13.9	36.7
Toluene	ug/l	<6.0	<6.0	<6.0	<6.0	<6.0	14.5
2-Chlorophenol	ug/l	3.4	6.68	7.23	7.43	<3.4	17.3
2,4-Dichlorophenol	ug/l	<2.8	<2.8	3.68	<2.9	<2.8	ND
2,4-Dimethylphenol	ug/l	<2.8	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ug/l	<10	<10	<10	<11	<10	ND
m&p-Cresols	ug/l	<10	<10	<10	<11	<10	ND
4-Chloroaniline	ug/l	<10	<10	<10	<11	ND	ND
Phenol	ug/l	51.4	2.24	2.12	2.42	<1.5	<1.5
Naphthalene	ug/l	10.5	<1.6	2.49	10.6	<1.6	4.88
Aniline	ug/l	<10	<10	<10	17.6	<10	78.3
4,4'-DDT	ug/l	<.1	<.1	<.20	NT	.334	NT
1,4-Dioxane	ug/l						
Aluminum	ug/l						
Arsenic	ug/l	<4	<4	<4	<4	4	<4
Barium	ug/l	344	375	318	315	253	NT
Iron	ug/l	81	102	100	92	69	59
Lead	ug/l	<10	<4	<4	6	5	4
Sodium	ug/l	846000	857000	916000	1010000	695000	488000
Zinc	ug/l	<10	<10	<10	<10	303000	NT
Chloride	mg/l	1700	2000	2300	1700	NT	1100
Fluoride	mg/l	.9	.6	.6	.5	.42	NT

ND - Not Detected

NT - Not Tested

G124S

		10/2/91
Acetone	ug/l	<34
Benzene	ug/l	<5
Methylene Chloride	ug/l	<5
4,4'-DDT	ug/l	<.1
4,4'-DDE	ug/l	<.1
1,4-Dioxane	ug/l	19
Aluminum	ug/l	<200
Arsenic	ug/l	<35
Barium	ug/l	<200
Iron	ug/l	3360
Lead	ug/l	<25
Sodium	ug/l	267000
Zinc	ug/l	<20
Chloride	mg/l	1100
Fluoride	mg/l	0.34

		7/2/91	4/3/91	1/4/91	10/25/90	7/24/90	4/26/90	1/22/90	10/24/89	7/25/89	4/24/89	1/31/89
Acetone	ug/l	<34	<34	<34	<34	<34	<34	<34	<34	<34	<10	<10
Benzene	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5 0	<5	<4.4
Methylene Chloride	ug/l	<5	<5	<5	<5	<5	<5	<5	<8	<5 0	<5	<2.8
4,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.12
4,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.12
1,4-Dioxane	ug/l	35	28	16	<10	<10	<50	<50	<50	<50	<50	<13
Aluminum	ug/l	<200	<200	<200	<200	<200	<200	341	<200	291	<200	
Arsenic	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<4
Barium	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	85
Iron	ug/l	1950	1750	4280	1440	2010	179	288	309	590	264	396
Lead	ug/l	<25	<25	<25	<25	<10	<5	<5	<5	<5	<5	<4
Sodium	ug/l	283000	277000	300000	267000	276000	281000	266000	212000	214000	208000	170000
Zinc	ug/l	<20	<20	<20	<20	<20	<20	27.4	<20	<20	<20	78
Chloride	mg/l	1090	1070	1030	1600	1230	1240	953	844	916	815	830
Fluoride	mg/l	0.40	0.41	0.39	0.42	0.40	0.38	0.41	.43	<.05	.31	.4

G124S

		10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	32.2	20.4	<10	13.0	18.0	NT
Benzene	ug/l	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4
Methylene Chloride	ug/l	11.2	14.6	<2.8	5.89	<2.8	<2.8
4,4'-DDT	ug/l	<.1	<.1	<.18	NT	.737	NT
4,4'-DDE	ug/l	<.1	<.1	<.18	NT	.256	NT
Aluminum	ug/l						
Arsenic	ug/l	4	<4	<4	<4	<4	<4
Barium	ug/l	108	111	93	108	88	ND
Iron	ug/l	482	163	159	148	37	141
Lead	ug/l	13	<4	<8	<10	<4	<4
Sodium	ug/l	167000	193000	177000	202000	159000	414000
Zinc	ug/l	<10	18	<10	18	234999	NT
Chloride	mg/l	950	750	1100	620	NT	850
Fluoride	mg/l	.8	.6	.8	.5	.48	NT

NT - Not Tested

G307

		10/2/91
1,4 - Dioxane	ug/l	270
Aluminum	ug/l	<200
Arsenic	ug/l	<35
Barium	ug/l	<200
Iron	ug/l	<100
Lead	ug/l	<25
Sodium	ug/l	223000
Zinc	ug/l	<20
Chloride	mg/l	210
Fluoride	mg/l	0.59

		7/1/91	4/3/91	1/4/91	10/25/90
1,4 - Dioxane	ug/l	190	46	23	120
Aluminum	ug/l	<200	<200	<200	<200
Arsenic	ug/l	<10	<10	<10	<10
Barium	ug/l	<200	<200	<200	<200
Iron	ug/l	<100	<100	<100	<100
Lead	ug/l	<25	<5	<25	<5
Sodium	ug/l	176000	87200	77400	136000
Zinc	ug/l	<20	<20	<20	<20
Chloride	mg/l	181	78.0	72.6	140
Fluoride	mg/l	0.59	0.73	0.82	0.76

IMPDE
(Surface Impoundment)

			10/2/91
Methylene chloride		ug/l	<25
Acetone		ug/l	<170
Phenol		ug/l	<10
4,4'-DDT		ug/l	.117
4,4'-DDE		ug/l	<.1
Aluminum	total	ug/l	<200
Arsenic	total	ug/l	<70
Barium	total	ug/l	<200
Iron	total	ug/l	202
Lead	total	ug/l	122
Sodium	total	ug/l	2980000
Zinc	total	ug/l	279
Aluminum		ug/l	<200
Arsenic		ug/l	41.0
Barium		ug/l	<200
Iron		ug/l	<100
Lead		ug/l	<25
Sodium		ug/l	2900000
Zinc		ug/l	71.9
Chloride		mg/l	3670
Fluoride		mg/l	15.8

IMPDE
(Surface Impoundment)

		7/2/91	4/3/91	1/4/91	10/25/90	7/23/90	4/27/90	1/23/90	10/24/89	7/26/89	4/25/89	2/3/89
Methylene chloride	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	2.95
Acetone	ug/l	<34	<34	<34	<34	<34	<34	<34	<34	<34	<34	27.9
Phenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1 6
4,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.10	<.10
4,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.10	<.10
Aluminum	total ug/l	<200	<200	<200	200	224	<200	<1000	<200	326	321	467
Arsenic	total ug/l	36.7	29.5	37.0	43.4	45.0	48.3	68.0	96.5	47.5	52.4	27
Barium	total ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	86
Iron	total ug/l	<500	137	143	239	227	142	203	<100	<100	<100	224
Lead	total ug/l	39.0	19.0	26.0	148.5	153	125	<50	105	<5	15.8	240
Sodium	total ug/l	1590000	1030000	1700000	2050000	1110000	2900000	3810000	4600000	6300000	5090000	5700000
Zinc	total ug/l	181	100	323	792	443	944	339	104	102	286	1050
Aluminum	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	527	<10	45
Arsenic	ug/l	31.5	19.5	51.5	43.5	31.5	<60	85.0	87.5	48.1	38.4	23
Barium	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	66
Iron	ug/l	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<30
Lead	ug/l	<25	<5	<25	<5	<25	<50	<5	<25	17.4	<5	<4
Sodium	ug/l	1410000	1020000	1880000	2140000	1100000	3140000	3500000	6240000	5280000	4630000	5410000
Zinc	ug/l	43.5	<20	134	145	40.8	30.6	218	51.8	37.2	180	643
Chloride	mg/l	1920	1280	2680	2690	1810	38300	4510	7600	8120	7580	12000
Fluoride	mg/l	9.3	6.5	11.0	13.2	8.9	<.05*	21.7	31.8	33.3	30.7	39

*Laboratory unable to verify result.

IMPDE
(Surface Impoundment)

			10/27/88	7/29/88	4/28/88	1/28/88	5/1/87	11/21/85
Methylene chloride		ug/l	15.2	9.68	<2.8	10.7	8.37	71.0
Acetone		ug/l	<10	20.7	<10	47.3	28.0	NT
Phenol		ug/l	<1.5	6.44	<1.5	<1.5	<1.5	
4,4'-DDT		ug/l	.11	<.1	<.20	NT	.509	
4,4'-DDE		ug/l	<.1	<.1	<.20	NT	.117	
Aluminum	total	ug/l	1040	4070	2230	950	3150	NT
Arsenic	total	ug/l	68	724	<64	30	190	<500
Barium	total	ug/l	281	<50	248	281	266	NT
Iron	total	ug/l	158	640	178	<30	1270	NT
Lead	total	ug/l	350	14	740	98	136	207
Sodium	total	ug/l	7700000	7780000	7460000	6930000	3920000	NT
Zinc	total	ug/l	284	494	385	527	416	NT
Aluminum		ug/l	1220	4170	2090	878		
Arsenic		ug/l	82	616	<64	30		
Barium		ug/l	333	<50	252	265		
Iron		ug/l	<30	47	<30	<30		
Lead		ug/l	84	14	380	70		
Sodium		ug/l	6680000	7940000	8000000	6790000		
Zinc		ug/l	102	138	59	128		
Chloride		mg/l	10000	11000	11000	9200	NT	NT
Fluoride		mg/l	67	39	59	34	70	NT

NT - Not Tested

* Laboratory unable to verify result.

CWM Chemical Services, Inc.
Chicago Incinerator

ATTACHMENT D

HISTORICAL GROUNDWATER ELEVATIONS WITH POTENTIOMETRIC SURFACE MAP

CWM CHEMICAL SERVICES, INC.
GROUNDWATER ELEVATION DATA
(FT MSL)

	10/91
Assessment Wells	
G120S	586.21
G121S	584.29
G123S	585.65
G124S	583.55
G307	582.89
State Wells	
G110*	588.71
G111A	583.59
G112B	586.68
G113A	582.27

* G110 was not used for drawing groundwater elevation contours as this well is not screened in the same formation as the other wells

CWM CHEMICAL SERVICES, INC.
GROUNDWATER ELEVATION DATA
(FT MSL)

	7/91	4/91	1/91	10/90	7/90	4/90	1/90	10/89	7/89	4/89	1/89
Assessment Wells											
G120S	586.12	582.77	583.01	584.60	585.05	583.49	583.44	586.45	585.96	583.72	584.13
G121S	585.89	584.76	584.21	583.65	587.38	584.04	583.77	585.30	585.81	585.66	585.70
G123S	586.87	586.88	586.81	586.85	588.77	588.40	587.33	586.57	587.57	587.96	588.43
G124S	583.96	583.97	583.23	583.78	584.47	584.31	584.20	584.22	584.64	584.58	584.31
G307	583.44	586.23	586.02	585.36							
State Wells											
G110*	587.07	586.01	586.38	587.85	589.69	590.19	589.94	590.33	589.73	589.58	588.32
G111A	585.09	585.36	584.50	583.92	581.84	583.45	582.98	584.42	585.09	585.09	585.03
G112B	587.31	587.91	587.00	586.87	587.86	588.63	587.23	587.39	588.02	587.67	587.72
G113A	583.52	583.59	583.46	583.40	583.59	583.98	583.87	583.78	584.37	584.34	584.24

* G110 was not used for drawing groundwater elevation contours as this well is not screened in the same formation as the other wells.

CWM CHEMICAL SERVICES, INC.
GROUNDWATER ELEVATION DATA
(FT MSL)

	10/88	7/88	4/88	1/88	4/87
Assessment Wells					
G120S	585.80	586.21	583.72	583.72	584.75
G121S	584.83	585.91	585.66	586.33	587.16
G123S	587.96	586.90	586.98	585.69	589.06
G124S	584.58	584.54	584.04	583.25	585.08
State Wells					
G110*	589.28	586.20	586.83	586.45	586.65
G111A	584.00	584.08	583.96	585.17	586.65
G112B	587.20	586.74	586.66		
G113A	584.21	584.21	583.80		

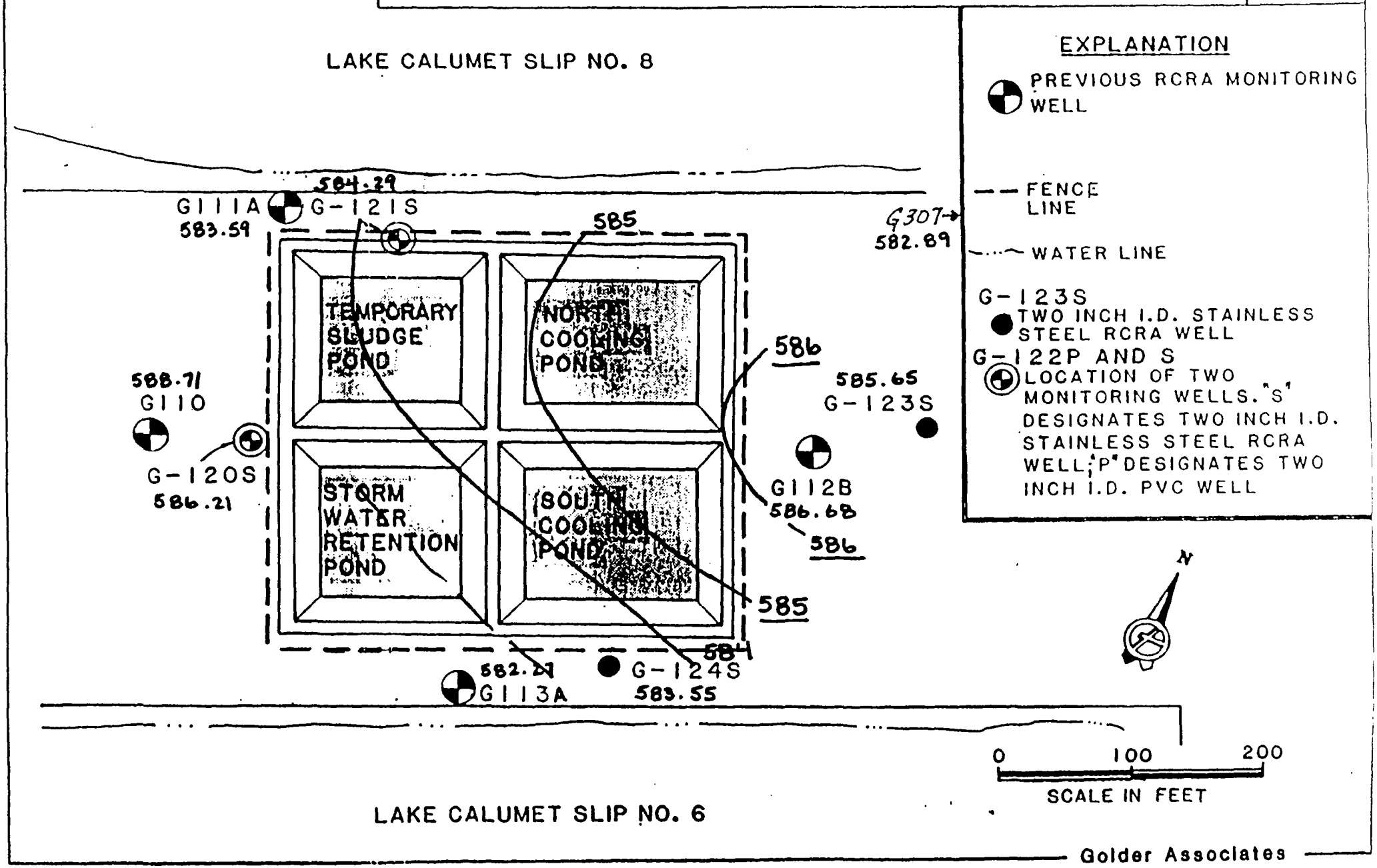
* G110 was not used for drawing groundwater elevation contours as this well is not screened in the same formation as the other wells.

Proj. No. 2054 Eng. D.L.Q. Date 11-1-85

MONITOR WELL LOCATION MAP

GROUNDWATER POTENTIOMETRIC SURFACE - 10/2/91

FIGURE 1



Golder Associates

CERTIFICATE OF ANALYSIS

Service Location	Received	Lab ID
EMS HERITAGE LABORATORIES, INC. 1319 MARQUETTE DRIVE ROMEOVILLE, IL 60441 (708)378-1600	01-NOV-91	C134324
	Complete 11-DEC-91	PO Number .....
	Printed 08-JAN-92	Sampled 30-OCT-91 13:00

Report To	Bill To
CWM CHEMICAL SERVICES, INC LADISLAO GARCIA 11700 S. STONEY ISLAND CHICAGO, IL 60617	CWM CHEMICAL SERVICES, INC ACCOUNTS PAYABLE 11700 S STONEY ISLAND CHICAGO, IL 60617

Sample Description

DESCRIPTION: F08828/INC 467
SAMPLE LOCATION: NORTHEAST INC. POND SLUDGE

ZERO HEADSPACE EXTRACTION (TCLP) SW846-1311

Analyst: R. ARB Analysis Date: 07-NOV-91 Test: P108.1. 0

Parameter	Result	Det. Limit	Units
TOTAL SAMPLE WEIGHT	27.51		Grams
LIQUID PORTION			mL
LIQUID FRACTION (GRAMS)			Grams
EXTRACTED SAMPLE	27.51		Grams
HASE ONE VOLUME (REP 0)	500		mL
IASE TWO VOLUME (REP 1)			mL
> .5% SOLIDS	100		Percent
BUFFER SOLUTION PH	4.98		Std. Units
VOLUME BUFFERED SOLUTION	500		mL
INITIAL TIME	1415		Hours
FINAL TIME	0815		Hours

TCLP VOLATILE ORGANICS (TOXICITY CHARACTERISTIC) SW846-8240

Analyst: K. MILLER Analysis Date: 08-NOV-91 Instrument: GC/MS VOA Test: 0513.3. 0

Prep: ZERO HEADSPACE EXTRACTION (TCLP) SW846-1311

Parameter	Corrected Result	Detection Limit	Units	Observed Result	Matrix Spike True Value	Sample + Spike	Matrix Spike % Recovery
ACETONE		.05	mg/L	BDL			
BENZENE		.025	mg/L	BDL			
CHLOROBENZENE		.025	mg/L	BDL			
1,2-DICHLOROBENZENE (O-DICHLOR		.025	mg/L	BDL			
DICHLORODIFLUOROMETHANE		.05	mg/L	BDL			
1,1-DICHLOROETHYLENE		.025	mg/L	BDL			
DICHLOROMETHANE (METHYLENE CHL		.05	mg/L	BDL			
1,4-DIOXANE		1	mg/L	BDL			
ETHYL BENZENE		.025	mg/L	BDL			
TOLUENE		.025	mg/L	BDL			
VINYL CHLORIDE		.05	mg/L	BDL			
-XYLENE		.025	mg/L	BDL			
XYLENE		.025	mg/L	BDL			
HLOROETHANE-D4			% Rec	102			
OLUENE-D8			% Rec	98			
BROMOFLUOROBENZENE			% Rec	100			

TOX CHAR LEACHING PROCEDURE (TCLP W/ ORGANICS) SW846-1311

Analyst: P. KOWALIK Analysis Date: 04-NOV-91 Test: P107.1. 0

Parameter	Result	Det. Limit	Units
TOTAL SAMPLE WEIGHT	90.0		Grams
LIQUID FRACTION (GRAMS)	0		Grams
EXTRACTED SAMPLE	90		Grams
SOLIDS	100		Percent
9.5 MM SIEVE TEST			Passed
INITIAL PH	9.39		Std. Units
ADJUSTED PH	3.87		Std. Units
BUFFER SOLUTION PH	4.93		Std. Units
FINAL PH	5.21		Std. Units
VOLUME BUFFERED SOLUTION	1800		mL
VOLUME EXTRACT FILTERED	1800		mL
LIQUID FRACTION	0		mL
TOTAL VOLUME FILTRATE	1800		mL
INITIAL TIME	08358.9		HRS
FINAL TIME	08376.9		HRS

*S-VOA's only.

GC/MS SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION SW846-3510

Analyst: D. BACKUS Analysis Date: 08-NOV-91 Test: P233.4. 0

Prep: TOX CHAR LEACHING PROCEDURE (TCLP W/ ORGANICS) SW846-1311

Parameter	Result	Det. Limit	Units
INITIAL WEIGHT OR VOLUME	200		mL
FINAL VOLUME	1		mL

TCLP SEMIVOLATILE ORGANICS (TOXICITY CHARACTERISTIC) SW846-8270

Analyst: S. BUSSEY Analysis Date: 11-NOV-91 Instrument: GC/MS SVOA Test: O514.3. 0

Prep: GC/MS SEPARATORY FUNNEL LIQUID-LIQUID EXTRACTION SW846-3510

Prep: TOX CHAR LEACHING PROCEDURE (TCLP W/ ORGANICS) SW846-1311

Parameter	Corrected Result	Detection Limit	Units	Observed Result	Matrix Spike True Value	Sample + Spike	Matrix Spike % Recovery
ANTHRACENE		50	ug/L	BDL			
4-CHLOROANILINE		50	ug/L	BDL			
1,2-DICHLOROBENZENE (O-DICHLOR		50	ug/L	BDL			
NAPHTHALENE		50	ug/L	BDL			
2-CHLOROPHENOL		50	ug/L	BDL			
2,4-DICHLOROPHENOL		50	ug/L	BDL			
2,4-DIMETHYLPHENOL		50	ug/L	BDL			
2-METHYL PHENOL		50	ug/L	BDL			
4-METHYLPHENOL		50	ug/L	BDL			
PHENOL		50	ug/L	BDL			

SURROGATE RECOVERY							

2-FLUOROPHENOL			% Rec	48			
PHENOL-D5			% Rec	32			
NITROBENZENE-D5			% Rec	83			
2-FLUOROBIPHENYL			% Rec	83			
2,4,6-TRIBROMOPHENOL			% Rec	62			
TERPHENYL-D14			% Rec	110			

Compounds searched for but not detected:

2,6-Dichlorophenol ---------- ND

EMS HERITAGE LABORATORIES, INC. Lab Sample ID: C134374

Aniline ---------- ND
DDE---------- ND
DDT---------- ND
**NOTE 3&4 methyl phenol co-elute so identification of these compounds is tenative.*

FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050
Analyst: A. JAGIELSKI Analysis Date: 06-NOV-91 Test: P129.7. 0

Parameter	Result	Det. Limit	Units
INITIAL WEIGHT OR VOLUME	2.54		Grams
FINAL WEIGHT OR VOLUME	50		mL

GFAA ACID DIGESTION OF S/S/S SAMPLES SW846-3050
Analyst: A. JAGIELSKI Analysis Date: 06-NOV-91 Test: P130.7. 0

Parameter	Result	Det. Limit	Units
INITIAL WEIGHT OR VOLUME	2.71		Grams
FINAL WEIGHT OR VOLUME	50		mL

GFAA ACID DIGESTION OF S/S/S SAMPLES SW846-3050
Analyst: A. JAGIELSKI Analysis Date: 27-NOV-91 Test: P130.7. 1

Parameter	Result	Det. Limit	Units
INITIAL WEIGHT OR VOLUME	2.57		Grams
FINAL WEIGHT OR VOLUME	50		mL

ALUMINUM FAA SW846-7020
Analyst: D. ROBERTS Analysis Date: 12-NOV-91 Instrument: FAA Test: M101.1. 0
Prep: FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
ALUMINUM	770	24	mg/kg

ARSENIC GFAA SW846-7060
Analyst: J. SCHOTT Analysis Date: 30-NOV-91 Instrument: GFAA Test: M103.2. 0
Prep: GFAA ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
ARSENIC	BDL	2.0	mg/kg

BARIUM FAA SW846-7080
Analyst: D. ROBERTS Analysis Date: 11-NOV-91 Instrument: FAA Test: M104.1. 0
Prep: FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
BARIUM	360	24	mg/kg

IRON FAA SW846-7380
Analyst: D. ROBERTS Analysis Date: 15-NOV-91 Instrument: FAA Test: M115.1. 0
Prep: FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
IRON	4300	200	mg/kg

LEAD FAA SW846-7420
Analyst: L. PAPA Analysis Date: 08-NOV-91 Instrument: FAA Test: M116.1. 0
Prep: FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
LEAD	4400	200	mg/kg

EMS HERITAGE LABORATORIES, INC. Lab Sample ID: C134324

ZINC FAA SW846-7950

Analyst: D. ROBERTS Analysis Date: 13-NOV-91 Instrument: FAA Test: M139.1. 0

Prep: FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
ZINC	6600	400	mg/kg

SODIUM FAA SW846-7770

Analyst: D. ROBERTS Analysis Date: 19-NOV-91 Instrument: FAA Test: M131.1. 0

Prep: FAA OR ICP ACID DIGESTION OF S/S/S SAMPLES SW846-3050

Parameter	Result	Det. Limit	Units
SODIUM	4700	100	mg/kg

CHLORIDE SM 407A

Analyst: D. RINELLA-SIEKERMAN Analysis Date: 14-NOV-91 Test: G102.4. 0

Parameter	Result	Det. Limit	Units
CHLORIDE	1900	40	mg/kg

FLUORIDE (ION SELECTIVE ELECTRODE) EPA 340.2

Analyst: T. NOHA Analysis Date: 05-NOV-91 Test: G104.4. 0

Parameter	Result	Det. Limit	Units
FLUORIDE	20	0.5	mg/kg

Sample Comments

BDL Below Detection Limit

Quality Assurance Officer: _____

CWM CHEMICAL SERVICES, INC.
Chicago Incinerator

Quarterly Groundwater Assessment Report

Second Quarter 1994

I. General Description

This report is the twenty-sixth quarterly report of CWMCS's continuing groundwater assessment plan from samples collected on April 29, 1994. The program is based upon the initial program design as determined on January 7, 1988, and in our letter to the IEPA dated January 21, 1988. This program was subsequently modified by the IEPA as described in a letter to SCA Chemical Services, Inc. (now CWMCS) dated March 25, 1988 and in a meeting with Geordie Smith of the IEPA on September 26, 1990. Additional modifications were made to the assessment plan upon the IEPA's approval of the Groundwater Monitoring Enhancements Work Plan, on December 4, 1991, as required by Section IV.B.10, of the Second Amended Interim Consent Decree. Additional analytical constituents were incorporated in this assessment plan, upon IEPA's approval of the CWMCS Surface Impoundment Interim Status Closure Plan on September 14, 1992 and revised on January 12, 1993.

This will be the final quarterly report for the groundwater assessment program. Beginning with the third quarter of 1994, the post-closure groundwater monitoring program will commence in accordance with the IEPA's June 30, 1994 letter to CWMCS.

II. Overview

The second quarter assessment data for all parameters including field data, at all sampling locations, is summarized in Attachment A. Client reports with associated field information forms and chain-of-custody records are included in Attachment B. Historical data for each sampling location is included in Attachment C. A table of historical groundwater elevations for the assessment wells and state wells is included with a potentiometric surface map of the impoundment area in Attachment D. Figure 1 identifies the sample locations.

CWM CHEMICAL SERVICES, INC.
Chicago Incinerator

Quarterly Groundwater Assessment Report

Second Quarter 1994

III. Data Review

A. Rate of Migration

The rate of migration through the fill materials at the facility has been defined by our consultants as approximately 0.28 feet per day. The hydraulic conductivities in the impoundment area, based upon slug tests from the existing assessment wells, are as follows: G123S = 0.312 ft/day, G121S = 0.017 ft/day, G124S = 0.006 ft/day and G120S = 1.56 ft/day.[1]

B. Extent of Migration of Hazardous Waste or Hazardous Waste Constituents

Upon review of the April, 1994 data, and comparison with the data from the two previous groundwater assessments and the past quarterly reports, it appears as though there may be some correlation between the inorganic constituents reported in the downgradient sample locations, and the incinerator process water previously delivered to the former surface impoundments. From review of the analytical results reported and the comparison of these results with the previous assessments, it appears as though the inorganic constituents detected, are due to the migration of the incinerator process water released from the previous underground pipe line, upgradient of the surface impoundments, with the minimal amount of materials which may have been tracked out of the surface impoundments during previous attempts at closure or clean-out and from upgradient sources. It does <u>not</u> appear as though a release has occurred from the surface impoundments themselves due to the concentrations and constituents reported.

Due to levels of total lead and arsenic identified in the downgradient monitoring wells, CWMCS investigated the location of the monitoring wells downgradient of the surface impoundments in relation to the Hyon (a previous operator of the facility) SWMUs (Solid Waste Management Units). The perimeters of the previous units are not precisely documented, however, it appears as though monitoring well G126S has been installed in one of the previous Hyon SWMUs, referred to as the High Solids Basin. Analytical results from G126S may be affected by this SWMU as well as the surface impoundments. Due to the

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[1] CWM Chemical Services, Inc., Chicago Incinerator Facility, Chicago, Illinois, <u>Final RCRA Facility Investigation</u>, Volume I, November, 1993; Dames & Moore.

proximity of the former Hyon SWMUs to the surface impoundments, it is not possible to install additional monitoring wells west of the surface impoundments, in the direction of groundwater flow, without potential impacts from the former Hyon SWMU.

C. Sampling Event Summary

Groundwater samples were obtained on April 29 and June 23 (field measurements only), 1994, from monitoring wells G120S, G121S, G123S, G124S, G126S and G307. Monitoring wells G307 and G123S are upgradient of the surface impoundments.

All field activities related to closure of the interim status surface impoundments were completed on October 29, 1993. The closure certification report for the former surface impoundments, which documents that these units were closed in accordance with the procedures and specifications in the approved closure plan, was submitted to the IEPA on December 30, 1993. CWMCS received approval of the certification report, from the IEPA, on April 14, 1994 with modifications to this approval on June 30, 1994.

D. Data Summary

Data from the existing monitoring wells, both upgradient and downgradient, are generally consistent with historical data.

Benzene has been reported in both upgradient and downgradient monitoring wells, but not in the surface impoundments. This constituent has not been reported in well G307, thereby indicating an upgradient, on-site source.

Phenol and naphthalene have been reported in both upgradient and downgradient wells at levels just above the reporting limits. The presence of these constituents at these levels is indicative of upgradient sources both on-site and off-site (see G307 - previous sampling events).

4-Chloroaniline has been reported in well G121S only this quarter. This constituent has also been reported previously in well G123S, indicating an on-site upgradient source.

The organic constituents noted above are all related to coal tar. The CWMCS facility has been constructed on fill material containing coal tar and its byproducts. Therefore, it is likely that the presence of these constituents, both upgradient and downgradient of the former surface impoundments is due to the presence of these materials in the fill material itself.

1,4-Dioxane has been reported in both upgradient wells and downgradient wells, but not the surface impoundments, indicating an upgradient, off-site source.

Both barium and iron have been reported in the downgradient monitoring wells. These constituents were reported in the surface impoundments in 1988-1989, but at levels substantially lower than those reported in the monitoring wells. These constituents were also reported in well G123S, but not in well G307 (the two upgradient wells), indicating an on-site, upgradient source for these constituents. However, the iron values reported, indicate that the fill materials on which the facility is constructed, is the primary source of the downgradient levels as neither upgradient nor surface impoundment levels have been reported at these levels in the past.

Increased levels of sodium, chloride and to some extent fluoride, reported in the downgradient wells, appears to be related to the breaks in the previously underground pipelines which carried incinerator process water to the surface impoundments and the minimal tracking out of materials from previous attempts at clean closure of the surface impoundments. Upgradient sources, both on and off-site, are also contributing to the increased levels of sodium, chloride and fluoride, as indicated through a review of results from wells G307 and G123S.

E. Groundwater Potentiometric Surface

The groundwater potentiometric surface for the second quarter of 1994, as shown in Attachment D, is relatively consistent with previous data. Groundwater at the facility flows generally from the east to the west-southwest.

Flows and groundwater elevations will be evaluated in future quarterly reports to determine any impacts from closure of the surface impoundments. A more comprehensive groundwater potentiometric surface map, using groundwater elevations from the entire facility, has been prepared, and is included in the RFI Report.

The groundwater elevation reported for well G110, has not been used in preparing the groundwater potentiometric surface map, as this well has been screened in both the fill material and in the underlying till. The other groundwater monitoring wells have been screened in the fill material only.

IV. Conclusions:

Based upon the quarterly groundwater analytical results, CWM believes that the former surface impoundments are not the source of organic and inorganic constituents found in the groundwater assessment monitoring wells. The data collected for the RCRA Facility Investigation (RFI), appear to confirm that the surface impoundments are not the source of the contamination, and that prior waste management activities at the facility, are the likely source of contamination, both upgradient and downgradient of the surface impoundments.

The data indicate the following:

1. The former surface impoundments are not the source of organics impacting the groundwater. Upgradient sources, both on-site and off-site, and the fill materials on which the facility is constructed, are the indicated sources.

2. The releases from the previously underground, incinerator process water pipeline are the likely source of the inorganics in the groundwater. Additional impact is likely from prior activities in the former surface impoundment area (ie. impoundment cleanout, closure activities), from upgradient sources and from the fill materials on which the facility is constructed.

3. The extent of contamination downgradient of well G121S has been adequately defined through the investigations conducted between the fourth quarter of 1990 and the first quarter of 1992.

4. The concentration of organics and inorganics in groundwater is relatively consistent over the last six years, with the exception of well G123S as indicated below.

5. The change in organic and inorganic constituents noted in well G123S may be attributed to upgradient sources and the subsequent movement of these constituents. This conclusion is supported by the results of the RFI.

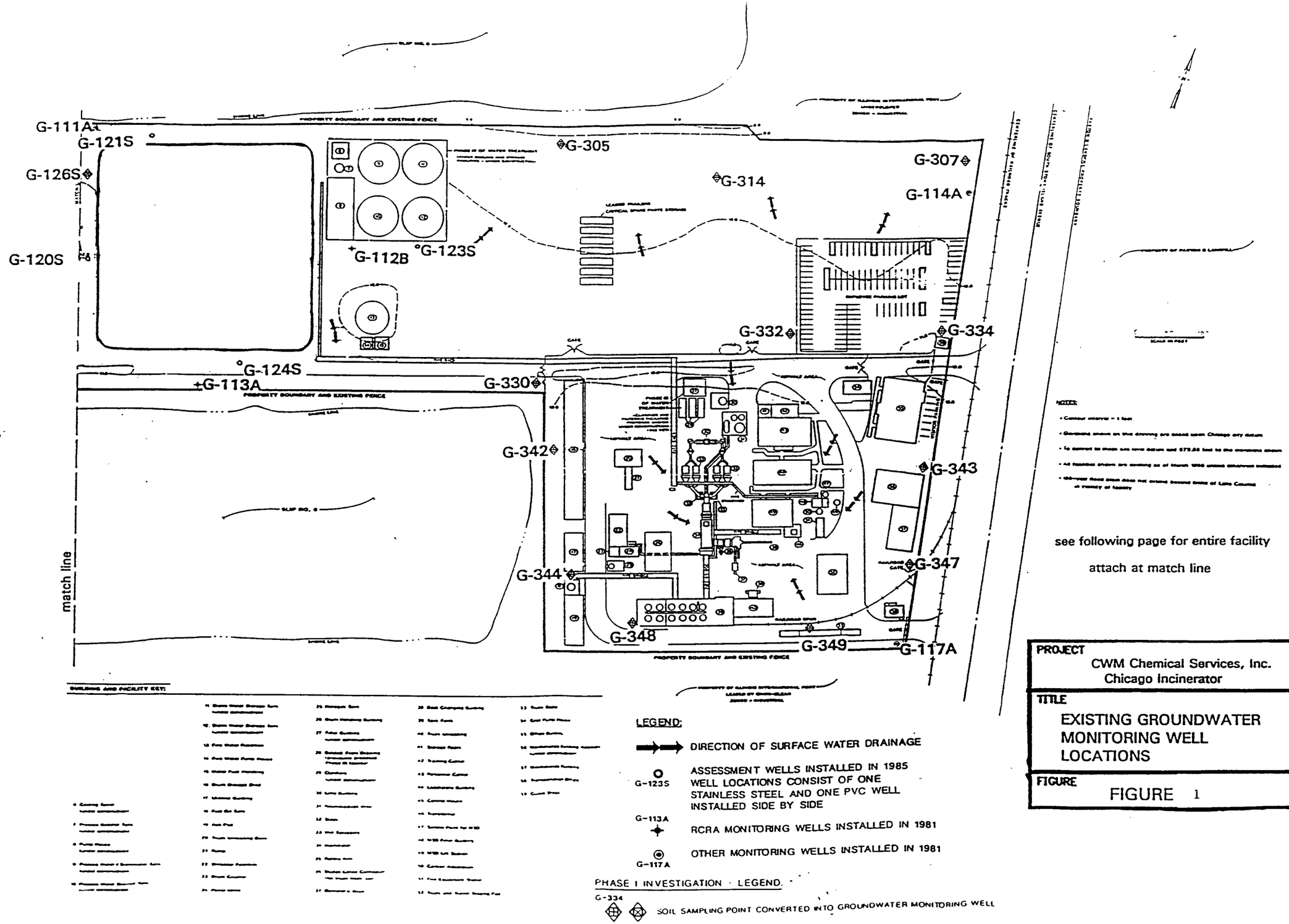
6. The results from this sampling event do not appear to definitively indicate a release from the former surface impoundments of hazardous waste or hazardous waste constituents to groundwater.

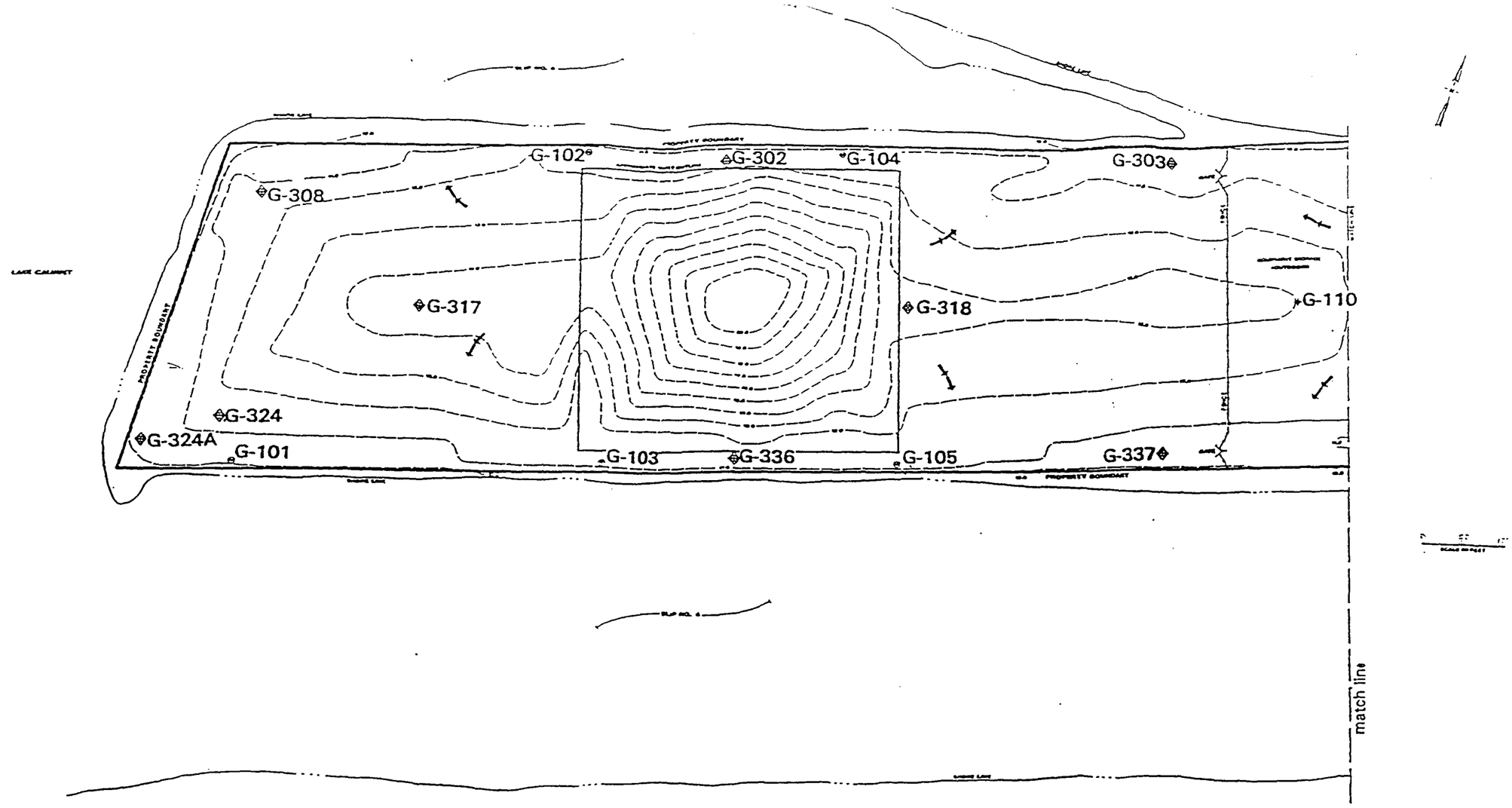
7. Relative groundwater elevations in the assessment are consistent with previous data.

VI. Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Bob LaBoube, Acting Plant Manager


G-111A
G-121S
G-126S
G-120S
G-305
G-307
G-314
G-114A
G-112B
G-123S
G-332
G-334
G-124S
G-113A
G-330
G-342
G-343
G-344
G-347
G-348
G-349
G-117A
match line
see following page for entire facility
attach at match line
LEGEND:
DIRECTION OF SURFACE WATER DRAINAGE
G-123S
ASSESSMENT WELLS INSTALLED IN 1985 WELL LOCATIONS CONSIST OF ONE STAINLESS STEEL AND ONE PVC WELL INSTALLED SIDE BY SIDE
G-113A
RCRA MONITORING WELLS INSTALLED IN 1981
G-117A
OTHER MONITORING WELLS INSTALLED IN 1981
PHASE I INVESTIGATION - LEGEND.
G-334
SOIL SAMPLING POINT CONVERTED INTO GROUNDWATER MONITORING WELL
PROJECT
CWM Chemical Services, Inc.
Chicago Incinerator
TITLE
EXISTING GROUNDWATER MONITORING WELL LOCATIONS
FIGURE
FIGURE 1



NOTES:

- Contour interval = 1 foot
- Elevations shown on this drawing are based upon Chicago city datum
- To convert to mean sea level datum add 579.88 feet to the elevations shown
- All facilities shown are existing as of March 1988 unless otherwise indicated
- 100-year flood plain does not extend beyond limits of Lake Calumet in vicinity of facility

Modified from Dames & Moore RFI Report

LEGEND:

DIRECTION OF SURFACE WATER DRAINAGE

G-103 MONITORING WELLS INSTALLED IN 1981

G-110 RCRA MONITORING WELL INSTALLED IN 1981

PHASE I INVESTIGATION - LEGEND:

G-336 SOIL SAMPLING POINT CONVERTED INTO GROUNDWATER MONITORING WELL

PROJECT	CWM Chemical Services, Inc. Chicago Incinerator
TITLE	EXISTING GROUNDWATER MONITORING WELL LOCATIONS
FIGURE	FIGURE 1

WMX ENVIRONMENTAL MONI[illegible] LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11875
MP: 705941
Rev / Task: 00 / 02
Sample Type: WELL
Reported: 25-MAY-1994

Analyte / Sample Point: / Sample Number: / Sampled:	705-G120S AJ8195 29-APR-1994	EML RL	705-G121S AJ8196 29-APR-1994	EML RL	705-G123S AJ8194 29-APR-1994	EML RL	Units
FIELD DATA:							
DEPTH TO WATER FROM TOP OF CASING	8.83		11.25		6.33		FT
GROUNDWATER ELEV.	585.01		582.64		587.80		FT MSL
PH FIELD	NA		NA		NA		PH UNITS
PH FIELD	NA		NA		NA		PH UNITS
PH FIELD	NA		NA		NA		PH UNITS
PH FIELD	6.82		7.88		8.24		PH UNITS
SPECIFIC CONDUCTANCE FIELD	NA		NA		NA		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	NA		NA		NA		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	NA		NA		NA		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD	3160		13390		4420		UMHOS/CM
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	0.85		1.20		2.39		FT
WATER TEMPERATURE IN DEGREES CELSIUS	10.3		9.1		11.8		DEGREES C
WELL DEPTH TOTAL	20.77		20.68		20.74		FT
INORGANICS:							
ALUMINUM-DISSOLVED	ND	200.	ND	200.	ND	200.	UG/L
ALUMINUM-TOTAL	1760	200.	263	200.	ND	200.	UG/L
ARSENIC-DISSOLVED	35.2	10.0	ND	14.0	ND	10.0	UG/L
ARSENIC-TOTAL	61.9	10.0	22.0	14.0	ND	10.0	UG/L
BARIUM-DISSOLVED	922	200.	626	200.	410	200.	UG/L
BARIUM-TOTAL	1020	200.	616	200.	393	200.	UG/L
CADMIUM-DISSOLVED	ND	5.0	ND	5.0	ND	5.0	UG/L
CADMIUM-TOTAL	ND	5.0	ND	5.0	ND	5.0	UG/L
CHLORIDE	347	1.0	5260	5.0	1370	5.0	MG/L
CHROMIUM-DISSOLVED	ND	10.0	ND	10.0	ND	10.0	UG/L
CHROMIUM-TOTAL	31.8	10.0	100	10.0	38.0	10.0	UG/L
FLUORIDE	0.43	0.050	1.93	0.050	0.38	0.050	MG/L
IRON-DISSOLVED	16400	100.	821	100.	294	100.	UG/L
IRON-TOTAL	23000	100.	5490	100.	1040	100.	UG/L
LEAD-DISSOLVED	ND	5.0	ND	16.0	ND	5.0	UG/L
LEAD-TOTAL	12.1	5.00	ND	16.0	ND	5.00	UG/L
SODIUM-DISSOLVED	110000	5000	3100000	80000	369000	5000	UG/L
SODIUM-TOTAL	116000	5000	3140000	8000	373000	5000	UG/L
ZINC-DISSOLVED	ND	20.0	ND	20.0	ND	20.0	UG/L
ZINC-TOTAL	63.4	20.0	50.5	20.0	ND	20.0	UG/L
SEMI-VOLATILE ORGANICS:							
1,2-DICHLOROBENZENE	ND	10.	ND	10.	ND	10.	UG/L
2,4-DICHLOROPHENOL	ND	10.	ND	10.	ND	10.	UG/L
2,4-DIMETHYLPHENOL	ND	10.	ND	10.	ND	10.	UG/L
2,6-DICHLOROPHENOL	ND	10.	ND	10.	ND	10.	UG/L
2-CHLOROPHENOL	ND	10.	ND	10.	ND	10.	UG/L
3-METHYLPHENOL	ND	10.	ND	10.	ND	10.	UG/L
4,4'-DDE	ND	0.1	ND	0.1	ND	0.1	UG/L
4,4'-DDT	ND	0.1	ND	0.1	ND	0.1	UG/L
4-CHLOROANILINE	ND	10.	55	10.	ND	10.	UG/L
4-METHYLPHENOL	ND	10.	ND	10.	ND	10.	UG/L
ANILINE	ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible] LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11875
MP: 705941
Rev / Task: 00 / 02
Sample Type: WELL
Reported: 25-MAY-1994

Analyte	Sample Point: / Sample Number: / Sampled:	705-G120S AJ8195 29-APR-1994	EML RL	705-G121S AJ8196 29-APR-1994	EML RL	705-G123S AJ8194 29-APR-1994	EML RL	Units
ANTHRACENE		ND	10.	ND	10.	ND	10.	UG/L
NAPHTHALENE		ND	10.	ND	10.	10	10.	UG/L
PHENOL		ND	10.	ND	10.	16	10.	UG/L
VOLATILE ORGANICS:								
(M and P)-XYLENE		ND	50.	ND	50.	ND	40.	UG/L
1,1,2-TRICHLOROETHANE		ND	100	ND	100	ND	80.	UG/L
1,1-DICHLOROETHENE		ND	50.	ND	50.	ND	40.	UG/L
2-BUTANONE		ND	250	ND	250	ND	200	UG/L
4-METHYL-2-PENTANONE		ND	250	ND	250	ND	200	UG/L
ACETONE		ND	600	ND	600	ND	480	UG/L
ACETONITRILE		ND	50.	ND	50.	ND	20.	UG/L
BENZENE		ND	10.	280.	10.	220.	8	UG/L
CHLOROBENZENE		ND	50.	ND	50.	ND	40.	UG/L
DICHLORODIFLUOROMETHANE		ND	100	ND	100	ND	80.	UG/L
ETHYLBENZENE		ND	50.	ND	50.	ND	40.	UG/L
METHYLENE CHLORIDE		ND	130	ND	130	ND	100	UG/L
O-XYLENE		ND	50.	ND	50.	ND	40.	UG/L
P-DIOXANE		ND	110	140.	110	250.	50.	UG/L
PROPIONITRILE		ND	36	ND	36	ND	14	UG/L
TOLUENE		ND	50.	ND	50.	ND	40.	UG/L
VINYL CHLORIDE		ND	100	ND	100	ND	80.	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible]G LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11875
MP: 705941
Rev / Task: 00 / 02
Sample Type: WELL
Reported: 25-MAY-1994

Analyte	Sample Point: / Sample Number: / Sampled:	705-G124S AJ8198 29-APR-1994	EML RL	705-G126S AJ8197 29-APR-1994	EML RL	705-G307 AJ8193 29-APR-1994	EML RL	Units
FIELD DATA:								
DEPTH TO WATER FROM TOP OF CASING		9.62		10.09		4.23		FT
GROUNDWATER ELEV.		583.66		583.64		586.48		FT MSL
PH FIELD		NA		NA		NA		PH UNITS
PH FIELD		NA		NA		NA		PH UNITS
PH FIELD		NA		NA		NA		PH UNITS
PH FIELD		7.36		9.27		8.14		PH UNITS
SPECIFIC CONDUCTANCE FIELD		NA		NA		NA		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD		NA		NA		NA		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD		NA		NA		NA		UMHOS/CM
SPECIFIC CONDUCTANCE FIELD		4720		4540		1870		UMHOS/CM
STICK-UP HEIGHT OF WELL ABOVE LAND SURF		1.51		1.78		2.16		FT
WATER TEMPERATURE IN DEGREES CELSIUS		10.2		8.7		9.7		DEGREES C
WELL DEPTH TOTAL		20.73		17.50		16.86		FT
INORGANICS:								
ALUMINUM-DISSOLVED		ND	200.	ND	200.	ND	200.	UG/L
ALUMINUM-TOTAL		2530	1000	1500	200.	3290	200.	UG/L
ARSENIC-DISSOLVED		ND	10.0	29.1	10.0	ND	10.0	UG/L
ARSENIC-TOTAL		ND	10.0	76.8	10.0	ND	10.0	UG/L
BARIUM-DISSOLVED		ND	200.	ND	200.	ND	200.	UG/L
BARIUM-TOTAL		ND	200.	ND	200.	ND	200.	UG/L
CADMIUM-DISSOLVED		ND	5.0	ND	5.0	ND	5.0	UG/L
CADMIUM-TOTAL		ND	5.0	ND	5.0	ND	5.0	UG/L
CHLORIDE		1330	1.0	1260	1.0	90.6	1.0	MG/L
CHROMIUM-DISSOLVED		ND	10.0	ND	10.0	ND	10.0	UG/L
CHROMIUM-TOTAL		49.3	10.0	29.4	10.0	11.9	10.0	UG/L
FLUORIDE		0.34	0.050	0.66	0.050	0.54	0.050	MG/L
IRON-DISSOLVED		600	100.	ND	100.	ND	100.	UG/L
IRON-TOTAL		12100	100.	3180	100.	7020	100.	UG/L
LEAD-DISSOLVED		ND	5.0	ND	5.0	ND	5.0	UG/L
LEAD-TOTAL		ND	5.00	11.9	5.00	10.6	5.00	UG/L
SODIUM-DISSOLVED		346000	5000	889000	5000	96000	5000	UG/L
SODIUM-TOTAL		400000	8000	807000	5000	111000	5000	UG/L
ZINC-DISSOLVED		ND	20.0	ND	20.0	ND	20.0	UG/L
ZINC-TOTAL		ND	84.0	35.7	20.0	35.3	20.0	UG/L
SEMI-VOLATILE ORGANICS:								
1,2-DICHLOROBENZENE		ND	10.	ND	10.	ND	10.	UG/L
2,4-DICHLOROPHENOL		ND	10.	ND	10.	ND	10.	UG/L
2,4-DIMETHYLPHENOL		ND	10.	ND	10.	ND	10.	UG/L
2,6-DICHLOROPHENOL		ND	10.	ND	10.	ND	10.	UG/L
2-CHLOROPHENOL		ND	10.	ND	10.	ND	10.	UG/L
3-METHYLPHENOL		ND	10.	ND	10.	ND	10.	UG/L
4,4'-DDE		ND	0.1	ND	0.1	ND	0.1	UG/L
4,4'-DDT		ND	0.1	ND	0.1	ND	0.1	UG/L
4-CHLOROANILINE		ND	10.	ND	10.	ND	10.	UG/L
4-METHYLPHENOL		ND	10.	ND	10.	ND	10.	UG/L
ANILINE		ND	10.	ND	10.	ND	10.	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11875
MP: 705941
Rev / Task: 00 / 02
Sample Type: WELL
Reported: 25-MAY-1994

Analyte	Sample Point: / Sample Number: / Sampled:	705-G124S AJ8198 29-APR-1994	EML RL	705-G126S AJ8197 29-APR-1994	EML RL	705-G307 AJ8193 29-APR-1994	EML RL	Units
ANTHRACENE		ND	10.	ND	10.	ND	10.	UG/L
NAPHTHALENE		ND	10.	11	10.	ND	10.	UG/L
PHENOL		ND	10.	12	10.	ND	10.	UG/L
VOLATILE ORGANICS:								
(M and P)-XYLENE		ND	20.	ND	50.	ND	10.	UG/L
1,1,2-TRICHLOROETHANE		ND	40.	ND	100	ND	5	UG/L
1,1-DICHLOROETHENE		ND	20.	ND	50.	ND	5	UG/L
2-BUTANONE		ND	100	ND	250	ND	10.	UG/L
4-METHYL-2-PENTANONE		ND	100	ND	250	ND	10.	UG/L
ACETONE		ND	240	ND	600	ND	34	UG/L
ACETONITRILE		ND	10.	ND	50.	ND	10.	UG/L
BENZENE		ND	5	ND	10.	ND	5	UG/L
CHLOROBENZENE		ND	20.	ND	50.	ND	5	UG/L
DICHLORODIFLUOROMETHANE		ND	40.	ND	100	ND	10.	UG/L
ETHYLBENZENE		ND	20.	ND	50.	ND	5	UG/L
METHYLENE CHLORIDE		ND	50.	ND	130	ND	5	UG/L
O-XYLENE		ND	20.	ND	50.	ND	10.	UG/L
P-DIOXANE		ND	50.	ND	110	140.	50.	UG/L
PROPIONITRILE		ND	10.	ND	36	ND	10.	UG/L
TOLUENE		ND	20.	ND	50.	ND	5	UG/L
VINYL CHLORIDE		ND	40.	ND	100	ND	10.	UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11875
MP: 705941
Rev / Task: 00 / 02
Sample Type: WELL
Reported: 25-MAY-1994

Analyte	Sample Point: TBK-G307 Sample Number: AJ8193 Sampled: 29-APR-1994	EML RL					Units
FIELD DATA:							
DEPTH TO WATER FROM TOP OF CASING							FT
GROUNDWATER ELEV.							FT MSL
PH FIELD							PH UNITS
PH FIELD							PH UNITS
PH FIELD							PH UNITS
PH FIELD							PH UNITS
SPECIFIC CONDUCTANCE FIELD							UMHOS/CM
SPECIFIC CONDUCTANCE FIELD							UMHOS/CM
SPECIFIC CONDUCTANCE FIELD							UMHOS/CM
SPECIFIC CONDUCTANCE FIELD							UMHOS/CM
STICK-UP HEIGHT OF WELL ABOVE LAND SURF							FT
WATER TEMPERATURE IN DEGREES CELSIUS							DEGREES C
WELL DEPTH TOTAL							FT
INORGANICS:							
ALUMINUM-DISSOLVED							UG/L
ALUMINUM-TOTAL							UG/L
ARSENIC-DISSOLVED							UG/L
ARSENIC-TOTAL							UG/L
BARIUM-DISSOLVED							UG/L
BARIUM-TOTAL							UG/L
CADMIUM-DISSOLVED							UG/L
CADMIUM-TOTAL							UG/L
CHLORIDE							MG/L
CHROMIUM-DISSOLVED							UG/L
CHROMIUM-TOTAL							UG/L
FLUORIDE							MG/L
IRON-DISSOLVED							UG/L
IRON-TOTAL							UG/L
LEAD-DISSOLVED							UG/L
LEAD-TOTAL							UG/L
SODIUM-DISSOLVED							UG/L
SODIUM-TOTAL							UG/L
ZINC-DISSOLVED							UG/L
ZINC-TOTAL							UG/L
SEMI-VOLATILE ORGANICS:							
1,2-DICHLOROBENZENE							UG/L
2,4-DICHLOROPHENOL							UG/L
2,4-DIMETHYLPHENOL							UG/L
2,6-DICHLOROPHENOL							UG/L
2-CHLOROPHENOL							UG/L
3-METHYLPHENOL							UG/L
4,4'-DDE							UG/L
4,4'-DDT							UG/L
4-CHLOROANILINE							UG/L
4-METHYLPHENOL							UG/L
ANILINE							UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONITO 3 LABORATORIES, INC.

E V E N T S U M M A R Y R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11875
MP: 705941
Rev / Task: 00 / 02
Sample Type: WELL
Reported: 25-MAY-1994

Analyte	Sample Point: TBK-G307 Sample Number: AJ8193 Sampled: 29-APR-1994	EML RL					Units
ANTHRACENE							UG/L
NAPHTHALENE							UG/L
PHENOL							UG/L
VOLATILE ORGANICS:							
(M and P)-XYLENE	ND	10.					UG/L
1,1,2-TRICHLOROETHANE	ND	5					UG/L
1,1-DICHLOROETHENE	ND	5					UG/L
2-BUTANONE	ND	10.					UG/L
4-METHYL-2-PENTANONE	ND	10.					UG/L
ACETONE	ND	34					UG/L
ACETONITRILE							UG/L
BENZENE	ND	5					UG/L
CHLOROBENZENE	ND	5					UG/L
DICHLORODIFLUOROMETHANE	ND	10.					UG/L
ETHYLBENZENE	ND	5					UG/L
METHYLENE CHLORIDE	ND	5					UG/L
O-XYLENE	ND	10.					UG/L
P-DIOXANE							UG/L
PROPIONITRILE							UG/L
TOLUENE	ND	5					UG/L
VINYL CHLORIDE	ND	10.					UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

WMX ENVIRONMENTAL MONI[illegible]G LABORATORIES, INC.

EVENT SUMMARY REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

ENS: 94-11877
MP: 705941
Rev / Task: 00 / 05
Sample Type: OTHER
Reported: 18-MAY-1994

Analyte	Sample Point: / Sample Number: / Sampled:	705-02FB / AJ8204 / 29-APR-1994	EML RL					Units
VOLATILE ORGANICS:								
(M and P)-XYLENE		ND	10.					UG/L
1,1,2-TRICHLOROETHANE		ND	5.					UG/L
1,1-DICHLOROETHENE		ND	5.					UG/L
2-BUTANONE		ND	10.					UG/L
4-METHYL-2-PENTANONE		ND	10.					UG/L
ACETONE		ND	34.					UG/L
ACETONITRILE		ND	10.					UG/L
BENZENE		ND	5.					UG/L
CHLOROBENZENE		ND	5.					UG/L
DICHLORODIFLUOROMETHANE		ND	10.					UG/L
ETHYLBENZENE		ND	5.					UG/L
METHYLENE CHLORIDE		ND	5.					UG/L
O-XYLENE		ND	10.					UG/L
P-DIOXANE		ND	50.					UG/L
PROPIONITRILE		ND	10.					UG/L
TOLUENE		ND	5.					UG/L
VINYL CHLORIDE		ND	10.					UG/L

NA = Not Analyzed ND = Not Detected TBK = Trip Blank s = EML Subcontract Data

ATTACHMENT B

CLIENT REPORTS AND ASSOCIATED FIELD INFORMATION FORMS/ CHAIN OF CUSTODY RECORDS

SAMPLE BOTTLE PARAMETERS

IDENTIFICATION KEY

The following KEY has been provided to assist in interpreting the correlation between the sample I.D. and the Analytes/Lab Groups as listed on the Field Chain of Custody Records.

This KEY applies to the following samples:

G120S (AJ8195)	G124S (AJ8198)
G121S (AJ8196)	G126S (AJ8197)
G123S (AJ8194)	G307 (AJ8193)

KEY: Sample I.D.	Analytes/Lab Groups
A	Total Metals
B	Dissolved Metals (ICP)
C	Dissolved Metals (AA)
D	Chloride
	Fluoride
E	Pesticides (DDE, DDT)
F	Semi-volatiles (A/B/N extractables)
G	Volatile Organics (Heated Purge & Trap)
H	Volatile Organics (Direct Aqueous Injection)
I	Volatile Organics - trip blank (HP&T)

This KEY applies to the following samples:

02FB (AJ8204)

KEY: Sample I.D.	Analytes/Lab Groups
A	Volatile Organics (Heated Purge & Trap)
B	Volatile Organics (Direct Aqueous Injection)

DATA QUALIFIER COMMENT CODE DEFINITIONS

AR: Acid surrogate recoveries did not meet the acceptance criteria of the method. Oxidative degradation due to sample matrix is suggested.

BB: Broken bottle.

BL: The method blank concentrations associated with this analyte did not meet the acceptance criteria of the method.

CX: The concentration of this compound exceeded the calibration used for this analysis. The concentration reported is estimated.

CU: Co-elution with another compound interferes with the quantitation of this compound. The concentration reported is estimated.

DL: The sample was diluted during analysis. Reporting limits have been adjusted where necessary.

DP: Aliquots or spiked aliquots of this sample were analyzed in duplicate. The relative percent difference between the two results did not meet the acceptance criteria of the method.

DW: Dry Well.

HS: Headspace in sample exceeded laboratory control limit. The reported results of the analysis may be less than actual value.

IS: The internal standard recoveries associated with this analysis did not meet the acceptance criteria of the method.

IV: The bottle did not contain enough sample to perform the analysis.

MP: 3-methylphenol and 4-methylphenol co-elute under the analytical conditions of the method, and cannot be differentiated solely on the basis of their mass spectra. The concentrations reported may be either or both isomers.

MX: This sample was used as a matrix spike. The percent recovery did not meet the acceptance criteria of the method. The analysis of a quality control standard showed the analytical system was in control. The result reported may therefore be affected by matrix interferences.

NN: N-nitrosodiphenylamine cannot be distinguished from diphenylamine using gas chromatography. The concentrations reported may be either or both compounds.

NQ: No standard qualifier code is in use for this qualification. See the associated comment.

NS: There was not enough sample to repeat this analysis.

P: (Wisconsin only) Concentration found between the method detection limit and the reporting limit indicates the presence of a compound.

PL: This result may be a product of contamination from phthalate plasticizers, which are a common lab contaminant.

PX: This sample required preservation in the field to a pH of less than 2. The pH was checked before analysis and did not have a pH of less than 2.

PY: This sample required preservation in the field to a pH of 4 to 5. The pH was checked before analysis and did not have a pH of 4 to 5.

PZ: This sample required preservation in the field to a pH of 12 or greater. The pH was checked before analysis and did not have a pH of 12 or greater.

QX: This sample was used as a matrix spike. The percent recovery did not meet the acceptance criteria of the method. The analysis of a quality control standard showed the analytical system was out-of-control. The analytical result for this parameter in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

SB: The analysis of this sample was performed by an approved subcontract laboratory.

ST: This compound is not stable in acidic water.

SU: The analysis of the surrogate with this sample did not meet the acceptance criteria of the method.

TX: The analysis for this parameter was conducted after the holding time specified in the method.

UN: This compound is not stable under the conditions of the analysis.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G120S
Sample Type: WELL
Sample Number: AJ8195

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
FIELD DATA:					
DEPTH TO WATER FROM TOP OF CASING	8.83		FT		FDWDTWTC01
GROUNDWATER ELEV.	585.01		FT MSL		FDWGWELWDT
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	6.82		PH UNITS		FDPHQUAD01
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	3160		UMHOS/CM		FDSPCOND04
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	0.85		FT		FDWSTKUP01
WATER TEMPERATURE IN DEGREES CELSIUS	10.3		DEGREES C		FDXTEMPC01
WELL DEPTH TOTAL	20.77		FT		FDWGWELWDT
INORGANICS:					
ALUMINUM-DISSOLVED	ND	200.	UG/L		INICPDISAL
ALUMINUM-TOTAL	1760	200.	UG/L	PX	INICPTOTAL
ARSENIC-DISSOLVED	35.2	10.0	UG/L		INGFAADIAS
ARSENIC-TOTAL	61.9	10.0	UG/L	PX	INGFAATOAS
BARIUM-DISSOLVED	922	200.	UG/L		INICPDISBA
BARIUM-TOTAL	1020	200.	UG/L	PX	INICPTOTBA
CADMIUM-DISSOLVED	ND	5.0	UG/L		INICPDISCD
CADMIUM-TOTAL	ND	5.0	UG/L	PX	INICPTOTCD
CHLORIDE	347	1.0	MG/L	DL	INCHLORI01
CHROMIUM-DISSOLVED	ND	10.0	UG/L		INICPDISCR
CHROMIUM-TOTAL	31.8	10.0	UG/L	PX	INICPTOTCR
FLUORIDE	0.43	0.050	MG/L		INFLPOTO01
IRON-DISSOLVED	16400	100.	UG/L		INICPDISFE
IRON-TOTAL	23000	100.	UG/L	PX	INICPTOTFE
LEAD-DISSOLVED	ND	5.0	UG/L		INGFAADIPB
LEAD-TOTAL	12.1	5.00	UG/L	PX	INGFAATOPB
SODIUM-DISSOLVED	110000	5000	UG/L		INICPDISNA
SODIUM-TOTAL	116000	5000	UG/L	PX	INICPTOTNA
ZINC-DISSOLVED	ND	20.0	UG/L		INICPDISZN
ZINC-TOTAL	63.4	20.0	UG/L	PX	INICPTOTZN
SEMI-VOLATILE ORGANICS:					
1,2-DICHLOROBENZENE	ND	10.	UG/L		SVMS1BNA03
2,4-DICHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
2,4-DIMETHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
2,6-DICHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
2-CHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
3-METHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
4,4'-DDE	ND	0.1	UG/L		SVGC1OCP06
4,4'-DDT	ND	0.1	UG/L		SVGC1OCP06
4-CHLOROANILINE	ND	10.	UG/L		SVMS1BNA03
4-METHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
ANILINE	ND	10.	UG/L		SVMS1BNA03
ANTHRACENE	ND	10.	UG/L		SVMS1BNA03
NAPHTHALENE	ND	10.	UG/L		SVMS1BNA03
PHENOL	ND	10.	UG/L		SVMS1BNA03
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	50.	UG/L		VOMSBA0126
1,1,2-TRICHLOROETHANE	ND	100	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Item	Additional Comment Explanations (NQ/DL)
ORIDE	Dilution factor 2 applied.
C1OCP06	Dilution factor 1.05 applied.
VOMSBA0126	Dilution factor 25 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.
VOMSDAX111	Dilution factor 5 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G120S
Sample Type: WELL
Sample Number: AJ8195

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
1,1-DICHLOROETHENE	ND	50.	UG/L		VOMSBA0126
2-BUTANONE	ND	250	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	250	UG/L		VOMSBA0126
ACETONE	ND	600	UG/L		VOMSBA0126
ACETONITRILE	ND	50.	UG/L	PY	VOMSDAX111
BENZENE	ND	10.	UG/L		VOMSBA0126
CHLOROBENZENE	ND	50.	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	100	UG/L		VOMSBA0126
ETHYLBENZENE	ND	50.	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	130	UG/L		VOMSBA0126
O-XYLENE	ND	50.	UG/L		VOMSBA0126
P-DIOXANE	ND	110	UG/L	PY	VOMSDAX111
PROPIONITRILE	ND	36	UG/L	PY	VOMSDAX111
TOLUENE	ND	50.	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	100	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMX Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 599
Date Sealed 9 4 4 4 1 9 (YY / MM / DD)
Seal # 66926
By: EP

SITE/FACILITY # 1081 SITE NAME [illegible] Chemical Service

Sample Point: [illegible] (Source Code)

SAMPLE DATE [illegible] (YY / MM / DD)

SAMPLE TIME 12:56 (2400 HR) MATRIX CODE: W

Water (W) Leachate (C)
Soil (S) Other (X)

Source Codes

Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream/Brook (R) Soil (S) Generation Pt (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # [illegible]

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y—N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8195-A	01	P	HNO3	IN 09 METHODS	Y N	EML	
AJ8195-B	01	P	HNO3	IN 07 METHODS	Y N	EML	
AJ8195-C	01	P	HNO3	IN 02 METHODS	Y N	EML	
AJ8195-D	01	P	NONE 4C	IN 02 METHODS	Y N	EML	
AJ8195-E	02	G	NONE 4C	SVGC10CP06	Y N	EML	
AJ8195-F	02	G	NONE 4C	SVMS1BNA03	Y N	EML	
AJ8195-G	04	G	HCL 4C	VOMSBA0126	Y N	EML	
AJ8195-H	04	G	NONE 4C	VOMSDAX111	Y N	EML	
~~AJ8195-I~~	~~01~~	~~G~~	~~HCL 4C~~	~~VOMSBA0126~~	Y N	~~EML~~	~~TSK~~ CANCEL EP
~~AJ8195-J~~	~~01~~	~~G~~	~~NONE 4C~~	~~VOMSDAX111~~	Y N	~~EML~~	~~TSK~~ 4-19-94
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/08/94 Time: 10:10 (2400 HR.)
Signature: Kevin Gallagher Seal #: 66926 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

4. AquaPak™/Sub Contr # _____ Sealed By: Kevin Gallagher (Print) Date: 04/09/94 Time: 15:10 (2400 HR)
Signature: Kevin Gallagher Seal # 67999 Intact: Yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 4/30/94 Time: 10:45 (2400 HR.)

AquaPak™/Sub. Contr. # 599 Temp.°C 3 (REGION) Seal # 67999 Intact. Y

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set:

Sample Point: W G 1 2 D S (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
94 04 29	1244	02	1.0	1.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) N (Circle one) Sampling Equipment Dedicated (Y) N (Circle one)

Purging Device	A	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- A (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 5913.84 (ft/msl)	Land Surface Elevation	5912.99 (ft/msl)
Depth to water From top of well casing	8.83 (ft)	Depth to water From land surface	7.98 (ft)
Groundwater Elevation	5850.1 (ft/msl)	Groundwater Elevation	5850.1 (ft/msl)
Well Depth	20.77 (ft)	Stickup	0.85 (ft)

1st	6.82 (STD) ph	1st	3160 μm/cm at 25° C spec. cond	Sample Temp.	10.3 (° C)
2nd	(STD) ph	2nd	μm/cm at 25° C spec. cond.	(other parameter)	2.0 (value) mg/L (units)
3rd	(STD) ph	3rd	μm/cm at 25° C spec. cond.	(other parameter)	value units
4th	(STD) ph	4th	μm/cm at 25° C spec cond.	(other parameter)	value units

FIELD COMMENTS

Sample Appearance: (if applicable) Odor: MODERATE Color: DARK GRAY Turbidity: MODERATE

Weather Conditions: Wind Speed 5-10 mph Direction NORTHWEST Precipitation Y/N (N) Outlook PARTLY CLOUDY 80°F

Specific Comments: *REFERENCE MEASUREMENT

CASING VOLUME: 20.77 − 8.83 = 11.94 x 0.163 = 1.95 (1) x 3 = 5.84 (3) GALLONS.

THE SAMPLE WAS OBTAINED AT 1256 ON 04/29/94

DEPTH TO WATER WAS TAKEN WITH THE BAILER IN THE WATER

THE PURGE WATER WAS FOAMY.

* = TOP OF INNER CASING

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

04/29/94 (Date) [signature] (Signature) Employer: WMI

EML FF-2A 4/90

REGION

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G121S
Sample Type: WELL
Sample Number: AJ8196

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
FIELD DATA:					
DEPTH TO WATER FROM TOP OF CASING	11.25		FT		FDWDTWTC01
GROUNDWATER ELEV.	582.64		FT MSL		FDWGWELWDT
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	7.88		PH UNITS		FDPHQUAD01
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	13390		UMHOS/CM		FDSPCOND04
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	1.20		FT		FDWSTKUP01
WATER TEMPERATURE IN DEGREES CELSIUS	9.1		DEGREES C		FDXTEMPC01
WELL DEPTH TOTAL	20.68		FT		FDWGWELWDT
INORGANICS:					
ALUMINUM-DISSOLVED	ND	200.	UG/L		INICPDISAL
ALUMINUM-TOTAL	263	200.	UG/L		INICPTOTAL
ARSENIC-DISSOLVED	ND	14.0	UG/L	DL	INGFAADIAS
ARSENIC-TOTAL	22.0	14.0	UG/L	DL	INGFAATOAS
BARIUM-DISSOLVED	626	200.	UG/L		INICPDISBA
BARIUM-TOTAL	616	200.	UG/L		INICPTOTBA
CADMIUM-DISSOLVED	ND	5.0	UG/L		INICPDISCD
CADMIUM-TOTAL	ND	5.0	UG/L		INICPTOTCD
CHLORIDE	5260	5.0	MG/L	DL	INCHLORI01
CHROMIUM-DISSOLVED	ND	10.0	UG/L		INICPDISCR
CHROMIUM-TOTAL	100	10.0	UG/L		INICPTOTCR
FLUORIDE	1.93	0.050	MG/L		INFLPOTO01
IRON-DISSOLVED	821	100.	UG/L		INICPDISFE
IRON-TOTAL	5490	100.	UG/L		INICPTOTFE
LEAD-DISSOLVED	ND	16.0	UG/L	DL	INGFAADIPB
LEAD-TOTAL	ND	16.0	UG/L	DL	INGFAATOPB
SODIUM-DISSOLVED	3100000	80000	UG/L	DL	INICPDISNA
SODIUM-TOTAL	3140000	8000.	UG/L	DL	INICPTOTNA
ZINC-DISSOLVED	ND	20.0	UG/L		INICPDISZN
ZINC-TOTAL	50.5	20.0	UG/L		INICPTOTZN
SEMI-VOLATILE ORGANICS:					
1,2-DICHLOROBENZENE	ND	10.	UG/L	SU	SVMS1BNA03
2,4-DICHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2,4-DIMETHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2,6-DICHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2-CHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
3-METHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
4,4'-DDE	ND	0.1	UG/L		SVGC1OCP06
4,4'-DDT	ND	0.1	UG/L		SVGC1OCP06
4-CHLOROANILINE	55	10.	UG/L	SU	SVMS1BNA03
4-METHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
ANILINE	ND	10.	UG/L	SU	SVMS1BNA03
ANTHRACENE	ND	10.	UG/L	SU	SVMS1BNA03
NAPHTHALENE	ND	10.	UG/L	SU	SVMS1BNA03
PHENOL	ND	10.	UG/L	SU	SVMS1BNA03

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Item	Additional Comment Explanations (NQ/DL)
ARSENIC-DISSOLVED	Dilution factor 05 applied.
RSENIC-TOTAL	Dilution factor 5 applied.
ORIDE	Dilution factor 10 applied.
D-DISSOLVED	Dilution factor 05 applied.
D-TOTAL	Dilution factor 05 applied.
SODIUM-DISSOLVED	Dilution factor 50 applied.
SODIUM-TOTAL	Dilution factor 5 applied.
SVGC1OCP06	Dilution factor 1.34 applied.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G121S
Sample Type: WELL
Sample Number: AJ8196

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	50.	UG/L		VOMSBA0126
1,1,2-TRICHLOROETHANE	ND	100	UG/L		VOMSBA0126
1,1-DICHLOROETHENE	ND	50.	UG/L		VOMSBA0126
2-BUTANONE	ND	250	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	250	UG/L		VOMSBA0126
ACETONE	ND	600	UG/L		VOMSBA0126
ACETONITRILE	ND	50.	UG/L	PY	VOMSDAX111
BENZENE	280.	10.	UG/L		VOMSBA0126
CHLOROBENZENE	ND	50.	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	100	UG/L		VOMSBA0126
ETHYLBENZENE	ND	50.	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	130	UG/L		VOMSBA0126
O-XYLENE	ND	50.	UG/L		VOMSBA0126
P-DIOXANE	140.	110	UG/L	PY	VOMSDAX111
PROPIONITRILE	ND	36	UG/L	PY	VOMSDAX111
TOLUENE	ND	50.	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	100	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Item	Additional Comment Explanations (NQ/DL)
VOMSBA0126	Dilution factor 25 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.
SDAX111	Dilution factor 5 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.

Subcontract To: _____

WMX Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 565
Date Sealed 94/04/19 (YY / MM / DD)
Seal # 66785
By: EL

SITE/FACILITY # 106 SITE NAME: CWM Chemical Services

Sample Point: WG121S (Source Code)

SAMPLE DATE: 94/04/29 (YY / MM / DD)

SAMPLE TIME: 10:48 (2400 HR.) MATRIX CODE: W

Water (W) Leachate (C)
Soil (S) Other (X)

Source Codes:
Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream/Brook (R) Soil (S) Generation Pt (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # 94-11375

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y—N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8196-A	01	P	HNO3	IN 09 METHODS	Y N	EML	
AJ8196-B	01	P	HNO3	IN 07 METHODS	Y N	EML	
AJ8196-C	01	P	HNO3	IN 02 METHODS	Y N	EML	
AJ8196-D	01	P	NONE 4C	IN 02 METHODS	Y N	EML	
AJ8196-E	02	G	NONE 4C	SVGC10CP06	Y N	EML	
AJ8196-F	02	G	NONE 4C	SVMS1BNA03	Y N	EML	
AJ8196-G	04	G	HCL 4C	VOMSBA0126	Y N	EML	
AJ8196-H	04	G	NONE 4C	VOMSDAX111	Y N	EML	
AJ8196-I	01	G	HCL 4C	VOMSBA0126	Y N	EML NO BUBBLE	TBK
AJ8196-J	01	G	NONE 4C	VOMSDAX111	Y N	EML 4/28/94 1006	TBK CANCEL EL 4-19-94
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/28/94 Time: 10:06 (2400 HR.)
Signature: Kevin Gallagher Seal #: 66785 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

4. AquaPak™/Sub Contr. # _____ Sealed By: Kevin Gallagher (Print) Date: 04/29/94 Time: 15:20 (2400 HR.)
Signature: Kevin Gallagher Seal #: 67959 Intact: yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 4/30/94 Time: 13:35 (2400 HR.)
AquaPak™/Sub. Contr. # 565 Temp.°C 3 Seal # 67959 Intact. Y

REGION

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: A5B196

Sample Point: WGD15 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940428	1112	01	15	20

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated | Y | N | (circle one) Sampling Equipment ..... Dedicated | Y | N | (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- (PURGING OTHER (SPECIFY))
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- (SAMPLING OTHER (SPECIFY))
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	A	A-Teflon	C-Polypropylene	E-Polyethylene	X- (PURGING OTHER (SPECIFY))
Sampling Material	A	B-Stainless Steel	D-PVC		X- (SAMPLING OTHER (SPECIFY))
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- (PURGING OTHER (SPECIFY))
Tubing-Sampling	C	B-Tygon C-Rope X- D (SPECIFY)	E-Polyethylene	G-Combination teflon/ Polypropylene	X- (SAMPLING OTHER (SPECIFY))
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.89 (ft/msl)	Land Surface Elevation	590.59 (ft/msl)
Depth to water From top of well casing	11.05 (ft)	Depth to water From land surface	10.05 (ft)
Groundwater Elevation	580.64 (ft/msl)	Groundwater Elevation	580.64 (ft/msl)
Well Depth	20.68 (ft)	Stickup	1.20 (ft)

1st	7.38 (STD) ph	1st	1339 μm/cm at 25° C spec. cond	Sample Temp.	9.1 (° C)
2nd	(STD) ph	2nd	μm/cm at 25° C spec cond	WELL DIA. (other parameter)	2.0 (value) IN. (units)
3rd	(STD) ph	3rd	μm/cm at 25° C spec. cond.	(other parameter)	(value) (units)
4th	(STD) ph	4th	μm/cm at 25° C spec cond	(other parameter)	(value) (units)

FIELD COMMENTS

Sample Appearance: _____ Odor: SLIGHT Color: TAN Turbidity: SLIGHT

Weather Conditions: PURGE: (if applicable) Wind Speed 10-15 mPH Direction NORTHEAST Precipitation (Y/N) Outlook CLOUDY / 50°F
SAMPLE: 5-15 mPH WEST PARTLY CLOUDY / 45°F

Specific Comments: *REFERENCE MEASUREMENT (N) MP: TOP OF INNER CASING

CASING VOLUME 20.68 - 11.05 = 9.43 x 0.163 = 1.54 x 3 = 4.61 GALLONS

DEPTH TO WATER WAS MEASURED WITH THE BAILER IN THE WATER

THE WELL WAS PURGED DRY AT 1117 ON 04/28/94.

THE SAMPLE WAS OBTAINED AT 1048 ON 04/29/94.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

04/29/94 (Date) [signature] (Signature) Employer: WESTON

EML FF-2A 4/90

REGION

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G123S
Sample Type: WELL
Sample Number: AJ8194

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
FIELD DATA:					
DEPTH TO WATER FROM TOP OF CASING	6.33		FT		FDWDTWTC01
GROUNDWATER ELEV.	587.80		FT MSL		FDWGWELWDT
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	8.24		PH UNITS		FDPHQUAD01
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	4420		UMHOS/CM		FDSPCOND04
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	2.39		FT		FDWSTKUP01
WATER TEMPERATURE IN DEGREES CELSIUS	11.8		DEGREES C		FDXTEMPC01
WELL DEPTH TOTAL	20.74		FT		FDWGWELWDT
INORGANICS:					
ALUMINUM-DISSOLVED	ND	200.	UG/L		INICPDISAL
ALUMINUM-TOTAL	ND	200.	UG/L		INICPTOTAL
ARSENIC-DISSOLVED	ND	10.0	UG/L		INGFAADIAS
ARSENIC-TOTAL	ND	10.0	UG/L		INGFAATOAS
BARIUM-DISSOLVED	410	200.	UG/L		INICPDISBA
BARIUM-TOTAL	393	200.	UG/L		INICPTOTBA
CADMIUM-DISSOLVED	ND	5.0	UG/L		INICPDISCD
CADMIUM-TOTAL	ND	5.0	UG/L		INICPTOTCD
CHLORIDE	1370	5.0	MG/L	DL	INCHLORI01
CHROMIUM-DISSOLVED	ND	10.0	UG/L		INICPDISCR
CHROMIUM-TOTAL	38.0	10.0	UG/L		INICPTOTCR
FLUORIDE	0.38	0.050	MG/L		INFLPOTO01
IRON-DISSOLVED	294	100.	UG/L		INICPDISFE
IRON-TOTAL	1040	100.	UG/L		INICPTOTFE
LEAD-DISSOLVED	ND	5.0	UG/L		INGFAADIPB
LEAD-TOTAL	ND	5.00	UG/L		INGFAATOPB
SODIUM-DISSOLVED	369000	5000	UG/L		INICPDISNA
SODIUM-TOTAL	373000	5000	UG/L		INICPTOTNA
ZINC-DISSOLVED	ND	20.0	UG/L		INICPDISZN
ZINC-TOTAL	ND	20.0	UG/L		INICPTOTZN
SEMI-VOLATILE ORGANICS:					
1,2-DICHLOROBENZENE	ND	10.	UG/L		SVMS1BNA03
2,4-DICHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
2,4-DIMETHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
2,6-DICHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
2-CHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
3-METHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
4,4'-DDE	ND	0.1	UG/L		SVGC1OCP06
4,4'-DDT	ND	0.1	UG/L		SVGC1OCP06
4-CHLOROANILINE	ND	10.	UG/L		SVMS1BNA03
4-METHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
ANILINE	ND	10.	UG/L		SVMS1BNA03
ANTHRACENE	ND	10.	UG/L		SVMS1BNA03
NAPHTHALENE	10	10.	UG/L		SVMS1BNA03
PHENOL	16	10.	UG/L		SVMS1BNA03
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	40.	UG/L		VOMSBAO126
1,1,2-TRICHLOROETHANE	ND	80.	UG/L		VOMSBAO126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Item	Additional Comment Explanations (NQ/DL)
ORIDE	Dilution factor 10 applied.
GC1OCP06	Dilution factor 1.07 applied.
VOMSBAO126	Dilution factor 20 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.
VOMSDAX111	Dilution factor 2 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

C L I E N T R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G123S
Sample Type: WELL
Sample Number: AJ8194

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
1,1-DICHLOROETHENE	ND	40.	UG/L		VOMSBA0126
2-BUTANONE	ND	200	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	200	UG/L		VOMSBA0126
ACETONE	ND	480	UG/L		VOMSBA0126
ACETONITRILE	ND	20.	UG/L	PY	VOMSDAX111
BENZENE	220.	8	UG/L		VOMSBA0126
CHLOROBENZENE	ND	40.	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	80.	UG/L		VOMSBA0126
ETHYLBENZENE	ND	40.	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	100	UG/L		VOMSBA0126
O-XYLENE	ND	40.	UG/L		VOMSBA0126
P-DIOXANE	250.	50.	UG/L	PY	VOMSDAX111
PROPIONITRILE	ND	14	UG/L	PY	VOMSDAX111
TOLUENE	ND	40.	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	80.	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMX Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 599
Date Sealed 94/04/19 (YY / MM / DD)
Seal # 66926
By: EL

SITE/FACILITY # 108 SITE NAME: CWM Chemical Services

Sample Point: WG1239 (Source Code)

SAMPLE DATE: 94/04/29 (YY / MM / DD)

SAMPLE TIME: 12:00 (2400 HR.) MATRIX CODE: W

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes

Well ..... (W) Leachate System ... (C) Pretreatment Facility ... (P) River/Stream/Brook ... (R) Soil ..... (S) Generation Pt .... (G)
Dewatering/Pressure Relief .... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Noise ..... (N) Specify _____

ENS # 94-11875

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8194-A	01	P	HNO3	IN 09 METHODS	Y N	EML	H3 NOT
AJ8194-B	01	P	HNO3	IN 07 METHODS	Y N	EML	RECEIVED
AJ8194-C	01	P	HNO3	IN 02 METHODS	Y N	EML	DONOBY
AJ8194-D	01	P	NONE 4C	IN 02 METHODS	Y N	EML	4-30-94
AJ8194-E	02	G	NONE 4C	SVGC10CP06	Y N	EML	
AJ8194-F	02	G	NONE 4C	SVMS1BNA03	Y N	EML	
AJ8194-G	04	G	HCL 4C	VOMSBAO126	Y N	EML	
AJ8194-H	04	G	NONE 4C	VOMSDAX111	Y N	EML	
AJ8194-I	01	G	HCL 4C	VOMSBAO126	Y N	EML NO BUBBLE	TBK
AJ8194-J	01	G	NONE 4C	VOMSDAX111	Y N	EML 4/28/94	TBK
					Y N		CANCEL EL 4-19-94
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/28/94 Time: 10:10 (2400 HR.)
Signature: Kevin Gallagher Seal #: 66926 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

4. AquaPak™/Sub Contr. # _____ Sealed By: Kevin Gallagher (Print) Date 04/29/94 Time: 15:10 (2400 HR.)
Signature: Kevin Gallagher Seal # 67999 Intact: yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 4/30/94 Time: 10:45 (2400 HR.)
AquaPak™/Sub. Contr. # 599 Temp.°C 3 Seal # 67999 Intact: Y

REGION

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AJ8194

Sample Point: W G1235 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940429	12.08	0.2	2.3	

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated (Y) | N (circle one) Sampling Equipment ..... Dedicated (Y) | N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 594.13 (ft/msl)	Land Surface Elevation	591.74 (ft/msl)
Depth to water From top of well casing	6.33 (ft)	Depth to water From land surface	3.94 (ft)
Groundwater Elevation	587.80 (ft/msl)	Groundwater Elevation	587.80 (ft/msl)
Well Depth	20.74 (ft)	Stickup	2.39 (ft)

	ph		spec. cond.		
1st	8.24 (STD)	1st	4420 μm/cm at 25° C	Sample Temp.	11.8 (° C)
2nd	(STD)	2nd	μm/cm at 25° C	Well DIA. (other parameter)	20 value / IN. units
3rd	(STD)	3rd	μm/cm at 25° C	(other parameter)	value / units
4th	(STD)	4th	μm/cm at 25° C	(other parameter)	value / units

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: MODERATE Color: TAN Turbidity: SLIGHT

Weather Conditions: Wind Speed 5-10 mph Direction NORTHWEST Precipitation Y/N Outlook PARTLY CLOUDY/50°F

Specific Comments: *REFERENCE MEASUREMENT

CASING VOLUME: 20.74 - 6.33 = 14.41 x 0.163 = 2.35 (1) x 3 = 7.05 (2) GALLONS

DEPTH TO WATER WAS MEASURED WITH THE BAILER IN THE WATER

THE SAMPLE WAS OBTAINED AT 1220 ON 04/29/94

MP = TOP OF INNER CASING

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

04/29/94 (Date) Kevin Gallagher (Signature) Employer: WESTON/GCL

EML FF-2A 4/90

REGION

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G124S
Sample Type: WELL
Sample Number: AJ8198

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
FIELD DATA:					
DEPTH TO WATER FROM TOP OF CASING	9.62		FT		FDWDTWTC01
GROUNDWATER ELEV.	583.66		FT MSL		FDWGWELWDT
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	7.36		PH UNITS		FDPHQUAD01
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	4720		UMHOS/CM		FDSPCOND04
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	1.51		FT		FDWSTKUP01
WATER TEMPERATURE IN DEGREES CELSIUS	10.2		DEGREES C		FDXTEMPC01
WELL DEPTH TOTAL	20.73		FT		FDWGWELWDT
INORGANICS:					
ALUMINUM-DISSOLVED	ND	200.	UG/L		INICPDISAL
ALUMINUM-TOTAL	2530	1000	UG/L	DL	INICPTOTAL
ARSENIC-DISSOLVED	ND	10.0	UG/L		INGFAADIAS
ARSENIC-TOTAL	ND	10.0	UG/L		INGFAATOAS
BARIUM-DISSOLVED	ND	200.	UG/L		INICPDISBA
BARIUM-TOTAL	ND	200.	UG/L	DL	INICPTOTBA
CADMIUM-DISSOLVED	ND	5.0	UG/L		INICPDISCD
CADMIUM-TOTAL	ND	5.0	UG/L		INICPTOTCD
CHLORIDE	1330	1.0	MG/L	DL	INCHLORI01
CHROMIUM-DISSOLVED	ND	10.0	UG/L		INICPDISCR
CHROMIUM-TOTAL	49.3	10.0	UG/L		INICPTOTCR
FLUORIDE	0.34	0.050	MG/L		INFLPOTO01
IRON-DISSOLVED	600	100.	UG/L		INICPDISFE
IRON-TOTAL	12100	100.	UG/L		INICPTOTFE
LEAD-DISSOLVED	ND	5.0	UG/L		INGFAADIPB
LEAD-TOTAL	ND	5.00	UG/L		INGFAATOPB
SODIUM-DISSOLVED	346000	5000	UG/L		INICPDISNA
SODIUM-TOTAL	400000	8000	UG/L	DL	INICPTOTNA
ZINC-DISSOLVED	ND	20.0	UG/L		INICPDISZN
ZINC-TOTAL	ND	84.0	UG/L	DL	INICPTOTZN
SEMI-VOLATILE ORGANICS:					
1,2-DICHLOROBENZENE	ND	10.	UG/L	SU	SVMS1BNA03
2,4-DICHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2,4-DIMETHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2,6-DICHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2-CHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
3-METHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
4,4'-DDE	ND	0.1	UG/L		SVGC1OCP06
4,4'-DDT	ND	0.1	UG/L		SVGC1OCP06
4-CHLOROANILINE	ND	10.	UG/L	SU	SVMS1BNA03
4-METHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
ANILINE	ND	10.	UG/L	SU	SVMS1BNA03
ANTHRACENE	ND	10.	UG/L	SU	SVMS1BNA03
NAPHTHALENE	ND	10.	UG/L	SU	SVMS1BNA03
PHENOL	ND	10.	UG/L	SU	SVMS1BNA03
VOLATILE ORGANICS:					

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Item	Additional Comment Explanations (NQ/DL)
MINUM-TOTAL	Dilution factor 5 applied.
UM-TOTAL	Dilution factor 5 applied.
ORIDE	Dilution factor 2 applied.
DIUM-TOTAL	Dilution factor 5 applied.
ZINC-TOTAL	Dilution factor 5 applied.
SVGC1OCP06	Dilution factor 1.32 applied.
VOMSBA0126	Dilution factor 10 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: 3124S
Sample Type: WELL
Sample Number: AJ8198

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
(M and P)-XYLENE	ND	20.	UG/L		VOMSBA0126
1,1,2-TRICHLOROETHANE	ND	40.	UG/L		VOMSBA0126
1,1-DICHLOROETHENE	ND	20.	UG/L		VOMSBA0126
2-BUTANONE	ND	100	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	100	UG/L		VOMSBA0126
ACETONE	ND	240	UG/L		VOMSBA0126
ACETONITRILE	ND	10.	UG/L		VOMSDAX111
BENZENE	ND	5	UG/L		VOMSBA0126
CHLOROBENZENE	ND	20.	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	40.	UG/L		VOMSBA0126
ETHYLBENZENE	ND	20.	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	50.	UG/L		VOMSBA0126
O-XYLENE	ND	20.	UG/L		VOMSBA0126
P-DIOXANE	ND	50.	UG/L		VOMSDAX111
PROPIONITRILE	ND	10.	UG/L		VOMSDAX111
TOLUENE	ND	20.	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	40.	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMX Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 743
Date Sealed 94/4/19 (YY / MM / DD)
Seal # 66159
By: EL

SITE/FACILITY # 108 SITE NAME: CWM Chemical Services

Sample Point: WG1245 (Source Code)

SAMPLE DATE - 940419 (YY / MM / DD)

SAMPLE TIME: 09:50 (2400 HR) MATRIX CODE: W

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes:
Well ..... (W) Leachate System ... (C) Pretreatment Facility ... (P) River/Stream/Brook ... (R) Soil ..... (S) Generation Pt ..... (G)
Dewatering/Pressure Relief .... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Noise ..... (N) Specify _____

ENS # 94-11875

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y—N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8198-A	01	P	HNO3	IN 09 METHODS	Y N	EML 4/30/94	I ØBBL
AJ8198-B	01	P	HNO3	IN 07 METHODS	Y N	EML	[illegible]
AJ8198-C	01	P	HNO3	IN 02 METHODS	Y N	EML	
AJ8198-D	01	P	NONE 4C	IN 02 METHODS	Y N	EML	4-30-94
AJ8198-E	02	G	NONE 4C	SVGC10CP06	Y N	EML	
AJ8198-F	02	G	NONE 4C	SVMS1BNA03	Y N	EML	[illegible]
AJ8198-G	04	G	HCL 4C	VOMSBA0126	Y N	EML	
AJ8198-H	04	G	NONE 4C	VOMSDAX111	Y N	EML	
AJ8198-I	01	G	HCL 4C	VOMSBA0126	Y N	EML NO BUBBLE 4/25/94 0946	TBK
AJ8198-J	01	G	NONE 4C	VOMSDAX111	Y N	EML	TBK CANCEL 4-19-94
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/08/94 Time: 09:46 (2400 HR.)
Signature: Kevin Gallagher Seal #: 66159 Intact: Yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

4. AquaPak™/Sub Contr. # _____ Sealed By: Kevin Gallagher (Print) Date: 04/09/94 Time: 14:45 (2400 HR.)
Signature: Kevin Gallagher Seal #: 67995 Intact: Yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 4/30/94 Time: 10:20 (2400 HR.)

AquaPak™/Sub. Contr. # 743 Temp.°C 0 REGION Seal # 67995 Intact. Y

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: A581978

Sample Point: W 1 2 3 4 5 6 7 8 4/28/94 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940428	1131	01	18	26

PURGING AND SAMPLING EQUIPMENT

Purging Equipment ..... Dedicated (Y) N (circle one) Sampling Equipment ..... Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	D	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	A	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon C-Rope X- D	E-Polyethylene (SPECIFY)	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
Filtering Devices 0.45 μ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 5913.28 (ft/msl)	Land Surface Elevation	5911.77 (ft/msl)
Depth to water From top of well casing	9.62 (ft)	Depth to water From land surface	8.11 (ft)
Groundwater Elevation	5813.66 (ft/msl)	Groundwater Elevation	(ft/msl)
Well Depth	20.73 (ft)	Stickup	1.51 (ft)

	ph	spec. cond	Sample Temp.
1st	7.36 (STD)	4720 μm/cm at 25° C	10.2 (° C)
2nd	(STD)	μm/cm at 25° C	NEW DIN. (other parameter) 2.9 (value) N. (units)
3rd	(STD)	μm/cm at 25° C	(other parameter) (value) (units)
4th	(STD)	μm/cm at 25° C	(other parameter) (value) (units)

FIELD COMMENTS

Sample Appearance: _____ Odor: SLIGHT Color: TAN Turbidity: SLIGHT

Weather Conditions: (if applicable) Wind Speed PURGE 10-15 MPH SAMPLE 5-15 MPH Direction NORTHEAST WEST Precipitation Y/N Outlook CLOUDY/45°F PARTLY CLOUDY/45°F

Specific Comments: * REFERENCE MEASUREMENT MP = TOP OF INNER CASING

CASING VOLUME: 20.73 - 9.62 = 11.11 x 0.163 = 1.81 x 3 = 5.43 GALLONS.

THE DEPTH TO WATER WAS MEASURED WITH THE BAILER IN THE WATER

THE WELL WAS PURGED DRY AT 1136 ON 04/28/94.

THE SAMPLE WAS OBTAINED AT 0950 ON 04/29/94.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

04/29/94 (Date) Glenn Gallagher (Signature) Employer: WESTON

EML FF-2A 4/90

REGION

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G126S
Sample Type: WELL
Sample Number: AJ8197

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
FIELD DATA:					
DEPTH TO WATER FROM TOP OF CASING	10.09		FT		FDWDTWTC01
GROUNDWATER ELEV.	583.64		FT MSL		FDWGWELWDT
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	9.27		PH UNITS		FDPHQUAD01
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	4540		UMHOS/CM		FDSPCOND04
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	1.78		FT		FDWSTKUP01
WATER TEMPERATURE IN DEGREES CELSIUS	8.7		DEGREES C		FDXTEMPC01
WELL DEPTH TOTAL	17.50		FT		FDWGWELWDT
INORGANICS:					
ALUMINUM-DISSOLVED	ND	200.	UG/L	MX	INICPDISAL
ALUMINUM-TOTAL	1500	200.	UG/L		INICPTOTAL
ARSENIC-DISSOLVED	29.1	10.0	UG/L		INGFAADIAS
ARSENIC-TOTAL	76.8	10.0	UG/L		INGFAATOAS
BARIUM-DISSOLVED	ND	200.	UG/L	MX	INICPDISBA
BARIUM-TOTAL	ND	200.	UG/L		INICPTOTBA
CADMIUM-DISSOLVED	ND	5.0	UG/L		INICPDISCD
CADMIUM-TOTAL	ND	5.0	UG/L		INICPTOTCD
CHLORIDE	1260	1.0	MG/L	DL	INCHLORI01
CHROMIUM-DISSOLVED	ND	10.0	UG/L		INICPDISCR
CHROMIUM-TOTAL	29.4	10.0	UG/L		INICPTOTCR
FLUORIDE	0.66	0.050	MG/L		INFLPOTO01
IRON-DISSOLVED	ND	100.	UG/L		INICPDISFE
IRON-TOTAL	3180	100.	UG/L		INICPTOTFE
LEAD-DISSOLVED	ND	5.0	UG/L		INGFAADIPB
LEAD-TOTAL	11.9	5.00	UG/L		INGFAATOPB
SODIUM-DISSOLVED	889000	5000	UG/L		INICPDISNA
SODIUM-TOTAL	807000	5000	UG/L		INICPTOTNA
ZINC-DISSOLVED	ND	20.0	UG/L		INICPDISZN
ZINC-TOTAL	35.7	20.0	UG/L		INICPTOTZN
SEMI-VOLATILE ORGANICS:					
1,2-DICHLOROBENZENE	ND	10.	UG/L		SVMS1BNA03
2,4-DICHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
2,4-DIMETHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
2,6-DICHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
2-CHLOROPHENOL	ND	10.	UG/L		SVMS1BNA03
3-METHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
4,4'-DDE	ND	0.1	UG/L		SVGC1OCP06
4,4'-DDT	ND	0.1	UG/L		SVGC1OCP06
4-CHLOROANILINE	ND	10.	UG/L		SVMS1BNA03
4-METHYLPHENOL	ND	10.	UG/L		SVMS1BNA03
ANILINE	ND	10.	UG/L		SVMS1BNA03
ANTHRACENE	ND	10.	UG/L		SVMS1BNA03
NAPHTHALENE	11	10.	UG/L		SVMS1BNA03
PHENOL	12	10.	UG/L		SVMS1BNA03
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	50.	UG/L		VOMSBAO126
1,1,2-TRICHLOROETHANE	ND	100	UG/L		VOMSBAO126

NA = Not Analyzed ND = Not Detected TBR = Trip Blank

em	Additional Comment Explanations (NQ/DL)
LORIDE	Dilution factor 2 applied.
SVGC1OCP06	Dilution factor 5.4 applied.
VOMSBAO126	Dilution factor 25 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.
VOMSDAX111	Dilution factor 5 applied. SAMPLE FOAMED THEREFORE DILUTION WAS NECESSARY.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G126S
Sample Type: WELL
Sample Number: AJ8197

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
1,1-DICHLOROETHENE	ND	50.	UG/L		VOMSBA0126
2-BUTANONE	ND	250	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	250	UG/L		VOMSBA0126
ACETONE	ND	600	UG/L		VOMSBA0126
ACETONITRILE	ND	50.	UG/L	PY	VOMSDAX111
BENZENE	ND	10.	UG/L		VOMSBA0126
CHLOROBENZENE	ND	50.	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	100	UG/L		VOMSBA0126
ETHYLBENZENE	ND	50.	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	130	UG/L		VOMSBA0126
O-XYLENE	ND	50.	UG/L		VOMSBA0126
P-DIOXANE	ND	110	UG/L	PY	VOMSDAX111
PROPIONITRILE	ND	36	UG/L	PY	VOMSDAX111
TOLUENE	ND	50.	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	100	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMX Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 565
Date Sealed 94/04/19 (YY / MM / DD)
Seal # 66785
By: CL

SITE/FACILITY # 1081 SITE NAME CWM Chemical Service

Sample Point: WG1D6S (Source Code)

SAMPLE DATE 94 04 29 (YY / MM / DD)

SAMPLE TIME: 11:27 (2400 HR) MATRIX CODE: W

Water (W) Leachate (C)
Soil (S) Other (X)

Source Codes:
Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream/Brook (R) Soil (S) Generation Pt (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # 94-11573

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y – N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8197-A	01	P	HNO3	IN 09 METHODS	Y / N	EML	
AJ8197-B	01	P	HNO3	IN 07 METHODS	Y / N	EML	
AJ8197-C	01	P	HNO3	IN 02 METHODS	Y / N	EML	
AJ8197-D	01	P	NONE 4C	IN 02 METHODS	Y / N	EML	
AJ8197-E	02	G	NONE 4C	SVGC10CP06	Y / N	EML	
AJ8197-F	02	G	NONE 4C	SVMS1BNA03	Y / N	EML	
AJ8197-G	04	G	HCL 4C	VOMSBA0126	Y / N	EML	
AJ8197-H	04	G	NONE 4C	VOMSDAX111	Y / N	EML	
~~AJ8197-I~~	~~01~~	~~G~~	~~HCL 4C~~	~~VOMSBA0126~~	Y / N	~~EML~~	~~TBK~~ CANCEL SK
~~AJ8197-J~~	~~01~~	~~G~~	~~NONE 4C~~	~~VOMSDAX111~~	Y / N	~~EML~~	~~TBK~~ 4-19-94
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/28/94 Time: 1026 (2400 HR.)
Signature: Kevin Gallagher Seal #: 66785 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

4. AquaPak™/Sub Contr. # / Sealed By: Kevin Gallagher (Print) Date: 04/29/94 Time: 15:20 (2400 HR)
Signature: Kevin Gallagher Seal #: 67959 Intact: yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 4/30/94 Time: 13:35 (2400 HR.)
AquaPak™/Sub. Contr. # 565 Temp.°C 3 Seal # 97959 Intact. Y

REGION

EML FF-1A 12/92

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AJ8197

Sample Point: WG126S (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940429	11:17	0.2	1.2	4.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) N (circle one) Sampling Equipment Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 µ:	B	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.73 (ft/msl)	Land Surface Elevation	591.95 (ft/msl)
Depth to water From top of well casing	10.09 (ft)	Depth to water From land surface	8.31 (ft)
Groundwater Elevation	583.64 (ft/msl)	Groundwater Elevation	583.64 (ft/msl)
Well Depth	17.50 (ft)	Stickup	1.78 (ft)

	ph		spec. cond.				
1st	9.27 (STD)	1st	4540 µm/cm at 25° C	Sample Temp.	8.7 (° C)		
2nd	(STD)	2nd	µm/cm at 25° C	WELL DIA (other parameter)	2.0 (value)	IN. (units)	
3rd	(STD)	3rd	µm/cm at 25° C	(other parameter)	(value)	(units)	
4th	(STD)	4th	µm/cm at 25° C	(other parameter)	(value)	(units)	

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: MODERATE Color: GRAY Turbidity: HIGH

Weather Conditions: Wind Speed 5-15 MPH Direction WEST Precipitation Y/N Outlook PARTLY CLOUDY/45°F

Specific Comments: * REFERENCE MEASUREMENT

CASING VOLUME: 17.50 - 10.09 = 7.41 x 0.163 = 1.21 (1) x 3 = 3.62 (2) GALLONS.

THE SAMPLE WAS OBTAINED AT 1127 ON 04/29/94

DEPTH TO WATER WAS MEASURED WITH THE BAILER IN THE WATER

MP = TOP OF INNER CASING

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

04/29/94 (Date) [signature] (Signature) Employer: WESTON

EML FF-2A 4/90

REGION

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

C L I E N T R E P O R T

ne: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G307
Sample Type: WELL
Sample Number: AJ8193

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	FML RL	Units	Comments	Method
FIELD DATA:					
DEPTH TO WATER FROM TOP OF CASING	4.23		FT		FDWDTWTC01
GROUNDWATER ELEV.	586.48		FT MSL		FDWGWELWDT
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	NA		PH UNITS		FDPHQUAD01
PH FIELD	8.14		PH UNITS		FDPHQUAD01
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	NA		UMHOS/CM		FDSPCOND04
SPECIFIC CONDUCTANCE FIELD	1870		UMHOS/CM		FDSPCOND04
STICK-UP HEIGHT OF WELL ABOVE LAND SURF	2.16		FT		FDWSTKUP01
WATER TEMPERATURE IN DEGREES CELSIUS	9.7		DEGREES C		FDXTEMPC01
WELL DEPTH TOTAL	16.86		FT		FDWGWELWDT
INORGANICS:					
ALUMINUM-DISSOLVED	ND	200.	UG/L		INICPDISAL
ALUMINUM-TOTAL	3290	200.	UG/L		INICPTOTAL
ARSENIC-DISSOLVED	ND	10.0	UG/L		INGFAADIAS
ARSENIC-TOTAL	ND	10.0	UG/L		INGFAATOAS
BARIUM-DISSOLVED	ND	200.	UG/L		INICPDISBA
BARIUM-TOTAL	ND	200.	UG/L		INICPTOTBA
CADMIUM-DISSOLVED	ND	5.0	UG/L		INICPDISCD
DMIUM-TOTAL	ND	5.0	UG/L		INICPTOTCD
LORIDE	90.6	1.0	MG/L	DL	INCHLORI01
CHROMIUM-DISSOLVED	ND	10.0	UG/L		INICPDISCR
CHROMIUM-TOTAL	11.9	10.0	UG/L		INICPTOTCR
FLUORIDE	0.54	0.050	MG/L		INFLPOTO01
IRON-DISSOLVED	ND	100.	UG/L		INICPDISFE
IRON-TOTAL	7020	100.	UG/L		INICPTOTFE
LEAD-DISSOLVED	ND	5.0	UG/L		INGFAADIPB
LEAD-TOTAL	10.6	5.00	UG/L		INGFAATOPB
SODIUM-DISSOLVED	96000	5000	UG/L		INICPDISNA
SODIUM-TOTAL	111000	5000	UG/L		INICPTOTNA
ZINC-DISSOLVED	ND	20.0	UG/L		INICPDISZN
ZINC-TOTAL	35.3	20.0	UG/L		INICPTOTZN
SEMI-VOLATILE ORGANICS:					
1,2-DICHLOROBENZENE	ND	10.	UG/L	SU	SVMS1BNA03
2,4-DICHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2,4-DIMETHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2,6-DICHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
2-CHLOROPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
3-METHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
4,4'-DDE	ND	0.1	UG/L		SVGC1OCP06
4,4'-DDT	ND	0.1	UG/L		SVGC1OCP06
4-CHLOROANILINE	ND	10.	UG/L	SU	SVMS1BNA03
4-METHYLPHENOL	ND	10.	UG/L	SU	SVMS1BNA03
ANILINE	ND	10.	UG/L	SU	SVMS1BNA03
ANTHRACENE	ND	10.	UG/L	MX,SU	SVMS1BNA03
NAPHTHALENE	ND	10.	UG/L	SU	SVMS1BNA03
PHENOL	ND	10.	UG/L	SU	SVMS1BNA03
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	10.	UG/L		VOMSBAO126
1,1,2-TRICHLOROETHANE	ND	5	UG/L		VOMSBAO126
1,1-DICHLOROETHENE	ND	5	UG/L		VOMSBAO126
2-BUTANONE	ND	10.	UG/L		VOMSBAO126
METHYL-2-PENTANONE	ND	10.	UG/L		VOMSBAO126
ETONE	ND	34	UG/L		VOMSBAO126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

tem	Additional Comment Explanations (NQ/DL)
LORIDE	Dilution factor 2 applied.
GC1OCP06	Dilution factor 1.09 applied.

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

C L I E N T R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: G307
Sample Type: WELL
Sample Number: AJ8193

ENS: 94-11975
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
ACETONITRILE	ND	10.	UG/L	PY	VOMSDAX111
BENZENE	ND	5	UG/L		VOMSBAO126
CHLOROBENZENE	ND	5	UG/L		VOMSBAO126
DICHLORODIFLUOROMETHANE	ND	10.	UG/L		VOMSBAO126
ETHYLBENZENE	ND	5	UG/L		VOMSBAO126
METHYLENE CHLORIDE	ND	5	UG/L		VOMSBAO126
O-XYLENE	ND	10.	UG/L		VOMSBAO126
P-DIOXANE	140.	50.	UG/L	PY	VOMSDAX111
PROPIONITRILE	ND	10.	UG/L	PY	VOMSDAX111
TOLUENE	ND	5	UG/L		VOMSBAO126
VINYL CHLORIDE	ND	10.	UG/L		VOMSBAO126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

CLIENT REPORT

te: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: TBK-G307
Sample Type: WELL
Sample Number: AJ8193

ENS: 94-11875
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 25-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	10.	UG/L		VOMSBA0126
1,1,2-TRICHLOROETHANE	ND	5	UG/L		VOMSBA0126
1,1-DICHLOROETHENE	ND	5	UG/L		VOMSBA0126
2-BUTANONE	ND	10.	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	10.	UG/L		VOMSBA0126
ACETONE	ND	34	UG/L		VOMSBA0126
BENZENE	ND	5	UG/L		VOMSBA0126
CHLOROBENZENE	ND	5	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	10.	UG/L		VOMSBA0126
ETHYLBENZENE	ND	5	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	5	UG/L		VOMSBA0126
O-XYLENE	ND	10.	UG/L		VOMSBA0126
TOLUENE	ND	5	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	10.	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMX Environmental Monitoring Laboratories; Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 799
Date Sealed 94/04/19 (YY / MM / DD)
Seal # 66946
By: EP

SITE/FACILITY # [illegible] SITE NAME: [illegible]

Sample Point: WG307 (Source Code)

SAMPLE DATE: 94 04 09 (YY / MM / DD)

SAMPLE TIME: 13:32 (2400 HR.) MATRIX CODE: W

Water (W) Leachate (C)
Soil (S) Other (X)

Source Codes
Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream/Brook (R) Soil (S) Generation Pt (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # 94-11875

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8193-A	01	P	HNO3	IN 09 METHODS	Y N	EML	NO BOBBLE 4-30-94
AJ8193-B	01	P	HNO3	IN 07 METHODS	Y N	EML	
AJ8193-C	01	P	HNO3	IN 02 METHODS	Y N	EML	
AJ8193-D	01	P	NONE 4C	IN 02 METHODS	Y N	EML	
AJ8193-E	04	G	NONE 4C	SVGC10CP06	Y N	EML	
AJ8193-F	04	G	NONE 4C	SVMS1BNA03	Y N	EML	
AJ8193-G	04	G	HCL 4C	VOMSBA0126	Y N	EML	
AJ8193-H	04	G	NONE 4C	VOMSDAX111	Y N	EML	
AJ8193-I	01	G	HCL 4C	VOMSBA0126	Y N	EML NO BOBBLE	TBK
AJ8193-J	01	G	NONE 4C	VOMSDAX111	Y N	EML 94/05/94 0959	TBK CANCEL EP 4-19-94
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/28/94 Time: 09:57 2400 HR.
Signature: Kevin Gallagher Seal #: 66946 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : 2400 HR. Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : 2400 HR. Remarks: _____

4. AquaPak™/Sub Contr. # _____ Sealed By: Kevin Gallagher (Print) Date: 04/29/94 Time: 15:05 2400 HR.
Signature: Kevin Gallagher Seal #: 67965 Intact: yes

LAB USE ONLY
Opened By: (Signature) [signature] Date: 4/30/94 Time: 12:30 2400 HR.

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: [illegible]

Sample Point: [illegible] (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated Y | N (circle one) Sampling Equipment Dedicated Y | N (circle one)

Purging Device	[illegible]	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	[illegible]	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	[illegible]	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	[illegible]	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	[illegible]	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	[illegible]	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	[illegible]	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	590.71 (ft/msl)	Land Surface Elevation	588.55 (ft/msl)
Depth to water from top of well casing	4.23 (ft)	Depth to water From land surface	2.07 (ft)
Groundwater Elevation	586.48 (ft/msl)	Groundwater Elevation	586.48 (ft/msl)
Well Depth	16.86 (ft)	Stickup	2.16 (ft)

1st	8.14 (STD) ph	1st	1870 μm/cm at 25° C spec. cond	Sample Temp.	9.7 (° C)
2nd	(STD) ph	2nd	μm/cm at 25° C spec cond	(other parameter)	value 20 units
3rd	(STD) ph	3rd	μm/cm at 25° C spec cond	(other parameter)	value units
4th	(STD) ph	4th	μm/cm at 25° C spec cond	(other parameter)	value units

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: MODERATE Color: [illegible] Turbidity: MODERATE

Weather Conditions: Wind Speed 5-10 mph Direction NORTHWEST Precipitation Y/N Outlook [illegible]

Specific Comments: REFERENCE MEASUREMENT

[illegible] 16.86 - 4.23 = 12.63 x 0.163 = 2.06 [illegible] x 2 = 6.17 [illegible]

[illegible] AT 1332 ON 04/29 [illegible]

[illegible] WITH THE [illegible]

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

[illegible] Employer: [illegible]

WMX ENVIRONMENTAL MONITORING LABORATORIES, INC

C L I E N T R E P O R T

Site: 705 - CWM Chemical Services
Incinerator
11700 S. Stony Island Ave.
Chicago IL 60617

Sample Point: 02FB
Sample Type: OTHER
Sample Number: AJ8204

ENS: 94-11877
MP: 705941
REV: 00

Sampled: 29-APR-1994
Received: 30-APR-1994
Reported: 18-MAY-1994

Analyte	Result	EML RL	Units	Comments	Method
VOLATILE ORGANICS:					
(M and P)-XYLENE	ND	10.	UG/L		VOMSBA0126
1,1,2-TRICHLOROETHANE	ND	5.	UG/L		VOMSBA0126
1,1-DICHLOROETHENE	ND	5.	UG/L		VOMSBA0126
2-BUTANONE	ND	10.	UG/L		VOMSBA0126
4-METHYL-2-PENTANONE	ND	10.	UG/L		VOMSBA0126
ACETONE	ND	34.	UG/L		VOMSBA0126
ACETONITRILE	ND	10.	UG/L		VOMSDAX111
BENZENE	ND	5.	UG/L		VOMSBA0126
CHLOROBENZENE	ND	5.	UG/L		VOMSBA0126
DICHLORODIFLUOROMETHANE	ND	10.	UG/L		VOMSBA0126
ETHYLBENZENE	ND	5.	UG/L		VOMSBA0126
METHYLENE CHLORIDE	ND	5.	UG/L		VOMSBA0126
O-XYLENE	ND	10.	UG/L		VOMSBA0126
P-DIOXANE	ND	50.	UG/L		VOMSDAX111
PROPIONITRILE	ND	10.	UG/L		VOMSDAX111
TOLUENE	ND	5.	UG/L		VOMSBA0126
VINYL CHLORIDE	ND	10.	UG/L		VOMSBA0126

NA = Not Analyzed ND = Not Detected TBK = Trip Blank

Subcontract To: _____

WMX Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # 743
Date Sealed 04/14/94 (YY / MM / DD)
Seal # 66159
By: EI

SITE/FACILITY # [illegible] SITE NAME [illegible]

Sample Point: [illegible] (Source Code)

SAMPLE DATE [illegible] (YY / MM / DD)

SAMPLE TIME [illegible] (2400 HR) MATRIX CODE: W

Water (W) Leachate (C)
Soil (S) Other (X)

Source Codes

Well (W) Leachate System (C) Pretreatment Facility (P) River/Stream Brook (R) Soil (S) Generation Pt (G)
Dewatering/Pressure Relief (D) Gas Condensate (M) Influent (U) Lake or Ocean (L) Bottom Sediment (B) Other (X)
Surface Water Impoundment (I) Air (A) Effluent (T) Outfall (O) Noise (N) Specify _____

ENS # [illegible]

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
AJ8204-A	04	G	HCL 4C	VOMSBA0126	Y (N)	EML	[illegible]
AJ8204-B	04	G	NONE 4C	VOMSDAX111	Y (N)	EML	[illegible]
AJ8204-C	04	G	HCL 4C	VOMSBA0126	Y N	EML	TBK CANCEL
AJ8204-D	04	G	NONE 4C	VOMSDAX111	Y N	EML	TBK 4-19-94
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		
					Y N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) Kevin Gallagher Date: 04/08/94 Time: 09:46 (2400 HR.)
Signature: [illegible] Seal #: 66159 Intact: yes

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : (2400 HR.) Remarks: _____

4. AquaPak™/Sub Contr # _____ Sealed By Kevin Gallagher (Print) Date 04/09/94 Time: 14:45 (2400 HR)
Signature [illegible] Seal # 67995 Intact: yes

LAB USE ONLY
Opened By: (Signature) [illegible] Date: 4/30/94 Time: 10:20 (2400 HR.)
AquaPak™/Sub. Contr. # 743 Temp.°C 0 REGION Seal # 67995 Intact. Y

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AT8204

Sample Point: X 02FB (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated Y N (circle one) Sampling Equipment Dedicated Y N (circle one)

Purging Device		A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	F	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material		A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	X	B-Stainless Steel	D-PVC		X- [illegible] SAMPLING OTHER (SPECIFY)
Tubing-Purging		A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling		B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- (SPECIFY)			
Filtering Devices 0.45 μ		A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	(ft/msl)	Land Surface Elevation	(ft/msl)
Depth to water From top of well casing	(ft)	Depth to water From land surface	(ft)
Groundwater Elevation	(ft/msl)	Groundwater Elevation	(ft/msl)
Well Depth	(ft)	Stickup	(ft)

1st	(STD) ph	1st	μm/cm at 25° C spec cond	Sample Temp.	(°C)
2nd	(STD) ph	2nd	μm/cm at 25° C spec cond	(other parameter)	value / units
3rd	(STD) ph	3rd	μm/cm at 25° C spec. cond	(other parameter)	value / units
4th	(STD) ph	4th	μm/cm at 25° C spec cond	(other parameter)	value / units

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: NONE Color: COLORLESS Turbidity: NONE

Weather Conditions: Wind Speed 5-15 MPH Direction WEST Precipitation Y/N Outlook PARTLY CLOUDY/45°F

Specific Comments: THE FIELD BLANK WAS POURED AT WELL G124S AT 1036 ON 04/29/94 USING VOA FIELD BLANK WATER SUPPLIED BY EML. SEAGULLS WERE ACTIVE IN THE AREA.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

04/29/94 (Date) [signature] (Signature) Employer: WESTON

EML FF-2A 4/90

REGION

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AK3481

Sample Point: WG1205 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940623	10.07	0.2	2.2	6.5

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) | N | (circle one) Sampling Equipment Dedicated (Y) | N | (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.84 (ft/msl)	Land Surface Elevation	592.99 (ft/msl)
Depth to water From top of well casing	7.56 (ft)	Depth to water From land surface	6.71 (ft)
Groundwater Elevation	586.28 (ft/msl)	Groundwater Elevation	586.28 (ft/msl)
Well Depth	20.76 (ft)	Stickup	0.85 (ft)

	ph		spec cond		
1st	7.13 (STD)	1st	2950. μm/cm at 25° C	Sample Temp.	12.8 (° C)
2nd	7.13 (STD)	2nd	2970. μm/cm at 25° C	Well dia. (other parameter)	2 (value) in. (units)
3rd	7.13 (STD)	3rd	2980. μm/cm at 25° C	(other parameter)	(value) (units)
4th	7.13 (STD)	4th	2980. μm/cm at 25° C	(other parameter)	(value) (units)

FIELD COMMENTS

Sample Appearance: foamy (if applicable) Odor: slight Color: grey black Turbidity: very cloudy

Weather Conditions: Wind Speed 0 Direction Calm Precipitation (Y)N Outlook overcast 70°F

Specific Comments: M.P. - Top of inner casing.

20.76 - 7.56 = 13.2 x 0.163 = 2.2 (1) x 3 = 6.5 (2) gal.

3 casing volumes obtained at 1017 on 6-23-94.

Sample taken at 1017 on 6-23-94.

Steady recharge. / Purge water was black and foamy.

No analysis required.

* Reference measurement. / Bailer was found to be in the water.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

6/23/94 Timothy C. Buss Employer: GCL

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AK3475

FIELD INFORMATION FORM

Sample Point: W G 1 2 1 5 (Source Code)

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940623	0830	0.1	1.5	2.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) N (circle one) Sampling Equipment Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.89 (ft/msl)	Land Surface Elevation	592.22 (ft/msl)
Depth to water From top of well casing	11.48 (ft)	Depth to water From land surface	9.81 (ft)
Groundwater Elevation	582.41 (ft/msl)	Groundwater Elevation	582.41 (ft/msl)
Well Depth	20.68 (ft)	Stickup	1.67 (ft)

	ph		spec cond		
1st	7.88 (STD)	1st	13800 μm/cm at 25° C	Sample Temp.	12.9 (° C)
2nd	7.89 (STD)	2nd	13800 μm/cm at 25° C	Well dia. (other parameter)	2 (value) in. (units)
3rd	7.89 (STD)	3rd	13800 μm/cm at 25° C	(other parameter)	(value) (units)
4th	7.90 (STD)	4th	13900 μm/cm at 25° C	(other parameter)	(value) (units)

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: Slight Color: yellow Turbidity: slightly cloudy

Weather Conditions: Wind Speed 0 Direction Calm Precipitation (Y) N Outlook overcast 70°F

Specific Comments: M.P. - Top of inner casing.

20.68-11.48 = 9.2 x 0.163 = 1.5 ① x 3 = 4.5 ③ gal.

Well purged dry at 0835 on 6-23-94.

Sample taken at 1105 on 6-23-94

No analysis required.

Bailer was found to be in the water.

*Reference measurement.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

[illegible] Employer: GCI

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AK3476

Sample Point: W G 1 2 3 S (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940623	0845	6.3	2.3	7.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) | N | (circle one) Sampling Equipment Dedicated (Y) | N | (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 µ	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 5941.13 (ft/msl)	Land Surface Elevation	5917.75 (ft/msl)
Depth to water From top of well casing	6.76 (ft)	Depth to water From land surface	4.38 (ft)
Groundwater Elevation	5837.37 (ft/msl)	Groundwater Elevation	5837.37 (ft/msl)
Well Depth	20.74 (ft)	Stickup	2.38 (ft)

1st	8.36 (STD) ph	1st	4370 µm/cm at 25° C spec cond	Sample Temp.	14.0 (° C)			
2nd	8.37 (STD) ph	2nd	4380 µm/cm at 25° C spec cond	Well dia. (other parameter)	2 value	in. units		
3rd	8.40 (STD) ph	3rd	4410 µm/cm at 25° C spec cond	(other parameter)	value	units		
4th	8.42 (STD) ph	4th	4400 µm/cm at 25° C spec cond	(other parameter)	value	units		

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: moderate Color: green grey Turbidity: moderately cloudy

Weather Conditions: Wind Speed 0 Direction Calm Precipitation (Y) N Outlook overcast 70°F

Specific Comments: M.P. - Top of inner casing.

20.74 - 6.76 = 13.98 x 0.163 = 2.3 (1) x 3 = 6.8 (5) gal.

3 casing volumes obtained at 0900 on 6-23-94.

Sample taken at 0900 on 6-23-94. pH-8.44 at 14.3°C S.C. 4380

Steady recharge. Duplicate pH-8.44 S.C. 4390

No analysis required. pH-8.44 S.C. 4390

* Reference measurement. / Bailer was in the water. pH-8.44 at 14.4°C S.C. 4380

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

Printed Timothy A. Ross Employer: GCI

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AK3479

Sample Point: WG1245 (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940623	08.00	0.1	1.8	2.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) N (circle one) Sampling Equipment Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.28 (ft/msl)	Land Surface Elevation	591.76 (ft/msl)
Depth to water from top of well casing	9.68 (ft)	Depth to water From land surface	8.16 (ft)
Groundwater Elevation	583.60 (ft/msl)	Groundwater Elevation	583.60 (ft/msl)
Well Depth	20.71 (ft)	Stickup	1.52 (ft)

	ph		spec cond				
1st	7.67 (STD)	1st	4480. μm/cm at 25° C	Sample Temp.	13.5 (° C)		
2nd	7.67 (STD)	2nd	4460. μm/cm at 25° C	Well dia. (other parameter)	2 (value)	in. (units)	
3rd	7.68 (STD)	3rd	4490. μm/cm at 25° C	(other parameter)	(value)	(units)	
4th	7.68 (STD)	4th	4500. μm/cm at 25° C	(other parameter)	(value)	(units)	

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: slight Color: yellow tan Turbidity: slightly cloudy

Weather Conditions: Wind Speed 0 Direction Calm Precipitation (Y) N Outlook overcast 70°F

Specific Comments: M.P. - Top of inner casing.
Well purged dry at 0805 on 6-23-94.
Sample taken at 0945 on 6-23-94.
20.71 - 9.68 = 11.03 x 0.163 = 1.8 (1) x 3 = 5.4 (3) gal.
Bailer was found to be in the water.
No analysis required.
* Reference measurement.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

6/23/94 Timothy A. Bass Employer: GCL

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: 013483

FIELD INFORMATION FORM

Sample Point: G 1 2 6 5 (Source Code)

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940623	10.33	0.1	1.2	4.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) | N | (circle one) Sampling Equipment Dedicated (Y) | N | (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 593.73 (ft/msl)	Land Surface Elevation	591.98 (ft/msl)
Depth to water From top of well casing	10.11 (ft)	Depth to water From land surface	8.36 (ft)
Groundwater Elevation	583.62 (ft/msl)	Groundwater Elevation	583.62 (ft/msl)
Well Depth	17.50 (ft)	Stickup	1.75 (ft)

	ph		spec cond				
1st	9.34 (STD)	1st	4730. μm/cm at 25° C	Sample Temp.	13.5 (° C)		
2nd	9.37 (STD)	2nd	4730. μm/cm at 25° C	Well dia. (other parameter)	2 (value)	in. (units)	
3rd	9.37 (STD)	3rd	4720. μm/cm at 25° C	(other parameter)	(value)	(units)	
4th	9.37 (STD)	4th	4740. μm/cm at 25° C	(other parameter)	(value)	(units)	

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: Strong Color: yellow grey Turbidity: moderately cloudy

Weather Conditions: Wind Speed 0 Direction Calm Precipitation (Y) N Outlook overcast 70°F

Specific Comments: M.P - Top of inner casing.

17.50 - 10.11 = 7.39 x 0.163 = 1.2 (1) x 3 = 3.6 (3) gal.

3 casing volumes obtained at 1037 on 6-23-94.

Sample taken at 1037 on 6-23-94.

Steady recharge.

No analysis required.

* Reference measurement. / Purge water was black and had a strong odor

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

6/23/94 Timothy J. Buss Employer: GCL

WMX Environmental Monitoring Laboratories, Inc.

Site # 705

Bottle Set: AK3478

FIELD INFORMATION FORM

Sample Point: WG307 (Source Code)

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (2400 Hr Clock)	ELAPSED HRS	WATER VOL IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
940623	0927	0.2	1.6	5.0

PURGING AND SAMPLING EQUIPMENT

Purging Equipment Dedicated (Y) N (circle one) Sampling Equipment Dedicated (Y) N (circle one)

Purging Device	G	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	G	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	D	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	D	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	C	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	C	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- D (SPECIFY)			
Filtering Devices 0.45 μ:	—	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 590.71 (ft/msl)	Land Surface Elevation	588.53 (ft/msl)
Depth to water From top of well casing	6.84 (ft)	Depth to water From land surface	4.66 (ft)
Groundwater Elevation	583.87 (ft/msl)	Groundwater Elevation	583.87 (ft/msl)
Well Depth	16.88 (ft)	Stickup	2.18 (ft)

	ph		spec cond		
1st	7.71 (STD)	1st	2260	μm/cm at 25° C	Sample Temp. 12.1 (° C)
2nd	7.71 (STD)	2nd	2310	μm/cm at 25° C	Well dia. (other parameter) 2 value in units
3rd	7.70 (STD)	3rd	2310	μm/cm at 25° C	(other parameter) value units
4th	7.70 (STD)	4th	2300	μm/cm at 25° C	(other parameter) value units

FIELD COMMENTS

Sample Appearance: _____ (if applicable) Odor: None Color: Tan Turbidity: very cloudy

Weather Conditions: Wind Speed 0 Direction Calm Precipitation (Y) N Outlook overcast 70°F

Specific Comments: M.P. - Top of inner casing.
3 casing volumes obtained at 0935 on 6-23-94.
Sample taken at 0935 on 6-23-94.
Slow steady recharge.
16.88 - 6.84 = 10.04 × 0.163 = 1.6 × 3 = 4.8 (3) gal.
No analysis required. / outer casing and well are loose.
* Reference measurement. / Bailer was in the water.

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

6/23/94 Timothy J. Buss (signature) Employer: GCL

G120S

		4/29/94	2/14/94	11/11/93	7/01/93	4/01/93	1/06/93	10/02/92	7/01/92	4/02/92	1/03/92	10/02/91	7/02/91	4/03/91	1/04/91
\cetone	ug/l	<600	<120	<240	<120	<48	<850	<340	<170	<170	<170	<170	<170	<34	<170
)ichlorodifluoromethane	ug/l	<100	38	<40	<20	<10	<250	<100	<50	<50	<50	<50	<50	<10	<50
Iethylene Chloride	ug/l	<130	<25	<50	<25	<10	<125	<50	<25	<25	<25	<25	<25	<5	<25
laphthalene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.2	<.1	<.1	<.1	<.1	<.1	<.1	<.1
luminum	ug/l	<200	<200	<200	<200	<600	<200	<1000	<200	<200	<200	<200	<200	<200	<200
rsenic	ug/l	35.2	29.2	<10	59.2	44.2	<70	<10	23.1	43.0	40.5	60.5	<60	<30	32.2
arium	ug/l	922	1000	1020	726	1080	1060	1020	1160	982	1010	888	981	930	1090
on	ug/l	16400	16800	15800	11900	18300	15700	14400	17400	15600	13200	14500	12300	14300	15200
ead	ug/l	<5	<16	<5	<5	<5	<5	<5	<5	<250	<5	<25	<5	<5	<5
odium	ug/l	110000	121000	118000	104000	139000	130000	143000	147000	132000	128000	112000	132000	130000	153000
inc	ug/l	<20	<20	<20	<20	<84	<20	<20	42.2	<20	<20	<20	<20	<20	<20
hloride	mg/l	347	373	326	306	263	661	306	319	283	332	276	269	270	300
luoride	mg/l	0.43	0.38	0.39	0.40	0.38	0.40	0.48	0.44	0.34	0.43	0.47	0.44	0.46	0.47

		10/24/90	7/23/90	4/26/90	1/22/90	10/24/89	7/25/89	4/24/89	1/30/89	10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
\cetone	ug/l	<170	<34	<170	<34	<34	<34	<10	22.1	59.3	23.4	<10	<10	10.7	NT
)ichlorodifluoromethane	ug/l	<50	<10	<50	23	18	14	<10	<10	77.8	33.6	64.6	24.3	43.8	NT
Iethylene Chloride	ug/l	<25	<5	<25	<5	<5	<5	<5	5.28	5.79	13.4	<2.8	5.70	<2.8	8.20
laphthalene	ug/l	<10	<10	<10	12	14	23	20	18.9	21.4	8.3	23.0	29.0	4.08	<1.6
,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.10	<.1	<.1	<.20	NT	98	NT
luminum	ug/l	<200	<200	<200	783	<200	549	<200							
rsenic	ug/l	45.6	50.2	32.0	50.5	52.5	73	40.3	38	48	51	34	50	58	18
arium	ug/l	991	906	907	1060	812	1060	964	939	1090	930	865	846	781	NT
on	ug/l	15400	14000	15400	17400	13000	12500	15600	13600	16700	16100	15400	14200	15500	1620
ead	ug/l	<5	<5	<5	<50	<25	<5	<5	90	<10	<4	<8	<4	<4	<4
odium	ug/l	126000	143000	136000	148000	128000	131000	158000	131000	137000	127000	117000	126000	115000	114000
inc	ug/l	83.8	<20	<20	21.7	<20	<20	<20	126	10	360	<10	<10	107000	NT
hloride	mg/l	309	306	309	306	212	273	258	200	300	260	460	250	NT	240
luoride	mg/l	0.50	0.44	0.45	0.51	0.46	<.05	.47	.4	.7	.6	.8	.5	.44	NT

T=NOT TESTED

G121S

		4/29/94	2/15/94	11/12/93	7/02/93	4/02/93	1/07/93	10/02/92	7/02/92	4/03/92	1/03/92	10/02/91	7/02/91	4/03/91	1/04/91
\cetone	ug/l	<600	<120	<120	<170	<240	<340	<340	<340	<170	<340	<340	<340	<340	<340
lenzene	ug/l	280	210	220	280	240	310	240	220	<5	250	210	230	200	190
:hlorobenzene	ug/l	<50	40	37	58	43	57	<50	<50	<25	<50	<50	<50	51	<50
thylbenzene	ug/l	<50	<10	<10	<14	<20	<50	<50	<50	<25	<50	<50	<50	<50	<50
'oluene	ug/l	<50	<10	<10	<14	<20	<50	<50	<50	<25	<50	<50	<50	<50	<50
Methylene Chloride	ug/l	<130	<25	<25	<36	<50	<50	<50	<50	<25	<50	<50	<50	<50	<50
'-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
,4-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
,4-Dimethylphenol	ug/l	<10	<10	<10	<10	<10	12	10	<10	11	<10	12	19	19	19
'henol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
,2-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
\nthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
laphthalene	ug/l	<10	<10	<10	<10	<10	15	<10	<10	10	10	<10	<10	12	13
\niline	ug/l	<10	<10	<10	<10	<10	10	<10	<10	<10	<10	<10	<10	<10	<10
l-Chloroaniline	ug/l	55	125	120	<10	41	93	90	48	56	68	220	230	150	160
n+p-Cresols	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
,4-Dioxane	ug/l	140	130	190	<110	140	56	80	97	68	81	69	100	120	90
(ylene, m	ug/l	<50	<10	<10	<14	<20	<50	<50	<50	<25	<50	<50	<50	<50	<50
(ylene, o+p	ug/l	<50	<10	<10	<14	<20	<50	<50	<50	<25	<50	<50	<50	<50	<50
,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<1	<1	<.1	<.1
,6-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
\luminum	ug/l	<200	<200	<200	<200	<200	<200	<2000	<200	<200	<200	<200	<200	<200	<200
\rsenic	ug/l	<14	<28.0	11.4	<10	<10	<10	<10	<70	<10	<10	<35	<30	<30	19.3
larium	ug/l	626	677	509	522	663	559	460	574	508	412	301	228	<200	210
:hromium	ug/l	<10	<10	<10	<10	<10	10.5								
on	ug/l	821	1250	783	1730	1590	2060	3490	4720	1060	862	3030	1860	736	688
ead	ug/l	<16	<32	<5	<16	<6.4	<10	<25	<25	<5	<50	<25	<25	<25	<25
odium	ug/l	3100000	2800000	2960000	3150000	3290000	3290000	4040000	3700000	3740000	3990000	4090000	3560000	3560000	4290000
'inc	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
:hloride	mg/l	5260	5580	5480	6130	6690	6690	7640	9070	8550	7460	7840	7210	6630	9840
luoride	mg/l	1.93	1.91	2.22	2.05	1.86	2.00	2.10	2.1	2.20	2.28	2.42	2.5	2.9	2.7

G121S

		10/24/90	7/24/90	4/26/90	1/22/90	10/24/89	7/26/89	4/24/89	1/31/89	10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
\cetone	ug/l	<340	<340	<310	<340	<340	<34	<10	4.1	<50	11.9	<10	<10	22.2	NT
;enzene	ug/l	240	230	260	200	230	250	260	178	285	<4.4	264	<4.4	371	270
:hlorobenzene	ug/l	51	51	59	<50	56	63	61	64.8	65.9	22.0	79.4	33.4	93.4	59.4
thylbenzene	ug/l	<50	<50	<46	<50	<50	15	17	14.4	<36	11.2	17.3	17.8	19.8	NT
'oluene	ug/l	<50	<50	<46	<50	<50	11	<5	9.95	<30	<6.0	34.5	18.3	59.5	67.1
1ethylene Chloride	ug/l	<50	<50	<46	<50	<50	6.2	7.5	5.84	560	7.28	<2.8	<2.8	<2.8	7.10
-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	5.45	9.53	7.09	11.6	13.3	24.7	25.0
,4-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<2.9	<2.9	3.32	<2.8	4.02	16.8	<2.7
,4-Dimethylphenol	ug/l	<10	26	26	26	32	40	32	25.3	32.2	17.9	32.0	32.5	54.6	30.3
'henol	ug/l	<10	<10	<10	<10	<10	<10	23	<1.6	<1.6	1.61	<1.5	4.83	17.1	47.0
,2-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	6.17	9.76	5.07	5.64	6.63	6.93	3.29
\nthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<2.0	<2.0	<4.3	<1.9	<2.0	2.07	NT
laphthalene	ug/l	17	<10	16	15	21	28	<10	18.1	20.3	<3.6	15.6	19.5	214	113
\niline	ug/l	<10	<10	<10	<10	10	13	<10	<11	<11	<23	16.1	26.9	38.5	491
-Chloroaniline	ug/l	220	180	170	160	200	240	57	220	198	<23	109	109	466	NT
ı+p-Cresols	ug/l	<10	<10	<10	<10	<10	<10	<10	<11	<11	<10	11.9	<10	30.4	25.7
,4-Dioxane	ug/l	51	54	<50	<50	<50	<50	<50	<13	<13	<13	<13	<13	57.2	NT
(ylene, m	ug/l	<50	<50	<46	<50	<50	<10	11	<10	<50	<10	13.8	12.2	16.5	NT
(ylene, o+p	ug/l	<50	<50	<46	<50	<50	10	12	14.9	<50	13.4	20.3	20.9	24.0	NT
,4'-DDT	ug/l	<.1	<.1	<.1	<.1	.1	<.1	<.1	<13	<.1	<.1	<.21	NT	.475	NT
,6-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<11	<11	<11	<10	<10	17.0	
\luminum	ug/l	<200	<200	<200	<1000	<200	373	320							
\rsenic	ug/l	20.2	31.9	44.6	<10	18	35.9	45.6	10	21	21	23	20	16	32
arium	ug/l	<200	<200	<200	<200	<200	<200	206	47	192	174	163	210	203	NT
:hromium	ug/l														
on	ug/l	602	683	227	990	564	142	610	230	232	343	97	141	140	<30
ead	ug/l	<50	<10	<5	<5	<5	<5	<5	<4	<10	<4	<4	<4	6	6
odium	ug/l	4260000	4670000	5110000	4720000	600000	5110000	4260000	5130000	6550000	5400000	5710000	5020000	5340000	6220000
inc	ug/l	<20	<20	<20	<50	<20	<20	26	<10	<10	10	<10	<10	837	NT
hloride	mg/l	8350	7610	80900	747	7070	8790	8170	9000	9700	9000	8900	9600	NT	11000
luoride	mg/l	2.9	3.1	3.2	3.4	4.4	5.7	3.9	1.1	5.7	6.9	15	3.4	2.6	NT

T - Not Tested

G123S

		4/29/94	2/15/94	11/12/93	7/01/93	04/02/93	1/07/93	10/02/92	7/02/92	4/03/92	1/03/92	10/02/91	7/01/91	4/03/91	1/04/91
cetone	ug/l	<480	<120	<120	45	<240	<243	<340	<523	<340	<486	<425	<340	620	<1360
enzene	ug/l	220	170	16	240	110	240	180	290	320	350	320	290	390	420
,1-Dichloroethylene	ug/l	<40	<10	<10	<5	<20	<35.7	<50	<76.9	<50	<71.5	<62.5	<50	56	398
lethylene Chloride	ug/l	<100	<25	<25	<5	<50	<35 7	<50	<76.9	<50	<71.5	<62 5	<50	<50	<200
inyl Chloride	ug/l	<80	<20	<20	<10	<40	<71 4	<100	<154	<100	<143	<125	<100	310	800
oluene	ug/l	<40	<10	<10	<5	<20	<35.7	<50	<76.9	<50	<71 5	<62 5	<50	71	<200
-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1000	<1000
,4-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1000	<1000
,4-Dimethylphenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1000	<1000
,6-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1000	<1000
&p-Cresols	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	11	36	30	68	<1000	<1000
-Chloroaniline	ug/l	<10	18.1	<10	<10	18	<10	21	12	<10	42	<10	27	<1000	<1000
henol	ug/l	16	29.5	<10	<10	<10	<10	41	33	140	640	2500	2292	7900	21000
aphthalene	ug/l	10	<10	<10	<10	<10	<10	<10	<10	<10	10	<10	<10	<1000	<1000
niline	ug/l	<10	<10	<10	<10	<10	<10	31	11	18	23	<10	18	<1000	<1000
,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<1	<1	<.1
,4-Dioxane	ug/l	250	380	230	170	180	330	150	290	390	370	300	270	610	710
cetonitrile	ug/l	<20	<20	<20	<20	<50	15	65							
luminum	ug/l	<200	<200	<200	<200	<200	<200	<1000	<200	<200	<200	<200	<200	<200	<200
rsenic	ug/l	<10	<10	<10	<14	<10	<10	<10	<140	<35	<10	<35	<30	<30	19.0
arium	ug/l	410	568	288	513	454	577	549	587	1010	1440	1100	1250	1600	1980
on	ug/l	294	266	<100	397	140	155	392	293	963	720	187	289	1530	1230
ead	ug/l	<5	<6.4	<5	<5	<16	<25	<25	<25	<50	<25	<25	<25	<25	<25
odium	ug/l	369000	511000	357000	415000	455000	453000	512000	454000	535000	493000	467000	535000	697000	730000
inc	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
hloride	mg/l	1370	1640	960	1500	1110	1440	1460	1300	1840	1990	1450	1750	2410	2530
luoride	mg/l	0.38	0.36	0.33	0.34	0.31	0.32	0.36	0.34	0.28	0.31	0.24	0.34	0.32	0.32

A - Not Analyzed

G123S

		10/24/90	7/24/90	4/26/90	1/22/90	10/24/89	7/25/89	4/25/89	1/30/89	10/28/88	7/29/88	4/28/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	<3400	<340000	<68000	<34	<6800	<34	10	428	92.6	72.1	165	13.9	20.0	NT
Benzene	ug/l	790	<10000	<2000	550	330	600	370	66.3	13.6	20.0	19.5	<4.4	6.4	32.0
1,1-Dichloroethylene	ug/l	2900	<50000	20000	5500	2400	4400	4100	167	2.90	48.8	24.4	<2.8	18.5	144
Methylene Chloride	ug/l	3200	<50000	30000	16000	5400	14000	23000	1440	16.3	15.5	680	<2.8	5.27	<2.8
Vinyl Chloride	ug/l	<1000	<100000	<20000	<10	<2000	620	400	41.9	<10	NT	<10	<10	13.9	36.7
Toluene	ug/l	<500	<50000	<10000	130	<1000	<5	<5	25.3	<6.0	<6.0	<6.0	<6.0	<6.0	14.5
2-Chlorophenol	ug/l	<2000	<2000	<1000	120	65	96	97	32.2	3.4	6.68	7.23	7.43	<3.4	17.3
2,4-Dichlorophenol	ug/l	<2000	<2000	1600	700	250	400	180	18.7	<2.8	<2.8	3.68	<2.9	<2.8	ND
2,4-Dimethylphenol	ug/l	<2000	<2000	<1000	<10	12	13	14	<2.8	<2.8	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ug/l	<2000	<2000	<1000	160	79	100	68	20.9	<10	<10	<10	<11	<10	ND
m&p-Cresols	ug/l	<2000	<2000	<1000	132	240	280	188	36.0	<10	<10	<10	<11	<10	ND
4-Chloroaniline	ug/l	<2000	<2000	<4500	130	97	140	73	12.3	<10	<10	<10	<11	ND	ND
Phenol	ug/l	29000	78000	70000	45000	32000	28000	16000	4250	51.4	2.24	2.12	2.42	<1.5	<1.5
Naphthalene	ug/l	<2000	<2000	<1000	158	23	27	29	11.8	10.5	<1.6	2.49	10.6	<1.6	4.88
Aniline	ug/l	<2000	<2000	<1000	180	120	120	160	48.1	<10	<10	<10	17.6	<10	78.3
4,4'-DDT	ug/l	<1.0	<.1	NA	<.1	<.1	<.1	<.1	<.10	<.1	<.1	<.20	NT	334	NT
1,4-Dioxane	ug/l	300	870	510	650	<50	300	<50							
Aluminum	ug/l	<200	<200	<200	<1000	<200	407	348							
Arsenic	ug/l	<30	17.1	<10	<10	15.7	16.1	17.2	<4	<4	<4	<4	<4	4	<4
Barium	ug/l	1620	1570	1620	1590	836	910	1060	615	344	375	318	315	253	NT
Iron	ug/l	1800	893	748	630	156	172	179	90	81	102	100	92	69	59
Lead	ug/l	<25	<10	<5	<50	<5	<5.0	48.7	<4	<10	<4	<4	6	5	4
Sodium	ug/l	608000	689000	762000	716000	783000	674000	959000	820000	846000	857000	916000	1010000	695000	488000
Zinc	ug/l	<20	<20	<20	24.0	<20	<20	<20	<10	<10	<10	<10	<10	303000	NT
Chloride	mg/l	1980	2750	25600	238	1500	1840	2090	200	1700	2000	2300	1700	NT	1100
Fluoride	mg/l	0.37	0.28	0.25	.28	.35	.32	.26	.3	.9	.6	.6	.5	.42	NT

ND - Not Detected

NT - Not Tested

G124S

		4/29/94	2/15/94	11/12/93	7/02/93	4/02/93	1/07/93	10/02/92	7/02/92	4/03/92	1/03/92	10/02/91	7/02/91	4/03/91	1/04/91
\cetone	ug/l	<240	<34	<34	<48	<34	<34	<170	<170	<34	<68	<34	<34	<34	<34
ienzene	ug/l	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Methylene Chloride	ug/l	<50	<5	<5	<10	<5	<5	<25	<25	<5	16	<5	<5	<5	<5
,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
,4-Dioxane	ug/l	<50	<50	<50	<50	<50	<50	<50	21	24	29	19	35	28	16
\luminum	ug/l	<200	<200	<200	<200	<200	<200	<1000	<200	<200	<200	<200	<200	<200	<200
\rsenic	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<35	<10	<10	<10
arium	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
on	ug/l	600	1140	206	1330	1060	2020	4110	2470	2950	1630	3360	1950	1750	4280
ead	ug/l	<5	<16	<5	<16	<16	<25	<25	<25	<25	<25	<25	<25	<25	<25
odium	ug/l	346000	293000	292000	329000	403000	353000	339000	329000	305000	284000	267000	283000	277000	300000
inc	ug/l	<20	<20	<20	<20	<20	<20	65.3	<20	<20	<20	<20	<20	<20	<20
hloride	mg/l	1330	1320	1200	1440	1390	1470	1390	1180	1280	1380	1100	1090	1070	1030
luoride	mg/l	0.34	0.32	0.40	0.33	0.30	0.30	0.34	0.41	0.36	0.34	0.34	0.40	0.41	0.39

		10/25/90	7/24/90	4/26/90	1/22/90	10/24/89	7/25/89	4/24/89	1/31/89	10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
\cetone	ug/l	<34	<34	<34	<34	<34	<34	<10	<10	32.2	20.4	<10	13.0	18.0	NT
enzene	ug/l	<5	<5	<5	<5	<5	<5.0	<5	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4
Methylene Chloride	ug/l	<5	<5	<5	<5	<8	<5.0	<5	<2.8	11.2	14.6	<2.8	5.89	<2.8	<2.8
,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.12	<.1	<.1	<.18	NT	737	NT
,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.12	<.1	<.1	<.18	NT	256	NT
,4-Dioxane	ug/l	<10	<10	<50	<50	<50	<50	<50	<13						
luminum	ug/l	<200	<200	<200	341	<200	291	<200							
rsenic	ug/l	<10	<10	<10	<10	<10	<10	<10	<4	4	<4	<4	<4	<4	<4
arium	ug/l	<200	<200	<200	<200	<200	<200	<200	85	108	111	93	108	88	ND
on	ug/l	1440	2010	179	288	309	590	264	396	482	163	159	148	37	141
ead	ug/l	<25	<10	<5	<5	<5	<5	<5	<4	13	<4	<8	<10	<4	<4
odium	ug/l	267000	276000	281000	266000	212000	214000	208000	170000	167000	193000	177000	202000	159000	414000
inc	ug/l	<20	<20	<20	27.4	<20	<20	<20	78	<10	18	<10	18	234999	NT
hloride	mg/l	1600	1230	1240	953	844	916	815	830	950	750	1100	620	NT	850
luoride	mg/l	0.42	0.40	0.38	0.41	.43	<.05	.31	.4	.8	.6	.8	.5	.48	NT

IT - Not Tested
ID - Not Detected

G126S

		4/29/94	2/15/94	11/11/93	7/01/93	4/01/93	1/06/93	10/02/92	7/01/92	4/02/92	1/03/92
enzene	ug/l	<10	5	5	6	<5	5	24	13	15	21
hlorobenzene	ug/l	<50	<10	<10	<10	<5	5	<25	<50	16	21
oluene	ug/l	<50	<10	<10	<10	<5	<10	<25	<50	6	7
laphthalene	ug/l	11	<10	12	<10	12	14	13	11	10	13
henol	ug/l	12	<10	<20	<10	<10	<10	<10	<10	12	<10
-Dioxane	ug/l	<110	<50	<110	<110	<50	<50	<50	17	17	<10
luminum	ug/l	<200	<200	<200	<200	2160	<200	<1000	<200	<200	<200
rsenic	ug/l	29.1	35.6	31.4	44.5	22.9	<10	<10	79.0	<140	<70
arium	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	209	<200
on	ug/l	<100	<100	<100	<100	4810	<100	<100	<100	<100	<100
ead	ug/l	<5	<6.4	<16	<5	27.5	<5	<25	<5	<5	<50
odium	ug/l	889000	963000	1180000	1370000	1550000	1400000	1520000	15800000	1680000	2000000
inc	ug/l	<20	<20	<20	<20	175	<20	<20	<20	<20	<20
hloride	mg/l	1260	1440	1780	2110	2060	2200	2330	2410	3000	3180
luoride	mg/l	0.66	0.51	0.52	0.42	0.34	0.36	0.40	0.40	0.37	0.40

G307

		4/29/94	2/15/94	11/11/93	7/01/93	4/01/93	1/06/93	10/02/92	7/02/92	4/08/92	1/03/92	10/02/91	7/01/91	4/03/91	1/04/91
Phenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	13	<10	<10	<10	<10	<10
1,4-Dioxane	ug/l	140	220	<50	150	<50	<50	200	310	24	26	270	190	46	23
2-Butanone (MEK)	ug/l	<10	<10	80	<10	<10	<50	<50							
Aluminum	ug/l	<200	<200	<200	<200	<200	<200	<1000	<200	<200	<200	<200	<200	<200	<200
Arsenic	ug/l	<10	<10	<10	<10	<10	<10	<10	<35	14.3	12.5	<35	<10	<10	<10
Barium	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Chromium	ug/l	<10	<10	<10	<10	<10	11.6								
Iron	ug/l	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Lead	ug/l	<5	<5	<5	<16	<5	<25	<5	<25	<5	<5	<25	<25	<5	<25
Sodium	ug/l	96000	157000	45700	163000	102000	67100	179000	216000	69400	77700	223000	176000	87200	77400
Zinc	ug/l	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Chloride	mg/l	90.6	146	11.3	132	65.9	66.4	101	193	65.7	48.2	210	181	78.0	72.6
Fluoride	mg/l	0.54	0.41	0.73	0.62	0.46	0.46	0.55	0.42	0.42	0.62	0.59	0.59	0.73	0.82

		10/25/90
Phenol	ug/l	<10
1,4-Dioxane	ug/l	120
2-Butanone (MEK)	ug/l	
Aluminum	ug/l	<200
Arsenic	ug/l	<10
Barium	ug/l	<200
Chromium	ug/l	
Iron	ug/l	<100
Lead	ug/l	<5
Sodium	ug/l	136000
Zinc	ug/l	<20
Chloride	mg/l	140
Fluoride	mg/l	0.76

IMPDE
(Surface Impoundment)

			4/02/93**	1/07/93**	10/02/92	7/02/92	4/02/92	1/02/92	10/02/91	7/02/91	4/03/91	1/04/91	10/25/90	7/23/90	4/27/90	1/23/90
Methylene Chloride		ug/l	<34	<5	<25	<5	<5	<25	<25	<5	<5	<5	<5	<5	<5	<5
Acetone		ug/l	<5	<34	<170	<34	<34	<170	<170	<34	<34	<34	<34	<34	<34	<34
Phenol		ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4,4'-DDT		ug/l	<.1	<.1	<.1	<.1	.1	<.1	.117	<.1	<.1	<.1	<.1	<.1	<.1	<.1
4,4'-DDE		ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
Aluminum	total	ug/l	992	832	239	459	348	838	<200	<200	<200	<200	<200	224	<200	<1000
Arsenic	total	ug/l	24.1	19	<35	47.5	17.5	22.4	<70	36.7	29.5	37.0	43.4	45.0	48.3	68.0
Barium	total	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Iron	total	ug/l	1000	1020	326	714	554	862	202	<500	137	143	239	227	142	203
Lead	total	ug/l	24.7	7.3	<125	240	52.5	32.0	122	39.0	19.0	26.0	148.5	153	125	<50
Sodium	total	ug/l	282000	420000	1840000	20800000	1150000	1210000	2980000	1590000	1030000	1700000	2050000	1110000	2900000	3810000
Zinc	total	ug/l	77.2	42.3	505	1430	97.7	73.4	279	181	100	323	792	443	944	339
Aluminum		ug/l	216	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Arsenic		ug/l	22.4	<35	<10	<70	<35	14.0	41.0	31.5	19.5	51.5	43.5	31.5	<60	85.0
Barium		ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Iron		ug/l	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Lead		ug/l	<5	<5	<25	<25	<100	<25	<25	<25	<5	<25	<5	<25	<50	<5
Sodium		ug/l	307000	470000	1800000	17200000	1110000	1000000	2900000	1410000	1020000	1880000	2140000	1100000	3140000	3500000
Zinc		ug/l	<20	<20	<20	<20	<20	<20	71.9	43.5	<20	134	145	40.8	30.6	218
Chloride		mg/l	378	680	2770	4260	1740	1620	3670	1920	1280	2680	2690	1810	38300	4510
Fluoride		mg/l	2.17	2.37	8.63	10.1	6.64	6.48	15.8	9.3	6.5	11.0	13.2	8.9	<.05*	21.7

* Laboratory unable to verify result.
** Sample was obtained from the northwest surface impoundment 1/07/93.
** Sample was obtained from the southeast surface impoundment 4/02/93.

NO SAMPLE HAS BEEN COLLECTED FROM THE SURFACE IMPOUNDMENTS SINCE APRIL, 1993 DUE TO CLOSURE OF THE UNITS.

IMPDE
(Surface Impoundment)

			10/24/89	7/26/89	4/25/89	2/03/89	10/27/88	7/29/88	4/28/88	1/28/88	5/01/87	11/21/85
Methylene Chloride		ug/l	<5	<5	<5	2.95	15.2	9.68	<2.8	10.7	8.37	71.0
Acetone		ug/l	<34	<34	<34	27.9	<10	20.7	<10	47.3	28.0	NT
Phenol		ug/l	<10	<10	<10	<1.6	<1.5	6.44	<1.5	<1.5	<1.5	
4,4'-DDT		ug/l	<.1	<.1	<.10	<.10	.11	<.1	<.20	NT	.509	
4,4'-DDE		ug/l	<.1	<.1	<.10	<.10	<.1	<.1	<.20	NT	.117	
Aluminum	total	ug/l	<200	326	321	467	1040	4070	2230	950	3150	NT
Arsenic	total	ug/l	96.5	47.5	52.4	27	68	724	<64	30	190	<500
Barium	total	ug/l	<200	<200	<200	86	281	<50	248	281	266	NT
Iron	total	ug/l	<100	<100	<100	224	158	640	178	<30	1270	NT
Lead	total	ug/l	105	<5	15.8	240	350	14	740	98	136	207
Sodium	total	ug/l	4600000	6300000	5090000	5700000	7700000	7780000	7460000	6930000	3920000	NT
Zinc	total	ug/l	104	102	286	1050	284	494	385	527	416	NT
Aluminum		ug/l	<200	527	<10	45	1220	4170	2090	878		
Arsenic		ug/l	87.5	48.1	38.4	23	82	616	<64	30		
Barium		ug/l	<200	<200	<200	66	333	<50	252	265		
Iron		ug/l	<100	<100	<100	<30	<30	47	<30	<30		
Lead		ug/l	<25	17.4	<5	<4	84	14	380	70		
Sodium		ug/l	6240000	5280000	4630000	5410000	6680000	7940000	8000000	6790000		
Zinc		ug/l	51.8	37.2	180	643	102	138	59	128		
Chloride		mg/l	7600	8120	7580	12000	10000	11000	11000	9200	NT	NT
Fluoride		mg/l	31.8	33.3	30.7	39	67	39	59	34	70	NT

NT - Not Tested

ATTACHMENT D

HISTORICAL GROUNDWATER

ELEVATIONS

WITH POTENTIOMETRIC SURFACE MAP

CWM CHEMICAL SERVICES, INC.
GROUNDWATER ELEVATION DATA
(FT MSL)

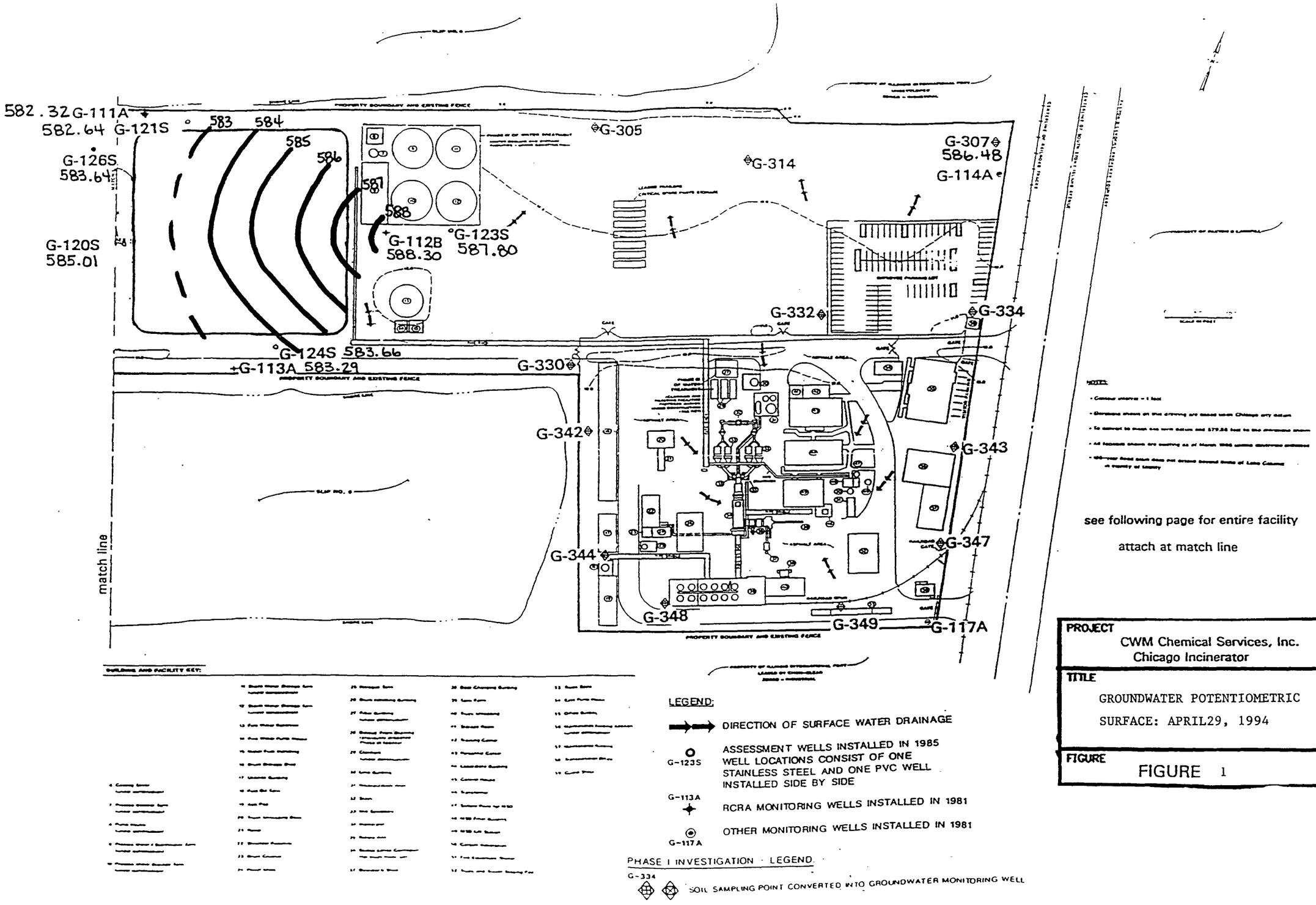
	4/94	2/94	11/93	7/93	4/93	1/93	10/92	7/92	4/92	1/92	10/91	7/91	4/91	1/91	10/90
Assessment Wells															
G120S	585.01	585.84	588.20	585.76	583.25	583.77	585.92	585.59	583.46	583.44	586.21	586.12	582.77	583.01	584.60
G121S	582.64	582.50	583.92	586.14	585.92	586.67	584.50	584.68	585.87	585.76	584.29	585.89	584.76	584.21	583.65
G123S	587.80	586.85	587.87	588.17	588.62	588.46	587.55	587.05	587.96	587.66	585.65	586.87	586.88	586.81	586.85
G124S	583.66	586.91	583.75	584.18	583.81	584.18	583.63	583.57	583.81	583.90	583.55	583.96	583.97	583.23	583.78
G126S	583.64	583.53	584.00	584.68	584.21	583.99	583.35	583.57	583.66	583.65					
G307	586.48	585.41	585.85	587.17	587.63	587.57	585.97	583.47	586.12	586.21	582.89	583.44	586.23	586.02	585.36
State Wells															
G110*	585.97	586.25	588.28	589.87	585.97	586.88	588.74	586.19	586.56	587.23	588.71	587.07	586.01	586.38	587.85
G111A	582.32	582.04	583.32	586.43	586.94	587.13	583.95	583.97	585.14	585.09	583.59	585.09	585.36	584.50	583.92
G112B	588.30	587.06	587.76	588.19	588.94	588.51	587.54	586.95	587.95	587.62	586.68	587.31	587.91	587.00	586.87
G113A	583.29	583.04	583.16	583.57	583.64	583.62	583.39	583.20	583.47	583.40	582.27	583.52	583.59	583.46	583.40
Lake Calumet															
	579.76 (4/29/94)	579.10 (2/14/94)	579.65 (11/11/93)	580.50 (7/01/93)	580.30 (4/01/93)	579.30 (1/06/93)	578.84 (10/2/92)	579.39 (7/1/92)	578.84 (4/2/92)	578.77 (1/2/92)					
		579.33 (2/15/94)	579.72 (11/12/93)	580.37 (7/02/93)	579.41 (4/02/93)	579.23 (1/07/93)		579.45 (7/2/92)	578.61 (4/3/92)	578.87 (1/3/92)					

*G110 was not used for drawing groundwater elevation contours, as this well is not screened in the same formation as the other wells.

CWM CHEMICAL SERVICES, INC.
GROUNDWATER ELEVATION DATA
(FT MSL)

	7/90	4/90	1/90	10/89	7/89	4/89	1/89	10/88	7/88	4/88	1/88	4/87
Assessment Wells												
G120S	585.05	583.49	583.44	586.45	585.96	583.72	584.13	585.80	586.21	583.72	583.72	584.75
G121S	587.38	584.04	583.77	585.30	585.81	585.66	585.70	584.83	585.91	585.66	586.33	587.16
G123S	588.77	588.40	587.33	586.57	587.57	587.96	588.43	587.96	586.90	586.98	585.69	589.06
G124S	584.47	584.31	584.20	584.22	584.64	584.58	584.31	584.58	584.54	584.04	583.25	585.08
G126S												
G307												
State Wells												
G110*	589.69	590.19	589.94	590.33	589.73	589.58	588.32	589.28	586.20	586.83	586.45	586.65
G111A	581.84	583.45	582.98	584.42	585.09	585.09	585.03	584.00	584.08	583.96	585.17	586.65
G112B	587.86	588.63	587.23	587.39	588.02	587.67	587.72	587.20	586.74	586.66		
G113A	583.59	583.98	583.87	583.78	584.37	584.34	584.24	584.21	584.21	583.80		
Lake Calumet												

*G110 was not used for drawing groundwater elevation contours, as this well is not screened in the same formation as the other wells.



PROJECT
CWM Chemical Services, Inc.
Chicago Incinerator

TITLE
GROUNDWATER POTENTIOMETRIC SURFACE: APRIL29, 1994

FIGURE
FIGURE 1

CWM CHEMICAL SERVICES, INC.
CHICAGO INCINERATOR
(FT MSL)

Assessment Wells	4/91	1/91	10/90	7/90	4/90	1/90	10/89	7/89	4/89	1/89	10/88	7/88	4/88	1/88	4/87
G120S	582.77	583.01	584.60	585.05	583.49	583.44	586.45	585.96	583.72	584.13	585.80	586.21	583.72	583.72	584.75
G121S	584.76	584.21	583.65	587.38	584.04	583.77	585.30	585.81	585.66	585.70	584.83	585.91	585.66	586.33	587.16
G123S	586.88	586.81	586.85	588.77	588.40	587.33	586.57	587.57	587.96	588.43	587.96	586.90	586.98	585.69	589.06
G124S	583.97	583.23	583.78	584.47	584.31	584.20	584.22	584.64	584.58	584.31	584.58	584.54	584.04	583.25	585.08
G307	586.23	586.02	585.36												
State Wells															
G110*	586.01	586.38	587.85	589.69	590.19	589.94	590.33	589.73	589.58	588.32	589.28	586.20	586.83	586.45	586.65
G111A	585.36	584.50	583.92	581.84	583.45	582.98	584.42	585.09	585.09	585.03	584.00	584.08	583.96	585.17	586.65
G112B	587.91	587.00	586.87	587.86	588.63	587.23	587.39	588.02	587.67	587.72	587.20	586.74	586.66		
G113A	583.59	583.46	583.40	583.59	583.98	583.87	583.78	584.37	584.34	584.24	584.21	584.21	583.80		

* – this well is not screened in the same formation as the other wells

		4/3/91	1/4/91	10/24/90	7/23/90	4/26/90	1/22/90	10/24/89	7/25/89	4/24/89	1/30/89
Acetone	ug/l	<34	<170	<170	<34	<170	<34	<34	<34	<10	22.1
Dichlorodifluoro-methane	ug/l	<10	<50	<50	<10	<50	23	18	14	<10	<10
Methylene chloride	ug/l	<5	<25	<25	<5	<25	<5	<5	<5	<5	5.28
Naphthalene	ug/l	<10	<10	<10	<10	<10	12	14	23	20	18.9
4,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.10
Aluminum	ug/l	<200	<200	<200	<200	<200	783	<200	549	<200	
Arsenic	ug/l	<30	32.2	45.6	50.2	32.0	50.5	52.5	73	40.3	38
Barium	ug/l	930	1090	991	906	907	1060	812	1060	964	939
Iron	ug/l	14300	15200	15400	14000	15400	17400	13000	12500	15600	13600
Lead	ug/l	<5	<5	<5	<5	<5	<50	<25	<5	<5	90
Sodium	ug/l	130000	153000	126000	143000	136000	148000	128000	131000	158000	131000
Zinc	ug/l	<20	<20	83.8	<20	<20	21.7	<20	<20	<20	126
Chloride	mg/l	270	300	309	306	309	306	212	273	258	200
Fluoride	mg/l	0.46	0.47	0.50	0.44	0.45	0.51	0.46	<.05	.47	.4

NT-Not Tested

		10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	59.3	23.4	<10	<10	10.7	NT
Dichlorodifluoro-methane	ug/l	77.8	33.6	64.6	24.3	43.8	NT
Methylene chloride	ug/l	5.79	13.4	<2.8	5.70	<2.8	8.20
Naphthalene	ug/l	21.4	8.3	23.0	29.0	4.08	<1.6
4,4'-DDE	ug/l	<.1	<.1	<.20	NT	.98	NT
Aluminum	ug/l						
Arsenic	ug/l	48	51	34	50	58	18
Barium	ug/l	1090	930	865	846	781	NT
Iron	ug/l	16700	16100	15400	14200	15500	1620
Lead	ug/l	<10	<4	<8	<4	<4	<4
Sodium	ug/l	137000	127000	117000	126000	115000	114000
Zinc	ug/l	10	360	<10	<10	107000	NT
Chloride	mg/l	300	260	460	250	NT	240
Fluoride	mg/l	.7	.6	.8	.5	.44	NT

NT-Not Tested

G121S

		4/3/91	1/4/91	10/24/90	7/24/90	4/26/90	1/22/90	10/24/89	7/26/89	4/24/89	1/31/89
Acetone	ug/l	<340	<340	<340	<340	<310	<340	<340	<34	<10	4.1
Benzene	ug/l	200	190	240	230	260	200	230	250	260	178
Chlorobenzene	ug/l	51	<50	51	51	59	<50	56	63	61	64.8
Ethylbenzene	ug/l	<50	<50	<50	<50	<46	<50	<50	15	17	14.4
Toluene	ug/l	<50	<50	<50	<50	<46	<50	<50	11	<5	9.95
Methylene Chloride	ug/l	<50	<50	<50	<50	<46	<50	<50	6.2	7.5	5.84
2-Chlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	5.45
2,4-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<2.9
2,4-Dimethylphenol	ug/l	19	19	<10	26	26	26	32	40	32	25.3
Phenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	23	<1.6
1,2-Dichlorobenzene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	6.17
Anthracene	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<2.0
Naphthalene	ug/l	12	13	17	<10	16	15	21	28	<10	18.1
Aniline	ug/l	<10	<10	<10	<10	<10	<10	10	13	<10	<11
4-Chloroaniline	ug/l	150	160	220	180	170	160	200	240	57	220
m+p-Cresols	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<11
1,4-Dioxane	mg/l	120	90	51	54	<50	<50	<50	<50	<50	<13
Xylene, m	ug/l	<50	<50	<50	<50	<46	<50	<50	<10	11	<10
Xylene, o+p	ug/l	<50	<50	<50	<50	<46	<50	<50	10	12	14.9
4,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	.1	<.1	<.1	<13
2,6-Dichlorophenol	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<11
Aluminum	ug/l	<200	<200	<200	<200	<200	<1000	<200	373	320	
Arsenic	ug/l	<30	19.3	20.2	31.9	44.6	<10	18	35.9	45.6	10
Barium	ug/l	<200	210	<200	<200	<200	<200	<200	<200	206	47
Iron	ug/l	736	688	602	683	227	990	564	142	610	230
Lead	ug/l	<25	<25	<50	<10	<5	<5	<5	<5	<5	<4
Sodium	ug/l	3560000	4290000	4260000	4670000	5110000	4720000	600000	5110000	4260000	5130000
Zinc	ug/l	<20	<20	<20	<20	<20	<50	<20	<20	26	<10
Chloride	mg/l	6630	9840	8350	7610	80900	747	7070	8790	8170	9000
Fluoride	mg/l	2.9	2.7	2.9	3.1	3.2	3.4	4.4	5.7	3.9	1.1

NT - Not Tested

G121S

		10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	<50	11.9	<10	<10	22.2	NT
Benzene	ug/l	285	<4.4	264	<4.4	371	270
Chlorobenzene	ug/l	65.9	22.0	79.4	33.4	93.4	59.4
Ethylbenzene	ug/l	<36	11.2	17.3	17.8	19.8	NT
Toluene	ug/l	<30	<6.0	34.5	18.3	59.5	67.1
Methylene Chloride	ug/l	560	7.28	<2.8	<2.8	<2.8	7.10
2-Chlorophenol	ug/l	9.53	7.09	11.6	13.3	24.7	25.0
2,4-Dichlorophenol	ug/l	<2.9	3.32	<2.8	4.02	16.8	<2.7
2,4-Dimethylphenol	ug/l	32.2	17.9	32.0	32.5	54.6	30.3
Phenol	ug/l	<1.6	1.61	<1.5	4.83	17.1	47.0
1,2-Dichlorobenzene	ug/l	9.76	5.07	5.64	6.63	6.93	3.29
Anthracene	ug/l	<2.0	<4.3	<1.9	<2.0	2.07	NT
Naphthalene	ug/l	20.3	<3.6	15.6	19.5	214	113
Aniline	ug/l	<11	<23	16.1	26.9	38.5	491
4-Chloroaniline	ug/l	198	<23	109	109	466	NT
m+p-Cresols	ug/l	<11	<10	11.9	<10	30.4	25.7
1,4-Dioxane	mg/l	<13	<13	<13	<13	57.2	NT
Xylene, m	ug/l	<50	<10	13.8	12.2	16.5	NT
Xylene, o+p	ug/l	<50	13.4	20.3	20.9	24.0	NT
4,4'-DDT	ug/l	<.1	<.1	<.21	NT	.475	NT
2,6-Dichlorophenol	ug/l	<11	<11	<10	<10	17.0	
Aluminum	ug/l						
Arsenic	ug/l	21	21	23	20	16	32
Barium	ug/l	192	174	163	210	203	NT
Iron	ug/l	232	343	97	141	140	<30
Lead	ug/l	<10	<4	<4	4	6	6
Sodium	ug/l	6550000	5400000	5710000	5020000	5340000	6220000
Zinc	ug/l	<10	10	<10	<10	837	NT
Chloride	mg/l	9700	9000	8900	9000	NT	11000
Fluoride	mg/l	5.7	6.9	15	3.4	2.6	NT

NT - Not Tested

G.

		4/3/91	1/4/91	10/24/90	7/24/90	4/26/90	1/22/90	10/24/89	7/25/89	4/25/89	1/30/89
Acetone	ug/l	620	<1360	<3400	<340000	<68000	<34	<6800	<34	<10	428
Benzene	ug/l	390	420	790	<10000	<2000	550	330	600	370	66.3
1,1-Dichloroethylene	ug/l	56	398	2900	<50000	20000	5500	2400	4400	4100	167
Methylene Chloride	ug/l	<50	<200	3200	<50000	30000	16000	5400	14000	23000	1440
Vinyl Chloride	ug/l	310	800	<1000	<100000	<20000	<10	<2000	620	400	41.9
Toluene	ug/l	71	<200	<500	<50000	<10000	130	<1000	<5	<5	25.3
2-Chlorophenol	ug/l	<1000	<1000	<2000	<2000	<1000	120	65	96	97	32.2
2,4-Dichlorophenol	ug/l	<1000	<1000	<2000	<2000	1600	700	250	400	180	18.7
2,4-Dimethylphenol	ug/l	<1000	<1000	<2000	<2000	<1000	<10	12	13	14	<2.8
2,6-Dichlorophenol	ug/l	<1000	<1000	<2000	<2000	<1000	160	79	100	68	20.9
m&p-Cresols	ug/l	<1000	<1000	<2000	<2000	<1000	132	240	280	188	36.0
4-Chloroaniline	ug/l	<1000	<1000	<2000	<2000	<4500	130	97	140	73	12.3
Phenol	ug/l	7900	21000	29000	78000	70000	45000	32000	28000	16000	4250
Naphthalene	ug/l	<1000	<1000	<2000	<2000	<1000	158	23	27	29	11.8
Aniline	ug/l	<1000	<1000	<2000	<2000	<1000	180	120	120	160	48.1
4,4'-DDT	ug/l	<.1	<.1	<1.0	<.1	NA	<.1	<.1	<.1	<.1	<.10
1,4-Dioxane	ug/l	610	710	300	870	510	650	<50	300	<50	
Aluminum	ug/l	<200	<200	<200	<200	<200	<1000	<200	407	348	
Arsenic	ug/l	<30	19.0	<30	17.1	<10	<10	15.7	16.1	17.2	<4
Barium	ug/l	1600	1980	1620	1570	1620	1590	836	910	1060	615
Iron	ug/l	1530	1230	1800	893	748	630	156	172	179	90
Lead	ug/l	<25	<25	<25	<10	<5	<50	<5	<5.0	48.7	<4
Sodium	ug/l	697000	730000	608000	689000	762000	716000	783000	674000	959000	820000
Zinc	ug/l	<20	<20	<20	<20	<20	24.0	<20	<20	<20	<10
Chloride	mg/l	2410	2530	1980	2750	25600	238	1500	1840	2090	200
Fluoride	mg/l	0.32	0.32	0.37	0.28	0.25	.28	.35	.32	.26	.3

NA - Not Analyzed

		10/28/88	7/29/88	4/28/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	92.6	72.1	165	13.9	20.0	NT
Benzene	ug/l	13.6	20.0	19.5	<4.4	6.4	32.0
1,1-Dichloroethylene	ug/l	2.90	48.8	24.4	<2.8	18.5	144
Methylene Chloride	ug/l	16.3	15.5	680	<2.8	5.27	<2.8
Vinyl Chloride	ug/l	<10	NT	<10	<10	13.9	36.7
Toluene	ug/l	<6.0	<6.0	<6.0	<6.0	<6.0	14.5
2-Chlorophenol	ug/l	3.4	6.68	7.23	7.43	<3.4	17.3
2,4-Dichlorophenol	ug/l	<2.8	<2.8	3.68	<2.9	<2.8	ND
2,4-Dimethylphenol	ug/l	<2.8	ND	ND	ND	ND	ND
2,6-Dichlorophenol	ug/l	<10	<10	<10	<11	<10	ND
m&p-Cresols	ug/l	<10	<10	<10	<11	<10	ND
4-Chloroaniline	ug/l	<10	<10	<10	<11	ND	ND
Phenol	ug/l	51.4	2.24	2.12	2.42	<1.5	<1.5
Naphthalene	ug/l	10.5	<1.6	2.49	10.6	<1.6	4.88
Aniline	ug/l	<10	<10	<10	17.6	<10	78.3
4,4'-DDT	ug/l	<.1	<.1	<.20	NT	.334	NT
1,4-Dioxane	ug/l						
Aluminum	ug/l						
Arsenic	ug/l	<4	<4	<4	<4	4	<4
Barium	ug/l	344	375	318	315	253	NT
Iron	ug/l	81	102	100	92	69	59
Lead	ug/l	<10	<4	<4	6	5	4
Sodium	ug/l	846000	857000	916000	1010000	695000	488000
Zinc	ug/l	<10	<10	<10	<10	303000	NT
Chloride	mg/l	1700	2000	2300	1700	NT	1100
Fluoride	mg/l	.9	.6	.6	.5	.42	NT

ND - Not Detected

NT - Not Tested

		4/3/91	1/4/91	10/25/90	7/24/90	4/26/90	1/22/90	10/24/89	7/25/89	4/24/89	1/31/89
Acetone	ug/l	<34	<34	<34	<34	<34	<34	<34	<34	<10	<10
Benzene	ug/l	<5	<5	<5	<5	<5	<5	<5	<5.0	<5	<4.4
Methylene Chloride	ug/l	<5	<5	<5	<5	<5	<5	<8	<5.0	<5	<2.8
4,4'-DDT	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.12
4,4'-DDE	ug/l	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.12
1,4-Dioxane	ug/l	28	16	<10	<10	<50	<50	<50	<50	<50	<13
Aluminum	ug/l	<200	<200	<200	<200	<200	341	<200	291	<200	
Arsenic	ug/l	<10	<10	<10	<10	<10	<10	<10	<10	<10	<4
Barium	ug/l	<200	<200	<200	<200	<200	<200	<200	<200	<200	85
Iron	ug/l	1750	4280	1440	2010	179	288	309	590	264	396
Lead	ug/l	<25	<25	<25	<10	<5	<5	<5	<5	<5	<4
Sodium	ug/l	277000	300000	267000	276000	281000	266000	212000	214000	208000	170000
Zinc	ug/l	<20	<20	<20	<20	<20	27.4	<20	<20	<20	78
Chloride	mg/l	1070	1030	1600	1230	1240	953	844	916	815	830
Fluoride	mg/l	0.41	0.39	0.42	0.40	0.38	0.41	.43	<.05	.31	.4

NT - Not Tested

G124S

		10/27/88	7/28/88	4/29/88	1/28/88	4/30/87	11/21/85
Acetone	ug/l	32.2	20.4	<10	13.0	18.0	NT
Benzene	ug/l	<4.4	<4.4	<4.4	<4.4	<4.4	<4.4
Methylene Chloride	ug/l	11.2	14.6	<2.8	5.89	<2.8	<2.8
4,4'-DDT	ug/l	<.1	<.1	<.18	NT	.737	NT
4,4'-DDE	ug/l	<.1	<.1	<.18	NT	.256	NT
Aluminum	ug/l						
Arsenic	ug/l	4	<4	<4	<4	<4	<4
Barium	ug/l	108	111	93	108	88	ND
Iron	ug/l	482	163	159	148	37	141
Lead	ug/l	13	<4	<8	<10	<4	<4
Sodium	ug/l	167000	193000	177000	202000	159000	414000
Zinc	ug/l	<10	18	<10	18	234999	NT
Chloride	mg/l	950	750	1100	620	NT	850
Fluoride	mg/l	.8	.6	.8	.5	.48	NT

NT - Not Tested

WMI MANUAL

FOR

GROUNDWATER SAMPLING

WMI Environmental Monitoring Laboratories, Inc.
2100 Cleanwater Drive
Geneva, Illinois 60134

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PREFACE

This manual contains detailed procedures for sampling groundwater, surface water and leachate at both hazardous and solid waste facilities. These procedures are based on regulatory requirements, and on many years of experience by WMI employees and contractors. They are to be followed by all WMI contractors and personnel engaged in the collection of groundwater samples for the purpose of determining the groundwater quality in and around WMI facilities. Following these procedures will ensure that goundwater samples are as representative as possible, and help produce analytical data that is of the highest quality and fully defensible. This manual is intended to be used in training personnel involved in sampling, and also as a reference for the proper procedures to be followed by experienced samplers.

1.0 Introduction

1.1 Waste Management Incorporated (WMI) Groundwater Monitoring Program Overview

The objective of the WMI Groundwater Monitoring Program is to determine if a waste facility may potentically affect the surrounding groundwater. Federal, state, and local regulatory agencies have established criteria that must be met for a facility to continue operating. These criteria involve standards that the groundwater must meet for the levels of chemical constituents. A Groundwater Monitoring Program is required at all WMI facilities to ensure that these standards are met.

Regulations seldom completely specify the procedures required to carry out a comprehensive groundwater monitoring program; therefore, Waste Management, Inc. [through its Environmental Monitoring Department within Waste Management of North America, Chemical Waste Management (CWM), and Environmental Monitoring Laboratories (EML)] has established a groundwater monitoring program that, when followed, will provide the most accurate data possible. This manual provides the necessary procedures to carry out the first and most critical element in a groundwater monitoring program--THE SAMPLING. Other elements of the groundwater monitoring program can be found in the Site Assessment Manual, the Site-Specific Groundwater Monitoring Plans, and PAP B-810. The WMI Groundwater Monitoring Program's structure is given schematically in Figure 1.1.

The Site-Specific Environmental Monitoring Plans are developed by the Site Engineer, in cooperation with Regional and Corporate Environmental staff, and is approved by Corporate Environmental staff. The plans include information on federal, state, and local regulatory monitoring requirements, as well as hydrogeological information. These plans and site-specific hydrogeological studies determine the need for and location of sample collection points.

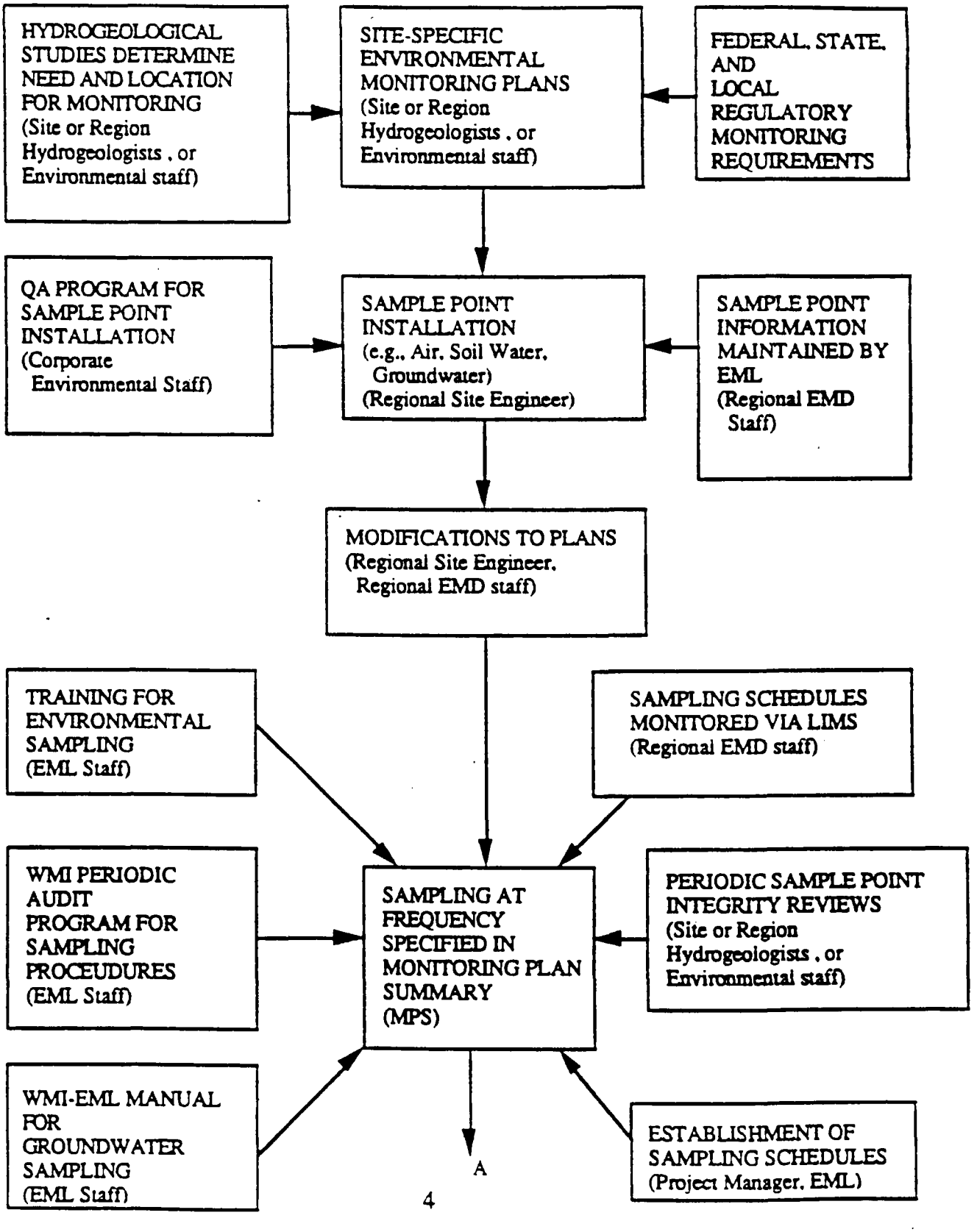
WMI recognizes that sampling is a critical step in an effective monitoring program, and it has therefore incorporated both the WMI Manual for Groundwater Sampling and the Site-Specific Environmental Monitoring Plan into the Waste Management, Inc., Policies and Procedures Manual (PAP-Ground Water Monitoring Policy B-810 of Waste Management, Inc.). The PAP B-810 provides a framework for Waste Management's groundwater monitoring program requirements at each facility. Incorporating these manuals into the PAP B-810 ensures that all activities related to groundwater monitoring must be reviewed and scrutinized for completeness and integrity.

The sampling team's performance is an integral part of the sampling event, so formalized training and audits of the sampling procedures at each facility will be performed to ensure their integrity. All samplers are trained prior to sampling at WMI facilities and periodically thereafter. Sampling teams are audited biannually. Records of training and audits are provided to Program Managers and Monitoring Coordinators and copies are retained at the EML. Groundwater samples are collected by consultants, Regional Environmental Technicians, or WMI site personnel at a frequency specified in the waste discharge requirements, regulatory permits and/or monitoring plans. The WMI Manual for Groundwater Sampling has been developed for use by WMI personnel and consultants.

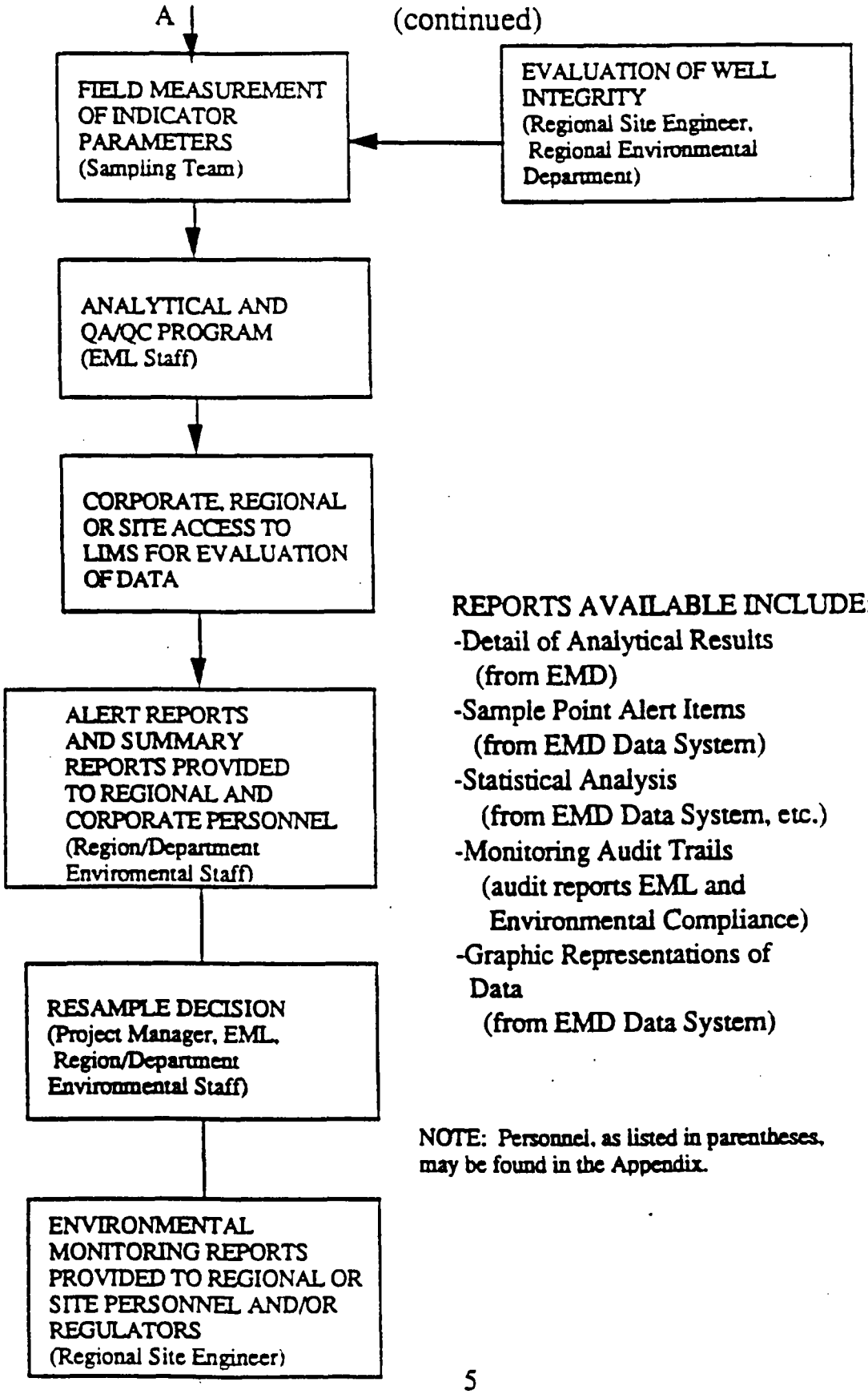
The analytical portion of the Groundwater Monitoring Program is managed by the WMI Environmental Monitoring Laboratories, Inc. (EML). The EML is responsible for generating and ensuring the quality of the analytical data. The EML provides the necessary analytical results for all groundwater sampling points. All analytical data are entered into the EML's LABORATORY INFORMATION MANAGEMENT SYSTEM (LIMS) database and are available for retrieval by corporate, regional and site personnel via computer. Hard copies of the data are provided by the EML Program Manager, Monitoring Coordinator and/or directly to the regulatory agencies where required. Various data report formats are available from the EML.

ENVIRONMENTAL MONITORING PROGRAM: STRUCTURE AND DESIGNATION OF RESPONSIBILITIES

Figure 1.1



ENVIRONMENTAL MONITORING PROGRAM
STRUCTURE AND DESIGNATION OF RESPONSIBILITIES
(continued)



REPORTS AVAILABLE INCLUDE:

- -Detail of Analytical Results (from EMD)
- -Sample Point Alert Items (from EMD Data System)
- -Statistical Analysis (from EMD Data System, etc.)
- -Monitoring Audit Trails (audit reports EML and Environmental Compliance)
- -Graphic Representations of Data (from EMD Data System)

NOTE: Personnel, as listed in parentheses, may be found in the Appendix.

1.2 WMI Sampling Program

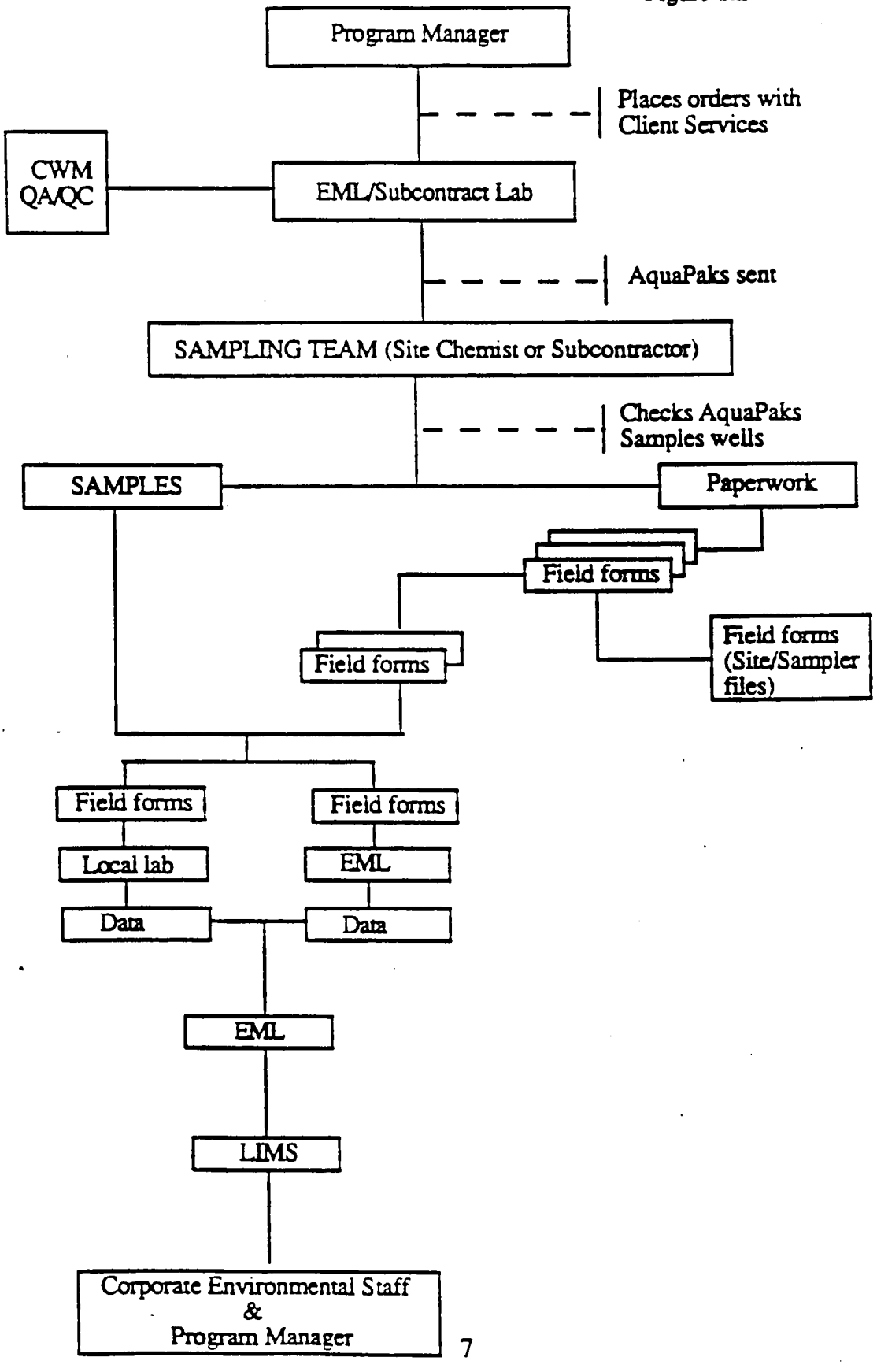
The WMI Sampling Program is just one part of the overall WMI Groundwater Monitoring Program that uses this Manual for Groundwater Sampling to define the procedures used. The WMI Sampling Program is outlined in Figure 1.2. The program begins and ends with the Program Managers, who act as administrators for their respective sites. Program Managers begin the sampling event process by defining the monitoring program with a representative from Client Services at the EML and by confirming sampling and analytical requirements prior to each sample event.

Once a sampling event is declared, the EML ships AquaPaks, containing the necessary sample bottles, paperwork, and preservatives to the sampling team (Site Chemist, Technician, Subcontractor or Consultant). The sampling team checks the condition of AquaPaks before sampling. If any problems exist, (for example, missing bottles), the Sampling Team must notify the EML's Client Services Department immediately. The Client Services Department, in turn, implements corrective actions to resolve the problem. Once the AquaPaks have been examined and any problems resolved, the sampling team collects the samples.

Sampling teams must complete WMI Field Chain-of-Custody Records and Field Information Forms during sampling. The proper completion of these forms is a critical aspect of the field QA/QC program. Together, they provide a comprehensive, consistent and accurate summary of field tests, measurements, and observations. They also document that the integrity of the samples is maintained. Once samples have been taken, the samples and associated field forms are submitted the EML. Once all sample analyses have been completed, the EML includes Field Chain-of-Custody Records and Field Information Forms, along with the resultant data, in a complete data package for each sample point. This data package is then sent to the Program Manager for review before being forwarded to the appropriate regulatory agency(ies).

ENVIRONMENTAL SAMPLING PROGRAM SEQUENCE FLOWCHART

Figure 1.2



2.0 RESPONSIBILITIES OF THE SAMPLING TEAM MEMBERS

2.0 Responsibilities of the Sampling Team Members

2.1 Regional Site Engineer or Program Manager

*Provide site-specific information for the Groundwater Monitoring Program.

*Set up a sampling program that complies with applicable regulations and corporate policy, and obtain the approval of the Manager of Environmental Monitoring for any changes before they are implemented.

*Notify the EML of any changes in sampling schedules or analytes, and confirm dates that AquaPaks will be sent to the sites.

*Work with the EML to set up a monitoring program event schedule.

*Notify the Site Manager, Corporate and EMD of maintenance required on wells or of any necessary replacements.

*Review analytical results and submit them to the proper agencies.

*Provide information for Well I.D. Charts.

*Oversee quality of well drilling procedures, and oversee hydrogeological studies at the site.

*Annually update the site specific groundwater manual where required.

*Respond to alert reports/schedule resampling, if necessary (i.e. holding exceedances).

2.2 Site Manager

*Ensure adequate well protection.

*Ensure that all wells are accessible.

*Provide maintenance for the wells where required, or when instructed to do so by the Program Manager or Regional and/or Site Engineer.

*Provide an isolated work area for sample preparation and equipment storage.

*At WMI sites, be the "keeper of the keys" for the monitoring wells, unless a designee has been assigned.

2.3 Sampling Team Manager

*Organize sampling team members and oversee all sampling activities.

*Contact courier for sample pickup.

*Notify the EML, by ENS number, of the dates on which samples should arrive and the number of samples.

*Review event schedule.

*Receive notification of the arrival condition of samples and accompanying paperwork to the EML, and initiate corrective actions if required. The Program Manager is notified if corrective actions would require resampling (e.g.. broken bottle).

*At CWM Sites, be the "keeper of the keys" for the monitoring wells. It will be his/her responsibility to protect and limit access to the wells.

*Notify the EML Client Services immediately if any problems occur. They will contact the appropriate Client Services staff member or Program Manager to resolve the problem or make the appropriate decision if necessary.

2.4 Sampling Team Member

*Follow all procedures in this manual to prevent the contamination of samples and wells.

*Obtain, maintain, and inspect all required equipment.

*Have spare parts available for field meters.

*Examine AquaPaks, bottles, and preservatives.

*Notify the Sampling Team Manager immediately if any problems are found.

*Place ice packs in a freezer upon receipt of AquaPaks.

*Assume responsibility for storage of AquaPaks and sampling equipment.

*Calibrate equipment.

*Take all field measurements, including pH, temperature, and specific conductance.

*Determine whether well water volume is adequate for taking all samples.

*Purge and sample wells.

*Prepare field blanks.

*Filter and preserve samples, as necessary.

*Ensure that samples are correctly identified and packed securely with ice packs in AquaPaks.

*Complete and sign the Field Information Form and Field Chain-of-Custody Record and enclose them in AquaPaks before sealing it.

NOTE: WMI/CWM personnel who participate in sampling will have their performance reviewed as part of the Annual Performance Appraisal. These appraisals will be based upon each team member's performance in carrying out his/her duties.

2.5 EML

*Provide a summary level data base, including all analytical results, field measurements and selected field data.

*Ensure that all analytical data are supported by permanent records of lab QA/QC procedures, raw data, chain-of-custody, information, etc.

*Assist in the organization and documentation of the monitoring program in the EML Monitoring Program System (computer database tables) at each site in conjunction with the Regional Site Engineer/Program Manager.

*Provide AquaPaks and their appropriate contents, including sample bottles, preservatives, and field forms.

*Establish and serve as the prime contractor for a network of subcontract labs.

*Notify Program Manager immediately of any confirmed data problems which might require resampling (i.e. holding time exceedance).

*Provide all analytical services in conjunction with local labs.

*Conduct annual audits of subcontract labs.

*Assist in the selection of subcontract samplers.

*Conduct biannual audits of sampling teams.

A complete list of contacts, including telephone numbers and addresses, is listed in the Appendix.

3.0 ESTABLISHING THE SAMPLING EVENT

3.0 Establishing the Sampling Event

3.1 Permit Review

Before beginning any sampling procedures, it is necessary to review all applicable regulatory and permit requirements. More than one regulatory program with specific requirements for sampling frequency and sample analysis may apply to a landfill. For instance, a site may be subject to regulation under RCRA (Resource Conservation and Recovery Act), city ordinances, sanitary districts, water quality boards, departments of health, departments of natural resources, or state EPA's.

It is therefore necessary to identify and understand each applicable requirement and to incorporate each into the Site-Specific Groundwater Monitoring Plan (GWMP). Fortunately, many of these requirements overlap, so the amount of variation may be minimal. It is important to ensure that each requirement is met during all phases of the sampling and analysis procedures, and that each requirement is also reflected in the Site-Specific GWMP.

3.2 Analytical Requirements

Once all sampling requirements have been identified and incorporated into the Site-Specific Groundwater Monitoring Plan, the laboratory analysis requirements of groundwater samples must be identified and implemented. This includes determining which analytes must be measured, (and at what frequency), which analytical methods are required, whether library searching (plus analysis) is required, and the reporting limit for each analyte.

It must be possible for the methods selected to meet the reporting requirements for each analyte. Consult with the EML to determine whether the method detection limits of the selected method will meet the reporting requirements. It is also important to do this whenever required reporting limits are lowered. The EML will also assist the regions in negotiating analytical methods and reporting limits with the agencies at the request of the regions.

Other special analytical requirements must also be reported to the EML. For example, if a site requires matrix spike or duplicate analyses at a greater frequency than that which the laboratory normally performs, the EML must be notified so it can implement these special requirements. Or, if a QA/QC report must be submitted with analysis results, the EML must

be notified enough in advance to ensure one is submitted along with the client report. Any other special requirements must be likewise be relayed to the EML.

3.3 Laboratory Requirements

The EML is responsible for all groundwater analyses. The EML also evaluates the sampling and analytical protocols of each Site-Specific GWMP as it relates to the EML's monitoring program system. As a result, all routine and specialized requirements must be clearly reported to and coordinated with the EML prior to the sampling event to ensure that the EML can adequately meet the requirements.

In a limited number of cases, the EML may subcontract samples to outside laboratories. For instance, if a parameter must be analyzed within 24 hours, and cannot be shipped to and analyzed at the EML within that time period, the sample will be subcontracted. Any subcontract lab used to perform groundwater monitoring analyses must be approved by the EML for that purpose. The Chemical Waste Management Vice President of Science and Technology maintains a list of the labs that have been approved for subcontracted services. Information about which labs may be used is available through the EML's Client Services Department.

Any subcontract lab must meet the requirements the EML has established before being used for groundwater analyses. Each lab must submit a Quality Assurance Plan (QAP) that defines the level and extent of QA and QC performed at the lab. The QAP must be found acceptable before a lab will be approved. In addition, the lab must successfully complete an audit by the EML's Quality Programs Department before the EML will grant full approval for the laboratory to analyze subcontracted samples.

4.0 Procedures

4.1 Preliminary Procedures

Before any sampling is done at a facility, a number of preliminary tasks must be completed. These tasks include locating the well, identifying well characteristics, defining the sampling schedule, and identifying parameters to monitor. If these preliminary procedures are followed properly at the outset, they can ensure that subsequent sampling is accurate and cost effective.

4.1.1 Well Location and Characteristics

The first step in any monitoring program is the installation or location of the monitoring points. Certain information about each well is required whether a new program or an existing one is involved. The Monitoring Well Construction Summary (Figure 4.1) and the Well I.D. Chart (Figure 4.2) must be completed for each sampling point before any monitoring can begin.

4.1.1.1 The Monitoring Well Construction Summary

Pertinent information about a well's characteristics (such as installation date, location, drilling method used, total depth, water levels), description of screened interval, and well log is recorded on the Monitoring Well Construction Summary (Figure 4.1) or within the site-specific groundwater monitoring plan (or other appropriate location). This data must be available in the Site-Specific Groundwater Monitoring Plan. The Regional or/Site Engineer is responsible for obtaining and recording this information.

FIGURE 4.1

Well No. _____

Boring No. X-Ref: _____

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: _____ Elevation Ground Level _____

Top of Casing _____

Drilling Summary:

Total Depth _____

Borehole Diameter _____

Casing Stick-up Height: _____

Driller _____

Rig _____

Bit(s) _____

Drilling Fluid _____

Protective Casing _____

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
Geophys. Logging:				
Casing:				
Filter Placement:				
Cementing:				
Development:				

Well Design & Specifications

Basis: Geologic Log ____ Geophysical Log ____

Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
____ - ____	____	____ - ____
____ - ____	____	____ - ____
____ - ____	____	____ - ____
____ - ____	____	____ - ____
____ - ____	____	____ - ____

Casing: C1 _____

C2 _____

Screen: S1 _____

S2 _____

Filter Pack: _____

Grout Seal: _____

Bentonite Seal: _____

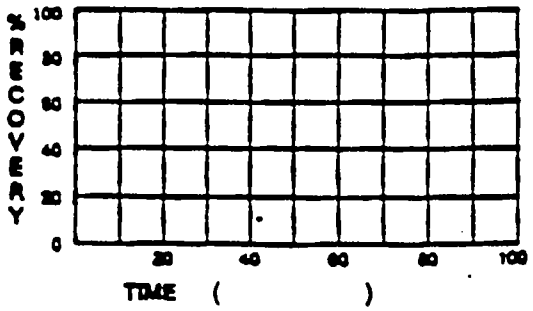
Well Development:

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)

Recovery Data:

Q= S_o=



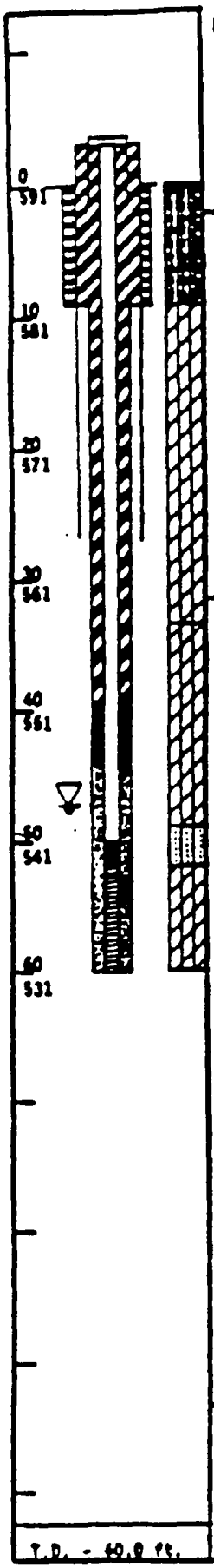
Comments: _____

SITE NAME _____ LOCATION _____

WC 9401

SUPERVISED BY _____ DATE _____

Figure 4.1.1



Project No. 88-034

Well No. G-123

Boring No. X-Ref: G-123

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: S - 15.26 (1)
E - 2734.73

Elevation Ground Level 590.75

Top of Casing 594.11

Drilling Summary:

Total Depth 60.0 ft.
Borehole Diameter 8"/6"/4"
Casing Stick-up Height: 3.4 ft.
Driller Fox Drilling

Rig CME 75
Bit(s) 0 to 20' - 8" auger
20 to 60' - 6" tricone
Drilling Fluid Clean Water

Protective Casing 4" anodized aluminum locking

Construction Time Log: 1988

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling	04/07	0800	04/11	1200
Well install.	04/11	1030	04/11	1200
Geophys.Logging:				
Casing: C1	04/11	1030	04/11	1100
C2	04/07	0830	04/07	1130
S1	04/11	1030	04/11	1100
C3	04/13	0800	04/13	0900
Filter Placement:	04/11	1030	04/11	1100
Cementing:	04/11	1100	04/11	1200
Development:	05/19	1100	05/20	1340

Well Design & Specifications

Basis: Geologic Log X Geophysical Log ___
Casing String (s): C = Casing S = Screen.

Depth	String(s)	Elevation
+3.0 - 50.0	C1	593.75 - 540.75
+3.0 - 27.0	C2	593.75 - 563.75
+3.4 - 1.6	C3	594.11 - 589.11
50.0 - 60.0	S1	540.75 - 530.75
-		-

Casing: C1 2" dia. 316 stainless steel
C2 6" dia. steel
C3 4" dia., 5' long aluminum
Screen: S1 2" dia. 316 stainless steel wire wound screen.
S2

Filter Pack: #5 quartz sand
Depth 44.0 - 60.0 ft.
Secondary filter 39.5 - 40.0 ft.
Grout Seal: Volclay grout
Depth 3.0 - 39.5 ft.

Bentonite Seal: 1/4" bentonite pellets
Depth 40.0 - 44.0 ft.

Well Development: 1988

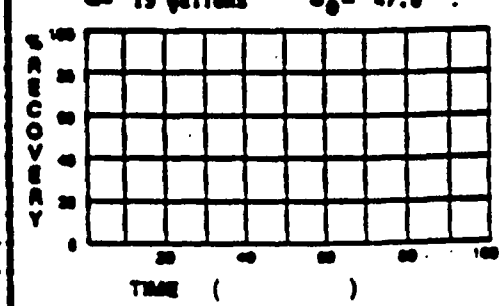
5/19 - 1100 to 1440 - Air jetted with compressed air.
5/20 - 1315 to 1340 - Bailed with PVC bailer.
Total water removed: 19 gallons

Stabilization Test Data: 1988

Time	pH	Spec. Cond.	Temp (F)
1100	8.00	2440	58.0 (5/19)
1340	7.87	1240	60.0 (5/20)

Recovery Data:

Q_o = 19 gallons S_o = 47.0'



Comments: (1)

SITE NAME WMI - xxx
LOCATION Anytown, USA
WC 02592
SUPERVISED BY MY - CANONIE
DATE 4 - 11 - 88

WMI GROUNDWATER MONITORING PROGRAM: MONITORING WELL CONSTRUCTION SUMMARY

Field Descriptions

Site:	Enter the site name and number.
Well Number:	Enter the sample point designation. It should be the same as that used in the Laboratory Information Management System (LIMS).
Date Installed:	Enter the date the well was installed or drilling was completed.
Location:	Enter the location relative to site boundaries (e.g., southeast corner) as well as the exact USGS location (if available).
Driller:	Enter the company name and the name of the person who supervised the drilling.
Supervising:	The name of the geotechnical company responsible for supervising the drilling. All drilling should have been supervised by a geotechnical engineer or registered qualified geologist.
Log By:	Enter the name of the person responsible for logging or drilling the well.
Drilling Method:	Specify the method used to drill the well.
Total Depth:	Specify the depth of drilling to the nearest tenth of a foot.
Boring Diameter:	Specify the boring diameter in inches to the nearest tenth of an inch.
Ground Elevation:	Enter the elevation at the bore hole to the nearest hundredth of a foot.

Standpipe Elevation:	Enter the elevation at the top of the (PVC inner or stainless) casing to the nearest hundredth of a foot Mean Sea Level (MSL).
Bit:	Tool which is used to progress a drilling device through the strata.
Casing Diameter:	Enter the casing diameter to the nearest tenth of an inch.
Casing Length:	Enter the length of the casing to the nearest tenth of a foot.
Casing Material: (Inner)	Describe the material of which the casing is made (e.g., Schedule 40 PVC).
Casing, Protective:	Anodized aluminum pipe with aluminum locking lid with provisions for a heavy-duty padlock, installed 3 feet above ground surface, to protect the well's innter casing from damage or other protective enclosure as specified in SSSP (Site-specific Sampling Program).
Casing Stick-up Height:	The distance that the outer protective casing protrudes from the ground.
Casing Volume:	The volume of water (in gallons) that is present in a well prior to purge and sampling.
Laboratory Reagent Quality Water:	Water containing non-detectible levels of each analyte of interest, a pH of 7, and conductivity equivalent to that of deionized or laboratory reagent quality water.
Rig:	Mechanical device which is used to bore holes through geologic media to provide physical specimens of strata from different depths.
Screen Diameter:	Enter the screen's diameter to the nearest tenth of an inch.
Screen Length:	Enter the screen's length to the nearest tenth of a foot.

Slot Size:	Enter the slots' width to the nearest thousandth of an inch.
Stick-up:	The vertical length of the protective casing protruding from the ground surface.
Water Level, Initial:	Enter the water level depth and elevation in MSL feet before development, to the nearest hundreth of a foot.
Water Level, 24-hour:	Enter the water level, after allowing recharge for 24 hours, to the nearest hundreth of a foot.
Other Water Levels:	Note whether water levels are from ground surface or from the top of the casing (MSL).
Comments:	Note anything unusual about the well in this space.
Description of Screened Interval:	Note the soil description for various depths throughout the screened interval. It is necessary to note soil composition and thickness of the soil strata.
Values Used:	Note whether the depth is from the ground surface, top of casing or from MSL.

4.1.1.2 Well I.D. Chart

A Well I.D. Chart should be completed for each WMI site. Each well I.D. Chart should be reviewed annually and revised where necessary. (See Figure 4.2.1 for an example). This chart is used by the sampling team for reference and provides a summary of the general design of, and historical information about, the wells at the site. The historical values in this chart should be compared with the new values when samples are taken. If any inconsistencies are observed between the two, complete the sampling and contact the Program Manager immediately. A copy of the complete Well I.D. Chart must be kept and used during sampling.

The Well I.D. chart must be updated as necessary, and must include:

Site:	Enter the name and number of the facility being monitored.
Well I.D. Number:	Enter the sample point identification number. Identification numbers assigned by state or local agencies should be shown in parentheses.
Well Status:	Enter "A" if the well is active and "C" if the well is closed. If the Well I.D. is closed, note the date on which it was closed in the "comments" section.
Purpose:	Note the type of the well regulatory program and/ or agency for which the well is monitored (e.g., RCRA, TSCA (Toxic Substances Control Act), information, state agency assessment).
Gradient:	Note whether the well is upgradient, downgradient, or lateral to the specific unit or formation being monitored.
Well Depth:	Note the total distance in feet from the top of the well casing (or reference point) to the bottom of the well.
Elevation at Top of Casing:	Note the elevation from (MSL), from the top of the well casing (usually tenths of a foot). If elevations have been measured from another point, this variation should be noted on the Well I.D. Chart.
Normal Ranges:	These are ranges, chosen by the Program Managers, which represent historic values, including seasonal variations. NOTE--These are <u>not</u> Alert Levels!
Purge Volume:	Note the approximate number of gallons purged from the well (3-5 casing volume are recommended).

Depth to Water:	Note the approximate or average range of the depth to groundwater, to the nearest 0.01 foot, from the top of the well casing (or reference point) to the water surface.
Elevation (MSL) of Water:	Calculate the elevation (Mean Sea Level) of the groundwater surface.
Time Needed to Recharge:	Note the approximate time, in hours, required for the well to recharge sufficiently to collect all samples.
Temperature:	Note the approximate or average or range of the water temperature in degrees celsius.
pH:	Note the water's pH in standard pH units.
Specific Conductance:	Note the approximate conductivity values, in umhos/cm. at 25°C.
Comments:	In this section, document such things as well closure dates, specific monitoring requirements, or recharge information for Well Wizards.

A site map, which includes well locations and I.D. numbers, is available in the site-specific Groundwater Monitoring Plan, and is available to sampling team members for use in locating and identifying the wells.

Site: _____(____)

WELL I.D. CHART

Figure 4.2

Date: _____

Well I.D. Number	Well Status	Purpose	Gradient	Normal Range								
				Well Depth (Feet)	Elevation at Top of Casing (MSL)	Purge Volume (Gallons) "Elevation to Surface of Water" (feet)	Depth to Water (Feet) "Elevation to Surface of Water" (feet)	Time Needed to Recharge (Hours)	Temp. °Celsius	pH (Std)	Specific Conduct. (umhos/cm. at 25°C)	Comments

Completed by: _____

WELL I.D. CHART

Figure 4.2.1 Date: 3-10-90

Site: Sun Site Landfill (050)

Well I.D. Number	Well Status	Purpose	Gradient	Normal Range: Well Depth (Feet)	Elevation at Top of Casing (MSL)	Purge Volume (Gallons)	Depth to Water (Feet)	Time Needed to Recharge (Hours)	Temp. °Celsius	pH (Std)	Specific Conduct. (umhos/cm. at 25°C)	Comments
	A	RCRA	DOWN	60	468.31	8-10	15'-18'	4	12	7.0-7.3	350-450	
	A	RCRA	DOWN	90	466.73	10-15	25'-27'	7	10	7.3-7.5	275-325	
	C	STATE	UP	30	465.11	1-3	35'-40'	48	13	7.5-7.7	350-370	Well abandoned 6/80
	A	RCRA	UP	50	495.81	8-10	5'-6'	72	14	6.5-6.8	1570-1800	Recharge time per R. Eng.
	A	RCRA	DOWN	120	495.76	20-25	10'-12'	24	10	6.1-6.4	970-1100	Strong odor
	A	RCRA	DOWN	70	515.81	7-10	30'-32'	<1	11	7.1-7.4	450-470	Good recharge rate

4.1.2 Sampling Schedules

For each site, the EML and the Regional and/or Site Engineer or Program Manager will review site and sampling information, including a schedule, which will be documented on the monitoring program. This document contains a description of a program, a schedule and approximate budget, sampling and analysis requirements, and administrative information (e.g., report distribution or AquaPak shipment address). Before each sampling event, the sampling and analysis requirements and the monitoring program must be verified.

After verification, the monitoring program is used by the EML to confirm the sampling event statement of work and to provide instructions to the sampling teams.

4.1.3 Verification or Initiation of a Sampling Event

The EML should be notified at least 50 days before a sampling event is scheduled. Sample bottles and AquaPaks are sent via courier (e.g., United Parcel Service), which requires approximately 5-7 days for delivery. For an emergency event, designated by the Regional and/or Site Engineers, AquaPaks, and bottles can be sent via overnight delivery (Federal Express), or they can be delivered by the subcontract laboratory. The need for express shipments at local labs or at the site can be minimized if storage space is available. In case of emergencies, a subcontract laboratory may be used if it is found on the non-WMI testing laboratory list. Insufficient notice of a event tends to increase costs, so as much notice as possible should be given before beginning the sampling event.

When verifying a sampling event, reference should be made to the appropriate monitoring program. An example of a monitoring program or Program Manager's Checklist is given in Figure 4.3. AquaPak shipment arrangements and any other special instructions should also be verified. Any changes should be noted verbally and confirmed in writing by sending the corrected Program Manager's Checklist to the appropriate EML Account Representative.

New events are created by written or verbal communication with EML Account Representatives, who will create and forward a Program Manager's Checklist for confirmation of the event. For emergency events, this information can be provided verbally, but it must also be confirmed in writing, using the Program Manager's Checklist. The information in the

Figure 4.3

WMI
Monitoring Program Services - Administrative Information
Programs Manager's Checklist

Monitoring Program No: 418912-00000
Period covered: 01/1991 - 12/1991
Region: TES District:

Rev # 00 Type: R
Rev date: 01/28/1991
Month: ALL

Description:
ROUTINE ENVIRONMENTAL MONITORING PROGRAM

Revision History:
1/28/91: EXAMPLE FOR SAMPLING MANUAL.

		Correct? Y	Correct? N	Changes
Site #418 :	WMI Landfill	[ ]	[ ]	
Site Address:	Landfill Address	[ ]	[ ]	
		[ ]	[ ]	
City:	Landfill City	[ ]	[ ]	
State & Zip:	XX 99999	[ ]	[ ]	
Phone	(999) 999-9999	[ ]	[ ]	
Program Manager:	MANAGER,X.	[ ]	[ ]	
Address:	WMI	[ ]	[ ]	
		[ ]	[ ]	
City:		[ ]	[ ]	
State & Zip:	000000000	[ ]	[ ]	
Phone	(000) 000-0000	[ ]	[ ]	
Alt. Program Mgr:	ALTERNATE,X.	[ ]	[ ]	
Address:		[ ]	[ ]	
		[ ]	[ ]	
City:		[ ]	[ ]	
State & Zip:	000000000	[ ]	[ ]	
Phone	(000) 000-0000	[ ]	[ ]	
Sampling Team:	SAMPLER,X.	[ ]	[ ]	
Address:	WMI OR CONSULTING FIRM	[ ]	[ ]	
	OFFICE ADDRESS	[ ]	[ ]	
City:		[ ]	[ ]	
State & Zip:	000000000	[ ]	[ ]	
Phone	(000) 000-0000	[ ]	[ ]	
Aquapak Shipment:	SAMPLER	[ ]	[ ]	
Address:	WMI OR CONSULTING FIRM	[ ]	[ ]	
	AS ADDRESS	[ ]	[ ]	
City:		[ ]	[ ]	
State & Zip:	000000000	[ ]	[ ]	
Phone	(000) 000-0000	[ ]	[ ]	

Figure 4.3 (cont.)

WMI
Sampling and Analysis Requirements
Programs Manager's Checklist

Monitoring Program No: 418912-00000
Task: # 01
Description: 2 WELLS, 1 FIELD BLANK

Rev # 00
Rev Date: 01/28/1991
Status: I

Month #			Correct? Y	N	Changes
JAN 1	Report Due: 02/28/1991	Fixed Sampling Date: 01/28/1991	[ ]	[ ]	_____
	Sample Matrix Code: W	Name: WELL			
	Sample Points: 01FB MW01 MW02		[ ]	[ ]	_____

Method Name	F	Report to	Lab	Y	N	Changes
ALKALINITY TOTAL METHYL O	N	WMI	EML	[ ]	[ ]	_____
CHLORIDE, AUTOMATED FERRI	Y	WMI	EML	[ ]	[ ]	_____
CHEMICAL OXYGEN DEMAND	Y	WMI	EML	[ ]	[ ]	_____
TOTAL ORGANIC CARBON DUPL	Y	WMI	EML	[ ]	[ ]	_____
SOLIDS,TOTAL SUSPENDED(RE	N	WMI	EML	[ ]	[ ]	_____
MERCURY BY COLD VAPOR AA-	Y	WMI	EML	[ ]	[ ]	_____
SSOLVED K BY FLAME AA	Y	WMI	EML	[ ]	[ ]	_____
LEAD BY GFAA-DISSOLVED	Y	WMI	EML	[ ]	[ ]	_____
CALCIUM BY ICP-DISSOLVED	Y	WMI	EML	[ ]	[ ]	_____
MAGNESIUM BY ICP-DISSOLVE	Y	WMI	EML	[ ]	[ ]	_____
SUB BACTERIA COLIFORM	N	WMI	SCL	[ ]	[ ]	_____
SV BNA 625 MS REV 1	N	WMI	EML	[ ]	[ ]	_____
31 Volatile Compounds	N	WMI	EML	[ ]	[ ]	_____

Sampling Instructions: Correct? Yes [ ] No [ ]

WMIS MANUAL FOR GROUND WATER SAMPLING IS TO BE FOLLOWED.

XXXX PER REGULATIONS/PERMIT.

Special Instructions: Correct? Yes [ ] No [ ]

USE METHOD XXXX FOR XXXX PER REGULATIONS/PERMIT.
REPORT DUE TO STATE ON XX/XX/XXXX..

following sections is to be provided by completing the Program Manager's Checklist.

* Facility Name and Site Code

The facility name and site code must be provided and all results are reported using the facility site code rather than the facility name, to maintain confidentiality. All monitoring data in automated storage in LIMS are filed under this number. All analyses done for WMI by the EML are stored in the EML's system and transferred to LIMS under this code. Site codes are also used on all Field Chain-of-Custody Records and Field Information Forms. If a site is new or is being expanded, a site code must be obtained from the Client Services Department of the EML.

* Monitoring Program Task(s)

For regularly scheduled events, reference is given to the tasks to be included in sampling event. For unscheduled events, a new task will be assigned. Generally, all samples requiring identical analyses will be grouped under a single task.

* Number of Samples and Matrix

The number of samples to be collected and analyzed must be specified including field and trip blanks, sample types, and matrices (e.g., water, duplicates and soil). It is important to identify samples that may have a complex matrix or potential interferences, such as high sulfide or chloride or organic concentrations. These samples require special cleanup procedures prior to analysis. The categories of matrices are listed in the Appendix.

* Sample Point Designations

Sample point designations must be standardized to avoid confusion. These designations are to be limited to six characters (alphabetic and/or numeric). The EML's Account Representatives will assist clients determine sample point designation assignments for emergency situations. The designations established in LIMS are to be used by the sampling crew, by the EML, and by the subcontract lab. The EML has been instructed not to accept samples for analysis that do not contain established sample point identifiers. If a new code must be established, or if a code must be modified, contact both the Corporate Environmental staff and the EML's Client Services Department.

The EML also uses a prefix to the sample method designation code which identifies the sample type. Sample I.D.'s with the abbreviated method designation codes are printed on the bottle labels. The method designations and associated methods are listed in the Appendix.

For samples that are field duplicates, the appropriate source code with the designation code is to be used (e.g., X-DUP). The Program Manager will retain the identity of the duplicate sample.

* Method Designations

The lab group is identified with an abbreviation of lab name and methodology. This abbreviation helps differentiate various analysis requirements for a lab group's samples or program tasks. For example, with INICPDISFE: IN represents the inorganics lab group; ICP represents ICP methodology; DIS represents dissolved and FE represents the metals for which to analyze (iron).

* Sampling Date(s)/Schedule

Specific dates for sample collection are to be scheduled as soon as possible. Expected arrival dates for sample AquaPaks should be communicated to the EML Account Representative or Sampling Coordinator so the lab manager may schedule work and reserve lab capacity for the event. Regulatory agencies should also be notified of scheduled dates as required.

* Analytes to be Tested/Reporting Requirements

The analytes to be tested are to be listed by sample designations. If not previously identified, non-routine detection limits or methodologies required by a regulatory agency must be defined as special instructions.

* Required Sampling Arrangements

The sampling team must be identified. The EML's Account Representative will maintain communications with those responsible for sampling (e.g., AquaPak check, transportation arrangements), and will work with the sampling team in coordinating sampling schedules. For special events, special expertise or equipment may be required, and as much information as needed should be provided for the subcontract sampling team.

* Delivery Address for AquaPaks and Sample Bottles

The delivery address for AquaPaks and sample bottles may be the subcontract lab, the sampling subcontractor, the site, or another WMI facility. Specific information should be given about the delivery location information including building and room. This will minimize the need to relocate AquaPaks and sample bottles for storage. The Program Managers's name will be included on all AquaPaks. A site contact is also necessary to allow the sampling team access to the site, to confirm arrival of sample bottles, etc.

* Special Instructions

Special instructions must also be noted. Some examples are noted next.

1. For emergency events, frozen ice packs may be received with the AquaPaks at the site. This must be specified,

2. Special packing requirements should be noted (e.g., bottles required for splits),

3. Special report requirements should be noted (e.g., state reporting forms),

4. Known interferences or known high levels of a compound from a specified sample point should be identified so special analytical procedures can be followed.

5. Sample filtering procedures, if used in the field, should be noted.

After an event is scheduled or declared, the EML will contact the subcontract laboratory and place an order. To confirm information concerning the sampling, copies of the Statement of Work (S.O.W.) (Figure 4.4) will be sent to the subcontract lab and sampler. The sampling team is to use Facility Codes and sample point designations identified in the S.O.W. and follow sampling instructions provided.

* Turnaround

The standard turnaround for analytical results is within 25 days from sample receipt by the lab. Exceptions may be made for unusual detection limits, odd matrices, special compounds, and subcontracted analyses.

Monitoring Program Information

MP no.	Rev	Rev date	Task	Month	ENS no.	Samp Date	No. AquaPaks
001	02	07/31/90	18	JUL1	90-11014	07/15/90	004

Sample Matrix Code: W | Sample Matrix Name: WELL

Site Information	Description
Number: 417 Name : EML Location: Aurora , IL	DEMONSTRATION EVENT

Sample Points:

AM1 AM2 FP01 FP02 PM1 PM2

---------- END SAMPLING REQUIREMENTS ----------

Method ID	Method Description	F	#	Size	Type	Preservative	Lab
CRCODXXX01	CHEMICAL OXYGEN DEMAND	Y	01-0125	G		H2SO4	EML
CRTDSXXX01	SOLIDS,TOTAL DISSOLVED(RE	N	01-1000	P		NONE/COOL 4 DEG C	EML
FDWDTWTC01	FDW/DTW TOP OF CASING		-				EML
FDWGWELWDT	FDW/GW ELEV/W DEPTH TOT		-				EML
FDWPURINFO	FDW/PURGING INFOMATION		-				EML
FDWPURSAMP	FDW/PURGING/SAMPLING EQUP		-				EML
FDXTEMPC01	FD/H2O TEMP IN DEG C		-				EML
FDPHSING01	FD/PH - SINGLE		-				EML
FDSPCOND01	FD/SP COND - SINGLE		-				EML
ICPDISBA	BARIUM BY ICP-DISSOLVED	Y	01-0500	P		HNO3	EML
ICPDISCA	CALCIUM BY ICP-DISSOLVED		-				EML
INICPDISCO	COBALT BY ICP-DISSOLVED		-				EML
INICPDISCR	CHROMIUM BY ICP-DISSOLVED		-				EML
INICPDISCU	COPPER BY ICP-DISSOLVED		-				EML
INICPDISMN	MANGANESE BY ICP-DISSOLVE		-				EML
INICPDISXB	BORON BY ICP-DISSOLVED		-				EML
INICPDISZN	ZINC BY ICP-DISSOLVED		-				EML
INCVAADIHG	MERCURY BY COLD VAPOR AA-	Y	01-1000	P		HNO3	EML
INGFAADIAS	ARSENIC BY GFAA-DISSOLVED		-				EML
INGFAADICD	CADMIUM BY GFAA-DISSOLVED		-				EML
INGFAADIPB	LEAD BY GFAA-DISSOLVED		-				EML
INGFAADISE	SELENIUM BY GFAA-DISSOLVE		-				EML
SVMS1BNA06	SV BNA 625 MS REV 1	N	02-1000	G		NONE/COOL 4 DEG C	EML
VOMSAAN301	31 Volatile Compounds	N	04-0040	G		HCL	EML
SVMS1BNA06	** SEMI-VOLATILE DUPS **	N	02-1000	G		NONE/COOL 4 DEG C	EML
VOMSAAN301	****** TRIP BLANK ******	N	01-0040	G		HCL	EML

---------- END BOTTLE REQUIREMENTS ----------

Sampling Instructions:

WMIS MANUAL FOR GROUND WATER SAMPLING IS TO BE FOLLOWED.
REFER TO SITE SPECIFIC MONITORING MANUAL; WELL AM1 MAY BE SLOW TO RECHARGE.

Special Instructions:

FILES REQUIRED SEMI-ANNUALLY.
K TASK 18 AND 19 TOGETHER.
CADMIUM BY GFAA BECAUSE LOW REPORTING LIMITS NEEDED.

---------- END STATEMENT OF WORK ----------

Express or emergency turnaround, (under 14 days) when required, must be communicated to the EML. Surcharges will be added to emergency turn around time events.

4.2 Presampling Procedures

Once the sampling event has been scheduled and declared, a considerable amount of preplanning must be done to ensure that sampling will go smoothly. Presampling procedures include procuring and calibrating of field meters and equipment, inspecting AquaPaks, reviewing Statement of Work Forms, and completing Field Chain-of-Custody Records. These procedures are addressed in the following sections. It is suggested that preparation for the sampling event begin at least one week before the event, to ensure enough time to complete all of the steps and correct any problems that occur. For emergency events, contact the EML for help to abbreviate procedures.

4.2.1 Organizing Equipment and Materials

All equipment necessary for a sampling event should be cleaned and/or decontaminated, checked and, if necessary, calibrated before going into the field. As much preparation as possible should be done ahead of time since neither the facilities nor the material required for equipment cleaning and calibration may be available at the facility.

The following is a checklist of equipment that may be required for a sampling event (Figure 4.5).

PRESAMPLING CHECKLIST
Figure 4.5

A. Nondedicated Equipment

1. Bailers

	PVC	Stainless	Teflon
3/4 inch	_____	_____	_____
1 1/2 inches	_____	_____	_____
3 inches	_____	_____	_____
Other	_____	_____	_____
S. steel chain/ cable/line		_____	

2. Spare parts for equipment

_____ Stainless steel chain
_____ Tubing
_____ Elbows
_____ Air hoses
_____ Well Wizard maintenance kit

3. _____ Gasoline compressor and controller

4. _____ Gas cylinder and regulator

B. Field Measurement Equipment

Primary	Backup
1. _____pH	1. _____pH
2. _____Specific conductivity	2. _____Specific conductivity
3. _____Temperature	3. _____Temperature
4. _____Temperature probe	
5. _____Depth to water probe	
6. _____Weighted tape with popper	
7. _____Surveyor's tape measure	

8. _____Specific conductivity standards
9. _____pH buffers

C. Site-Specific Material

1. _____ Site map with well location
2. _____ Well I.D. Chart
3. _____ Keys for wells and gates
4. _____ Frozen ice packs
5. _____ Deionized water (or laboratory reagent quality) (five gallons minimum)
6. _____ Filtering equipment
7. _____ S.O.W.
8. _____ Site-specific Groundwater Monitoring Plan
9. _____ AquaPaks
10. _____ Extra bottles (e.g., pre-filtration bottles)

D. Other Sampling Equipment

1. _____ Personal protective equipment
2. _____ Preservative kit
3. _____ Tools (e.g. pipe wrench)
4. _____ Funnels
5. _____ Calibrated 5-gallon bucket
6. _____ Disposable latex or PVC gloves (without powder)
7. _____ Paper towels
8. _____ Flashlight
9. _____ Calculator
10. _____ Camera
11. _____ Conversion charts
12. _____ Black pens and permanent marker
13. _____ Field meter log book
14. _____ Manual for groundwater sampling

4.2.1.1 Pumps

The type of pump used depends on the site conditin and nature of the analytes being tested. Positive-displacement bladder pumps constructed of teflon and stainless steel or PVC (e.g. Well Wizard (R)) are the preferred type of pump for most sampling programs. Before another type of pump is used, its advantages and disadvantages should be evaluated. For example, bladder pumps are preferred for volatile organic compounds because the use of suction-lift pumps may result in degassing and the loss of volatile compounds. Portable submersible pumps are not suitable if lubricants are used in the pump, since that can cause the sample to be contaminated with organics. Air-lift samples may result in degassing and the loss of volatile compounds. Air-lifted samples are also not suitable when sampling for pH-sensitive analytes, such as metals.

When non-dedicated pumps are used, stringent cleaning procedures must be followed between sampling sites. Before purging wells at the next site, sufficient amounts of deionized or laboratory reagent quality water must be flushed through the pump and tubing. Figure 4.6 is a form for non-dedicated pump cleaning documentation. Figure 4.6.1 is an example of a completed form.

Decontamination procedures should be performed in a clean room or laboratory environment.

To clean a non-dedicated pump, place it in a PVC or stainless steel standpipe, filled with laboratory grade deionized or laboratory reagent quality water. Add a continual supply of water to the standpipe. Initial specific conductance and amount of deionized or laboratory reagent quality water used should be accurately measured and recorded on Figure 4.6. The pump and tubing should continue to be flushed until the specific conductance of the discharged deionized or laboratory reagent quality water is within ±10 umhos (at 25°C) of the initial measurement. (See Figure 4.6.1 for an example). Once this figure is achieved, the pump and tubing should be properly stored and will be ready for use at the next site.

Decontamination procedures at the sample location are also important. To ensure the integrity of a non-dedicated pump between wells, a minimum of three gallons of deionized or laboratory reagent quality water should be used to thoroughly flush the pump and tubing before and after use at each well.

4.2.1.2 Bailers

Bailers should be made of suitable inert materials, when monitoring for organic compounds, (such as stainless steel or PVC or in some cases teflon). They are appropriate for sampl ing all required RCRA parameters. Stainless steel bailers should be used for such applications as "oily" matrices where ease of cleaning and possibly durability may be a factor. PVC bailers with nonglued joints may also be used. Non-dedicated equipment should only be used in emergencies. When used, non-dedicated bailers must be triple-rinsed with deionized water (or laboratory reagent quality) before and after sampling each well. Dedicated bailers require no rinsing. Disposable bailers may be used at each well if preferred.

NONDEDICATED PUMPS:
LABORATORY CLEANING DOCUMENTATION

Figure 4.6

				Deionized Water					
Date	Pump #	Pump/Mfg. Model #	Initial sp.cond. of deionized water at 25°C	Number of Gallons Used	Sp. cond. at 25°C	Number of Gallons Used	Sp. cond. at 25°C	Number of Gallons Used	Sp. cond. at 25°C

NONDEDICATED PUMPS:
LABORATORY CLEANING DOCUMENTATION

Figure 4.6.1 SAMPLE

				Deionized Water					
Date	Pump #	Pump/Mfg. Model #	Initial sp.cond. of deionized water at 25°C	Number of Gallons Used	Sp. cond. at 25°C	Number of Gallons Used	Sp. cond. at 25°C	Number of Gallons Used	Sp. cond. at 25°C
5/16/90	#A	FULTZ #SP-202	12	10	40	10	15	N/R	N/R
5/30/90	#A	FULTZ #SP-202	10	10	100	10	65	25	17
6/30/90	#A	#5E12	9	10	15	N/R	N/R	N/R	N/R

4.2.1.3 The AquaPak and Sample Bottles

The sampler or sampling team is responsible for checking all sample bottles and AquaPaks when received and for preparing ice packs prior to the sampling event. This person must immediately notify the EML of any problems or questions. The AquaPaks may also be shipped to the subcontractor or to the sampling site, depending on the location requested when the monitoring program is created. If AquaPaks are shipped to the site, the subcontractor must communicate with those on the site to ensure the timely arrival of AquaPaks. The subcontractor must also communicate with site personnel to ensure access to the site before the sampling event so that equipment, AquaPaks, and supplies may be checked. If the AquaPaks are shipped to the subcontract lab, the recipients must arrange with site's Program Manager who will contact the EML to arrange for the delivery of the AquaPaks to the sampling team. (Note: It is important that AquaPaks be sorted in buildings that do not contain solvents, cleaners or gasoline or diesel fuels.)

Bottles from more than one lab may be used when sampling. The following are some examples:

* All sample bottles and AquaPaks from the EML.
* Sample bottles and AquaPaks from both the EML and the subcontract lab.
* Bottles supplied by a regulatory agency for split samples.

The EML provides AquaPaks, which are rotary molded, high-density, plastic insulated sample containers. Each AquaPak also contains bottles packed in molded polyethene. Ice packs are provided to thermally preserve samples for up to 40 hours. Chain-of-custody seals, preservatives and forms for documentation of the sampling event, are also provided within the AquaPak.

The EML will notify the sampling team of AquaPak delivery arrangements and of the correct contents of all AquaPaks. Before the sampling event, the team leader will receive information for the sampling program on the Statement of Work (see Figure 4.4).

Upon receipt of the AquaPak, the gray numbered seal must be examined. If it is not intact, contact the EML immediately for instructions. If the seal is unbroken, break the seal, open the AquaPak, and remove the plastic field

bag from inside. (Document the seal number on the Field Chain-of-Custody Record.)

This bag contains Field Chain-of-Custody Record and Field Information Forms, red temporary seals, return labels, a Federal Express ticket, and one gray numbered seal. The gray seal is used as the final seal when the AquaPaks are returned to the lab. The red, unnumbered seals are used to seal the AquaPak if it is left unattended.

Fill out the Field Chain-of-Custody Record (Figures 4.7 and 4.7.1) and Field Information Form (Figures 4.8 and 4.8.1) when initially opening the AquaPak (e.g. record the seal number). If the samples are returned directly to the EML, send the white (original) and yellow copies of both the Field Chain-of-Custody Record and the Field Information Form with the samples. If samples are returned directly to a subcontract lab, send the pink copy of the subcontract Chain-of-Custody Record to the EML with the AquaPak.

Note the arrangement of the bottles and ice packs inside the AquaPaks before removing them. Repack them in the same order when sampling is complete. AquaPaks are packed for economy of space and often, unless special attention is given, it is difficult to fit everything back in place.

An inventory of the bottles and their condition should be noted. The bottle list, analyses required, and preservation requirements are noted on the Field Chain-of-Custody Record in the "AquaPak Contents" section. Each sample bottle is labeled with its own bottle I.D. number, which refers to the lab group, method of filtering, and necessary preservatives. All bottles used for a particular sample point must have the same bottle set number, since samples from several sample points may be packed in the same AquaPak.

New, properly cleaned sample bottles are provided in each AquaPak. The type of bottle will vary depending on the analysis required. For samples requiring preservatives, premeasured amounts of preservatives are supplied in small vials and are placed next to the proper bottle in the bottle holder. These preservatives should be added to the sample bottles after filling. However, the preservatives for the VOA and TOX methods are placed in the bottle prior to shipment. Each bottle is labeled with a sticker to identify the preservatives that are required. Preservatives must not be put in bottles that do not require them. Verification that the appropriate preservatives have been included with the bottles and that the appropriate

bottles are available is imperative. A list of sample bottles (type and size) and preservatives required for each analysis is included in the Appendix.

Each AquaPak that includes bottles for volatile organic analyses, also includes a trip blank (40 ml. vial filled with reagent free water). When volatile organic analyses have been requested, the AquaPak will contain a trip blank regardless of whether a request has been placed for analysis of the trip blank. Prior to shipment, the EML checks each trip blank vial to ensure that it has no air bubbles. Occasionally, due to pressure and temperature changes, small bubbles will appear in the blank. Note the condition of the blanks as, well as any relevant information about the AquaPak, on the Chain-of-Custody Record.

For field blank analyses, bottles will be included within the AquaPak. The water the sampling team uses in the field should be used for field blanks.

The AquaPak also contains ice packs to maintain sample temperature at the level required by EPA methods. The sampling period must be planned to allow adequate time for freezing of the ice packs. Usually a 24-hour period is required to ensure that the ice pack will be frozen solid. After the AquaPak is checked in, the ice packs should be placed in the freezer, and the Field Chain-of-Custody Record is signed. The AquaPak is then closed and a red seal is placed through the chain of custody hole. The red temporary seals are to be used whenever the AquaPak is left unattended. The gray seal is to be used after sample collection when returning the AquaPak to the EML.

If any questions arise, or if there are any problems with the AquaPaks and their contents, call the EML before proceeding.

4.2.1.4 Equipment Storage

If storage before sampling is necessary, all AquaPaks, containers, and equipment are inspected, and must be stored in a designated, contaminant-free area. (i.e. a room free of solvents, cleaners, gasoline or where none of these products are ever used.) The area must be locked. All AquaPaks must be sealed (use the red temporary seal).

Occasionally, some bottle sets will not be used (for example, if the well was dry and no sample could be taken). These sets should be returned to the lab.

Unused AquaPaks should be returned to the EML via air courier after sampling is completed. The lab must be notified regarding the return of unused AquaPaks.

4.2.1.5 Calibration and Use of Meters

The proper measurement and documentation of field analytes are integral parts of a monitoring program. Before going to the field, all equipment must be cleaned and checked for any malfunctions.

The sampling team must calibrate all meters before using them in the field. This is necessary to ensure the proper working order of the meters, and to ensure the integrity the values measured. Manufacturers' calibration procedures must be followed. Where the manufacturer has provided no calibration procedures, follow the procedures contained in Standard Methods for the Examination of Water and Wastewater, 17th Edition.

NOTE: A COPY OF THE PROCEDURES USED IN THE CALIBRATION OF THE FIELD METERS SHOULD BE ATTACHED TO YOUR COPY OF THIS MANUAL

Calibrate the pH meter using pH 7 and pH 10 buffers, and a pH 4 buffer as a check, or with pH 7 and pH 4 buffers, and a pH 10 buffer as a check. The choice depends on the expected pH values of the samples. The calibration for pH is temperature-corrected. Please note the actual pH of your buffers at the temperature used for calibration. A chart for this is usually provided on the buffer container. You may need to calibrate the PH 7 buffer to 6.95 or 7.03 or some point in between, depending on the temperature of your buffers. This second standard should be within ±0.1 pH unit of the expected value (e.g., pH 4 buffer, calibrated to within pH 3.90-4.10). The measured value for the check buffer must be within the recalibration limits listed at the bottom of the page. If not, the meter must be recalibrated.

Calibrate the specific conductance meter standard for the conductivity expected at the site at (or converted to) 25°C. At least one additional standard must also be checked, of the same conductivity as the original standard, but cooled below room temperature (refrigerated). Checking the conductivity of this cooled standard checks the automatic temperature compensation of the meter (or conversion calculation). Specific conductance must be within ±5% of the expected value (e.g., 1,413 umhos standard, calibrated to within 1,342-1,484). If the recheck of either of the instrument's calibration does not fall within these limits, the instrument

must be recalibrated. The calibration of the field instruments must be checked every four hours and at the end of the day. Additional information on calibration of redox potential (Eh), dissolved oxygen (DO) and turbidity meters may be found in the Appendix.

If the result of the calibration check is not within the limits listed in the preceding paragraph, the meter must be recalibrated and noted in the log book. Note that the range of each well is a more important guideline.

All thermometers must also be checked, before each sampling event, for accuracy against a National Bureau of Standards (NBS) calibrated thermometer. Record this information in the Field Meter Log Book.

Sampling team members are responsible for maintaining log books for all field meters. These log books contain the same information as those for permanent lab instruments (e.g., serial number, name and model of meter, year purchased, etc.). These books also contain quality control (QC) results, maintenance performed by the factory, and calibration notes for each day the equipment is used.

NOTE: Log books may be obtained from the Senior Director of Quality Assurance for CWM for use by CWM personnel. (Refer to Figures 4.7 and 4.7.1 for examples of a log book page.)

Measure and record the specific conductance of the deionized or laboratory reagent quality water being used in the field each morning. Record the daily conductivity values in the log book of the meter that is used (field or lab). If the specific conductance of the deionized or laboratory reagent quality water is greater than 50 umhos at 25°C, the Program Manager or Site Engineer should be contacted immediately. The suspect deionized or laboratory reagent quality water should <u>not</u> be used in that case. Deionized water or reagent quality should be obtained from an alternate source (e.g., subcontract lab, EML) until the problem can be corrected.

FIELD METER LOG BOOK

Figure 4.7

		Temperature		pH Results						Specific Conductivity				Deionized Water
Date	Meter #	NBS	Meter	Read 7	Calibrate 7	Read 4	Calibrate 10	Read 4	Calibrate 4	Std.	At 25°C	At X°C	°C	Specific Conduct.

FIELD METER LOG BOOK

Figure 4.7.1 SAMPLE

		Temperature		pH Results						Specific Conductivity				Deionized Water
Date	Meter #	NBS	Meter	Read 7	Calibrate 7	Read 4	Calibrate 10	Read 4	Calibrate 4	Std.	At 25°C	At X°C	°C	Specific Conduct.
3/6/85	II	24.7°	25°	–	–	–	–	–	–	–	–	–	–	–
3/6/85	I	–	–	7.06	7.00	10.03	10.00	(check) 4.01	N/R	–	–	–	–	–
3/6/85	III	–	–	–	–	–	–	–	–	707	715	700	10°	<10
3/6/85	III	–	–	–	–	–	–	–	–	1413	1405	–	–	–
3/6/85	(backup) I(A)	24.3°	25°	7.04	7.00	10.08	10.00	(check) 4.03	N/R	707	700	723	10°	<10
3/6/85	(backup) I(A)	–	–	–	–	–	–	–	–	1413	1405	–	–	–

4.2.2 Completing Field Records

Improper documentation or inadequate information regarding the circumstances of collection and/or subsequent disposition of the samples (e.g., field chain-of-custody) may render resultant data useless. Proper chain-of-custody documentation is a crucial part of the quality assurance and quality control (QA/QC) program. Comprehensive, consistent, and accurate documentation of field tests, measurements, and field observations is also extremely important.

Two forms must be filled out by the sampler during a sampling event. A Field Chain-of-Custody Record and a Field Information Form are completed for each sample. The original for each form must be sent with the samples to the lab. Under no circumstances will samples be analyzed without these forms. The forms are included in the client report the EML prepares when the analyses are complete. If sample bottles and AquaPaks are provided by both the EML and a subcontract lab, and each supplies Field Information Forms, only one should be filled out for each sample point. These forms must be completed with black (ball point) ink only. Pencils and felt-tip pens should not be used.

Copies of all forms are to be maintained by the Program Manager and Regional and/or Site Engineer for easy reference. Analytical data and field forms must also be maintained in the site files.

4.2.2.1 Field Chain-of-Custody Record (Figures 4.8 and 4.8.1)

To help maintain the integrity of the samples, strict chain-of-custody procedures are necessary. These procedures ensure that tampering with the samples does not occur. From the time the sample bottles leave the laboratory until the issuance of the analytical laboratory results, the samples and/or sample containers must be in the custody of assigned WMI personnel or an assigned consultant or contractor. In order to maintain the chain-of-custody, the samples must be:

* in sight of the assigned custodian;
* locked in a tamper-proof location; or
* sealed with a red, tamper-proof seal.

A written record of sample bottle possession and any transfers of samples must be maintained, and documented on the Field Chain-of-Custody Record.

The Field Chain-of-Custody Record is signed with the date and time for the following activities:

* Each time the AquaPak's seal is broken. When the AquaPak is initially opened for inspection of its contents, the seal number must also be noted.

* Each time the AquaPak is transferred to the custody of another person.

* Immediately before sealing the AquaPak for transport to the lab. (The form must be signed and enclosed within the field bag.) For the EML AquaPaks, the seal number must also be noted. Samples from the same sample point that are placed in more than one AquaPak require a Field Chain-of-Custody Record in each AquaPak.

In addition, the sample point designation, source code, date, and time (starting) for sampling must be recorded on the form. Use of prefiltration bottles and any problems with the AquaPaks' contents must also be noted on the form. Upon receipt of the AquaPak by the lab, the seal is broken, and the condition of the samples, temperature, date, and time are recorded on the Field Chain-of-Custody Record by the log-in personnel receiving the AquaPaks.

The Field Chain-of-Custody Record indicates by bottle and analysis group whether samples are to be preserved. If actual preservation and filtration procedures vary from the instructions provided in these spaces, the chain-of-custody instructions must be modified by a member of the sampling team and initialed in the appropriate locations provided on the Field Chain-of-Custody Record or on the accompanying Field Information Form. Failure to complete the Field Chain-of-Custody Record will render the data useless. Use the Chain-of-Custody Record checklist (page A-7) to ensure all pertinent information has been included.

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # _____
Date Sealed |_|_|_|_|_|_| YY / MM / DD
Seal # _____
By: _____

E/FACILITY # |_|_|_|_| SITE NAME: _____

Sample Point: |_|_|_|_|_|_|_|_| Source Code

SAMPLE DATE: - |_|_|_|_|_|_| YY / MM / DD

SAMPLE TIME: |_|_|:|_|_| (2400 HR.) MATRIX CODE: _____

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes

Well ..... (W) Leachate System ... (C) Pretreatment Facility ... (P) River/Stream/Brook ... (R) Soil ..... (S) Generation Pt. ..... (G)
Dewatering/Pressure Relief .... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Noise ..... (N) Specify _____

ENS #

AquaPak™ CONTENT

SAMPLE I.D	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y — N	FIELD COMMENTS	E.M.L. COMMENTS
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		
					Y / N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) _____ Date: / / Time: : 2400 HR.
Signature: _____ Seal #: _____ Intact: _____

I have received these materials in good condition from the above person.

2. Name: _____ Signature: _____
Date: / / Time: : 2400 HR. Remarks: _____

I have received these materials in good condition from the above person.

3. Name: _____ Signature: _____
Date: / / Time: : 2400 HR. Remarks: _____

AquaPak™ Sealed By: (print) _____ Date: / / Time: : 2400 HR.
Signature: _____ Seal #: _____ Intact: _____

LAB USE ONLY
Opened By: (Signature) _____ Date: / / Time: : 2400 HR.
AquaPak™ # _____ TEMP. °C _____ SEAL # _____ INTACT. _____

ORIGINAL LAB

Figure 4.8.1

WMI Environmental Monitoring Laboratories, Inc.

FIELD CHAIN-OF-CUSTODY RECORD

AquaPak™ PREP
AquaPak™ # ___
Date Sealed ___ / ___ / ___ (YY / MM / DD)
Seal # 18296
By: MOG

SITE/FACILITY # ___ SITE NAME: ___

Sample Point: ___ (Source Code)

SAMPLE DATE: ___ (YY / MM / DD)

SAMPLE TIME: ___ (2400 HR.) MATRIX CODE: ___

Water ..... (W) Leachate ..... (C)
Soil ..... (S) Other ..... (X)

Source Codes

Well ..... (W) Leachate System ... (C) Pretreatment Facility ... (P) River/Stream/Brook ... (R) Soil ..... (S) Generation Pt ..... (G)
Dewatering/Pressure Relief ... (D) Gas Condensate ... (M) Influent ..... (U) Lake or Ocean ..... (L) Bottom Sediment ... (B) Other ..... (X)
Surface Water Impoundment ... (I) Air ..... (A) Effluent ..... (T) Outfall ..... (O) Hose ..... (H) Specify ___

ENS # ___

AquaPak™ CONTENT

SAMPLE I.D.	# OF BOTTLES	BOTTLE TYPE	PRESERVATIVE TYPE	ANALYTES/LAB GROUPS	FILTER Y—N	FIELD COMMENTS	E.M.L. COMMENTS
[illegible]	[illegible]	[illegible]	[illegible]	CR	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	CR	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	IN	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	IN	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	SV	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	SV	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	VO	Y/N		
[illegible]	[illegible]	[illegible]	[illegible]	VO	Y/N		
					Y/N		
					Y/N		
					Y/N		
					Y/N		
					Y/N		
					Y/N		
					Y/N		
					Y/N		

CHAIN OF CUSTODY CHRONICLE

1. AquaPak™ Opened By: (print) ___ Date: ___ / ___ / ___ Time: ___ : ___ 2400 HR.
   Signature: ___ Seal #: ___ Intact: ___

I have received these materials in good condition from the above person.

2. Name: ___ Signature: ___
   Date: ___ / ___ / ___ Time: ___ : ___ 2400 HR. Remarks: ___

I have received these materials in good condition from the above person.

3. Name: ___ Signature: ___
   Date: ___ / ___ / ___ Time: ___ : ___ 2400 HR. Remarks: ___

AquaPak™ Sealed By: (print) ___ Date: ___ / ___ / ___ Time: ___ : ___ 2400 HR.
Signature: ___ Seal #: ___ Intact: ___

LAB USE ONLY
Opened By: (Signature) ___ Date: ___ / ___ / ___ Time: ___ : ___ 2400 HR.
AquaPak™ # ___ TEMP. °C ___ SEAL # ___ INTACT. ___

WMI GROUNDWATER MONITORING PROGRAM
Field Chain-of-Custody Record

Field Description

Seal #*:	Enter the actual number recorded from custody seal.
ENS #*:	Enter the grouping of similar sample points and analyses together, assigned for each sampling event.
AquaPak #*:	Enter the bar coded number on the AquaPak.
Date Sealed:	Enter the date sealed at the EML for shipment.
Site/Facility #:	Enter the site code of facility being sampled.
Site Name:	Enter the complete name of the site.
Matrix Code*:	Enter water(W), soil(S), leachate(C), other(X).
Sample Point*:	Enter the source code and sample point designation for the monitoring point.
Sample Date*:	Enter the date (yy, mm, dd) monitoring point is sampled.
Sample Time*:	Enter the time sampling begins (24-hour check).
Sample I.D. Contents:	Enter the bottle I.D. for each method being run.
# of Bottles:	Enter the actual number of bottles for this bottle I.D.
Bottle Type:	Enter the type of bottle (plastic or glass).
Preservative Type:	Enter the preservative for this bottle.
Analyte/Lab Groups:	Enter the lab group performing the analysis.
Filtered*:	Enter yes or no. Should agree with the information the statement of work/bottle information.

Field Comments*: Note whether the bottle was intact, preservatives were missing, or any other problems were noticed with the bottles. Any additional problems with the AquaPaks should be noted on this form as well (e.g., the AquaPak integrity, broken chain-of-custody seal). Also, note whether filtration was done in-line, or with pressure filtration in the field or in the lab.

EML Comments: Enter any problem with receipt of bottles (e.g., empty, broken, missing, leaking) or AquaPaks.

Chain-of-Custody Chronicle*:

1. To be filled out by the person opening and checking AquaPaks contents.

2 and 3. To be filled out by someone other than the person who opened it, who had temporary custody of the AquaPaks.

4. To be filled out by the person releasing the AquaPak to the shipper, or the person who finally seals it. Names listed for 3 and 4 must be the same.

If additional space is needed, an additional Field Chain-of-Custody Record or piece of paper may be attached to the original form. Do not write on the back of the form.

* Information filled out by sampler. The other information in this section is preprinted or manually filled out at the EML.

4.2.2.2 Field Information Forms (Figures 4.9 and 4.9.1)

The Field Information Form contains information regarding site and well conditions, sampling and purging procedures used, and field measurements. The Field Information Form must be filled out by the sampler for each sample point and enclosed in the AquaPak. If sample bottles are split between the EML and the subcontract lab, the Field Information Form must be enclosed in the AquaPak transported to the EML. A Field

Information Form does not have to be completed for the subcontract lab. Field Chain-of-Custody Records must be filled out for each sample point, including dry wells. The following information must be documented:

4.2.2.2.1 Sample Point

The source code and sample point designation are contained on the Field Chain-of-Custody Record for the sample. This information will be provided prior to sampling by the EML on the Statement of Work (Figure 4.4). All sample point designations must be approved by the Corporate Environmental staff to ensure appropriate coding.

4.2.2.2.2 Purging Information

This section should be completed if the sample points are wells. All wells must be purged prior to sampling. The date and time the well was purged, the elapsed time for purging, the volume of water in the casing (gallons), and the volume purged (gallons) must be documented.

The Field Chain-of-Custody Records and Field Information Forms must indicate whether the well was dry and if a sample was not collected. The Field Information Forms must contain the purging data.

4.2.2.2.3 Purging and Sampling Information Equipment

Document the types of equipment used for purging and sample collection, and the materials of which they are constructed. If Well Wizards or pumps are used, the pump and tubing material must be documented. If a code letter does not correspond to the actual material, then a written description must be provided.

4.2.2.2.4 Samples Composited

For samples composited in the field, the procedures and proportions of samples used are to be described in the Field Comments section of the Chain-of-Custody Record and Field Information Form. (For example, "one quart obtained hourly by grab sampling over 8 hours.")

4.2.2.2.5 Field Measurements

The Site Specific Groundwater Monitoring Plan and the statement of work indicates which measurements are to be taken for each sampling event. For groundwater sampling events, the groundwater elevation (depth to

groundwater adjusted to MSL and depth to water), temperature, pH, and specific conductance at 25°C are usually required to be determined. Additional field measurements such as dissolved oxygen, field turbidity, and redox potential (EH), may also be required if noted on the Statement of Work. Space is provided for these additional parameters. Note on the document the units and values of these measurements.

4.2.2.2.6 Field Comments

The section on field comments should include field observations such as:

* Condition of the well and dedicated equipment.

* Weather condition such as wind direction and speed, upwind activities, temperature, outlook (cloud cover), barometric pressure (where needed for regulatory requirements). Any difference in weather conditions between purging and sampling should also be noted.

* Any landfill gas odor coming out of the well head vent hole.

* Sample appearance: odor, color, turbidity.

  Odor: e.g., rotten eggs, earthy, strong, moderate, slight, metallic.

  Color: True "color" is the color after the turbidity has been removed. The color observed after sampling is an "apparent color," influenced by sediment in the sample. True color may be caused by among other things, metallic ions, humus, peat, or industrial chemicals. Hold the sample up to the light and describe the color as well as possible. Observations might include no color, brown, gray or yellow.

* Turbidity:

  None: (sample is clear.);

  Trace: (sediment only slightly clouds or colors the sample; sediment does not accumulate at the bottom of the bottle.);

  Moderate: (definite cloudiness or color; sediment accumulates at the bottom of sample bottle.);

  High: (muddy appearance.).

* Reference point for well measurements.

* Well I.D. where the field blank or duplicate sample is prepared.

* All calculations for purge volumes and temperature conversions. Note when wells are purged dry, or explain when less than three casing volumes are removed.

* Duplicate field measurement results.

* Other conditions, such as sample splits with regulatory agencies, potential safety or health hazards (e.g., fire ants, presence of landfill gas in well). Note whether sampling occurred downwind from the on-site activity or disposal.

  NOTE: When samples are split with regulatory agencies, note on the Field Information Form such things as the condition of the bottles or preservatives used by the agency.

4.2.2.2.7 Sampling Certification

On the bottom of the Field Information Form, the sample team leader must sign the form certifying that the sampling procedures were in accordance with applicable federal and state regulations, and corporate policy as outlined in the WMI Manual for Groundwater Sampling and the Site-Specific Groundwater Monitoring Plans. The person signing the sampling certification must be present throughout the entire sampling process.

4.2.3 Well Observations and Measurements

It is essential that during each sampling event various observations concerning the condition of the well be made. Also required are specific measurements such as purge volume, water level, and depth of well. These observations and measurements are all documented on the Field Information Form. Any abnormal or problem condition of the well and the surrounding area must be observed and recorded on the Field Information Form upon arrival at the well location.

WMI Environmental Monitoring Laboratories, Inc.

Site # ____

Bottle Set: ____

Sample Point: ____ (Source Code)

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (24:00 hr Clock)	ELAPSED HRS	WATER VOL. IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)

PURGING AND SAMPLING EQUIPMENT

Purging Equipment .....Dedicated | Y | | N | (circle one) Sampling Equipment .....Dedicated | Y | | N | (circle one)

Purging Device	____	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X-____ (PURGING OTHER (SPECIFY))
Sampling Device	____	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X-____ (SAMPLING OTHER (SPECIFY))
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	____	A-Teflon	C-Polypropylene	E-Polyethylene	X-____ (PURGING OTHER (SPECIFY))
Sampling Material	____	B-Stainless Steel	D-PVC		X-____ (SAMPLING OTHER (SPECIFY))
Tubing-Purging	____	A-Teflon	D-Polypropylene	F-Silicon	X-____ (PURGING OTHER (SPECIFY))
Tubing-Sampling	____	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X-____ (SAMPLING OTHER (SPECIFY))
		C-Rope X-____ (SPECIFY)			
Filtering Devices 0.45 μ:	____	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	____ (ft/msl)	Land Surface Elevation	____ (ft/msl)
Depth to water From top of well casing	____ (ft)	Depth to water From land surface	____ (ft)
Groundwater Elevation	____ (ft/msl)	Groundwater Elevation	____ (ft/msl)
Depth	____ (ft)	Stickup	____ (ft)

	pH	Spec. cond.	Sample Temp.
1st	____ (STD)	____ μm/cm at 25° C	____ (° C)
2nd	____ (STD)	____ μm/cm at 25° C	____ (other parameter) ____ (value) ____ (units)
3rd	____ (STD)	____ μm/cm at 25° C	____ (other parameter) ____ (value) ____ (units)
4th	____ (STD)	____ μm/cm at 25° C	____ (other parameter) ____ (value) ____ (units)

FIELD COMMENTS

Sample Appearance: ____ (if applicable) Odor: ____ Color: ____ Turbidity: ____

Weather Conditions: Wind Speed ____ Direction ____ Precipitation Y/N Outlook ____

Specific Comments: ____

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

____ / / ____ (Date) ____ (Signature) Employer: ____

FT-3A 4/90

ORIGINAL LAB

Figure 4.9.1

WMI Environmental Monitoring Laboratories, Inc.

Site # [illegible]

Bottle Set: AB8388

Sample Point: WAM1

FIELD INFORMATION FORM

PURGING INFORMATION

PURGE DATE (YY MM DD)	START PURGE (0400 Hr Clock)	ELAPSED HRS	WATER VOL. IN CASING (Gallons)	ACTUAL VOLUME PURGED (Gallons)
900130	1315	05	56	170

PURGING AND SAMPLING EQUIPMENT

Purging Equipment .....Dedicated (Y) N Sampling Equipment .....Dedicated (Y) N

Purging Device	C	A-Submersible Pump	D-Gas Lift Pump	G-Bailer	X- PURGING OTHER (SPECIFY)
Sampling Device	C	B-Peristaltic Pump	E-Venturi Pump	H-Scoop/Shovel	X- SAMPLING OTHER (SPECIFY)
		C-Bladder Pump	F-Dipper/Bottle	I-Piston Pump	
Purging Material	A/B	A-Teflon	C-Polypropylene	E-Polyethylene	X- PURGING OTHER (SPECIFY)
Sampling Material	A/B	B-Stainless Steel	D-PVC		X- SAMPLING OTHER (SPECIFY)
Tubing-Purging	G	A-Teflon	D-Polypropylene	F-Silicon	X- PURGING OTHER (SPECIFY)
Tubing-Sampling	G	B-Tygon	E-Polyethylene	G-Combination teflon/ Polypropylene	X- SAMPLING OTHER (SPECIFY)
		C-Rope X- (SPECIFY)			
Filtering Devices 0.45 μ:	A	A-In-line Disposable	B-Pressure	C-Vacuum	

FIELD MEASUREMENTS

Well Elevation	* 654.01 (ft/msl)	Land Surface Elevation	(ft/msl)
Depth to water From top of well casing	99.67 (ft)	Depth to water From land surface	(ft)
Groundwater Elevation	554.34 (ft/msl)	Groundwater Elevation	(ft/msl)
Well Depth	* 134.50 (ft)	Stickup	(ft)

1st	7.41 (STD)	1st	652 μm/cm at 25° C	Sample Temp.	12.8 (° C)
2nd	(STD)	2nd	μm/cm at 25° C	Well dia	2.0 in.
3rd	(STD)	3rd	μm/cm at 25° C	Stick-up	1.71 ft.
4th	(STD)	4th	μm/cm at 25° C		

FIELD COMMENTS

Sample Appearance: [illegible] Odor: Slight Color: Light gray Turbidity: Slight

Weather Conditions: Wind Speed 15 mph Direction Southwest Precipitation WN Outlook Partly cloud

Specific Comments: * Obtained from Well I.D. Chart (1990)
Well condition is good, access good.

134.5-99.67 = 34.83 x .163 = 5.67' x 3 = 17.0³
Good recharge rate; 3 casings obtained at 13:46 hrs.
Duplicate field readings: pH-7.44 at 13.0 SC-656
Well is located in N.W. corner of site - 10 yds. from haul/road

I certify that sampling procedures were in accordance with applicable EPA, State and WMI protocols.

1/31/91 Michael J. Grazioli Employer: WMI/EML

EML FF-2A 4/90

ORIGINAL LAB

4.2.3.1 Observe Maintenance Conditions at Well

The conditions of the well and its surrounding area must be observed and problems and changes recorded on the Field Information Form upon arrival at the well location. The following information should be noted:

* The presence and condition of the well's identification sign.
* Whether the well was recently painted.
* Whether the well is locked and whether the key works.
* Well integrity:
    * physical surroundings (e.g., high weeds, standing water, cleanliness, nearby activities).
    * condition of the Well Wizard or dedicated bailer.
    * condition of the protective casing.
    * any obstructions or kinks in the well casing.
    * condition of the cement footing (e.g., cracked, raised).
    * any presence of water in the annular space.
    * any grease around top of the well on the threaded caps.
    * whether the cap fits securely so contaminants cannot penetrate.
* Evidence of contamination (e.g., animal or insect parts in the well).
* Well guard posts' condition.

4.2.3.2 Measurements to Determine Purge Volume

The elevation of the groundwater at each monitoring well is determined for each sampling. The static water level is measured before well purging and sample withdrawal. The elevation of the groundwater is then determined by the following equation:

Groundwater elevation (MSL) =
Elevation at top of casing (ft. MSL)* – Depth to water (ft.)
*From Well I.D. Chart

Note: All well measurements must be made from the point at which the elevation was measured (e.g., top of the well casing). This point must be noted in the comments section of the Field Information Form.

4.2.3.3 Static Water Level Measurements

If wells have not been equipped with Well Wizards (which contain static head sensors to measure depth) a water level or slope indicator (or similar device) or weighted tape, is used to determine the static level of water in the well, as well as the total depth of the well. Water level indicators with lead weights should not be used.

A slope indicator works on a conductivity principle. An alarm sounds and a red light is seen when the probe comes into contact with the water. The cable is permanently marked in increments of tenths of feet or feet (0-150 feet). To measure the static water level with a slope indicator, the following procedures should be followed:

1. Rinse the slope indicator cable with deionized water or reagent quality water. Shake off all excess water and/or wipe the cable clean with a paper towel. Additional cleaning procedures may be implemented if required.

2. Switch the sensitivity dial to 4-5. Depress the red button. The red light should be seen and a buzzing sound should be heard. This will ensure that the meter is working.

3. Slowly unreel the cable into the well until the buzzing sound can be heard and the red light is observed on the meter. The cable should be lowered through the vent hole without removing the cap, if possible.

4. Slowly raise and lower the cable to the point when the buzzer and light (together) just begin to activate. This indicates the static water level.

5. Using the thumb and index finger, mark this position on the cable, using as a reference the point at which the elevation has been measured.

6. The measured distance should be recorded in hundreths of feet from the incremental slope indicator. If the slope indicator is not incremental, measure with a ruler the distance between the closest one foot increment and the point marked, to the nearest inch, and convert these units to hundreths of feet. Record this informationon the Field Information Form in hundreths of feet.

7. Rinse the slope indicator off with deionized or laboratory reagent quality water after reeling the cable back onto the spool. Record the measurement on the Field Information Form in hundreths of feet.

8. Shake off all excess water.

9. All measurements taken in feet and inches should be converted to hundredths of feet. Example: measure 10'8" = 10.67'. (See Conversion Chart in the Appendix.)

The following procedures should be used to determine the distance to the water using a weighted tape:

1. Check to see that the weight (or popper) is securely fastened to the tape. Wire (teflon coated if possible) is the preferred method for attaching the weight to the tape.

2. Thoroughly rinse the tape and weight with deionized or laboratory reagent quality water.

3. Shake off any excess water.

4. Slowly lower the weighted tape into the well, until the weight can be heard hitting the water.

5. Raise and lower the tape to determine the precise location at which the weight comes into contact with the water. If the well casing is wet, the tape may cling to the sides of the well. If so, shaking the tape while lowering and raising should provide an accurate measurement.

6. While holding the tape where the elevation has been recorded, note the measured value.

7. Record the measurement on the Field Information Form.

   If the end (bottom) of the weight has not been attached to the tape at the zero-inch mark, the original measurement will need to be recorded on the Field Information Form in the "comments" section. The additional distance, as measured from the end of the tape to the end of the weight, should be added to the original measurement. This final value should then be placed on the Field Information Form under "Field Measurements."

8. Reel the tape and weight out of the well, while wiping off any dirt or sediment.

9. Thoroughly rinse the tape and weight with deionized or laboratory reagent quality water.

10. Shake off any excess water.

4.2.3.4 Depth of Well Measurements

The depth of well measurement is required every two years or as required by permit. Wells with dedicated pumps installed may be exempt from this requirement. The depth of the well, when not measured, should be obtained from the Well I.D. Chart and noted on the Field Information Form in the Field Comments section. In the "comments section", indicate the information is "from Well I.D. Chart."

Use of the slope indicator or weighted tape for measuring the depth of the well is not as accurate as the water level measurement, as the bottom is determined entirely by "feel." This measurement should be reported to the nearest foot and inch and is used to calculate the volume of water in the casing for purging operations.

1. After recording the static water level, unreel the cable or tape until it hits the bottom of the well.

2. Slowly pull up the slack until slight tension is felt on the cable.

3. Slowly raise up and down until a feel for the bottom is obtained.

4. Using the point at which the elevation has been measured as a reference point, mark the cable with a finger, and measure as for the water level.

5. Reel the cable back onto the spool, rinse it with deionized or laboratory reagent quality water, and shake off all excess water.

6. Record the measurement on the Field Information Form.

4.2.3.5 Additional Field Measurements

At this time, stickup and casing size are measured and recorded on the Field Information Form (Figure 4.9) as required. Additional sampling and

purging information, as listed on this form, should also be recorded (e.g., sampler type, material).

4.2.4 Purging Procedures

Monitoring wells should be pumped or bailed prior to sample withdrawal to prevent collection of nonrepresentative stagnant water in a sample. As a general rule, pump or bail a minimum of three times the volume of water standing in the well (for moderate-to high-yield formations) and at least one casing volume for low-yield formations (those with slow recharge). Well purging should be sufficient to increase the likelihood that the water collected is representative of the groundwater within the formation around the well. Purging should continue, when possible, until field parameters (including pH temperature and electrical conductivity) have stabilized. Measurements should be taken at short intervals during the purging process to determine stabilization.

If a monitoring well is a very low-yield well, bail or pump the volume of water standing in the well and allow the well to recharge for up to 24 hours. If there is not sufficient water for sampling any parameter, then the well is considered dry for the purpose of sampling. If water is available to partially complete sampling requirements, samples should be taken wherever possible. Contact the EML for minimum testing volumes for each analyte (unless otherwise specified by the regulatory agency or the Program Manager or Regional and/or Site Engineer). In any of these situations, notify the Regional and/or Site Engineer immediately. If a well, which normally can be purged, is dry, contact the Regional and/or Site Engineer immediately.

Note: Low permeability formations may be allowed to recharge for three days, or as otherwise specified by the Regional and/or Site Engineer.

When purging a well with a double pump system (upper and lower), six screen volumes must be removed from the well, unless otherwise specified by the Program Manager or Regional and/or Site Engineer. In all double pump wells, the upper (purge) pump must be left on while the lower pump is used for sampling.

4.2.4.1. Calculating Purge Volume

To determine the volume of water to be purged, use the following equation: (or see chart copy attached)

Water Column (feet) =

Total well depth (ft.)* – depth to water (ft.)

*From the Well I.D. Chart, or as measured.

The volume (gallons) of the water column can then be determined from charts 1 or 2 (see pages 60 or 61).

NOTE: Volumes in these charts must be multiplied by the number of casing volumes (or well bore volumes where required) of water to be purged (e.g., for moderate-to high-yield formations, multiply the value by at least 3). Purge volumes may also be determined by calculation. (The formula for this calculation is given in the Appendix).

Example No. 1:

Field Measurements

Well Elevation (ft./MSL)	48.56	Well Depth (ft.) 27*
Depth to Groundwater (ft.)	3.63	
Groundwater Elevation (ft./MSL)	44.93	*From Well I.D. Chart

Field Comments

2 inch well casing

Feet of water in column 27 – 3.63 = 23.37

From purge volume charts:

4 gallons of water to be purged for one casing volume and

4 gallons x 3 casings = 12 gallons of water to be purged.

NOTE: Low yielding well: purged 1.5 casing volumes.

Well purged dry! Heavy sediment/ strong odor.

Example: 4" well casing
High-yield formation (purge 3 casing volume)
Total well depth = 46'
Depth to water = 14.33'

46' – 14.33' = 31.67' of water in column

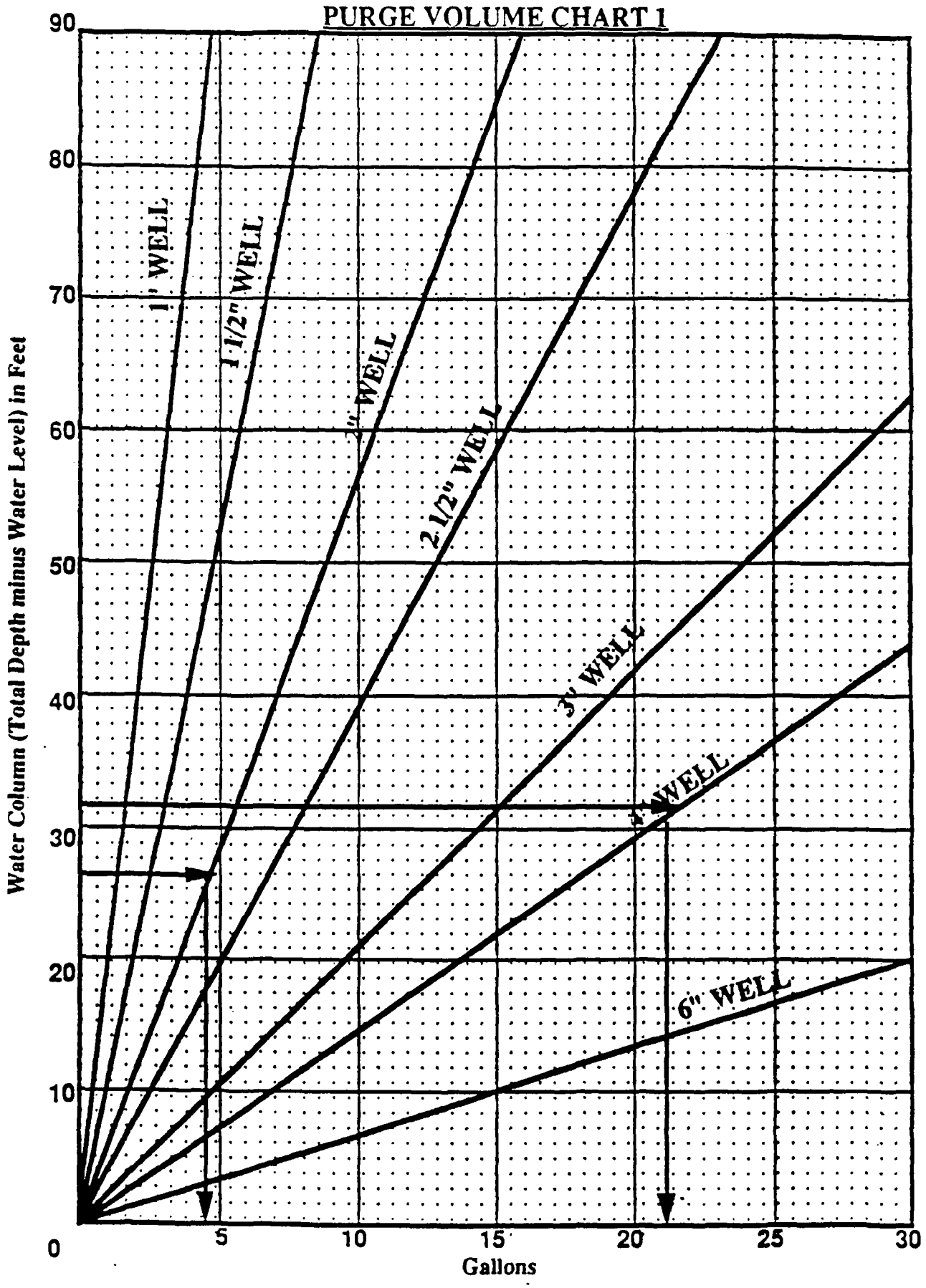
From purge volume charts:
21 gallons of water to be purged for one casing.
21 gallons x 3 casings = 63 gallons of water to be purged

The recovery time may be noted on the Field Information Form in the "other" section. This time should initially be determined during development of a newly installed well.

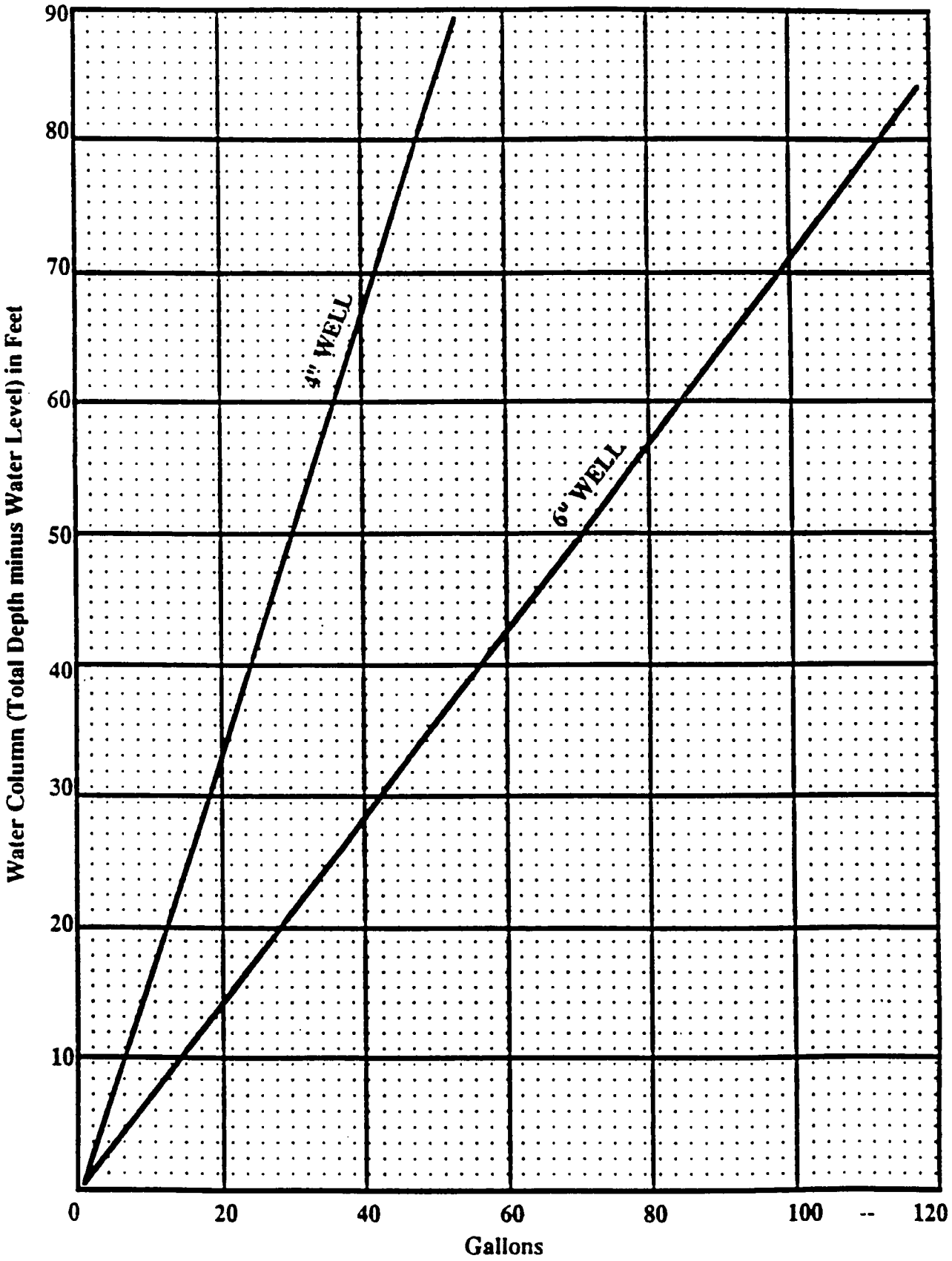
4.2.4.2 Purging the Well

After the necessary field measurements are made and the volume of water to be purged is determined, the purging process can begin. A key objective when purging a well is minimizing contamination. Equipment should never touch the ground or any other possible contamination sources. For example, to avoid contamination a fiber drum lined with a new plastic bag may be used to collect the rope when using a bailer. If required, purged water should be discarded far enough away from the well footing to prevent the possibility of contaminating a shallow earth formation, surface water or soils. Permit conditions or results from previous sampling events may prevent on site disposal of purge water. The Program Manager will define the proper method for the disposal of purge water. If purge water is deemed hazardous by previous testing, it may be necessary to collect all purge water in drums and to collect or dispose of them in an approved manner or collected.

To me asure the volume of water being removed from the well, a calibrated five-gallon bucket or container of known volume should be used to collect the water.


PURGE VOLUME CHART 1
Water Column (Total Depth minus Water Level) in Feet
Gallons
0
10
20
30
40
50
60
70
80
90
5
10
15
20
25
30
1" WELL
1 1/2" WELL
2" WELL
2 1/2" WELL
3" WELL
4" WELL
6" WELL

PURGE VOLUME CHART 2



4.2.4.2.1 Procedure Using Bailers

When using a bailer for purging, use the largest available bailer that will fit into the well, in order to minimize purge time.

Nylon or stainless steel rope or polypropylene, preferably braided, is to be used. This rope must be new (decontaminated and in good condition). In addition, the rope should be of adequate length and strength; thicker rope is easier to grip. The end of the rope should be fastened to the well cap. When this is not possible, the rope should be secured to a large spool to prevent losing the rope and bailer in the well.

If a non-dedicated bailer is used, it must be triple rinsed inside and out with deionized or laboratory reagent quality water before purging. Additional cleaning procedures may be required at some sites. Also, the people handling the bailer should wash their hands before purging the well. Disposable PVC or latex powderless gloves must be worn. New gloves should be used at each well, or more frequently (e.g., change them if they are dirty or torn). The rope should be securely tied onto the bailer and checked with each bail during the purging process.

The well is purged by a repetitive lowering, raising, and dumping of the bailer.

1. Slowly lower the bailer into the well until the bailer contacts the water.

2. Allow the bailer to fill with water. The bailer will "gulp" when it is full and increased tension will be felt on the rope.

3. Pull the bailer out of the well while coiling the rope and dropping it in the plastic-bag-lined fiber drum.

4. Pour out water from the bailer into a calibrated bucket and observe the water's characteristics.

5. Repeat the process until the appropriate volume of water has been purged from the well.

Suggested precautions while purging a well:

1. Lower the bailer slowly into the well; for the following reasons:

- to prevent contamination from rust or other sediment, which may accumulate around the top of the well casing;
- to minimize the upwelling of bottom sediment;
- to prevent degassing of the well by the sampler; and
- to minimize the possibility of the bailer becoming lodged in the well due to a kink in the well casing.

2. Never allow the bailer to come into contact with any surface other than your gloved hands, the plastic bag-lined drum, and the inside of the well.

3. Always be conscious of possible contamination sources (e.g., grease on well cap).

4.2.4.2.2 Procedure Using Nondedicated Pumps

Nondedicated pumps are most often used for purging when large volumes of water must be removed from the well before sampling. The best (and most commonly used) pumps are submersible, centrifugal pumps. These pumps are generally used in wells of four inches diameter or larger, due to their size.

All of the equipment must be thoroughly rinsed with deionized or laboratory reagent quality water and air dried before use. Additional cleaning procedures may be required. The sampling team should wash their hands before purging the well. Disposable PVC or latex powderless gloves must be worn. New gloves should be used at each well, or more frequently (e.g., change them when they are dirty or torn).

Well purging involves correctly positioning the pump and turning it on.

1. Slowly lower the equipment (pump, hose, rope) into the well. All of the equipment must be lowered simultaneously to prevent possible jamming in the well.

2. Place the pump well below the static water level head (above the well screen), because damage to the pump may occur if the pump is run dry for even a few seconds.

3. Turn the pump on. Assuming a high recharge, remove 2-1/2 well volumes at the initial pump position.

4. Continue purging while raising the pump, until the static water level is reached.

5. Turn off the pump.

6. Lower pump to just below the static water level and complete the purge.

7. Turn off the pump.

8. Remove the equipment from the well when purging is complete. All equipment must be removed simultaneously to prevent possible jamming in the well.

9. Rinse and dry all equipment before reusing, according to the procedure for cleaning non-dedicated bailers in section 4.2.4.2.1 (Procedure Using Bailers).

4.2.4.2.3 Dedicated Pump Procedures

Dedicated pump procedures involve the connection of the dedicated pump to its power source and turning on the pump. Electrical power sources are preferred where possible to minimize possible contamination sources.

4.3 Sampling the Well

You are now ready to begin work on the main objective of the sampling procedures: collecting the samples. Groundwater samples should be collected in the shortest possible time, while still maintaining sampling integrity.

4.3.1 Field Measurements

At a minimum, three field measurements must be conducted at each sample point after purging: pH, specific conductance, and temperature. A separate bottle or beaker should be used for each of the 3 sets of measurements (required measurements are specified in the EML S.O.W.). These bottles may be reused, if thoroughly rinsed with deionized or laboratory reagent quality water after the previous use and rinsed thoroughly with sample water before the next use. All results must be recorded on the Field Information Form, noting units to three significant figures. (All pH meters must provide a reading to the nearest hundredths [e.g., 7.14]).

When field measurements appear to be in error, all data must be discarded, new samples taken, and new measurements made. A line should be drawn through any error or correction, and the entry initialed and dated.

Duplicate field measurements must be taken for 1 out of every 10 samples, or at least once per day, which ever is more frequent (for quadruplicate samples, four measurements are made). The duplicate field measurements are recorded on the Field Information Form in the "field comments" section.

If the values obtained are not within the normal ranges, as indicated on the Well I.D. Charts in the site-specific Groundwater Monitoring Plan, notify the Program Manager or Regional and/or Site Engineer immediately. Such readings may result from inadequate purging, repurging should be considered before sampling. Do not discard this sample, as regulatory requirements may indicate it must be analyzed. Additional samples may be requested by the Program Manager or Regional and/or Site Engineer to ascertain the cause of abnormal readings.

In some permits, pH and conductivity measurements are required to be done in quadruplicate. Four measurements are to be made from one sample container. Between measurements, the instrument should be turned off, rinsed and dried.

4.3.2 When Not to Sample

During a sampling event, all scheduled wells must be sampled, except in the following cases:

* If the well has been destroyed or otherwise rendered useless (e.g., casing broken off or severely bent so as to preclude sampling);

* If the well is dry (e.g., no water can be pumped within 24-72 hours of the end of purging). The bailer is dropped to the very bottom of the well (e.g., silty area) and a partially full bailer is obtained. Note: Some regulatory agencies, permits, or program managers may require a longer recharge time before sampling;

* If the well is new and has not been properly developed (pH and specific conductance must be stabilized);

* If the Program Manager or Regional and/or Site Engineer states that the sampling should not be done.

4.3.3 Sampling

The method to be used for sampling is usually the same as that used for purging, unless otherwise specified by regulatory agencies or the Program Manager or Regional and/or Site Engineer.

Procedures for sampling are the same as those for purging, with the except that in sampling, the water removed from the well is placed in sample bottles rather than being discarded.

4.3.4 Filling Sample Bottles

Sample bottles should be filled directly from the bailer or pump with a minimal amount of air contact. Volatile organics (VOA) and TOX bottles should be headspace-free (i.e., no air bubbles in the sample bottle). (See Appendix A4 and A5 for VOA sampling procedure.) All samples must be filtered unless specifically stated otherwise. Specific filtering instructions are included on the S.O.W. from the EML. Where in-line filtration is not available, prefiltration bottles may be used to collect the samples. This collection method is to ensure that no sediment will be introduced into the filtered sample which could cause possible analytical errors. [Prefiltration bottles must be obtained from the EML with the AquaPaks]. (See Appendix for filtration procedures for sampling points not having in-line filtration.) Plastic prefiltration containers should only be used for inorganic analytes. Any organic analytes to be filtered must be placed in glass prefiltration containers. All bottles or containers must be kept in a clean and locked storage area.

When filling the sample bottles, the following procedures and precautions are essential:

1. Bottle caps should be removed carefully so that the inside of the cap is not touched. Caps should never be put on the ground. Caps for VOA vials contain a teflon lined septum. The teflon side of the septum must be facing the sample to prevent contamination of the sample through the septum.

2. Field technicians should wear appropriate gloves.

3. AquaPaks should have cold ice packs in them before taking them into the field to aid in the cooling process or samples.

NOTE: UNDER NO CIRCUMSTANCES SHOULD BOTTLES (SAMPLE OR PREFILTRATION) OR CAPS NOT SUPPLIED BY THE EML OR THE SUBCONTRACT LAB BE USED FOR ANY SAMPLING!

4. The sample bottles should be filled with a minimal amount of air contact, and without allowing the sampling equipment or personnel to touch the inside of the bottles or bottle caps.

   Tubing or hoses from Well Wizards or pumps must not touch or be placed in the sample bottles.

5. Samples that are to be filtered and preserved, should be placed in prefiltration bottles and filled completely to allow for any loss of water from sediment during filtering.

   After filtering, sufficient space should be available in the sample bottles for the addition of required preservatives. The bottle caps should then be replaced tightly.

6. Samples for TOX and volatiles that are not to be filtered will have preservatives in the bottles when received. These bottles should be completely filled with the sample, with as little overflow as possible, and the bottle caps should be replaced tightly.

7. TOX and VOA vials must be filled so that they are headspace-free. These sample bottles, therefore, need to be slightly overfilled (water tension will maintain a convex water surface in the bottle). The caps for these bottles should be replaced gently, to eliminate any air bubbles in the sample. These bottles must then be checked by inverting them and tapping them sharply with a finger. If any air bubbles appear, open the bottle, add more water, and repeat this process until all air bubbles are gone. Do not empty the bottle and refill it. For additional information on filling VOA vials, see pages A4 and A5.

8. Air space should be left in coliform sample bottles, because these samples must be shaken before analysis.

9. All sample bottles after required filtering, filling, and preserving, must be placed in a refrigerator or AquaPak with ice until ready to be shipped. Samples must be shipped to the EML or the subcontract lab

the day they are collected. Due to the extremely short hold and extraction times involved with many of these methods, it is necessary to ship the same day as sampling occurs. Therefore, allow time at the end of the day to get the collected samples to the courier.

10. Never place VOA or TOX bottles in direct contact with ice packs because they may cause the sample to freeze and the bottle to break.

11. Sample bottles, caps, or septums that fall on the ground before filling should be thoroughly rinsed with sample water before being used. All circumstances regarding dropped caps or bottles, and their subsequent rinsing and use, must be noted on the Field Information Form.

4.3.5 Blanks

Trip and field blanks are a required part of the field sampling QA/QC program. They are used to detect contamination that may be introduced in the field (either atmospheric or from sampling equipment), in transit to or from the sampling site, or in the bottle preparation, sample log-in, or sample storage stages at the lab. Lab or method blanks will also reflect any contamination that may occur during the analytical process.

Trip blanks are samples of organic-free water that are prepared at the EML. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the EML. Trip blank sample bottles are not opened at any time during this process. Upon return to the lab, they are analyzed following the same procedures as for ordinary field samples.

If trip blank sample bottles are accidentally opened, note this fact on the Field Chain-of-Custody Record.

Field blanks are prepared in the field (at the sampling site), using empty bottles and the deionized or laboratory reagent quality water used for cleaning sampling equipment. Field blank water for VOA samples, which is the same as the GC/MS water used for trip blank creation, will be sent by the EML. All other field blank water must be supplied by the sampling team. Procedures may vary from site to site. Check with the Regional and/or Site Engineer or Project Manager before sampling, and note on the Field Chain-of-Custody Record whether procedures other than those listed in the following sections are followed. The well at which the field blank is prepared must be identified in the "comments" section of the Field Information Form.

For non-dedicated equipment, the deionized or laboratory reagent quality water is poured into the sampling device (e.g., the bailer) after it has been cleaned, in preparation for the next sample point. If the analytes for the field blank would normally be filtered, this water should be placed into a prefiltration bottle and subsequently filtered. Whether or not it is filtered, this water should be placed into the field blank bottles, and the proper preservative added (as required.).

For dedicated sampling equipment with no filtration, or in-line filtration, the deionized or laboratory reagent quality water should be exposed to the air, transferred to the field blank bottles, and the proper preservative added as required. If the required filtration is not done in-line, the deionized or laboratory reagent quality water should be exposed to the air, poured into prefiltration bottles, filtered (as required), and placed in the field blank bottles, and the proper preservative should be added as required.

The following guidelines have been established by WMI for the use of trip and field blanks:

1. For all WMI sites, with sampling programs involving volatile organic analyses, at least one field blank should be analyzed for the first 20 samples or less.

2. For CWM sites, with sampling programs involving volatile organics analyses, at least one field or trip blank should be analyzed for volatile organics for a project involving 1 to 10 samples. For programs of 11 to 20 samples, a field and a trip blank should be used. For every additional 10 samples or fraction thereof, an additional field and an additional trip blank should be used (e.g., for 21-30 field samples, two field and trip blanks should be used). (See Table 4.1)

   For programs that do not involve volatile organics analyses, the duplicate well sample will take the place of the field blank.

   The preceding instructions are minimum requirements. Additional blanks and/or analytes may be tested if required by the Regional and/or Site Engineer or CWM Manager of QC. Field and trip blank results will be reported in the Technical Report as separate samples, using the designations FB or TB in their sample point designation.

Table 4.1.

CWM/WMI FIELD AND TRIP BLANK REQUIREMENTS

	CWM		WMI	
# of Samples	Field	Trip	Field	Trip
1-10	1	-	(3-10) 1	-
11-20	1	1	1	1
21-30	2	2	2	2
31-40	3	3	2	2
41-50	4	4	3	3
51-60	5	5	3	3

4.3.6 Duplicate Samples (CWM Sites)

The sampling team is responsible for submitting duplicate well samples to the lab. For each sampling event, a duplicate well sample is obtained from one of the wells, as selected by the Site Chemist or Project Manager. The sample is labeled "X-DUP" and sent to the lab with the other well samples. The actual sample point designation of the duplicate sample should be noted in the "Comments" section of the Field Information Form. On subsequent sampling events, a different well will be selected for obtaining the duplicate sample. All wells should be used as duplicates at some point (volume permitting), and a record of these duplicates must be maintained at the site.

4.3.6.1 Procedures for Filling Bottles for Split Samples and Duplicates

Special procedures are required when split samples or duplicates are to be obtained. Aliquots of water obtained from the well, bailers, or pump cycles should be alternated between sampling teams and/or sample bottles to provide samples to each group that will be as representative as possible. Examples of the bottle filling sequences for split samples and duplicates are given next.

Example 1: Split Sample

Bailer 1 (cycle 1), team 1, VOA vial
Bailer 2 (cycle 2), team 2, VOA vial
Bailer 3 (cycle 3), team 1, TOX bottle
Bailer 4 (cycle 4), team 2, TOX bottle
Bailer 5 (cycle 5), team 1, TOX bottle
Bailer 6 (cycle 6), team 2, TOX bottle
Bailer 7 (cycle 7), team 1, TOC bottle

Example 2: Duplicate

Bailer 1 (cycle 1), sample VOA vial
Bailer 2 (cycle 2), duplicate VOA vial
Bailer 3 (cycle 3), sample TOC bottle
Bailer 4 (cycle 4), duplicate TOC bottle
Bailer 5 (cycle 5), sample TOX bottle
Bailer 6 (cycle 6), duplicate TOX bottle
Bailer 7 (cycle 7), sample TOX bottle

4.3.7 Filtration

Regulatory guidelines and permit requirements for sample filtration in the field may vary from site to site. However, all samples (except those listed below) must be filtered through a 0.45 micron membrane pressure filter, unless regulatory requirements specify otherwise.

Samples Not Requiring Filtration	Exceptions - "Total" Samples Requiring Filtration[1]
*Alkalinity	*TOC
*Turbidity	*Total Hardness
*Total Suspended Solids (TSS)	*Total Kjeldahl Nitrogen
*Total Solids	*Total Cyanide
*Semi Volatile Organics	*Total Petroleum Hydrocarbons
*Volatile Organics (VOA)	*Total Phosphorus
*Total Organic Halides (TOX)	
*Total Metals	
*Any other analytes listed as Total refer to unfiltered samples (if it does not say Total, assume it is Dissolved) EXCEPT FOR THE ANALYTES APPEARING IN THE COLUMN TO THE RIGHT	
*Coliform	
*pH	
*Specific conductivity	
*Oil and grease	

[1] Note: These analytes require filtration whether listed as "Total" or not. For example, samples are filtered whether analyzed for "Total Cyanide" or "Cyanide".

Regulatory and permit requirements will generally specify whether to analyze, for example, for total mercury as opposed to mercury or dissolved mercury. Corporate policy is to filter all heavy metals samples unless otherwise specifically requested.

Site specific requirements are contained in each monitoring program for the sampling event. The requirements must be noted on the Field Chain-of-Custody Records in the column labeled "Filt. (Y/N)". Filtering is necessary to determine the ions and compounds that are dissolved in

solution in the groundwater (rather than those that are present as particulates.). Monitoring wells are not as fully developed as drinking-water wells and often contain silts and sediment that must be removed by filtration. If the water is not filtered, ions and compounds naturally present in, or absorbed on to, the suspended particles may be released when samples are preserved and analyzed. This release would result in much higher concentration levels than are actually are present as dissolved constituents in the groundwater.

Filtration and preservation of groundwater samples is an integral part of the monitoring program. Improper techniques during this process can destroy the integrity of the sample. All possible precautions should therefore be taken to ensure that no contamination sources are introduced during filtration or preservation.

Notes:

* Filtering should be performed immediately after or during (in line filters) sample collection and should be done in the field. When this is not possible, filtration should be completed as soon as possible after the sample has been collected (within two hours) and should be done under the most contaminant-free conditions available.

* Refer to the Well I.D. Chart for the range of pH and specific conductances, to assist in determining the order of filtering. Any sample suspected or known to have high contamination levels, as identified by the Program Manager or Regional and/or Site Engineer, is to be filtered last, to prevent any contamination of the clean samples through the use of the same filtering equipment.

* Filtering equipment must be dedicated for groundwater only. Do not use any filtering apparatus that is used for other procedures such as EP-TOX or TCLP.

* Surface water, private wells, and leachate samples are never filtered unless specifically required by permit

* Prefiltration bottles are not to be reused. The material and use of prefiltration bottles must be noted on the Field Chain-of-Custody Record.

4.3.7.1 Filtration Equipment and Procedures

The following list delineates the equipment and other requirements for proper filtering and preservation of groundwater samples when filtration is not performed in-line.

* Only where field filtration is not possible, use a clean bench space with a readily accessible sink. This should be isolated from possible contamination sources, including outside air and inside fumes;

* Stainless steel pressure filter holder (1.5 liter reservoir); (In some EPA Regions, stainless steel is expressly forbidden. Contact the appropriate Regional office for recommendations where this is true.)

* 0.45 um filters (142 mm. diameter);

* Nitrogen (OSHA Class D) tank and regulator;

* Glass funnels;

* Large supply of deionized or laboratory reagent quality water or reagent quality water;

* Miscellaneous supplies (e.g., paper towels, tools, markers);

* Statement of Work Form (S.O.W.) to ensure there is a proper bottle and preservative for each analysis or series of analyses required for that particular sample;

* Designation of which samples are to be filtered for each sample point; (See S.O.W.);

The following list is a step-by-step procedure for filtering and preserving a typical monitoring well sample when filtering is not performed in-line.

1. Make sure that all filtering apparatus has been completely cleaned with deionized or laboratory reagent quality water only and dried, and that all pressure fittings are tight.

2. Remove the top, or reservoir, portion of the filter holder and position a new 0.45 um (142 mm. diameter) filter on top of the filter support screen, making sure it is flush on all edges. Care should be taken in

handling the filter paper, which is easily torn. A small amount of deionized or reagent quality water may be used to wet the filter and hold it on the filter screen, when excessively windy field conditions exist.

3. Replace the top or reservoir portion of the filter holder, over the filter paper, and tighten with the three wing-type clamps (finger tight only with equal force).

4. Unscrew the insert cover and fill the reservoir with the sample to be filtered, using a clean, dry funnel.

5. Screw down the inlet cover and reservoir securely.

6. Use a new sample container.

7. Position the new bottle under the outlet valve, beneath the filter holder.

8. Open the nitrogen cylinder, regulate pressure to a maximum of 40 psi, and pressurize the reservoir. Use the minimal amount of air pressure necessary for filtration. The filtration is now in process.

9. When the sample bottle is full or the filtration flow ceases, turn the stopcock to the "off" position. Turn the pressure relief valve to the "on" position to release the pressure.

10. Check the Field Chain-of-Custody Record for a list of appropriate preservatives, add the proper preservative (which is provided next to the sample bottle in the bottle holder) to the filtered sample and recap the bottle. Invert the bottle several times to mix the sample. Refer to the Appendix (A13-A16), for specific procedures on verifying that sufficient preservatives were added.

11. Record the necessary information of the Field Information Form and Field Chain-of-Custody Record after every filter change.

12. Between samples, disassemble the filter holder and its components and thoroughly rinse (a minimum of three times) with deionized or laboratory reagent quality water. Air dry the filter holder completely or dry with white paper towels.

13. Reassemble the filter apparatus and begin the process again.

It is imperative that the proper filtration and preservation techniques be strictly followed. Although at times the process may become tedious and may even seem trivial, it is essential that procedures are meticulously followed at all times. Failure to do so may invalidate all the precautions taken during purging, sampling, and transport, thus rendering the subsequent analysis useless. This precise care is necessary, since many of the analytes are measured in the part-per-billion range.

4.3.7.2 In-Line Filtration

When using an in-line filtration system (e.g., Well Wizard, Gelman, Millipore), a minimum of three pump cycles of water must be allowed to pass through the filter before obtaining a sample. These filters should only be used for filtering inorganic parameters, unless analytical data is available to support the conclusion that no sample contamination will occur.

4.4 Sample Preservation, Storage, and Shipment

4.4.1 Sample Preservation

Samples are to be preserved immediately after filtering or immediately after sample collection (if samples are not filtered). TOX and volatile organic samples (VOA's), which can have no headspace (no air bubbles trapped in the sample), have preservatives included in the sample bottle. When filling them, do not allow the bottles to overflow any more than necessary to eliminate headspace.

Premeasured amounts of preservative reagents are supplied with the sample bottles EML sends . The preservatives are provided in small vials and are packed in the bottle holders next to the bottle requiring preservation. The preservatives should be added to the sample bottle after it has been filled. Bottles must not be overfilled, and they should be inverted (once capped) to mix the preservative with the sample. Refer to the Appendix for procedures for correct preservation. Bottle lids must not be placed on the ground or interchanged among sample bottles. Empty preservative vials should be returned in the AquaPak with the sample bottles.

A listing of preservatives, by analysis, is included in the Appendix (A13-A16) for reference only. Do not use a substitute for the chemical preservative supplied, because the reagents are batched, controlled, and supplied by the lab group that willconduct the analysis. If substitutions are

made from stockpiles at a site, this fact should be noted on the Field Chain-of-Custody Record. At no time should preservatives be kept for greater than six months.

4.4.1.1 Temperature Control

The sample should be cooled to 4°C from the time the sample is taken through analysis. Samples should be maintained in temperature regulated refrigerators, in coolers, or in AquaPaks containing frozen ice packs. Provisions must be made in advance for facilities to freeze the ice packs. Most solid waste sites have no such facilities so it is recommended to bring prefrozen coolers and/or dry ice to the site. The ice packs should be frozen solid prior to use. See A-30 through A-32 for additional details on temperature preservation procedures.

4.4.2 Sample Packing and Storage

4.4.2.1 Checking Sample Codes and Numbers

The sampler must record the sample designations in the appropriate spaces on the Field Chain-of-Custody Records and Field Information Forms. It is extremely important that the proper designations be recorded in the proper space on the form and that they be double-checked before sealing the AquaPak (See A.6 and A.7). Proper sample designations are included on the Statement of Work, which is sent to the site or the consultant sampling team, before the start of the sampling event.

In addition, the ENS numbers, when assigned, must be indicated on all paperwork from the subcontract lab.

ALL BOTTLE SETS AND CORRESPONDING CHAIN-OF-CUSTODY RECORDS AND FIELD INFORMATION FORMS MUST HAVE THE SAME SAMPLE POINT DESIGNATION NUMBER AND ENS NUMBERS.

All bottles filled from the same sample point at the same time must have identical sample designations and bottle set numbers (except field duplicates). Bottle set labels should be double-checked for consistency between those being sent to the subcontract lab and those being sent to the EML. Samples that are split with regulatory agencies should also be checked for consistent sample point designation numbers and for other methods of identification used by the agency.

4.4.2.2 Sample Packing

After the sample is collected and the preservatives are added, when applicable, the bottles are capped and placed in the AquaPak. The frozen ice packs are then placed into the AquaPak. The Field Chain-of-Custody Records and Field Information Forms must then be reviewed to ensure that they have been completed. (See A.6 and A.7) All paperwork is then placed in the plastic bag, which is then sealed and placed inside the AquaPak.

All bottles should be wiped clean with paper towels before placement in the AquaPak. The bottle sets and ice packs should be repacked in the same configuration as when received. It is essential that VOA vials and TOX bottles should never be placed directly on the ice packs. The AquaPak must be kept as clean as possible to minimize the potential for contamination. All bottle caps should be checked to ensure they are tight and will not become loose when inserted in the AquaPak. Do not tape the bottle caps! Labels should be taped only if they are loose, and this should be noted on the Field Information Form or Chain-of-Custody Record.

Containers and packing materials designed to prevent breakage and spills must be used for shipping. In AquaPaks, tight shock-resistant bottle holders are provided around each glass bottle. The AquaPaks must never be shipped without the ice packs or the bottle holders in place. After the AquaPak is repacked and locked, the gray numbered seal is placed through the outside latch and locked. Finally, a black poly strap should be placed through the center channel, and over the gray seal of the AquaPak.

There are three important reminders for packing the AquaPaks:

1. Glass containers should not be packed in contact with each other. Bottle holders should be used for glass bottles to protect them from potential breakage.

2. In very cold weather the ice packs should be unfrozen or slushy.

3. If the ice packs appear to be leaking, they should be sealed in a sealable plastic bag before being placed in the AquaPak.

4.4.2.3 Sample Storage

Samples should be stored at 4°C, in an enclosed cooler or darkened refrigerator where possible, before shipment to the lab for analysis. Samples should be shipped daily to the lab to ensure proper temperature

control and holding holding time requirements are met. A listing of recommended holding times is in the Appendix (A13-A16) for reference.

4.4.3 Sample Shipment

4.4.3.1 AquaPak Transportation Arrangements

A member of the sampling team must be appointed to arrange sample pickup and transportation to the lab. Friday shipment of samples to the subcontract lab should be avoided to ensure that holding times are not exceeded over a weekend. This is especially true for coliform analyses because few labs analyze samples on the weekend. The EML accepts AquaPaks for delivery six days per week. Delivery requested on Saturday must be noted specifically on the shipping/packing air bill for the courier.

AquaPaks should be returned via Federal Express, if possible. When contacting the courier for transport of a sample, specify the AquaPak's contents. Alert the courier to the potential problems of the samples freezing in the winter or ice packs melting in the summer, and note these potential problems on the shipping/packing label. The courier must take care to minimize exposure of the AquaPaks to temperature extremes. AquaPaks should be received at the lab within 24 to 44 hours of when the frozen ice packs were placed in the AquaPak. This is necessary for temperature preservation and to meet required holding times for some analytes. Time lags must be documented on the Field Chain-of-Custody Record. Use the preaddressed shipping label supplied with the AquaPak and remove all old shipping labels.

For coolers containing samples from subcontract labs, the EML generally makes the arrangements for the subcontract lab for container delivery. The sampling team is responsible for notifying them of the time for sample pickup.

4.4.3.2 Lab Notification

The following information must be given to the EML when the AquaPak is shipped:

1. the name of the carrier;

2. ENS numbers and the number of AquaPaks shipped; and

3. the estimated arrival time and date.

4.4.3.3 Lab Sample Receipt

The lab will receive and login samples and will continue to maintain the chain-of-custody procedures until the analyses are completed and reported.

Each lab, upon receipt of any sample, must record the following information on the Sample Receipt Log:

* Presence/absence of the custody seal(s);

* Condition of the custody seal (e.g., intact, broken);

* Presence/absence of Field Chain-of-Custody Record and Field Information Forms;

* Presence/absence of air bills and/or bills of lading documentation for shipment of samples;

* Condition of the samples (e.g., intact, broken, obvious movement during shipment, bubbles in VOA/TOX samples or trip blanks, O.K.);

* Presence/absence of sample point ID numbers (where applicable), job numbers on bottles;

* Notation of discrepancies between numbers on bottles received and those listed on the Field Chain-of-Custody Record; and

* Temperature blank/sample bottle measurement of the AquaPak.

The lab will contact the person responsible for sampling and the Program Manager to resolve any deficiencies. It is essential to respond quickly so analyses will not be delayed beyond the allowable holding time. Complete documentation and detailed filing procedures are necessary at the sites and at the EML to resolve such problems quickly. Sample results may be delayed by incomplete shipments that do not include all completed paperwork. All Field Information Forms and Field Chain-of-Custody Records must accompany samples. If copies are required for your files, make them before shipment.

If all samples recorded on the Field Chain-of-Custody Record were received by the lab, and there were no problems observed with the sample shipment, lab personnel will sign the Field Chain-of-Custody Record in the

"received for laboratory by" box, with the date and time. If problems are observed with sample bottles or AquaPaks, these will be recorded on the Filed Chain-of-Custody Record under "Lab Observations", and detailed on the Sample Receipt Log in addition to the normal log-in procedures.

Lab personnel will provide feedback promptly on the condition of the samples to the Program Manager and sampling team leader to allow for resampling, if time permits. The sampling team is responsible for the completeness of the paperwork. If problems are encountered, the Program Manager must be notified.

Copies of the Field Chain-of-Custody Records and Field Information Forms are included in the analytical report provided by the EML. Documentation of sample condition or incomplete paperwork is also provided on these forms.

4.4.4 Resampling

Resampling of wells between regularly scheduled sampling events should be conducted only when required. The decision to resample, based on the analytical results, should always be reviewed with the Regional EMD staff. However, when samples are, for example, received broken, or samples are missing, resampling should be done as soon as possible. The EML will notify the Program Manager promptly, should these problems occur, and a resampling decision can then be made.

All special sampling events should first be reviewed by the EML to determine whether the EML can perform the analyses required or whether they need to be subcontracted.

5.0 Private Well Sampling

5.1 Purpose

Private well sampling is usually performed in response to requests from concerned residents in the area around the site, or in response to requests by the Board of Health or the local Water Quality Board. These samples may provide useful information on groundwater quality, but are usually more beneficial for maintaining a good working relationship with the area's residents.

Private wells are usually installed with little documentation of subsurface geological conditions, and water is usually obtained through high volume, submersible pumps. It is therefore difficult to correlate results from these wells with those for groundwater monitoring wells.

5.2 Sampling Procedures

Some general procedures are included in this section. The procedures for private well sampling are similar to those used for groundwater sampling. Please refer to Section 4.0 of this manual (e.g., procedures for measuring pH, specific conductance and temperature, and for bottle filling) for further information.

Those responsible for sampling should display a professional attitude when collecting samples from private wells.

All private wells must be purged before sample collection. Initial samples taken from a tap or faucet and not directly from the aquifer, will be representative of the plumbing. Therefore, it is essential to evacuate the plumbing and water storage tank (where present) before obtaining any samples. This evacuation can be done a minimum of 15 minutes before sampling collection but a longer time is preferable. To purge the plumbing, open two faucets, flush the toilet, or otherwise use water in the pipes. To ensure the plumbing is being evacuated, listen for the well pump. Two-to-three cycles are preferred.

Samples should be taken from as close to the well source as possible, so basement faucets or outside faucets are preferable. (Note: Document the place from which samples were taken.) The well owner should also be asked about any treatment equipment installed in the system. Softening, iron removal, pH adjustment, and other equipment are often used (e.g.,

home carbon filters for removal of organics). Basement and outside faucets will usually not produce such treated water. Contact the Regional Site Engineer or Project Manager if the sample must be taken from water affected by a treatment unit. At a minimum, the type, size, and purpose of the unit should be noted on the Field Information Form.

Be sure that an aeration screen has not been installed on the faucet being used. If a screen has been installed, this must be removed before sampling (especially for organics), since the screen tends to agitate the water, and some organics could be lost. If it can not be removed, this should be noted on the Field Information Form.

Samples should be collected in clean, new bottles; preserved; and stored with ice. Private well samples should not be filtered unless regulatory requirements specify otherwise. Field measurements should be taken as requested on the Statement of Work. These values, and all sampling information, should be entered on the Field Information Form. All paperwork should be completed, and samples should be packed in ice for shipment to the lab.

6.0 SURFACE WATER SAMPLING

6.0 Surface Water Sampling

6.1 Purpose

The Surface Water Monitoring Program is designed to protect the environment, by minimizing any adverse effect on surrounding waters from surface water leaving the site. Periodic monitoring of the surface water flow and surface water quality is performed to ensure that the surface water drainage systems are not affected by the facility. An effective monitoring system will help identify operational problems and permit early correction. Monitoring the surface water discharged from the site can provide valuable information for WMI should any nearby off-site surface water problems be detected.

Surface water drainage is regulated primarily though National Pollutant Discharges Elimination System (NPDES) permits. The NPDES permits generally require that periodic flow estimates be obtained from specific surface water discharge outlets and sampling points. In addition, periodic water quality samples of surface water discharges and outfalls are normally required.

6.2 Sampling Procedures

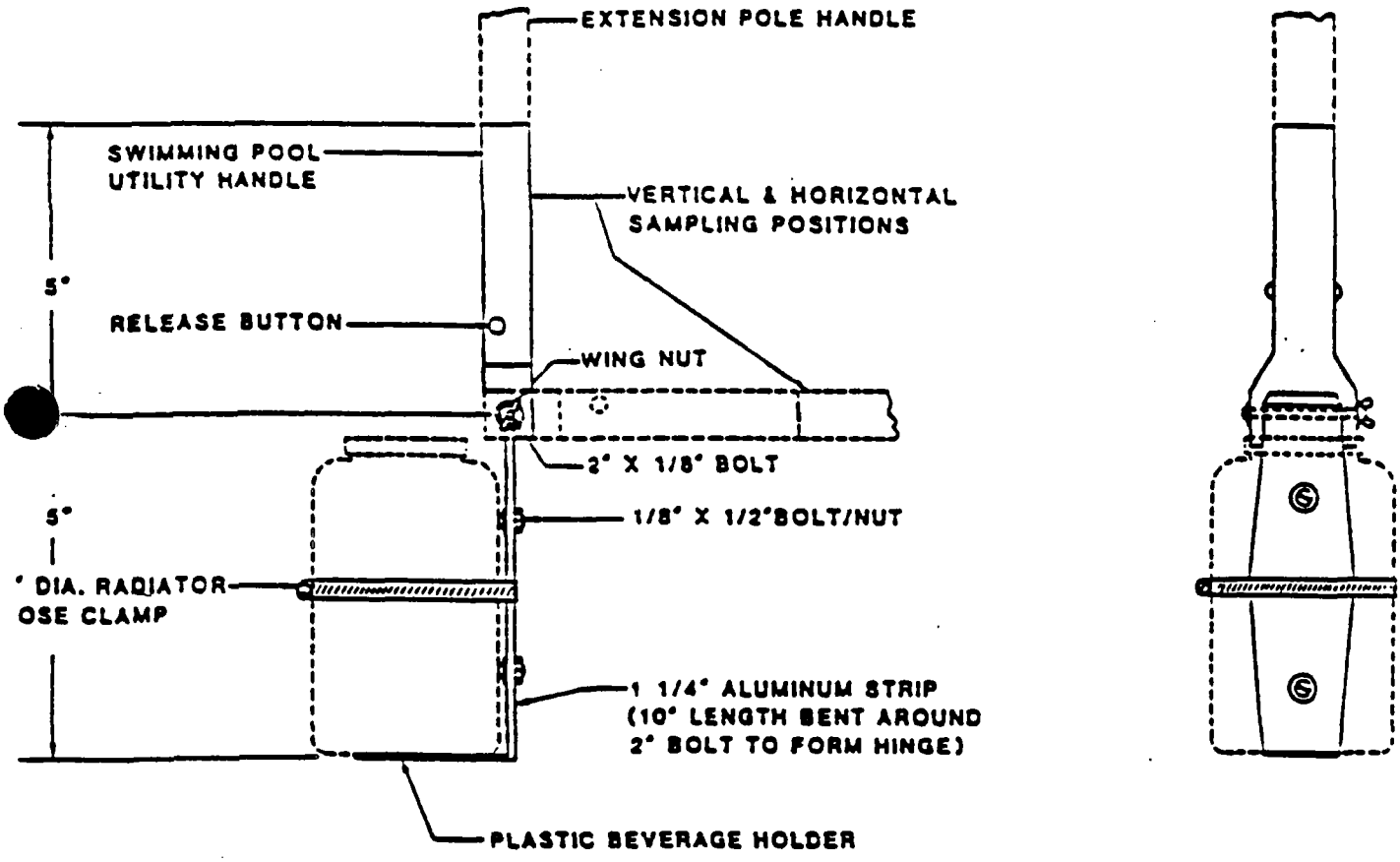
Some general procedures for sampling are included in this section. Many of the procedures used for surface water sampling also apply to groundwater sampling. For more detailed procedures, please refer to Section 4.0 of this manual.

Little equipment is needed for surface water sampling. A specially designed surface water sampler should be used (see Figure 6.1), to help obtain a sample without excessively disturbing the sample location. The sampling device should be rinsed with deionized or laboratory reagent quality water before sampling, and only bottles supplied by EML or the subcontract lab should be used.

When sampling lakes, streams, or runoffs, it is essential to obtain a fresh, representative sample. Samples should be collected from the center of the stream or body of water, at mid-depth. This will ensure an average flow of water with minimal settling of solids. The sample container should be lowered into the water while still capped, uncapped under water to allow the sample bottle to fill, and then recapped before removal from the water. The mouth of the sample bottle should be facing into the flow of water, or

Surface Water Sampling Device

Figure 6.1



Front Elevation **Side Elevation**

facing the water surface. Always face upstream when sampling in the water, and try to keep your hands away from the mouth of the bottle.

Once a sample is obtained, pH, specific conductance, and temperature measurements are usually made. The Statement of Work has a list of all required measurements. All values obtained should be recorded on the Field Information Form, along with a precise description of the sampling location.

Samples should be placed in the proper sample bottles and preserved. SURFACE WATER SAMPLES ARE NEVER FILTERED. All samples should be kept in ice or with ice packs in the sample AquaPaks or coolers.

All necessary paperwork should be completed and included with the samples for shipment to the lab.

7.0 Leachate Sampling

7.1 Purpose

The purpose of leachate monitoring is to provide data on the quantity and quality of leachate being generated within a landfill. Knowledge of the leachate quantity is often necessary to evaluate the effectiveness of the landfill design, particularly of the soil cover and liner performance. Therefore, periodic sampling of leachate risers and manholes is performed to evaluate leachate quality and quantity. Leachate from risers that are not pumped regularly should be purged. Leachate from pumped manholes or sumps should be taken after a pumping cycle has been collected. Leachate data provides potential groundwater quality comparison data for the site monitoring wells to assist in determining any impact on the groundwater. Analysis of leachate samples can also provide information on the degree of leachate treatment required, including an assessment of the need for treatment.

7.2 Sampling Procedures

Proper planning and preparation, as with groundwater monitoring, are necessary for problem-free leachate sampling. Refer to the Leachate Well I.D. Chart (where available) for information on the leachate wells, risers, and manholes to be sampled. The Statement of Work should be used for listing the required sampling points and analytes. Leachate sampling points do not need to be purged of stagnant liquids, so minimal field time is required before sampling. The analytical lab should be notified in advance of the sampling schedule, number of samples, and analytes to be sampled. Sampling personnel should have the following equipment ready before going to the field:

NOTE: Equipment used for leachate monitoring should not be used for any other type of environmental sampling or monitoring.

1. Leachate well, riser, manhole well location map;

2. Leachate Well I.D. Chart;

3. Sample Bottles and AquaPaks;

4. Separate cooler for storing samples and dedicated leachate monitoring equipment (as needed);

5. Dedicated electronic water (leachate) level indicator;

6. Dedicated (for leachate) pH, specific conductivity, and temperature meters;

7. Dedicated leachate bailer and rope, or pump, if required;

8. Dedicated container to collect deionized or laboratory reagent quality water from rinsing leachate sampling equipment;

9. Keys for wells and gates; and

10. Protective clothing including rubber gloves, boots, hard hat, safety glasses, tyvec suit, respirator, and other necessary items per site requirements. NOTE: Samplers must check with Safety Manager/Site Manager before sampling leachate wells, risers, and manholes.

There are six basic steps to obtaining a leachate sample.

1. Identify the sample point and analytes to be analyzed;

2. Check with the Safety Manager/Site Manager;

3. Obtain a leachate level;

4. Take a leachate sample;

5. Record all necessary information on the Field Information Forms and Field Chain-of-Custody Records; and,

6. Preserve and store the sample in a dedicated AquaPak/cooler and return it to the lab.

Leachate level measurements should be obtained and recorded on the Field Information Form line provided for "depth to water for top of well casing or other parameters". If a slope indicator is used, the sensitivity adjustment can be used to screen out false signals, often caused by moisture. To determine the proper setting, turn the sensitivity knob to the full setting (10th position), and lower the probe until it contacts the leachate (a buzzer will sound and the light will show). Raise the probe out of the leachate and turn the sensitivity knob to a lower setting until the light and buzzer turn off. Repeat, and adjust sensitivity knobs so the light and

buzzer turn off promptly when withdrawing the probe from the leachate. Do not lower the sensitivity knob more than necessary, or accuracy will be reduced. The leachate level is measured at the point where the light first shows.

Before sampling, rinse the dedicated leachate bailer with deionized or laboratory reagent quality water.

Each sample bottle should be filled according to the procedures listed in the Groundwater Sampling section of this manual (Section 4.3.4).

After sampling, preservatives should be added to each sample bottle (where required). Preservatives are added to stabilize the chemical composition of the sample.

SPECIAL CARE SHOULD BE TAKEN WHEN PRESERVING LEACHATE SAMPLES WITH ACID, SINCE A VIOLENT REACTION MAY OCCUR. ADD ACID SLOWLY AND CAREFULLY!!! LEACHATE SAMPLES SHOULD NOT BE FILTERED!!!!

During sampling, observe the samples and provide a description of the color, odor (if required), and any layers or phases present in the sample on the Field Information Form. The sampler should remember that leachate is a derivative of decomposed refuse and waste, and caution should be used in smelling the sample. It is inadvisable to smell it directly from the riser or manhole, as gases may be escaping via this route.

The pH, temperature, and specific conductance measurements should be performed in the field after the sample is collected. All results must be recorded on the Field Information Form, with pH and specific conductivity results recorded to three significant figures.

Once the sampling is completed, all equipment should be thoroughly cleaned and stored in a separate area until it is needed again. Where a sampling device (e.g., bailer) is not stored in the well or riser, it may be stored in a new, clean plastic bag, identified with the well or riser I.D. All equipment must be marked for leachate sampling only!

All AquaPaks or coolers with samples should contain ice or ice packs for sample preservation. Once completed, the Field Chain-of-Custody Records and Field Information Forms should be placed in the plastic bag within the AquaPak, and the AquaPak should be sealed.

GLOSSARY

Annular Space
The space between the well casing and protective casing. (Some wells have two casings and a protective casing.)

APSR
AquaPak Shipping and Receiving Report. The system used to track the shipment of AquaPaks and sample bottles to, and AquaPaks containing samples from, a site.

AquaPak
The specialized container used to store and ship samples and sample bottles to and from a site. The EML provides AquaPaks, which contain bottle holders, sampling bottles, paperwork and preservatives for each sampling event.

Aquifer
A geologic formation, group of formations, or part of a formation that is saturated, and contributes a significant quantity of water to wells or springs.

Bailer
A hollow tube with a check valve constructed of PVC, teflon, or stainless steel. Used to remove water from a well.

Bladder Pump
A gas-driven, positive-displacement purging and sampling device containing an internal flexible teflon bladder (with upper and lower check valves) that can pump water with no air contact and minimum turbulence.

Bottle Set
An eight-character alphanumeric sample identifier. For a sample taken at a given well, there is one designation number, and a different bottle set letter for each bottle. Example: AB2387-L0

Casing
Tubular steel, finished in sections with either threaded connections or bevelled edges to be field welded, which is installed to counteract caving of the drilled hole.

The static volume of water in a casing (if required, use well bore volume) before it is purged. Calculated using the following equation: Casing volume (gallons) = ($\pi r^2 h$) x 7.48, where r = radius of the well casing in feet and h = height of the water column in the well in feet.

Chain-of-Custody
A record of possession maintained for each sample bottle. Used to document where and in whose possession a sample was, from the time of collection through analysis.

Conductivity Standard
Solution having a known conductance, prepared per "Standard Methods for the Examination of Water and Wastewater," 17th edition, and/or QA/QC Manual.

Contaminent-free Area
Area not known to contain volatile organic contamination over the required reporting limit levels as measured in the trip blank.

Dedicated Equipment
Equipment dedicated for use with only one specific well. It is usually stored within the well.

Deionized Water or Laboratory Reagent Quality Water
Water that has passed through a column containing both anion- and cation-exchange resins. Water having no concentrations of analytes of interest above the required reporting limits reference: ASTM III or equivalent.

Depth to Water Meter
An electronic probe that, on contact with water, registers a response. Used to determine the distance from the top of a well to the water.

Distilled Water
Water that has been boiled and the steam condensed. The condensate is distilled water.

EMLIS
Environmental Monitoring Laboratories Information System. The system incorporating all of EML's computerized modules.

ENS
Event Notification System. The system the EML uses to track and document all phases of a sampling event. A separate ENS number is used for each part of the event requiring different analyses.

Field Blank
A blank used to check for analyte contamination during the sampling and shipping processes. A portion of this water is poured into a sample bottle and analyzed as an actual sample, to determine whether any contamination is present.

Field Information Form
The form used to track field observations and measurements, such as purging information, equipment used, and all pertinent comments relating to a sampling event.

Groundwater Elevation
The difference between the depth of well water and Mean Sea Level. (MSL)

Headspace
Air in a sample bottle. Generally, air trapped between the water and bottle surfaces.

LIMS
Laboratory Information Management System. The electronic data system the EML uses to process and store data.

Lock
Marine lock made of brass stainless steel, used to ensure a sampling well remains secure when company (or designated) personnel are not taking samples.

Meniscus
In a container filled with liquid, the curved upper surface of the liquid.

MPS
Monitoring Program System. The system the EML uses to define specific sampling and analysis information for a site, including sampling points, sampling frequency, sampling dates, reporting requirements, and analytes.

MSL
Mean Sea Level.

Nondedicated Equipment
Sampling equipment used to sample more than one sampling point. (Dedicated sampling equipment is preferred.)

NPDES
National Pollution Discharge Elimination System.

PAP B-810
The section of WMI's Policies and Procedures Manual defining corporate groundwater monitoring policies. The EML, along with WMNA, CWM and Corporate EMD is responsible for maintaining this document and revising it as necessary.

pH Buffer
A solution of known pH, used to calibrate a pH meter before using the meter.

pH Meter
The analytical equipment used to measure the pH of a liquid.

Preservatives
Chemical solutions added to a sample to help prevent the degradation of analytes between the time of sampling and analysis.

Private Wells
A well located on private property. These are often drinking-water wells, located on property not belonging to WMI or any governmental body.

Program Manager
The person responsible for setting up monitoring programs, ensuring correct sampling procedures are followed, and reviewing and assessing monitoring data.

Protective Casing
An outer steel or iodized aluminum, surrounding a well casing which is used to prevent contaminants from migrating into the well.

Purge
The removal of 3 to 5 well volumes (as required) of water from a well. This is done before collecting a sample, to ensure that the sample contains no stagnant water and that it is representative of the aquifer. (i.e. table measurements pH, temperatures, and conductivity, if possible.)

QA
Quality Assurance. A program set in place to continually monitor the reliability of a process.

QAP
Quality Assurance Plan. A written protocol defining a laboratory's QA and QC requirements.

QC
Quality Control. Definite, required steps for monitoring a process, to ensure that the process results are correct.

RCRA:
Resource Conservation and Recovery Act

Recharge Time
The amount of time between the end of purging and the point at which the well returns to the approximate prepurging level.

Statement of Work
The system which, along with the APSR system, creates a template for each sampling event.

Sample Composite
Samples taken over a period of time, which are mixed in equal volumes to form one sample.

Sample I.D.
A unique, six-character number used to identify samples. Samples are entered into the EML's LIMS system, along with resultant data. (See bottle set for further clarification.)

Sample Matrix
The major constituent of a sample. (e.g. water, soil, leachate)

Sample Point
The location from which a sample is taken.

Site-Specific Groundwater Monitoring Plan
The plan outlining a site's groundwater monitoring requirements. Each site is responsible for developing such a plan which must incorporate all applicable requlatory requirements and WMI PAP
B-810.

Specific Conductance
The conductivity of water, measured at 25C°.

Static Water Level
The elevation of, or depth to, water before purging and sampling.

Stickup
The height of a well casing, from the top of the casing to its cement footing.

Trip Blank
A blank used to check for volatile organic contamination of samples during shipment. When sample bottles are initially prepared for shipment, one is completely filled with deionized water. This bottle remains with the other bottles during the shipment and sampling steps. The sample is then analyzed as if it were an actual sample.

TSCA:
Toxic Substances Control Act

IDENTIFICATION CODES

Facility/Site Codes:	Available through EML
Matrix Codes:	W - Water S - Soil C - Leachate X - Other
Source Codes:	W - Well D - Dewatering/Pressure Relief I - Surface Water Impoundment C - Leachate System M - Gas Condensate A - Air P - Pretreatment Facility U - Influent T - Effluent R - River/Stream/Brook L - Lake or Ocean O - Outfall S - Soil B - Bottom Sediment N - Noise G - Generation Point X - Other

CONVERSION CHARTS

Temperature $0.566(°F) - 17.8 = °C$

°F	°C	°F	°C	°F	°C
40.0	4.44	51.0	10.6	61.0	16.1
41.0	5.00	52.0	11.1	62.0	16.7
42.0	5.56	53.0	11.7	63.0	17.2
43.0	6.11	54.0	12.2	64.0	17.8
44.0	6.67	55.0	12.8	65.0	18.3
45.0	7.22	56.0	13.3	66.0	18.9
46.0	7.78	57.0	13.9	67.0	19.4
47.0	8.33	58.0	14.4	68.0	20.0
48.0	8.89	59.0	15.0	69.0	20.7
49.0	9.44	60.0	15.6	70.0	21.1
50.0	10.0				

Length/Depth

Inches	Feet	Inches	Feet
1	0.08	7	0.58
2	0.17	8	0.67
3	0.25	9	0.75
4	0.33	10	0.83
5	0.42	11	0.92
6	0.50	12	1.00

Purge Volumes 1 Casing (or well-bore) Volume (Gallons) = $\pi r^2 h \times 7.48$

where $\pi = 3.14$
r = radius of well casing (or well bore) in feet
h = height of water column in well in feet

OR For a 1" diameter well casing - 1 casing volume (gal.) = 0.04h
For a 2" diameter well casing - 1 casing volume (gal.) = 0.163h
For a 4" diameter well casing - 1 casing volume (gal.) = 0.652h

SPECIFIC CONDUCTIVITY CHART

$$K_{25} = K_m (0.02 \ (25 - T_m)) + K_m$$

$T_m = 10$	$K_{25} = K_m (0.3) + K_m$
$T_m = 11$	$K_{25} = K_m (0.28) + K_m$
$T_m = 12$	$K_{25} = K_m (0.26) + K_m$
$T_m = 13$	$K_{25} = K_m (0.24) + K_m$
$T_m = 14$	$K_{25} = K_m (0.22) + K_m$
$T_m = 15$	$K_{25} = K_m (0.20) + K_m$
$T_m = 16$	$K_{25} = K_m (0.18) + K_m$
$T_m = 17$	$K_{25} = K_m (0.16) + K_m$
$T_m = 18$	$K_{25} = K_m (0.14) + K_m$
$T_m = 19$	$K_{25} = K_m (0.12) + K_m$
$T_m = 20$	$K_{25} = K_m (0.10) + K_m$
$T_m = 21$	$K_{25} = K_m (0.08) + K_m$
$T_m = 22$	$K_{25} = K_m (0.06) + K_m$
$T_m = 23$	$K_{25} = K_m (0.04) + K_m$
$T_m = 24$	$K_{25} = K_m (0.02) + K_m$
$T_m = 25$	$K_{25} = K_m (0.00) + K_m$

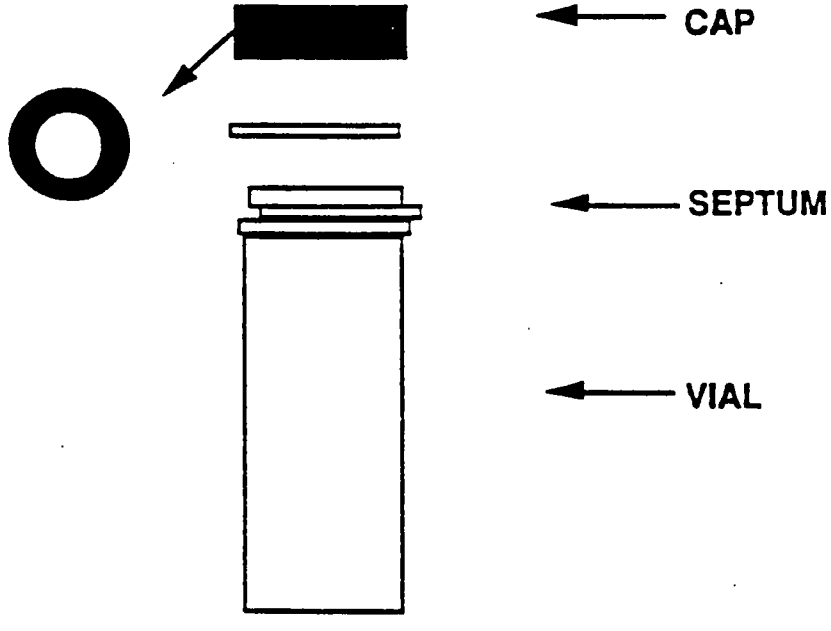
NOTE: K_m = Conductivity Measurement
T_m = Temperature Measurement
K_{25} = Specific Conductance

PROPER SAMPLING PROCEDURE
40 ML. VOA VIALS

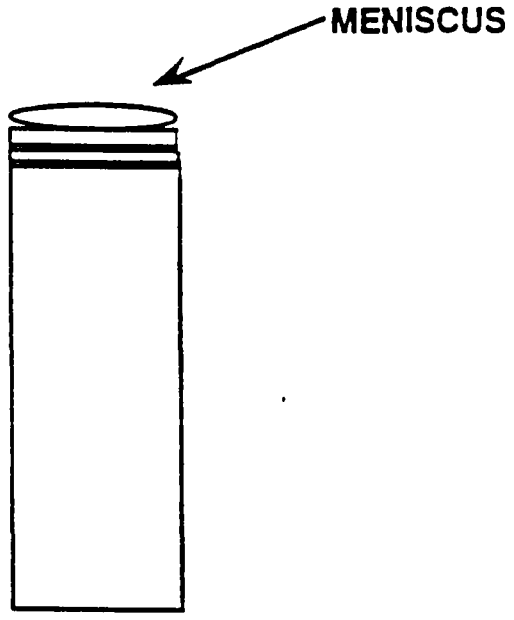
Careful sampling techniques must be used to obtain a representative sample for the analysis of volatile organic compounds (VOAs). As the name suggests, these compounds will volatilize from the water sample upon exposure to air. Therefore, this exposure time must be minimized. Sample contamination may easily occur if the samples are exposed to a source of volatile organics. Extra quality control procedures are used to avoid this possibility and to detect contamination if it has occurred.

Step 1: Carefully remove teflon septum cap, being careful not to allow the cap to contact potential contaminants.

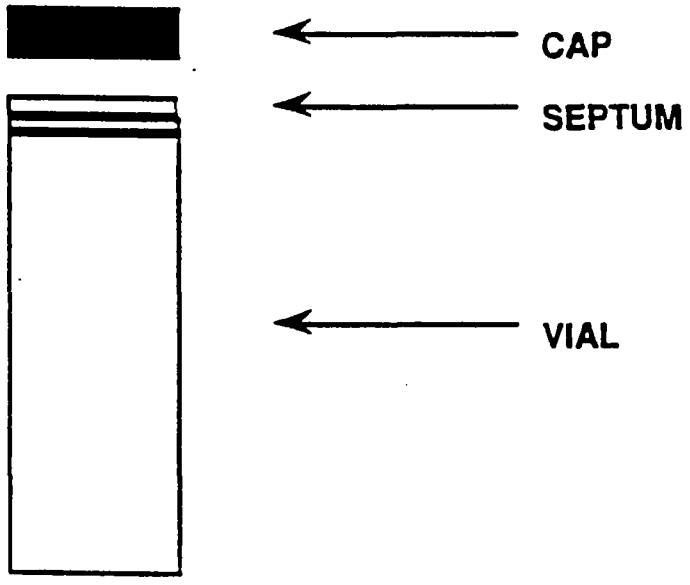
NOTE: Vial must not be opened before sampling. If the vial and/or cap appears defective, call EML. The vial should be open for a minimum amount of time (no longer than 3 minutes).



Step 2: Carefully fill vial with sample until a meniscus (mound of water) forms on top. Avoid shaking or agitating the sample, as this may cause volatiles to vaporize.



Step 3: Carefully replace the septum and cap on the meniscus. This will force a small amount of water off the top. Check the sample for air bubbles. If bubbles are present, remove the cap, top off the sample, and repeat Step 3. (generally to a maximum of 3 times.)



Field Information Form Checklist

_____1) Purge date — Must be complete and correct.
_____2) Start purge — Must be complete and correct (24-hour clock).
_____3) Elapsed hours — Must reflect in tenth of hours the time from start of purge to the end of purge.
_____4) Casing volume — Actual volume present in well casing before purge in nearest 1/2 gallons.
_____5) Volume purged — The actual number of gallons to nearest 1/2 gallon of volume of water purged.

6) Purging and sampling equipment

_____ **Purging:**
Is equipment dedicated, what type of pump or device is it, what is the tubing constructed of?

_____ **Sampling:**
Is this equipment dedicated, what type of device or pump, what materials is it constructed of?

_____ **Filtering Devices:**
Indicate type of device used in-line cartridge, pressure, vacuum (peristaltic pump).

7) Field measurements

_____ **Well Elevation:**
Must be recorded to two places to right, must be * in comment section as to its origin.

_____ **Depth to Water:**
Recorded in feet, must be recorded to two places to the right.

_____ **Groundwater Elevation:**
Must be complete, correct and recorded to two places to the right.

_____ **Well Depth:**
Must be correct, complete to two places to the right.. An asterisk notation (*) should be recorded in comments as to the origin of this entry.

_____ **pH/SC Temperature:**
Must be recorded to 3 significant figures. SC must be read at 25°C or temperature compensated.

8) Field Comments

_____ **Sample Appearance:**
Should be descriptive, complete, and accurate. Note appearance(physical), odor, color outlook.

_____ **Weather Conditions:**
Wind speed, direction, precipitation, outlook.

_____ **Other Comments:**
All sources of * information, purge conversions, duplicate field readings.

_____ **Sampler Certification:**
Must be dated, complete, neat, printed employer, and signed.

Information on Chain-of-Custody Checklist

_____1) Sample Point	Source code first then designation. Must be correct I.D. Designation must be legible and correct.
_____2) Sample Date	Must be correct and complete.
_____3) Sample Time	Must be correct and complete (24 hr. clock).
_____4) Filtering Information	Should be circled and agree with S.O.W/bottle information.
_____5) ENS Number	Must be in agreement with S.O.W. and sample I.D.'s.
_____6) Chain-of-Custody Chronicle	Must sign, date, log AquaPak, condition and seal number.

USE OF A FLOW CELL AND ADDITIONAL REFERENCE PROCEDURES: Eh DO AND ALKALINITY

Field measurements are required in certin areas of the country for three additional field parameters: oxidation-reduction potential (Eh), alkalinity and dissolved oxygen. Oxidation reduction potentials (Eh) are useful for predicting the migration of contaminants in groundwater and surface water. Dissolved oxygen is necessary for the survival and growth of many aquatic organisms. It's absence promotes the production of toxic materials from anaerobic decay of organic matter. Alkalinity is a general indicator of groundwater quality. It is a quantitative measurement of the ability of a sample to react with strong acid to a designated pH.

ASTM procedures for these methods have been included for guidance in completing the analysis of these field parameters. In addition, a description of a recommended procedure for use of a flow cell has been included for those sites that want to use this procedure.

Use of a Flow Cell for Field Measurements

Use of a closed flow-through cell in obtaining reliable field measurements helps minimize such interferences as heating or cooling, turbulence and atmospheric gas exchange. Representativeness of groundwater's pH, Eh, conductivity, dissolved oxygen and temperature measurements may be improved by use of a flow cell. Fewer chemical and physical changes are thought to occur with the use of a flow cell.

Procedure:

1. The pump outlet is connected to the inlet of the flow cell.

2. Calibrated electrodes are inserted into the flow cell.

3. The pump is turned on and water pumped through into a container where calibrating solutions and buffers are submerged to allow them to reach sample water temperature. These solutions should be +/- 10 degrees of the sample temperature.

4. After temperature equilibrium has been achieved, the electrodes shall be recalibrated.

5. Flow rate through the cell should not be more than one liter per minute to prevent inaccurate pH readings caused by static charge effects of water moving through small openings.

6. Electrode calibration should be rechecked just before sampling.

7. The pump should be shut off, tubing disconnected and the electrodes removed from the flow cell.

8. The flow cell should be cleaned with distilled water and then preparation for sample collection begun.

9. Use of a closed flow cell should be documented on the Field Information Form comments section.

Standard Practice for
OXIDATION-REDUCTION POTENTIAL OF WATER[1]

This standard is issued under the fixed designation D 1498; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

NOTE - New Section 7.9 was editorially added in December 1982.

1. Scope

1.1 This practice covers the apparatus and procedure for the electrometric measurement of oxidation-reduction potential (ORP) in water. It does not deal with the manner in which the solutions are prepared, the theoretical interpretation of the oxidation-reduction potential, or the establishment of a standard oxidation-reduction potential for any given system. The practice described has been designed for the routine and process measurement of oxidation-reduction potential.

2. Applicable Documents

2.1 *ASTM Standards:*

D 1129 Definitions of Terms Relating to Water[2]

D 1193 Specification for Reagent Water[2]

D 3370 Practices for Sampling Water[2]

3. Summary of Practice

3.1 This is a practice designed to measure the ORP which is defined as the electromotive force between a noble metal electrode and a reference electrode when immersed in a solution. The practice describes the electronic equipment available to make the measurement and describes how to determine the sensitivity of the electrodes as well as the calibration of equipment to solutions having a known potential. The ORP electrodes are inert and measure the ratio of the activities of the oxidized to the reduced species in the process reactions.

4. Definitions

4.1 The term "oxidation-reduction potential" used in this method is defined in accordance with Definitions D 1129 as follows:

4.1.1 *oxidation-reduction potential*—the electromotive force developed by a noble metal electrode immersed in the water, referred to the standard hydrogen electrode.

4.1.2 The oxidation-reduction potential (ORP) of a process solution can be described as the millivolt signal, E_m, produced when a noble metal electrode and a reference electrode are placed in water. The millivolt signal produced can be represented as follows:

$$E_m = E^\circ + 2.3\frac{RT}{nF}\log A_{ox}/A_{red}$$

where:

E_m	= ORP,
E°	= constant that depends on the choice of reference electrodes.
F	= Faraday constant,
R	= gas constant,
T	= absolute temperature, °C + 273.15,
n	= number of electrons involved in process reaction, and
A_{ox} and A_{red}	= activities of the reactants in the process.

4.2 For definitions of other items used in this method, refer to Definitions D 1129.

[1] This practice is under the jurisdiction of ASTM Committee D-19 on Water and is the direct responsibility of Subcommittee D19.09 on Saline and Brackish Water.

Current edition approved Sept. 24, 1976. Published November 1976. Originally published as D 1498 - 57 T. Last previous edition D 1498 - 59 (1970).

[2] *Annual Book of ASTM Standards*, Vol 11.01.

5. Interferences

5.1 The ORP electrodes reliably measured ORP in nearly all aqueous solutions and in general are not subject to solution interference from color, turbidity, colloidal matter, and suspended matter.

5.2 The ORP of an aqueous solution is sensitive to change in temperature of the solution, but temperature correction is rarely done due to its minimal effect and complex reactions. Temperature corrections are usually applied only when it is desired to relate the ORP to the activity of an ion in the solutions.

5.3 The ORP of an aqueous solution is sensitive to pH variations when the oxidation-reduction reaction involves either hydrogen or hydroxyl ions. The ORP generally tends to increase with an increase in hydrogen ions and to decrease with an increase in hydroxyl ions during such reactions.

5.4 Reproducible oxidation-reduction potentials cannot be obtained for chemical systems that are not reversible. The measurement of end point potential in oxidation-reduction titration is sometimes of this type.

5.5 If the metallic portion of the ORP electrode is sponge-like, materials absorbed from solutions may not be washed away, even by repeated rinsings. In such cases, the electrode may exhibit a memory effect, particularly if it is desired to detect a relatively low concentration of a particular species immediately after a measurement has been made in a relatively concentrated solution. A brightly polished metal electrode surface is required for accurate measurements.

5.6 The ORP resulting from interactions among several chemical systems present in mixed solutions may not be assignable to any single chemical.

6. Apparatus

6.1 *Meter*—Most laboratory pH meters can be used for measurements of ORP by substitution of an appropriate set of electrodes and meter scale. The characteristics of a variety of laboratory meters are shown in Table 1. The choice will depend on the accuracy desired in the determination.

6.1.1 Most process pH meters can be used for measurement of ORP by substitution of an appropriate set of electrodes and meter scale. These instruments are generally much more rugged than those which are used for very accurate measurements in the laboratory. Usually, these more rugged instruments produce results that are somewhat less accurate and precise than those obtained from laboratory instruments. The characteristics of three types of process ORP analyzers are presented in Table 2. Each of these analyzers is satisfactory for process ORP measurements. The choice of analyzer is generally based on how closely the characteristics of the analyzer match the requirements of the application. Typical factors which may be considered include, for example, the types of signals which the analyzer can produce to drive external devices, and the span ranges available.

6.1.2 For remote ORP measurements the potential generated can be transmitted to an external indicating meter. Special shielded cable is required to transmit the signal.

6.2 *Reference Electrode*—A calomel, silver-silver chloride, or other reference electrode of constant potential shall be used. If a saturated calomel electrode is used, some potassium chloride crystals shall be contained in the saturated potassium chloride solution. If the reference electrode is of the flowing junction type, the design of the electrode shall allow for each measurement a fresh liquid junction to be formed between the solution of potassium chloride and the standard or the test solution. The electrode design shall also allow traces of solution to be washed from the outer surfaces of the electrodes. To ensure the desired slow outward flow of the reference-electrode solution, the solution pressure inside the liquid junction should be somewhat in excess of that outside the junction. In nonpressurized applications this requirement can be met by maintaining the inside solution level higher than the outside solution level. If the reference electrode is of the nonflowing junction type, these outward flow and pressurization considerations shall not apply. The reference electrode and junction shall perform satisfactorily as required in the procedure for checking sensitivity described in Section 9.

6.3 *Oxidation-Reduction Electrode*—A noble metal is used in the construction of oxidation-reduction electrodes. The most common metals employed are: platinum, gold, and silver. It is

important to select a metal that is not attacked by the test solution. The construction of the electrode shall be such that only the noble metal comes in contact with the test solution. The area of the noble metal in contact with the test solution should be approximately 1 cm^2.

6.4 *Electrode Assembly*—A conventional electrode holder or support can be employed for laboratory measurements. Many different styles of electrode holders are suitable for various process applications such as measurements in an open tank, process pipe line, pressure vessel, or a high pressure sample line.

7. Reagents and Materials

7.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society.[3] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 *Purity of Water*—Unless otherwise indicated, reference to water shall be understood to mean reagent water conforming to Specifications D 1193, Type II.

7.3 *Aqua Regia*—Mix 1 volume of concentrated nitric acid (HNO_3, sp gr 1.42) with 3 volumes of concentrated hydrochloric acid (HCl, sp gr 1.18). It is recommended that only enough solution be prepared for immediate requirements.

7.4 *Buffer Standard Salts*—Table 3 lists the buffer salts available from the National Bureau of Standards specifically for the preparation of standard buffer solutions. The NBS included numbers and drying procedures.

7.4.1 *Phthalate Reference Buffer Solution* (pH_s = 4.00 at 25°C)—Dissolve 10.12 g of potassium hydrogen phthalate ($KHC_8H_4O_4$) in water and dilute to 1 L.

7.4.2 *Phosphate Reference Buffer Solution* (pH_s = 6.86 at 25°C)—Dissolve 3.39 g of potassium dihydrogen phosphate (KH_2PO_4) and 3.53 g of anhydrous disodium hydrogen phosphate (Na_2HPO_4) in water and dilute to 1 L.

7.5 *Chromic Acid Cleaning Solution*—Dissolve about 5 g of potassium dichromate ($K_2Cr_2O_7$) in 500 mL of concentrated sulfuric acid (H_2SO_4, sp gr 1.84).

7.6 *Detergent*—Use any commercially available "low-suds" liquid or solid detergent.

7.7 *Nitric Acid* (1 + 1)—Mix equal volumes of concentrated nitric acid (HNO_3, sp gr 1.42) and water.

7.8 *Redox Standard Solution; Ferrous-Ferric Reference Solution*[4]—Dissolve 39.21 g of ferrous ammonium sulfate ($Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$), 48.22 g of ferric ammonium sulfate ($FeNH_4(SO_4)_2 \cdot 12H_2O$) and 56.2 mL of sulfuric acid (H_2SO_4, sp gr 1.84) in water and dilute to 1 L. It is necessary to prepare the solution using reagent grade chemicals that have an assay confining them to be within 1 % of the nominal composition. The solution should be stored in a closed glass or plastic container.

7.8.1 The ferrous-ferric reference solution is a reasonably stable solution with a measurable oxidation - reduction potential. Table 4 presents the potential of the platinum electrode for various reference electrodes at 25°C in the standard ferrous-ferric solution.

7.9 *Redox Reference Quinhydrone Solutions*—Mix 1 L of pH 4 buffer solution, see 7.4.1, with 10 g of quinhydrone. Mix 1 L of pH 7 buffer solution, see 7.4.2, with 10 g of quinhydrone. Be sure that excess quinhydrone is used in each solution so that solid crystals are always present. These reference solutions are stable for only 8 h. Table 5 lists the nominal millivolt redox readings for the quinhydrone reference solutions at temperatures of 20°C, 25°C, and 30°C.

8. Sampling

8.1 Collect the samples in accordance with Practices D 3370.

9. Preparation

9.1 *Electrode Treatment*—Condition and maintain ORP electrodes as recommended by the manufacturer. If the assembly is in intermittent use, the immersible ends of the elec-

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[3] "Reagent Chemicals, American Chemical Society Specifications," Am. Chem. Soc., Washington, D. C. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, N. Y., and "The United States Pharmacopeia."

[4] "Standard Solution for Redox Potential Measurements," Analytical Chemistry, Vol 44, 1972, p. 1038.

trode should be kept in water between measurements. Cover the junctions and fill-holes of reference electrodes to reduce evaporation during prolonged storage.

9.2 *ORP Electrode Cleaning*—Remove traces of foreign matter. Immerse the oxidation-reduction electrode in warm aqua regia (70°C) and allow to stand for a period of about 1 min. This solution dissolves the noble metal as well as any foreign matter so that the electrode should not be allowed to stand in it longer than the time specified. The above treatment in aqua regia may also be used cautiously to recondition an electrode that has become unreliable in its operation. It is also possible to clean the electrode in HNO_3 (1 + 1). Warm the solution and electrode gradually to boiling. Maintain it just below the boiling point for about 5 min and then allow the solution and electrode to cool. Wash the electrode in water several times. It is desirable to clean the electrode daily. An alternative cleaning procedure is to immerse the electrode at room temperature in chromic acid cleaning mixture and then rinse first with dilute hydrochloric acid and then thoroughly with water. Preliminary cleaning with a detergent sometimes is desirable to remove oily residues. A mild abrasive can be used to remove some particulate matter. In these cleaning operations particular care must be exercised to protect the glass-metal seals from sudden changes of temperature, which might crack them.

10. Calibration and Standardization

10.1 Before using electronic type meters, turn them on and allow them to warm up thoroughly. Bring them to electrical balance by carefully following the manufacturer's instructions. Set the scale or range to the desired millivolt level expected in the test solution.

10.2 Verify the sensitivity of the electrodes by noting the change in millivolt reading when the pH of the test solution is altered. The ORP will increase when the pH of the test solution decreases and the ORP will decrease if the test solution pH is increased. Place the sample in a clean glass beaker and agitate the sample. Insert the electrodes and note the ORP or millivolt reading. Add a small amount of a dilute NaOH solution and note the value of the ORP. If the ORP drops sharply when the caustic is added, the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions. If the ORP does not respond as above when the caustic is added the electrodes should be cleaned as described in 9.2 and the above procedure repeated.

10.3 *Checking Response Electrodes to the Standard Redox Solutions* (see 7.8 and 7.9)—Wash the metal and reference electrode and the sample cup or container with three changes of water or by means of a flowing stream from a wash bottle. Fill the sample container with fresh redox standard solution and immerse the electrodes. Turn the range switch to the proper range and engage the operating button. Adjust the asymmetry control to the millivolt potential of the standard redox solution. Without changing the setting of the asymmetry potential knob, repeat the above procedure until two successive instrument readings are constant. The readings should not differ from the millivolt value of the standard redox solution by more than 10 mV.

10.3.1 It usually suffices to check the sensitivity of the electrodes since the important feature is the change of potential as related to the concentration of the oxidant or reductant present. The actual numerical value of the potential will vary depending on the constituents present in the water.

10.4 *Indirect Calibration and Standardization:*

10.4.1 Employ this procedure when it is not convenient or practical to remove the electrodes from the flowing stream or container in which the ORP is being determined. Use of a laboratory ORP meter or an additional analyzer is required.

10.4.2 Verify the sensitivity of the laboratory ORP meter or additional process analyzer in accordance with 10.2.

10.4.3 Collect a grab sample that is representative of the material that is in contact with the electrodes of the analyzer that is to be standardized. If a submersion-style electrode chamber is in use, collect the sample from the discharge of the chamber. Immediately transport the sample to the laboratory ORP meter or additional process analyzer and measure the ORP. It is absolutely essential that the sample be representative of the solution in contact with

the electrodes of the analyzer being adjusted and that the integrity of the sample be maintained until its ORP has been measured. In particular, the temperature of the sample must remain constant. Then adjust the standardization control on the process analyzer being calibrated until the reading corresponds to the ORP of the sample. Repeat the procedure described above until two successive readings are obtained that differ by no more than 10 mV. This procedure cannot be employed if the ORP of the solution being tested is fluctuating by more than 10 mV at the time of standardization.

10.4.4 The sensitivity of the electrodes can also be verified by a determination of the concentration of the oxidants or reductants in a grab sample collected in accordance with 10.4.3. It is necessary to determine the conditions required in each individual system to use this method of verifying electrode sensitivity. For example, the chlorine residual determination can be used to verify the sensitivity of an ORP electrode system used to control an alkaline chlorination-cyanide destruction system.

11. Procedure

11.1 After the assembly has been checked for sensitivity (10.2) or standardized as described in 10.4, wash the electrodes with three changes of water or by means of a flowing stream from a wash bottle. Place the sample in a clean glass beaker or sample cup and insert the electrodes. Provide adequate agitation throughout the measurement period. Read the millivolt potential of the solution allowing sufficient time for the system to stabilize. Measure successive portions of the sample until readings on two successive portions differ by no more than 10 mV. A system that is very slow to stabilize probably will not yield a meaningful ORP.

11.2 *Continuous Determination of the ORP of Flowing Streams or Batch Systems*—Process ORP analyzers with their rugged electrodes and electrode chambers provide continuous measurements which are the basis for fully automatic control. Make selection of the electrodes and electrode chamber to suit the physical and chemical characteristics of the process material. Locate the submersion-style electrode chamber so that fresh solution representative of the process stream or batch continuously passes across the electrodes. Agitation may be employed in order to make the stream or batch more nearly homogeneous. The ORP value is usually displayed continuously and can be noted at any specific time. Frequently, the pH value is continuously recorded, yielding a permanent record.

12. Calculation

12.1 If the meter is calibrated in millivolts, read the oxidation-reduction potential directly from the meter scale. This ORP potential is related to the reference electrode used in the measurement.

12.2 Calculate the oxidation-reduction potential of the sample, in millivolts, referred to the hydrogen scale as follows:

$$E_h = E_{noble} + E_{ref}$$

where:

E_h = oxidation-reduction potential referred to the hydrogen scale, mV,

E_{noble} = observed oxidation-reduction potential of the noble metal-reference electrode employed, mV, and

E_{ref} = oxidation-reduction potential of the reference electrode as related to the hydrogen electrode, mV.

13. Report

13.1 Report the oxidation-reduction potential to the nearest 10 mV, interpolating the meter scale as required. When considered appropriate, the temperature at which the measurement was made, the electrode system employed, and the pH at the time of measurement, may also be reported.

14. Precision and Accuracy

14.1 Precision and accuracy of the measurement depends largely on the condition of the electrode system and on the degree to which the chemical system being measured fits the qualifications given in Sections 3 and 5. In the absence of substances that coat or poison the electrode, the precision is ± 10 mV.

Table 1 Laboratory ORP Meters

	Type I	Type II	Type III	Type IV
Range:				
Normal	0 – ±1400 mV	0 – ±1400 mV	0 – ±1400 mV	0 – ±1400 m
Expanded		any 200 mV	any 140 mV	
Scale:				
Normal	10	10	10	0.1
Expanded		.1	1	
Accuracy	±7	±1	±0.7	±0.1
Repeatability	±2	±0.5	±0.2	±0.2
Asymmetry potential compensator	yes	yes	yes	yes

Table 2 ORP Analyzers for Process Measurements

	Type I	Type II	Type III
Range	200, 500, or 1000 mV with lower limit between ±700 mV	0 to 1000 mV	100 to 200 mV
Stability	±2 mV/24 h	±0.06 mV/week	±0.1% of span
Output signal, full scale:			
Potentiometric	10,100 mV 1, 5 V	1, 10 V	...
Current	4 to 20, 10 to 50 mA	0 to 16, 0 to 20, 4 to 20, 5 to 25, 10 to 50 mA	4 to 20, 10 to 50 mA

Table 3 National Bureau of Standards (NBS) Materials for Reference Buffer Solutions

NBS Standard Sample Designation[a]	Buffer Salt	Drying Procedure
186-II-C	disodium hydrogen phosphate	2 h in oven at 130° C
186-I-C	potassium dihydrogen phosphate	2 h in oven at 130° C
185-e	potassium hydrogen phthalate	drying not necessary

[a] The buffer salts listed can be purchased from the Office of Standard Reference Materials, National Bureau of Standards, Washington, D.C. 20234.

Table 4 Potential of the Platinum Electrode for Several Reference Electrodes at 25°C in Ferrous-Ferric Reference Solution

Reference Electrode	Potential EMF, mV
Hg, Hg_2Cl_2, satd KCl[a]	+430
Ag, AgCl, 1.00 M KCl	+439
Ag, AgCl, 4.00 M KCl	+475
Ag, AgCl, satd KCl	+476
Pt, H_2 (p = 1), H (a = 1)	+675

Table 5 Nominal ORP of Reference Quinhydrone Solutions

	ORP = mV					
Buffer solution, nominal pH		4			7	
Temperature, °C	20	25	30	20	25	30
Reference Electrode						
Silver/silver chloride	268	263	258	92	86	79
Calomel	223	218	213	47	41	34
Hydrogen	470	462	454	295	285	275

Standard Test Methods for
ACIDITY OR ALKALINITY OF WATER[1]

This standard is issued under the fixed designation D 1067; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

These methods have been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards

1. Scope

1.1 These methods[2] cover the determination of acidity or alkalinity of all types of water. Five methods are given as follows:

	Sections
Method A (Electrometric Titration)	7 to 15
Method B (Electrometric or Color-Change Titration)	16 to 24
Method C (Color-Comparison Titration)	25 to 32
Method D (Color-Change Titration After Boiling)	33 to 40
Method E (Color-Change Titration After Hydrogen Peroxide Oxidation and Boiling	41 to 49

1.2 In all of the methods the hydrogen or hydroxyl ions present in water by virtue of the dissociation or hydrolysis of its solutes, or both, are neutralized by titration with standard alkali (acidity) or acid (alkalinity). Of the five procedures, Method A is the most precise and accurate. It is used to develop an electrometric titration curve (sometimes referred to as a pH curve), which defines the acidity or alkalinity of the sample and indicates inflection points and buffering capacity, if any. In addition, the acidity or alkalinity can be determined with respect to any pH of particular interest. The other four methods are used to determine acidity or alkalinity relative to a predesignated end point based on the change in color of an internal indicator or the equivalent end point measured by a pH meter. They are suitable for routine control purposes.

1.3 When titrating to a specific end point, the choice of end point will require a careful analysis of the titration curve, the effects of any anticipated changes in composition on the titration curve, knowledge of the intended uses or disposition of the water, and a knowledge of the characteristics of the process controls involved. While inflection points (rapid changes in pH) are usually preferred for accurate analysis of sample conposition and obtaining the best precision, the use of an inflection point for process control may result in significant errors in chemical treatment or process control in some applications. When titrating to a selected end point dictated by practical considerations, (*1*) only a part of the actual neutralizing capacity of the water may be measured, or (*2*) this capacity may actually be exceeded in arriving at optimum acidity or alkalinity conditions.

1.4 Scope section is provided in each method as a guide. It is the responsibility of the analyst to determine the acceptability of these methods for each matrix.

2. Applicable Documents

2.1 *ASTM Standards:*

D 596 Method of Reporting Results of Analysis of Water[3]

D 1129 Definitions of Terms Relating to Water[3]

D 1192 Specification for Equipment for Sampling Water and Steam[3]

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[1] These methods are under the jurisdiction of ASTM Committee D-19 on Water and are the responsibility of Subcommittee D 19.05 on Inorganic Constituents in Water.

Current edition approved June 25, 1982. Published October 1982. Originally published as D 1067 – 49. Last previous edition D 1067 – 70 (1977).

[2] The basic procedures used in these methods have appeared widespread in the technical literature for many years. Only the particular adaptation of the electrometric titration appearing as the Referee Method is believed to be largely the work of ASTM Committee D-19.

[3] *Annual Book of ASTM Standards*, Vol 11.01.

D 1193 Specification for Reagent Water[3]
D 1293 Test Methods for pH of Water[3]
D 3370 Practices for Sampling Water[3]
E 200 Practice for Preparation, Standardization, and Storage of Standard Solutions for Chemical Analysis[3]

3. Significance and Use

3.1 Acidity and alkalinity measurements are used to assist in establishing levels of chemical treatment to control scale, corrosion, and other adverse chemical equilibria.

3.2 Levels of acidity or alkalinity are critical in establishing solubilities of some metals, toxicity of some metals, and the buffering capacity of some waters.

4. Definitions

4.1 The terms in these methods are defined in accordance with Definitions D 1129.

4.2 Certain uses of terminology exist in the water treatment industry which may differ from these definitions. A discussion of terms is presented in Appendix X1.

5. Purity of Reagents

5.1 Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[4] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Specification D 1193, Type I. In addition, reagent water for this test shall be free of carbon dioxide (CO_2) and shall have a pH between 6.2 and 7.2 at 25°C. A procedure for the preparation of carbon dioxide-free water is given in Methods E 200.

6. Sampling

6.1 Collect the sample in accordance with the applicable ASTM method as follows: Specification D 1192 and Practices D 3370.

6.2 The time interval between sampling and analysis shall be as short as practically possible in all cases. It is mandatory that analyses by Method A be carried out the same day the samples are taken; essentially immediate analysis is desirable for those waste waters containing hydrolyzable salts that contain cations in several oxidation states.

METHOD A—ELECTROMETRIC TITRATION

7. Scope

7.1 This method is applicable to the determination of acidity or alkalinity of all waters that are free of constituents that interfere with electrometric pH measurements. It is used for the development of a titration curve that will define inflection points and indicate buffering capacity, if any. The acidity or alkalinity of the water or that relative to a particular pH is determined from the curve.

8. Summary of Method

8.1 To develop a titration curve that will properly identify the inflection points, standard acid or alkali is added to the sample in small increments and a pH reading is taken after each addition. The cumulative volume of solution added is plotted against the observed pH values. All pH measurements are made electrometrically.

9. Interferences

9.1 Although oily matter, soaps, suspended solids, and other waste materials may interfere with the pH measurement, these materials may not be removed to increase precision, because some are an important component of the acid- or alkali-consuming property of the sample. Similarly, the development of a precipitate during titration may make the glass electrode sluggish and cause high results.

10. Apparatus

10.1 *Electrometric pH Measurement Apparatus*, conforming to the requirements given in Method D 1293.

11. Reagents[4]

11.1 *Hydrochloric Acid, Standard* (0.02 *N*) (Note 1)—Prepare and standardize as directed in Methods E 200, except that the titration shall

[4] "Reagent Chemicals, American Chemical Society Specifications," Am. Chemical Soc., Washington, D.C. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, N.Y., and the "United States Pharmacopeia."

be made electrometrically. The inflection point corresponding to the complete titration of carbonic acid salts will be very close to pH 3.9.

NOTE 1—Sulfuric acid of similar normality may be used instead of hydrochloric acid. Prepare and standardize in like manner.

11.2 *Sodium Hydroxide, Standard* (0.02 *N*)—Prepare and standardize as directed in Methods E 200, except that the titration shall be made electrometrically. The inflection point corresponding to the complete titration of the phthalic acid salt will be very close to pH 8.6.

12. Procedure

12.1 Mount the glass and reference electrodes in two of the holes of a clean, threehole rubber stopper chosen to fit a 300-mL, tall-form Berzelius beaker without spout. Place the electrodes in the beaker and standardize the pH meter, using a reference buffer having a pH approximating that expected for the sample (see Method D 1293). Rinse the electrodes, first with reagent water, then with a portion of the sample. Following the final rinse, drain the beaker and electrodes completely.

12.2 Pipet 100 mL of the sample, adjusted, if necessary, to room temperature, into the beaker through the third hole in the stopper. Hold the tip of the pipet near the bottom of the beaker while discharging the sample.

12.3 Measure the pH of the sample in accordance with Method D 1293.

12.4 Add either 0.02 *N* acid or alkali solution, as indicated, in increments of 0.5 mL or less (Note 2). After each addition, mix the solution thoroughly. Determine the pH when the mixture has reached equilibrium as indicated by a constant reading (Note 3). Mechanical stirring, preferably of the magnetic type, is required for this operation; mixing by means of a gas stream is not permitted. Continue the titration until the necessary data for the titration curve have been obtained.

NOTE 2—If the sample requires appreciably more than 25 mL of standard solution for its titration, use a 0.1 *N* solution, prepared and standardized in the same manner (see Methods E 200).

NOTE 3—An electrometric titration curve is smooth, with the pH changing progressively in a single direction, if equilibrium is achieved after each incremental addition of titrant, and may contain one or more inflection points. Ragged or irregular curves may indicate that equilibrium was not attained before adding succeeding increments. The time required will vary with different waters as the reaction rate constants of different chemical equilibria vary. In some instances the reaction time may be an interval of a few seconds while other slower, more complex reactions may require much longer intervals. It is important, therefore, that the period be sufficient to allow for any significant pH changes, yet consistent with good laboratory practices.

12.5 To develop a titration curve, plot the cumulative millilitres of standard solution added to the sample aliquot against the observed pH values. The acidity or alkalinity relative to a particular pH may be determined from the curve.

13. Calculation

13.1 Calculate the acidity or alkalinity, in milliequivalents per litre, as follows:

$$\text{Acidity (or alkalinity), meq/L (epm)} = AN \times 10$$

where:

A = millilitres of standard acid or alkali required for the titration, and

N = normality of the standard solution.

14. Report

14.1 Report the results of titrations to specific end points as follows: "The acidity (or alkalinity) to pH ___ at ___ °C = ___ meq/L (epm)."

14.2 Appropriate factors for converting milliequivalents per litre (epm) to other units are given in Method D 596.

15. Precision[6]

15.1 No statement can be made concerning the precision of this method because of the transient nature of the equilibria involved and the pronounced variation in the characteristics of different waters.

METHOD B—ELECTROMETRIC OR COLOR-CHANGE TITRATION

16. Scope

16.1 This method covers the rapid, routine control measurement of acidity or alkalinity to predesignated end points of waters that contain no materials that buffer at the end point or other materials that interfere with the titration by reason of color, precipitation, etc.

17. Summary of Method

17.1 The sample is titrated with standard acid or alkali to a designated pH, the end point

[6] Possible programs to obtain this important information are being considered.

being determined electrometrically or by the color change of an internal indicator.

18. Interferences

18.1 Natural color or the formation of a precipitate while titrating the sample may mask the color change of an internal indicator. Suspended solids may interfere in electrometric titrations by making the glass electrode sluggish. Waste materials present in some waters may interfere chemically with color titrations by destroying the indicator. Variable results may be experienced with waters containing oxidizing or reducing substances, depending on the equilibrium conditions and the manner in which the sample is handled.

19. Apparatus

19.1 *Electrometric pH Measurement Apparatus*—See 10.1.

20. Reagents

20.1 *Bromcresol Green Indicator Solution* (1 g/L)—Dissolve 0.1 g of bromcresol green in 2.9 mL of 0.02 *N* sodium hydroxide (NaOH) solution. Dilute to 100 mL with water.

20.2 *Hydrochloric Acid, Standard* (0.02 *N*) (Note 1)—See 11.1, except that the acid may be standardized by colorimetric titration as directed in Methods E 200 when an indicator is used for sample titration.

20.3 *Methyl Orange Indicator Solution* (0.5 g/L)—Dissolve 0.05 g of methyl orange in water and dilute to 100 mL.

20.4 *Methyl Purple Indicator Solution* (1 g/L)—Dissolve 0.45 g of dimethyl-aminoazobenzene-O-carboxylic acid, sodium salt, in approximately 300 mL of water. To this solution add 0.55 g of a water-soluble blue dye-stuff, Color Index No. 714,[6] and dissolve. Dilute to 1 L with water. This indicator is available commercially in prepared form.

20.5 *Methyl Red Indicator Solution* (1 g/L)—Dissolve 0.1 g of water-soluble methyl red in water and dilute to 100 mL.

20.6 *Phenolphthalein Indicator Solution* (5 g/L)—Dissolve 0.5 g of phenolphthalein in 50 mL of ethyl alcohol (95 %) and dilute to 100 mL with water.

NOTE 4—Specially denatured ethyl alcohol conforming to Formula No. 3A or 30 of the U. S. Bureau of Internal Revenue may be substituted for ethyl alcohol (95 %).

20.7 *Sodium Hydroxide, Standard* (0.02 *N*)—See 11.2, except that the alkali may be standardized by colorimetric titration as directed in Methods E 200 when an indicator is used for sample titration.

21. Procedure

21.1 Depending on the method of titration to be used, pipet 100 mL of the sample, adjusted, if necessary, to room temperature, into a 300-mL, tall-form beaker or a 250-mL, narrow-mouth Erlenmeyer flask. Hold the tip of the pipet near the bottom of the container while discharging the sample.

21.2 Titrate the aliquot electrometrically to the pH corresponding to the desired end point (Note 5). When using an indicator, add 0.2 mL (Note 6) and titrate with 0.02 *N* acid (for alkalinity) or 0.02 *N* NaOH solution (for acidity) until a persistent color change is noted (Note 7). Add the standard solution in small increments, swirling the flask vigorously after each addition. As the end point is approached, a momentary change in color will be noted in that portion of the sample with which the reagent first mixes. From that point on, make dropwise additions.

NOTE 5—The choice of end point will have been made to provide optimum data for the intended use or disposition of the water. When an indicator is used, those listed in 20.1 and 20.3 through 20.6 are the ones used most frequently; others may be employed if it is to the user's advantage. Color change and endpoint data for indicators listed herein are presented in Appendix X2 and Table X1.

NOTE 6—After some practice, slightly more or less indicator may be preferred. The analyst must use the same quantity of phenolphthalein at all times, however, because at a given pH, the intensity of one-color indicators depends on the quantity.

NOTE 7—If the sample requires appreciably more than 25 mL of 0.02 *N* solution for its titration, use a smaller aliquot, or a 0.1 *N* reagent prepared and standardized in the same manner (see Methods E 200).

22. Calculation

22.1 Calculate the acidity or alkalinity, in milliequivalents per litre, as follows:

$$\text{Acidity (or alkalinity), meq/L (epm)} = (AN/B) \times 1000$$

[6] Refers to compounds, bearing such number, as described in "Color Index," Society of Dyers and Colourists, Yorkshire, England (1924). American Cyanamid Company's "Calcocid Blue AX Double" has been found satisfactory for this purpose.

Standard Test Methods for
DISSOLVED OXYGEN IN WATER[1]

This standard is issued under the fixed designation D 888; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

These test methods have been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

ε NOTE—Editorial changes were made throughout these test methods in April 1986.

1. Scope

1.1 These test methods cover the determination of dissolved oxygen in water. Four test methods are given as follows:

	Range, mg/L	Sections
Test Method A—Colorimetric Indigo Carmine	<0.06	8 to 16
Test Method B—Titrimetric Procedure-Low Level	<1.0	17 to 24
Test Method C—Titrimetric Procedure-High Level	>1.0	25 to 31
Test Method D—Instrumental Probe Procedure	0.05 to 20	32 to 40

1.2 Due to instability of samples adequate testing has not been carried out to validate Test Methods A and B. The precision of Test Methods C and D was carried out using a saturated sample of reagent water. It is the user's responsibility to ensure the validity of the test methods for waters of untested matrices.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For a specific precautionary statement, see Note 19.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1066 Practice for Sampling Steam[2]

D 1129 Definitions of Terms Relating to Water[2]

D 1192 Specification for Equipment for Sampling Water and Steam[2]

D 1193 Specification for Reagent Water[2]

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water[2]

D 3370 Practices for Sampling Water[2]

E 200 Practice for Preparation, Standardization, and Storage of Standard Solutions for Chemical Analysis[2]

3. Terminology

3.1 For definitions of terms used in these test methods, refer to Definitions D 1129.

3.2 *Descriptions of Terms Specific to This Standard:*

3.2.1 *amperometric systems*—those instrumental probes which involve the generation of an electrical current from which the final measurement is derived.

3.2.2 *instrumental probes*—devices used to penetrate and examine a system for the purpose of relaying information on its properties or composition. The term "probe" is used in this test method to signify the entire sensor assembly, including electrodes, electrolyte, membrane, materials of fabrications, etc.

3.2.3 *potentiometric systems*—those instrumental probes in which an electrical potential is generated and from which the final measurement is derived.

[1] These test methods are under the jurisdiction of ASTM Committee D-19 on Water and are the direct responsibility of Subcommittee D19.05 on Inorganic Constituents in Water.

Current edition approved Jan. 30, 1981. Published March 1981. Originally published as D 888 – 46T. Last previous edition D 888 – 66 (1977).

[2] *Annual Book of ASTM Standards*, Vol 11.01.

4. Significance and Use

4.1 Dissolved oxygen is required for the survival and growth of many aquatic organisms, including fish. The concentration of dissolved oxygen may also be associated with corrosivity and photosynthetic activity. The absence of oxygen may permit anaerobic decay of organic matter and the production of toxic and undesirable esthetic materials in the water.

4.2 Dissolved oxygen is detrimental in a boiler/steam cycle because its presence may accelerate corrosion. Dissolved oxygen concentrations greater than 10 µg/L are unacceptable in many high pressure boiler systems. The efficiency of dissolved oxygen removal from boiler feedwater either by chemical or mechanical means is determined by measuring the dissolved oxygen concentration before and after the removal process. The measurement is also made to check for possible air leakage into the boiler system.

5. Purity of Reagents

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[3] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

5.2 Reagent grade chemicals, as defined in Methods E 200, shall be used unless otherwise indicated. It is intended that all reagents conform to this specification.

5.3 Unless otherwise indicated, reference to water shall be understood to mean reagent water conforming to Type II of Specification D 1193.

6. Sampling

6.1 Collect the samples in accordance with Practice D 1066 and Practices D 3370.

6.2 For low levels of dissolved oxygen (Test Method B), collect the samples using apparatus similar to that shown in Fig. 1.[4]

6.3 For higher concentration of dissolved oxygen, collect the samples in narrow-mouth glass-stoppered bottles of 300-mL capacity, taking care to prevent entrainment or solution of atmospheric oxygen.

6.4 With water under pressure, connect a tube of inert material to the inlet and extend the tube outlet to the bottom of the sample bottle. Use stainless steel, Type 304 or Type 316, or glass tubing with short neoprene connections. Do not use copper tubing, long sections of neoprene tubing, or other types of polymeric materials. The sample line shall contain a suitable cooling coil if the water being sampled is above room temperature, in which case cool the sample 16 to 18°C. When a cooling coil is used, the valve for cooling water adjustment shall be at the inlet to the cooling coil and the overflow shall be to a point of lower elevation. The valve for adjusting the flow of sample shall be at the outlet from the cooling coil. The sample flow shall be adjusted to a rate that will fill the sampling vessel or vessels in 40 to 60 s and flow long enough to provide a minimum of ten changes of water in the sample vessel. If the sampling line is used intermittently, flush the sample line and cooling coil adequately before using.

6.5 Where samples are collected at varying depths from the surface, a special sample bottle holder or weighted sampler with a removable air-tight cover should be used. This unit may be designed to collect several 250 or 300-mL samples at the same time. Inlet tubes extending to the bottom of each bottle and the water after passing through the sample bottle or bottles, displaces air from the container. When bubbles stop rising from the sampler, the unit is filled. Water temperature is measured in the excess water in the sampler.

6.6 For depths greater than 2 m, use a Kemmerer-type sampler. Bleed the sample from the bottom of the sampler through a tube extending to the bottom of a 250 to 300 mL biological oxygen demand (BOD) bottle. Fill the bottle to overflowing and prevent turbulence and the formation of bubbles while filling the bottle.

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[3] "Reagent Chemicals, American Chemical Society Specifications," Am. Chemical Soc., Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."

[4] McLean sampling tube as modified by the Engineering Experiment Station, U.S. Navy, and by the Heat Exchange Institute. This figure was editorially revised in February 1951. For information on the modification of the sampling tube and test procedure developed by the Heat Exchange Institute, see the paper by Sebold, J. F., "An Evaluation of Test Methods for the Determination of Dissolved Oxygen in Deaerated Boiler Feedwater, *Proceedings*, ASTM, Vol 47, 1947, p. 1121.

7. Preservation of Samples

7.1 Do not delay the determination of dissolved oxygen. Samples for Test Method C may be preserved 4 to 8 h by adding 0.7 mL of concentrated sulfuric acid (H_2SO_4, sp gr 1.84) and 1.0 mL of sodium azide (NaN_3) solution (20 g/L) to the bottle containing the sample in which dissolved oxygen is to be determined. Biological activity will be inhibited and the dissolved oxygen retained by storing at the temperature of collection or by water sealing (inverting bottle in water) and maintaining at a temperature of 10 to 20°C. Complete the determination as soon as possible, using the appropriate procedure for determining the concentration of dissolved oxygen.

TEST METHOD A—COLORIMETRIC INDIGO CARMINE

8. Scope

8.1 This test method is applicable to water containing less than 60 µg/L of dissolved oxygen, such as steam condensate and deaerated boiler feedwater only. It is the user's responsibility to ensure the validity of this test method for waters of untested matrices.

8.2 Due to the instability of the samples, adequate testing has not been carried out to validate this test method.

9. Summary of Test Method

9.1 Dissolved oxygen reacts under alkaline conditions with the indigo carmine solution to produce a progressive color change from yellow-green through red to blue and blue-green. The result of each test can be determined by comparison of color developed in the sample with color standards made up to represent different concentrations of dissolved oxygen.

10. Interferences

10.1 Tannin, hydrazine, and sulfite do not interfere in concentrations up to 1 mg/L. Ferric iron, cyclohexylamine, and morpholine in concentrations up to 4 mg/L can be tolerated. Ferrous iron will produce low results and copper will cause high results. In samples where ferrous iron and copper are present, their combined interference is frequently zero. Nitrate is a possible interference.

11. Apparatus

11.1 *Buret*, 25 or 50-mL.

11.2 *Sampling Bucket*, with an overflow at least 20 mm above the top of the sampling vessel.

11.3 *Sampling Vessels*—Nessler-type 60-mL tubes or 300-mL BOD bottles having a raised lip around the neck and glass stoppers ground to a conical lower tip, or low-level sampling bottles for determining low levels of dissolved oxygen (see 6.2).

12. Reagents

12.1 *Color Standards, Stock Solutions:*

12.1.1 *Red Color Standard, No. CS-A*—Dissolve 59.29 g of cobaltous chloride hexahydrate ($CoCl_2 \cdot 6H_2O$) in sufficient HCl (1 + 99) to make 1 L.

12.1.2 *Yellow Color Standard, No CS-B*—Dissolve 45.05 g of ferric chloride hexahydrate ($FeCl_3 \cdot 6H_2O$) in sufficient HCl (1 + 99) to make 1 L.

12.1.3 *Blue Color Standard, No. CS-C*—Dissolve 62.45 g of cupric sulfate pentahydrate ($CuSO_4 \cdot 5H_2O$) in sufficient HCl (1 + 99) to make 1 L.

12.1.3.1 Store all stock solutions in dark-colored bottles to prevent fading.

12.2 *Hydrochloric Acid* (sp gr 1.19)—Concentrated hydrochloric acid (HCl).

12.3 *Hydrochloric Acid* (1 + 99)—Mix 1 volume of concentrated HCl (sp gr 1.19) with 99 volumes of water.

12.4 *Indigo Carmine Solution*—Dissolve 0.18 g of 100 % indigo carmine and 2.0 g of dextrose (or glucose) in 50 mL of water. Allowance must be made for the purity of the indigo carmine when the assay is less than 100 %. Add 750 mL of glycerin and mix thoroughly. The solution is usable for at least 30 days if stored in a refrigerator. The stock solution deteriorates rapidly if allowed to stand in a lighted room at ambient temperature in an ordinary reagent bottle. Smaller quantities of the indigo carmine solution may be prepared by proportionately reducing the quantity of reagents. The indigo carmine and dextrose may be weighed, mixed, and stored in capsules or vials for long periods of time as long as the mixture remains dry.

12.5 *Indigo Carmine-Potassium Hydroxide Reagent*—In a small bottle mix 4 parts by volume of indigo carmine solution with 1 part of the potassium hydroxide solution. Stopper and invert several times until mixture is complete. Allow the reagent to stand undisturbed until the initial red color changes to lemon yellow. Keep

in a dark cool place. Prepare a fresh solution daily.

12.6 *Potassium Hydroxide Solution* (530 g/L)—Dissolve 530 g of potassium hydroxide (KOH) in water and dilute to 1 L.

13. Sampling

13.1 Place a scrupulously clean sampling vessel in the sampling bucket and collect the sample under water, following the precautions in 6.4 and 6.5. Adjust the sample flow to between 500 and 1000 mL/min, when using 300-mL bottles, or 100 to 200-mL/min when using 60-mL sample tubes. Spin the sample vessel several times to dislodge air bubbles or film adhering to the glass wall. Allow the sample to continue overflowing from the vessel for several more minutes.

14. Calibration

14.1 Prepare a series of color standards as listed in Table 1. Place the amounts of stock solutions listed in Table 1 in 300-mL borosilicate glass-stoppered reagent bottles. Add 3.0 mL of HCl (sp gr 1.19) to each and dilute to the neck of the bottle with water. Stopper with plastic or lightly lubricated glass stoppers and mix by inversion. Store in a dark place to minimize fading of colors.

15. Procedure

15.1 Mount the buret directly above the sampling vessel neck so that the buret tip dips into the overflowing sample to a depth of 10 to 15 mm. Fill the buret with indigo carmine-potassium hydroxide reagent to about 1 mL above the zero mark. Drain the buret to the zero mark into the overflowing sample, and allow the sample to flush for 1 min longer. Remove the sample tubing gently from the sampling vessel so as not to introduce air bubbles. Do not remove the sample bottle or tube from the sample bucket. Quickly introduce 0.8 mL of indigo carmine-potassium hydroxide reagent from the buret into the sample if a 60-mL Nessler-type tube is used. If a BOD bottle is used, add 4 mL of the reagent. Raise the buret above the sample vessel and immediately stopper the vessel firmly with a rinsed glass stopper, being careful to exclude air bubbles. Invert the vessel several times to mix. A color indicative of the dissolved oxygen concentration will develop. Place the sample vessel on a white surface and match its color with the previously prepared standards by viewing them at a 45° angle using a "cool" white fluorescent lamp for illumination. A better color match may be obtained by using a three-lamp fixture containing two "deluxe white" and one "daylite" fluorescent lamps with an opal glass beneath the sample tubes or bottles. Match colors as soon as possible after mixing the reagent and sample, since the colors are not stable for more than 30 min and air leakage may cause a change in color.

15.2 The test method used should be stated when reporting results.

16. Precision and Bias

16.1 The overall precision and bias of this test method cannot be determined by round-robin testing because of the instability of shipped solutions. The single-operator precision of this test method may be expressed as follows:

$$S_o = 0.052X + 0.7$$

where:

S_o = single-operator precision, and

X = concentration of dissolved oxygen determined, µg/L.

16.2 Due to the instability of samples adequate testing has not been carried out to validate this test method.

16.3 Supporting data on file as RR: D19-1070 at ASTM headquarters do not include information on number of replicates and concentration levels.

TEST METHOD B—TITRIMETRIC PROCEDURE—LOW LEVELS

17. Scope

17.1 This test method is applicable to water containing less than 1000 µg/L of dissolved oxygen such as in steam condensate, boiler feedwater and industrial water. It is the user's responsibility to ensure the validity of the test method for waters of untested matrices.

17.2 Due to the instability of samples adequate testing has not been carried out to validate this test method.

18. Summary of Test Method

18.1 The sample is collected in a tube of special design. Free iodine is liberated in an amount equivalent to the oxygen originally dissolved in the sample. The iodine is: (*1*) titrated with phenylarsine oxide or sodium thiosulfate potentiometrically, the end point being the maximum change in voltage per unit of titrant added or (*2*) (see Note 1) using starch indicator.

19. Interferences

19.1 Careful preparation of the iodized alkaline iodide reagent minimizes reducing interferences at low levels of dissolved oxygen.[5]

20. Apparatus

20.1 For *Potentiometric Determination*:

20.1.1 Beaker, 800-mL Griffin low-form.

20.1.2 *Burets*—Three 10 or 25-mL burets having a stopcock bore not greater than 2 mm and a maximum tip diameter not exceeding 3 mm; two 10-mL burets with 0.01-mL divisions.

20.1.3 *Graduated Cylinder*, 10-mL, graduated, with 0.1-mL divisions.

20.1.4 *Calomel Electrode*—Any calomel reference electrode of either the glass sleeve or asbestos fiber wick type of satisfactory size is suitable. The 5-in. (127-mm) pencil-type is a convenient form.

20.1.5 *Platinum Electrodes*—Any commercial platinum electrode of suitable size can be used. The 5-in. (127-mm) pencil-type is a convenient form.

20.1.6 *Potentiometer*—A potentiometer having a limit of error not greater than ±0.003 V and a total range of the order of 1 V. A galvanometer for use with this potentiometer should have an external critical damping resistance of the order of 10 000 Ω and a sensitivity of the order of 0.125 μA/mm scale division. The potentiometer may be of the type employing either a self-contained galvanometer or an external galvanometer, as desired. A glass electrode pH meter having the proper voltage range may be used.

20.1.7 *Sample Tubes*—Two glass sample tubes as shown in Fig. 1, having a nominal capacity of 500 mL. The two tubes should not vary from each other by more than 10 mL, and the capacity of each tube shall be determined to the nearest 1 mL.

20.2 *Colorimetric Titration*:

20.2.1 *Casserole*, 1-L glazed porcelain, clear white in color.

20.2.2 *Miscellaneous*—Sample tubes and 10-mL burets with 0.01-mL divisions (see 20.1.2).

20.2.3 *Stirrer*—A variable-speed, motor-driven stirrer with a TFE-fluorocarbon-coated stirrer bar is convenient.

21. Reagents

21.1 *Alkaline Iodide Solution*—Dissolve 500 g of sodium hydroxide (NaOH) or 700 g of potassium hydroxide (KOH) and 135 g of sodium iodide (NaI) or 150 g of potassium iodide (KI) in water and dilute to 1 L. Chemically equivalent potassium and sodium salts may be used interchangeably. The solution should not give a color with starch indicator when diluted and acidified. Store the solution in a dark, rubber-stoppered bottle.

21.2 *Iodine Solution* (0.1 *N*)—Dissolve 6.346 g of resublimed iodine in a solution of 75 g of KI in 60 mL of water and dilute with water to 500 mL in a volumetric flask. Store in a dark, stoppered bottle.

21.3 *Manganous Sulfate Solution* (364 g/L)—Dissolve 364 g of manganous sulfate ($MnSO_4 \cdot H_2O$) in water, filter, and dilute to 1 L. No more than a trace of iodine should be liberated when the solution is added to an acidified potassium iodide (KI) solution.

21.4 *Phenylarsine Oxide Solution* (0.025 *N*)—Dissolve 2.6005 g of phenylarsine oxide in 110 mL of NaOH solution (12 g/L). Add 800 mL of water to the solution, and bring to a pH of 9.0 by adding HCl (1 + 1). This should require about 2 mL of HCl. Continue acidification with HCl (1 + 1) until a pH of 6 to 7 is reached, as indicated by a glass-electrode system; then dilute to 1 L. Add 1 mL of chloroform for preservation. Standardize against potassium biiodate solution.

NOTE 1—Phenylarsine oxide is available from Wallace and Tiernan, Hach Chemical Co., and others.[6] It is more stable than sodium thiosulfate. However, sodium thiosulfate may be used. The analyst should specify which titrant is used. For a stock solution (0.1 *N*), dissolve 24.82 g of $Na_2S_2O_3 \cdot 5H_2O$ in boiled and cooled water and dilute to 1 L. Preserve by adding 5 mL of chloroform. For a dilute standard titrating solution (0.005 *N*) transfer 25.00 mL of 0.1 *N* $Na_2S_2O_3$ to a 500-mL volumetric flask. Dilute to the mark with water and mix completely. Do not prepare more than 12 to 15 h before use.

21.5 *Phenylarsine Oxide Solution* (0.005 *N*)—Transfer 100 mL of 0.025 *N* phenylarsine oxide solution to a 500-mL volumetric flask. Dilute to the mark and mix completely.

21.6 *Potassium Biiodate Solution* (0.1 *N*)—Dissolve 3.2500 g of potassium biiodate [$KH(IO_3)_2$] in water and dilute to 1 L in a volumetric flask.

21.7 *Potassium Iodide, Iodized Alkaline So-*

[5] For further information on interferences, see Adams, R. C., Barnett, R. E., and Keller, D. Y., Jr., "Field and Laboratory Determination of Dissolved Oxygen," *Proceedings*, ASTM, Vol 43, 1943, p. 1240.

[6] Eastman 10884 has been found satisfactory and is available from Eastman Organic Chemicals, Eastman Kodak Co., Rochester, NY 14650. An equivalent may also be used.

lution—Half fill a 250-mL volumetric flask with the alkaline KI solution. Add an accurately measured, small amount of 0.1 *N* iodine solution, sufficient to react with all reducing interference in the water to be analyzed when the procedure described in Section 22 is followed. Dilute to the mark with the alkaline KI solution.

21.7.1 While the iodized alkaline iodide solution must be used for accurate determinations, the minimum sufficient quantity of 0.1 *N* iodine solution required to yield detectable iodine in the blank should be used because the precision of the results decreases with increase in iodine concentration. As a trial, use 10 mL of 0.1 *N* iodine solution in preparing the iodized alkaline iodide solution and use on a test run. Prepare a second solution, if necessary, using more or less 0.1 *N* iodine solution, depending on the results of the test run.

21.8 *Starch Solution*—Make a paste of 6 g of arrowroot starch or soluble iodometric starch with cold water. Pour the paste into 1 L of boiling water. Then add 20 g of potassium hydroxide, mix thoroughly, and allow to stand for 2 h. Add 6 mL of glacial acetic acid (99.5 %). Mix thoroughly and then add sufficient HCl (sp gr 1.19) to adjust the pH value of the solution to 4.0. Store in a glass-stoppered bottle. Starch solution prepared in this manner will remain chemically stable for 1 year.

NOTE 2—Powdered starches such as thyodene[7] have been found adequate. Some commercial laundry starches have also been found to be usable.

NOTE 3—If the indicator is not prepared as specified or a proprietary starch indicator preparation is used, the report of analysis shall state this deviation.

21.9 *Sulfuric Acid Solution* (3 + 1)—Pour carefully 750 mL of concentrated sulfuric acid (H_2SO_4, sp gr 1.84) into 250 mL of water in a beaker. Cool to room temperature, transfer to a 1-L volumetric flask, and dilute to the mark with water. Sulfamic acid packets may be substituted.[8]

22. Procedure

22.1 *Sampling*—Arrange the two sample tubes (Fig. 1) in a support so that they are vertical, with their outlets free of hose connections and at a higher level than the valve for adjustment of a sample flow. Connect the lower ends to the sampling lines with a Y-tube. Follow the precautions in 6.4 and 6.5.

22.2 *Fixing*—Fill the three burets with the iodized alkaline iodide solution, $MnSO_4$ solution, and H_2SO_4 (3 + 1), respectively. Designate the larger one of the duplicate tubes as the sample and the other as the blank.

22.2.1 Flick the water from the upper nipple of the sample flask (*A*) and fill the nipple to the upper calibration mark with the iodized alkaline iodide solution. Any bubble entrapped in the nipple within or below the reagent can be removed by probing with a clean copper wire until it rises to the surface. Open one stopcock and admit the reagent by control with the other until the meniscus in the nipple coincides with the lower calibration mark. Precisely the same point on the meniscus at the upper and lower calibration must be used. Close both stopcocks and rinse both nipples of the sampling tube with a fine stream of water. Flick out the excess water, invert the tube, and fill the nipple now on top to the 2.0-mL calibration mark with the $MnSO_4$ solution and introduce it into the sample as described for the addition of the iodized alkaline iodide solution. Again rinse both nipples of the sampling tube, shake or rotate the tube to mix the sample thoroughly, and lay it aside. Following precisely the directions given above for adding the reagents to the sample, add to the blank the indicated amount of iodized alkaline iodide solution through the upper nipple and stopcock, and add the same amount, first of H_2SO_4 (3 + 1) and then of the $MnSO_4$ solution, through the lower nipple (*B*). Rinse both nipples between additions, as directed above, and mix the blank between the second and final addition. Finally, mix the "sample" thoroughly, as directed above, to resuspend the precipitate. A significant error is introduced if the precipitate is allowed to settle so that more than a proportional amount is removed with the volume withdrawn to permit the addition of the H_2SO_4 (3 + 1). Add to the sample an amount of H_2SO_4 (3 + 1) to fill the nipple to the upper calibration point, rinse both ends of the flask, and again mix thoroughly. Complete within 15 min after sampling.

22.3 *Potentiometric Titration*:

22.3.1 *Titration of Blank*—Invert the sample tube and drain out a sufficient volume of sample

[7] Fisher T-183 has been found to be satisfactory and is available from Fisher Scientific Co., 711 Forbes Ave., Pittsburgh, PA 15219. An equivalent may also be used.

[8] Kroner, R. C., Longbottom, J. E., Gorman, R., "A Comparison of Various Reagents Proposed for Use in the Winkler Procedure for Dissolved Oxygen, PHS Water Pollution Surveillance System Applications and Development Report No. 12, Water Quality Section, Basis Data Branch, July 1964.

to equalize the volume of "sample" and "blank" into a 10-mL graduated cylinder. Record the volume withdrawn and discard it. Drain the blank into the clean 800-mL beaker by opening both stopcocks. Do not rinse or blow through the sampling tube, but shake the last drops from the lower nipple into the beaker. Rinse both electrodes with water, and readjust the sleeve on the calomel electrode to provide a fresh junction. Place the beaker on the titrating stand with both electrodes immersed in the sample, start the stirrer, and adjust its speed to mix the sample rapidly without causing a vortex sufficient to draw bubbles of air into the liquid. Read and record the emf (electromotive force) between the electrodes. Fill a 10-mL buret (0.01-mL subdivisions) with 0.005 *N* standard solution and adjust exactly to the zero mark. Proceed with the titration, rinsing the tip of the pipet in the sample after each addition. Record the cumulative amounts of titrant and the emf after each addition, and make progressively smaller additions as the end point is approached and passed, allowing a sufficient interval between additions to enable electrodes and solution to come to equilibrium. Titration should be completed within 30 min after sampling. In a third column, parallel to those used for recording the millilitres of titrant and emf, record the quotient (Δemf)/(Δtitrant) for each addition. The maximum numerical value of this quotient, without regard to sign, occurs at the end point of the titration. The end point can be identified by inspection of the values in the third column, so that plotting of the data is unnecessary.

22.3.2 *Titration of Sample*—Empty the beaker, rinse it and the electrodes with water, prepare fresh junction with the sleeve of the calomel electrode, and drain the sample into the beaker. Titrate the sample as described for the blank in 22.3.1.

22.4 *Visual End Point Titration:*

22.4.1 *Titration of Blank*—Drain the blank, which shall be at a temperature not above 20°C, into the clean casserole and add 10 drops of starch indicator solution. Fill the buret with the volume required for the titration, with 0.005 *N* titrating solution. Start the motor stirrer, if available; otherwise, stir constantly with a clean glass rod. Titrate to the disappearance of the blue, starch iodine color, rinsing the tip of the buret in the sample after each addition as the end point approaches.

22.4.2 *Titration of Sample*—Empty and rinse the casserole and drain the sample into it. Titrate as described in 22.4.1.

23. Calculation

23.1 Calculate the dissolved oxygen content of the sample, in milligrams per litre as follows (Note 5):

$$\text{Dissolved oxygen, mg/L} = \frac{16\,000\, n\,(S-B)}{V_s + V_b} - 0.0104$$

where:

n = normality of the titrating solution (nominally 0.005),

S = volume of titrating solution required for titration of the sample, L,

V_s = volume of sample (volume of sample tube minus volume of portion discarded immediately before titration) (22.3.1), mL,

B = volume of titrating solution required for titration of the blank, mL,

V_b = volume of blank, mL, and

0.0104 = correction for oxygen introduced with the reagents.

NOTE 4—The reagents must be prepared several days prior to use and allowed to come to equilibrium with the oxygen in the air.[9]

NOTE 5—Inaccuracy of the results calculated by the method increases with difference in capacities of the two sampling tubes, the amount of oxygen dissolved in the water samples, and the concentration of redox impurities in the water.

23.2 The test method used should be stated when reporting results.

24. Precision and Bias

24.1 The overall precision and bias of this test method cannot be determined by round-robin testing because of the instability of shipped solutions. The single-operator precision of the test method is 0.002 mg/L oxygen, if the potentiometric titration is used, and if 0.005 mg/L of starch is used for detecting the end point of the titration.

24.2 Due to the instability of samples adequate testing has not been carried out to validate this test method.

24.3 Supporting data on file as RR: D19-1070 at ASTM headquarters do not include informa-

[9] For further information, see White, A. H., LeLand, C. H., and Button, D. W., "Determination of Dissolved Oxygen in Boiler Feedwater, *Proceedings*, ASTM, Vol 36, Part II, 1936, p. 697.

tion on number of replicates and concentration levels.

TEST METHOD C—TITRIMETRIC PROCEDURE—HIGH LEVEL

25. Scope

25.1 This test method is applicable to waters containing more than 1000 µg/L of dissolved oxygen much as stream samples and sewage samples. It is the user's responsibility to ensure the validity of the test method for waters of untested matrices.

25.2 This test method, with the appropriate agent, is usable with a wide variety of interferences. It is a combination of the Winkler Method, the Alsterberg (Azide) Procedure, the Rideal-Stewart (permanganate) modification, and the Pomeroy-Kirshman-Alsterberg modification.

25.3 The precision of the test method was carried out using a saturated sample of reagent water.

26. Interferences

26.1 Nitrite interferences are eliminated by routine use of sodium azide. Ferric iron interferes unless 1 mL of potassium fluoride solution is used, in which case 100 to 200 mg/L can be tolerated. Ferrous iron interferes, but that interference is eliminated by the use of potassium permanganate solution. High levels of organic material or dissolved oxygen can be accommodated by use of the concentrated iodide-azide solution.

27. Reagents

27.1 *Alkaline Iodide Solutions:*

27.1.1 *Alkaline Iodide Solution* (see 21.1)—This solution may be used if nitrite is known to be absent, and must be used if adjustments are made for ferrous ion interference.

27.1.2 *Alkaline Iodide-Sodium Azide Solution I*—This solution may be used in all of these submethods except when adjustment is made for ferrous ion. Dissolve 500 g of sodium hydroxide (NaOH) or 700 g of potassium hydroxide (KOH) and 135 g of sodium iodide (NaI) or 150 g of potassium iodide (KI) in water and dilute to 950 mL. To the cooled solution add 10 g of sodium azide (NaN_3) dissolved in 40 mL of water. Add the NaN_3 solution slowly, with constant stirring. Chemically equivalent potassium and sodium salts may be used interchangeably. The solution should not give a color with starch indicator solution when diluted and acidified. Store the solution in a dark, rubber-stoppered bottle.

27.1.3 *Alkaline Iodide-Sodium Azide Solution II*—This solution is useful when high concentrations of organic matter are found, or when the dissolved oxygen concentration exceeds 15 mg/L. Dissolve 400 g of sodium hydroxide (NaOH) in 500 mL of freshly boiled and cooled water. Cool the water slightly and dissolve 900 g of sodium iodide (NaI). Dissolve 10 g of sodium azide (NaN_3) in 40 mL of water. Slowly add, with stirring, the azide solution to the alkaline iodide solution, bringing the total volume to 1 L.

27.2 *Manganous Sulfate Solution*—See 21.3.

27.3 *Potassium Biiodate Solution* (0.025 *N*)—Dissolve 0.8125 g of potassium biiodate $KH(IO_3)_2$ in water and dilute to 1 L in a volumetric flask.

NOTE 6—If the bottle technique is used, dissolve 1.2188 g of biiodate in water and dilute to 1 L to make 0.0375 *N*.

27.4 *Phenylarsine Oxide Solution* (0.025 *N*)—See 21.4.

NOTE 7—If the full-bottle technique is used, 3.9007 g must be used to make 0.0375 *N*.

NOTE 8—If sodium thiosulfate is used, prepare and preserve a 0.1 *N* solution as described in Note 1. Determine the exact normality by titration against 0.025 *N* potassium biiodate solution. Dilute the appropriate volume (nominally 250 mL) of standardized 0.1 *N* $Na_2S_2O_3$ solution to 1 L. One millilitre of 0.025 *N* thiosulfate solution is equivalent to 0.2 mg of oxygen. If the full-bottle technique is followed, use 37.5 mL of sodium thiosulfate solution and standardize to 0.0375 *N*.

27.5 *Starch Solution*—See 21.8.

27.6 *Sulfuric Acid* (sp gr 1.84)—Concentrated sulfuric acid (H_2SO_4). One millilitre neutralizes about 3 mL of the alkaline iodide reagent.

NOTE 9—Sulfamic acid packets containing 3 g may be substituted.[10]

27.7 *Potassium Fluoride Solution* (400 g/L)—Dissolve 40 g of potassium fluoride ($KF \cdot 2H_2O$) in water and dilute to 100 mL. This solution is used in the procedure for eliminating ferric ion interference. Store this solution in a plastic bottle.

27.8 *Potassium Oxalate Solution* (20 g/L)—Dissolve 2 g of potassium oxalate ($K_2C_2O_4 \cdot H_2O$) in 100 mL of water. One millilitre of this solution will reduce 1.1 mL of the $KMnO_4$ solution. This solution is used in the procedure for eliminating ferrous ion interference.

[10] Available from Hach Chemical Co., P. O. Box 389, Loveland, CO 80537, among others.

27.9 *Potassium Permanganate Solution* (6.3 g/L)—Dissolve 6.3 g of potassium permanganate ($KMnO_4$) in water and dilute to 1 L. With very high ferrous iron concentrations, solution of $KMnO_4$ should be stronger so that 1 mL will satisfy the demand. This solution is used in the procedure for eliminating ferrous ion interference.

28. Apparatus

28.1 *Sample Bottles*, 250 or 300-mL capacity, with tapered ground-glass stoppers. Special bottles with pointed stoppers and flared mouths are available from supply houses, but regular types (tall- or low-form) are satisfactory.

28.2 *Pipets*, 10-mL capacity, graduated in 0.1-mL divisions for adding all reagents except sulfuric acid. These pipets should have elongated tips of approximately 10 mm for adding reagents well below the surface in the sample bottle. Only the sulfuric acid used in the final step is allowed to run down the neck of the bottle into the sample.

29. Procedure

29.1 *Elimination of Ferrous Ion Interference, If Necessary:*

29.1.1 Add to the sample (collected as in 6.3) 0.70 mL of H_2SO_4, followed by 1.0 mL of $KMnO_4$ solution. Where high iron is present, also add 1.0 mL of KF solution. Stopper and mix by inversion. The acid should be added with a 1-mL pipet graduated in 0.1-mL divisions. Add sufficient $KMnO_4$ solution to maintain a violet tinge for 5 min. If the color does not persist for 5 min, add more $KMnO_4$ solution, but avoid large excesses. In those cases where more than 5 mL of $KMnO_4$ solution is required, a stronger solution of this reagent may be used to avoid dilution of the sample.

29.1.2 After 5 min, completely destroy the permanganate color by adding 0.5 to 1.0 mL of $K_2C_2O_4$ solution. Mix the sample well and allow it to stand in the dark. Low results are caused by excess oxalate, so that it is essential to add only sufficient oxalate to completely decolorize the permanganate without having an excess of more than 0.5 mL. Complete decolorization should be obtained in 2 to 10 min. If the sample cannot be decolorized without a large excess of oxalate, the dissolved oxygen results will be of doubtful value.

29.2 Add 2.0 mL of $MnSO_4$ solution to the sample as collected in a sample bottle, followed by 2.0 mL of alkaline iodide-sodium azide solution well below the surface of the liquid (see Notes 10 and 11). Be sure the solution temperature is below 30°C to prevent losses due to volatility of iodine. Carefully replace the stopper to exclude air bubbles, and mix by inverting the bottle several times. Repeat the mixing a second time after the floc has settled, leaving a clear supernatant solution. Water high in chloride requires a 10-min contact period with the precipitate. When the floc has settled, leaving at least 100 mL of clear supernatant solution, remove the stopper and add 2.0 mL of H_2SO_4, allowing the acid to run down the neck of the bottle. Restopper and mix by inversion until the iodine is uniformly distributed throughout the bottle. Titrate without delay 203 mL of original sample. A correction is necessary for the 4 mL of reagents added (2 mL of $MnSO_4$ solution and 2 mL of alkaline iodide-sodium axide solution: $200 \times [300/(300 - 4)] = 203$ mL (see Note 12).

NOTE 10—Take care to use the correct alkaline iodide solution (27.1.1) if no nitrite is present or ferrous ion was oxidized, (27.1.2) for normal use or, (27.1.3) if there is a high organic or dissolved oxygen concentration.

NOTE 11—Two millilitres of the alkaline iodide-sodium azide solution are used to ensure better contact of the iodide-azide solution and sample with less agitation. With 250-mL bottles, 1 mL of the iodide-azide solution may be used if desired. In this procedure, as in the succeeding ones, all reagents except the H_2SO_4 are added well below the surface of the liquid.

NOTE 12—In the case where ferrous ion interference has been eliminated, a total of 6.7 mL of reagents were added (0.7 mL of acid, 1 mL of $KMnO_4$ solution, 2 mL of $MnSO_4$ solution, and 3 mL of alkaline iodide solution). The volume of sample for titration is 203 mL. A slight error occurs due to the dissolved oxygen of the $KMnO_4$ solution, but rather than complicate the correction further, this error is ignored.

29.3 Rapidly titrate the 203 mL of sample with 0.025 *N* titrating solution to a pale, straw-yellow color. Add 1 to 2 mL of starch indicator. Continue the titration to the disappearance of the blue color.

NOTE 13—If the full-bottle technique is used, transfer the entire contents of the bottle, 300 ± 3 mL, to a 500-mL Erlenmeyer flask and titrate with 0.0375 *N* titrating solution.

NOTE 14—At the correct end point, one drop of 0.025 *N* $KH(IO_3)_2$ solution will cause the return of the blue color. If the end point is overrun, continue adding 0.025 *N* $KH(IO_3)_2$ solution until it reappears, noting the volume required. Subtract this value, minus the last drop of $KH(IO_3)_2$ (0.04 mL) from the volume of 0.025 *N* titrating solution used. Disregard the late reappearance of the blue color, which may be due to the catalytic

effect of organic material or traces of uncomplexed metal salts.

30. Calculation

30.1 Calculate the dissolved oxygen content of the sample as follows:

$$\text{Dissolved oxygen, mg/L} = \frac{T \times 0.2}{200} \times 1000$$

where:

T = millilitres of 0.025 N titrating solution required for titration of the sample.

30.2 $$\text{Dissolved oxygen, mg/L} = \frac{A}{0.698}$$

where:

A = millilitres of oxygen at 0°C and 760 mm Hg.

NOTE 15—Each millilitre of 0.0375 N titrant is equivalent to 1 mg/L O_2 when the full bottle technique is used.

NOTE 16—If the percentage of saturation at 760-mm atmospheric pressure is desired, the dissolved oxygen found is compared with solubility data from standard solubility tables,[11] making corrections for barometric pressure and the aqueous vapor pressure, when necessary. See Appendix X1.

31. Precision and Bias[12]

31.1 The precision of the test method was determined by six operators in three laboratories, running three duplicates each, (not six laboratories as required by Practice D 2777 – 85) using a saturated sample of reagent water. The mean concentration was 9.0 mg/L and the pooled single-operator precision in these samples was 0.052 mg/L.

TEST METHOD D—INSTRUMENTAL PROBE PROCEDURE

32. Scope

32.1 This test method is applicable to waters containing dissolved oxygen in the range from 50 to 20 000 µg/L. It is the user's responsibility to ensure the validity of this test method for waters of untested matrices.

32.2 This test method describes procedures that utilize probes for the determination of dissolved oxygen in fresh water and in brackish and marine waters which may contain dissolved or suspended solids. Samples can be analyzed in situ in bodies of water or in streams, or samples can be collected and analyzed subsequent to collection. The probe method is especially useful in the monitoring of water systems in which it is desired to obtain a continuous record of the dissolved oxygen content.

32.2.1 The test method is recommended for measuring dissolved oxygen in waters containing materials that interfere with the chemical methods, such as sulfite, thiosulfate, polythionate, mercaptans, oxidizing metal ions, hypochlorite, and organic substances readily hydrolyzable in alkaline solutions.

33.3 Dissolved oxygen probes are practical for the continuous monitoring of dissolved oxygen content in natural waters, process streams, biological processes, etc. when the probe output is conditioned by a suitably stable electronic circuit and recorded. The probe must be standardized before use on samples free of interfering materials, preferably with the azide modification of Test Method C.

33. Summary of Test Method

33.1 The most common instrumental probes for determination of oxygen dissolved in water are dependent upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with dissolved oxygen concentrations.

NOTE 17—Steady-state conditions necessitate the probe being in thermal equilibrium with the solution, this typically taking some 20 min for nonlaboratory conditions.[13]

33.1.1 Probes that employ membranes normally involve metals of different nobility immersed in an electrolyte which is retained by the membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed which is directly proportional to the rate of arrival of oxygen molecules at the cathode.

33.1.2 The thallium probe, which does not utilize a membrane, exposes a thallium electrode to the water sample. Reaction of oxygen with the thallium establishes a potential between the thallium electrode and a reference electrode. The

[11] Carpenter, J. H., "New Measurement of Oxygen Solubility in Pure and Natural Water," Limnology and Oceanography, Vol 11, No. 2, April 1966, pp. 264–277.

[12] Supporting data for the precision statement have been filed at ASTM Headquarters, 1916 Race St., Philadelphia, PA 19103. Request RR: D 19 – 1070.

[13] D'Aoust, B. G., Clark, M. J. R., "Analysis of Supersaturated Air in Natural Waters and Reservoirs," *Transactions of the American Fisheries Society*, 1980, Vol 109, pp. 708–724.

potential is related logarithmically to dissolved oxygen concentration. The cell output decreases (theoretically 59 mV/decade at 25°C) with increased oxygen concentration.

NOTE 18—The thallium probe has utility in waste-treatment monitoring systems; it has limited application under conditions of high dissolved oxygen, (>8 mg/L) and low temperature (<10°C).

33.1.3 The electronic readout meter for the output from dissolved oxygen probes is normally calibrated in convenient scales (0 to 10, 0 to 15, or 0 to 20 mg/L for example) with a sensitivity of approximately 0.05 mg/L. More sensitive dissolved oxygen ranges are practical through amplification in the electronic readout (including µg/L readings in boiler feed waters).

33.2 Interfacial dynamics at the probe-sample interface are a factor in probe response. Turbulence should be constant or above some minimum level as recommended by the instrument manufacturer.

33.3 Response rates of dissolved oxygen probes are relatively rapid, often as fast as 99 % in 15 s. Probe outputs may be recorded for continual monitoring or utilized for process control (see Note 17).

34. Interferences

34.1 Dissolved organic materials normally encountered in water are not known to interfere in the output from dissolved oxygen probes.

34.2 Dissolved inorganic salts are a factor in the calibration of dissolved oxygen probe.

34.2.1 Solubility of oxygen in water at a given oxygen partial pressure changes with the kind and concentration of dissolved inorganic salts. Conversion factors for seawater and brackish waters may be calculated from dissolved oxygen saturation versus salinity data if internal compensation is not included in the instrument. Conversion factors for specific inorganic salts may be developed experimentally. Broad variations in the kinds and concentrations of salts in samples can make the use of a membraned probe difficult.

34.2.2 The thallium probe measures ionic activity instead of concentration as do all ion selective electrodes. Gross changes in the concentration of dissolved salts will affect the activity coefficient of thallous ion and thus shift the span (see 36.2.1). The thallium probe may be calibrated and operated in water of any conductivity above 100 µS, but a ten-fold change in conductivity will produce an error of approximately 20 %. Since the thallium requires a conducting path through the sample to the reference electrode, the response will become sluggish at very low conductivity. It is therefore desirable to calibrate the sensor in solutions having a conductivity greater than 100 µS.

34.3 Reactive compounds can interfere with the output or the performance of dissolved oxygen probes.

34.3.1 Membraned probes are sensitive to reactive gases that may pass through the membrane. Chlorine will depolarize the cathode and cause a high probe output. Long-term exposure to chlorine can coat the anode with the chloride of the anode metal and may eventually desensitize the probe. Hydrogen sulfide will interfere with membraned probes if the applied potential is greater than the half-wave potential of the sulfide ion. If the applied potential is less than the half-wave potential, an interfering reaction will not occur, but coating of the anode metal can occur.

34.3.2 The thallium probe is affected by interference from soluble sulfur compounds, such as hydrogen sulfide or mercaptans. Ten milligrams of hydrogen sulfide per litre of water will produce a negative error corresponding to approximately 1 mg/L of dissolved oxygen. Free halogens also will interfere with the thallium probe if present in appreciable concentrations, such as above 2 mg of chlorine per litre of water.

34.4 At dissolved oxygen concentrations below 2 mg/L, pH variation below pH 4 and above pH 10 interfere with the performance of the thallium probe (approximately ± 0.05 mg/L dissolved oxygen per pH unit). The performance of membraned probes is not affected by pH changes.

34.5 Dissolved oxygen probes are temperature sensitive and temperature compensation is normally provided by the manufacturer. The thallium probe has a temperature coefficient of 1.0 mV/°C, membraned probes have a temperature coefficient of 4 to 6 %/°C dependent upon the membrane employed.

34.6 Insoluble organic or inorganic materials that can coat the surface of dissolved oxygen probes will affect the performance of either the thallium or membraned probes.

35. Apparatus

35.1 *Amperometric Probes*—Oxygen-sensitive probes of the amperometric type are nor-

mally composed of two solid metal electrodes of different nobility in contact with a supporting electrolyte which is separated from the test solution by a selective membrane. The current generated by the reduction of oxygen at the cathode is measured through an electronic circuit and displayed on a meter. Typically, the anode is constructed of metallic silver or lead and the cathode of gold or platinum. Probes are generally not affected by hydraulic pressure and can be used in the temperature range from 0 to 50°C.

35.1.1 *Semipermeable Membranes of Polyethylene or TFE-fluorocarbon* permit satisfactory oxygen diffusion and limit interference from most materials.

35.1.2 *Accessory Equipment* may involve apparatus to move the sample past the probe and to provide suitable turbulence at the membrane-sample interface.

35.2 *Potentiometric Probes*—The commonly used potentiometric probe employs a thallium-measuring electrode and a suitable reference half cell such as a saturated calomel. At 25°C and 0.1 mg/L of dissolved oxygen, the cell establishes a negative potential of approximately 817 mV. The potential decreases logarithmically in absolute value with increased dissolved oxygen concentration (theoretically, 59 mV/decade change in dissolved oxygen concentration) to approximately 688 mV at 15 mg/L of dissolved oxygen. An external millivoltage source that opposes the output of the electrometer is used to adjust the net readout of output to the desired range.

NOTE 19—Thallium and its salts are toxic; avoid contact with the skin.

36. Apparatus Standardization

36.1 *Instrument Reading*—Consider carefully the manufacturer's recommended procedure. If it is necessary to zero the instrument, do this by immersing the probe in water containing 1 g of sodium sulfite and 2 drops of saturated cobalt chloride solution (as deoxygenation catalyst) per litre of water and adjust the instrument to read zero.

36.2 Carefully obtain approximately 1 L of the type of water to be tested and saturate it with oxygen from the atmosphere by passing clean air through it. Carefully draw three replicate samples from the well-mixed sample and immediately determine the dissolved oxygen concentration by Test Method C in duplicate. In the third replicate sample immerse the probe and provide for suitable turbulence in the sample. Standardize the probe by adjusting the meter reading to the dissolved oxygen value as determined by the chemical procedure. If substances that interfere with the chemical method are present in the natural water or wastewater sample, standardize the probe using reagent water or a synthetic sample as indicated below.

36.2.1 *Fresh Water Samples* (less than 1000 mg/L of dissolved salts)—If chemical interferences are absent, use a test sample as indicated above. If interferences are present, use reagent water for membraned probes. With thallium probes, the greatest accuracy can be obtained from calibrating in a sample of the water to be tested or a synthetic sample similar to the test sample.

36.2.2 *Salt Water Samples and Membraned Probes* (greater than 1000 mg/L of dissolved salts)—Use a sample of clean water having the same salt content as the test material. If a sample free from substances which interfere with the azide method is not available, prepare a synthetic standardization sample by adding the same salts as that contained in the sample until the two solutions have the same electrical conductance within 5 %. High concentrations of dissolved salts are not a problem with the thallium probe.

36.3 *Temperature Coefficient*—Systems are available with automatic temperature compensation that permit direct measurements in milligrams per litre of dissolved oxygen. The temperature compensation of membraned probes corrects for changes in membrane characteristics including boundary-layer effects at the membrane-water interface and the changes in solubility of oxygen in water. The temperature compensation of thallium probes corrects for the changes characteristic of oxidation/reduction systems (see Note 17). It is necessary that the probe be in thermal equilibrium with the solution to be measured for satisfactory temperature correction.

36.3.1 For those instrumental systems using membraned probes that are not temperature-compensated, the following procedure is recommended to obtain the temperature coefficient. Measure the oxygen content in water samples for five temperatures over a ±10°C range greater and less than the expected sample temperature. By a least-squares procedure, or graphically in a sem-

ilog plot of Y versus T, calculate the slope and intercept constant as follows:

$$\text{Log } y = B/T + A$$

where:

y = scale factor, milligrams of dissolved oxygen per litre per microampere of electrode current,
B = slope constant,
T = temperature, °C, and
A = intercept constant.

This relationship is linear on a semilog plot only over a range of about ±10°C. Over larger ranges an equation of higher degree is necessary to reflect the curvature of the relationship.

36.3.2 If the thallium probe is utilized in a circuit without temperature compensation, the observed output in millivolts must be corrected for the temperature sensitivity of the measuring cell that has a temperature coefficient of 1.0 mV/°C. The measuring cell's output will increase (apparent dissolved oxygen concentration decrease) with an increase in temperature.

$$MV_R = MV_0 - 1.0\,(T_o - T_R)$$

where:

MV_R = millivolts of output at reference temperature,
MV_0 = millivolts of output observed,
T_R = reference temperature, °C, and
T_o = temperature at the observed output, °C.

36.4 *Correction for Content of Dissolved Salts*—If the concentration of salts is above 1000 mg/L it will be necessary to correct for the effect of the salts in the relationship between oxygen partial pressure and concentration and also for the activity of thallium ion. For any given salt a series of experimental data should be obtained in which solutions are prepared by dissolving varying weights of the salt in reagent water in the range of interest. The solutions, plus a reagent water control, are aerated at constant temperature until oxygen saturation is achieved. Determine the oxygen concentration of each solution by the chemical method and, at the same time, obtain probe readings. Determine the ratio A for each solution as follows:

$$A = O/R$$

where:

O = actual dissolved oxygen concentration, mg/L, as determined by Test Method C and
R = reading of the probe meter.

For the reagent water control to which the probe is calibrated, the value of A is 1.0. Prepare a plot with salt concentration as abscissa and the ratio A as ordinate. Use the developed curve for calculation of the dissolved oxygen content of salt waters.

37. Sampling

37.1 *Bottle Samples*—Collect a bottle sample by the procedure described in Practice D 1066 or Practices D 3370. Collect the samples in 300-mL BOD bottles or other suitable glass-stoppered bottles, taking care to prevent entrainment or solution of atmospheric oxygen. If analysis is delayed beyond 15 min, cool the sample below 5°C and hold at this temperature until analyzed. Make the dissolved oxygen determination without further temperature adjustment using the appropriate temperature coefficient. It will be necessary to have the probe at the temperature of the sample or otherwise compensate for instability due to heat flow from probe to sample.

37.2 *In Situ Samples*—An effective use of the instrumental probes is for the direct, in situ determination of dissolved oxygen. By this means, sample handling problems are avoided and data may be obtained quickly at various locations in a body of water without concern for the change in oxygen during storage or handling.

38. Procedure

38.1 Consider carefully the manufacturer's recommendations on the use of his equipment in order to obtain satisfactory operation.

38.2 Provide for suitable turbulent flow past the membrane of membraned probes or past the thallium probe. This may, under some circumstances, be achieved adequately in flowing streams; however, in large bodies of water, it may be necessary to employ mechanical stirring or pumping of water past the probe. For accurate results, it is important that comparable degrees of turbulence be employed both for calibration and utilization.

38.3 If the probe is not automatically compensated for temperature changes, record the temperature of the water at the sample probe at the time of dissolved oxygen measurement. To avoid heat-flow effects, it is important that temperature equilibrium be established between sample and probe.

38.4 Recalibrate the probe whenever the com-

parison with reference samples (36.2) indicates an absolute error of more than ±0.2 mg/L of dissolved oxygen or other value that is compatible with the desired accuracy.

38.4.1 Careful handling is required with membraned probes to avoid rupturing the thin membrane.

38.4.2 Recalibrate the probe after replacing the membrane or cleaning the probe in accordance with the manufacturer's directions. For a period of a few hours after a membrane replacement, the probe output may drift, and frequent recalibration may be required.

38.5 Probes can become fouled by oil, grease, biological growths, etc., and cleaning may be required. Some of the techniques currently in use include air-blasting, brush cleaning, and ultrasonic cleaning systems.

38.6 The probe may be utilized in situ or the sample may be transferred to a sampling station that houses the probe and associated equipment.

38.6.1 In situ placement of the probe is preferable from the consideration that sample handling is not involved. However, in situ installations may be impractical because of problems with vandalism, severe climate condition (freezing, etc.) and difficulty in recovery of the probe for maintenance.

38.6.2 The use of sample transfer systems is practical when proper consideration is given to design features such as line size, rates of transfer, kind of pump and location, practicality for cleaning the transfer system, and other maintenance.

38.6.3 Examine unattended probes at least once per week and recalibrate when required depending upon condition and service. Recalibration may be accomplished by using a portable probe that has been placed into position next to the unattended probe and that has been properly calibrated as outlined in 36.2.

39. Calculation

39.1 For uncompensated probes, correct the observed meter reading for the difference of the observed temperature from the standardization temperature by means of the factors developed in 36.3.

39.2 For wastewaters with varying salt contents, make corrections utilizing the date developed in 36.4.

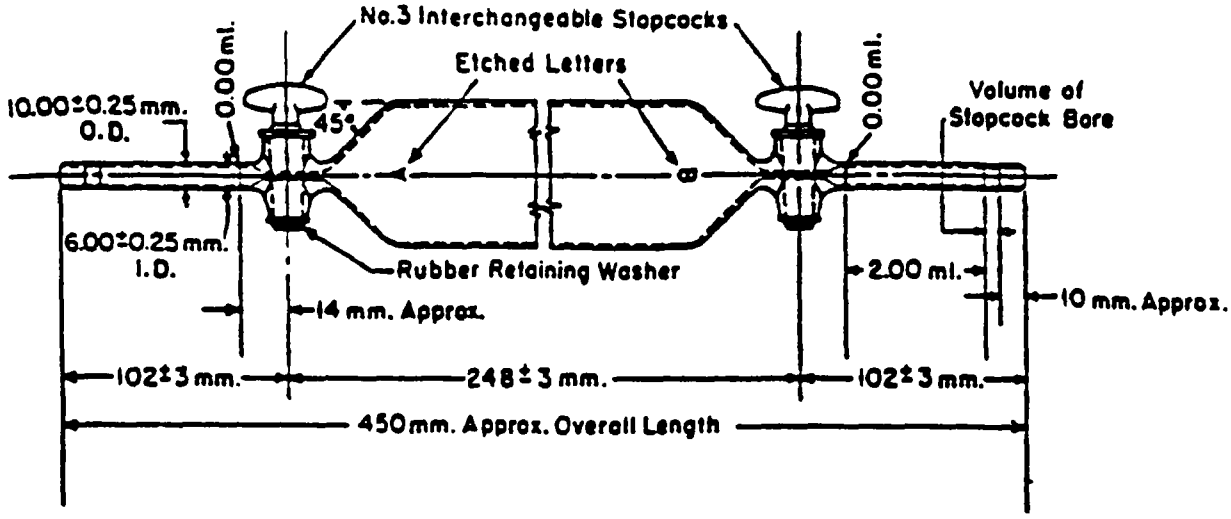
40. Precision

40.1 The precision of this test method was determined by six operators in three laboratories running three duplicates each, (not six laboraties as required by Practice D 2777 – 85) using a saturated sample of reagent water. The mean concentration was 9.0 mg/L and the pooled single-operator precision in these samples was 0.029 mg/L.

TABLE 1 Stock Solutions

Equivalent Dissolved Oxygen, µg/L	Millilitres of Color Standards		
	CS-A	CS-B	CS-C
0	0.75	05.0	...
5	5.0	20.0	...
10	6.25	12.5	...
15	9.4	10.0	...
20	(13.0)	(5.4)	...
25	14.4	5.5	...
30	(14.5)	(3.3)	(0.2)[A]
35	(15.1)	(2.9)	(1.1)
40	(15.5)	(2.4)	(2.2)
45	(16.1)	(2.0)	(2.5)
50	(18.3)	(1.7)	(3.1)
55	(21.7)	(1.4)	(13.1)
60	(25.0)	(1.0)	(15.0)

[A] Figures in parentheses are estimated from original data which are not in parentheses.



NOTE—Stopcocks should be of TFE-fluorocarbon.

FIG. 1 500-mL Sample Tube for Dissolved Oxygen Determination[3]

APPENDIX

(Nonmandatory Information)

X1. OXYGEN SATURATION VALUES

X1.1 *Oxygen Saturation Values in Water and Elevations*—The solubility of oxygen in water at various temperatures and elevations under an atmospheric pressure of 760 mm is shown in Table X1.1.

X1.2 *Oxygen Saturation Values in Water and Salt Waters*—The solubility of oxygen in water exposed to water saturated air under an atmospheric pressure of 760 mm is shown in Table X1.2 at several temperatures and concentrations of sea water for purpose of illustrating the effects of salt concentration and temperature. The solubility versus dissolved salt concentration can vary considerably with the nature of the salts in solution.

TABLE X1.1 Solubility of Oxygen (mg/L) at Various Temperatures and Elevations (Based on Sea Level Barometric Pressure of 760 mm Hg)[12]

Temperature, °C	Elevation, Feet above Sea Level						
	0	1000	2000	3000	4000	5000	6000
0	14.6	14.1	13.6	13.2	12.7	12.3	11.8
2	13.8	13.3	12.9	12.4	12.0	11.6	11.2
4	13.1	12.7	12.2	11.9	11.4	11.0	10.6
6	12.4	12.0	11.6	11.2	10.8	10.4	10.1
8	11.8	11.4	11.0	10.6	10.3	9.9	9.6
10	11.3	10.9	10.5	10.2	9.8	9.5	9.2
12	10.8	10.4	10.1	9.7	9.4	9.1	8.8
14	10.3	9.9	9.6	9.3	9.0	8.7	8.3
16	9.9	9.7	9.2	8.9	8.6	8.3	8.0
18	9.5	9.2	8.7	8.6	8.3	8.0	7.7
20	9.1	8.8	8.5	8.2	7.9	7.7	7.4
22	8.7	8.4	8.1	7.8	7.7	7.3	7.1
24	8.4	8.1	7.8	7.6	7.3	7.1	6.8
26	8.1	7.8	7.6	7.3	7.0	6.8	6.6
28	7.8	7.5	7.3	7.0	6.8	6.6	6.3
30	7.5	7.2	7.0	6.8	6.5	6.3	6.1
32	7.3	7.1	6.8	6.6	6.4	6.1	5.9
34	7.1	6.9	6.6	6.4	6.2	6.0	5.8
36	6.8	6.6	6.3	6.1	5.9	5.7	5.5
38	6.6	6.4	6.2	5.9	5.7	5.6	5.4
40	6.4	6.2	6.0	5.8	5.6	5.4	5.2

TABLE X1.2 Solubility of Oxygen (mg/L) at Various Temperatures and Chlorinity (Based on Sea Level Barometric Pressure of 760 mm Hg)[12]

Temperature, °C	Chlorinity, ‰					
	0	4.0	8.0	12.0	16.0	20.0
0	14.6	13.9	13.2	12.5	11.9	11.3
2	13.8	13.2	12.5	11.9	11.4	10.8
4	13.1	12.5	11.9	11.3	10.8	10.3
6	12.4	11.8	11.3	10.8	10.3	9.8
8	11.8	11.3	10.8	10.3	9.8	9.4
10	11.3	10.8	10.3	9.8	9.4	9.0
12	10.8	10.3	9.8	9.4	9.0	8.6
14	10.3	9.9	9.4	9.0	8.6	8.3
16	9.9	9.4	9.0	8.6	8.3	8.0
18	9.5	9.1	8.7	8.3	8.0	7.6
20	9.1	8.7	8.3	8.0	7.7	7.4
22	8.7	8.4	8.0	7.7	7.4	7.1
24	8.4	8.1	7.7	7.4	7.1	6.9
26	8.1	7.8	7.5	7.2	6.9	6.6
28	7.8	7.5	7.2	6.9	6.6	6.4
30	7.5	7.2	7.0	6.7	6.4	6.2
32	7.3	7.0	6.7	6.5	6.2	6.0
34	7.1	6.8	6.5	6.3	6.0	5.8
36	6.8	6.6	6.3	6.1	5.8	5.6
38	6.6	6.4	6.1	5.9	5.6	5.4
40	6.4	6.2	5.9	5.7	5.4	5.2

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

ENVIRONMENTAL MONITORING LABORATORIES (EML)

March, 1991

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Assistant Laboratory Director	Deborah Hockman
Manager of Client Services	Barb Hill
Manager of Quality Programs	Frank Jarke
Manager of CMR Lab	Frank Dias
Manager of Inorganics Lab	Bruce Warden
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Sampling Trainer:

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Well Wizard trouble-shooting number: (800) 624-2026

EML RECOMMENDATION FOR SAMPLING AND PRESERVATION OF SAMPLES ACCORDING TO ANALYTE[1]

Measurement	Vol. Req.(ml.)	Container[2]	Preservative[3,4]	Holding Time[5]
100 Physical Properties				
Color	50	P	Cool, 4°C	48 hrs.
Conductance	100	P	Cool, 4°C	28 days
Hardness	50	P	HNO_3 to pH<2	6 mos.
Odor	200	G only	Cool, 4°C	24 hrs.
pH	25	P	Cool, 4°C	Analyze Promptly Upon Receipt
Residue				
Filterable(TSS)	500	P	Cool, 4°C	7 days
Nonfilterable (TOS)	500	P	Cool, 4°C	7 days
Total(TS)	500	P	Cool, 4°C	7 days
Volatile	100	P	Cool, 4°C	7 days
Settleable Matter	1000	P	Cool, 4°C	48 hrs.
Temperature	1000	P	Cool, 4°C	Analyze Immediately
Turbidity	100	G	Cool, 4°C	48 hrs.
200 Metals				
Dissolved	500	P	Filter on site HNO_3 to pH<2	6 mos.
Suspended	200	P	Filter on site	6 mos.[8]

Measurement	Vol. Req.(ml.)	Container[2]	Preservative[3,4]	Holding Time[5]
Total	500	P	HNO_3 to pH<2	6 mos.
Chromium[6]	200	P	Cool, 4°C	24 hrs.
Mercury				
Dissolved	100	P	Filter HNO_3 to pH<2	28 days
Total	100	P	HNO_3 to pH<2	28 days
300 Inorganics, Non-Metallics				
Acidity	100	P	Cool, 4°C	14 days
Alkalinity	100	P	Cool, 4°C	14 days
Bromide	100	P	None Req.	28 days
Chloride	50	P	None Req.	28 days
Cyanides	500	P	Cool, 4°C NaOH to pH>12 0.6g ascorbic acid[6]	14 days[7]
Fluoride	100	P	None Req.	28 days
Nitrogen				
Ammonia	100	G	Cool, 4°C H_2SO_4 to pH<2	28 days
Kjeldahl, total	100	G	Cool, 4°C H_2SO_4 to pH<2	28 days
Nitrate plus Nitrite	100	P,G	Cool, 4°C	28 days
Nitrate plus Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days*
Nitrite	100	P,G	Cool, 4°C H_2SO_4 to pH<2	2 wks.
Nitrate	50	P,G	Cool, 4°C	2 wks.

Measurement	Vol. Req.(ml.)	Container[2]	Preservative[3,4]	Holding Time[5]
Dissolved Oxygen				
Probe	300	G	None Req.	Analyze Immediately
Winkler	300	G	Fix on site and store in dark	8 hrs.
Phosphorus				
Orthophosphate, dissolved	50	G	Filter on site Cool, 4°C	48 hrs.
Total	50	G	Cool, 4°C H_2SO_4 to pH<2	28 days
Total, dissolved	50	G	Filter on site Cool, 4°C H_2SO_4 to pH<2	24 hrs.
Silica	50	P	Cool, 4°C	28 days
Sulfate	50	P	Cool, 4°C	28 days
Sulfide	500	P,G	Cool, 4°C add 2 ml. zinc acetate plus NaOH to pH>9	7 days
300 SVOA Methods				
GC/MS SVOA organics: BNA, PCBs, PAHs, and/or Pesticides	1,000	G only w/TefLn	Cool, 4°C	Extract within 7 days, analyze within 40 days
Pesticides/herbicides	1,000	G only w/TefLn	Cool, 4°C	Extract within 7 days, analyze within 40 days

Measurement	Vol. Req.(ml.)	Container[2]	Preservative[3,4]	Holding Time[5]
HPLC SVOA organics Ex: carbonates	1,000	G only w/TefLn	Cool, 4°C	Extract within 7 days analyze within 40 days

400 Organics

BOD	1000	P,G	Cool, 4°C	48 hrs.
COD	50	P,G	Cool, 4°C H_2SO_4 to pH<2	28 days
Oil and grease	1000	G only	Cool, 4°C HCL to pH<2	28 days
Organic carbon	25	G	Cool, 4°C H_2SO_4 or HCL to pH<2	28 days
Phenolics	500	G only	Cool, 4°C H_2SO_4 to pH<2	28 days

400 VOA Methods

Volatile organics (VOA)	2-40 ml vial w/septum caps	G only	HCL or Cool, 4°C	14 days
Purgeable Halocarbons only	4-40 ml vial w/septum caps		Cool, 4°C	14 days
Purgeable Aromatic Hydrocarbons	4-40 ml vial w/septum caps		Cool, 4°C HCE	14 days
Acrolein and acrylonitrite	4-40 ml vial w/septum caps		Cool, 4°C Adjust pH to 4-5	14 days

1 More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-81 (1976) Method D-3370 and 40 CFR Part 136.

2 Plastic(P) or Glass(G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

3 Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

4 When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such materials for transportation is responsible for ensuring such compliance. For the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); nitric acid (HNO_3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); sulfuric acid (H_2SO_4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

5 Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring lab, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional EPA Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring lab, is obligated to hold the sample for a short time if information exists to show this is necessary to maintain sample stability.

6 Should only be used in the presence of residual chlorine.

7 Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before the pH adjustment in order to determine whether sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and the NaOH is added to pH 12.

8 *Note: Acid preservation has been shown to rapidly degrade nitrite to nitrate. It is listed here to accomodate sites specifically requiring acid preservation in their permits. It is strongly recommended that nitrate-nitrite samples not be preserved. Holding times have been demonstrated to exceed 28 days in non-preserved groundwater samples (references available).

SAMPLE PRESERVATION (ACID/BASE) PROCEDURES

Proper Presentation (acid/base)

In order to ensure that a sufficient amount of preservative (acid or base) has been added to a sample, a method has been established for checking the pH of a sample with as little disturbance as possible to the sample. Field preservation kits (see pg. A20 and A21) are available upon request from the EML Client Services Department. These can be used, if necessary, to complete the preservation of samples.

Required equipment includes: Capillary tubes
pH paper (narrow range 0-6)
Extra preservative vials (supplied by EML)

Once a sample has been preserved with preservative supplied by the EML, and inverted several times to mix the sample, the following procedures should be followed:

1. Open sample bottle.

2. Insert one capillary tube into the sample bottle, limiting the length of time of insertion into the sample until the tube is filled. Do not plug the end of the capillary tube. The water will rise into this tube on its own.

3. Remove the capillary tube and close the sample bottle.

4. Place the capillary tube end onto a piece of pH paper and determine the pH value.

5.
   a. If the pH is less than 2 (for acid preservation) or greater than 12 (for base preservation), the sample has been adequately preserved.

   b. If the proper pH has not been achieved, an additional preservative vial, the same type as originally used, should be emptied into the sample and mixed, and steps 1-5 should be repeated.

FIELD PRESERVATION KIT

QUANTITY	ITEM DESCRIPTION	VENDOR	CATALOG #
2 packs	Colorfast pH indicator strips Intermidiate Range (0-6 pH)	VWR	#EN-9590-3
1 pack	Kimble non-heparinzed capillary tubes (200 ct.)	VWR	#15401-537
1 pack	Pyrex glass beaker #T-1000 (150 ml.)	VWR	#13912-502
1 pack	Flambeau high density 14.5" plastic tool box	Ames	#14800
14 packs	5 ml. glass vials containing 1:8 dilution HCL	EML	
7 packs	5 ml. plastic vials containing 1:1 dilution Nitric acid	EML	
6 packs	5 ml. glass vials containing 1:1 dilution Sulphuric acid	EML	

FIELD PRESERVATION KIT ACIDIFICATION INFORMATION SHEET

METHODS	PRESERVATIVE	VIAL	VOLUME	PRESERVED pH
CMR. (all)	Sulphuric Acid	8 ml. glass	1 mls.	<2
INORG. (all)	Nitric Acid HNO_3	8 ml. plastic	2 mls.	<2
VOA	Hydrochloric Acid HCL (1:1)		.3 mls.	<2
VOA*	Hydrochloric Acid HCL (1:8)		.3 mls.	4-5

* Methods requiring pH preservation between pH 4-5

RECOMMENDED FIELD EQUIPMENT/SUPPLIERS

Water Level Indicator

Slope Indicator Co.
3668 Alborn Place
P.O. Box C-30316
Seattle, WA 98103
(206) 633-3073

Soiltest, Inc.
2205 Lee Street
Evanston, IL 60202
(708) 869-5500

In-Situ, Inc.
209 Grand Avenue
Laramie, WY 82070
(307) 742-8213

pH Meter

Beckman Instruments, Inc.
Fullerton, CA
(714) 871-4848

*Model 10 pH Meter	12314
*Epoxy body electrode	395420
*Electrode cable	597578
*ATC probe	598115

Baxter Scientific Products Division
1430 Waukegan Road
Mc Gaw Park, IL 60085-6787

*pH Meter Set	H4292-21
*Conductivity/TDS Meter Set	H4292-22
*DO Meter Set	H4292-23
*Deluxe Field System	H4292-20
*Meter Module Only	H4292-24
*pH Sensor	H4292-25
*DO Sensor	H4292-26
*Conductivity/TDS Sensor	H4292-27

Combination Temp./ pH / SC meter

Cambridge Scientific Industries
P.O. Box 265
Moose Lodge Road
Cambridge, MD 21613

Comb. Temp./ pH/ SC meter	301353
pH electrode	102927
Buffer kit	102953

Filtration Apparatus

MFS: Micro Filtration Systems
Dublin, CA
(415) 828 - 6010

In-Line
Flat stainless 142 mm pressure holder
Model #KS142ST 302100

Reservoir
Reservoir stainless 142 mm pressure holder (1.5 liter capacity)
Model #KST142 302300

Filter Paper
Cellulose nitrate filter, 0.45 um pore size
142 mm diameter AA045A142C

Q.E.D. Environmental Systems, Inc.
P.O. Box 3726
Ann Arbor, MI 48106
(313) 995-2547

In-Line disposable Sample Pro™ filters
0.45 Micron High capacity field filter FF8000

Dedicated Bladder Pumps

Q.E.D. Environmental Systems, Inc.
1254 N. Main Street
Ann Arbor, MI 48017
(800) 624-2026

Controller Units for Bladder Pumps

GeoTech Environmental Equipment, Inc.
1441 W. 46th Avenue
Denver, CO 80211
(303) 433-7101

Pneumatic logic unit	5504
Electrical pneumatic logic unit	5505

Q.E.D. Environmental Systems
P.O. Box 3726
Ann Arbor, MI 48106

Sample Pro Electronic Controller	350
Pneumatic controller (automatic)	3013
Gasoline driven driver controller	3111

Bailers

Diedrich Drilling Equipment, Inc.
2008 Ohio Street
LaPorte, IN 46350
(800) 348-8809

Timco Manufacturing Co.
851 15th Street
Prairie du Sac, WI 53578
(608) 643-8534

Galter Corporation
Jonathon Industrial Center
Chasra, MN 55318
(612) 448-6717

Submersible Pumps

GRUNDFOS Pumps Corporation
2555 Clouis Avenue
Clouis, CA 93612
(209) 299-9741

Retrofitted with teflon by:

PFC Equipment, Inc.
7409 Jolly Lane
Minneapolis, MN 55470
(612) 425-7890

Safety Equipment

Powder-Free Gloves
Glove Liners
Boots and Tyvek Suit

Shamrock Industrial Glove
920 West Byers Place
Denver, CO 80223
(303) 778-0667

SAMPLING TEAM LAB AND STORAGE BUILDING

A designated sampling team lab and storage building is required for all facilities for environmental sampling. This building is intended to isolate the environmental samples and equipment from possible contamination sources, such as the site lab or site pollutants. Due to the low levels of detection required by regulatory agencies, every possible precaution must be taken to preserve the integrity of the samples from airborne or direct-contact contamination. The samples, as well as all sampling equipment and dedicated lab equipment, must be isolated. NO LEACHATE OR SALES SAMPLES ARE TO BE STORED OR PLACED IN THIS BUILDING.

The sampling team lab and storage building should have a "dirty" room and a "clean" room. This design is intended to minimize the risk of most contaminants, which are present on site from being introduced into the samples during filtration and preservation. It also provides for ample storage space for all sampling equipment and shuttles. All entry to the building is made through the "dirty" room, which acts as a filter for most site contaminants and dirt, by trapping these materials before entry into the "clean" room.

This lab and storage building will need to be cleaned thoroughly with deionized water before each use. Tap water may be used to remove the excess dirt, but it must then be thoroughly rinsed with deionized water.

SAMPLING TEAM LAB AND STORAGE BUILDING USE

The following list provides some of the uses for "dirty" rooms and "clean" rooms in lab and storage buildings.

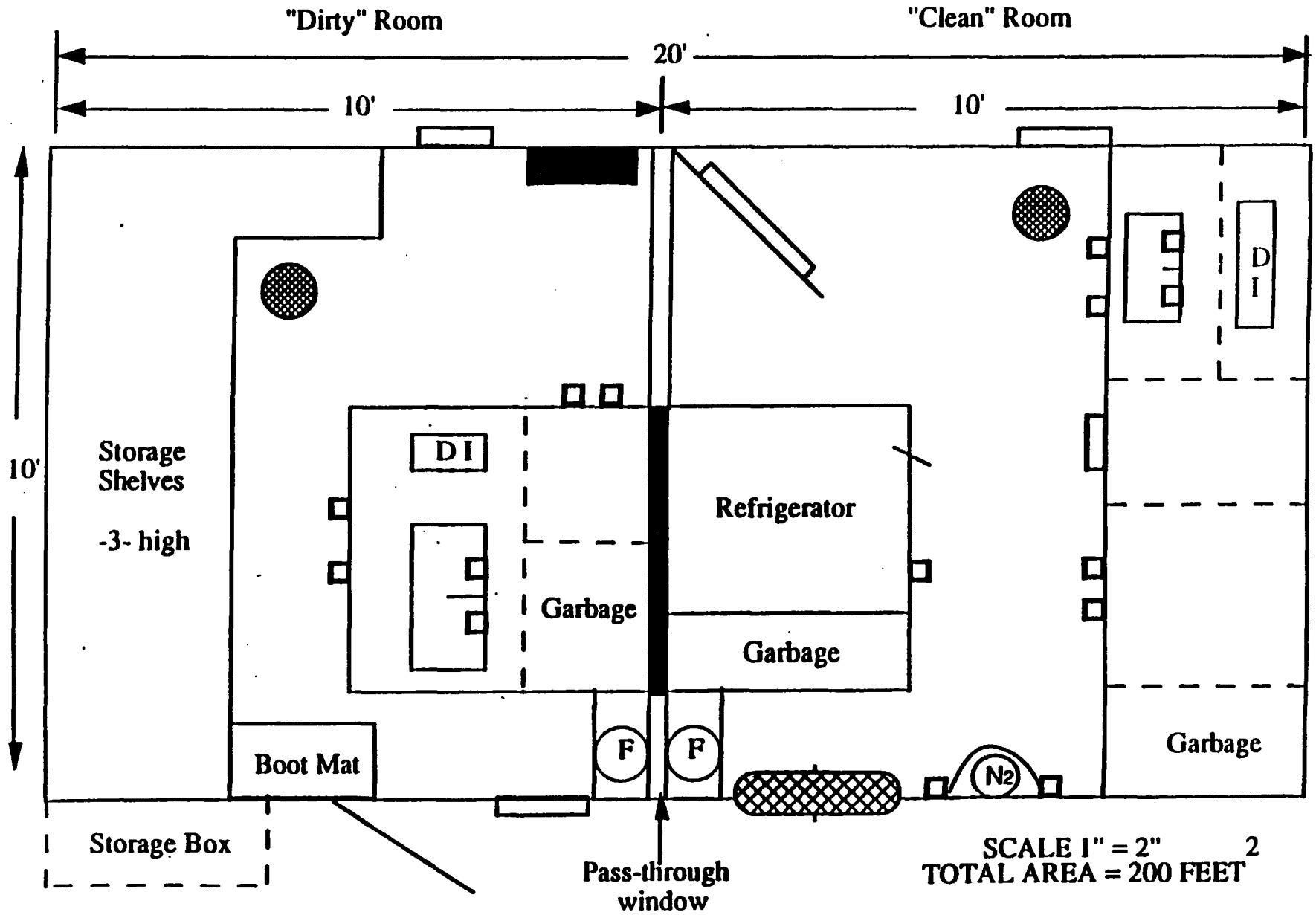
"Dirty" Room	"Clean" Room
Receive AquaPaks.	Place ice packs in freezer.
Open and inspect AquaPaks.	Calibrate pH and specific conductivity meters.
Reseal AquaPaks and store until used.	Store prefiltration bottles.
Return AquaPaks after sampling.	Receive samples.
Clean AquaPaks.	Measure pH and specific conductivity.
Clean sampling equipment.	Filter samples.
Store sampling equipment.	Preserve samples.
Store boots, rain gear, etc.	Place samples in refrigerator.
Repack AquaPaks.	Complete field forms.
	Store filtering equipment.
	Store extra preservatives and field forms.
	Store pH and specific conductivity meters.
	Store pH and specific conductivity standards.

SUGGESTED SAMPLING TEAM LAB AND STORAGE BUILDING

Key to Symbols

F	Fire Extinguisher
N_2	Nitrogen Tank or Compressed Air Source
D.I.	Deionized Water
	Sealed Window
	Drawers
	Cabinets with Shelves
	Emergency Exit
	Floor Drain
	First Aid Kit
	Sink

SUGGESTED SAMPLING TEAM AND STORAGE BUILDING



AQUAPAK TEMPERATURE CONTROL

PROPER CHILLING
(Wet Ice Method)

- Samples are collected and preserved.
- Place in a separate cooler/AquaPak 2-3 10 lb. bags of ice.
- Add 2-3 gallons of deionized water.
- Remove samples from bottle holders and place into cooler/AquaPak.
- Place a temporary Chain-of-Custody seal on cooler/AquaPak.
- Remove samples from cooler/AquaPak at end of day's sampling, dry the bottles using clean paper towels, and repack into original AquaPak.

AQUAPAK TEMPERATURE CONTROL

PROPER PACKING

- Repack the samples with adequate space to allow extra packing of ice packs.
- Repacking should include lining the AquaPak on all sides, top, and bottom with a layer of blue ice packs.
- All ice packs should be **completely frozen** prior to use.

AQUAPAK TEMPERATURE CONTROL

PROPER CHILLING
(Blue Ice Pack Method)

- Samples are collected and preserved.
- Line a separate cooler/AquaPak with 25-30 blue ice packs.
- Remove samples from bottle holders and place into cooler/AquaPak.
- Place a temporary Chain-of-Custody seal on cooler/AquaPak.
- Remove samples from cooler/AquaPak at end of day's sampling and repack into original AquaPak

Comments on Specific Fractions

Pesticide and Herbicide

The presence of 4,4'-DDT detected in the QC Blank would normally warrant repeat preparation of this QC batch. However, it was determined that this original data would be qualified, and is here reported.

Because 4,4-DDT was found in the QC Blank at a reportable level and 4,4'-DDE was also found in the QC Blank, although at a level considered to be not detected, the reported presence of 4,4-DDT/4,4'-DDD in this sample should be considered suspect.

The identification of all compounds here reported as present has been confirmed by second column analysis.

The QC Spiked Blank recoveries for the herbicide compounds 2,4-D, 2,4,5-T and 2,4,5-TP have been manually verified. The QC Spiked Blank may have inadvertantly not been spiked for these compounds. The QC Matrix Spike recoveries are within acceptable limits.

APPENDIX 6

Groundwater Assessment Report

Golder and Associates, 1987

See Vol. VI and VII of this Part B Application

SUMMARY REPORT
GROUNDWATER MONITORING ENHANCEMENTS PROGRAM
CWM CHEMICAL SERVICES, INC., CHICAGO INCINERATOR
CHICAGO, ILLINOIS

Under Contract With
CWM Chemical Services, Inc.
Chicago Incinerator
11700 S. Stony Island Avenue
Chicago, IL 60617

Prepared By:

SEC Donohue
3001 Butterfield Road
Oak Brook, IL 605211

Summary Report
CWM Chemical Services, Inc., Chicago Incinerator
Groundwater Monitoring Enhancements

This summary report documents the activities conducted by SEC Donohue under the CWM Chemical Services, Inc. (CWMCS) Groundwater Monitoring Enhancements program. SEC Donohue was contracted by CWMCS to install one groundwater monitoring well and three Hydropunch II samplers.

SEC Donohue contracted K&S Testing and Engineering (K&S) to perform drilling services at the Chicago Incinerator (Site). Work began at the Site on December 18, 1991. A safety meeting was held prior to beginning work. Personnel on site included: Lisa Grassl (CWMCS), Sarah Joyner (SEC Donohue), Mark Henderson (K&S), Mike Rich (K&S) and Gino Bruni (Illinois Environmental Protection Agency).

At approximately 12:00 pm, K&S set up at the Well G126S location as specified in the Groundwater Monitoring Enhancements Work Plan. A Diedrich 120 (D-120) drill rig was used with 3 1/4 inch hollow stem augers. Soil samples were collected continuously with a 2-inch split-spoon sampler. Sarah Joyner monitored the driller's breathing zone with a 10.2 Microtip photoionization detector (PID). Concentrations in the driller's breathing zone remained at between 1-3 ppm. All drilling work was performed in Level D protection. The soil cuttings from the borehole were placed in DOT approved 55-gallon drums and staged near the borehole.

The PID was also used to screen the split-spoon samples as they were retrieved. The highest concentration detected by the PID was 20 ppm from the soil sample collected at 6 to 8 feet below ground surface (BGS). During the borehole drilling, fill material was encountered from ground surface to approximately 16 feet BGS. The fill was variable, consisting of silty sand and ashy material, concrete, and coarse sandy material. From 16 feet to the bottom of the borehole (18 feet BGS) there was native soil - stiff grey silty clay.

The bottom of the borehole was drilled to 18 feet, but the last split-spoon was advanced from 18 to 20 feet. The soil borehole log for G126S is Attachment A.

At approximately 4:00 pm on December 18, 1991, K&S completed the borehole for well G126S. Upon completion of the borehole, K&S changed from 3 1/4 inch augers to 4 1/4 inch inner diameter augers. The 4 1/4 inch augers were used to enlarge the borehole prior to installing the monitoring well. The enlarged borehole was drilled down to 15 feet BGS. A tape measure was dropped to the bottom of the hole and K&S determined that the original borehole made with 3 1/4 inch augers had collapsed from 15 feet to 18 feet. Therefore, a 15 foot deep .67 foot diameter borehole remained.

Schedule 316 stainless steel (SS) well construction materials were used for well construction. A 5 foot long 0.010 slotted screen with a flush joint cap was installed from 10 to 15 feet BGS. The riser casing extends from 10 feet BGS to 2.64' above ground surface. The filter pack consists of Number 5 Torpedo sand and extends from 15 feet BGS to 8 feet. A 3-foot bentonite seal was installed above the filter pack, using bentonite pellets. On December 18, the drillers only had enough bentonite pellets to complete 1 foot of the 3 foot bentonite seal. Therefore, K&S and SEC Donohue left the Site at 5:00 p.m.

K&S returned to the Site on December 19 with enough bentonite to complete the seal, and the bentonite seal was completed up to 5 feet BGS. A 6 inch sand layer was placed on top of the bentonite seal. The annulus was then grouted from 4.5 feet BGS to the ground surface using a portland cement bentonite powder slurry mix.

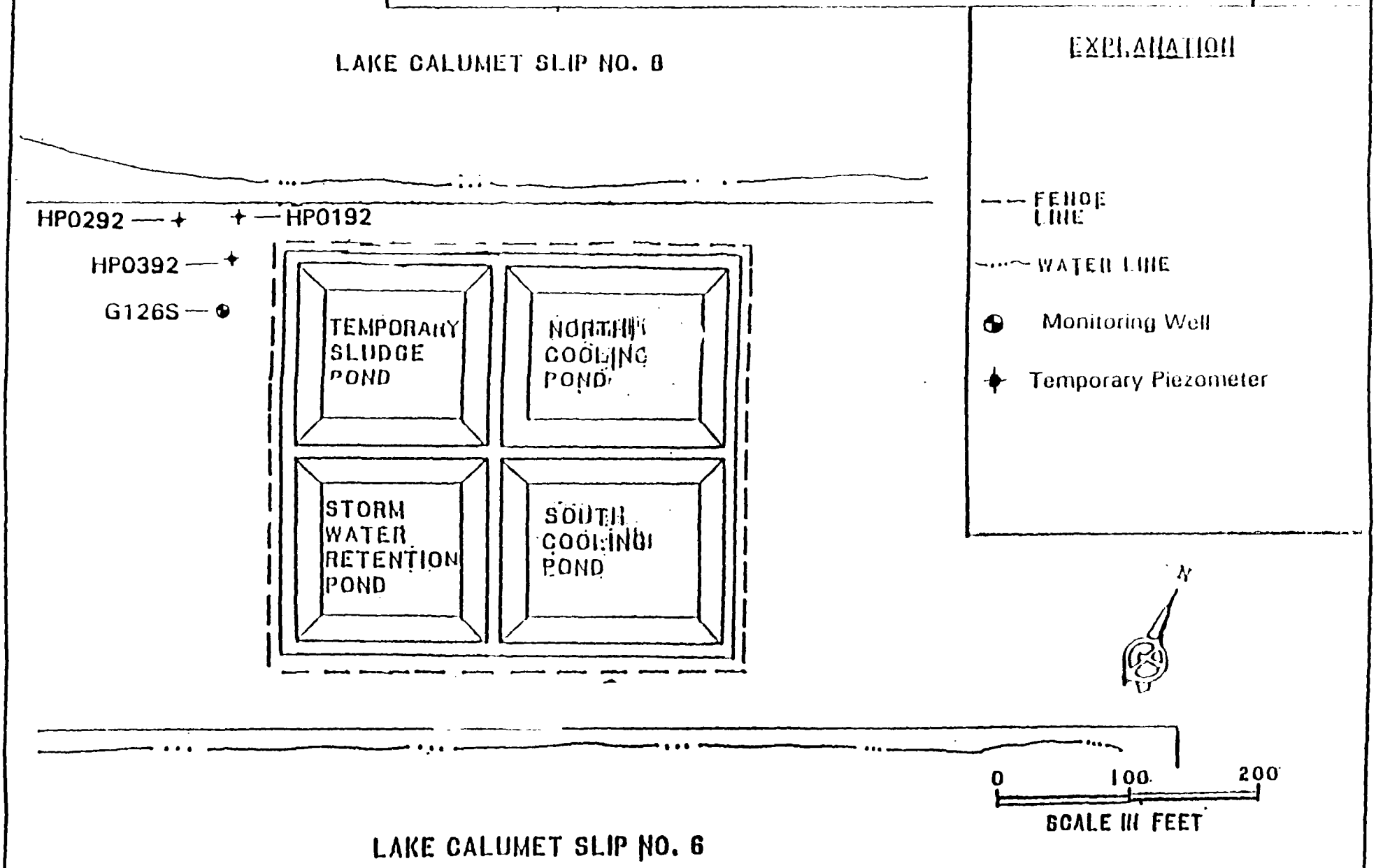
While the grout seal was setting, K&S and SEC Donohue drilled three pilot borings for the Hydropunch II to facilitate the placing of the Hydropunch II samplers in the Sites' thick fill. The locations for the three pilot holes were as specified in the Groundwater Monitoring Enhancements Work Plan. K&S drilled each hole to approximately 10 feet BGS. The holes were then back-filled with pea gravel in order to keep them from collapsing. The cuttings from the pilot holes were drummed and staged with the other soil cuttings.

The pilot hole drilling activity was completed by 12:00. K&S and SEC Donohue then installed the aluminum well cover over well G126S, and a concrete well pad was built. K&S and SEC Donohue left the Site by 2:00 p.m.

Sarah Joyner from SEC Donohue returned to the Site on January 2, 1992 with Andy and George Strutynsky of Stratigraphics to install temporary piezometers. The temporary piezometers were a modification to Sirrine's scope of work which specified the installation of Hydropunch II Samples. The temporary piezometers used were based conceptually on the Hydropunch II. Stratigraphics used its 20-ton, truck mounted cone penetrometer system to install the temporary piezometers. The piezometers were made of 1 1/4 inch (outer diameter), 0.010 slot PVC screen with PVC risers. After installation, the temporary piezometers were sampled by personnel from Weston-Gulf Coast Laboratories using a PVC bailer. When the sampling activities were complete, the temporary piezometers were abandoned by removing the PVC screen and risers and sealing the open holes with bentonite grout. At location HP0392 the PVC risers could not be retrieved, and were grouted in place. The approximate locations of the temporary piezometers are shown on Figure 1. The procedures for installing the temporary piezometers are discussed in more detail in a letter report dated January 6, 1992, from Stratigraphics to Sarah Joyner (Attachment B).

Location Of Temporary Piezometers And Monitoring Well G126S

Figure 1



SOIL BOREHOLE LOG

SITE NAME AND LOCATION CWM Chemical Services, Inc. Chicago Incinerator Well G126S	DRILLING METHOD: Used 3-1/4 inch hollow stem auger for drilling & sampling - 4-1/4 inch HSA to install monitoring well					BORING NO. G126S
	SAMPLING METHOD: Continuous split spoon					SHEET 1 OF 3
						DRILLING
						START / FINISH
	WATER LEVEL	8.21 TOC				TIME / TIME
	TIME	0930				1200 / 1600
	DATE	12/19/91				DATE / DATE
DATUM Grade ELEVATION	CASING DEPTH	15 ft				12/18/91 / 12/18/91
DRILL RIG Diedrich 120	SURFACE CONDITIONS					
ANGLE Vertical Bearing N/A	Gravel Area					
SAMPLE HAMMER TORQUE FT-LBS.						

DEPTH IN FEET (ELEVATION)	BLOWS/6 IN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NO.	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER & BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS: WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS Q.
				Surface - compressed gravel Drilled to 1 foot below ground surface. - Fill -								
2	16 23 <50		S1	Clayey Silt (ML) Gray to black. Stiff, dry silt with some pebbles (2 cm) at the bottom. Encountered split spoon refusal 2'6" (cement) - Fill -								
3 4				Drilled down to 4' without sampling. - Fill -								
5	14 9			Gravelly Sand (SW) Greenish well graded coarse sand to gravel, moist.								
6	20 31		S2	Silty Sand (SM) Black, ashy sand with some wood chips and red brick fragments. - Fill -								
	20 25 >50		S3	Silty Sand (SM) Top 12" (to 6'10") same black ashy sand as above. Gravelly Sand (SW) Greenish well graded coarse sand to gravel, moist. - Fill -								

DRILLING CONTR K&S Testing & Engineering - M. Henderson

LOGGED BY S. Joyner

DATE 12/18/91 CHK'D BY M. Wayali

SI 19951

SOIL BOREHOLE LOG

SITE NAME AND LOCATION CWM Chemical Services, Inc. Chicago Incinerator Well G126S	DRILLING METHOD: Used 3-1/4 inch hollow stem auger for drilling & sampling - 4-1/4 inch HSA to install monitoring well					BORING NO. G126S	
	SAMPLING METHOD: Continuous split spoon					SHEET 2 OF 3	
						DRILLING	
						START	FINISH
	WATER LEVEL	8.21 TOC				TIME	TIME
	TIME	0930				1200	1600
	DATE	12/19/91				DATE 12/18/91	DATE 12/18/91
DATUM Grade ELEVATION	CASING DEPTH	15 FT					
DRILL RIG Diedrich 120	SURFACE CONDITIONS						
ANGLE Vertical Bearing N/A	Gravel Area						
SAMPLE HAMMER TORQUE FT-LBS.							

DEPTH IN FEET (ELEVATION)	BLOWS/6 IN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NO.	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER & BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS: WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS Q.
8			S3	- Fill - Cement Fragments								
	4 3		S4	Gravelly Sand (SW) Greenish blue well graded coarse sand to gravel.								
10	4 4			Sandy Silt (ML) Black moist to wet silt, some fine sand. - Fill -								
	3 4 35		S5	Sandy Silt (ML) Same as 9-10' with some coarse sand and trace gravel.								
12	17			Gravelly Sand (SP) Brown-black well graded sand with gravel. - Fill -								
13 14	6 6 85 13		S6	Gravelly Sand (SP) Same as 11.5'-12'. Well graded black, wet sandy-silt, some gravel. - Fill -								
15	4 3		S7	No recovery - Split spoon blocked by 1.5" gravel. - Fill -								

DRILLING CONTR K&S Testing & Engineering - M. Henderson

LOGGED BY S. Joyner

DATE 12/18/91 CHK'D BY M. Wagli

SI 10951

SOIL BOREHOLE LOG

SITE NAME AND LOCATION CWM Chemical Services, Inc. Chicago Incinerator Well G126S	DRILLING METHOD: Used 3-1/4 inch hollow stem auger for drilling & sampling - 4-1/4 inch HSA to install monitoring well	BORING NO. G126S
	SAMPLING METHOD: Continuous split spoon	SHEET 3 OF 3
		DRILLING
		START / FINISH
	WATER LEVEL: 8.21 TOC	TIME / TIME
	TIME: 0930	1200 / 1600
	DATE: 12/19/91	DATE 12/18/91 / DATE 12/18/91
DATUM Grade ELEVATION	CASING DEPTH: 15 ft	
DRILL RIG Diedrich 120	SURFACE CONDITIONS	
ANGLE Vertical Bearing N/A	Gravel Area	
SAMPLE HAMMER TORQUE FT-LBS.		

DEPTH IN FEET (ELEVATION)	BLOWS/6 IN ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NO.	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER & BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS: WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPECIFIC GRAVITY	OTHER TESTS Q.
16	4 5		S7	- Fill -								
17	2 2		S8	Sandy Silt (ML) Black to olive sandy silt.								
18	7 12			Silty Clay (CL) Gray silty clay, some coarse sand, stiff.								
19 20	4 6 9 13		S9	Silty Clay (CL) Same silty gray clay as S8.								
				End of boring. Drilled to 18' split spoon to 20'.								

DRILLING CONTR K&S Testing & Engineering - M. Henderson

LOGGED BY S. Joyner

ST 10051

Well No. G126S
Boring No. X-Ref. G126S

MONITOR WELL CONSTRUCTION SUMMARY

Survey Coords: _____ Elevation Ground Level _____
Top of Casing _____

Drilling Summary:

Total Depth 13 feet
Borehole Diameter 6.7 feet (4-1/4 HSA)
Casing Stick-Up Height 2.64 feet
Driller Mark Henderson
Mike Rich
K&S Testing & Engineering
Rig Diedrich 120 (D120)
Bit(s) Carbide Tooth

Drilling Fluid N/A

Protective Casing 6" Aluminum Cover

Construction Time Log:

Task	Start Date	Start Time	Finish Date	Finish Time
Drilling				
K&S Testing	12/18	1200	12/18	1600
SEC Donohue				
Continuous SS				
Geophys.Logging:				
Casing:				
Filter Placement:	12/18/91	1600	12/19	0915
Cementing:	12/19/91	1000	12/19	1040
Development:	1/2/92	1415	1/2/92	1545

Well Design & Specifications:

Basis: Geologic Log X Geophysical Log __

Casing String(s): C=Casing S=Screen

Depth	String(s)	Elevation
G.S. - 10 ft	C1	-
10 ft - 15 ft	S1	-
-		-
-		-
-		-

Casing: C1 2.0 inch (316) S.S. Riser
flush joint
C2
Screen: S1 2.0 inch (316) S.S. .010 slot screen
flush joint cap
S2
Filter Pack: Number 5 Torpedo Sand
3.5 bags (15 ft to 8 ft)

Grout Seal: 1/4 inch non-coated pellets - 1.5 buckets
(8 ft to 5 ft)
Sand Seal #5 Torpedo Sand (5 ft to 4.5 ft)
Bentonite Seal:

Well Development:

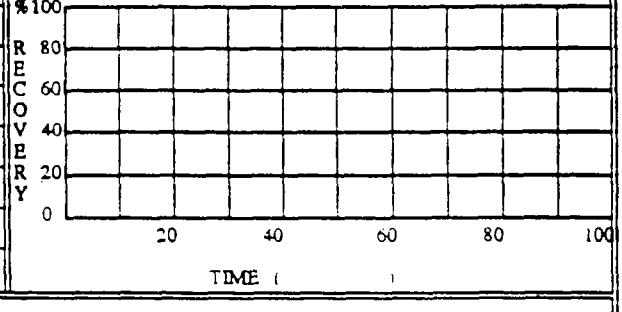
Dedicated S.S. Bailer = 1.5 hours
Total Gallons Purged: 18.0
Casing Volume: 1.11

Stabilization Test Data:

Time	pH	Spec. Cond.	Temp (C)
1425	9.31	11,580	11.0
1442	9.14	11,530	10.8
1505	9.26	11,550	10.3
1525	9.30	11,600	10.5
1542	9.39	11,650	10.6

Recovery Data:

Q = S =



Comments: Placed 1 ft of the bentonite seal over the filter pack of 12/18/92. The drillers were out of pellets so the remaining bentonite seal was placed on 12/19/91.

SITE NAME CWM Chemical Services, Inc. Chicago Incinerator
LOCATION Chicago, IL
WC 8814
SUPERVISED BY S. Joyner
DATE 1/3/92

STRATIGRAPHICS, The Geotechnical Data Acquisition Corporation
439 Taylor Avenue, Glen Ellyn, Illinois 60137 (708) 790-4610

Sarah Joyner
Sirrine Environmental Consultants, Inc.
2001 Butterfield Rd.
Oakbrook, Illinois 60521

January 6, 1992

Dear Sarah:

This letter report provides details of the installation of temporary piezometers at the Chemical Waste Management, Chicago Incinerator site. STRATIGRAPHICS used its 20 ton, truck mounted penetrometer system to install 3 temporary piezometers at the site on January 2 and 3, 1992, under the direction of Sirrine personnel. Temporary piezometers were installed to allow sampling of ground water at the site by personnel from Weston-Gulf Coast Laboratories. Installation details are provided on the attached figures.

In general, the procedure to install the temporary piezometers was as follows:

1. The penetrometer truck was set up at a location, and a prepunch tool was used to penetrate through surficial, random fill. The fill includes various obstructions, such as concrete slabs, so several attempts were typically required to reach target depths below the random fill. Predrilling of the fill, using a hollow stem auger rig, proved only partially successful, as large particles apparently caved into the bottom of the predrilled hole, prior to its being backfilled with pea gravel. These obstructions prevented passage of penetrometer tools.

2. After prepunching, BQ outer casing (2.31" OD, 1.81" ID) was pushed to the target depth of about 15 ft. The end of the outer casing was sealed with a slip-on PVC cap to prevent soil from entering the casing.

3. After the outer casing was pushed to the required depth, 1 1/4 inch (1.66" OD, 1.38" ID) PVC well screen and risers were lowered down the casing to the PVC cap. The outer casing was then withdrawn, leaving the PVC screen and risers downhole.

4. After a period of time, the water level in the temporary piezometer was measured by Sirrine. The piezometer was then sampled by personnel from Weston-Gulf Coast Laboratories, using a bailer.

5. After completion of sampling, the temporary piezometers were abandoned by sealing all open hole using a bentonite grout. The PVC screen and risers were removed where possible.

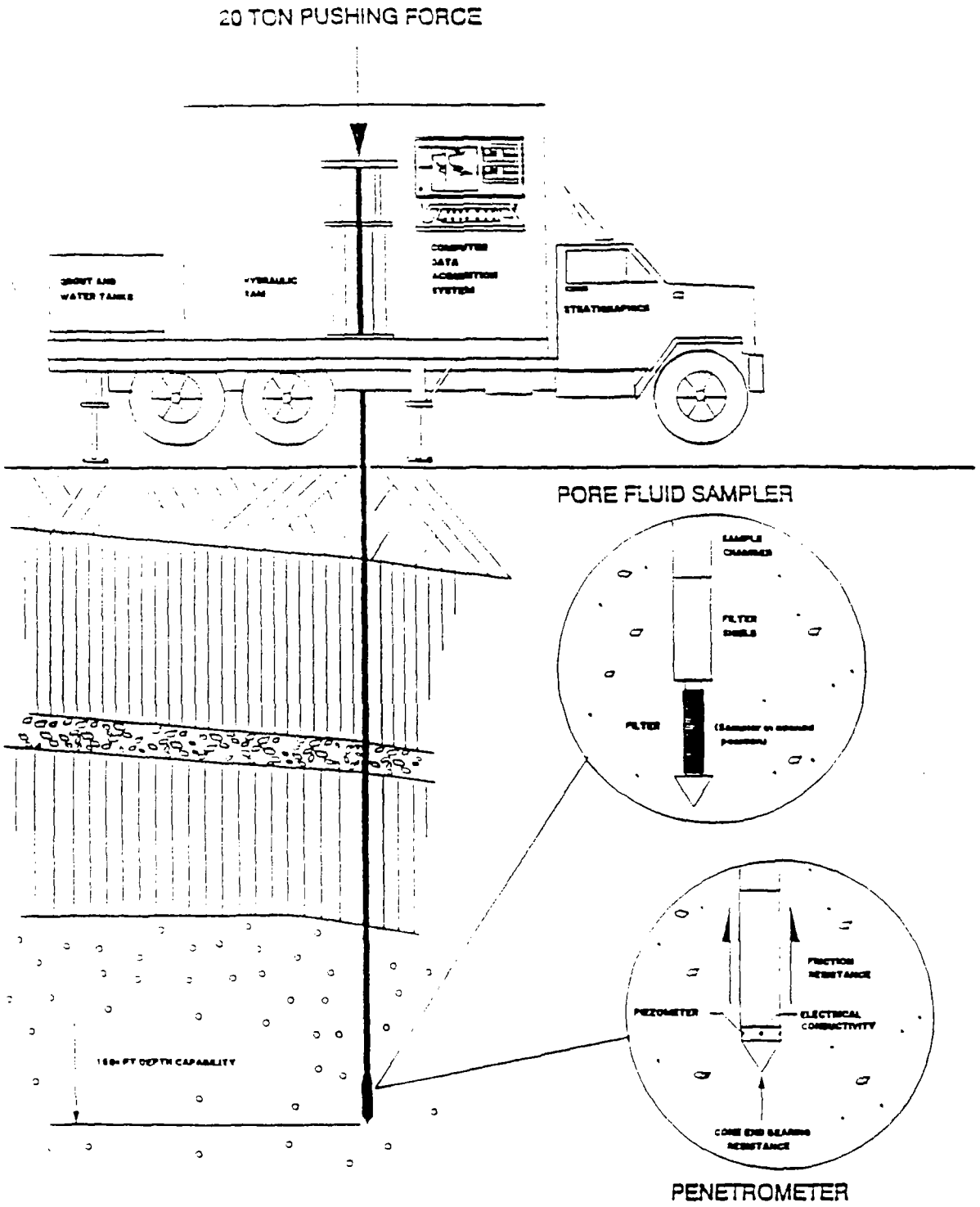
All downhole equipment was steam cleaned prior to deployment, and in between holes. Temporary piezometers were installed during the afternoon of January 2, and on the morning of January 3, 1992. The temporary piezometers were abandoned during the afternoon of January 3, 1992. Prior to abandonment, an inertial pump was deployed in one of the piezometers for evaluation purposes. The pump performed well, and should prove useful in improving sample quality while decreasing ground water sampling costs during future projects.

We have enjoyed providing assistance to Sirrine Environmental Consultants on this project. If you have any questions regarding this work, or on other applications of penetrometer technologies to your projects, do not hesitate to call.

Regards,

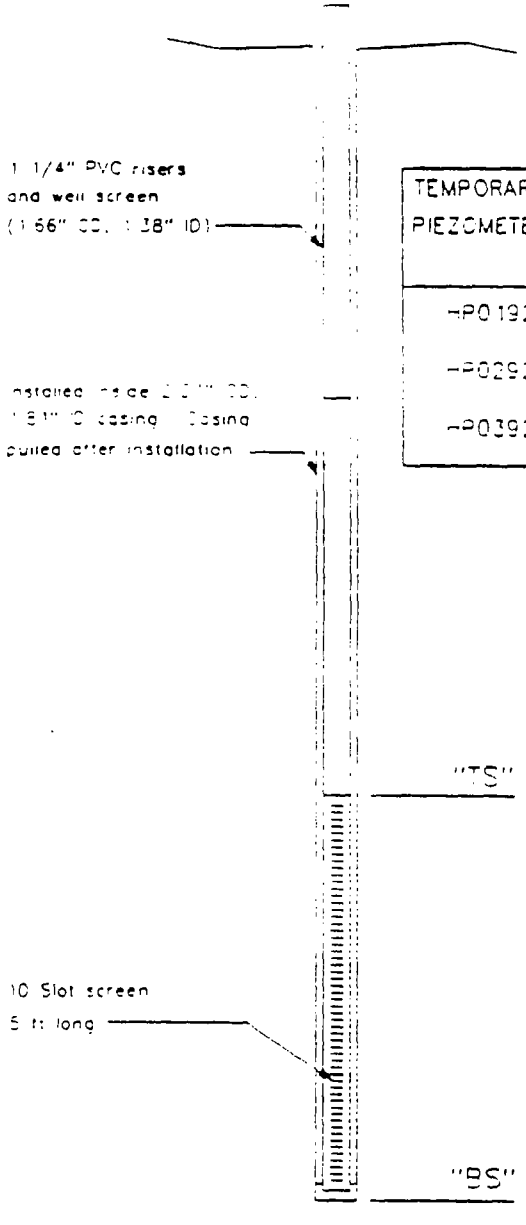
Andrew I. Strutynsky, P.E.
Technical Director

AIS/olb R92010.let



PENETROMETER SUBSURFACE EXPLORATION SYSTEM

STRATIGRAPHICS



TEMPORARY PIEZOMETER	"TS" DEPTH TO TOP OF SCREEN, FT	"BS" DEPTH TO BOTTOM OF SCREEN, FT	DATE OF INSTALLATION
HP0192	9.7	14.7	01/03/92
HP0292	9.7	14.7	01/02/92
HP0392	9.3	14.3	01/03/92

All temporary piezometers sampled on 01/03/92 by Weston Gulf Coast personnel. Piezometers abandoned after sampling, by removal and filling of open hole by bentonite grout. Risers at HP0392 could not be retrieved and were filled with bentonite grout.

STRATIGRAPHICS

TEMPORARY PIEZOMETER INSTALLATION DETAILS

CHICAGO INCINERATOR