IHSS GROUP 000-5
PRESENT LANDFILL (IHSS-114)

ACCELERATED ACTION FOR THE PRESENT LANDFILL
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
CONSTRUCTION CERTIFICATION REPORT

ATTACHMENT A OF THE
FINAL CLOSEOUT REPORT

VOLUME II

Prepared for:

KAISER-HILL COMPANY, LLC
ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE
12101 Airport Way, Unit B
Broomfield, CO 80021-2583

Prepared by:

TETRA TECH, INC.
1900 South Sunset Street, Suite 1-F
Longmont, Colorado 80501

Reviewed for Classification/UCNI
By: Janet Nesheim, Derivative Classifier
DOE, EMCBC
Date: 11-06-08
Confirmed Unclassified, Not UCNI

Tech Job No. 19-4886.001.00

September 2005

RECEIVED
OCT 1 2 2005

TETRA TECH, INC.

ADMIN RECORD

Tetra Tech, Inc. is an Equal Opportunity Employer

Y/608

KAISER·HILL
COMPANY

Final Closeout Report for IHSS Group 000-5 Present Landfill (IHSS-114)

Volume II

Environmental Restoration
Rocky Flats Environmental
Technology Site

September 2005

APPENDIX A

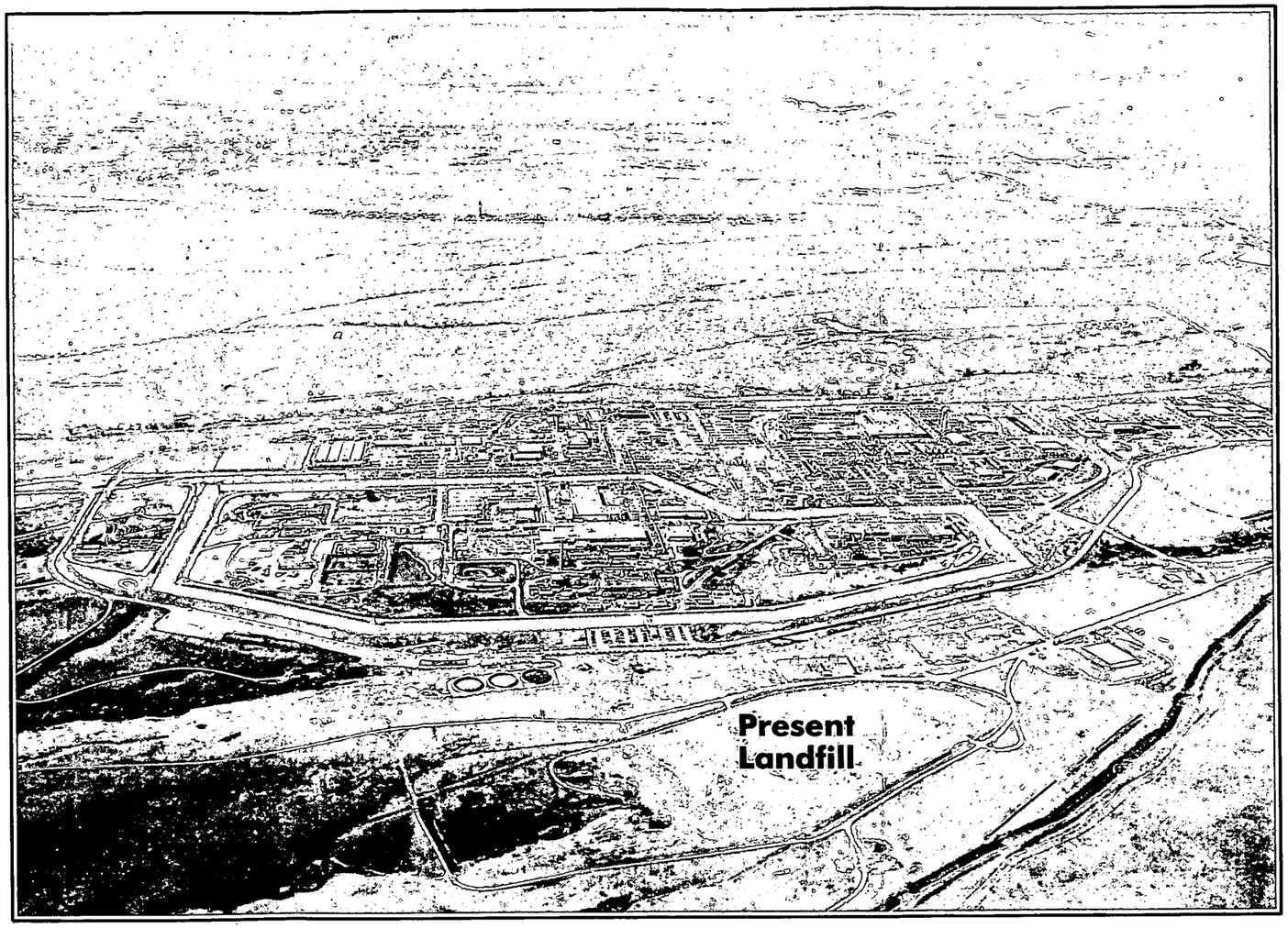
DESIGN DRAWINGS (95% AND 100%, STAMPED) AND CONSTRUCTION SPECIFICATIONS

	QUAL	DESCRIPTION	MATERIAL

ACCELERATED ACTION DESIGN FOR THE PRESENT LANDFILL

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

DRAWINGS



AERIAL VIEW LOOKING SOUTH
June 6, 2000

GOLDEN
COLORADO

FINAL DESIGN
AUGUST 2004

NOTE:
Additional elevation contour tie-ins are required at the east face only for construction layout, and will be provided at a later date.

EARTH TECH

EARTH TECH, INC.
5575 DTC PARKWAY
SUITE 200
ENGLEWOOD, CO 80111
(303) 694-6660

GROUP\CAD\ROCKY_FLATS\New_Design2003\COVER.DGN 10/8/02

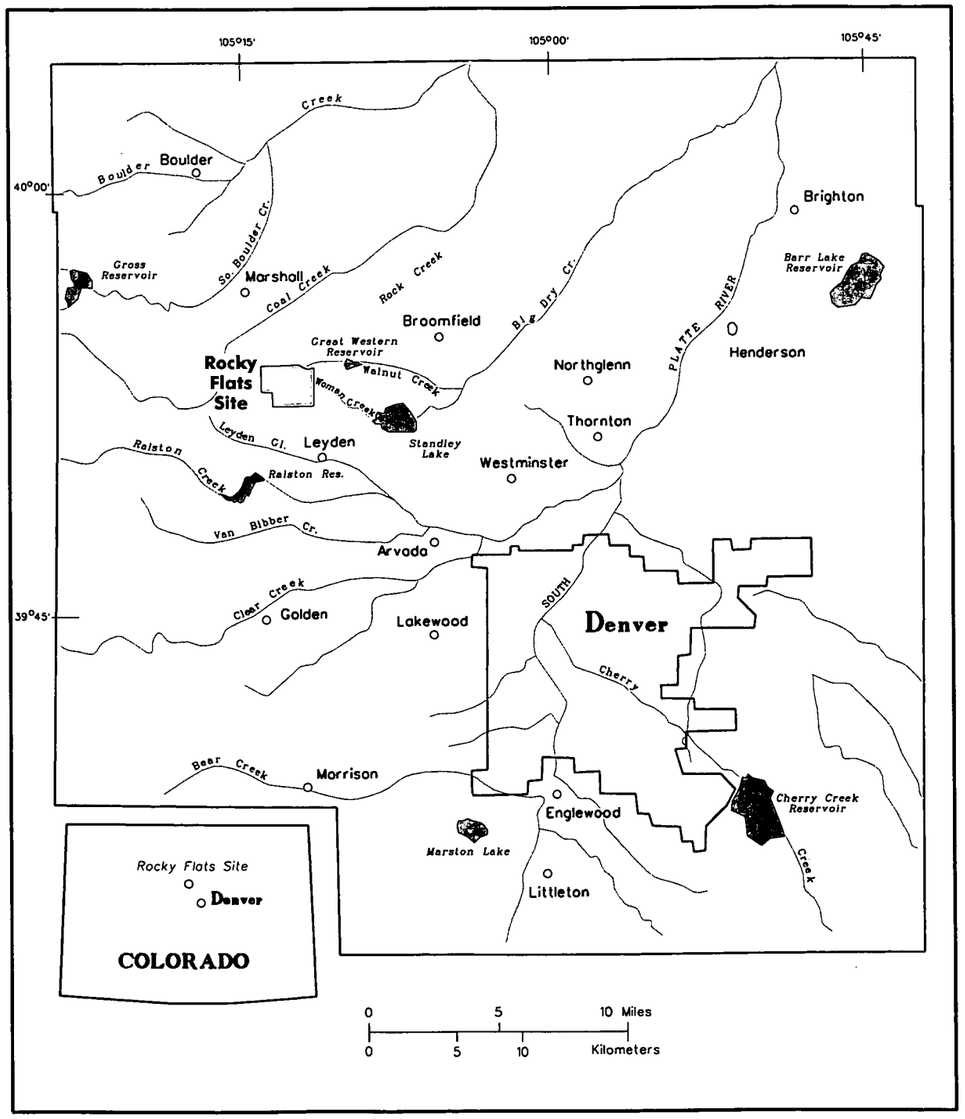
	QUAN.	DESCRIPTION	MATERIAL

DESIGN OF AN ENGINEERED COVER FOR THE PRESENT LANDFILL

SHEET INDEX

SHEET NO.	DESCRIPTION
51781-X001	RFETS PLF COVER SHEET
51781-001	VICINITY MAP AND DRAWING INDEX
51781-002	TRAFFIC FLOW PATTERNS
51781-003	EXISTING CONDITIONS
51781-004	CUT/FILL ISOPACH TOP OF REGRADED SURFACE
51781-005	DESIGN TOP OF REGRADED SURFACE
51781-006	DESIGN PERIMETER CHANNEL
51781-007	DESIGN TOP OF SUBGRADE
51781-008	DESIGN TOP OF FINAL COVER
51781-009	SURFACE WATER MANAGEMENT PLAN
51781-010	GAS MANAGEMENT SYSTEM
51781-011	LANDFILL CROSS SECTIONS
51781-012	LANDFILL COVER AND SURFACE WATER DETAILS
51781-013	LANDFILL COVER DETAILS EAST FACE
51781-014	GAS MANAGEMENT DETAILS
51781-015	EXISTING SEEP PASSIVE TREATMENT SYSTEM
51781-016	NEW SEEP PASSIVE TREATMENT SYSTEM PLAN VIEW
51781-017	NEW SEEP PASSIVE TREATMENT SYSTEM LAYOUT
51781-018	NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL

VICINITY MAP



	REVISION DESCRIPTION									
ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

DESCRIPTION

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

KEYWORDS
1.
2.
3.
4.
5.
BLDG./FACILITY SITE
ROOM/AREA NA
GRID COORD./COL NO. NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY NA
SCALE: AS SHOWN

DESIGN COMPANY		
DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. ARCHIBALD	8/16/04
INDEPENDENT VERIFIER	S. LAWRENCE	8/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

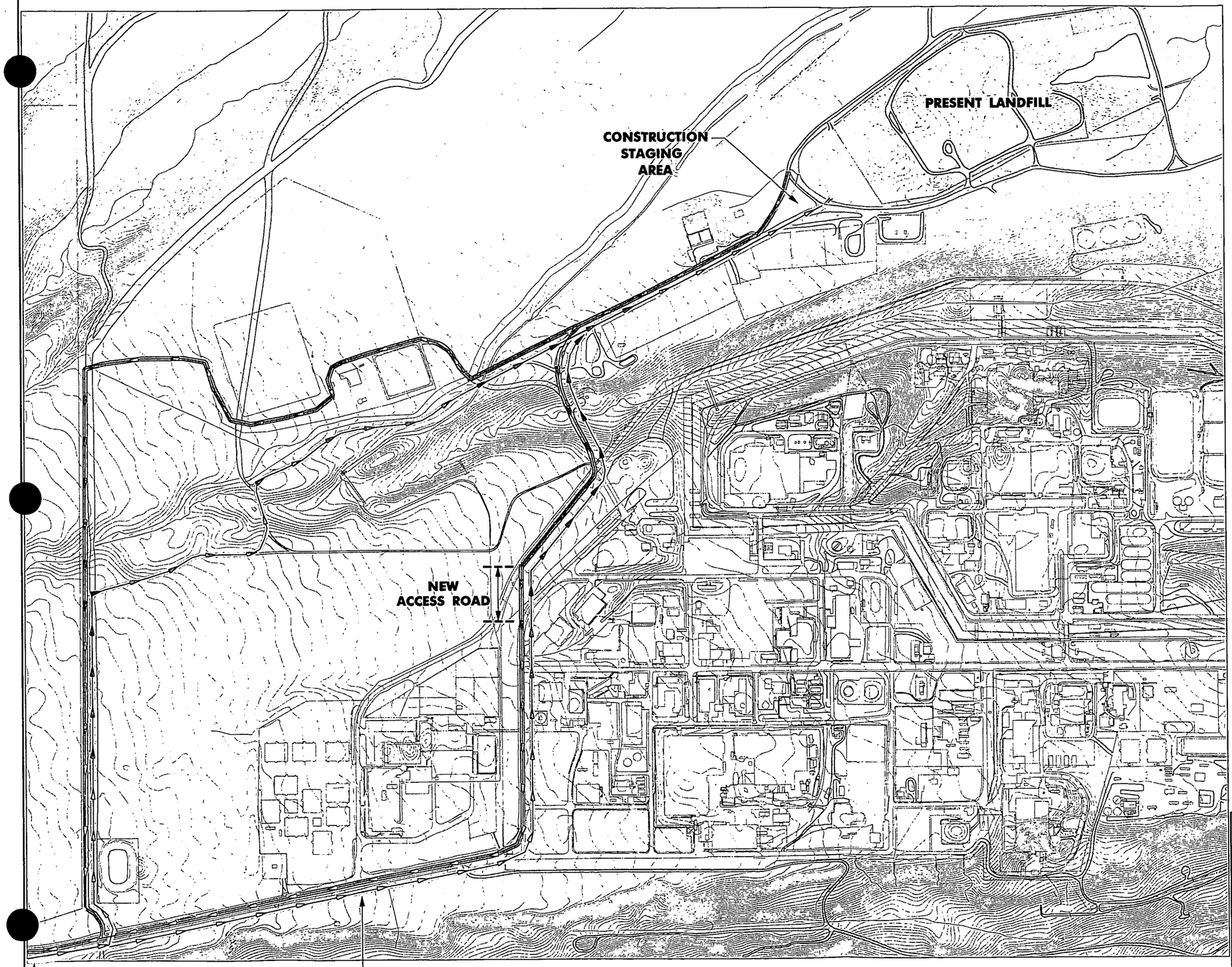
VICINITY MAP AND DRAWING INDEX

PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-001	0

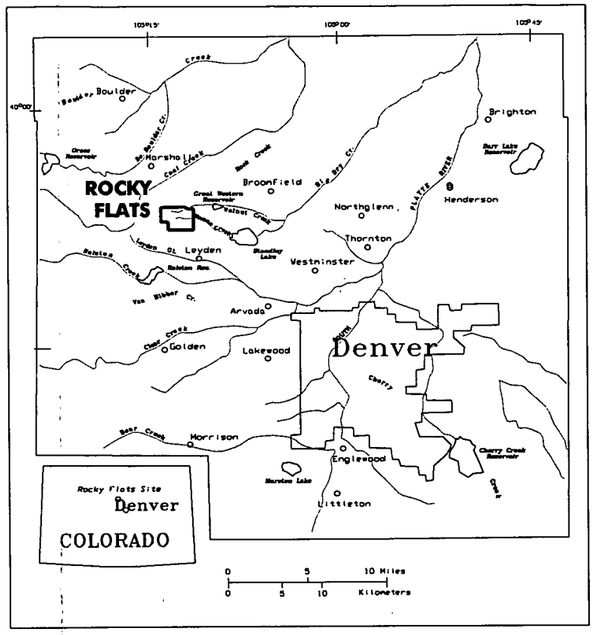
GROUP\CAD\ROCKY_FLATS\NewDesign_2003\LOCATION\LOCATION.DGN 1/19/04

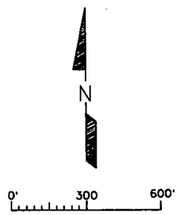
	QUAN.	DESCRIPTION	MATERIAL



IN ROUTE

OUT ROUTE





ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE								

ISSUE	DESCRIPTION
0	ORIGINAL ISSUE

KEYWORDS
1.
2.
3.
4.
5.

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: KAISER-HILL COMPANY, L.L.C.

DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/9/04
CHECKED BY	R. ARCHBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	8/10/04
APPROVED BY	R. THOMPSON	8/11/04

CLASSIFER
LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

TRAFFIC FLOW PATTERNS

PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

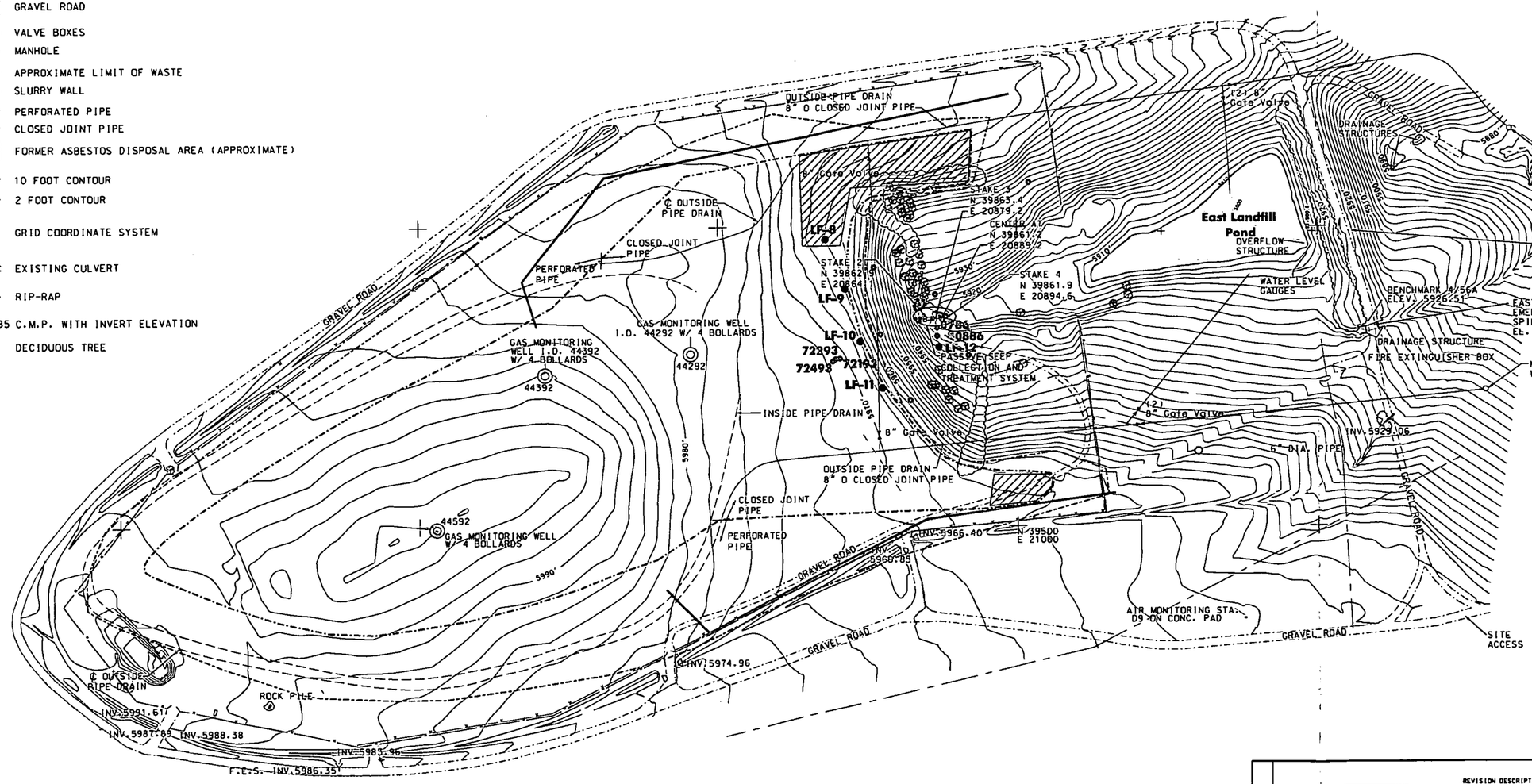
SIZE	DRAWING NUMBER	ISSUE
B	51781-002	0

GROUP\CAD\ROCKY_FLATS\New Design2003\Haul_rte\haulrte.dgn Date: 4-2004

QUAN.	DESCRIPTION	MATERIAL

LEGEND

- CONTROL POINT
- POWER POLE
- XXXX GAS MONITORING WELL AND WELL NUMBER
- FENCE
- GUY WIRE
- BENCHMARK
- TRANSMISSION LINE
- GRAVEL ROAD
- VALVE BOXES
- MANHOLE
- APPROXIMATE LIMIT OF WASTE
- SLURRY WALL
- PERFORATED PIPE
- CLOSED JOINT PIPE
- FORMER ASBESTOS DISPOSAL AREA (APPROXIMATE)
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- N 40500 E 20000 GRID COORDINATE SYSTEM
- EXISTING CULVERT
- RIP-RAP
- INV.5966.85 C.M.P. WITH INVERT ELEVATION
- DECIDUOUS TREE



NOTES:
(1) GRID COORDINATE SYSTEM BASED ON ROCKY FLATS COORDINATE SYSTEM.
(2) ELEVATION BASED ON MEAN SEA LEVEL NAVD88.
(3) TOPOGRAPHIC MAP AND GENERAL SURFACE FEATURES PROVIDED BY KAISER-HILL [OCTOBER 2003].
(4) SLURRY WALL DETAILS WERE COMPILED FROM DRAWINGS IN THE OU 7 CLOSURE PLAN NORTH SLURRY WALL TECHNICAL SPECIFICATIONS (MAY 1995).
(5) SEEP SYSTEM DETAILS WERE COMPILED FROM DRAWINGS IN THE OU 7 PASSIVE SEEP COLLECTION AND TREATMENT SYSTEM TECHNICAL SPECIFICATIONS (DECEMBER 1995).
(6) GROUNDWATER DIVERSION PIPE DETAILS WERE COMPILED FROM THE SANITARY LANDFILL RENOVATION DRAWINGS (AUGUST 1974).
(7) THE LIMIT OF WASTE WAS DETERMINED IN THE WESTERN HALF OF THE LANDFILL FROM THE SANITARY LANDFILL RENOVATION DRAWINGS (AUGUST 1974), AND IN THE EASTERN HALF OF THE LANDFILL FROM HISTORICAL AERIAL PHOTOGRAPHS.
(8) ASBESTOS CELL DETAILS WERE COMPILED FROM DRAWINGS IN THE OU 7 CLOSURE PLAN NORTH SLURRY WALL TECHNICAL SPECIFICATIONS (MAY 1995).

N 39000 E 21000

N

0' 100 200'

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE								

DESCRIPTION

KEYWORDS
1.
2.
3.
4.
5.
BLDG./FACILITY SITE
ROOM/AREA NA
GRID COORD./COL. NO. NA

TOLERANCES FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY NA
SCALE: AS SHOWN

DESIGN COMPANY: KAISER-HILL COMPANY LLC
DESIGNED BY R. THOMPSON 3/9/04
DRAWN BY A. SHOTNIK 8/10/04
CHECKED BY R. ARCHIBALD 8/10/04
INDEPENDENT VERIFIER S. LAWRENCE 8/11/04
APPROVED BY R. THOMPSON 8/11/04
CLASSIFER
LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

EXISTING CONDITIONS

PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

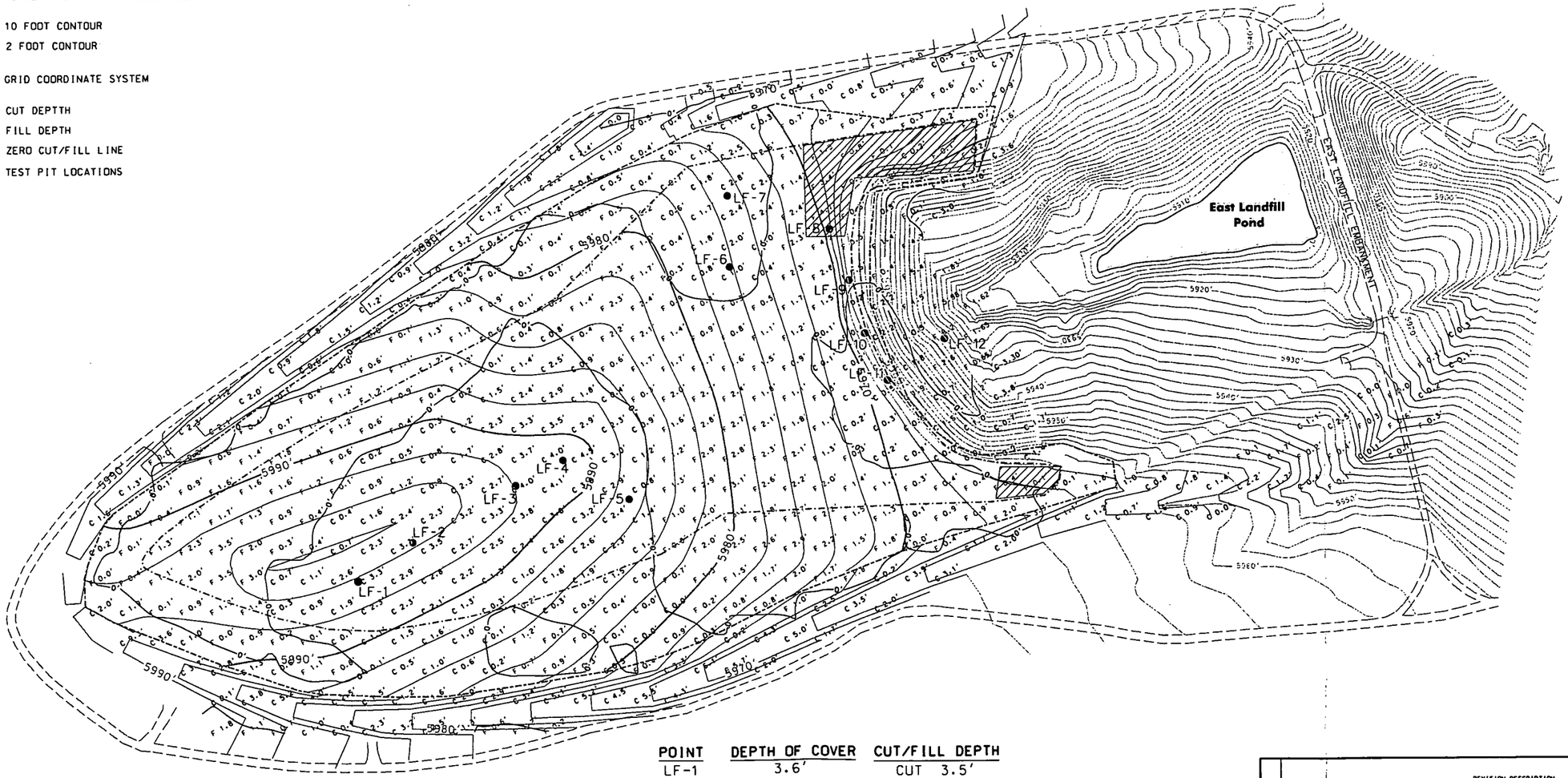
SIZE	DRAWING NUMBER	ISSUE
B	51781-003	0

GROUP\CAD\ROCKY_FLATS\New Design2003\EXIST_COND\EXISTCOND.dgn Date: 1-2004

	QUAN.	DESCRIPTION	MATERIAL

LEGEND

- CONTROL POINT
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- GRAVEL ROAD
- APPROXIMATE LIMIT OF WASTE
- FORMER ASBESTOS DISPOSAL AREA (APPROXIMATE)
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- GRID COORDINATE SYSTEM
- C 1.0' CUT DEPTTH
- F 1.0' FILL DEPTH
- ZERO CUT/FILL LINE
- LF-1 TEST PIT LOCATIONS



POINT	DEPTH OF COVER	CUT/FILL DEPTH
LF-1	3.6'	CUT 3.5'
LF-2	4.3'	CUT 3.4'
LF-3	4.7'	CUT 3.3'
LF-4	4.7'	CUT 4.6'
LF-5	3.0'	CUT 1.9'
LF-6	3.0'	CUT 1.7'
LF-7	2.7'	CUT 2.7'
LF-8	3.7'	FILL 4.1'
LF-9	1.7'	FILL 1.5'
LF-10	3.4'	CUT 2.1'
LF-11	2.0'	CUT 1.4'
LF-12	2.8'	FILL 6.8'

N

0' 100 200'

LANDFILL
CUT = 22,219 (cu yd)
FILL= 25,334 (cu yd)
NET = -3,114 (cu yd)

PERIMETER CHANNEL
CUT = 19,032 (cu yd)
FILL= 1,953 (cu yd)
NET = 17,079 (cu yd)

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE								

KEYWORDS: 1. 2. 3. 4. 5. BLDG./FACILITY SITE: NA; ROOM/AREA: NA; GRID COORD./COL NO.: NA

TOLERANCES: FRACT. : ; ANGLE ; DEC. : ; UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: SAIC		
DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. ARCHBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

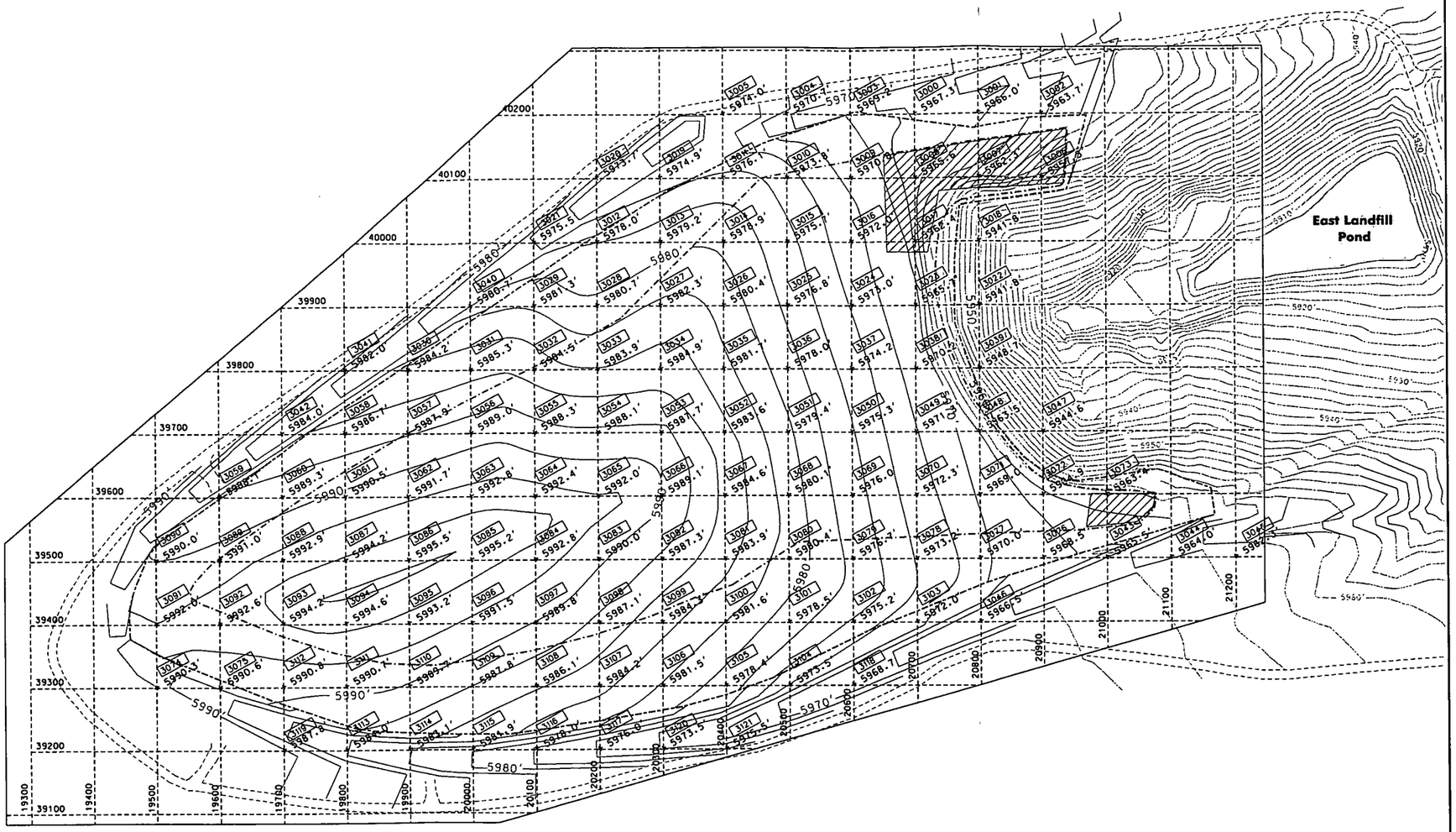
CUT/FILL ISOPACH TOP OF REGRADED SURFACE
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-004	0

GROUP\CAD\ROCKY_FLATS\New Design2003\Regrades95%\Regrad95.dgn Date: 1-2004

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
3000	40200.0	20700.0	5967.3
3001	40200.0	20800.0	5966.0
3002	40200.0	20900.0	5963.7
3003	40200.0	20600.0	5969.2
3004	40200.0	20500.0	5970.7
3005	40200.0	20400.0	5974.0
3006	40100.0	20900.0	5957.3
3007	40100.0	20800.0	5962.3
3008	40100.0	20700.0	5965.6
3009	40100.0	20600.0	5970.8
3010	40100.0	20500.0	5973.8
3011	40100.0	20400.0	5976.1
3012	40000.0	20200.0	5978.0
3013	40000.0	20300.0	5979.2
3014	40000.0	20400.0	5978.9
3015	40000.0	20500.0	5975.7
3016	40000.0	20600.0	5972.0
3017	40000.0	20700.0	5962.4
3018	40000.0	20800.0	5941.8
3019	40100.0	20300.0	5974.9
3020	40100.0	20200.0	5973.7
3021	40000.0	20100.0	5975.5
3022	39900.0	20800.0	5941.8
3023	39900.0	20700.0	5965.7
3024	39900.0	20600.0	5973.0
3025	39900.0	20500.0	5976.8
3026	39900.0	20400.0	5980.4
3027	39900.0	20300.0	5982.3
3028	39900.0	20200.0	5980.7
3029	39900.0	20100.0	5981.3
3030	39800.0	19900.0	5984.2
3031	39800.0	20000.0	5985.3
3032	39800.0	20100.0	5984.5
3033	39800.0	20200.0	5983.9
3034	39800.0	20300.0	5984.9
3035	39800.0	20400.0	5981.7
3036	39800.0	20500.0	5978.0
3037	39800.0	20600.0	5974.2
3038	39800.0	20700.0	5970.2
3039	39800.0	20800.0	5948.7
3040	39900.0	20300.0	5980.7
3041	39800.0	19800.0	5982.0
3042	39700.0	19700.0	5984.0
3043	39500.0	21000.0	5965.5
3044	39500.0	21100.0	5964.0
3045	39500.0	21200.0	5962.5
3046	39400.0	20800.0	5966.5
3047	39700.0	20900.0	5944.6
3048	39700.0	20800.0	5963.5
3049	39700.0	20700.0	5971.3
3050	39700.0	20600.0	5975.3
3051	39700.0	20500.0	5979.4
3052	39700.0	20400.0	5983.6
3053	39700.0	20300.0	5987.7
3054	39700.0	20200.0	5988.1
3055	39700.0	20100.0	5988.3
3056	39700.0	20000.0	5989.0
3057	39700.0	19900.0	5987.9
3058	39700.0	19800.0	5986.7
3059	39600.0	19600.0	5988.1
3060	39600.0	19700.0	5989.3
3061	39600.0	19800.0	5990.5
3062	39600.0	19900.0	5991.7
3063	39600.0	20000.0	5992.8
3064	39600.0	20100.0	5992.4
3065	39600.0	20200.0	5992.0
3066	39600.0	20300.0	5989.1
3067	39600.0	20400.0	5984.6
3068	39600.0	20500.0	5980.1
3069	39600.0	20600.0	5976.0
3070	39600.0	20700.0	5972.3
3071	39600.0	20800.0	5969.0
3072	39600.0	20900.0	5964.9
3073	39600.0	21000.0	5963.4
3074	39300.0	19500.0	5990.3
3075	39300.0	19600.0	5990.6
3076	39500.0	20900.0	5968.5
3077	39500.0	20800.0	5970.0
3078	39500.0	20700.0	5973.2
3079	39500.0	20600.0	5976.7
3080	39500.0	20500.0	5980.4
3081	39500.0	20400.0	5983.9
3082	39500.0	20300.0	5987.3
3083	39500.0	20200.0	5990.0
3084	39500.0	20100.0	5992.8
3085	39500.0	20000.0	5995.2
3086	39500.0	19900.0	5995.5
3087	39500.0	19800.0	5994.2
3088	39500.0	19700.0	5992.9
3089	39500.0	19600.0	5991.0
3090	39500.0	19500.0	5990.0
3091	39400.0	19500.0	5992.0
3092	39400.0	19600.0	5992.6
3093	39400.0	19700.0	5994.2
3094	39400.0	19800.0	5994.6
3095	39400.0	19900.0	5993.2
3096	39400.0	20000.0	5991.5
3097	39400.0	20100.0	5989.8
3098	39400.0	20200.0	5987.1
3099	39400.0	20300.0	5984.3
3100	39400.0	20400.0	5981.6
3101	39400.0	20500.0	5978.5
3102	39400.0	20600.0	5975.2
3103	39400.0	20700.0	5972.0
3104	39300.0	20500.0	5973.5
3105	39300.0	20400.0	5978.4
3106	39300.0	20300.0	5981.5
3107	39300.0	20200.0	5984.2
3108	39300.0	20100.0	5986.1
3109	39300.0	20000.0	5987.8
3110	39300.0	19900.0	5989.7
3111	39300.0	19800.0	5990.7
3112	39300.0	19700.0	5990.8
3113	39200.0	19800.0	5984.0
3114	39200.0	19900.0	5983.1
3115	39200.0	20000.0	5981.9
3116	39200.0	20100.0	5978.0
3117	39200.0	20200.0	5976.0
3118	39300.0	20600.0	5968.7
3119	39200.0	19700.0	5987.8
3120	39200.0	20300.0	5973.5
3121	39200.0	20400.0	5975.5



LEGEND

- APROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- GRAVEL ROAD
- APPROXIMATE LIMIT OF WASTE
- FORMER ASBESTOS DISPOSAL AREA (APPROXIMATE)
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- N 40500 E 20000 — GRID COORDINATE SYSTEM
- 3029 * 5984.76' — CONTROL POINT NUMBER / CONTROL POINT ELEVATION

N

0' 100 200'

QUAN.	DESCRIPTION	MATERIAL

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE								

DESCRIPTION

KEYWORDS
1.
2.
3.
4.
5.

BLDG./FACILITY SITE
ROOM/AREA NA
GRID COORD./COL. NO. NA

TOLERANCES FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY NA
SCALE: AS SHOWN

DESIGN COMPANY: KAISER-HILL COMPANY, LLC
DESCHKD BY R. THOMPSON 8/9/04
DRAWN BY A. SHOTNIK 8/8/04
CHECKED BY R. ARCHIBALD 8/10/04
INDEPENDENT VERIFIER S. LAWRENCE 11/10/04
APPROVED BY R. THOMPSON 11/10/04
CLASSIFIER
LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN TOP OF REGRADED SURFACE
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-005	0

GROUP\CAD\ROCKY_FLATS\New Design2003\Regrades95%\RGCTRL95.dgn Date: 1-2004

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
4000	39381.7	19424.9	5992.0
4001	39383.1	19450.1	5992.0
4002	39466.9	19427.0	5990.0
4003	39455.9	19449.8	5990.0
4004	39555.2	19466.9	5990.0
4005	39529.5	19491.5	5988.0
4006	39548.0	19474.2	5988.0
4007	39611.0	19552.8	5986.0
4008	39592.5	19569.1	5986.0
4009	39658.6	19658.4	5984.0
4010	39678.2	19642.3	5984.0
4011	39777.4	19718.7	5982.0
4012	39757.3	19794.0	5982.0
4013	39858.7	19933.2	5980.0
4014	39878.1	19917.0	5980.0
4015	39943.2	20005.9	5978.0
4016	39923.5	20021.8	5978.0
4017	39989.4	20112.2	5976.0
4018	40007.6	20094.6	5976.0
4019	40054.3	20156.4	5974.0
4020	40035.1	20172.9	5974.0
4021	40138.4	20273.2	5972.0
4022	40118.3	20288.4	5972.0
4023	40171.2	20418.9	5974.0
4024	40149.3	20431.7	5974.0
4025	40186.3	20461.1	5972.0
4026	40163.6	20472.5	5972.0
4027	40176.1	20513.9	5970.0
4028	40200.4	20506.7	5970.0
4029	40204.8	20641.6	5968.0
4030	40229.3	20635.5	5968.0
4031	40229.3	20772.0	5966.0
4032	40253.5	20764.5	5966.0
4033	40277.5	20871.3	5964.0
4034	40254.1	20880.9	5964.0
4035	40254.1	20880.9	5964.0
4036	40297.4	20941.4	5962.0
4037	40318.0	20992.7	5960.0
4038	40309.6	20998.4	5960.0
4039	39361.1	19437.7	5992.0
4040	39376.8	19457.5	5992.0
4041	39323.4	19531.5	5990.0
4042	39301.1	19519.5	5990.0
4043	39258.4	19610.5	5988.0
4044	39281.3	19621.4	5988.0
4045	39246.1	19715.3	5986.0
4046	39222.8	19705.5	5986.0
4047	39192.2	19800.6	5984.0
4048	39216.1	19806.5	5984.0
4049	39202.7	19901.1	5982.0
4050	39178.1	19897.7	5982.0
4051	39171.2	19998.0	5980.0
4052	39196.5	19998.1	5980.0
4053	39202.4	20095.4	5978.0
4054	39177.1	20095.8	5978.0
4055	39188.0	20135.4	5976.0
4056	39213.2	20194.3	5976.0
4057	39223.7	20293.3	5974.0
4058	39200.5	20295.0	5974.0
4059	39215.6	20396.6	5972.0
4060	39240.2	20395.8	5972.0
4061	39272.2	20480.8	5970.0
4062	39248.0	20488.0	5970.0
4063	39329.5	20670.5	5968.0
4064	39353.1	20661.1	5968.0
4065	39434.1	20846.2	5966.0
4066	39410.2	20854.6	5966.0
4067	39482.8	21042.5	5964.0
4068	39507.2	21035.8	5964.0
4069	39545.3	21149.0	5962.0
4070	39520.0	21149.9	5962.0
4071	39530.4	21238.0	5960.0
4072	39543.1	21235.9	5960.0
4073	39553.9	21335.3	5958.0
4074	39543.8	21336.7	5958.0
4075	39547.2	21383.0	5956.0
4076	39556.8	21382.5	5956.0
4077	39560.6	21417.2	5954.0
4078	39548.6	21419.1	5954.0
4079	39550.7	21438.0	5952.0
4080	39561.3	21436.3	5952.0
4081	39568.4	21469.3	5950.0
4082	39558.6	21471.2	5950.0
4083	39566.6	21497.0	5948.0
4084	39574.5	21493.5	5948.0
4085	39585.6	21518.1	5946.0
4086	39573.0	21526.2	5946.0
4087	39586.3	21542.4	5944.0
4088	39595.4	21535.3	5944.0
4089	39608.2	21548.0	5942.0
4090	39597.2	21557.3	5942.0
4091	39602.8	21572.9	5940.0
4092	39617.9	21560.7	5940.0
4093	39619.9	21569.7	5938.0
4094	39607.5	21578.6	5938.0
4095	39613.4	21582.8	5936.0
4096	39620.6	21574.2	5936.0
4097	39633.3	21585.1	5934.0
4098	39625.2	21594.8	5934.0
4099	39640.1	21604.7	5932.0
4100	39646.4	21595.8	5932.0
4101	39683.3	21615.3	5930.0
4102	39676.3	21626.2	5930.0
4103	39698.2	21649.5	5928.0
4104	39705.6	21642.0	5928.0
4105	39716.6	21652.4	5926.0
4106	39706.6	21660.1	5926.0
4107	39720.0	21677.4	5924.0
4108	39728.6	21670.1	5924.0
4109	39739.3	21682.3	5922.0
4110	39733.8	21688.6	5922.0
4111	39749.7	21698.2	5920.0
4112	39754.8	21680.4	5920.0
4113	39768.3	21700.3	5918.0
4114	39763.6	21707.7	5918.0
4115	39778.3	21714.8	5916.0
4116	39784.0	21708.5	5916.0
4117	39799.9	21717.7	5914.0
4118	39795.7	21723.9	5914.0
4119	39809.7	21736.6	5912.0
4120	39814.9	21727.3	5912.0
4121	39830.4	21734.5	5910.0
4122	39825.7	21741.1	5910.0
4123	39841.3	21750.5	5908.0
4124	39845.9	21744.2	5908.0
4125	39863.9	21753.4	5906.0
4126	39855.6	21762.1	5906.0

LEGEND

- APROXIMATE LIMIT OF FINAL COVER
- GRAVEL ROAD
- APPROXIMATE LIMIT OF WASTE
- FORMER ASBESTOS DISPOSAL AREA (APPROXIMATE)
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- GRID COORDINATE SYSTEM
- 3029 + 5984.76' — CONTROL POINT NUMBER / CONTROL POINT ELEVATION

East Landfill Pond

QUAN.	DESCRIPTION	MATERIAL

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE								

KEYWORDS: 1. 2. 3. 4. 5.

BLDG./FACILITY: SITE

ROOM/AREA: NA

GRID COORD./COL NO.: NA

TOLERANCES: FRACT. ; ANGLE ; DEC. ; UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: BARTON MALOW

DESIGNED BY	R. ARCHIBALD	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. THOMPSON	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04

CLASSIFER

LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN PERIMETER CHANNEL
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-006	0

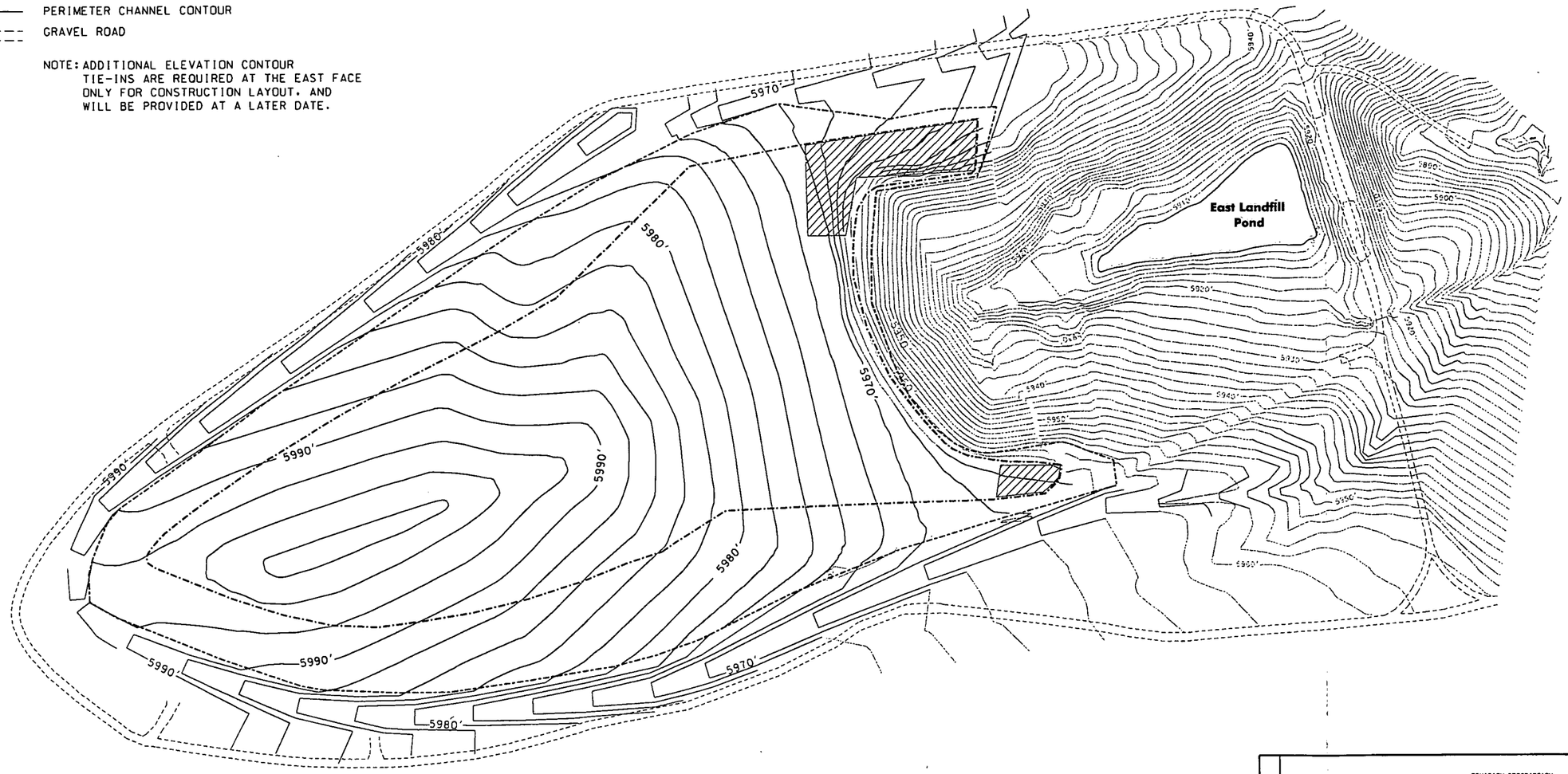
GROUP\CAD\ROCKY_FLATS\New Design\Trench 100\TrnchPts.dgn Date: 4-15-2004

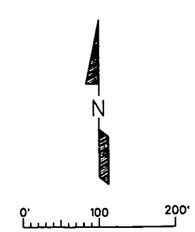
QUAN.	DESCRIPTION	MATERIAL

LEGEND

- 10 FOOT CONTOURS
- 2 FOOT CONTOURS
- EXISTING TOPOGRAPHY, MAJOR CONTOURS
- EXISTING TOPOGRAPHY, MINOR CONTOURS
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- PERIMETER CHANNEL CONTOUR
- GRAVEL ROAD

NOTE: ADDITIONAL ELEVATION CONTOUR TIE-INS ARE REQUIRED AT THE EAST FACE ONLY FOR CONSTRUCTION LAYOUT, AND WILL BE PROVIDED AT A LATER DATE.





ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE										

REVISION DESCRIPTION

DESCRIPTION

KEYWORDS
1.
2.
3.
4.
5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES: FRACT. ±; ANGLE ±; DEC. ±; UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: E A R T H T E C H
DESIGNED BY: R. ARCHIBALD RA 8/9/04
DRAWN BY: A. SHOTNIK AS 8/10/04
CHECKED BY: R. THOMPSON RT 8/10/04
INDEPENDENT VERIFIER: S. LAWRENCE SL 11/10/04
APPROVED BY: R. THOMPSON RT 8/11/04
CLASSIFIER
LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN TOP OF SUBGRADE
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-007	0

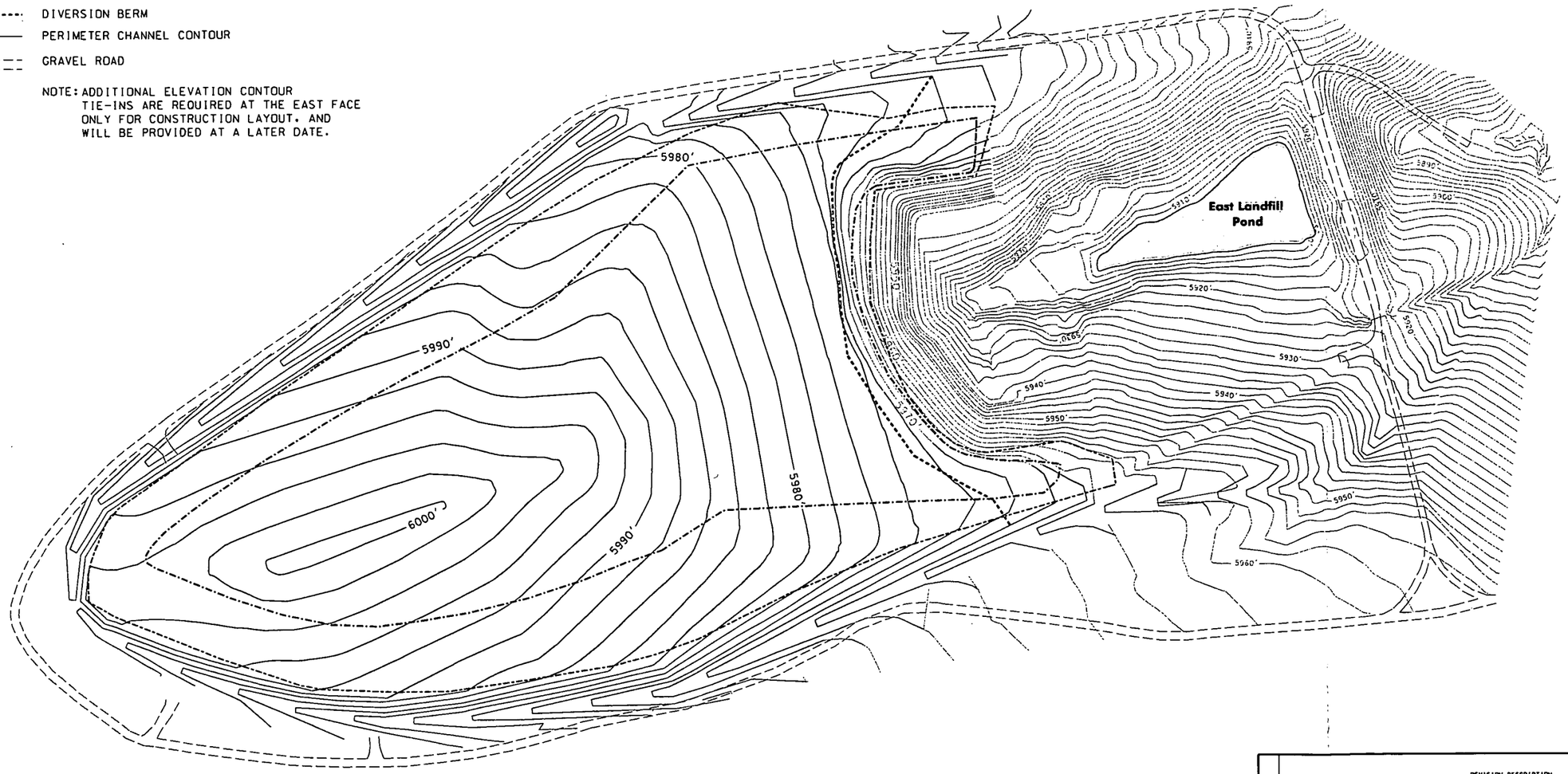
GROUP\CAD\ROCKY_FLATS\New Design2003\DESIGNS95%\DESGRD95.dgn Date: 1-2004

	QUAN.	DESCRIPTION	MATERIAL

LEGEND

- 10 FOOT CONTOURS
- 2 FOOT CONTOURS
- EXISTING TOPOGRAPHY. MAJOR CONTOURS
- EXISTING TOPOGRAPHY. MINOR CONTOURS
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- DIVERSION BERM
- PERIMETER CHANNEL CONTOUR
- GRAVEL ROAD

NOTE: ADDITIONAL ELEVATION CONTOUR TIE-INS ARE REQUIRED AT THE EAST FACE ONLY FOR CONSTRUCTION LAYOUT. AND WILL BE PROVIDED AT A LATER DATE.



N

0' 100 200'

ISSUE	REVISION DESCRIPTION	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	LV	APVD	CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE									

KEYWORDS	
1.	
2.	
3.	
4.	
5.	
BLDG./FACILITY	SITE
ROOM/AREA	NA
GRID COORD./COL. NO.	NA

TOLERANCES	
FRACT. :	
ANGLE	
DEC. :	
UNLESS NOTED OTHERWISE	
REMOVE BURRS AND SHARP EDGES	
NEXT ASSEMBLY	NA
SCALE:	AS SHOWN

DESIGN COMPANY		
DESIGNED BY	R. ARCHIBALD	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. THOMPSON	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	8/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN TOP OF FINAL COVER
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-008	0

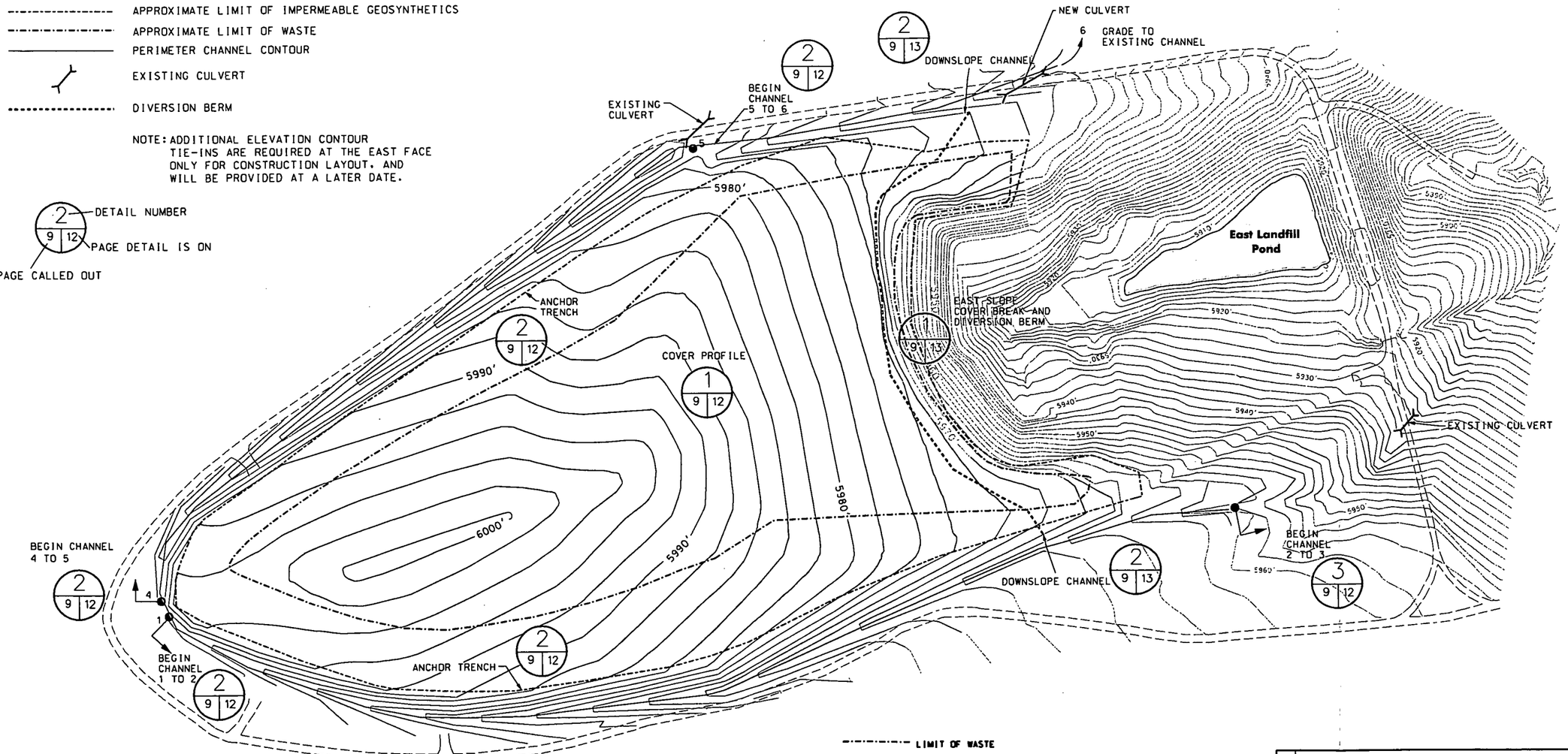
GROUP\CAD\ROCKY_FLATS\New Design_2003\FINAL_CVR95%\FINAL433.dgn Date: 1-2004

LEGEND

- 10 FOOT CONTOURS
- 2 FOOT CONTOURS
- EXISTING TOPOGRAPHY, MAJOR CONTOURS
- EXISTING TOPOGRAPHY, MINOR CONTOURS
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- PERIMETER CHANNEL CONTOUR
- EXISTING CULVERT
- DIVERSION BERM

NOTE: ADDITIONAL ELEVATION CONTOUR TIE-INS ARE REQUIRED AT THE EAST FACE ONLY FOR CONSTRUCTION LAYOUT, AND WILL BE PROVIDED AT A LATER DATE.

2 — DETAIL NUMBER
9 | 12 — PAGE DETAIL IS ON
PAGE CALLED OUT



QUAN.	DESCRIPTION	MATERIAL

REVISION DESCRIPTION

ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE										

DESCRIPTION

KEYWORDS
1.
2.
3.
4.
5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES: FRACT.: ANGLE: DEC.: UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH
DESIGNED BY: R. ARCHIBALD RA 8/9/04
DRAWN BY: A. SHOTNIK AL 8/10/04
CHECKED BY: R. THOMPSON TH 8/10/04
INDEPENDENT VERIFIER: S. LAWRENCE SL 11/10/04
APPROVED BY: R. THOMPSON TH 8/11/04
CLASSIFIER
LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

SURFACE WATER MANAGEMENT PLAN

PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-009	0

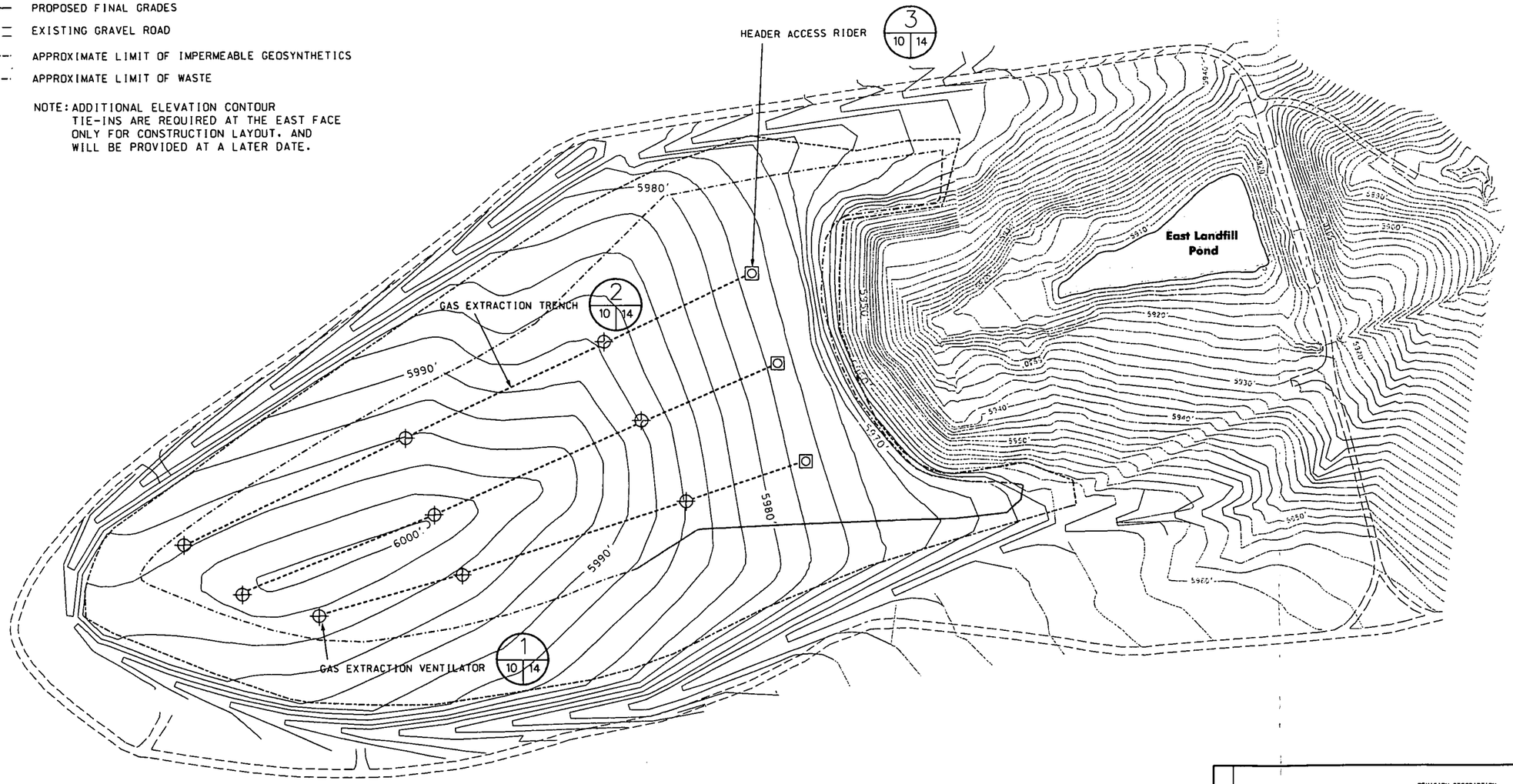
GROUP\CAD\ROCKY_FLATS\New Design_2003\SURFACE_WAT95%\SURFWT95.dgn Date: 1-2004

QUAN.	DESCRIPTION	MATERIAL

LEGEND

- PROPOSED GAS EXTRACTION VENTILATOR
- PROPOSED HEADER ACCESS RISER
- PROPOSED GAS EXTRACTION TRENCH
- 5920' EXISTING CONTOURS
- 5980' PROPOSED FINAL GRADES
- EXISTING GRAVEL ROAD
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE

NOTE: ADDITIONAL ELEVATION CONTOUR TIE-INS ARE REQUIRED AT THE EAST FACE ONLY FOR CONSTRUCTION LAYOUT. AND WILL BE PROVIDED AT A LATER DATE.



N

0' 100 200'

ISSUE	REVISION DESCRIPTION									
	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE									

DESCRIPTION

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY: SITE

ROOM/AREA: NA

GRID COORD./COL NO.: NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

MAT'L ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: SAIC			
DESIGNED BY	R. THOMPSON	TDT	8/9/04
DRAWN BY	A. SHOTNIK	AS	8/10/04
CHECKED BY	R. ARCHIBALD	RA	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL	11/10/04
APPROVED BY	R. THOMPSON	TDT	8/11/04
CLASSIFIER			
LANDLORD			

PROJECT/WCF NO. D20525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

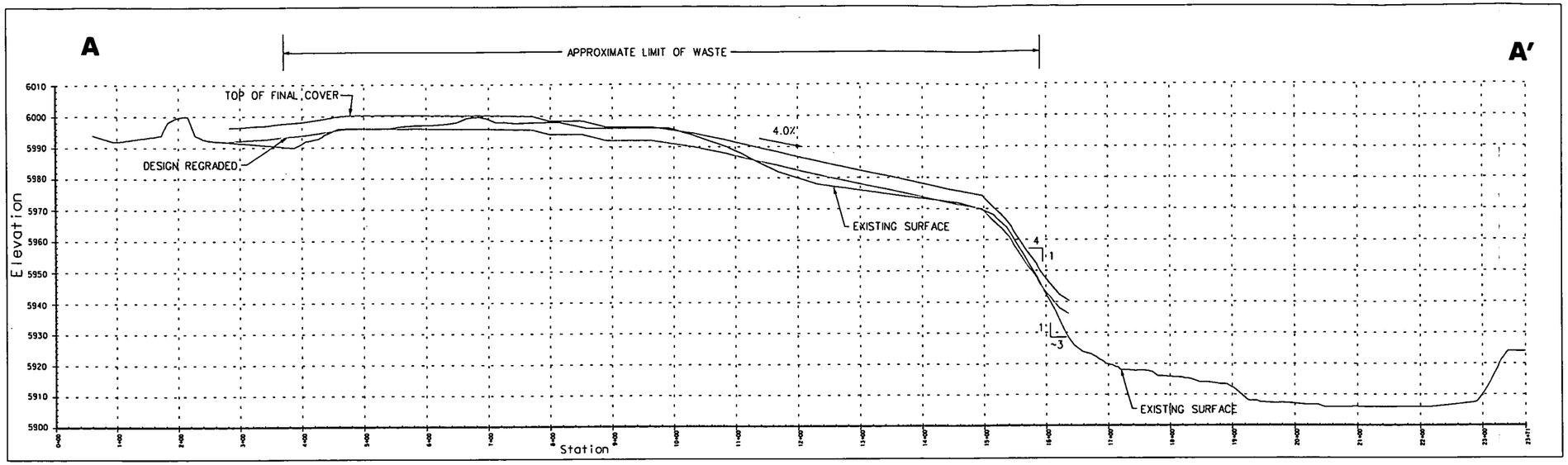
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

GAS MANAGEMENT SYSTEM
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-010	0

GROUP\CAD\ROCKY_FLATS\New Design2003\GAS_MGN_95%\GASMG95B.dgn Date: 6-2004

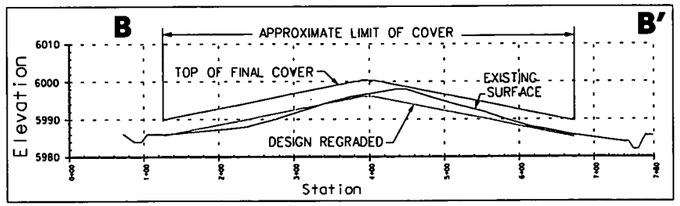
	QUAN.	DESCRIPTION	MATERIAL

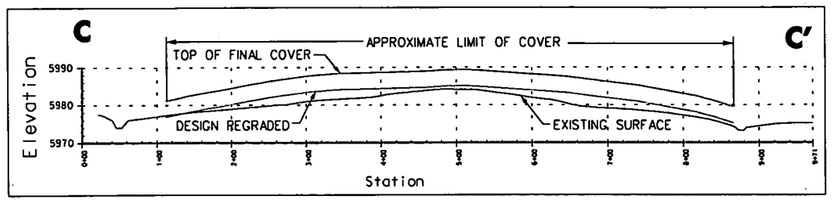


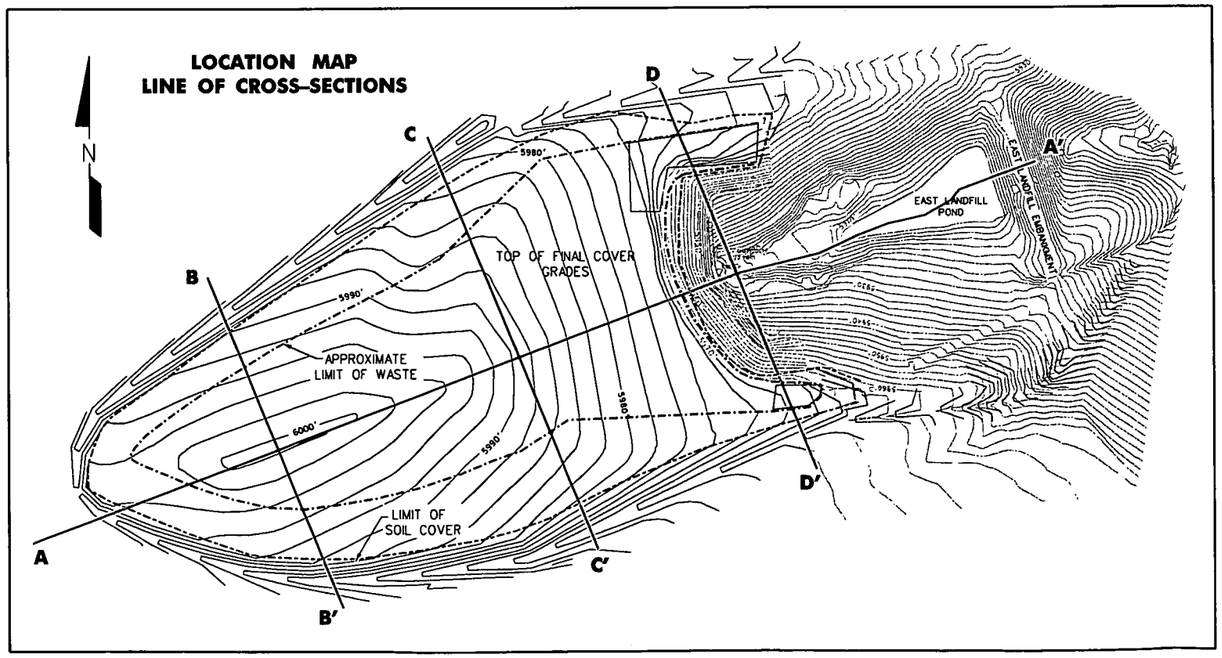
LEGEND

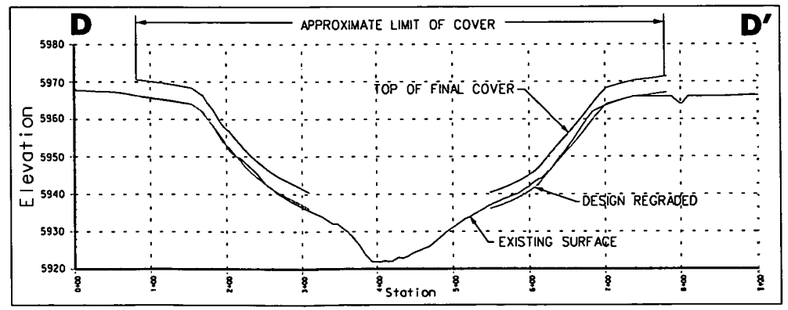
LINE	SURFACE	OFFSET
	EXISTING SURFACE	
	DESIGN REGRADED	
	TOP OF SURFACE	

Scaled 5.00 Times Ver.
Scaled 1.00 Times Hor.









NOTE: ADDITIONAL ELEVATION CONTOUR TIE-INS ARE REQUIRED AT THE EAST FACE ONLY FOR CONSTRUCTION LAYOUT, AND WILL BE PROVIDED AT A LATER DATE.

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE										

DESCRIPTION

KEYWORDS
1.
2.
3.
4.
5.
BLDG./FACILITY SITE
NA
ROOM/AREA
NA
GRID COORD./COL NO.
NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY
NA

SCALE:
AS SHOWN

DESIGN COMPANY: EASTECH		
DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. ARCHIBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	8/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

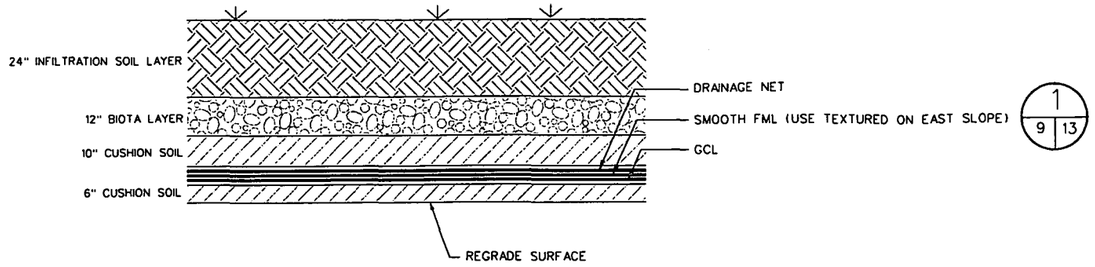
LANDFILL CROSS SECTIONS

PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-011	0

GROUP\CAD\ROCKY_FLATS\New Design_2003\XSEC_95\XSECTS95.dgn Date: 1-2004

QUAN.	DESCRIPTION	MATERIAL

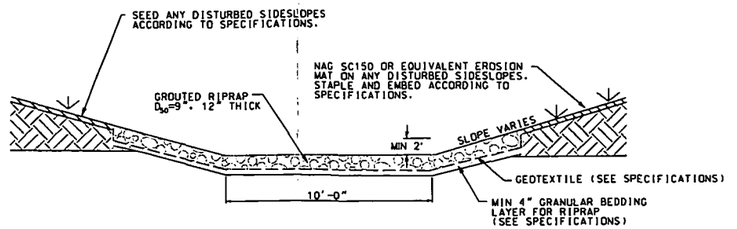


1 / 9 | 13

GEOSYNTHETIC COMPOSITE FINAL COVER

NTS

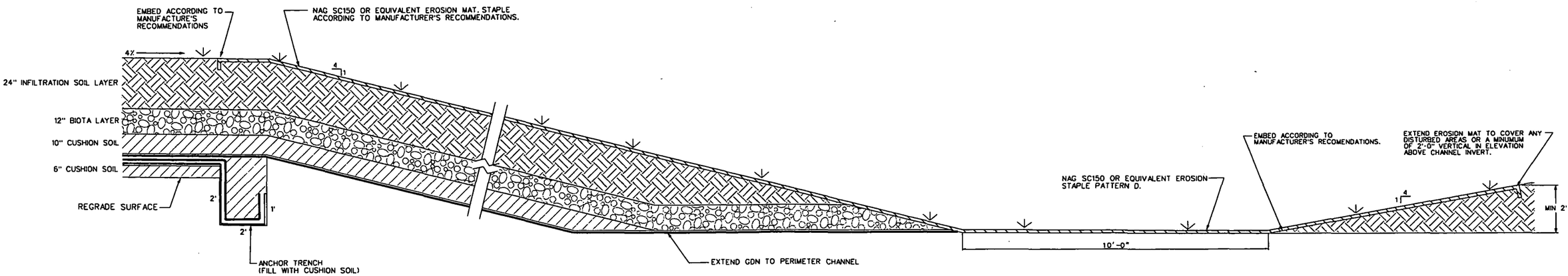
1 / 9 | 12



RIPRAP LINED CHANNEL DETAIL

NTS

3 / 9 | 12



ANCHOR TRENCH *

NTS

2 / 9 | 12

* NOTE: IF WASTE IS ENCOUNTERED DURING THE EXCAVATION OF THE ANCHOR TRENCH, WASTE MATERIAL WILL BE OVER EXCAVATED AN ADDITIONAL 1-FOOT. OVER EXCAVATIONS WILL BE FILLED WITH CUSHION LAYER SOIL TO THE DESIGN DIMENSIONS OF ANCHOR TRENCH.

ISSUE	REVISION DESCRIPTION	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

LANDFILL COVER AND SURFACE WATER DETAIL
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

KEYWORDS	
1.	
2.	
3.	
4.	
5.	
BLDG./FACILITY	SITE
ROOM/AREA	NA
GRID COORD./COL NO.	NA

TOLERANCES: FRACT. : ; ANGLE ; DEC. : ; UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: KAISER-HILL

DESIGNED BY	R. ARCHIBALD	8/10/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. THOMPSON	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04

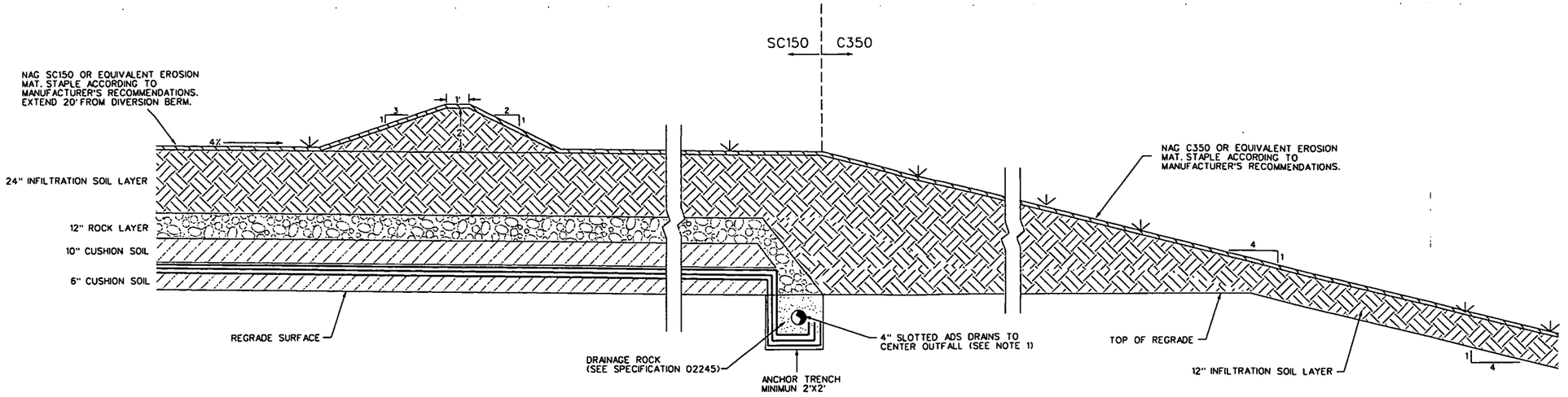
CLASSIFIER

LANDLORD

SIZE	DRAWING NUMBER	ISSUE
B	51781-012	0

L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2003 \DETAILS\LNDFILLCVR.DGN 1/23/04

QUAN.	DESCRIPTION	MATERIAL

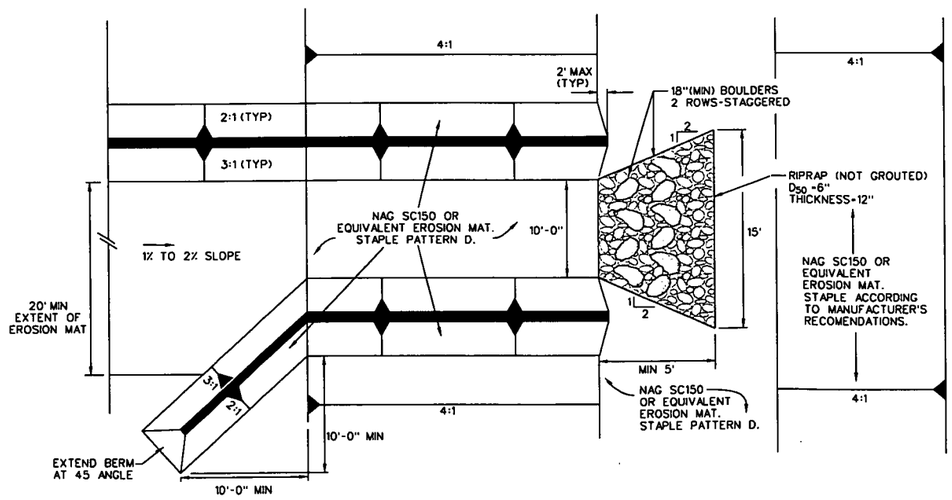


EAST SLOPE COVER BREAK AND DIVERSION BERM

1 / 9 / 13

NTS

NOTE: IF WASTE IS ENCOUNTERED DURING THE EXCAVATION OF THE ANCHOR TRENCH, WASTE MATERIAL WILL BE OVER EXCAVATED AN ADDITIONAL 1-FOOT. OVER EXCAVATIONS WILL BE FILLED WITH CUSHION LAYER SOIL TO THE DESIGN DIMENSIONS OF ANCHOR TRENCH.



DOWNSLOPE CHANNEL TRANSITION FROM EAST SLOPE BERM TO PERIMETER CHANNEL

2 / 9 / 13

NTS

NOTES:

1. ADS PIPE MEET THE FOLLOWING SPECIFICATIONS:
   4.0"I.D.
   4.72" O.D.
   0.40 LBS/FT
   SLOTTED PERFORATIONS (3 AT 120)
   SLOT LENGTH - 0.875"
   SLOT WIDTH - 0.125"

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE								

KEYWORDS: 1. 2. 3. 4. 5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL. NO.: NA

TOLERANCES: FRACT. ± ; ANGLE ± ; DEC. ± ; UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
HEAT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: SAIC		
DESIGNED BY	R. ARCHBALD	8/9/04
DRAWN BY	A. SHOTNIK	8/9/04
CHECKED BY	R. THOMPSON	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

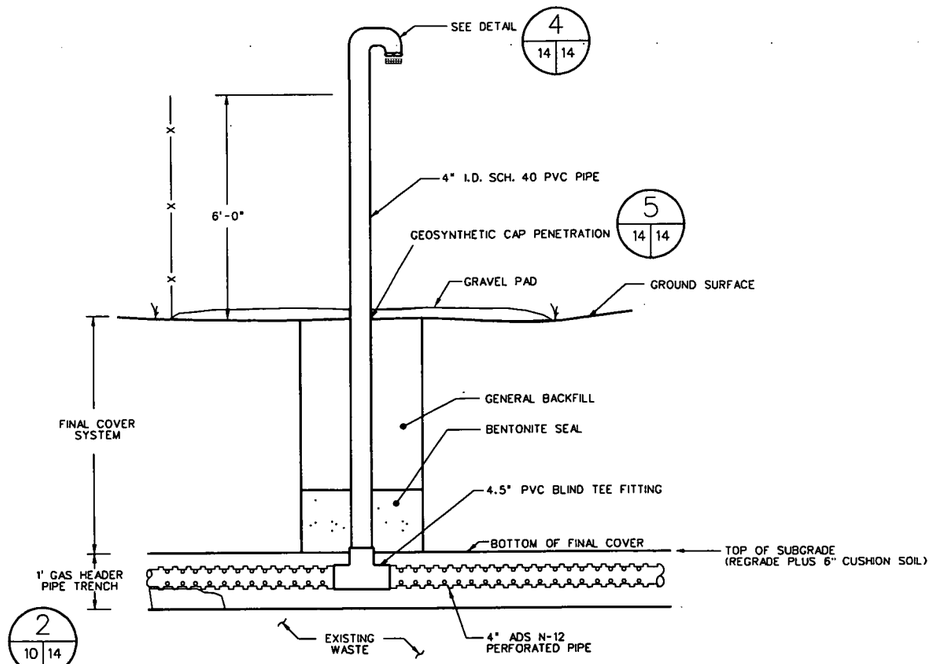
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

LANDFILL COVER DETAILS EAST FACE

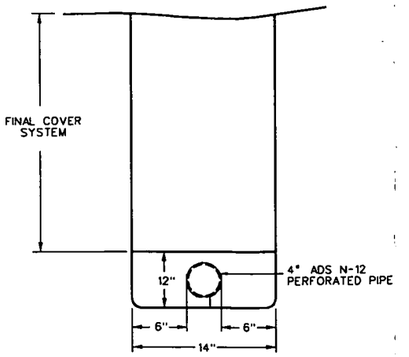
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-013	0

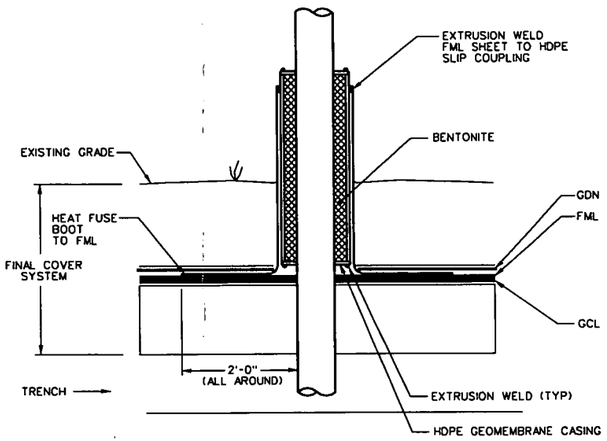
L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2003 \DETAILS\LNDFILLCVR.DGN 1/23/04



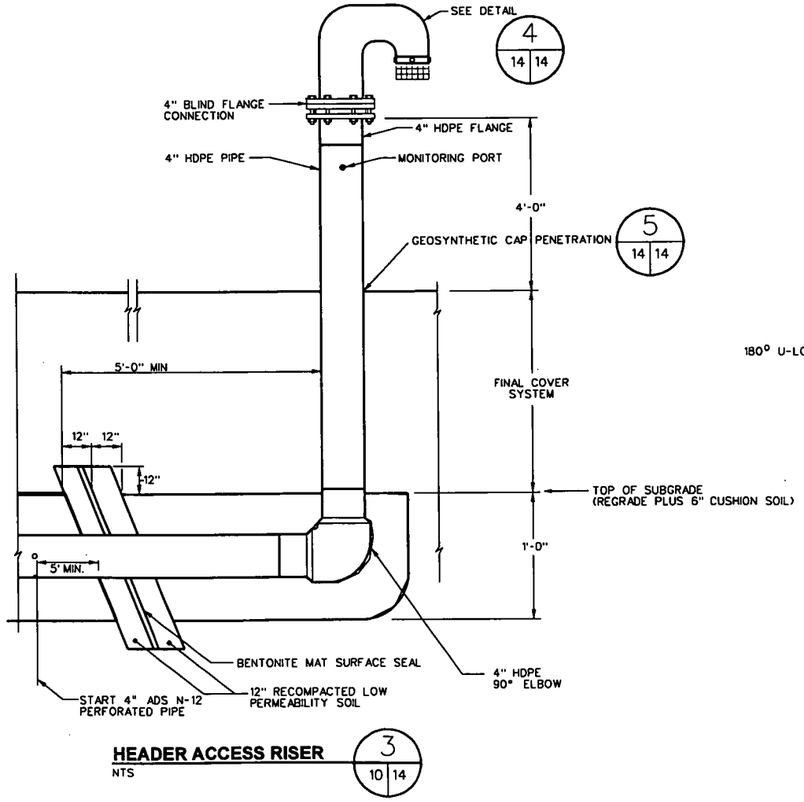
GAS EXTRACTION VENTILATOR 1 10 14



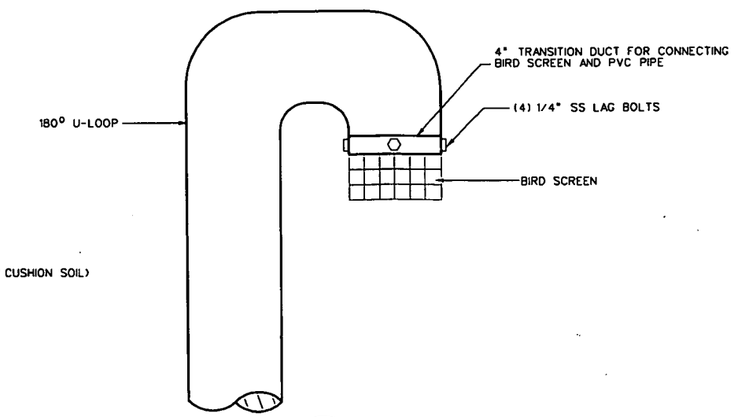
GAS EXTRACTION TRENCH 2 10 14



TYPICAL GEOSYNTHETIC CAP PENETRATION 5 14 14
NTS



HEADER ACCESS RISER 3 10 14
NTS



GAS VENT 4 14 14
NTS

NOTES

1. LANDFILL GAS SYSTEM MAY CHANGE DUE TO SITE CONDITIONS AT THE TIME OF CONSTRUCTION.
2. ALL PVC PIPE AND FITTINGS ARE SCH 80 EXCEPT AS NOTED.
3. ALL HDPE PIPE IS SDR-17 AND ALL HDPE FITTINGS ARE SDR-11 EXCEPT AS NOTED.
4. COMPACT CLEAN SAND BEDDING AND BACKFILL IN MAXIMUM LIFTS OF 9".
5. ALL NUTS, BOLTS, AND WASHERS ARE CADMIUM PLATED UNLESS OTHERWISE NOTED.

QUAN.	DESCRIPTION	MATERIAL

ISSUE	REVISION DESCRIPTION	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

KEYWORDS
1.
2.
3.
4.
5.
BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

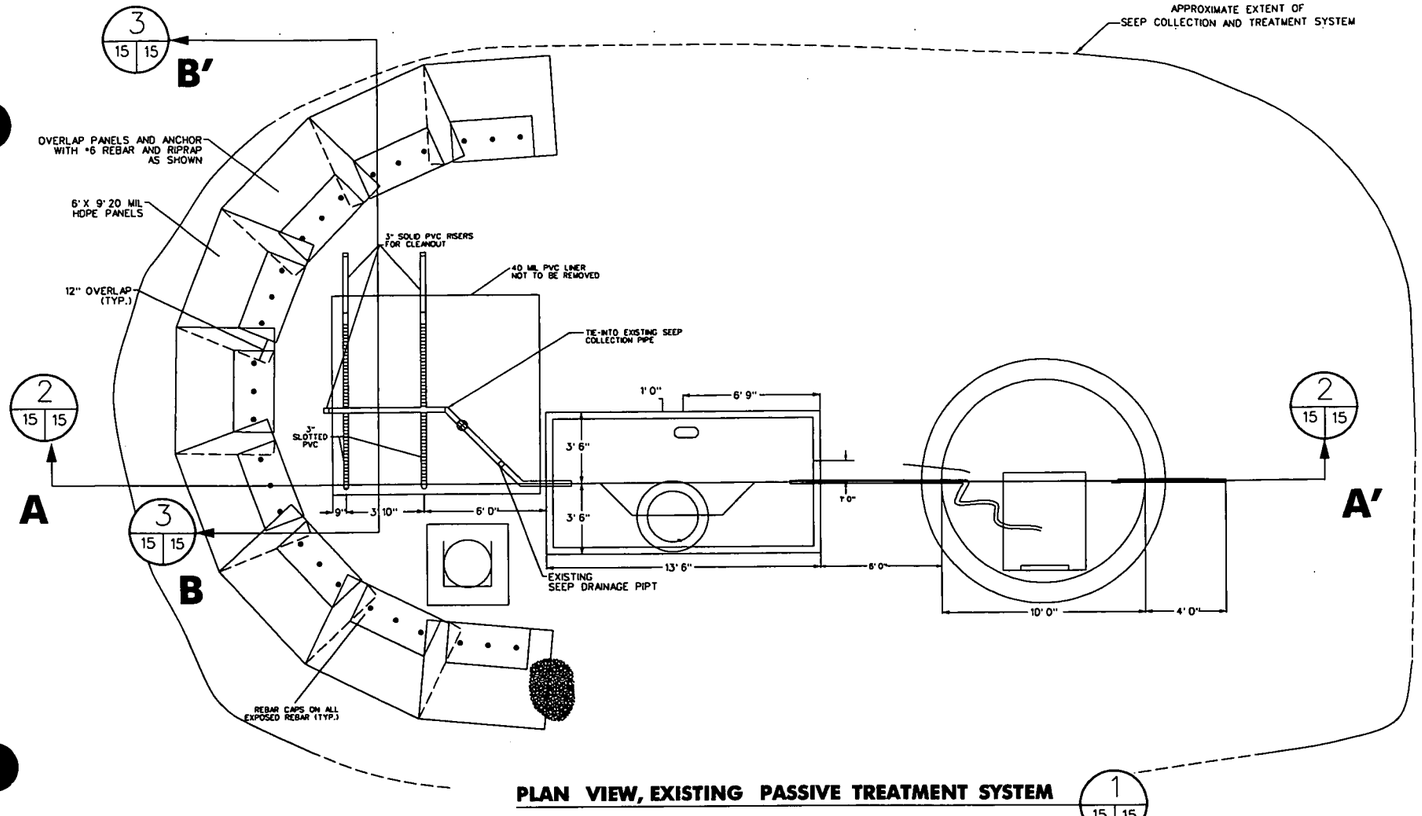
DESIGN COMPANY
DESIGNED BY: R. THOMPSON 8/9/04
DRAWN BY: A. SHOTNIK 8/10/04
CHECKED BY: R. ARCHIBALD 8/10/04
INDEPENDENT VERIFIER: S. LAWRENCE 8/11/04
APPROVED BY: R. THOMPSON 8/11/04
CLASSIFIER
LANDLORD

PROJECT/WCF NO. 020525
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

GAS MANAGEMENT DETAILS
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-014	0

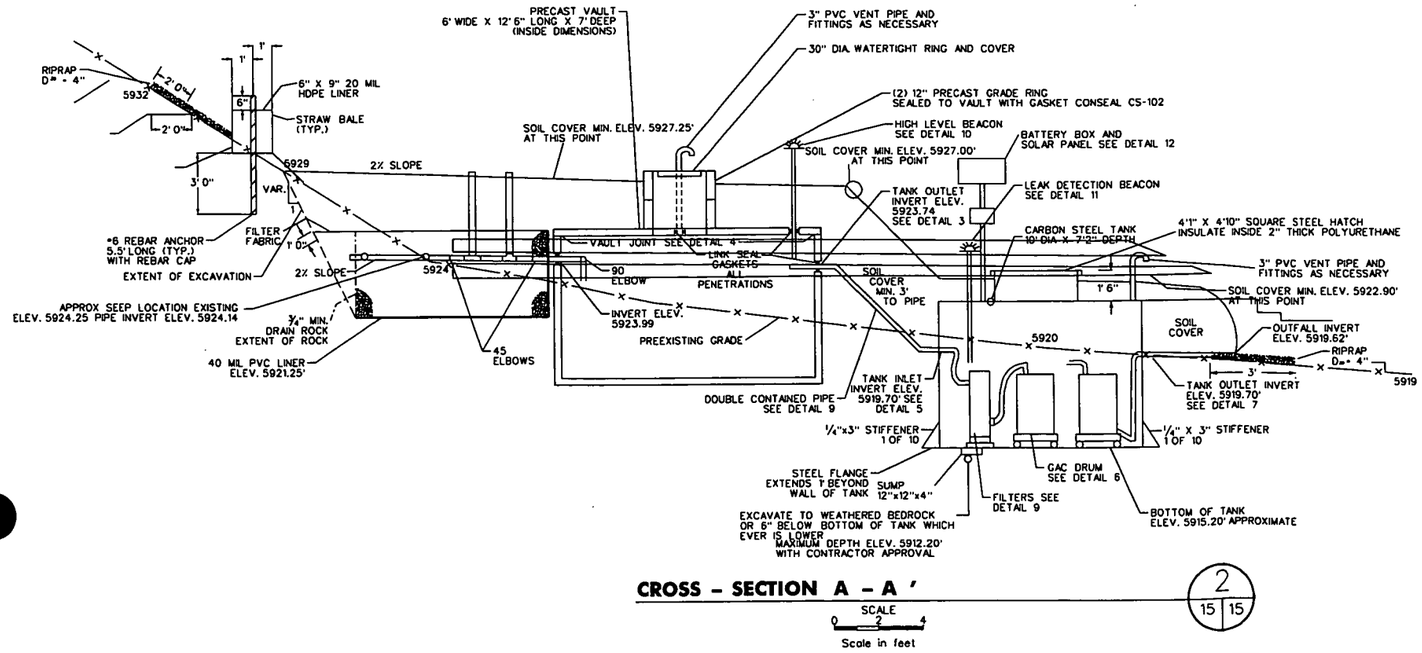
GROUP\CAD\ROCKY_FLATS\New Design 2003/dindo/gas-extr/rock_det2.DGN 1/26/04



PLAN VIEW, EXISTING PASSIVE TREATMENT SYSTEM

1 / 15 / 15

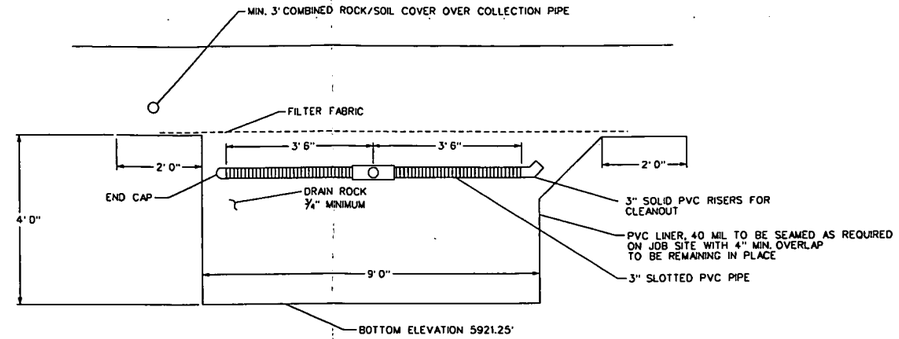
SCALE 0 2 4
Scale in feet



CROSS - SECTION A - A'

2 / 15 / 15

SCALE 0 2 4
Scale in feet



ALL 3" PVC PIPE IS SCHEDULE 40. SEE SPECIFICATION SECTION 03100

CROSS - SECTION B - B'

3 / 15 / 15

QUAN.	DESCRIPTION	MATERIAL

REVISION DESCRIPTION

ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE										

DESCRIPTION

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

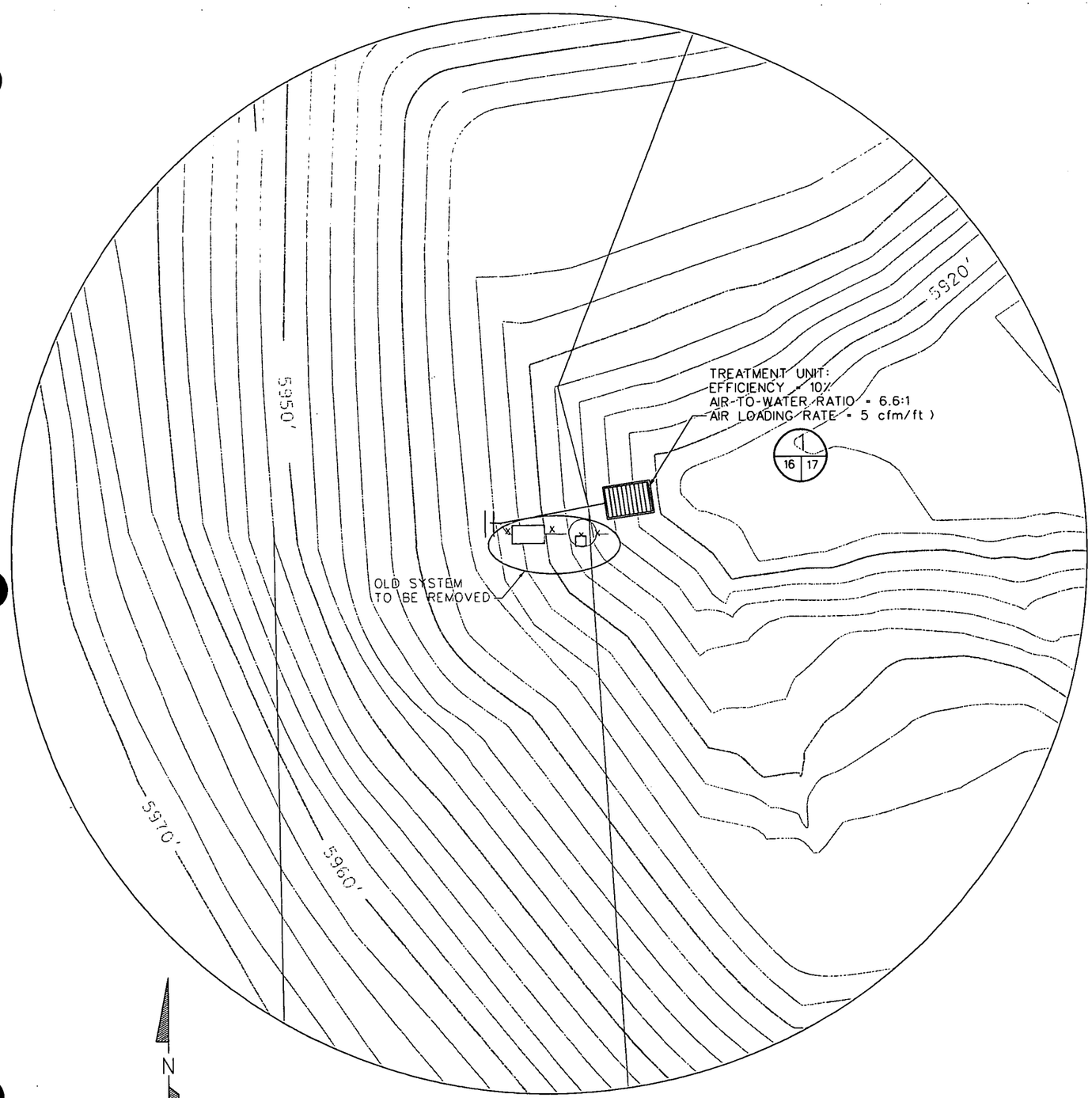
EXISTING SEEP PASSIVE TREATMENT SYSTEM
PRESENT LANDFILL CLOSURE PROJECT
95% DESIGN

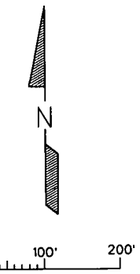
KEYWORDS	TOLERANCES FRACT. : ANGLE : DEC. : UNLESS NOTED OTHERWISE	DESIGN COMPANY: ARTEMIS	
1.		DESIGNED BY	
2.		R. THOMPSON	8/9/04
3.		DRAWN BY	
4.		A. SHOTNIK	8/10/04
5.	REMOVE BURRS AND SHARP EDGES	CHECKED BY	
BLDG./FACILITY SITE	NEXT ASSEMBLY	R. ARCHIBALD	8/10/04
ROOM/AREA NA	NA	INDEPENDENT VERIFIER	
GRID COORD./COL NO. NA	SCALE: AS SHOWN	S. LAWRENCE	8/10/04
		APPROVED BY	
		R. THOMPSON	8/10/04
		CLASSIFIER	
		LANDLORD	

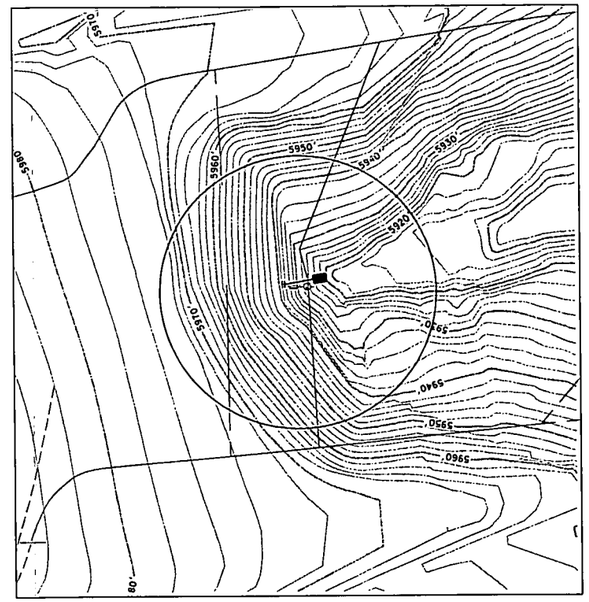
SIZE	DRAWING NUMBER	ISSUE
B	51781-015	0

GROUP\CAD\ROCKY_FLATS\NEW-DESIGN2003\DETAILS\SEEPDET.DGN 10/11/02

	QUAN.	DESCRIPTION	MATERIAL







REVISION DESCRIPTION										
ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE									

DESCRIPTION

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

NEW SEEP PASSIVE TREATMENT SYSTEM PLAN VIEW

PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY SITE

ROOM/AREA NA

GRID COORD./COL NO. NA

TOLERANCES
FRACT. :
ANGLE :
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY NA

SCALE: AS SHOWN

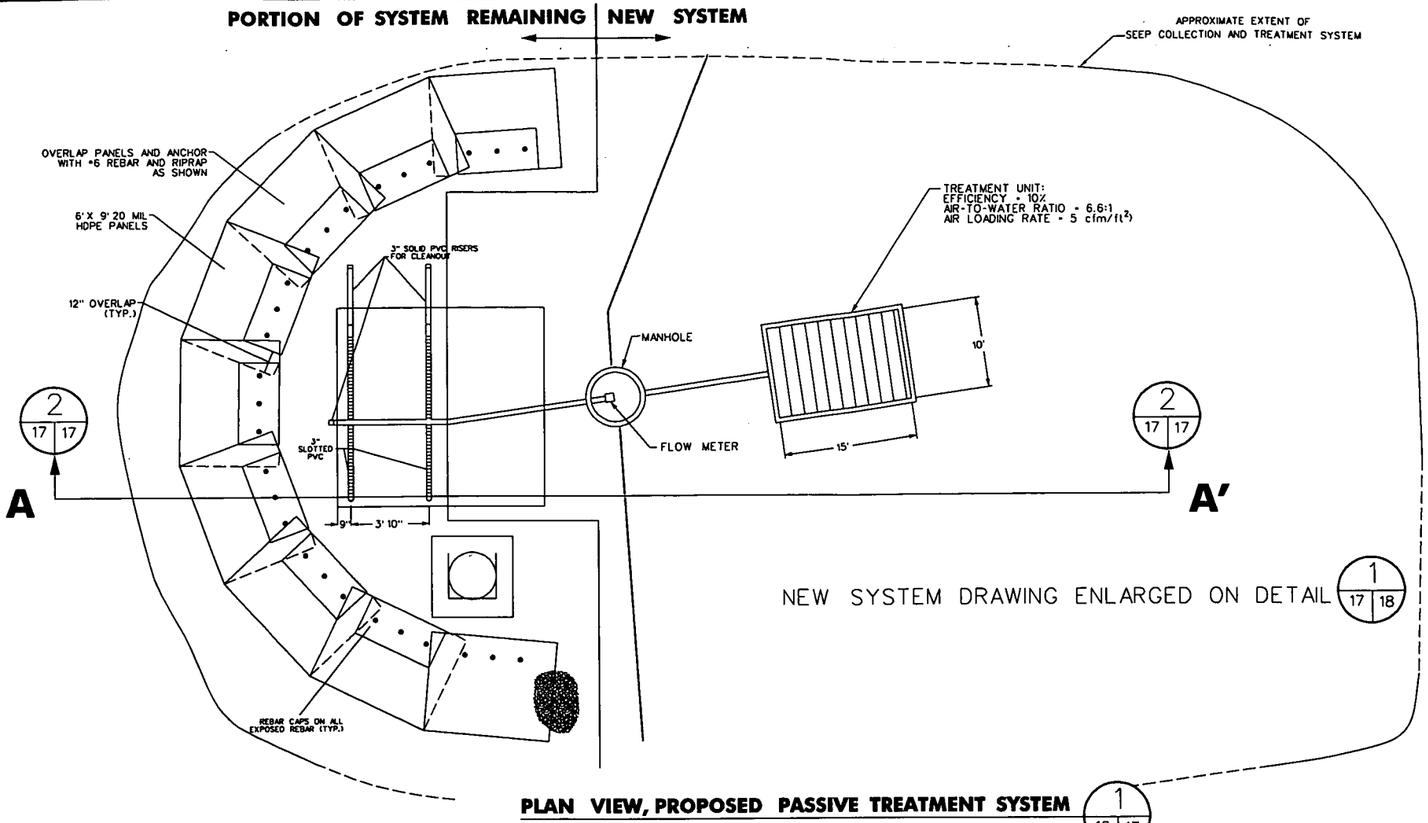
DESIGN COMPANY: EARTECH

DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/9/04
CHECKED BY	R. ARCHIBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

SIZE	DRAWING NUMBER	ISSUE
B	51781-016	0

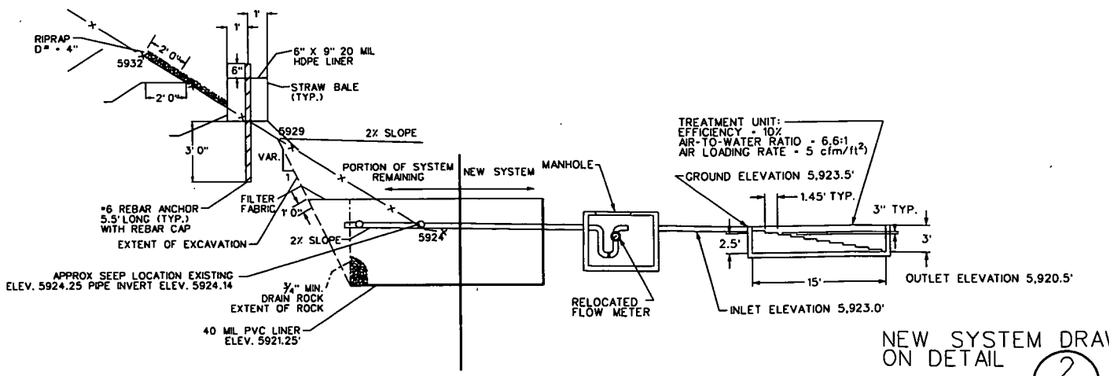
GROUP\CAD\ROCKY_FLATS\New Design2003\treat_seep\treatsp.dgn

	QUAN.	DESCRIPTION	MATERIAL



PLAN VIEW, PROPOSED PASSIVE TREATMENT SYSTEM 1 16 17

SCALE 0 2 4
Scale in feet



NEW SYSTEM DRAWING ENLARGED ON DETAIL 2 17 18

CROSS - SECTION A - A ' (PROPOSED) 2 17 17

SCALE 0 2 4
Scale in feet

NOTE: RELOCATE EXISTING FLOW METER AND ASSOCIATED ELECTRONICS TO NEW MANHOLE LOCATION.

ISSUE	REVISION DESCRIPTION									
	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE									

DESCRIPTION

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

NEW SEEP PASSIVE TREATMENT SYSTEM LAYOUT

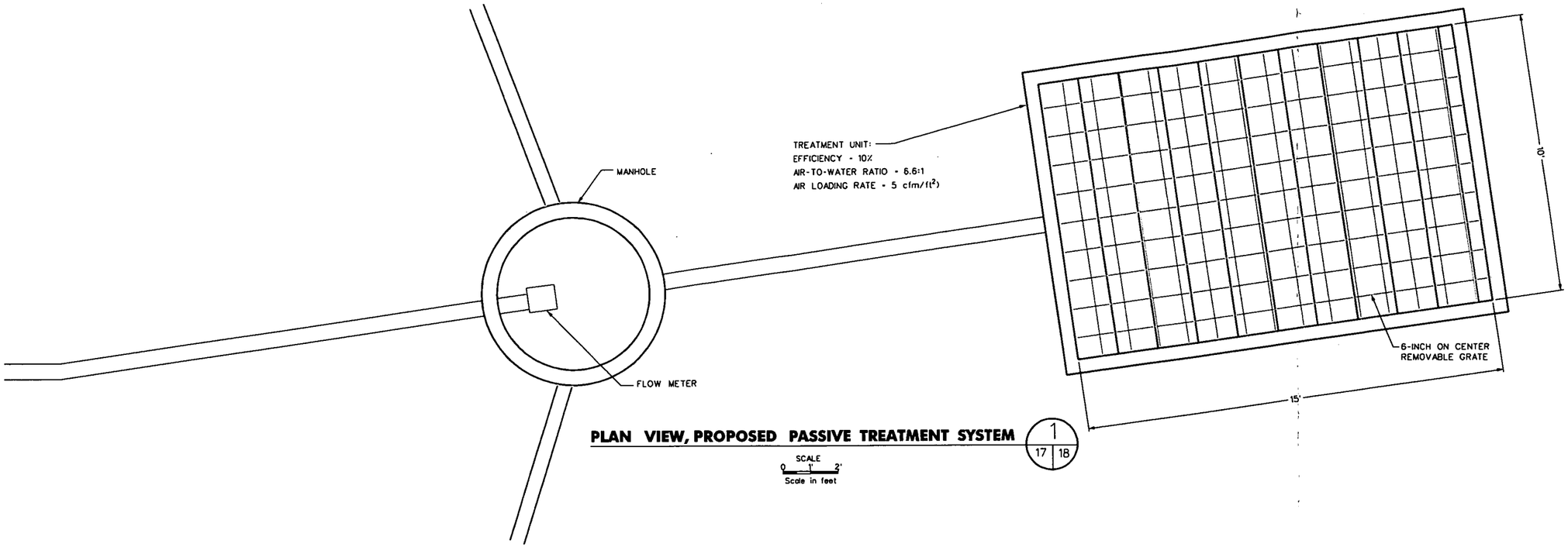
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

KEYWORDS	TOLERANCES	DESIGN COMPANY: EARTECH
1.	FRACT. :	DESIGNED BY: R. THOMPSON 12/9/04
2.	ANGLE	DRAWN BY: A. SHOTNIK 12/10/04
3.	DEC. :	CHECKED BY: R. ARCHIBALD 12/10/04
4.	UNLESS NOTED OTHERWISE	INDEPENDENT VERIFIER: S. LAWRENCE 12/10/04
5.	REMOVE BURRS AND SHARP EDGES	APPROVED BY: R. THOMPSON 12/14/04
BLDG./FACILITY: SITE	NEXT ASSEMBLY: NA	CLASSIFER
ROOM/AREA: NA	SCALE: AS SHOWN	LANDLORD
GRID COORD/COL NO.: NA		

SIZE	DRAWING NUMBER	ISSUE
B	51781-017	0

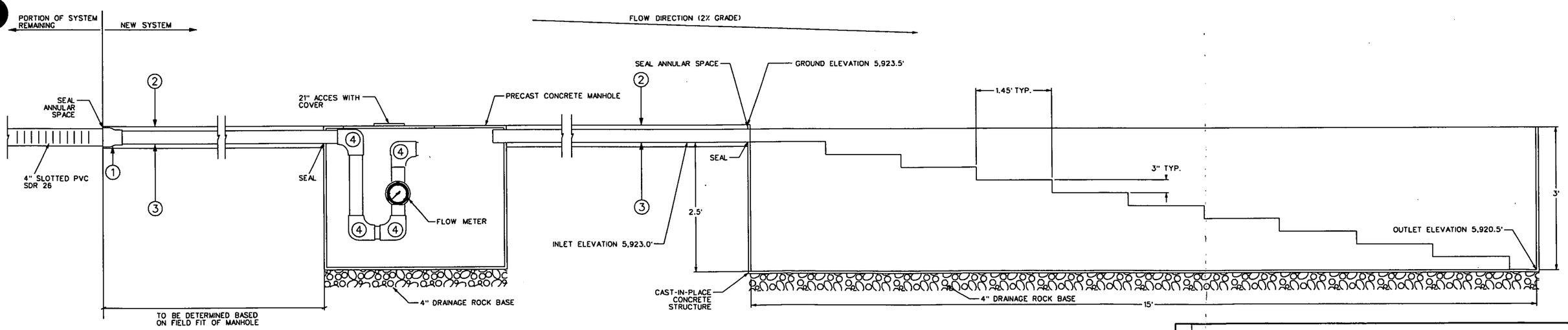
L:\GROUP\CAD\ROCKY FLATS\NEW DESIGN 2003\DETAILS\WTRBUNKERDTL.DGN

QUAN.	DESCRIPTION	MATERIAL



PLAN VIEW, PROPOSED PASSIVE TREATMENT SYSTEM (1 / 17 | 18)

SCALE
0 1' 2'
Scale in feet



CROSS - SECTION A - A ' (PROPOSED) (2 / 17 | 18)

SCALE
0 0.5' 1'
Scale in feet

PARTS LIST

1. 4"x3" REDUCER SCH 80
2. 5" SCH 80 PVC (SECONDARY CONTAINMENT PIPE)
3. 3" SCH 80 PVC (CARRIER PIPE)
4. 3" SCH 80 PVC 90° ELBOW
5. ULTRASONIC FLOW METER (EXISTING)

NOTE: RELOCATE EXISTING FLOW METER AND ASSOCIATED ELECTRONICS TO NEW MANHOLE LOCATION.

REVISION DESCRIPTION									
ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE								

KEYWORDS: 1. 2. 3. 4. 5.

BLDG./FACILITY SITE

ROOM/AREA NA

GRID COORD./COL NO. NA

DESCRIPTION

TOLERANCES FRACT. : ANGLE : DEC. : UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY NA

SCALE: AS SHOWN

DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. ARCHIBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04

CLASSIFER

LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-018	0

L:\GROUP\CAD\ROCKY FLATS\NEW DESIGN 2003\DETAILS\TRTMNTNT1.DGN

	QUAN.	DESCRIPTION	MATERIAL

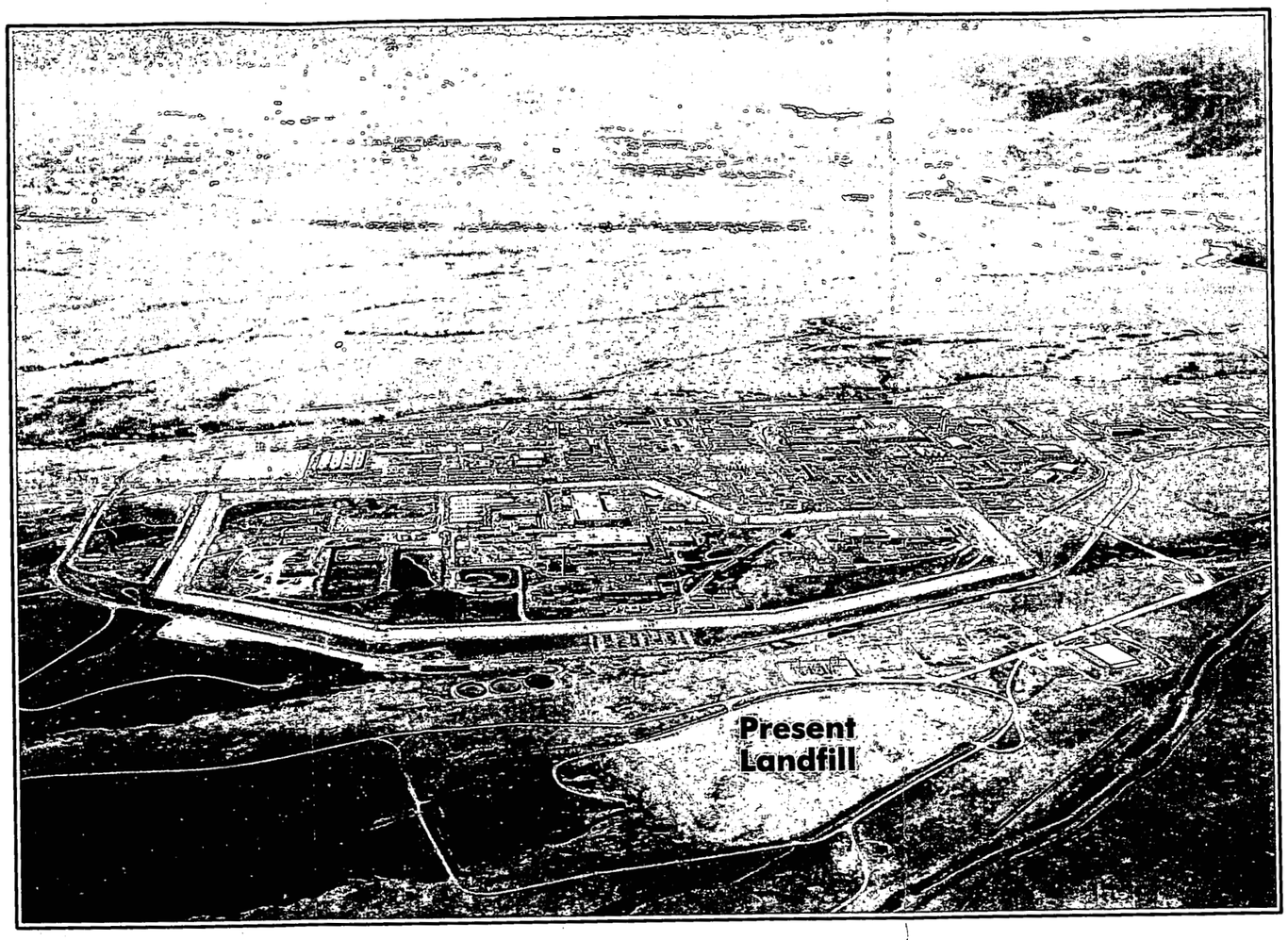
ACCELERATED ACTION DESIGN FOR THE PRESENT LANDFILL

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

DRAWINGS

GOLDEN COLORADO

REVISED DRAWINGS JANUARY 2005



AERIAL VIEW LOOKING SOUTH
June 6, 2000

NOTE:
Additional elevation contour tie-ins are required at the east face only for construction layout, and will be provided at a later date.

COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDALL C. THOMPSON
30639
3/8/05

EARTH TECH

EARTH TECH, INC.
5575 DTC PARKWAY
SUITE 200
ENGLEWOOD, CO 80111
(303) 694-6660

GROUP\CAD\ROCKY_FLATS\New_Design2004\COVER.DGN 12/8/04

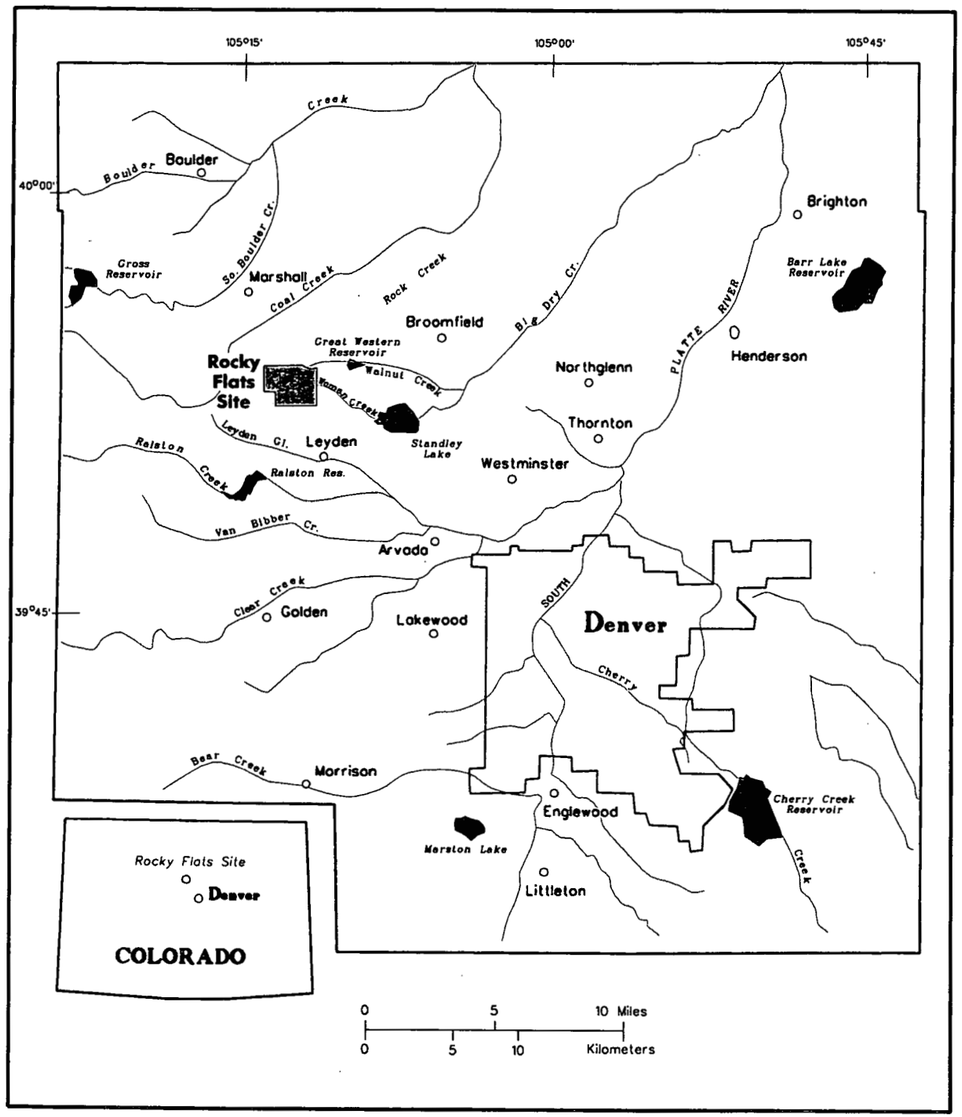
	QUAN.	DESCRIPTION	MATERIAL

DESIGN OF AN ENGINEERED COVER FOR THE PRESENT LANDFILL

SHEET INDEX

SHEET NO.	DESCRIPTION
51781-X001	RFETS PLF COVER SHEET
51781-001	VICINITY MAP AND DRAWING INDEX
51781-002	TRAFFIC FLOW PATTERNS
51781-003	EXISTING CONDITIONS
51781-004	CUT/FILL ISOPACH TOP OF REGRADED SURFACE
51781-005	DESIGN TOP OF REGRADED SURFACE
51781-006A	DESIGN PERIMETER CHANNEL
51787-006B	ANCHOR TRENCH
51781-006C	GRADE BREAKS
51781-007	DESIGN TOP OF SUBGRADE
51781-008	DESIGN TOP OF FINAL COVER
51781-009	SURFACE WATER MANAGEMENT PLAN
51781-010	GAS MANAGEMENT SYSTEM
51781-011	LANDFILL CROSS SECTIONS
51781-012	LANDFILL COVER AND SURFACE WATER DETAILS
51781-013A	LANDFILL COVER DETAILS EAST FACE
51781-013B	LANDFILL COVER DETAILS EAST FACE
51781-014	GAS MANAGEMENT DETAILS
51781-015	EXISTING SEEP PASSIVE TREATMENT SYSTEM
51781-016	NEW SEEP PASSIVE TREATMENT SYSTEM LAYOUT
51781-017	NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL
51781-018	NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL

VICINITY MAP



COLORADO REGISTERED
R. THOMPSON
30633
3/16/05
PROFESSIONAL ENGINEER

ISSUE	REVISION DESCRIPTION									
1	REVISED INDEX INCLUDING EAST FACE DESIGN									
	EARTH TECH DESIGN COMPANY	1/04/05 DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

KEYWORDS	TOLERANCES FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE	DESIGN COMPANY: EARTH TECH	PROJECT/WCF NO. 020525
1.		DESIGNED BY R. THOMPSON	U.S. DEPARTMENT OF ENERGY ROCKY FLATS OFFICE GOLDEN, COLORADO
2.		DRAWN BY A. SHOTNIK	Rocky Flats Environmental Technology Site GOLDEN, COLORADO
3.		CHECKED BY R. ARCHIBALD	VICINITY MAP AND DRAWING INDEX
4.		INDEPENDENT VERIFIER S. LAWRENCE	PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN
5.	REMOVE BURRS AND SHARP EDGES	APPROVED BY R. THOMPSON	
BLDG./FACILITY SITE	NEXT ASSEMBLY NA	CLASSIFIER	SIZE B — DRAWING NUMBER 51781-001 — ISSUE 1
ROOM/AREA NA	SCALE: AS SHOWN	LANDLORD	
GRID COORD./COL NO. NA			

	QUAN.	DESCRIPTION	MATERIAL

IN ROUTE

OUT ROUTE

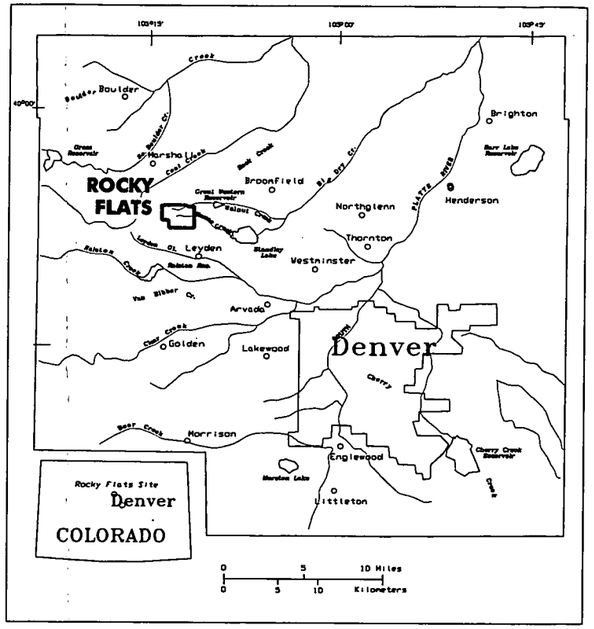
CONSTRUCTION STAGING AREA

PRESENT LANDFILL

NEW ACCESS ROAD

TO WEST ACCESS GATE

DOUBLE TRAFFIC



N

0 300 600'

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE										

DESCRIPTION

KEYWORDS

1.

2.

3.

4.

5.

BLDG./FACILITY SITE

ROOM/AREA NA

GRID COORD./COL. NO. NA

TOLERANCES FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY NA

SCALE: AS SHOWN

DESIGN COMPANY: [illegible]		
DESIGNED BY		
R. THOMPSON	RJT	8/9/04
DRAWN BY		
A. SHOTNIK	AS	8/10/04
CHECKED BY		
R. ARCHIBALD	RA	8/10/04
INDEPENDENT VERIFIER		
S. LAWRENCE	SL	11/10/04
APPROVED BY		
R. THOMPSON	RJT	8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

TRAFFIC FLOW PATTERNS

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-002	0

GROUP\CAD\ROCKY_FLATS\New Design2003\Haul_rte\haulrte.dgn Date: 4-2004

LEGEND

- CONTROL POINT
- PP POWER POLE
- XXXX GAS MONITORING WELL AND WELL NUMBER
- FENCE
- GUY WIRE
- BENCHMARK
- TRANSMISSION LINE
- GRAVEL ROAD
- VALVE BOXES
- MANHOLE
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- SLURRY WALL
- PERFORATED PIPE
- CLOSED JOINT PIPE
- FORMER ASBESTOS DISPOSAL AREA (APPROXIMATE)
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- N 40500 E 20000 GRID COORDINATE SYSTEM
- EXISTING CULVERT
- RIP-RAP
- INV.5966.85 C.M.P. WITH INVERT ELEVATION
- DECIDUOUS TREE
- CONIFEROUS TREE
- INFERRED FAULT

	QUAN.	DESCRIPTION	MATERIAL

INFERRED FAULT NO.2
AREA OF SURFACE SLUMP (9)
NORTH SLURRY TRENCH
OUTSIDE PIPE DRAIN 8" DIA. CLOSED JOINT PIPE
12-1 8" Gate Valve
DRAINAGE STRUCTURES
GRAVEL ROAD
MEASURING WEIR
East Landfill Pond
OVERFLOW STRUCTURE
EAST POND EMBANKMENT
WATER LEVEL GAUGES
BENCHMARK ELEV. 5926.51
EAST POND EMERGENCY SPILLWAY EL. 5921
DRAINAGE STRUCTURE
FIRE EXTINGUISHER BOX
MEASURING WEIR
INV. 5929.06
5" DIA. PIPE
12-1 8" Gate Valve
STAKE 1 N 39863.4 E 20879.2
CENTER N 39861.7 E 20889.7
STAKE 2 N 39862.9 E 20864.1
STAKE 4 N 39861.9 E 20894.6
PASSIVE SEEP COLLECTION AND TREATMENT SYSTEM
BH1 BH2 BH3 BH4 BH5 BH6 BH7
PLFBH4 PLFP1 PLFP2
LF-9 LF-10 LF-11 LF-12
59886 59884 72293 72294 72295
8" Gate Valve
℄ OUTSIDE PIPE DRAIN
PERFORATED PIPE
CLOSED JOINT PIPE
GAS MONITORING WELL I.D. 44292 W/ 4 BOLLARDS
44292
GAS MONITORING WELL I.D. 44392 W/ 4 BOLLARDS
44392
INSIDE PIPE DRAIN
OUTSIDE PIPE DRAIN 8" DIA. CLOSED JOINT PIPE
CLOSED JOINT PIPE
PERFORATED PIPE
44592
GAS MONITORING WELL W/ 4 BOLLARDS
INV. 5966.40
N 39500 E 21000
SOUTH SLURRY TRENCH
INV. 5966.85
GRAVEL ROAD
AIR MONITORING STA. 09 ON CONC. PAD
SITE ACCESS
℄ OUTSIDE PIPE DRAIN
ROCK PILE
INV. 5991.61
INV. 5987.89
INV. 5988.38
INV. 5988.96
INV. 5986.35
INV. 5974.96
N 39000 E 21000
N
0' 100 200'

COLORADO REGISTERED RANDALL C. THOMPSON 30633 PROFESSIONAL ENGINEER 3/18/05

NOTES:
(1) GRID COORDINATE SYSTEM BASED ON ROCKY FLATS COORDINATE SYSTEM.
(2) ELEVATION BASED ON MEAN SEA LEVEL NAVD88.
(3) TOPOGRAPHIC MAP AND GENERAL SURFACE FEATURES PROVIDED BY KAISER-HILL [OCTOBER 2003].
(4) SLURRY WALL DETAILS WERE COMPILED FROM DRAWINGS IN THE OU 7 CLOSURE PLAN NORTH SLURRY WALL TECHNICAL SPECIFICATIONS (MAY 1995).
(5) SEEP SYSTEM DETAILS WERE COMPILED FROM DRAWINGS IN THE OU 7 PASSIVE SEEP COLLECTION AND TREATMENT SYSTEM TECHNICAL SPECIFICATIONS (DECEMBER 1995).
(6) GROUNDWATER DIVERSION PIPE DETAILS WERE COMPILED FROM THE SANITARY LANDFILL RENOVATION DRAWINGS (AUGUST 1974).
(7) THE LIMIT OF WASTE WAS DETERMINED IN THE WESTERN HALF OF THE LANDFILL FROM THE SANITARY LANDFILL RENOVATION DRAWINGS (AUGUST 1974). AND IN THE EASTERN HALF OF THE LANDFILL FROM HISTORICAL AERIAL PHOTGRAPHS.
(8) ASBESTOS CELL DETAILS WERE COMPILED FROM DRAWINGS IN THE OU 7 CLOSURE PLAN NORTH SLURRY WALL TECHNICAL SPECIFICATIONS (MAY 1995).
(9) TEST PITS INDICATE THIS SLUMP IS A LOCALIZED SURFACE DEPRESSION AND NOT A DEEPER LANDSLIDE.

2 ISSUE	INFERRED FAULT AND AREA OF SURFACE SLUMP ADDED								
	REVISION DESCRIPTION								
	EARTH TECH DESIGN COMPANY	1/21/05 DATE	RJ DSGN	AS DWN	RA CHKD	SL IV	RJ APVD		CLASS 57378 PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE								PROJECT/WCF NO. 020525
	DESCRIPTION								

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY
ROOM/AREA
GRID COORD./COL NO.

TOLERANCES
FRACT. ±
ANGLE ±
DEC. ±.
UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY
SCALE: 1 INCH=200 FEET

DESIGN COMPANY: EARTH TECH

DESIGNED BY		
R. THOMPSON	RJ	8/9/04
DRAWN BY		
A. SHOTNIK	AS	8/10/04
CHECKED BY		
R. ARCHIBALD	RA	8/10/04
INDEPENDENT VERIFIER		
M. HEINSTEIN	SL	11/10/04
APPROVED BY		
R. THOMPSON	RJ	8/11/04
CLASSIFIER		

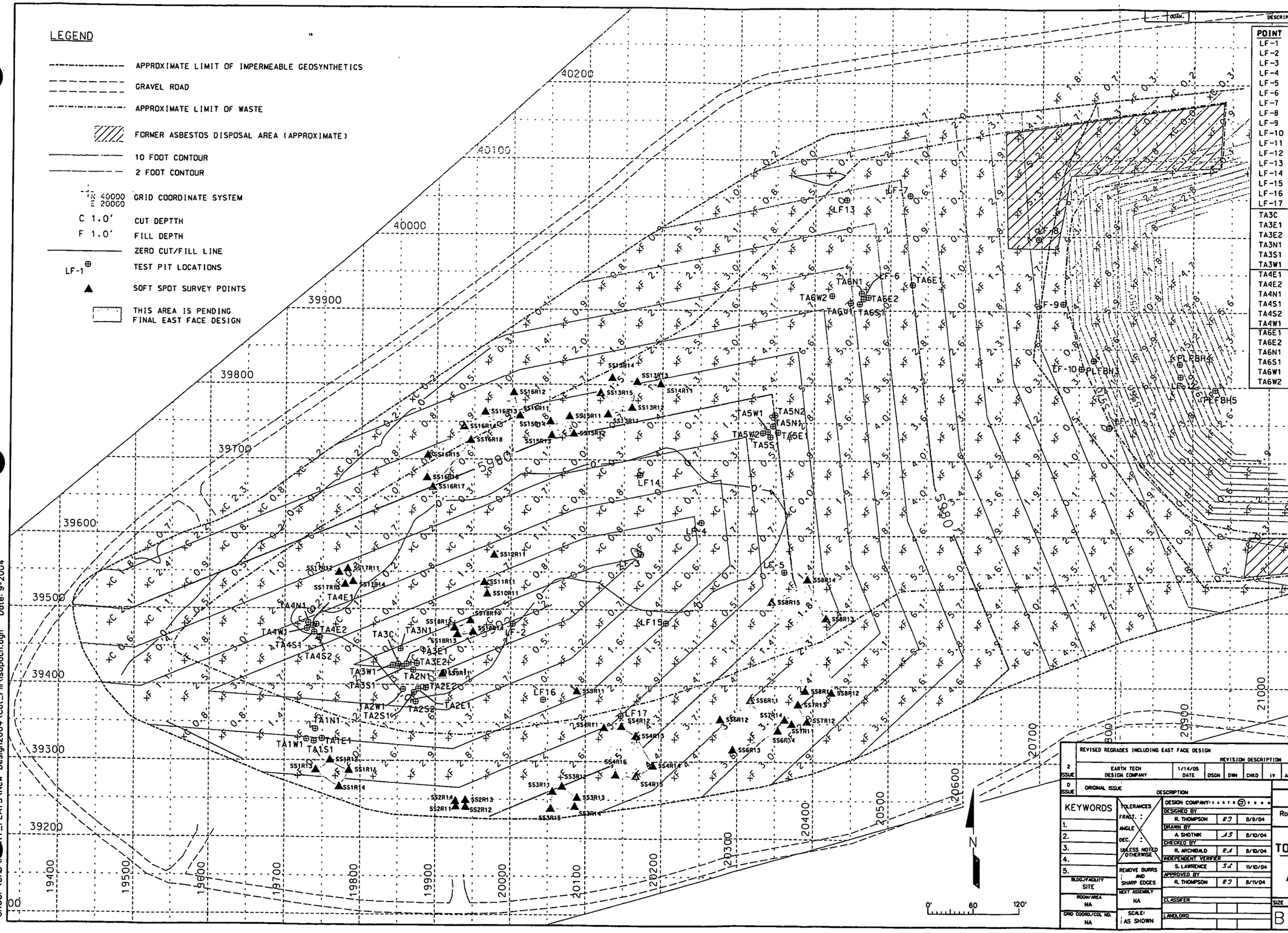
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

EXISTING CONDITIONS
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-003	0

GROUP\CAD\ROCKY_FLATS\New Design2004\EXISTCOND\EXISTCON.dgn Date: 1-2004



POINT	DEPTH OF COVER	CUT/FILL DEPTH
LF-1	3.6'	CUT 2.6'
LF-2	4.3'	CUT 0.6'
LF-3	4.7'	CUT 0.6'
LF-4	4.7'	CUT 2.7'
LF-5	3.0'	FILL 0.7'
LF-6	3.0'	CUT 0.7'
LF-7	2.7'	CUT 0.9'
LF-8	3.7'	FILL 5.6'
LF-9	1.7'	FILL 6.1'
LF-10	3.4'	FILL 2.2'
LF-11	2.0'	FILL 4.1'
LF-12	2.8'	FILL ?'
LF-13	1.8'	FILL 0.4'
LF-14	3.0'	CUT 0.4'
LF-15	3.0'	FILL 0.1'
LF-16	3.0'	FILL 1.3'
LF-17	3.0'	FILL 3.8'
TA3C	1.0'	CUT 0.6'
TA3E1	0.4'	CUT 0.8'
TA3E2	1.3'	CUT 0.9'
TA3N1	1.3'	CUT 1.9'
TA3S1	3.0'	CUT 0.8'
TA3W1	1.4'	CUT 0.6'
TA4E1	0.5'	CUT 0.3'
TA4E2	1.3'	CUT 0.4'
TA4N1	1.2'	CUT 0.2'
TA4S1	0.6'	CUT 0.3'
TA4S2	1.3'	CUT 0.4'
TA4W1	1.0'	CUT 0.3'
TA6E1	0.8'	CUT 0.2'
TA6E2	0.6'	CUT 0.2'
TA6N1	0.7'	CUT 0.1'
TA6S1	1.0'	FILL 0.2'
TA6W1	2.3'	FILL 0.6'
TA6W2	2.2'	FILL 1.2'

COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDALL C. THOMPSON
30633
3/18/05

ISSUE	REVISED REGRADES INCLUDING EAST FACE DESIGN — REVISION DESCRIPTION									
2	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	57378 PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

KEYWORDS: 1. 2. 3. 4. 5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES: FRACT. ± ANGLE ± DEC. ± UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH

DESIGNED BY	R. THOMPSON	RJ 8/9/04
DRAWN BY	A. SHOTNIK	AS 8/10/04
CHECKED BY	R. ARCHIBALD	RA 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
APPROVED BY	R. THOMPSON	RJ 8/11/04
CLASSIFER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

CUT/FILL ISOPACH TOP OF REGRADED SURFACE

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-004	2

GROUP\CAD\ROCKY_FLATS\New Design2004\Cut_Fill\Isopach.dgn Date: 9-2004

CONSTRUCTION CONTROL POINTS			
POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
10000	39550	19450	5988
10001	39500	19450	5990
10002	39450	19450	5992
10003	39400	19500	5993.9
10004	39450	19500	5991.9
10005	39500	19500	5990
10006	39550	19500	5988.2
10007	39550	19550	5988.9
10008	39500	19550	5990.8
10009	39450	19550	5992.6
10010	39400	19550	5994.6
10011	39350	19550	5994.3
10012	39350	19600	5994.4
10013	39400	19600	5995.5
10014	39450	19600	5993.4
10015	39500	19600	5991.5
10016	39550	19600	5989.7
10017	39600	19600	5987.8
10018	39600	19650	5988.6
10019	39550	19650	5990.5
10020	39500	19650	5992.3
10021	39450	19650	5994.2
10022	39400	19650	5996.5
10023	39350	19650	5994.6
10024	39300	19650	5992.6
10025	39300	19700	5992.7
10026	39350	19700	5994.7
10027	39400	19700	5996.7
10028	39450	19700	5995.1
10029	39500	19700	5993.1
10030	39550	19700	5991.2
10031	39600	19700	5989.4
10032	39650	19700	5987.5
10033	39700	19750	5986.44
10034	39650	19750	5988.3
10035	39600	19750	5990.1
10036	39550	19750	5992
10037	39500	19750	5993.8
10038	39450	19750	5994.9
10039	39400	19750	5996.9
10040	39350	19750	5994.9
10041	39300	19750	5992.9
10042	39250	19800	5990.9
10043	39300	19800	5993
10044	39350	19800	5995
10045	39400	19800	5997
10046	39450	19800	5997
10047	39500	19800	5994.7
10048	39550	19800	5992.7
10049	39600	19800	5990.9
10050	39650	19800	5989.1
10051	39700	19800	5987.2
10052	39750	19850	5986.1
10053	39700	19850	5988
10054	39650	19850	5989.8
10055	39600	19850	5991.7
10056	39550	19850	5993.5
10057	39500	19850	5995.7
10058	39450	19850	5998
10059	39400	19850	5997.2
10060	39350	19850	5995.2
10061	39300	19850	5993.2
10062	39250	19850	5991
10063	39250	19900	5991
10064	39300	19900	5993.3
10065	39350	19900	5995.3
10066	39400	19900	5997.3
10067	39450	19900	5998.7
10068	39500	19900	5996.6
10069	39550	19900	5994.3
10070	39600	19900	5992.4
10071	39650	19900	5990.6
10072	39700	19900	5988.7
10073	39800	19900	5986.9
10074	39800	19950	5985
10075	39800	19950	5985.8
10076	39750	19950	5987.8
10077	39700	19950	5989.5
10078	39650	19950	5991.3
10079	39600	19950	5993.2
10080	39550	19950	5995.3
10081	39500	19950	5997.6
10082	39450	19950	5998.5
10083	39400	19950	5996.7
10084	39350	19950	5994.9
10085	39300	19950	5993
10086	39250	19950	5991.2
10087	39250	20000	5990.4
10088	39300	20000	5992.3
10089	39350	20000	5994.1
10090	39400	20000	5996
10091	39450	20000	5997.8
10092	39500	20000	5998.4
10093	39550	20000	5996.2
10094	39600	20000	5994
10095	39650	20000	5992.1
10096	39700	20000	5990.3
10097	39750	20000	5988.4
10098	39800	20000	5986.6
10099	39850	20000	5984.7
10100	39900	20050	5983.1
10101	39850	20050	5985.1
10102	39800	20050	5987.1
10103	39750	20050	5989.1
10104	39700	20050	5991
10105	39650	20050	5992.9
10106	39600	20050	5994.9
10107	39550	20050	5997.2
10108	39500	20050	5998.9
10109	39450	20050	5997
10110	39400	20050	5995.2
10111	39350	20050	5993.3
10112	39300	20050	5991.5
10113	39250	20050	5989.6
10114	39250	20100	5988.9
10115	39300	20100	5990.7
10116	39350	20100	5992.6
10117	39400	20100	5994.4
10118	39450	20100	5995.9
10119	39500	20100	5997.7
10120	39550	20100	5998.1
10121	39600	20100	5995.8
10122	39650	20100	5993.5

CONSTRUCTION CONTROL POINTS			
POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
10123	39700	20100	5991.5
10124	39750	20100	5989.5
10125	39800	20100	5987.5
10126	39850	20100	5985.5
10127	39900	20100	5983.5
10128	39950	20150	5981.9
10129	39900	20150	5983.9
10130	39850	20150	5985.9
10131	39800	20150	5987.9
10132	39750	20150	5989.9
10133	39700	20150	5991.9
10134	39650	20150	5993.9
10135	39600	20150	5995.8
10136	39550	20150	5997.9
10137	39500	20150	5996.1
10138	39450	20150	5994.6
10139	39400	20150	5993.1
10140	39350	20150	5991.6
10141	39300	20150	5990.7
10142	39250	20150	5988.1
10143	39250	20200	5987.0
10144	39300	20200	5988.8
10145	39350	20200	5990.3
10146	39400	20200	5991.7
10147	39450	20200	5993.2
10148	39500	20200	5994.7
10149	39550	20200	5996.2
10150	39600	20200	5995.8
10151	39650	20200	5994.4
10152	39700	20200	5992.3
10153	39750	20200	5990.3
10154	39800	20200	5988.3
10155	39850	20200	5986.3
10156	39900	20200	5984.3
10157	39950	20200	5982.4
10158	39950	20250	5980.4
10159	39900	20250	5980.8
10160	39850	20250	5982.8
10161	39800	20250	5984.8
10162	39750	20250	5986.8
10163	39700	20250	5988.3
10164	39650	20250	5990.3
10165	39600	20250	5992.3
10166	39550	20250	5994.4
10167	39500	20250	5995.8
10168	39450	20250	5994.8
10169	39400	20250	5993.3
10170	39350	20250	5991.9
10171	39300	20250	5990.5
10172	39250	20250	5988.9
10173	39250	20300	5987.4
10174	39300	20300	5988.1
10175	39350	20300	5987.6
10176	39400	20300	5989
10177	39450	20300	5990.5
10178	39500	20300	5993.8
10179	39550	20300	5993.5
10180	39600	20300	5993.3
10181	39650	20300	5993
10182	39700	20300	5992.7
10183	39750	20300	5991.2
10184	39800	20300	5989.2
10185	39850	20300	5987.2
10186	39900	20300	5985.2
10187	39950	20300	5983.2
10188	39950	20350	5981.2
10189	39900	20350	5979.2
10190	39850	20350	5979.6
10191	39800	20350	5981.6
10192	39750	20350	5983.6
10193	39700	20350	5985.6
10194	39650	20350	5987.6
10195	39600	20350	5989.6
10196	39550	20350	5991.5
10197	39500	20350	5990.8
10198	39450	20350	5990.5
10199	39400	20350	5990.8
10200	39350	20350	5991.1
10201	39300	20350	5990.8
10202	39250	20350	5989.2
10203	39250	20400	5987.7
10204	39300	20400	5987.7
10205	39350	20400	5985.0
10206	39400	20400	5983.4
10207	39450	20400	5984.9
10208	39500	20400	5987.8
10209	39550	20400	5987.8
10210	39600	20400	5989.3
10211	39650	20400	5988.6
10212	39700	20400	5988.3
10213	39750	20400	5988
10214	39800	20400	5987.7
10215	39850	20400	5987.5
10216	39800	20400	5987.2
10217	39850	20400	5986.9
10218	39900	20400	5986
10219	39950	20400	5984
10220	40000	20400	5982
10221	40050	20400	5980
10222	40100	20400	5978.1
10223	40100	20450	5978.5
10224	40050	20450	5980.4
10225	40000	20450	5982.4
10226	39950	20450	5983.8
10227	39800	20450	5984.1
10228	39850	20450	5984.4
10229	39800	20450	5984.7
10230	39750	20450	5985
10231	39700	20450	5985.3
10232	39650	20450	5985.5
10233	39600	20450	5985.8
10234	39550	20450	5986.3
10235	39500	20450	5987.3
10236	39450	20450	5986.4
10237	39400	20450	5985
10238	39350	20450	5983.5
10239	39300	20450	5982.1
10240	39300	20500	5982.1
10241	39350	20500	5985.1
10242	39500	20500	5984.9
10243	39550	20500	5984
10244	39600	20500	5983.4
10245	39650	20500	5983.1

CONSTRUCTION CONTROL POINTS			
POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
10246	39700	20500	5982.8
10247	39750	20500	5982.5
10248	39800	20500	5982.2
10249	39850	20500	5981.9
10250	39900	20500	5981.6
10251	39950	20500	5981.3
10252	40000	20500	5981
10253	40050	20500	5980.8
10254	40100	20500	5978.5
10255	40100	20550	5978
10256	40050	20550	5978.3
10257	40000	20550	5978.6
10258	39950	20550	5978.8
10259	39900	20550	5978.6
10260	39850	20550	5978.8
10261	39800	20550	5979.1
10262	39750	20550	5979.4
10263	39700	20550	5979.7
10264	39650	20550	5980.3
10265	39600	20550	5980.3
10266	39550	20550	5980.6
10267	39500	20550	5981.4
10268	39450	20550	5982.1
10269	39400	20550	5982.9
10270	39350	20550	5983.7
10271	39300	20550	5983.6
10272	39250	20550	5981.0
10273	39250	20600	5979.4
10274	39300	20600	5981.8
10275	39350	20600	5980.3
10276	39400	20600	5978.4
10277	39450	20600	5979.5
10278	39500	20600	5978.8
10279	39550	20600	5978.0
10280	39600	20600	5977.5
10281	39650	20600	5977.2
10282	39700	20600	5976.9
10283	39750	20600	5976.7
10284	39800	20600	5976.4
10285	39850	20600	5976.1
10286	39900	20600	5975.8
10287	39950	20600	5975.5
10288	40000	20600	5975.2
10289	40050	20600	5975.1
10290	40100	20600	5977.7
10291	40100	20650	5973.0
10292	40050	20650	5973.3
10293	40000	20650	5973.6
10294	39950	20650	5973.9
10295	39900	20650	5974.2
10296	39850	20650	5974.5
10297	39800	20650	5974.7
10298	39750	20650	5975.4
10299	39700	20650	5976.2
10300	39650	20650	5978.0
10301	39600	20650	5977.9
10302	39550	20650	5978.4
10303	39500	20650	5979.2
10304	39450	20650	5980
10305	39400	20650	5979.4
10306	39350	20650	5978.1
10307	39500	20700	5977.4
10308	39550	20700	5976.6
10309	39600	20700	5975.8
10310	39650	20700	5975.1
10311	39700	20700	5974.3
10312	39750	20700	5973.5
10313	39800	20700	5972.8
10314	39850	20700	5972.1
10315	39900	20700	5971.3
10316	39950	20700	5970.6
10317	40000	20700	5971.2
10318	40050	20700	5971
10319	40100	20700	5970.9
10320	40100	20750	5970.8
10321	40050	20750	5968.9
10322	40000	20750	5968.4
10323	39950	20750	5965.0
10324	39900	20750	5965.91
10325	39850	20750	5966.8
10326	39800	20750	5967.7
10327	39750	20750	5970.2
10328	39800	20750	5970.9
10329	39750	20750	5971.7
10330	39700	20750	5972.5
10331	39650	20750	5973.2
10332	39600	20750	5974.0
10333	39550	20750	5974.8
10334	39500	20750	5975.5
10335	39450	20750	5976.3
10336	39400	20750	5973.7
10337	39350	20750	5972.9
10338	39300	20750	5971.6
10339	39250	20750	5970.4
10340	39250	20800	5969.2
10341	39300	20800	5969.0
10342	39350	20800	5968.3
10343	39400	20800	5968.0
10344	39450	20800	5967.7
10345	39500	20800	5967.4
10346	39550	20800	5967
10347	39600	20800	5954.4
10348	39650	20800	5952.7
10349	39700	20800	5951.5
10350	39750	20800	5950.7
10351	40100	20850	5952.7
10352	40050	20850	5950.7
10353	40000	20850	5941.0
10354	39950	20850	5941.9
10355	39900	20850	5943.2
10356	39850	20850	5947.9
10357	39800	20850	5952.7
10358	39750	20850	5952.5
10359	39700	20850	5952.3
10360	39650	20850	5968.3
10361	39600	20850	5970.3
10362	39550	20850	5971.1
10363	39500	20850	5971.8
10364	39450	20850	5970.4
10365	39400	20850	5968.4
10366	39350	20850	5966.0
10367	39300	20850	5965.7
10368	39250	20850	5965.3
10369	39250	20900	5962.8
10370	39300	20900	5961.2
10371	39350	20900	5959.6
10372	39400	20900	5958.0
10373	39450	20900	5956.4
10374	39500	20900	5954.7
10375	39550	20900	5950.7
10376	39600	20900	5952.2
10377	39650	20900	5953.7
10378	39700	20900	5955.3
10379	39750	20900	5955.3
10380	39800	20900	5943.4
10381	39850	20900	5941.9
10382	39900	20900	5940.4
10383	39950	20900	5938.9
10384	39850	20950	5924.8
10385	39800	20950	
10386	39750	20950	
10387	39700	20950	5945.3
10388	39650	20950	5957.6
10389	39600	20950	5966
10390	39550	20950	5968
10391	39550	21000	5967.7
10392	39600	21000	5965.7
10393	39650	21000	5957.4
10394	39700	21000	
10395	39750	21000	
10396	39800	21000	
10397	39850	21000	
10398	39900	21000	
10399	39950	21000	
10400	40000	21000	
10401	40050	21000	
10402	40100	21000	5949.8
10413	39800	21050	
10414	39750	21050	
10415	39700	21050	
10416	39650	21050	5957.1
10417	39600	21050	5965.3
10418	39550	21050	5967.4
10419	39550	21100	5967
10420	39600	21100	5964.9

CONSTRUCTION CONTROL POINTS			
POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
16000	39864.1	20841.7	
16001	39912.2	20950.0	
16002	39881.8	20963.6	
16003	39823.0	20953.4	
16004	39785.9	20873.3	

QUAN.	DESCRIPTION	MATERIAL
	PRIOR TO FILL, FLOW-FILL EXISTING RIPRAP IN ACCORDANCE WITH CDOT CONSTRUCTION SPECIFICATION, SECTION 206 "EXCAVATION AND BACKFILL FOR STRUCTURES"	
	PRIOR TO FILL, EXCAVATE AREA TO COMPETENT WEATHERED CLAYSTONE AT THE DISCRETION OF QA AND THE GEOTECHNICAL ENGINEER - BACKFILL WITH ROCKY FLATS ALLUVIUM	
	PRIOR TO FILL, FLOW-FILL EXISTING RIPRAP IN ACCORDANCE WITH CDOT CONSTRUCTION SPECIFICATION SECTION 206 "EXCAVATION AND BACKFILL FOR STRUCTURES"	

LEGEND

- ANCHOR TRENCH
- GRAVEL ROAD
- APPROXIMATE LIMIT OF WASTE
- FORMER ASBESTOS DISPOSAL AREA (APPROXIMATE)
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- GRID COORDINATE SYSTEM
- 10288 — CONTROL POINT NUMBER
- 5975.2 — CONTROL POINT ELEVATION
- EXTENT OF RIPRAP

N

0' 70 140'

COLORADO REGISTERED RANDALL C. THOMPSON 30639 PROFESSIONAL ENGINEER 3/15/05

2 ISSUE	REVISED REGRADES INCLUDING EAST FACE DESIGN										
	REVISION DESCRIPTION										
	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DRN	CHKD	IV	APVD			CLASS	57378 PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE	DESCRIPTION									

KEYWORDS	TOLERANCES FRACT. :	DESIGN COMPANY: EARTH TECH	
1.	ANGLE DEC. :	DESIGNED BY R. THOMPSON	RJT 8/9/04
2.	UNLESS NOTED OTHERWISE	DRAWN BY A. SHOTNIK	AS 8/10/04
3.	REMOVE BURRS AND SHARP EDGES	CHECKED BY R. ARCHIBALD	RA 8/10/04
4.	WBS# ASSEMBLY NA	INDEPENDENT VERIFIER S. LAWRENCE	SL 11/10/04
5.	SCALE: AS SHOWN	APPROVED BY R. THOMPSON	RJT 8/11/04
BLDG./FACILITY SITE		CLASSIFIER	
ROOM/AREA NA		LANDLORD	
GRID COORD./COL NO. NA			

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN TOP OF REGRADED SURFACE
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-005	2

GROUP\CAD\ROCKY_FLATS\New Design2004\Regrds_Fin\RGPts.dgn Date: 10-2004

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
6525	39559.6	19452.8	5987.1
6526	39580.2	19437.5	5987.1
11000	40318	20992.7	5960
11001	40309.6	20998.4	5960
11002	40285.5	20952	5962
11003	40306	20936.2	5962
11004	40286.8	20867.5	5964
11005	40263.9	20879.1	5964
11006	40239.2	20770.1	5966
11007	40263.1	20761.6	5966
11008	40239	20633.1	5968
11009	40214.7	20640.6	5968
11010	40182.8	20511.9	5970
11011	40207.1	20504.8	5970
11012	40199.8	20450.8	5972
11013	40175.5	20457.9	5972
11014	40192.8	20417.2	5974
11015	40167.5	20419.2	5974
11016	40118.3	20288.4	5972
11017	40138.4	20273.2	5972
11018	40054.3	20156.4	5974
11019	40035.1	20172.9	5974
11020	39989.4	20112.2	5976
11021	40007.6	20094.6	5976
11022	39943.2	20005.9	5978
11023	39923.5	20021.8	5978
11024	39858.7	19933.2	5980
11025	39878.1	19917	5980
11026	39786.1	19791.5	5982
11027	39766.2	19806.5	5982
11028	39670.9	19677.4	5984
11029	39691.1	19662.7	5984
11030	39621.6	19521.8	5986
11031	39599.1	19532.6	5986
11032	39521.6	19409.6	5988
11033	39533.9	19387.8	5988
11034	39441	19395.5	5990
11035	39458	19413.8	5990
11036	39407.8	19439	5992
11037	39390.8	19420.7	5992
11038	39333.2	19465.6	5994
11039	39350.2	19483.9	5994
11040	39346.6	19487.2	5994
11041	39321.6	19473.8	5994
11042	39299.2	19518.9	5992
11043	39320	19529.8	5992
11044	39281.3	19621.4	5990
11045	39258.4	19610.5	5990

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
11046	39222.8	19705.5	5988
11047	39246.1	19715.3	5988
11048	39216.1	19806.5	5986
11049	39192.2	19800.6	5986
11050	39178.1	19897.7	5984
11051	39202.7	19903.7	5984
11052	39196.5	19998.1	5982
11053	39171.2	19998	5982
11054	39177.1	20095.8	5980
11055	39202.4	20095.4	5980
11056	39213.2	20194.3	5978
11057	39188	20195.4	5978
11058	39200.5	20295	5976
11059	39225.7	20293.3	5976
11060	39240.2	20390.8	5974
11061	39215.6	20396.6	5974
11062	39248	20488	5972
11063	39272.2	20480.8	5972
11064	39307.8	20570.2	5970
11065	39290.1	20577.8	5970
11066	39329.5	20670.3	5968
11067	39353.1	20661.1	5968
11068	39434.1	20846.2	5966
11069	39410.2	20854.6	5966
11070	39482.8	21042.5	5964
11071	39507.2	21035.8	5964
11072	39545.3	21149	5962
11073	39520	21149.9	5962

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
11074	39530.4	21238	5960
11075	39543.1	21235.9	5960
11076	39553.9	21335.3	5958
11077	39543.8	21336.7	5958
11078	39547.2	21383	5956
11079	39556.8	21382.5	5956
11080	39560.6	21417.2	5954
11081	39548.6	21419.1	5954
11082	39550.7	21438	5952
11083	39561.3	21436.3	5952
11084	39568.4	21469.3	5950
11085	39558.6	21471.2	5950
11086	39566.6	21497	5948
11087	39574.5	21493.5	5948
11088	39585.6	21518.1	5946
11089	39573	21526.2	5946
11090	39586.3	21542.4	5944
11091	39595.4	21535.3	5944
11092	39608.2	21548	5942

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
11093	39597.2	21557.3	5942
11094	39602.8	21572.9	5940
11095	39617.9	21560.7	5940
11096	39619.9	21569.7	5938
11097	39607.5	21578.6	5938
11098	39613.4	21582.8	5936
11099	39620.6	21574.2	5936
11100	39633.3	21585.1	5934
11101	39625.2	21594.8	5934
11102	39640.1	21604.7	5932
11103	39646.4	21595.8	5932
11104	39683.3	21615.3	5930
11105	39676.3	21626.2	5930
11106	39698.2	21649.5	5928

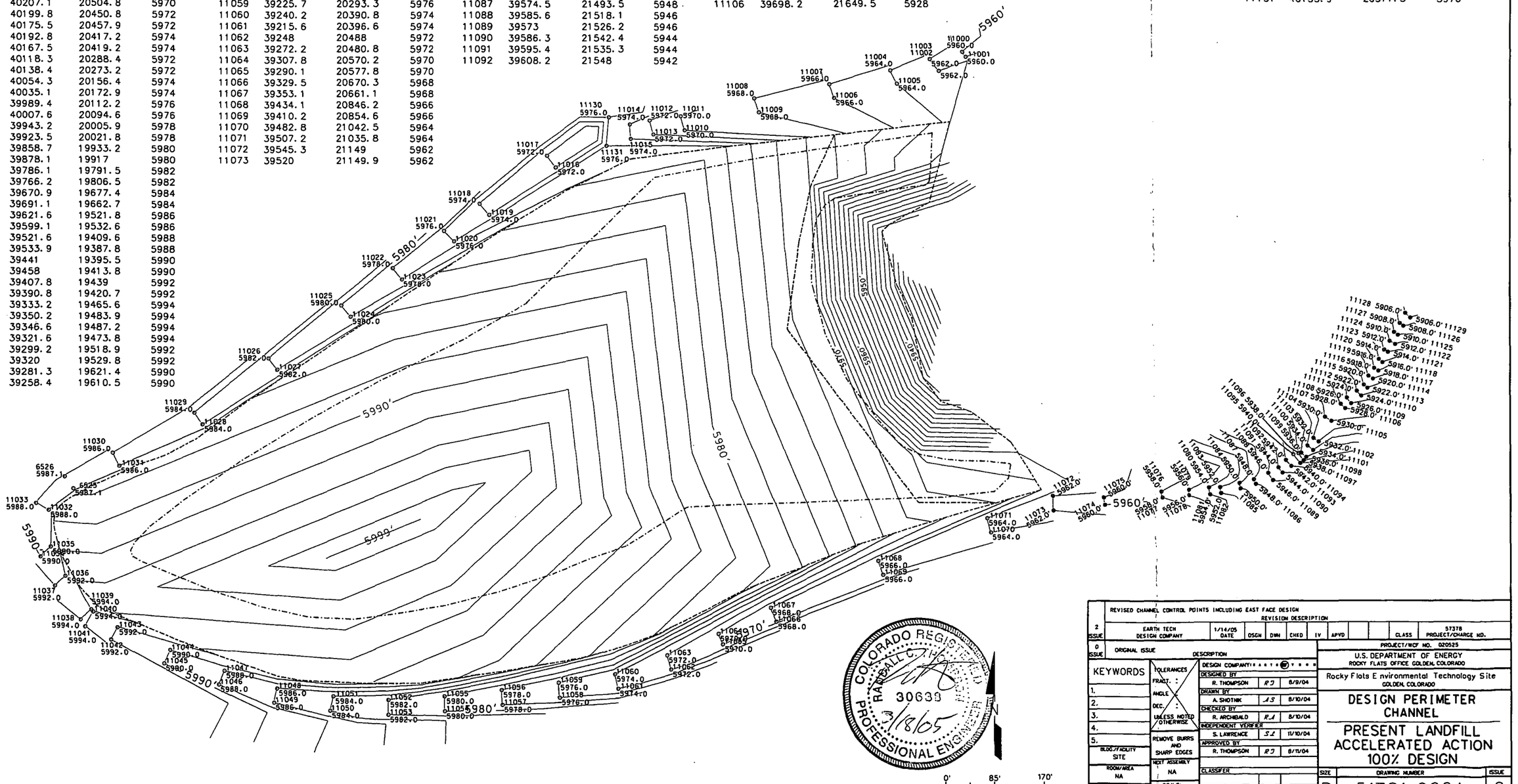
CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
11107	39705.6	21642	5928
11108	39716.6	21652.4	5926
11109	39706.6	21660.1	5926
11110	39720	21677.4	5924
11111	39728.6	21670.1	5924
11112	39739.3	21682.3	5922
11113	39733.8	21688.6	5922
11114	39749.7	21698.2	5920
11115	39754.8	21690.4	5920
11116	39768.3	21700.3	5918
11117	39763.6	21707.7	5918
11118	39778.3	21714.8	5916

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
11119	39784	21708.5	5916
11120	39799.9	21717.7	5914
11121	39795.7	21723.9	5914
11122	39809.7	21736.6	5912
11123	39814.9	21727.3	5912
11124	39830.4	21734.5	5910
11125	39825.7	21741.1	5910
11126	39841.3	21750.5	5908
11127	39845.9	21744.2	5908
11128	39863.9	21753.4	5906
11129	39855.6	21762.1	5906
11130	40205.7	20381	5976
11131	40155.9	20377.3	5976

QUAN.	DESCRIPTION	MATERIAL



COLORADO REGISTERED RANDALL C. THOMPSON 30639 PROFESSIONAL ENGINEER 3/18/05

ISSUE	DESCRIPTION	DATE	DSGN	DWN	CHKD	LV	APVD	CLASS	PROJECT/CHARGE NO.
2	REVISED CHANNEL CONTROL POINTS INCLUDING EAST FACE DESIGN	1/14/05							57378
0	ORIGINAL ISSUE								

EARTH TECH DESIGN COMPANY

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN PERIMETER CHANNEL
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

KEYWORDS
1.
2.
3.
4.
5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES: FRACT. ±, ANGLE ±, DEC. ±, UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH		
DESIGNED BY	R. THOMPSON	RT 8/9/04
DRAWN BY	A. SHOTNIK	AS 8/10/04
CHECKED BY	R. ARCHBALD	RA 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
APPROVED BY	R. THOMPSON	RT 8/11/04
CLASSIFER		
LANDLORD		

SIZE	DRAWING NUMBER	ISSUE
B	51781-006A	2

GROUP\CAD\...Y_FLATS\New Design_2004\Trench \TrnMod.dgn Date: 10-15-2004

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
12000	39353.5	19499.9	5994.1
12001	39312.4	19600	5992.9
12002	39273.2	19700	5991.8
12003	39239.3	19800	5991.2
12004	39227.5	19900	5991.1
12005	39225	20000	5989.5
12006	39230.8	20100	5988.2
12007	39245.2	20200	5987.2
12008	39261.8	20300	5985
12009	39285.5	20400	5983
12010	39326	20500	5981.4
12011	39374.6	20600	5980.2
12012	39417.3	20700	5978.6
12013	39457.9	20800	5974.3
12014	39489.3	20900	5970.3
12015	39518.9	21000	5968.9
12016	39547.7	21100	5967.1
12017	39555.9	21129.4	5966.6
12018	39639.4	21077.1	5959.6
12019	39691.6	21009.5	5946.9
12020	39710.4	20955.2	5942.5
12021	39752.3	20924.7	5940.0
12022	39855.9	20905.3	5934.6
12023	39873.6	20895.6	5935.1
12024	39894.4	20889.4	5934.6
12025	39912.4	20879.5	5935.1
12026	40006.1	20853.4	5940.6
12027	40017.8	20864.1	5942.0
12028	40056.8	20936.0	5946.1
12029	39533.6	21048.0	5968.0
12030	39534.6	20916.0	5968.8
12031	39836.5	20689.7	5972.6
12032	39988.4	20709.9	5971.0
12033	40086.4	20729.8	5969.4
12034	40175.0	20770.6	5968.0
12035	40075.5	20900	5963.1
12036	40080.9	20939	5962
12037	40099.8	20946	5962
12038	40197.1	20971.0	5963.2

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
12041	40189.2	20900	5964.9
12042	40172.7	20750	5968.3
12044	40155.6	20594.1	5975.5
12045	40132.6	20418.2	5976.9
12046	40123.5	20400	5977.1
12047	40100	20352.2	5977.7
12048	40073.3	20300	5978.3
12049	40011.2	20200	5979.9
12050	39945.4	20100	5981.7
12051	39876.9	20000	5983.6
12052	39800	19886.3	5984.8
12053	39741.4	19800	5985.7
12054	39700	19740.5	5986.3
12055	39670.2	19700	5986.8
12056	39648.6	19672	5987.2
12057	39612.9	19600.3	5987.4
12058	39600.4	19565.4	5987.3
12059	39570.7	19500.3	5987.4
12060	39549.8	19459.9	5988
12061	39529.2	19429.2	5988.9
12062	39499.9	19418.7	5990.1
12063	39449.9	19430.2	5992.2
12064	39400	19457.8	5994
12065	39382.2	19467.6	5994

5965.1

SEE DETAIL 1 DRAWING 13B FOR ANCHOR TRENCH - GDN TRANSITION DETAILS (1 / 6B | 13B)

SEE DETAIL 1 DRAWING 13B FOR ANCHOR TRENCH - GDN TRANSITION DETAILS (1 / 6B | 13B)

THIS AREA IS PENDING FINAL EAST FACE DESIGN

QUAN.	DESCRIPTION	MATERIAL

ISSUE	REVISION DESCRIPTION						
1	REVISED ANCHOR TRENCH CONTROL POINTS INCLUDING EAST FACE DESIGN						
	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD
0	ORIGINAL ISSUE						

CLASS: 57378 PROJECT/CHARGE NO.

DESCRIPTION

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH
DESIGNED BY: R. ARCHIBALD RA
DRAWN BY: A. SHOTNIK AS
CHECKED BY: R. THOMPSON RT
INDEPENDENT VERIFIER: S. LAWRENCE SL
APPROVED BY: R. THOMPSON RT
CLASSIFIER
LANDLORD

ANCHOR TRENCH TOP OF REGRADED SURFACE
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-006B	1

COLORADO REGISTERED RANDALL C. THOMPSON 30639 PROFESSIONAL ENGINEER 1/18/05

N

0' 60 120'

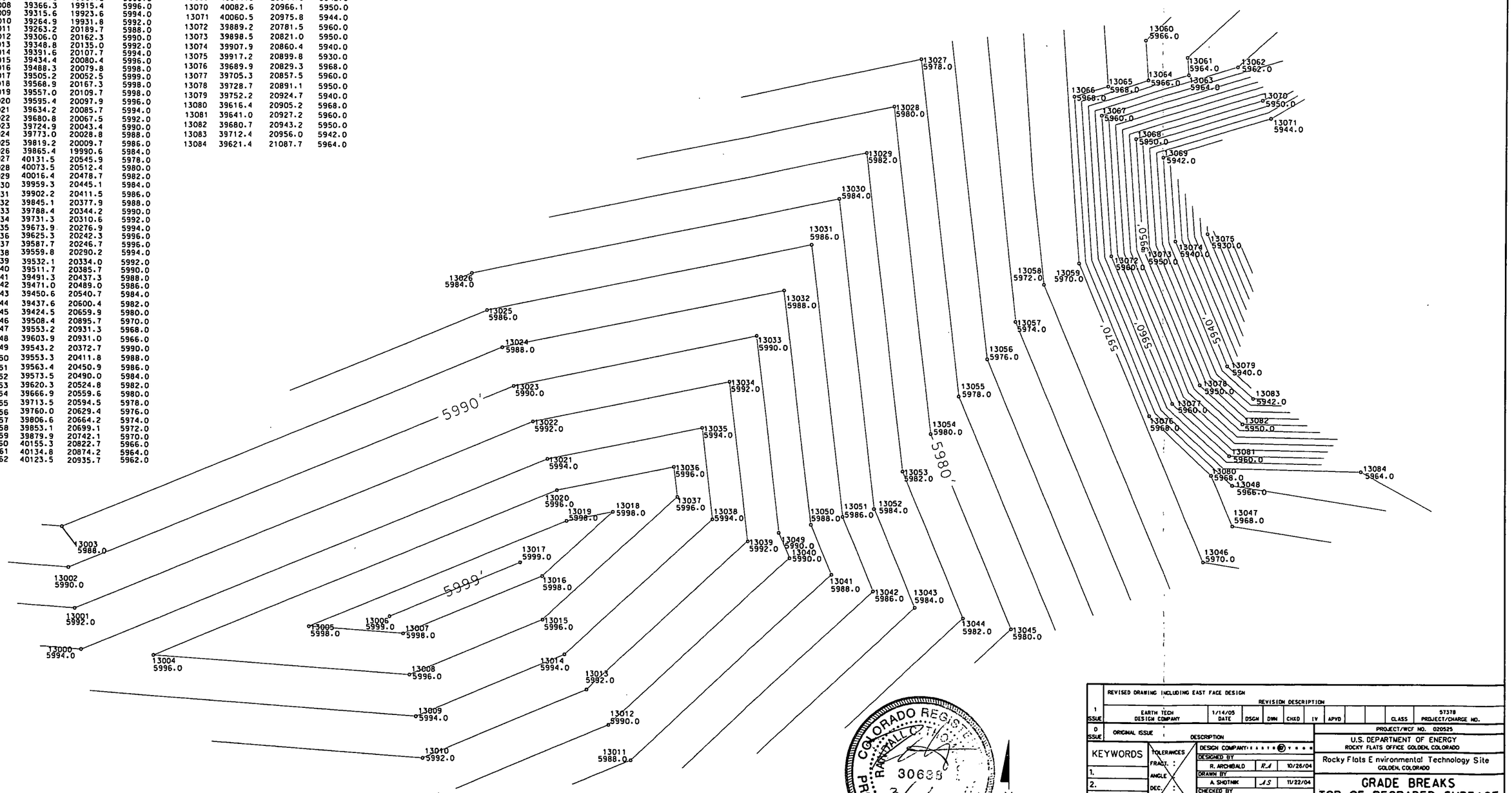
GROUP\CAD\ROCKY_FLATS\New Design2004\Anchor_Trnch\Cntripts.dgn Date: 10-2004

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
13000	39395.7	19508.9	5994.0
13001	39446.4	19500.7	5992.0
13002	39497.1	19492.5	5990.0
13003	39547.8	19484.3	5988.0
13004	39389.2	19598.7	5996.0
13005	39425.4	19791.1	5998.0
13006	39438.3	19890.5	5999.0
13007	39411.0	19907.2	5998.0
13008	39366.3	19915.4	5996.0
13009	39315.6	19923.6	5994.0
13010	39264.9	19931.8	5992.0
13011	39263.2	20189.7	5988.0
13012	39306.0	20162.3	5990.0
13013	39348.8	20135.0	5992.0
13014	39391.6	20107.7	5994.0
13015	39434.4	20080.4	5996.0
13016	39488.3	20079.8	5998.0
13017	39505.2	20052.5	5999.0
13018	39568.9	20167.3	5998.0
13019	39557.0	20109.7	5998.0
13020	39595.4	20097.9	5996.0
13021	39634.2	20085.7	5994.0
13022	39680.8	20067.5	5992.0
13023	39724.9	20043.4	5990.0
13024	39773.0	20028.8	5988.0
13025	39819.2	20009.7	5986.0
13026	39865.4	19990.6	5984.0
13027	40131.5	20545.9	5978.0
13028	40073.5	20512.4	5980.0
13029	40016.4	20478.7	5982.0
13030	39959.3	20445.1	5984.0
13031	39902.2	20411.5	5986.0
13032	39845.1	20377.9	5988.0
13033	39788.4	20344.2	5990.0
13034	39731.3	20310.6	5992.0
13035	39673.9	20276.9	5994.0
13036	39625.3	20242.3	5996.0
13037	39587.7	20246.7	5996.0
13038	39559.8	20290.2	5994.0
13039	39532.1	20334.0	5992.0
13040	39511.7	20385.7	5990.0
13041	39491.3	20437.3	5988.0
13042	39471.0	20489.0	5986.0
13043	39450.6	20540.7	5984.0
13044	39437.6	20600.4	5982.0
13045	39424.5	20659.9	5980.0
13046	39508.4	20895.7	5970.0
13047	39553.2	20931.3	5968.0
13048	39603.9	20931.0	5966.0
13049	39543.2	20372.7	5990.0
13050	39553.3	20411.8	5988.0
13051	39563.4	20450.9	5986.0
13052	39573.5	20490.0	5984.0
13053	39620.3	20524.8	5982.0
13054	39666.9	20559.6	5980.0
13055	39713.5	20594.5	5978.0
13056	39760.0	20629.4	5976.0
13057	39806.6	20664.2	5974.0
13058	39853.1	20699.1	5972.0
13059	39879.9	20742.1	5970.0
13060	40155.3	20822.7	5966.0
13061	40134.8	20874.2	5964.0
13062	40123.5	20935.7	5962.0

CONSTRUCTION CONTROL POINTS

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
13063	40113.4	20875.8	5964.0
13064	40106.5	20826.1	5966.0
13065	40099.6	20776.5	5968.0
13066	40086.9	20735.3	5968.0
13067	40063.8	20769.0	5960.0
13068	40035.0	20811.2	5950.0
13069	40011.9	20844.9	5942.0
13070	40082.6	20966.1	5950.0
13071	40060.5	20975.8	5944.0
13072	39889.2	20781.5	5960.0
13073	39898.5	20821.0	5950.0
13074	39907.9	20860.4	5940.0
13075	39917.2	20899.8	5930.0
13076	39689.9	20829.3	5968.0
13077	39705.3	20857.5	5960.0
13078	39728.7	20891.1	5950.0
13079	39752.2	20924.7	5940.0
13080	39616.4	20905.2	5968.0
13081	39641.0	20927.2	5960.0
13082	39680.7	20943.2	5950.0
13083	39712.4	20956.0	5942.0
13084	39621.4	21087.7	5964.0



QUAN.	DESCRIPTION	MATERIAL

COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDALL C. THOMPSON
30639
3/18/05

N

0' 60 120'

	REVISION DESCRIPTION							
1 ISSUE	REVISED DRAWING INCLUDING EAST FACE DESIGN							
	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD	CLASS 57378 PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE							

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

GRADE BREAKS TOP OF REGRADED SURFACE PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

KEYWORDS	
1.	
2.	
3.	
4.	
5.	
BLDG./FACILITY	SITE
ROOM/AREA	NA
GRID COORD/COL NO.	NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY
NA

SCALE:
AS SHOWN

DESIGN COMPANY: EARTH TECH		
DESIGNED BY		
R. ARCHIBALD	RA	10/26/04
DRAWN BY		
A. SHOTNIK	AS	11/22/04
CHECKED BY		
R. THOMPSON	RT	11/22/04
INDEPENDENT VERIFIER		
S. LAWRENCE	SL	12/8/04
APPROVED BY		
R. THOMPSON	RT	12/8/04
CLASSIFER		
LANDLORD		

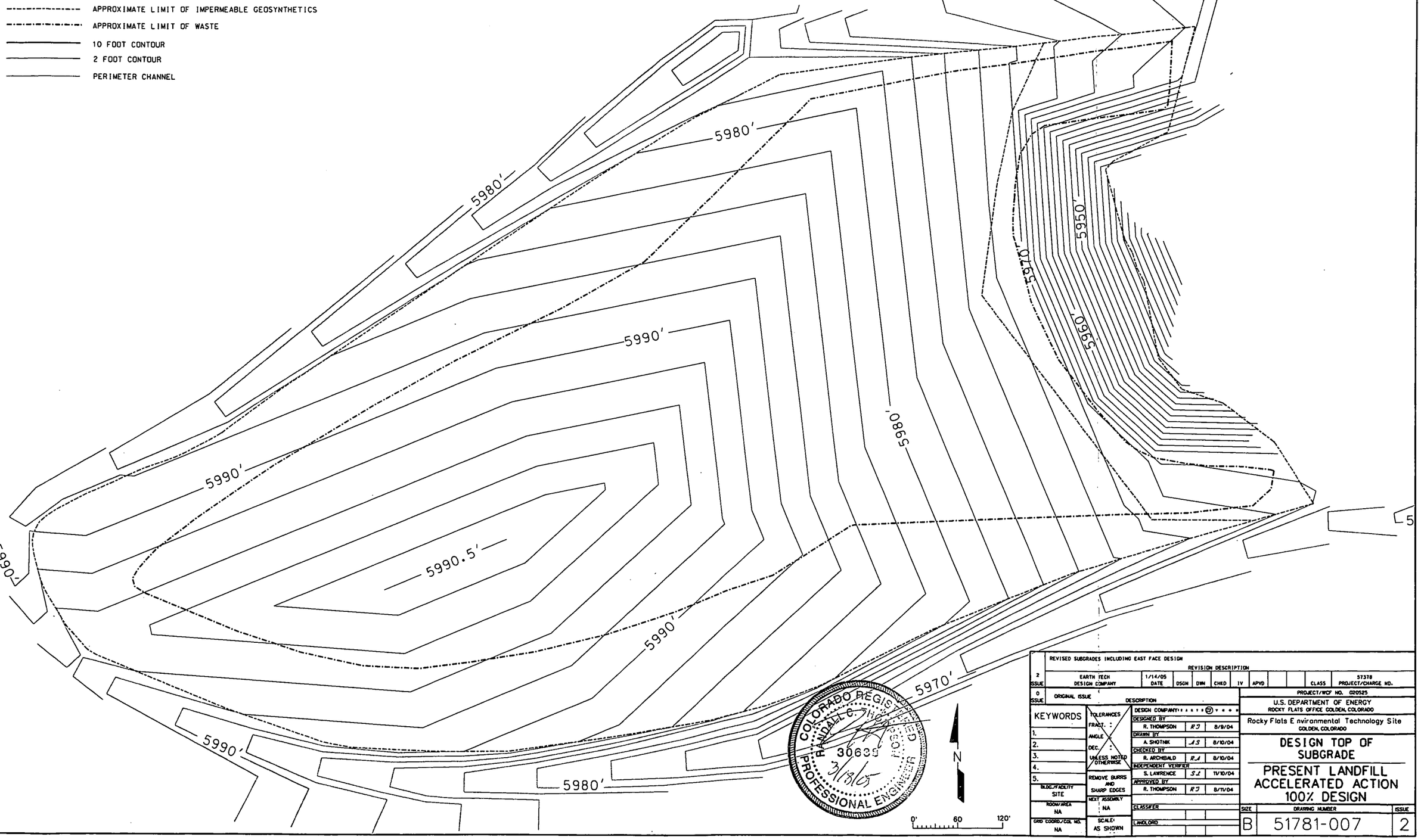
SIZE	DRAWING NUMBER	ISSUE
B	51781-006C	1

GROUP\CAD\ROCKY_FLATS\New Design2004\RG_Brkline\RGBrkLns.dgn Date: 10-2004

QUAN.	DESCRIPTION	MATERIAL

LEGEND

- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- 10 FOOT CONTOUR
- 2 FOOT CONTOUR
- PERIMETER CHANNEL



COLORADO REGISTERED
RANDALL C. THOMPSON
30639
PROFESSIONAL ENGINEER
3/18/05

	REVISION DESCRIPTION								
2 ISSUE	REVISED SUBGRADES INCLUDING EAST FACE DESIGN								
0 ISSUE	ORIGINAL ISSUE								
	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	57378 PROJECT/CHARGE NO.

KEYWORDS	TOLERANCES	DESCRIPTION		
1.	FRACT. :	DESIGN COMPANY		
2.	ANGLE	DESIGNED BY	R. THOMPSON	RJ 8/9/04
3.	DEC. :	DRAWN BY	A. SHOTNIK	AS 8/10/04
4.	UNLESS NOTED OTHERWISE	CHECKED BY	R. ARCHIBALD	RA 8/10/04
5.		INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
BLDG./FACILITY SITE	REMOVE BURRS AND SHARP EDGES	APPROVED BY	R. THOMPSON	RJ 8/11/04
ROOM/AREA NA	NEXT ASSEMBLY NA	CLASSIFIER		
GRID COORD./COL NOS. NA	SCALE: AS SHOWN	LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN TOP OF SUBGRADE
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-007	2

GROUP\CAD_FLATS\New Design2004\SubGrd_100%\up61122.dgn Date: 11-2004

LEGEND

- 10 FOOT CONTOURS
- 2 FOOT CONTOURS
- EXISTING TOPOGRAPHY, MAJOR CONTOURS
- EXISTING TOPOGRAPHY, MINOR CONTOURS
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- TOP ANCHOR TRENCH/DIVERSION BERM FLOW LINE
- PERIMETER CHANNEL CONTOUR
- GRAVEL ROAD

QUAN.	DESCRIPTION	MATERIAL

TIE FINAL COVER GRADES TO EXISTING GRADES AT A 4:1 SLOPE

5960'
5970'
5980'
5990'
6000'
5950'
5990'
6000'
6000'
5990'
5980'
5970'
5990'
5970'

COLORADO REGISTERED PROFESSIONAL ENGINEER 30623 3/18/05

0 60 120'

N

	REVISION DESCRIPTION								
1 ISSUE	REVISED REGRADES INCLUDING EAST FACE DESIGN								
	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DRN	CHKD	LV	APVD	CLASS	57378 PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE								

DESCRIPTION

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY SITE

ROOM/AREA NA

GRID COORD./COL NO. NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY NA

SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH

DESIGNED BY		
R. THOMPSON	RJT	8/9/04
DRAWN BY		
A. SHOTNIK	AS	8/10/04
CHECKED BY		
R. ARCHIBALD	RJA	8/10/04
INDEPENDENT VERIFIER		
S. LAWRENCE	SL	11/10/04
APPROVED BY		
R. THOMPSON	RJT	8/11/04

CLASSIFIER

LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

DESIGN TOP OF FINAL COVER
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-008	1

GROUP\CAD\...Y_FLATS\New Design2004\FinalCover\finalgrd.dgn Date: 1-2005

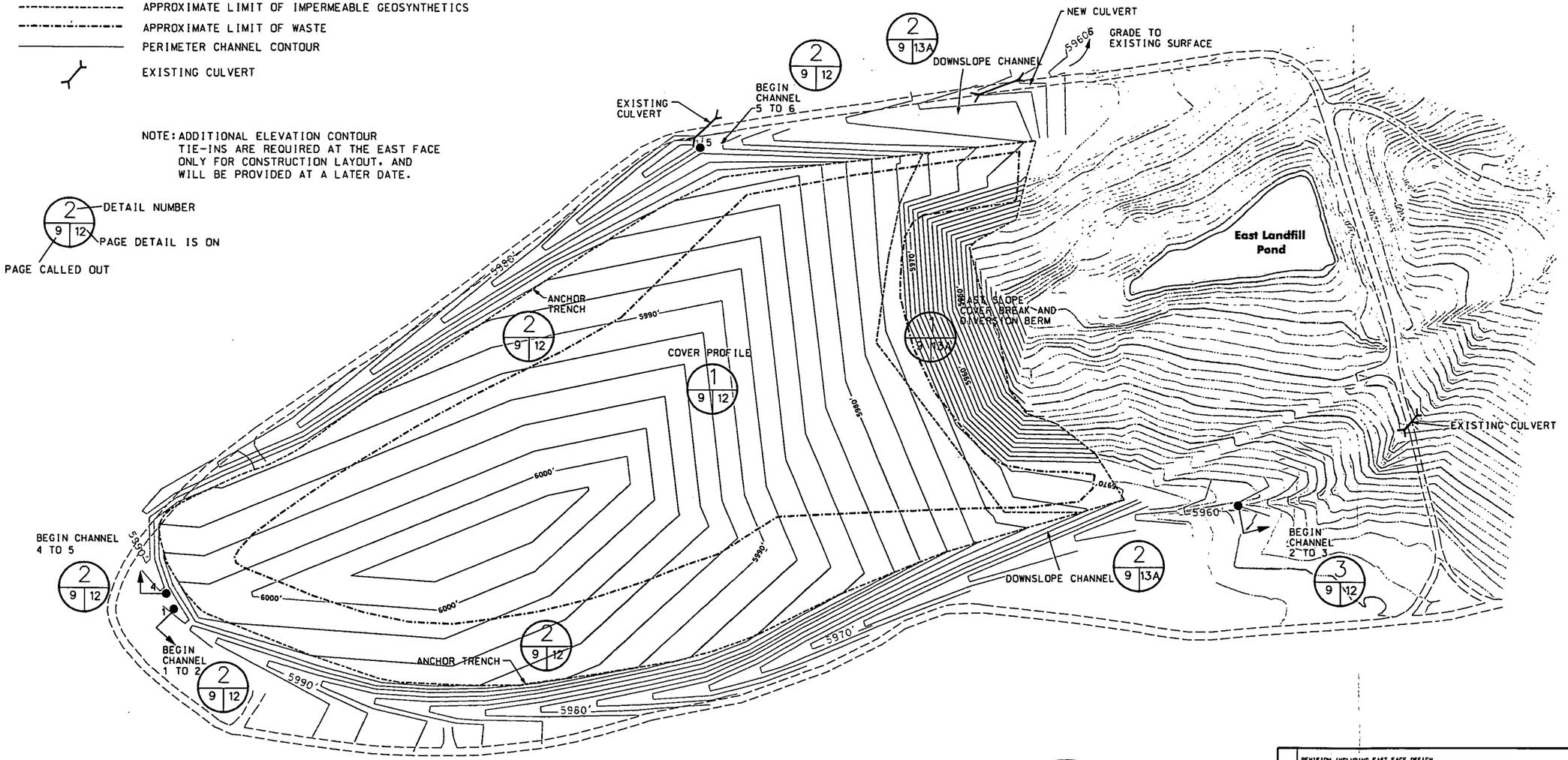
QUAN.	DESCRIPTION	MATERIAL

LEGEND

- 10 FOOT CONTOURS
- 2 FOOT CONTOURS
- EXISTING TOPOGRAPHY, MAJOR CONTOURS
- EXISTING TOPOGRAPHY, MINOR CONTOURS
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- PERIMETER CHANNEL CONTOUR
- EXISTING CULVERT

NOTE: ADDITIONAL ELEVATION CONTOUR TIE-INS ARE REQUIRED AT THE EAST FACE ONLY FOR CONSTRUCTION LAYOUT, AND WILL BE PROVIDED AT A LATER DATE.

2 — DETAIL NUMBER
9 | 12 — PAGE DETAIL IS ON
PAGE CALLED OUT



COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDALL C. THOMPSON
30633
3/8/05

N

0' 100 200'

ISSUE	REVISION INCLUDING EAST FACE DESIGN									
1	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE	DESCRIPTION								

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

KEYWORDS
1.
2.
3.
4.
5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES: FRACT. : ANGLE : DEC. : UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY		
DESIGNED BY: R. ARCHIBALD	RA	8/9/04
DRAWN BY: A. SHOTNIK	AS	8/10/04
CHECKED BY: R. THOMPSON	RJ	8/10/04
INDEPENDENT VERIFIER: S. LAWRENCE	SL	11/10/04
APPROVED BY: R. THOMPSON	RJ	8/11/04
CLASSIFIER		
LANDLORD		

SURFACE WATER MANAGEMENT PLAN
PRESENT LANDFILL CLOSURE PROJECT 95% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-009	1

GROUP\CAD\ROCKY_FLATS\New Design_2004\SURfWtr\SURFWT100.dgn Date: 1-2005

LEGEND

- PROPOSED GAS EXTRACTION VENTILATOR
- PROPOSED HEADER ACCESS RISER
- PROPOSED GAS EXTRACTION TRENCH
- 5920' EXISTING CONTOURS
- 5980' PROPOSED FINAL GRADES
- EXISTING GRAVEL ROAD
- APPROXIMATE LIMIT OF IMPERMEABLE GEOSYNTHETICS
- APPROXIMATE LIMIT OF WASTE
- THIS AREA IS PENDING FINAL EAST FACE DESIGN

CONTROL POINTS

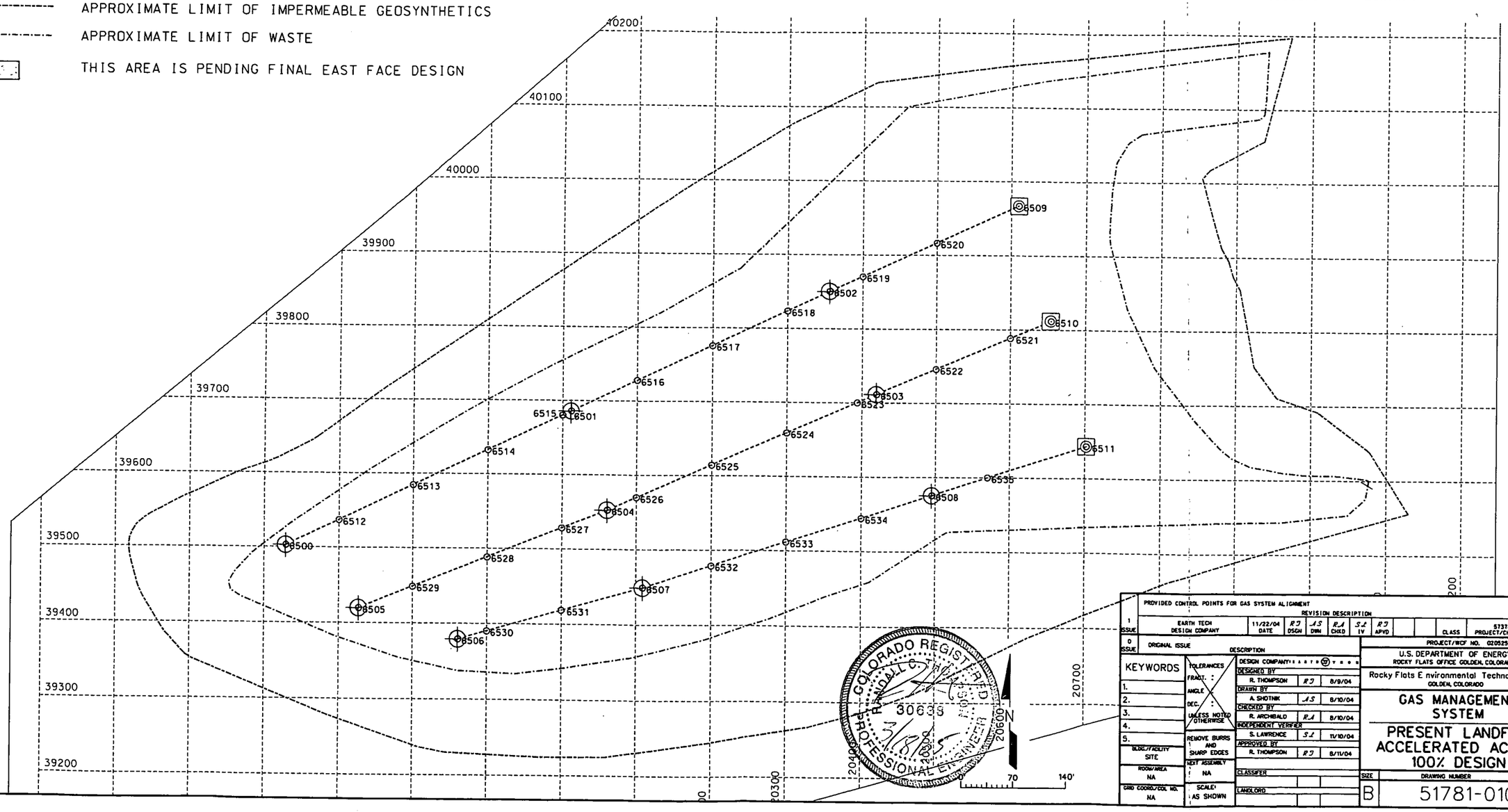
POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
6500	39502.6	19629.1	
6501	39685.6	20011.8	
6502	39850.3	20356.0	
6503	39711.3	20419.7	
6504	39552.6	20061.1	
6505	39419.3	19727.0	
6506	39379.1	19861.1	
6507	39449.3	20109.0	
6508	39575.4	20495.3	
6509	39966.9	20610.4	
6510	39811.9	20653.9	
6511	39643.0	20702.1	

TRENCH CONTROL POINTS 100ft Grid

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
6512	39536.5	19700.0	
6513	39584.3	19800.0	
6514	39632.1	19900.0	
6515	39679.9	20000.0	
6516	39727.8	20100.0	
6517	39775.6	20200.0	
6518	39823.4	20300.0	
6519	39870.4	20400.0	
6520	39916.2	20500.0	
6521	39788.3	20600.0	
6522	39745.7	20500.0	
6523	39700.0	20393.8	

TRENCH CONTROL POINTS 100ft Grid

POINT NUMBER	NORTH COORDINATE	EAST COORDINATE	DESIGN ELEVATION
6524	39658.4	20300.0	
6525	39614.0	20200.0	
6526	39569.7	20100.0	
6527	39528.1	20000.0	
6528	39488.3	19900.0	
6529	39448.5	19800.0	
6530	39390.1	19900.0	
6531	39418.4	20000.0	
6532	39479.0	20200.0	
6533	39511.6	20300.0	
6534	39544.3	20400.0	
6535	39600.0	20570.4	



QUAN.	DESCRIPTION	MATERIAL

PROVIDED CONTROL POINTS FOR GAS SYSTEM ALIGNMENT

REVISION DESCRIPTION

ISSUE	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
1	EARTH TECH	11/22/04	RJ	AS	RA	SL	RJ		57378
0	ORIGINAL ISSUE								

DESCRIPTION

KEYWORDS: 1. 2. 3. 4. 5.

TOLERANCES: FRACT. : ANGLE : DEC. : UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

BLDG./FACILITY: SITE

ROOM/AREA: NA

GRID COORD./COL NO.: NA

SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH

DESIGNED BY	R. THOMPSON	RJ 8/9/04
DRAWN BY	A. SHOTNIK	AS 8/10/04
CHECKED BY	R. ARCHIBALD	RA 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
APPROVED BY	R. THOMPSON	RJ 8/11/04

CLASSIFIER

LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

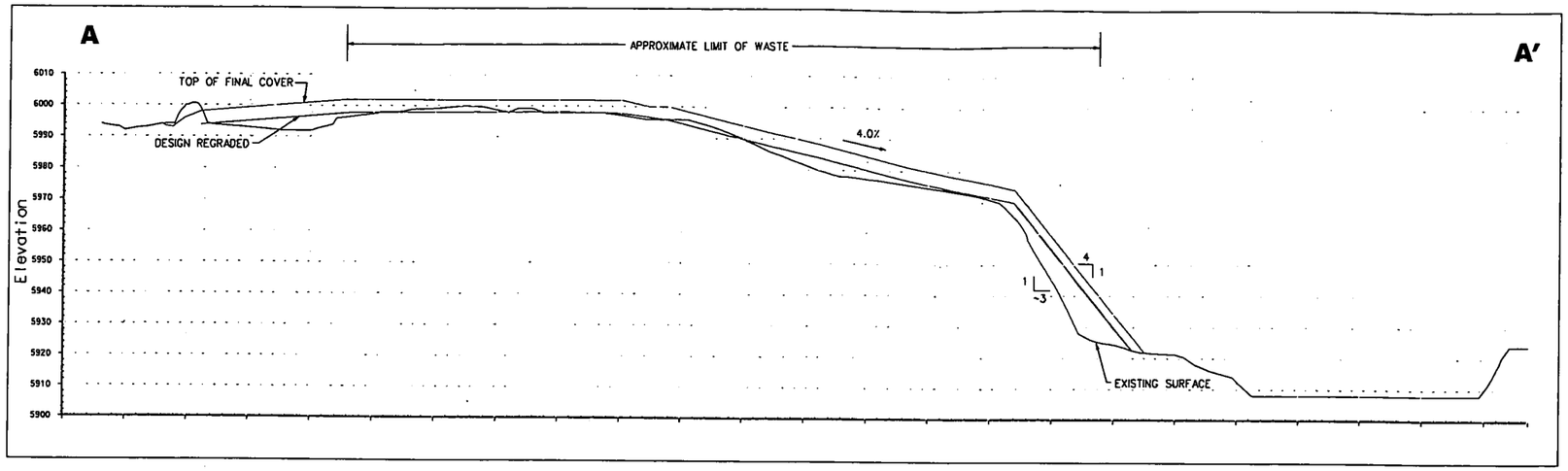
GAS MANAGEMENT SYSTEM

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-010	1

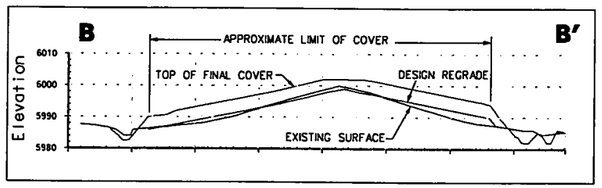
GROUP\CA[illegible]CKY_FLATS\New Design2004\GASMGNT\GASMG100.dgn Date: 10-2004

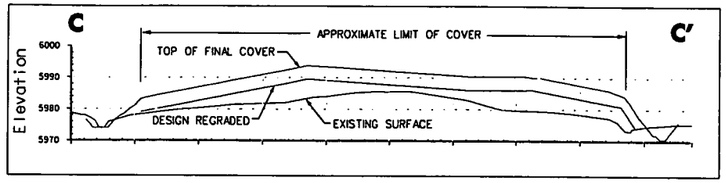
QUAN.	DESCRIPTION	MATERIAL

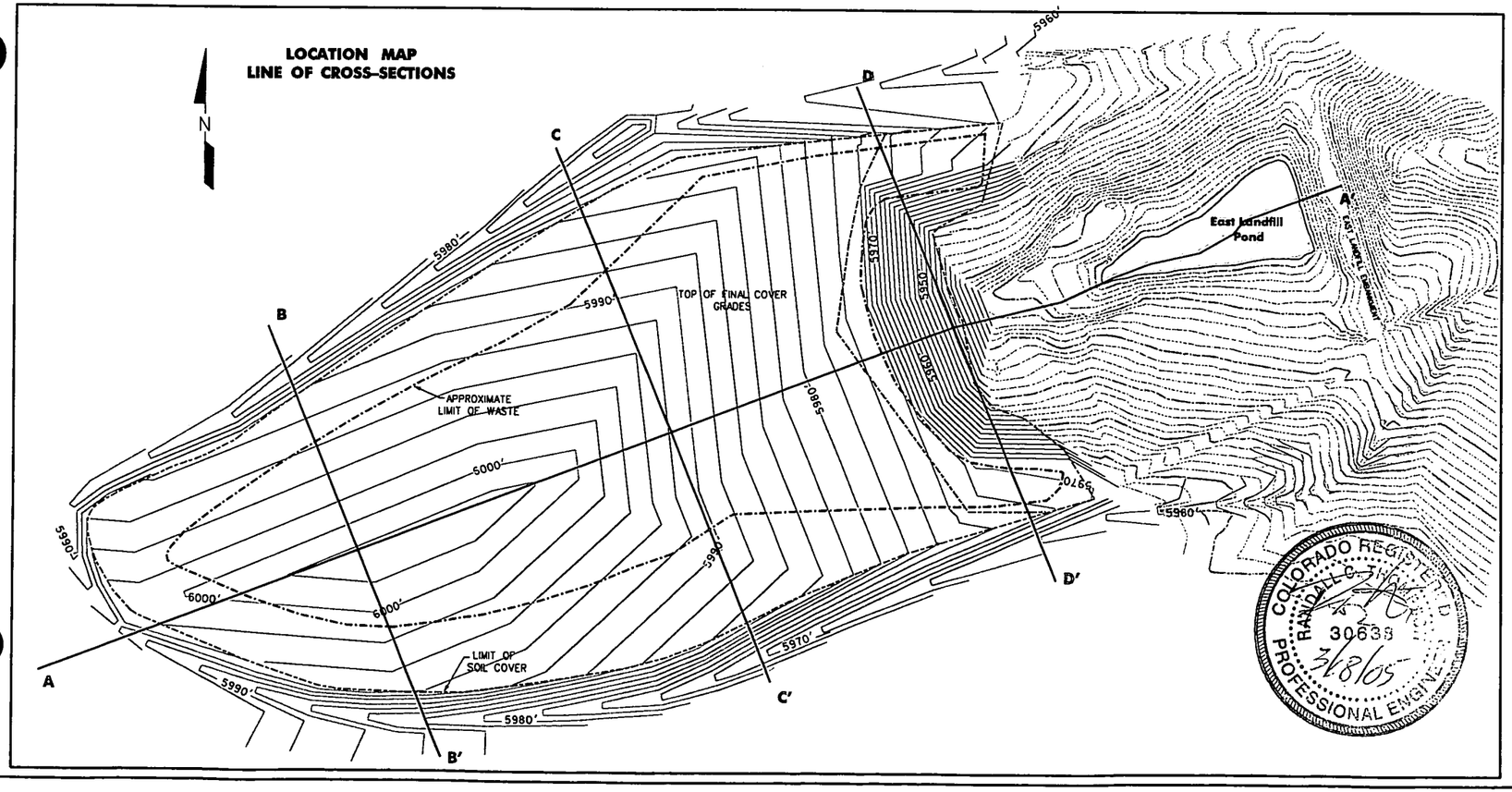


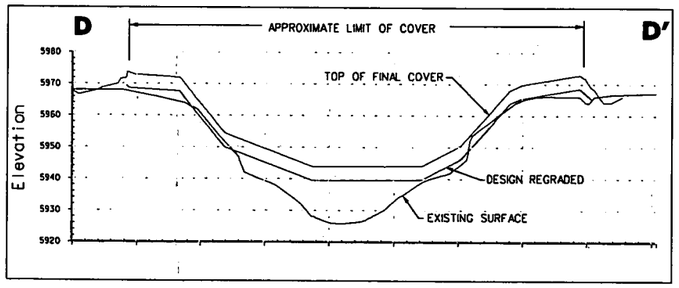
LEGEND

	EXISTING SURFACE
	TOP OF SURFACE
	DESIGN REGRADE
Scaled 5.00 Times Ver. Scaled 1.00 Times Hor.	









COLORADO REGISTERED
RANDALL C. [illegible]
30638
5/18/05
PROFESSIONAL ENGINEER

	REVISION DESCRIPTION								
1 ISSUE	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DRN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE								

DESCRIPTION

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY: SITE
ROOM/AREA: NA
GRID COORD./COL NO.: NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: E A R T H T E C H		
DESIGNED BY	R. THOMPSON	RT 8/9/04
DRAWN BY	A. SHOTNIK	AS 8/10/04
CHECKED BY	R. ARCHIBALD	RA 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
APPROVED BY	R. THOMPSON	RT 8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

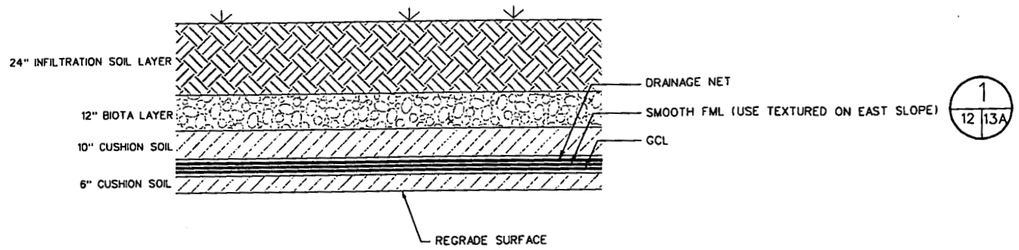
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

LANDFILL CROSS SECTIONS

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

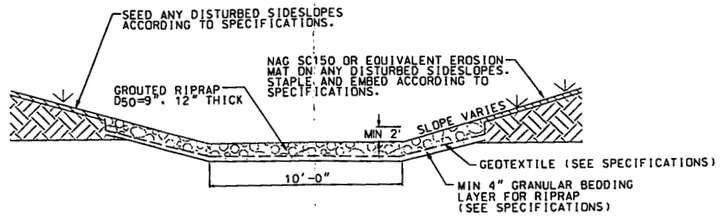
SIZE	DRAWING NUMBER	ISSUE
B	51781-011	1



1 / 12 | 13A

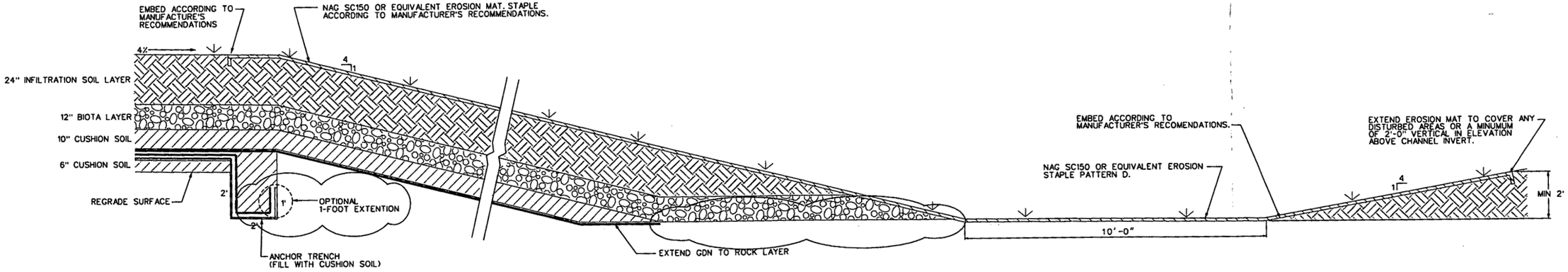
GEOSYNTHETIC COMPOSITE FINAL COVER 1 / 9 | 12

NTS



RIPRAP LINED CHANNEL DETAIL 3 / 9 | 12

NTS



ANCHOR TRENCH * 2 / 9 | 12

NTS

* NOTE: IF WASTE IS ENCOUNTERED DURING THE EXCAVATION OF THE ANCHOR TRENCH, WASTE MATERIAL WILL BE OVER EXCAVATED AN ADDITIONAL 1-FOOT. OVER EXCAVATIONS WILL BE FILLED WITH CUSHION LAYER SOIL TO THE DESIGN DIMENSIONS OF ANCHOR TRENCH.

QUAN	DESCRIPTION	MATERIAL

COLORADO REGISTERED RANDALL C. ARCHIBALD 30609 PROFESSIONAL ENGINEER 3/2/05

ISSUE	REVISION DESCRIPTION							
1	REVISED GDN EXTENTION AND ANCHOR TRENCH TERMINATION							
0	ORIGINAL ISSUE	EARTH TECH DESIGN COMPANY	11/16/04 DATE	RJ DSGN	AS DRN	RJ CHKD	SJ IV	RJ APVD	CLASS	57378 PROJECT/CHARGE NO.

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

LANDFILL COVER AND SURFACE WATER DETAIL
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

KEYWORDS

1.
2.
3.
4.
5.
BLDG/FACILITY SITE
ROOM/AREA NA
GRID COORD/COL NO. NA

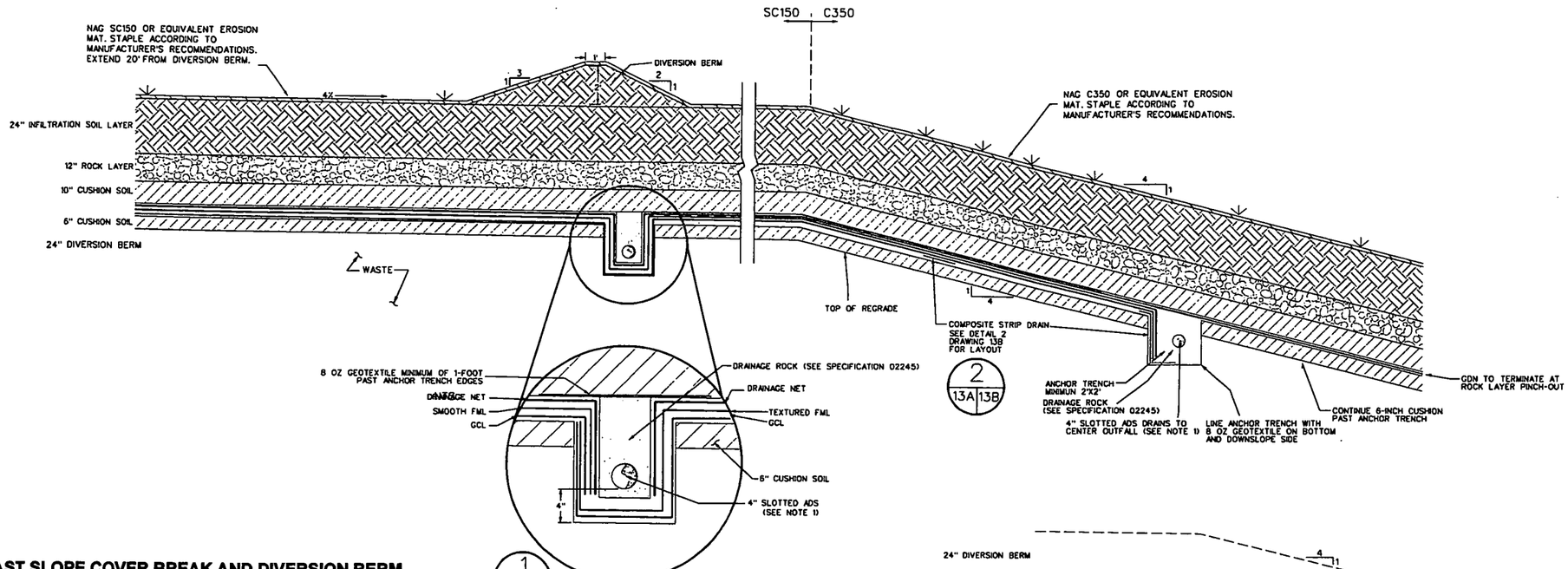
TOLERANCES FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY NA
SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH		
DESIGNED BY		
R. ARCHIBALD	RJ	8/9/04
DRAWN BY		
A. SHOTNK	AS	8/10/04
CHECKED BY		
R. THOMPSON	RT	8/10/04
INDEPENDENT VERIFIER		
S. LAWRENCE	SJ	11/10/04
APPROVED BY		
R. THOMPSON	RT	8/11/04
CLASSIFIER		
LANDLORD		

SIZE	DRAWING NUMBER	ISSUE
B	51781-012	1

L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2004 \DETAILS\LNDFILLCVR.DGN 1/23/04

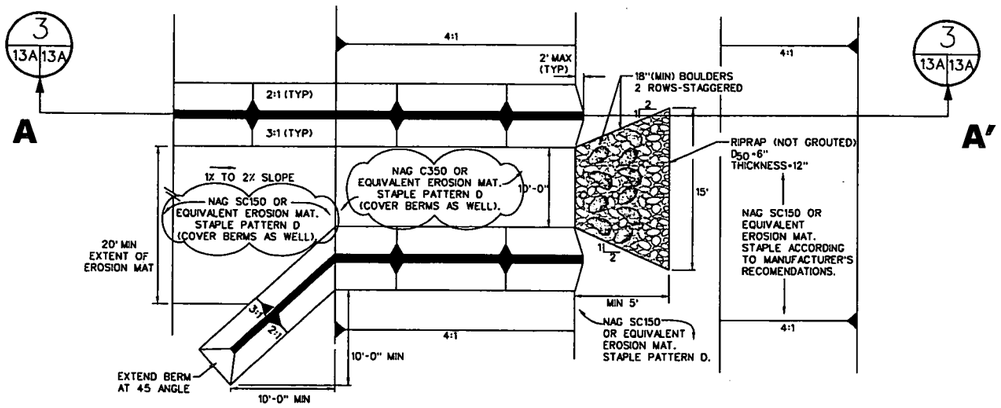
	QUAN.	DESCRIPTION	MATERIAL



EAST SLOPE COVER BREAK AND DIVERSION BERM

1
9 13A

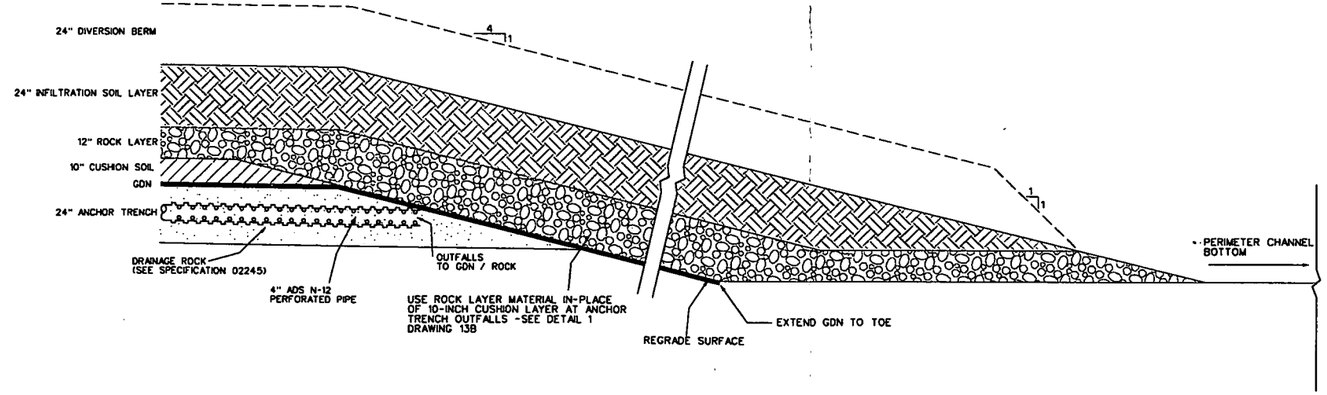
NOTE: IF WASTE IS ENCOUNTERED DURING THE EXCAVATION OF THE ANCHOR TRENCH, WASTE MATERIAL WILL BE OVER EXCAVATED AN ADDITIONAL 1-FOOT. OVER EXCAVATIONS WILL BE FILLED WITH CUSHION LAYER SOIL TO THE DESIGN DIMENSIONS OF ANCHOR TRENCH.



DOWNSLOPE CHANNEL TRANSITION FROM EAST SLOPE BERM TO PERIMETER CHANNEL

2
9 13A

NTS



CROSS-SECTION A - A'

3
13A 13A

NTS

NOTES:

1. ADS PIPE MEET THE FOLLOWING SPECIFICATIONS:
   4.0"I.D.
   4.72" O.D.
   0.40 LBS/FT
   SLOTTED PERFORATIONS (3 AT 120)
   SLOT LENGTH = 0.875"
   SLOT WIDTH = 0.125"

COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDALL C. THOMPSON
30635
3/8/05

ISSUE		DESCRIPTION								
2	REVISED INCLUDING NEW EAST FACE DESIGN									
1	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	57378 PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

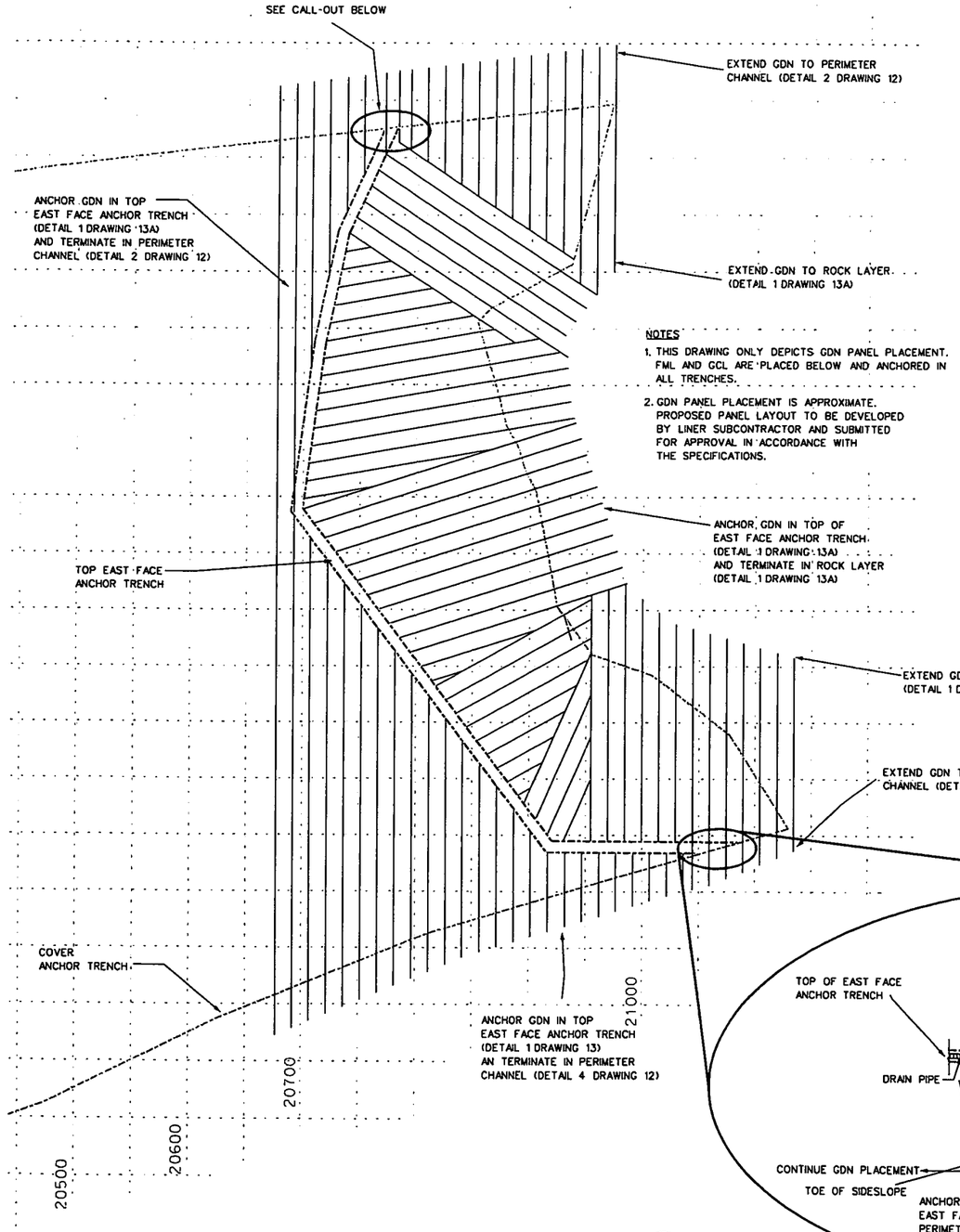
LANDFILL COVER DETAILS EAST FACE

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

KEYWORDS	TOLERANCES	DESIGN COMPANY: EARTH TECH
1.	FRACT.	DESIGNED BY: R. ARCHIBALD RA 8/9/04
2.	ANGLE	DRAWN BY: A. SHOTNIK AS 8/10/04
3.	DEC.	CHECKED BY: R. THOMPSON RT 8/10/04
4.	UNLESS NOTED OTHERWISE	INDEPENDENT VERIFIER: S. LAWRENCE SL 11/10/04
5.	REMOVE BURRS AND SHARP EDGES	APPROVED BY: R. THOMPSON RT 8/11/04
BLDG./FACILITY SITE	NEXT ASSEMBLY NA	CLASSIFER
ROOM/AREA NA		
GRID COORD/COL NO. NA	SCALE: AS SHOWN	LANDLORD

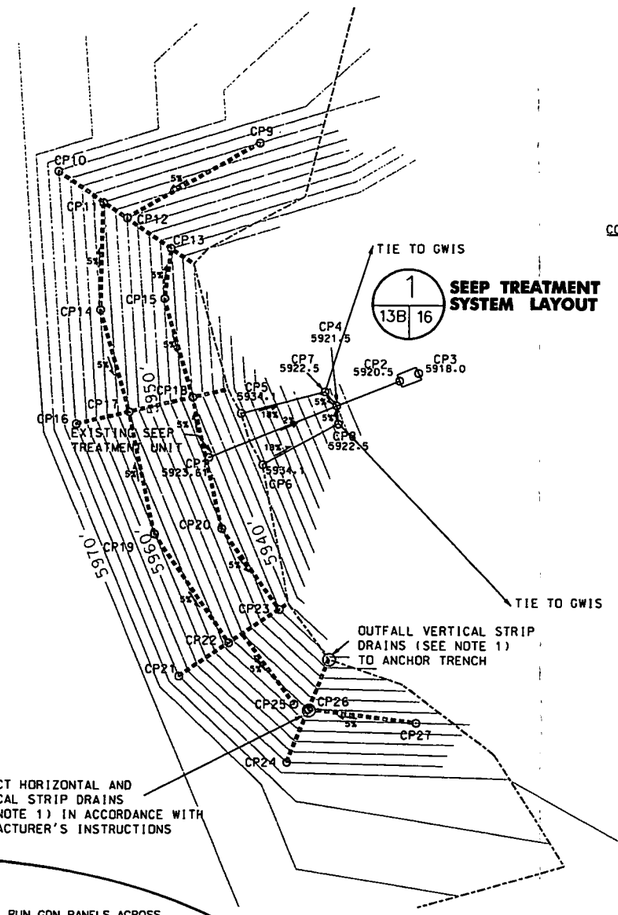
SIZE	DRAWING NUMBER	ISSUE
B	51781-013A	2

L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2004 \DETAILS\LNDFILLCVR.DGN 1/23/04



ANCHOR TRENCH - GDN PLACEMENT

1 / 6B | 13B



CONTROL POINT	DESCRIPTION	NORTHING	EASTING
CP1	EXISTING UNIT TIE-IN	39861.2	20865.3
CP2	TREATMENT UNIT INLET	39919.5	21006.3
CP3	TREATMENT UNIT OUTLET	39925.2	21020.1
CP4	SEEP MANHOLE OUTLET	39900.6	20960.0
CP5	ANCHOR TRENCH OUTLET	39894.4	20889.4
CP6	ANCHOR TRENCH OUTLET	39856.1	20905.4
CP7	MANHOLE INLET	39911.0	20951.5
CP8	MANHOLE INLET	39886.8	20961.6
CP9	BEGIN STRIP DRAIN	40096.2	20902.1
CP10	BEGIN STRIP DRAIN	40074.9	20751.9
CP11	END STRIP DRAIN	40051.8	20785.6
CP12	END STRIP DRAIN	40040.7	20802.8
CP13	END STRIP DRAIN	40017.6	20836.5
CP14	BEGIN STRIP DRAIN	39971.9	20784.1
CP15	BEGIN STRIP DRAIN	39980.2	20831.7
CP16	BEGIN STRIP DRAIN	39885.5	20765.8
CP17	END STRIP DRAIN	39894.8	20805.2
CP18	END STRIP DRAIN	39906.2	20853.2
CP19	BEGIN STRIP DRAIN	39804.1	20824.9
CP20	BEGIN STRIP DRAIN	39808.1	20874.8
CP21	BEGIN STRIP DRAIN	39697.5	20843.5
CP22	END STRIP DRAIN	39722.7	20880.7
CP23	END STRIP DRAIN	39747.8	20917.8
CP24	BEGIN STRIP DRAIN	39633.1	20924.0
CP25	BEGIN STRIP DRAIN	39676.7	20929.3
CP26	END STRIP DRAIN	39672.8	20940.0
CP27	BEGIN STRIP DRAIN	39662.9	21019.4

NOTES
USE AMERICAN WICK DRAIN CORPORATION'S 12-INCH AKWADRAIN SOIL STRIP DRAINS OR EQUIVALENT. ANCHOR TO SOIL WITH EROSION MAT STAPLES OR NAIL AFFIXED WITH A WASHER TO PREVENT BREAKTHROUGH.

SEEP CAPTURE

2 / 13A | 13B

QUAN.	DESCRIPTION	MATERIAL

COLORADO REGISTERED R. A. THOMPSON 30698 PROFESSIONAL ENGINEER 1/18/05

ISSUE	REVISION DESCRIPTION									
	EARTH TECH DESIGN COMPANY	DATE	DSGN	DRN	CHKD	IV	APVD		CLASS	5737B PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

KEYWORDS
1.
2.
3.
4.
5.
BLDG./FACILITY SITE
NA
ROOM/AREA
NA
GRID COORD/COL NO.
NA

TOLERANCES
FRACT.
ANGLE
DEC.
UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY
NA
SCALE:
AS SHOWN

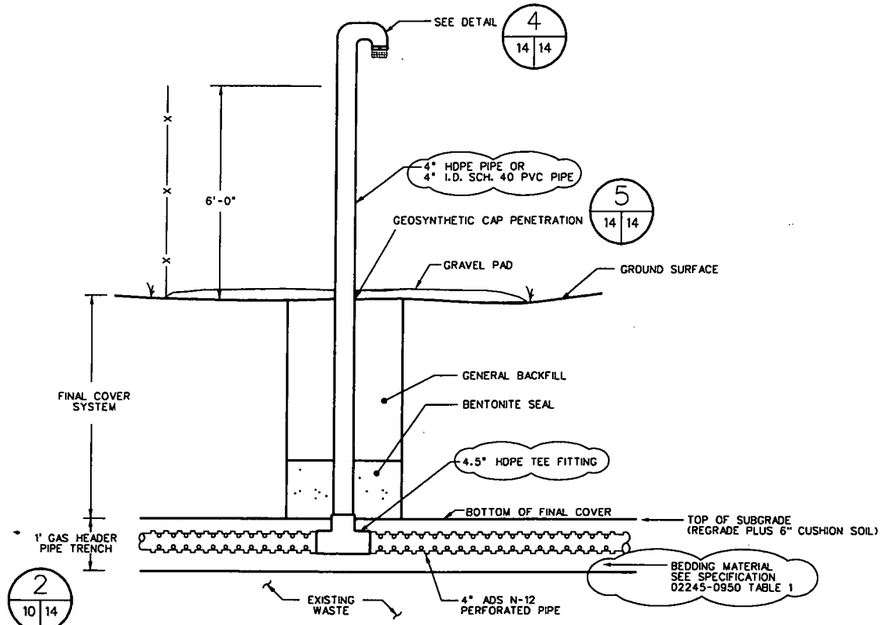
DESIGN COMPANY: EARTH TECH
DESIGNED BY: R. ARCHIBALD 1/14/05
DRAWN BY: A. SHOTNIK
CHECKED BY: R. THOMPSON
INDEPENDENT VERIFIER: S. LAWRENCE
APPROVED BY: R. THOMPSON
CLASSIFIER
LANDLORD

PROJECT/WCF NO. 020525
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

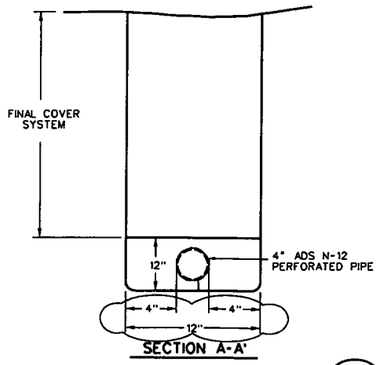
ANCHOR TRENCH EAST FACE
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE: B
DRAWING NUMBER: 51781-013B
ISSUE: 0

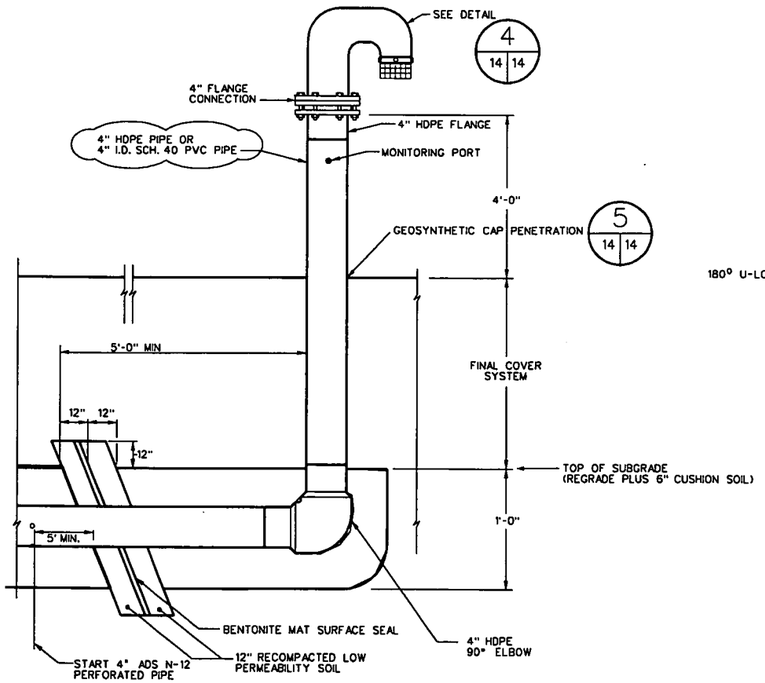
L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2004 \DETAILS\AT3D.DGN 1/12/05



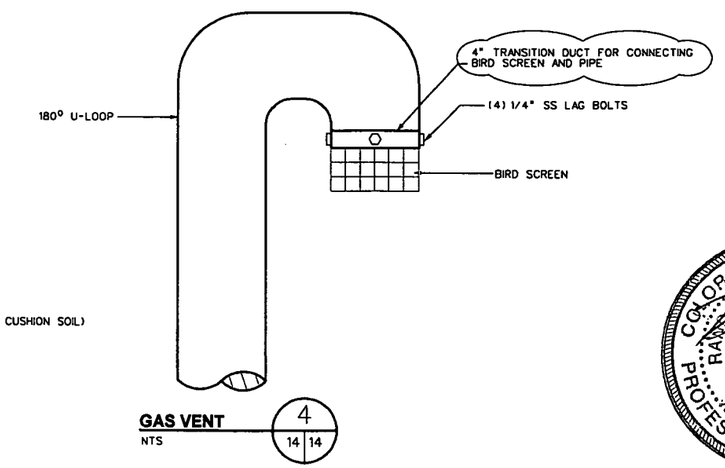
GAS EXTRACTION VENTILATOR 1 10 14



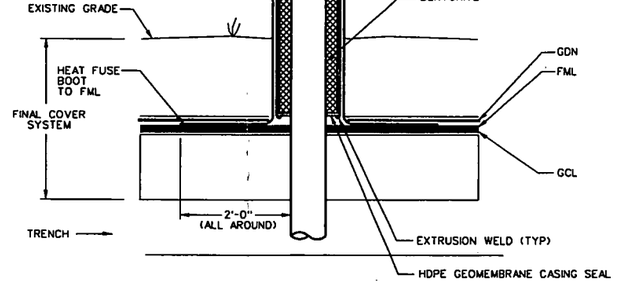
GAS EXTRACTION TRENCH 2 10 14



HEADER ACCESS RISER 3 10 14
NTS

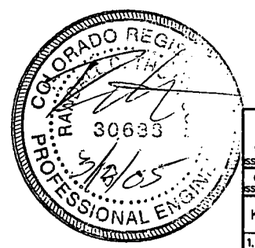


GAS VENT 4 14 14
NTS



TYPICAL GEOSYNTHETIC CAP PENETRATION 5 14 14
NTS

QUAN.	DESCRIPTION	MATERIAL



NOTES

1. LANDFILL GAS SYSTEM MAY CHANGE DUE TO SITE CONDITIONS AT THE TIME OF CONSTRUCTION.
2. ALL PVC PIPE AND FITTINGS ARE SCH 80 EXCEPT AS NOTED.
3. ALL HDPE PIPE IS SDR-17 AND ALL HDPE FITTINGS ARE SDR-11 EXCEPT AS NOTED.
4. COMPACT CLEAN SAND BEDDING AND BACKFILL IN MAXIMUM LIFTS OF 9".
5. ALL NUTS, BOLTS, AND WASHERS ARE CADMIUM PLATED UNLESS OTHERWISE NOTED.

REVISE PIPE MATERIAL CALL OUTS, DIMENSIONS AND BEDDING MATERIAL

REVISION DESCRIPTION

ISSUE	DESCRIPTION	DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
1		EARTH TECH	11/16/04	RJ	AS	RA	SA	RJ		57378
0	ORIGINAL ISSUE									

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

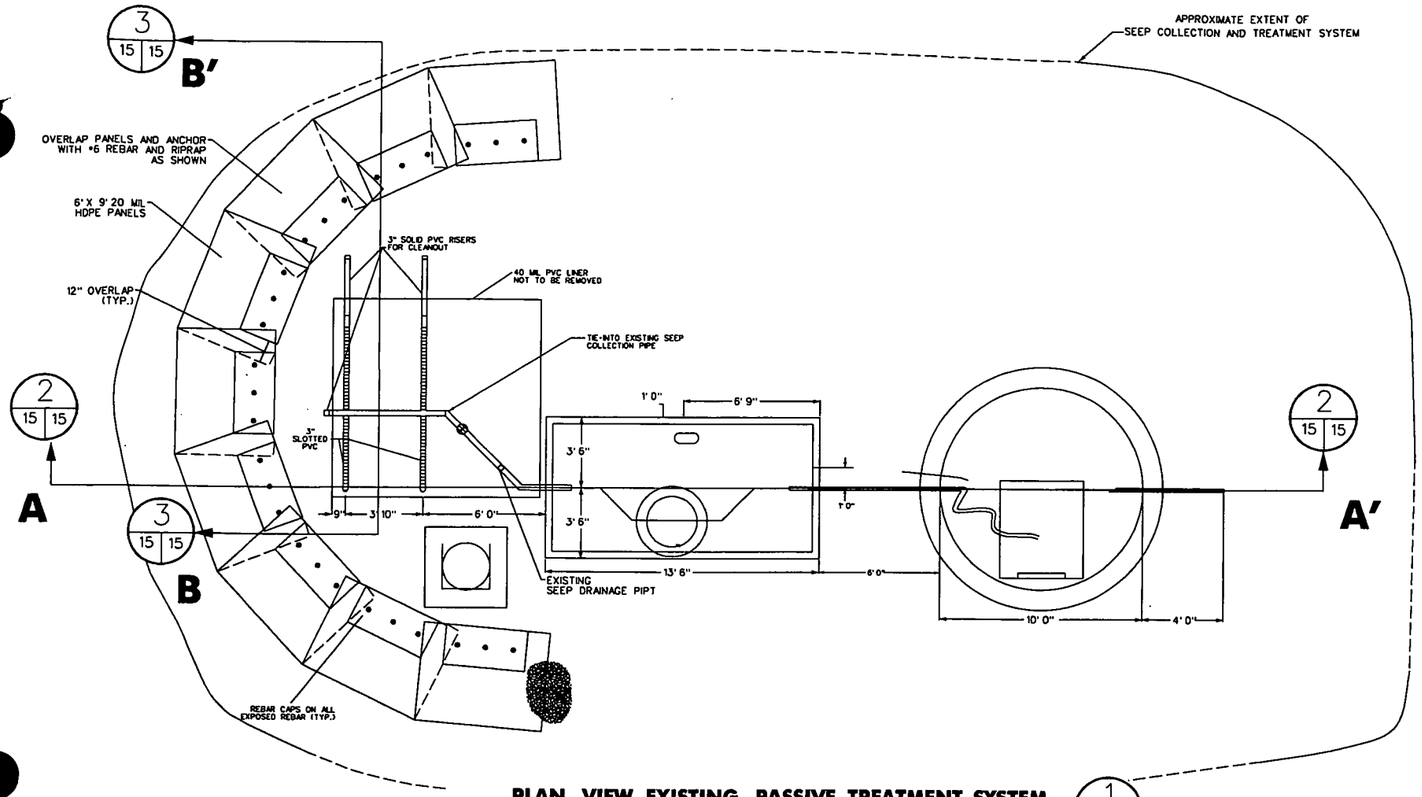
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

GAS MANAGEMENT DETAILS
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

KEYWORDS	
1.	
2.	
3.	
4.	
5.	
BLDG./FACILITY	SITE
ROOM/AREA	NA
GRID COORD./COL NO.	NA
TOLERANCES FRACT.	
ANGLE	
DEC.	
UNLESS NOTED OTHERWISE	
REMOVE BURRS AND SHARP EDGES	
NEXT ASSEMBLY	NA
SCALE:	AS SHOWN

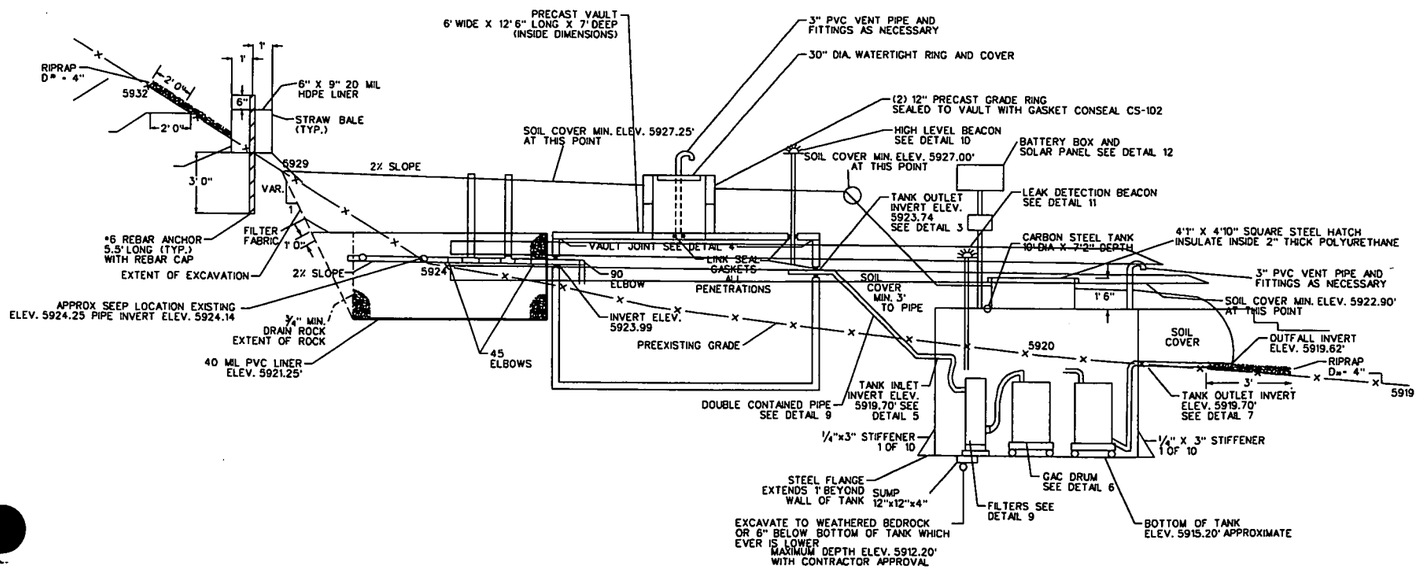
DESIGNED BY	R. THOMPSON	RJ	8/9/04
DRAWN BY	A. SHOTNIK	AS	8/10/04
CHECKED BY	R. ARCHBALD	RA	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SA	11/10/04
APPROVED BY	R. THOMPSON	RJ	8/11/04
CLASSIFIER			
LANDLORD			

SIZE	DRAWING NUMBER	ISSUE
B	51781-014	1



PLAN VIEW, EXISTING PASSIVE TREATMENT SYSTEM 1/15|15

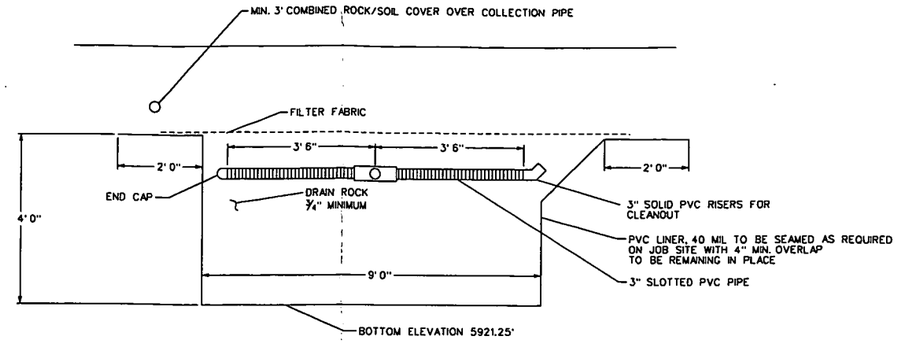
SCALE 0 2 4
Scale in feet



CROSS - SECTION A - A' 2/15|15

SCALE 0 2 4
Scale in feet

QUAN.	DESCRIPTION	MATERIAL



ALL 3" PVC PIPE IS SCHEDULE 40. SEE SPECIFICATION SECTION 03100

CROSS - SECTION B - B' 3/15|15

COLORADO REGISTERED RANDAL C. THOMPSON 30639 PROFESSIONAL ENGINEER 3/18/05

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									

KEYWORDS: 1. 2. 3. 4. 5. BLDG./FACILITY SITE: NA; ROOM/AREA: NA; GRID COORD./COL NO.: NA

TOLERANCES: FRACT. ; ANGLE ; DEC. ; UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: ENERGY MANAGEMENT SERVICES

DESIGNED BY	R. THOMPSON	RJT 8/9/04
DRAWN BY	A. SHOTNIK	AS 8/10/04
CHECKED BY	R. ARCHBALD	RJA 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SJL 11/10/04
APPROVED BY	R. THOMPSON	RJT 8/11/04

CLASSIFIER

LANDLORD

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

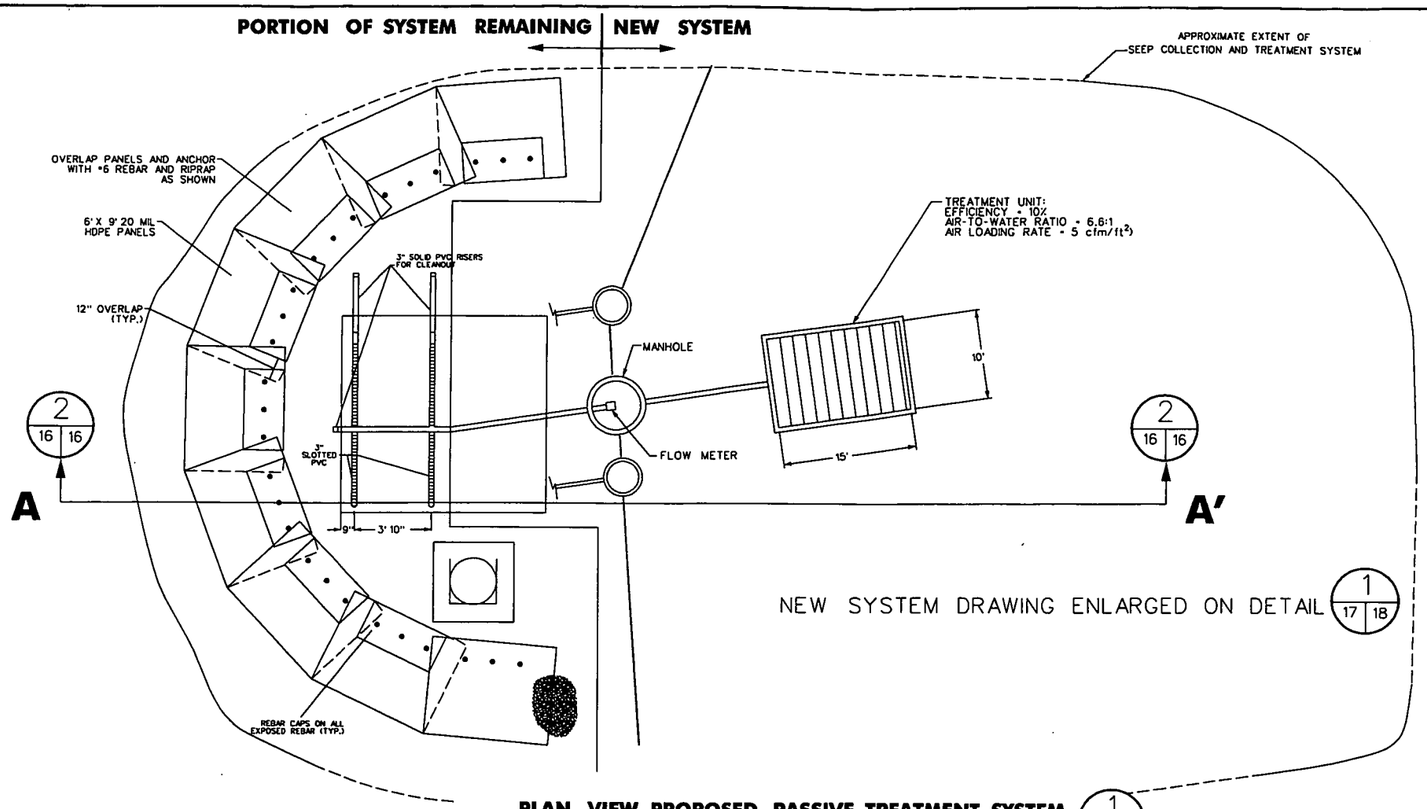
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

EXISTING SEEP PASSIVE TREATMENT SYSTEM
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-015	0

GROUP\CAD\ROCKY_FLATS\NEW-DESIGN2003\DETAILS\SEEPDET.DGN 10/11/02

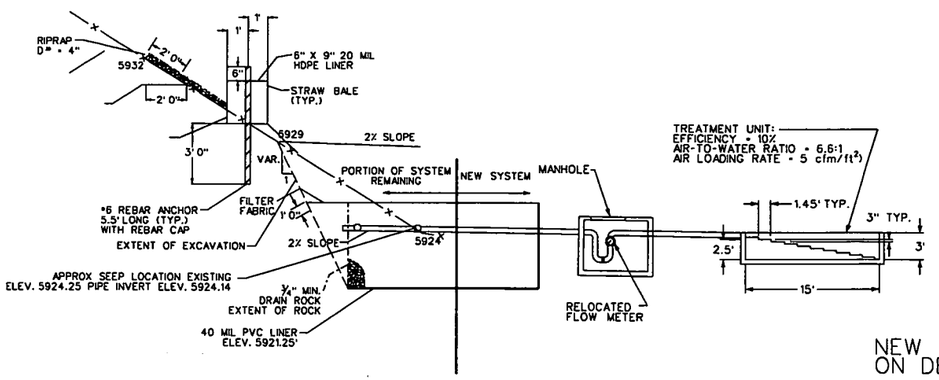
QUAN.	DESCRIPTION	MATERIAL



PLAN VIEW, PROPOSED PASSIVE TREATMENT SYSTEM

1 / 138 16

SCALE 0 2 4
Scale in feet



NEW SYSTEM DRAWING ENLARGED ON DETAIL 2 / 16 17

CROSS - SECTION A - A ' (PROPOSED)

2 / 16 16

SCALE 0 2 4
Scale in feet

COLORADO REGISTERED PROFESSIONAL ENGINEER
RANDAL C. [illegible]
30639
3/8/05

NOTE: RELOCATE EXISTING FLOW METER AND ASSOCIATED ELECTRONICS TO NEW MANHOLE LOCATION.

ISSUE	REVISION DESCRIPTION									
1	REVISED TREATMENT UNIT DESIGN									
	EARTH TECH DESIGN COMPANY	1/14/05 DATE	DSGN	DWN	CHKD	IV	APVD		CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE									PROJECT/WCF NO. 020525

DESCRIPTION

KEYWORDS	
1.	
2.	
3.	
4.	
5.	
BLDG./FACILITY SITE	
ROOM/AREA NA	
GRID COORD./COL NO. NA	

TOLERANCES: FRACT. : ; ANGLE ; DEC. : ; UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY NA

SCALE: AS SHOWN

DESIGN COMPANY: E A R T H T E C H

DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. ARCHBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04

CLASSIFIER

LANDLORD

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

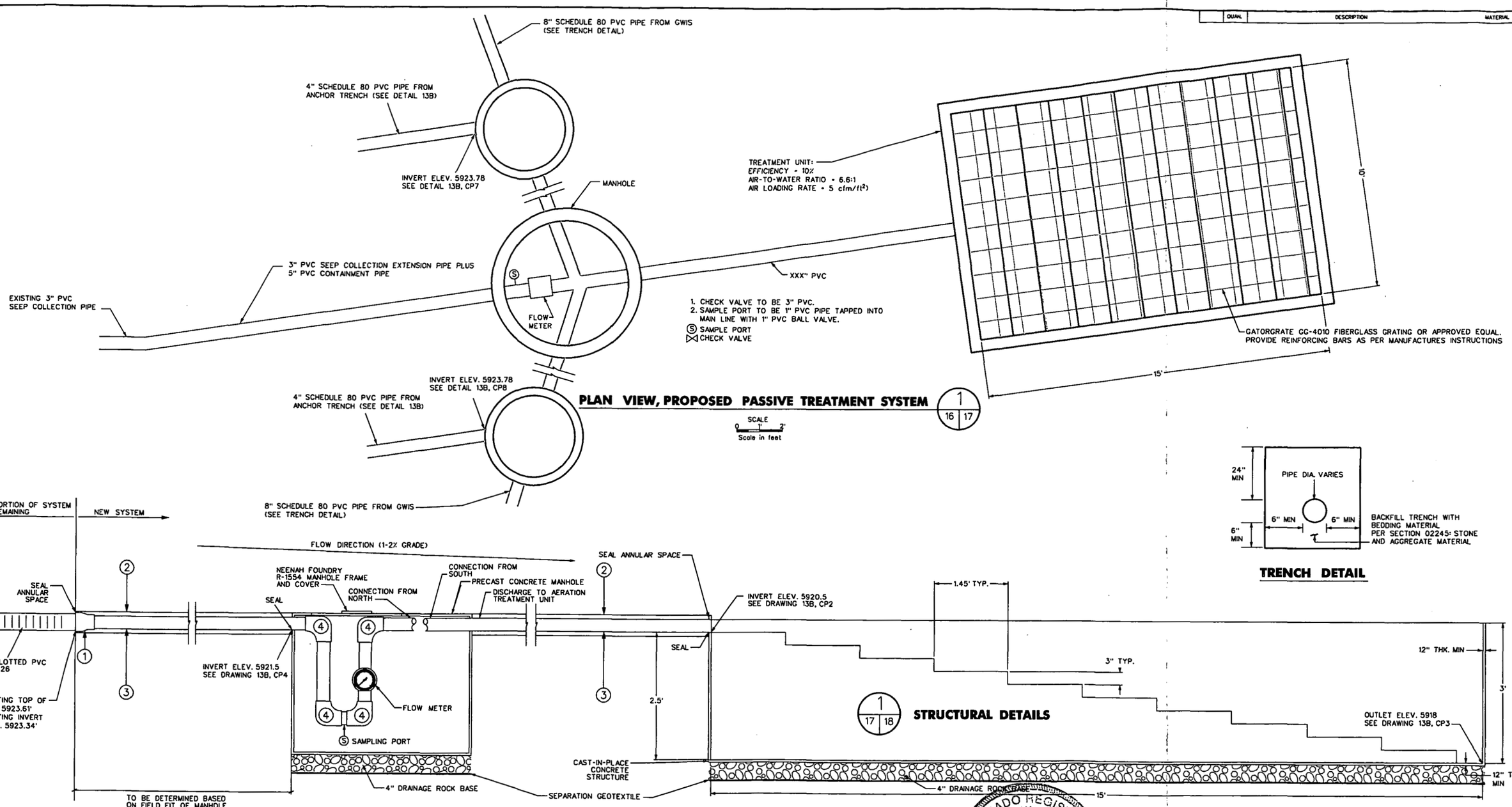
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

NEW SEEP PASSIVE TREATMENT SYSTEM LAYOUT
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-016	1

L:\GROUP\CAD\ROCKY FLATS\NEW DESIGN 2003\DETAILS\WTRBUNKERDTL.DGN

QUAN.	DESCRIPTION	MATERIAL



PLAN VIEW, PROPOSED PASSIVE TREATMENT SYSTEM (1 / 16 | 17)

SCALE 0 1' 2' Scale in feet

STRUCTURAL DETAILS (1 / 17 | 18)

TRENCH DETAIL

PARTS LIST

1. 4"x3" REDUCER SCH 80
2. 5" SCH 80 PVC (SECONDARY CONTAINMENT PIPE)
3. 3" SCH 80 PVC (CARRIER PIPE)
4. 3" SCH 80 PVC 90° ELBOW
5. ULTRASONIC FLOW METER (EXISTING)
6. 3" PVC CHECK VALVE
7. SAMPLE PORT

NOTES:

1. PROVIDE NEENAH FOUNDRY R-1981-N STEPS AND HAVE CAST INTO MANHOLE.
2. INSTALL PIPE AT A 2% MIN. GRADE
3. DISTANCE FROM SEEP COLLECTION PIPE CONNECTION TO AERATION TREATMENT UNIT IS APPROX. 250 FEET. AERATION TREATMENT UNIT IS TO BE PLACED AT TOE OF CONSTRUCTED SLOPES. ELEVATIONS OF AERATION TREATMENT UNIT AS BASED ON 250 FOOT EXTENSION AT 2% SLOPE.
4. PLACE MANHOLE APPROX. 20 FEET TO THE WEST OF AERATION TREATMENT UNIT.

SIDE VIEW, PROPOSED PASSIVE TREATMENT SYSTEM (2 / 16 | 17)

SCALE 0 0.5' 1' Scale in feet

COLORADO REGISTERED RANDALL THOMPSON 30635 PROFESSIONAL ENGINEER 3/18/05

NOTE: RELOCATE EXISTING FLOW METER AND ASSOCIATED ELECTRONICS TO NEW MANHOLE LOCATION.

ISSUE	REVISION DESCRIPTION	DATE	DSGN	DRN	CHKD	IV	APVD	CLASS	PROJECT/CHARGE NO.
1	REVISED ELEVATIONS BASED ON EAST FACE DESIGN	1/14/05							
0	ORIGINAL ISSUE								

EARTH TECH DESIGN COMPANY

KEYWORDS

1. 2. 3. 4. 5.

BLDG./FACILITY SITE

ROOM/AREA NA

GRID COORD./COL. NO. NA

TOLERANCES: FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY NA

SCALE: AS SHOWN

DESCRIPTION		
DESIGN COMPANY		
DESIGNED BY	R. THOMPSON	8/9/04
DRAWN BY	A. SHOTNIK	8/10/04
CHECKED BY	R. ARCHBALD	8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	11/10/04
APPROVED BY	R. THOMPSON	8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

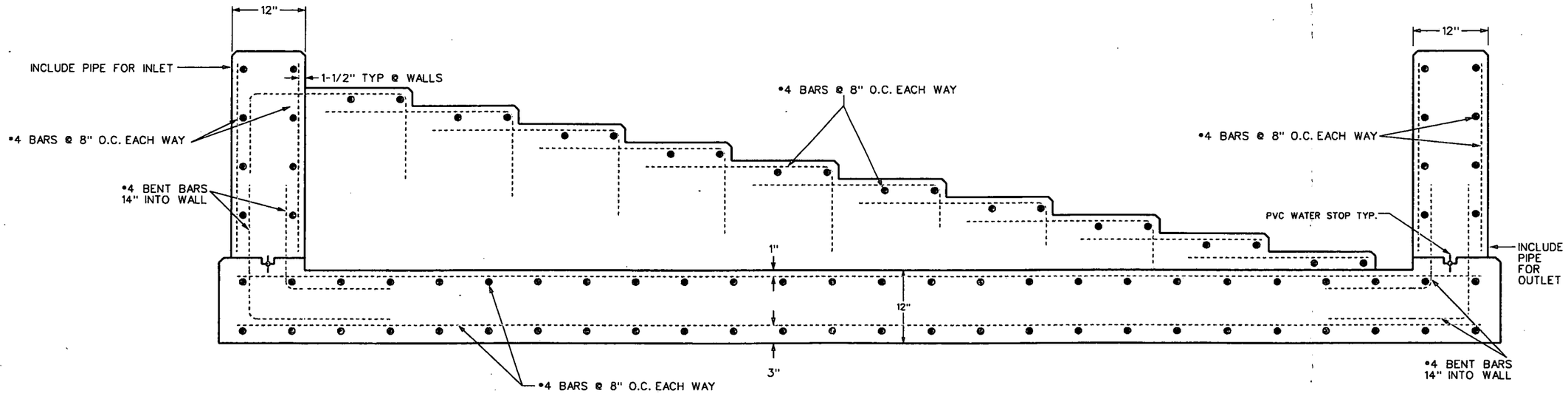
NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-017	1

L:\GROUP\CAD\ROCKY FLATS\NEW DESIGN 2004\DETAILS\SeepPass.DGN 12/9/04

	QUAN.	DESCRIPTION	MATERIAL



CROSS - SECTION A - A ' (PROPOSED)

1
17 | 18

COLORADO REGISTERED
RANDALL T. HARGIS
30077
PROFESSIONAL ENGINEER
1/13/05

ISSUE	REVISION DESCRIPTION: DESIGN COMPANY	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
0	ORIGINAL ISSUE										

ISSUE	DESCRIPTION
0	ORIGINAL ISSUE

KEYWORDS
1.
2.
3.
4.
5.
BLDG./FACILITY: SITE
ROCKY/AREA: NA
GRID COORD/COL NO.: NA

TOLERANCES: FRACT. ± ; ANGLE DEC. ± ; UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY: NA
SCALE: AS SHOWN

DESIGN COMPANY: S A B T R W H K	
DESIGNED BY	R. THOMPSON
DRAWN BY	A. SHOTNIK
CHECKED BY	R. ARCHBALD 1/14/05
INDEPENDENT VERIFIER	S. LAWRENCE
APPROVED BY	R. THOMPSON
CLASSIFER	
LANDLORD	

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-018	0

	QUAN.	DESCRIPTION	MATERIAL

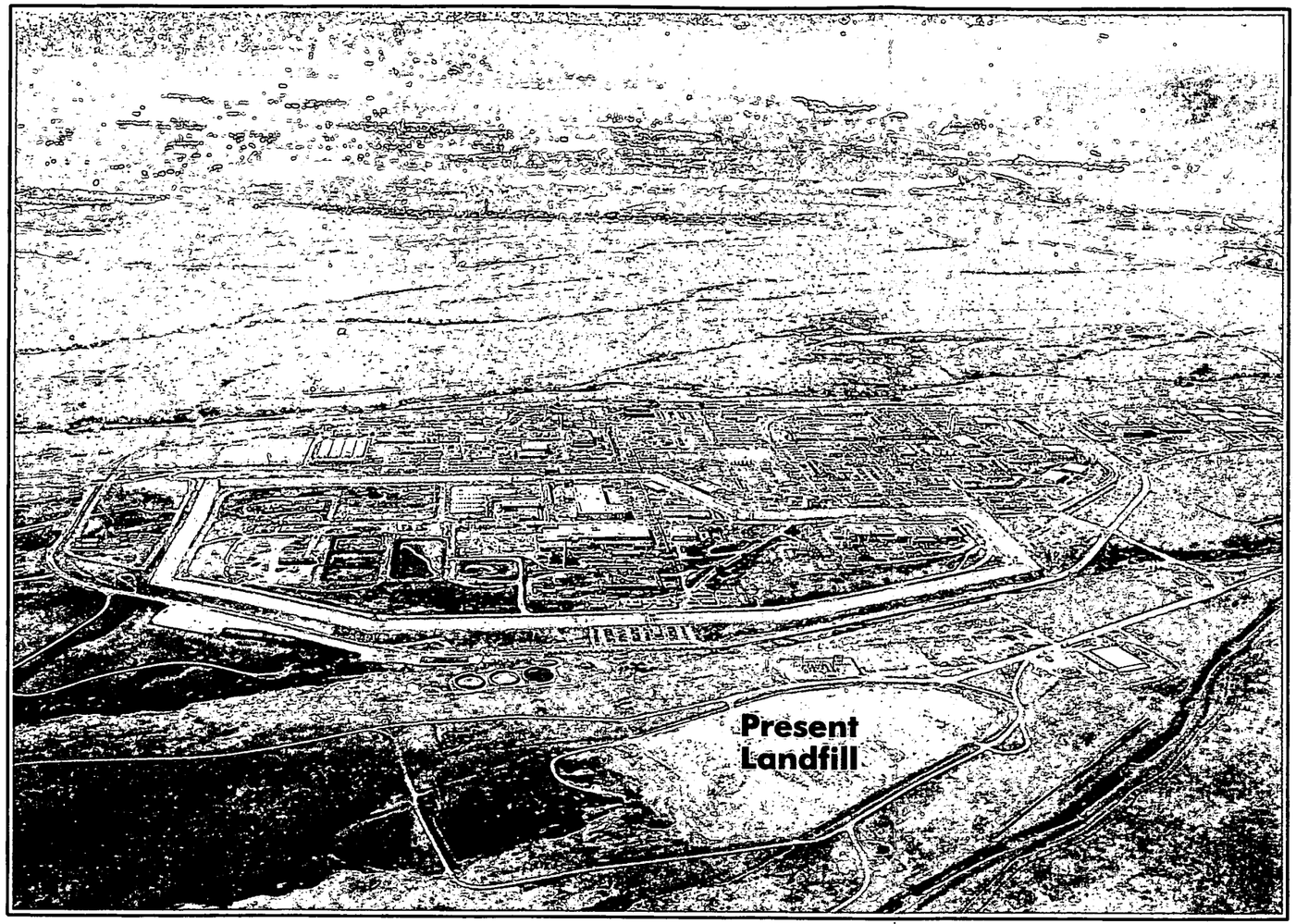
ACCELERATED ACTION DESIGN FOR THE PRESENT LANDFILL

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

DRAWINGS

GOLDEN COLORADO

REVISED DRAWINGS APRIL 2005



AERIAL VIEW LOOKING SOUTH
June 6, 2000

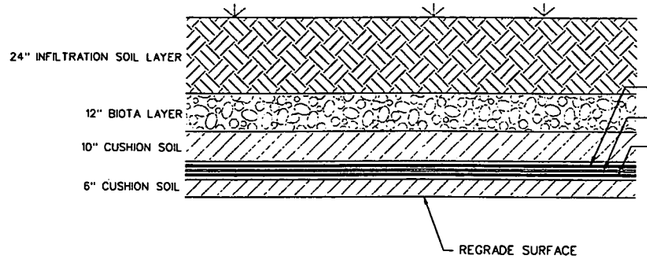
COLORADO REGISTERED
RANDALL C. THOMPSON
30638
4/14/05
PROFESSIONAL ENGINEER

EARTH TECH

EARTH TECH, INC.
5575 DTC PARKWAY
SUITE 200
ENGLEWOOD, CO 80111
(303) 694-6660

GROUP\CAD\ROCKY_FLATS\New_Design2005\COVER.DGN 4/13/05

	QUAN.	DESCRIPTION	MATERIAL

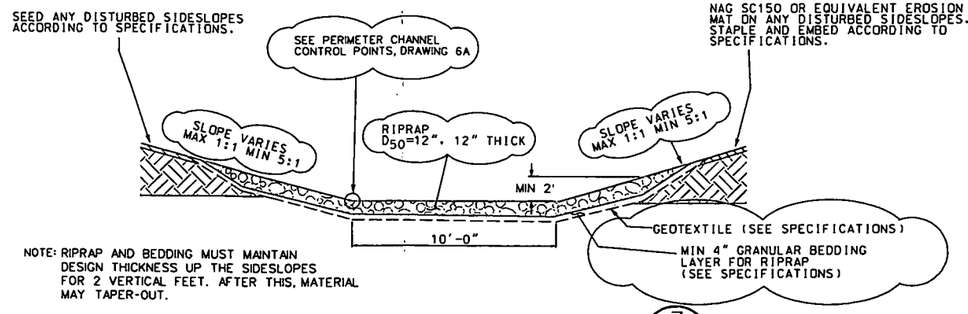


1 / 12 | 13A

GEOSYNTHETIC COMPOSITE FINAL COVER

NTS

1 / 9 | 12

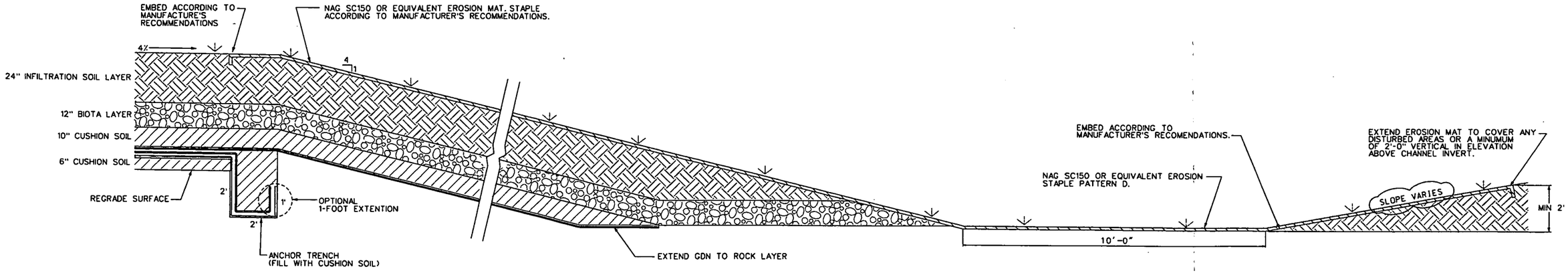


NOTE: RIPRAP AND BEDDING MUST MAINTAIN DESIGN THICKNESS UP THE SIDESLOPES FOR 2 VERTICAL FEET. AFTER THIS, MATERIAL MAY TAPER-OUT.

RIPRAP LINED CHANNEL DETAIL

NTS

3 / 9 | 12



ANCHOR TRENCH *

NTS

2 / 9 | 12

* NOTE: IF WASTE IS ENCOUNTERED DURING THE EXCAVATION OF THE ANCHOR TRENCH, WASTE MATERIAL WILL BE OVER EXCAVATED AN ADDITIONAL 1-FOOT. OVER EXCAVATIONS WILL BE FILLED WITH CUSHION LAYER SOIL TO THE DESIGN DIMENSIONS OF ANCHOR TRENCH.

	ADDED DETAIL TO RIPRAP LINED CHANNEL DRAWING									
	REVISION DESCRIPTION									
2 ISSUE	EARTH TECH DESIGN COMPANY	2/15/05 DATE	RA DSGN	AS DWN	RD CHKD	SP IV	RD APVD		CLASS	51378 PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE									

DESCRIPTION

KEYWORDS

1.
2.
3.
4.
5.

BLDG./FACILITY: SITE

ROOM/AREA: NA

GRID COORD./COL NO.: NA

TOLERANCES
FRACT. :
ANGLE
DEC. :
UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

NEXT ASSEMBLY: NA

SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH		
DESIGNED BY	R. ARCHIBALD	RA 8/9/04
DRAWN BY	A. SHOTNIK	AS 8/10/04
CHECKED BY	R. THOMPSON	RD 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
APPROVED BY	R. THOMPSON	RD 8/11/04
CLASSIFIER		
LANDLORD		

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

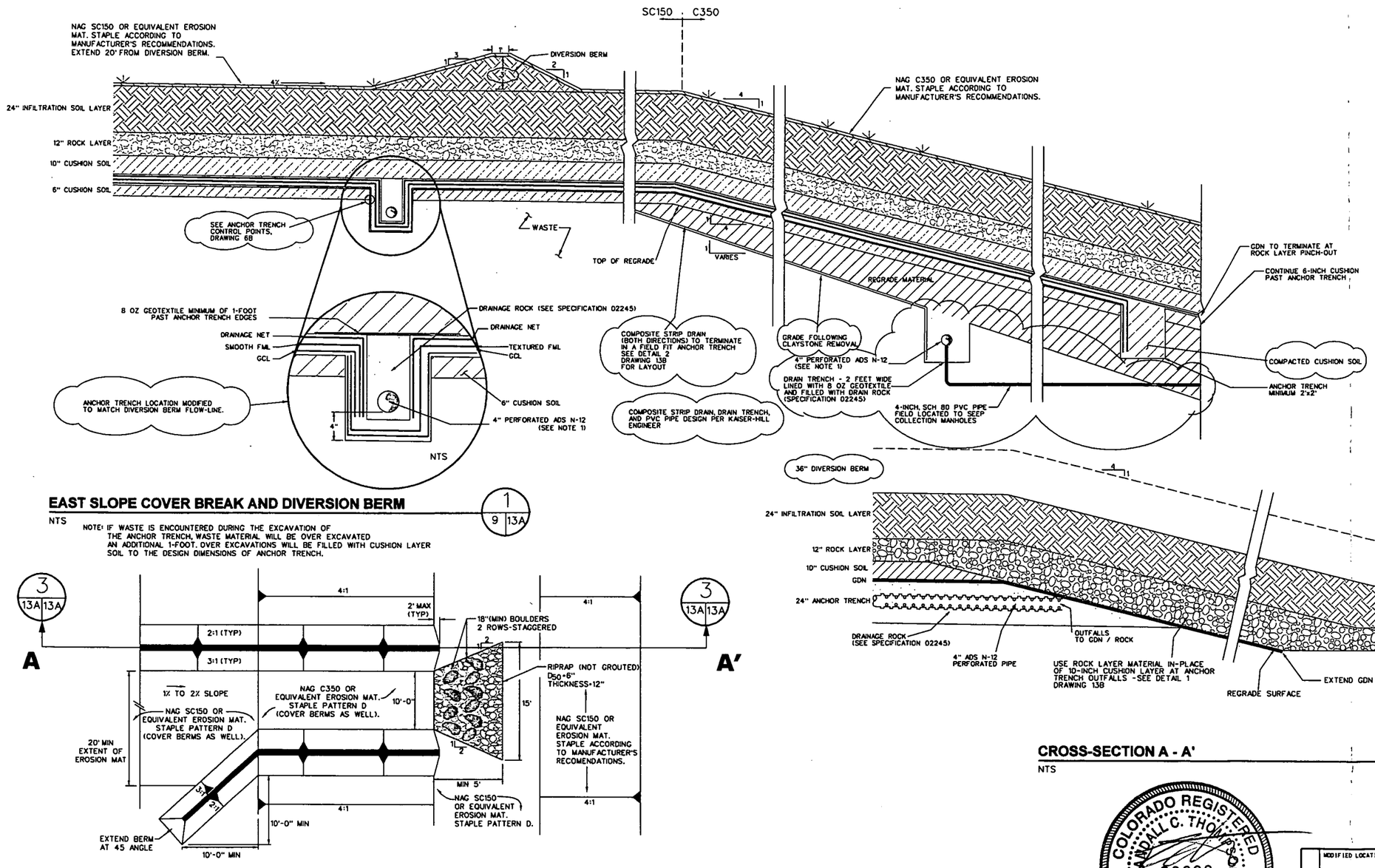
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

LANDFILL COVER AND SURFACE WATER DETAIL
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-012	2

L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2004 \DETAILS\LNDFILLCVR.DGN 1/23/04

	QUAN.	DESCRIPTION	MATERIAL



EAST SLOPE COVER BREAK AND DIVERSION BERM

1 / 9 13A

NTS

NOTE: IF WASTE IS ENCOUNTERED DURING THE EXCAVATION OF THE ANCHOR TRENCH, WASTE MATERIAL WILL BE OVER EXCAVATED AN ADDITIONAL 1-FOOT. OVER EXCAVATIONS WILL BE FILLED WITH CUSHION LAYER SOIL TO THE DESIGN DIMENSIONS OF ANCHOR TRENCH.

DOWNSLOPE CHANNEL TRANSITION FROM EAST SLOPE BERM TO PERIMETER CHANNEL

2 / 9 13A

NTS

CROSS-SECTION A - A'

3 / 13A 13A

NTS

NOTES:

1. ADS N-12 PIPE MEET THE FOLLOWING SPECIFICATIONS:
   4.0"I.D.
   4.72" O.D.
   0.40 LBS/FT
   SLOTTED PERFORATIONS (3 AT 120)
   SLOT LENGTH - 0.875"
   SLOT WIDTH - 0.125"

	REVISION DESCRIPTION							
3 ISSUE	MODIFIED LOCATION AND HEIGHT OF DIVERSION BERM. ADDED STRIP DRAIN CHANGES.							
	EARTH TECH (DESIGN COMPANY)	2/15/05 DATE	RA DSGN	JS DRN	RJ CHKD	SP IV	RJ APVD	CLASS 57378 PROJECT/CHARGE NO.
0 ISSUE	ORIGINAL ISSUE							

KEYWORDS	
1.	
2.	
3.	
4.	
5.	
BLDG./FACILITY	SITE
ROOM/AREA	NA
GRID COORD./COL. NO.	NA

TOLERANCES FRACT.	
ANGLE	
DEC.	
UNLESS NOTED OTHERWISE	
REMOVE BURRS AND SHARP EDGES	
NEXT ASSEMBLY	NA
SCALE:	AS SHOWN

DESIGN COMPANY: EARTH TECH		
DESIGNED BY	R. ARCHIBALD	RA 8/9/04
DRAWN BY	A. SHOTNIK	JS 8/10/04
CHECKED BY	R. THOMPSON	RJ 8/10/04
INDEPENDENT VERIFIER	S. LAWRENCE	SL 11/10/04
APPROVED BY	R. THOMPSON	RJ 8/11/04
CLASSIFIER		
LANDLORD		

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

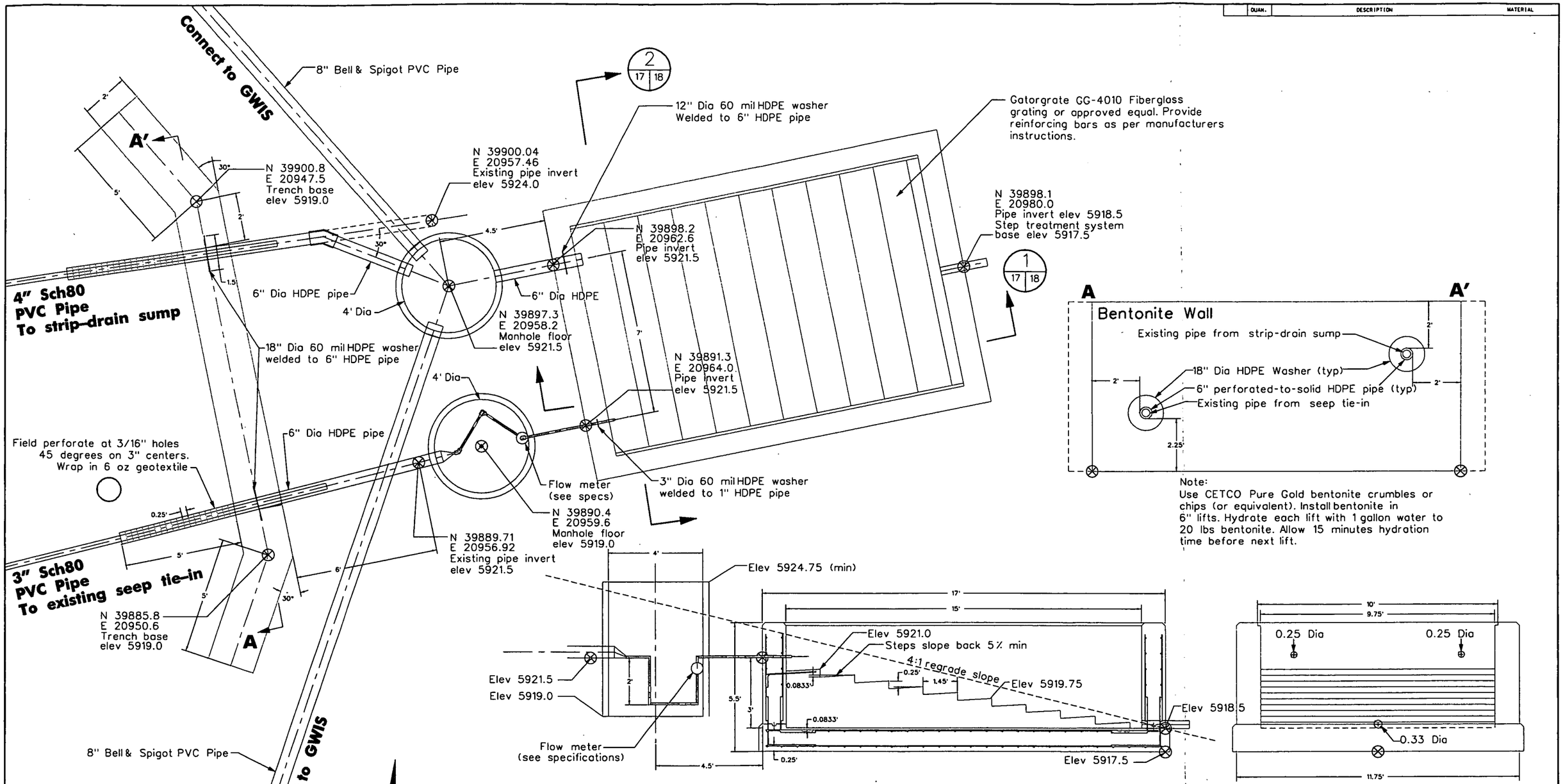
LANDFILL COVER DETAILS EAST FACE

PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

SIZE	DRAWING NUMBER	ISSUE
B	51781-013A	3

L:\GROUP\CAD\ROCKY_FLATS\NEW DESIGN 2004 \DETAILS\LNDFILLCVR2.DGN 2/15/05

QUAN.	DESCRIPTION	MATERIAL



PLAN VIEW, PASSIVE TREATMENT SYSTEM

1 | 16 | 17

SCALE
0 2 4
Scale in feet

SIDE VIEW, PASSIVE TREATMENT SYSTEM

2 | 17 | 18

SCALE
0 2 4
Scale in feet

Note:
Use CETCO Pure Gold bentonite crumbles or chips (or equivalent). Install bentonite in 6" lifts. Hydrate each lift with 1 gallon water to 20 lbs bentonite. Allow 15 minutes hydration time before next lift.

COLORADO REGISTERED
RANDALL C. THOMPSON
30635
PROFESSIONAL ENGINEER
4/14/05

ISSUE	DESCRIPTION	DATE	DSGN	DWN	CHKD	IV	APVD			CLASS	PROJECT/CHARGE NO.
2	REVISED PIPING, MANHOLES, AND BENTONITE WALL DETAILS EARTH TECH DESIGN COMPANY	4/13/05	SP	SP	RA	SL	RD				
0	ORIGINAL ISSUE										

KEYWORDS

1.
2.
3.
4.
5.
BLDG./FACILITY
ROOM/AREA
GRID COORD./COL. NO.

TOLERANCES
FRACT. ±
ANGLE ±
DEC. ±
UNLESS NOTED OTHERWISE
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY
SCALE: AS SHOWN

DESIGN COMPANY/EARTH TECH		
DESIGNED BY		
R. THOMPSON	RD	8/9/04
DRAWN BY		
A. SHOTNIK	AS	8/10/04
CHECKED BY		
R. ARCHIBALD	RA	8/10/04
INDEPENDENT VERIFIER		
S. LAWRENCE	SL	11/10/04
APPROVED BY		
R. THOMPSON	RD	8/11/04
CLASSIFIER		

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO
Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

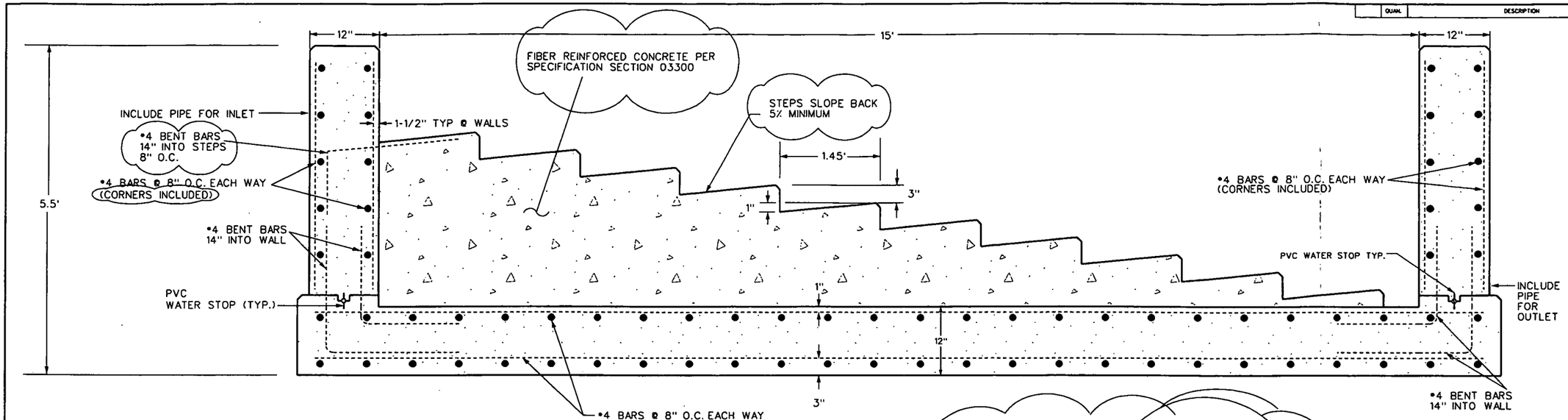
NEW SEEP PASSIVE TREATMENT SYSTEM LAYOUT
PRESENT LANDFILL ACCELERATED ACTION 95% DESIGN

PROJECT/WCF NO. 020525

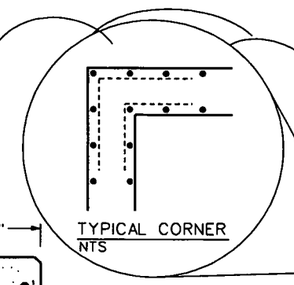
SIZE	DRAWING NUMBER	ISSUE
B	51781-017	2

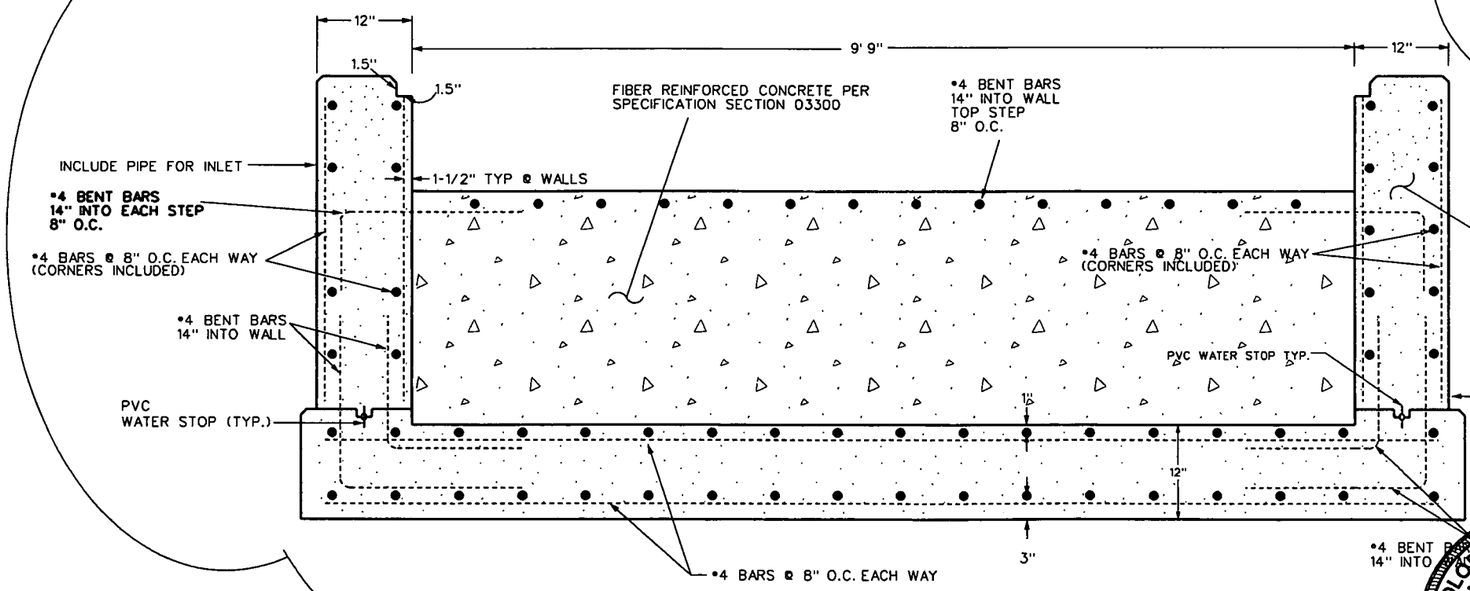
GROUP\CAD\ROCKY_FLATS\New_Design2005\Details\Seep0405.dgn Date: 4-2005

QUAN	DESCRIPTION	MATERIAL

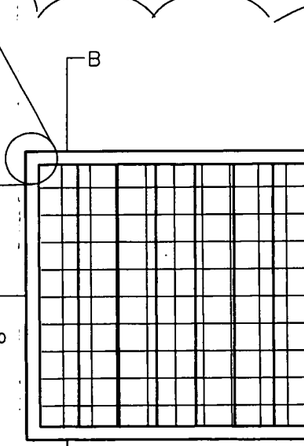


CROSS - SECTION A - A ' 1 | 17 | 18





CROSS - SECTION B - B ' (TYPICAL STEP SECTION) 2 | 17 | 18



PLAN VIEW - TREATMENT UNIT

COLORADO REGISTERED RANDALL C. THOMPSON 30638 4/14/05 PROFESSIONAL ENGINEER

ISSUE	REVISION DESCRIPTION	DATE	DSGN	DWN	CHKD	APVD	CLASS	PROJECT/CHARGE NO.
1	REVISED PER RFI 208.	4/13/05	SK	RA	RA	RT		
0	ORIGINAL ISSUE							

EARTH TECH DESIGN COMPANY

PROJECT/WCF NO. 020525

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Environmental Technology Site
GOLDEN, COLORADO

NEW SEEP PASSIVE TREATMENT SYSTEM DETAIL
PRESENT LANDFILL ACCELERATED ACTION 100% DESIGN

KEYWORDS

1.
2.
3.
4.
5.

BLDG/FACILITY SITE

ROOM/AREA NA

GRID COORD/COL NO. NA

TOLERANCES FRACT. : ANGLE DEC. : UNLESS NOTED OTHERWISE

REMOVE BURRS AND SHARP EDGES

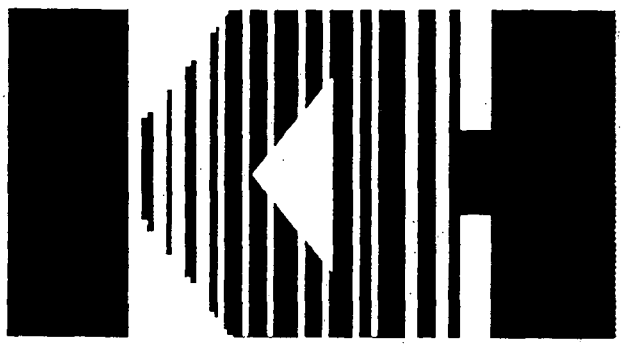
NEXT ASSEMBLY NA

SCALE: AS SHOWN

DESIGN COMPANY: EARTH TECH		
DESIGNED BY	S. KEITH	SK 1/13/05
DRAWN BY	R. ARCHIBALD	RA 1/14/05
CHECKED BY	R. ARCHIBALD	RA 1/14/05
INDEPENDENT VERIFIER	S. LAWRENCE	SL 1/14/05
APPROVED BY	R. THOMPSON	RT 1/14/05
CLASSIFIER		
LANDLORD		

SIZE	DRAWING NUMBER	ISSUE
B	51781-018	1

L:\GROUP\CAD\ROCKY FLATS\NEW DESIGN 2004\DETAILS\Seep2005r.DGN 4/13/05



KAISER HILL COMPANY

ACCELERATED ACTION DESIGN FOR THE PRESENT LANDFILL ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

FINAL DESIGN SUBMITTAL

SPECIFICATIONS

Project No. 57378.4001
October 2004
With Revisions

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

DIVISION 1 - GENERAL REQUIREMENTS

01100	General Project Definitions
01110	Summary of Work
01190	Progress Meetings
01200	Warranty of Construction
01270	Measurements and Payments
01300	Submittal Descriptions
01305	Submittal Procedures
01310	Construction Surveying
01320	Construction Photographs
01350	Special Procedures - Materials and Waste Handling
01401	Safety, Health, and Emergency Response
01405	Temporary Fire Protection
01430	Environmental Protection
01440	Contractor Quality Control
01500	Temporary Construction Facilities
01700	Execution Requirements
01702	Contract Closeout
01720	Project Record Documents
01722	Field Engineering
01820	Demonstration and Training
01900	Material, Vehicle, and Equipment Decontamination

DIVISION 2 - SITE CONSTRUCTION

02110	Site Preparation
02200	Geotechnical Testing
02210	Geosynthetics Interface Testing
02221	Earthwork
02222	Rock Layer
02224	Geosynthetic Composite Drainage Net
02225	LLDPE Geomembrane Liner
02226	Geosynthetic Clay Liner
02227	Erosion Matting
02228	Erosion Control
02245	Stone and Aggregate Material
02720	Contaminated Liquids Removal
02900	Seeding

DIVISION 3 - CONCRETE

03200	Concrete Reinforcement
03300	Cast-In-Place Concrete
03410	Structural Precast Concrete

DIVISION 11 - EQUIPMENT

11100	Seep Passive Treatment System
11101	PVC Piping
11110	Passive Landfill Gas Venting System
11111	HDPE Piping

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01100-0919
GENERAL PROJECT DEFINITIONS

(APPROVED)	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

Humphreys

SPEC-01100-0919
GENERAL PROJECT DEFINITIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS AND DEFINITIONS

A. Drawings and general provisions of the Subcontract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. The following definitions and abbreviations/acronyms apply to these Specifications:

1. "RFETS" means the Rocky Flats Environmental Technology Site. RFETS is a government owned facility operated for the US Department of Energy by a primary CONTRACTOR.
2. "DOE" means the US Department of Energy, which owns RFETS.
3. "CONTRACTOR" means the primary CONTRACTOR, i.e., Kaiser-Hill, LLC, which operates RFETS for DOE. (CC), (CM), or (DA) following "CONTRACTOR" refer to specific individuals who may represent the "CONTRACTOR."
4. "SUBCONTRACTOR" means the party to whom this Subcontract is awarded.
5. "SA" means the CONTRACTOR'S Subcontract Administrator who has overall authority for this subcontract. See RFETS Contract Documents for additional information.
6. "CTR" means the CONTRACTOR'S Technical Representative who is the technical authority and field interface with the SUBCONTRACTOR. See RFETS Contract Documents for additional information.
7. "CC" means the CONTRACTOR'S Construction Coordinator(s) who assist(s) the SUBCONTRACTOR as the primary interface with building and area management. The CC also assists with coordination of special requirements from other RFETS organizations.
8. "CM" means the CONTRACTOR'S Construction Group Manager, who is responsible for the overall management of construction resources.
9. "DESIGNER" means the Design Authority responsible for the design package that directs the Work to be done. Typically this is an Architect and/or Engineering firm or employee of the CONTRACTOR.
10. "CFE" means CONTRACTOR Furnished Equipment, which is being provided (or will be provided) by the CONTRACTOR for use or installation by the SUBCONTRACTOR.
11. "GFE" means Government Furnished Equipment, which is being provided (or will be provided) by DOE for use or installation by the SUBCONTRACTOR.
12. "IWCP" means Integrated Work Control Program, which is a formal planning method to implement a set of integrated safety and compliance controls, which address activities that pose a threat to the health and safety of the public, the workers or the environment.
13. "ECR" means Engineering Change Request, which is a change to the contract drawings and/or specifications directed by the CONTRACTOR.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project consists of the construction of a Synthetic Geocomposite Cover at the Present Landfill at the RFETS.

1. Project Location: The RFETS is located near Golden, Colorado. See contract drawings for Vicinity and Area Plot plan.

B. Project Personnel Identification: The following people are the CONTRACTOR'S representatives:

1. SA Ms. Mary Kaiser Ext. 3225 Pager _____

2. CTR Mr. Bob Davis Ext. 7026 Pager _____

3. CC Not Applicable Ext. _____ Pager _____

1.3 CONTRACT, DRAWINGS AND SPECIFICATIONS

A. SUBCONTRACTOR will be furnished, without charge, four (4) sets each of specifications, full size (ANSI D) drawings, and half size (ANSI B) drawings. A drawing list, which constitutes a part of the subcontract documents, shall include the Drawing number, Revision number, and Drawing Title. The SUBCONTRACTOR shall observe, and so caution any subcontractors, that the scales on the half-size drawings are not correct and are not usable for material take-offs.

B. Specification Format: The Specifications are organized into Divisions and Sections using the 16-division format and CSI "MasterFormat" number system.

1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents.

C. If any conflicting information is found between drawings and specifications, the specifications shall overrule the drawings. SUBCONTRACTOR shall report any such conflicts to the CTR as soon as they are discovered.

1.4 WORK SEQUENCE

A. The Work may be conducted in phases, as proposed by the SUBCONTRACTOR and approved by the CTR.

B. PROGRESS SCHEDULES

1 The subcontractor shall submit a proposed progress schedule for review and approval by the CONTRACTOR at the time of Subcontract award. The schedule shall be in a sufficiently detailed Critical Path Method format and shall be updated on a weekly basis unless otherwise directed in writing by the CONTRACTOR. The scheduling system used shall include an earned value measurement of both cost and schedule with the capability to compare planned versus actual performance.

1.5 USE OF PREMISES

A. General: SUBCONTRACTOR will only have access to those portions of the premises required for construction operations and necessary support functions during the construction period, with the following limitations:

1. Periodic, announced and unannounced security and emergency preparedness exercises may infringe on construction activities for periods generally not exceeding one day.
2. For safety purposes, access to RFETS may be restricted to essential personnel and construction activities will be suspended during periods of severely inclement weather.
3. During periods of high winds (i.e., exceeding 35 mph), hail and/or lightning outside construction, use of cranes and access to roofs and elevated work structures may be restricted for safety considerations.

B. Security Measures: The SUBCONTRACTOR shall furnish the CONTRACTOR a list of all employees and lower-tier subcontractor employees that will require access to the site.

1. See the RFETS Contract Documents for additional information regarding access badges.
2. Access will be granted for the period of performance of work.
    a. When the duration of construction or an individual task is less than 30 days, the SUBCONTRACTOR employees will be issued a daily, non-picture security badge for access to the plant.
    b. When the duration of construction is 30 days or more the SUBCONTRACTOR employees will be issued individual picture badges for access to the plant. These badges are accountable property of the U.S. Government and shall be returned to the CTR upon completion of the project.
    c. Failure of the SUBCONTRACTOR to return all badges could result in delay of contract closing and deductions from the final payment.
    d. The SUBCONTRACTOR shall notify the CONTRACTOR (CC) immediately of any missing or lost badges.
3. The SUBCONTRACTOR shall notify the CONTRACTOR (CC) should termination of employment occur for any individuals submitted for access.
4. The CONTRACTOR reserves the right to exclude any employee from the plantsite as appropriate.
5. Access will not be granted to persons who are not citizens of the United States of America, without special approval.

C. Work under this contract may be performed in security areas and SUBCONTRACTOR employees will be subject to security controls required by DOE. The SUBCONTRACTOR shall arrange for access with the CONTRACTOR (CC).

1.6 MISCELLANEOUS PROVISIONS

A. Change Control - All project changes that occur during construction shall be documented. Several forms of written communications shall be utilized to provide direction and document field changes during the contract:

1. Construction Notice - This form shall be issued by the CONTRACTOR to provide guidance, clarify a condition or situation, or to provide instruction that is relevant to the subcontract or codes, policies, standards, orders, or procedures. Construction Notices are not intended to impact cost or schedule. The SUBCONTRACTOR shall at no time accept a Construction Notice if the direction causes an extension of the approved contract

schedule or adds cost to the subcontract. If the SUBCONTRACTOR should receive a Construction Notice, which will add either time or- cost to the subcontract, he shall immediately return it to the SA for clarification.

2. Construction Order - A Construction Order may be issued by the CONTRACTOR to communicate short term information and administrative instructions to the CONTRACTOR. Construction Orders are not intended to change existing procedures, work packages, or subcontract documentation. If the SUBCONTRACTOR should receive a Construction Order, which has a long term effect or cost implication, he shall return it to the SA for clarification.

3. Construction Field Change - A Construction Field Change is issued to the SUBCONTRACTOR by the CTR or the SA and may result in a change to the contract documents. These changes will be incorporated to into an ECR in accordance with I-VSI-COEM-DES-210 and these changes will be formalized by a contract modification. Changes to the work package will be made in accordance with the Integrated Work Control Program Manual MAN-07 I -IWCP. The CONTRACTOR shall place a Not-To-Exceed amount on the Construction Field Change. The SUBCONTRACTOR shall immediately start work on the Construction Field Change upon receipt of the approved document. The SUBCONTRACTOR shall present a formal proposal for the cost of the change to the CONTRACTOR within three (3) working days. The SUBCONTRACTOR shall not exceed the dollar amount shown in the Not-To-Exceed space without prior written approval from the SA.

4. Redlined Drawings - The SUBCONTRACTOR shall maintain one (1) current set of subcontract redlined specifications and drawings at the construction site. Copies of all ECR's shall be attached to this set. The SUBCONTRACTOR shall redline all changes, not reflected in contract documents modified by Engineering Change Requests, within one (1) working day of receipt of change. The subcontractor shall provide to the contractor, one (1) complete set of full size redline drawings and other documents (specifications) within seven (7) calendar days after completion of construction activities.

B. Traffic Control

1. The SUBCONTRACTOR shall provide all necessary barricades, lights, signals, etc. for the protection of the workers and the public, as established by the Occupational Safety and Health Administration (OSHA) Construction Safety and Health Regulation 29 CFR, Part 1926, Subpart G, Signs, Signals, and Barricades.

C. Supervision - The SUBCONTRACTOR is required to have a full time, non-working superintendent on site while any work is being performed.

D. Plan of Operations - In general, there will be no stipulated sequence of construction, except for certain specific activities identified in the Planning Section of the IWCP. The SUBCONTRACTOR shall arrange his schedule such that, when work is started, work will proceed promptly and vigorously to completion. Normal working hours for SUBCONTRACTOR shall be **6:30 a.m. to 5:00 p.m.** (with a 30 minute lunch period), Monday through Thursday, unless otherwise directed.

E. Meetings - SUBCONTRACTOR'S representative will be required to attend the following meetings:

1. Pre-construction Indoctrination /Kick off meetings
2. Weekly progress meetings
3. Periodic meetings as required, to resolve issues or discuss potential changes.
4. Plan of the Day
5. Representatives of lower-tier SUBCONTRACTORS may be required to attend some of the meetings depending upon the meeting agenda.

F. Medical Radioisotope Procedures on SUBCONTRACTOR Personnel - All persons engaged in construction at RFETS are required to report any diagnostic or therapeutic treatment with radioisotopes to the CONTRACTOR. Personnel should report prior to treatment, if possible, or when
they return to work after such treatment.

G. Privately owned radios and pagers - Security regulations do not allow the use of privately owned radio pagers and mobile phones at RFETS in areas designated as "controlled," such as the Protected Area, etc. – Pagers and telephones shall also be left in privately owned vehicles when entering any "controlled" area.

H. Holiday work curtailment - During the holiday periods covering days as agreed to by the SA and CTR, SUBCONTRACTOR activities will be suspended. SUBCONTRACTOR and its lower-tier subcontractors shall plan their work accordingly. Access to the plantsite during these periods will be by Special arrangement with the CONTRACTOR (CC).

I. SUBCONTRACTOR training requirements. All costs for time involved as a result of these required actions shall be included in the SUBCONTRACTOR'S bid proposal.

1. SUBCONTRACTOR employees who are new to RFETS are required to attend General Employee Radiation Training (GERT) at the plantsite's Computer Based Training Center prior to receiving an access badge. It is the responsibility of the SUBCONTRACTOR to schedule this training.

2. The SUBCONTRACTOR shall provide a matrix, which cross references all job functions to required training, as an appendix to the Health and Safety Plan. All required training should be identified e.g., General, Building Specific, Project Specific and OSHA 29 CFR.

J. Lost Time Reports - The SUBCONTRACTOR shall notify the CTR immediately when construction activities have been unduly delayed for reasons beyond his control. Lost Time Reports shall be submitted as necessary on a daily basis by the SUBCONTRACTOR to the CTR and must document all craft and equipment down time. The CTR shall review and approve or deny the request. If denied, the CTR shall indicate the reason for denial on the report. No request for down time will be accepted more than ten (10) working days after the occurrence. A cost proposal shall be submitted for approved down time within three (3) working days of the incident.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF CONTRACTOR FURNISHED EQUIPMENT

Not Applicable

3.2 SCHEDULE OF GOVERNMENT FURNISHED EQUIPMENT

Not Applicable

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01110-0920
SUMMARY OF WORK

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER Thomason — DATE 10/28/04

SPEC-01110-0920
SUMMARY OF WORK

PART 1 GENERAL

1.01 PROJECT DESCRIPTION

A. Work of this Contract comprises the construction of a Synthetic Geocomposite Cover at the Present Landfill at the Rocky Flats Environmental Technology Site (RFETS), Golden, Colorado. Major items of the work include, but are not limited to:

1. Mobilization and site preparation, to include, but not be limited to:

   a. Preparation of storage areas, laydown areas, temporary soil stockpile areas, operations support areas, and access roads. As necessary, these areas shall be graded to provide all-weather access and facilitate drainage, and gravel surfaces shall be placed to prevent tracking of mud into the existing area access roads.
   b. Coordination to set up contractor-supplied water service.
   c. Installation of a temporary generator, capable of supplying adequate current to satisfy site office and equipment calibration needs. It is assumed that this unit will be self-contained, not requiring a separate fuel storage tank. The generator will be placed in a lined and bermed area to provide secondary containment needs as they relate to on-site fuel storage.
   d. Placement of the site administrative area for the construction team, to include three office trailers, break area trailer, and temporary containers for storage activities (health and safety supplies and tool storage).
   e. Trailer must include office space for subcontractor, superintendent, Construction Quality Assurance Engineer, DESIGNER, and CTR.
   f. Placement of access control fencing.
   g. Establishing protected site survey benchmarks to provide for readily accessible horizontal and vertical control points.
   h. Establishing of temporary haul roads, and implementation of a hauling protocol for RFETS security.

2. Preparation of on-site soil borrow area, to include, but not be limited to:

   a. Establishing the final excavation layout (areal extent, cut staking, and slope staking).
   b. Establishing access control and traffic warning signage.
   c. Installing provisions for a local water source to provide for soil moisture conditioning and control (as required).
   d. Clearing vegetation and debris from the surface to be excavated.

3. Preparation of temporary haul routes on RFETS property, to include, but not be limited to: land survey of proposed routing, setting new gates and

fencing, clearing and preliminary grading, installation of drainage culverts, placement of geotextile reinforcing fabric, as necessary, in proposed roadway, and placement of temporary roadway materials.

4. Preparation of the existing interim cap surface, to include, but not be limited to:

   a. Removal/abandonment of the existing landfill gas venting risers.
   b. Removal of all surface debris and rubble items.
   c. Staking and protection of any monitoring wells DESIGNATED by the CTR to remain after the completion of the Synthetic Geocomposite Cover installation.
   d. Clearing and grubbing, executed in two ways: Close mowing of the vegetation on the existing Interim Cover in the area defined by the assumed extent of the synthetic geocomposite cover, and normal clearing and grubbing actions for the areas on the steeper east face of the Present Landfill (e.g. faces of existing dam).

5. Establishing base grades for Synthetic Geocomposite Cover surface. Perform excavation and manipulation of materials from the existing Interim Cover surface and imported soil material to establish the design base grades required to allow for placement of the final Synthetic Geocomposite Cover system such that boundaries and slopes tie in smoothly as the Synthetic Geocomposite Cover is placed. This step shall include placement and compaction of limited on-site import materials to establish final grades required by the design.

6. Pre-compaction and Proof Rolling. Upon completion of the clearing and grubbing and establishing of base grades, the remaining undisturbed surface of the landfill will be traversed by a heavy compactor, and the surface will be proof-rolled using loaded heavy construction equipment to establish any soft areas that may affect Synthetic Geocomposite cover performance. Areas shown to indicate unacceptable deflection (in the order of 1-3 inches) upon proof-rolling shall be repaired in accordance with these specifications.

7. Execution of a constructability assessment. Prior to placing components of the Synthetic Geocomposite Cover system, the Subcontractor will establish acceptable procedures for placement of the soils and demonstrate the procedures by executing assessment on a small portion of the landfill. The test fill area will have a width at least four times the equipment width and a length at least twice the equipment length. The procedures used to construct the assessment area will demonstrate conformance with the final design specification requirements associated with density and moisture content. The Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA) will then have the opportunity to informally evaluate and sign off on this procedure prior to its approval for use by the subcontractor. Once construction procedures are demonstrated that provide compliance with the specifications, the procedures will be used throughout the placement of these sub-grade soils, with the intent being to obtain a uniform placement and compaction of the soils within the

parameters for compaction set by the final design, and to minimize compaction verification sampling and testing. Any adjustment in the procedures used must be accompanied by a demonstration that the newly adopted procedures will yield results consistent with specification requirements.

8. Placement of the landfill gas venting system, to include but not be limited to:

   a. Lateral gas collection piping placed as shown on the drawings.
   b. Vents as shown on the drawings.
   c. Header assembly risers as shown on the drawings.

9. Placement of the Synthetic Geocomposite Cover system, to include but not be limited to:

   a. Placing the 6-inch cushion layer of soils directly on the regraded, prepared and proof-rolled Present Landfill surface. The soils comprising the cover system are to be imported clay-loam or sandy clay-loam, and are intended to be placed in one lift, pending results of the constructability assessment. The procedures used to execute the constructability assessment will demonstrate conformance with the final design specification requirements associated with density and moisture content. Once construction procedures are demonstrated that provide compliance with the specifications, the procedures will be used throughout the placement of these soils, with the intent being to obtain a uniform placement and compaction of the soils within the parameters for compaction set by the final design, and to minimize compaction verification sampling and testing. Any adjustment in the procedures used must be accompanied by a demonstration that the newly adopted procedures will yield results consistent with specification requirements.
   b. Placing a Geosynthetic Clay Liner (GCL) directly onto the 6" cushion soil surface.
   c. Placing a 60-mil LLDPE directly onto the GCL layer.
   d. Placing a geocomposite drainage net (GDN) onto the LLDPE.
   e. Placing a 10-inch layer of cushion soils onto the geonet. This layer will be placed in front of equipment so that heavy equipment does not drive directly on the geosynthetic components of the cover.
   f. Placing a 12-inch-thick rock layer onto the 10" cushion layer. This rock layer is to be comprised of durable rock materials and is intended to be placed in a single 12-inch thick layer. The rock will be placed by equipment operating on the 10-inch cushion layer. Heavy equipment will not drive on the rock surface.
   g. Placing a 24-inch layer of rocky flats alluvium soil directly onto the rock layer. This layer is intended to be placed in two 12" loose lifts to achieve a minimum 24 inch thick finished soil layer. The soil will be placed in front of equipment so that heavy equipment does not drive directly on the rock.

h. Replacement of the existing seep treatment system located at the toe of the eastern face of the landfill. The existing concrete vault and steel tank will all be excavated and removed. The existing polyvinyl chloride (PVC) seep collection grid will be kept. The outlet pipe from the PVC seep collection grid will be extended from the former seep collection point approximately 36 feet east at a 2 percent grade to an outlet beyond the 4:1 grade of the proposed eastern structural wedge slope. The pipe will discharge to a multi-step aeration tank. The steps will cause the discharged seep to flow in a waterfall and provide volatilization necessary to treat the water. The outlet pipe will be constructed of 3-inch Schedule 80 PVC double-contained in 5-inch Schedule 80 PVC and will be installed according to Specification Section 11100. The footprints of the existing concrete vault and steel tank will be filled with cushion soil compacted to 95 percent standard Proctor.

i. Establish surface run-off controls by modification to existing drainage features, grading and construction of new features as detailed in the final design package, and installation of channel-lining materials (erosion matting and riprap).

10. Demobilization. This activity will occur throughout the project as various activities are completed and equipment is no longer needed. Any equipment that does come in contact with landfill waste will be decontaminated by steam cleaning before leaving the site. Waste materials will be containerized for temporary storage and transported to the disposal site in accordance with the Waste Management Plan and RFETS Waste Generation Instructions and other waste characterization, handling, and disposition guidance. Contract closeout shall require the disconnecting and removal of all temporary utilities from the site, as well as the removal of support area facilities and materials. All disturbed areas will be graded and included in the vegetation efforts as appropriate. Demobilization activities will be coordinated closely with the CTR with respect to schedule and transportation routes. On-going irrigation plans and needs will be planned into the demobilization as required.

1.02 FORM OF SPECIFICATIONS

A. These Specifications are written in imperative and abbreviated form. Imperative language of Specification sections is directed at SUBCONTRACTOR, unless specifically noted otherwise. Incomplete sentences in Specifications shall be completed by inserting "shall," "SUBCONTRACTOR shall," "shall be," and similar mandatory phrases by inference in same manner as they are applied to notes on Drawings. Words "shall be" shall be supplied by inference where colon (:) used within sentences or phrases. Except as worded to contrary, fulfill (perform) indicated requirements whether stated imperatively or otherwise.

B. Items of Work are specified by section. Specifications or requirements of one or more sections may apply or be referenced in other sections.

C. Provide Work described and comply with requirements stated in each Specification section and Design Drawings unless specifically assigned to others.

1.03 WORK BY OTHERS

A. CONTRACTOR has or may award separate subcontract(s) for performance of certain construction operations identified on the Design Drawings. These operations will be conducted simultaneously with work under this Construction Contract.

1.04 SUBCONTRACTOR'S USE OF PREMISES

A. SUBCONTRACTOR shall have complete use of premises for execution of Work. SUBCONTRACTOR'S use of premises is limited only by CONTRACTOR'S right to perform construction operations with their own forces or to employ separate subcontractors on portions of the site.

B. SUBCONTRACTOR shall confine operations to areas within limits indicated. Portions of site beyond areas in which construction operations are indicated are not to be disturbed.

C. Keep driveways, roads, and entrances serving premises clear and available to CONTRACTOR at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

D. SUBCONTRACTOR will be responsible for their own project site security. All procedures and methods must be approved by RFETS personnel.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01190-0921
PROGRESS MEETINGS

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER Thurston — DATE 10/28/04

SPEC-01190-0921
PROGRESS MEETINGS

PART 1 GENERAL

1.01 SUMMARY

This section covers the required progress meetings that will be held at the project site.

1.02 GENERAL REQUIREMENTS

SUBCONTRACTOR shall administer the following general requirements:

A. Prepare agenda for meetings

B. Make physical arrangements for meetings

C. Preside at meetings

D. Record the minutes; include significant proceedings and decisions

E. Reproduce and distribute copies of minutes before the next meeting to meeting participants and to parties affected by decisions made at the meeting. Furnish three copies of the minutes to the CONTRACTOR.

1.03 ATTENDANCE

Suggested attendance for the progress meetings includes but is not limited to the following:

A. CONTRACTOR'S Technical Representative (CTR)

B. SUBCONTRACTOR'S Construction Manager

C. SUBCONTRACTOR'S Quality Control Site Manager

D. Construction Quality Assurance Engineer

E. Regulatory Agency(ies) Representative (as needed or available)

F. Additional SUBCONTRACTOR personnel as appropriate to the agenda

G. DESIGNER

H. CONTRACTOR'S Contract Administrator

I. Suppliers as appropriate to the agenda

J. Others as appropriate

1.04 SUGGESTED AGENDA

The suggested agenda items for the progress meetings include but are not limited to the following:

A. Safety Report, includes maintenance of quality and safety standards

B. Review and approval of minutes of previous meeting

C. Review of progress since previous meeting

D. Field observations, problems, and conflicts

E. Problems that impede construction schedule and proposed corrective actions

F. Review of off-site delivery schedules

G. Corrective measures and procedures to regain projected schedule

H. Revisions to construction schedule

I. Projected progress during succeeding work period

J. Coordination of schedules

K. Review submittal schedules; expedite as required

L. Changes and substitutions, if required

M. Review proposed changes for effect on construction schedule and on completion date, and effect on other contracts of the project

N. Other business as appropriate

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 MINIMUM REQUIREMENTS

CONTRACTOR shall schedule and administer at least one progress meeting weekly and such additional meetings as necessary to meet project needs. These meetings shall be held at the project site.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01200-0922
WARRANTY OF CONSTRUCTION

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

SPEC-01200-0922
WARRANTY OF CONSTRUCTION

PART 1 WARRANTY OF CONSTRUCTION

1.01 Foremost and in addition to any other warranties in this contract, the SUBCONTRACTOR warrants, except as provided in paragraph 1.10 of this clause, that work performed under this contract conforms to the contract requirements and is free of defects in equipment, material, or workmanship performed by the SUBCONTRACTOR and any of his subcontractors or suppliers at any tier.

1.02 WARRANTY DURATION

A. The warranty for the Present Landfill Synthetic Geocomposite Cover Construction shall extend for 1 year from the date of acceptance by the CONTRACTOR.

B. The warranty for site reconstruction work shall continue for a period of 1 year from the date of final acceptance of the work. If the CONTRACTOR takes possession of any part of the work before final acceptance, this warranty shall commence for that part on the date of possession and continue for a period of 1 year.

1.03 The SUBCONTRACTOR shall remedy, at the SUBCONTRACTOR'S expense, any failure to conform to the intent of the design, or any defect. In addition, the SUBCONTRACTOR shall remedy, at the SUBCONTRACTOR'S expense, any damage to CONTRACTOR-owned or controlled real or personal property, when that damage is the result of:

A. The SUBCONTRACTOR'S failure to conform to contract requirements; or

B. Any defect of equipment, material, workmanship, or design furnished by the SUBCONTRACTOR.

1.04 The SUBCONTRACTOR shall restore any work damaged in fulfilling the terms and conditions of this clause.

1.05 The SUBCONTRACTOR'S warranty with respect to work restored, repaired or replaced will run for 1 year from the date of restoration, repair or replacement. This provision applies equally to all items restored, repaired, or replaced under paragraphs 1.03 and 1.04 above.

1.06 The CONTRACTOR will notify the SUBCONTRACTOR, in writing with substantiation, within a reasonable time after the discovery of any failure, defect, or damage that is due to a defect in the SUBCONTRACTOR'S materials, equipment, or workmanship. Repair work necessary to correct a warranty condition which arises to threaten the health or safety of personnel, the physical safety of property or equipment, or which impairs operations, etc., will be performed by the SUBCONTRACTOR on an immediate basis as directed verbally by the CONTRACTOR. Written verification will follow verbal instruction.

1.07 Failure of the SUBCONTRACTOR to respond to written direction will be cause for the CONTRACTOR to have the warranty repair work performed by others and to proceed against the SUBCONTRACTOR as outlined in the paragraph 2.01. If the SUBCONTRACTOR fails to remedy such a failure, defect, or damage within a reasonable time after receipt of notice, the

CONTRACTOR shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the SUBCONTRACTOR'S expense, as outlined in paragraph 2.01.

1.08 With respect to all warranties, expressed or implied, from SUBCONTRACTORS, manufacturers, or suppliers for work performed and materials furnished under this contract, the SUBCONTRACTOR shall:

A. Obtain all warranties that would be given in normal commercial practice;

B. Require all warranties to be executed, in writing, for the benefit of the CONTRACTOR.

1.09 Unless a defect is caused by the negligence of the SUBCONTRACTOR or supplier/SUBCONTRACTOR at any tier, the SUBCONTRACTOR shall not be liable for the repair of any defects of material or design furnished by the CONTRACTOR nor for the repair of any damage that results from any defect in CONTRACTOR-furnished material or design.

1.10 This warranty shall not limit the CONTRACTOR'S right under the contract with respect to latent defect, gross mistakes, or fraud.

PART 2 ADDITIONAL WARRANTY REQUIREMENTS

2.01 PERFORMANCE

A. If either the SUBCONTRACTOR or his representative does not diligently pursue warranty work to completion, the SUBCONTRACTOR and his surety will be liable for all costs. The CONTRACTOR, at its option, will either have the work performed by others or require the surety to have it done. Both direct and administrative costs will be reimbursable to the CONTRACTOR.

2.02 PRE-WARRANTY CONFERENCE

A. Prior to contract completion and at a time designated by the CONTRACTOR, the SUBCONTRACTOR shall meet with the CONTRACTOR to develop a mutual understanding with respect to the requirements of the Paragraph: WARRANTY OF CONSTRUCTION. Communication procedures for SUBCONTRACTOR notification of warranty defects, priorities with respect to the type of defect and other details deemed necessary by the CONTRACTOR for the execution of the construction warranty shall be established/reviewed at this meeting.

B. In connection with these requirements and at the time of the SUBCONTRACTOR'S quality control completion inspection, the SUBCONTRACTOR will furnish the name, telephone number and address of the representative that is authorized to initiate and pursue warranty work action on behalf of the SUBCONTRACTOR and surety. This single point of contact will be located within the local service area of the warranted construction, will be continuously available, and will be responsive to CONTRACTOR inquiry on warranty work action and status. This requirement does not relieve the SUBCONTRACTOR of any Contractual responsibilities in connection with the paragraph: WARRANTY OF CONSTRUCTION.

C. Local service area is defined as the area in which the SUBCONTRACTOR or his representative can meet the response times as described in paragraph 2.03 and in any event shall not exceed 200 miles radius of the construction site.

2.03 WARRANTY SERVICE CALLS

The SUBCONTRACTOR will respond to the site within twenty-four (24) hours of a call from the site.

PART 3 SUBMITTALS

The following shall be submitted in accordance with Section 01300-0924:

Names of service representatives that will make warranty calls along with the day, night, weekend and holiday contacts for response to a call within the time period specified.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01270-0923
MEASUREMENT AND PAYMENT

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

SECTION 01270
MEASUREMENTS AND PAYMENTS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. This section identifies Bid items by number and lists applicable Specification sections and method of payment and measurement.

B. Provide labor, materials, equipment, supervision, and other services to construct each Bid item as required by Contract Documents.

1.02 DESCRIPTION OF BID ITEMS - GENERAL

A. Bid Items No. 1, 2, 3, and 4: Mobilization/Demobilization and Project administration.

1. Materials and installation as described below.

   a. General and Special Provisions.
   b. Section 01722: Field Engineering.
   c. Section 01270: Measurements and Payments.
   d. Section 01300: Submittal Descriptions.
   e. Section 01500: Temporary Construction Facilities.
   f. Section 01430: Environmental Protection.
   g. Section 02110: Site Preparation.
   h. Other sections containing appurtenant and incidental Work.

2. Include cost of:

   a. Job preparation, administration, and Project closeout.
   b. Submittals.
   c. Cleaning and dust control.
   d. Temporary facilities.
   e. Environmental protection measures and employee sanitation needs.
   f. Moving construction equipment onto and off of construction site.
   g. Coordination of Subcontractors.
   h. Permits and notifications.
   i. Surveying and replacement of survey movements.
   j. Temporary site work.
   k. Project construction trailers and offices.
   l. Soils and materials testing performed for CONTRACTOR'S information.
   m. Temporary site work construction and removal.
   n. Other appurtenant and incidental Work.
   o. General requirements of sections listed.

3. Do not include cost of:

   a. Traffic control.
   b. Work included in other Bid items.

4. Measurement for Payment:

a. Monthly payments will be made in accordance with following formula.

1.) First month payment =
0.20 x contract lump sum price
2.) Last month payment =
0.10 x contract lump sum price
3.) Intervening month payment =
0.7 x contract lump sum price x percent of work completed during invoice period.
(final completion)
4.) Invoice payment reduced by 10 percent retainage.

b. Mobilization bid item may not exceed 5% of Project total.

5. Payment:

a. Include cost of Work listed herein in lump sum price bid.

1.03 DESCRIPTION OF BID ITEMS - EARTHWORK

A. Bid Item No. 5: Earthwork

1. Material and installation as described below.

a. Section 02110: Site Preparation.
b. Section 02221: Earthwork
c. Other sections containing appurtenant and incidental Work.

2. Include cost of:

a. Excavation, removal, and disposal of material above grade shown on Drawings or as authorized by CTR.
b. Protecting existing utilities, site objects, and new work which are to remain in service after completion of cover.
c. Removal, stockpiling, replacement, and compaction of cohesive materials as shown on Drawings to allow for placement of geomembrane liners and geotextile fabric.
d. Clearing and grubbing prior to excavation.
e. Stockpiling topsoil after stripping from areas to be cut.
f. Clean up.

3. Do not include cost of:

a. Excavation, removal, and disposal beyond grades shown or authorized limits set by CTR.
b. Excavation, removal, and disposal of material required to be excavated, removed or disposed by other Bid items.
c. Geomembranes or geotextiles.
d. Restoration of surface.

4. Measurement of Payment:

a. Monthly payments will be made on a time and materials basis.

5. Payment:

Include earthwork time and materials.

B. Bid Item Nos. 6 and 12: Rock layer material placement.

1. Materials and installation as described below.

a. Section 02222: Rock Layer, and 02245: Stone and Aggregate Material.
b. Other sections containing appurtenant and incidental Work.

2. Include cost of:

a. Granular materials, and placement.
b. Clean up.

3. Do not include cost of:

a. Granular materials, placement, and compaction outside of pay limit lines.
b. Bedding, cover, and backfill materials, and placement and compaction.
c. Work included in other Bid items.

4. Measurement for Payment:

a. Measure, in tons, quantity of aggregate material placed as ground cover.
b. Copies of load tickets shall be submitted as verification of quantities used.

5. Payment:

a. Include cost of Work in unit price bid for granular material placement.

C. Bid Item Nos. 7, 8, 9, and 10: GDN, GCL, geomembrane liner, and erosion matting.

1. Materials and installation as described below.

a. Section 02110: Site Preparation.
b. Section 02224: Geocomposite Drainage Net.
c. Section 02225: LLDPE Geomembrane Liner.
d. Section 02226: Geosynthetic Clay Liner.
e. Section 02227: Erosion Matting.
f. Other sections containing appurtenant and incidental Work.

2. Include cost of:

a. Site preparation.
b. Rolling and compacting surface to receive material.
c. Deploying liner and fabric.

d. Seaming liner by extrusion or fusion welding.
e. Seaming fabric by sewing or hot air gun.
f. Clean up.

3. Do not include cost of:

a. Excavation or placement of earth cover on liner and fabric.
b. Geotextile fabric used in trenches or at other locations.
c. Work included in other Bid items.

4. Measurement for Payment:

a. Measure liner and fabric in square yards actually installed in-place by surveying, excluding overlaps.

5. Payment:

a. Include cost of Work in unit prices bid for geomembrane liner, geocomposite, GCL, or geotextile fabric drain.

D. Bid Item No. 14: Seeding.

1. Materials and installation as described below.

a. Section 02110: Site Preparation.
b. Section 02900: Seeding.
c. Other sections containing appurtenant and incidental Work.

2. Include cost of:

a. Site preparation.
b. Protecting existing utilities, site objects, and new work.
c. Providing and salvaging topsoil and installation thereof.
d. Final grading to lines and grades specified.
e. Providing and installing seed as appropriate, with mulch, fertilizer, and watering if required.
f. Clean up.
g. Other appurtenant and incidental Work.
h. General requirements of sections listed.

3. Do not include cost of:

a. Work outside of pay limit lines shown on Drawings.
b. Work included in other Bid items.

4. Measurement for Payment:

a. Calculate area by surveying in acres for seeding as measured in-place within pay limit lines.

5. Payment:

a. Include cost of Work in unit price bid for appropriate Bid item.

E. Bid Item No. 11: Erosion Control

F. Bid Item No. 15: Seep Passive Treatment System

G. Bid Item No. 16: Passive Landfill Gas Venting System

PART 2 PRODUCTS

(Not Used)

PART 3 EXECUTION

(Not Used)

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01300-0924
SUBMITTAL DESCRIPTIONS

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

R Hamilton 10/28/04

PROJECT CHIEF ENGINEER — DATE

R Hamilton

SPEC-01300-0924
SUBMITTAL DESCRIPTIONS

PART 1 GENERAL

1.01 SUBMITTALS

The submittals described below are those required and further described in other sections of the specifications. Other requirements pertaining to submittals are included in the SPECIAL CLAUSES and Section 01305: SUBMITTAL PROCEDURES. Submittals required by the CONTRACT CLAUSES and other non-technical parts of the contract are not included in this section.

A. Data. Submittals, which provide calculations, descriptions, or documentation regarding the work.

B. Drawings. Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

C. Instructions. Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

D. Schedules. Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

E. Statements. A document, required by the Vendor, or through the Vendor, from a supplier, installer, manufacturer, or other lower tier Vendor, the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verifications of quality.

F. Reports. Reports of inspections or tests, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.

G. Certifications. Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the product, system or material meets specified requirements. The statement must be dated after the award of this contract, must state the Vendor's name and address, must name the project and location, and must list the specific requirements that are being certified.

H. Samples. Samples, including both fabricated and non-fabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

I. Records. Documentation to record compliance with technical or administrative requirements.

J. Operation and Maintenance Manuals. Data, which forms a part of an operation and maintenance manual.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

Submittals prepared pursuant to this specification shall be done in accordance with Section 01305: SUBMITTAL PROCEDURES.

3.01 Submittals are required for the following materials:

a. Cushion and Foundations layers
b. GCL
c. LLDPE Liner
d. Geocomposite
e. Rock Layer
f. Seeding
g. Passive Landfill Gas Venting System
h. Seep Passive Treatment System
i. Erosion Matting

3.02 Detailed construction schedule is as follows:

a. Submittals for all materials required ten (10) calendar days after contract is awarded. Expected date of award: April 2, 2004
b. Mobilization – 10 days total
c. Subgrade Preparation – 10 days of cutting activities, 25 days of filling activities, for a total of 35 days
d. 6-inch Cushion Layer – included in the subgrade preparation
e. Liner Installation (placement of GCL, LLDPE, Geonet) with 10-inch cushion layer placed concurrent as liner is placed – 40 days total
f. Biota Layer Placement – lag 10 days behind liner placement, 40 days total
g. 24-inch soil cover – lag 10 days behind rock placement, 25 days total
h. Seeding – 5 days total
i. Perimeter Drainage Ditches – 30 days total concurrent with subgrade preparation
j. Passive Treatment System – 30 days total also concurrent with subgrade preparation
k. Completion Date, assuming an April 2, 2004, NTP of August 20, 2004.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01305-0925
SUBMITTAL PROCEDURES

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER Humiston — DATE 10/28/04

SPEC-01305-0925
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY (Not Applicable)

1.02 REFERENCES (Not Applicable)

1.03 RESPONSIBILITIES

A. SUBCONTRACTOR and CONTRACTOR Responsibilities

The SUBCONTRACTOR is responsible for management of his work including scheduling, control, and submittals. The submittal management system provided in these specifications is intended to be a complete system for the CONTRACTOR and SUBCONTRACTOR to use to control the quality of materials, equipment and workmanship provided by manufacturers, fabricators, suppliers and SUBCONTRACTORS. The CONTRACTOR and SUBCONTRACTOR shall review each submittal for contract compliance. Submittals that do not conform will be returned to the originator to be corrected. A Submittal Register will be utilized to log and monitor all submittal activities. The Submittal Register shall be provided by CONTRACTOR to SUBCONTRACTOR prior to the Preconstruction Conference. No construction or installation activities shall be performed prior to required approvals of applicable submittals. The SUBCONTRACTOR shall perform a check to ensure that all materials and/or equipment have been tested, submitted and approved during the preparatory phase of quality control inspections.

B. CONTRACTOR Responsibilities

The CONTRACTOR will prepare a list of submittals based on the requirements set forth in the drawings and specifications. This list will be prepared on the Submittal Register. The CTR will review submittals for approval and approve those that conform to contract requirements. The approval of submittals by the CONTRACTOR shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the SUBCONTRACTOR of the responsibility for any error that may exist, as the SUBCONTRACTOR under the CQC requirements of this contract is responsible for the dimensions and design of adequate connections, details and satisfactory construction of all work. After submittals have been approved, no resubmittal for the purpose of substituting materials or equipment will be given consideration unless accompanied by justification as to why a substitution is necessary.

1.04 SUBMITTAL CLASSIFICATION

CONTRACTOR approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the CONTRACTOR. Within the terms of the contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.05 CATEGORIES OF SUBMITTALS

The CONTRACTOR's approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information is satisfactory. Approval will not relieve the subcontractor of the responsibility for any error that may exist, as the subcontractor under the CQC requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been approved by the CONTRACTOR, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.06 DISAPPROVED SUBMITTALS

The SUBCONTRACTOR shall make all corrections required by the CONTRACTOR and promptly furnish a corrected submittal in the form and number of copies as specified for the initial submittal. If the SUBCONTRACTOR considers any correction indicated on the submittals to constitute a change to the contract, notice as required under the Contract Clause entitled "Changes" shall be given promptly to the CONTRACTOR.

1.07 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required submittals/approvals have not been obtained.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 GENERAL

The SUBCONTRACTOR shall submit all items listed on the Submittal Register or specified in the other sections of these specifications. The CONTRACTOR may request submittals in addition to those listed when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same used in the contract drawings. Submittals shall be made in the respective number of copies and to the respective addresses set forth below. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with all contract requirements. Prior to submittal, all items shall be checked and approved by the SUBCONTRACTOR and each respective Transmittal Form shall be signed and dated by the SUBCONTRACTOR certifying that the accompanying submittal complies with all the contract requirements. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: SUBCONTRACTOR'S, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals including parts list; certifications; warranties and other such required submittals. Submittals requiring approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby.

3.02 SUBMITTAL REGISTER

The CONTRACTOR will be furnished one copy of the Submittal Register at the preconstruction conference on which will be listed each item of equipment and material of each type for which fabricators drawings, and/or related descriptive data, test reports, samples, spare parts lists, O&M manuals, or other types of submittals are required by the specifications. The submittal register will also include respective addresses and required copies. The approved submittal register will become the scheduling document and will be used to control submittals throughout the life of the contract. This register and the progress schedules shall be coordinated.

3.03 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Submittals are scheduled to be delivered seven (7) calendar days after contract award. Certifications to be submitted with the pertinent drawings shall be so scheduled. Adequate time (a minimum of seven (7) calendar days exclusive of mailing time) shall be allowed on the register for review and approval. No delays, damages, or time extensions will be allowed for time lost in late submittals.

3.04 TRANSMITTAL FORM

A formal transmittal form shall be used for submitting submittals. This form shall be properly completed by filling out all the heading blank spaces and identifying each item submitted. Special care will be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

3.05 SUBMITTAL PROCEDURE

All items listed on the Submittal Register shall be mailed directly to the CTR. The mailing address is:

Mr. Bob Davis
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B, Building 116
Golden, Colorado 80403-8200

All catalog and descriptive data shall be submitted in three (3) copies. Catalog cuts and other descriptive data which have more than one model, size, or type or which shows optional equipment shall be clearly marked to show the model, size, or type and all optional equipment that is proposed for approval. Submittals on component items forming a system or that are interrelated shall be submitted at one time as a single submittal in order to demonstrate that the items have been properly coordinated and will function as a unit.

A. Certificates of Compliance

Each certificate shall be signed by an official authorized to certify on behalf of the manufacturing company and shall contain the name and address of the SUBCONTRACTOR, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the SUBCONTRACTOR from furnishing satisfactory material, if,

after tests are performed on selected samples, the material is found not to meet the specific requirements.

B. Deviations

The SUBCONTRACTOR shall set forth in writing the reason for any deviations and annotate such deviations on the submittal. The CONTRACTOR/ENGINEER reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

3.06 CONTROL OF SUBMITTALS

The SUBCONTRACTOR shall carefully control his procurement operations to ensure that each individual submittal is made on or before the SUBCONTRACTOR scheduled submittal date shown on the approved "Submittal Register."

3.07 CONTRACTOR APPROVED SUBMITTALS

Upon completion of review of submittals, the submittals will be identified as having received approval by being so stamped and dated.

The drawing print and three (3) sets of all catalog data and descriptive literature will be given to the CTR. After approval, the CTR will return one to the SUBCONTRACTOR.

3.08 STAMPS

Stamps used by the SUBCONTRACTOR on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

SUBCONTRACTOR

(Firm Name)

☐ Approved

☐ Approved with corrections as noted on submittal data and/or attached sheets(s).

☐ Revise and Resubmit

Signature:

Title:

Date:

3.09 DISPOSAL OF SUBMITTAL SAMPLES

When submittal samples are no longer required for review or testing, the SUBCONTRACTOR shall, upon notification from the CONTRACTOR, pick up and dispose of the samples in accordance with manufacturers' Material Safety Data Sheets (MSDS), all applicable Federal, State, and local regulations, and in a manner approved by the CONTRACTOR.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01310-0926
CONSTRUCTION SURVEYING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER 10/28/04 DATE

Humiston

SPEC-01310-0926
CONSTRUCTION SURVEYING

PART 1 GENERAL

1.01 SUMMARY

A. SUBCONTRACTOR RESPONSIBILITIES

1. Vertical and horizontal control shall be established by SUBCONTRACTOR in the form of benchmarks prior to starting work at the project site. SUBCONTRACTOR shall choose which type of surveying equipment to use (GES, total station, etc.). All construction staking shall be the responsibility of SUBCONTRACTOR. In addition, SUBCONTRACTOR shall be responsible to review all construction staking with ENGINEER and CONTRACTOR to identify the features staked.

2. SUBCONTRACTOR shall perform record surveys for certification in accordance with the Specification Sections 01720: Project Record Documents, and 01722: Field Engineering.

3. Survey work shall be performed under the direction of a Professional Land Surveyor registered in the State of Colorado.

B. Primary Control Monuments

Established benchmarks shall be verified by SUBCONTRACTOR to establish primary vertical and horizontal control for Work.

1.02 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS and Section 01305 SUBMITTAL PROCEDURES:

A. Computations for control stations and benchmarks.

B. Field notes.

C. Survey data.

D. Record Surveys.

PART 2 PRODUCTS

1.01 Record Surveys

Record surveys for the surfaces and layer thicknesses will include the information and details as described in the QA/QC Plan. These surveys must be stamped by a Colorado licensed land surveyor, approved by CTR and submitted to the CONTRACTOR for final acceptance.

PART 3 EXECUTION

3.01 BENCHMARKS

Permanent horizontal/vertical control monuments will be established at the landfill site, as appropriate. Each monument will be assigned 3rd order State Plane coordinates and Mean Sea Level elevations as well as coordinates adjusted to RFETS datum.

A. Accuracy

The site survey work shall meet or exceed the horizontal and vertical accuracy criteria as defined by the Standards and Accuracy and General Specifications of Geodetic Control Surveys established by the U.S. Department of Commerce. Horizontal control positions (i.e., benchmarks) shall be within Third Order, Class I accuracy and accomplished by those standards. Drawing 51781-004 of the Accelerated Action Design for the Present Landfill presents the control monuments in the project area. The closing error of control leveling for the survey/monuments shall not exceed 0.05 foot times the square of M, where M is the miles of leveling. Computations for all control stations and benchmarks shall be furnished to the CONTRACTOR upon request.

3.02 CONSTRUCTION LINE AND GRADE

SUBCONTRACTOR shall bear sole responsibility for correct transfer of construction lines and grades from benchmarks for the correct alignment and grade of completed Work based on lines and grades shown on Drawings. SUBCONTRACTOR shall establish vertical and horizontal reference control stakes in the proximity of the work.

A. Survey Accuracy

Vertical Surveys shall be reported to the nearest 0.1 foot. Horizontal surveys shall be reported to the nearest 0.1 foot.

B. Datum for Control

Horizontal coordinates shall be based on the Rocky Flats coordinate system. Elevations shall be based on Mean Sea Level NAV 88.

C. Construction Staking and Record Surveys

1. Elevations shall be taken on existing ground using the control point locations given in the Drawings prior to construction for use as reference data for verification of record quantities.

2. Rough cut/fill stakes shall be set for the final cover subbase when SUBCONTRACTOR starts construction. Alternately, SUBCONTRACTOR may use laser-guided equipment.

3. Record surveys for the required layers shall be performed as described in the QA/QC Plan.

C. Data Transfer

If requested by CONTRACTOR, SUBCONTRACTOR shall provide a copy of field notes in a neat and legible format to CONTRACTOR at the end of the day upon which the survey is performed. In addition, at least once per each week survey work is performed, a copy of the survey data shall be submitted on a high density, 1.44 MB, 3.5" diskette (or approved alternative), in a standard ASCII file format. Coordinates should be input as decimal numbers in columns for point ID, northing, easting and elevation. Blanks, tabs, or commas shall separate all columns.

3.03 SURVEYED ITEMS

Surveying will be conducted at a minimum to support the production of the following as-built record drawings:

1. Top of regrade surface, and sample locations (vertical tolerance of ±0.1 feet).
2. Top of 6-inch cushion layer, and sample locations (vertical tolerance of –0 to +0.2 feet).
3. Gas system alignments.
4. Geosynthetic panel layout and sample and repair locations.
5. Top of 10-inch cushion layer and sample locations (vertical tolerance of –0 to +0.2)
6. Anchor trench alignment.
7. Top of rock layer (vertical tolerance of –0 to +0.2 feet).
8. Top of final cover surface, and sample locations (vertical tolerance of –0 to +0.2 feet).
9. Perimeter channel, with slope and width.
10. Diversion berm toe of slope.
11. Seep treatment system layout.
12. Final project completion site topographic map.

3.04 SURVEY MONUMENTS

SUBCONTRACTOR shall protect survey monuments marked by CONTRACTOR existing throughout Project area. If monuments are damaged, the SUBCONTRACTOR shall advise CONTRACTOR immediately. SUBCONTRACTOR shall replace damaged monuments by a Registered Land Surveyor at SUBCONTRACTOR'S expense.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01320-0927
CONSTRUCTION PHOTOGRAPHS

(APPROVED)	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE

10/28/04

Humiston

SPEC-01320-0927
CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.01 SUMMARY

This section covers the required construction photographs to be taken at the site.

1.02 GENERAL REQUIREMENTS

SUBCONTRACTOR shall take construction record photographs periodically during the course of work. The SUBCONTRACTOR shall coordinate and obtain the appropriate camera pass through the CONTRACTOR. The SUBCONTRACTOR shall comply with all Rocky Flats Environmental Technology Site (RFETS) regulations and procedures associated with the operation of a camera on the RFETS property.

1.03 SUBMITTALS

A. Pre-work Photographs

Take views of general site showing location and arrangement of facilities, equipment, fencing, and access roads.

B. Progress Photographs

After work has started at site, photographically record progress of Work. Include coverage of following:

1. Site preparation.

2. Fine grading and subgrade preparation.

3. Construction of the Synthetic Geocomposite Cover.

Photographs shall illustrate conditions and location of work and state of progress. Photograph from locations to adequately illustrate condition of construction:

1. At each location to adequately illustrate condition of construction.

2. At successive periods of photography, take at least one photograph from the same overall view as previous.

   Actual number and location of views to be taken for progress photographs shall be as directed by CONTRACTOR or his representative.

C. Post-Work Photographs

After completion of work, SUBCONTRACTOR shall take sufficient views of general site to record post-work condition using wide angle lens.

D. Negatives

If transfer of electronic formats to film is necessary, negatives shall remain property of CONTRACTOR.

1.04 QUALITY ASSURANCE

A. Use digital color camera, and provide Windows-based program to view photographs.

PART 2 PRODUCTS

2.01 PRINTS *(The following section applies only when generating prints from electronic versions)*

A. Color

1. Paper

Commercial quality, single weight, white base

2. Finish

Smooth surface, glossy

3. Size

a. Prework, Post Work: 3-1/2-in. by 5-in.

b. Progress: 3-1/2-in. by 5-in.

B. Identification

Each print shall show, by photographic means, information box, 1 in. by 2 in. taped to the back of the photograph.

Box shall be typewritten and arranged as follows.

Accelerated Action Present Landfill
Project No.: _____ Contract No.: _____
Contractor: _____
Photograph No.: _____ Date: _____
Description: _____

PART 3 EXECUTION

3.01 TECHNIQUE

A. Factual presentation

B. Correct exposure and focus

High resolution and sharpness
Maximum depth-of-field
Minimum distortion

C. Floppy disks shall be stored as to prevent damage.

3.02 DELIVERY OF PRINTS AND ELECTRONIC MEDIA

Deliver electronic versions of each photograph, stored on CD-ROMs upon project completion. Photographs and electronic media shall be CONTRACTOR property and not released by SUBCONTRACTOR to anyone except CONTRACTOR or his representative. If requested "Hard copies" or prints of photographs shall be prepared and enclosed back-to-back in double-faced plastic sleeve punched to fit standard 3-ring binder. Both electronic versions and hard copies of photographs shall be properly identified by including the project number, date, and general description of the presentation.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01350-0928
SPECIAL PROCEDURES
MATERIALS AND WASTE HANDLING

(APPROVED)	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

Humiston

SPEC-01350-0928
SPECIAL PROCEDURES
MATERIALS AND WASTE HANDLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division I Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedures that the Subcontractor must follow for proper handling and disposal of various forms of waste at RFETS.

B. Related Sections include the following:

1. General Provisions for project specific Health and Safety Plan.

1.3 DEFINITIONS OF WASTE

A. Onsite Sanitary Waste - Excess excavated materials, asphalt street paving, and waste generated during construction shall be handled in accordance with the Sanitary Waste Disposal Procedure (SWODP), I-PRO-573-SWODP.

B. Hazardous Waste - Those waste materials exhibiting a hazardous characteristic (ignitibility, corrosivity, reactivity, or toxicity) or are listed in Colorado Hazardous Waste Regulations 6CCR-1007-3 will be handled in accordance with the Hazardous Waste Requirements Manual (HWRM) Number 1-10000-HWRM. Examples of hazardous wastes include- paint thinners, Freon, epoxy, and enamel paints.

C. TSCA Waste - Those waste materials identified and controlled under the Toxic Substance Control Act. Examples of TSCA wastes include materials containing asbestos and PCB's (Polychlorinated Biphenyl's).

1.4 PROCEDURES

A. The Subcontractor shall closely adhere to the following procedures to assure that all waste generated during construction will be properly dispositioned and disposed:

1. All material and equipment being removed from the construction area shall be monitored by Contractor's Radiation Monitoring group before being removed from the area.

2. Subcontractor shall, at all times, keep the work area clean and orderly. All debris, scrap, and rubble shall be removed from the area as it is generated. At the end of each work shift, the work area shall be clean and left in a neat and orderly manner. Access routes for other personnel shall be kept clear at all times.

3. Installed equipment and materials removed by the Subcontractor under this contract, and authorized to be reused in the work, shall remain the property of the Contractor. All such equipment and material shall be properly identified and delivered to the Contractor as directed. The Subcontractor shall use care in removing salvageable materials and equipment so as not to cause undue damage that may render the equipment or materials unusable.

4. Materials containing TSCA wastes shall be handled and stabilized in accordance with the RFETS TSCA Management Plan, TSCA Guidance No. 32.

1.5 WASTE DISPOSAL SITES

A. Sanitary Waste will be handled and disposed of by the Sanitary Waste Collection/Disposal Contractor at an approved offsite commercial landfill that complies with all applicable Federal, State, and Local regulations and the offsite sanitary landfill waste acceptance criteria. Subcontractor shall ensure that Sanitary Wastes are segregated from other wastes.

B. Hazardous Waste will be handled, shipped and disposed of in accordance with HWRM at a DOE approved disposal site. In order to minimize hazardous waste volume, Subcontractor shall ensure that sanitary wastes are not mixed with hazardous wastes.

C. TSCA Waste will be handled, shipped and disposed of in accordance with the RFETS TSCA Management Plan, TSCA Guidance No. 32 to a TSCA certified disposal site. In order to minimize TSCA waste volume, Subcontractor shall ensure that sanitary wastes are not mixed with TSCA wastes.

1.6 WASTE SEGREGATION, CONTROLLED RELEASE AREAS

A. All areas of the plant have the potential to contain multiple types of waste, including sanitary and hazardous waste. This section deals with the segregation and disposal of waste from these areas. Subcontractor shall prepare sanitary waste, for disposal and assure that it meets the requirements defined in SWODP.

1. Recycling and reuse options should be considered before the sanitary waste is sent to a landfill or other disposal site as dictated by federal and state regulations and DOE Orders.

a. Any discardable items eligible for recycle shall be separated from the sanitary waste and placed in the proper recycle containers or recycled through Property Utilization and Disposal. Recycle Programs accept the following:

1) Office paper
2) Aluminum Cans
3) Printer cartridges
4) Cardboard
5) Scrap metal
6) Food/biodegradable cafeteria waste
7) Glass, tin, No. 1 and 2 plastics
8) Phonebooks
9) Newspapers

10) Wood (i.e., pallets)
11) Shrink wrap
12) Computer software manuals

2. Information regarding recycling is in I-B27-REC-001, Rocky Flats Recycling and the Waste Minimization Program Plan.

3. Hazardous waste separated from other waste shall be managed in accordance with the requirements found in HWRM.

1.7 HANDLING AND DISPOSAL OF SANITARY WASTE

A. Subcontractor shall follow the requirements set forth in the SWODP and operate in compliance with all site and governing regulatory requirements. The Sanitary Waste Collection/Disposal Contractor furnishes labor, supervision, and equipment to collect, transport, and, dispose solid sanitary waste and special waste from the site on a scheduled and unscheduled basis.

1.8 HANDLING AND DISPOSAL OF HAZARDOUS WASTE

A. Subcontractor is subject to the responsibilities and tasks identified in various federal and state regulations, as well as those plant procedures that implement federal, state, local and individual disposal site contract standards addressing the generation, handling, treatment, storage, transfer, and/or disposal of hazardous waste.

B. Subcontractors who handle a hazardous waste are responsible for satisfying the requirements of the HWRM from the point of generation to disposal through the accountability procedures established in the HWRM.

1.9 HANDLING AND DISPOSAL OF TSCA WASTE

A. Subcontractor is subject to the responsibilities and tasks identified in various federal and state regulations, as well as those plant procedures that implement federal, state, local and individual disposal site contract standards addressing the generation, handling, treatment, storage, transfer, and/or disposal of TSCA waste.

B. Subcontractors who handle a TSCA waste are responsible for satisfying the, requirements of the TSCA Management Plan from the point of generation to disposal through the accountability procedures established in the TSCA Management Plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

*****END OF SECTION*****

SPEC-01401-0929
SAFETY, HEALTH AND EMERGENCY RESPONSE

PART 1 GENERAL

1.01 SUMMARY

Safety, health and emergency response shall be as detailed in the below-referenced plan. All work performed under the project shall comply with all applicable federal, state and local safety and occupational health rules and regulations.

1.02 REFERENCES (NOT APPLICABLE)

1.03 GENERAL REQUIREMENTS

A. Safety, health and emergency response requirements shall be as detailed in the project-specific Health and Safety Plan (HASP) to be provided by the SUBCONTRACTOR to the CONTRACTOR.

B. Within seven calendar days after receiving the authorization to begin the construction phase of the Subcontract, the SUBCONTRACTOR shall perform a thorough walkdown of the construction site with the CONTRACTOR. Within seven calendar days after the walkdown, the SUBCONTRACTOR shall prepare and submit a draft, project specific HASP to the CONTRACTOR's Project Manager for review and comment.

C. The HASP shall comply with the requirements of 29 CFR 1926.65, Hazardous Waste Operations and Emergency Response, and DOE Order 5480.9A, Construction Project Safety and Health Management, which include the following elements:

1. Job Hazard Analysis (JHA). The HASP shall be in the form of a project-specific JHA, which shall be in the form prescribed by the CONTRACTOR.
2. Hazard Recognition and Control. The HASP shall identify the project-specific controls that will be implemented to address the hazards identified in the project-specific HASP.
3. Personal Protective Equipment. The HASP shall identify the required project-specific personal protective equipment (PPE).
4. Personnel Monitoring. The HASP shall describe the personnel monitoring (e.g. dust) activities that will be performed by the Subcontractor during construction activities.
5. Unanticipated Hazards or Conditions. The HASP shall describe the procedures that will be implemented by the SUBCONTRACTOR in the event of an unanticipated hazard or condition.

D. The SUBCONTRACTOR shall not initiate field work until the final HASP has been approved by the CONTRACTOR.

PART 2 PRODUCTS

The final HASP will be submitted as a bound document.

PART 3 EXECUTION

Safety, health and emergency response actions shall be as detailed in the Health and Safety Plan to be provided to SUBCONTRACTOR by the CONTRACTOR.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01405-0930
TEMPORARY FIRE PROTECTION

(APPROVED)	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

H. Thomas Humiston 10/28/04

PROJECT CHIEF ENGINEER DATE

H. Humiston

SPEC-01405-0930
TEMPORARY FIRE PROTECTION

PART 1 GENERAL

1.01 This section covers SUBCONTRACTOR's responsibilities for the prevention and control of fire at the project site during the contract period.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fire Extinguishers

Fire extinguisher sizing and placement shall comply with requirements of the Rocky Flats Environmental Technology Site (RFETS) Fire Department, but shall basically consist of 20-pound type ABC fire extinguishers.

PART 3 EXECUTION

3.01 TRAINING OF SUBCONTRACTOR PERSONNEL

All SUBCONTRACTOR personnel who may be involved in fire fighting activities shall have received fire fighting training in accordance with OSHA 20 CFR 1910.156. Training shall include dealing with smoke in air supply masks and malfunctions in other protective equipment.

3.02 FIRE FIGHTING EQUIPMENT REQUIREMENTS

A. Site Trailers. A minimum of one fire extinguisher shall be located in each site trailer, depending on final size and configuration of trailer floor space.

B. Equipment. Each piece of equipment operated on the project site shall be equipped with one fire extinguisher, readily accessible to the equipment operator.

C. Seep passive treatment system construction site. One fire extinguisher will be located at the seep passive treatment system construction site.

3.03 OUTSIDE ASSISTANCE

The SUBCONTRACTOR shall prearrange for the services of the RFETS Fire Department and coordinate roles of the local fire department and SUBCONTRACTOR personnel.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01430-0931
ENVIRONMENTAL PROTECTION

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

Hamilton

SPEC-01430-0931
ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.01 SUMMARY

Environmental protection shall be as described in the plans referenced below.

1.02 REFERENCES (Not applicable)

1.03 GENERAL REQUIREMENTS

A. Environmental protection requirements shall be as detailed in the Field Implementation Plan (FIP) Work Control Document to be prepared by the SUBCONTRACTOR. This FIP shall include provisions for erosion control and storm water management.

B. Within seven calendar days after receiving the authorization to begin the construction phase of the Subcontract, the SUBCONTRACTOR shall prepare and submit a draft FIP to the CONTRACTOR for review and comment. The FIP shall include a subsection to cover CONTRACTOR requirements for an Erosion Control and Storm Water Management Plan (ECSWMP).

C. The FIP shall describe the overall implementation of the project based on the requirements of the final design package and, for environmental protection requirements and responsibilities, shall include the following elements:

1. Project Controls. The FIP shall describe the controls that will be established and implemented by the SUBCONTRACTOR to ensure that the environment is protected in accordance with all applicable RFETS regulatory guidelines and Standard Operating Procedures. These shall include:
   a. Access and traffic controls as they relate to environmental impacts (e.g., erosion and dust control purposes).
   b. Transportation controls as they relate to fueling requirements and spill response measures.
   c. Dust control measures.
   d. Equipment inspection requirements and fluid leakage controls.
   e. Waste generation and management.
   f. Emergency response requirements.

2. Erosion and Sedimentation Controls. The FIP shall describe all necessary sediment control devices that shall be installed before the initiation of any land disturbances, and shall include controls that ensure:
   a. Surface area of erodible material exposed by clearing and grubbing is limited, and permanent or temporary sediment control measures are implemented as necessary to prevent transport of sediment.
   b. Sediment-laden water does not enter watercourses.
   c. Excavated or delivered soils are not stockpiled in such a manner to cause sedimentation of a watercourse.

d. Surface water is controlled so that stability of excavated or constructed slopes is not adversely affected by water, erosion is minimized, and flooding of excavations does not occur.

3. Dust Control. The FIP should describe all methods used to control fugitive dust emissions during the project life. No dust emissions from roadways, or construction operations within the project boundary will be allowed.

D. The SUBCONTRACTOR shall not initiate field work until the final FIP has been approved by the CONTRACTOR.

PART 2 PRODUCTS

The final FIP will be submitted as a bound document.

PART 3 EXECUTION

3.01 GENERAL

Environmental protection actions shall be as detailed in the FIP Work Control Document to be supplied to SUBCONTRACTOR by the CONTRACTOR.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01440-0932
CONTRACTOR QUALITY CONTROL

(APPROVED) APPROVED AS CORRECTED

NOT APPROVED REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

Humiston

SPEC-01440-0932
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

Quality control shall be as described in the plans referenced below.

1.02 REFERENCES (Not applicable)

1.03 GENERAL REQUIREMENTS

Quality control requirements shall be as detailed in the project-specific *Construction Quality Assurance/Quality Control Plan*, of the *Accelerated Action for the Present Landfill*, which will be supplied to the SUBCONTRACTOR by the CONTRACTOR.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 GENERAL

Quality control actions shall be as detailed in the *Construction Quality Assurance/Quality Control Plan*, of the *Accelerated Action for the Present Landfill*, which will be supplied to the SUBCONTRACTOR by the CONTRACTOR.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01500-0933
TEMPORARY CONSTRUCTION FACILITIES

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER 10/28/04
DATE

Humiston

SPEC-01500-0933
TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Contract Compliance

All temporary facilities shall be planned, developed, installed, and maintained in accordance with Appendix D of the Contract Statement of Work, *Guidelines for the Design and Installation of Temporary Facilities.*

B. Site Plan

The SUBCONTRACTOR shall prepare a site plan in accordance with the Drawings indicating the proposed location and dimensions of any areas to be fenced and used by the SUBCONTRACTOR. The site plan shall indicate the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Any areas, which may have to be graveled to prevent the tracking of mud, shall also be identified. The SUBCONTRACTOR shall also indicate if the use of supplemental or other staging areas will be necessary.

B. Employee Parking

CONTRACTOR and SUBCONTRACTOR employee parking shall not interfere with existing and established parking requirements of the Rocky Flats Environmental Technology Site (RFETS). CONTRACTOR and SUBCONTRACTOR employees shall park privately owned vehicles in the mutually-agreed area.

1.02 AVAILABILITY AND USE OF UTILITY SERVICES

A. Electricity

The SUBCONTRACTOR assumes that site electrical needs will be fulfilled through the use of a temporary generator, capable of supplying adequate current to satisfy site office and equipment calibration needs. It is assumed that this unit will be self-contained, not requiring a separate fuel storage tank. The generator will be placed in a lined and bermed area in order to meet secondary containment needs as they relate to on-site fuel storage. Appropriate calculations and coordination will be made relative to emissions requirements of the RFETS Operating Permit, with the generator considered a stationary source complying with the 20 percent opacity limitation prescribed by Colorado Air Quality Control Commission Regulation No. 1.

B. Fueling

If temporary fueling stations are required, fuel tanks will be placed in a lined and bermed area in order to meet secondary containment needs.

C. Sanitation

RFETS toilet facilities will not be available to SUBCONTRACTOR personnel at the project site. Portable temporary hand wash and portable toilet units for trailers/personnel will be provided by the SUBCONTRACTOR in quantities to accommodate the site layout and the anticipated size of the project workforce for the project. The final quantity and configuration may be revised based on the final breakdown of gender of the site staff.

D. Telephone

The CONTRACTOR has determined that dedicated phone service is not available to the project site. Project communications will be accomplished through the use of wireless equipment, with fax capability.

1.03 BULLETIN BOARD AND PROJECT SIGN

A. Bulletin Board

Immediately upon beginning of work, the SUBCONTRACTOR shall provide a weatherproof glass-covered bulletin board not less than 915 by 1220 mm (36 by 48 inches) in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the CONTRACTOR. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the CONTRACTOR representative. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the SUBCONTRACTOR.

B. Project Sign

Immediately upon beginning of work, the SUBCONTRACTOR shall provide a safety sign in accordance with the sign specifications and details at the end of this Section. The sign shall be erected within 15 days after receipt of the notice to proceed. Upon completion of the project, the sign shall be removed by and remain the property of the SUBCONTRACTOR.

1.04 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction, the SUBCONTRACTOR shall provide access and temporary relocated roads as necessary to maintain traffic. The SUBCONTRACTOR shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the CONTRACTOR Technical Representative. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the RFETS Security and Safety Organizations. The traveling public shall be protected from damage to person and property. The SUBCONTRACTOR's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with normal traffic. The SUBCONTRACTOR shall investigate the adequacy of existing roads and the allowable load limit on these roads. The SUBCONTRACTOR shall be responsible for the repair of any damage to roads caused by construction operations.

A. Haul Roads

The SUBCONTRACTOR shall construct access and haul roads necessary for proper execution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The SUBCONTRACTOR shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Dust generation shall be monitored on a visible dust basis, not allowing for the use of airborne dust monitoring equipment or instrumentation. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the CONTRACTOR. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the CONTRACTOR shall be removed.

1.05 CONTRACTOR/SUBCONTRACTOR'S TEMPORARY FACILITIES

A. Administrative and Storage Areas

Mobile facilities will be located in an area designated and prepared by the CONTRACTOR. Anticipated trailers include: an office for the ENGINEER's representative, an office for the RFETS's representative, an office for the Independent QA ENGINEER, a lunch room and meeting room. The CONTRACTOR will provide areas of 100' by 100' for each of the proposed trailers. The area will be reasonably level, graded, well-drained subgrade of satisfactory soil material, compacted to no less than 95 percent of maximum dry density in the top 6 inches. It will also have a surface consisting of gravel paving course of sub-base material not less than 3 inches thick; roller compacted to a level, smooth, dense surface.

B. Field Offices

The SUBCONTRACTOR shall provide and maintain administrative field office facilities within the area designated by the CONTRACTOR. Each of the administrative field offices will at a minimum contain: a desk, file cabinet, and two chairs. SUBCONTRACTOR-provided facilities shall meet all applicable codes including ANSI, ASTM, NEC/NFPA, and UBC for the specific facility classification applicable to the temporary facility chosen. The SUBCONTRACTOR shall certify in writing that all facilities satisfy or exceed the applicable code requirements.

The SUBCONTRACTOR shall install the mobile facilities in the CONTRACTOR designated area, and shall not disturb areas outside these limits. Where feasible, flora on or adjacent to the area shall be preserved and protected from vehicular and pedestrian traffic.

The SUBCONTRACTOR shall provide mobile facility tie-downs, lightning protection, and temporary electrical power (generator system as described above).

C. Storage Area

The CONTRACTOR will also designate areas appropriate for material laydown and storage for the SUBCONTRACTOR's use.

D. Appearance of Trailers

Trailers utilized by the CONTRACTOR and SUBCONTRACTOR for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the CONTRACTOR that require exterior painting or maintenance will not be allowed on the RFETS property.

The temporary facilities shall be prefabricated with aluminum steps, lockable entrances, operable windows. They shall be heated and air-conditioned, blocked and supported with skirting. Fire extinguishers shall be installed in walls on mounting brackets; visible and accessible from the space being served; of classification, agent, and size required by location and class of fire exposure; and with signs mounted above.

The temporary facilities shall be equipped with HVAC units capable of maintaining a uniform indoor temperature of 68 to 75 degrees Fahrenheit, with individual space control.

E. Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should the SUBCONTRACTOR elect to traverse with construction equipment or other vehicles on grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the SUBCONTRACTOR'S discretion.

F. Security Provisions

The SUBCONTRACTOR shall be responsible for the security of its own equipment, materials, and supplies.

1.06 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud that is tracked onto paved or surfaced roadways shall be cleared away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored. SUBCONTRACTOR is responsible for collection and disposal of liquid and solid wastes. CONTRACTOR to provide general waste collection bin and disposal. SUBCONTRACTOR to provide size requirements.

1.07 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and disposed of at an appropriate off-site facility. Areas used by the SUBCONTRACTOR for the storage of equipment or material, or other use, shall be restored to the original or better condition.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01700-0934
EXECUTION REQUIREMENTS

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

Humiston

SPEC-01700-0934
EXECUTION REQUIREMENTS

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division I Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural, requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. General installation of products.
4. Coordination of Contractor-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Sections include the following:

1. Division 1 Section 01305: Submittal Procedures for submitting surveys.

2. Division 1 Section 01702: Contract Closeout for submitting final property survey with Project Record Documents, recording of CONTRACTOR-accepted deviations from indicated design, and final cleaning.

1.3 SUBMITTALS

A. Qualification Data: For professional land surveyor, QCSM, and CQA Engineer to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Certificates: Submit certificate signed by professional land surveyor and engineer certifying that location and elevation of improvements comply with requirements. See OS & IH Program Manual MAN-072-SO & III PM.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Certified Surveys: Submit two copies signed by professional land surveyor.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in Colorado and who is experienced in providing land-surveying services of the kind indicated.

B. CQA Engineer: A professional engineer with demonsratable experience performing CQA duties on similar projects.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and -location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by RFETS utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

   a. Description of the Work.
   b. List of detrimental conditions, including substrates.
   c. List of unacceptable installation tolerances.
   d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to CONTRACTOR that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Contractor unless as permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Contractor not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without CONTRACTOR'S written permission.

C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a "Request for Information" to the Construction Coordinator. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. A letter should be sent to the Contract Administrator to address contract changes as required.

3.3 CONSTRUCTION LAYOUT

A. Coordination: Construction, control, property and topographic surveys shall be coordinated with the CONTRACTOR'S Site Surveyor.

B. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify CONTRACTOR (Site Surveyor, DA and CM) promptly.

C. General: Engage a professional land surveyor to lay out the Work using accepted surveying practices and in accordance with RFETS Engineering Standard Number SC-207.

1. Establish benchmarks and control points to set lines and levels for each phase of construction and elsewhere as needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Notify Contractor (DA and CM) when deviations from required lines and levels exceed allowable tolerances.

D. Site Improvements: Locate and lay out site improvements, including grading, fill, geosynthetic compounds, and soil placement, utility slopes, and invert elevations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Submit the log to the Contractor for control of documentation.

3.4 FIELD ENGINEERING

A. Identification: Contractor will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of CONTRACTOR. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to CONTRACTOR before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly at the direction of the Site Surveyor. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain permanent benchmarks in accordance with SC-207 referenced to data established by existing control points. Comply with Site Surveyor for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

4. Submit legible level notes and calculations to CONTRACTOR'S Site Design Document Control organization with. a RFETS Calculation Cover Sheet.

D. Certified Survey: On completion of major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Prepare a final property survey showing significant features for Project. Include on the survey a certification, signed by a professional land surveyor, that in principle meets, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site comer to a legal point.

2. Recording: At Substantial Completion, submit final property survey drawings to Contractor in accordance with SC-207.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located, and aligned with other portions of the Work.

G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

H. Hazardous Materials, Use products, cleaners, and installation materials that are not considered hazardous. For any materials that are hazardous, submit Material Safety Data Sheets to Contractor, prior to bringing them to RFETS.

3.6 CONTRACTOR - INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for CONTRACTOR'S construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by CONTRACTOR'S construction forces.

1. Construction Schedule: Inform CONTRACTOR of SUBCONTRACTORS preferred construction schedule for SUBCONTRACTOR'S portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify CONTRACTOR if changes to schedule are required due to differences in actual construction progress.

2. Preinstallation Conferences: Include CONTRACTORS construction forces at preinstallation conferences covering portions of the Work that are to receive CONTRACTORS work. Attend preinstallation conferences conducted by CONTRACTOR'S construction forces if portions of the Work depend on CONTRACTOR'S construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully and as directed by the Construction Coordinator.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with Division I Section 01350: Special Procedures - Material and Waste Handling.

B. Site: Maintain Project site free of waste materials and debris. Refer to OSHA 29CFR part 1926.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate or develop dust abatement procedures under the approval of the CTR.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

1. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

H. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

I. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

J. Cutting and Patching: Clean areas where cutting and patching are performed.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, and refinishing damaged surfaces.

B. Restore permanent facilities used during construction to their specified condition.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01702-0935
CONTRACT CLOSEOUT

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

SPEC-01702-0935
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SUMMARY

This section covers the activities necessary to close out the contract.

1.02 GENERAL REQUIREMENTS

A. Work Activities

Work activities for contract closeout shall include the following:

1. Decontamination and removal from site of all SUBCONTRACTOR equipment and materials within the Construction Zone.

2. Collection and disposal of all SUBCONTRACTOR-generated contaminated materials and equipment for which decontamination is inappropriate.

3. Decontamination of site-dedicated equipment and facilities operated by the CONTRACTOR and removal from site of same.

4. Disconnection and removal of temporary utilities from site.

5. Removal of support area facilities.

6. Repair/reconditioning of roadways.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 DECONTAMINATION

All facilities, equipment, and materials that may have been used during construction shall be cleaned in accordance with the procedures described in Section 01900: MATERIAL, VEHICLE AND EQUIPMENT CLEANING and in accordance with the Field Implementation Plan Work Control Document prior to final removal.

3.02 UTILITIES

Temporary facilities and outdoor lighting fixtures required during the construction period shall be disconnected at the source and removed from the site.

3.04 OPERATIONS AREA

All equipment and facilities used for closure activities shall be thoroughly cleaned prior to site closeout.

3.05 WASH UNITS

Wash units shall be the final equipment removed from the site.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01720-0936
PROJECT RECORD DOCUMENTS

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE

10/28/04

HUMISTON

SPEC-01720-0936
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SUMMARY

Maintain at site one record copy of:

A. Drawings and Specifications.

B. Project Manual.

C. Addenda.

D. Change orders and other modifications to Contract.

E. CONTRACTOR field orders, written instructions, or clarifications.

F. Approved submittals.

G. Field test records.

H. Construction photographs.

I. Associated permits.

J. Certificates of inspection and approvals.

1.02 SUBMITTALS

A. General

At Substantial Completion:

Deliver one set of as-built construction Drawings and Specifications to CONTRACTOR for use in preparation of the construction project record file. At a minimum, as-built drawings must include:

1. Top of regrade surface.

2. Top of subgrade surface.

3. Gas system alignments.

4. Geosynthetic panel layout and sample locations.

5. Top of 10-inch cushion layer.

6. Anchor trench alignment.

7. Top of rock layer.

8. Top of final cover surface.

9. Perimeter channel with slope and width.

10. Diversion berm toe of slope.

11. Seep treatment system layout.

12. Final project completion site topographic map.

Each of these drawings represents a hold point for approval and release prior to the commencement of the next phase of construction.

B. Transmittal Letters

Accompany submittals with transmittal letter containing following:

1. Date.

2. Project title and number.

3. SUBCONTRACTOR'S name and address.

4. Title of record document.

5. Signature of SUBCONTRACTOR or authorized representative.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. General

Maintain documents in clean, dry, legible condition and in good order. Do not use record documents for construction purposes. Make documents and samples available for inspection by CONTRACTOR. Failure to properly maintain record documents may be reason to delay a portion of progress payments until records comply with Contract Documents.

B. Storage

Store documents and samples in SUBCONTRACTOR'S field office apart from documents used for construction.

1. Provide files and racks for storage of documents.

2. Provide secure storage space for storage of samples.

3.02 RECORD DOCUMENTS

A. Labeling

Label each document "PROJECT RECORD" in neat, large printed letters.

B. Alterations

Maintain record set of Drawings and Specifications legibly annotated to show all changes made during construction.

1. Graphically depict changes by modifying or adding to plans, details, or sections. Changes in horizontal location and associated elevations shall be transmitted to the CONTRACTOR via the survey data; however, obvious changes to the plans shall be noted on the Drawings with reference to survey data providing more precise information.

2. Make changes on each sheet affected by changes.

3. Do not conceal Work until required information is recorded.

4. Record changes made by Written Amendment, Field Order, Change Order or Work Directive Change.

C Drawings

1. General

a. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

b. Location of utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

c. Field changes.

d. Details not on original Drawings.

2. Specifications

a. Mark Specification sections to show substantial variations in actual Work performed in comparison with test of Specifications and modifications.

Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation.

b. Note related record drawing information and Product Data.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01722-0937
FIELD ENGINEERING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER 70/28/04 DATE

Hunt STON

SPEC-01722-0937
FIELD ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. All survey control work will be performed by the SUBCONTRACTOR. SUBCONTRACTOR shall notify DESIGNER at least 3 working days prior to start of work and when making periodic requests for line and grade stake changes. SUBCONTRACTOR shall choose which type of surveying equipment to use (GPS, Total Station, etc.). All surveys will be performed under the direction of a Licensed Surveyor in the State of Colorado and in accordance with all applicable surveying codes.

1.02 PRIMARY CONTROL MONUMENT

A. Bench marks, monuments or references provided by CONTRACTOR to establish primary vertical control for Work are indicated on Drawing 51781-004. Each monument will be assigned 3rd order Rocky Flats coordinate system coordinates and USGS mean sea level elevations.

B. Protect and maintain primary control monuments shown on Drawings throughout Project area.

C. If marked corners and monuments are damaged by SUBCONTRACTOR, replace by Registered Land Surveyor at SUBCONTRACTOR'S expense.

1.03 PRIMARY LINE AND GRADE

A. Primary line and grade will be provided by CTR and established by SUBCONTRACTOR by means of stakes placed at site of Work.

B. Stakes for construction will be set:

1. **50 ft x 50 ft** grid lines over Project Site.
2. At changes in grade.
3. Offset to best serve SUBCONTRACTOR.

C. Stakes for excavation and embankment will be set:

1. Parallel to toe of slope at **50** ft intervals.
2. Offset to best serve SUBCONTRACTOR.

D. Stakes for roads will be set:

1. At subgrade elevation on road centerline and edge of road or pavement at 50 ft intervals.
2. At top of base course elevation on road centerline and edge of road or pavement at 50 ft intervals.

E. SUBCONTRACTOR shall:

1. Provide assistance as required.
2. Arrange operations to avoid interference with establishment of primary lines and grades.

3. Check accuracy of line and grade by visual inspection, checks between stakes, and periodic checks (with surveying equipment) between primary control monuments and stakes.
4. Protect and preserve stakes. Restaking will be done by SUBCONTRACTOR at SUBCONTRACTOR'S expense.

1.04 CONSTRUCTION LINE AND GRADE

A. Transfer construction lines and grades from primary line and grade points.

PART 2 PRODUCTS

(Not used)

PART 3 EXECUTION

(Not used)

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01820-0938
DEMONSTRATION AND TRAINING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE

Humiston — 10/28/04

SPEC-01820-0938
DEMONSTRATION AND TRAINING

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions- of the Contract, including General and Supplementary Conditions and other Division I Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

B. Related Sections include the following:

1. Section 1190: Progress Meetings for requirements for preinstruction conferences.

C. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit one complete training manual[s] for Contractor's use.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

E. Demonstration and Training Videotape: Submit two copies at end of each training module.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating construction personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 1440: Contractor Quality Control, experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 1190: Progress Meetings. Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Contractor's operations. Adjust schedule as required to minimize disrupting Contractor's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Contractor (DA).

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:

1. Equipment, including earth moving equipment and geosynthetic installation equipment.
2. Laboratory equipment, including laboratory **[air] [and] [vacuum]** equipment and piping.
3. Electrical service and distribution, including **[transformers] [switchboards] [panelboards] [uninterruptible power supplies] [and] [motor controls].**
4. Packaged engine generators, including transfer switches.
5. Lighting equipment and controls.
6. Communication systems, including **[intercommunication) [surveillance] [clocks and programming] [and] [voice and data]** equipment.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project Record Documents.
    e. Identification systems.
    f. Warranties.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:

   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
   h. Lockout / tagout worker training.

8. Repairs: Include the following:

   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Subcontractor and Contractor for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Contractor's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Contractor (DA) will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Contractor will furnish an instructor to describe Contractor's operational philosophy.
3. Contractor will furnish Subcontractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation provide instruction to simulate the start of each season.

1. Schedule training with Contractor (CC), with at least seven days advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral and/or a demonstration performance-based test.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 1

SPEC-01900-0939
MATERIAL, VEHICLE, AND EQUIPMENT CLEANING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

Humiston

SPEC-01900-0939
MATERIAL, VEHICLE, AND EQUIPMENT CLEANING

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

Prior to introduction of personnel or equipment into the work area, the SUBCONTRACTOR shall provide a pad for cleaning of equipment, vehicles, and personnel. A detailed drawing of the pad is to be provided as an attachment to the Field Implementation Plan (FIP) Work Control Document (as described under Section 3.2 of the Contract Statement of Work). The SUBCONTRACTOR shall submit a plan for maintaining the pad, and the proposed pad location to the CONTRACTOR as an item within the FIP. The intent of the cleaning pad is to wash dirt and mud off of tires and equipment so as not to track mud and dirt across RFETS site roads.

PART 2 PRODUCTS

The cleaning pad must, at a minimum, be of an appropriate size to accommodate vehicles and equipment, be capable of supporting the weight of heavy equipment and fully loaded vehicles leaving the construction site, and be constructed to drain to a point from which rinsate and solids/sediments from cleaning can be collected. The pad and sump shall be constructed to accommodate a 25-year recurrence interval, 24-hour duration rainfall without overfilling. The pad shall be constructed of a durable leak proof material capable of containing all wash and rinse water anticipated for each wash event.

PART 3 EXECUTION

3.01 MOBILIZATION ACTIVITIES

Mobilization activities will include preparation of the cleaning pad staging area and leak testing the cleaning system. The area to receive the cleaning pad will be graded with a slight slope to one corner of the pad. This will allow for complete drainage and collection of all wash water. A portable pump shall be used to transfer fluids from the cleaning pad to a temporary storage tank for use as dust control water within the landfill waste boundary. Following placement of the pad and connection of all hoses or piping, the integrity of the system will be tested by filling the cleaning pad with clean water, and operating the transfer pump.

The cleaning pad will be filled to near capacity and the water level will then be marked. After this, the pad will be left undisturbed for a period of at least 3 hours. Following this 3-hour period, the water level will be checked and compared to the filled water level mark, and the ground surface immediately adjacent to the cleaning pad will be visually inspected for any signs of leakage. If the water level has remained constant (evaporation may have to be considered), no signs of leakage observed, testing of the transfer system will be performed. Testing of the transfer system will consist of starting the transfer pump and checking all fittings, hoses, and piping for any signs of leakage. The clean water from the cleaning pad will be pumped directly into the storage tank. Once all fluid has been transferred, the water level in the storage tank will be marked and the storage tank will be left undisturbed for a period of at least 3 hours. Following this three-hour period, the water level will be checked and compared to the filed water level mark, and the ground surface immediately adjacent to the storage tank will be visually inspected for any signs of

leakage. Any leaks or deficiencies in the system as identified by the CTR will be promptly fixed by the SUBCONTRACTOR. The system will be tested again to insure the proper repairs have been made prior to use.

3.02 CLEANING

Wash water from the cleaning pad shall be collected and disposed of as stated in Section 02720: CONTAMINATED LIQUIDS REMOVAL.

Solids from the cleaning pad shall be collected and disposed into the landfill footprint.

Any spill or release of materials from the cleaning pad is the responsibility of the SUBCONTRACTOR. This includes costs associated with containment and cleanup of spills, disposal of materials, and any fines or penalties related to the spill/release.

The pad shall also be used to clean the tires of vehicles leaving the site, if needed.

3.03 PAD DEMOBILIZATION

The pad shall be removed upon completion of the project as directed by the CONTRACTOR, and will be disposed of according to Section 01350: SPECIAL PROCEDURES - MATERIALS AND WASTE HANDLING.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02110-0940
SITE PREPARATION

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

[signature] 10/28/04

PROJECT/CHIEF ENGINEER DATE

Humiston

SPEC-02110-0940
SITE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

Section Includes:

A. Protection.

B. Preparation.

C. Clearing and grubbing.

D. Restoration.

1.02 DEFINITIONS

A. Structures and Surface Features

Existing structures and surface features including buildings, pavements, curb and gutter, signs, posts, fences, trees, shrubs, landscaped surface features, and other miscellaneous items.

B. Utilities

Existing gas mains, water mains, steam lines, electric lines and conduits, telephone and other communication lines, pole, and conduits, sewer pipe, cable television, other utilities, and appurtenances.

C. Clearing and Grubbing

Cutting and disposing of trees, brush, windfalls, logs, grasses, and other vegetation, and removing and disposing of roots, stumps, stubs, grubs, logs, and other timber.

1.03 PROJECT/SITE CONDITIONS

Do not block or obstruct roads or streets with excavated or grubbed materials, except as authorized by the CONTRACTOR.

1.04 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the Construction QA/QC plan.

Work will be monitored and tested in accordance with the requirements of the QA/QC plan.

The SUBCONTRACTOR shall be aware of all activities outlined in the QA/QC plan, and the SUBCONTRACTOR shall account for these activities in the construction schedule. No additional cost to the CONTRACTOR shall be allowed by the SUBCONTRACTOR as a result of the performance of the QA/QC activities.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 PROTECTION

Existing utilities shall be protected against damage. Rocky Flats personnel shall be contacted by the CONTRACTOR for marking (or verifying) utility locations before beginning excavation. If excavation work is being performed within the immediate area (10 feet) of existing buried utilities, existing underground utilities shall be located by hand excavation. If uncharted utilities are encountered during excavation, stop work in the immediate area or as appropriate and notify CONTRACTOR and the appropriate utility provider. Damaged utilities shall be repaired at the SUBCONTRACTOR'S expense.

The SUBCONTRACTOR shall preserve and protect groundwater-monitoring wells. Damaged or destroyed monitoring wells shall be replaced at SUBCONTRACTOR'S expense. The SUBCONTRACTOR shall protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in place during work.

3.02 PREPARATION

The SUBCONTRACTOR shall provide 3 working days notice, prior to beginning construction, to owners of existing utilities, structures, and surface features. Obstructions such as fences, culverts, end walls, and guard posts shall be removed and replaced when need for removal is completed. The SUBCONTRACTOR shall provide stormwater discharge and erosion control.

3.03 CLEARING AND GRUBBING

The SUBCONTRACTOR shall close mow all areas where grade within the landfill waste boundary is to be razed of shrubs, trees, stumps, vegetation, rubbish, and other perishable or objectionable matter. Stumps and associated roots shall be removed. Material resulting from the mowing operation shall be removed from the project site. Place any cleared material at the location specified by the CONTRACTOR. For areas to be cleared that are outside the landfill waste boundary all vegetative materials shall be removed and the resulting soil surface scarified to a depth of 6 inches. Material scraped from these areas shall be removed from the project sites.

3.04 RESTORATION

Existing utilities, surface features, and structures shall be restored to condition equal to condition which existed prior to construction. Damaged landscape work within and outside of construction limits shall be replaced to original condition or better in accordance with Section 02900: SEEDING.

END OF SECTION

SPEC-02200-0941
GEOTECHNICAL TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Specifications and guidelines for the geotechnical testing of the soils to be used during construction. Soils to be tested include:

- Rocky Flats Alluvial
- Cushion soil (under rock layer)
- Foundation soil (under geosynthetics)

All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. D 422 Standard Test Method for Particle Size Analysis of Soils
2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (standard Proctor)
3. D 854 Specific Gravity of Soils
4. D 2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
5. D 2435 Standard Test Method for One-Dimensional Consolidation Properties of Soils
6. D 2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
7. D 4318B Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limits)
8. D 4767 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils (with pore pressure measurements)

B. Relevant Publications
1. U.S. EPA (2002), *Technical Guidance for RCRA/CERCLA Final Covers.*
2. U.S. EPA (1993), *Technical Guidance Document, Quality Assurance and Quality Control for Waste Containment Facilities* EPA/600/R-93/182.
3. R.M. Koerner, 1999, *Designing with Geosynthetics.*

1.03 DEFINITIONS

A. CONTRACTOR – Kaiser-Hill Company, L.L.C.

B. CTR – Contractor Technical Representative

C. Geotechnical Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER, responsible for conducting laboratory tests on samples prior to construction, usually under the direction of the SUBCONTRACTOR. TESTING LABORATORY must have a radioactive material license if a borrow area within RFETS is selected.

D. SUBCONTRACTOR – Company awarded contract for construction activities.

1.04 SUBMITTALS

A. Prior to and after testing:

1. Information from the selected quarry or borrow area for the Rocky Flats Alluvial. At a minimum, location, size, and any geotechnical data if available.
2. Information from the selected quarry or borrow area for the cushion and foundation soils. At a minimum, location, size and any geotechnical data if available.
3. TESTING LABORATORY results for the tests described in Part 3.03. Submit a minimum of one month prior to construction.

B. Submit in accordance with Section 01305: SUBMITTAL PROCEDURES.

PART 2 – PRODUCTS

A. Rocky Flats Alluvial Soil
Soil as defined in Section 02221, and characterized in conformance with Section 02200.

B. Cushion Soil
Soil as defined in Section 02221, and characterized in conformance with Section 02200.

C. Foundation Soil
Soil as defined in Section 02221, and characterized in conformance with Section 02200.

PART 3 - EXECUTION

3.01 SUBMIT MATERIALS TO TESTING LABORATORY

A. Upon consultation with the CTR, submit samples from quarry or borrow area to characterize the material. If borrow area is within the RFETS, coordinate sampling effort with CONTRACTOR.

3.02 SUBMIT TEST SPECIFICATIONS TO TESTING LABORATORY

A. Specify 95% standard Proctor for consolidation and shear testing.

B. Specify shear tests to be conducted at three normal stresses of 3 pounds per square inch (psi), 6 psi, and 9 psi or as otherwise directed by the CTR.

3.03 GEOTECHNICAL TESTS

A. TESTING LABORATORY to conduct the following tests under conditions outlined in Section 3.03 for Rocky Flats Alluvial and cushion soils. Tests to be conducted at frequencies in accordance with the approved *Quality Assurance/Quality Control Plan* and will typically be one test per 5,000 cubic meters (6,500 cubic yards) of soil:

1. D 422 Standard Test Method for Particle Size Analysis of Soils
2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (standard Proctor)
3. D 2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
4. D 2435 Standard Test Method for One-Dimensional Consolidation Properties of Soils
5. D 2487 Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
6. D 4318B Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (Atterberg Limits)
7. D 4767 Standard Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils

B. TESTING LABORATORY results to be submitted to CTR for possible design modifications. Submit one month prior to construction.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02210-0942
GEOSYNTHETICS INTERFACE TESTING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER 10/28/04
DATE

SPEC-02210-0942
GEOSYNTHETICS INTERFACE TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Specifications and guidelines for the testing of the geosynthetic interfaces to ensure adequate slope stability. Interfaces to be tested include:

- Rock layer cushion soil/geosynthetic drainage net (GDN)
- GDN/flexible membrane liner (FML)
- FML/geosynthetic clay liner (GCL)
- GCL/GCL foundation soil layer

All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. D 5321 Standard Test for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method
   2. D 6243 Standard Test for Determining the Internal and Interface Shear Resistance of GCL by the Direct Shear Method

B. Relevant Publications
   1. U.S. EPA (2002), *Technical Guidance for RCRA/CERCLA Final Covers.*
   2. R.M. Koerner, 1999, *Designing with Geosynthetics.*

1.03 DEFINITIONS

A. CONTRACTOR – Kaiser-Hill Company, L.L.C.

B. CTR – Contractor Technical Representative

C. Geosynthetic Manufacturer (MANUFACTURER) - The party responsible for manufacturing the geosynthetic component.

D. Geosynthetic Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER, responsible for conducting laboratory shear tests on samples of geosynthetics prior to construction, usually under the direction of the CONTRACTOR. TESTING LABORATORY shall have provided quality control and/or quality assurance testing of the proposed geosynthetics for at least five completed projects having a minimum area of 2 million square feet. The TESTING LABORATORY shall be accredited via the Geosynthetics Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) or participate in ASTM's "Round Robin" testing. TESTING LABORATORY must have a radioactive material license if a borrow area within RFETS is selected.

E. SUBCONTRACTOR – Company awarded contract for construction activities.

1.04 SUBMITTALS

A. Submit TESTING LABORATORY GRI accreditation or proof of participation in ASTM "Round Robin " testing program prior to laboratory tests being performed.

B. Prior to and after testing:

1. MANUFACTURER'S lot number of GDN to be submitted to the TESTING LABORATORY. GDN must be that used for the project selected in accordance with Section 02224: GEOSYNTHETIC COMPOSITE DRAINAGE NET.
2. MANUFACTURER'S lot number of FML to be submitted to the TESTING LABORATORY. FML must be that used for the project selected in accordance with Section 02225: LLDPE GEOMEMBRANE LINER.
3. MANUFACTURER'S lot number of GCL to be submitted to the TESTING LABORATORY. GCL must be that used for the project selected in accordance with Section 02226: GEOSYNTHETIC CLAY LINER.
4. TESTING LABORATORY results for cushion and foundation soils selected for the project as required by Section 02200: GEOTECHNICAL TESTING. Geotechnical testing results to be submitted to the CONTRACTOR include ASTM D 422 (sieve analysis), ASTM D 4318 (Atterberg Limits), and ASTM D 698 (standard Proctor Compaction).
5. Test specifications to CTR as outlined in Part 3.02.
6. TESTING LABORATORY shear results of the four interfaces described in Part 3.03. Submit a minimum of one month prior to construction.

C. Submit in accordance with Section 01305: SUBMITTAL PROCEDURES.

PART 2 - PRODUCTS

A. Cushion Soil
As defined in Section 02221 and characterized in accordance with Section 02200.

B. Foundation Soil
As defined in Section 02221 and characterized in accordance with Section 02200.

C. GDN
Selected in accordance with Section 02224.

D. FML
Selected in accordance with Section 02225.

E. GCL
Selected in accordance with Section 02226.

PART 3 - EXECUTION

3.01 SUBMIT MATERIALS TO TESTING LABORATORY

A. Conduct geotechnical testing on cushion and foundation soils in accordance with Specification Section 02200. Submit results of ASTM D 422 (sieve analysis), ASTM D 4318 (Atterberg Limits), and ASTM D 698 (standard Proctor Compaction) to interface TESTING LABORATORY if different from geotechnical laboratory.

B. Select GDN, FML, and GCL in accordance with Specification Sections 02224, 02225, and 02226, respectively. Submit adequate samples of materials to TESTING LABORATORY.

3.02 SUBMIT TEST SPECIFICATIONS TO TESTING LABORATORY

A. For shear tests involving cushion and foundation soils, soil must be tested at 95% standard Proctor compaction at +2% optimum moisture content.

B. Specify that tests involving cushion and foundation soils are to be fully consolidated at saturated conditions with a shear displacement rate of 0.005 mm/s.

C. Specify tests to be conducted at three normal stresses of 3 pounds per square inch (psi), 6 psi, and 9 psi (432, 864, 1,296 pounds per square foot) or as otherwise directed by the CTR.

D. For shear tests involving GCL, GCL must be hydrated a minimum of 72 hours prior to testing.

3.03 SHEAR TESTS

A. TESTING LABORATORY to conduct the following tests under conditions outlined in Part 3.02 for the following interfaces:

1. Rock layer cushion soil/GDN in Accordance with ASTM D 5321
2. GDN/FML in accordance with ASTM D 5321
3. FML/GCL in accordance with ASTM D 6243
4. GCL/GCL cushion soil layer in accordance with ASTM D 6243

Frequencies will be established once the cushion and foundation soils have been characterized in accordance with Section 02200, but will be a minimum of one per interface, and one per soil type.

B. TESTING LABORATORY results to be submitted to CTR for possible design modifications. Submit one month prior to construction.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02221-0943
EARTHWORK

Revised 01/24/2005
Robert N. Davis

APPROVED

APPROVED AS CORRECTED

NOT APPROVED

REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert N. Davis for 01/25/05
PROJECT CHIEF ENGINEER DATE

PART 1 GENERAL

1.01 SUMMARY

The existing surface of the landfill has not been modified since waste placement operations ceased. The existing surface of the landfill will be regraded to match slopes and contours of the final Synthetic Geocomposite cover surface grades as shown on the Drawings. This section includes procedures that may be required for preparation, excavation, and relocation of existing interim cover soils, and various import soils that make up the final cover profile. Solid waste relocation is not anticipated.

Placement of imported grade fill is anticipated, presuming to continue with immediate placement of the 6-inches of cushion soils once the interim cover soils have been manipulated in accordance with the design drawings. Subsequent soil layer will include a 10-inch cushion layer and a 2 foot soil layer.

1.02 DEFINITIONS

A. INTERIM COVER SOILS

Any materials generated from breaking the plane of the existing Interim Cover of the landfill for purposes of manipulating the surface contours or elevations of the Interim Cover in order to establish initial slopes or elevations required in accordance with the design drawings.

B. GRADE FILL

Soil from a CONTRACTOR approved borrow source which is free of hazardous or solid waste materials and free of ice or snow, organic soils, vegetation, wood, peat, or other unsuitable material. Grade fill shall be a material that is readily capable of being compacted as an engineered fill material and will be used to fulfill the requirement for additional fill during preparation of the regrade surface and the perimeter channels. It is intended that Rocky Flats Alluvium fulfill this requirement.

C. COVER LAYER SOIL (ROCKY FLATS ALLUVIUM)

Soil from a CONTRACTOR approved borrow source which is free of hazardous or solid waste materials and free of ice or snow, organic soils, vegetation, wood, peat, or other unsuitable material. Cover layer soil shall be a material that is readily capable of being compacted as an engineered fill material. This material will be used to fulfill the requirement for additional fill during preparation of the regrade surface and for the top final two feet of the final cover.

D. CUSHION SOIL

Soil from a CONTRACTOR approved borrow source which is free of hazardous or solid waste materials and free of ice or snow, organic soils, vegetation, wood, peat, and is similar to the gradation listed in Table A of this section. Cushion Layer Soil shall be a material that is readily capable of being compacted as an engineered fill material and will be used to provide a 10-inch cushion above the geosynthetic composite cover components for the placement of the rock layer, and to provide a 6-inch cushion for the construction of geosynthetic composite cover.

1.03 SUBMITTALS

The following shall be submitted in accordance with Section 01305 SUBMITTAL PROCEDURES:

A. Equipment:
Motor Grader (Caterpillar 14G or equivalent)
Self-Propelled Scraper (Caterpillar 627 or equivalent)
Bulldozer (Caterpillar D-6 LGP or equivalent)
Self-Propelled Compactor (Caterpillar 815B or equivalent)

B. Geotechnical test results demonstrating soil source compliance with this specification and the Construction QA/QC plan.

C. Certified waybills and delivery tickets for all materials.

1.04 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the Construction QA/QC (QA/QC) plan.

Work will be monitored and tested in accordance with the requirements of the QA/QC Plan.

The SUBCONTRACTOR shall be aware of all activities outlined in the Construction QA/QC plan, and the SUBCONTRACTOR shall account for these activities in the construction schedule. No additional cost shall be allowed to the CONTRACTOR as a result of the performance of the QA/QC activities of the SUBCONTRACTOR.

1.05 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENT

PART 2 MATERIALS

2.01 GRADE FILL

If required, supply per definition above.

2.02 ROCKY FLATS ALLUVIUM

Supply per definition above.

2.03 CUSHION LAYER SOIL

Supply per definition above.

PART 3 EXECUTION

3.01 PREPARATION

A. Before commencement of construction of the cover system, the site shall be prepared in accordance with the following:

1. Place temporary erosion protection as required per Section 02228: EROSION CONTROL.

2. The existing landfill grade (i.e. top surface of the existing landfill Interim Cover) shall be close-mowed in accordance with Section 02110: SITE PREPARATION. All trees shall be cut flush to original ground surface or subgrade and stumps/roots removed.

3. The landfill regrade cut and fill program portrayed in the project design drawings shall be established in accordance with standard construction staking practice and to tolerances established in this section and in accordance with Section 01722: FIELD ENGINEERING. All staking shall be maintained as required to support construction activities necessary to establish the landfill regrade surface as portrayed in the project design drawings.

4. The landfill surface outside the area of the regrade cut and fill program shall be investigated for bearing capacity performance and suitability as a subgrade surface. This landfill subgrade area shall be proof-rolled using a rubber-tired roller or loaded scraper, operating at a speed not to exceed 5 miles per hour. Rubber-tired rollers shall contain a minimum of four wheels per axle equipped with pneumatic tires such as a CAT PS-110 or approved equivalent. Rubber-tired rollers shall have a minimum operating weight of 25,000 pounds and shall be equipped with tires of sufficient size to maintain a tire pressure between 80 and 100 pounds per square inch during operation. Proof-rolling shall consist of a minimum of 2 coverages with a coverage defined as a single pass of the entire vehicle. If used, scrapers shall have a minimum loaded operating weight of 150,000 pounds and shall make a minimum of 2 coverages with a coverage defined as the area in direct contact with the tires of the scraper due to a single pass of the entire vehicle. Areas with unacceptable deflections (in the order of 1 to 3 inches) shall be repaired at the direction of the CTR, such that deflections are less than 1 inch when proof-rolled again.

5. Remove unsuitable grade fill, or bridge the area with material capable of adequately limiting deflection. Proof roll and repeat as necessary.

6. Assure fill area is not impacted by ice, snow, and/or frozen material prior to beginning placement.

7. Unsuitable soil shall be excavated and placed in accordance with the following subsections.

3.02 EXCAVATION/REGRADING

A. Where excavation of materials from the cut and fill program, or of unsuitable soil, is required the following procedure shall be initiated:

1. Excavate/remove soils or waste items in accordance with the regrade cut and fill program. During excavation of materials from or within the existing Interim Cover of the Landfill, follow all instruction and requirements of the Health and Safety Work Control Document and Field Implementation Work Control Document as they relate to the exposure and monitoring of waste, and subsequent decontamination procedures as appropriate. Transport excavated materials to fill area.

2. Proof roll final excavation surface and over excavate to remove unsuitable material that will not form an adequate regrade surface for the final cover layer. Replace with grade fill in accordance with Paragraph 3.04. During regrading activities, the entire surface of the landfill area will be traversed with heavy equipment to achieve a minimum compaction performance standard of 95 percent standard Proctor dry density (ASTM D698). The development of the method to achieve this compaction goal will be accomplished using a test fill prior to construction to determine the number of required of passes with a piece of equipment to achieve the required compaction. If any areas of unacceptable deflections (in the order of 1 to 3 inches) are encountered, they shall be repaired at the direction of the CRT such that deflections are less than 1 inch when proof-rolled again.

3. Placement of grade fill may be required to maintain positive drainage if excavation extends beyond the limit of excavation shown on the Drawings, or below excavation grades shown. Grade fill shall be placed in accordance with Section 3.04 of this Specification and as such to facilitate the placement of overlying fill and cover materials. If wet soil/material is encountered at a depth greater than 2 feet, placement of bridging materials (e.g. washed rock in excess of 1 1/2" minimum dimension) in the area, or other methods approved by the DESIGNER to improve bearing capacity will be performed.

3.03 DEWATERING

A. No surface dewatering is expected from the current site conditions, or the cut and fill program for the subgrade. However, if dewatering is required, the following procedure shall be initiated:

1. Maintain surface water control and free drainage such that all incidental waters of precipitation and dust control are retained within the footprint of the landfill waste boundary.

2. If necessary, provide surface water pumps, hoses and other necessary equipment and labor to keep excavation free of standing water. Water coming in contact with soil shall be collected and disposed per Section 02720: LIQUIDS REMOVAL.

3.04 INTERIM COVER SOIL - REGRADE MATERIAL PLACEMENT

For the execution of the regrade preparation cut and fill program, the following placement procedure shall be initiated where placement is required:

1. Scarify prepared surface before placement of fill material to provide bonding between materials.

2. Begin construction of subgrade fill at lowest point of fill below grade and construct in layers by spreading and leveling material during placement. Spread individual layers to uniform thickness throughout and approximately parallel with finished grade within current working area of fill placement. Step transition between work areas as filling progresses to prevent vertical joints within fill.

3. Place materials uniformly in maximum 1-foot loose lifts within current working area of fill placement.

4. Compact materials by traversing with a minimum of 6 passes with a CAT 815B compactor, or alternate piece of equipment approved by the CTR before placing next lift. Revisions to the number of passes and equipment type may only be made with the CTR's approval.

5. Maintain lifts to provide positive drainage away from construction.

6. Where material for fill consists of rock, rubble, or waste material of such size as to render placing in 1-foot layers impractical, material may be placed in layers not exceeding in thickness the approximate average size of larger materials provided individual pieces are so placed that there will be no nesting, and voids are filled with smaller soil or waste materials.

7. Do not place frozen materials, and do not place materials on frozen surfaces. Frozen materials are defined as soil with a temperature less than 32°F or containing visible ice crystals, or clods of frozen soil larger than 4 inches in any direction.

8. Supplemental aeration may be necessary to facilitate drying.

9. Wet soil shall be spread over an area to receive fill and shall be allowed to air dry to a sufficient state that it may be compacted and may serve as adequate material for placement of overlying fill and cover materials.

3.05 6-INCH CUSHION LAYER SOIL PLACEMENT

For the execution of the 6-inch foundation layer preparation program, the following placement procedure shall be initiated:

1. Place foundation soils in accordance with this Specification and the approved design drawings and design report.

2. The regraded landfill surface shall be scarified to promote bonding between materials.

3. Place materials in a uniform single thickness of material sufficiently thick to accommodate establishing grade of the final surface, and to account for settlement due to grading. This process is intended to form a uniformly thick soil mass of a minimum finished thickness of 6 inches, free of large voids throughout and approximately parallel with finished grade within current working area of final cover placement. Remove cobbles greater than 0.5 inches and break down clods to less than 4 inches in maximum dimension. In general the 6-inch cushion soil will meet the physical characteristics of the "pit fine" soils detailed in Appendix D of the Design Analysis Report. A typical grain size distribution for this material is included in the table below.

TABLE A

Sieve Size	Percent Finer
0.5 in.	100.0
0.375 in.	96.5
#4	81.3
#10	66.1
#20	50.9
#40	38.2
#60	30.5
#100	25.0
#200	20.5

4. Materials shall be placed at a final compaction of 95 percent standard proctor dry density (ASTM D698) with a moisture requirement of ±2 percent of the optimum moisture content (OMC) as measured by standard proctor density (ASTM D698).

3.06 10 –INCH CUSHION LAYER SOIL PLACEMENT

For the execution of the 10-inch cushion layer preparation program, the following placement procedure shall be initiated:

1. Place cushion soils in accordance with this Specification and the approved design drawings and design report.

2. The soil will be placed in front of the equipment such that the equipment does not drive directly on top of the geosynthetic components of the liner. The soil

will be spread using a Caterpillar Low-Ground Pressure D-6 bulldozer (or equivalent).

3. Place materials in a uniform single thickness of material sufficiently thick to accommodate establishing grade of the final surface, and to account for settlement due to grading. This process is intended to form a uniformly thick soil mass of a minimum finished thickness of 10 inches, free of large voids throughout and approximately parallel with finished grade within current working area of final cover placement. Remove cobbles greater than 0.5 inches and break down clods to less than 4 inches in maximum dimension. In general the 10-inch cushion soil will meet the physical characteristics of the "pit fine" soils detailed in Appendix D of the Design Analysis Report. A typical grain size distribution for this material is included in the table below.

TABLE B

Sieve Size	Percent Finer
0.5 in.	100.0
0.375 in.	96.5
#4	81.3
#10	66.1
#20	50.9
#40	38.2
#60	30.5
#100	25.0
#200	20.5

4. Materials shall be placed at a final compaction of 95 percent standard proctor dry density (ASTM D698) with a moisture requirement of ±2 percent of the optimum moisture content (OMC) as measured by standard proctor density (ASTM D698).

3.07 ROCKY FLATS ALLUVIUM FINAL COVER SOIL PLACEMENT

The final soil cover shall be placed with minimal compaction. For the execution of the final soil cover, the following placement elements and procedures shall be followed:

1. Place final cover soils in accordance with this Specification and the design drawings. The borrow source (Rocky Flats Alluvium) for the layer of final cover soils will be provided by the SUBCONTRACTOR.

2. The soil cover materials will be placed in stockpiles directly from the trucks onto the top of the Rock Layer system. No trucks will be allowed to drive on top of the Rock Layer rock surface. Soil will be placed and pushed forward across the Rock Layer surface.

3. Soil materials will be evenly spread across on the top surface to reach grading requirements as depicted in the design drawings, using a Caterpillar Low-Ground Pressure D-6 bulldozer (or equivalent).

4. Place materials in one uniform lift to create a interim finished thickness of 22-inches (minimum). The intent is for the material to be sufficiently thick to establish final surface grades as shown on the design drawings. Placement is intended to form a uniformly thick soil mass of a minimum finished thickness of 22-inches, free of large voids throughout and parallel with finished grade within current working area of final cover placement.

5. Place an additional 2 to 3 inches of materials in one uniform lift to create a final finished soil layer thickness of 24-inches (minimum). Placement of this material shall be sufficiently thick to reach final surface grades as shown on the design drawings. The soil for this final layer will be obtained from the stockpile of soil that was grubbed from the surface of the landfill at the beginning of the project. These soils contain the root systems and organic matter that had previously established on the interim cover, and will facilitate the establishment of the new vegetation.

3.08 FIELD QUALITY ASSURANCE/QUALITY CONTROL

A. Grade Fill Placement and Compaction

In accordance with the Construction QA/QC plan.

B. Tolerances

1. The regrade of the landfill surface shall be within 0.5 feet horizontal and ±0.1 feet vertical of the control points shown on the Drawings, and meet the minimum slope requirements shown on the drawings unless approved in writing by the CTR.
2. For the cushion, foundations, rock and cover soil layers, the thickness of the layers shall be within 0.0 ft to +0.2 ft of the specified thickness.

C. Final Grades

In accordance with the QA/QC Plan, the completed design subgrades shall be surveyed by SUBCONTRACTOR and approved by Site QA Manager before further placement of cover materials.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02222-0944
ROCK LAYER

APPROVED

APPROVED AS CORRECTED

NOT APPROVED

REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE

10/28/04

Humiston

SPEC-02222-0944
ROCK LAYER

PART 1 GENERAL

1.01 SUMMARY

This specification section covers the supply, installation, and testing of materials for use in a rock layer as indicated in the Design Drawings. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

The rock layer is intended to serve two primary functions for the Accelerated Action at the Present Landfill: (1) protect the environment from exposure by deterring animals from burrowing into the underlying waste/consolidated materials and bringing it back to the surface and (2) protect biota (animals) by deterring their direct contact with these materials.

1.02 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the referenced Test Methods shall be used in all cases.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	Specific Gravity and Absorption of Coarse Aggregates
ASTM C 131	Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Method for sieve analysis of fine and coarse aggregates
ASTM D2938	Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens

1.03 SUBMITTALS

The following shall be submitted in accordance with Section 01305: SUBMITTAL PROCEDURES:

- List of proposed equipment to be used in performance of construction work including descriptive data.
- Suppliers' Test Results demonstrating compliance with Part 2 of this Specification.
- Certified waybills and delivery tickets for all aggregates.

1.04 DELIVERY

A. Delivery Tickets

Copies of waybills and delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed, SUBCONTRACTOR shall file certified waybills and certified delivery tickets for all material actually used.

1.05 EQUIPMENT

All equipment and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.06 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the Construction Quality Assurance/Quality Control Plan (QA/QC) and the Field Implementation Plan Work Control Document (FIP WCD).

Work will be monitored and tested in accordance with the requirements of the approved Construction QA/QC plan.

The SUBCONTRACTOR shall be aware of all activities outlined in the Construction QA/QC plan, and the SUBCONTRACTOR shall account for these activities in the construction schedule.

1.07 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270 MEASUREMENTS AND PAYMENTS.

PART 2 PRODUCTS

2.01 ROCK LAYER

A. Properties:

1. The aggregate is to be a granular rock layer that has a nominal thickness of twelve inches and consists of at least thirty-three percent particles that are a minimum 6 inches in diameter and a maximum size of about nine inches in diameter. Gradation characteristics are as follows:

Maximum Sieve Size	Percent Passing
10 inches	100
6 inches	50 – 67
3 inches	30 – 55
1 inch	10 – 35
3/8 inch	5 – 15

2. Granular barriers should be placed with a maximum void space of 2 inches. This criteria considers a void running continuously through the entire barrier thickness.
3. The unconfined compressive strength of the particle material should be at least 4000 pounds per square inch, and the unit weight of the material should be a minimum of 130 pounds per cubic foot.
4. Rock materials shall consist of clean, sound rock consisting of silica-based material containing durable particles of crushed stone meeting the durability requirements in Section 02245: STONE AND AGGREGATE MATERIALS, carbonate-based materials will not be used.

Control of gradation will be by suppliers sieve analysis in accordance with the QA/QC Plan. All tests will be performed by and at the expense of the SUBCONTRACTOR and submitted to the CONTRACTOR'S TECHNICAL REPRESENTATIVE (CTR).

PART 3 EXECUTION

3.01 PREPARATION

Areas on which rock layer materials are to be placed shall be graded and dressed to lines and grades shown on drawings and in accordance with Section 02110: SITE PREPARATION and Section 02221: EARTH WORK. Eroded or washed out areas shall be repaired prior to placement of material.

3.02 ROCK LAYER MATERIAL

A. General

Rock layer material shall be placed on the subgrade within the limits and thickness shown on the drawings or as staked in the field. The completed surface of the rock layer shall have a thickness tolerance of +0.0 to +0.2 feet as determined by construction surveying.

B. Placement

Rock layer material shall be spread uniformly in a manner developed during the test fill activities, and approved by QA/QC personnel, that limits disturbance of the 10-inch cushion layer and in a satisfactory manner to the slope lines, thickness, and grades indicated on the design drawings or as directed. Equipment must not drive directly on top of the rock surface. This is required to prevent puncture of the underlying geosynthetic components. Placing of material by methods that will tend to segregate particle sizes within the rock layer will not be permitted. The larger stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded to conform to the gradation specified. The finished rock layer material shall be free from objectionable pockets of small stones and clusters of larger stones. The desired

distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing and placement. All stone shall be placed to a uniform thickness of twelve inches. Compaction of the rock layer material will not be required but it shall be finished to present a uniform even surface free from depressions, mounds, or windrows.

C. Field Verification

A visual field verification of rock layer material shall be performed by QA and QC Personnel to evaluate if the material as delivered to the job meets requirements of this Specification and will be performed in accordance with the approved Construction QA/QC Plan.

3.05 PROTECTION

The SUBCONTRACTOR shall maintain the rock layer material until accepted and any material displaced by any cause shall be replaced at his expense to the lines and grades shown on the drawings.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02224-0945
GEOCOMPOSITE DRAINAGE NET

(APPROVED) APPROVED AS CORRECTED

NOT APPROVED REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER 10/28/04 DATE

Humiston

SPEC-02224-0945
GEOCOMPOSITE DRAINAGE NET

PART 1: GENERAL

1.01 SUMMARY

A. Specifications and guidelines for MANUFACTURING and INSTALLING GEOCOMPOSITE DRAINAGE NET (GDN). This geocomposite consists of a layer of GDN "sandwiched" between 2 layers of 8 oz. geotextile used as filter and drainage media in lining systems. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. D 1238-01 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
2. D 1505-98 Standard Test Method for Density of Plastics by the Density-Gradient Technique
3. D 1603-94 Standard Test Method for Carbon Black in Olefin Plastics
4. D 4716-00 Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
5. D 5035-95 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
6. D 5199-99 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes

B. Relevant publications from the Environmental Protection Agency (EPA):
1. Daniel, D.E. and R.M. Koerner, (1993), *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities,* EPA/600/R-93/182.

1.03 DEFINITIONS

A. Construction Quality Assurance Engineer (CQAE) - Party, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

B. DESIGN ENGINEER - The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

C. GDN Manufacturer (MANUFACTURER) - The party responsible for manufacturing the GDN rolls.

D. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the CONTRACTOR.

E. INSTALLER- Party responsible for field handling, transporting, storing and deploying the GDN.

F. Lot - A quantity of resin (usually the capacity of one rail car) used to manufacture polyethylene GDN rolls. The finished rolls will be identified by a roll number traceable to the resin lot.

1.04 SUBMITTALS

The following shall be submitted in accordance with Section 01305: SUBMITTAL PROCEDURES:

- List of proposed equipment to be used in performance of construction work including descriptive data.
- Suppliers' Test Results demonstrating compliance with this specification and the Construction QA/QC Plan.
- Certified waybills and delivery tickets for all materials.

1.05 QUALIFICATIONS

A. MANUFACTURER
1. GDN shall be manufactured by the following:
   a. GSE Lining Technology, Inc.
   b. Cetco
   c. Poly-flex
   d. approved equal
2. MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene GDN material during the last year.

B. INSTALLER
1. Installation shall be performed by one of the following installation companies:
   a. GSE Lining Technology, Inc.
   b. Poly-flex
   c. Cetco
   d. Approved equal
2. INSTALLER shall have worked in a similar capacity on a project of similar complexity to the project described in the Contract Documents.
3. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

1.06 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling- Each roll of GDN delivered to the site shall be labeled by the MANUFACTURER. The label will identify:
1. manufacturer's name
2. product identification
3. length
4. width
5. roll number
6. lot number

B. Delivery- Rolls of GDN will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location for the GDN, provided by the SUBCONTRACTOR to protect the GDN from ultraviolet light exposure, abrasions, excessive dirt and moisture shall have the following characteristics:

1. level (no wooden pallets)
2. smooth
3. protected from theft and vandalism
4. adjacent to the area being lined.

D. Handling

1. The SUBCONTRACTOR and INSTALLER shall handle all GDN in such a manner as to ensure it is not damaged in any way.
2. The INSTALLER shall take any necessary precautions to prevent damage to underlying layers during placement of the GDN.

1.07 WARRANTY

A. Material shall be warranted, on a pro-rata basis against defects for a period of 1-year from the date of the GDN installation.

B. Installation shall be warranted against defects in workmanship for a period of 1-year from the date of GDN completion.

1.08 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENTS

PART 2: PRODUCTS

2.01 GDN PROPERTIES

A. A GDN shall be manufactured by extruding two crossing strands to form a bi-planar drainage net structure.

B. The GDN specified shall have properties that meet or exceed the values listed in the table below.

C. The GDN shall be double sided, with 8 oz geotextile bonded to both sides of the geonet core.

Table SPEC-02224-0945-1

Tested Property	Test Method	Frequency	Minimum Average Roll Value
Composite Bond Adhesion (lb/in)	GRIGC-7, ASTM D 413 or F 904	1/50,000 ft^2	1.0
Composite Transmissivity[a] gal/min/ft (m^2/sec)	ASTM D 4716-00	1/540,000 FT^2	0.19 ($4X10^{-5}$)
Geonet Thickness, mil (mm)	ASTM D 5199	1/50,000 FT^2	200 (5)
Geonet Density, g/cm^3	ASTM D 1505 or ASTM D 792	1/50,000 FT^2	0.94
Geonet MD Tensile Strength, lb/in (N/mm)	ASTM D 5035	1/50,000 FT^2	45 (7.9)
Geonet Carbon Black Content, %	ASTM D 1603 or ASTM D 4218	1/50,000 FT^2	2.0
Geotextile mass per unit area oz/yd^2	ASTM D 5261	1/90,000	8
Geotextile Puncture Strength (lb)	ASTM D 4833	1/90,000 ft^2	120
Geotextile Apparent Opening Size (mm)	ASTM D 4752	1/540,000 ft^2	0.150 mm

Notes:
[a] Gradient of 0.1, normal load of 10,000 psf, water at 70° F (20° C), between steel plates for 15 minutes.

D. Resin
1. Resin shall be first quality, compounded polyethylene resin.
2. Natural resin (without carbon black) shall meet the following additional minimum requirements:

Table SPEC-02224-0945-2

Property	Test Method	Testing Frequencies	Value
Density (g/cm3)	ASTM D 1505	1 test per 50,000 ft^2 of material produced or once per resin lot, whichever is less.	>0.94
Melt Flow Index (g/10 min)	ASTM D 1238	1 test per 50,000 ft^2 of material produced or once per resin lot, whichever is less.	$\leq$ 1.0

E. The geotextile portion of the GDN shall be eight oz per square yard.

2.02 MANUFACTURING QUALITY CONTROL

A. The GDN shall be manufactured in accordance with the Manufacturer's Quality Control Plan.

B. The GDN shall be tested according to the test methods and frequencies listed below:

Table SPEC-02224-0945-3

Manufacturing Quality Control Test Frequencies			
Characteristics	**Test Method**	**Units**	**FREQUENCY**
	Resin		
Polymer Density **Melt Flow Index**	ASTM D 1505 ASTM D 1238	g/cm^3 g/10 min	1 test per 50,000 ft^2 of material produced or once per resin lot, whichever is less.
	GDN Test		
Thickness	ASTM D 5199	mil	1/50,000 ft^2
Carbon Black	ASTM D 4218	%	1/50,000 ft^2
Tensile Strength, MD	ASTM D 4595	lbs/ft	1/50,000 ft^2
Transmissivity	ASTM D 4716-00	m^2/sec	1/540,000 ft^2

2.03 QUALITY ASSURANCE

Quality assurance testing will be conducted to verify manufacturers quality control data consistent with procedure outline in the approved QA/QC Plan.

PART 3: EXECUTION

3.01 FAMILIARIZATION

A. Inspection
   1. Prior to implementing any of the work in the Section to be lined, the INSTALLER shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the Section may properly commence without adverse impact.
   2. If the INSTALLER has any concerns regarding the installed work of other Sections, he shall notify the CTR.

3.02 MATERIAL PLACEMENT

A. The GDN roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by the CTR.

B. All GDNs shall be weighted down with sandbags or equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.

C. The project includes an anchor trench at the top of the slopes. Therefore the GDN shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the GDN.

D. In applying fill material, no equipment can drive directly across the GDN. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.

E. The cover soil shall be placed on the GDN in a manner that prevents damage to the GDN. Placement of the cover soil shall proceed immediately following the placement and inspection of the GDN.

F. The installer shall submit an Installation Plan that addresses these issues.

3.03 GDN SEAMS AND OVERLAPS PROCEDURES

A. Each component of the GDN will be secured to the like component at overlaps.

B. GDN Components

1. Deploy and fasten the geocomposite in accordance with the Manufacturer's recommendations, unless otherwise stated in these specifications.
2. Adjoining net rolls (end to end) across the roll width should be shingled down in the direction of the slope and joined together with cable ties spaced every 5 feet along the roll width.
3. GDN should be tied every 6 inches in the anchor trench or as specified by the CTR.
4. In general, no horizontal seams are allowed on side slopes except as part of a patch.

3.04 FIELD REPAIR PROCEDURES

A. Prior to covering the deployed GDN, each roll shall be inspected for damage resulting from construction.

B. Any rips, tears or damaged areas on the deployed GDN shall be removed and patched. The patch shall be secured to the original GDN by tying every 6 inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the GDN shall be cut out and the two portions of the GDN shall be joined in accordance with Subsection 3.03. This will be performed at the SUBCONTRACTOR'S expense.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specification Division 2

SPEC-0225-0943

LLDPE GEOMEMBRANE LINER

Revision Date: July 8, 2004

Revision By: Earth Tech, Inc.

Earth Tech Project Manager: _____

Kaiser-Hill Project Manager: _____

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02225-0946
LLDPE GEOMEMBRANE LINER
REVISION 1

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis for 06/20/05

PROJECT CHIEF ENGINEER DATE

SPEC-02225-0946
LINEAR LOW DENSITY POLYETHYLENE (LLDPE)
GEOMEMBRANE LINER

PART 1 GENERAL

1.01 SUMMARY

A. Specifications and guidelines for MANUFACTURING and INSTALLING geomembrane liner systems. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)
   1. D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
   2. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
   3. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
   4. D 1603 Test Method for Carbon Black in Olefin Plastics
   5. D 3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
   6. D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
   7. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
   8. D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
   9. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
   10. D 6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
   11. D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

B. Geosynthetic Research Institute
   1. GRI GM 17 Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Geomembranes

1.03 DEFINITIONS

A. Lot - A quantity of resin (usually the capacity of one rail car) used in the manufacture of geomembranes. Finished roll will be identified by a roll number traceable to the resin lot used.

B. Construction Quality Assurance Engineer (CQAE) - Party, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

C. CONTRACTOR'S TECHNICAL REPRESENTATIVE (CTR) – CONTRACTOR'S technical representative, who has the technical authority and field interface with the SUBCONTRACTOR.

D. DESIGNER – Firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

E. Geomembrane Manufacturer (MANUFACTURER) - The party responsible for manufacturing the geomembrane rolls.

F. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the CONTRACTOR.

G. INSTALLER- Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.

H. Panel- Unit area of a geomembrane that will be seamed in the field that is larger than 100 ft^2.

I. Patch- Unit area of a geomembrane that will be seamed in the field that is less than 100 ft^2.

J. Subgrade Surface- Soil layer surface, which immediately underlies the geosynthetic material(s).

1.04 SUBMITTALS

A. Furnish the following product data, in writing, to CTR prior to installation of the geomembrane material:
   1. Resin Data shall include the following.
      a. Certification stating that the resin meets the specification requirements (see Section 1.09).
   2. Geomembrane Roll
      a. Statement certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin (product run may be recycled).
      b. Copy of the manufacturer's quality control program.
      c. Quality control tests and methods used and results of these tests.

B. The INSTALLER shall furnish the following information to the CTR and CONTRACTOR prior to installation:
   1. Installation layout drawings
      a. Must show proposed panel layout including field seams and details
      b. Must be approved prior to installing the geomembrane
         1. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.
   2. Installer's Geosynthetic Field Installation Quality Assurance Plan
   3. Installation schedule
   4. Copy of the INSTALLER'S license or letter of approval from geomembrane manufacturer
   5. List of all proposed equipment to be used by make and model
   6. Anticipated average daily production rate on this project
   7. QC and QA tests in accordance with Table 4.2 of the QA/QC Plan

C. The INSTALLER will submit the following to the CTR upon completion of installation:
   1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents
   2. Material and installation warranties
   3. As-built drawings showing actual geomembrane placement and seams including typical anchor trench detail
   4. As-built drawings showing locations of destructive seam tests

D. The EPA and CDPHE will have sufficient opportunity to examine all submittals as they become available from the SUBCONTRACTOR.

1.05 QUALITY ASSURANCE

A. The independent CQAE will be responsible for coordination of laboratory services to monitor geomembrane installation.

1.06 QUALIFICATIONS

A. MANUFACTURER
   1. Geomembrane shall be manufactured by the following:
      a. AGRU America
      b. GSE Lining Technology, Inc.
      c. Poly-Flex
      d. approved equal
   2. MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene geomembrane during the last year.

B. INSTALLER
   1. Installation shall be performed by one of the following installation companies (or approved equal)
      a. AGRU America
      b. GSE Lining Technology, Inc.
      c. Poly-flex
      d. Approved Dealer/Installers
      e. approved equal
   2. INSTALLER shall have installed a minimum of 1,000,000 square feet of LLDPE geomembrane during the last 2 years.
   3. INSTALLER shall have worked in a similar capacity on projects similar in complexity to the project described in the contract documents.
   4. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.
   5. The INSTALLER shall provide a minimum of one Master Seamer for work on the project.
      a. Must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for the use on this project.

1.07 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling - Each roll of geomembrane delivered to the site shall be labeled by the MANUFACTURER. The label will identify:
   1. manufacturer's name
   2. product identification
   3. thickness
   4. length
   5. width
   6. roll number
   7. lot number

B. Delivery- Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.

C. Storage- The on-site storage location for geomembrane material, provided by the SUB-CONTRACTOR to protect the geomembrane from punctures, abrasions, ultraviolet light, and excessive dirt and moisture should have the following characteristics:

1. level (no wooden pallets)
2. smooth
3. dry
4. protected from theft and vandalism
5. adjacent to the area being lined

D. Handling- Materials are to be handled so as to prevent damage.

1.08 WARRANTY

A. Material shall be warranted, on a pro-rata basis against Manufacturer's defects for a period of 5 years from the date of geomembrane installation.

B. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

1.09 GEOMEMBRANE

A. Material shall be smooth polyethylene geomembrane as shown on the drawings.

B. Resin

1. Resin shall be new, first-quality, compounded and manufactured specifically for producing geomembrane.
2. Natural resin (without carbon black) shall meet the following minimum requirements:

Property	Test Method	LLDPE
Density [g/cm^3]	ASTM D 1505	0.915
Melt Flow Index [g/10 min.]	ASTM D 1238 (190/2.16)	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 atm/200°C)	100

C. Geomembrane Rolls

1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
2. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width and MANUFACTURER.
4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in section 1.09, B, and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

D. Smooth surfaced geomembrane shall meet the requirements shown in the following table(s) for the following material(s):

1. Table 1.1 for black LLDPE

E. Extrudate Rod or Bead

1. Extrudate material shall be made from same type resin as the geomembrane (See Part 1.09 B for physical properties requirements of resin).
2. Additives shall be thoroughly dispersed.
3. Materials shall be free of contamination by moisture or foreign matter.

1.10 EQUIPMENT

A. Welding equipment and accessories shall meet the following requirements:

1. Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present.
2. An adequate number of welding apparati shall be available to avoid delaying work.
3. Power source must be capable of providing constant voltage under combined line load.

1.11 DEPLOYMENT

A. Assign and clearly label each panel with a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.

B. Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.

C. Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

1. Unroll geomembrane using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).
2. Place ballast (commonly sandbags) on geomembrane that will not damage geomembrane to prevent wind uplift.
3. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.
4. Do not allow heavy vehicular traffic directly on geomembrane. Rubber-tired ATV's and trucks are acceptable if wheel contact is less than 6 psi.
5. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
6. Generators shall not be placed over the geomembrane.

D. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

E. In order to assure intimate contact, wrinkles in the geomembrane shall be minimized. Wrinkle height shall not exceed 6 inches and the wrinkle height to width ratio for installed geomembrane shall not exceed 0.5.

1.12 FIELD SEAMING

A. Seams shall meet the follcwing requirements:

1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.
3. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area.

4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the CTR and INSTALLER.
5. Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch overlap is commonly suggested.

B. During Welding Operations
1. Provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

C. Extrusion Welding
1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.
2. Clean geomembrane surfaces by disc grinder or equivalent.
3. Purge welding apparatus of heat-degraded extrudate before welding.

D. Hot Wedge Welding
1. Welding apparatus shall be a self-propelled device equipped with an electronic controller that displays applicable temperatures.
2. Welding apparatus shall have 2 tracks, producing a dual hot wedge seam.
3. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.
4. Protect against moisture build-up between sheets.

E. Trial Welds
1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.
3. Conduct trial welds for smooth-smooth, smooth-textured, and textured-textured geomembrane seams daily if applicable to that day's work.
4. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid shift.
5. Cut four, one-inch wide by six-inch long test strips from the trial weld.
6. Quantitatively test specimens for peel adhesion, and then for shear strength.
7. Trial weld specimens shall pass when the results shown in Table 3.1 are achieved in both peel and shear test.
   a. The break, when peel testing, occurs in the liner material itself; not through peel separation (FTB).
   b. The break is ductile.
8. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
9. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.
10. Trial welds will be performed when there is a change in personnel or equipment.
11. Trial welds will be performed when the ambient temperature changes more then 20°F in a seaming period.

F. Seaming
1. Geomembrane seaming will be performed in ambient temperatures less than 104°F and greater than 32°F, as measured 6 inches above the geomembrane surface.
2. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. INSTALLER shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

G. Defects and Repairs
1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

1.13 FIELD QUALITY ASSURANCE

A. MANUFACTURER and INSTALLER shall participate in and conform to all terms and requirements of the Owner's quality assurance program. SUBCONTRACTOR shall be responsible for assuring this participation.

B. The SUBCONTRACTOR shall provide its own Field Installation Quality Assurance/Quality Control (QA/QC) manual.

C. Field Testing
1. Non-destructive testing will be carried out as the seaming progresses.
   a. Vacuum Testing
      1) Shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
   b. Air Pressure Testing
      1) Shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
   c. Other approved methods.
2. Destructive Testing (performed by CQAE with assistance from INSTALLER)
   a. Location and Frequency of Testing
      1) Collect destructive test samples at a frequency of one per every 500 lineal feet of seam length.
      2) Test locations will be determined after seaming.
      3) Exercise Method of Attributes as described by GRI GM-14 (Geosynthetic Research Institute) to minimize test samples taken.
   b. Sampling Procedures are performed as follows:
      1) INSTALLER shall cut samples at locations designated by the CQCE as the seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.
      2) CQCE will number each sample, and the location will be noted on the installation as-built.
      3) Samples shall be twelve (12) inches wide by a minimum of 34 inches with the seam centered lengthwise.
      4) Cut a 2-inch wide strip from each end of the sample for field-testing.
      5) Cut the remaining sample into two parts for distribution as follows:
         a) One portion for INSTALLER, 12-inches by 12 inches
         b) One portion for the Third Party laboratory, 12-inches by 18-inches
         c) Additional samples may be archived if required.
      6) Destructive testing shall be performed in accordance with ASTM D 6392, Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
      7) INSTALLER shall repair all holes in the geomembrane resulting from destructive sampling.
      8) Repair and test the continuity of the repair in accordance with these Specifications.

3. Failed Seam Procedures
    1) If the seam fails, INSTALLER shall follow one of two options:
        a) Reconstruct the seam between any two passed test locations.
        b) Trace the weld to intermediate location at least 10 feet minimum or where the seam ends in both directions from the location of the failed test.
    2) The next seam welded using the same welding device is required to obtain an additional sample, i.e., if one side of the seam is less than 10 feet long.
    3) If sample passes, then the seam shall be reconstructed or capped between the test sample locations.
    4) If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

1.14 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.

C. INSTALLER shall be responsible for repair of defective areas.

D. Agreement upon the appropriate repair method shall be decided between CTR and INSTALLER by using one of the following repair methods:
1. Patching- Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
2. Abrading and Re-welding- Used to repair short section of a seam.
3. Spot Welding- Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.
4. Capping- Used to repair long lengths of failed seams.
5. Flap Welding- Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
6. Remove the unacceptable seam and replace with new material.

E. The following procedures shall be observed when a repair method is used:
1. All geomembrane surfaces shall be clean and dry at the time of repair.
2. Surfaces of the polyethylene that are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.
3. Extend patches or caps at least 6 inches for extrusion welds and 4 inches for wedge welds beyond the edge of the defect, and around all corners of patch material.

F. Repair Verification
1. Number and log each patch repair (performed by CONSULTANT).
2. Non-destructively test each repair using methods specified in this Specification.

1.15 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENTS.

Table 1.1: Minimum Values for Smooth Black-Surfaced LLDPE Geomembranes

Property	Test Method[1]	Requirement
Thickness, mil (mm) Minimum Average Lowest Individual Reading	ASTM D 5199	 60 (1.52) 54 (1.37)
Density, g/cm^3	ASTM D 1505	0.92
Carbon Black Content, %	ASTM D 1603 mod, or D4218	2.0
Carbon Black Dispersion	ASTM D 5596	*Note 2*
Tensile Properties: *(each direction)*	ASTM D 6693	
Strength at Break, lb/in (kN/m)		228 (40.5)
Elongation at Break, %	(2.0" gauge length)	800
Tear Resistance, lb (N)	ASTM D 1004	33 (150)
Puncture Resistance, lb (N)	ASTM D 4833	84 (373.5)
Oxidative Induction Time, minutes	ASTM 3598, 200° C @ 1 atm	>100
Oven Aging at 85°C:	ASTM D5721	-
Standard OIT (min ave) - % Retained after 90 days, or	ASTM D3895	35
High Pressure OIT (min. ave) - % Retained after 90 days	ASTM D5885	60
UV Resistance	-	-
High Pressure OIT (min ave) - % Retained after 1600 hrs	ASTM D5885	35

Notes:

[1] Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

[2] Only near spherical agglomerates are considered. 9 of 10 views shall be Category 1 or 2. No more than one view Category 3.

Table 1.2: Minimum Values for Textured Black Surfaced LLDPE Geomembranes

Property	Test Method[1]	Requirement
Thickness, mil (mm) Minimum Average Lowest Individual Reading	ASTM D 5994	 60 (1.52) 54 (1.37)
Asperity Height	GRI GM 12	*Note 2*
Density, g/cm^3	ASTM D 1505	0.92
Carbon Black Content, %	ASTM D 1603, modified	2.0
Carbon Black Dispersion	ASTM D 5596	*Note 3*
Tensile Properties[4]: *(each direction)*	ASTM D 6693	
Strength at Break, lb/in (kN/m)		132 (23)
Elongation at Break, %	(2.0" gauge length)	500
Tear Resistance, lb (N)	ASTM D 1004	33 (150)
Puncture Resistance, lb (N)	ASTM D 4833	73 (325)
Oxidative Induction Time, min.	ASTM D 3895	>100

[1] Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

[2] 10 mil average. 8 of 10 readings >= 7 mils. Lowest individual reading >=5 mils.

[3] Only near spherical agglomerates are considered. 9 of 10 views shall be Category 1 or 2. No more than one view Category 3.

[4] The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variations of test results. Therefore, these tensile properties are average roll values.

Table 1.3: Minimum Weld Values for LLDPE Geomembranes

Property	Test Method	Requirement
Peel Strength (extrusion), lb/in	ASTM D 6392	72
Peel Strength (fusion), lb/in	ASTM D 6392	75
Shear Strength (fusion & ext.), lb/in	ASTM D 6392	90

*****END OF SECTION*****

L:\work\57378\Work\Geosyntetic Composite Cover\100% Design\New Specs\SPEC-02225-0946 LLDPE Geomembrane Liner - Textured.doc

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02226-0947
GEOSYNTHETIC CLAY LINER
REVISION 1

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert N. Davis for 06/20/05

PROJECT CHIEF ENGINEER DATE

SPEC-02226-0947
GEOSYNTHETIC CLAY LINER (GCL)

PART 1 - GENERAL

1.01 SUMMARY

A. Specifications and guidelines for manufacturing and installing GCL liner systems. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 DEFINITIONS

A. Construction Quality Assurance Engineer (CQAE) - Party, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

B. DESIGNER- The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

C. GCL Manufacturer (MANUFACTURER) - The party responsible for manufacturing the geomembrane rolls.

D. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)- Party, independent from the MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the CONTRACTOR.

E. INSTALLER- Party responsible for field handling, transporting, storing, deploying, seaming and testing of the GCL seams.

F. Panel- Unit area of a GCL that will be seamed in the field that is larger than 100 ft^2.

G. Patch- Unit area of a GCL that will be seamed in the field that is less than 100 ft^2.

H. Subgrade Surface- Soil layer surface that immediately underlies the geosynthetic material(s).

1.03 SUBMITTALS

A. Prior to installation:

1. Identification of bentonite (usually sodium montmorillonite) used for production of GCL.
2. Results of quality control tests conducted by GCL Manufacturer to verify that bentonite supplied met GCL Manufacturer's specifications.
3. Written certification that minimum values given in Specifications are guaranteed by Manufacturer.
4. Quality control certificates, signed by responsible party employed by Manufacturer. Each quality control certificate shall include roll identification numbers, testing

procedures, and results of quality control tests. At a minimum, the following quality control tests must be performed by the Manufacturer and the listed frequencies:

a. GCL Peel Strength (ASTM D 4632) - 1 per 40,000 ft^2.
b. GCL Internal Shear Strength (ASTM D 6243) – receive QA/QC approval of Manufacturer's frequency.
c. GCL Permeability (ASTM D 5084 or ASTM D 5887) – 1 per week.
d. GCL Index Flux (ASTM D 5887) – 1 per week.
e. Bentonite Mass Per Unit Area (ASTM D 5993) - 1 per 40,000 ft^2.
f. Bentonite Moisture Content (ASTM D 2216 or D 4643) – 1 per 100,000 lbs.
g. Bentonite Swell Index (ASTM D 5890) – 1 per 100,000 lbs.

5. Verification that needle punched nonwoven geotextiles have been inspected continuously for broken needles.
6. Any test results not meeting the requirements listed above will result in rejection of the applicable GCL roll.
7. Manufacturer's guidance documents and installation manuals for review and approval by the CTR and DESIGNER.

B. Submit in accordance with Section 01305: SUBMITTAL PROCEDURES.

1.04 QUALITY ASSURANCE

A. SUBCONTRACTOR shall inventory GCL rolls and obtain laboratory conformance samples.

B. One sample representing each 100,000 sq ft of material delivered shall be tested for:

1. GCL Peel Strength (ASTM D 4632).
2. GCL Internal Shear Strength (ASTM D 6243).
3. GCL Permeability (ASTM D 5084 or ASTM D 5887).
4. GCL Index Flux (ASTM D 5887).
5. GCL Moisture Content (ASTM D 2216 or D 4643).
6. Bentonite Mass per unit area (ASTM D 5993)
7. Bentonite Swell Index (ASTM D 5890).

C. Material not meeting Specification shall be rejected and removed from site at SUBCONTRACTOR's expense.

1.05 DELIVERY, STORAGE, AND HANDLING

A. SUBCONTRACTOR is responsible for providing protected GCL storage area.

B. Protect GCL from ultraviolet light exposure, moisture, excessive humidity, puncture, cutting, or other damaging conditions.

C. Identify rolls of GCL with following:
1. Manufacturer's name.
2. Product identification.
3. Roll number.
4. Roll dimensions.

5. Lot number.
6. Manufacturer date.

D. Handle rolls in accordance with ASTM D4873.

1.06 MEASUREMENT AND PAYMENT

A. Measurement for Payments:

1. Payment for geosynthetic clay liner installation will be as per contract unit price per square foot, as measured parallel to liner surface, including designed anchor trench material and is based upon net lined area.
2. Net lined area is defined to be the true area of all surfaces to be lined plus designed burial in all anchor trenches, rubsheets, and sacrificial layers.
3. Prices shall include full compensation for furnishing all labor, material, tools, equipment, and incidentals.
4. Prices also include doing all the work involved in performing geosynthetic clay liner installation completely as shown on the drawing, as specified herein, and as directed by the CTR.

B. Payment:

1. Include cost of work listed herein in time and materials price bid.

PART 2 - PRODUCTS

2.01 MATERIALS

A. GCL will be obtained by SUBCONTRACTOR.

B. Manufacturers:

1. Bentomat ST – Manufactured by CETCO, Lovell, Wyoming.
2. Or equal.

C. GCL Properties (see also QA/QC Plan Table 4.1):

GEOSYNTHETIC CLAY LINER – COVER		
Property	**Method**	**Value**
Permeability	ASTM D 5084	$5x10^{-9}$ cm/sec max.
Mass Per Unit Area		
1. Bentonite Content	ASTM D5993	0.75 lb/ft^2 dry weight min.
2. Geotextile Lower Layer	ASTM D5261	3.1 oz/yd^2 min.
3. Geotextile Upper Layer (Non-Woven)	ASTM D5261	6.0 oz/yd^2 min.
Shear Strength	ASTM D6243	500 psf

GEOSYNTHETIC CLAY LINER – EAST FACE *USE CETCO BENTOMAT DN OR EQUIVALENT*		
Property	**Method**	**Value**
Permeability	ASTM D 5887	$5x10^{-9}$ cm/sec max.
Mass Per Unit Area		
1. Bentonite Content	ASTM D5993	0.75 lb/ft^2 dry weight min.
2. **Nonwoven** Geotextile Lower Layer	ASTM D5261	6.0 oz/yd^2 min.[1]
3. **Nonwoven** Geotextile Upper Layer	ASTM D5261	6.0 oz/yd^2 min.[1]
Shear Strength	ASTM D6243	500 psf

[1] Submit geotextile weights along with material submittal prior to ordering GCL.

PART 3 – EXECUTION

Surface preparation, installation, repair, and GCL protection must be performed in a manner consistent with Manufacturer's guidance documents and installation manuals.

3.01 EXAMINATION

A. Insure supporting soil surface for GCL is below 100% saturation and free of debris or materials that could damage rolls.

3.02 INSTALLATION

A. Overlap GCL seams minimum of 6 in. on edge seams and minimum of 24 in. on end seams after shrinkage and before placing FML.

B. Do not deploy more GCL in one day than can be covered by end of that day.

C. Repair perforations or cuts in GCL with additional GCL layer extending 1 ft past edge of perforation or cut in each direction.

D. Handle rolls as recommended by manufacturer to minimize loss of bentonite along edges during deployment.

E. Remove GCL exposed to moisture and prematurely hydrated prior to placement of overlying material and replaced with new GCL.

3.03 GCL PROTECTION

All GCL installed during a shift must be covered with 10" cushion layer soil by the end of the shift. No installed GCL will be left exposed at the end of a work shift.

A. Materials placed on top of GCL shall comply with following:

1. GCL and underlying materials are not damaged.
2. Minimum slippage of GCL on underlying layers occurs.
3. No excess tensile stress occurs in GCL.

*****END OF SECTION*****

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02227-0948
EROSION MATTING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert V. Davis for 06/20/05

PROJECT CHIEF ENGINEER DATE

SPEC-02227-0948
EROSION MATTING

ATTACHMENTS: Staple Patterns "A" through "E" from North American Green

PART 1 GENERAL

1.01 SUMMARY

This specification section covers the supply and installation of synthetic erosion controls for the channels and slopes of the embankments as shown on the Drawings. All activities performed by the SUBCONTRACTOR at any tier shall be in accordance with all applicable Federal, State, and local laws and regulations. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the reference test methods shall be used in all cases.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1682 Standard Test Method for Measuring Tensile Strength and Percent Strength Retention of Material after 1000 hours of Exposure in Xenon-Arc Weatherometer

ASTM D 4355 Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc type Apparatus)

ASTM D 5035 Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

ASTM D 5199 Standard Test Method for Measuring Thickness of Textile Materials

ASTM D 5261 Standard Test Method for Mass Per Unit Area of Geotextiles

1.03 GENERAL

The SUBCONTRACTOR shall implement the storm water pollution prevention measures specified in this section and in Section 02228: EROSION CONTROL in a manner which will ensure that all soils are retained on-site.

1.04 SUBMITTALS

The following shall be submitted in accordance with Section 01300: SUBMITTAL DESCRIPTIONS and Section: 01305 SUBMITTAL PROCEDURES:

Manufacturing, Sampling, and Testing

A minimum of 14 days prior to scheduled use, erosion mat manufacturer's quality control manual including instructions for storage, handling, installation, seaming, and repair.

Erosion Mat

A minimum of 14 days prior to scheduled use, Manufacturer's certificate of compliance stating that the erosion mat meets the requirements of this section. This submittal shall include copies of manufacturer's quality control test results. The certificate of compliance shall be attested to by a person having legal authority to bind the erosion mat manufacturing company.

1.05 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the Construction Quality Assurance / Quality Control Plan (QA/QC) and the Field Implementation Plan Work Control Document (FIP WCD).

Work will be monitored and tested in accordance with the requirements of Construction QA/QC plan.

The SUBCONTRACTOR shall be aware of all activities outlined in the Construction QA/QC plan, and the SUBCONTRACTOR shall account for these activities in the construction schedule.

1.06 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270 MEASUREMENTS AND PAYMENTS.

PART 2 PRODUCTS

2.01.1 SYNTHETIC EROSION CONTROL MATERIALS

A. Temporary (2-year longevity) erosion control blanket shall be a machine-produced mat consisting of 70 percent straw and 30 percent coconut fiber.

The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 5/8-inch by 5/8-inch mesh, and on the bottom side with an approximate 1/2-inch by 1/2-inch mesh. The blanket shall be sewn together on 1.5-inch centers with degradable thread.

Straw/coconut fiber erosion control blanket shall be NAG SC150 as manufactured by North American Green, or Lead Engineer-approved equivalent. The NAG SC150 erosion control blanket shall conform to Table SPEC-02227-0948-1.

Table SPEC-02227-0948-1

Material Content	
Straw	70% (.35 lb/yd^2)
Coconut Fiber	30% (.15 lb/yd^2)
Netting	Top side heavyweight photodegradable with UV additives (3 lb/1,000 ft^2 approximate weight)
Thread	Degradable
Physical Specifications (Roll)	
Width	6.67 feet
Length	108 feet
Weight	40 pounds +/- 10 percent
Area	80 yd^2
Stitch spacing	1.5 inches

B. The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% coconut fiber matrix incorporated into a permanent three-dimensional turf reinforcement matting.

The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a super heavy duty UV stabilized bottom net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra-heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent three-dimensional turf reinforcement matting.

All mats shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The permanent erosion control/turf reinforcement mat shall conform to Table SPEC-02227-0948-2. Permanent erosion control/turf reinforcement mat shall be C350 as manufactured by North America Green, or Lead Engineer-approved equivalent.

Table SPEC-02227-0948-2

Property	Test Method	Value	Units
Thickness	ASTM D 6525	0.67	in
Resiliency	ASTM D 1777	90	%
Density	ASTM D 792	0.528	oz/in^3
Mass per Unit Area	ASTM D 6566	12.57	oz/yd^2
Porosity	ECTC Guidelines	99	%
Open Volume per Unit Area	ECTC Guidelines	789	in^3/yd^2
Stiffness	ASTM D 1388/ECTC	3.83	oz-in
Light Penetration	ECTC Guidelines	9	%
MD Tensile Strength	ASTM D 6818 [ASTM D 5035]	625	[658 lbs/ft]
MD Elongation	ASTM D 6818 [ASTM D 5035]	22	[8.50%]
TD Tensile Strength	ASTM D 6818 [ASTM D 5035]	768	[910 lbs/ft]
TD Elongation	ASTM D 6818 [ASTM D 5035]	15	[10.90%]
MD Tensile Strength at 10% elongation	ASTM D 5035	232	lbs/ft
TD Tensile Strength at 10% elongation	ASTM D 5035	488	lbs/ft
Physical Specifications (Roll)			
Width	Measured	6.5	ft
Length	Measured	55.5	ft
Weight	Measured	37±10%	lbs
Area	Measured	40	yd^2
MD = Machine Direction			
TD = Transverse Direction			

PART 3 EXECUTION

3.01 INSTALLATION OF SYNTHETIC EROSION CONTROL MATERIAL IN CHANNELS

A. Preparation

1. Prepare soil before installing blankets, including application of lime, fertilizer, and seed.

B. Placement

1. Begin 10 feet back from the top of the channel by anchoring the blanket in a 6-inch deep by 6-inch wide trench. Staple into trench and backfill per manufacturer's recommendations.

2. Roll center blanket in direction of water flow on bottom of channel.

3. Place blankets end over end (shingle style) with a 6-inch overlap. Use a double row of staggered staples 4 inches apart to secure blankets.

4. Full length edge blankets at top of side slopes must be anchored in 6-inch deep by 6-inch wide trenches. Staple into trench and backfill per manufacturer's recommendations.

5. Blankets on side slopes must be overlapped 4 inches (2 inches for NAG C350 matting) over the center blanket and stapled.

6. Staple the entire length over the width of the channel. Staple pattern "D" will be used for Channel 1 to 2, Channel 1 to 5, Channel 5 to 6, and Channel 5 to 8; staple pattern "E" will be used for Channel 2 to 3, Channel 3 to 4, Channel 6 to 7, and Channel 7 to 4. All erosion blankets shall receive staples as shown on the Drawings. See Section 3.04 for staple patterns.

7. In Channel 7 to 4, Channel 2 to 3, and Channel 3 to 4, a staple check slot shall be installed at 30 to 40 foot intervals. Use a row of staples 4 inches apart over entire width of channel. Place a second row 4 inches below the first row in a staggered pattern.

8. The terminal end of the blankets must be anchored in a 6-inch deep by 6-inch wide trench. Staple into trench and backfill per manufacturer's recommendations.

3.03 INSTALLATION OF SYNTHETIC EROSION CONTROL MATERIAL ON SLOPES

A. Preparation

Prepare soil before installing blankets, including application fertilizer, and seed.

B. Placement

1. The NAG SC150 erosion control/turf reinforcement mat for 4H:1V slopes and other designated areas as shown on the Drawings. The entire east slope of the landfill will receive NAG C350 mat. All remaining 4H:IV side slopes of the landfill cover will receive NAG SC150 mat (north, south, west side slopes).

2. Begin 10 feet back from the top of the slope by anchoring the blanket in a 6-inch deep by 6-inch wide trench.

3. Staple into trench and backfill per manufacturer's recommendations.

4 Roll the blankets down or horizontally across the slope.

5. The edges of parallel blankets must be stapled with approximately 5-inch overlap.

6. When blankets must be spliced down the slope, place blankets end over end (shingle style) with approximately 4-inch overlap. Water should flow from upslope mat onto downslope mat without flowing under. Staple through overlapped area, approximately 12 inches apart.

7. Staple the entire length over the width of the slope. Use the recommended staple pattern from paragraph 3.04 based on application, slope, and slope length.

3.04 STAPLE PATTERNS

A. General

The following staple patterns shall be used for erosion control materials placed on slopes.

Table SPEC-02227-0948-3

Slope Length	Slope			
(feet)	4:1	3:1	2:1	1:1
300	B	C	C	C
275	B	C	C	C
250	B	C	C	C
225	B	B	C	C
200	B	B	C	C
175	B	B	C	C
150	A	B	C	C
125	A	A	C	C
100	A	A	C	C
75	A	A	B	C
50	A	A	B	B
25	A	A	B	B

B. Staple Pattern "A"

0.7 staples per square yard using 6-inch, 11 gauge. Wire "U" staples. 8-inch staples and longer may be used for loose soils. 9 gauge wire staples or heavier may be necessary in hard or rocky soils. Staples shall be placed along the long edge at 6.0-foot intervals and staggered along the shorter edge at 6.5-foot intervals. See the attached Staple Pattern Template at the end of the Specification.

C. Staple Pattern "B"

1.15 staples per square yard using 6-inch, 11 gauge. Wire "U" staples. 8-inch staples and longer may be used for loose soils. 9 gauge wire staples or heavier may be necessary in hard or rocky soils. Staples shall be placed along the long edge at 6-foot intervals and staggered along the shorter edge at 3-foot intervals and 1.5-foot intervals from the edge. See the Staple Pattern Template at the end of the Specification.

D. Staple Pattern "C"

1.7 staples per square yard using 6-inch, 11 gauge. Wire "U" staples. 8-inch staples and longer may be used for loose soils. 9 gauge wire staples or heavier may be necessary in hard or rocky soils. Staples shall be placed along the long edge at 4-foot intervals and staggered along the shorter edge at 2-foot intervals and 1.5-foot. intervals from the edge. See the Staple Pattern Template at the end of the Specification.

E. Staple Pattern "D"

3.4 staples per square yard using 6-inch, 11 gauge. Wire "U" staples. 8-inch staples and longer may be used for loose soils. 9 gauge wire staples or heavier may be necessary in hard or rocky soils. Staples shall be placed along the long edge at 2-foot intervals and along the shorter edge at 20-inch intervals. See the Staple Pattern Template at the end of the Specification.

F. Staple Pattern "E"

3.75 staples per square yard using 6-inch, 11 gauge. Wire "U" staples. 8-inch staples and longer may be used for loose soils. 9 gauge wire staples or heavier may be necessary in hard or rocky soils. Staples shall be placed along the long edge at 2-foot intervals. Short edge rows shall alternate between 20-inch intervals starting at the edge and 20-inch intervals starting from an additional staple placed 10 inches from the edge. See the Staple Pattern Template at the end of the Specification.

3.05 MAINTENANCE

The SUBCONTRACTOR shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures.

3.06 INSPECTIONS

A. General

The SUBCONTRACTOR shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every 14 calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

B. Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

C. Inspection Reports

For each inspection conducted, the SUBCONTRACTOR shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, maintenance performed, and actions taken.

A copy of the inspection report shall be submitted to the Site CQA Manager and a copy shall be maintained on the job site.

END OF SECTION

ATTACHMENT

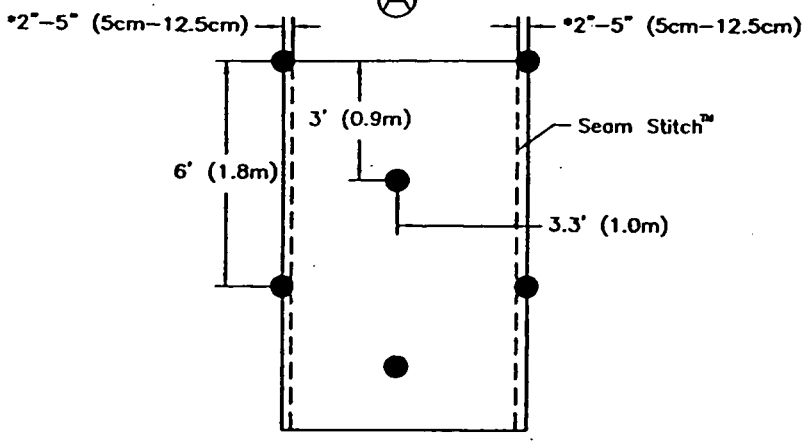
STAPLE PATTERNS "A" THROUGH "E" FROM NORTH AMERICAN GREEN

STAPLE PATTERN GUIDE

NORTH AMERICAN GREEN

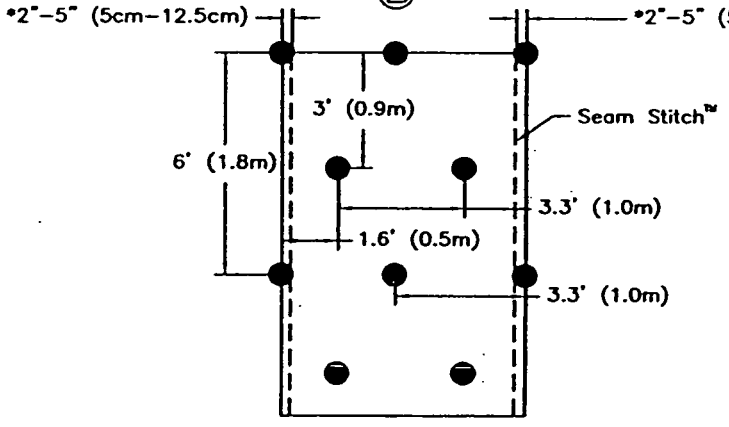
14649 HIGHWAY 41 NORTH
EVANSVILLE, IN 47725
USA 1-800-772-2040
CANADA 1-800-448-2040
www.nagreen.com

Ⓐ



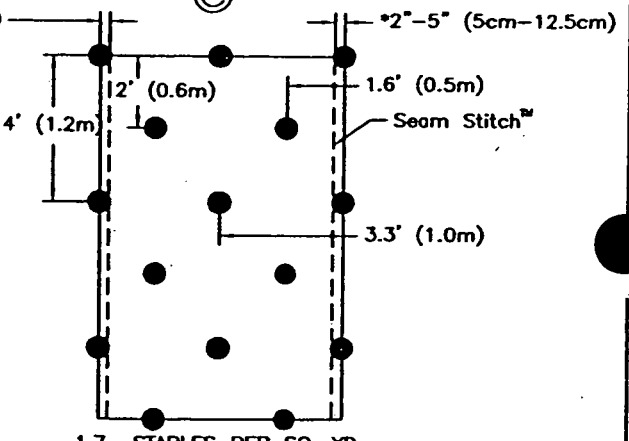
0.7 STAPLES PER SQ. YD.
(0.8 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the BLUE colored dots.

Ⓑ



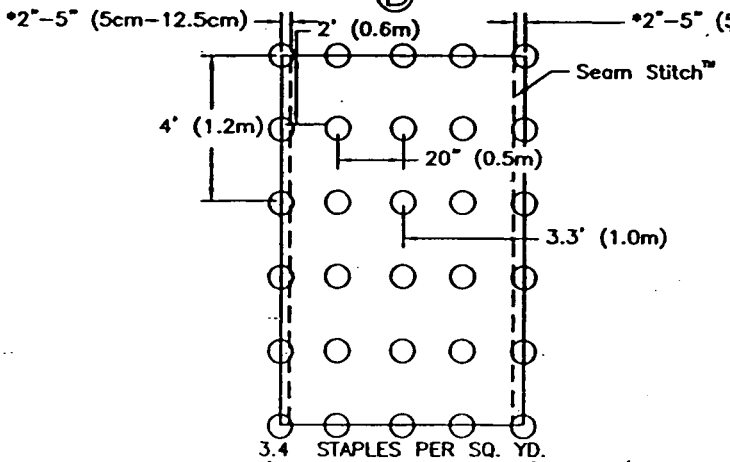
1.15 STAPLES PER SQ. YD.
(1.35 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the RED colored dots.

Ⓒ



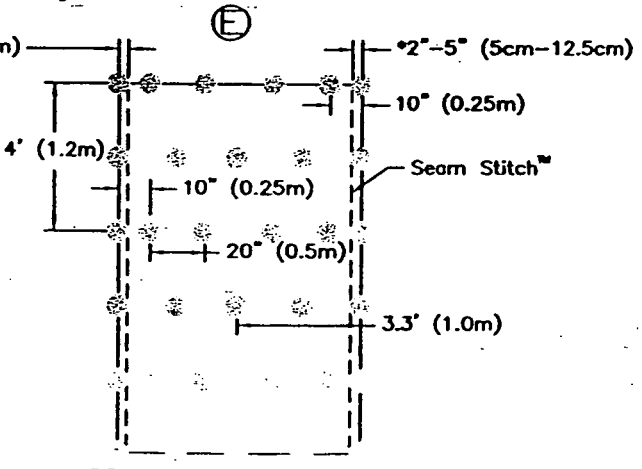
1.7 STAPLES PER SQ. YD.
(2.0 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the GREEN colored dots.

Ⓓ



3.4 STAPLES PER SQ. YD.
(4.1 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the WHITE colored dots.

Ⓔ



3.75 STAPLES PER SQ. YD.
(4.5 STAPLES PER SQ. M)
For blankets with the optional North American Green DOT System™ place staples/stakes through each of the YELLOW colored dots.

*Location of Seam Stitch™ will vary depending on North American Green product type:

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02228-0949
EROSION CONTROL

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis Jr. 06/29/05

PROJECT CHIEF ENGINEER DATE

SPEC-02228-0949
EROSION CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Specifications for erosion control components and their installation. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the reference test methods shall be used in all cases.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3786	Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics - Diaphragm Bursting Strength Tester Method
ASTM D 4439	Standard Terminology for Geotextiles
ASTM D 4491	Water Permeability of Geotextiles by Permittivity
ASTM D 4533	Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	Determining Apparent Opening Size of a Geotextile
ASTM D 4873	Identification, Storage, and Handling of Geotextiles

1.03 GENERAL

The SUBCONTRACTOR shall implement the storm water pollution prevention measures specified in this section, and outlined in the Field Implementation Plan Work Control Document (FIP WCD), in a manner which will ensure that all soils are retained on-site.

1.04 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the SUBCONTRACTOR are described below.

A. Stabilization Practices

The stabilization practices to be implemented shall include geotextiles, erosion control mats, and preservation of mature vegetation. On the Daily Quality Control (QC) Report, the SUBCONTRACTOR shall record the dates when the major grading activities occur; when construction activities temporarily or permanently cease on a portion of the site;

and when stabilization practices are initiated. Except as provided in the paragraphs below, stabilization practices shall be initiated as soon as practicable, but no more than 14 days, in any portion of the site where construction activities have permanently ceased.

1. Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity permanently ceases is precluded by unsuitable conditions caused by the weather as determined by the Site CQA Manager, stabilization practices shall be initiated as soon as practicable after conditions become suitable.

2. No Activity for Less Than 21 Days

Where construction activity will resume on a portion of the site within 21 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 21 days), then stabilization practices do not have to be initiated on that portion of the site by the fourteenth day after construction activity temporarily ceased.

B. Structural Practices

Structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Structural practices shall include the following devices.

1. Silt Fences

The SUBCONTRACTOR shall maintain existing silt fences and provide additional silt fences as necessary for temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fences shall be installed/maintained in the locations indicated on the drawings. Final removal of silt fence barriers shall be upon approval by the Site CQA Manager and the CONTRACTOR.

2. Straw Bales

The SUBCONTRACTOR shall provide bales of straw as a temporary structural practice to minimize erosion and sediment runoff. Bales shall be properly placed to effectively retain sediment immediately after completing each phase of work (e.g., clearing and grubbing, excavation, embankment, and grading) in each independent runoff area (e.g., after clearing and grubbing in a area between a ridge and drain, bales shall be placed as work progresses, bales shall be removed/replaced/relocated as needed for work to progress in the drainage area). Areas where straw bales are to be used are shown on the drawings. Final removal of straw bale barriers shall be upon approval by the Site CQA

Manager and the CONTRACTOR. Rows of bales of straw shall be provided as follows:

a. Along the downhill perimeter edge of all areas disturbed.

b. Along the top of the slope or top bank of drainage ditches, channels, swales, etc. that traverse disturbed areas.

c. Along the toe of all cut slopes and fill slopes of the construction areas.

d. Perpendicular to the flow in the bottom of existing drainage ditches, channels, swales, etc. that traverse disturbed areas or carry runoff from disturbed areas.

e. Perpendicular to the flow in the bottom of new drainage ditches, channels, and swales.

f. At the entrance to culverts that receive runoff from disturbed areas.

1.05 SUBMITTALS

The following shall be submitted in accordance with Section 01305: SUBMITTAL PROCEDURES:

- List of proposed equipment to be used in performance of construction work including descriptive data.
- Suppliers' Test Results demonstrating compliance with this specification and the Construction Quality Assurance/Quality Control Plan (QA/QC).
- Certified waybills and delivery tickets for all materials.

1.06 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the QA/QC plan, the Erosion Control and Storm Water Management Plan Work Control Document (EC&SWM WCD), and the Field Implementation Plan Work Control Document (FIP WCD).

Work will be monitored and tested in accordance with the requirements of the EC&SWM WCD.

The SUBCONTRACTOR shall be aware of all activities outlined in the EC&SWM WCD and the CQA/QC WCD, and the SUBCONTRACTOR shall account for these activities in the construction schedule. No additional cost to the CONTRACTOR shall be allowed by the SUBCONTRACTOR as a result of the performance of the QA/QC activities.

Payment and prices for erosion control will be included within the payment and cost for earth work activities.

1.07 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENT.

PART 2 PRODUCTS

2.01 COMPONENTS FOR SILT FENCES

A. Filter Fabric

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. Unless otherwise approved by the Site CQA Manager or CTR, the filter fabric shall meet the following requirements:

Filter Fabric For Silt Screen Fence

Physical Property	Test Procedure	Strength Requirement
Grab Tensile Elongation (%)	ASTM D 4632 (30% max.)	100 lbs. min.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

B. Silt Fence Stakes and Posts

The SUBCONTRACTOR may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

C. Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The SUBCONTRACTOR shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

D. Identification Storage and Handling

Filter fabric shall be identified, stored and handled in accordance with ASTM D 4873.

2.02 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, or rice, furnished in air-dry condition. The bales shall have a standard cross section of 14 inches by 18 inches. All bales shall be either wire-bound or string-tied. The SUBCONTRACTOR may use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 inches x 2 inches in cross section and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 3 feet. The Site CQA Manager will verify the condition and components of the straw bales.

PART 3 EXECUTION

3.01 INSTALLATION OF SILT FENCES

Silt fences shall be installed to reduce sediment loss. Silt fences shall be installed in accordance with manufacturer's recommendations A six-inch deep trench shall be dug just outside the upstream side of the posts for the full length of the silt fence. Set the posts a maximum of 8 feet on center. Drive the posts into the ground so that no more than 3 feet protrudes about the ground. Steel wires, or similar strengthening, shall be installed to support the fence posts in areas where the potential for heavy hydraulic/sediment loading may occur. Attach the fabric to the posts, and place the fabric into the trench and backfill and compact the soil. All splice joints shall overlap a minimum of 18 inches. Silt fences shall be removed at the decision of the Site CQA Manager.

3.02 INSTALLATION OF STRAW BALES

Straw bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier. Loose straw shall be scattered over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.

3.03 MAINTENANCE

The SUBCONTRACTOR shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

A. Silt Fence Maintenance

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade

B. Straw Bale Maintenance

Straw bale barriers shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged bales, end runs and undercutting beneath bales. Necessary repairs to barriers or replacement of bales shall be accomplished promptly. Sediment deposits shall be removed when deposits reach one-half of the height of the barrier. Bale rows used to retain sediment shall be turned uphill at each end of each row. When a straw bale barrier is no longer required, it shall be removed. The immediate area occupied by the bales and any sediment deposits shall be shaped to an acceptable grade.

3.04 INSPECTIONS

A. General

The SUBCONTRACTOR shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

B. Inspections Details

Disturbed areas and areas used for material storage that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures will be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

C. Inspection Reports

For each inspection conducted, the SUBCONTRACTOR shall prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, maintenance performed, and actions taken. A copy of the inspection report shall be submitted to the Site CQA Manager and a copy shall be maintained on the job site.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02245-0950
STONE AND AGGREGATE MATERIALS

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis Jr 06/28/05

PROJECT CHIEF ENGINEER DATE

SPEC-02245-0950
STONE AND AGGREGATE MATERIALS

PART 1 GENERAL

1.01 SUMMARY

This specification section covers the supply, installation, and testing of stone protection materials for the channel and slopes of the embankment as shown on the Drawings. All activities performed by the SUBCONTRACTOR or any subcontractor at any tier shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the referenced Test Methods shall be used in all cases.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 127	Specific Gravity and Absorption of Coarse Aggregates
ASTM C 131	Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D 422	Method for Particle size Analysis of Soils

1.03 SUBMITTALS

The following shall be submitted in accordance with Section 01305: SUBMITTAL PROCEDURES:

- List of proposed equipment to be used in performance of construction work including descriptive data.
- Suppliers' Test Results demonstrating compliance with Part 2 and riprap geologic source.
- Certified waybills and delivery tickets for all aggregates

1.04 UNIT PRICES

A. Waybills and Delivery Tickets

Copies of waybills and delivery tickets shall be submitted during the progress of the work. Before the final payment is allowed, SUBCONTRACTOR shall file certified waybills and certified delivery tickets for all material actually used.

B. Measurement

Measurement and payment will be made on a per ton basis of useable rock materials delivered and deposited at the project site, whether into a temporary stockpile or directly onto the landfill surface. Deductions will be made for any material wasted, unused, or rejected.

1.05 EQUIPMENT

All equipment and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

1.06 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the Construction Quality Assurance/Quality Control Plan (QA/QC) and the Field Implementation Plan Work Control Document (FIP WCD).

Work will be monitored and tested in accordance with the requirements of the Construction QA/QC plan.

The SUBCONTRACTOR shall be aware of all activities outlined in the Construction QA/QC plan, and the SUBCONTRACTOR shall account for these activities in the construction schedule. No additional cost to the CONTRACTOR shall be allowed by the SUBCONTRACTOR as a result of the performance of the quality assurance/quality control activities.

1.07 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENTS.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bedding Material

Bedding material shall consist of sand, gravel, or crushed stone with 3-in. maximum size. Bedding material shall be composed of tough, durable particles, reasonably free from thin, flat, and elongated particles and containing no organic or soft friable particles in quantities objectionable by the CONTRACTOR, or Site CQA Manager. Uniform gradations shall be within the following limits unless otherwise approved by the Site CQA Manager:

Table SPEC-02245-0950-1

Sieve Size	Percent Passing by Weight
3"	90-100
3/4"	20-90
#4	0-20
#200	0-3

B. Riprap

Stone used for riprap shall be hard, dense, angular in shape, resistant to weathering, and free from seams, cracks or other structural defects. The stone shall have a specific gravity of at least 2.60. Each piece shall have its greatest dimension not greater than four times its least dimension. The riprap shall be reasonably well graded from coarse to fine, falling within the limits of the gradation requirements given on Table SPEC-02245-0950-2.

Control of gradation will be by visual inspection and the supplier's gradation submittal. Riprap material shall not be placed until the material delivered to the job has passed a visual field gradation test. All tests will be performed by and at the expense of the SUBCONTRACTOR and submitted to the Site CQA Manager.

Riprap conforming to the requirements specified above shall have a percentage of wear not to exceed 10 percent after 100 revolutions or 40 percent after 500 revolutions as determined by ASTM C131. Riprap shall have a percentage loss not to exceed 10 percent as determined by ASTM C88 and an absorption of 2 percent or less as determined by ASTM C127.

Table SPEC-02245-0950-2

RIPRAP GRADATION REQUIREMENTS

D_{50} stone size[1] (inches)	% of material smaller than typical stone[2]	typical stone dimensions[3] (inches)	typical stone weight[4] (pounds)
6	70-100	12	85
	50-70	9	35
	35-50	6	10
	2-10	2	0.4
9	70-100	15	160
	50-70	12	85
	35-50	9	35
	2-10	3	1.3
12	70-100	21	440
	50-70	18	275
	35-50	12	80
	2-10	4	3

Notes:

[1] D_{50} = Nominal stone size
[2] Based on typical rock weight
[3] Equivalent spherical diameter
[4] Based on specific gravity=2.60

C. 3/4-inch Drainage Rock (Free Draining Rock)

Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm (1 inch) sieve and 0 to 5 percent passing a 4.75 mm (No. 4) sieve.

D. Separation Geotextile

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments that are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. Unless otherwise approved by the Site CQA Manager or Contractor's Technical Representative (CTR), the filter fabric shall meet the following requirements:

Filter Fabric For Separation Geotextile

Physical Property	Test Procedure	Strength Requirement
Grab Tensile Elongation (%)	ASTM D 4632 (30% max.)	100 lbs. min.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

PART 3 EXECUTION

3.01 PREPARATION

Areas on which separation geotextile, bedding material, and riprap are to be placed shall be graded and dressed to lines and grades shown on drawings and in accordance with Section 02110: SITE PREPARATION. Eroded or washed out areas shall be repaired prior to placement of material.

3.02 SEPARATION GEOTEXTILE

A. Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place sufficient course of free draining rock material on drainage fabric to support drainage pipe, as application dictates. Complete backfilling with free draining rock material to accommodate design requirements. Wrap top of drainage trench in drainage fabric, overlapping sides and ends at least 150 mm (6 inches).

3.03 BEDDING and 3/4-INCH DRAINAGE ROCK MATERIAL

A. General

Material composed of the specified bedding material or ¾-inch drainage rock shall be placed on filter fabric where required within the limits and thickness shown on the drawings or as staked in the field. Bedding material shall be placed to form a backing for riprap protection or for areas where geotextile fabric will be placed.

B. Placement

These materials shall be spread uniformly from down slope to up slope, as applicable, using a low ground pressure dozer (or equipment approved by the Site CQA Manager) on the filter fabric in a satisfactory manner to the slope lines, thickness, and grades indicated on the drawings or as directed. Placing of material by methods, which will tend to segregate particle sizes within the bedding will not be permitted. Any damage to the surface of the bedding foundation during placing of the bedding shall be repaired before proceeding with the work. Compaction of the bedding material will not be required but it shall be finished to present a reasonably even surface free from depressions, mounds, or windrows.

3.04 RIPRAP

A. General

Riprap shall be placed on the bedding material within the limits shown on the drawings.

B. Field Gradation

A visual field gradation test of riprap material shall be performed by the Site CQA Manager to evaluate if the material as delivered to the job meets the gradation requirements of this Specification.

C. Placement

Riprap stone shall be placed in such manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids. Riprap shall be placed to its full course thickness in one operation and in such manner as to avoid damage to the bedding material and to minimize segregation of the riprap. The larger stones shall be well distributed and the entire mass of stones in their final position shall be roughly graded to conform to the gradation specified. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. The desired distribution of the various sizes of stones throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing and placement. Zero drop height placement procedures are to be utilized for riprap stone to avoid displacing or damaging the underlying bedding. Dumping of stone at the top of slopes and rolling or pushing into place will not be permitted. Manipulating or moving stone at any time prior to placement by means of dozers or other blade equipment will not be permitted. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to obtain a reasonably well-graded distribution of stone sizes as specified above. Riprap shall be placed from down slope to up slope to form a continuous buttress of rock as placement progresses.

3.06 GROUTING

Where specified on the Drawings, fill spaces between stones with cement mortar. Use sufficient amount of mortar to fill voids and leave face surface of stone exposed. Place grout from bottom to top and sweep surface with stiff broom. After grouting completed, wet cure surface. Mortar should be machine mixed unless otherwise permitted by the Site CQA Manager. Use mortar within 45 minutes after mixing and do not retemper mortar.

3.07 PROTECTION

The SUBCONTRACTOR shall maintain the riprap stone until accepted and any material displaced by any cause shall be replaced at his expense to the lines and grades shown on the Drawings.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02720-0951
LIQUIDS REMOVAL

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

PROJECT CHIEF ENGINEER — DATE 10/28/04

SPEC-02720-0951
LIQUIDS REMOVAL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Sources

Liquid sources include personnel and vehicle cleaning activities, incidental waters, and sanitary sewage wastewater from personnel facilities. Free liquids consist of liquids from spills, contaminated runoff, and liquids encountered during excavation.

B. Procedures

The SUBCONTRACTOR shall be responsible for the characterization, collection, removal, and disposal of liquids as described in the Waste Management Section of the Field Implementation Plan Work Control Document (FIP WCD), and in accordance with all Rocky Flats Environmental Technology Site (RFETS) Standard Operating Procedures (SOPs).

C. Characterization

The SUBCONTRACTOR is responsible for the sampling, analysis, and characterization of liquids as may be needed to meet regulatory requirements and the treatment/disposal facility requirements.

1.02 MEASUREMENT AND PAYMENT

A. Measurement for Payment:
1. Payment for liquids removal will be as per contract unit price per removal event, as measured in total gallons removed.
2. Prices shall include full compensation for furnishing all labor, material, tools, equipment, and incidentals.

B. Payment:
1. Include cost of work listed herein in a time and materials price bid.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 INCIDENTAL WATERS

Incidental waters encountered as a result of storm water or groundwater entering and collecting within the landfill work boundary will be removed from the landfill if sufficient volume is present, and transferred to a holding tank adjacent to the landfill area. This holding tank will be constructed with sufficient secondary containment. Incidental water will be evaluated per the appropriate and applicable RFETS SOP(s). If incidental waters are found to be contaminated per

the SOP(s) or greater than the Rocky Flats Cleanup Agreement (RFCA) surface water standards, the water will be sent to the Consolidated Water Treatment Facility. If not above RFCA surface water standards, the waters will be distributed onto the landfill interim cover surface as a dust control measure. All actions surrounding the disposition of incidental waters shall be fully detailed in the FIP WCD noted above.

3.02 SANITARY SEWAGE WASTEWATER

All sanitary sewage wastewater shall be stored separately from all other liquids removal, within self-contained restroom or hand wash facilities or units, and shall be disposed of in accordance with the Vendor requirements for these units, and in accordance with the FIP WCD noted above.

END OF SECTION

Present Landfill Accelerated Action

Design Specifications Division 2

SPEC-02900-0952
SEEDING

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis Jr. 06/20/05

PROJECT CHIEF ENGINEER DATE

SPEC-02900-0952
SEEDING

PART 1 GENERAL

1.01 SUMMARY

The vegetation requirements for seeding shall be as described in the plans referenced below. All activities performed by the SUBCONTRACTOR shall be in accordance with all applicable Federal, State, and local laws and regulations.

1.02 REFERENCES

The following publications listed below form a part of the Specification to the extent referenced. The publications are references in the text by basic designation only. The most recent version of the reference Test methods shall be used in all cases.

U.S. DEPARTMENT OF AGRICULTURE: Federal Seed Act of 9 August 1939 (55 Stat. 1275)

1.03 SUBMITTALS

Manufacturer's Catalog Data:

Manufacturer's standard catalog data giving the brand names and catalog numbers of erosion control materials, in sufficient detail to demonstrate complete compliance with this section.

A. Equipment:

1. List of proposed equipment to be used in performance of seeding activities including descriptive data.

B. Manufacturers Instructions:

The manufacturers installation instructions and procedures.

C. Sampling and Testing:

Copies of field test results within 24 hours of completion of tests.

D. Approval of Materials:

Material sources and material test results prior to field use.

E. Certified copy of seed analysis.

F. Seed bag tickets.

G. Documentation of seed drill calibration.

1.04 CONSTRUCTION QUALITY ASSURANCE/QUALITY CONTROL

The SUBCONTRACTOR shall abide by all qualification and submittal requirements of the Construction Quality Assurance / Quality Control Plan (CQA/QC), the Vegetation Plan Work Control Document (VP WCD), and the Field Implementation Plan Work Control Document (FIP WCD).

Work will be monitored and tested in accordance with the requirements of the Construction QA/QC plan.

The SUBCONTRACTOR shall be aware of all activities outlined in the Construction QA/QC plan, and the SUBCONTRACTOR shall account for these activities in the construction schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery

Material used for seeding, such as seed, hay, hay bales, blankets, etc., shall be inspected upon arrival at the job site. Unacceptable material shall be removed from the job site.

B. Storage

Seed shall be protected from any drying, moisture or contamination by detrimental material upon delivery and when being stored.

1.06 MEASUREMENTS AND PAYMENT

A. Measurement for Payment

Make measurements of time and materials necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENTS.

PART 2 PRODUCTS

2.01 SEED

Seed shall be state-certified seed of the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, weed-seed content, and inert material. All seed material shall be certified to be free of noxious weed seed. The date of testing shall be one year or less at time of planting. Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable state seed laws. Seed that has become wet, moldy, or otherwise damaged will not be acceptable. All seed shall be adapted to eastern Colorado.

On-site seed mixing shall be performed in the presence of the Site CQA Manager or his designee. The pure live seed mixture to be used shall be as follows:

A. Seed Mixture

1. Purchase attached seed mixture for the total number of acres to be reseeded. The values in the far right hand column are the amounts per acre to be used when drill seeding. Be sure to order the correct variety of seed. NOTE: For broadcast seeding, double the amounts shown in the far right hand column.
2. The seed is to be ordered as pure live seed (PLS).
3. The seed must be certified weed free.
4. Seed is to be ordered and bagged separately by species (i.e. the seed company should deliver all the seed in separate bags by species). This allows Site ecologists to examine the seed for purity prior to seeding.
5. Pull the seed bag tags off the bags and provide them to the Contractor's Technical Representative (CTR).

B. Critical Area Seeding Rate

Those areas which have been graded, received repeated foot traffic or have slopes 3:1 or greater. The seeding mix and rate stated in paragraph A shall be applied to all areas designated as a critical area.

C. Commercial Seed Formula

The following formula shall be used to determine the amount of commercial seed required to provide in each kind of seed the specified quantities of Pure Live Seed (PLS).

$$\frac{\text{Required Pounds Pure Live Seed} \times 100 \times 100}{\text{Purity}^2 \times \text{Germination}^2} = \text{Pounds Commercial Seed}$$

[2]Purity and Germination expressed as whole numbers.

2.02 TOPSOIL

A. Definitions

The topsoil will consist of the final two inches of the 24-inch Present Landfill soil cover. This topsoil will be comprised of the previously grubbed soil from the Present Landfill interim soil cover, soil from the 280 stockpile that was previously vegetated, or from other sources as approved by the CONTRATOR and the Site CQA Manager.

2.03 MULCH

A. Placement

The SUBCONTRACTOR shall use certified weed free native grass hay at a rate of two tons (air dry weight) per acre, fixed in place with disk land packers or disk harrows on all surfaces with a 3:1 slope or less. Hydromulching will also be an acceptable placement method. See the attached hydromulching submittal and Part 3.03 Paragraph C for further mulching guidance. Slopes steeper than a 3:1 slope shall require an erosion control blanket as described in Section 02228: EROSION CONTROL, as amended by Part 2.04, Paragraph A. All other mulch materials and/or methods of application shall be approved by the CONTRACTOR and Site CQA Manager, prior to application.

B. Type

Mulch shall be long stem native grass hay that is free from noxious weeds, mold or other objectionable material. When long stem native grass hay is not available, a substitute may be used when approved by the CONTRACTOR and Site CQA Manager. If approved, acceptable substitutes are straw from oats, wheat, rye, barley or rice from which grain has been removed, and that are free of noxious weeds, mold, or other objectionable material. The mulch shall contain at least 50 percent by weight of material which is 10 inches or longer. Mulch shall be in air-dry condition and suitable for placing with blower equipment.

2.04 SOIL EROSION CONTROL MATERIAL AND STAPLES

A. Synthetic Erosion Control Materials

Synthetic erosion control materials shall conform to Section 02228: EROSION CONTROL.

B. Erosion Control Fence

Silt fencing shall conform to Section 02228: EROSION CONTROL.

C. Straw or Hay Bales

Straw or hay bales shall conform to Section 02228: EROSION CONTROL.

PART 3 EXECUTION

3.01 DATES FOR SEEDING

Seedbed preparation and seeding shall be accomplished between the dates of 1 May to 31 October, depending upon soil moisture conditions, except as otherwise directed in writing by the CONTRACTOR. Seeding operations shall not be performed when the soil is wet, sticks to tires and equipment, or is frozen.

3.02 PREPARATION OF SEEDBED

A. General

All vegetation, weeds, brush, and rubbish shall be cleared and removed from areas to be seeded. Ground surface shall conform to the grades indicated and any deviations shall be corrected prior to seeding.

B. Tillage

Compaction of both the 22-inch layer and final 2-inch topsoil layer will be minimized. The final cover will be prepared for planting using scarification, ripping, or discing, to break up the compacted soil. Ripping will be conducted to a depth of 9-12 inches in two directions. This will be followed be discing.

3.03 PLANTING SEED

A. General

Any previously prepared seedbed areas compacted or damaged by interim rains, traffic, or other cause, shall be reworked to restore the ground condition previously specified prior to seeding. Seed shall be planted (drilled) as specified in paragraph 3.03B.

B. Methods

The specified seed varieties and indicated amounts of the mixture shall be uniformly drilled over all ground areas disturbed in a manner that will produce an even stand of grass over the entire areas seeded. On areas with slopes 3:1 or flatter, (unless limited by size of area) seed shall be drilled using a rangeland seed drill, unless otherwise approved by the CONTRACTOR and Site CQA Manager.

1. Although no seeding windows are specified, greater success may be achieved when seeding is done in late fall, winter, or early spring.

2. The seed can be drill seeded or broadcast seeded over the disturbed areas. Make sure to use the correct amount of seed for the application method chosen.

3. For broadcast seeding, handseeding or mechanical seeders such as a centrifugal, fan, airblast, or hydroseeder are to be used to distribute the seed. After broadcasting, the area is to be drag-chained or raked to cover the seed slightly and provide better seed/soil contact. Broadcasting may be more appropriate on the steeper slopes for safety concerns.

4. Drill seeding is best used on the flat or shallow slope areas. For drill seeding, the seeding depth is to be between 0.25 inches and 0.5 inches. Because the Site is prone to high winds, drill seeding is to be done using two passes, with the applications being perpendicular to each other and 45 degrees offset from the predominant wind direction. Seeding should not be done when wind speeds are greater than 20 mph.

5. Seeding will be done prior to any mulch applications.

C. Vegetative Mulching

Vegetative Mulching shall be done within the same day as seeding. Erosion controls are important to prevent soil erosion from the revegetation locations and provide for better vegetation establishment. For the gentle upper slope surfaces of the landfill cover crimped straw mulch will be used. The following guidelines will be followed:

1. Straw mulch is to be spread across the revegetated area after seeding (drilled or broadcast) has been completed. It is to be applied at a rate of 1.5 tons per acre. NOTE: The straw must be certified as weed and pest free according to the Colorado Weed Free Forage Act. It should be either winter wheat or oats.

2. The straw is to then be crimped into the soil to prevent it from blowing away. If crimping is not feasible, then after the straw has been blown onto the seeded surface it is to be covered with a chemical tackifier following the manufacturers

recommended application rate. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. Tackifier is to be applied at the manufacturer recommended rate per acre.

For the steep slopes on the eastern end of the landfill, hydromulch and/or erosion control mats and straw wattles (biologs) will be used for erosion control. Acceptable hydromulches include inert wood and plant fiber products (cellulose). Only tackifiers based on vegetable-based binders are acceptable at the Site to prevent undesired chemicals from leaching into the groundwater. Tackifying agents found to be "environmentally friendly" and chemically acceptable for use at the Site are those comprised of plant gums or organic co-polymers. The product known by the brand name "SoilGuard®" was also found to be chemically acceptable. Hydromulch and tackifier are to be applied at the manufacturer recommended rates per acre.

The K-H Ecology Group should be contacted as the project is nearing completion for more information and to set up a site visit to evaluate the specific mulching and erosion control requirements for the project.

D. Watering

No water will be applied to native, field, (dry land) seedings unless required for erosion control blanket installation.

3.04 SOIL EROSION CONTROL MATERIAL

See Section 02228: EROSION CONTROL for soil erosion control material and placement.

3.05 PROTECTION AND CLEANUP

After seeding and mulching operations have been completed, barricades and approved warning signs shall be erected as required to provide protection against traffic and trespass. Excess material from seeding and mulching operations, and all debris, shall be cleaned up and disposed of off the site at an approved location.

3.06 ESTABLISHMENT AND MAINTENANCE

A. General

The SUBCONTRACTOR shall be responsible for the accomplishment of the specifications in Division 2. Proper maintenance shall include protection of embankments and ditches from erosion, and maintenance of the mulch covering up to the completion of the final inspection.

B. Protection of Seeded Areas

Immediately after seeding, the area shall be protected against traffic or other use by erecting barricades, as required, and placing approved signs at appropriate intervals until final acceptance.

C. Reseeding and Repair

During the maintenance period, any eroded or otherwise damaged areas shall be promptly repaired to reestablish the end condition specified herein. Repair shall include all the operations indicated for the particular area involved to produce the end result specified prior to damage.

3.07 FINAL ACCEPTANCE

Final inspection and acceptance will take place when the SUBCONTRACTOR has completed all procedures outlined in the contract. Acceptance will be based upon compliance with seedbed preparation, seeding and mulching as defined in Paragraphs 3.02 through 3.06.

END OF SECTION

ATTACHMENT 1

PRESENT LANDFILL SEED MIX

Seed Mixtures for use in 3 [redacted]d Driller Boxes; Revision 1

March 10, 2005

Mixture 1 (for Use in the Warm Season Seeder Box)						
Fluffy/ Round	**Species**	**Common Name – Variety**	**Sd / sq ft***	**% PLS[1]**	**Lb/ac**	**Role**
F	Andropogon gerardii	Big bluestem – Kaw	4	10.5	1.4	Deep-rooted, warm-season; accessing deep moisture when shallow moisture is deficient
F	Bouteloua curtipendula	Sideoats grama – Vaughn	2	5.3	0.7	Moderately deep-rooted, warm-season; establishes well on restoration sites
F	Chondrosum gracile	Blue grama – Bad River	4	10.5	0.2	Ditto except blue grama is a wide-spreading bunchgrass
F	Sorghastrum nutans	Yellow Indiangrass – Holt	2	5.3	0.5	Deep-rooted, warm-season; accessing deep moisture when shallow moisture is deficient
	Total		12***	31.6	2.8***	

Mixture 2 (for Use in the Cool Season Seeder Box)						
R	Buchloe dactyloides	Buffalograss – Cody	3	7.9	2.3	Warm-season turfgrass of short stature that can be expected to provide important ground cover when drought restricts cover of other species
R	Buchloe dactyloides	Buffalograss – Native**	1	2.6	0.8	Ditto
R	Elymus lanceolatus var. psammophilus	Streambank wheatgrass - Sodar	5	13.2	1.4	Native cool-season turfgrass that can be expected to dependably establish and provide important erosion control
R	Elymus lanceolatus var. lanceolatus	Thickspike wheatgrass-Critana	5	13.2	1.4	Ditto
R	Elymus trachycaulus	Slender wheatgrass – San Luis	3	7.9	0.8	Native bunchgrass of moderate to tall stature that establishes vigorously, providing early cover; can be expected to fade as slower-growing natives progress after the first few years
R	Pascopyrum smithii	Western wheatgrass – Arriba	3	7.9	01.2	Native cool-season turfgrass that can be expected to dependably establish and provide important erosion control
R	Stipa viridula	Green needlegrass – LoDorm	2	5.3	0.5	Native cool-season bunchgrass that establishes dependably
	Total		28***	57.9	9.3***	

Mixture 3 (for Use in the Legume Seeder Box)						
R	Koeleria pyrimidata	Prairie Junegrass – Native**	1	2.6	0.2	Native bunchgrass of the plains, slow to establish but then durable.
R	Poa canbyi (P. secunda)	Canby bluegrass – Canbar	1	2.6	0.5	Native bunchgrass of the plains, slow to establish but then durable.
R	Sporobolus cryptandrus	Sand dropseed - Native	2	5.3	0.01	Native warm-season bunchgrass that establishes well on sites with coarser soil texture. Elective.
	Total		4***	10.5	0.71***	

*Seeds per square foot for drill seeding

** Native = source in central Great Plains

*** 38 seeds per square foot, when drilled with a drill with 8-inch furrow spacing results in an average of two seeds per lineal inch of drill furrow.

[1] PLS = pure live seed

Present Landfill Accelerated Action

Design Specifications Division 3

SPEC-03200
CONCRETE REINFORCEMENT

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis Jr 06/20/05

PROJECT CHIEF ENGINEER DATE

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.2 REFERENCES

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(1988) Standard specification for concrete construction and materials
ACI 318	(1999) Building Code Requirements for Structural Concrete & Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 370	(1997) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 615	(2001) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706	(2001) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI	"Placing Reinforcing Bars."

1.2 SUBMITTALS

a. Shop Drawings:

1. Conform to ACI SP-66 showing bending diagrams; assembly diagrams: location diagrams; splicing and laps of bars, shapes, and dimensions; and details for bar reinforcing, stirrup spacing, accessories, and openings.
2. Coordinate bar splicing and placement with concrete placing schedule and joint locations.
3. Submit with construction joint submittals required in Section 03300 CAST-IN-PLACE CONCRETE.

b. Submit in accordance with Section 01305 SUBMITTAL REQUIREMENTS.

1.2 DELIVERY, STORAGE, AND HANDLING

Store reinforcing steel on supports above ground; cover and keep clean.

PART 2 PRODUCTS

2.1 MATERIALS

a. Steel Reinforcing Bars:

1. Deformed bars conforming to ASTM A615, Grade 60.

b. Reinforcing Supports:

1. Exterior exposed surfaces, surfaces in contact with earth or liquid, and interior exposed surfaces in humid areas shall have all plastic or stainless steel supports.
2. Interior exposed surfaces in dry areas shall have all plastic, stainless steel, or plastic tipped steel supports.

2.2 FABRICATION

a. Fabricate to schedules and details on Design Drawings and in accordance with ACI 318.

PART 3 EXECUTION

3.1 PLACEMENT

a. Placement of reinforcing steel shall be approved by GOVERNMENT before covered with concrete.

b. Correct displacement of reinforcement prior to and during concrete pouring operations. Maintain clear cover as noted on Design Drawings. Tolerances shall be in accordance with ACI 117 and ACI 318, unless noted otherwise.

c. Support reinforcing steel in accordance with CRSI "Placing Reinforcing Bars" with maximum spacing of 4 ft.

d. Tie reinforcing steel at intersections in accordance with CRSI "Placing Reinforcing Bars."

e. Locate reinforcing to avoid interference with items drilled in later.

f. Do not field bend bars, including bars partially embedded in concrete unless indicated.

g. Do not place bars having kinks and bends other than shown on approved Shop Drawings.

h. Tack welding reinforcement is prohibited.

i. Reinforcement shall be clean and free from loose mill scale, dirt, grease, oil, form release agent, dried concrete or any material reducing bond with concrete.

j. Vertical reinforcement shall be placed by bonding the bars into holes drilled into the existing hardened concrete with rotary core-type drills that can be maintained in a position perpendicular to the existing concrete slab. A non-epoxy bonding compound will be used.

k. The reinforcement hole shall have a diameter that should be larger--but not more than 1/8-inch larger--than the diameter of the bar.

** END OF SECTION **

Present Landfill Accelerated Action

Design Specifications Division 3

SPEC-03300
CAST-IN-PLACE CONCRETE

APPROVED (circled)

APPROVED AS CORRECTED

NOT APPROVED

REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis 06/20/05

PROJECT CHIEF ENGINEER DATE

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

Construct Aeration Treatment Unit to the lines and grades as shown on the drawings. The Aeration Treatment Unit is a too be constructed as a cast-in-place concrete vault where water will flow over a series of steps at decreasing elevations. The steps will cause the water to flow in a waterfall and provide volatilization necessary to treat the water, in a manner similar to the existing flagstone waterfall steps.

The Aeration Treatment Unit shall be constructed as a single concrete placement, with no construction joints. Fiberglass grating will be installed on top of the vault to provide access for inspections, maintenance, and to provide ventilation.

1.02 REFERENCES

ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 308	Standard Specification for Curing Concrete
ACI 318	Building Code Requirements for Structural Concrete & Commentary
ACI SP-66	Detailing Manual
ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C31	Standard Specification for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete.
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete

ASTM C150	Standard Specification for Portland Cement
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete.
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
CRSI	Concrete Reinforcing Steel Institute, "Placing Reinforcement Bars," 1996.

1.03 GENERAL REQUIREMENTS

The area where the Aeration Treatment Unit is to be constructed shall be graded and dressed to lines and grades shown on drawings and in accordance with Section 02110: SITE PREPARATION. Eroded or washed out areas shall be repaired prior to placement of material.

All excavation and backfilling requirements shall be executed in accordance with Section 02221: EARTHWORK and Section 02245: STONE AND AGGREGATE MATERIALS.

1.04 SUBMITTALS

A. Shop Drawings:

1. Reinforcing steel drawings conforming to ACI SP-66 showing bending diagrams, assembly diagrams, location diagrams, splicing and laps of bars, shapes, dimensions, and details for bar reinforcing and stirrup spacing, accessories, and openings.

B. Product Data:

1. Manufacturer's literature and product sample.

C. Test Results:

1. Concrete test Results.
2. Provide with each load of concrete delivered, duplicate delivery tickets one for CONTRACTOR and one for ENGINEER with following information.

   a. Date and serial number of ticket.
   b. Name of ready mixed concrete plant, operator, and job location.
   c. Type of cement, admixtures, if any, and brand name.
   d. Cement content, in bags/cu yd of concrete, and mix design.
   e. Truck number, time loaded, and name of dispatcher.
   f. Amount of concrete in load, in cu yds, delivered.
   g. Maximum size aggregate.
   h. Gal of water added at job, if any, and slump of concrete after water was added.
   i. Temperature of concrete at delivery.

j. Number of revolutions of mixer.

D. Miscellaneous Submittals:

1. Statement by ready mix supplier giving source and material certificates, and proportions by weight of cement, fine and coarse aggregates, and admixtures.

E. Submit in accordance with Section 01305: SUBMITTAL PROCEDURES.

1.05 QUALITY ASSURANCE

A. Testing:

1. Sampling and testing will be performed by independent testing laboratory.
2. Perform slump tests (ASTM C143), air-entrainment tests (ASTM C231), and compressive strength tests (ASTM C31 and C39) daily for each class of concrete poured.

B. Tolerances:

1. Conform to requirements of ACI 117.
2. Concrete shall be within 3/16 in. of 10 ft straightedge in all directions except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 in.

1.06 PROJECT SITE CONDITIONS

A. Hot Weather:

1. Comply with ACI 301 and 305R.
2. Concrete temperature shall not exceed 90°F.
3. At air temperatures of 80°F or above, keep concrete as cool as possible during placement and curing. Cool forms by water wash.
4. When concrete temperatures exceed 80°F, water reducing, set retarding admixtures shall be used in accordance with manufacturer's recommendations.

B. Cold Weather:

1. Comply with ACI 306.1.
2. Temperature of reinforcement, forms, fillers, and other materials in contact with concrete at time of placement shall not be less than 35°F. Preheat if temperature is below 35°F.
3. Maintain air and forms in contact with concrete sections having minimum dimension less than 12 in. at temperature above 50°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.
4. Maintain air and forms in contact with concrete in more massive sections at temperature above 40°F for at least first 3 days and at temperature above 32°F for remainder of specified curing period.

PART 2 PRODUCTs

2.01 MATERIALS

A. Portland Cement:

1. ASTM C150, Type I. Except tricalcium aluminate (C_3A) content of Type I shall not exceed 12%.

B. Aggregates:

1. ASTM C33, free of foreign materials.
2. Fine Aggregate: Natural sand.
3. Coarse Aggregate: Crushed stone, crushed gravel or gravel. Size 67 (3/4 in. maximum).

C. Admixtures for Concrete:

1. Air-Entraining: ASTM C260.
2. Chemical Admixtures: Optional, ASTM C494.

   a. Water Reducing: Type A.
   b. Retarding: Type B.
   c. Water Reducing and Retarding: Type D.

3. Chemical Admixtures for Flowing Concrete: ASTM C1017.

   a. Type 1, water reducing, high range.
   b. Type 2, water reducing and retardant, high range.

D. Water: Potable:

E. Steel Reinforcing Bars:

1. Deformed bars conforming to ASTM A615, grade 60.

F. Finishing Grout:

1. Manufacturers:

   a. Thoroseal with Acryl 60, by Thoro.
   b. Concrete Finisher with AKKRO-7T, by Tamms Industries Company.

2.02 CONCRETE MIX DESIGN

A. Concrete Mix: Measure and combine cement, aggregates, water, and admixtures in accordance with ASTM C94.

1. Class A:

   a. Minimum 28-Day Strength: 4,000 psi.
   b. Air Content: 6%, ±1%.
   c. Maximum Slump: 4 in.
   d. Water/Cement Ratio: 0.45 maximum.

2.03 MIXING AND DELIVERY

A. Furnish and deliver concrete in conformance with ASTM C94.

B. Deliver and complete discharge within 1-1/2 hrs of commencing mixing or before 300 revolutions of drum or blades, whichever comes first. Includes revolutions required by transit mix trucks. Limitations may be waived by ENGINEER if concrete is of such slump after 1-1/2 hrs or 300 revolution limit, it can be placed without addition of water.

C. Do not add water on job unless authorized by ENGINEER. If water is added, additional mixing of 30 drum revolutions is required.

2.04 GRATING

A. Provide and install Fiberglass open molded grating.

1. Gatorgrate GG-HD10 by AIMCO or approved equal.
2. Provide shop drawings detailing bracing and connections to concrete vault.
3. Shop drawing to be stamped by an engineer registered in the State of Colorado.

2.05 SEPARATION GEOTEXTILE

A. The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments that are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. Unless otherwise approved by the Construction Quality Assurance Engineer or DESIGNER, the filter fabric shall meet the following requirements:

Filter Fabric For Separation Geotextile		
Physical Property	**Test Procedure**	**Strength Requirement**
Grab Tensile Elongation (%)	ASTM D 4632 (30% max.)	100 lbs. min.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.06 DRAINAGE ROCK

A. Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm (1 inch) sieve and 0 to 5 percent passing a 4.75 mm (No. 4) sieve.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Subgrade and Bedding: Compacted and free of frost. For placement at temperatures below freezing, provide temporary heat and protection as required to remove frost.

B. Provide mud slabs where necessary and when required by ENGINEER to obtain dry and stable working platform for placement of slabs on grade.

C. Remove standing water, ice, mud, and foreign matter before concrete is deposited.

D. Place a layer of Separation Geotextile over prepared subgrade.

E. Place 4-inches of Drainage Rock Base over geotextile prior to placing concrete.

3.02 FORMS

A. Workmanship: Formwork shall prevent leakage of mortar. Removal of wall ties shall leave holes clean cut and without appreciable spalling at face of concrete. Conform to requirements of ACI 347R.

B. Materials:

1. Unless specified otherwise, type of forms used is CONTRACTOR'S option. CONTRACTOR may use metal, plywood, presswood form liners or plastic surfaced plywood.
2. Use approved commercially manufactured devices for form ties. Arrange ties so when forms are removed, no metal will be within 1 in. of formed face of concrete.

C. Do not disturb forms until concrete adequately cured.

D. Form system design shall be CONTRACTOR'S responsibility.

3.03 JOINTS

A. No construction joints will be allowed.

3.04 REINFORCEMENT PLACEMENT

A. Reinforcing steel shall be approved by ENGINEER before being covered with concrete.

B. Correct displacement of reinforcement prior to and during concrete pouring operations. Maintain clear cover as noted on Drawings. Tolerances shall be in accordance with ACI 318, unless noted otherwise.

C. Support reinforcing steel in accordance with CRSI "Placing Reinforcing Bars," with maximum spacing of 4 ft 0 in.

D. Tie reinforcing steel at intersections in accordance with CRSI "Placing Reinforcing Bars." Maximum spacing for footings, and walls every third intersection or 3 ft 0 in. Maximum spacing for slabs and other Work every fourth intersection or 3 ft 0 in. Dowels shall be tied in-place.

E. Locate reinforcing to avoid interference with items drilled in later, such as concrete anchors.

F. Do not field bend bars including bars partially embedded in concrete unless indicated or approved by ENGINEER.

G. Welding of reinforcing bars permitted only where indicated or as otherwise approved by ENGINEER.

3.05 CONCRETE PLACEMENT

A. Except as modified herein, ACI 304-Chapter V, shall constitute requirements of this Specification.

B. Avoid damage to reinforcing, and ensure accurate positioning after concrete placed.

C. Do not spread concrete with vibrators.

D. Place concrete with aid of internal mechanical vibrator equipment capable of 7,000 impulses/min. Transmit vibration directly to concrete. Duration of vibration at any location shall be necessary to produce thorough consolidation and to cause maximum amount of air bubbles to migrate to top of pour.

E. Set embedded items such as bolts, anchors, and piping in concrete as required by manufacturer of equipment used. Verify location with equipment manufacturers.

3.06 SLAB FINISHES

A. Interior slabs shall receive 1 trowelings.

1. Perform initial troweling by power or hand with trowel blade kept as flat as possible against concrete surface to prevent washboard or chatter effect.

3.07 FINISHING FORMED CONCRETE

A. Smooth Finish: Interior concrete surfaces.

1. Patch honeycombing, stone pockets, form ties, spalls, and other irregularities.
2. Grind joint marks and fins smooth with adjacent wall surface. Remove oil stains and rinse surface.

3.08 PROTECTION AND CURING

A. Protect concrete from frost and rapid drying, and keep moist for minimum curing period of 7 days after placing in accordance with ACI 308.

B. Wet cure or apply curing compound. Do not use curing compound where other coating or topping will be applied.

C. Formed surfaces may be cured by leaving forms in-place. Spray surface of forms left in-place during curing period as frequently as drying conditions may require to keep concrete surfaces moist. For vertical surfaces, apply water to run down on inside of forms, if necessary to keep concrete wet.

D. Protect from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

E. Protect finished concrete surfaces from damage caused by construction equipment, materials or methods, and rain or running water.

F. Do not load self-supporting structures as to overstress concrete.

* * * END OF SECTION * * *

Present Landfill Accelerated Action

Design Specifications Division 3

SPEC-03410
STRUCTURAL PRECAST CONCRETE

(APPROVED)	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert K. Davis for 06/20/05

PROJECT CHIEF ENGINEER DATE

SECTION 03410
STRUCTURAL PRECAST CONCRETE

PART 1 GENERAL

1.01 SUMMARY

Provide and install manhole for use in combining three separate inflows, discharging to the Aeration Treatment Unit. The manhole will contain a flowmeter to measure flow from the existing seep collection system. The combined flow will discharge to the Aeration Treatment Unit for treatment.

1.02 REFERENCES

ACI 318	Building Code Requirements for Structural Concrete & Commentary
PCI MNL-116	Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-117	Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
AWS D 1.1	Structural Welding Code- Steel
AWS D 1.4	Structural Welding Code- Reinforcing Steel
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A184	Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 SI Tensile Strength
ASTM A416	Standard Specification for Steel Strand, Uncoated Seven- Wire for Prestressed Concrete
ASTM A615	Standard Specification for Deformed and Plain Billet- Steel Bars for Concrete Reinforcement
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C185	Standard Test Method for Air Content of Hydraulic Cement Mortar
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C307	Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C330	Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete

1.03 GENERAL REQUIREMENTS

The area where the Manhole is to be placed shall be graded and dressed to lines and grades shown on drawings and in accordance with Section 02110: SITE PREPARATION. Eroded or washed out areas shall be repaired prior to placement of material.

All excavation and backfilling requirements shall be executed in accordance with Section 02221: EARTHWORK and Section 02245: STONE AND AGGREGATE MATERIALS.

1.04 SUBMITTALS

A. Shop Drawings:

1. Content:

   a. Dimensions.
   b. Design camber.
   c. Details of inserts, anchors, connections, accessories, joints, formed openings and scheduled field cut openings, anchor bolt layout plan, fabrication detail, and design loads.
   d. Chamfer and radius of corners.
   e. Lifting positions or devices.
   f. Reinforcement and tendons.
   g. Welds.
   h. Finish type(s).

2. Show location of precast prestressed sections with same identification marks used in fabrication.

3. Shop Drawings shall bear stamp of Professional Engineer registered in State of Colorado.

B. Product Data:

1. Where standard catalog or tabled members used, submit copy of catalog or table which is basis for member design.
2. Manufacturer's written instructions for handling, transporting, and erecting.

C. Test Results:

1. Reports of tests on concrete.

D. Miscellaneous Submittals:

1. Manufacturer's certificates of material or procedures are in compliance with Specifications.
2. When requested by ENGINEER, evidence of certification or experience qualifications.

E. Submit in accordance with Section 01305: SUBMITTAL PROCEDURES

1.05 QUALITY ASSURANCE

A. Design Changes:

1. If CONTRACTOR proposes to change selected portions of precast to cast-in-place concrete, submit to ENGINEER for approval and coordination.
2. If CONTRACTOR proposes to change selected portions of precast dimensions or framing systems from shown on Drawings, submit for approval and coordination.

B. Testing:

1. Conduct testing in accordance with PCI MNL-116 and MNL-117.

C. Regulatory Requirements:

1. Design, fabricate, and install precast, prestressed sections to meet requirements of ACI 318, PCI MNL-116, and PCI Design Handbook.

D. Shop Inspection:

1. Shop inspection may be required by OWNER. CONTRACTOR shall give minimum of seven days notice to ENGINEER prior to beginning of any fabrication work and shipment of completed components so inspection may be provided.
2. CONTRACTOR shall allow ENGINEER free access to necessary parts of Work. ENGINEER shall have authority to reject materials or Work not meeting requirements of Specifications.
3. Inspection at shop intended as means of facilitating Work and avoiding errors, but will in no way relieve CONTRACTOR from responsibility for furnishing proper materials and workmanship under these specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Follow manufacturer's written instructions for handling and transporting.

B. Lift members at designated points only, and use lifting inserts if provided.

C. Use lifting slings or spreader bars to keep angle between lifted member and cable greater than 45 degrees.

D. Do not place members in position causing overstress, warp or twist.

E. Handle members to protect from dirt and damage.

F. Place stored members so identification marks discernible.

G. Separate stacked members by battens across full width of each bearing point.

H. Stack members so lifting devices accessible and undamaged.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firms specializing in providing precast or precast prestressed concrete products and service normally associated with industry for at least 3 yrs.

B. PCI certified producer.

C. Manufacturers meeting requirements of PCI MNL-116 and PCI MNL-117.

D. Manufacturers may be required to submit written evidence showing experience, qualifications, and adequacy of plant capability, facilities, and ability to perform Work in accordance with these Specifications.

1. Evidence shall consist of PCI plant certification or results of tests performed by independent testing laboratory to monitor conformance to provisions of PCI MNL-116, PCI MNL-117 and requirements herein.

2.02 MATERIALS

A. Portland Cement: ASTM C150, Type I

B. Admixtures:

1. Air-Entraining: ASTM C260.
2. Water Reduction and Set Retardation: ASTM C494, Type A.
3. Super Plasticizer: ASTM C494, Type A.

C. Aggregates:

1. ASTM C33 or C330.
2. Material: Natural.
3. Maximum 1 in.

D. Water: Potable or free from foreign materials in amounts harmful to concrete.

E. Reinforcing Steel:

1. Deformed Steel Bars: ASTM A615, Grade 40 or 60.
2. Wire Fabric: Welded steel, ASTM A185.
3. Fabricated Steel Bar or Rod Mats: ASTM A184.

F. Tendons: Uncoated, stress-relieved strand, ASTM A416, Grade 250K or 270K. Low relaxation strand conforming to Supplement I may be used.

G. Anchors and Inserts:

1. Material: Steel, ASTM A36 or A307.
2. Finish:

   a. Shop primer: Manufacturer's standard.

H. Grout:

1. Cement Grout: One part Portland cement, 3 parts sand, sufficient water for placement and hydration.

I. Bearing Pads:

1. Hollow Core Slabs:

   a. 1/8 in. thick, smooth on both sides.
   b. Tempered hardboard or high density plastic.

2. Tees and Girders:

   a. Chloroprene or fiber reinforced elastomeric.
   b. Size and hardness to be determined by manufacturer.

J. Welded Studs: In accordance with AWS D1.1.

K. Curing Materials:

1. Liquid membrane forming compound, ASTM C309 or sheet materials, ASTM C171.

L. Manhole Cover

1. Provide and install Neenah Foundry R-1554 manhole frame and cover.

M. Manhole Stairs

1. Provide Neenah Foundry R-1981-N steps and cast into manhole.

N. Separation Geotextile

The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments that are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. unless otherwise approved by the Construction Quality Assurance Engineer or DESIGNER, the filter fabric shall meet the following requirements:

Filter Fabric For Separation Geotextile		
Physical Property	**Test Procedure**	**Strength Requirement**
Grab Tensile Elongation (%)	ASTM D 4632 (30% max.)	100 lbs. min.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

O. Drainage Rock

Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm (1 inch) sieve and 0 to 5 percent passing a 4.75 mm (No. 4) sieve.

2.03 MIX DESIGN

A. Mix design shall be in accordance with manufacturer's recommendations.

B. Precast manufacturer shall be responsible for structural design of individual precast components, connections between components, and combining of components to provide total structure.

C. Design, reinforce, and prestress units as required by ACI 318, PCI Design Handbook, as specified herein, and as shown on Drawings. Design and provide members capable of sustaining superimposed loads as noted on Drawings and below.

D. Concrete Properties:

1. Water-Cement Ratio: Maximum 40 lbs water to 100 lbs cement.
2. Air-Entrainment:

   a. 19% (±3%) in standard 1:4 sand mortar as tested in accordance with ASTM C185.
   b. 7% (±2%) in concrete as tested according to ASTM C231.

3. 28 day Compressive Strength: 4,000 psi.

4. Do not use calcium chloride or other salts.

2.04 FABRICATION

A. Formwork:

1. Construct forms to withstand tensioning and detensioning operations.
2. Construct forms to maintain units within specified tolerances with radius or chamfer at corners.
3. Securely attach anchorage devices to formwork in locations not affecting position of main reinforcement or placing of concrete.
4. Form treatments or curing compounds shall not contain ingredients which might stain through or otherwise injure concrete or reduce bond with subsequent coatings, finishes, grout or caulking.

B. Reinforcement:

1. Pretension tendons by single strand tensioning or multi-strand tensioning method, in accordance with PCI MNL-116.
2. Provide reinforcement necessary to resist stresses from applied loads, handling, and erecting.
3. Place and anchor reinforcement in position.
4. Locate lifting devices to not harm appearance of unit in finished position.

C. Concrete Placement:

1. Batch, mix, and handle concrete in accordance with ACI and PCI recommended practices.
2. Place concrete in continuous operation to prevent formation of seams.
3. Consolidate placed concrete by vibration without dislocation or damage to reinforcement and built-in items.

D. Cure units in accordance with PCI MNL-116.

E. Detensioning:

1. Delay detensioning of prestressed units until corresponding concrete test cylinder has attained release strength in accordance with design.
2. Perform detensioning while concrete warm and moist, if heat-cured.
3. Detension pretensioned tendons by gradual release of tensioning jacks or heat cutting tendons in sequence and pattern to prevent shock or unbalanced loading.

F. Finishes:

1. Unexposed Areas: As cast.

G. Fabrication tolerances shall conform to requirements of MNL-116 and ACI 117, the more stringent requirements shall apply.

2.05 HOLES, ANCHORS, AND FRAMING

A. Embedded Items: Provide pipes, sleeves, inserts, weld plates, anchor plates, and other embedded items shown on Drawings and as required and cast into members during manufacture. Place dissimilar metals to avoid physical contact between them.

B. Furnish inserts, plates, fastening devices, and anchors to be set in supporting structure.

C. Holes:

1. Over 8 in. dia shall be formed during manufacture of units, or field cut or cored by precast manufacturer
2. 8-in. and under may be field cut or cored by contractor. Location shall be coordinated with precast manufacturer before cutting or coring.

D. Large Openings: Design and provide steel headers.

1. Reinforce units adjacent to units with openings larger than 12 in. to support additional dead and live load.

E. At holes and along cut edges of hollow core units, exposed cores shall be grouted solid within 6 in. of hole or cut edge. Holes or cuts made in shop shall be shop grouted.

2.06 SOURCE QUALITY CONTROL

A. In general compliance with applicable provisions of PCI MNL-116 and MNL-117.

1. Concrete Compression Tests:

a. ASTM C39.
b. Make one compression test for each day's production.
c. Specimens:

1) Provide 4 test specimens for each compression test.
2) Obtain concrete for specimens from actual production batch.
3) Concrete cylinders, ASTM C31.

2. Failure of any member to come within tolerances specified in PCI MNL-116 or PCI MNL-117 shall be cause for rejection.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect bearing surfaces of structure to ensure they are smooth, level, and free of debris.

B. Verify required inserts and anchors for connection to precast sections installed.

3.02 SUBGRADE PREPARATION

A. Subgrade and Bedding: Compacted and free of frost. For placement at temperatures below freezing, provide temporary heat and protection as required to remove frost.

B. Remove standing water, ice, mud, and foreign matter before placing geotextile.

D. Place a layer of Separation Geotextile over prepared subgrade.

E. Place 4-inches of Drainage Rock Base over geotextile prior to placing concrete.

3.03 ERECTION

A. Erect precast sections in accordance with manufacturer's written instructions.

B. Align, place, and level units in final position on accepted bearing surfaces.

C. Place no warped, cracked or broken units.

D. Ends of units may be saw cut if required for proper clearance. Breaking of units with hammer to produce fit not accepted.

E. Perform welding according to AWS D1.1 and D1.4.

F. Cutting of holes or strands shall be approved by manufacturer and ENGINEER. Do not cut tension rods or prestressed strands without manufacturer's consent.

G. Remove lifting devices and grout surfaces flush with concrete.

H. Refinish damaged surfaces to match adjacent areas.

I. Allowable Erection Tolerances:

1. Alignment between Units and Along Other Structural Elements: 1/8 in./10 ft, vertical and horizontal.

3.04 GROUTING, POINTING, AND CAULKING

A. Grout joints between units.

3.05 CLEANING

A. After installation, clean exposed concrete surfaces with water using brush or pressure wash. Rinse thoroughly with clean water.

* * * END OF SECTION * * *

Present Landfill Accelerated Action

Design Specifications Division 11

SPEC-11100-0953
SEEP PASSIVE TREATMENT SYSTEM
REVISION 1

APPROVED	APPROVED AS CORRECTED
NOT APPROVED	REVISE AND SUBMIT

APPROVAL IS FOR CONFORMANCE TO THE SITE DESIGN PROCESS AND WITH THE DESIGN CONCEPT OF THE CALCULATIONS, PLANS, AND SPECIFICATIONS.

Robert Davis for 06/29/05

PROJECT CHIEF ENGINEER DATE

SPEC-11100-0953
SEEP PASSIVE TREATMENT SYSTEM

PART 1 GENERAL

1.01 SUMMARY

This section discusses extension and replacement of the existing seep treatment system located at the toe of the eastern face of the landfill. Flow from the anchor trench and the groundwater interceptor system will be connected to the seep treatment system and three new manholes will be constructed to combine the flows prior to treatment in the aeration unit. A system layout is shown on drawing 51781-017 which discusses the inflows of the three manholes.

The existing concrete vault and steel tank and interconnected piping will be excavated/exposed (except the flow meter and associated electronics), and removed as solid waste. The footprints of the existing concrete vault and steel tank will be filled with soil compacted to 95 percent standard Proctor. The existing polyvinyl chloride (PVC) seep collection grid will remain intact. The outlet pipe from the PVC seep collection grid will be extended from the former vault invert at a minimum 2 percent grade to an outlet in a new manhole. This extended outlet pipe will be constructed of 3-inch Schedule 80 PVC double contained in a 5-inch Schedule 80 PVC carrier pipe.

This double contained extension will be placed in a drainage trench feature, filled with free draining rock encased in a geotextile envelope. This geotextile-wrapped drainage trench will communicate with the existing PVC-lined pit under the existing seep collection gallery. This will then act as a final backup drainage pathway should the primary discharge piping, either new or existing, become impeded to flow.

The new manholes will be pre-cast concrete and constructed in accordance with Section 03410: STRUCTURAL PRECAST CONCRETE. The inflows will enter the manhole at the elevations shown on Drawing 51781-017. The existing flow meter and associated electronics from the existing seep treatment system will be relocated to the new manhole and installed on the extended seep collection system. The two outside pipe drain lines will drain into the manhole without a flow meter.

An 3-inch Schedule 80 PVC pipe will flow from the manhole to the new Aeration Treatment Unit. The Aeration Treatment Unit will be a Cast-In-Place concrete vault where, the discharged fluids will flow over a series of steps at decreasing elevations. The steps will cause the water to flow in a waterfall and provide volatilization necessary to treat the water, in a manner similar to the existing flagstone waterfall steps

During the period of the execution of this task, the treatment system will remain in operation as long as possible. During any interruptions in treatment system operation, any discharging or collected fluids will be containerized for transport and disposal in the Rocky Flats Environmental Technology Site Consolidated Water Treatment Facility or treated in the temporary passive treatment system.

1.02 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D2467-92	Standard Specification for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings, Schedule 80
D2564 Rev A-91	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
D4439	Standard Specification for Non-Woven Geotextile Fabrics

1.03 GENERAL REQUIREMENTS

Areas on which separation geotextile, or piping materials are to be placed shall be graded and dressed to lines and grades shown on drawings and in accordance with Section 02110: SITE PREPARATION. Eroded or washed out areas shall be repaired prior to placement of material.

All excavation and backfilling requirements shall be executed in accordance with Section 02221: EARTHWORK and Section 02245: STONE AND AGGREGATE MATERIALS.

1.04 SUBMITTALS

A. PVC Piping Product Data:

1. Submit catalog cuts, product specifications, installation instructions, and dimensioned drawings for each type of pipe, tube, and fitting.

B. Separation Geotextile:

1. Submit catalog cuts, product specifications, installation instructions, and material samples.

C. SUBMITTALS

1. The following shall be submitted in accordance with Section 01305: SUBMITTAL PROCEDURES:

a. List of proposed equipment to be used in performance of construction work including descriptive data.

b. Suppliers' Test Results demonstrating compliance with this specification and the Construction QA/QC plan.

c. Certified waybills and delivery tickets for all materials.

1.05 MEASUREMENT AND PAYMENT

A. Measurement for Payment

Make measurements of volumes and/or areas necessary to support monthly project status reports that include an estimate of project percent complete.

B. Payment

Payment will be made as outlined in Section 01270: MEASUREMENTS AND PAYMENTS.

PART 2 PRODUCTS

2.01 Plastic Pipe and Fittings

A. General
1. Poly Vinyl Chloride Pipe (PVC): ASTM D2467
2. Schedule 80 socket type fittings: ASTM D2467
3. Solvent Cement: ASTM D2564

B. Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections and pipe manufacturer's recommendations where applicable.

2.02 Separation Geotextile

A. The geotextile shall comply with the requirements of ASTM D 4439, and shall consist of polymeric filaments that are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistance to deterioration due to ultraviolet and heat exposure. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. Unless otherwise approved by the Construction Quality Assurance Engineer or DESIGNER, the filter fabric shall meet the following requirements:

Filter Fabric For Separation Geotextile		
Physical Property	**Test Procedure**	**Strength Requirement**
Grab Tensile Elongation (%)	ASTM D 4632 (30% max.)	100 lbs. min.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Mullen Burst	ASTM D 3786	270 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.03 Drainage Rock

A. Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm (1 inch) sieve and 0 to 5 percent passing a 4.75 mm (No. 4) sieve.

2.04 Concrete

A. See Section 03410: STRUCTURAL PRECAST CONCRETE for details on installation and construction of the new manhole.

B. See Section 03300: CAST-IN-PLACE CONCRTE for details on installation and construction of the Aeration Treatment Unit.

PART 3 EXECUTION

INSTALLATION

3.01 PVC Piping

A. Install pipe, tube, and fittings in accordance with recognized industry practices and Section 11101: PVC PIPING achieving permanently leak proof piping systems, capable of transporting the seep liquid to the treatment tank. Install the run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance and/or replacement of valves and equipment.

B. For buried piping, furnish fill material and install piping in accordance with Section 02245: STONE AND AGGREGATE MATERIAL.

3.02 Separation Geotextile

A. Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place sufficient course of free draining rock material on drainage fabric to support drainage pipe, as application dictates. Complete backfilling with free draining rock material to accommodate design requirements. Wrap top of drainage trench in drainage fabric, overlapping sides and ends at least 6 inches.

B. Place a layer of fabric under the manhole and Aeration Treatment Unit as shown on Drawing 51781-017.

3.03 Manholes

A. Install the manholes to the lines and grades as shown in the Drawings in accordance with recognized industry practices and Section 03410: STRUCTURAL PRECAST CONCRETE. Place manhole over 4-inches of drainage rock base and a separation geotextile as shown on Drawing 51781-017.

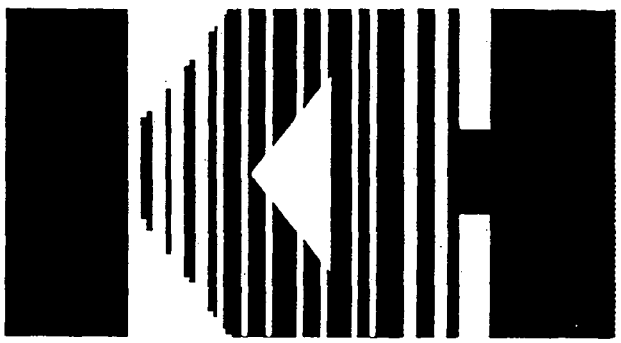
3.04 Aeration Treatment Unit

A. Construct the Aeration Treatment Unit to the lines and grades as shown in the Drawings in accordance with recognized industry practices and Section 03300: CAST-IN-PLACE CONCRETE and reinforced according to Section 03200: REINFORCING CONCRETE. Construct Aeration Treatment Unit over 4-inches of drainage rock base and a separation geotextile as shown on Drawing 51781-017 and 51781-018.

*****END OF SECTION*****

APPENDIX B

CONSTRUCTION QA/QC PLAN

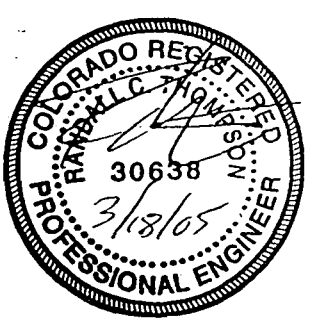


KAISER HILL COMPANY

ACCELERATED ACTION DESIGN FOR THE PRESENT LANDFILL ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

FINAL DESIGN SUBMITTAL

CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN



Project No. 57378.5001
October 2004

EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

ACCELERATED ACTION DESIGN FOR THE PRESENT LANDFILL ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

FINAL CONSTRUCTION QUALITY ASSURANCE/ QUALITY CONTROL PLAN

Prepared for:
Kaiser-Hill Company, L.L.C.
Golden, Colorado

Prepared by:
Earth Tech, Inc.
Englewood, Colorado

Project No. 57378.5001

October 2004

TABLE OF CONTENTS

LIST OF TABLES iii

LIST OF ATTACHMENTS iii

LIST OF ACRONYMS AND ABBREVIATIONS iv

1.0 PURPOSE AND SCOPE 1-1
1.1 DEFINITIONS OF QUALITY CONTROL AND QUALITY ASSURANCE 1-1
1.2 CHANGED CONDITIONS/CHANGE NOTICES 1-2
1.3 ORGANIZATION 1-3

2.0 QUALITY ASSURANCE/QUALITY CONTROL ORGANIZATION 2-1
2.1 PROJECT ORGANIZATION 2-1
2.2 PROJECT MEETINGS 2-4
2.2.1 Preconstruction Inspection and Meeting 2-4
2.2.2 QA/QC Meeting 2-5
2.2.3 Weekly Progress Meetings 2-5
2.2.4 Health and Safety Meetings 2-6
2.2.5 Problem or Work Deficiency Meetings 2-6
2.2.6 Phase Meetings 2-6
2.3 PROJECT PROTOCOL 2-6
2.3.1 QA/QC Documentation 2-7
2.3.2 Document Etiquette 2-8
2.3.3 Record Keeping 2-8
2.3.4 Hold Point/Release 2-8
2.3.5 Nonconforming Conditions 2-9

3.0 DEFINABLE FEATURES OF WORK 3-1
3.1 PREPARATORY PHASE 3-1
3.2 INITIAL PHASE 3-2
3.3 FOLLOW-UP PHASE 3-3

4.0 QUALITY CONTROL PROGRAM 4-1
4.1 LANDFILL SUBGRADE PREPARATION AND FILL PLACEMENT 4-1
4.1.1 Verification of Landfill Cover Subgrade Continuity 4-1
4.1.2 Fill Placement and Compaction 4-2
4.1.3 Conformance Evaluation 4-2
4.2 GEOSYNTHETIC CLAY LINER 4-3
4.2.1 Manufacturing and Delivery 4-3
4.2.2 Labeling 4-4
4.2.3 Shipment and Storage 4-4
4.2.4 Conformance Testing 4-4
4.2.5 Handling and Placement 4-5

4.2.6 Seams and Overlaps 4-6
4.2.7 Repair 4-6
4.3 GEOMEMBRANE 4-7
4.3.1 Manufacturing and Delivery 4-7
4.3.2 Geomembrane Installation 4-10
4.4 SYNTHETIC GEOCOMPOSITE DRAINAGE NET 4-17
4.4.1 Geocomposite Manufacturing and Delivery 4-17
4.4.2 Labeling 4-17
4.4.3 Shipment and Storage 4-17
4.4.4 Conformance Testing 4-18
4.4.5 Handling and Placement 4-19
4.4.6 Seams and Overlaps 4-19
4.4.7 Repair 4-19
4.5 ROCK BARRIER 4-20
4.5.1 Material 4-20
4.5.2 Conformance Testing 4-20
4.5.3 Handling and Placement 4-20
4.6 SOILS 4-21
4.6.1 Material 4-21
4.6.2 Handling and Placement 4-21
4.6.3 Verification of Thickness 4-21
4.7 SEEP PASSIVE TREATMENT SYSTEM 4-22
4.7.1 Manufacturing and Delivery 4-22
4.7.2 Materials and Design 4-22
4.7.3 Installation 4-22
4.8 PIPE AND FITTINGS 4-23
4.8.1 Manufacturing 4-23
4.8.2 Labeling 4-23
4.8.3 Shipment and Storage 4-23
4.8.4 Pipe Perforations 4-23
4.8.5 Pipe Installation 4-23
4.9 BARBED WIRE FENCING AND GATES 4-24
4.9.1 Manufacturing 4-24
4.9.2 Installation 4-24
4.10 SURFACE WATER CONTROL MATERIAL 4-25
4.10.1 Supplier 4-25
4.10.2 Placement 4-25
4.11 SEEDING 4-26
4.12 RECORD SURVEY 4-26

5.0 CONSTRUCTION QUALITY ASSURANCE 5-1

6.0 DOCUMENTATION AND SUBMITTALS 6-1

7.0 GOVERNMENT PROPERTY INVENTORY 7-1

LIST OF TABLES

Table	Title
4.1	Geosynthetics QA/QC Conformance Testing Summary
4.2	Natural Materials QA/QC Conformance Testing Summary
4.3	Material Quantities

LIST OF TABLES

Attachment	Title
1	Sample Project Forms

LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
CDPHE	Colorado Department of Public Health and Environment
CQA	construction quality assurance
CQAE	Construction Quality Assurance Engineer
CTR	Contractor's Technical Representative
DFW	definable feature of work
DOE	Department of Energy
Earth Tech	Earth Tech, Inc.
EPA	Environmental Protection Agency
FECR	Field Engineering Change Request
FML	flexible membrane liner
ft^2	square feet
GCL	geosynthetic clay liner
GDN	geocomposite drainage net
GRI	Geosynthetic Research Institute
Kaiser-Hill	Kaiser-Hill Company L.L.C.
LLDPE	linear low-density polyethylene
PE	Professional Engineer
PLF	Present Landfill
PLF Cover	geosynthetic composite cover
QA	quality assurance
QC	quality control
QCSM	Quality Control Site Manager
RFETS	Rocky Flats Environmental Technology Site
RFI	Request for Information/Clarification
SQAM	Site Quality Assurance Manager
Subcontractor	Construction Subcontractor
Team	Design Team

1.0 PURPOSE AND SCOPE

Quality assurance (QA)/quality control (QC) for the construction of the geosynthetic composite cover (Present Landfill [PLF] Cover) at the Present Landfill will be conducted in accordance with this QA/QC Plan. This QA/QC Plan has been prepared by Earth Tech, Inc. (Earth Tech) for the Contractor (Kaiser-Hill Company, L.L.C. [Kaiser-Hill]) in conjunction with the design of the PLF Cover and will be implemented in its entirety to ensure the following:

- All Rocky Flats Environmental Technology Site (RFETS) project activities are performed in a manner consistent with the intent of all approved drawings and specifications.
- All performance criteria are achieved.
- The specified quality of work is maintained.

This Construction QA/QC Plan is a site-specific document that addresses organization, authority, responsibilities, the definable features of work (DFW), specific QA/QC requirements of project-specific tasks, and QA/QC documentation and submittals. This document includes considerations specific to the requirements of the construction of the PLF Cover.

1.1 DEFINITIONS OF QUALITY CONTROL AND QUALITY ASSURANCE

QC is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that the process, item, or standard meets the established requirements. Effective QC will benefit the Contractor, subcontractors, the Department of Energy (DOE), and RFETS by reducing deficiencies and the need for corrective actions, resulting in reduction of costs and adherence to project schedules. QC will be the complete responsibility of the designated construction subcontractor (Subcontractor). QC duties include generation of the Daily QC Report, generation of site photographs, oversight of DFW, review of Tier 2 Subcontractor submittals (final approval by the Construction Quality Assurance [CQA] Engineer [CQAE] and Contractor's Technical Representative [CTR]), and documentation of overall site activity.

QA is the system that provides oversight and evaluation of the QC process and overall quality goals to ensure that QC is working effectively and that the project goals are being met. QA personnel are responsible for monitoring QC activities to ensure that the work complies with the contract requirements.

1.2 CHANGED CONDITIONS/CHANGE NOTICES

All members of the overall Design Team (Team) (Kaiser-Hill and Earth Tech) recognize the potential for the project scope or site conditions to change during execution of environmental restoration projects. All changes will be handled by a consensus approach by the Team, the Colorado Department of Public Health and Environment (CDPHE), and the Environmental Protection Agency (EPA) and will be thoroughly discussed at the weekly Status Meeting.

When a project change is agreed upon by the Team, it shall be evaluated for the level of documentation required for the change to be implemented. Documentation of a change can be included in the QA/QC daily reports with approval by the CQAE or as detailed as a formal submittal to Kaiser-Hill/DOE on a Field Engineering Change Request (FECR) form (see Appendix A).

The EPA and CDPHE will be notified and their concurrence obtained for major design changes after the design documents have been approved. Minor design changes resulting in a more conservative construction approach will be documented and approved by the CQAE in the daily reports or using the Request for Information/Clarification (RFI) process. Regardless of the documentation, CDPHE and EPA will be notified of the change. Minor design changes resulting in a less conservative construction approach will be handled through the RFI process, in which the CDPHE and EPA will be involved.

The RFI process is used when the Subcontractor or QA/QC personnel require additional information or clarification on any design or specification aspect of the PLF cover. The RFI will be submitted to the Team and tracked on a RFI log. A copy of the RFI log will be submitted to the EPA and CDPHE whenever there is a change or at a minimum of once a week.

1.3 ORGANIZATION

The remainder of this document is organized as follows:

- Section 2.0 presents the anticipated project organization and personnel.
- Section 3.0 contains definable features of work.
- Section 4.0 presents the Quality Control Program.
- Section 5.0 discusses Construction Quality Assurance.
- Section 6.0 presents documentation and submittal information.
- Section 7.0 discusses government property inventory.

2.0 QUALITY ASSURANCE/QUALITY CONTROL ORGANIZATION

2.1 PROJECT ORGANIZATION

It is the responsibility of all personnel to create a work environment in which all project entities work together to produce the type and quality of results that are expected. This includes site personnel from all organizations concerned: Earth Tech, the Subcontractor, the Tier 2 subcontractors, Kaiser-Hill, RFETS, and the DOE. The organization of the project outlines a structure that includes overall contract management and responsibility by the Subcontractor, and on-site construction management, health and safety monitoring, and construction quality control. With this organization, the Subcontractor conducts the majority of fieldwork, provides overall direction, and acts as a liaison between Kaiser-Hill and the DOE. It is anticipated that the following personnel will serve in specific QA/QC roles for the construction of the PLF Cover:

- Mr. Bob Davis (Kaiser-Hill), CTR
- Mr. Randy Thompson (Earth Tech), Design Manager
- John Rahe (Tetra Tech), CQAE
- Josh Valentine (Tetra Tech), Site QA Manager (SQAM)
- Mark McClain (Golder), Quality Control Site Manager (QCSM)
- Mr. Ryan Archibald (Earth Tech), Engineer's Representative
- Paul Kreitz (Stoller), Construction Manager
- Ms. Mary Kaiser (Kaiser-Hill), Contract Manager

As CTR, Mr. Davis has responsibility for coordination of work performed at RFETS by the Subcontractor. Mr. Davis, in the role of CTR, has overall responsibility for verifying that all project participants properly implement their duties as related to the construction of the PLF Cover. Changes to the project scope or approach to the implementation of the design brought on by differing site conditions or refinements to the task approach will be approved through Mr. Davis. Mr. Davis will also serve as the primary point of contact for all issues involving the DOE or RFETS. The CTR will be responsible for overall management and coordination of project-related engineering and construction activities and the execution of the QA/QC Plan, including final approval of all submittals along with the CQAE. He will be assisted by the Design Manager, Mr. Randy Thompson, and in the field by the Engineer's Representative, Mr. Ryan Archibald.

The CQAE will be responsible for certifying to RFETS, EPA, and CDPHE that the construction has been completed in accordance with the EPA/CDPHE-approved plans, drawings, and specifications. The CQAE will be a Professional Engineer (PE) registered in the State of Colorado who has provided engineering oversight for at least five completed projects totaling over 2 million square feet (ft^2) of each geosynthetic layer installed. The CQAE represents the organization responsible for QA; therefore reference to the CQAE also refers to his/her company or designee. The designee for the PLF Cover installation will be the CQAE; any reference to the SQAM in this Construction QA Plan also refers to the CQAE. The CQAE is responsible for the development, implementation, and compliance of the manufacturing and construction QA program for the entire scope of work administered by the Subcontractor. As such, the CQAE will coordinate QA policy in accordance with EPA guidance for activities at RFETS and evaluate the QA policy impacts to construction tasks at RFETS.

The CQAE is responsible for on-site project QA on a daily basis and for communication with the Team. This mainly entails the responsibility to monitor, oversee, and direct the daily QA activity. The SQAM will complete a Daily QA Report and review the Daily QC Report. The SQAM will be onsite during all construction operations. The CQAE will be on site when appropriate. It is also the CQAE's responsibility to approve Subcontractor submittals and submit them to the CTR for final approval before construction of the PLF Cover begins.

The CQAE and his/her authorized representatives will be hired from companies separate from the Subcontractor, Kaiser-Hill, or Earth Tech, or any of their corporate affiliations. Furthermore, all CQA staff, including the SQAM, will be employed by the CQAE or his/her firm or will otherwise be subcontracted by the CQAE or his/her firm. However, the persons who will serve as the CQAE and SQAM will not be determined until the project is approved for construction and a formal bid and contracting effort have been undertaken. The EPA and CDPHE will receive the CQAE's qualifications at least 10 days before construction operations begin for verification that his/her qualifications meet the requirements.

The SQAM will be present, full-time, for the duration of the project. The SQAM has primary responsibility for field activity performance and documentation and for direct coordination with subcontractors and RFETS personnel as the fieldwork is conducted. The SQAM shall have

provided QA or QC oversight for at least five completed projects totaling over 2 million ft^2 of each geosynthetic layer installed. The SQAM will ensure that construction activities follow the procedures presented in the Work Plan and will support the CQAE in implementing the QA program. The person serving as the SQAM will not be determined until the project is approved for construction and a formal bid and contracting effort have been undertaken. The EPA and CDPHE will receive the qualifications of the SQAM at least 10 days before construction operations begin for verification that his/her qualifications meet the requirements. If any alternate SQAM is used, their qualifications must be submitted to the EPA and CDPHE for approval prior to commencing their duties.

The Subcontractor will provide the QCSM who will verify that day-to-day tasks are performed according to the approved project specifications and procedures and who will report directly to the Team and the CQAE. The QCSM will be present, full-time, for the duration of the project. The QCSM shall have provided QA or QC oversight for at least five completed projects totaling over 2 million ft^2 of each geosynthetic layer installed. The QCSM's daily activities will include assimilation of data for, and preparation of, the Daily QC Report and coordination and control of project-specific quality records. The QCSM will also implement and take the lead role in promoting and enforcing QC to all project Tier 2 subcontractors as well as coordinate all project inspections in accordance with criteria established by the overall construction team. The EPA and CDPHE will receive the qualifications of the QCSM at least 10 days before construction operations begin for verification that his/her qualifications meet the requirements. If any alternate QCSM is used, their qualifications must be submitted to the EPA and CDPHE for approval prior to commencing their duties.

The geosynthetics testing laboratory shall have provided quality control and/or quality assurance testing of the proposed geosynthetics for at least five completed projects having a minimum area of 2 million square feet. The laboratory shall be accredited via the Geosynthetics Accreditation Institute's Laboratory Accreditation Program (GAI-LAP) or participate in ASTM's "Round Robin" testing. The soils geotechnical testing laboratory shall be accredited by the American Association of State Highway and Transportation Officials (AASHTO).

2.2 PROJECT MEETINGS

Periodic meetings will be held throughout the construction project to help ensure quality work. The meetings are intended to maintain communication among the Contractor, CQAE, QCSM, Subcontractor, DOE, EPA, and CDPHE and their representatives. These meetings will help maintain familiarity with construction procedures and activities, quality issues, health and safety issues, and recent design changes, if any. Meetings to be conducted are as follows:

- Preconstruction inspection and meeting;
- QA/QC meeting;
- Weekly progress meetings;
- Health and safety meetings;
- Problem or work deficiency meetings (as needed); and,
- Phase meetings (preparatory, initial, and follow-up phases).

The schedule, agenda, and attendees of these meetings are discussed in the following subsections.

2.2.1 Preconstruction Inspection and Meeting

A preconstruction inspection and meeting will held at the site and will be scheduled a minimum of 3 weeks before construction activities begin. The CTR, CQAE, QCSM, Subcontractor, DOE, EPA, and CDPHE will be asked to attend. The purposes of the preconstruction inspection and meeting are to:

- Conduct a site walk to discuss work plans and inspect work areas;
- Discuss any appropriate modifications and develop design addenda, if necessary;
- Review the responsibilities of each party;
- Review lines of authority and communication;
- Review procedures for documentation and reporting of information;
- Review procedures for submittal of RFIs;
- Review distribution and storage of documents and reports;
- Review protocol for testing;
- Establish protocol for handling construction deficiencies, repairs and retesting;
- Review a time line schedule for all operations; and
- Discuss the Subcontractor's intended procedures.

2.2.2 QA/QC Meeting

A QA/QC meeting shall be held before the start of construction activities to clarify the roles of the QA/QC staff. At a minimum, the meeting will be attended by the QCSM, who is in charge of QC activities; the CQAE, who is charge of QA activities; the CTR; the Design Manager; and representatives from the CDPHE and EPA. The meeting shall include the following:

- Conduct a site walk to discuss QA/QC work as it pertains to each site;
- Review procedures for submittal of a RFI;
- Discuss the lines of authority;
- Discuss the lines of communication between the QA/QC staff;
- Review the responsibilities of each party;
- Review the protocol for testing;
- Establish procedures by which the Subcontractor assists the QA/QC staff in obtaining samples;
- Review the protocol for handling construction deficiencies, repairs and retesting outlined in the following sections;
- Review procedures for documentation and reporting of information;
- Review distribution and storage of documents and reports; and
- Establish a schedule for completion of all documentation.

2.2.3 Weekly Progress Meetings

Weekly progress meetings will be held to (1) review and discuss the previous week's activities and progress, (2) discuss current and future work, (3) discuss any current or potential construction problems, (4) discuss outstanding action items and their resolutions, and (5) discuss new action items. The QCSM and CQAE will attend all meetings or assign a representative to attend in their absence. The QCSM will schedule and conduct the weekly progress meetings and will transmit the meeting minutes to all parties attending the meeting and to the CTR. The CTR shall be informed of all scheduled meetings and may add special agenda items. Other individuals may be requested to attend the weekly meetings depending upon recent or future

work activities. Designated representatives from the CDPHE and EPA shall be invited by the CTR to attend all weekly meetings so that they may discuss and evaluate progress.

2.2.4 Health and Safety Meetings

Health and safety meetings will be conducted by representatives from RFETS. The meetings will be held at least weekly or (1) whenever risks or hazards change, (2) whenever new personnel arrive, and (3) when field operations warrant indoctrination and training. Safety meetings will be conducted by the RFETS representative and will be attended by all site project personnel involved, as appropriate. Where procedural deficiencies are identified, additional safety meetings will be conducted to address the situation. The following will be addressed during the health and safety meetings:

- Review of planned activities,
- Work area health and safety designations,
- Hazards suspected,
- Personal protective equipment required,
- Communications,
- Field personnel responsibilities, and
- Emergency procedures.

2.2.5 Problem or Work Deficiency Meetings

Special meetings may be held when a problem or deficiency occurs or is identified. Personnel will not wait until weekly progress meetings to address problems or deficiencies. Special work deficiency meetings will be attended by the CTR, QCSM, Design Manager, CQAE, SQAM, relevant subcontractors, and/or other involved parties, as necessary. The purpose of these meetings will be to identify problems or deficiencies in the construction work, review alternative solutions, and select and implement corrective measures to resolve the problems or deficiencies.

2.2.6 Phase Meetings

Meetings will be held prior to beginning any activities for each phase of a DFW. DFWs and each phase of control are described in detail in the Section 3.0.

2.3 PROJECT PROTOCOL

Adherence to approved project protocol will be the responsibility of all parties throughout construction of the PLF Cover. The protocol is applicable to all phases of the project will be

enforced by both QA and QC personnel. Protocol includes project documentation, proper document etiquette, and the hold point/release process.

2.3.1 QA/QC Documentation

Final acceptance of the constructed cover system will be achieved through adequate documentation of the construction and QA/QC activities. Attachment 1 provides sample project forms to be used throughout construction and lists the party responsible for completion of each form. Final approval of all project forms will come from the CQAE and the CTR. All project forms may be modified to suit construction activities so long as the modifications are approved by the CQAE and CTR. Project forms are as follows:

- Daily Quality Control Report - QCSM
- Daily Quality Assurance Report - SQAM
- Field Nuclear Density Test Log - QCSM
- Certificate of Acceptance of Soil Regrade Surface - QCSM
- Certificate and Acceptance of Soil Subgrade Surface - Geosynthetic Installer's Representative
- Material Delivery/Inventory Checklist - QCSM
- Log of Geosynthetics Received - QCSM
- FML [Flexible Membrane Liner] Destructive Test Log - QCSM
- FML Non-Destructive Test Log - QCSM
- Trial Weld Information Log - QCSM
- FML Panel Placement Form - QCSM
- FML Panel Seaming Form - QCSM
- FML Repair Report - QCSM
- GCL [Geosynthetic Clay Liner] Panel Placement Form - QCSM
- RFI Form - QCSM
- RFI Log - QCSM
- Hold Point/Release Forms - QCSM

Project forms are not limited to this list and may be added as needed during construction or as required by the CQAE. Completed forms will be included in the Construction Completion Report described in Section 6.0.

2.3.2 Document Etiquette

All project forms will be completed in blue or black ink in a legible manner. Errors made in any handwritten form will be crossed out with a single line and the correct information entered. The change will be initialed and dated by the individual making the correction.

Upon completion of a project form, it will be submitted to CQAE for review and approval. Ongoing forms, such as field nuclear density test logs, will be submitted daily to SQAM. After approval by the CQAE, the forms will be submitted to the CTR.

2.3.3 Record Keeping

It is the responsibility of all parties involved to adequately handle project records to eliminate misplaced or stolen records. All project records generated on the site during construction will be placed in a locked file cabinet under the control of the QCSM and SQAM. Examples of on-site project records include daily reports, testing logs, and load tickets. Following construction, relevant file copies of all site records will be kept by the Subcontractor, the QA subcontractor, and the Contractor. Any record requiring Contractor approval will be kept in project files at the Contractor's place of business. QA-approved documents will be kept on-site and with the QA firm's place of business. Correspondence with the EPA, CDPHE, or other regulator will be through Certified Mail unless the item is handled over electronic mail.

2.3.4 Hold Point/Release

The hold point/release process will be utilized during construction to ensure design and specification requirements are met prior to proceeding with work. The Subcontractor may not proceed with subsequent phase work until the following hold points are met with written documentation and approval by the CQAE and CTR. Once approval of the hold point is given the work is released and the subcontractor may proceed. Hold points are outlined in the following table:

Hold Point	Release Point
Geotech testing in accordance with Specification 02200.	Geosynthetics Interface Testing in accordance with Specification 02210.
Geosynthetics Interface Testing in accordance with Specification 02210.	Procurement of geosynthetic material, cushion soils, and infiltration layer soils.
Equipment list.	Mobilization of equipment and construction.
Acceptance of regraded surface (including as-built survey.	GCL cushion soil placement (active area).
Acceptance of subgrade surface (including as-built survey).	GCL placement (active area).
Acceptance of gas management system (including as-built survey).	GCL placement (active area).
Acceptance of GCL material and placement (including as-built survey).	Liner low-density polyethylene (LLDPE) placement (active area).
Acceptance of LLDPE material and placement (seams, panels, repairs, destructive test sampling, and as-built surveys of placement and anchor trench alignment).	Geocomposite drainage net (GDN) placement (active area).
Acceptance of GDN material and placement (including as-built survey).	Rock cushion layer placement (active area).
Acceptance of rock cushion layer material and placement (including as-built survey).	Rock layer placement (active area).
Acceptance of rock material and placement (including as-built survey).	Soil infiltration layer placement (active area).
Acceptance of soil infiltration layer material and placement (including as-built surveys of final surface, perimeter drainage channels, and diversion berms).	Seeding.
Acceptance of seep treatment system (including as-built survey).	Operation of seep treatment system.
Erosion mat manufacturer's QC data.	Placement of erosion mat.

Hold points may be added at the discretion of QA/QC personnel, the Design Engineer, or the CTR. Each PLF Cover layer will be qualitatively inspected, surveyed, and documented on the forms discussed in Section 2.3.1. Since the layers will be placed concurrently, drawings showing the active areas of approved hold points will be included with the Daily QC Reports.

2.3.5 Nonconforming Conditions

Nonconforming conditions will first be noted in the QCSM's or SQAM's daily report. The reports will have action item checklists that will be carried over to following reports until the nonconformance is remedied. If the issue cannot be addressed by the QCSM or SQAM, the nonconforming conditions may be handled through the Request for Information (RFI) process, which involves the entire Design Team as well as the Regulators. In any case, discussion of nonconforming conditions will take place during weekly construction meetings. For major

3.0 DEFINABLE FEATURES OF WORK

The specific QA/QC activities required throughout the work sequence of the construction of the PLF Cover will be based on DFW and the three phases of control. A DFW is a task that is separate and distinct from other tasks and has separate control requirements. The following DFWs are anticipated for the construction of the PLF Cover:

- Regrade surface preparation,
- Installation of the landfill gas venting system,
- Subgrade preparation,
- Installation of the composite cover system,
- Installation of the seep treatment system, and
- Installation of surface water and access control structures.

The phases of control (Preparatory, Initial, and Follow-up) will be followed for each DFW, and all phases will be documented in the Daily QC Report as they occur. All phase meetings will be conducted by the QCSM and attended by the CQAE and the foreman responsible for the DFW. The CTR will be notified at least 48 hours prior to the phase meeting.

3.1 PREPARATORY PHASE

The Preparatory Phase involves review of design plans and specifications, inspection of materials, and a preparatory meeting with all supervisors involved with the DFW. A Preparatory Phase meeting shall be performed prior to beginning work on each DFW and shall include the following:

- A review of each paragraph of the applicable specifications;
- A review of the contract/delivery order plans;
- A check to ensure that all materials and/or equipment has been tested, submitted, and approved;
- A check to ensure that provisions have been made to provide required QC inspection and testing;
- An examination of the work area to ensure that all required preliminary work has been completed and is in compliance with the contract;

- A physical examination of the required materials, equipment, and sample work to ensure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored;
- A review of the appropriate activity hazard analyses to ensure safety requirements are met (hazard analysis forms are required to be submitted 48 hours prior to the meeting);
- A discussion of procedures for conducting the work, including elimination of repeated deficiencies, document tolerances, and workmanship standards for that phase of work; and
- A check to ensure that the portion of the plan for the work to be performed has been accepted by the CQAE and CTR.

At the meeting, the CTR shall instruct applicable workers as to the acceptable level of workmanship required to meet the contract requirements.

When working in many areas on similar tasks, such as geotextile placement for surface water drainages or GDN deployment, mini-preparatory meetings will be initiated at the discretion of the SQAM. Recognizing the importance of safety, all parties will review/revise the task-specific Job Safety Analyses as a part of the Preparatory Phase meeting.

3.2 INITIAL PHASE

The Initial Phase consists of a review of work practices and procedures and must be accomplished at the beginning of a DFW field activity. The following will be accomplished:

- Check of preliminary work,
- Verify full contract compliance and required control inspection and testing,
- Establish level of workmanship,
- Resolve all differences, and
- Check safety to include compliance with safety plan and activity hazard analyses.

The CTR and CQAE shall be notified at least 48 hours in advance of beginning the Initial Phase, as required in Specification Section 01440. The CTR and CQAE shall ensure that the workers are instructed as to the acceptance level of workmanship. The Initial Phase shall be repeated for each new crew that will be working on-site or any time the established level of workmanship is not being met.

3.3 FOLLOW-UP PHASE

The Follow-up Phase is the continued inspection of practices and procedures for the remainder of site activities for that DFW. Daily checks shall be performed to ensure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. Final follow-up checks shall be conducted, and all deficiencies shall be corrected prior to the start of additional features of work.

Pre-final and final inspections of completed systems and/or segments of systems will be conducted to verify compliance with documented instructions, drawings, procedures, and specifications. The CTR and CQAE will be notified 48 hours in advance of each inspection. Inspections will be documented in the Daily QC Report.

Section 4.0 of this plan describes the QA/QC inspections and activities required for each significant component of the project. Each significant component references the DFW to which the component is assigned.

4.0 QUALITY CONTROL PROGRAM

This section of the Construction QA/QC Plan addresses the field QC requirements for construction of the PLF Cover. It specifies the QC program to be implemented by the Subcontractor with regard to observation requirements, laboratory and field testing requirements, testing frequency, required testing parameters, and resolution of deficiencies/problems. The latest version of all American Society for Testing and Materials (ASTM) and Geosynthetic Research Institute (GRI) testing standards shall be utilized. Section 5.0 presents the QA program.

In general, QC test locations will be chosen either randomly or based on identified suspect areas. The final QC tests will be performed on the remaining fractions of the required frequency interval given in Tables 4.1 and 4.2. Material quantity estimates are found in Table 4.3.

The QCSM will be responsible for implementing the requirements set forth in this section. All deficiencies will be reported to the SQAM for resolution. The CQAE or authorized representatives will be responsible for verifying and documenting adherence to the requirements set forth in this section. Documentation will be performed in accordance with Section 6.0. The QCSM will obtain the services of an independent QC laboratory/firm (when this function is not delegated to the supplier/installer in the Specifications) to ensure QC monitoring/testing of all design components. All QC laboratories/firms will be approved by the CQAE.

4.1 LANDFILL SUBGRADE PREPARATION AND FILL PLACEMENT

4.1.1 Verification of Landfill Cover Subgrade Continuity

During cut and fill of the landfill cover subgrade, the QCSM will:

- Inspect the subgrade and note areas of weak subgrade material;
- Observe the proof rolling of the subgrade and note areas for repair that exhibit excessive rutting, heaving, or softening;
- Verify that the soil within the top 6 inches of the subgrade does not contain refuse, debris, vegetation, or any material that may leave voids in the subgrade;

- Observe and document placement and compaction of grade fill including lift thickness (through direct measurement or GPS survey), type of equipment used, and number of passes; and

- Ensure through record survey by a Professional Land Surveyor that the design grades are met.

The Subcontractor will be required, in accordance with the Specifications, to remove and replace or repair subgrade areas that exhibit excessive rutting, heaving, softening, or deflection. After the areas identified have been repaired, the QCSM will verify and document the repair. The QCSM will report any problems or deviations from the above requirements to the SQAM.

4.1.2 Fill Placement and Compaction

The Specifications will be followed for the placement and compaction of grade fill or compacted backfill. The QCSM will monitor the fill placement and compaction to verify and document the following:

- The soil being placed meets the Specification requirements as determined by the test methods and frequencies presented in Table 4.2.

- The compacted lift thickness is in accordance with the requirements of the Specifications.

- The fill is moisture-conditioned and compacted in accordance with the Specifications.

4.1.3 Conformance Evaluation

Where density testing is required by the Specifications, either nuclear density meter, sandcone, or rubber balloon test methods will be used for the field testing of the in-situ dry unit weight and moisture content of the in-place, compacted fill. One sand cone test (ASTM D 1556) or rubber balloon test (ASTM D 2167) and one laboratory moisture content (ASTM D 2216) test will be conducted per 20 nuclear density tests (ASTM D 2922) to calibrate the results of the nuclear density meter and in cases of uncertainty about the nuclear density meter test results. Allowable moisture and dry density correlation deviation limits are presented in the Specifications. Any discrepancies between test results will be resolved by the CQAE and the Team.

If an in-place density test result fails to meet the Specifications, a confirmatory test will be performed immediately adjacent to the failed test. If the confirmatory test meets or exceeds

Specifications, a second confirmatory test will be performed at a second location immediately next to the failed test. If the second confirmatory test also meets or exceeds Specifications, the area will be declared as meeting project Specifications and the confirmatory tests will be reported. If either confirmatory test fails to meet the Specifications, additional testing will be performed to identify the limits of the area that does not meet project Specifications. These areas will be reworked or the failing soils will be removed and replaced, and retesting will be performed until passing results are obtained.

If a defective area is discovered in the fill, the QCSM and SQAM will evaluate the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the QCSM and SQAM will assess the extent of the defective area by additional tests, observations, a review of records, or other means that the CQAE deems appropriate. If the defect is related to adverse site conditions, such as excessively wet soils or surface desiccation, the QCSM and SQAM will define the limits and nature of the defect by testing or observation. After the extent and nature of a defect are identified, the QCSM will notify the CQAE and Subcontractor and verify that the deficiency has been corrected by the Subcontractor before any additional work is performed in the area of the deficiency.

4.2 GEOSYNTHETIC CLAY LINER

4.2.1 Manufacturing and Delivery

The geosynthetics subcontractor will be required to provide the QCSM with the following information from the GCL manufacturer:

- Certifications required by the Specifications signed by a responsible party employed by the GCL manufacturer.
- The manufacturing QC certificates for each shift's production of GCL rolls, which include GCL roll numbers and identification, sampling procedures, and descriptions, and results of QC tests for GCLs required in the Specifications signed by a responsible party employed by the GCL manufacturer.

The QCSM will examine all GCL manufacturer's certifications to verify and document that the property values listed on the certifications meet or exceed those described in the Specifications and that proper and complete documentation has been provided by the GCL manufacturer for all

GCL used at the site. The QCSM will report any deviations from the above requirements to the SQAM and the geosynthetics subcontractor prior to installation of the GCL.

4.2.2 Labeling

The QCSM will verify and document that the GCL manufacturer has labeled all rolls of GCL as described in the Specifications. The QCSM will examine the rolls upon delivery, and any deviation from the Specification requirements will be reported to the SQAM and the geosynthetics subcontractor prior to installation of the GCL.

4.2.3 Shipment and Storage

The QCSM will observe the rolls of GCL upon delivery at the site. Any deviations from the requirements described in the Specifications will be reported to the SQAM and the geosynthetics subcontractor. Any damaged rolls will be rejected by the QCSM and will be required to be repaired or replaced by the geosynthetics subcontractor.

The rolls shall be stored in an area capable of protecting the material from ultraviolet light exposure, moisture, excessive humidity, puncture, cutting, or other damaging conditions. Rolls may not be left unprotected on the project site unless being placed that day.

4.2.4 Conformance Testing

The QCSM and SQAM shall examine the GCL rolls upon delivery and shall verify that the GCL manufacturer has labeled all rolls of GCL with the manufacturer's name, product identification, lot number, roll number, roll dimensions, roll weight, and date manufactured. The SQAM shall record the roll number and the date each roll was delivered.

The QCSM will ensure that manufacturer's QC tests comply with the requirements listed in Table 4.1 and the Specifications. The CQAE is responsible for conformance samples at frequencies listed in Table 4.1. Samples will be taken across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet long (minimum) by the roll width. The SQAM will mark the samples with an arrow to indicate the direction of the cut. Samples will be taken at a rate of one per 100,000 ft^2 or one per lot, whichever results in a greater testing frequency. These samples will be tested for peel strength (ASTM D 4632),

internal shear strength (ASTM D 6243), permeability (ASTM D 5094 or ASTM D 5887), index flux (ASTM D 5887), bentonite mass per unit area (ASTM D 5993), bentonite moisture content (ASTM D 2216 or ASTM D 4643), and bentonite swell index (ASTM D 5890). The CQAE will examine all results from laboratory conformance testing and will report any nonconformance to the CTR and Subcontractor as soon as the results become available (see Table 4.1).

The following procedure will apply whenever a sample fails a conformance test that is conducted by the geosynthetic laboratory:

- The Subcontractor will be required to replace the roll (or rolls) of GCL not in conformance with the Specifications with a roll that meets the Specifications.
- The SQAM will ensure that conformance samples are removed for testing by the independent laboratory from the closest numerical roll on each side of the failed roll. These two samples must pass the above conformance tests. If either of these samples fails, samples will be collected from the five numerically closest untested rolls on each side of the failed sample and tested by the independent laboratory. These 10 samples and samples from every roll subsequently delivered from the same manufacturer must be conformance-tested by the independent laboratory. The costs of all such additional tests are to be borne by the GCL supplier.

QA/QC personnel will document actions taken in conjunction with conformance test failures and report all actions to the SQAM and geosynthetics subcontractor.

4.2.5 Handling and Placement

The Subcontractor responsible for GCL installation will be required to certify in writing that the surface on which the GCL will be installed is acceptable. The certificate of acceptance will be required to be given by the Subcontractor to the QCSM, who will then verify to the CQAE that the subgrade is accepted immediately prior to commencement of GCL installation in the area under consideration.

After the surface on which the GCL is to be installed has been accepted by the Subcontractor responsible for GCL installation, it will be the QCSM's responsibility to indicate to the SQAM and Subcontractor any changes in the underlying layer that may, in accordance with the Specifications, require repair work. If the QCSM requires repair work to be performed, it will be the responsibility of the Subcontractor to repair the underlying layer.

The Subcontractor will be required to handle all GCL in such a manner as to ensure the GCL is not damaged. The QCSM will verify and document compliance with the following:

- Just prior to GCL placement, the subgrade that will underlie the GCL meets the requirements of the Specifications and Drawings, is approved by the CQAE, and is free of standing water, clumps, stones, rocks, or other obstructions that could potentially damage the GCL or overlying geomembrane.
- The GCL is weighted with sandbags (or equivalent weight approved by the QCSM).
- The GCL is kept under tension to minimize the presence of wrinkles. If necessary, the GCL is to be positioned by hand after being unrolled to minimize wrinkles.
- The GCLs are cut using a GCL cutter approved by the GCL manufacturer and the QCSM. If cut in place, special care is to be taken to protect other materials from damage that could be caused by cutting the GCL.
- The methods and equipment used to deploy the GCL have not damaged the adjacent GCL or the subgrade.
- The GCL is deployed in a manner that protects the GCL against the adverse effects of precipitation during deployment.
- The GCL is not deployed during precipitation, and exposed GCL is covered in a timely manner.

The QCSM will document any noncompliance with the above requirements and report it to the SQAM and Subcontractor.

4.2.6 Seams and Overlaps

The QCSM will document that the GCL is overlapped and secured in accordance with the Specifications and the manufacturer's approved QC manual. Unless otherwise stated in the manufacturer's QC manual, the minimum overlap is 6 inches on edges and 24 inches on ends.

4.2.7 Repair

The QCSM will verify that any defects in the GCL are repaired in accordance with the Specifications and the manufacturer's approved QC manual. The QCSM will observe any repair, note any noncompliance with the above requirements, and report the noncompliance(s) to

the SQAM and geosynthetics subcontractor for resolution. All repair locations will be surveyed with GPS.

4.3 GEOMEMBRANE

4.3.1 Manufacturing and Delivery

4.3.1.1 Resin

Prior to the installation of the LLDPE geomembrane material, the geosynthetics subcontractor will be required to provide the following information from the geomembrane manufacturer:

- A copy of the QC certificates issued by the resin supplier that include the origin (resin supplier's name and resin production plant), identification (brand name, number), the production date of the resin used in the manufacture of the geomembrane shipped to the site, and the results of tests conducted to verify that the quality of the resin used to manufacture the geomembrane rolls assigned to the project meets the Specifications.
- Certification from the geomembrane manufacturer that the resin used to manufacture the geomembrane meets the requirements of the Technical Specifications.

The QCSM will review these documents and report any deviations from the above requirements to the SQAM and geosynthetics subcontractor for resolution. Final approval of the certificates will come from the CQAE and the CTR.

4.3.1.2 Geomembrane Manufacturing Quality Control

Prior to the installation of the LLDPE geomembrane, the geosynthetics subcontractor will be required to provide the QCSM with the manufacturing QC certificates for each shift's production of geomembrane signed by a responsible party employed by the geomembrane manufacturer (such as the production manager). The QC certificates will include the following:

- Roll numbers and identification, and
- Sampling procedures and results of QC tests required by the Specifications, including descriptions of the test methods used for geomembrane rolls.

The QCSM will verify and document that:

- The property values reported by the geomembrane manufacturer meet all of the specified values listed in the Specifications.

- The measurements of properties by the geomembrane manufacturer are properly documented and the test methods used are in accordance with the Specifications.
- The QC certificates have been provided at the specified frequency for geomembrane rolls, and each certificate identifies the rolls or batch number related to that certificate.

The QCSM will report deviations from the above requirements to the SQAM and Subcontractor for resolution prior to installation of the geomembrane. The CQAE and the CTR will approve these submittals.

4.3.1.3 Labeling

The QCSM will verify and document that the geomembrane manufacturer has labeled each roll of geomembrane as required in the Specifications. The QCSM will examine the geomembrane rolls upon delivery and will report any deviation from the above requirements to the SQAM and Subcontractor for resolution prior to installation of the geomembrane.

4.3.1.4 Transportation and Handling

Upon delivery at the site, the QCSM will conduct a visual inspection of the rolls for defects and for damage. This examination will be conducted without unrolling the rolls unless visible defects or damages are found. The QCSM will indicate to the SQAM and geosynthetics subcontractor:

- Any rolls that should be unrolled to allow for their inspection and/or sampling;
- Any rolls, or portions thereof, that should be rejected and removed from the site because they have severe flaws; and
- Any rolls that include minor repairable flaws.

4.3.1.5 Storage

The SQAM will verify and document that storage of the geomembrane is in accordance with the Specifications.

The following procedure will apply whenever a sample fails a conformance test that is conducted by the independent QC laboratory:

- The Subcontractor will be required to replace the roll (or rolls) of geomembrane not in conformance with the Specifications with a roll (or rolls) that meets the Specifications.
- The SQAM will ensure that conformance samples are removed for testing by the independent laboratory from the closest numerical roll on each side of the failed roll. These two samples must pass the above conformance tests. If either of these samples fails, samples will be collected from the five numerically closest untested rolls on each side of the failed sample and tested by the independent laboratory. These 10 samples and samples from every roll subsequently delivered from the same manufacturer must be conformance-tested by the independent laboratory. The costs of all such additional tests are to be borne by the Subcontractor.

QA/QC personnel will document actions taken in conjunction with conformance test failures and report all actions to the SQAM and Subcontractor.

4.3.2 Geomembrane Installation

4.3.2.1 Geomembrane Deployment

4.3.2.1.1 Layout Drawing

The geosynthetics subcontractor will be required to produce layout drawings that show the geomembrane panel configuration, dimensions, details, and seam locations. The CQAE and the CTR will review the layout drawings. The CQAE will provide any comments on the layout drawings to the CTR. The layout drawings must be approved by the CQAE and CTR prior to the installation of the geomembrane. The layout drawings, as modified and/or approved by the CQAE and CTR, will be part of the specifications, and a copy will be furnished to the QCSM. The QCSM will become familiar with the layout drawings.

4.3.2.1.2 Field Panel Identification

A field panel is the unit area of geomembrane that is to be seamed in the field, i.e., a field panel is a roll or a portion of a roll cut in the field.

The QCSM will verify that each field panel is given an identification code (number or letter-number) consistent with the layout plan. This identification code will be agreed upon by the

CQAE and the geosynthetics subcontractor. This field panel identification code should be as simple and logical as possible. (Note: Manufacturing plant roll numbers are usually cumbersome and are not related to location in the field.) It will be the responsibility of the Subcontractor to ensure that each field panel placed is marked with the manufacturing plant roll number. The roll number will be marked in the center of the panel in a color to allow for easy inspection.

The QCSM will develop a table or chart showing the correspondence between manufacturing plant roll numbers and field panel identification codes. The field panel identification code will be used for all QA/QC records.

4.3.2.1.3 Field Panel Placement

The QCSM will verify and document that field panels are installed at the locations and positions indicated in the Subcontractor's layout plan, as approved or modified by the CQAE.

The QCSM will verify and document that the condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the geosynthetics subcontractor in accordance with the Specifications.

The QCSM will record the identification code, location, and date of installation of each field panel. The QCSM will verify and document that geomembrane is not placed during inclement weather conditions, as indicated in the Specifications. Additionally, the QCSM will verify and document that the underlying layer has not been damaged by weather conditions. The QCSM will visually observe each panel after placement and prior to seaming for damage (e.g., holes, blisters, creases). The QCSM will advise the geosynthetics subcontractor which panels, or portions of panels, should be rejected, repaired, or accepted. Damaged panels or portions of damaged panels that have been rejected by the QCSM will be marked, and their removal from the work area will be documented by the QCSM.

4.3.2.2 Field Seaming

4.3.2.2.1 Seam Layout

The QCSM will verify and document that the seam layout shown on the Panel Layout Drawing is consistent with the Specifications. No panels may be seamed in the field without the QCSM's approval. A seam numbering system compatible with the panel numbering system will be agreed upon by the CTR, the CQAE, the geosynthetics subcontractor, the Subcontractor, and the QCSM.

4.3.2.2.2 Seaming Equipment and Products

Seaming shall be by thermal fusion methods. Extrusion welding shall only be used for patching and seaming around appurtenances and repairs of identified defects and areas of destructive seam testing. Only seaming apparatus that the CQAE has specifically approved by make and model will be used. The geosynthetics subcontractor will be required to use a pyrometer to ensure that accurate temperatures of the extrudate and seamer nozzle are being achieved.

The QCSM will log ambient temperatures, seaming apparatus temperatures, and extrudate temperatures or fusion-seaming apparatus speeds. Ambient temperatures will be measured as specified in the Specifications.

4.3.2.2.3 Seam Preparation

The QCSM will verify and document that:

- Prior to seaming, the seam area is clean and free of moisture, dust, dirt, debris, and foreign material.
- Preparation of seams is in accordance with the Specifications.

4.3.2.2.4 Weather Conditions for Seaming

The QCSM will verify and document that weather conditions for seaming are within the limits required in the Specifications.

4.3.2.2.5 Trial Seams

The geosynthetics subcontractor will be required to make trial seams on fragment pieces of geomembrane liner to verify that seaming conditions are adequate. The geosynthetics subcontractor will be required to make and test trial seams at the frequency and in accordance with the methods specified in the Specifications.

The QCSM and SQAM will observe all trial seam procedures. The successful trial seam sample will be assigned a number and marked accordingly by the QCSM, who will log the date, hour, ambient temperature, number of the seaming unit, name of the seamer, and pass or fail description. The sample itself will be retained only until the construction of the liner is complete and the liner has been accepted by the CQAE.

4.3.2.2.6 Nondestructive Seam Continuity Testing

Except as otherwise noted in the Specifications, the Subcontractor will nondestructively test all field seams over their full length in accordance with the Specifications and Table 4.1. The purpose of nondestructive tests is to check the continuity of seams. Continuity testing will be carried out as the seaming work progresses, not at the completion of all field seaming. Nondestructive testing will not be permitted before sunrise or after sunset unless the geosynthetics subcontractor demonstrates to QA/QC personnel that they have the capabilities to perform continuity testing under reduced light conditions (reduced light conditions are discussed in the Health and Safety Plan). The QCSM and SQAM will observe and document the continuity testing. The geosynthetics subcontractor will be required to complete any required repairs in accordance with the Specifications. The QCSM and SQAM will observe and document the repair and retesting of the repair.

The SQAM will observe nondestructive seam continuity testing and perform the following: record location, date, test unit number, name of tester, and outcome of all testing; indicate that repairs of failed seams have been made by marking on the geomembrane; and document the results of the testing.

If the weld is accessible to testing equipment prior to final installation, the weld will be nondestructively tested prior to final installation. If a weld is not accessible to test, a cap strip will be placed over the weld. The cap strip, or LLDPE strip, will be placed over the weld and extrusion welded to the LLDPE. This is a precautionary measure since the weld could not undergo nondestructive testing. Welding and cap-stripping operations must be observed by the SQAM and the geomembrane installer for uniformity and completeness. The location, date of visual observation, name of tester, and outcome of the test or observation, indication that repairs of failed seams have been made by marking on the geomembrane, and document results will be recorded by the QCSM and reported to CTR and the CQAE.

4.3.2.2.7 Destructive Seam Testing

Destructive seam tests will be performed at selected locations in accordance with Table 4.1. The purpose of these tests is to evaluate seam strength and integrity. Seam strength testing will be done as the seaming work progresses, not at the completion of all field sampling.

The QCSM will select locations where seam samples will be cut out for laboratory testing. The SQAM may also select the sample locations. The geosynthetics subcontractor will not be informed in advance of the location of sites where seam samples will be taken. The test frequency and locations will be established as follows:

- Samples will be collected at the minimum frequency given in the Specifications.
- Test locations will be selected during seaming at the QCSM's discretion. Selection of such locations may be prompted by suspicion of excess crystallinity, contamination, offset seams, or any potential cause of imperfect seaming.

The geosynthetics subcontractor will be required to cut samples as directed by the QCSM as the seaming progresses. The QCSM will:

- Observe sample cutting,
- Assign a number to each sample and mark it accordingly,
- Record the sample number and location on the panel layout drawing, and
- Record the reason for taking the sample at this location (e.g., routine testing, suspicious feature of the geomembrane).

All holes in the geomembrane resulting from destructive seam sampling will be covered by the Subcontractor immediately after sampling and repaired in accordance with the repair procedures described in the Specifications. The continuity of the new seams in the repaired area will be nondestructively tested according to the Specifications.

At each specified sampling location, the destructive samples will be tested in accordance with the Specifications.

The procedures described within the Specifications will be followed whenever a sample fails a destructive test. The QCSM will verify and document that one of the procedures specified within the Specifications has been followed. The QCSM will document all actions taken in conjunction with destructive test failures.

4.3.2.3 Defects and Repairs

4.3.2.3.1 Identification

All seams and non-seam areas of the geomembrane will be inspected by the QCSM for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter by walking the panels. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane will be clean at the time of examination. The geomembrane surface will be broomed or washed by the geosynthetics subcontractor if the amount of dust or mud inhibits examination. Any areas requiring repair will be marked by the QCSM for easy identification by the repair crew. After the area is repaired it will be tested in accordance with Section 4.3.2.3.5.

4.3.2.3.2 Evaluation

Each suspect location, both in seam and non-seam areas, will be either nondestructively tested using the methods described in the Specifications or repaired as appropriate, as required by the QCSM. Each location that fails the nondestructive testing will be marked by the QCSM and will be required to be repaired by the geosynthetics subcontractor. Materials should not be placed over geomembrane locations that have been repaired until the QCSM and SQAM have approved the repair.

4.3.2.3.3 Large Wrinkles

When seaming of the geomembrane is completed (or when seaming of a large area of the geomembrane is completed) and before the overlying materials are placed, the QCSM will visually inspect the geomembrane for wrinkles. The wrinkle height to width ratio for installed FML shall not exceed 0.5 or the total wrinkle height shall not exceed 6-inches. Wrinkles that do not meet the above criteria shall be cut and repaired in accordance with the Specifications. The QCSM will indicate to the geosynthetics subcontractor which wrinkles, if any, should be cut and reseamed in accordance with the Specifications. The seam thus produced will be tested like any other seam.

4.3.2.3.4 Repair Procedures

Any portion of the geomembrane exhibiting a flaw or failing a destructive or nondestructive test will be repaired by the geosynthetics subcontractor in accordance with the applicable method described in the Specifications.

4.3.2.3.5 Testing of Repairs

Each repair will be nondestructively tested using the methods described in the Specifications as appropriate. Repairs that pass the nondestructive test will be considered as adequate. Large geomembrane cap repairs may be of sufficient extent to require destructive testing, which will be at the discretion of the QCSM. Failed tests will require the repair to be redone and retested until

passing test results are obtained. The QCSM will observe the nondestructive testing of repairs and will document the date of the repair and test results.

4.4 SYNTHETIC GEOCOMPOSITE DRAINAGE NET

4.4.1 Geocomposite Manufacturing and Delivery

The Subcontractor will be required to provide the QCSM with the manufacturing QC certificates for each shift's production of geocomposite rolls, which include geocomposite roll numbers and identification, sampling procedures, and descriptions and results of the QC tests required in the Specifications signed by a responsible party employed by the geocomposite manufacturer.

The QCSM will examine all geocomposite manufacturer's certifications to verify and document that the property values listed on the certifications meet or exceed those specified within the Specifications and that proper and complete documentation has been provided by the geocomposite manufacturer for all geocomposite used at the site. The QCSM will report any deviations from the above requirements to the SQAM and geosynthetics subcontractor prior to installation of the geocomposite. The CQAE and the CTR will approve these submittals.

4.4.2 Labeling

The SQAM will verify and document that the geocomposite manufacturer has labeled all rolls of geocomposite as described in the Specifications. The QCSM will examine the rolls upon delivery and report any deviation from the above requirements to the SQAM and geosynthetics subcontractor before the geocomposite is installed.

4.4.3 Shipment and Storage

The QCSM will observe the rolls of geocomposite upon their delivery at the site and report any deviation from the requirements described within the Specifications to the SQAM and geosynthetics subcontractor. Any damaged rolls will be rejected by the QCSM and will be required to be repaired or replaced by the Subcontractor.

The rolls shall be stored in an area capable of protecting the material from ultraviolet light exposure, moisture, excessive humidity, puncture, cutting, or other damaging conditions. Rolls may not be left unprotected on the project site unless being placed that day.

4.4.4 Conformance Testing

The QCSM will ensure that manufacturer's QC tests comply with the requirements listed in Table 4.1 and the Specifications. The CQAE is responsible for conformance samples at frequencies listed in Table 4.1. Samples will be taken across the entire width of the roll and will not include the first 3 feet. Unless otherwise specified, samples will be 3 feet long (minimum) by the roll width. The SQAM will mark the samples with an arrow to indicate the direction of the cut. Samples will be taken at a rate of one per 100,000 ft^2 or one per lot, whichever results in a greater testing frequency. These geocomposite will be tested for bond adhesion (ASTM D 413, GRI GC 7, or F904) and transmissivity (ASTM D 4716). The geonet component will be tested for thickness (ASTM 5199), density (ASTM D 1505 of ASTM D 792), MD tensile strength (ASTM D 5035), and carbon black content (ASTM D 1603 modified or ASTM D 4218). The geotextile component of the geocomposite will be tested for mass per unit area (ASTM D 5261), puncture strength (ASTM D 4833), and apparent opening size (ASTM D 4751). The CQAE will examine all results from laboratory conformance testing and will report any nonconformance to the CTR and Subcontractor as soon as the results become available (see Table 4.1).

The following procedure will apply whenever a sample fails a conformance test that is conducted by the independent QC laboratory:

- The Subcontractor will be required to replace the roll (or rolls) of geocomposite not in conformance with the Specifications with a roll (or rolls) that meets the Specifications.
- The SQAM will ensure that conformance samples are removed for testing by the independent laboratory from the closest numerical roll on each side of the failed roll. These two samples must pass the above conformance tests. If either of these samples fails, samples will be collected from the five numerically closest untested rolls on either side of the failed sample and tested by the independent laboratory. These 10 samples and samples from every roll subsequently delivered from the same manufacturer must be conformance tested by the independent QC laboratory. The costs of all such additional tests are to be borne by the Subcontractor.

QA/QC personnel will document actions taken in conjunction with conformance test failures and report all actions to the SQAM and Subcontractor.

4.4.5 Handling and Placement

The Subcontractor will be required to handle all geocomposite in such a manner as to ensure the geocomposite is not damaged in any way. The QCSM will verify and document compliance with the following:

- Just prior to geocomposite placement, the geomembrane is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions that could potentially damage the liner system.
- The geocomposite is weighted with sandbags (or equivalent weight approved by the QCSM).
- The geocomposite is cut using a geocomposite cutter approved by the geotextile manufacturer and the QCSM. If cut in place, special care is to be taken to protect other materials (such as underlying geosynthetics) from damage that could be caused by cutting the geocomposite.
- The Subcontractor takes any necessary precautions to prevent damage to the underlying layers during placement of the geocomposite.
- During placement of the geocomposite, care is taken not to entrap stones, excessive dust, or moisture in the geotextile that could damage the underlying layers, clog drains or filters, or hamper subsequent seaming.
- The geocomposite is not left exposed for a period more than 30 days after placement unless a longer exposure period is approved by the QCSM, the Team, and the CQAE.

The QCSM will document any noncompliances with the above requirements and report them to the SQAM and geosynthetics subcontractor.

4.4.6 Seams and Overlaps

The QCSM and CQAE will verify and document that all geocomposite seams are overlapped and joined in accordance with the Specifications.

4.4.7 Repair

The QCSM will verify and document that any damage to the geocomposite has been repaired in accordance with the requirements of the Specifications. The QCSM will document any noncompliance with the above requirements and report it to the SQAM and geosynthetics subcontractor.

4.5 ROCK BARRIER

4.5.1 Material

The Subcontractor will provide the QCSM with QC test results and a written certification signed by a responsible party of the aggregate supplier that the tests required by the Specifications have been performed on material representative of that which is to be delivered to the site. The QCSM will examine the test results and report any deviations from the Specifications to the SQAM and Subcontractor. The CQAE and the CTR will approve these submittals.

The QCSM and Subcontractor shall inspect the rock barrier material when on-site to ensure that no segregation or contamination of the material has occurred.

4.5.2 Conformance Testing

The QCSM will perform conformance testing of the rock. Conformance tests include sieve analysis (ASTM C 136 or ASTM D 5519) and unconfined compressive strength (ASTM D 2938). Testing will be performed on the rock in a manner such that no damage to any geosynthetics occurs. Frequencies for the aggregate conformance testing are given in Table 4.2. The SQAM will sample the rock for the same tests at a frequency of 1/20 QC samples.

4.5.3 Handling and Placement

Before the aggregate rock barrier is placed, the QCSM will verify and document that:

- The underlying soil cushion layer is clean, free of all foreign substances, not disturbed by traffic or other operations, and maintained in a satisfactory condition.
- All work on underlying materials is complete and accepted by SQAM and Subcontractor.

During placement of the aggregate rock barrier, the QCSM will verify and document that:

- The aggregate meets the requirements of the Specifications in accordance with the test methods and frequencies prescribed in Table 4.2.
- The condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the Subcontractor in accordance with the Specifications.
- The aggregate rock barrier is placed in accordance with the Specifications.

4.6 SOILS

4.6.1 Material

The QCSM will conduct conformance tests on cover soils in accordance with Table 4.2. The QCSM will examine the test results and report any deviations to the SQAM and Subcontractor. The CQAE and the CTR will approve these submittals.

The QCSM and Subcontractor shall inspect the material for the 6-inch and 10-inch cushion layers when on-site to ensure that no contamination of the material has occurred.

4.6.2 Handling and Placement

Before either the 6-inch GCL cushion layer, the 10-inch rock cushion layer, or the 24-inch final cover soils are placed, the QCSM will verify and document that:

- The underlying surface is clean, free of all foreign substances, not disturbed by traffic or other operations, and is maintained in a satisfactory condition.
- All work on underlying materials is complete and accepted by the SQAM.

During placement of the soils, the QCSM will verify and document that:

- The 6-inch and 10-inch cushion layers and the 24-inch final cover soils meet the requirements of the Specifications in accordance with the test methods and frequencies prescribed in this Construction QA/QC Plan (Table 4.2).
- The condition of the underlying layer has not changed detrimentally during installation. Any damage to the surface of the underlying layer will be repaired by the Subcontractor in accordance with the Specifications.
- The 6-inch and 10-inch cushion layers and the 24-inch final cover soils are placed in accordance with the Specifications.

4.6.3 Verification of Thickness

The QCSM will verify that the design thicknesses of the 6-inch GCL cushion layer, and the 10-inch rock cushion layer, and the 24-inch infiltration soil layer are within the tolerances required by Specifications. This will be performed by completing a record survey of the top of the layers. The surveys shall be conducted by a PLS registered in the State of Colorado. At a minimum, thickness verifications will be obtained at the applicable control point locations shown on

Drawing 51781-006. The QCSM will also verify that the finished soil surface at the time of the thickness measurements is free of excessive disturbances (rutting, footprints, etc.).

4.7 SEEP PASSIVE TREATMENT SYSTEM

4.7.1 Manufacturing and Delivery

The manufacturer will be required to conform with all submittal requirements of the Specifications. The Subcontractor and QCSM will be required to inspect all sections of the Seep Passive Treatment System when it arrives on-site. It shall be inspected for general appearance, dimensions, and soundness. The surface shall be dense, close textured, and free of blisters, cracks, roughness, and exposure of reinforcement.

4.7.2 Materials and Design

The Seep Passive Treatment System shall meet all the construction and performance requirements of the Drawings and Specifications.

4.7.3 Installation

In general, the QCSM will visually observe and document the installation of the Seep Passive Treatment System to ensure the following:

- The Seep Passive Treatment System is installed at the proper location and elevation as shown on the Drawings.
- The Subcontractor takes any necessary precautions to prevent damage to the Seep Passive Treatment System during installation.
- The subgrade for the Seep Passive Treatment System is prepared in accordance with the Specifications.
- The condition of the subgrade has not changed detrimentally during installation. Any damage to the surface of the subgrade will be repaired by the Subcontractor in accordance with the Specifications.
- Field testing is performed in accordance with the Specifications.
- Backfilling is performed in accordance with the Specifications, and QA/QC is performed in accordance with Section 4.1.

4.8 PIPE AND FITTINGS

4.8.1 Manufacturing

Before the polyvinyl chloride (PVC) and high density polyethylene (HDPE) pipe and fittings are incorporated into the work, the Subcontractor will be required to provide the QCSM with the product data required by the Specifications. The QCSM will verify and document that the property values given in the submittals meet the requirements of the Specifications. The QCSM will report any deviations from the above requirements to the SQAM and the Subcontractor.

4.8.2 Labeling

The QCSM will verify that the pipe is labeled with the information specified in the Specifications. Any deviations from the labeling requirements will be reported to the QCSM and the Subcontractor prior to pipe installation.

4.8.3 Shipment and Storage

The QCSM will verify and document that the pipe and fittings are stored in accordance with the Specifications. The QCSM will visually inspect the pipe upon delivery at the site and report any deviations from the requirements of the Specifications to the SQAM and the Subcontractor.

4.8.4 Pipe Perforations

The QCSM will verify and document that pipe perforations are in accordance with the Drawings. Deviations from the specified requirements will be reported to the SQAM and the Subcontractor.

4.8.5 Pipe Installation

4.8.5.1 Handling and Layout

The QCSM will verify and document that the pipe is installed at the specified locations and grades and that placement of backfill around and over the pipe is conducted in accordance with the requirements of the Specifications and in a manner intended to prevent damage to the pipe. The QCSM will also verify that the pipe is installed with the perforations oriented as shown in the Drawings. The pipe fittings will be carefully examined before installation by the QCSM. The QCSM will verify and document that cracks, damage, and defects are not present in the pipe and fittings in excess of those allowed in the Specifications. The QCSM will also note the

condition of the interior of pipes and fittings. Foreign material shall be removed from the pipe interior before the pipe is moved into final position. No pipe will be permitted to be placed until the QCSM has observed the condition of the pipe. The QCSM will document any deviation from the above requirements and report it to the SQAM and the Subcontractor.

4.8.5.2 Joint and Connections

Lengths of pipe will be required to be assembled into suitable installation lengths by the process described in the Specifications. The QCSM will monitor all procedures used to make joints and connections to ensure that the Subcontractor follows the appropriate procedures described in the Specifications. The QCSM will document any noncompliance with the above requirements and report it to the SQAM and the Subcontractor.

4.9 BARBED WIRE FENCING AND GATES

4.9.1 Manufacturing

Before the barbed wire fencing and gates are incorporated into the work, the Subcontractor will be required to provide the QCSM with the product data required by the Specifications. The QCSM will verify and document that the data given in the submittals meet the requirements of the Specifications. The QCSM will report any deviations from the above requirements to the SQAM and Subcontractor.

4.9.2 Installation

In general, the QCSM will visually observe the installation of the barbed wire fencing and gates to ensure the following:

- The Subcontractor takes any necessary precautions to prevent damage to the underlying composite cover system layers during installation of the fence posts.
- The new barbed wire fence is installed to the lines and grades indicated on the Drawings.
- The new barbed wire fence posts are set plumb and in alignment.
- The new barbed wire fence postholes are cleared of loose material before the posts are placed.

- The barbed wire is installed and pulled taut to provide a smooth and uniform appearance that is free from sag.
- The new barbed wire fence is installed in accordance with the Specifications and all manufacturer's installation guidelines.

4.10 SURFACE WATER CONTROL MATERIAL

4.10.1 Supplier

Surface water control materials include riprap, geotextile, and erosion matting. For riprap, the Subcontractor will provide the QCSM with QC test results and a written certification signed by a responsible party of the riprap supplier that the tests required by the Specifications have been performed on material representative of that which is to be delivered to the site. The QCSM will examine the test results and report any deviations from the Specifications to the SQAM and Subcontractor. The QCSM will sample for sieve analysis (ASTM 0136 or ASTM D 5514) in accordance with Table 4.2. Geotextile and erosion matting tests will be conducted in accordance with Table 4.1.

4.10.2 Placement

Before the riprap is placed, the QCSM will verify and document that:

- The underlying subgrade is smooth and free of soft areas and voids and meets the grading requirements of the Specifications and Drawings.
- All work on underlying materials is complete and accepted by the SQAM and Subcontractor.

During placement of the riprap, the QCSM will verify and document that:

- The riprap meets the requirements of the Specifications in accordance with the test methods and frequencies prescribed in this Construction QA/QC Plan.
- The condition of the underlying layer has not changed detrimentally during installation.
- Any damage to the surface of the underlying layer will be repaired by the Subcontractor in accordance with the Specifications.
- The riprap is placed in accordance with the Specifications.

- Geotextile erosion matting will be placed in accordance with the Specifications.

4.11 SEEDING

QA/QC personnel will ensure that seeding is completed in accordance with Specification Section 02900. This includes both temporary and/or permanent vegetation.

4.12 RECORD SURVEY

At a minimum, the Subcontractor will be required to submit Record Surveys conducted by a professional land surveyor registered in the State of Colorado of the following components:

- Top of Regrade;
- Top of Subgrade (includes 6-inch cushion layer);
- Gas Management System (trench alignments);
- Geosynthetics Panel Layout;
- Anchor Trench Alignment;
- Top of 10-inch Cushion Layer;
- Top of Rock Layer;
- Top of Final Surface;
- Perimeter Drainage Channel (before riprap installation);
- Diversion Berm Toe of Slope;
- Seep Treatment System Layout; and,
- Final Project Completion Site Topographic Map.

Except for the geomembrane record drawing, the survey locations will match the applicable horizontal control point locations shown on Drawing 51781-006. Required vertical elevations will be obtained by taking the top of subgrade elevations given on Drawing 51781-006 and adding the design thicknesses as appropriate. As part of these record surveys, the outside edge of the component being surveyed will be surveyed at the approximate locations shown on Drawing C-5. The QCSM and the CQAE will review the record surveys to confirm that the existing grades and thicknesses meet the design grades and thicknesses and are within the tolerances in the Specifications.

The geomembrane record drawing will include the location of all panels, seams, all repair locations, panel identification information, dates of panel installations, penetrations, and test locations. The survey locations will define the limits of the geomembrane and key seam

intersections identified by the QCSM and CQAE. These survey locations and field measurements obtained during the installation will be used to prepare the record drawing.

At a minimum, the gas venting and gas condensate collection systems will be surveyed at the ends of each trend of strip drain or pipe, at approximately 50-foot intervals along each pipe trend to ensure a minimum 1 percent slope, and at each vent location. The QCSM will review the results of this survey to verify that the piping is installed at the correct grades and locations in accordance with the Drawings and Specifications.

The QCSM will submit the record drawings to the CQAE and CTR for final review and approval before proceeding with construction of any subsequent cover system components.

5.0 CONSTRUCTION QUALITY ASSURANCE

The CQAE will oversee and audit the QC testing equipment, procedures, and results throughout the project to ensure that proper QC testing equipment and methods are used and that accurate QC test results are obtained. The minimum QC testing frequencies are presented in Tables 4.1 and 4.2. The CQAE will verify a minimum 5 percent of the field QC test results by performing QA tests on the same materials. If both a QA and a QC test result on a given material meet the specification requirements, no further action is required. If one organization's test passes and another's fails, the QC test result will be the official test result. However, the CQAE will have the authority, based on his/her judgment, to overrule any QC test result and may require additional tests, repairs, or reworking of a given area/material based solely on the CQAE's test results and/or observations.

The CQAE or his/her representative will contract with an independent CQA laboratory(s) to perform the conformance testing described in Section 4.0. The CQAE will review all conformance test results for compliance with the Specifications. All non-conforming test results will be reported to the QCSM, Earth Tech, and the Subcontractor. The SQAM will perform continuous QA oversight during construction operations and report to the CQAE.

In addition to the QA activities described above and elsewhere in this QA/QC Plan, the CQAE will perform the following tasks:

- Through the SQAM, observe all construction activities to ensure that the QCSM is fulfilling the observation, testing, and documentation requirements identified in Section 4.0;
- Observe all construction activities to ensure that the Subcontractor is utilizing the construction materials and procedures required by the EPA/CDPHE-approved Project Plans, Specifications, and Drawings;
- Review all submittals for conformance with the EPA/CDPHE-approved Project Plans, Specifications, and Drawings;
- Review the Daily Quality Assurance Report prepared by the SQAM;
- Inspect the subgrade for unsuitable areas and observe proof-rolling operation;

- Review the gas condensate collection system for conformance with the approved plans and specifications;
- Review all conformance test results for conformance with the EPA/CDPHE-approved Project Plans, Specifications, and Drawings;
- Review all Record Drawings, including gas vent piping and strip drains, for conformance with the EPA/CDPHE-approved Project Plans, Specifications, and Drawings;
- Participate in delineating failing or otherwise unacceptable areas;
- Participate in problem or conflict identification, resolution, and documentation;
- Participate in identifying sample locations for conformance or destructive testing;
- Participate in all construction meetings identified in this Construction QA/QC Plan; and
- Prepare, sign, and seal the Construction Completion Report, as described in Section 6.0.

6.0 DOCUMENTATION AND SUBMITTALS

Subcontractors will be responsible for their own reporting, including documentation of personnel, hours worked, all activities and progress, equipment on-site, health and safety issues, and any problems or issues encountered. Each Subcontractor will prepare a Daily Subcontractor Report and submit it to the QCSM. Daily Subcontractor Reports will be appended to the Daily QC Report filled out by the QCSM. This report will be submitted to the SQAM by the following morning. Following receipt of the Daily QC Report, the SQAM will prepare a Daily QA Report that summarizes all Subcontractor QC and QA activities and CQA organization activities. The SQAM will transmit the Daily QA Report to the CQAE and the CTR. Typical types of formal submittals include test data, drawings, instructions, schedules, statements, reports, and certificates. All required submittals must be provided in time to allow for the review, approval, procurements, delivery, and QC preparatory phase of all items before they are needed for construction. As described in Specification Section 1305, Eng. Form 1288–Submittal Register will be used for submittal control and scheduling. Eng. Form 4025–Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance will be used for transmitting submittals.

A Certification Report will be prepared and submitted to the EPA, the CDPHE and the DOE following construction of the PLF Cover. The Construction Completion Report will, at a minimum, include the following elements:

- A detailed chronology of the construction of the PLF Cover and gas and gas condensate collection systems;
- A detailed chronology of the construction of the PLF Cover subgrade;
- A detailed chronology of the construction of the surface water and access control structures, including the drainage berms, storm-water treatment system, and security fence;
- A description of and rationale for any modifications to the Work Plan Drawings and Specifications;
- A discussion of problems encountered and how they were addressed;

- Copies of all QA/QC field and laboratory soil and geosynthetic test results;
- Locations of all field test and samples through global positioning system surveying and shown on appropriate drawings.
- Quantities of all material used for the PLF cover system;
- Copies of key inspection, testing, and other documents, included as appendices;
- As-built drawings and photographs; and
- A summary statement, signed and sealed by the CQAE, that the project was completed in accordance with the CDPHE-approved Plans, Drawings, and Specifications.

7.0 GOVERNMENT PROPERTY INVENTORY

The Subcontractor acknowledges and accepts the responsibility and accountability for all government property in the possession or control of the Subcontractor. The Project Accountant is responsible for keeping an inventory of all government property used during the project. Accountable property includes property that costs more than $25.00 and is not expendable. Accountable property will be labeled and inventoried monthly. Government-owned property may include office equipment, health and safety property, and field operations property. A final inventory of government property will be compiled at the completion of the project and submitted to the CTR.

TABLES

TABLE 4.1

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
GCL-Composite	4.2	02226	Submittal	Certification that minimum values required are guaranteed by Manufacturer.	Submit prior to use.	Review	Review and Approve
			Submittal	Quality Control Certification	Submit prior to use.	Review	Review and Approve
			Submittal	Verification that geotextile has been inspected for broken needles.	Submit prior to use.	Review	Review and Approve
			Label Review/Delivery	Visual Inspection	Inspect for Manufacturer's name, roll identification, roll length, roll width, roll number, and lot number.	Inspect upon delivery	Inspect upon delivery
			Storage	Visual Inspection	GCL shall be stored in an area capable of protecting the material from ultraviolet light exposure, excessive humidity, puncture, cutting, or other damaging conditions.	Inspect after stored	Inspect after stored
			Peel Strength	ASTM D 4632	15 lbs	Review Manufacturer's QC test (1 per 40,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Internal Shear Strength	ASTM D 6243	500 lb/ft^2	Review Manufacturer's QC tests (3 total tests)	Conduct 2 tests
			Permeability	ASTM D 5084 or ASTM D 5887	5 x 10^{-9} cm/sec	Review Manufacturer's QC test (1 per week)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Index Flux at i=1.0	ASTM D 5887	1 x 10^{-x} $m^3/m^2/sec$	Review Manufacturer's QC test (1 per week)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Failed Conformance Test	NA	Subcontractor must replace roll and closest numerical roll on each side must be retested.	As needed	As needed
			Installation Documentation	Visual Inspection	Prior to placement, document that the subgrade is approved by the Subcontractor and free of standing water (less than 100% saturated), excessive amounts of clumps, stones, rocks, or other obstructions that could damage GCL. Surface must be certified by Installer.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	GCL is weighted with sandbags or equivalent.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	GCL kept under tension.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	GCL is cut by a cutter approved by the GCL Manufacturer.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Methods and equipment have not damaged adjacent GCL or subgrade.	Continuous	Oversight of QC

TABLE 4.1

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
GCL-Composite Cont.	4.2	02226	Installation Documentation	Visual Inspection	GCL is deployed in a manner that protects the GCL against adverse effects of precipitation and is deployed in a timely manner.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	The GCL is seamed in accordance with Specifications.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Any repairs are conducted in accordance with Specifications.	Continuous	Oversight of QC
GCL - Bentonite	4.2	02226	Submittal	Identification of bentonite used for production of GCL.	Submit prior to use.	Review	Review and Approve
			Mass per Unit Area	ASTM D 5993	0.75 lb/ft^2	Review Manufacturer's QC test (1 per 40,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Moisture Content	ASTM D 2216 or ASTM D 4643	12% (maximum)	Review Manufacturer's QC test (1 per 100,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Swell Index	ASTM D 5890	24 mL/2g	Review Manufacturer's QC test (1 per 100,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
Black LLDPE*	4.3	02225	Manufacturer Submittal	Resin Certification	Submit prior to use.	Review	Review and Approve
			Manufacturer Submittal	Statement certifying that no recycled polymer and no more than 10% rework added to resin and that it meets project requirements.	Submit prior to use.	Review	Review and Approve
			Manufacturer Submittal	Copy of Manufacturer's Quality Control Plan.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	Installation layout drawings showing geomembrane panel configuration, dimensions, details, and seam locations.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	Field Installation Quality Control Plan.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	Schedule and anticipated average daily production rate.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	Copy of license or letter of approval from Manufacturer.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	List of proposed equipment.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	As-built drawings showing actual placement and locations of destructive seam tests.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	Certification that the geomembrane has been installed in accordance with the contract documents.	Submit prior to use.	Review	Review and Approve
			Installer Submittal	Material and Installation warranties.	Submit prior to use.	Review	Review and Approve

TABLE 4.1

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Black LLDPE* Cont.	4.3	02225	Label Review/Delivery	Visual Inspection	Inspect for defects and damage without unrolling the rolls unless visible defects or damages are found. Inspect for Manufacturer's name, roll identification, roll length, roll width, roll number, thickness, and lot number.	Inspect upon delivery	Inspect upon delivery
			Storage	Visual Inspection	Protect from puncture, abrasion, and excessive dirt and moisture. Area should be level (no wooden pallets), smooth, dry, protected from theft/vandalsim, and adjacent to area being lined.	Inspect after stored	Inspect after stored
			Thickness	ASTM D 5199	60 mils (minimum average) 54 mils *(lowest reading)*	Review Manufacturer's QC test *(every roll)*	Test at 1/100,000 ft^2 *(1 per lot if more frequent)*
			Asperity Height (Textured Only)	GRI GM 12	10 mil average (8 of 10 readings >= 7 mils with lowest individual >= 5 mils)	Review Manufacturer's QC test (every second roll)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Density	ASTM D 1505 or ASTM D 792	0.92 g/cm^3 (minimum)	Review Manufacturer's QC test (1 per 200,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Break Strength	ASTM D 6693	228 lb/in (smooth) 132 lb/in (textured)	Review Manufacturer's QC test (1 per 20,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Break Elongation	ASTM D 6693	800% (smooth) 500% (textured)	Review Manufacturer's QC test (1 per 20,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Puncture Resistance	ASTM D 4833	84 lbs (smooth) 73 lbs (textured)	Review Manufacturer's QC test (1 per 45,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Tear Resistance	ASTM D 1004, Die C	33 lbs (minimum)	Review Manufacturer's QC test (1 per 45,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Carbon Black Content	ASTM D 1603	2%	Review Manufacturer's QC test (1 per 20,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Carbon Black Dispersion	ASTM D 5596	9 of 10 Category 1 or 2 (no more than 1 Category 3)	Review Manufacturer's QC test (1 per 45,000 lbs)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Resin Certificates	Manufacturer's Data	Specification 02225-1.09	Review prior to installation	Review prior to installation
			Resin QC test results verification	Manufacturer's Data	Specification 02225-1.09	Review prior to installation	Review prior to installation
			Failed Conformance Test	NA	Subcontractor must replace roll and closest numerical roll on each side must be retested.	As needed	As needed
			QC Qualifications	Manufacturer QCSM QC Laboratory	Specification 02225-1.09	Review prior to installation (excluding QCSM qualifications)	Review prior to installation
Black LLDPE Installation	4.3	02225	Penetrations	Manufacturer's QC Manual	Ensure that penetrations comply with Design and MQC Manual and verify that pipe penetrations are collar wrapped and securely fastened to pipe.	Continuous	Continuous

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Black LLDPE Installation Cont.	4.3	02225	Destructive Seam Test Repairs	ASTM D 5641 or ASTM D 5820	Pass in accordance with Manufacturer's QC Manual	Every test location	Oversight of all tests
			Patch Testing	ASTM D 5641 or ASTM D 5820	Pass in accordance with Manufacturer's QC Manual	Every patch	Oversight of all tests
			Nondestructive seam continuity testing	ASTM D 5641 or ASTM D 5820	Pass in accordance with Manufacturer's QC Manual	Full length of seams as seaming work progresses	Oversight of all tests
			Destructive seam testing	ASTM D 6392	Fusion: 90 lb/in (shear strength) Fusion: 75 lb/in (peel strength) Extrusion: 72 lb/in (peel strength)	1 per 500 lineal feet of seam	1 QA sample per 20 QC samples.
			Installation Inspection	Visual Inspection	Inspect for faulty or suspect areas prior to covering GCL. All seam and non-seam areas inspected for evidence of defects, holes, blisters, undispersed raw materials, and foreign matter. Non-destructively test each suspect area, repair if necessary, and nondestructively test repair.	Continuous	Continuous
			Installation Documentation	Visual Inspection	Verify that each field panel is given an ID code and develop a chart showing correspondence to roll numbers.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Document that panels are installed in accordance with approved layout plan.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Document that the existing conditions of the underlying layer have not changed during installation.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Record ID code, location, and date of each field panel installation.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Inspect each panel after placement and prior to seaming for damage.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Document that seams are installed in accordance with approved layout plan.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Develop a seam numbering system.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Seaming completed using thermal fusion methods (extrusion welding only for repairs).	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Log ambient temperatures, seaming apparatus temperatures, and extrudate temperatures or fusion-seaming apparatus speeds.	Continuous	Oversight of QC

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Black LLDPE Installation Cont.	4.3	02225	Seaming Documentation	Visual Inspection	The seam is clean and free of moisture, dirt, debris, and foreign material and preparation of the seams is in accordance with Specifications.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Observe all trial seam procedures and assign successful seams a number and log the date, hour, ambient temperature, number of seaming unit, name of seamer, and description.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Observe nondestructive seam tests and record location, date, test, name of tester, and outcome, and indicate on geomembrane the failed seams.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	Select destructive seam test locations without informing the installation subcontractor.	Continuous	Oversight of QC
			Seaming Documentation	Visual Inspection	For destructive seam test observe sample cutting, assign a number, record sample number and location on the panel layout drawing, and record reason for sample.	Continuous	Oversight of QC
			Wrinkle Inspection	Visual Inspection	Ensure the wrinkle height to width ratio for installed FML does not exceed 0.5 or the total wrinkle height does not exceed 6-inches.	Continuous	Oversight of QC
GDN	4.4	02224	Submittal	Proposed Equipment List	Submit prior to use.	Review	Review and Approve
			Submittal	Certified Waybills	Submit prior to use.	Review	Review and Approve
			Label Review/Delivery	Visual Inspection	Inspect for Manufacturer's name, roll identification, roll length, roll width, roll number, and lot number.	Inspect upon delivery	Inspect upon delivery
			Storage	Visual Inspection	Protect from abrasion, and excessive dirt and moisture. Area should be level (no wooden pallets), smooth, dry, protected from theft/vandalsim, and adjacent to area being lined.	Inspect after stored	Inspect after stored
			Bond Adhesion (composite)	ASTM D 413, GRI GC 7, or F904	1.0 lb/in	Review Manufacturer's QC test (1 per 50,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Transmissivity (composite)	ASTM D 4716-00	0.19 gal/min/ft	Review Manufacturer's QC test (1 per 540,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)

TABLE 4.1

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
GDN Cont.	4.4	02224	Thickness (geonet)	ASTM D 5199	200 mil	Review Manufacturer's QC test (1 per 50,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Density (geonet)	ASTM D 1505 or ASTM D 792	0.94 g/cm^3	Review Manufacturer's QC test (1 per 50,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			MD Tensile Strength (geonet)	ASTM D 5035	45 lbs/in	Review Manufacturer's QC test (1 per 50,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Carbon Black content (geonet)	ASTM D 1603 modified or ASTM D 4218	2%	Review Manufacturer's QC test (1 per 50,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Mass per unit area (geotextile)	ASTM D 5261	8 oz/yd^2	Review Manufacturer's QC test (1 per 90,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Puncture Strength (geotextile)	ASTM D 4833	120 lbs	Review Manufacturer's QC test (1 per 90,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Apparent opening size (geotextile)	ASTM D 4751	0.180 mm (maximum)	Review Manufacturer's QC test (1 per 540,000 ft^2)	Test at 1/100,000 ft^2 (1 per lot if more frequent)
			Failed Conformance Test	NA	Subcontractor must replace roll and closest numerical roll on each side must be retested.	As needed	As needed
			Installation Inspection	Visual Inspection	Inspect for damage prior to covering with soil.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Prior to placement, the layer that underlies is clean and free of excessive amounts of dust, dirt, stones, rocks, or other obstructions.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Geocomposite is weighted with sandbags.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	GDN is cut by a cutter approved by the GDN manufacturer.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Damage to underlying layers is prevented.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Care is taken to not entrap stones, excessive dust, or moisture that could damage underlying layers, clog drains or filters, or hamper subsequent seaming.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	GDN is not left exposed for a period more than 30 days after placement.	Continuous	Oversight of QC
			Installation Documentation	Visual Inspection	Document than seams are overlapped in accordance with Specifications.	Continuous	Oversight of QC

TABLE 4.1

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
GDN Cont.	4.4	02224	Installation Documentation	Visual Inspection	Document that damage has been repaired in accordance with Specifications.	Continuous	Oversight of QC
Separation Geotextiles	4.10	02245	Label Review	Visual Inspection	Inspect for Manufacturer's name and product identification.	Inspect upon delivery	Inspect upon delivery
			Listed in Specification 02245	Listed in Specification 02245	Listed in Specification 02245	Review Manufacturer's QC tests.	Review Manufacturer's QC tests.
Erosion Matting (Pennanent)	4.10	02227	Submittal	Manufacturer's QC Manual	Submit prior to use.	Review	Review and Approve
			Submittal	Manufacturer's certification that erosion mat meets project requirements.	Submit prior to use.	Review	Review and Approve
			Mass per unit area	ASTM D 6566	12.57 oz/in^2	Review Manufacturer's QC test per MQC Manual	Test at 1/100,000 ft^2
			MD tensile strength	ASTM D 6818	625 lbs/ft	Review Manufacturer's QC test per MQC Manual	Test at 1/100,000 ft^2
			MD elongation	ASTM D 6818	22%	Review Manufacturer's QC test per MQC Manual	Test at 1/100,000 ft^2
			TD tensile strength	ASTM D 6818	768 lbs/ft	Review Manufacturer's QC test per MQC Manual	Test at 1/100,000 ft^2
Erosion Matting (Pennanent) Cont.	4.10	02227	TD elongation	ASTM D 6818	15%	Manufacturer's QC test per MQC Manual	Test at 1/100,000 ft^2
Erosion Matting (Temporary)	4.10	02227	Listed in Specification 02227	Listed in Specification 02227	Listed in Specification 02227	Ensure all rolls in compliance with Specification 02227	Ensure all rolls in compliance with Specification 02227
Gas Venting and Condensate Collection System Pipework	4.8	11111	Listed in Specification 11111	Listed in Specification 11111	Listed in Specification 11111	Review of Manufacturer's QC data.	Review of Manufacturer's QC data.

TABLE 4.1

GEOSYNTHETIC QA/QC SUMMARY
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO
REVISION 1

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action

Notes:

Testing frequencies to be further developed.

1. Bentonite mass/unit area is based on a geosynthetic clay liner moisture content of 0 percent, as determined by ASTM D 2216 or ASTM 4643, and is exclusive of glues added to the bentonite.
2. Test methods refer to American Society for Testing and Materials (ASTM) and Geosynthetic Research Institute (GRI) standard test methods.
3. All frequencies are minimums.

% = percent
cm = centimeter
ft = feet
g = grams
gal = gallons
GCL = geosynthetic clay liner
in. = inches
lbs = pounds
LLDPE = linear low density polyethylene
MD = machine direction
mL = milliliters
m = meter
min = minute
MQC = manufacturer's quality control
oz = ounces
QA = quality assurance
QC = quality control
QCSM = Quality Control Site Manager
sec = second
TD = transverse direction
yd = yard

TA[illegible]

EARTHWORK QA/QC SUMMARY
100% DESIGN - PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
General Project	1.1	01310, 01320	Submittal	QA/QC Personnel Requirements	Submit to EPA/CDPHE 10 days prior to construction, including alternates.	NA	NA
			Construction Photographs	Digital Camera	Sufficient pre-construction, construction, and post-construction photographs to document the process.	Daily	Review
			RFI Log	Documentation	Submit RFI log weekly to EPA/CDPHE or whenever a change is made.	Review	Review and Approve
			Daily Reports	Documentation	QA Daily and QC Daily.	Submit QC Dailies to SQAM for Review	Submit QA Report to CTR
Site Preparation	4.0	02110	Grubbing within limit of waste	Visual inspection	Ensure areas are close mowed.	Continuous	Continuous
			Grubbing outside limit of waste	Visual inspection	Ensure the vegetation is removed and area is scarified to 6-inches.	Continuous	Continuous
Rocky Flats Alluvium	4.6	02221	Submittal	Proposed Equipment List	Submit prior to use.	Review	Review and Approve
			Submittal	Geotechnical Test Results	Submit prior to use.	Review	Review and Approve
			Submittal	Certified Waybills	Submit prior to use.	Review	Review and Approve
			Field density	Method Specification	See Specification 02221	Continuous	Oversight of QC
			Atterberg limits	ASTM D 4318	Consistent with initial borrow area sampling as determined by the CQAE.	1/6,500 cy	1 per 20 QC samples (minimum of 1)
			Sieve analysis (with USCS classification)	ASTM D 422	Consistent with initial borrow area sampling as determined by the CQAE.	1/6,500 cy	
			Placement Documentation	Visual inspection	Ensure and document that no trucks traverse the rock layer when placing RFA. Place in uniform lifts.	Continuous	Oversight of QC
Cushion Soils	4.6	02221	Submittal	Proposed Equipment List	Submit prior to use.	Review	Review and Approve
			Submittal	Geotechnical Test Results	Submit prior to use.	Review	Review and Approve
			Submittal	Certified Waybills	Submit prior to use.	Review	Review and Approve
			Field density	ASTM D 2922	95% of maximum dry density +- 2 percent optimum moisture content	1/5,000 ft2/lift	1 per 20 QC samples (minimum of 1)
			Field Density Calibration	Standard Counts	Conduct daily standard counts per Manufacturer's representative.	Daily when device is used	Oversight of QC
			Field Density Verification	ASTM D 1556, ASTM D 2167	Verify ASTM D 2922 results	1/20 field density	Oversight of QC
			Field Moisture Verification	ASTM D 2216	Verify ASTM D 2922 moisture	1/20 field density	Oversight of QC

EARTHWORK QA/QC SUMMARY
100% DESIGN - PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Cushion Soils Cont.	4.6	02221	Failed Density Test	ASTM D 2922	Two confirmatory tests adjacent to failed test. If either fails, area needs to be reworked.	As needed	Oversight of QC
			Laboratory compaction	ASTM D 698	Report	1/6,500 cy	1 per 20 QC samples (minimum of 1)
			Atterberg limits	ASTM D 4318	Consistent with initial borrow area sampling as determined by the CQAE	1/6,500 cy	
			Sieve analysis (with USCS classification)	ASTM D 422	Consistent with initial borrow area sampling as determined by the CQAE	1/6,500 cy	
			Placement Documentation	Visual inspection	For GCL cushion, scarify regraded surface, place in 6-inch lifts, remove clods greater than 4-inches in any dimension. For rock cushion, place with D6LGP in a single uniform lift removing clods greater than 4-inches in any direction. Ensure fill is moisture-conditioned in accordance with Test Fill Program.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Underlying surface is clean, free of all foreign debris, not disturbed by traffic or other operations, and maintained in a satisfactory condition.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	The underlying material is accepted by the SQAM and has not changed detrimentally.	Continuous	Continuous
Regrade Soil	4.1	02221	Material Type	Visual inspection	Free of ice, snow, organic soils, vegetation, wood, peat, stones larger than 6-inches in any direction.	Continuous	Oversight of QC
			Field density	ASTM D 2922, D 3017, D 1556, or D 2167 or as developed in Test Fill	95% of maximum dry density or as developed in Test Fill Program.	1/5,000 ft2/lift	1 per 20 QC samples (minimum of 1)
			Proof-rolling	See Specification 02221, paragraph 3.01	Unacceptable deflection between 1-3 inches	Full coverage	Full coverage
			Unstable Areas	Remove unstable material or bridge	Remedy to less than 1-inch of deflection	Approve remedy installation and proof-roll	Approve remedy installation and proof-roll

TABLE

EARTHWORK QA/QC SUMMARY
100% DESIGN - PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Regrade Soil Cont.	4.1	02221	Placement Documentation	Visual inspection	Scarify before fill is placed, place in maximum 1-foot lifts, and step transition work areas to prevent vertical joints. Do not place fill on frozen surfaces (less than 32°F) or surfaces containing ice crystals or clods of frozen soil larger than 4-inches.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Verify that the soil within the top 6-inches does not contain refuse, debris, vegetation, or any material that may leave voids in the subgrade.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Document placement and compaction including lift thickness, type of equipment used, and number of passes. Minimum of 6 passes with a CAT 815B compactor or in accordance with the Test Fill Program.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Document placement and compaction including lift thickness, type of equipment used, and number of passes.	Continuous	Oversight of QC
Drainage Rock (gas collection trenches, anchor trench)	4.7	02245	Submittal	Proposed Equipment List	Submit prior to use.	Review	Review and Approve
			Submittal	Geotechnical Test Results	Submit prior to use.	Review	Review and Approve
			Submittal	Certified Waybills	Submit prior to use.	Review	Review and Approve
			Sieve analysis	ASTM D 422	See 02245 2.01C	1/6,500 cy	1 per 20 QC samples (minimum of 1)
			Laboratory compaction	ASTM D 1557	Report	1/6,500 cy	1 per 20 QC samples (minimum of 1)
			Layer thickness	Survey	See paragraph 3.06, Specification 02714	Oversight	Oversight
			Placement Documentation	Visual inspection	Area to receive drainage rock to be lined with separation geotextile per CQAP Table 4.1 with 6-inch end and edge overlaps, including the top of the drainage rock.	Continuous	Oversight of QC

TAB

EARTHWORK QA/QC SUMMARY
100% DESIGN - PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Seep Passive Treatment System	4.7	11100	Component Documentation	Visual inspection	General appearance, dimensions, soundness, etc. Concrete shall be dense, close textured, and free of blisters, cracks, roughness, and exposure of reinforcement.	As materials arrive on-site	As materials arrive on-site
			Placement Documentation	Visual inspection	Installed to design, precautions to prevent damage, subgrade prepared to specifications, condition of subgrade has not changed detrimentally, field tested or Specifications, backfilled to Specifications.	Continuous	Oversight of QC
Riprap and Riprap Bedding	4.10	02245	Submittal	Proposed Equipment List	Submit prior to use.	Review	Review and Approve
			Submittal	Geotechnical Test Results	Submit prior to use.	Review	Review and Approve
			Submittal	Certified Waybills	Submit prior to use.	Review	Review and Approve
			Field gradation	Visual inspection	See Table 02245-2	1/Material type (i.e., 6-inch or 9-inch riprap)	1/Material type (i.e., 6-inch or 9-inch riprap)
			Sieve analysis	ASTM C 136 or ASTM D 5519	See Table 02245-2	1/Material type (i.e., 6-inch or 9-inch riprap)	1 per 20 QC samples (minimum of 1)
			Specific gravity	ASTM C 127	2.5 or greater	Review of supplier's test data for each riprap gradation	Review of supplier's test data for each riprap gradation
			Absorption	ASTM C 127	2% or less		
			LA abrasion	ASTM C 131	≤ 10% loss for 100 revs., or ≤ 40% loss for 500 revs.		
			Sodium sulfate soundness	ASTM C 88	≤ 10% loss		
			Placement Documentation	Visual inspection	Place to produce a well-graded mass using a zero-drop height. Begin placement downslope and proceed upslope. Ensure no organic or soft friable material is present.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Underlying subgrade is smooth and free of soft areas and voids and meets grading requirements.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	All work on underlying materials is complete and accepted by SQAM.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	The condition of the underlying layer has not changed detrimentally during installation and repaired if necessary.	Continuous	Oversight of QC
Rock Layer	4.5	02222	Submittal	Proposed Equipment List	Submit prior to use.	Review	Review and Approve
			Submittal	Geotechnical Test Results	Submit prior to use.	Review	Review and Approve
			Submittal	Certified Waybills	Submit prior to use.	Review	Review and Approve

TABLE

EARTHWORK QA/QC SUMMARY
100% DESIGN - PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
Rock Layer Cont.	4.5	02222	Field gradation	Visual inspection	See Specification 02222-2.01	Daily inspections as material is delivered	Daily inspections as material is delivered
			Sieve analysis	ASTM C 136 or ASTM D 5519	See Specification 02222-2.01	1/6,500 cy	1 per 20 QC samples (minimum of 1)
			Unconfined compressive strength	ASTM D 2938	4,000 psi	1/6,500 cy	1 per 20 QC samples (minimum of 1)
			Placement Documentation	Visual inspection	Place with a maximum void space of 2-inches, keep larger rocks well distributed, and do not drive equipment on placed rocks.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Underlying cushion soil is clean, free of all foreign debris, not disturbed by traffic or other operations, and maintained in a satisfactory condition.	Continuous	Oversight of QC
			Placement Documentation	Visual inspection	Underlying materials is accepted by the SQAM and has not changed detrimentally.	Continuous	Oversight of QC
Seeding	4.11	02900	Submittal	List of proposed equipment	Submit prior to use.	Review	Review and Approve
			Submittal	Certified copy of seed analysis	Submit prior to use.	Review	Review and Approve
			Submittal	Seed bag tickets	Submit prior to use.	Review	Review and Approve
			Submittal	Documentation of seed calibration	Submit prior to use.	Review	Review and Approve
			Topsoil Sieve Analysis	USDA	Report	Review	Review and Approve
			Topsoil Organic Content	USDA	Report	Review	Review and Approve
			Topsoil N,P,K	USDA	Report	Review	Review and Approve
			Surface Inspection	Visual inspection	Topsoil is free from hard lumps, plants, roots, gravel, cinders, and stones over 1-inch in any dimension.	Continuous	Oversight of QC
As-Built Surveys	4.12	01310	Top of regrade	See requirements in Specification 01310	Verify elevations required by design.	As required	As required, at the discretion of the CQAE.
			Top of subgrade		Verify elevations required by design.		
			Gas management system (trench alignments)		Verify trench locations required by design.		

TAB

EARTHWORK QA/QC SUMMARY
100% DESIGN - PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Quality Control Item	CQAP Section	Specification Section	QA/QC Item	Method	Requirements	QC Action	QA Action
As-Built Surveys Cont.	4.12	01310	Geosynthetics panel layout	See requirements in Specification 01310	Obtain as-built survey of all geosynthetic panel layouts.	As required	As required, at the discretion of the CQAE.
			Anchor trench alignment		Verify location and slope required by design.		
			Top of 10-inch cushion layer		Verify elevations required by design.		
			Top of rock layer		Verify elevations required by design.		
			Top of final surface		Verify elevations required by design.		
			Perimeter drainage channel (slope and width)		Verify slope and width of channel required by design		
			Diversion berm toe of slope		Verify slope required by design.		
			Seep treatment system layout		Verify location and elevations required by design.		
			Final project completion site topographic map		Verify compliance with design.		

Notes:
Test methods refer to American Society for Testing and Materials (ASTM) standard test methods.
* = Minimum of 1 test per backfill area.
≤ = less than or equal
% = percent
cm/s = centimeters per second
CQAE = Construction Quality Assurance Engineer
cy = cubic yards
ft2 = square foot
LA = Los Angeles
QA = quality assurance
QC = quality control
revs = revolutions
USCS = Unified Soil Classification System

TABLE 4.3

MATERIAL QUANTITIES
PRESENT LANDFILL DESIGN, RFETS, GOLDEN, COLORADO

Material	Quantity	Unit
GCL Cushion Soil	18,311	bank cubic yards
GCL	121,561	square yards
FML	120,322	square yards
GDN	143,105	square yards
Rock Cushion Soil	33,343	bank cubic yards
Rock	40,011	cubic yards
Infiltration Layer Soil	80,022	bank cubic yards
Erosion Matting (SC150)	31,350	square yards
Erosion Matting (C350)	11,800	square yards
Geotextile	1,700	square yards
Drainage Rock	500	cubic yards
Riprap	600	cubic yards
Bedding Material	200	cubic yards

Notes:

Quantities are based on the 95% Design Drawings and will be modified upon completion of the eastern portion of the cover design.

FML = flexible membrane liner

GDN = geocomposite drainage net

GCL = geosynthetic clay liner

APPENDIX C

PROJECT PHOTOGRAPHIC LOG

Photo 1: An eastward view of the Present Landfill prior to construction activities (August 2004).

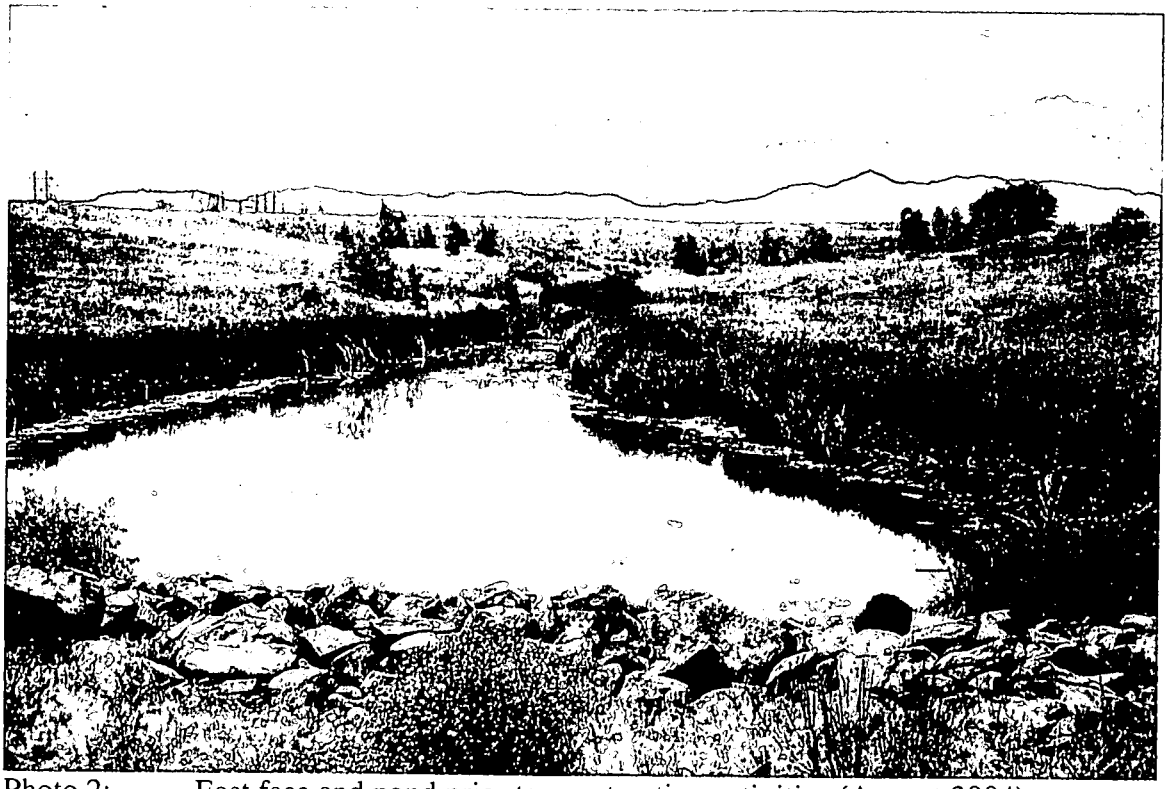


Photo 2: East face and pond prior to construction activities (August 2004).

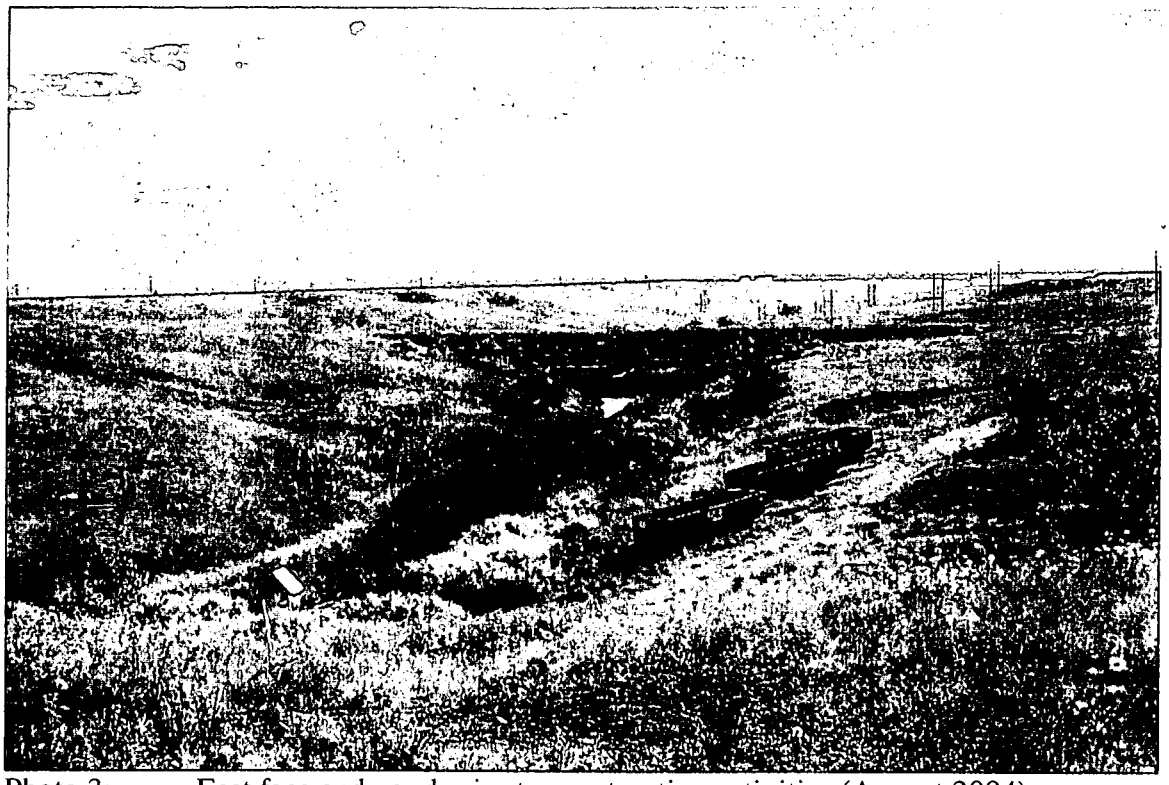


Photo 3: East face and pond prior to construction activities (August 2004).

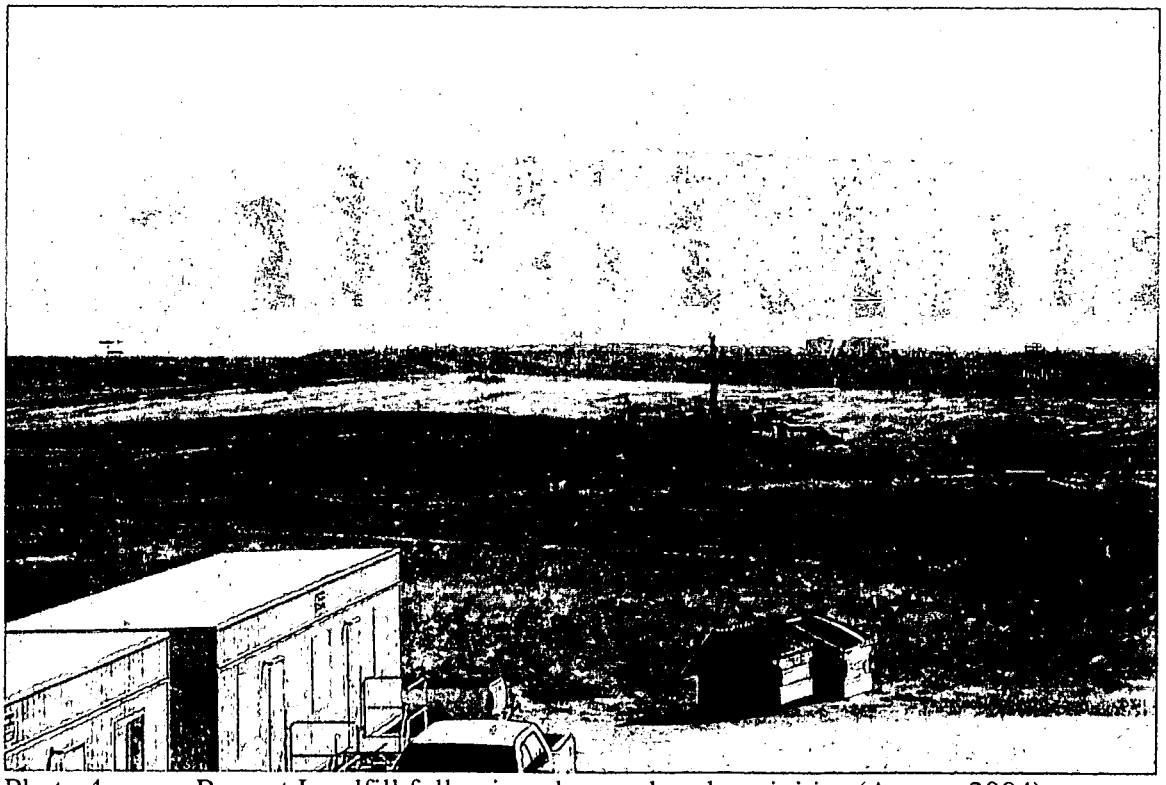


Photo 4: Present Landfill following clear and grub activities (August 2004).

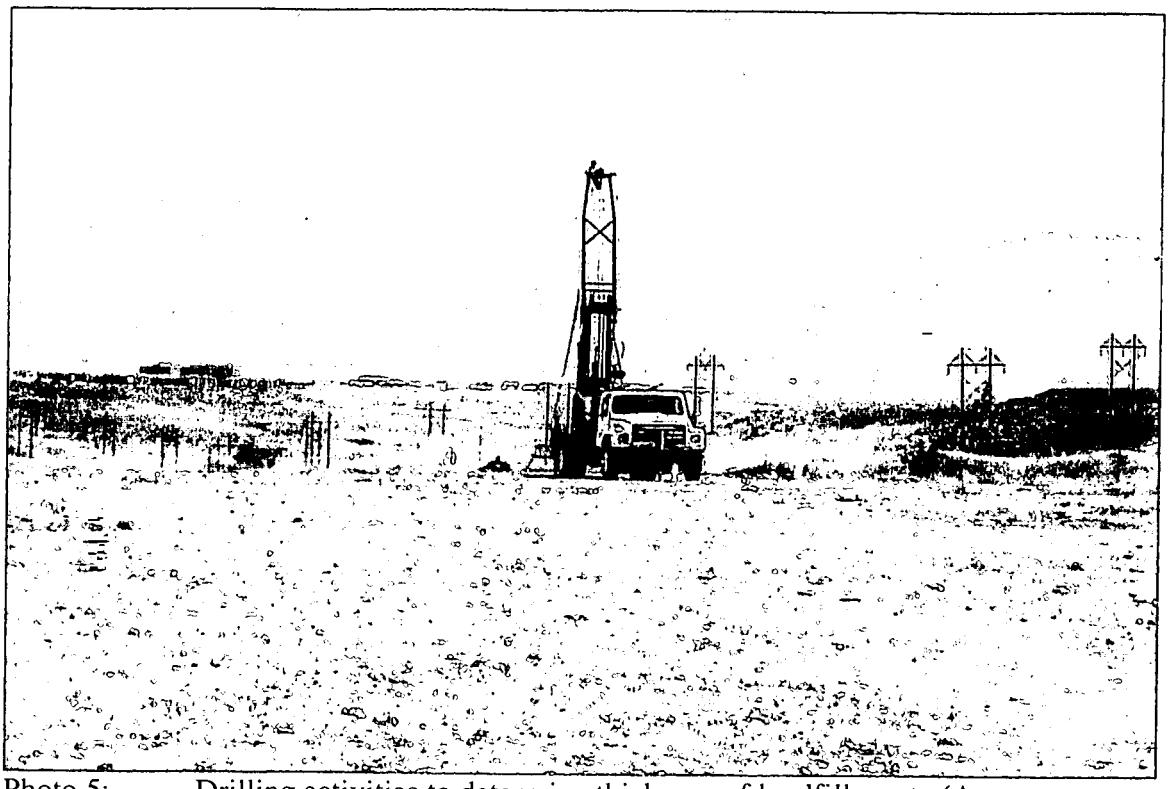


Photo 5: Drilling activities to determine thickness of landfill waste (August 2004).

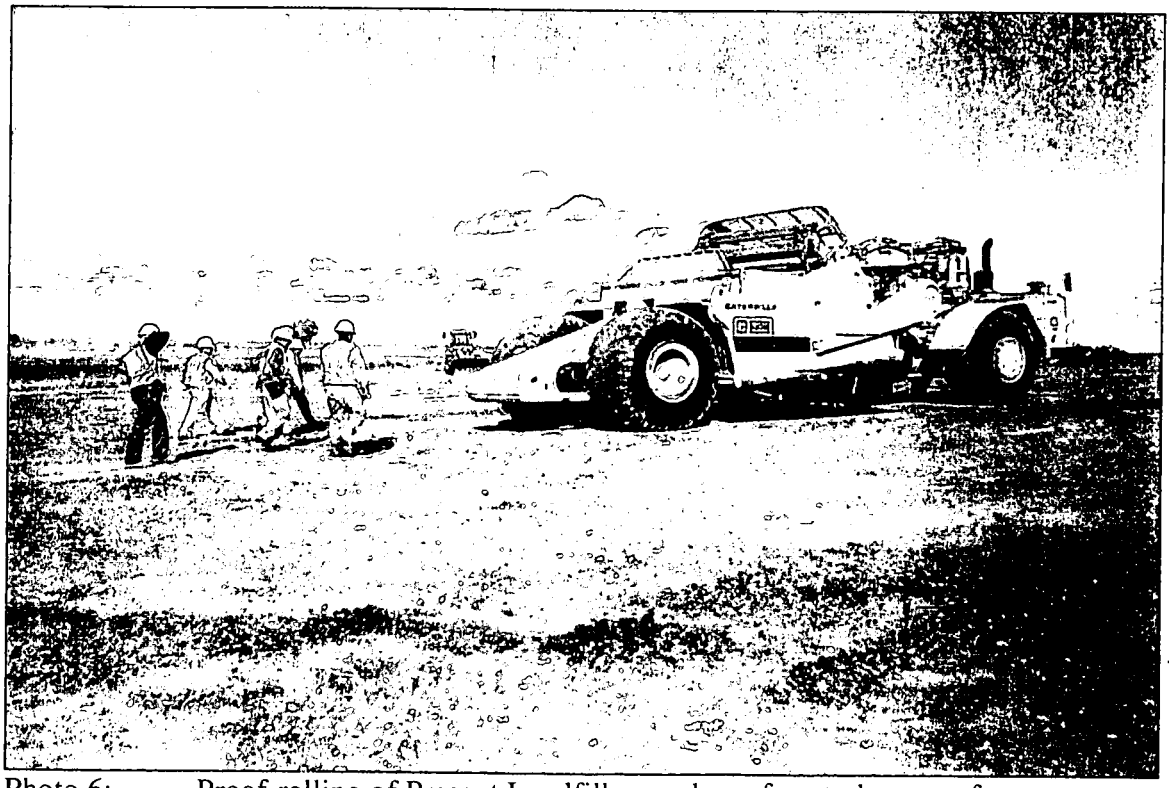


Photo 6: Proof-rolling of Present Landfill regrade surface to locate soft spots using a Cat 633D scraper (September 2004).

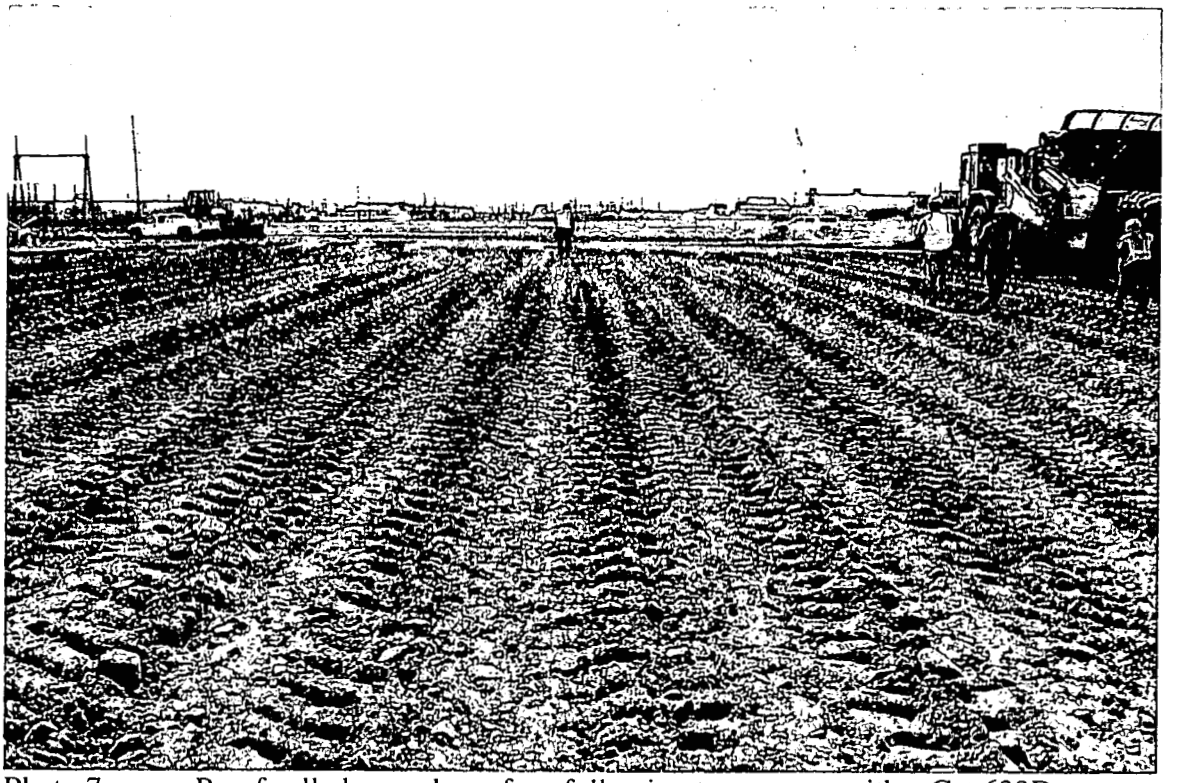


Photo 7: Proof-rolled regrade surface following two passes with a Cat 633D scraper (September 2004).

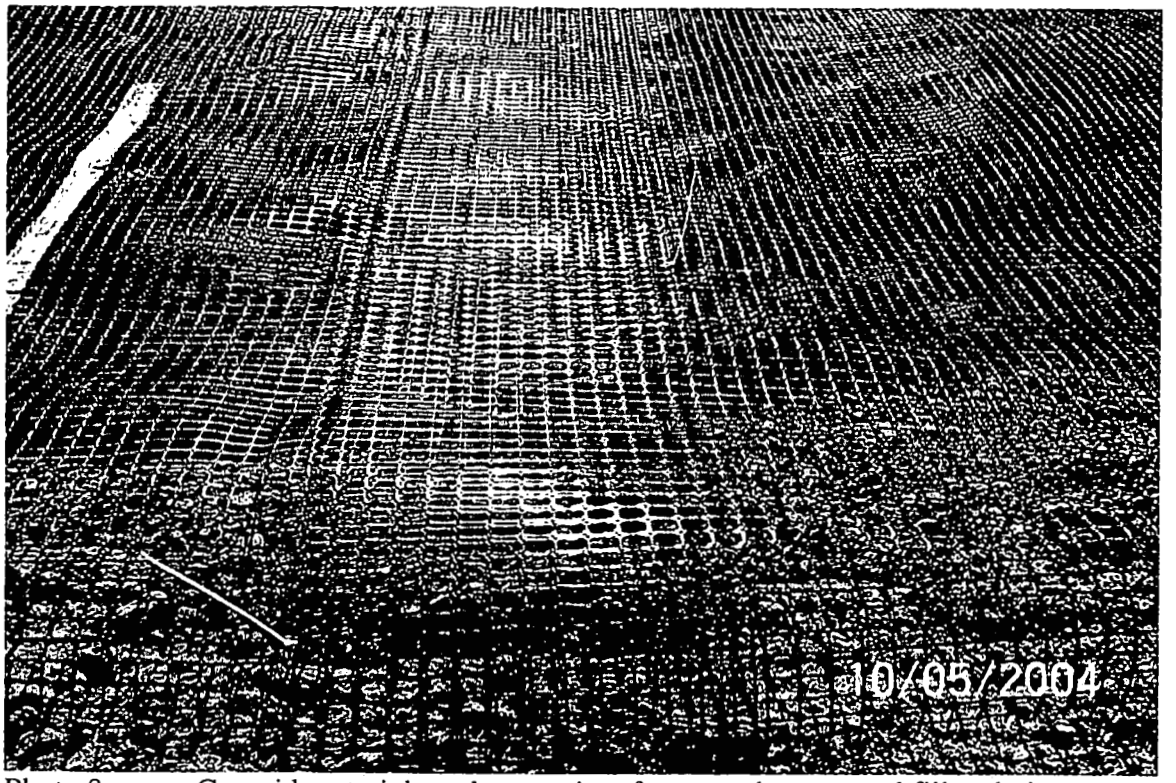


Photo 8: Geogrid material used to repair soft spots when cut and fill techniques could not be used due to landfill waste near surface (October 2004).

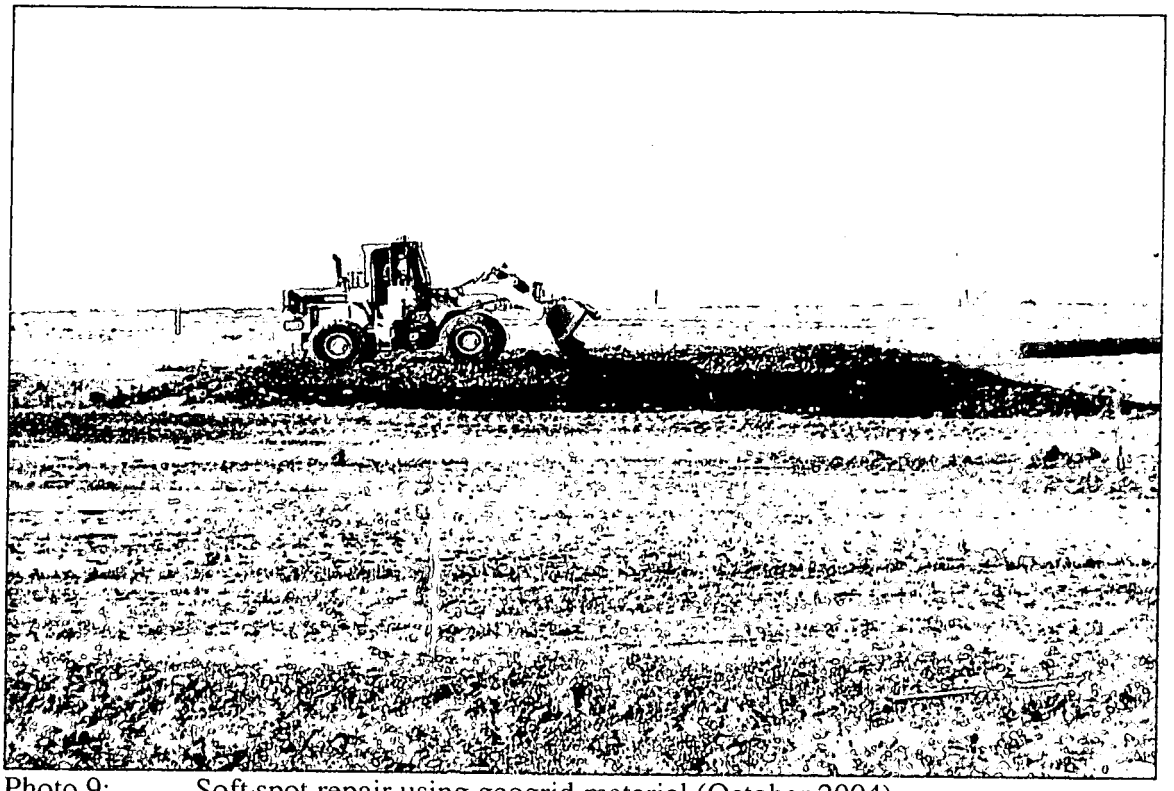


Photo 9: Soft spot repair using geogrid material (October 2004).

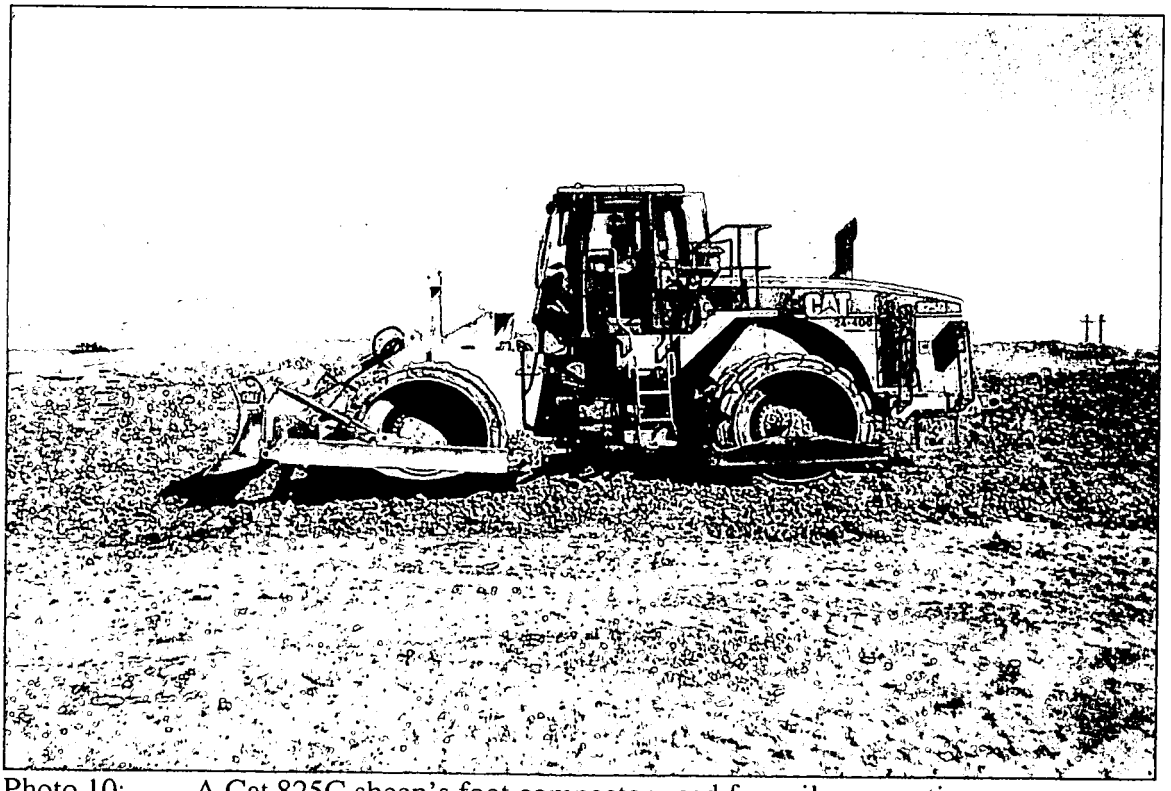


Photo 10: A Cat 825C sheep's foot compactor used for soil compaction (September 2004).

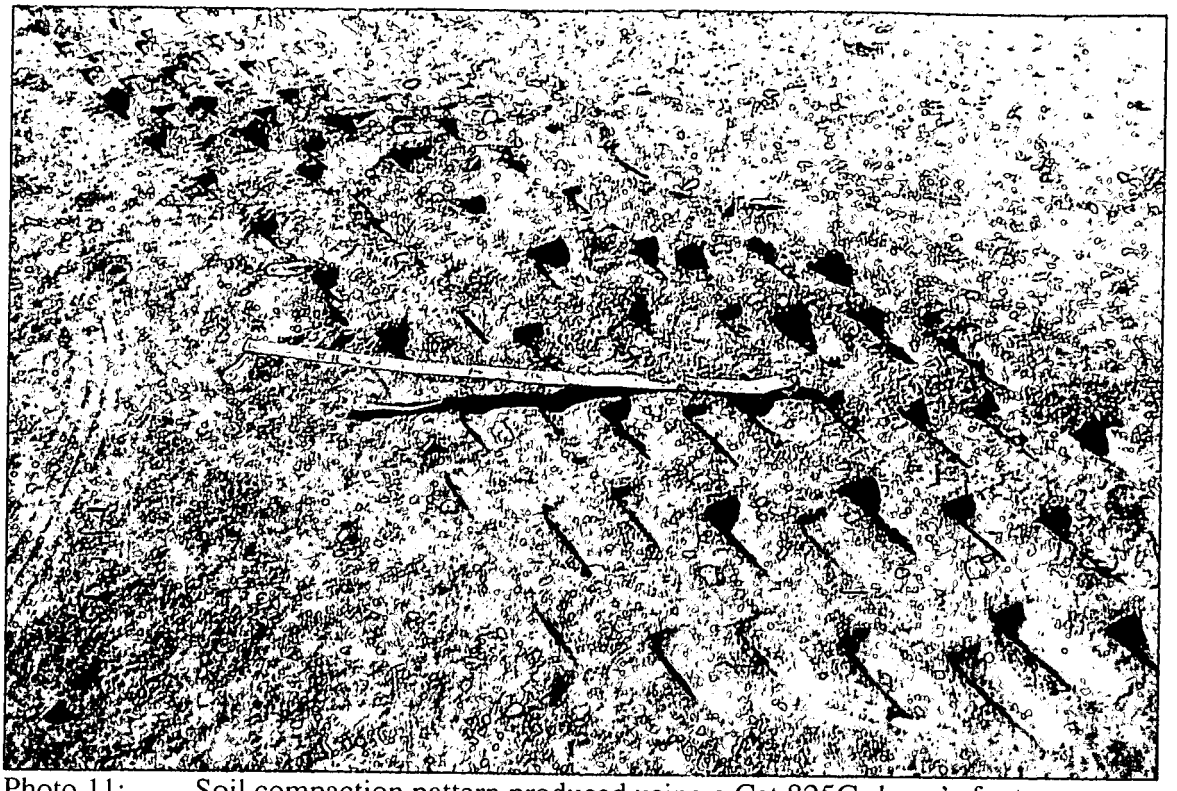


Photo 11: Soil compaction pattern produced using a Cat 825C sheep's foot compactor (September 2004).

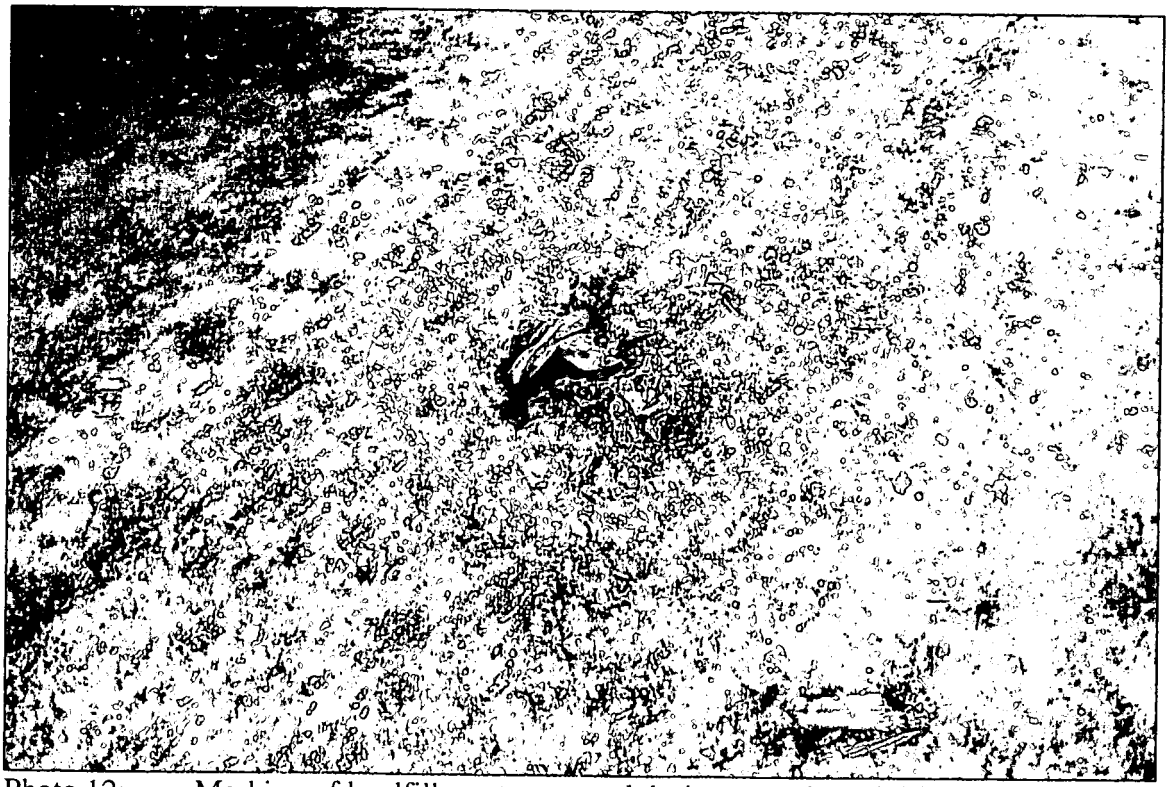


Photo 12: Marking of landfill waste exposed during regrade activities (October 2004).

Photo 13: Landfill waste removed during regrade and soft spot repair activities. Non-hazardous waste placed in roll-off dumpsters (October 2004).

Photo 14: Graphite removal from Present Landfill (October 2004).

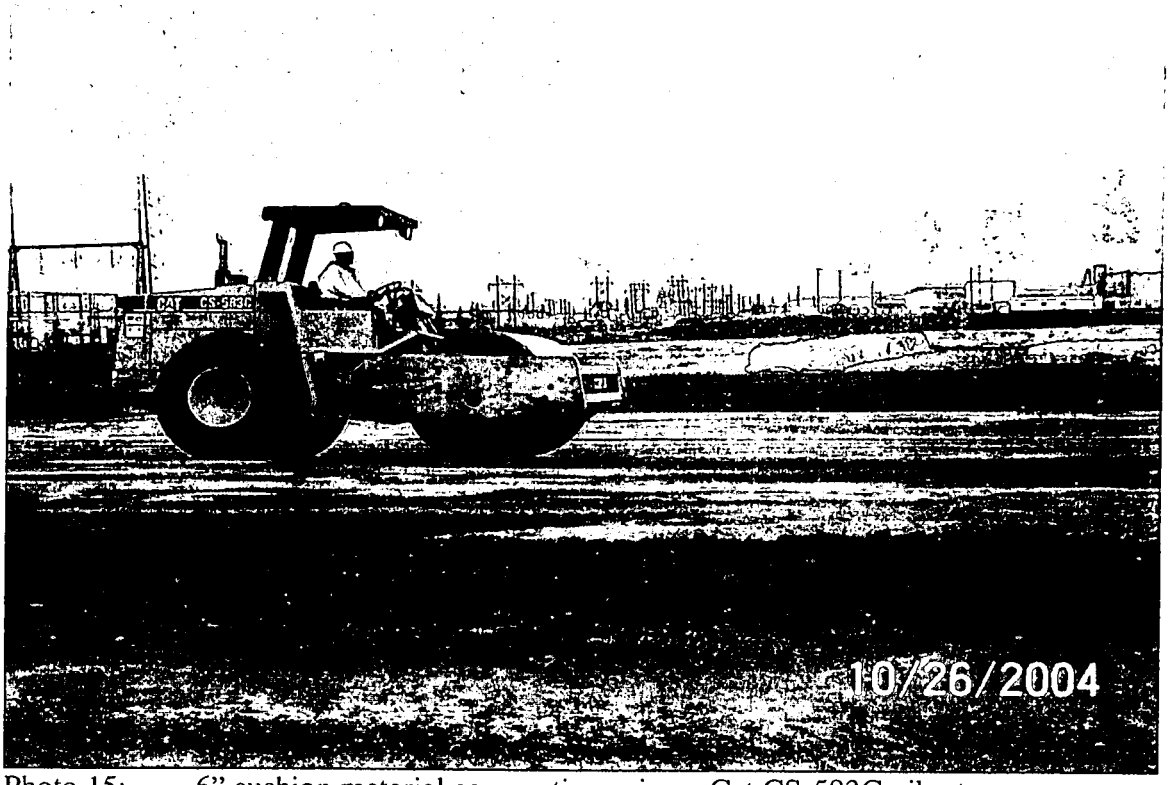


Photo 15: 6" cushion material compaction using a Cat CS-583C vibratory compactor (October 2004).

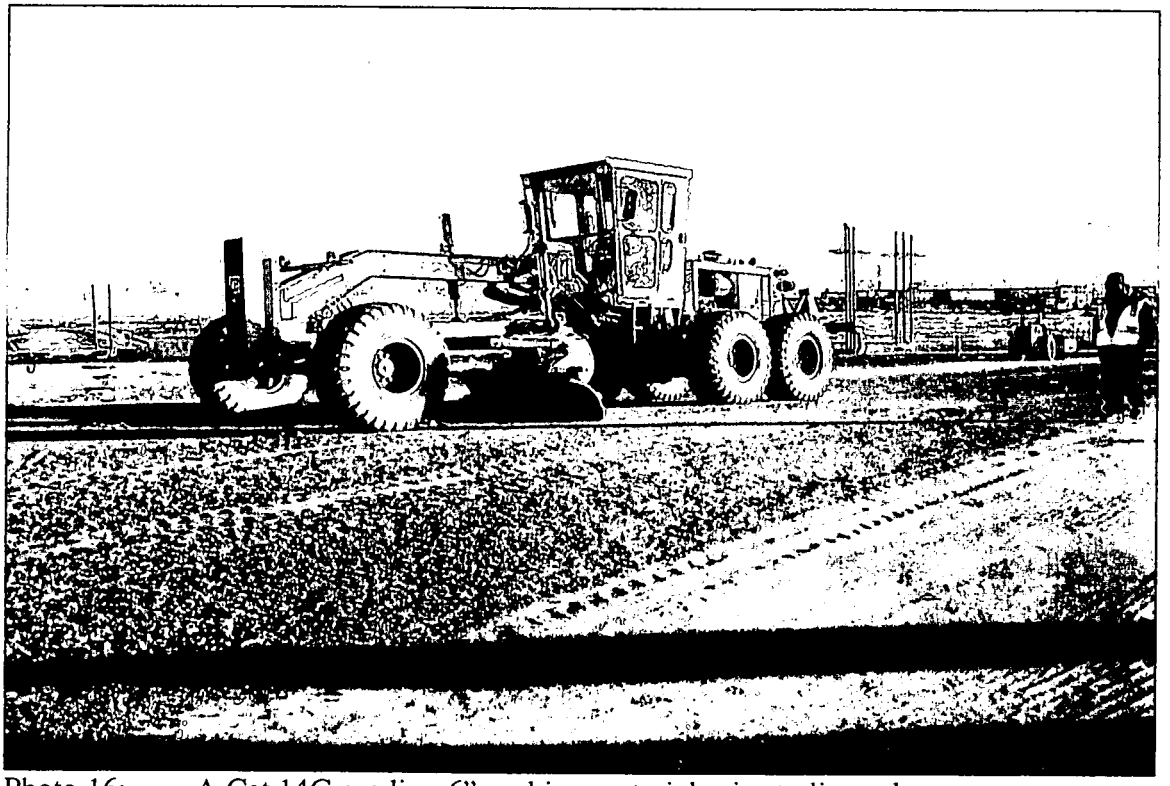


Photo 16: A Cat 14G grading 6" cushion material prior to liner placement (October 2004).

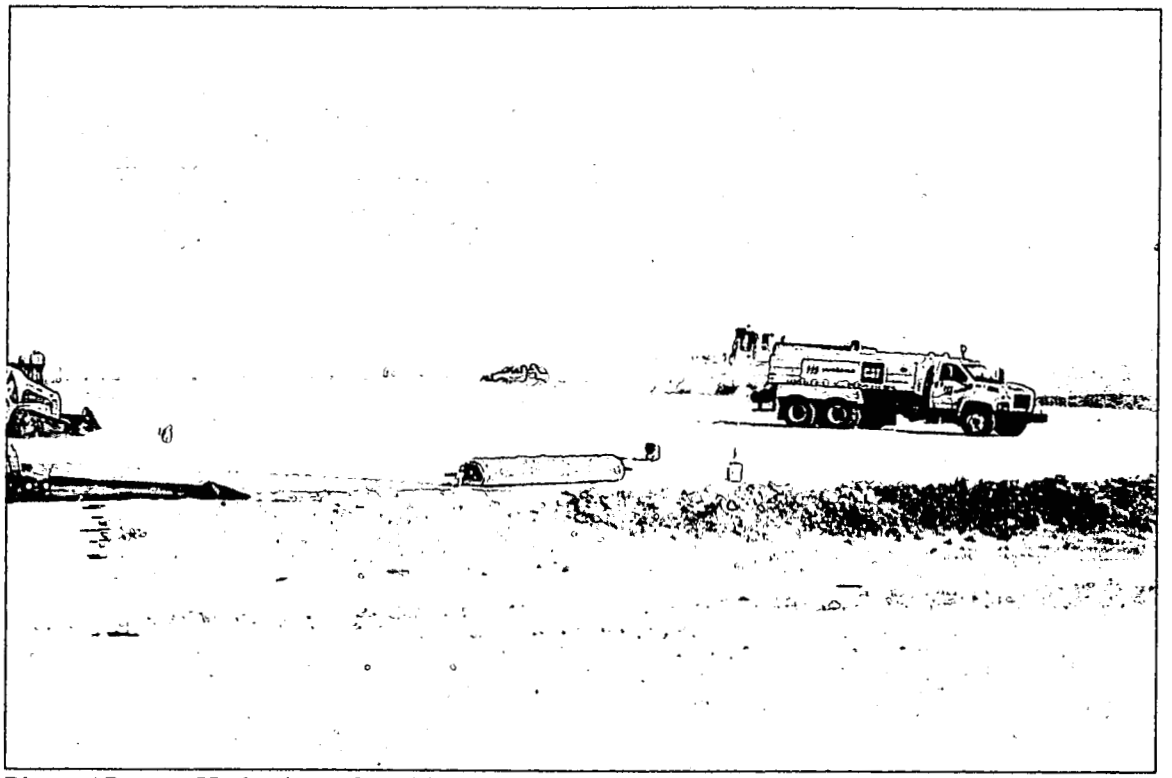


Photo 17: Hydration of cushion soils using a water truck to minimize dust and maximize compaction (November 2004).

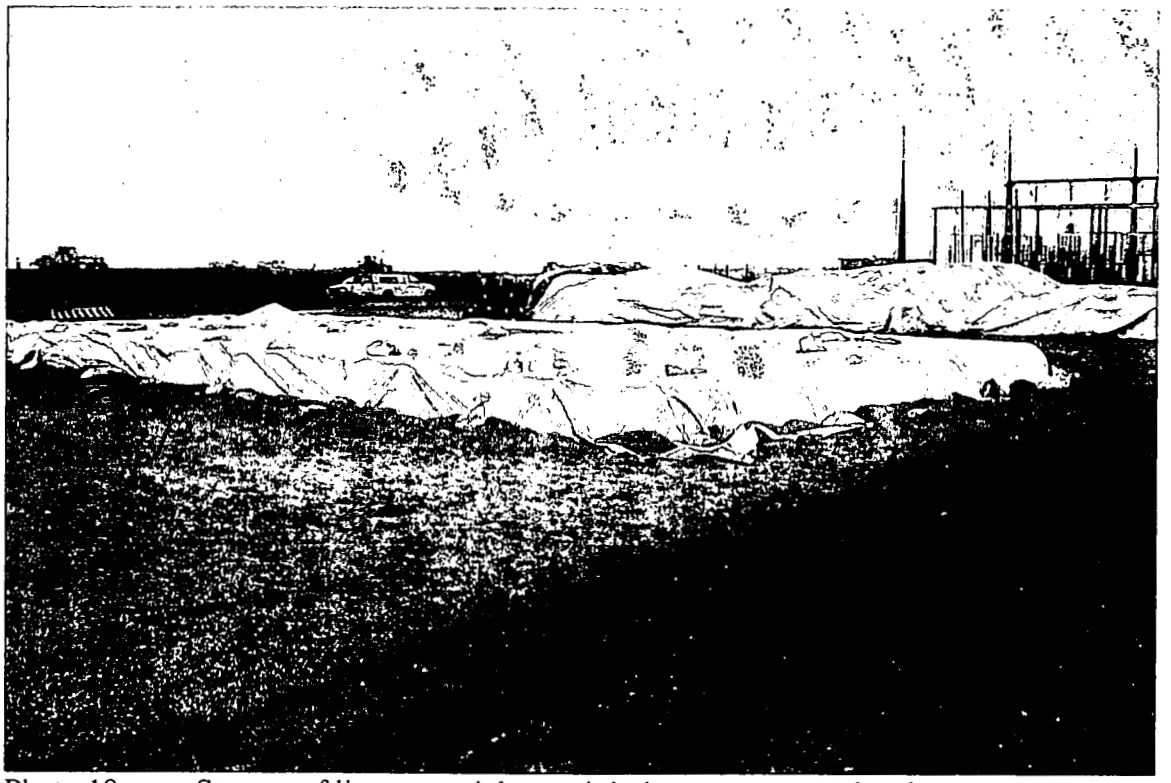


Photo 18: Storage of liner materials to minimize exposure to the elements (October 2004).

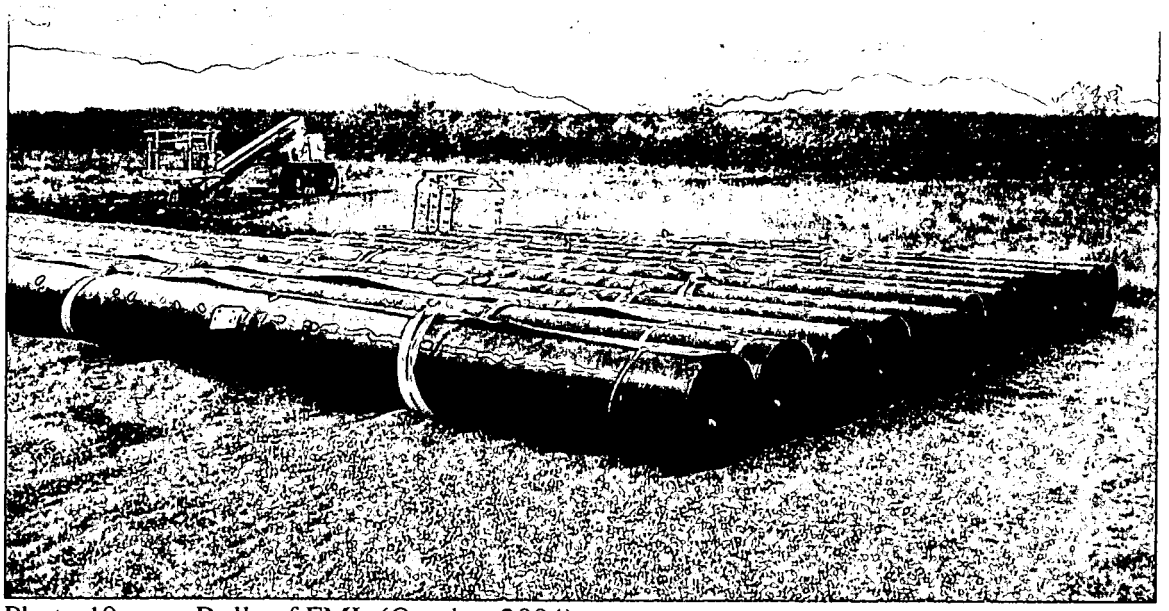


Photo 19: Rolls of FML (October 2004).

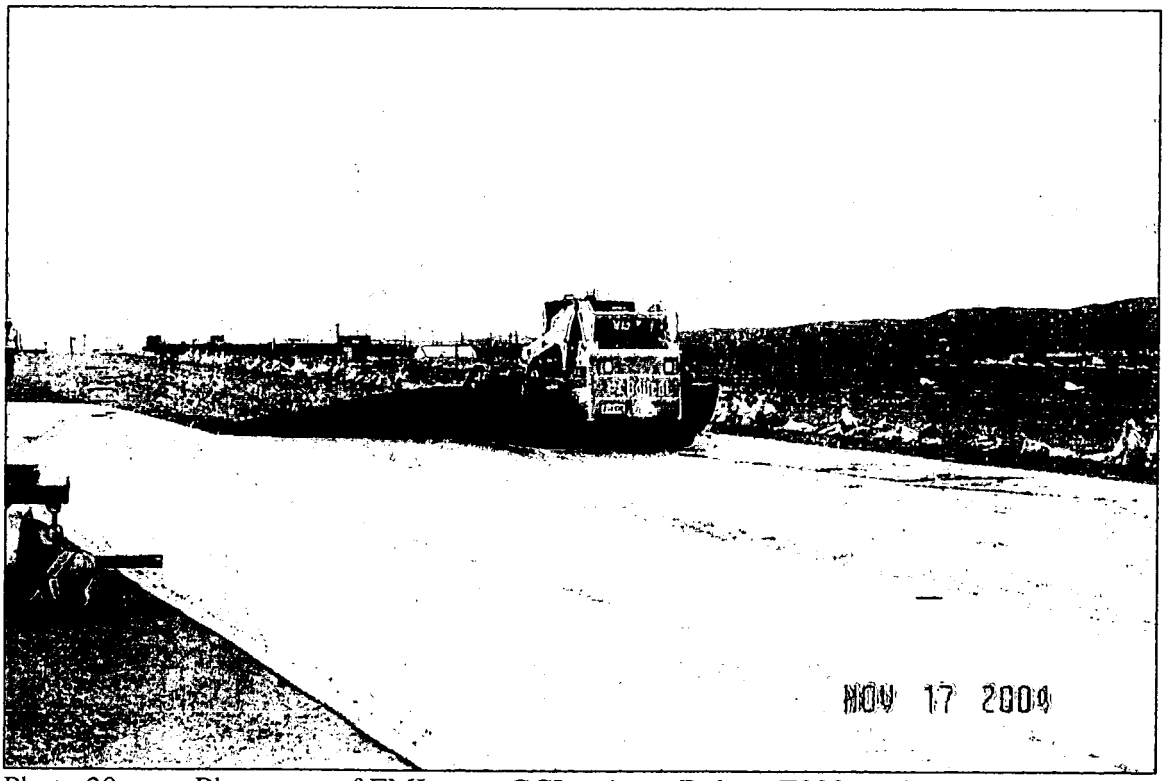


Photo 20: Placement of FML over GCL using a Bobcat T300 track mounted skid-steer (November 2004).

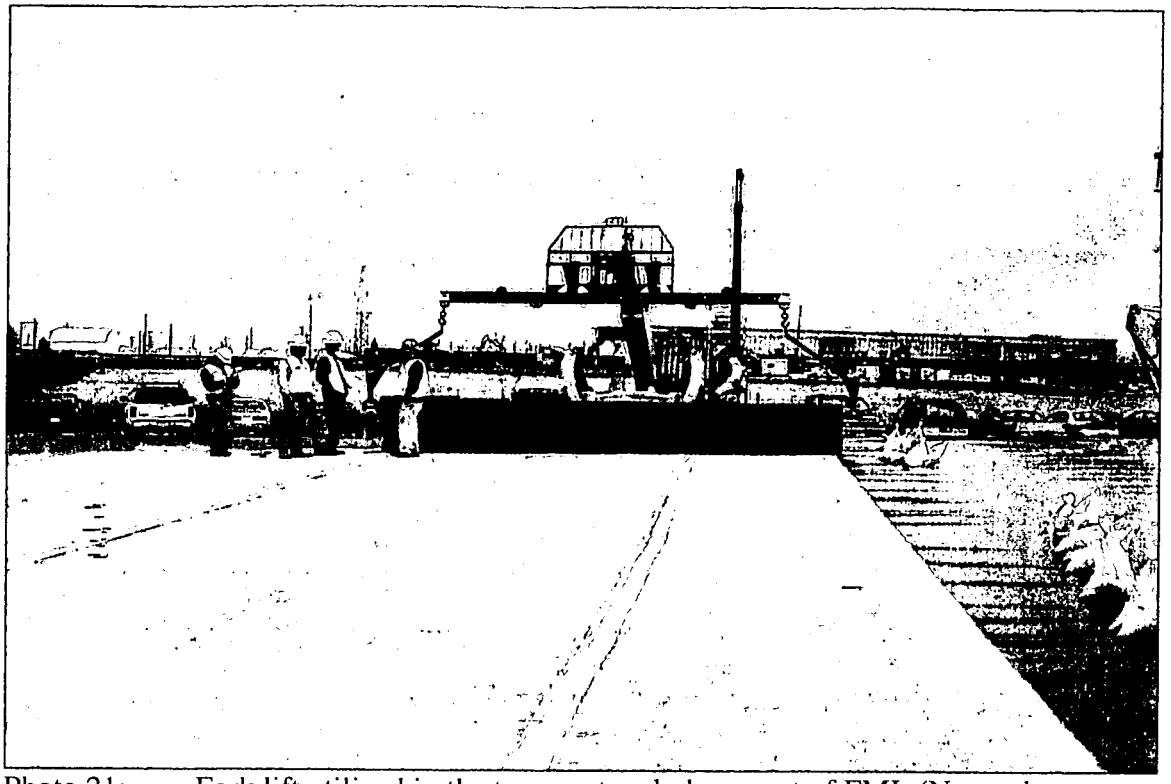


Photo 21: Fork lift utilized in the transport and placement of FML (November 2004).

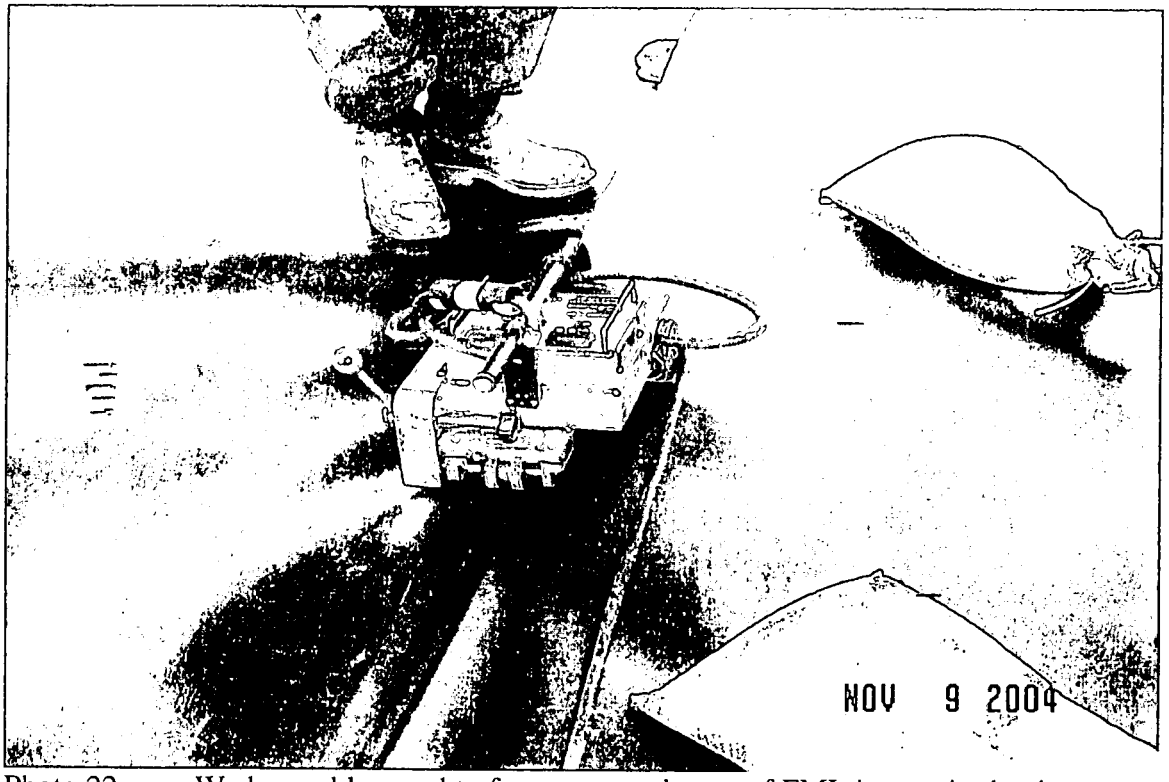


Photo 22: Wedge welder used to fuse separate layers of FML into a single piece (November 2004).

Photo 23: Patching of defects on the FML liner using an extrusion welder (November 2004).

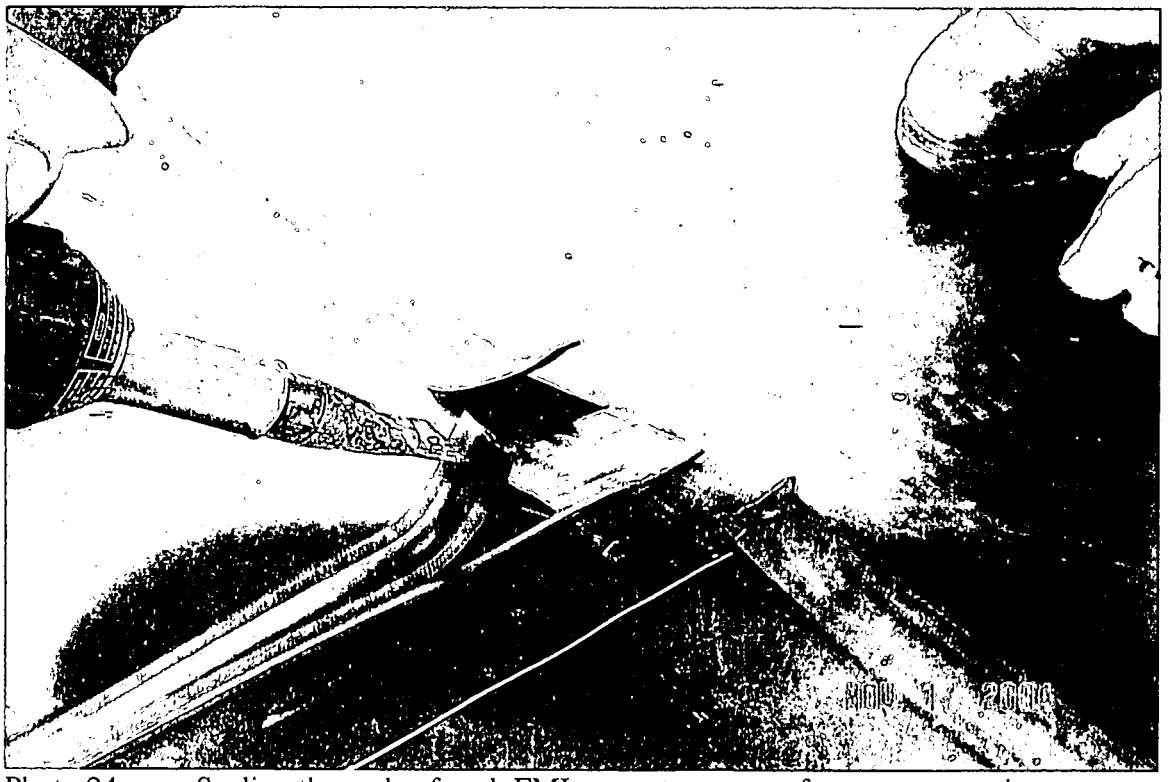


Photo 24: Sealing the ends of each FML seam to prepare for pressure testing (November 2004).

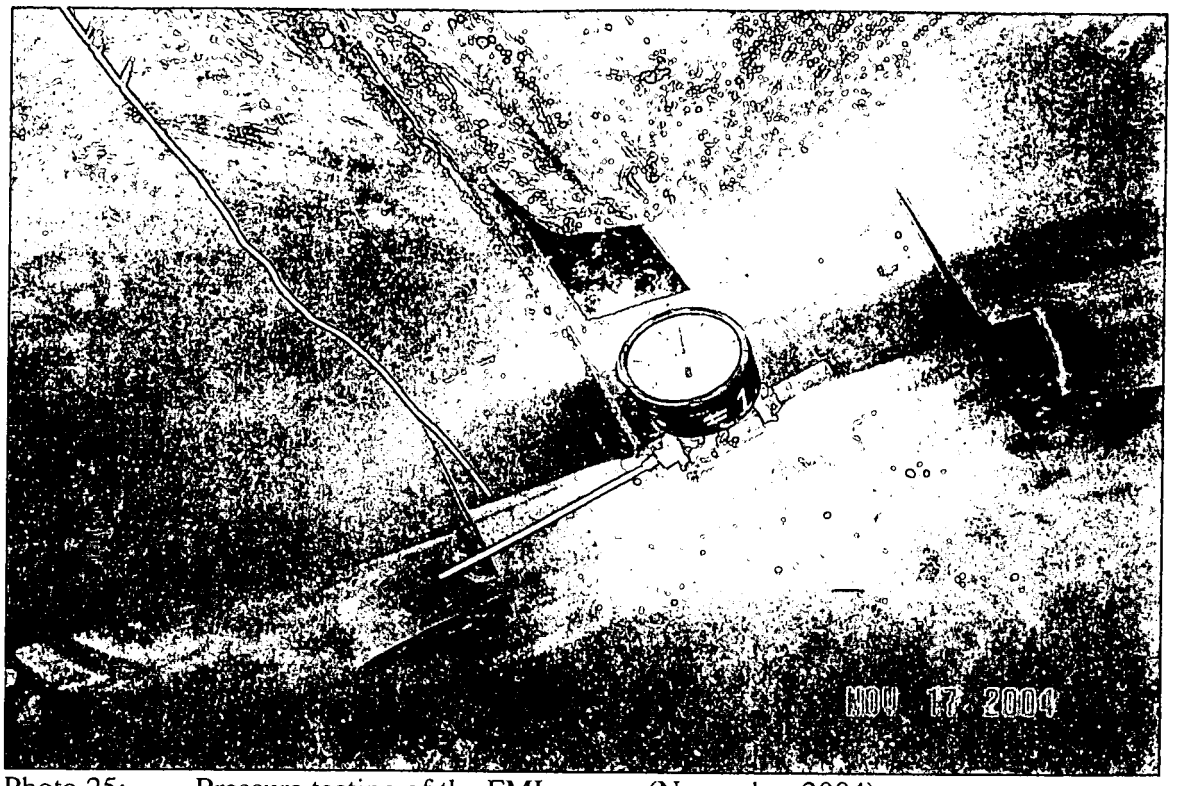


Photo 25: Pressure testing of the FML seams (November 2004).

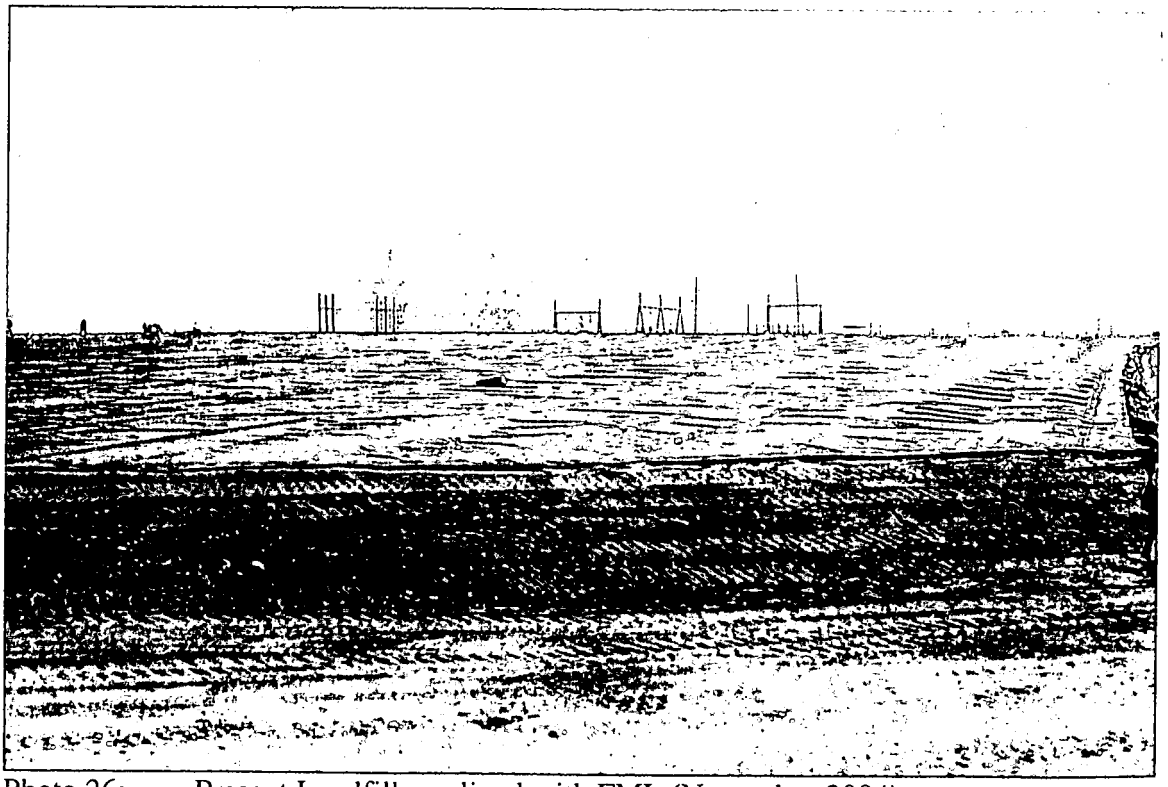


Photo 26: Present Landfill cap lined with FML (November 2004).

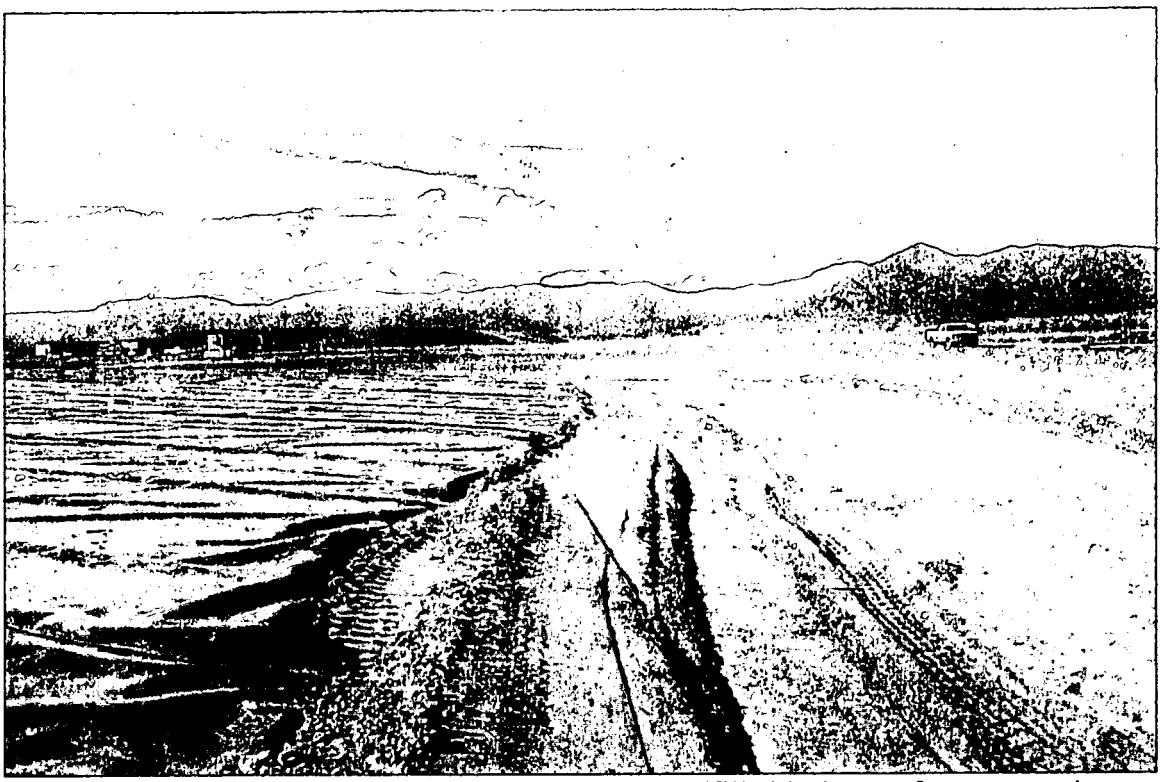


Photo 27: Transition of FML liner to Present Landfill sideslopes after compaction of perimeter trench cushion (November 2004).

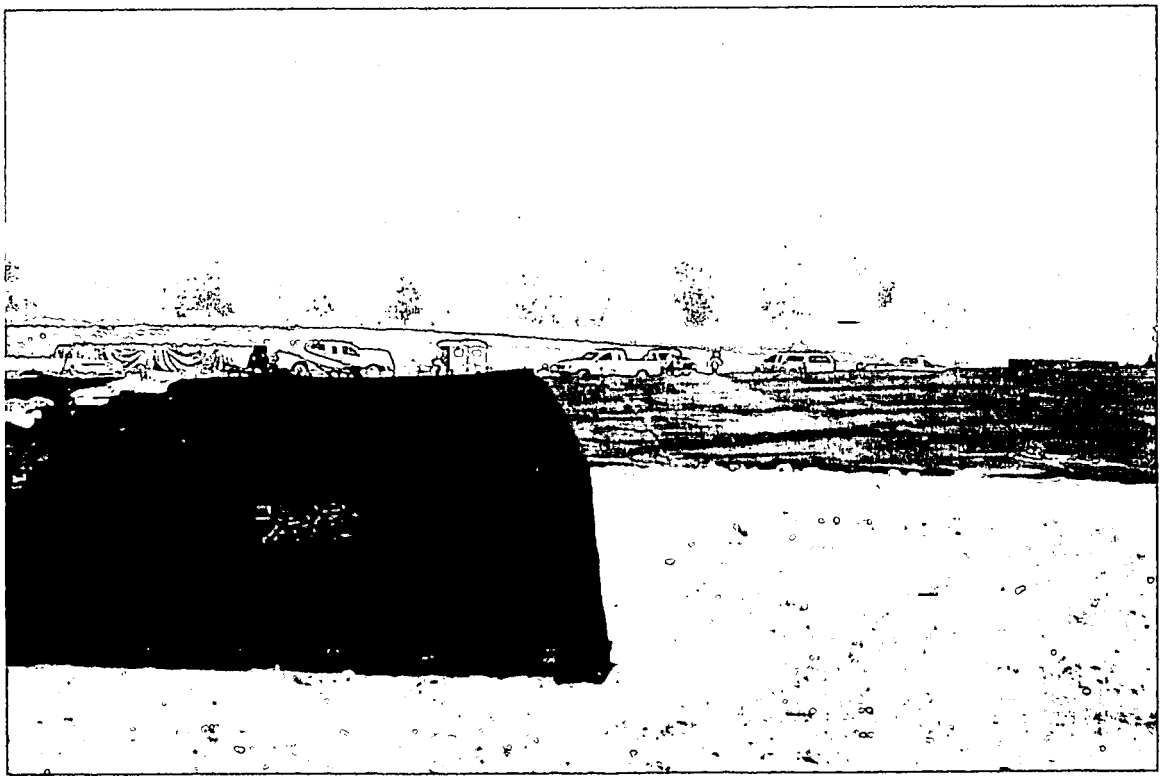


Photo 28: Transition between GDN and FML (November 2004).

Photo 29: Zip-ties placed every five feet along edges of GDN (November 2004).

Photo 30: Zip-ties placed every foot across butt seams of GDN (November 2004).

Photo 31: Placement of corrugated, 4" perforated air vent pipe into the 6" cushion layer material. Drain rock used for air vent bedding (November 2004).

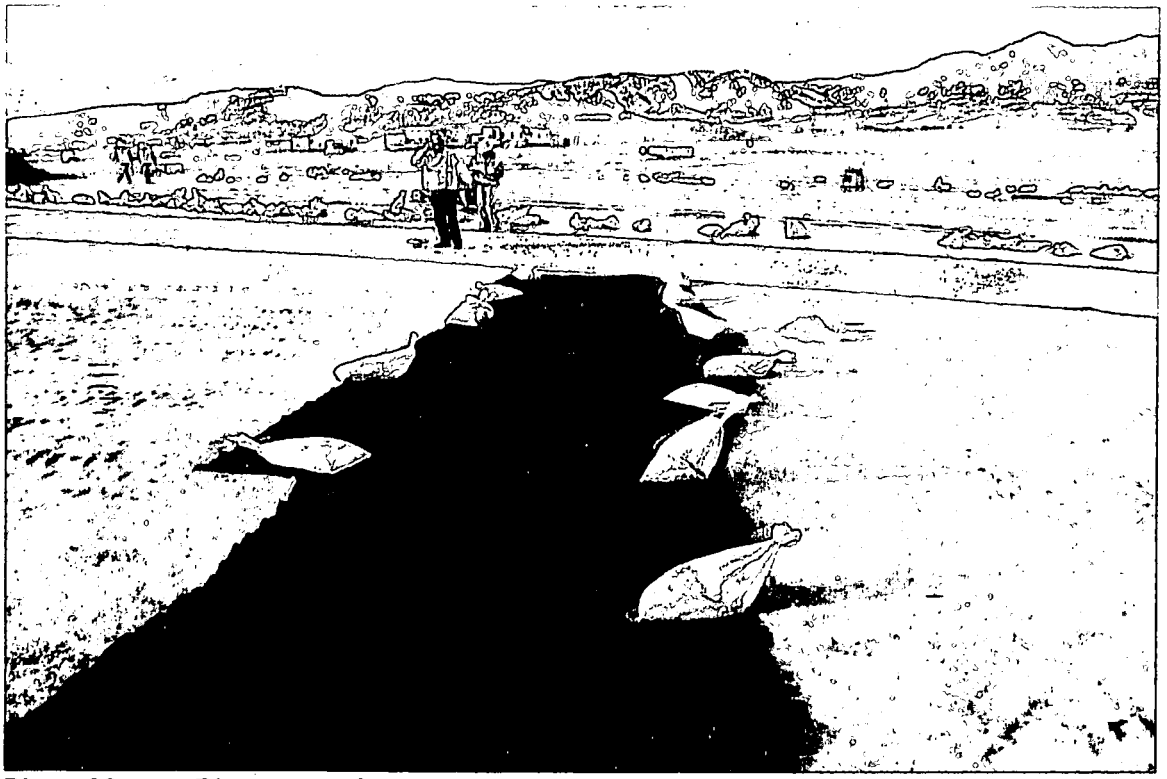


Photo 32: Placement of non-woven geotextile over air vent trenches to act as a separation barrier (November 2004).

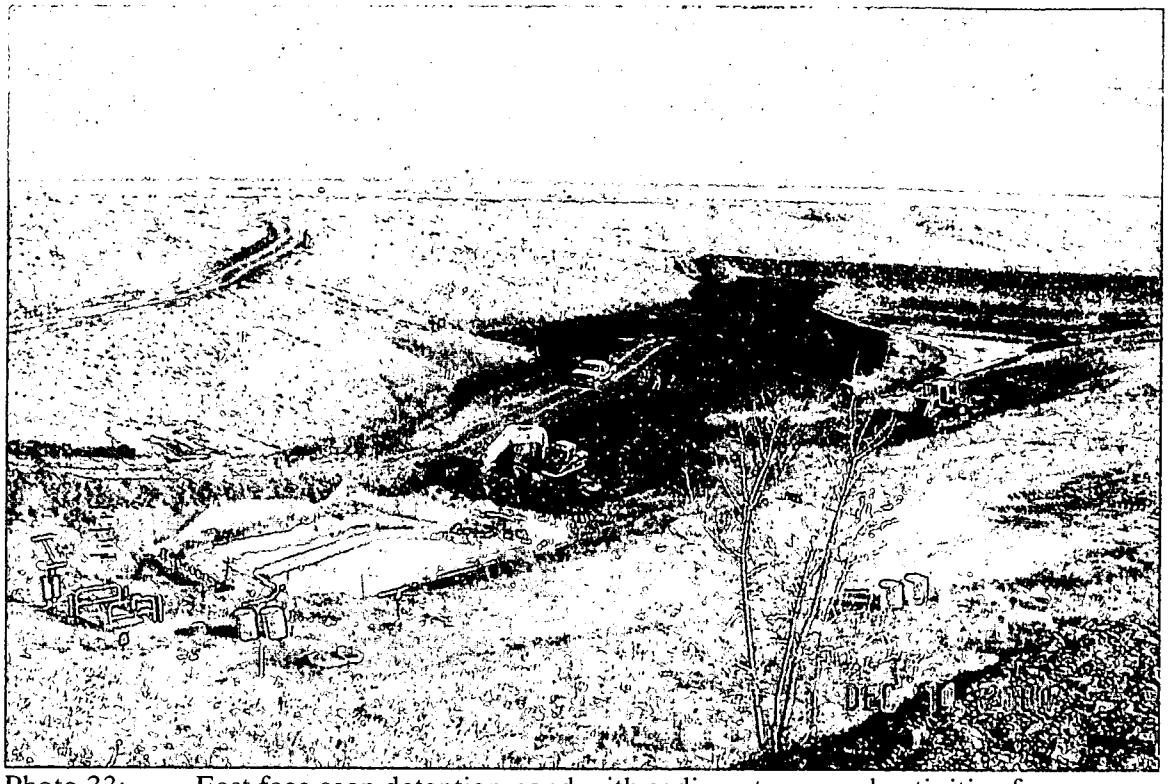


Photo 33: East face seep detention pond with sediment removal activities from east pond slopes (December 2004).

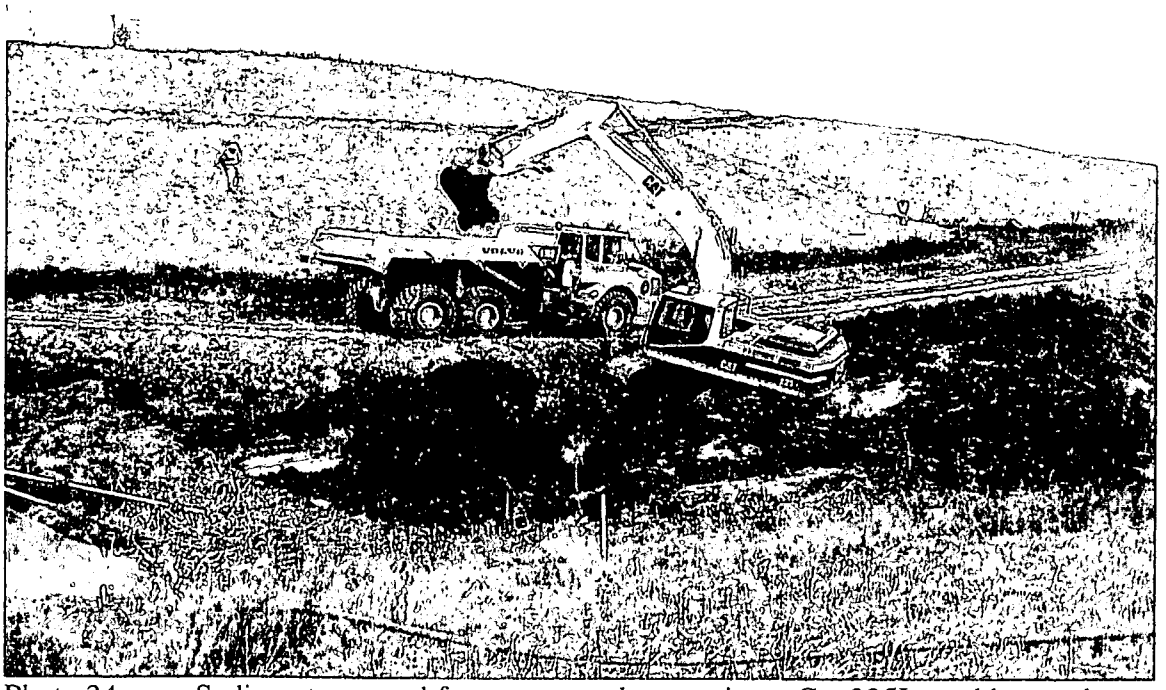


Photo 34: Sediment removal from east pond area using a Cat 325L trackhoe and a Volvo A30D haul truck (December 2004).

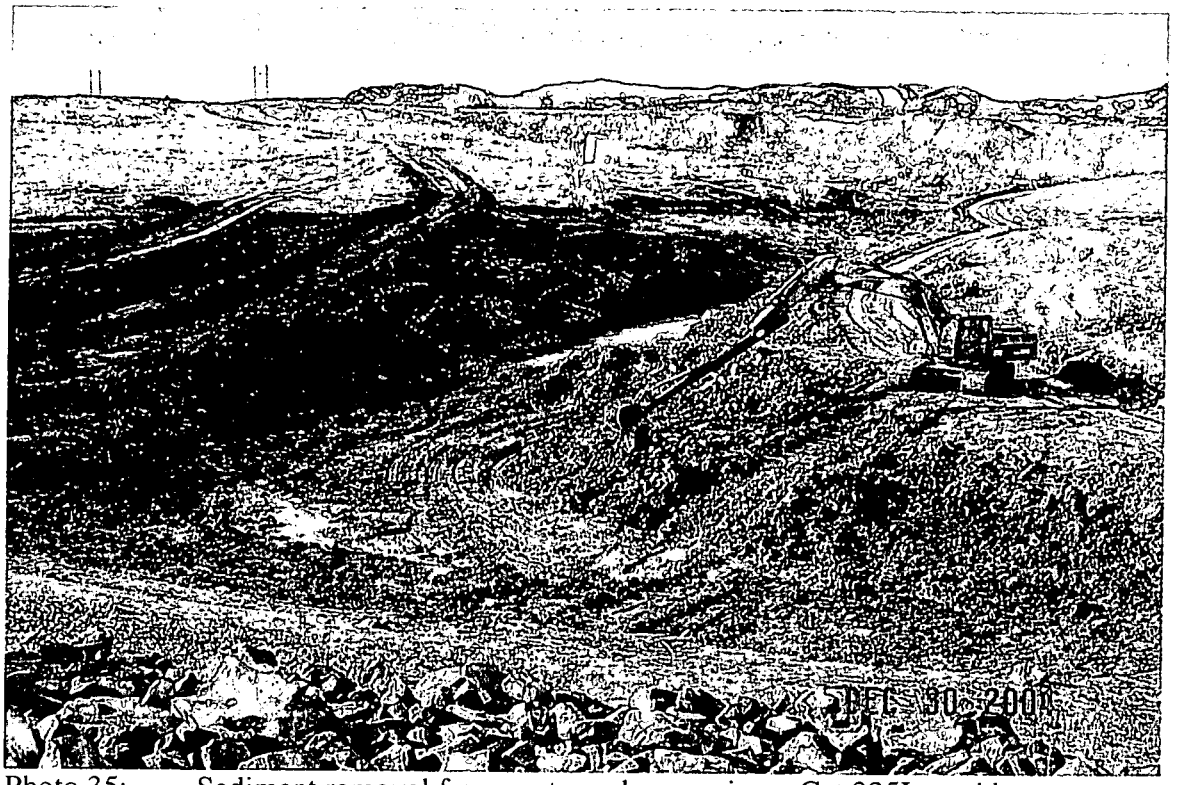


Photo 35: Sediment removal from east pond area using a Cat 325L trackhoe (December 2004).

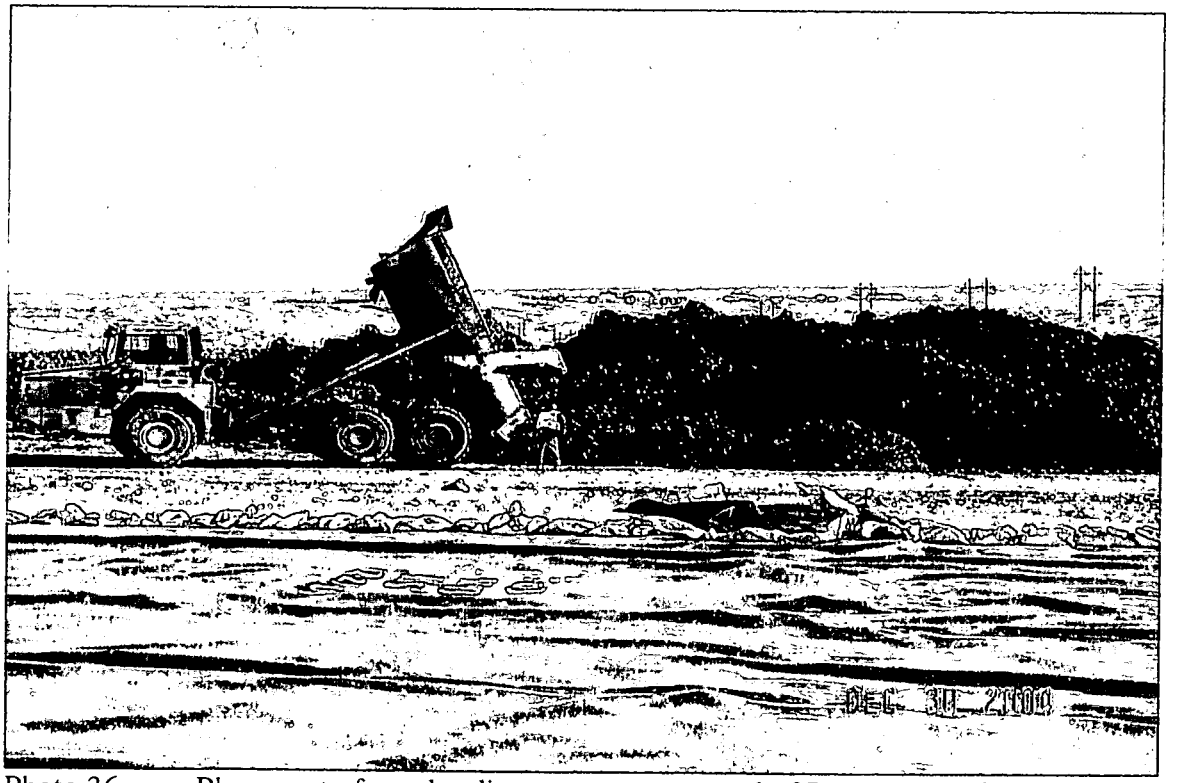


Photo 36: Placement of pond sediments on eastern end of Present Landfill prior to mixing with kiln dust (December 2004).

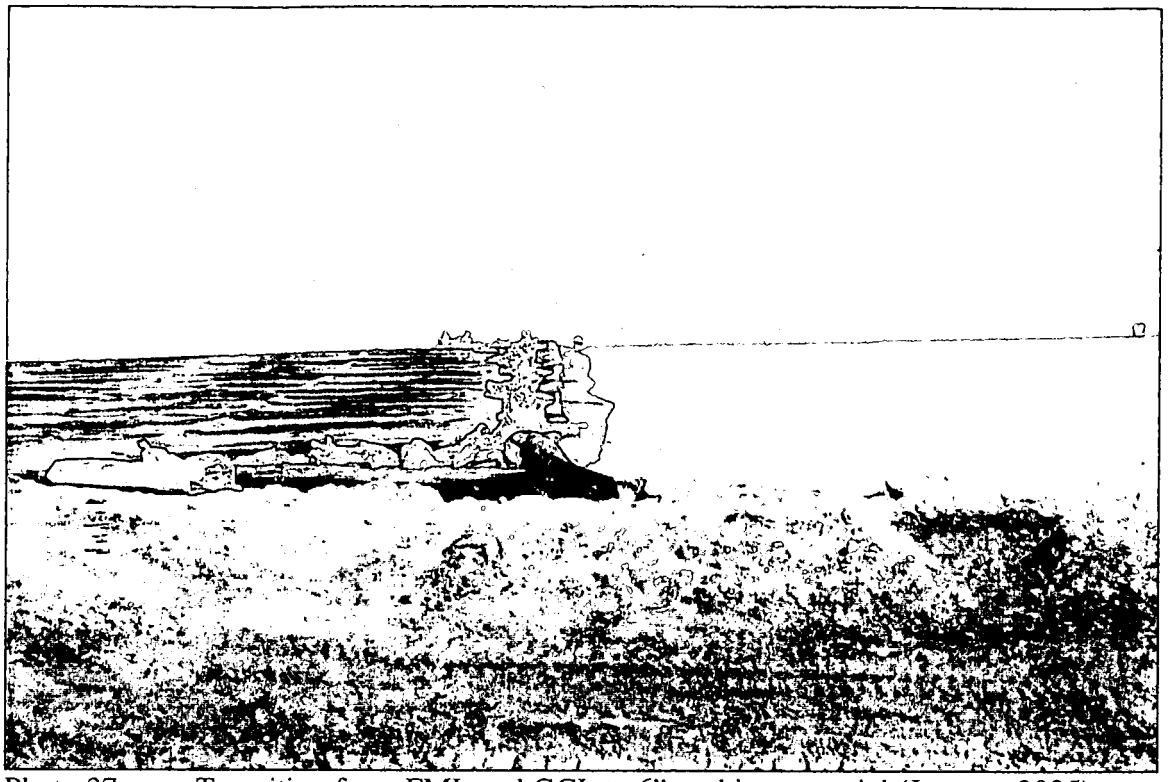


Photo 37: Transition from FML and GCL to 6" cushion material (January 2005).

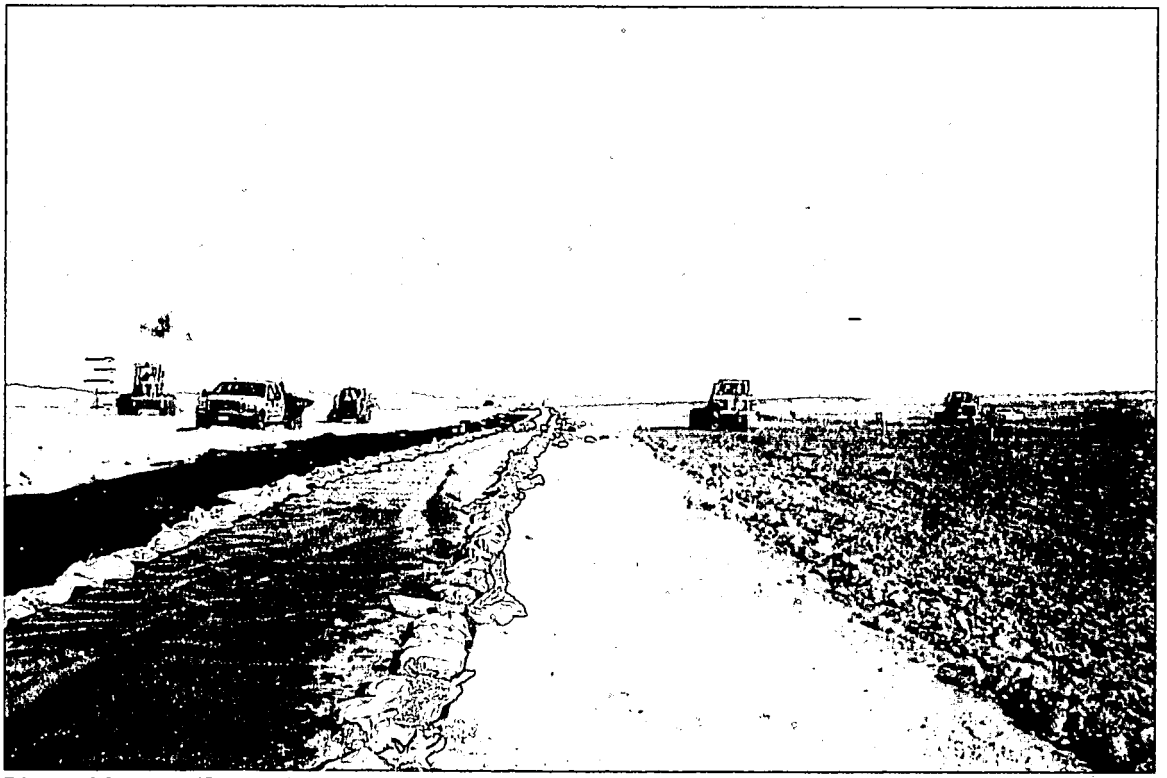


Photo 38: Transition from 10" cushion material, GDN, FML, 6" cushion material, and regrade surface (left to right) on the Present Landfill cap (January 2005).

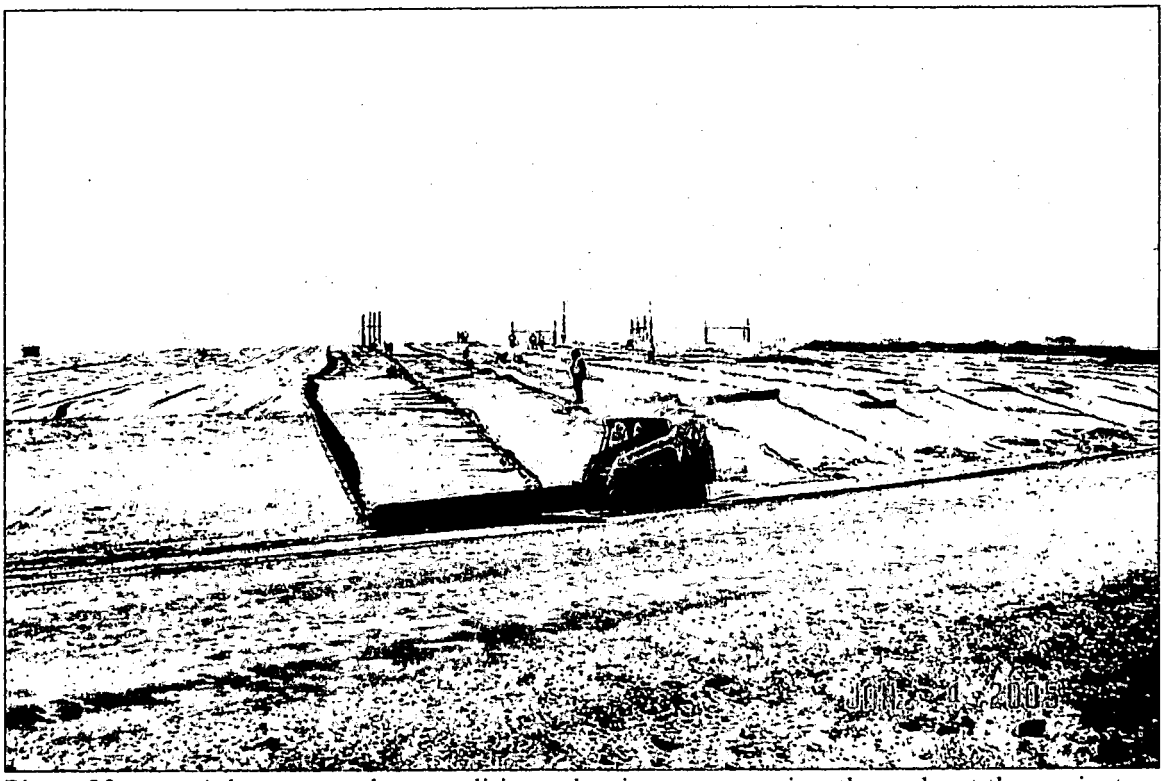


Photo 39: Adverse weather conditions slowing construction throughout the project (January 2005).

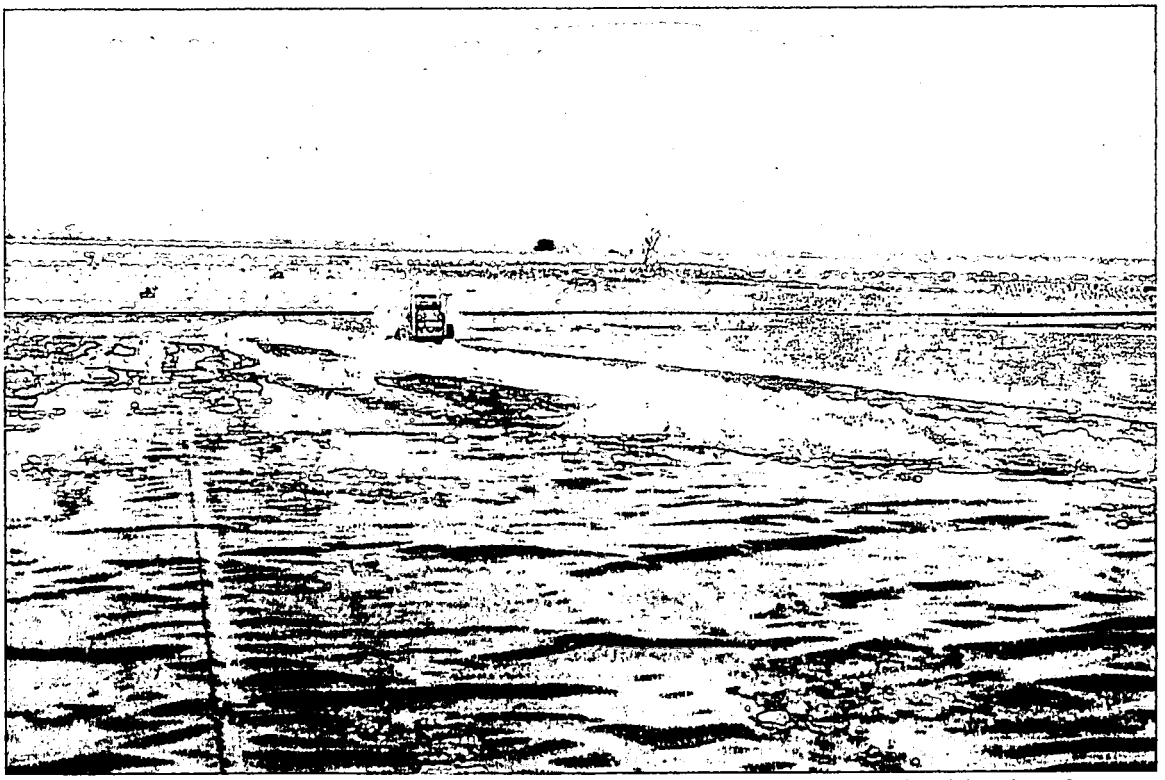


Photo 40: Snow removal from the FML liner using a Bobcat T300 with a brush attachment (January 2005).

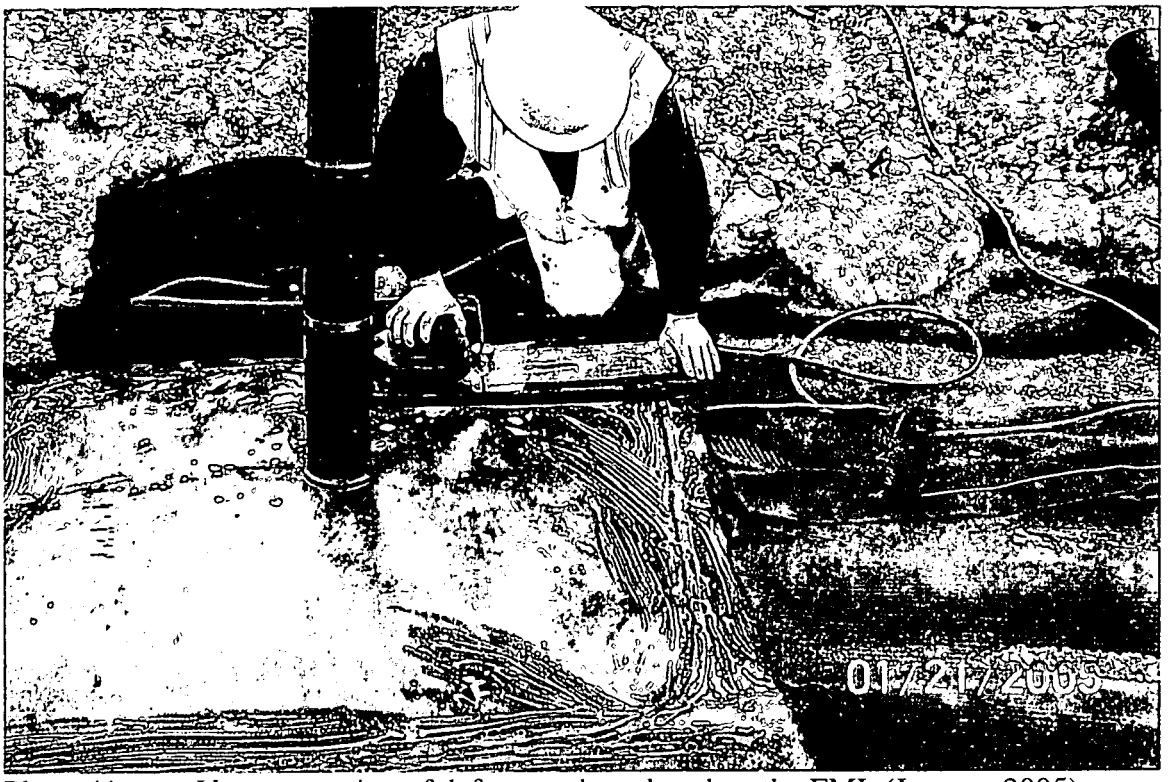


Photo 41: Vacuum testing of defect patches placed on the FML (January 2005).

Photo 42: Transitioning of liner materials to vertical air vent riser (January 2005).

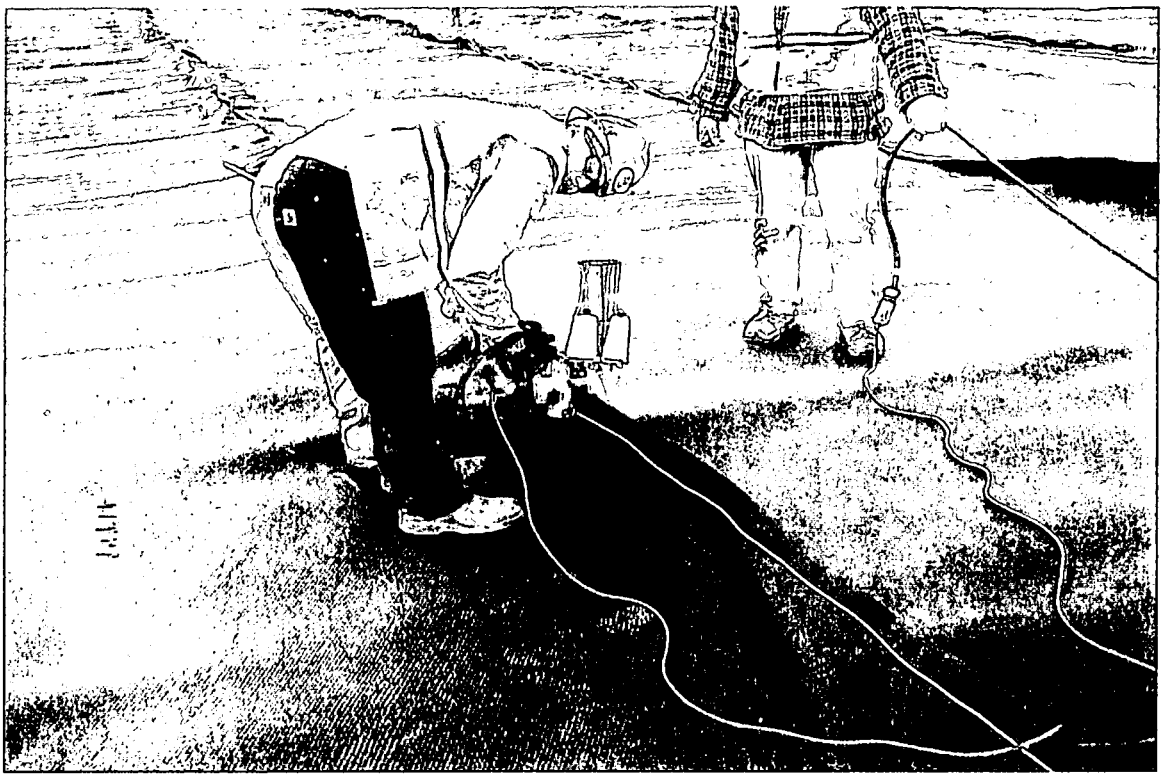


Photo 43: Sewing machine used to connect the fabric edges of the GDN (January 2005).

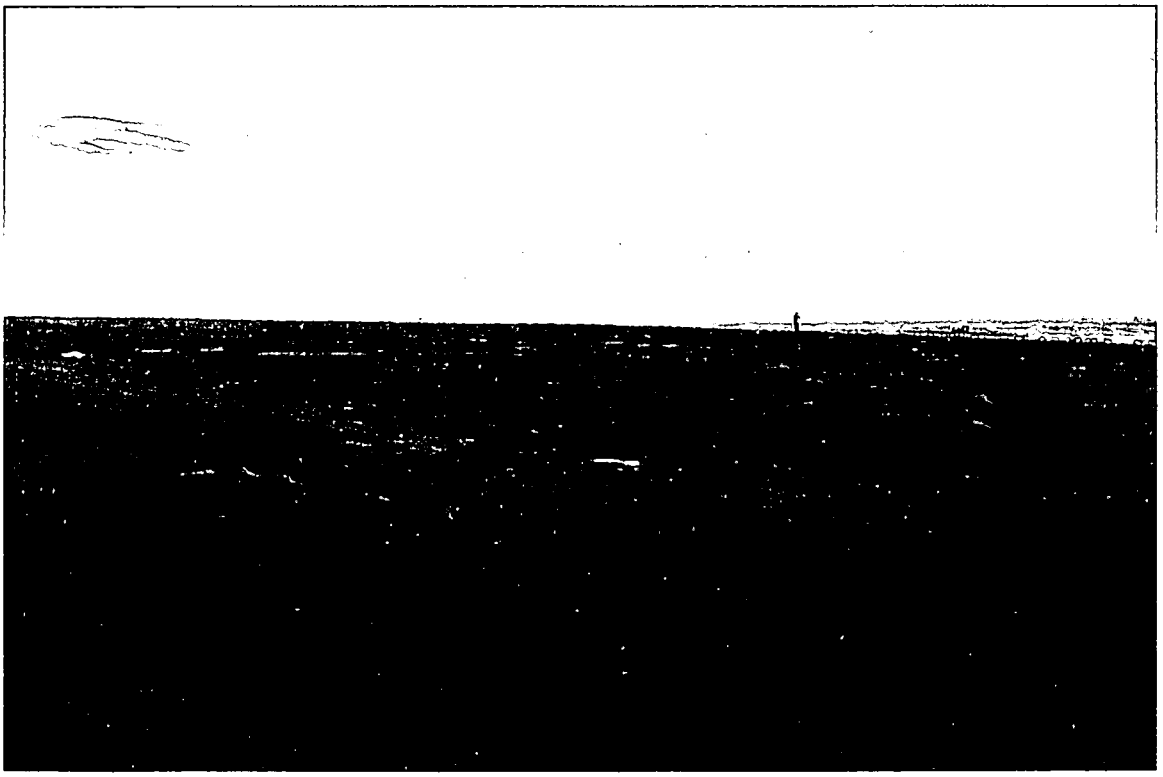


Photo 44: GDN liner across cap of Present Landfill (January 2005).

Photo 45: 10" cushion placement over GDN on cap of Present Landfill (February 2005).

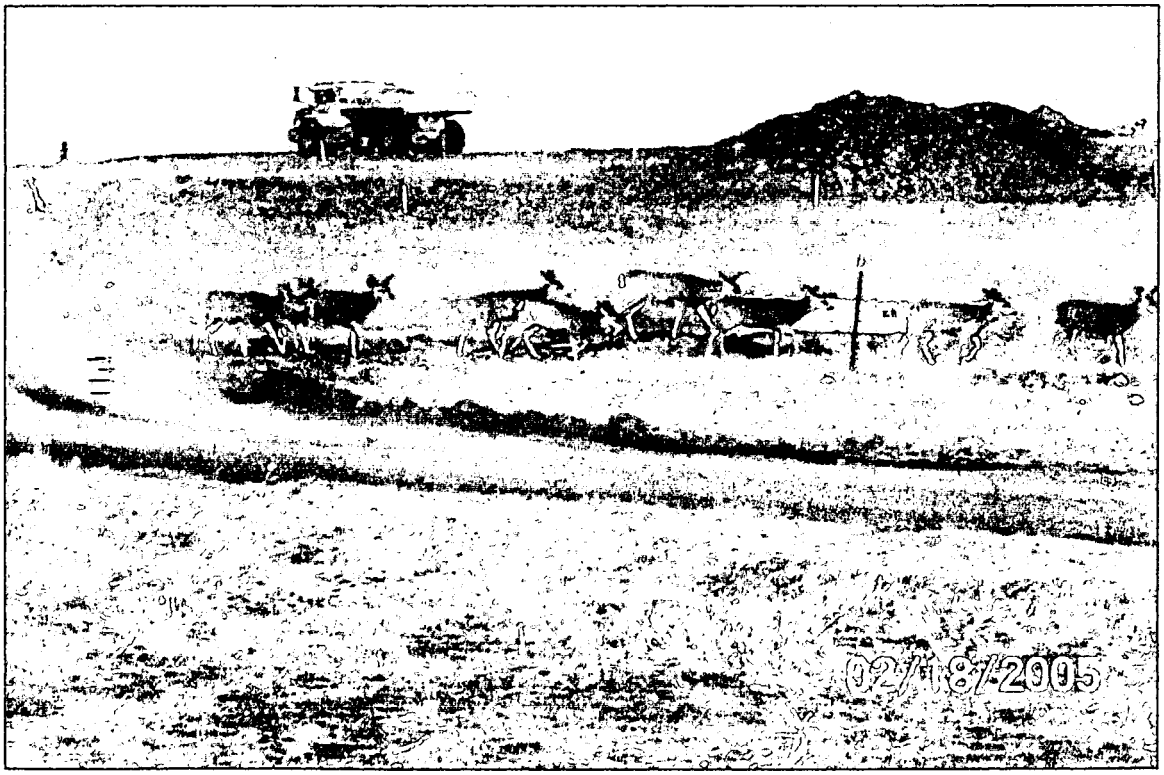


Photo 46: Wildlife present during construction activities. Placement of 22" Rocky Flats Alluvium in background (February 2005).

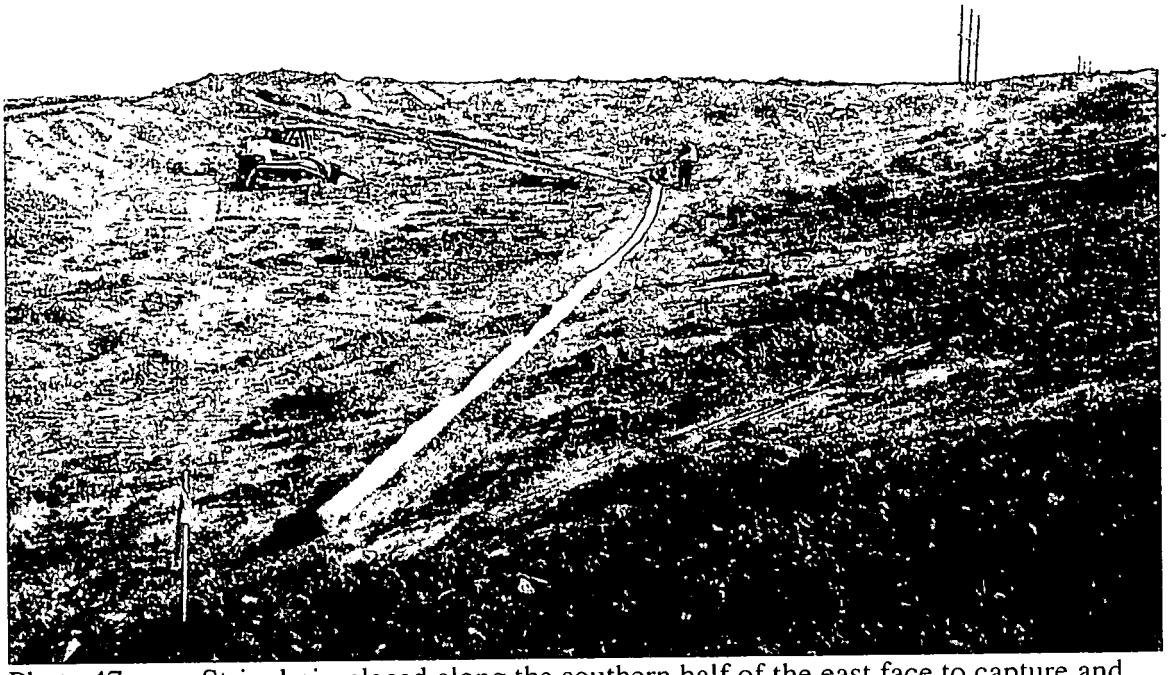


Photo 47: Strip drain placed along the southern half of the east face to capture and channel seepage to the seep treatment system (February 2005).

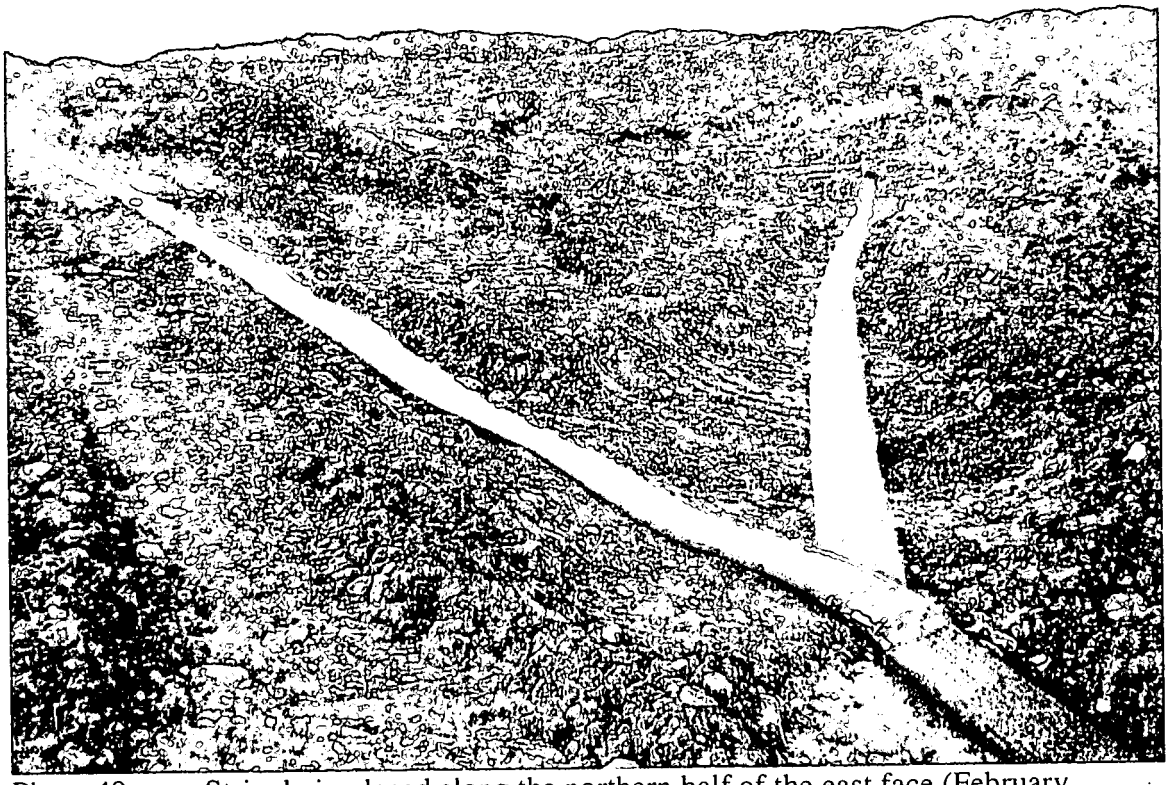


Photo 48: Strip drain placed along the northern half of the east face (February 2005).

Photo 49: Drain rock placed over strip drains to aid in the capture of seepage (February 2005).

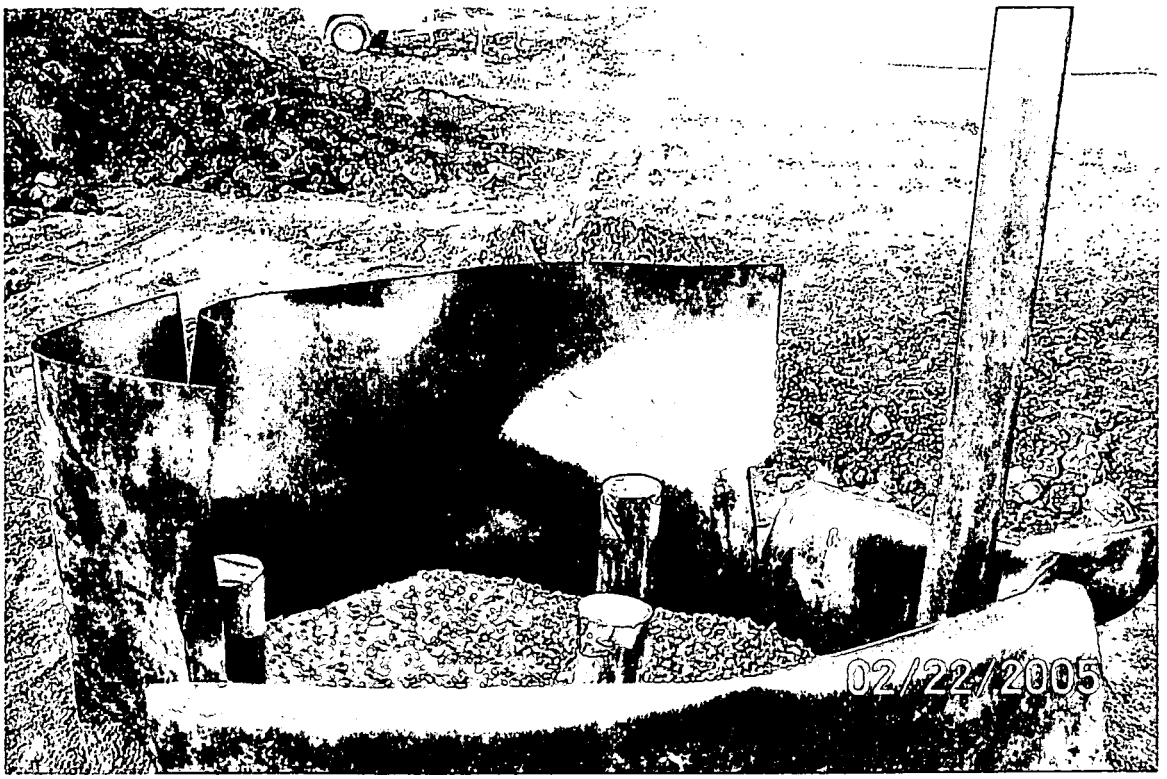


Photo 50: East Face seep capture system constructed with FML and filled with drain rock (February 2005).

Photo 51: East face strip drains discharging into the seep capture system (February 2005).

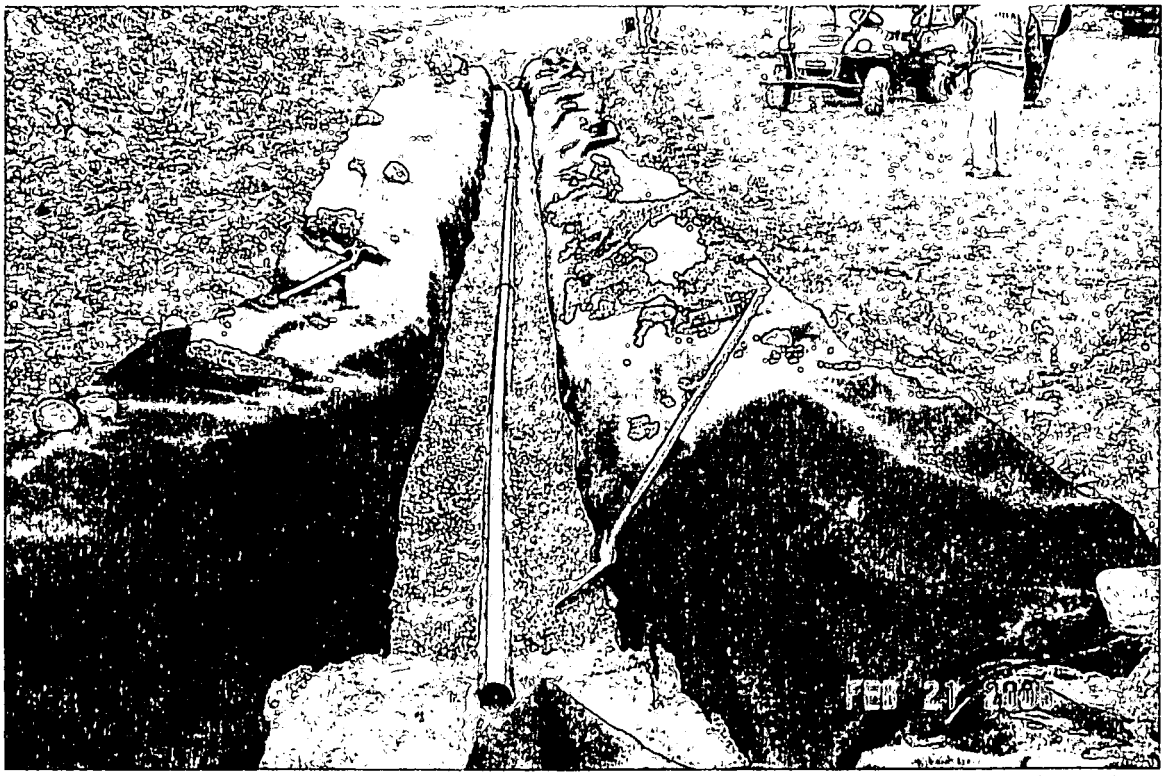


Photo 52: Discharge pipeline for the seep capture system surrounded by drain rock and non-woven geosynthetic liner (February 2005).

Photo 53: Temporary seep treatment system during construction (February 2005).

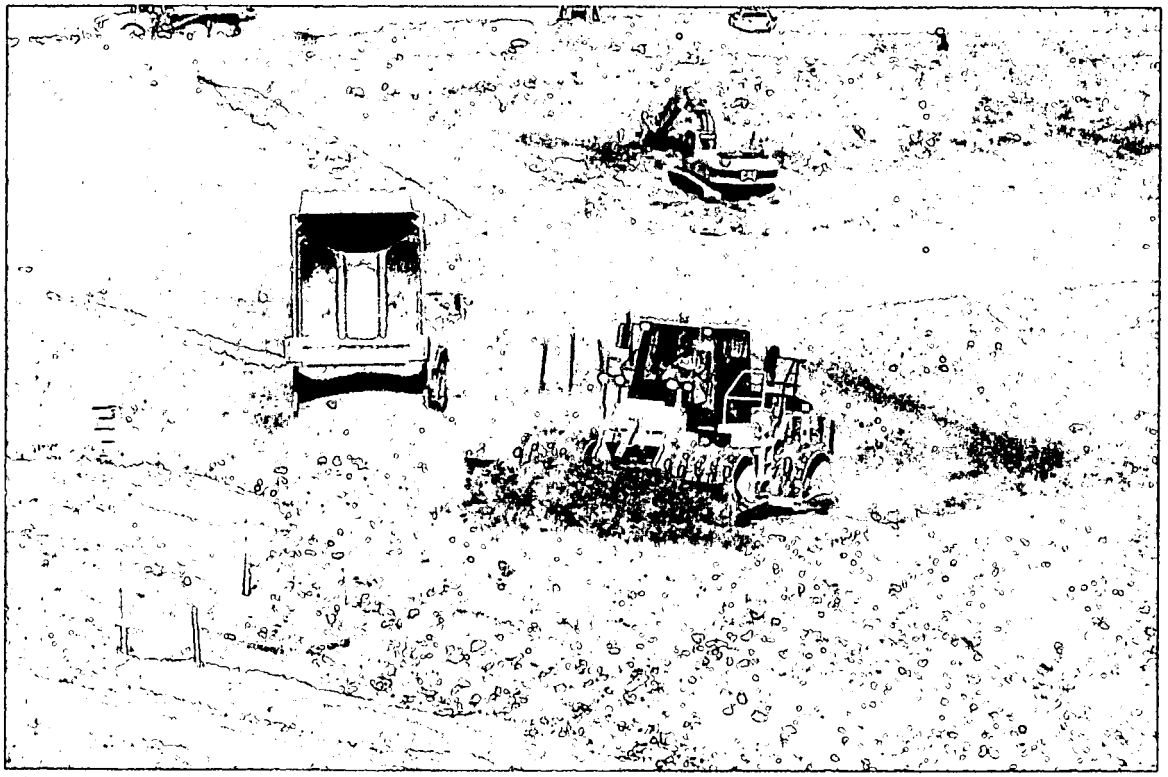


Photo 54: Placement of Rocky Flats Alluvium along the east face using a Volvo A30D and compacted using a Cat 825C sheep's foot compactor (February 2005).

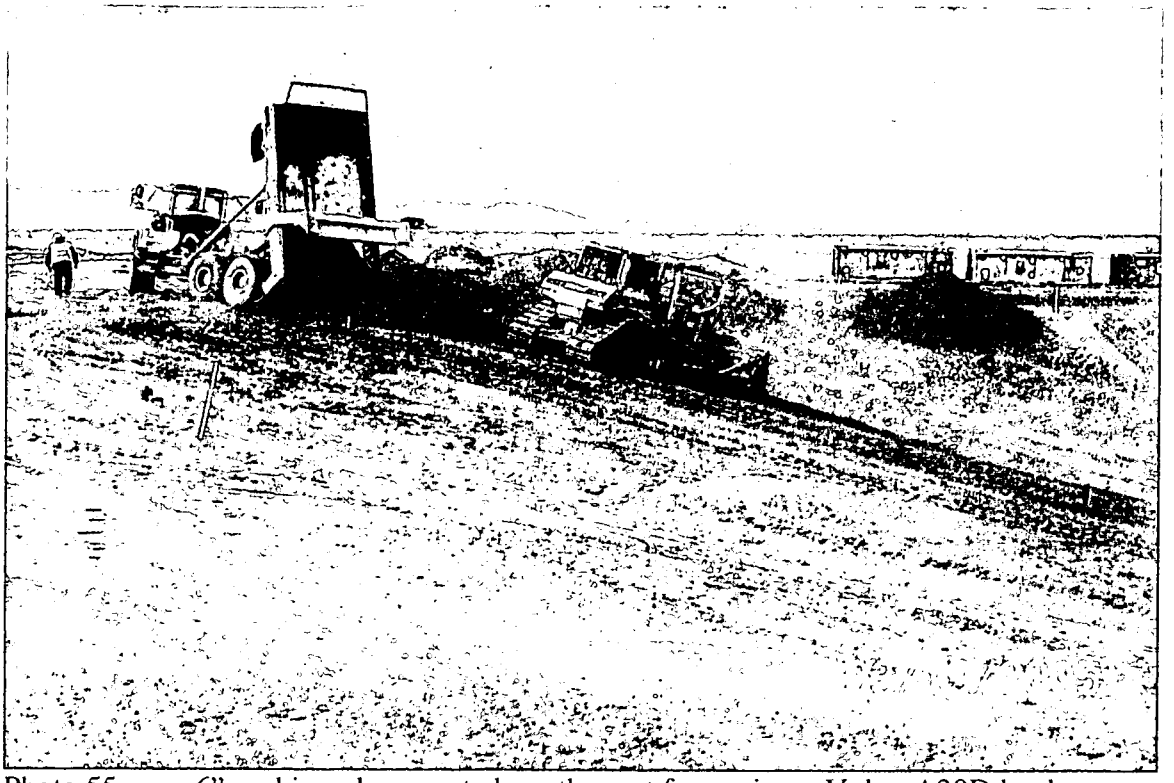


Photo 55: 6" cushion placement along the east face using a Volvo A30D haul truck and a D6R dozer (March 2005).

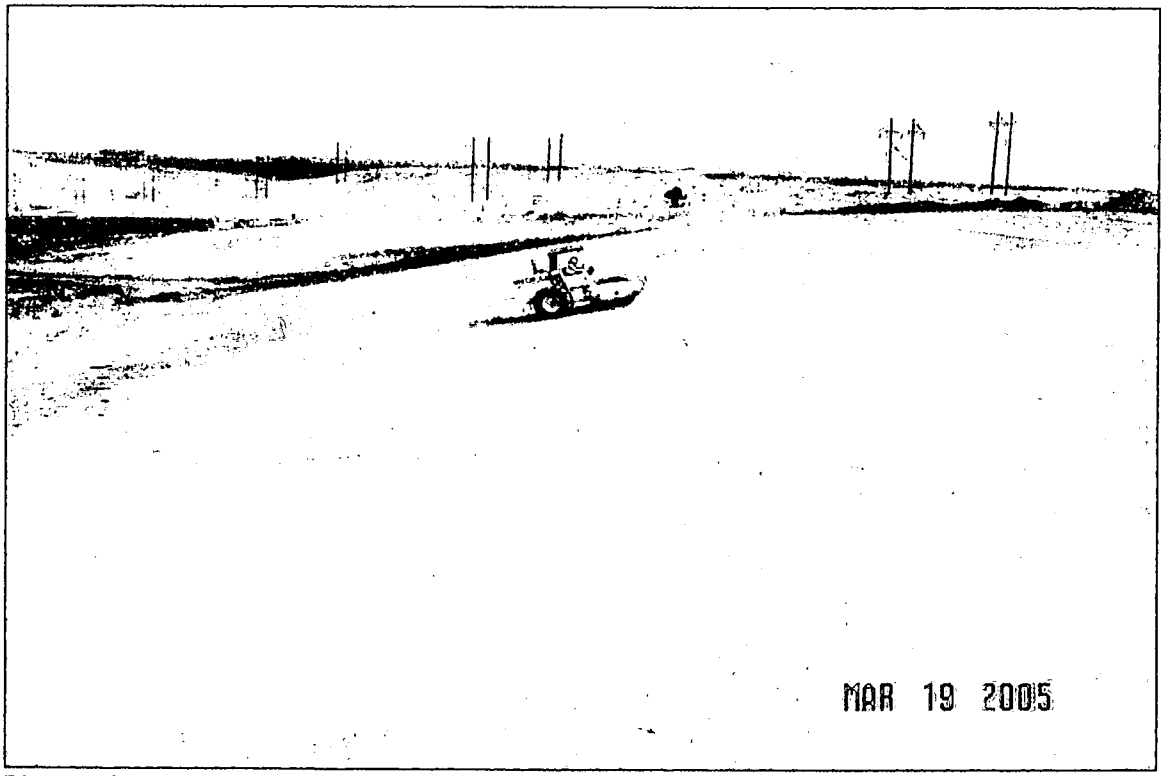


Photo 56: Compaction of 6" cushion material along the east face using a Cat CS-583C vibratory compactor (March 2005).

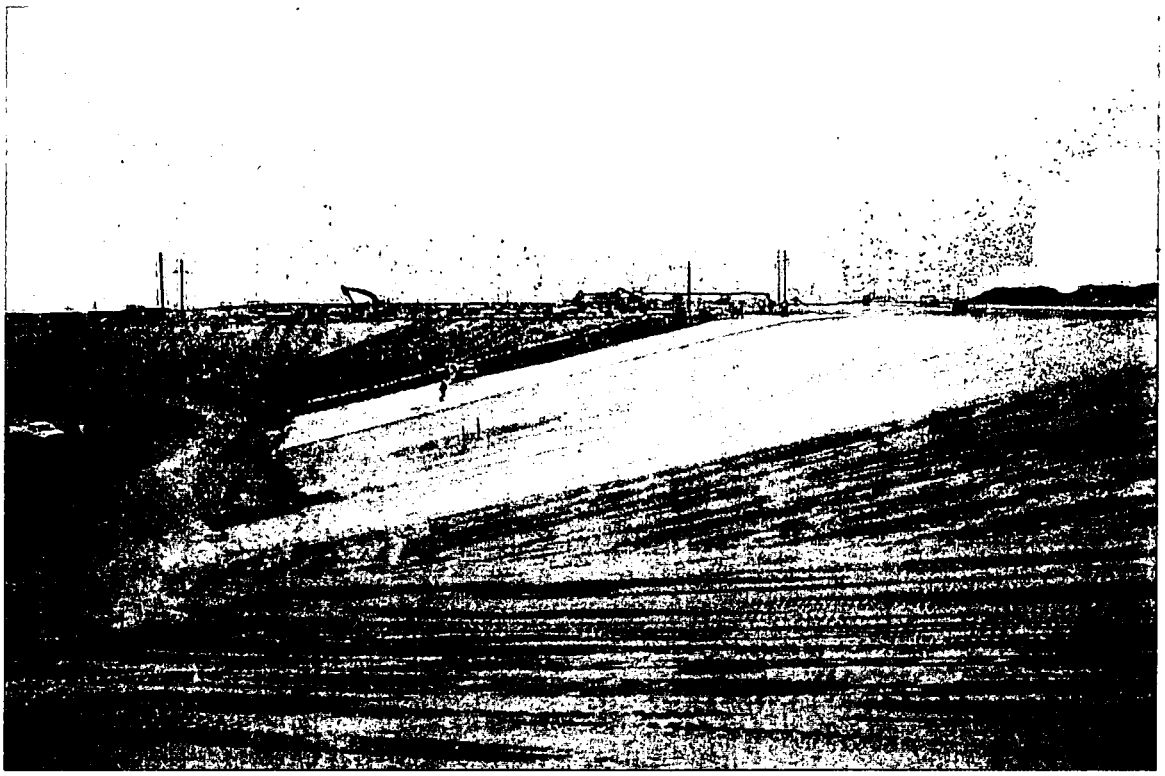


Photo 57: Transition between textured FML (FML-T), GCL, and 6" cushion material along the east face (March 2005).

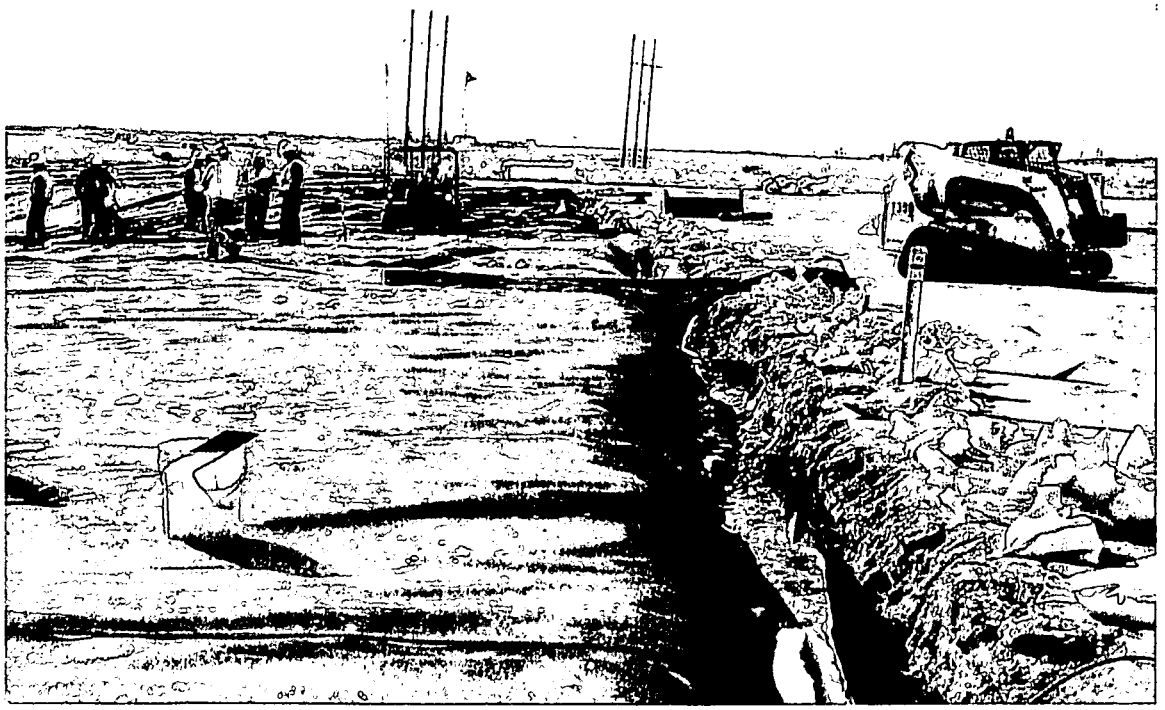


Photo 58: North-south anchor trench near the crest of the east face (March 2005).

Photo 59: Hand-tamper used to compact cushion material in anchor trenches (March 2005).

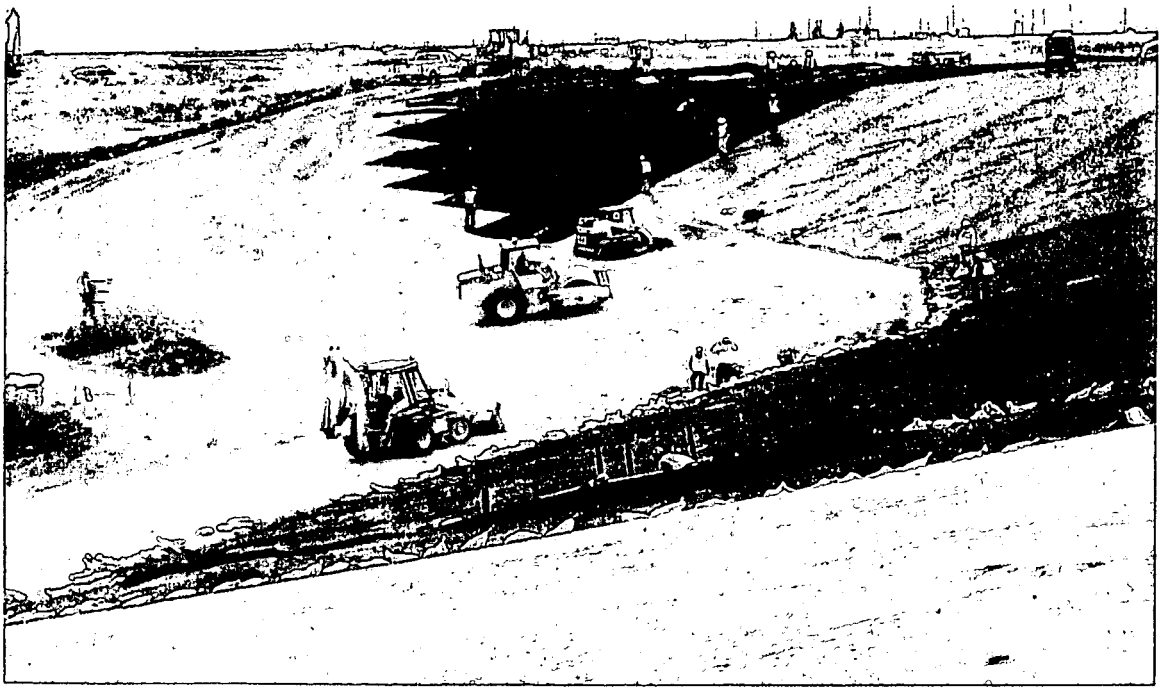


Photo 60: Liner placement and soil compaction along the south half of the east face (March 2005).

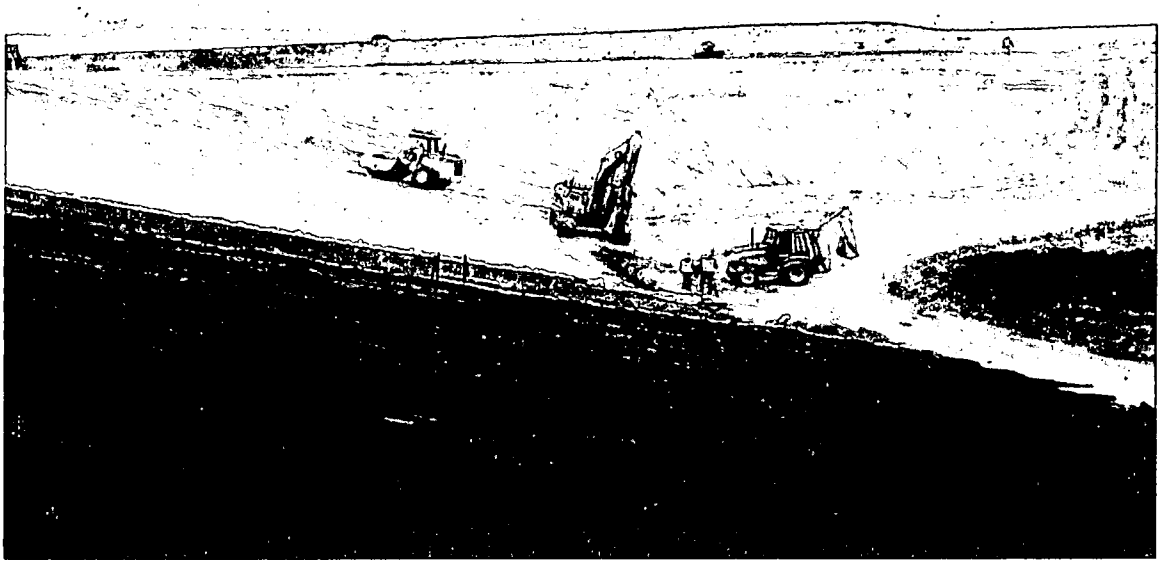


Photo 61: Compaction of 6" cushion material and digging of anchor trench along the east face (March 2005).

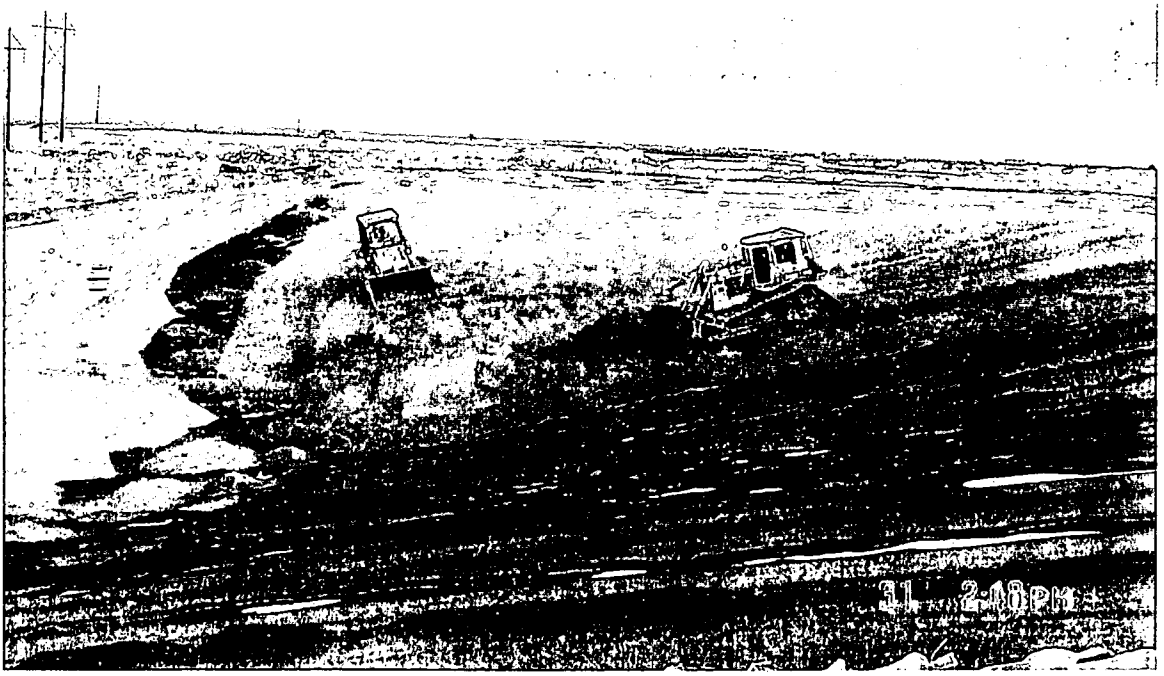


Photo 62: Placement of 10" cushion material on south half of east face using a Cat 953C trackloader and a D6H dozer (March 2005).

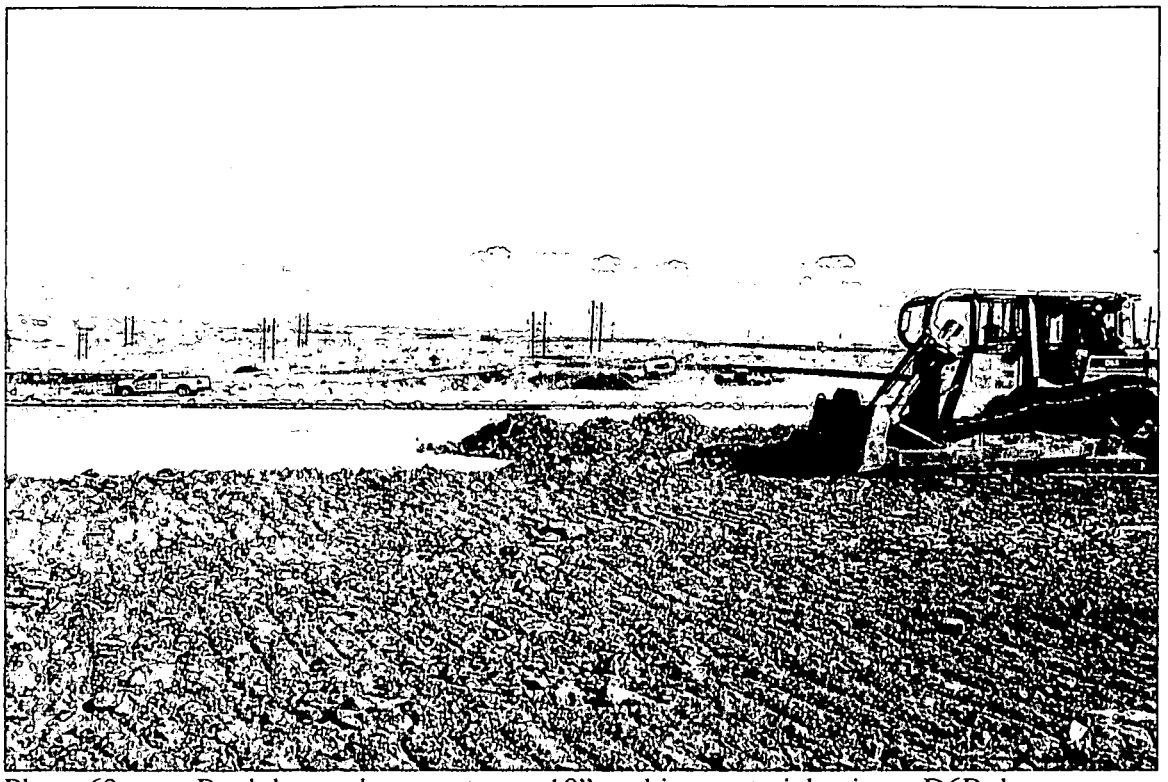


Photo 63: Rock layer placement over 10" cushion material using a D6R dozer (March 2005).

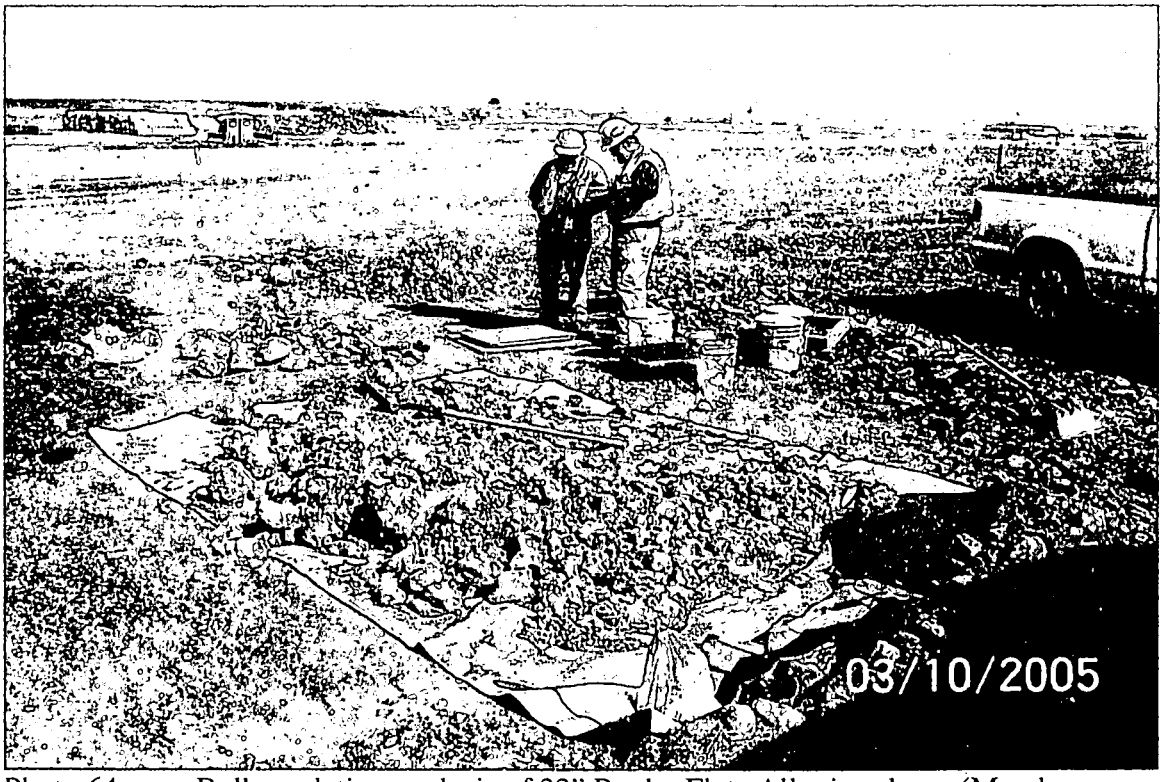


Photo 64: Bulk gradation analysis of 22" Rocky Flats Alluvium layer (March 2005).

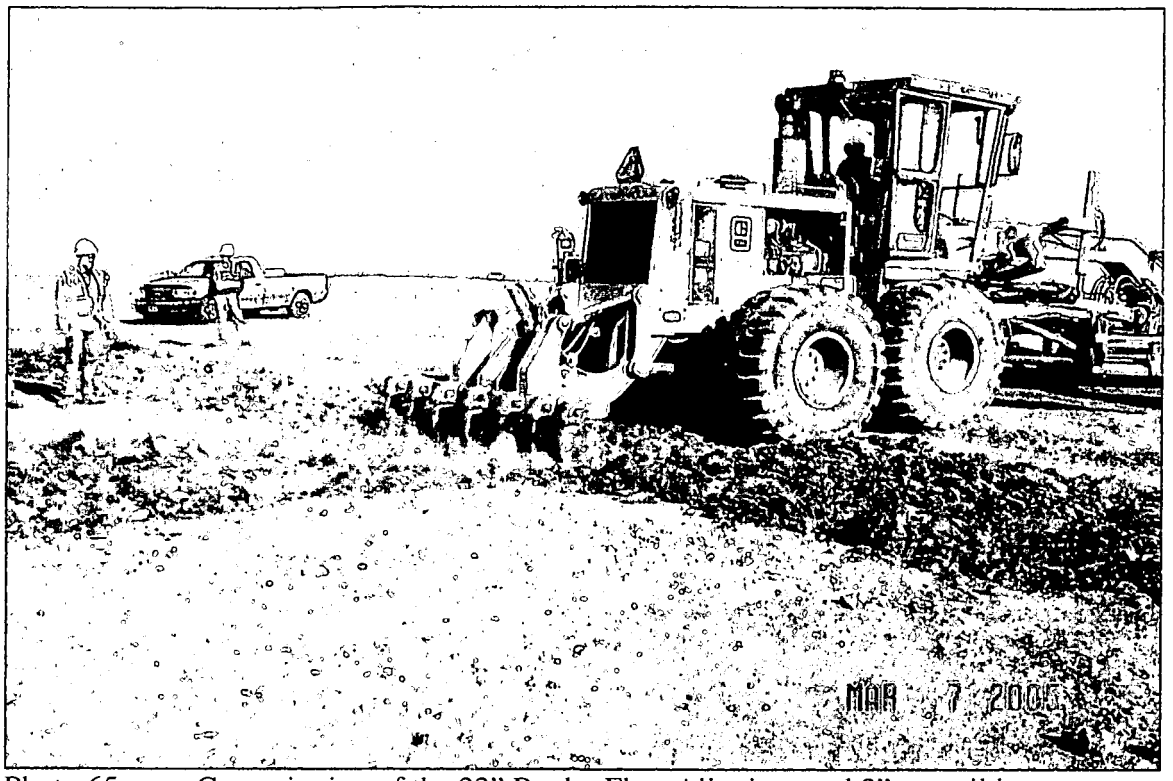


Photo 65: Cross ripping of the 22" Rocky Flats Alluvium and 2" topsoil layers using a Cat 14G grader (March 2005).

Photo 66: Construction personnel and regulators observing the effectiveness of 22" Rocky Flats Alluvium ripping procedures (March 2005).

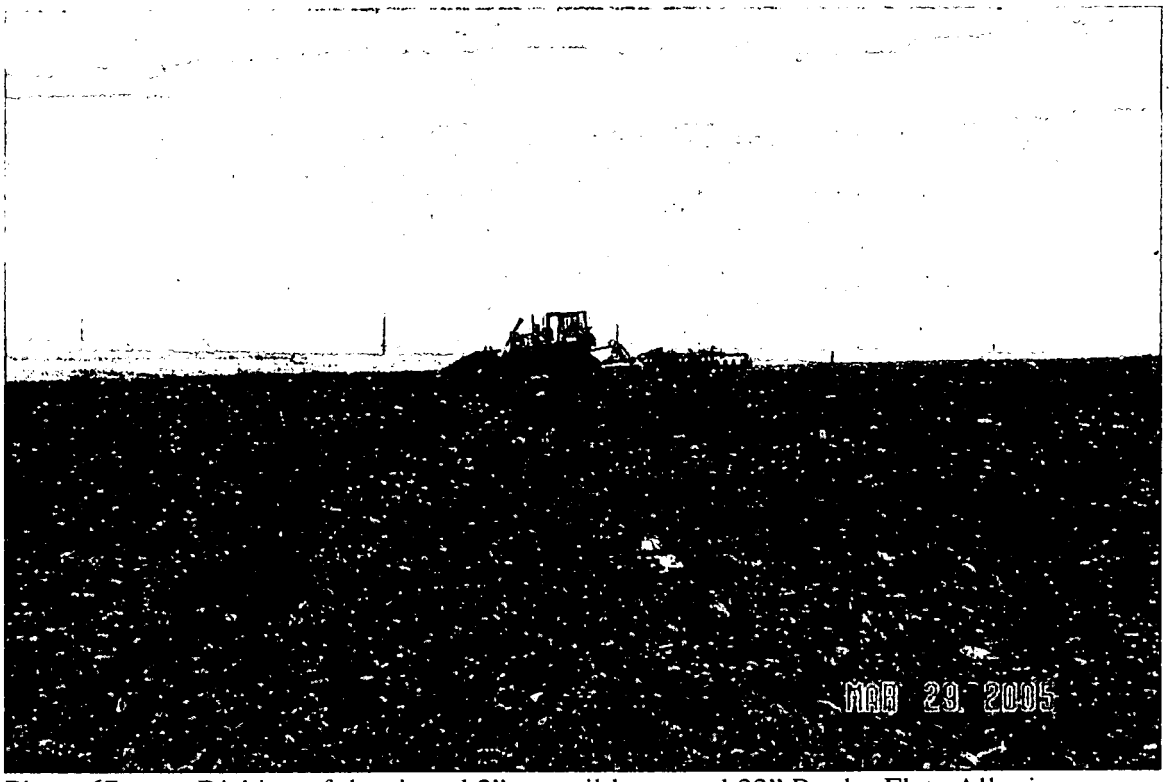


Photo 67: Disking of the ripped 2" topsoil layer and 22" Rocky Flats Alluvium layer using a D6H dozer with a disk (March 2005).

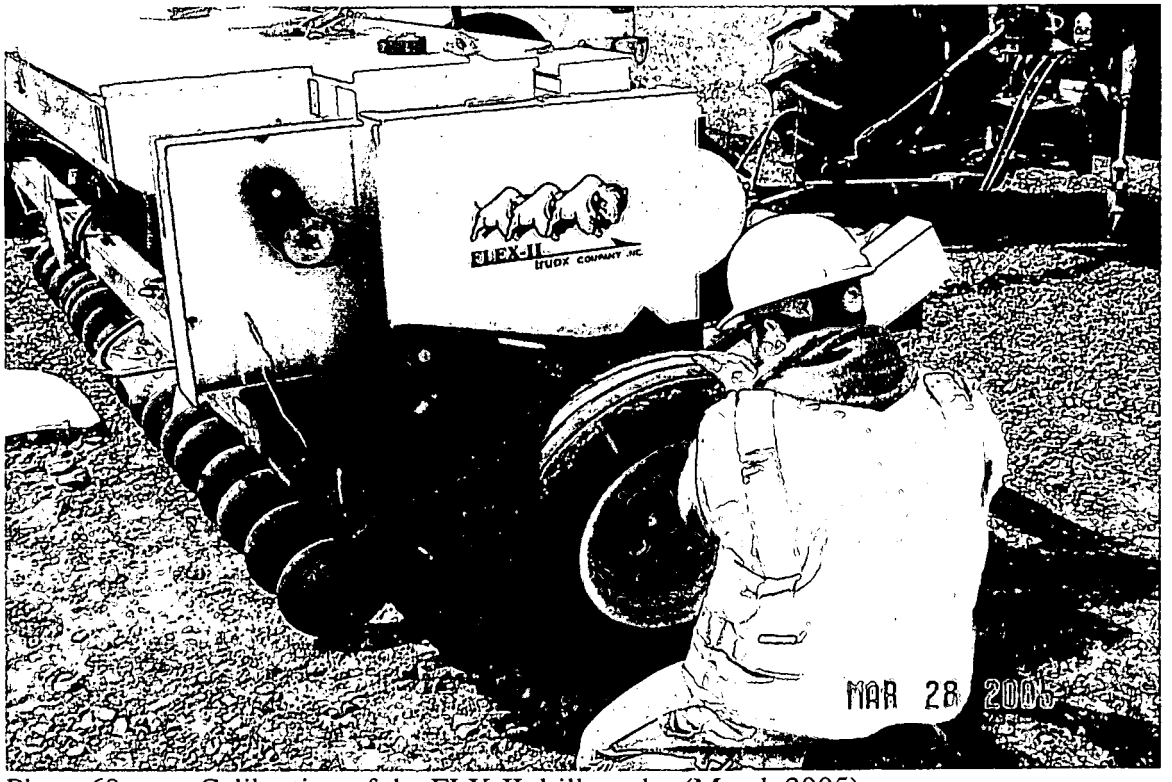


Photo 68: Calibration of the FLX-II drill seeder (March 2005).

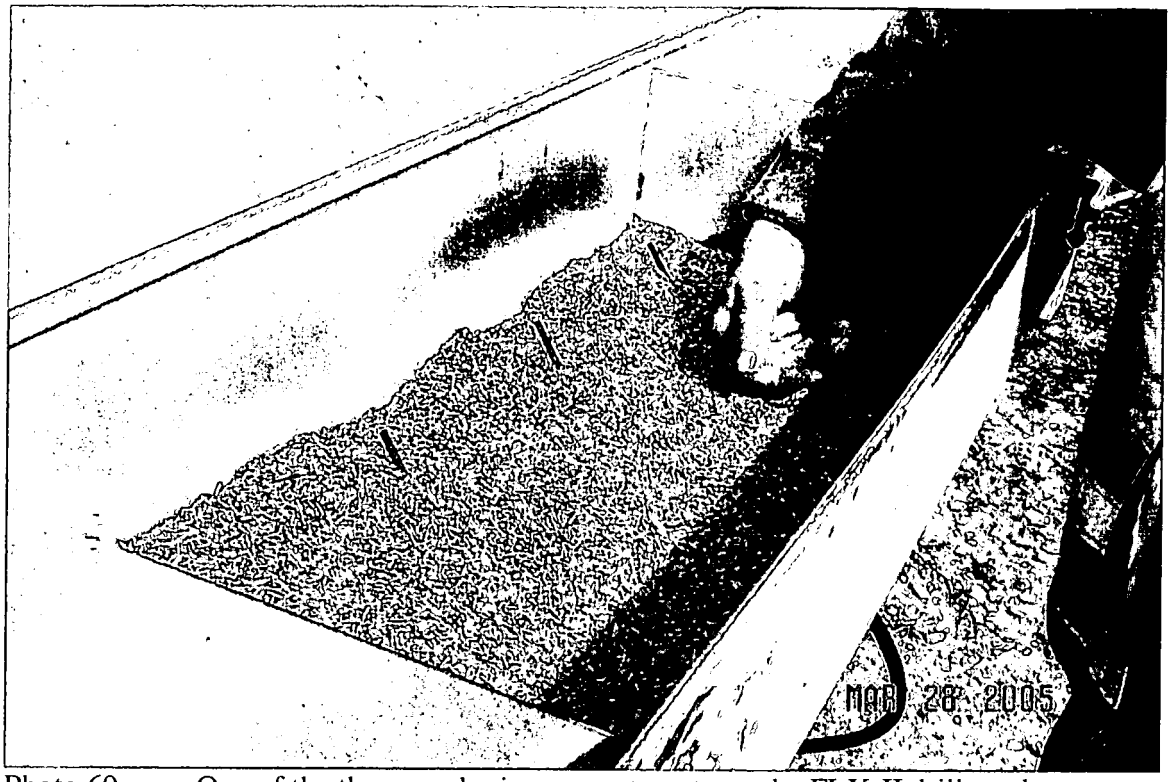


Photo 69: One of the three seed mix compartments on the FLX-II drill seeder (March 2005).

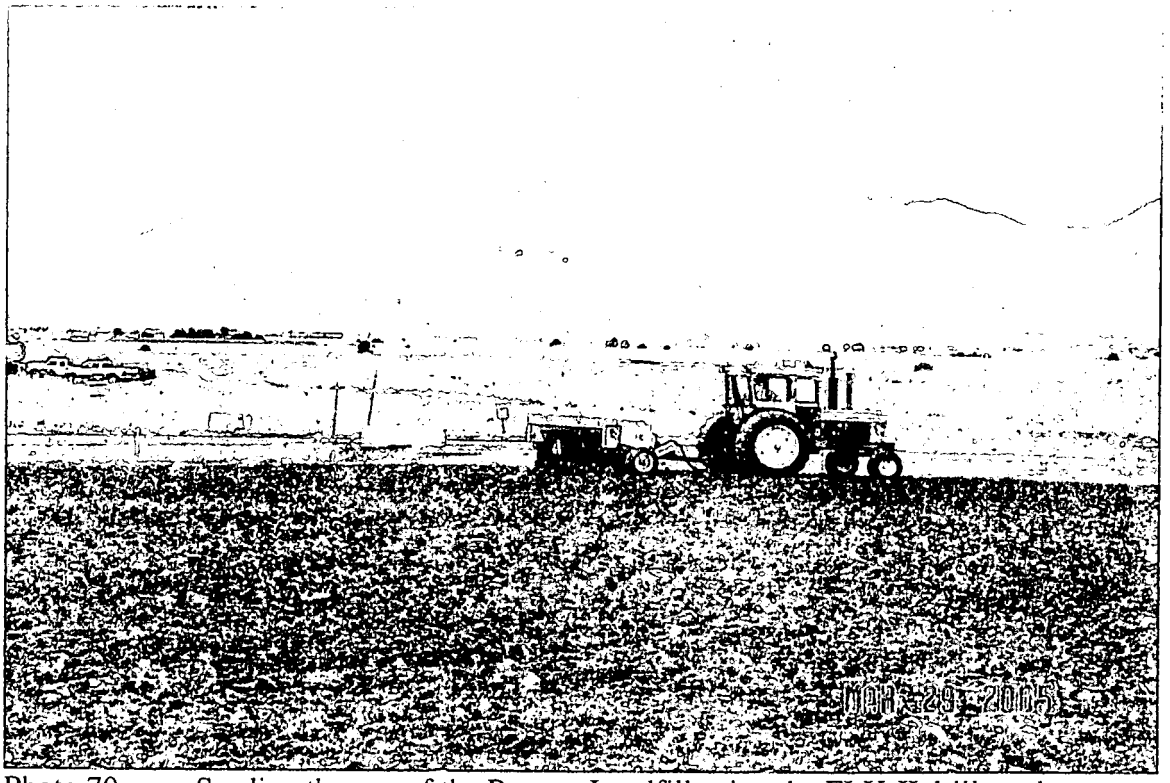


Photo 70: Seeding the cap of the Present Landfill using the FLX-II drill seeder (March 2005).

Photo 71: Anchor trench used to anchor GCL and FML liner materials to the Present Landfill cap (April 2005).

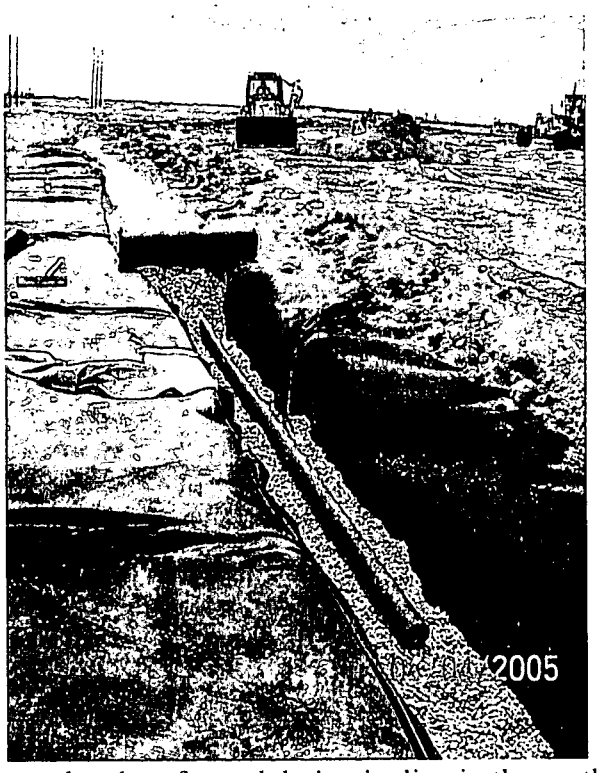


Photo 72: Corrugated and perforated drain pipeline in the north-south anchor trench near the crest of the east face (April 2005).

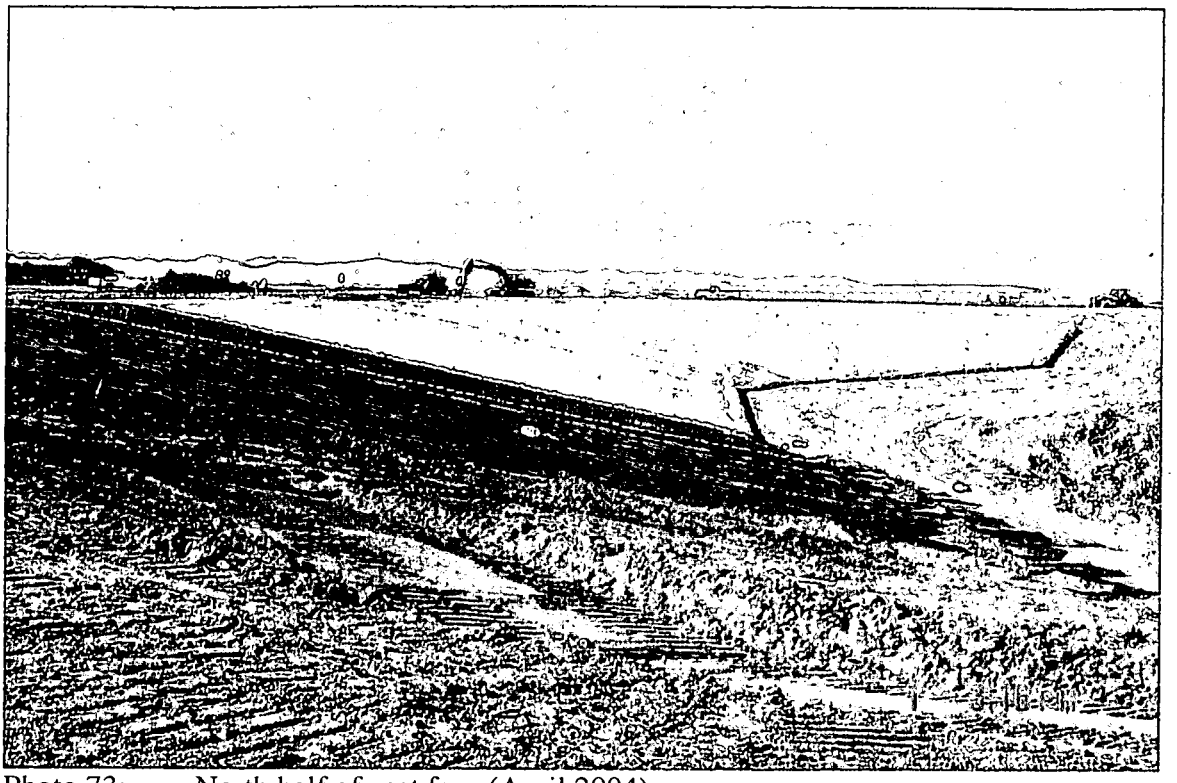


Photo 73: North half of east face (April 2004).

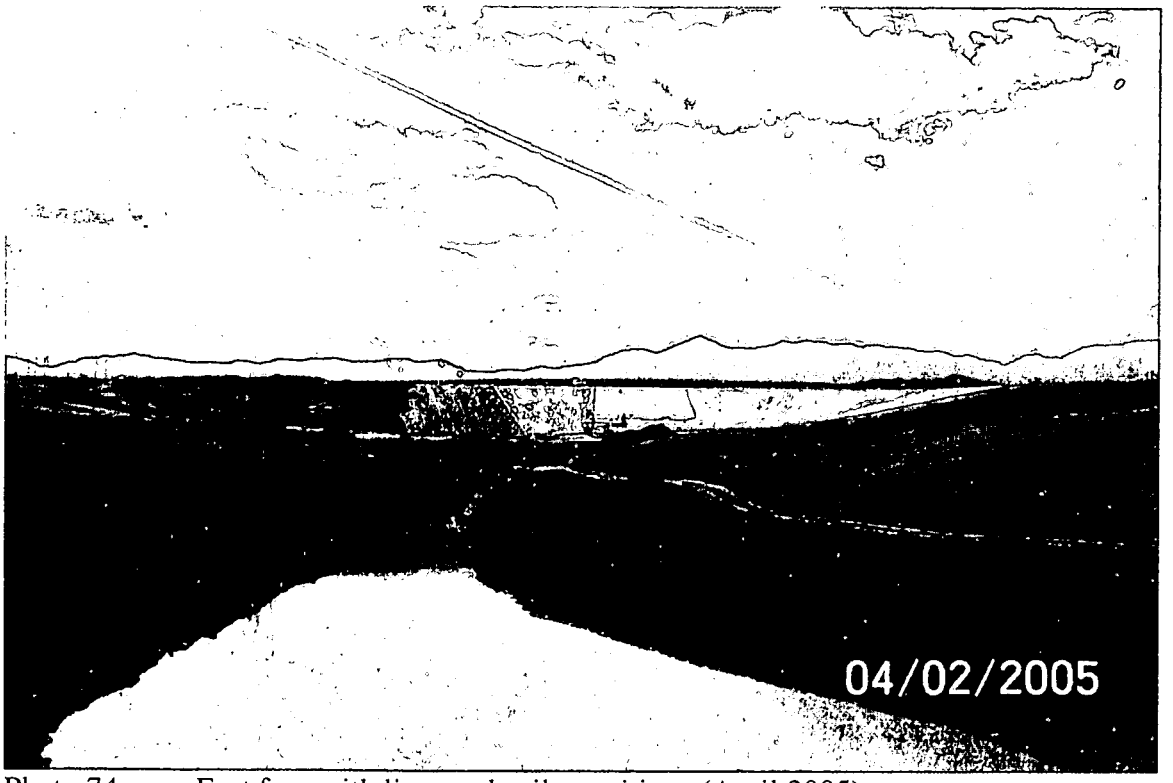


Photo 74: East face with liner and soil transitions (April 2005).

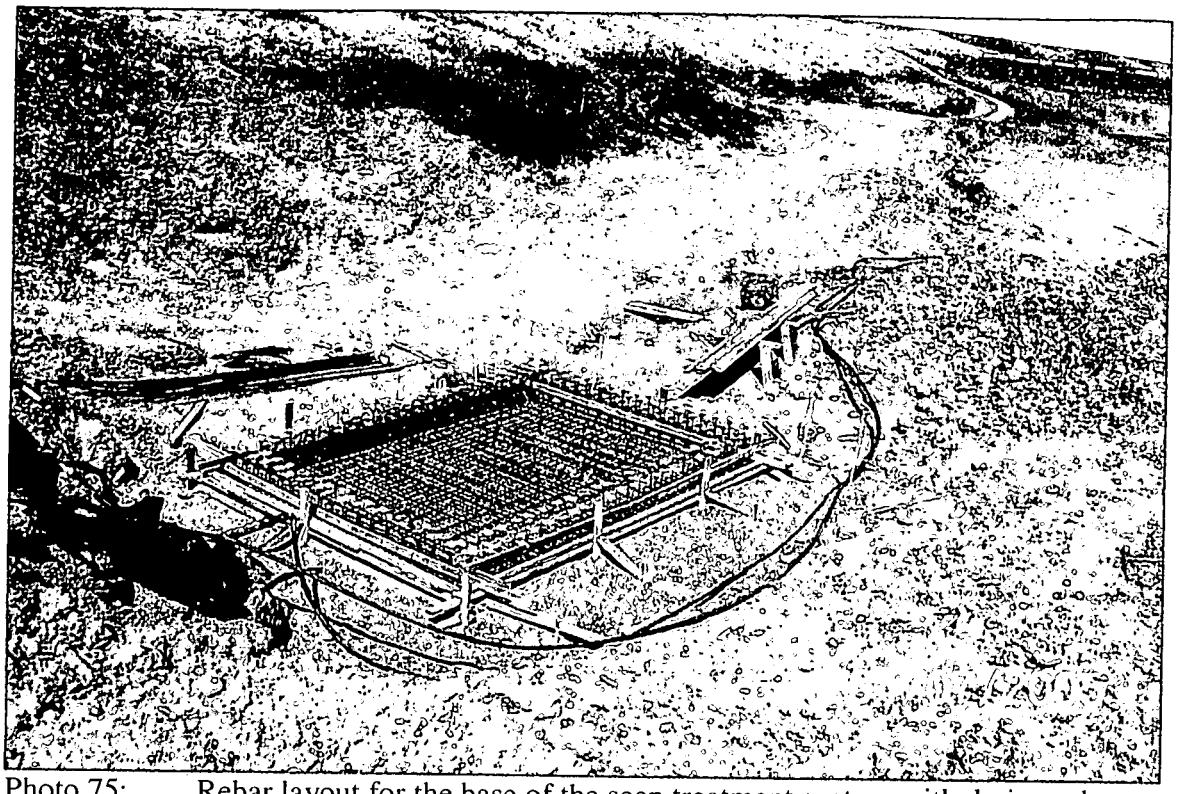


Photo 75: Rebar layout for the base of the seep treatment system with drain rock bedding (April 2005).

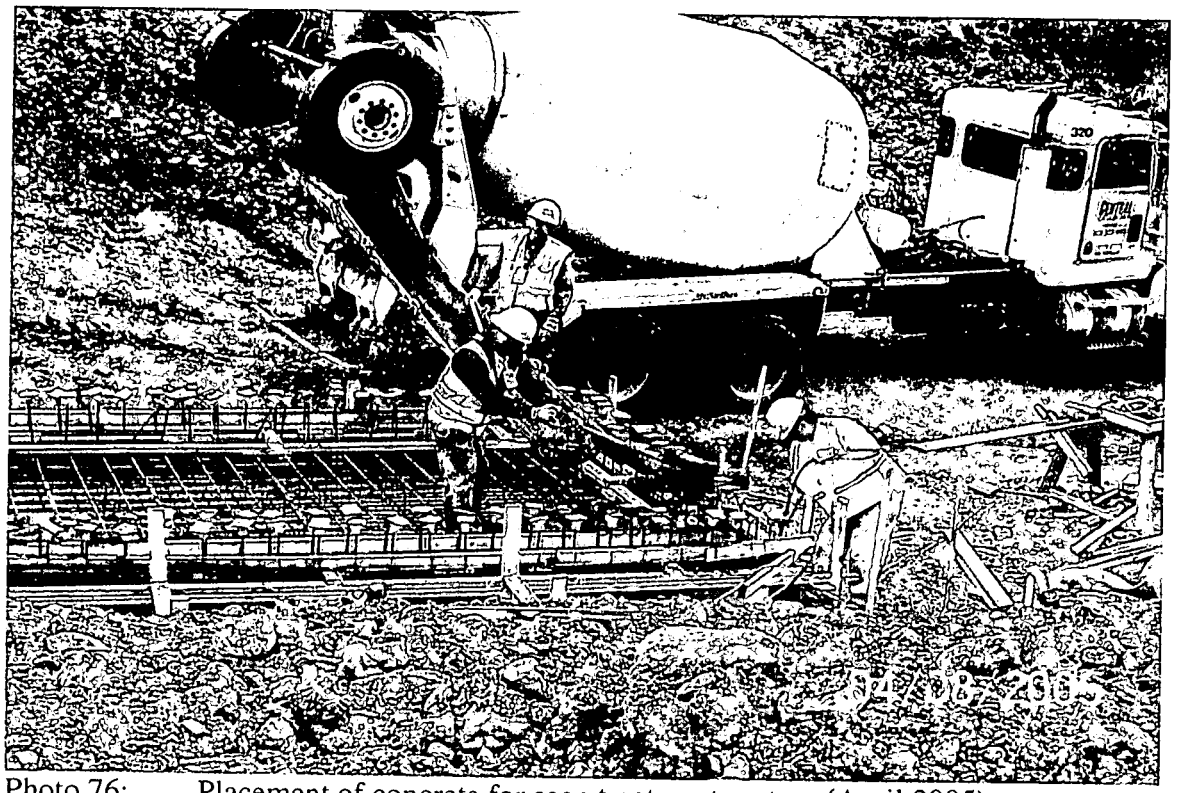


Photo 76: Placement of concrete for seep treatment system (April 2005).

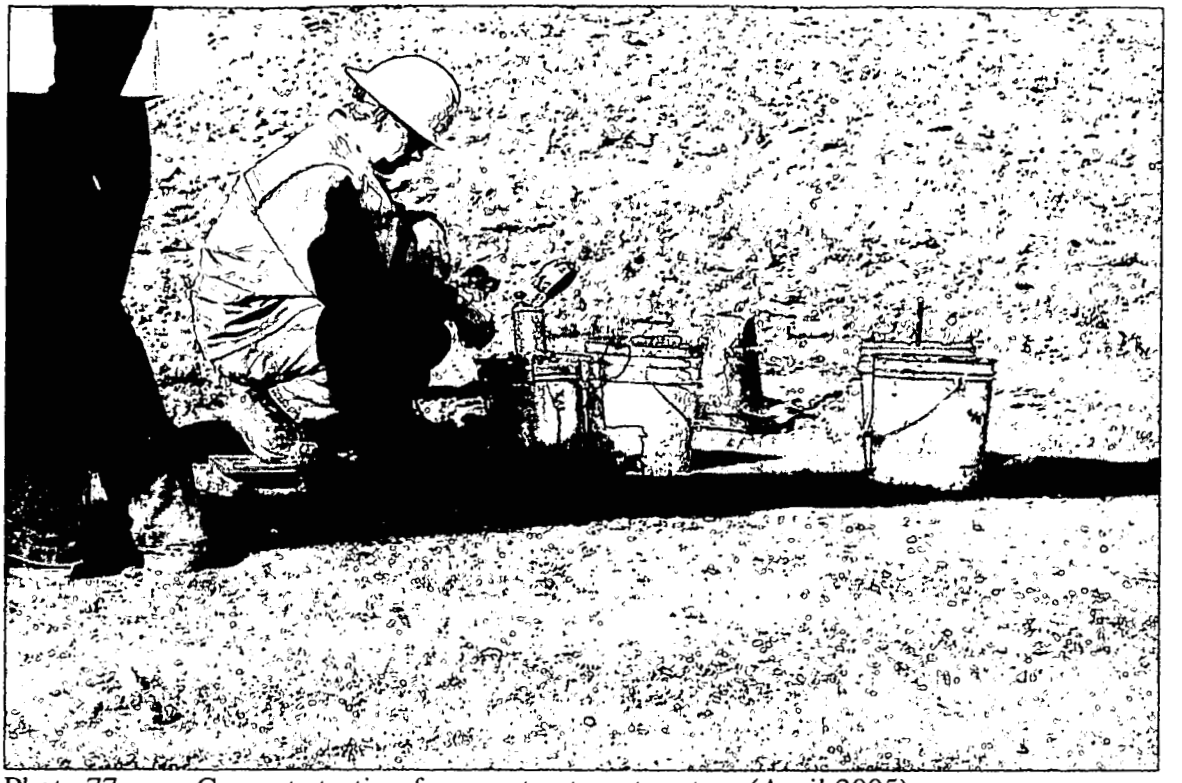


Photo 77: Concrete testing for seep treatment system (April 2005).

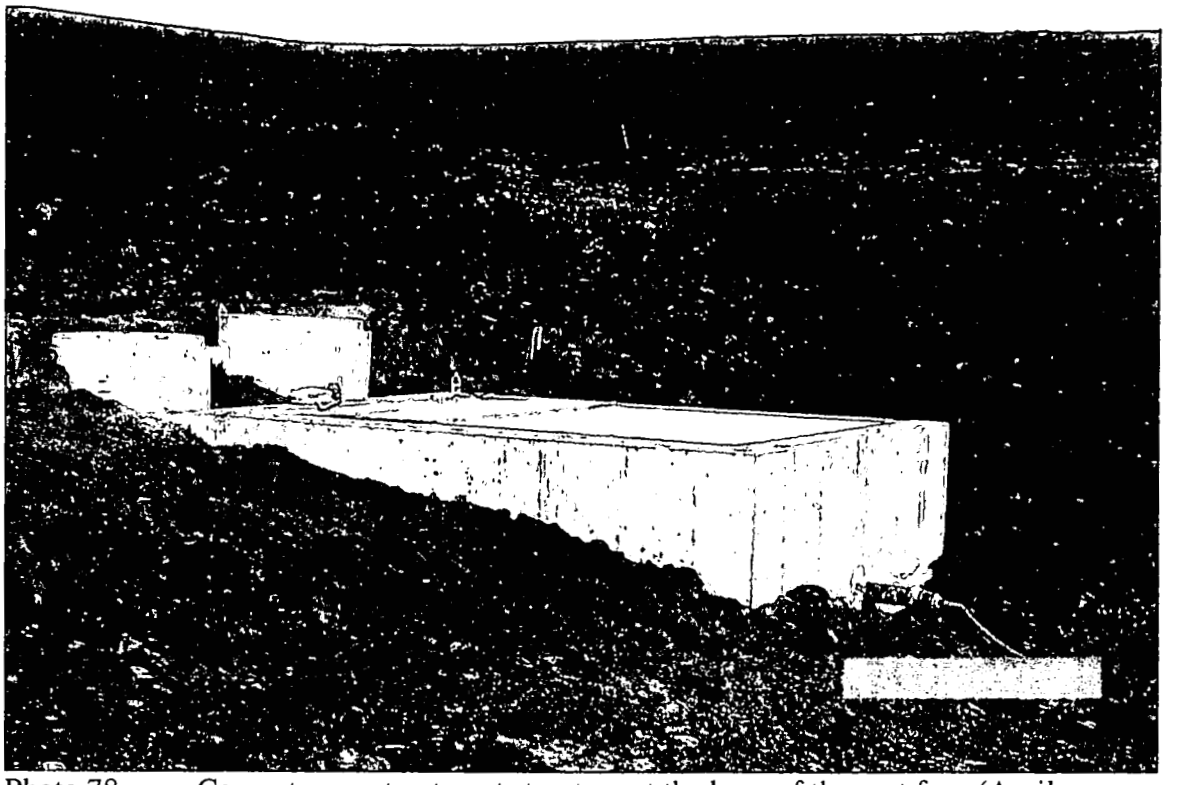


Photo 78: Concrete seep treatment structure at the base of the east face (April 2005).

Photo 79: Inflow pipes and aeration steps of the seep treatment system. Left pipe from original seep; right pipe from strip drains and north GWIS pipe (April 2005).

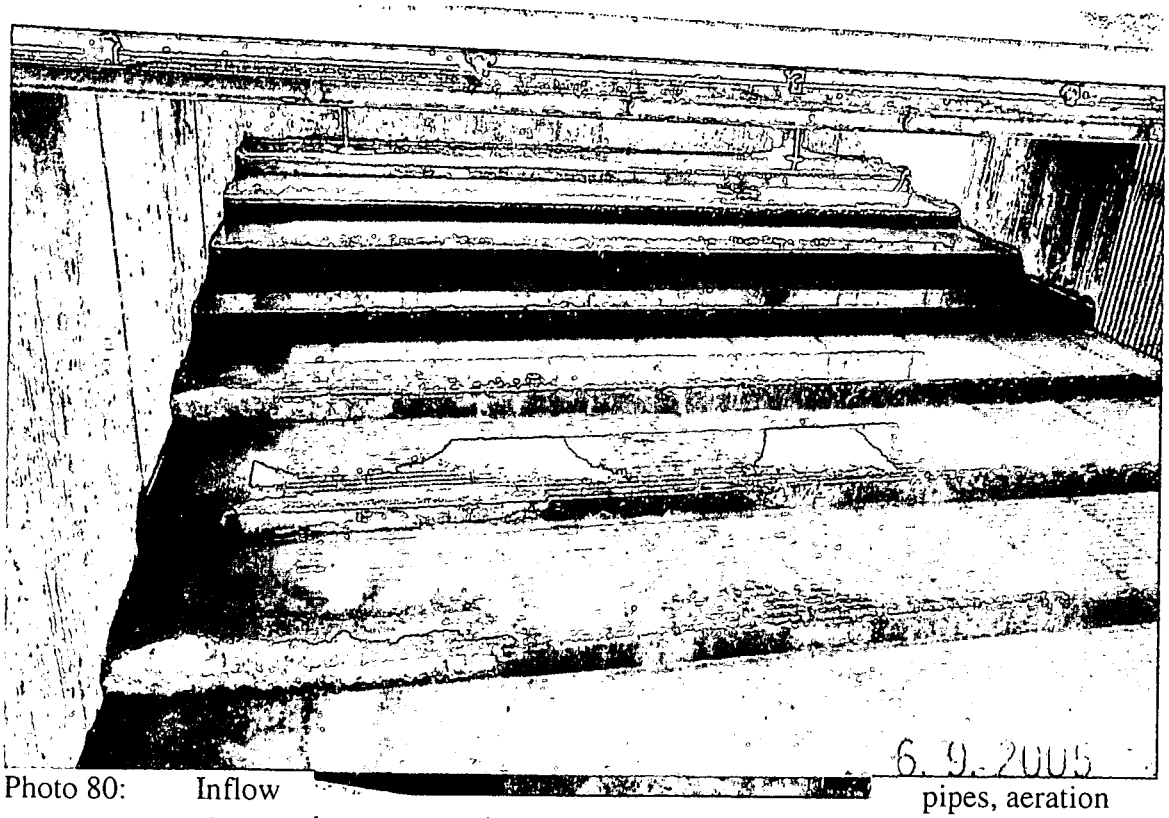


Photo 80: Inflow pipes, aeration steps, and cover grate for the seep treatment system (June 2005).

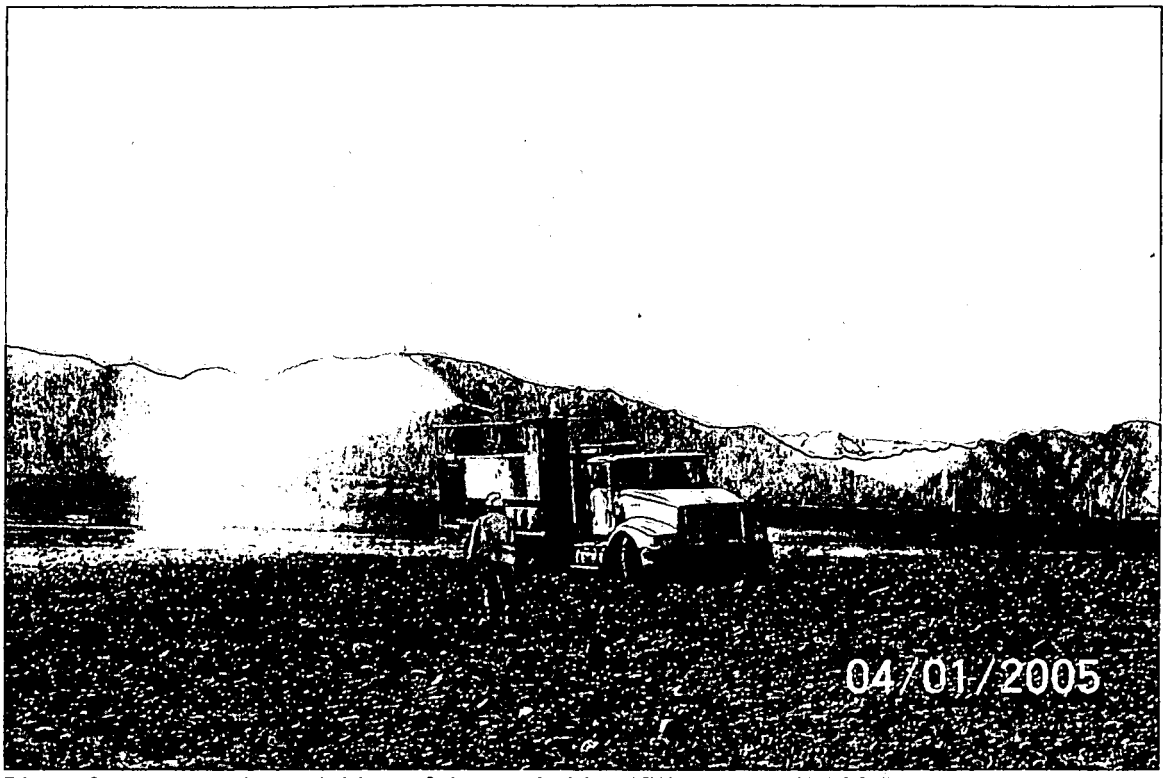


Photo 81: Hydromulching of the seeded landfill cap (April 2005).

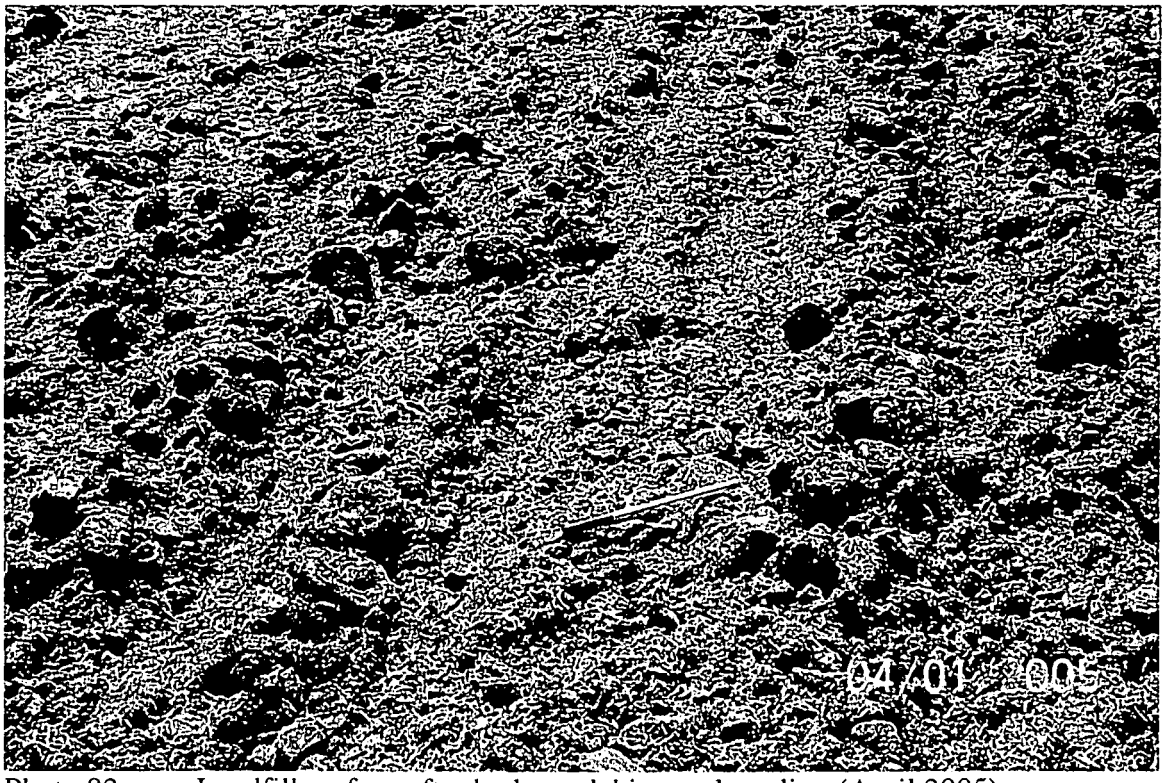


Photo 82: Landfill surface after hydromulching and seeding (April 2005).

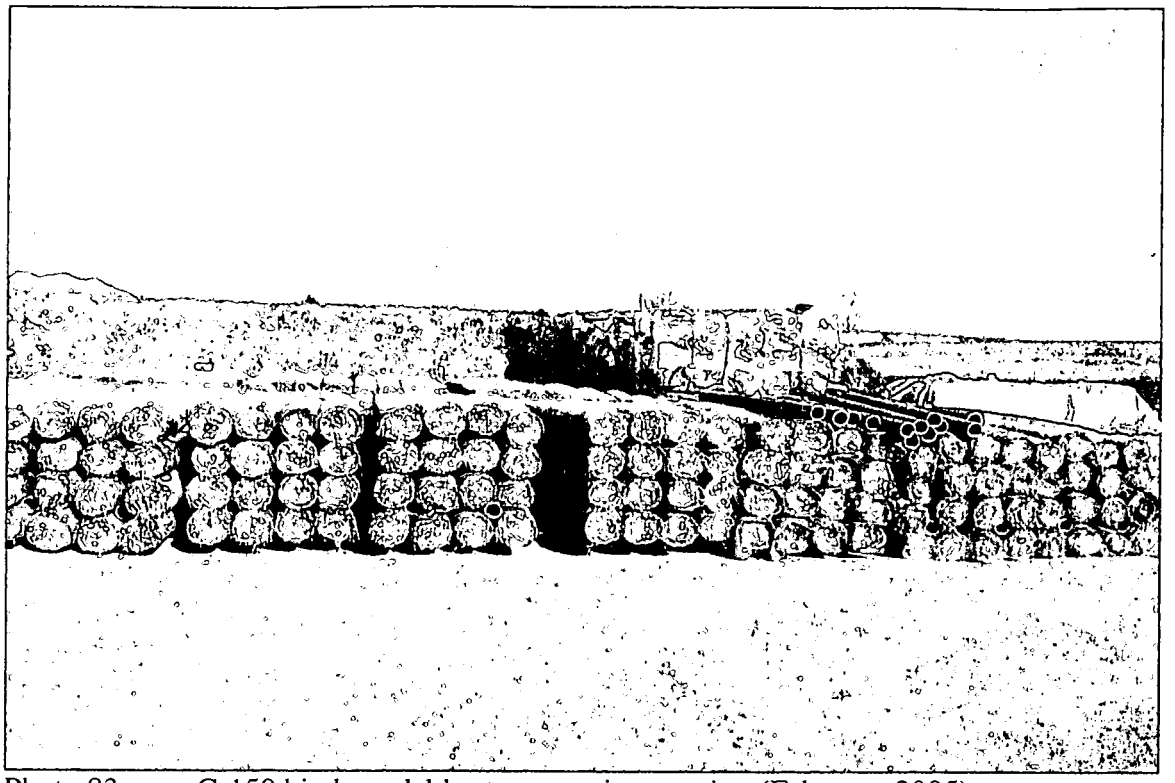


Photo 83: C-150 biodegradable straw erosion matting (February 2005).

Photo 84: Transition between hydromulched topsoil and C-125 coconut erosion matting (April 2005).

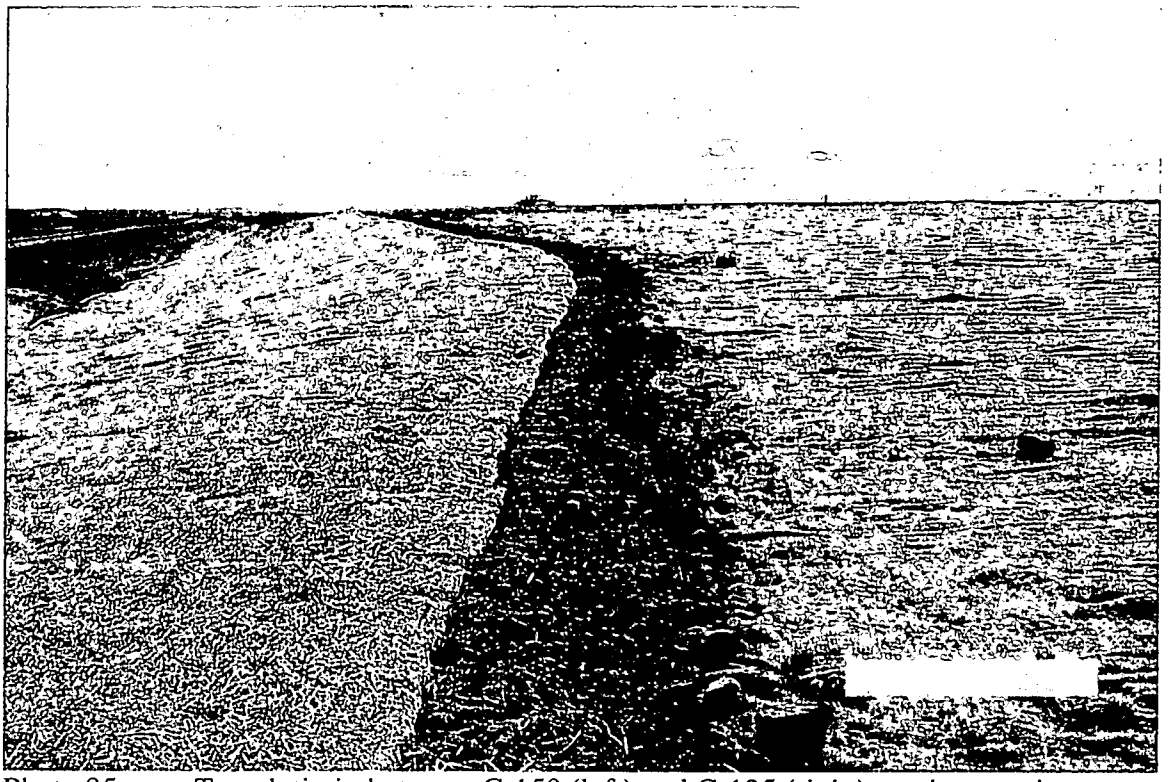


Photo 85: Trench tie-in between C-150 (left) and C-125 (right) erosion matting (April 2005).

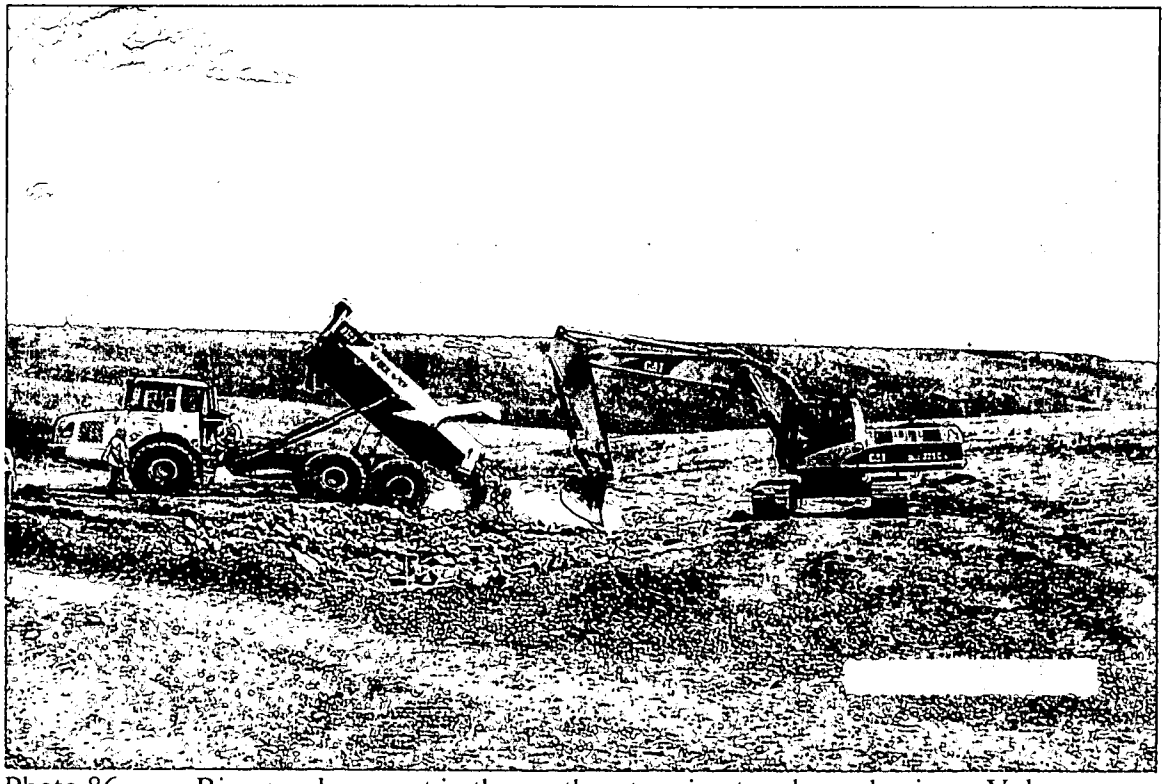


Photo 86: Rip-rap placement in the southeast perimeter channel using a Volvo A30D haul truck and a Cat 325C trackhoe (May 2005).

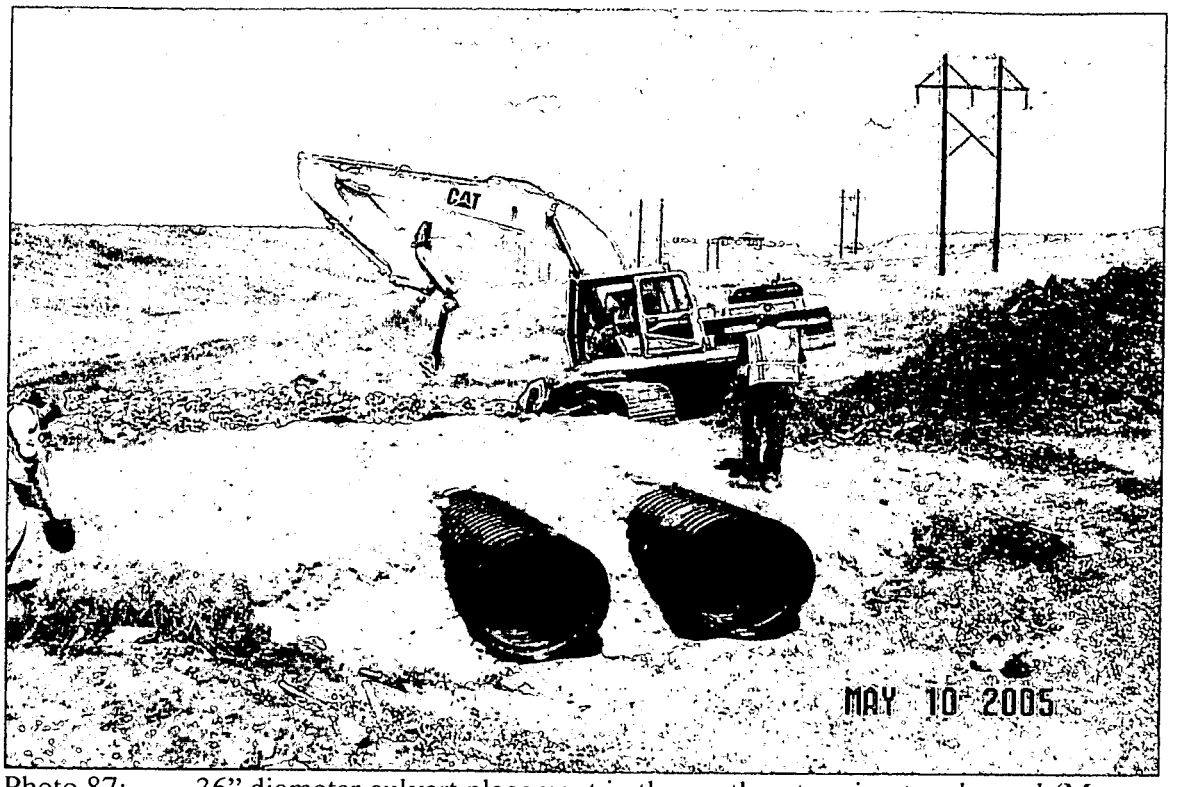


Photo 87: 36" diameter culvert placement in the southeast perimeter channel (May 2005).

Photo 88: Southeast perimeter channel rip-rap and culverts as viewed from downslope (May 2005).

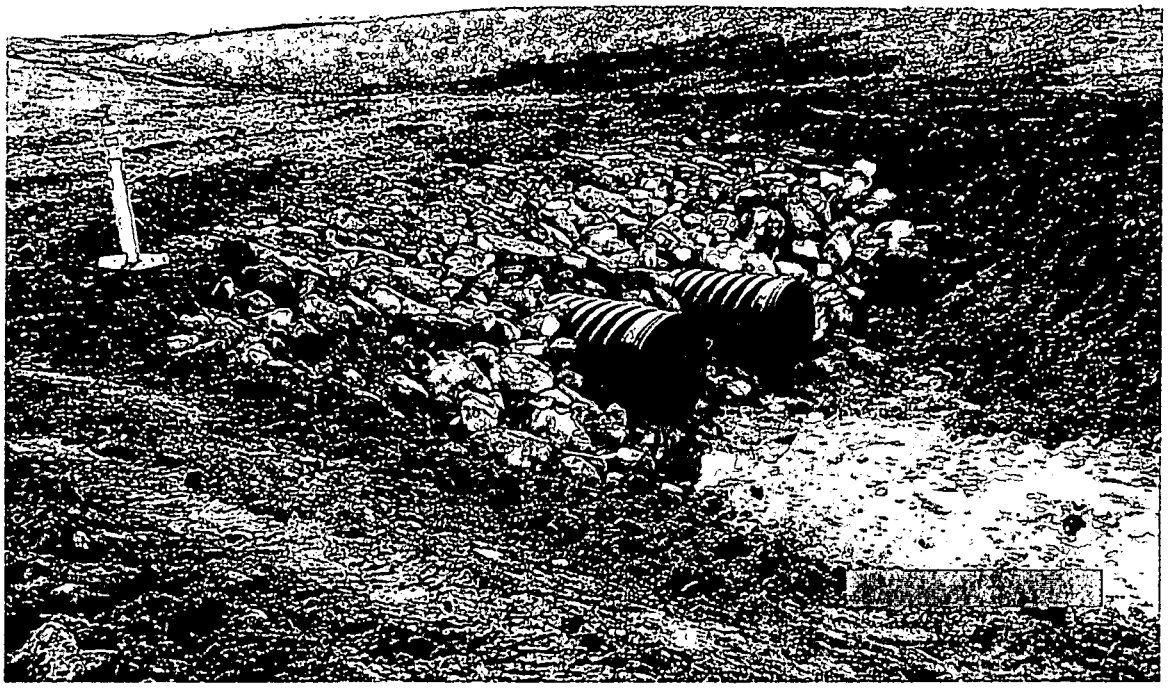


Photo 89: Culverts along northern side of Present Landfill (May 2005).

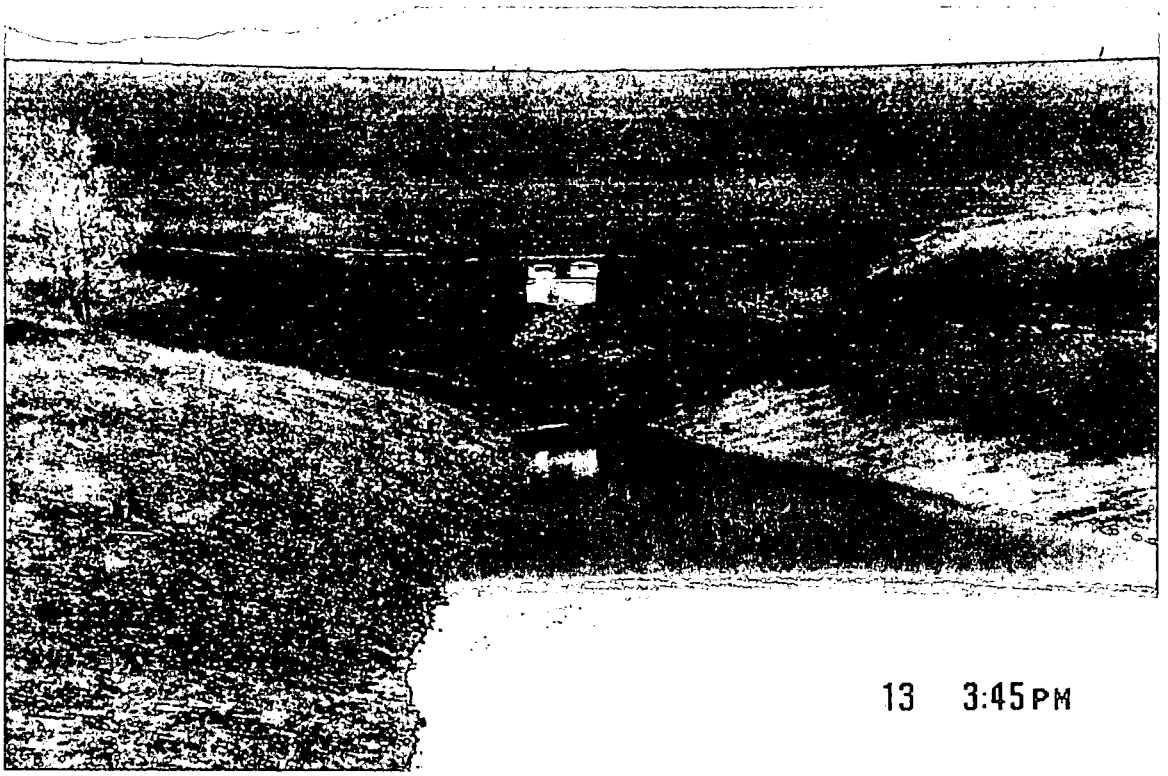


Photo 90: East face with seep treatment system prior to seeding and hydromulching (May 2005).

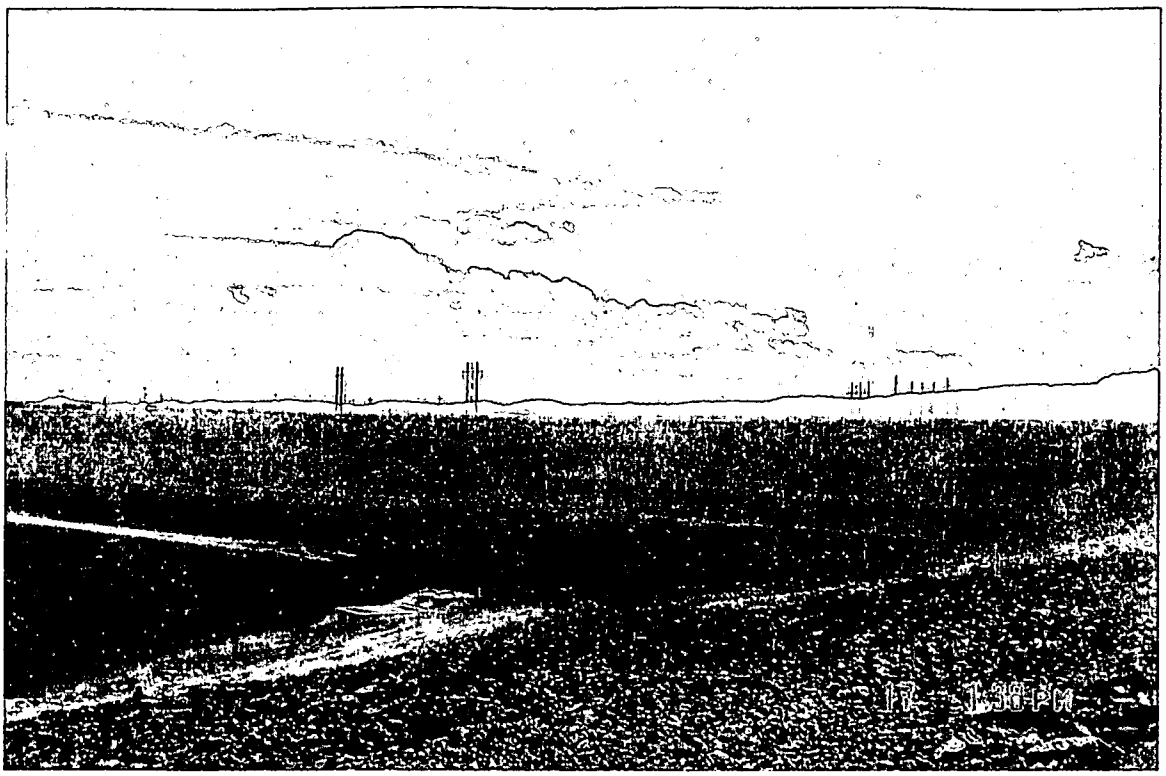


Photo 91: East face prior to seeding or hydromulching (May 2005).

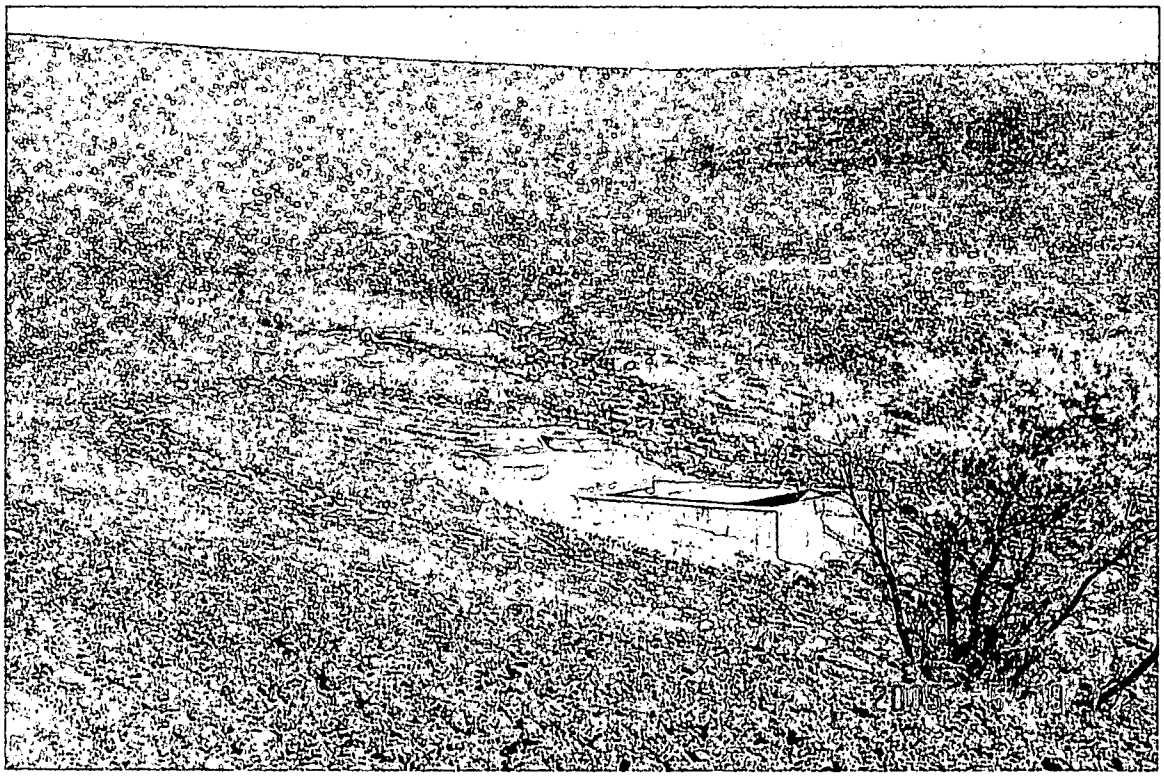


Photo 92: Complete concrete seep treatment system and vicinity prior to seeding and hydromulching (May 2005).

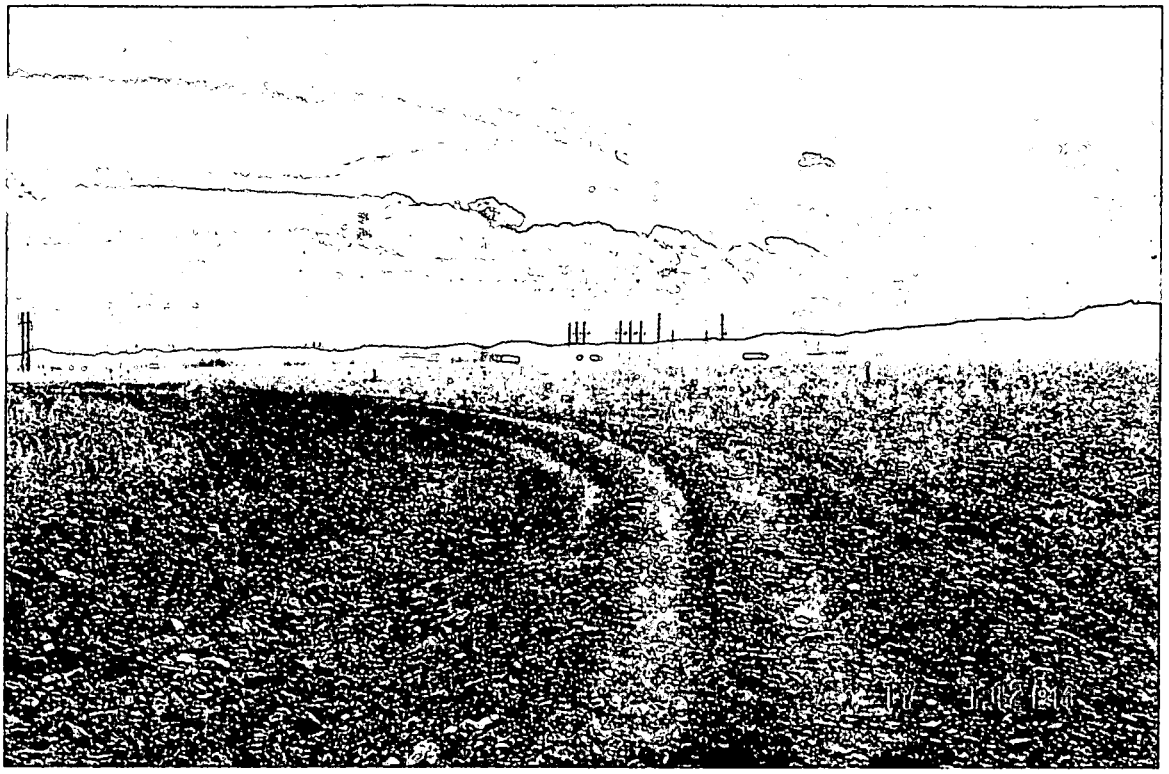


Photo 93: Topsoil diversion berm west of the east face and cap transition (May 2005).

Photo 94: Topsoil diversion berm with riprap along south side of cap (May 2005).

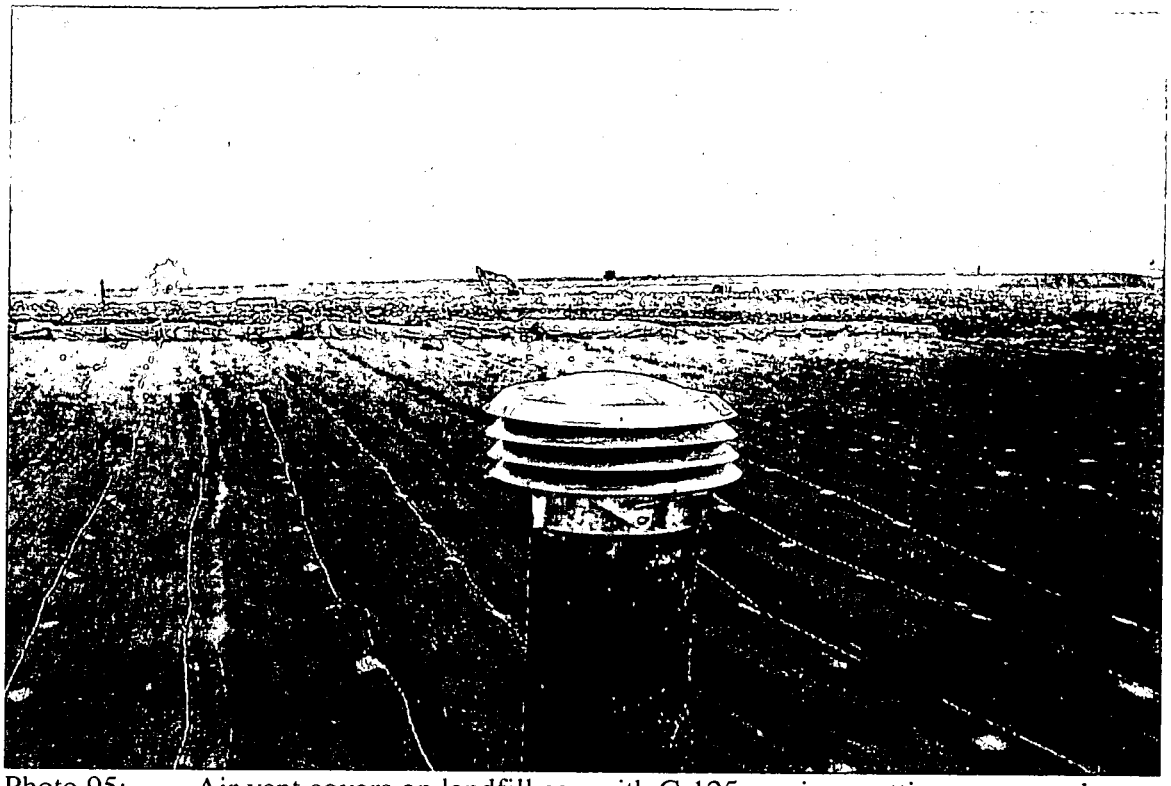


Photo 95: Air vent covers on landfill cap with C-125 erosion matting on ground surface (May 2005).

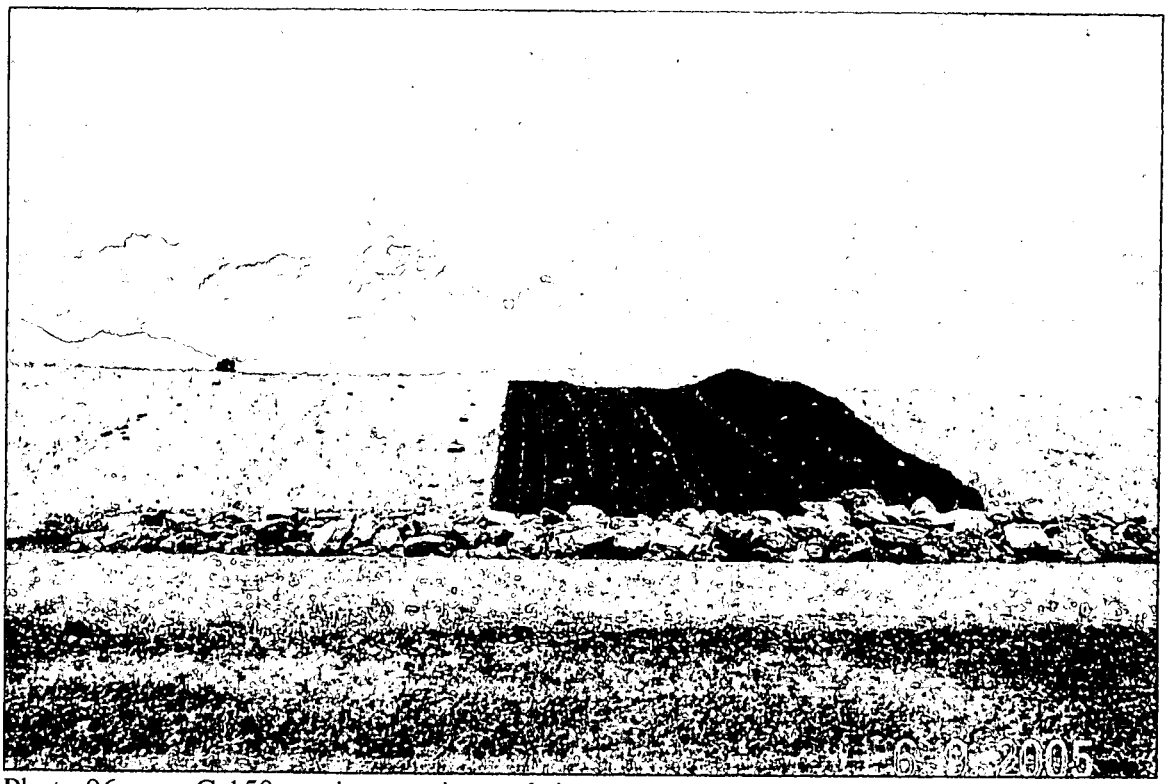


Photo 96: C-150 erosion matting and rip-rap near southern berm outfall (June 2005).

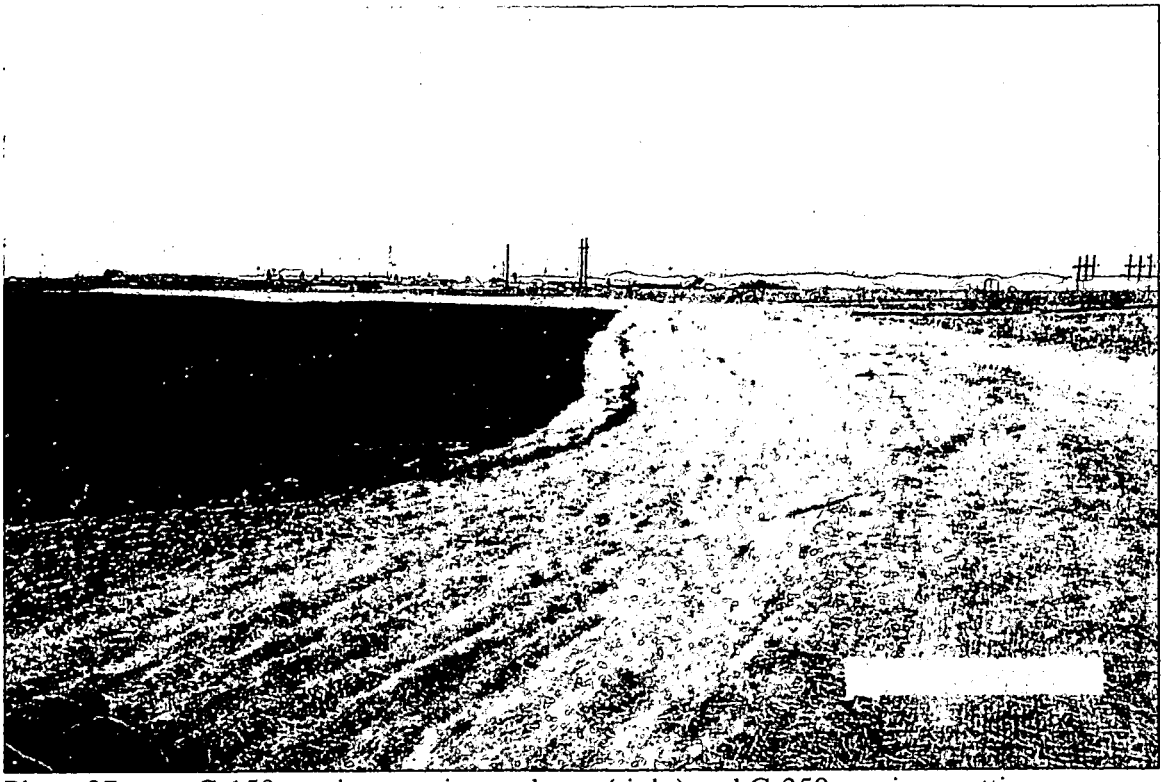


Photo 97: C-150 erosion matting on berm (right) and C-350 erosion matting on east face (left) (May 2005).

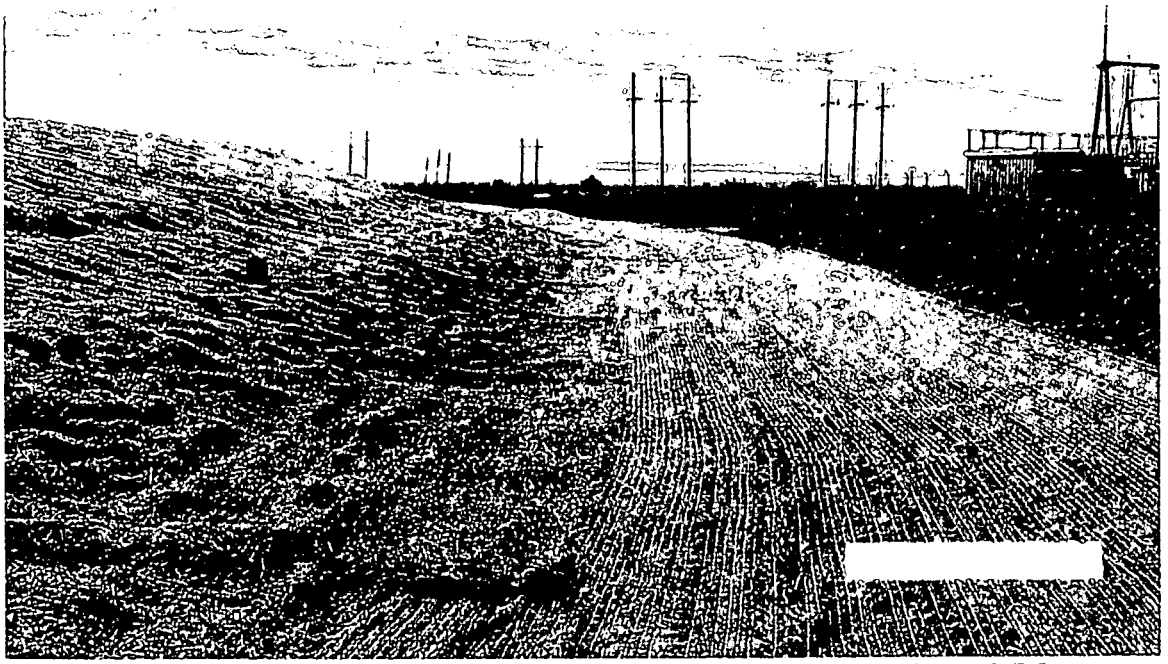


Photo 98: Erosion matting on southwest sideslope and perimeter channel (May 2005).

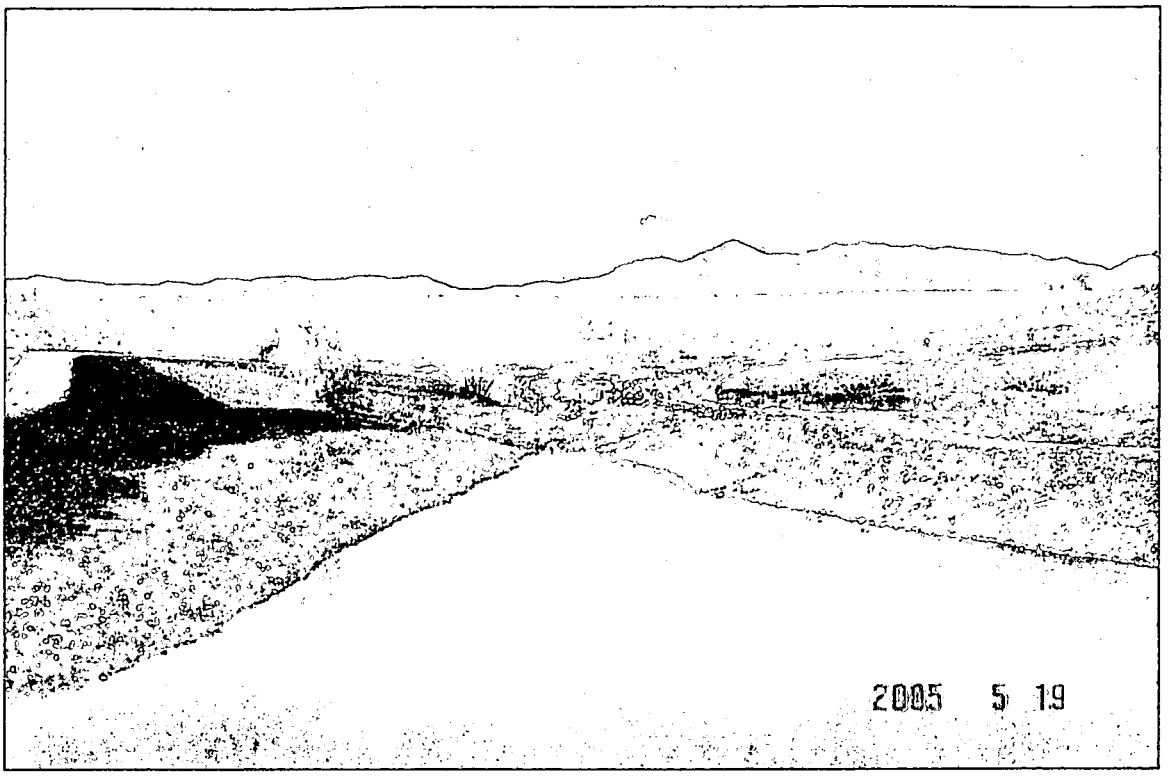


Photo 99: East face and pond during hydromulching and seeding operations (May 2005).

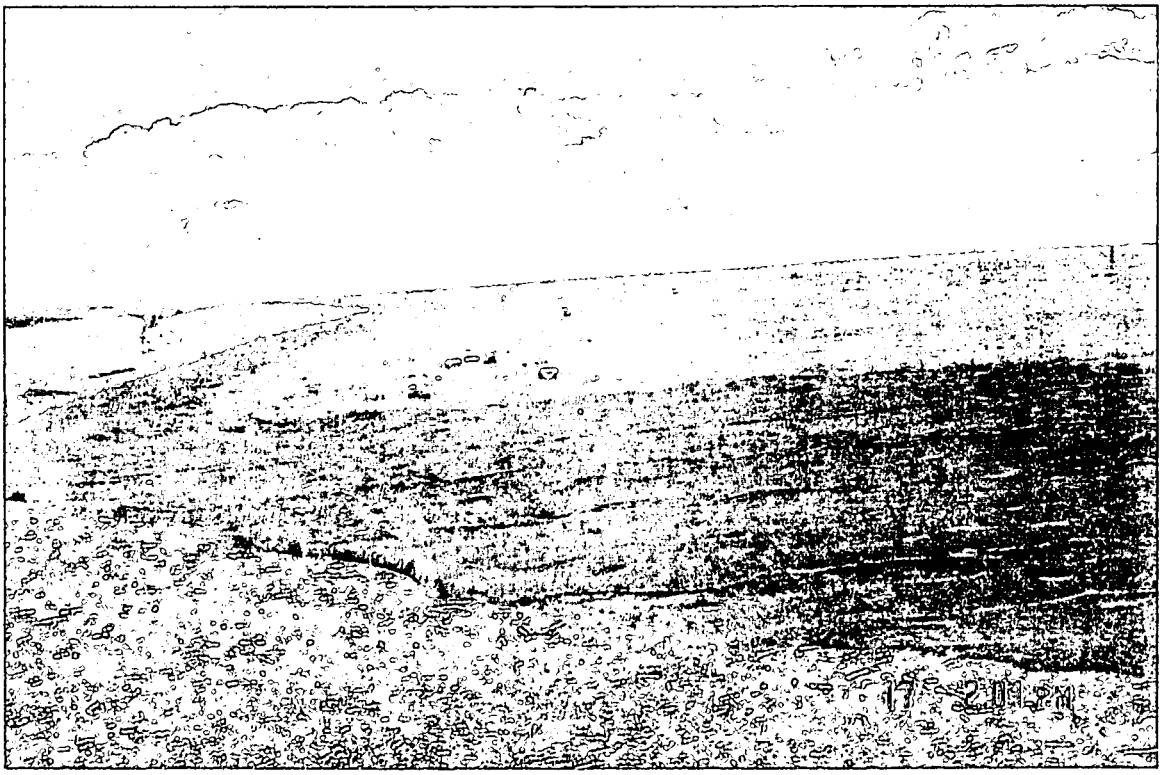


Photo 100: Complete C-125 and C-150 erosion matting near northwest portion of landfill (May 2005).

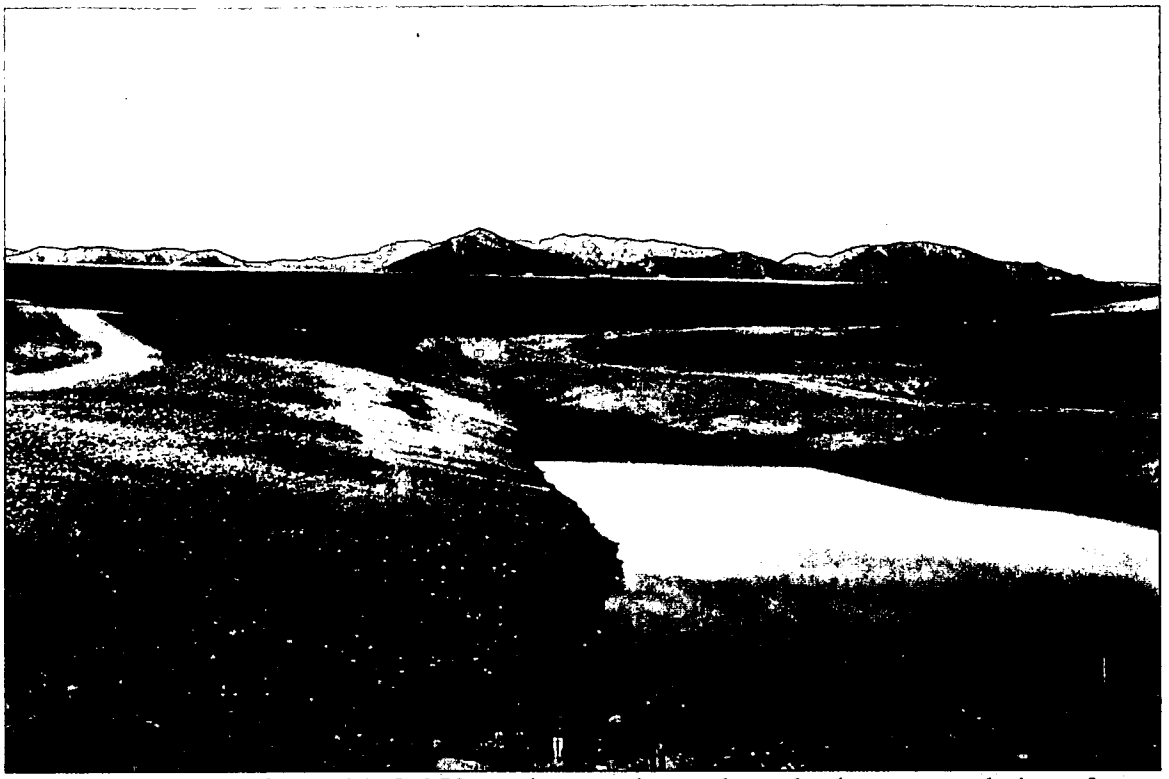


Photo 101: East face with C-350 erosion matting and pond prior to completion of hydromulching operations (May 2005).

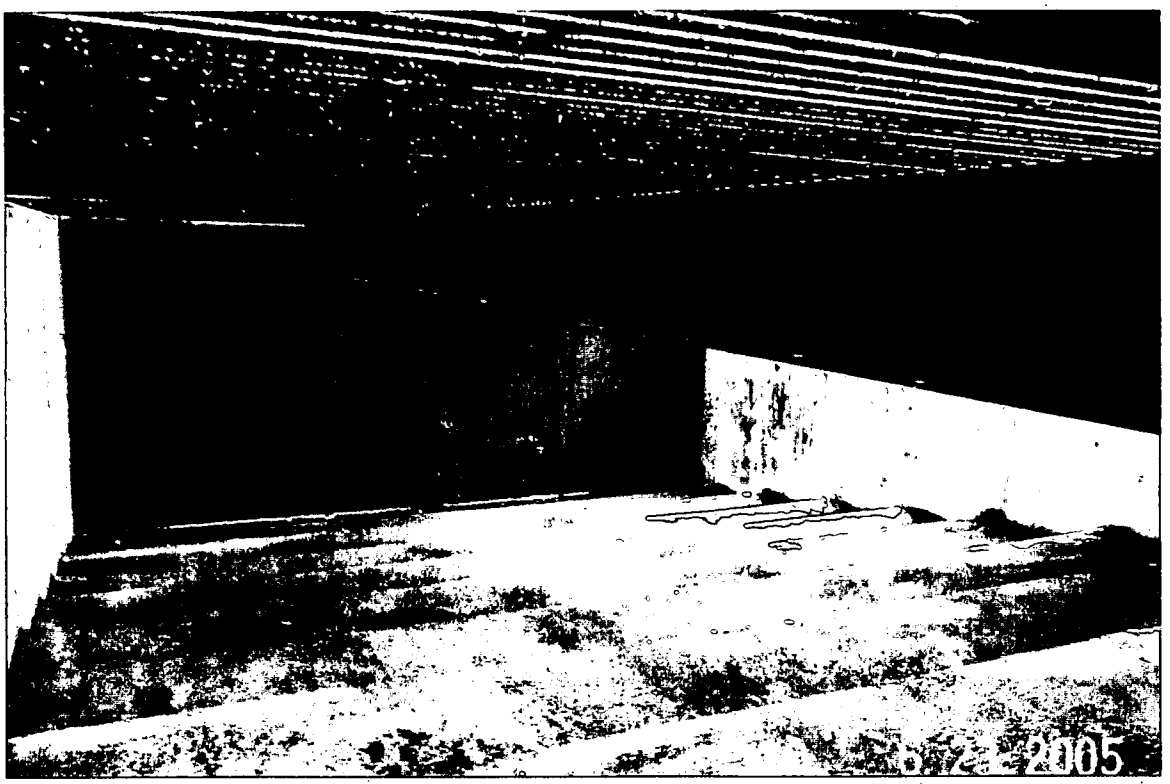


Photo 102: One of two steel beams utilized to support the grate on the seep treatment system (June 2005).

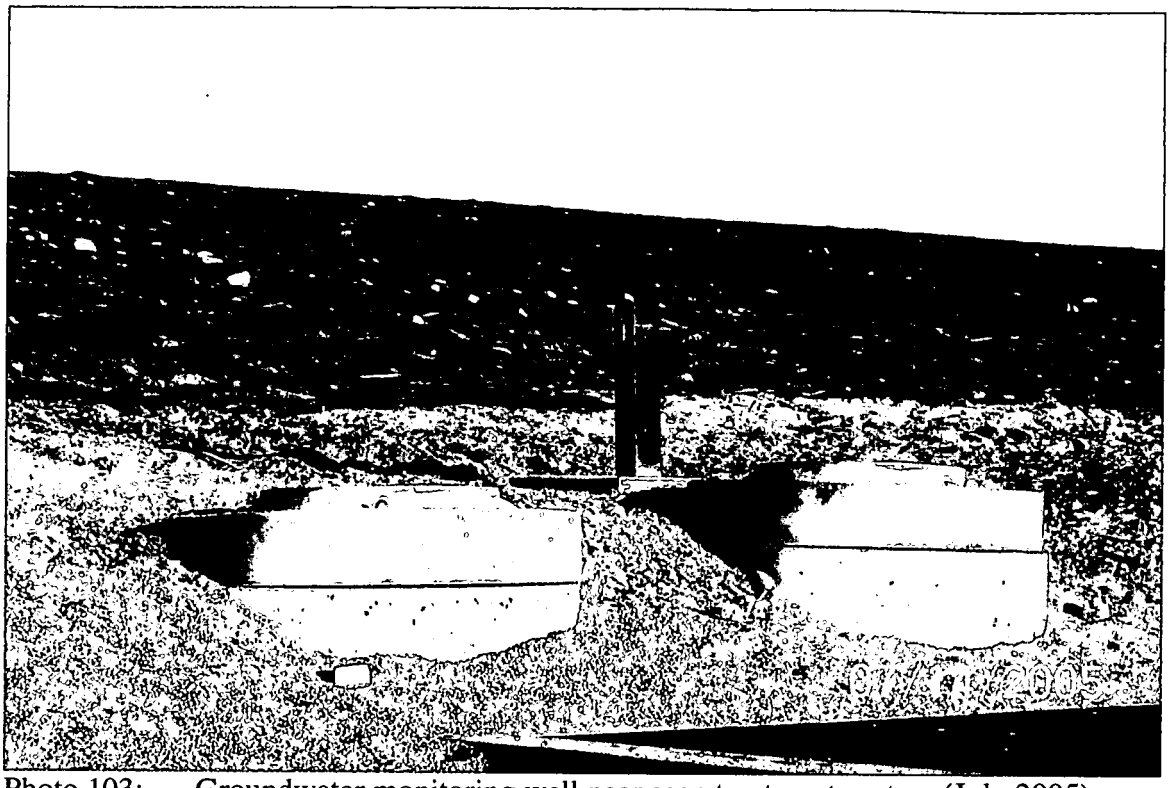


Photo 103: Groundwater monitoring well near seep treatment system (July 2005).

Photo 104: Emerging vegetation from the Present Landfill cap (July 2005).

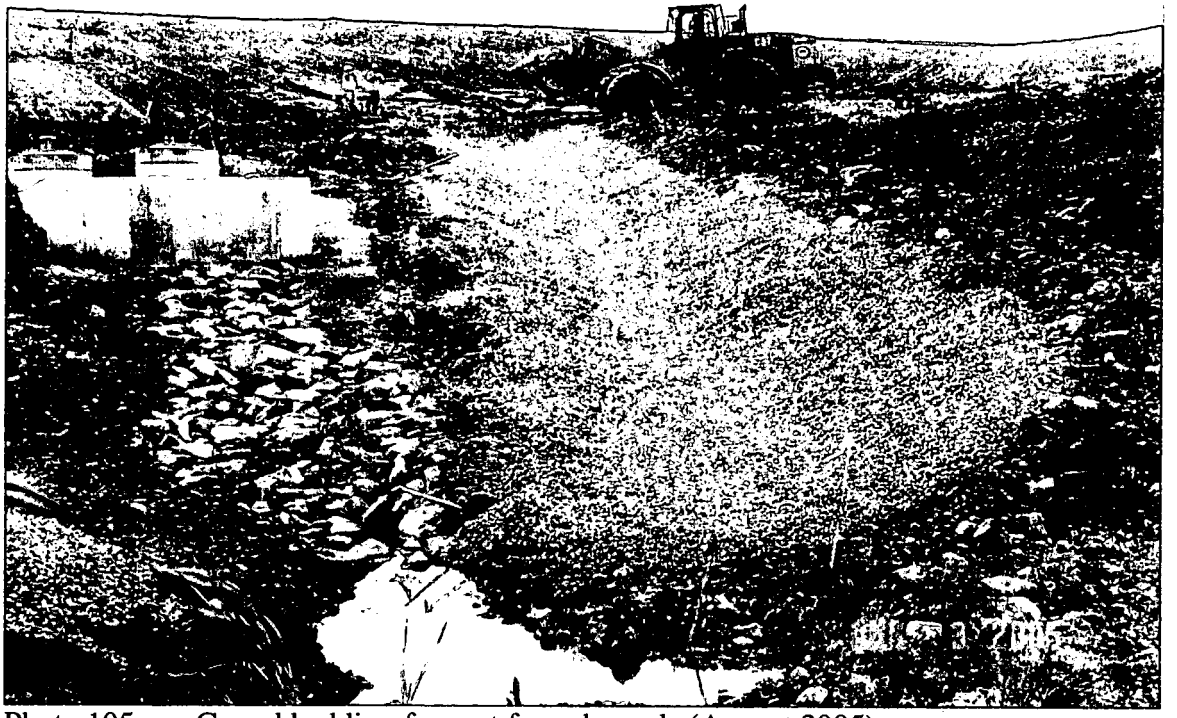


Photo 105: Gravel bedding for east face channels (August 2005).

Photo 106: East face channels near seep treatment system (August 2005).

Photo 107: North Groundwater Interception System (GWIS) during tie-in construction. See Survey Control Points 4713 and 4715 of As-Built Survey, Sheet 3 (April 2005).

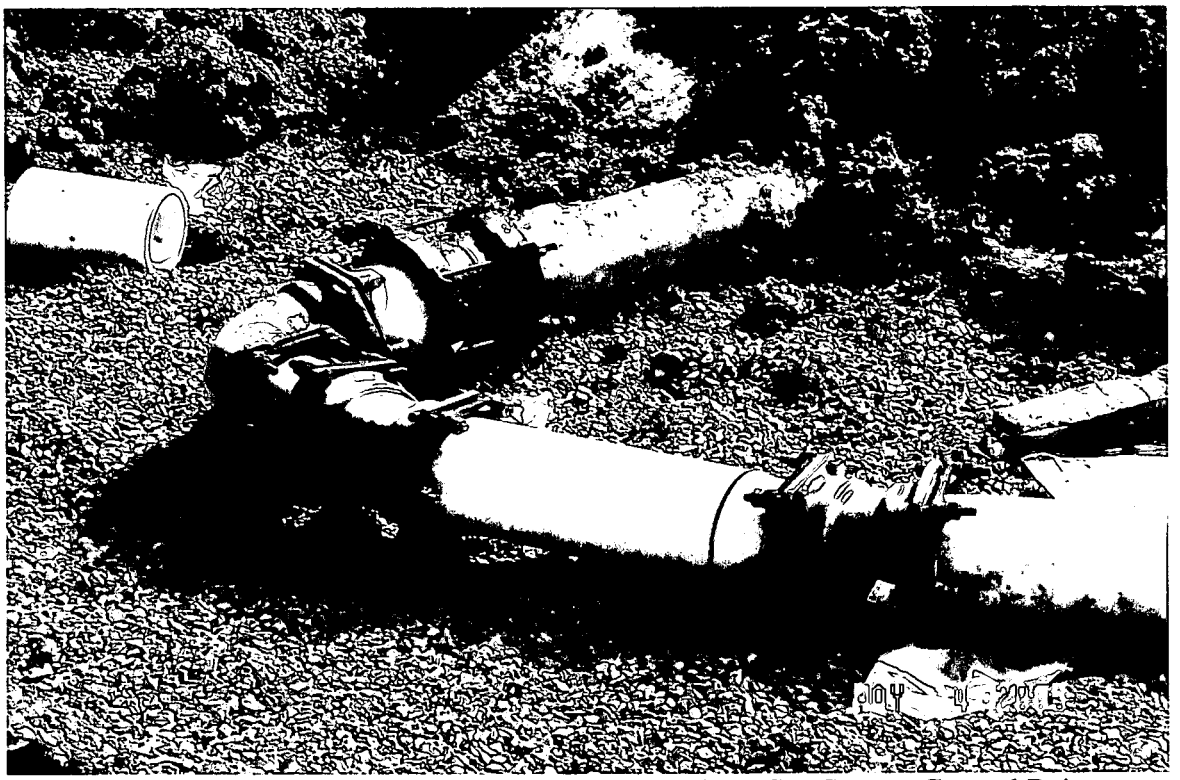


Photo 108: South GWIS following tie-in construction. See Survey Control Points 4757, 4760 and 4761 of As-Built Survey, Sheet 3 (May 2005).

APPENDIX D

CONSTRUCTION CONTRACTOR'S SUBMITTALS AND APPROVAL DOCUMENTATION (EXCLUDING PROGRESS RECORD SURVEYS)

APPENDIX D-1: SUBMITTAL LOG

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
001	Staff Resumes	7/1/2004	7/31/2004			Approved
002	Health & Safety Plan Draft	7/2/2004	7/31/2004		Comments by D. Snyder (see file); comments were incorporated	Resubmitted (see Submital No. 006)
003	Detailed Project Schedule	7/7/2004	7/31/2004		To be revised and resubmitted every two weeks at weekly meetings	Approved/Revise & Resubmit
004	S&H001 (Golder)	7/8/2004	7/31/2004			Submitted
005	Geotextiles (40 mil)	7/7/2004	8/26/2004	8/23/2004	Comments Provided	Revise & Resubmit/Approved
005A	Geotextiles (60 mil)	7/22/2004	8/4/2004			Approved as Corrected
005B/C	White LLDPE (60 mil)	7/23/2004	N/A		Not Used	Submitted
006	HASP Additions	7/13/2004	7/31/2004	8/16/2004	Resubmittal Approved	Approved
007	Paragon Resumes/Certifications	7/13/2004	7/31/2004		Pending approval of SUB-004	Approved as Corrected
008	Silt Fence	7/13/2004	7/15/2005			Approved
009	Nonwoven Geotextiles	7/13/2004	7/15/2005			Approved
010	Erosion Mat	7/13/2004	8/7/2004		Mat Style 150 Approved; Submit Mat Style 350 (see 10a)	Approved/Revise & Resubmit
010A	Erosion Mat	2/2/2005	2/20/2005		Mat Style 350	Approved
011	S&H001 (Paragon)	7/13/2004	8/4/2004		Error in calculations for manhours	Revise & Resubmit

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
012	Project Management Plan Draft	7/13/2004	N/A		For information/remains in draft	Submitted
013	R.F. Alluvium Sampling W.P.	7/19/2004	7/27/2004			Approved
014	Haul Map, Material Quantities Summary, Mobilization Equipment	7/20/2004	N/A		For information only	Not Approved
015	Cushion Soil Geotechnical Data	7/22/2004	N/A		See Submittal No. 20	Submitted
016	Project Site Plan	7/23/2004	N/A		For information only	Submitted
017	MSDS for Lignosulfonate Dust Suppressant	7/27/2004	8/7/2004		Keep off Preble's Mouse area	Approved as Corrected
018	Mobilization W.P.	7/29/2004	8/11/2004	8/4/2004		Approved
019	S&H Exception (United Site Services), S&H001 (Gash)	7/29/2004	8/7/2004			Approved
020	Cushion Soil Geotechnical Data	7/29/2004	9/7/2004		Please provide map of borrow area and sample locations	Approved
020A	Cushion Soil Geotechnical Data	9/8/2004	10/9/2004			Approved
021	Temporary Construction Facilities	7/30/2004	7/31/2004			Approved
022	Haul Road W.P.	8/4/2004	8/17/2004	8/12/2004		Approved
023	Training Matrix	8/9/2004	10/9/2004	9/8/2004		Receipt Acknowledged
024	Water Supply Station W.P.	8/10/2004	8/16/2004	8/13/2004		Approved

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
025	Pre-Grade & Roll W.P.	8/23/2004	8/31/2004	8/30/2004		Approved
026	Subgrade Prep/Cushion Layer Placement W.P.	9/15/2004	9/29/2005			Approved
027	Bentonite Specs for Abandoned Gas Vent Wells	8/31/2004	9/17/2004			Approved
028/028A	Liner Panel Layouts	8/31/2004	10/9/2004	9/9/2004		Approved
029	Boring Pad Construction W.P.	9/7/2004	9/13/2004	9/10/2004		Approved
030	Service Representative Contact Info	9/8/2004	10/9/2004			Approved
031	Kiln Dust to Solidify Pond Sludge	9/8/2004	5/16/2005		Verbal Approval given on 9/28/04	Approved
032	Texas Research International Company Info	9/9/2004	10/9/2004			Approved
033	Liner Laydown Yards W.P.	9/20/2004	9/23/2004			Approved
034	Rock Layer Sieve Analysis	9/15/2004	10/9/2004		Comments on gradation analysis (see file)	Approved as Corrected
035/035 Rev. 1	Temporary Seep Recovery System Design	9/17/2004	10/12/2004	10/8/2004	Material must stay within boundary of pond sediment removal	Approved as Corrected
036	Seep Water Pump & Store System W.P.	9/23/2004	10/21/2004	10/12/2004		Approved
037	Geogrid Product Info	9/23/2004	10/1/2004		Install as per attached "soft spots" repair procedures	Approved as Corrected
038	Temporary Seep System Equipment	9/29/2004	10/9/2004			Approved

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
039	R.F. Alluvium Geotechnical Data	10/1/2004	10/10/2004			Approved
040	Soft Spot Repair Material for "wet" spots - non-woven geotextiles	10/1/2004	10/10/2004			Approved
041	Liner/Upper Cushion Install W.P.	10/8/2004	10/19/2004	10/12/2004	Revise as noted in mark-ups	Approved
042	Pond Sediment Removal W.P.	10/13/2004	12/13/2004			Approved
043	LLDPE Roll Certifications	10/13/2004	10/18/2004		Certs and test data to be compared to specs and to delivered rolls	Approved as Corrected
044	Scale Inspection Report	10/18/2004	12/12/2004	11/22/2004		Approved
045	TRI Interface Shear Test Reports	10/18/2004	1/30/2005	12/4/2004		Receipt Acknowledged
046	Marking Stick MSDS	10/25/2004	11/13/2004		For information only	Receipt Acknowledged
047	Summary of Soil QC Data	10/26/2004	N/A		See Submittal No. 48	Submitted
048	Summary of Soil QC Data	10/1/2004	3/18/2005			Receipt Acknowledged
049	Offsite Rocky Flats Alluvium Test Results	11/8/2004	11/8/2004		Conduct compaction test like first test fill	Approved as Corrected
050	Rock Layer W.P.	11/9/2004	12/11/2004	12/6/2004		Approved
051	Record Survey 11/2/04	11/9/2004	12/12/2004		For information only	Receipt Acknowledged
052	Record Survey 11/9/04	11/15/2004	12/12/2004		For information only	Receipt Acknowledged

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
053	Soil Cover Test Fill W.P.	11/18/2004	12/3/2004		The work was never performed. The W.P. was cancelled.	Submitted
054	Record Survey 11/13/04	11/19/2004	12/12/2004		For information only	Receipt Acknowledged
055	Pond Sediment Sampling W.P.	12/10/2004	N/A		The work was not performed by Stoller. The W.P. was cancelled.	Submitted
056	Ground Pressures - Volvo Haul Trucks	11/22/2004	1/28/2005		Volvo trucks OK to use on 10" cushion and 2' cover	Receipt Acknowledged
057	North Firing Range Soil Sampling W.P.	11/23/2004	12/11/2004			Approved
058	Rock Layer Strength Test Results	11/29/2004	11/30/2004			Approved
059	Record Survey 11/20/04	11/30/2004	12/12/2004		For information only	Receipt Acknowledged
060	Record Survey 11/27/04	12/1/2004	12/12/2004		For information only	Receipt Acknowledged
061	Record Survey 12/4/04	12/10/2004	1/8/2005		For information only	Receipt Acknowledged
062	Record Survey 12/11/04	12/17/2004	1/8/2005		For information only	Receipt Acknowledged
063	Record Survey 12/18/04	1/4/2005	1/8/2005		For information only	Receipt Acknowledged
064	Bulldozer Ground Pressure Test on Rock Layer W.P.	12/21/2004	12/21/2004			Approved
065	Record Survey 12/25/04	1/11/2005	1/30/2005		For information only	Receipt Acknowledged
066	TRI Interface Shear Test Reports	1/12/2005	1/18/2005		Incomplete. Needs maximum results and results of third test.	Resubmitted - See Submittal No. 082

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
067	Soil Cover W.P.	1/12/2005	1/21/2005			Approved
068	East Face Clear & Grub W.P.	1/13/2005	1/19/2005			Approved
069	GCL - DN Certifications	1/17/2005	1/20/2005		See Submittal No. 149 for ST Information	Approved as Corrected
070	Vent Vertical Boot Detail	1/18/2005	1/29/2005		Correction on sketch in file	Approved as Corrected
071	Baker Tank Cleanout W.P.	1/20/2005	1/21/2005		Use as little water as possible.	Approved
072	North Firing Range Soil Sampling Test Results	1/21/2005	1/30/2005			Approved
073	East Face Panel Layouts	1/27/2005	N/A		See Submittal No. 096	Submitted
074	East Face Buttress Fill W.P.	1/27/2005	1/27/2005			Approved
075	Record Survey 1/8/05	1/28/2005	1/31/2005		For information only	Receipt Acknowledged
076	Record Survey 1/15/05	1/28/2005	1/31/2005		For information only	Receipt Acknowledged
077	Record Survey 1/22/05	1/28/2005	1/31/2005		For information only	Receipt Acknowledged
078/078A	Sand Cone Density Test - 10" Cushion	1/28/2005	3/18/2005		Provide Density Gauge Results	Receipt Acknowledged
079	North Firing Range D422 Test Data	1/29/2005	3/18/2005			Receipt Acknowledged
080	Seep Capture System Repair W.P.	2/2/2005	2/5/2005	2/4/2005	(Existing Seep System)	Approved

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
081	Strip Drains	2/2/2005	3/18/2005		Verbal Approval given on 2/6/05	Approved
082	TRI Interface Friction Test Results	2/2/2005	2/20/2005			Receipt Acknowledged
083	Truck Recovery W.P.	2/3/2005	2/3/2005			Approved
084	Record Survey 1/29/05	2/4/2005	2/20/2005		For information only	Receipt Acknowledged
085	B371 Stockpile Soil Sampling Test Results	2/10/2005	4/1/2005			Receipt Acknowledged
086	Earthwork Volume Calculations	2/15/2005	3/18/2005	2/16/2005		Receipt Acknowledged
087	Record Survey 2/5/05	2/21/2005	3/18/2005		For information only	Receipt Acknowledged
088	Record Survey 2/12/05	2/25/2005	3/18/2005		For information only	Receipt Acknowledged
089	Erosion Mat Offload W.P.	2/21/2005	2/22/2005			Approved
090	Seep Treatment System Cost Estimate	2/22/2005	5/2/2005		Remove requirement of 40-hr training	Revise & Resubmit/Receipt Acknowledged
091	Rock Layer QC Test Results	2/23/2005	3/18/2005			Receipt Acknowledged
092	East Face Liner Certifications	2/23/2005	3/18/2005		Also See submittal No. 149	Receipt Acknowledged
093	Test Results on Drain Rock for Vent Systems	2/23/2005	3/18/2005			Approved
094	Rock Strength Test Data	2/23/2005	3/19/2005			Approved

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
095	Soil Cover D422 Test Data	2/23/2005	3/18/2005			Receipt Acknowledged
096	East Face Panel Layouts	3/1/2005	3/21/2005		Place highest asperity side of textured FML up towards GDN	Approved as Corrected
097	East Face Liner W.P.	3/2/2005	3/21/2005			Approved
098	Asbestos Removal W.P.	3/7/2005	3/7/2005			Approved
099	Soil Cover On-site Sampling W.P.	3/7/2005	3/7/2005			Approved
100	New Seep System Excavation and Repair W.P.	3/8/2005	3/9/2005			Approved
101	Test Results on 2" Material from 280 Stockpile	3/9/2005	3/18/2005			Receipt Acknowledged
102	Record Survey 2/19/05	3/9/2005	3/18/2005		For information only	Receipt Acknowledged
103	Rocky Flats Alluvium D5519 Test Results	3/14/2005	3/18/2005			Receipt Acknowledged
104	Perimeter Channel Certification	3/14/2005	3/18/2005		Certs need to be obtained from QA	Not Approved
105	East Face Upper Cushion W.P.	3/16/2005	3/25/2005		Revise per input from EarthTech on equipment allowed on cover	Receipt Acknowledged
106	Rocky Flats Alluvium D5519 Test Results	3/16/2005	3/18/2005			Receipt Acknowledged
107	New Seep Aeration Box - Concrete and Grating	3/18/2005	3/22/2005		Obtain embedment angles for fiberglass grating	Approved as Corrected
108	Record Survey 2/26/05	3/21/2005	4/1/2005		For information only	Receipt Acknowledged

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
109	Record Survey 3/5/05	3/21/2005	4/1/2005		For information only	Receipt Acknowledged
110	Record Survey 3/12/05	3/21/2005	4/1/2005		For information only	Receipt Acknowledged
111	Track Loader Weight and Ground Pressure Information	3/23/2005	4/1/2005			Receipt Acknowledged
112	Soil Cover QC Sampling Test Results - D422 only	3/23/2005	4/2/2005			Receipt Acknowledged
113	Erosion Mat Certification Reports	3/23/2005	4/2/2005			Approved
114	Soil Cover Test Results - D5519 & D422	3/28/2005	4/2/2005			Receipt Acknowledged
115	East Face Rock Layer W.P.	3/30/2005	4/1/2005		Include discussions on placement and spreading of rock layer on slope	Approved
116	Seep Treatment System Construction W.P.	3/31/2005	4/1/2005		Revise as per 4/1/05 meeting	Approved
117	Record Survey 3/19/05	3/31/2005	3/31/2005		For information only	Receipt Acknowledged
118	Record Survey 3/26/05	3/31/2005	4/1/2005		For information only	Receipt Acknowledged
119	Concrete Reinforcing Shop Drawings	4/7/2005	5/2/2005		Missing Information provided on 05/13/05	Revise & resubmit/Approved
120	Preliminary Demobilization W.P.	4/11/2005	4/13/2005			Approved
121	Resume of Jim Erickson	4/13/2005	5/2/2005			Receipt Acknowledged
122/122A	Fiber Reinforced Concrete	4/13/2005	5/2/2005	5/10/2005		Approved

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
123	East Face Soil Cover W.P.	4/15/2005	4/18/2005			Approved
124	PVC Bell & Sipgot Piping	4/21/2005	5/2/2005			Approved
125	Final Demobilization W.P.	4/21/2005	4/28/2005		Add ripping of compacted soil areas	Approved as Corrected
126	Project Photo Log/CD	5/7/2005	5/9/2005			Receipt Acknowledged
127	FML Archive Destructs	5/9/2005	N/A		Retained until project file closeout	Submitted
128	Pea Gravel Bulk Gradations	5/9/2005	5/9/2005			Approved
129	Culvert &ADS Pipe Info	5/17/2005	5/19/2005			Approved
130	Redlines/QC Data	5/16/2005	5/17/2005			Receipt Acknowledged
131	As-Built Construction Schedule	5/18/2005	5/23/2005		Provide in "pdf" format	Receipt Acknowledged
132	Competed Work Packages	5/18/2005	N/A			Receipt Acknowledged
133	Additional "Redlined" Drawings	5/18/2005	N/A			Receipt Acknowledged
134	Draft QC Reports	5/18/2005	5/18/2005			Receipt Acknowledged
135	Vent Cap	5/18/2005	7/7/2005	7/6/2005		Approved
136	Completed Work packages	5/18/2005	N/A			Receipt Acknowledged

Submittal Log
Present Landfill Accelerated Action Construction Project
Rocky Flats Environmental Technology Site

Shaded Submittals are included in Appendix D of CCR

Submittal No.	Description	Date Received	Date Returned	Revised Date	Submittal Comments	Status
137	Seep Treatment System Rebar Certifications	5/20/2005	6/20/2005			Receipt Acknowledged
138	Seep System Draft As-built drawing	5/21/2005	6/15/2005		Revision requested along with other as-built and record drawings	Revise & Resubmit/See Submittal No. 142
139	Certified Payroll	6/15/2005	N/A			Receipt Acknowledged
140	Golder QC Data Packages	6/15/2005	N/A			Receipt Acknowledged
141	Material Quantities	6/14/2005	N/A			Receipt Acknowledged
142	Record & As-built Drawings	6/14/2005	6/15/2005		Additional Revisions	Receipt Acknowledged
143	Certified Payroll	6/16/2005	N/A			Receipt Acknowledged
144	Certified Payroll	7/7/2005	7/7/2005			Receipt Acknowledged
145	Grating Support Shop Drawing	5/25/2005	5/25/2005			Approved
146	Additional QC Daily Reports	7/7/2005	7/7/2005			Receipt Acknowledged
147	Sch. 80 PVC Pipe	7/7/2005	7/7/2005			Approved
148	HDPE Pipe	7/7/2005	7/7/2005			Approved
149	Additional MQC Data (ST)	7/7/2005	7/8/2005	7/8/2005		Approved
150	Concrete Manhole & Alum. Covers	7/11/2005	7/12/2005			Approved

APPENDIX D-2: TECHNICAL AND MATERIAL SUBMITTALS

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: July 7, 2004	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To: Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	From: Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026	Subcontract No: KH020577	Submittal No. 003 Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document: Spec. Paragraph No.	Contract Reference Document: Drawing Sheet No.	Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
a.	b.	c.	d.	e.	f.	g.	h.
1	Detailed Schedule	N/A	4	SOW 5.0	N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☒ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert Davis DATE: 07/31/04

Remarks: Stoller understands this schedule to fulfill the requirements of Statement of work Section 5.0, Sprecial Provision 30, and specification 01100, Section 1.4.B. Rolling 4-Week schedules will be submitted at the weekly progress meetings.

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

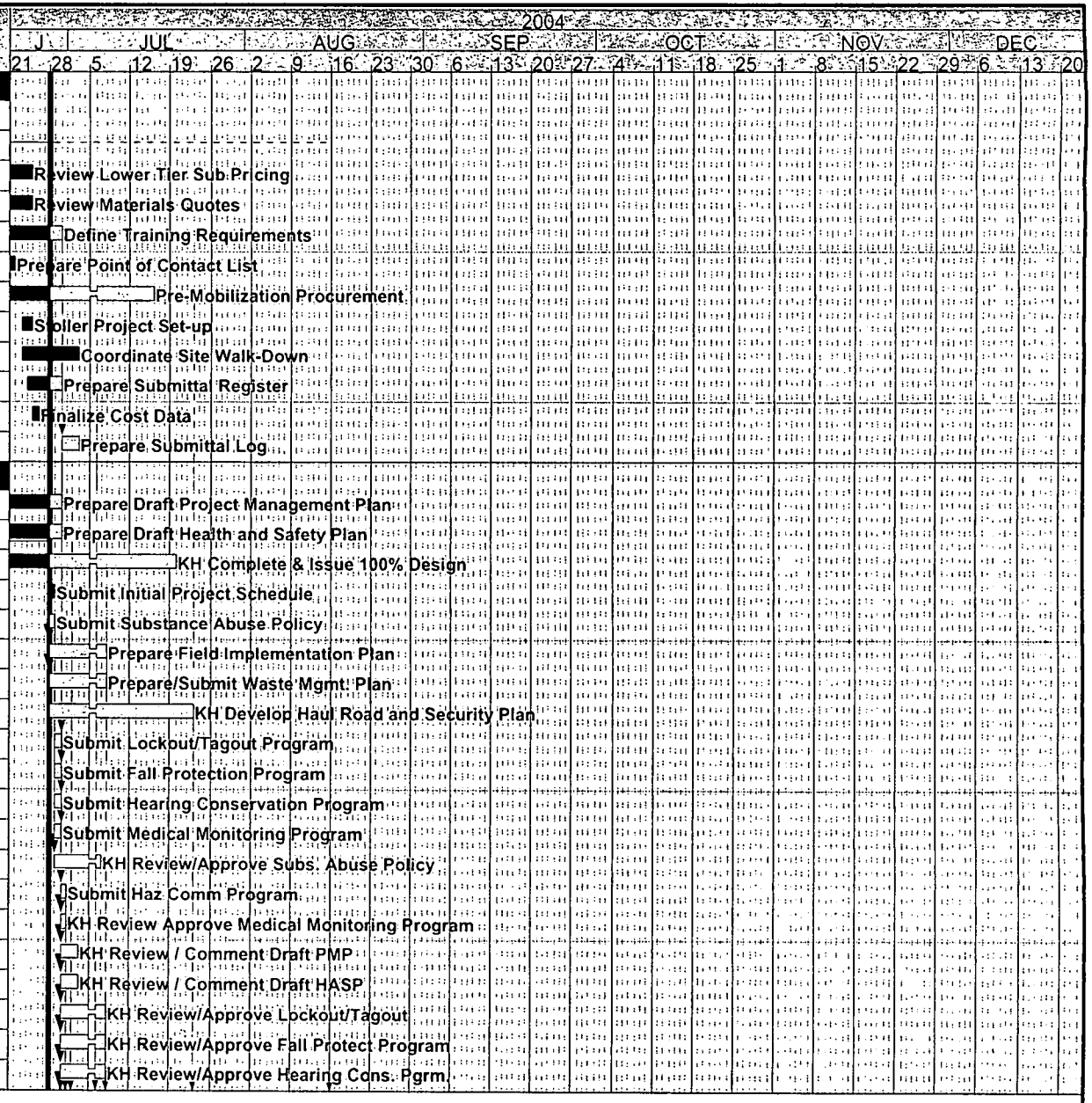
Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

Provide Updated Total Project Schedule
Every Two Weeks at Weekly Construction Meeting
(OK CQA [illegible] Tetratech)
RWD

Activity Description	Orig Dur	Total Float	Early Start	Early Finish
Subcontract Administration				
Project Kick-Off Meeting	1		17JUN04A	17JUN04A
K-H Award Contract	0		18JUN04A	
Review Lower Tier Sub Pricing	1		18JUN04A	24JUN04A
Review Materials Quotes	1		18JUN04A	24JUN04A
Define Training Requirements	7	15	18JUN04A	29JUN04
Prepare Point of Contact List	1		21JUN04A	21JUN04A
Pre-Mobilization Procurement	13	13	21JUN04A	15JUL04
Stoller Project Set-up	1		23JUN04A	24JUN04A
Coordinate Site Walk-Down	5	0	23JUN04A	02JUL04
Prepare Submittal Register	4	1	24JUN04A	29JUN04
Finalize Cost Data	1		25JUN04A	25JUN04A
Prepare Submittal Log	3	1	30JUN04	02JUL04
Premobilization Plans & Submittals				
Prepare Draft Project Management Plan	7	13	18JUN04A	29JUN04
Prepare Draft Health and Safety Plan	7	13	18JUN04A	29JUN04
KH Complete & Issue 100% Design	21*	11	18JUN04A	19JUL04
Submit Initial Project Schedule	1	0	28JUN04*	28JUN04
Submit Substance Abuse Policy	1	20	28JUN04	28JUN04
Prepare Field Implementation Plan	7	8	28JUN04	07JUL04
Prepare/Submit Waste Mgmt. Plan	7	14	28JUN04	07JUL04
KH Develop Haul Road and Security Plan	20	18	28JUN04	22JUL04
Submit Lockout/Tagout Program	1	19	29JUN04	29JUN04
Submit Fall Protection Program	1	19	29JUN04	29JUN04
Submit Hearing Conservation Program	1	19	29JUN04	29JUN04
Submit Medical Monitoring Program	1	23	29JUN04	29JUN04
KH Review/Approve Subs. Abuse Policy	5	20	29JUN04	06JUL04
Submit Haz Comm Program	1	18	30JUN04	30JUN04
KH Review Approve Medical Monitoring	1	23	30JUN04	30JUN04
KH Review / Comment Draft PMP	3	15	30JUN04	02JUL04
KH Review / Comment Draft HASP	3	15	30JUN04	02JUL04
KH Review/Approve Lockout/Tagout	5	19	30JUN04	07JUL04
KH Review/Approve Fall Protect Program	5	19	30JUN04	07JUL04
KH Review/Approve Hearing Cons. Pgrm.	5	19	30JUN04	07JUL04



Start Date	17JUN04
Finish Date	13DEC04
Data Date	28JUN04
Run Date	08JUL05 08:26

© Primavera Systems, Inc.

Early Bar
Progress Bar
Critical Activity

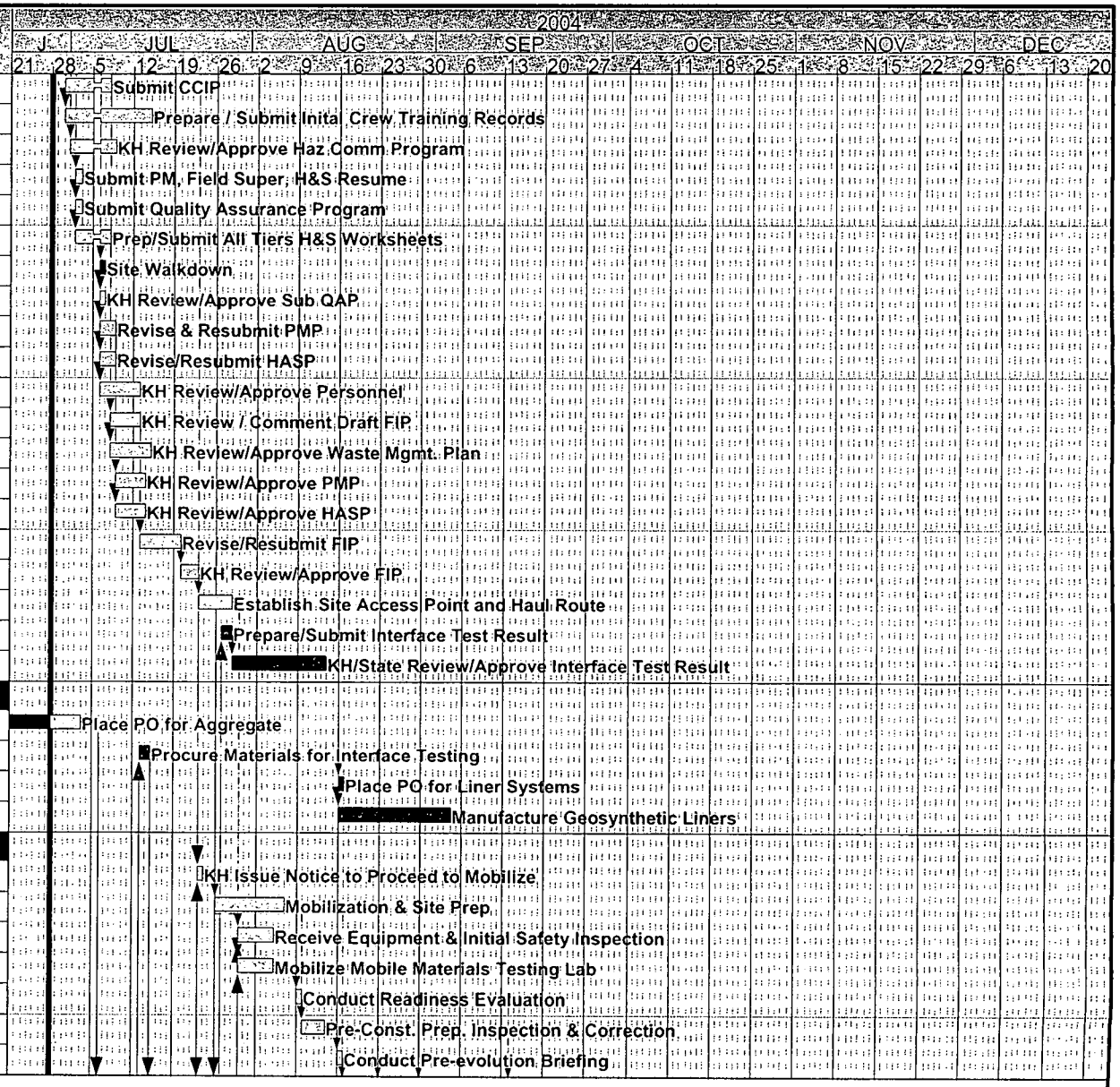
RFLF

Sheet 1 of 3

Stoller Team
Rocky Flats Landfill Cap
Four Week Rolling Schedule

Date	Revision	Checked	Approved

Activity Description	Orig Dur	Total Float	Early Start	Early Finish
Submit CCIP	5	19	30JUN04	07JUL04
Prepare / Submit Inital Crew Training	10	15	30JUN04	14JUL04
KH Review/Approve Haz Comm Program	5	18	01JUL04	08JUL04
Submit PM, Field Super, H&S Resume	1	16	02JUL04	02JUL04
Submit Quality Assurance Program	1	20	02JUL04	02JUL04
Prep/Submit All Tiers H&S Worksheets	3	19	02JUL04	07JUL04
Site Walkdown	1	0	06JUL04*	06JUL04
KH Review/Approve Sub QAP	1	20	06JUL04	06JUL04
Revise & Resubmit PMP	3	15	06JUL04	08JUL04
Revise/Resubmit HASP	3	15	06JUL04	08JUL04
KH Review/Approve Personnel	5	16	06JUL04	12JUL04
KH Review / Comment Draft FIP	3	8	08JUL04	12JUL04
KH Review/Approve Waste Mgmt. Plan	5	14	08JUL04	14JUL04
KH Review/Approve PMP	3	15	09JUL04	13JUL04
KH Review/Approve HASP	3	15	09JUL04	13JUL04
Revise/Resubmit FIP	5	8	13JUL04	19JUL04
KH Review/Approve FIP	3	8	20JUL04	22JUL04
Establish Site Access Point and Haul	1	18	23JUL04	28JUL04
Prepare/Submit Interface Test Result	2	0	27JUL04	28JUL04
KH/State Review/Approve Interface Test	12	0	29JUL04	13AUG04
Procurement				
Place PO for Aggregate	11	105	18JUN04A	02JUL04
Procure Materials for Interface Testing	2	0	13JUL04	14JUL04
Place PO for Liner Systems	1	0	16AUG04	16AUG04
Manufacture Geosynthetic Liners	15	0	16AUG04	03SEP04
Mobilization				
KH Issue Notice to Proceed to Mobilize	1	8	23JUL04	23JUL04
Mobilization & Site Prep	10	8	26JUL04	06AUG04
Receive Equipment & Initial Safety	4	17	30JUL04	04AUG04
Mobilize Mobile Materials Testing Lab	4	27	30JUL04	04AUG04
Conduct Readiness Evaluation	1	8	09AUG04	09AUG04
Pre-Const. Prep. Inspection & Correction	4	8	10AUG04	13AUG04
Conduct Pre-evolution Briefing	1	8	16AUG04	16AUG04



Start Date	17JUN04
Finish Date	13DEC04
Data Date	28JUN04
Run Date	08JUL05 08:26

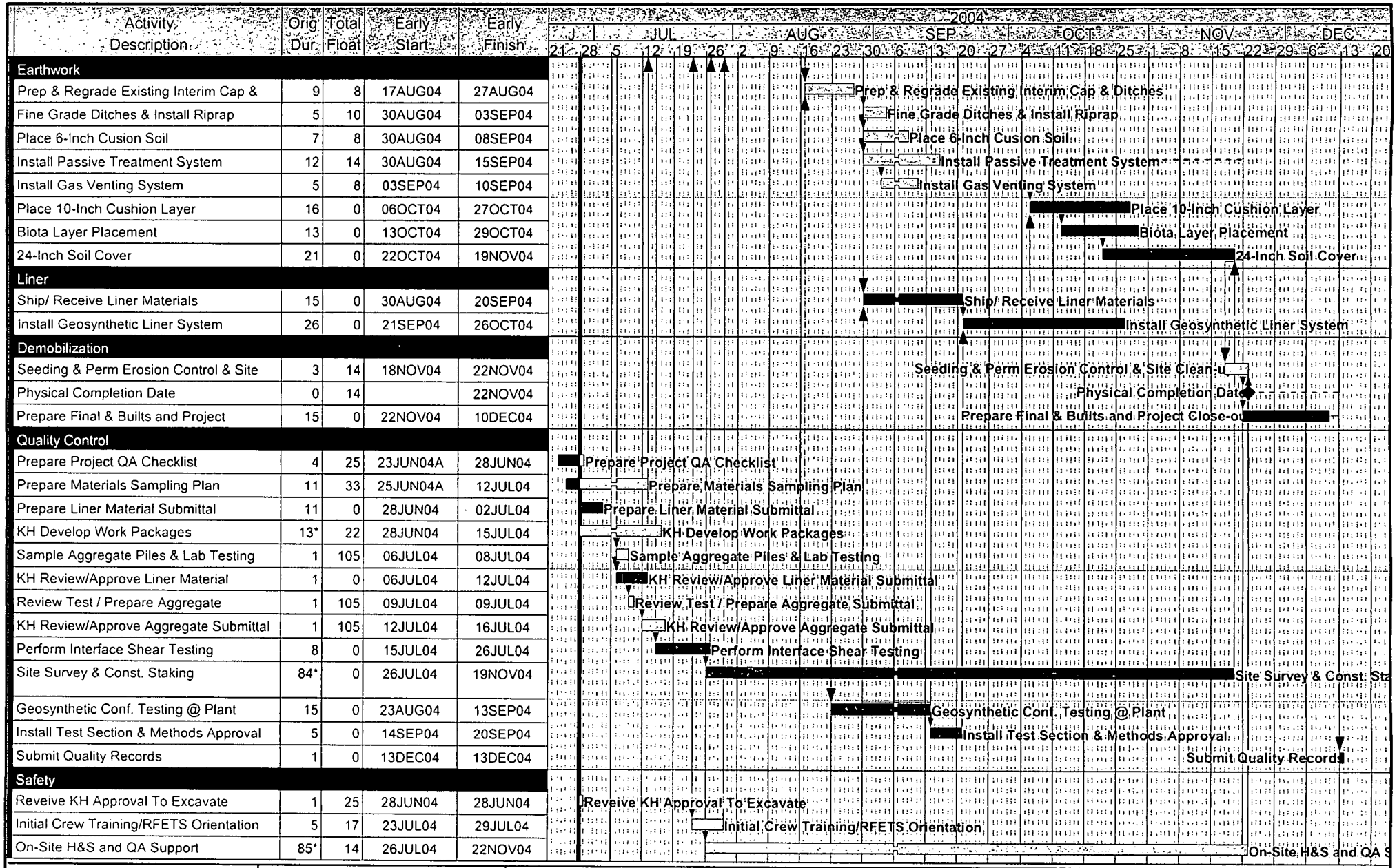
© Primavera Systems, Inc.

Early Bar
Progress Bar
Critical Activity

RFLF

Stoller Team
Rocky Flats Landfill Cap
Four Week Rolling Schedule

Date	Revision	Checked	Approved



Activity Description	Orig Dur	Total Float	Early Start	Early Finish
Earthwork				
Prep & Regrade Existing Interim Cap &	9	8	17AUG04	27AUG04
Fine Grade Ditches & Install Riprap	5	10	30AUG04	03SEP04
Place 6-Inch Cusion Soil	7	8	30AUG04	08SEP04
Install Passive Treatment System	12	14	30AUG04	15SEP04
Install Gas Venting System	5	8	03SEP04	10SEP04
Place 10-Inch Cushion Layer	16	0	06OCT04	27OCT04
Biota Layer Placement	13	0	13OCT04	29OCT04
24-Inch Soil Cover	21	0	22OCT04	19NOV04
Liner				
Ship/ Receive Liner Materials	15	0	30AUG04	20SEP04
Install Geosynthetic Liner System	26	0	21SEP04	26OCT04
Demobilization				
Seeding & Perm Erosion Control & Site	3	14	18NOV04	22NOV04
Physical Completion Date	0	14		22NOV04
Prepare Final & Builts and Project	15	0	22NOV04	10DEC04
Quality Control				
Prepare Project QA Checklist	4	25	23JUN04A	28JUN04
Prepare Materials Sampling Plan	11	33	25JUN04A	12JUL04
Prepare Liner Material Submittal	11	0	28JUN04	02JUL04
KH Develop Work Packages	13*	22	28JUN04	15JUL04
Sample Aggregate Piles & Lab Testing	1	105	06JUL04	08JUL04
KH Review/Approve Liner Material	1	0	06JUL04	12JUL04
Review Test / Prepare Aggregate	1	105	09JUL04	09JUL04
KH Review/Approve Aggregate Submittal	1	105	12JUL04	16JUL04
Perform Interface Shear Testing	8	0	15JUL04	26JUL04
Site Survey & Const. Staking	84*	0	26JUL04	19NOV04
Geosynthetic Conf. Testing @ Plant	15	0	23AUG04	13SEP04
Install Test Section & Methods Approval	5	0	14SEP04	20SEP04
Submit Quality Records	1	0	13DEC04	13DEC04
Safety				
Reveive KH Approval To Excavate	1	25	28JUN04	28JUN04
Initial Crew Training/RFETS Orientation	5	17	23JUL04	29JUL04
On-Site H&S and QA Support	85*	14	26JUL04	22NOV04

Start Date 17JUN04
Finish Date 13DEC04
Data Date 28JUN04
Run Date 08JUL05 08:26

© Primavera Systems, Inc.

Early Bar
Progress Bar
Critical Activity

RFLF

Sheet 3 of 3

Stoller Team
Rocky Flats Landfill Cap
Four Week Rolling Schedule

Date	Revision	Checked	Approved

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: July 7, 2004	X	New Submittal
			Resubmittal

Section I **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:		
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	**Paul Kreitz** **S.M. Stoller Corporation** **990 South Public Road, Suite A** **Lafayette, CO 80026**	**Subcontract No: KH020577**	**Submittal No. 005** **Previous Submittal No.**

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	GSE Untraflex 40 Mil LLDPE	See Attached	6	02225	N/A	X	
2	GSE Ultraflex 40 Mil Textured LLDPE	See Attached	6	02225		X	
3	Texdrain 200 DS	See Attached	6	02224			
4	Bentomat ST	See Attached	6	02226		X	

Remarks: LLDPE Tear resistance passes minimum value when expressed in English units, but is 2% low in the metric (Newtons) expression.

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Rocky Flats Plant

☐ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☒ REVISE AND RESUBMIT

Reviewed

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Robert Davis DATE: 07/31/2004

See Attached Comments

Section II

Enclosures Returned (List by Item No.)

Title and Signature of Accepting Authority:

Date:

SUBMITTAL TRANSMITTAL FORM

Instructions

1. Section I will be initiated by the Subcontractor.

2. Each submittal shall be numbered consecutively in the space titled "Submittal No." beginning with Number 001. This number, in addition to the contract number and specification number, will form a serial number for identifying each submittal. For new submittals, mark the appropriate box; on resubmittals, insert submittal number of last submission and use the original submittal number with an alphabetic suffix; e.g., 001-A.

3. Separate submittal forms shall be used for each specification section. Multiple items under the same specification section may be included on one submittal form.

4. The "Item No." shall be consecutive from 1 to the last item on a submittal.

5. Submittals requiring expeditious handling shall be submitted separately and shall so state in bold type in the remarks area. There is no guarantee of expeditious handling.

6. A check shall be placed in Column "g" when a submittal is not in accordance with the plans and specifications–also, a written statement to that effect shall be included in the space titled "Remarks".

7. Form is self-transmittal; letter of transmittal is not required.

8. When a sample material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in Column "c" Section I.

9. Contractor will assign action codes as indicated below in spaces provided in Section I, Column "h" to each item submitted and complete Section II of the form.

   The following action codes are given to items submitted:
   - A Proceed
   - B Proceed except as noted
   - C Revise and Resubmit
   - D Disapproved
   - E Receipt Acknowledged

10. Review of items does not relieve the Subcontractor from complying with all requirements of the contract plans and specifications.

Attachments:

Line 1 GSE Untraflex 40 Mil LLDPE

- Product Data Sheet (1)
- GSE Ultraflex, 40 Mil, Sample (2)

Line 2 GSE Ultraflex 40 Mil Textured LLDPE

- Product Data Sheet (1)
- GSE Ultraflex Textured 40 Mil, Sample (2)

Line 3 Texdrain 200 DS 8

- Certified Properties
- Texdrain Geocomposite Installation Guidelines
- Texdrain Geocomposite Manufacturing Quality Assurance and Quality Control

Line 4 Bentomat ST

- Certified Properties
- Product Sample
- Bentomat Claymax Installation Guidelines
- SGI Testing Services Letter, 18 March 2002
- GCL Performance & Design Reference (TR-327)
- Manufacturing Quality Assurance and Quality Control Manual (TR-403)
- Construction Quality Assurance (CQA) Manual (TR-404)
- CETCO Lining Technologies Letter, June 28, 2004 to Colorado Lining

Additional Attachments

- Colorado Lining Certification from GSE
- GSE Geomembranes Manufacturing Quality Assurance Manual

GSE July 07 2004 Certification letter

Davis, Robert W.

From: Archibald, Ryan [Ryan.Archibald@earthtech.com]
Sent: Tuesday, July 13, 2004 9:47 AM
To: Davis, Robert W.
Cc: Thompson, Randy
Subject: Geosynthetic Material Submittal Comments

Hey Bob,

Attached are comments on the submittal you provided yesterday. I checked all data to both the Specs and QA/QC Plan. I do have some minor edits to the specs based on the submittal. I will send you the latest versions when completed.

Thanks,
Ryan

Geosynthetic Submittal Comment...

<<Geosynthetic Submittal Comments.doc>>

Geosynthetic Materials Submittal
July 13, 2004
Comments

GENERAL

The information provided is used to demonstrate that the manufacturer can produce geosynthetics that meet specifications. Per Table 4.1 of the QA/QC Plan, QC personnel must prove that the specific project material (delivered to the site) meets the requirements in the QA/QC Plan and Specifications. This will be accomplished with manufacturer certification sheets similar to the one provided with the GDN information. It is the responsibility of the third party QA to then sample the material delivered to the site at the frequencies listed in Table 4.1.

GDN

1. The GDN specification discusses resin properties (Section 2.01 C). From the cut-sheet provided, I could not verify that the resin used to produce the geonet meets these requirements. I assume the resin information provided with the LLDPE information is applicable. If so, the GDN properties are acceptable.

2. The GDN specification states anchor ties every 6-inches not every 12-inches as stated in the TexDrain Geocomposite Installation Guidelines.

3. The GDN specification states the GDN overlap shall be 3-inches on the edges and 6-inches on the ends. The TexDrain Geocomposite Installation Guidelines states 4-inches on the edges and 12-inches on the ends. This is acceptable, but leads to slightly larger material requirements.

4. The Geocomposite Certification Sheet should include all tests provided in Table 4.1 of the QA/QC Plan.

GCL

1. The GCL Internal Shear Strength test frequency is listed as "Periodic". Per Table 4.1 of the QA/QC Plan, please provide the frequency for QA/QC approval.

2. The memo dated June 28, 2004 states that the bentonite will be tested for swell index (ASTM D 5890) at 1 per 50 tons. The GCL MQA Manual states 1 per 50 tonnes. Please clarify which frequency is correct for the swell index and moisture content tests.

3. The memo dated June 28, 2004 states that CETCO will provide GCL with standard mass per unit rate of 0.893 lbs/ft^2. Please note that the revised Specification 02226

states 0.75 lbs/ft^2. An increased density is of course acceptable so long as the other properties are met.

4. The SuperGroove seam enhancement includes a precision cut in the GCL. This may make the Regulators nervous. Can the liner subcontractor provide project specific information on use of the SuperGroove or if it is incorporated into modeling? Does GRI endorse the SuperGroove? Which column in Table 1 of the SuperGroove submittal represents the SuperGroove test?

5. The CQA Manual provided is useful but during construction, the liner contractor must install GCL in accordance with the approved QA/QC Plan.

6. During construction, the manufacturer must provide a GCL Certification Sheet similar to that included with the GDN information. The sheet will show results of all tests required by the QA/QC Plan and Specifications.

7. Please include in the GCL Certification Sheet verification that needle punched nonwoven geotextiles have been inspected for broken needles (per Specification 02226 Section 1.03 Part A Number 5.

LLDPE

1. 60-mil LLDPE information provided is acceptable.

2. During construction, the manufacturer must provide a LLDPE Certification Sheet similar to that included with the GDN information. The sheet will show results of all tests required by the QA/QC Plan and Specifications.

GEOSYNTHETIC COMPOSITE DRAINAGE NET

Submittal Information

Present Landfill Accelerated Action Construction Project

Rocky Flats Technology Site

August 12, 2004

CETCO LINING TECHNOLOGIES

Certified Properties

TexDrain™ 200 DS 8
Certified Properties

TD 200 DS 8 is a superior quality composite drainage product produced by thermally laminating two 8 ounce per square yard nonwoven geotextiles to a core of high-flow polyethylene drainage net. TexDrain Geocomposites are designed to provide high capacity planar flow of liquids, with integrated protection from clogging and damage protection for adjacent geomembranes.

TD 200 DS 8 and individual components conform to the physical property values listed below:

200 mil GEONET PROPERTIES	TEST METHOD	UNITS	VALUE
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.162
Thickness	ASTM D 5199	mils	200
Polymer Density	ASTM D 1505	g/cm^3	0.940
Transmissivity[1]	ASTM D 4716	g/min/ft (m^2/s)	4.8 (1.0×10^{-3})
Carbon Black	ASTM D 1603	%	2
Tensile Strength	ASTM D 5035 (mod)	lbs/in	45

1 -Transmissivity measured using water at 20 Degrees C (68 degree F) with a gradient of one, under a confining pressure of 15,000 psf, between two steel plates, after 1 hour. Values may vary based on dimension of the transmissivity specimen and specific laboratory.

GEOTEXTILE PROPERTIES[2]	TEST METHOD	UNITS	VALUE
Weight	ASTM D 5261	oz/yd^2	8.0
Grab Tensile	ASTM D 4632	lbs	203
Puncture	ASTM D 4833	lbs	130
Mullen Burst	ASTM D 3786	psi	450
Water Flow Rate	ASTM D 4491	gpm/ft^2	110
AOS	ASTM D 4751	US Sieve	100 sieve

2 - Prior to lamination to geonet core. Thermal lamination may alter these properties.

GEOCOMPOSITE PROPERTIES	TEST METHOD	UNITS	VALUE
Transmissivity[3]	ASTM D 4716	g/min/ft (m^2/s)	0.19 (4.0×10^{-5})
Peel Adhesion	ASTM D 413	lbs/in	1

3 - Transmissivity measured under a gradient of one, under a confining pressure of 15,000 psf, between two steel plates, after 1 hour. Values may vary based on dimension of the transmissivity specimen and specific laboratory.

ROLL DIMENSIONS[4]	WIDTH	LENGTH	AREA	WEIGHT
	13.5 feet	200 feet	2,700 feet	750 lbs

4 - Weight is nominal. Length subject to change based on optimized shipping dimensions.

CETCO® LINING TECHNOLOGIES

TR-711
Revised 12/02

1500 West Shure Drive Arlington Heights, IL 60004 USA 800.527.9948 Fax 847.577.5571
For the most up-to-date product information please visit our website, www.cetco.com
A wholly owned subsidiary of AMCOL International Corporation

The information and data contained herein are believed to be accurate and reliable, CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

CETCO LINING TECHNOLOGIES

TexDrain®
GEOCOMPOSITE
INSTALLATION GUIDELINES

1.0 Handling and Placement

All TexDrain Geocomposites shall be handled in a manner to ensure they are not damaged. The following special handling requirements shall be adhered to:

1.1 On slopes the TexDrain Geocomposite shall be secured in the anchor trench and then rolled down the slope. It should be deployed in such a manner as to continually keep the TexDrain Geocomposite sheet in sufficient tension to reduce folds and wrinkles.

1.2 In the presence of high wind, all TexDrain Geocomposites shall be weighted with sandbags or the equivalent.

1.3 TexDrain Geocomposite shall be cut using an approved cutter (i.e., hook blade). If the material is being cut in place, special care must be taken to protect other geosynthetic materials from damage.

1.4 Care shall be taken not to entrap stones or excessive dust that could damage the TexDrain Geocomposite or geomembrane, or generate clogging of drains or filters.

2.0 Seams and Overlaps

TexDrain Geocomposites may be seamed by overlapping and tying the geonet with an approved method (eg. wire ties) and overlapping the geotextiles by either thermal bonding or sewing the geotextiles per the project specifications.

2.1 When connecting the rolls side to side, the geonet shall be overlapped a minimum of four inches and tied. Tying shall be every five feet to ten feet across the bottom of the

TR-701
Revised 10/02

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

panel and every five feet along the length of the geonet panel. At The top of the slope, the geocomposite in the anchor trench shall be tied at one foot internals.

When connecting geocomposite rolls end to end, the geonet should be overlapped a minimum of one foot and tied every 12 inches across the roll. The geotextiles should be overlapped and thermal bonded or sewn per project specifications. No horizontal seams shall be allowed on side slopes greater than 4:1, unless approved by the design or CQC/CQA engineer.

2.2 Tying of the geonet will be with plastic fasteners (eg. wire ties). Tying devices shall be white or yellow for easy inspection. Metallic devices are not allowed.

2.3 On slopes steeper than 10 horizontal to one vertical, it is recommended that the TexDrain Geocomposite geotextile be continuously sewn. The geotextile must be overlapped by a minimum of four inches.

2.4 On bottoms areas or slopes less than ten horizontal to one vertical, TexDrain Geocomposites shall be sewn, thermally bonded, or overlapped per the project specifications.

3.0 Repairs

The repair will be observed and if smaller than three feet by three feet, the TexDrain Geocomposite will be repaired. If the tear or hole is larger, then the roll will be cut and a butt joint placed.

3.1 If the geonet is undamaged, and the geotextile is damaged, a patch of geotextile shall be placed. The geotextile patch shall be thermally bonded in place and shall be thermal bonded a minimum of twelve inches in all directions.

The information contained herein has been compiled by CETCO. This information is provided gratis and is intended only as a guideline. Installation is the sole responsibility of the Contractor. There is no implied or expressed warranty regarding installation of this product.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

CETCO LINING TECHNOLOGIES

TexDrain® Geocomposite
Manufacturing Quality Assurance and Quality Control

1.1 TexDrain Drainage Net

TexDrain drainage net consists of approximately 97% polyethylene, 2 to 3% carbon black, and up to 1% antioxidants. The drainage net is continuously monitored during the manufacturing process. The key element to successfully manufacturing high quality drainage nets is to maintain consistency in both the raw material and the process. Raw material consistency is established in the laboratory when the resin is initially received and tested. An on-line quality control monitor establishes consistency during the processing. This representative of the quality department has been specially trained to monitor the process and the products during the manufacturing process. The on-line quality monitor can place material on hold if the material has any visual defects or dimensional abnormalities. All materials placed on hold will be further inspected and tested. If the material passes specification and is approved by the quality control manager and/or production manager, the material will then be released into stock. If the material fails to pass the specification or does not get approval of the quality control manager or production manager then the material will be reclassified or scrapped. In either case it cannot be sold as a prime TexDrain drainage net.

1.2 TexDrain Geocomposite

TexDrain geocomposites consist of a geotextile bonded to one or both sides of the CETCO drainage net. All geotextiles must meet the specifications before being eligible for production of geocomposites. CETCO utilizes a heat bonding process to laminate the geotextile to the drainage net. An on-line quality control monitor establishes consistency during the processing. This representative of the quality department has been specially trained to monitor the process and the products during the lamination process. The on-line quality monitor can place material on hold if the material has any visual defects or dimensional abnormalities. All materials placed on hold will be further inspected and tested. If the material passes specification and is approved by the quality control manager and/or production manager, the material will then be released into stock. If the material fails to pass the specification or does not get approval of the quality control manager or production manager then the material will be reclassified or scrapped. In either case it cannot be sold as a prime CETCO geocomposite.

TR-702
Revised 10/02

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

1.3 Roll Labeling

Three labels are affixed to each roll as described below:

1. One label on the inside of the core.
2. One label on the face on the roll
3. One label on the end of the roll *An additional label is attached to the laboratory sample.

1.4 Storage, Staging and Shipping of drainage net and Geocomposite Rolls

All drainage net and geocomposite rolls are stretch wrapped prior to moving them to the storage area. Before shipment, all documentation is checked against the information on the roll labels. A full truckload consists of 24 rolls of drainage net and/or geocomposite material.

1.5 Laboratory Testing Program

1.5.1. Drainage Net

A 15 inch wide sample is cut across the width of every 10th roll and brought to the CETCO laboratory for testing. The sample is checked for visual defects and then tested according to the following:

Property	Test Method	Testing Frequency (min.)
Thickness	ASTM D 5199	50,000 sf
Mass per Unit Area	ASTM D 5261	50,000 sf
Density	ASTM D 1505	50,000 sf
Melt Index	ASTM D 1238	50,000 sf
Carbon Black Content	ASTM D 1603	50,000 sf
Tensile Strength	ASTM D 1682 or D 5035	50,000 sf
Transmissivity[1]	ASTM D 4716	100,000 sf

The laboratory manager reviews all test results to insure the product meets the specification. Any roll that does not meet the specification is immediately reported to the on-line quality control manager and the roll(s) is placed on hold for further evaluation.

1.5.2. Geotextile

The manufacturer of the geotextile shall submit quality control test results for the geotextile rolls. The rolls must meet the specifications before they are accepted for production of geocomposites.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

The geotextile manufacturer shall perform the following tests.

Property	Test Method	Testing Frequency (min.)
Unit Weight	ASTM D 5261	50,000 sf
Grab Tensile	ASTM D 4632	50,000 sf
Mullen Burst	ASTM D 3786	50,000 sf
Puncture Resistance	ASTM D 4833	50,000 sf
AOS	ASTM D 4751	100,000 sf
Permittivity	ASTM D 4491	100,000 sf

1.5.3. Geocomposite

A 15 inch wide sample is cut across the width of every 20th roll and brought to the CETCO laboratory for testing. The sample is checked for visual defects and then tested according to the following.

Property	Test Method	Testing Frequency (min.)
Transmissivity[1]	ASTM D 4716	100,000 sf
Peel Adhesion	ASTM D 413 or F904	100,000 sf

1. Transmissivity test is performed with the drainage net or the geocomposite between two steel plates at a hydraulic gradient of 1.0 and a normal pressure of 15,000 psf (718 kPa). The seating time is 15 minutes. The laboratory manager reviews all test results to insure the product meets the specification. Any roll that does not meet the specification is immediately reported to the on-line quality control manager and the roll(s) is placed on hold for further evaluation.

1.6 Quality Control Report

The following reports are sent to the engineer/client as CETCO standard quality control reports. They document the property values of the specific rolls shipped to the project.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

1.6.1. Drainage Net Certification Sheet

TEXDRAIN GEOCOMPOSITE CERTIFICATION

Project No.: _____
Trip No.: _____

Date: _____
Order No.: _____
Certified By: _____

CETCO
1500 West Shure Drive
Arlington Heights, IL 60004

TEST DESCRIPTION					TRANSMISSIVITY	PEEL	
ASTM METHOD					ASTM D 4716	ASTM D 413 or F 904	
MODIFICATIONS						TOP	BOTTOM
UNITS					X 10^{-3} sq m / s	ppi	ppi
SPECIFICATION							
GEOCOMPOSITE ROLL NUMBER	BLEND	GEONET ROLL NUMBER	GEOTEXTILE TOP	GEOTEXTILE BOTTOM			

TR-702
Revised 10/02

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

1.6.2. **Geocomposite Certification Sheet**

TEXDRAIN GEONET CERTIFICATION

	Date:		**CETCO**
	Order No.:		1500 West Shure Drive
Trip No.:	Certified By:		Arlington Heights, IL 60004

TEST DESCRIPTION		THICKNESS	MASS/AREA	CARBON BLACK	ULTIMATE TENSILE STRENGTH	TRANSMISSIVITY
ASTM METHOD		ASTM D 5199	ASTM D 5261	ASTM D 1603	ASTM D 5035	ASTM D 4716
MODIFICATIONS		Avg.		min		
UNITS		mils	lbs / sq ft	%	ppi	X 10^{-3} sq m / s
SPECIFICATION						
ROLL NUMBER	BLEND					

TR-702
Revised 10/02

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information

GEOSYNTHETIC CLAY LINER

Submittal Information

Present Landfill Accelerated Action Construction Project

Rocky Flats Technology Site

August 12, 2004

CETCO
LINING TECHNOLOGIES
800.527.9948 www.cetco.com

MEMO **June 28, 2004**

To: Dan Lahr
Colorado Lining

From: Jim Olsta

cc: Joe Kaul
Kathy Brazeau

Subject: Rocky Flats

Dear Mr. Lahr:

CETCO has reviewed the specifications for the geosynthetic composite drainage net (GDN) and geosynthetic clay liner (GCL). CETCO takes the following exceptions:

- The GDN transmissivity test frequency is listed with two different frequencies. CETCO will test the GDN at a frequency of 1/540,000 sq.ft. as listed in Table 02621-3.
- CETCO cannot test the GCL moisture content, swell index and mass per unit area at a frequency of 1/10,000 sq.ft. at this time of year due to disruption to production. Manufacturing at this test frequency would have to be delayed until October. CETCO GCL clay swell index frequency is 1 per 50 tons and GCL moisture content and mass per unit area frequency is 1/40,000 sq.ft. as recommended in ASTM D5889, *Standard Guide for GCL Manufacturing Quality Control.*
- Also per ASTM D5889, CETCO uses the following test methods; permeability (D5887), swell index (D5890 prior to incorporation into the GCL) and mass per unit area (D 5993).
- Please note CETCO's standard mass per unit area is 0.75lbs/ft2 at o% moisture, however we will provide the specified 0.893lbs/ ft2 for this project at no extra charge.

Extra cost for permeability testing is $300.00 each x 10 extra tests which equals $3000 in extra perm tests required for this project.

If you have any questions, feel free to contact me.

Sincerely,

Jim Olsta
Technical Manager

CETCO® LINING TECHNOLOGIES

Certified Properties

BENTOMAT® ST CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 ml/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 ml max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.6 kg/m^2) min
GCL Grab Strength[3]	ASTM D 4632 ASTM D 6768	200,000 ft^2 (20,000 m^2)	90 lbs (400 N) min 22.5 lbs/in (40 N/cm) min
GCL Peel Strength[3]	ASTM D 4632 ASTM D 6496	40,000 ft^2 (4,000 m^2)	15 lbs (65 N) min 2.5 lbs/in (4.4 N/cm) min
GCL Index Flux[4]	ASTM D 5887	Weekly	1 x 10^{-8} $m^3/m^2/sec$ max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Weekly	5 x 10^{-9} cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typ @ 200 psf 6,500 psf (311 kPa) typ @ 10,800 psf

Bentomat ST is a reinforced GCL consisting of a layer of sodium bentonite between a woven and a nonwoven geotextiles, which are needlepunched together.

Notes

[1] Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

[2] Bentonite mass/area reported at 0 percent moisture content.

[3] All tensile strength and peel strength testing is performed in the machine direction using 4 inch grips per modified ASTM D 4632. Results are reported as minimum average roll values unless otherwise indicated. Upon request, tensile strength can be reported per ASTM D 6768 and peel strength can be reported per ASTM D 6496.

[4] Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of $5x10^{-9}$ cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.

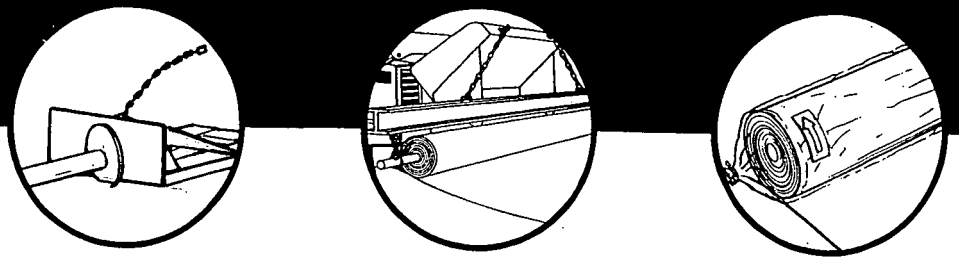
[5] Peak values measured at 200 psf (10 kPa) and 10,800 psf (517 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

CETCO® LINING TECHNOLOGIES

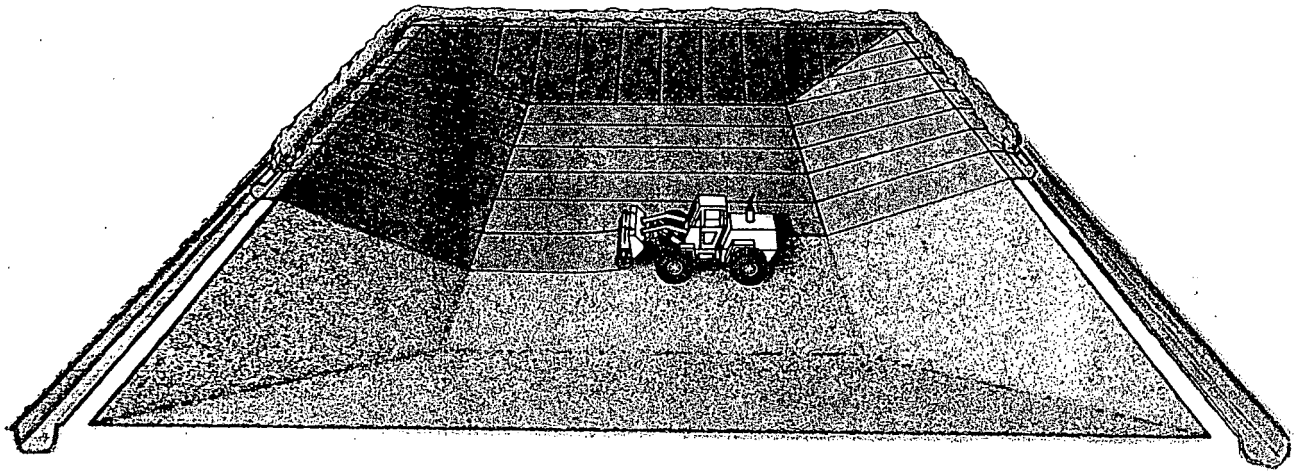
1500 West Shure Drive Arlington Heights, IL 60004 USA 800.527.9948 Fax 847.577.5571
For the most up-to-date product information please visit our website, www.cetco.com
A wholly owned subsidiary of AMCOL International Corporation

The information and data contained herein are believed to be accurate and reliable. CETCO make no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

Revised 01/04
TR 401-BMST



Installation Guidelines

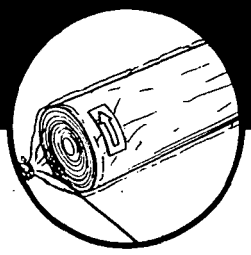


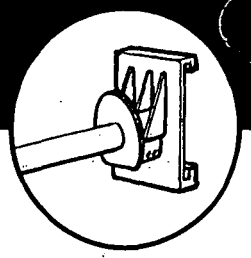
BENTOMAT®
CLAYMAX®

Geosynthetic Clay Liners

CETCO®
LINING TECHNOLOGIES
800.527.9948 www.cetco.com

TABLE OF CONTENTS





1. Introduction 3

2. Equipment Requirements 3

3. Shipping, Unloading, and Storage 5

4. Subgrade Preparation 6

5. Installation 6

6. Anchorage 9

7. Seaming 9

8. Sealing Around Penetrations and Structures 11

9. Damage Repair 14

10. Cover Placement 15

11. Hydration 15

1 INTRODUCTION

1.1 This document provides procedures for the installation of CETCO's GCLs in a manner that maximizes safety, efficiency, and the physical integrity of the GCL.

1.2 These guidelines are based upon several years of experience at a variety of sites and should be generally applicable to any type of lining project using CETCO's GCLs. Variance from these guidelines is at the engineer's discretion.

1.3 The performance of the GCL is wholly dependent on the quality of its installation. It is the installer's responsibility to adhere to these guidelines, and to the project specifications and drawings, as closely as possible. It is the engineer's and owner's responsibility to provide construction quality assurance (CQA) for the installation, to ensure that the installation has been executed properly. This document covers only installation procedures.

2 EQUIPMENT REQUIREMENTS

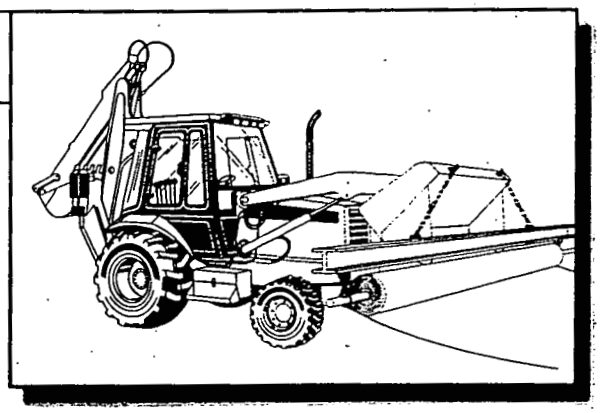
2.1 CETCO GCLs are delivered in rolls weighing 2,600-2,950 lbs (1180-1340 kg). It is necessary to support this weight using an appropriate core pipe as indicated in Table 1. For any installation, the core pipe must not deflect more than 3 inches (75 mm) as measured from end to midpoint when a full GCL roll is lifted.

TABLE 1 CORE REQUIREMENTS

Product(s)	Nominal GCL Roll Size W x Dia. Ft. (m) x in. (mm)	Typical GCL Roll Wt., lbs. (kg)	Interior Core Size, in. (mm)	Core Pipe Length x Diameter, ft. x in. (m x mm)	Minimum Core Pipe Strength
Bentomat CL, DN, SDN	16' x 24" (4.9 x 610)	2,650 (1200)	3 3/4 (100)	20 x 2.88"O.D.(6.1 cm x 73.1mm)	XXH
Bentomat ST	16' x 24" (4.9 x 610)	2,600 (1180)	3 3/4 (100)	20 x 2.88"O.D.(6.1 cm x 73.1mm)	XXH
Bentomat CLT	16' x 26" (4.9 x 660)	2,950 (1340)	3 3/4 (100)	20 x 2.88"O.D.(6.1 cm x 73.1mm)	XXH
Claymax 200R, 600CL	16' x 20" (4.9 x 510)	2,750 (1250)	3 3/4 (100)	20 x 2.88"O.D.(6.1 cm x 73.1mm)	XXH

2.2 Lifting chains or straps appropriately rated should be used in combination with a spreader bar made from an I-beam as shown in Figure 1.

FIGURE 1 **SPREADER BAR LIFTING ASSEMBLY**



2.3 The spreader bar ensures that lifting chains or straps do not chafe against the ends of the GCL roll, allowing it to rotate freely during installation. Spreader bar and core pipe kits are available through CETCO.

2.4 A front end-loader, backhoe, dozer, or other equipment can be utilized with the spreader bar and core pipe or slings. Alternatively, a forklift with a "stinger" attachment may be used for on-site handling and, in certain cases, installation. A forklift without a stinger attachment should not be used to lift or handle the GCL rolls. Stinger attachments (shown in Figures 2-4) are specially fabricated to fit various forklift makes and models.

FIGURE 2 **HOOK MOUNT**

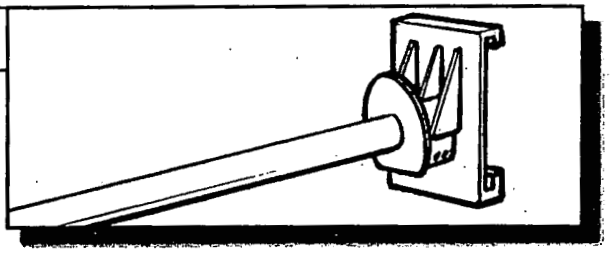


FIGURE 3 **FORK MOUNT** (with fork pockets)

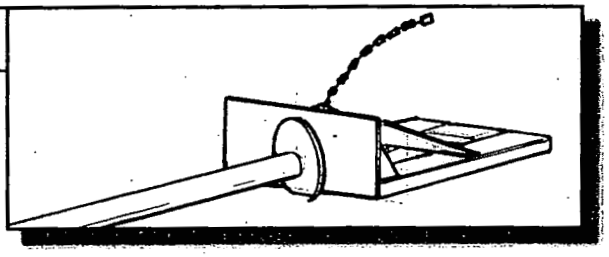
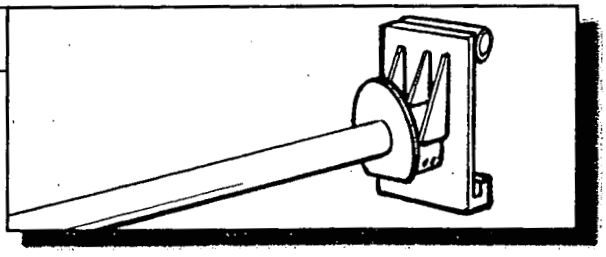


FIGURE 4 **PIN MOUNT**



2.5 When installing over certain geosynthetic materials, a 4-wheel, all-terrain vehicle (ATV) can be used to deploy the GCL. An ATV can be driven directly on the GCL provided that no sudden stops, starts, or turns are made.

2.6 Additional equipment needed for installation of CETCO's GCLs includes:

- Utility knife and spare blades (for cutting the GCL).
- Bentonite mastic (for sealing around structures and details) and/or granular bentonite (for end-of-roll seams of GCLs with needle punched, non-woven geotextiles and for sealing around structures and details). Both are available from CETCO.
- Waterproof tarpaulins (for temporary cover on installed material as well as for stockpiled rolls).
- Optional flat-bladed vise grips (for positioning the GCL panel by hand).

3 SHIPPING, UNLOADING & STORAGE

3.1 All lot and roll numbers should be recorded and compared to the packing list. Each roll of GCL should also be visually inspected during unloading to determine if any packaging has been damaged. Damage, whether obvious or suspected, should be recorded and marked.

3.2 Major damage suspected to have occurred during transit should be reported immediately to the carrier and to CETCO. The nature of the damage should also be indicated on the bill of lading with the specific lot and roll numbers.

3.3 The party directly responsible for unloading the GCL should refer to this manual prior to shipment to ascertain the appropriateness of their unloading equipment and procedures. Unloading and on-site handling of the GCL should be supervised to ensure these goals are achieved. Roll dimensions and weights will vary with the dimensions of the product ordered.

3.4 In most cases, CETCO GCLs are delivered on flatbed trucks. There are three methods of unloading; core pipe and spreader bar, slings or stinger bar. To unload the rolls from the flatbed using a core pipe and spreader bar, first insert the core pipe through the core tube. Secure the lifting chains or straps to each end of the core pipe and to the spreader bar mounted on the lifting equipment. Hoist the roll straight up and make sure its weight is evenly distributed so that it does not tilt or sway when lifted.

3.5 CETCO GCLs can be delivered with two 2" x 12' Type V polyester endless slings on each roll. Before lifting, check the position of the slings. Each sling should be tied off in the choke position approximately 1/3 the way in from the end of the roll. Hoist the roll straight up so that it does not tilt or sway when lifted.

3.6 In some cases, GCL rolls will be stacked in three pyramids on flatbed trucks. If slings are not used rolls will require unloading with a stinger bar and extendible boom fork lift. Spreader bars will not work in this situation because of the limited distance between the pyramids of GCL. Three types of stinger bars are available from CETCO (refer to Figures 2-4). To unload GCL rolls oriented like this, guide the stinger bar as far as possible through the core tube before lifting the GCL roll and unloading from the truck.

3.7 Rolls should be stored at the job site away from high-traffic areas but sufficiently close to the active work area to minimize handling. The designated storage area should be flat, dry and stable. Moisture protection of the GCL is provided by its packaging; however, an additional tarpaulin or plastic sheet is recommended.

3.8 Rolls should be stacked in a manner that prevents them from sliding or rolling. This can be accomplished by frequent chocking of the bottom layer of rolls. Rolls should be stacked no higher than the height at which they can be safely handled by laborers (typically no higher than four layers or rolls). Rolls should never be stacked on end.

4 SUBGRADE PREPARATION

4.1 Subgrade surfaces consisting of granular soils or gravel may not be acceptable due to their large void fracture and puncture potential. In high head (greater than one foot) applications subgrade soils should possess a particle size distribution such that at least 80 percent of the soil is finer than a #60 sieve (0.250 mm) unless a membrane laminated GCL Bentomat CL, Bentomat CLT, or Claymax CL is used.

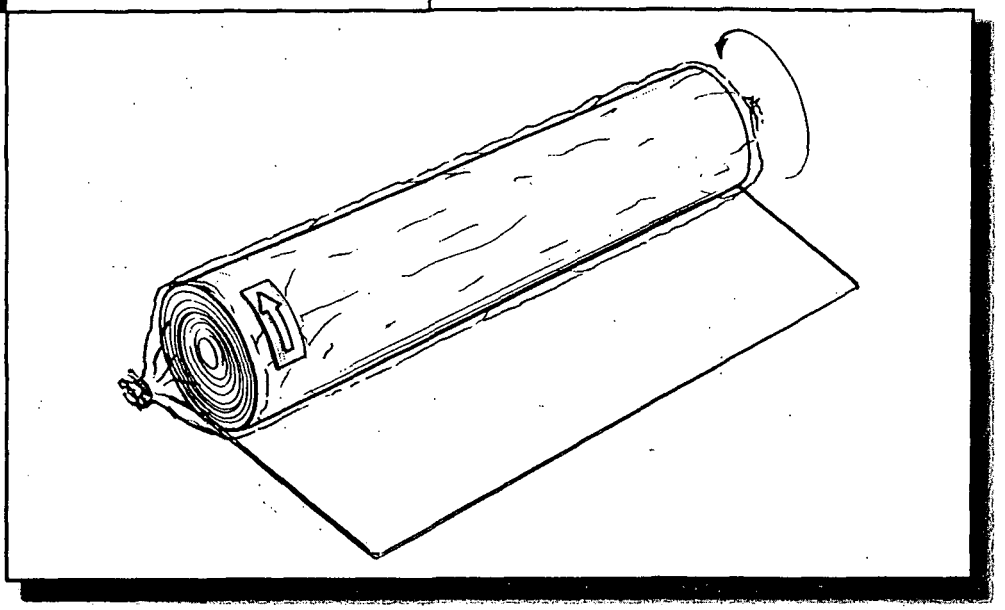
4.2 When the GCL is placed over an earthen subgrade, the subgrade surface must be in accordance with the project specifications. Engineer's approval of the subgrade must be obtained prior to installation. The finished surface should be firm and unyielding, without abrupt elevation changes, voids, cracks, ice, or standing water.

4.3 The subgrade surface must be smooth and free of vegetation, sharp-edged rocks, stones, sticks, construction debris, and other foreign matter that could contact the GCL. The subgrade should be rolled with a smooth-drum compactor to remove any wheel ruts, footprints, or other abrupt grade changes. Furthermore, all protrusions extending more than 0.5 inch (12 mm) from the subgrade surface shall be removed, crushed, or pushed into the surface with a smooth-drum compactor. The GCL may be installed on a frozen subgrade, but the subgrade soil in the unfrozen state should meet the above requirements.

5 INSTALLATION

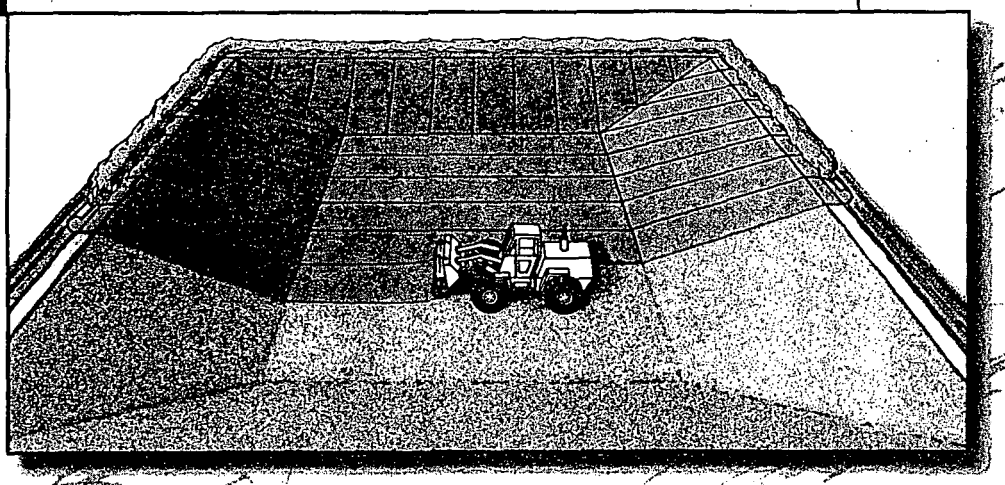
5.1 GCL rolls should be taken to the work area of the site in their original packaging. The orientation of the GCL (i.e., which side faces up) may be important if the GCL has two different types of geosynthetics. Unless otherwise specified the GCL is deployed with the outward side down. The arrow sticker on the plastic sleeve indicates the direction the roll will unwind when placed on the ground, (see figure 5). Prior to deployment, the packaging should be carefully removed without damaging the GCL.

FIGURE 5 DIRECTION TO UNROLL GCL



5.2 Equipment which could damage the GCL should not be allowed to travel directly on it. Acceptable installation, therefore, may be accomplished such that the GCL is unrolled in front of the backwards-moving equipment (Figure 6). If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

FIGURE 6 TYPICAL BENTOMAT®/CLAYMAX® INSTALLATION TECHNIQUE

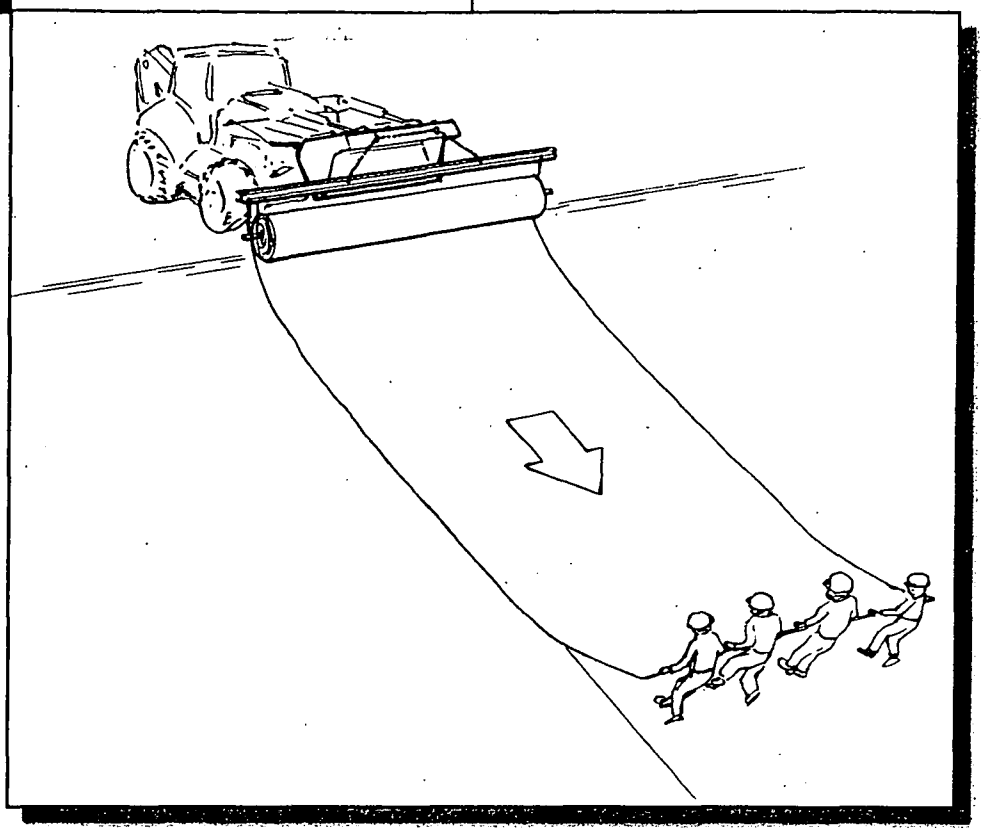


5.3 If sufficient access is available, GCL may be deployed by suspending the roll at the top of the slope with a group of laborers pulling the material off of the roll and down the slope (see Figure 7).

5.4 GCL rolls should not be released on the slope and allowed to unroll freely by gravity.

5.5 Care must be taken to minimize the extent to which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. Care must also be taken when adjusting Bentomat CLT panels to avoid damage to the geotextile surface of one panel of GCL by the textured sheet of another panel of GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

FIGURE 7 **UNROLLING BENTOMAT**



5.6 The GCL should be placed so that seams are parallel to the direction of the slope. End-of-roll seams should also be located at least 3 ft (1m) from the toe and crest of slopes steeper than 4H: 1V. End-of-roll seams should be used only if the liner is not expected to be in tension when installed on slopes.

5.7 All GCL panels should lie flat on the underlying surface, with no wrinkles or folds, especially at the exposed edges of the panels. When Bentomat with SuperGroove® is repositioned it should be gripped inside the SuperGroove by folding the edge.

5.8 The GCL should not be installed in standing water or during rainy weather. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project engineer and CQA inspector should be consulted for specific guidance if premature hydration occurs.

5.9 For the convenience of the installer, hash marks are placed approximately every 5' of length of Bentomat.

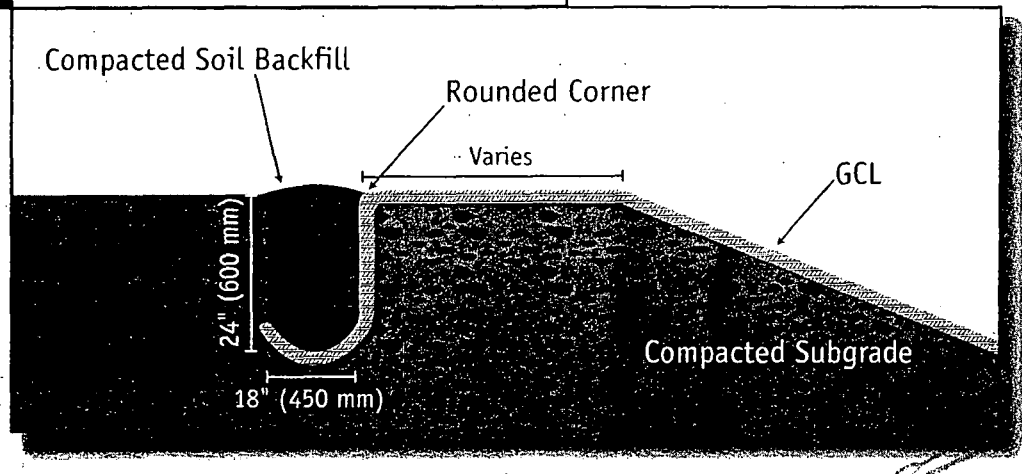
6 ANCHORAGE

6.1 If required by the project drawings, the end of the GCL roll should be placed in an anchor trench at the top of a slope. The front edge of the trench should be rounded to eliminate any sharp corners that could cause excessive stress on the GCL. Loose soil should be removed or compacted into the floor of the trench.

6.2 If a trench is used for anchoring the end of the GCL, soil backfill should be placed in the trench to provide resistance against pullout. The size and shape of the trench, as well as the appropriate backfill procedures, should be in accordance with the project drawings and specifications. Typical dimensions are shown in Figure 8.

6.3 The GCL should be placed in the anchor trench such that it covers the entire trench floor but does not extend up the rear trench wall.

FIGURE 8 TYPICAL ANCHOR TRENCH DESIGN

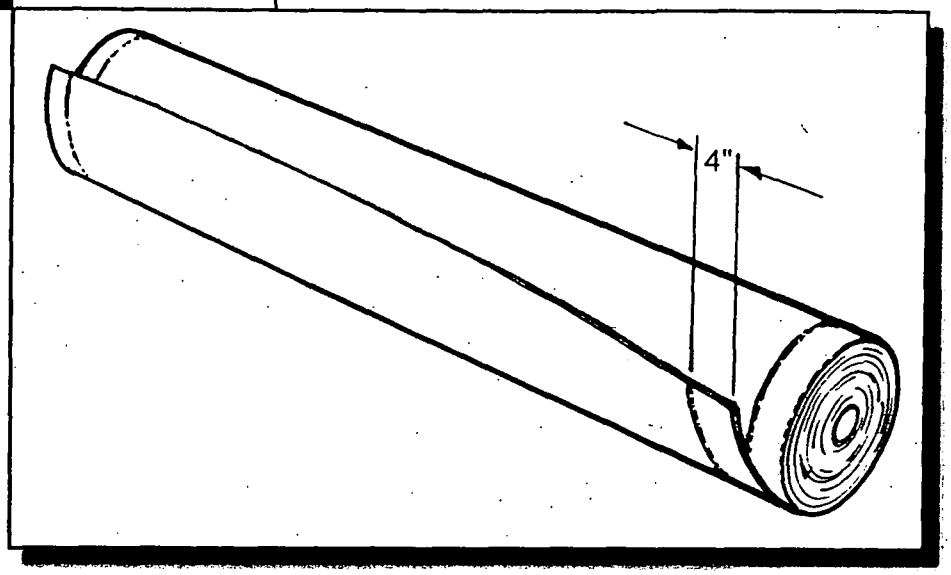


6.4 Sufficient anchorage may alternately be obtained by extending the end of the GCL roll back from the crest of the slope, and placing cover soil. The length of this "runout" anchor is project-specific.

7 SEAMING

7.1 GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is not required for Claymax 200R, 600CL. Bentomat ST, SDN, or DN with Supergroove provides self-seaming (See Figure 9) without the need for supplemental bentonite. Bentomat CL and CLT require bentonite enhanced seams. For pond applications CETCO recommends using supplemental bentonite in longitudinal seams irregardless of the CETCO GCL being used.

FIGURE 9 **SUPERGROOVE**



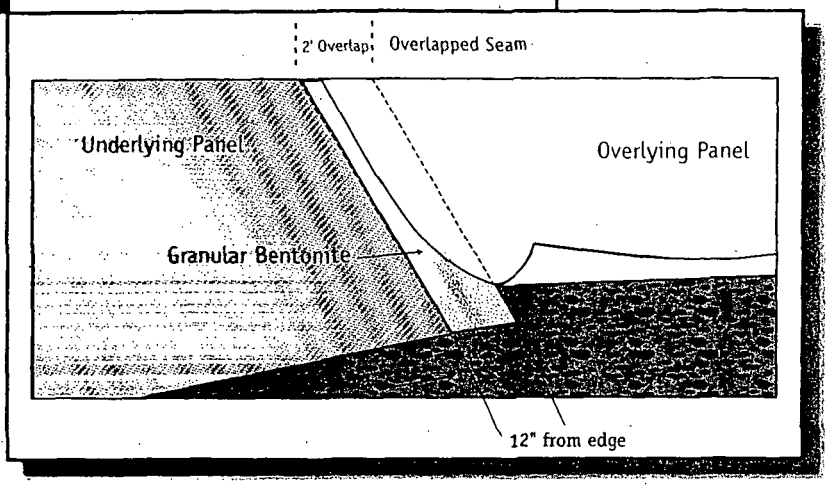
7.2 End-of-panel overlapped seams should overlap 24 inches (600 mm).

7.3 End-of-panel overlapped seams, should be constructed such that they are shingled in the direction of the grade to prevent runoff flow from entering the overlap zone. End-of-panel seams on slopes are permissible; provided adequate slope stability analysis has been conducted (i.e. the GCL is not expected to be in tension). Bentonite-enhanced seams are required for Bentomat end-of-panel overlapped seams.

7.4 End-of-panel overlapped seams are constructed first by overlapping the adjacent panels, exposing the underlying panel, and then applying a continuous bead or fillet of granular sodium bentonite (supplied with the GCL) 12" from the edge of the underlying panel (See Figure 10) starting from the end-of-roll. The minimum application rate at which the bentonite is applied is one quarter pound per linear foot (0.4 kg/m).

7.5 If longitudinal bentonite enhanced seams are required, they are constructed first by overlapping the adjacent panels by a minimum 6-inches (150 mm), exposing the underlying edge and applying a continuous bead of granular bentonite approximately 3-inches (75 mm) from the edge. The minimum application rate for the granular bentonite is one quarter pound per linear foot (0.4 kg/m).

FIGURE 10 **END-OF-PANEL OVERLAPPED SEAM**



8 SEALING AROUND PENETRATIONS AND STRUCTURES

8.1 Cutting the GCL should be performed using a sharp utility knife. Frequent blade changes are recommended to avoid irregular tearing of the geotextile components of the GCL during the cutting process.

8.2 The GCL should be sealed around penetrations and structures embedded in the subgrade in accordance with Figures 11 through 13. Granular bentonite or a bentonite mastic shall be used liberally (approx. 2 lbs. /ln ft. or 3 kg/m) to seal the GCL to these structures.

FIGURE 11A **CROSS-SECTION OF A HORIZONTAL PIPE PENETRATION**

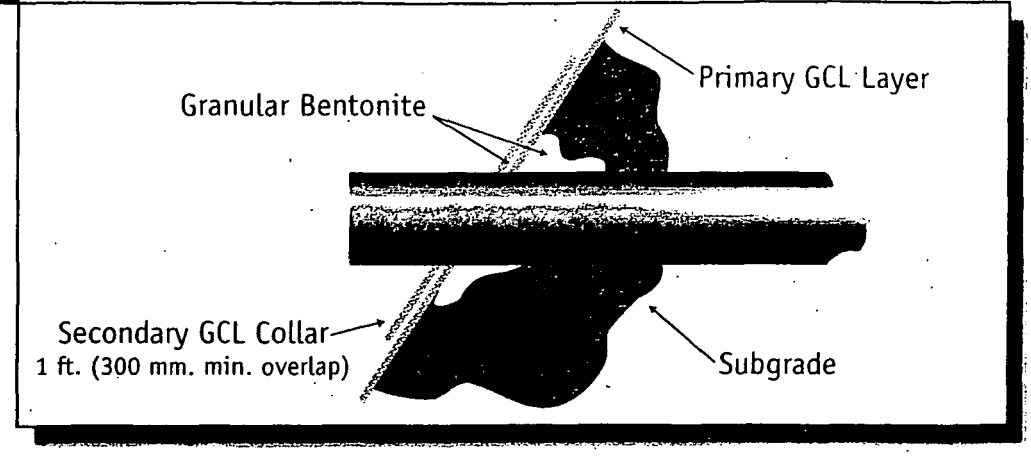
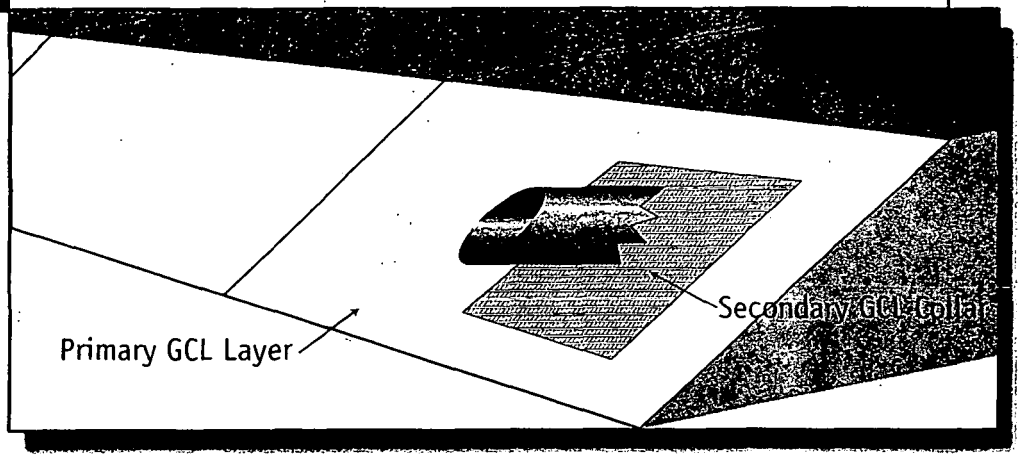
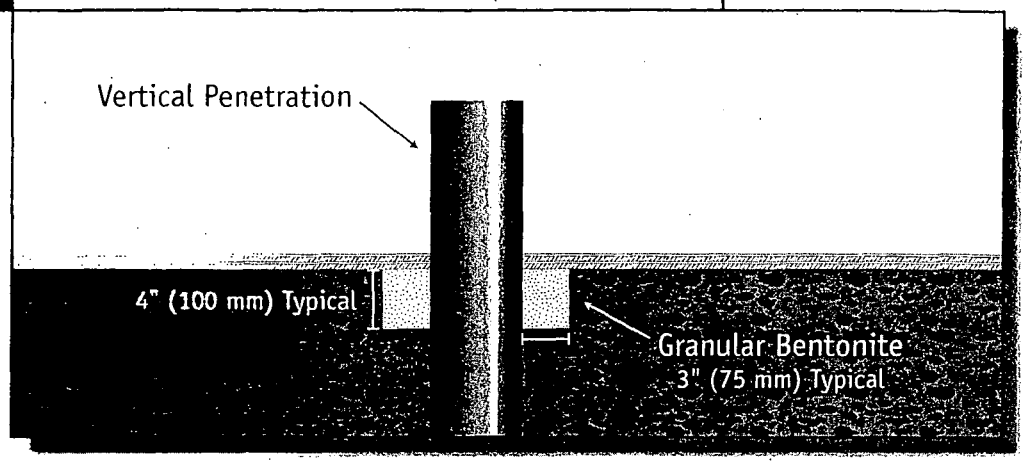


FIGURE 11B **ISOMETRIC VIEW OF A COMPLETED HORIZONTAL PIPE PENETRATION**



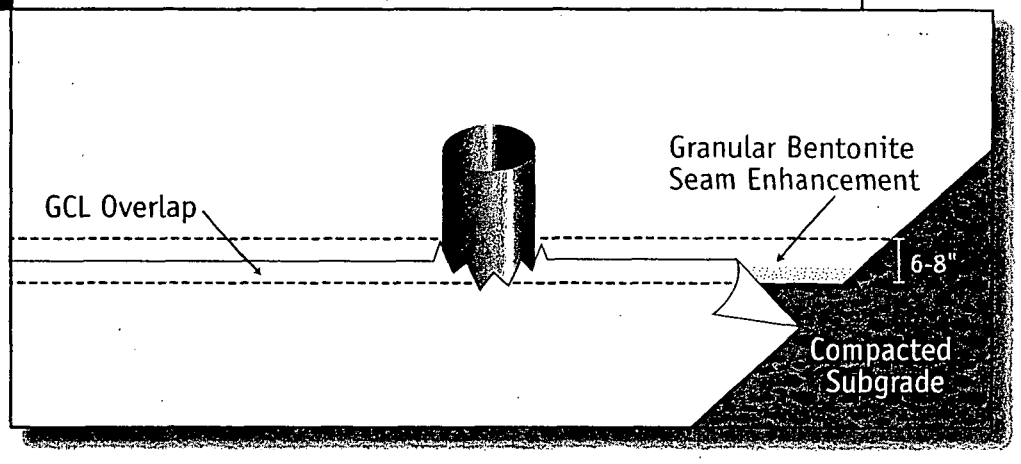
8.3 When the GCL is placed over a horizontal pipe penetration, a "notch" should be excavated into the subgrade around the penetration (Figure 11a). The notch should then be backfilled with granular bentonite. A secondary collar of GCL should be placed around the penetration as shown in Figure 11b. It is helpful to first trace an outline of the penetration on the GCL and then cut a "star" pattern in the collar to enhance the collar's fit to the penetration. Granular bentonite should be applied between the primary GCL layer and the secondary GCL collar.

FIGURE 12A **CROSS-SECTION OF A VERTICAL PENETRATION**



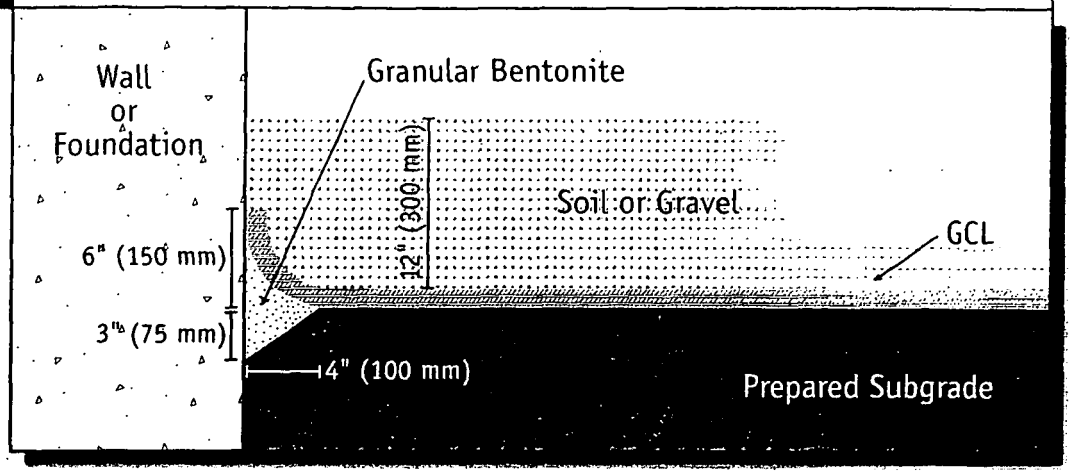
8.4 Vertical penetrations are prepared by notching into the subgrade as shown in Figure 12a. The penetration can be completed with two separate pieces of GCL as shown in Figure 12b. Alternatively, a secondary collar can be placed as in Figure 11a or 11b.

FIGURE 12B **ISOMETRIC VIEW OF THE COMPLETED VERTICAL PENETRATION**



8.5 When the GCL is terminated at a structure or wall that is embedded into the subgrade on the floor of the containment area, the subgrade should be notched as described in sections 8.3 and 8.4. The notch is filled with granular bentonite, and the GCL should be placed over the notch and up against the structure (Figure 13). The connection to the structure can be the accomplished by placement of soil or stone backfill in this area. When structures or walls are on or at the top of a slope, additional detailing may be required. Contact CETCO's Technical Support Services for project specific guidance.

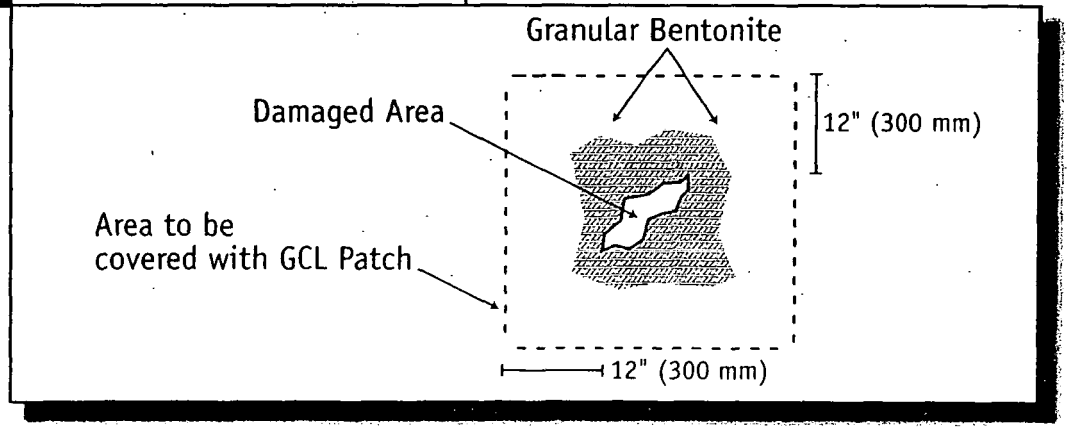
FIGURE 13 **CROSS-SECTION OF GCL SEAL AGAINST AN EMBEDDED STRUCTURE OR WALL**



9 DAMAGE REPAIR

9.1 If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area (Figure 14). The patch should be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all parts of the damaged area. Granular bentonite or bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be necessary to use an adhesive such as wood glue to affix the patch in place so that it is not displaced during cover placement. Smaller patches also may be tucked under the damaged area to prevent patch movement.

FIGURE 14 **DAMAGE REPAIR BY PATCHING**



10 COVER SEAL

10.1 The final thickness of soil cover on the GCL varies with the application. A minimum cover layer must be at least 1 foot (300 mm) thick to provide confining stress to the GCL and prevent damage by equipment, erosion, etc.

10.2 Cover soils should be free of angular stones or other foreign matter that could damage the GCL. Cover soils should be approved by the Engineer with respect to particle size, uniformity, and chemical compatibility. Consult your CETCO representative if cover soils with high concentrations of calcium (e.g., limestone, dolomite, gypsum, seashell fragments) are present.

10.3 Recommended cover soils should have a particle size distribution ranging between fines and 1 inch (25 mm), unless a cushioning geotextile is specified.

10.4 Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover soil should be maintained between the equipment tires/tracks and the GCL at all times during the covering process. In frequently high traffic areas or roadways, a minimum thickness of 2 feet (600 mm) is required.

10.5 Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. Soil cover should be pushed up slopes, not down slopes, to minimize tensile forces on the GCL.

10.6 When a textured geomembrane is installed over the GCL, a temporary geosynthetic covering known as a slip sheet or rub sheet should be used to minimize friction during placement and to allow the textured geomembrane to be more easily moved into its final position.

11 HYDRATION

11.1 In cases where the containment of non-aqueous liquid is required, it may be necessary to hydrate the covered GCL with water prior to use. Hydration is usually accomplished by natural rainfall and/or absorption of moisture from soil.

11.2 If manual hydration is necessary, water can be introduced by flooding the covered lined area or using a sprinkler system.

NOTICE: This document is intended for use as a GENERAL GUIDELINE for the installation of CETCO's GCLs. The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

1500 West Shure Drive Arlington Heights, IL 60004-1440 TEL 800.527.9948 FAX 847.577.5571

©2003 Colloid Environmental Technologies Company

SGI TESTING SERVICES, LLC

18 March 2002

Mr. Robert Trauger, P.E.
Colloid Environmental Technologies Co.
1500 West Shure Drive
Arlington Heights, IL 60004-1440

Subject: Laboratory Test Results Transmittal
Large-Scale Flow Rate Testing
Unseamed and Seamed Bentomat ST GCLs

Dear Mr. Trauger,

SGI Testing Services, LLC (SGI®) is pleased to present the attached large-scale flow rate test results on Bentomat ST GCL, Bentomat ST GCL seamed with groove and no bentonite, and Bentomat ST GCL seamed without groove and bentonite. The note section below addresses sample preparation, sample disposal and a disclosure statement.

SGI® appreciates the opportunity to provide laboratory testing services to CETCO. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,

Zehong Yuan, Ph.D., P.E.
Chief Technical Officer

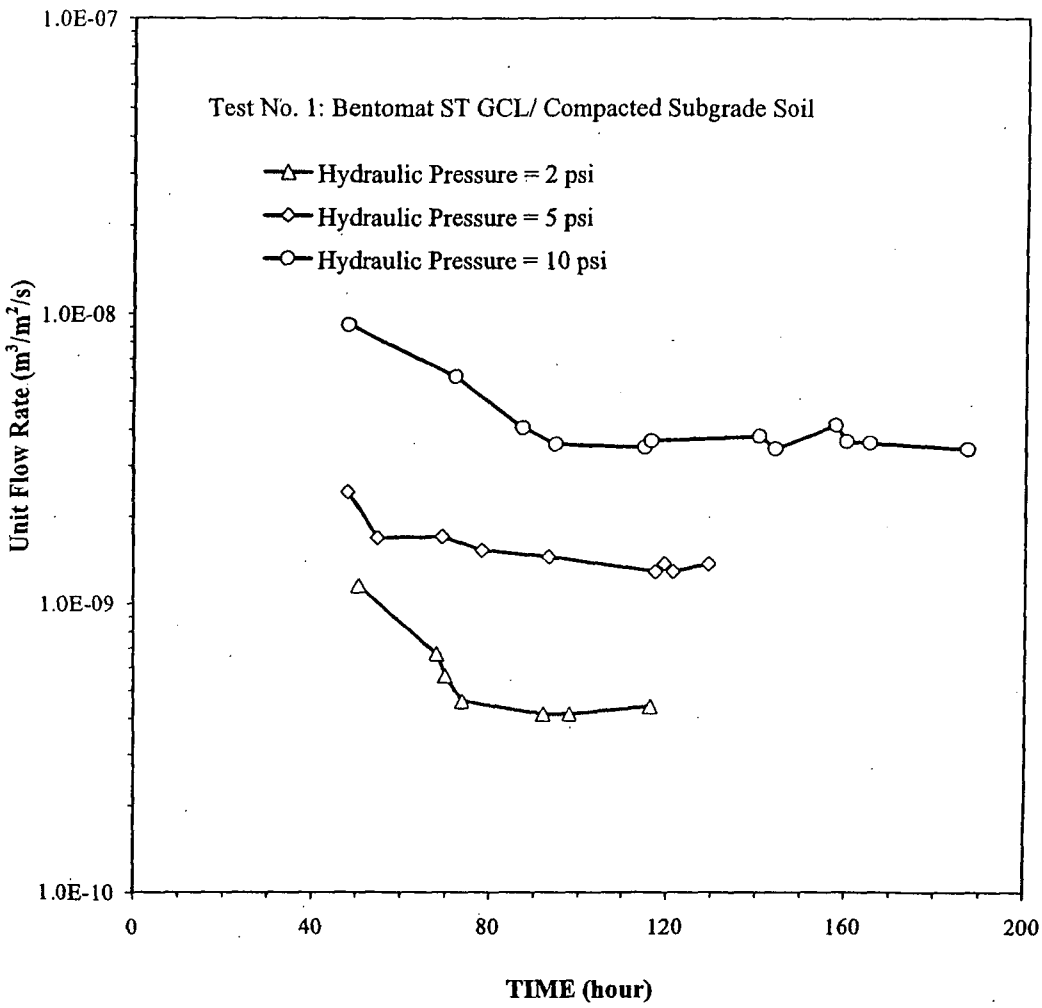
Attachment

Notes:
(1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
(2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI®.
(3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. Archived specimens will be discarded 60 days after the samples are received at the laboratory, unless long-term storage arrangements are specifically made with the laboratory.
(4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

SGI1029/SGI02054

SGI® Testing Services, LLC
5775 PEACHTREE DUNWOODY ROAD
SUITE 11D
ATLANTA, GEORGIA 30342
PHONE: 404.256.9939 FAX: 404.705.9300
WEB SITE: WWW.INTERACTIONSPECIALISTS.COM

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING
BENTOMAT ST GCL



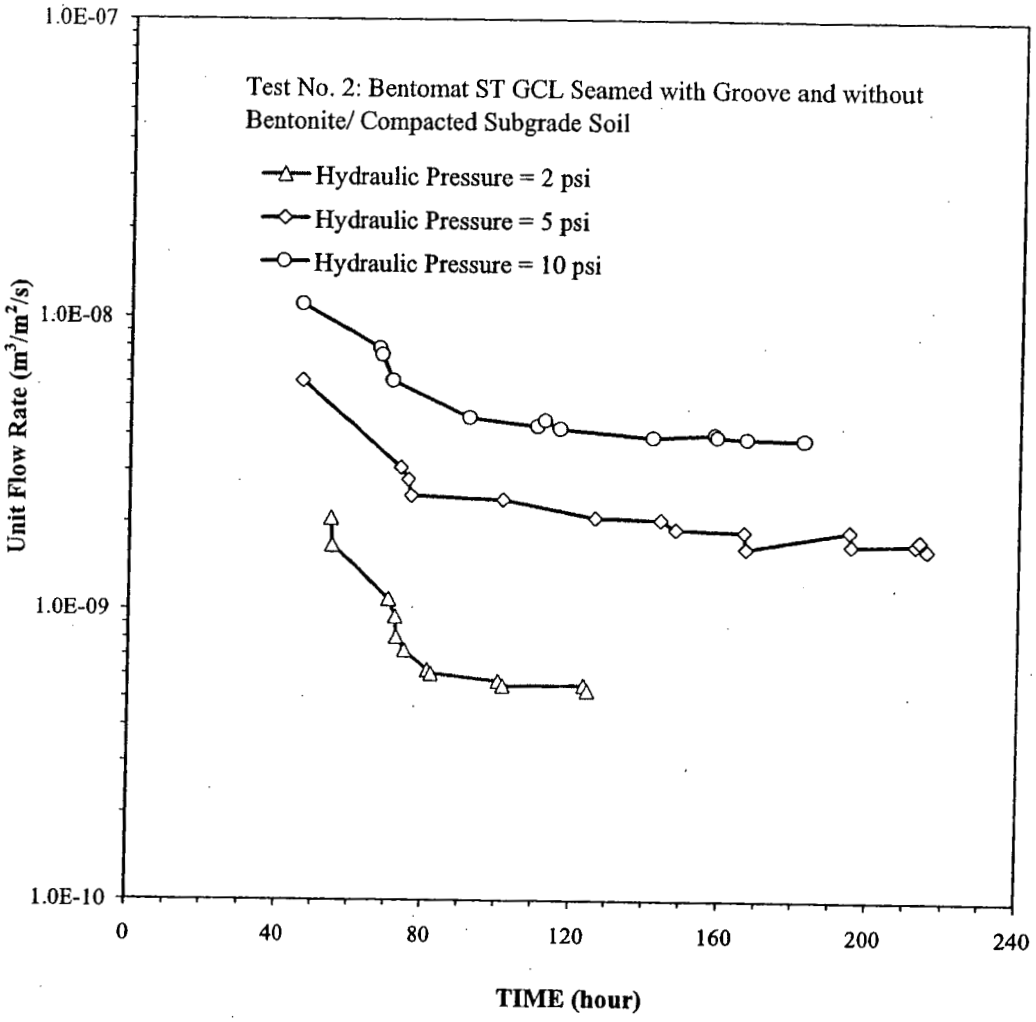
Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Test Duration (hours)	Flow Rate at Completion of Testing ($m^3/m^2/s$)
1	23.5	2.0	116	4.40E-10
2	23.5	5.0	129	1.37E-09
3	23.5	10.0	187	3.41E-09

DATE REPORTED: 17 January 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	A-1
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING
BENTOMAT ST GCL SEAMED WITH GROOVE AND WITHOUT BENTONITE



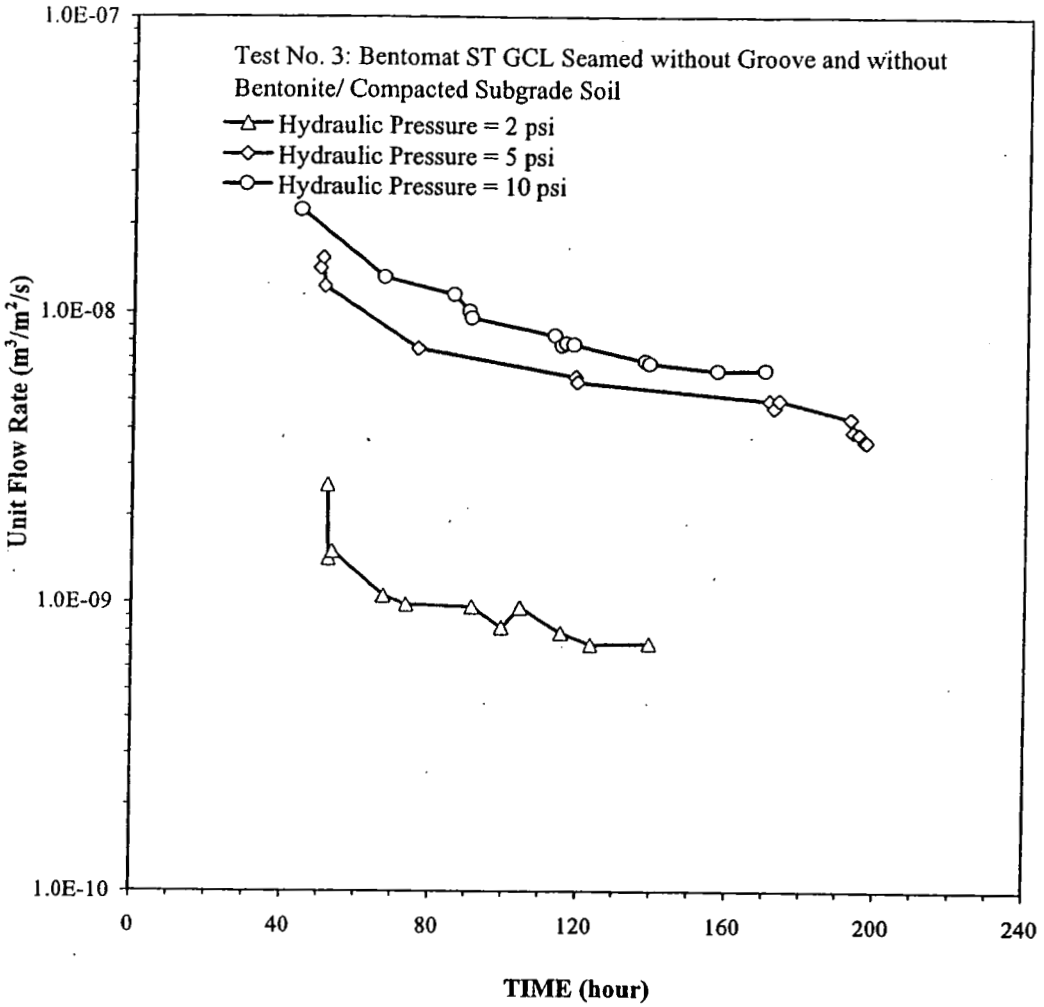
Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Test Duration (hours)	Flow Rate at Completion of Testing ($m^3/m^2/s$)
1	23.5	2.0	125	5.28E-10
2	23.5	5.0	215	1.63E-09
3	23.5	10.0	182	3.85E-09

DATE REPORTED: 4 February 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	C-2
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING
BENTOMAT ST GCL SEAMED WITHOUT GROOVE AND WITHOUT BENTONITE



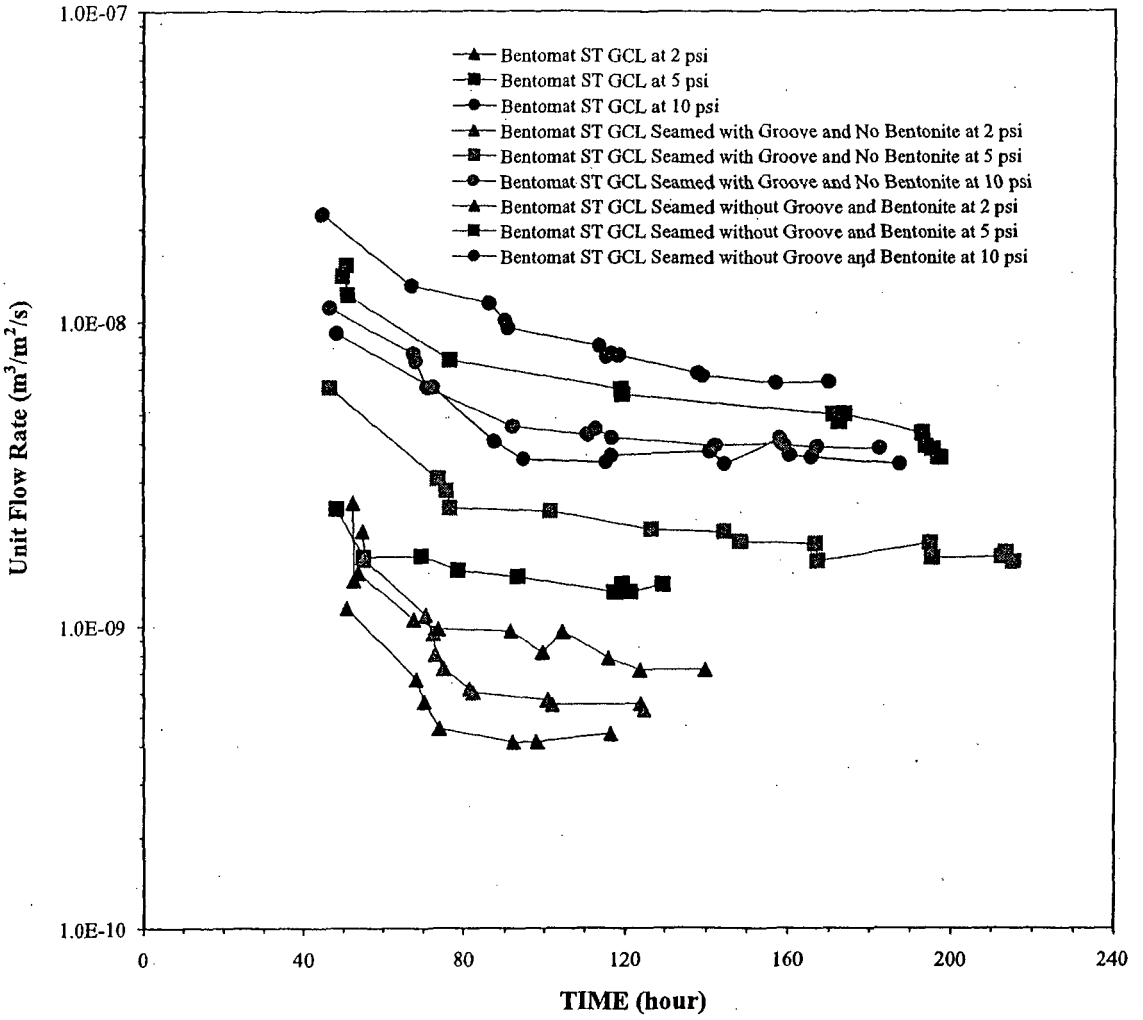
Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Test Duration (hours)	Flow Rate at Completion of Testing ($m^3/m^2/s$)
1	23.5	2.0	139	7.21E-10
2	23.5	5.0	197	3.59E-09
3	23.5	10.0	170	6.34E-09

DATE REPORTED: 15 March 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	C-3
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING



Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Bentomat ST GCL		Bentomat ST GCL Seamed with Groove and No Bentoite		Bentomat ST GCL Seamed without Groove and Bentoite	
			Duration (hours)	Flow Rate ($m^3/m^2/s$)	Duration (hours)	Flow Rate ($m^3/m^2/s$)	Duration (hours)	Flow Rate ($m^3/m^2/s$)
1	23.5	2.0	116	4.40E-10	125	5.28E-10	139	7.21E-10
2	23.5	5.0	129	1.37E-09	215	1.63E-09	197	3.59E-09
3	23.5	10.0	187	3.41E-09	182	3.85E-09	170	6.34E-09

Note:

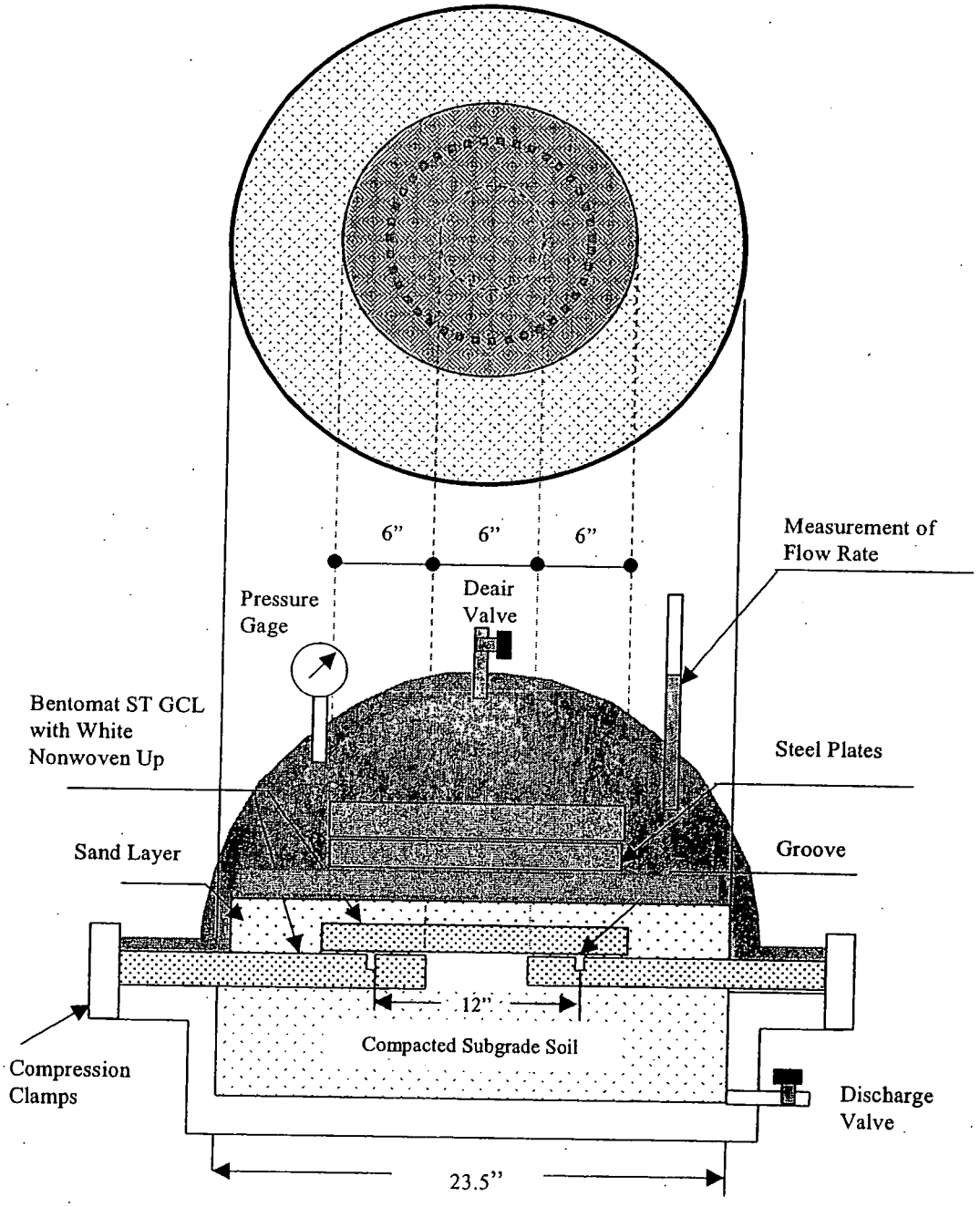
For each test, the flow rate reported in the above table is the flow rate at the completion of test.

DATE REPORTED: 15 March 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	C-4
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

FIGURE A-1. SCHEMATIC DIAGRAM OF TEST CONFIGURATION LARGE-SCALE FLOW RATE TESTING ON GCL SEAMED WITH GROOVE



Total Normal Stress Over Test Specimen: 132 psf

TESTING SERVICES

BENTOMAT®

THE GCL WITH THE "WINNING EDGE™ "

Available now and standard on all Bentomat products, the "Winning Edge™" is a new overlapped seam enhancement system that brings higher levels of performance and convenience to the world's best-selling GCL. The patented SuperGroove™ eliminates the need for accessory bentonite in the overlapped seam. Available only on Bentomat products, the SuperGroove will increase performance and decrease GCL installation headaches.

The SuperGroove™

All Bentomat products have at least one nonwoven needlepunched geotextile. In comparison to woven geotextiles, needlepunched nonwovens are thicker and can transmit flow in the plane of the geotextile. Planar flow can cause excessive leakage in the overlapped seam of a GCL. The addition of granular bentonite within the overlap area can eliminate this preferential flow by sealing the nonwoven geotextile, which has been the standard of practice for many years.

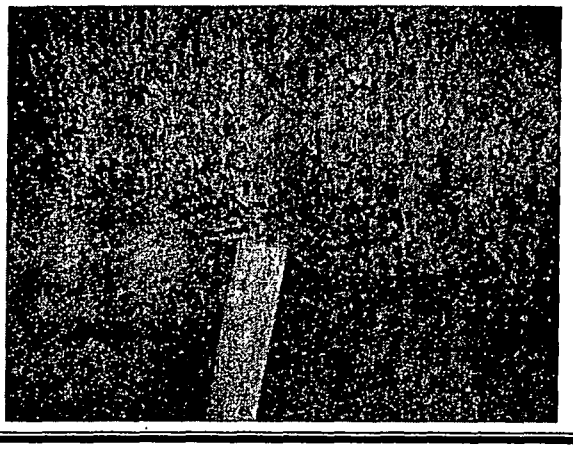
The SuperGroove is a precision cut in the nonwoven geotextile of Bentomat that allows bentonite to more freely extrude into the overlap zone (Figure 1). Upon hydration, a seal is formed, eliminating the possibility of preferential seam flow (Figure 2). Supplemental bentonite is not required.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

Figure 1. The SuperGroove on Bentomat.

Figure 2. A test overlap showing bentonite "stain" on the surface of the woven geotextile, indicating extrusion from the non-woven.



The SuperGroove ensures that the hydraulic performance of the entire seamed GCL system is equal to that of unseamed portions. Added benefits include:

- No need for supplemental bentonite
- No concerns over improper seaming technique
- Eliminates labor associated with adding bentonite
- Simplifies CQA/CQC procedures
- Eliminates a source of geomembrane seam contamination

The SuperGroove is located approximately 3 inches (75 mm) inside the outermost limit of the bentonite clay component of the GCL, about 4 inches (100 mm) outside the first lap line (Figure 3). The SuperGroove is placed on <u>both</u> longitudinal edges of the Bentomat product.

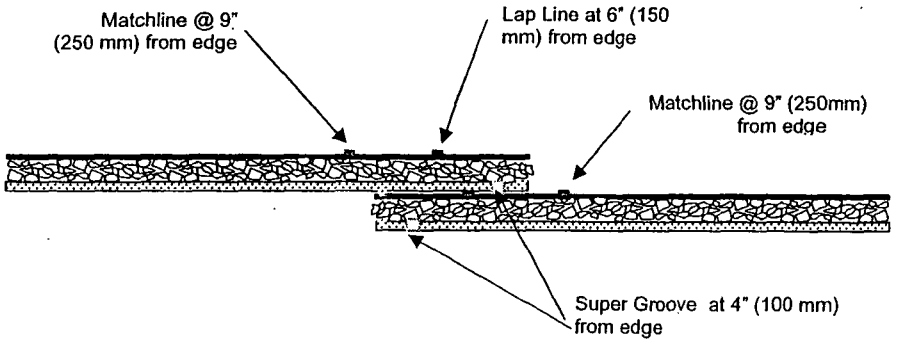


Figure 3. Location of the SuperGroove on Bentomat panels.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

Performance of the SuperGroove seam was evaluated in comparison to a traditional bentonite-enhanced seam. Third-party laboratory tests were performed under a variety of head pressures and confining pressures. A test at low confining pressure is a "worst-case" scenario because the volume of void spaces in the overlap is larger than when a higher confining pressure is applied. Even in low-stress conditions, test data shows that the SuperGroove still allowed extrusion to completely seal the overlap (Table 1).

Table 1. Comparative performance of Bentomat ST with traditional bentonite-enhanced seam and with new SuperGroove™.

Hydraulic Pressure (psi)	Unseamed Flux ($m^3/m^2/s$)	Seamed Flux ($m^3/m^2/s$)	Flux difference ($m^3/m^2/s$)	Seam correction factor*	Seam flux ($m^3/m^2/s$)**	Seam flux, % of total flux of seamed sample
2	4.4×10^{-10}	5.28×10^{-10}	8.8×10^{-11}	13.7	6.42×10^{-12}	1.2%
5	1.37×10^{-9}	1.63×10^{-9}	2.6×10^{-10}	13.7	1.90×10^{-11}	1.2%
10	3.41×10^{-9}	3.85×10^{-9}	4.4×10^{-10}	13.7	3.21×10^{-10}	0.8%

*Laboratory tests are performed with 13.7 times more seam length (per unit area of GCL) than in field seams.
**Flux difference divided by seam correction factor results in estimated preferential flow per unit area through field seam.

The test data shows that in all test conditions, there is a very small component of the total flux that is attributable to the overlapped seams. Expressed as a percentage of total seam area (3.9% on full-size GCL rolls laid in a large area, it can be seen that the percentage of total seam flux is proportionally less than the percentage of seamed area. Thus, it can be concluded that SuperGroove seams function effectively.

It should be noted that the SuperGroove does not appear on end-of-roll overlaps. CETCO recommends the continued use of supplemental bentonite for all end-of-roll overlaps of Bentomat.

Bentomat—the GCL with the Winning Edge™

The Winning Edge, featuring the SuperGroove, comes on all orders of Bentomat ST, Bentomat DN, Bentomat SDN and Bentomat YSDN. For more information about the Winning Edge, contact your local CETCO representative.

References

SGI Project No. SGI1029, Document No. SGI 01071, "Final Report, Large-Scale Flow Rate Testing, Seamed and Unseamed Bentomat GCL," 3 August 2001.

SGI Project No. SGI1029, Document No. SGI 01071, SGI02037; "Final Report, Large-Scale Flow Rate Testing, Seamed and Unseamed Bentomat GCL," 4 February 2002.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

FAQs ABOUT THE WINNING EDGE

Does the bentonite fall out of the SuperGroove during handling? No. CETCO's production process allows most of the bentonite to remain within the SuperGroove. Even if small amounts of bentonite are lost during installation, the resulting void spaces are rapidly filled by swelling bentonite particles immediately adjacent to the SuperGroove.

Will the SuperGroove affect the strength of the Bentomat? No. The narrow groove affects a tiny percentage of one geotextile component of Bentomat. The nonwoven geotextile is still securely needlepunched on either side of the SuperGroove and therefore does not affect the shear or tensile strength of the product.

Will bentonite extrusion from the SuperGroove leave a void where preferential leakage can occur downward through the GCL? No. The bentonite does not leave a large void, and the SuperGroove is located only where there is already a double layer of bentonite (in the overlap), so there is no possibility of a "short circuit" around or through it.

How do I know the SuperGroove is really present? The SuperGroove is on the bottom of the Bentomat, such that it faces the installer and inspector as the roll is unrolled and installed. The SuperGroove is in plain sight throughout the deployment process. Random checks after installation can also be included in a CQA plan as needed to document its continuous presence.

Is the SuperGroove present in the upper geotextile component of Bentomat also? No. It is only present in the lower geotextile.

How do I specify the Winning Edge? CETCO has modified its GCL specification guidelines to include generic language regarding GCL edge treatment. Please visit our GCL engineering website for the latest Bentomat specification document.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

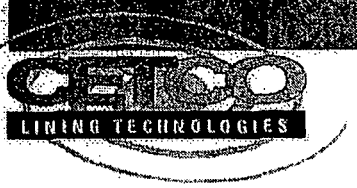
Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.

Page containing possible Proprietary information removed.



CETCO GCL

CONSTRUCTION QUALITY ASSURANCE (CQA) MANUAL

Version 4.0, January 2001

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

TABLE OF CONTENTS

SECTION			PAGE
1.	INTRODUCTION		1
	1.1	Definitions	1
	1.2	Scope and Purpose of the CQA Manual	1
2.	PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES		2
3.	ON-SITE HANDLING		4
	3.1	Unloading Procedures	4
		3.1.1 Flatbed Truck Delivery	4
		3.1.2 Trailer Delivery	5
	3.2	Materials Handling	5
	3.3	On-Site Storage	5
4.	INSTALLATION		7
	4.1	Start-Up Assistance	7
	4.2	Equipment	7
	4.3	Field Conditions	8
	4.4	Site Inspection	8
	4.5	Panel Deployment	8
	4.6	Seaming	8
	4.7	Detail Work	10
	4.8	Damage and Damage Repair	10
		4.8.1 Damage from Shipping and Handling	10
		4.8.2 Damage from Installation Activities	11
5.	PLACEMENT OF COVER MATERIALS		12
	5.1	Soil/Stone Cover	12
	5.2	Geosynthetic Cover	13
6.	CONFORMANCE TESTING		14
	6.1	Bentonite Mass per Unit Area	14
	6.2	Bentonite Swell	14
	6.3	Accessory Bentonite Mass per Unit Length	14
	6.4	Other Conformance Tests	15

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

TABLE OF CONTENTS (continued)

SECTION		PAGE
7.	DOCUMENTATION	16

LIST OF APPENDICES

APPENDIX A List of Applicable ASTM Standards

APPENDIX B GCL Construction Quality Assurance Checklist

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

SECTION 1
INTRODUCTION

1.1 Definitions

Construction Quality Assurance. For the purposes of this manual, construction quality assurance (CQA) is defined as a planned system of activities that provides assurance that *installation* of the geosynthetic clay liner (GCL) proceeds in accordance with the project design drawings and specifications. In general, these activities include continuous inspection of the installation, testing of materials and procedures, and overall documentation.

Construction Quality Control. Again, for the purposes of this manual, construction quality control (CQC) is defined as a planned system of activities that provides assurance that the properties of the GCL *materials* meet the requirements of the project specifications. These activities primarily include materials testing and documentation.

There is a great deal of overlap in the nature of CQA and CQC, and from a practical standpoint, CQA and CQC activities are often performed by the same party. For this reason, we will use the term CQA to describe *all* of the quality-oriented tasks relating to the GCL and its installation.

1.2 Scope and Purpose of the CQA Manual

This manual is written to address third-party CQA activities and is *not* intended as a guide for GCL installati Installation guidelines are available separately from CETCO (see Technical References TR-405). This manual is also not intended to describe the various *manufacturing* quality assurance and quality control (MQA/MQC) activities performed by CETCO at the GCL manufacturing facilities (see Technical Reference No. TR-409).

The purpose of the CQA Manual is provide the project CQA personnel with a general format for assuring that the GCL delivered to the job meets the requirements of the specifications and that this material is installed in accordance with the design drawings and specifications. This manual should be modified as necessary by the design or CQA engineer in order to account for site-specific or project-specific concerns and conditions. Any such changes, however, should be discussed with CETCO before they are introduced into the final version of the project CQA plan.

For the convenience of the CQA personnel, an overall CQA Checklist is provided in Appendix A. This checklist or a similar version thereof is designed to be used on a daily basis to document that all CQA activities are consistently executed throughout the project. The checklists should be maintained at the job site and should be included chronologically in the final CQA documentation package (Section 7).

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

SECTION 2
PERSONNEL QUALIFICATIONS AND RESPONSIBILITIES

It is vital that all parties involved in the installation of the GCL are in close communication with each other throughout the project, and that they fully understand the requirements of the project CQA plan. For the purposes of this manual, the qualifications and responsibilities of the various parties are delineated as follows:

Installing Contractor

Responsible for installing the GCL. The contractor should appoint an on-site Construction Supervisor to coordinate the installation effort and to interact with the other parties on the job site.

Ideally, the installing contractor should have prior experience in GCL installation and should staff the project with certified technicians. In November 1992, the National Institute for Certification in Engineering Technologies (NICET) began a program for the certification of installers of geosynthetic materials, including GCLs. Certification requires employer recommendations, field experience, and successful completion of written examinations. A prospective technician may select from several geosynthetics subfields and may pursue different levels of certification. It is encouraged that, at a minimum, the on-site supervisor be a NICET-certified technician.

On-Site Engineer

Usually the design engineer or designee, this person is responsible for general oversight of the installation. Provides assurance that construction is performed as designed, although not formally responsible for CQA. Primary contact when the installing contractor is in need of clarification of design issues. Primary contact for dispute/problem resolution. This person should be a registered professional engineer.

CQA Engineer

Charged with CQA for Bentomat installation as well as for any other liner system components. Oversees all CQA inspection, testing, and documentation. This person should be a registered professional engineer or a NICET-certified geosynthetics installation technician. This person must also be independent of the other parties on site.

Manufacturer's Representative

CETCO may provide on-site start-up assistance, especially those in which the installer has little or no prior experience or where unusual site conditions exist. The on-site engineer or installer is responsible for notifying CETCO of the intended installation schedule such that CETCO may provide timely guidance during the critical start-up process. CETCO's substantial GCL installation experience may provide valuable insights to the uninitiated engineer and/or installer.

CETCO also acts as the liaison between the manufacturing plant and the installer and coordinates the release of GCL from the plant in accordance with the installer's schedule. CETCO's *on-site* involvement is typically lessened when it is determined that the installer is sufficiently capable of installing GCL without CETCO's

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

continuous assistance. CETCO remains available throughout the project should questions or problems arise.

CQA Laboratory

The GCL conformance tests in this manual are designed to be performed at the job site to facilitate real-time response as test results are generated. In some projects where additional testing is required, however, it may be necessary to utilize the services of an off-site laboratory. The on-site engineer should verify that the selected laboratory has ample experience in the testing of GCLs and is aware of the general content of the project CQA plan as well as its specific testing requirements. The CQA engineer should establish a key contact at the laboratory to coordinate sample delivery procedures, confirm testing parameters and methods, and arrange the timely reporting of test results.

It is recommended that a preconstruction meeting be held between the above parties in order to establish working relationships with one another and to review the design drawings and specifications prior to deployment of the GCL. Thereafter, regular meetings on a daily or weekly basis are recommended as the project continues.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

SECTION 3
ON-SITE HANDLING

This section describes the procedures and equipment to be used in handling the GCL when it arrives at the job site. Proper execution of these procedures will ensure that the GCL is not damaged prior to installation. It should be noted that ASTM D 5888 also provides guidelines for GCL handling. The recommendations included herein are consistent with all ASTM guidelines.

CETCO's GCLs are produced in slightly different sizes depending upon the product selected. Weights and dimensions of these products and their corresponding core pipe sizes required for safe handling are provided in Table 1 below.

Product	Panel Size(m)	Roll Diam. (mm)	Roll Weight (kg)	Core Diam. (mm)	Core Pipe Diameter (mm)	Core Pipe Length (m)	Minimum Core Pipe Strength
Bentomat	4.57 x 45.7	610	1,225	100	75-90	5.5	XXH
Claymax	4.21 x 45.7	510	1,130	100	75-90	5.0	XXH

Table 1. GCL panel sizes and corresponding core pipe requirements.

It should be recognized that the weight of the GCL rolls will dictate what type of core pipe will be sufficiently strong for unloading and handling activities. Experience has shown that the type of steel from which the pipe was produced will influence its ability to sustain the weight of the roll. The strongest steel available should be used to prevent pipe bending. A core pipe that deflects more than 75 mm as measured from end to midpoint when the roll is lifted can cause damage to the GCL and is *not acceptable.* The pipes used to unload or deploy the GCL *must not bend* at any time.

3.1 Unloading Procedures

The GCL may be delivered to the job site in one of two ways: by flatbed truck or by closed trailer/container. Regardless of the delivery method, all unloading activities should take place away from main roadways and high-traffic areas at the site. The designated unloading area should be flat, dry, and stable, and should provide adequate peripheral access for the unloading equipment. Different techniques for unloading the GCL are used accordingly. Using the procedures and equipment described below will minimize unloading time.

3.1.1 Flatbed Truck Delivery

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

A front-end loader or backhoe is typically used to remove the rolls from the flatbed truck. Starting from the top rolls on the truck, the core pipe is inserted through the roll core. The core has an inside diameter of 100 mm may be slightly bowed upon arrival to the job site. In this case, it may be necessary to assist the core pipe insertion process by using the back of the loader bucket to carefully push the pipe through the core.

After the core pipe has been inserted, straps or chains are looped around each end of the pipe protruding from the roll. The other ends of the chains should be connected to a spreader bar (typically an I-beam) of equal length to the core pipe. The spreader bar itself is suspended from the loader bucket. The purpose of the spreader bar is to prevent the chains from chafing the ends of the roll as it is lifted. It is recommended that the chains or straps be secured by the placing a pin through each end of the pipe. The GCL roll should then be lifted and slowly carried from the flatbed to the temporary storage area.

3.1.2 Trailer or Container Delivery

The GCL may also be delivered in closed trailers or shipping containers. In these cases, different unloading equipment and techniques must be employed. Because of limited access to the GCL rolls, it is usually necessary to utilize an extendable-boom forklift with a "stinger" attachment. The forklift dealer or manufacturer can provide details on selecting the proper stinger for the type of forklift used at the job site.

The rolls are placed inside the trailer or container in the same way that they are positioned on a flatbed truck. The rolls are removed by inserting the stinger through the roll cores and lifting/pulling the rolls from the trailer/container.

3.2 Materials Handling

The equipment used to unload the GCL from the delivery vehicle may also be used to handle the material on site and to convey it to work areas. All unloading and handling activities must be undertaken with great care to avoid damage to the GCL. The GCL should never be handled in ways that could affect its performance. Some activities to avoid:

- Dropping the rolls from the edge of the delivery truck or container.
- Pushing or pulling the rolls on the ground surface.
- Lifting the roll without a core pipe.
- Bending the rolls by using a core pipe that cannot bear the weight of the roll.
- Forcing a bent core pipe through the core.
- Carrying the GCL over excessively rutted, bumpy terrain, causing the roll to bend and bounce in transit.

Adherence to these common-sense precautions will prevent handling-related damage to the Bentomat.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

The CQA engineer or designee should supervise the unloading and storage operations. It is the duty of the CQA engineer to maintain records of the shipments and to verify that the roll numbers on the labels match the roll numbers on the bills of lading. Any apparent discrepancies should be noted and reported to CETCO.

At this time, all of the rolls should also be visually inspected for damage. Damaged rolls should be clearly marked and set aside where they will not be immediately used. Major damage suspected to have occurred during shipment should *immediately* be reported to the carrier and to CETCO (see Section 4.8.1).

3.3 On-Site Storage

The GCL may be stored at a project site indefinitely, provided that proper storage procedures are followed. First, a dedicated storage area should be identified. This area should be level, dry, well drained, and located away from high-traffic areas of the job site.

For reasons of safety and material integrity, GCL rolls must never be stored on end. Rolls should be stored horizontally, in small stacks not to exceed four to five rolls in height. It is preferred that the bottom rolls be placed on plywood, on an arrangement of pallets, or on some other man-made surface, to promote drainage and to prevent damage by contact with the ground surface. If the rolls are to be placed directly on the ground, the local ground surface should be carefully prepared and proof-rolled to minimize the potential for damage. It is good practice to cover the stored rolls with a tarpaulin or plastic sheeting for supplemental protection from the elements.

The polyethylene sleeves of the GCL rolls should be examined for any obvious rips or tears. Sleeve damage should be repaired immediately with adhesive tape or additional plastic sheeting. At this time it is also recommended that the labels be examined and taped to the roll if they were displaced in transit.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

SECTION 4
INSTALLATION

This section of the CETCO GCL CQA Manual covers the techniques and procedures to be used for ensuring the quality of a GCL installation. Although some installation techniques are described, this section is *not* an installation guide. Refer instead to CETCO GCL Technical Reference TR-405 for specific GCL installation guidelines. ASTM D 6102 also contains sound GCL installation guidelines.

4.1 Start-Up Assistance

CETCO or its representatives can provide on-site start-up assistance, especially where the installer has little or no prior GCL installation experience or in which the application is relatively unique. CETCO will work with the on-site engineer and CQA engineer in order to verify that the proper unloading, installation and conformance testing procedures are utilized. CETCO's input is based on extensive experience with GCL installation and on intimate knowledge of the physical characteristics of GCLs. It should be recognized, however, that it is the site engineer's responsibility to implement CETCO's recommendations.

4.2 Equipment

In many projects, the equipment used for unloading the GCL can also be used to install it. Most applications require a vehicle to lift and suspend the roll as it is deployed. Front-end loaders, bulldozers, boom cranes, forklifts, and tracked excavators all have been successfully used for this task. Other, more specialized equipment exists for these operations and may also be used. The equipment for unrolling the GCL should be able to lift the roll and suspend it *freely* such that it does not chafe against the vehicle or the ground. The vehicle must also have the ability to accommodate a spreader bar above the roll of GCL.

The spreader bar should be sufficiently strong to bear the full weight of the GCL roll without bending. Readily available I-beams or T-beams made of structural steel are typically used for this purpose, although steel pipes have also been successfully used. The chains or straps should be checked for their strength before the installation is begun and should continually be inspected for wear as the installation continues.

The core pipe should be of the dimensions and strength indicated in Table 1. It has been CETCO's experience that the schedule of the core pipe is not always an accurate indicator of its strength. The type of steel from which the pipe is made, the presence of a longitudinal weld, and the overall length of the pipe all have an influence on its ability to sustain the weight of the GCL. It is essential that the core pipe *does not bend* when the full roll of GCL is suspended from it. Lastly, it is recommended that the core pipe have a means to prevent the chains or straps from slipping off the ends of the pipe. This can be accomplished by using pins or clamps.

It will often be necessary to cut the GCL before the end of the roll or to cut it to fit in certain confined areas. Cutting the GCL requires a *sharp* utility knife. It is very important to maintain the sharpness of the knife blades used for cutting the GCL, in order to prevent tearing its geosynthetic components and damaging the GCL where the cut is made. Frequent blade changes for the utility knives are strongly recommended.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

For construction of the bentonite enhanced overlapped seams of the Bentomat products, an acceptable fillet of bentonite can be poured directly from the bags of granular bentonite supplied with each roll of Bentomat, but a watering can (without a sprinkler head) is easier to use and produces a more controlled seam enhancement. A line chalker, such as those used for marking athletic fields, may also be used.

4.3 Field Conditions

At the beginning of each working day, the CQA engineer should confirm that there are no ambient site conditions, which could affect the quality of the installation. Specifically, the presence at the job site of excessively high winds, rain, standing water, or snow may be construed as unsuitable weather for GCL installation. There are no temperature restrictions for installing the GCL, however.

Bentomat is not as susceptible as Claymax to damage due to "premature hydration" (i.e., hydration before a confining stress is applied). Although Bentomat will not delaminate when wetted, CETCO nevertheless recommends that it be installed in dry weather as with Claymax. This lessens the potential for damage to the material and ensures that its integrity is not compromised by the swelling of the bentonite. Should the GCL become prematurely hydrated, it urged that CETCO be contacted in order to recommend a project-specific and product-specific recommendation as to whether the GCL must be removed and replaced.

4.4 Site Inspection

Prior to each day's installation activities, the site engineer and/or CQA engineer should inspect the work area to ensure that it has been prepared in accordance with the specification and design drawings. Specifically, the design grades should be verified, the slope length and steepness should be checked, the anchor trench dimensions should be measured, and the subgrade should be inspected and approved. Any deviations from the specifications or design drawings should be noted and rectified before the GCL is installed.

The anchor trench is especially important in applications where slopes are present. The anchor trench must meet or exceed the design dimensions but must also be free of any sharp corners or protrusions which could put excessive stress on the GCL. The CQA engineer must ensure that the anchor trench is as carefully prepared as the rest of the subgrade.

4.5 Panel Placement

The unrolling and placement of the GCL should be performed in such a way that the GCL is not damaged or

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

unduly stretched, folded, or creased. The GCL rolls are typically suspended from the front of the vehicle while it travels backwards along the intended path of placement. During this activity, the roll should be able to rotate freely around the core pipe. Excessive friction due to a bent or large-diameter core pipe, or due to con between the roll and the deployment equipment, may cause undesirable levels of tension to develop. It is necessary that the GCL be deployed in a fully relaxed (but not wrinkled) state.

A common deployment technique when the GCL is placed on slopes is to suspend the roll at the top of the slope while several laborers unroll it as they walk downslope. This is an acceptable technique, but the CQA engineer should verify that excessive tension does not develop on the material and that the underside of the panel is not damaged by friction with the subgrade. Unless the subgrade is acceptably smooth, the GCL should be unrolled over an already-placed panel and then moved laterally into its correct position. Flat-bladed vise grips are very useful for handling and moving unrolled panels.

It is important to ensure that, at the top of a slope, the GCL is properly placed in the anchor trench. After confirming that the trench has been constructed according to the specifications, the GCL should be placed in the trench such that it extends across the trench floor but not up the rear wall of the trench. Excess material if any, should be cut off, *not* folded over on top of the existing material. Proper anchorage will be achieved if and only if the GCL is placed within the trench in this manner.

The orientation of the GCL panels is important. When working in sloping areas, the panels should be positioned such that their long dimension is parallel to the direction of the slope. Panels may only be placed across the slope when the slope is less steep than 4H:1V or when the slope length is very short (less than or equal to 3 m).

4.6 Seaming

Proper field seaming is vital for the liner to function to its maximum abilities. There are three elements of CQA for this important task:

- Verification of the minimum acceptable overlap.
- Verification of the continuity of the accessory bentonite (Bentomat only).
- Verification that there is no dirt in the overlap zone or on the bottom geotextile of the overlying GCL panel.

These elements for field seam CQA are straightforward and require only visual inspection by the CQA engineer. The upper surface of the GCL has two heavy dashed lines on both sides of the panel. The lap lines are 150 mm from the edges of the panel, and the match lines are 250 mm from the edges of the panel. The minimum acceptable overlap is 150 mm. Thus, the installer's objective is to place the overlying panel *between* the two lines of the underlying panel. The CQA engineer needs only to visually verify that the 150-mm lap line of the underlying panel is not visible. A properly executed seam, therefore, is verified when three dashed lines (not four) are visible at the overlap, as shown in Figure 1.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

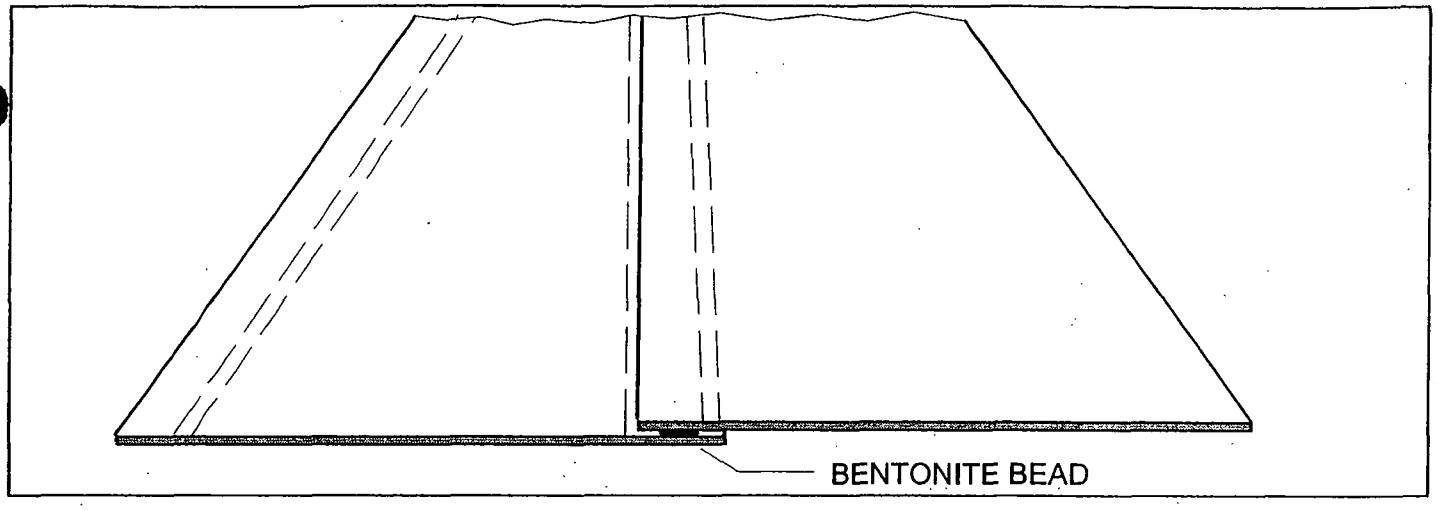


Figure 1. Schematic representation of a properly executed Bentomat field seam.

The hydraulic performance of Bentomat is maximized when the accessory bentonite is placed *continuously* within the overlap zone. Continuity is best achieved when a watering can or other similar device is used. Pouring the bentonite directly from the bag is less effective in this regard. Verification of continuity should be performed visually by the CQA engineer. The CQA engineer should observe the accessory bentonite as it is being placed within the overlap zone and should give verbal approval of the seam before the overlap is flipped back into place.

Verification of the cleanliness of the overlap is also required, because dirt can enter the overlap and create a conduit for excessive lateral leakage. This is one reason CETCO recommends that the overlying panel is placed and then its edge flipped back to reveal the overlap zone. Exposing the overlap in this manner forces extra attention on the seam and reveals the presence of loose dirt that may have inadvertently entered the overlap zone or may have become adhered to the bottom geotextile of the overlying panel. The CQA engineer should either verify that no dirt is present or ensure that the dirt is swept out of the overlap.

Verification of the *amount* of bentonite placed at the seam may be achieved by ensuring that one full 22.5 kg bag of granular bentonite is used for the lateral and longitudinal seaming of each roll of GCL. CETCO recommends that a minimum of 375 grams of granular bentonite be applied per lineal meter of seam. If the installer places bentonite at the rate of one bag per roll, this target application rate will be achieved.

As stated above, the longitudinal overlap for the GCL should be at least 150 mm. Overlaps at the *ends* of the rolls, however, ("transverse" overlaps) should be at least 0.5 m to account for any incidental loss of bentonite that could occur due to excessive handling of this portion of the roll or to stress relaxation after placement. Overlap distances can always be increased if unusual site conditions such as a soft subgrade exist.

4.7 Detail Work

The term "detail work" refers to the placement of GCL around structures such as vertical walls, gas vents, drainage basins, and pipe penetrations. In all of these cases, it is necessary to utilize granular bentonite or a

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

bentonite mastic to create a seal between the GCL and the structure. CQA of these areas involves a visual inspection of the methods used to make the seal. Specific items requiring inspection include:

- Dimensions of the "notch" excavated around the structure.
- Amount of bentonite applied to the detail
- Condition of the GCL at its cut edge (the cut should be clean, not frayed, with little or no bentonite edge loss from the GCL)
- Integrity of the detail as cover material is placed over and around it.

When cutting the GCL, it is important to ensure that the cut is made where the GCL hangs from the roll or where it rests on the subgrade . The GCL cut should *never* be made on the roll itself or when it rests on any other liner system component.

4.8 Damage and Damage Repair

Even when all reasonable protective measures are taken, the GCL may still become damaged during shipping and handling or during installation. This section provides instructions on assessing and managing the damaged materials.

4.8.1 Damage From Shipping and Handling

Occasionally, a GCL roll will arrive at a job site with its protective plastic sleeve torn due to movement during transit. This roll should be inspected for damage in the area where the sleeve was torn. If the geotextile under the torn sleeve is also torn, The outermost wrap of GCL on the roll should be unwound and discarded when the roll is installed. It is not necessary to consider the entire roll unusable. It is important, however, to mark the roll in order to alert the installer that the initial wrap should be cut away and discarded, because the damaged geotextile may be hidden from view when the GCL is unrolled. It is remotely possible that further layers of GCL on the roll could be similarly damaged. If this happens, additional wraps may be unrolled and discarded prior to placement.

Damage due to poor handling may occur as a result of accidentally dropping a suspended roll onto the ground or using weak core pipes that bend when the GCL is lifted. These activities can cause damage not just to the outer wrap of GCL but to the entire roll. If such damage occurs, the rolls should be clearly marked and moved away from the storage area. The CQA engineer should ensure that procedures are immediately implemented in order to prevent the recurrence of this problem. The CQA engineer should also contact CETCO to help make a determination as to whether the mis-handled GCL is acceptable for use on the project.

4.8.2 Damage From Installation Activities

The more commonly observed incidents of damage occur during installation, as a result of inadvertent contact by heavy equipment. Because this type of damage will potentially have the largest overall effect on the integrity

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

of the liner system, CETCO strongly recommends that equipment operating on or near the GCL *be monitored continuously.*

Equipment operators should be made fully aware of the importance of their actions and should be encouraged to notify the CQA engineer directly if they suspect at any time that the liner may have become damaged by their equipment. Close communication among everyone involved in the installation will help to ensure that this type of damage is reported and repaired.

Repeated passes by loaded dump trucks over GCL, which has minimal cover, can cause damage. It is therefore preferred to prevent potential for such damage by placing the GCL over these high-traffic areas *after* cover material delivery is largely completed. If this is not possible, then extra cover should be placed over high-traffic areas. At least 600-900 mm of screened, cohesive soil is recommended.

Should damage occur to the already-installed GCL, the following procedures should be followed:

1. Remove equipment from the damaged area and notify the CQA engineer.

2. *Manually* clean away all cover material within a 600-mm radius of the damaged area. Use a broom to sweep away the remaining dirt in order to make the area as clean as possible.

3. If necessary, repair the subgrade to its original conditions. Replace the torn/damaged GCL as closely as possible to its original position.

4. Place a bead of granular bentonite or bentonite paste at the minimum rate of 500 g per lineal meter around the damaged area.

5. Cut a patch of new GCL to fit over the damaged area and extending 600 mm beyond it.

6. Place the patch over the damaged area and carefully backfill over the patch.

Note that it is necessary only to repair the damaged portion of the GCL. It is usually not necessary to remove and replace the entire panel, unless the damage has occurred on a slope. In this case, slope stability may be compromised and the site engineer should be contacted to help determine whether a repair is acceptable.

SECTION 5
PLACEMENT OF COVER MATERIALS

As mentioned previously, the proper placement of cover on the GCL is crucial to the overall success of the installation. This section of the Bentomat CQA manual includes recommended materials and procedures, which will help to ensure that the integrity of the GCL is not compromised when it is covered.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

Regardless of the nature of the cover material used, it should be placed as soon as possible after the GCL has been deployed. The efforts of placing the GCL and placing the final cover should be coordinated to the ext that only as much GCL as can be covered should be deployed in one working day. This will prevent premature hydration and will greatly reduce the chances for incidental damage to the GCL during other activities.

5.1 Soil/Stone Cover

When a GCL is the sole liner system component, soil or stone cover *must* be placed over it to provide protection from physical damage, erosional forces, and degradation by UV light. The presence of cover also provides a confining stress, which allows the overlapped seam to perform properly and enhances the long-term physical integrity of the material. Lastly, the cover may provide a base for vehicular traffic. Because it serves so many functions, proper placement and CQA of the soil/stone cover is essential.

Frequently used cover materials include sand, gravel, crushed stone, and common earth fill. Regardless of the type of material selected for the cover, it should be free of large stones (greater than 50 mm in diameter), sticks, and any other materials, which could cause puncture or tearing. The source of all cover material should be identified in order to ascertain its suitability well in advance of the installation.

In addition to particle size, the *angularity* of a crushed stone or gravel will impact the construction survivability of the GCL. It is preferred that relatively rounded materials be utilized. If these materials are not available, then extra caution must be taken during cover placement. Dumping the cover from a loader bucket positioned high above the GCL is unacceptable. The cover should be gently placed from as low a height as possible. Vehicular traffic should also be restricted if particularly angular or abrasive material is used. If there is some doubt as t the suitability of a potential cover material, a representative sample should be submitted to CETCO for analys

With respect to the equipment used to place the protective cover, it is strongly recommended that no heavy equipment come in direct contact with the GCL. Obviously, tracked equipment will damage the liner. In some cases, however it is necessary to drive equipment directly on the GCL. This can be accomplished with low-pressure, *rubber-tired* equipment. Permission to do so will be granted by CETCO through the CQA engineer on a case-by-case basis *only* and will include restrictions on the equipment itself and on the type of movements the vehicle may make on the GCL.

The chemical nature of the cover soil must also be considered. The use of fine-grained, calcareous soil or stone is strongly discouraged due to the potential for an adverse reaction with the sodium bentonite contained in the GCL.

The cover material placed as backfill in the anchor trench should be of the same quality as the rest of the backfill. It is especially important that the anchor trench backfill be compacted either by hand tamping or by the use of a small walk-behind compactor. Compaction should be performed over each 150-mm lift of backfill placed in the anchor trench.

5.2 Geosynthetic Cover

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

A geomembrane or other geosynthetic liner system component is often placed over the GCL. Caution must be used during this activity to prevent GCL damage. Again, it is strongly recommended that no heavy equipment directly contact the GCL, but exceptions can be made on a project-specific basis.

A special precaution should be taken when textured geomembrane is installed directly over the GCL in a composite liner system. Because considerable friction may develop between the geomembrane and the GCL, it is difficult to pull the geomembrane into position for welding to adjacent sheets. A smooth "slip sheet" should be used to provide a low-friction sliding surface for the geomembrane until it is in position for welding.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

SECTION 6
CONFORMANCE TESTING

Conformance testing is necessary in order to verify that the materials installed meet the requirements set forth in the specification. Although CETCO performs regular testing on its GCLs as part of its manufacturing QA/QC program, the engineer may require additional testing at the job site. This section lists several tests, which may be utilized to verify the quality of the delivered materials and the quality of the installation of those materials.

6.1 Bentonite Mass Per Unit Area

A relatively simple test to verify that the specified amount of bentonite has been encapsulated in the GCL is to measure the bentonite mass per unit area of representative samples cut from delivered rolls. The results of this test may be used in conjunction with the results of the bentonite swell test described in Section 6.2 to arrive at an indirect verification of the hydraulic performance of the GCL.

ASTM D 5993 provides procedures for performing the mass per unit area test. After the correction for geotextile mass is made, there should be at least 3,600 g of bentonite contained within the GCL per square meter. This is CETCO's minimum average roll value (MARV) for bentonite content of all of its GCLs. These values are always subject to change, so please refer to GCL Technical Reference No. TR-404 for the most recent list of certified physical GCL properties.

If for any reason the resulting mass per unit area values do not meet the required MARVs, the corresponding rolls should be set-aside for additional inspection and testing. CETCO should be notified to assist in resolving the problem if it persists.

6.2 Bentonite Swell Index and Fluid Loss

The swell capacity and fluid loss of the bentonite are two of the most important indicators of its ability to function as a barrier material. ASTM D 5890 provides a detailed free swell testing procedure used by CETCO. CETCO's MARV requirement for the bentonite is 24 mL/2g. ASTM D5891 provides a detailed fluid loss testing procedure. CETCO's maximum requirement for fluid loss of the bentonite is 18 ml. As with the mass per unit area test described in Section 6.1, if these values are not achieved in conformance testing, the corresponding rolls should be set aside for additional inspection and testing. CETCO should be notified to assist in resolving the problem if it persists.

6.3 Other Conformance Tests

Other conformance tests may be conducted at the request of the on-site engineer or the CQA engineer on a project specific basis. ASTM D6495 suggests grab tensile strength and index flux/permeability (as per ASTM D 5887), although it should be cautioned that rapid "real-time" results of index flux/permeability are not possible due to the time required to achieve steady-state permeability values. Thus, it is difficult to use permeability testing as a pass/fail criterion for GCL acceptance at the job site.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

Also, the laminated GCLs are not easily tested for index flux/permeability due to potential sidewall leakage around the membrane. CETCO has a special setup procedure for its laminated GCLs in TR-302.

Lastly, it should be recognized that field-scale test pads and infiltrometer tests are typically *not* performed in GCL projects. This contrasts with compacted clay liner (CCL) projects, in which, for two reasons, field-scale data is almost always required. First, field data for CCL projects is necessary because there are many variables involved in their construction (compactor weight, speed, number of passes; soil type; moisture content; lift thickness; etc.). It is therefore necessary to build a test pad to ensure that the construction materials and methods intended for the project will provide the required level of performance. Second, laboratory test results and field test results may vary significantly with CCLs due to the difficulties in retrieving representative, undisturbed samples. This factor also warrants that field data be obtained for CCL projects.

With GCL installations, however, there are very few construction-related variables. Additionally, the GCL that is tested for permeability in the laboratory is the *same* material deployed in the field. For this reason, a GCL such as Bentomat or Claymax does not require a field permeability test.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

SECTION 7
DOCUMENTATION

Thorough documentation of all CQA activities and tests is necessary in order to provide a written record that the GCL has been properly installed. The CQA documentation package for a GCL installation should include the following items:

- Bills of lading and corresponding packing list confirming receipt of all GCL installed at the site.
- A panel layout drawing in which the GCL roll numbers are keyed to their location in the field. Locations where damage was encountered and repaired should also be marked.
- The roll numbers from which samples were taken for conformance tests, along with the results of those tests.
- A daily report or diary of the activities undertaken at the site during construction.
- Certification that the requirements for the subgrade and for the cover material were achieved.
- A compilation of all CQA checklists completed during the installation.
- The manufacturing quality control (MQC) certification and accompanying test data.
- A description of deviations, if any, made to the original CQA plan during the installation.
- Photographs of the GCL during installation.

CETCO provides the MQC certification. All other items on the above list are the responsibility of the CQA engineer.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

APPENDIX A
List of Applicable ASTM Standards

ASTM D 5887, "Standard Test Method for Measurement of the Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

This method describes the specimen preparation, stress and gradient conditions, and testing procedures to be used for determining the flux (flow per unit area) through GCLs. Adherence to the specimen preparation procedures presented will help to minimize sidewall leakage, a common problem when testing thin barriers. This is an index test designed to determine product acceptability and uses a maximum confining stress of 35 kPa (5 psi) and a hydraulic gradient of 14 kPa (2 psi).

ASTM D 5888, "Standard Guide for Storage and Handling of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

This is a guide for the safe handling of GCL rolls at a job site, identifying the equipment and techniques typically employed to unload the material from delivery trucks and to place it in a dedicated storage area. Procedures are also presented for proper storage of the GCL in order to minimize the potential for product damage while in storage.

ASTM D 5889, "Standard Practice for Quality Control of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

Test methods and testing frequencies are presented for manufacturing quality control (MQC) of GCLs. This standard practice includes conformance tests to be performed on the GCL components (bentonite and geotextiles and/or geomembranes) as well as tests to be performed on the finished GCL product. Special procedures for GCL permeability/flux testing require the manufacturer to provide an historical database to demonstrate the consistency of the hydraulic performance of the finished product and to justify the reduced need for frequent MQA permeability testing.

ASTM D 5890, "Standard Test Method for Swell Index Measurement of Clay Mineral Component of Geosynthetic Clay Liners," *Annual Book of ASTM Standards, Vol. 4.09,* American Society for Testing and Materials, W. Conshohocken, PA.

This test method was adapted from the basic elements of a swell test presented in the USP/NF (United States Pharmacopeia/National Formulary). Two grams of dried and powdered bentonite are slowly dropped into a graduate cylinder containing 100 mL of distilled water. The swell value in mL is recorded after 24 hours, by reading the value on the graduate cylinder at the clay/water interface.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

APPENDIX A (continued)
List of Applicable ASTM Standards

ASTM D 5891, "Standard Test Method for Measurement of Fluid Loss of Clay Mineral Component of Geosynthetic Clay Liners," ***Annual Book of ASTM Standards, Vol. 4.09,*** **American Society for Testing and Materials, W. Conshohocken, PA.**

This test method was adapted from the API (American Petroleum Institute) Procedure 13A/13B for bentonite. A bentonite slurry is created, aged, and then filtered in a pressurized cell. The amount of water passing through the filter cake in a specified time interval is recorded as the filtrate loss or fluid loss. The test indicates the clay's general ability to function as a barrier to liquids.

ASTM D 5993, "Standard Test Method for Measuring the Mass per Unit Area of Geosynthetic Clay Liners," ***Annual Book of ASTM Standards, Vol. 4.09,*** **American Society for Testing and Materials, W. Conshohocken, PA.**

This test method describes how to measure the bentonite mass per unit area of a GCL sample. A GCL specimen of a certain minimum area is weighed, oven-dried, and weighed again. The dry weight of the specimen, minus the nominal weight of the geosynthetic component(s), is then divided by the area of the specimen. The moisture content of the specimen is determined by subtracting the dry weight from the wet weight.

ASTM D 6072, "Standard Guide for Obtaining Samples of Geosynthetic Clay Liners," ***Annual Book of ASTM Standards, Vol. 4.09,*** **American Society for Testing and Materials, W. Conshohocken, PA.**

Presents procedures for obtaining representative samples of GCL material for laboratory testing purposes. The samples may be obtained either at the factory or in the field. Procedures for packaging and protecting the sample are also included to prevent the possibility of damage in transit to the laboratory.

ASTM D 6102, "Standard Guide for Installation of Geosynthetic Clay Liners," ***Annual Book of ASTM Standards, Vol. 4.09,*** **American Society for Testing and Materials, W. Conshohocken, PA.**

Provides detailed recommendations for the proper installation of GCLs. Discusses the necessary site conditions, equipment, and techniques for installing GCLs without damaging them. Includes recommendations on panel placement, overlaps, and special considerations for slopes. Also discusses the preferred types of soil cover and equipment used to apply this cover.

ASTM D 6495, "Standard Guide for Acceptance Testing Requirements for Geosynthetic Clay Liners", *Annual Book of ASTM Standards, Vol. 4.09,* **American Society for Testing and Materials, W. Conshohocken, PA**

Provides guidelines for acceptance testing requirements for GCLs, including test methods and verifications.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

APPENDIX B

CETCO GCL Construction Quality Assurance Checklist

Project Name/Number:_____

CQA Inspector:_____

Date:_____ Weather:_____

STORAGE AREA

_____ Rolls covered/tarped
_____ Rolls labeled
_____ No standing water present
_____ Packaging intact/repaired
_____ Accessory bentonite protected

_____ Storage area maintained

MATERIALS RECEIVED TODAY

_____ Packaging intact
_____ Rolls inspected for damage--
none found
_____ Damage suspected (indicate
roll numbers and nature of
damage _____
_____
_____

SITE INSPECTION

_____ Subgrade surface acceptable
_____ Installation area dry
_____ Anchor trenches acceptable
_____ Design grades achieved
_____ Cover soil acceptable (as applicable)

INSTALLATION

_____ Number of rolls deployed today
(attach list of roll numbers)
_____ Anchor trench fill compacted
_____ Min. seam overlap achieved
_____ All seams visually inspected
_____ Seam bentonite added (as applicable)
_____ All detail work inspected
_____ Downslope panel orientation
_____ All mat covered at end of day

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

INSTALLATION EQUIPMENT

_____ Core pipe straight
_____ Spreader bar straight
_____ Chains/Straps inspected
_____ Knife blades replaced
_____ Seaming clay supply available

CONFORMANCE TESTING

Bentonite Mass/Area:

Bentomat Roll No.	Bentonite (g/sm)	Pass/ Fail?

Bentonite Swell:

Bentomat Roll No.	Final Swell Value (mL/2g)	Pass/ Fail?

NOTES/OBSERVATIONS

_____
_____
_____

NOTE:

This checklist is intended to serve as a *guideline* for the CQA engineer to use in the development of a project-specific or company-specific CQA plan. The checklist is not all-inclusive. The items presented in this list are those that CETCO feels are the most important for the proper installation of Bentomat.

1500 W. Shure Drive • Arlington Heights, IL 60004 • USA • (847) 392-5800 • FAX (847) 577-5571
A wholly owned subsidiary of AMCOL International

The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and no responsibility for the results obtained through application of this information.

LLDPE GEOMEMBRANE LINER

Submittal Information

Present Landfill Accelerated Action Construction Project

Rocky Flats Technology Site

August 12, 2004

Colorado Lining
Construction,
Inc

July 12, 2004

SM Stoller
Attn: Jim Erickson
Phone: 303-546-4351
Fax: 303-443-1408

RE: RFETS Landfill – Paper Submittal - #1.07-12-04

Jim:

Attached is the requested paper submittal (7 sets), pertaining to the following geosynthetic material (02225 – 60 Mil LLDPE Geomembrane Liner – GSE).

Also, included in this submittal package is information pertaining to the geosynthetic welding equipment that Colorado Lining intends to use on this project. PWT manufactures the "Wedge-It" used for LLDPE material seaming, the "Mini-Wedge" used for welding the geotextile component of the GDN, the "Accura-Lite" tensiometer used for field testing of LLDPE geomembrane seam strength, the "Triac S" hand held welder used for adhering LLDPE patches to the damaged LLDPE geomembrane and various other uses, the "MA-40-D, MA-60-D, X3-EX" extruders used for sealing patches and other detail work involving extrusion welded seaming. The "V-Plate" vacuum box manufactured by DEMTECH will be used for non-destructive seam and patch testing.

Once the 60 Mil LLDPE material in this paper submittal is approved, Colorado Lining Construction (CLC) will send sample materials to TRI testing laboratory for section 02210 – Geosynthetics Interface Testing. Upon completion of final project design and approved Geosynthetics Interface Testing results, Colorado Lining Construction will issue panel layouts, CLC installation QA/QC manual, and all other required submittal information pertinent to our scope of work.

Please let me know if any other paper submittal information is required. Also, please inform me as soon as the paper submittal is approved and final design materials are selected for Geosynthetic Interface Testing.

Regards,

Dan E. Lahr
Senior Estimator

GSE®
GSE Lining Technology, Inc.
19103 Gundle Road
Houston, Texas 77073
800-435-2008

13 July 2004

Dan Lahr
Colorado Lining.
1062 Singing Hills Road
Parker, CO 80138

Re: Rocky Flats Present Closure
GSE Project No. 515122

CERTIFICATION

The undersigned, being qualified and authorized to do so, hereby certifies that standard GSE 60 mil average Double-sided Texture LLDPE geomembrane and the GSE 60 mil average Smooth LLDPE will meet or exceed the following specified property values and/or conditions:

- GSE LLDPE will meet a Density value of ≥ 0.915 g/cc for resin and a density value of ≥ 0.920 g/cc for geomembrane per ASTM D 1505.
- GSE LLDPE will meet a Melt Index value <1.0 g/10 minutes per ASTM D1238.
- GSE LLDPE will meet an Oxidation Induction Time value of ≥100 minutes per ASTM D3895.

Regards,

Jimmy Youngblood
GSE Technical Support Specialist

cc: Mary Cruthirds. GSE Lining Technology, Inc.

GSE Lining Technology, Inc.

19103 Gundle Road
Houston, Texas 77073
800-435-2008
281-443-8564
Fax: 281-230-8650

July 31, 2003

Dan Lahr
Colorado Lining Co.
1062 Singing Hills Road
Parker, CO 80138

CERTIFICATION

This is to certify that **Colorado Lining Co.** is an approved and authorized Dealer and installer of GSE products. As an authorized Dealer of GSE, **Colorado Lining Co.** has been provided with a copy of GSE's proprietary product manual containing the data sheets of all GSE's products, and the GSE Field Installation quality assurance manual. As an authorized Dealer of GSE, **Colorado Lining Co.** has access to GSE's Technical Department representatives who can respond to questions on specifications and installation techniques. Individual employees of authorized GSE Dealer may have participated in training programs sponsored by GSE at its headquarters in Houston, Texas.

Regards,

David Leggett
V.P., Dealer Sales

DL:cdb

GSE

GSE STANDARD PRODUCTS

Product Data Sheet

GSE UltraFlex Textured

GSE UltraFlex Textured is the coextruded textured version of GSE UltraFlex. It is a high quality, linear low density polyethylene (LLDPE) geomembrane with one or two coextruded, textured surfaces, and consisting of approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. The resin used is a specially formulated, proprietary virgin polyethylene and is designed specifically for flexible geomembrane applications. GSE UltraFlex Textured has excellent resistance to UV radiation and is suitable for exposed conditions. This product allows projects with greater slopes to be designed since frictional characteristics are enhanced. *These product specifications meet or exceed GRI GM17.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A000	LUT060A000	LUT080A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, minutes	ASTM D 3895, 200° C O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS016 R03/10/04

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc, certain of which are registered in the U.S.A. and other countries.

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

GSE

Product Data Sheet

GSE STANDARD PRODUCTS

GSE UltraFlex

GSE UltraFlex is a high quality, linear low density polyethylene (LLDPE) geomembrane produced from specially formulated, virgin polyethylene with outstanding flexibility. This polyethylene resin is designed specifically for flexible geomembrane applications. Its high uniaxial and multiaxial elongation characteristics make it very suitable for applications where differential or localized subgrade settlements are expected such as leach pads, landfill closure caps, or any application where elongation or puncture resistance is critical. GSE UltraFlex contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no fillers or extenders are used. GSE UltraFlex is the only material of its type on the market with many years of proven performance in applications throughout the world. *These product specifications meet or exceed GRI GM17.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			LLD 030A000	LLD 040A000	LLD 060A000	LLD 080A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850	850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (71)	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	46 (205)	62 (276)	92 (409)	123 (547)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C 1 ATM	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex is available in rolls weighing about 3,800 lb (1,724 kg) respectively.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS003 R03/08/04

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc. certain of which are registered in the U.S.A. and other countries.

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

GSE Geomembranes

Geomembranes ▫ Geonets ▫ Geocomposites ▫ GCLs ▫ Geotextiles ▫ Concrete Protection ▫ Installation Services ▫ Fabrications

Manufacturing Quality Assurance Manual

www.gseworld.com

This manual contains proprietary information belonging to GSE Lining Technology, Inc. This information is intended to provide a summary of standard quality procedures practiced by GSE's Manufacturing Quality Assurance Laboratories in Houston, Texas. These procedures apply to standard geomembrane materials only and do not explicitly address non-conforming materials.

This manual replaces in its entirety and supersedes all earlier versions issued by GSE Lining Technology, Inc. We suggest you maintain contact with your GSE representative to confirm the validity of this version at future dates.

GSE Lining Technology, Inc. reserves the right to change, modify, or discontinue the use of the policies and procedures described herein without notice or prior consent except as contractually obligated otherwise.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Table of Contents

Overview

I.	Quality Manifest	3
II.	Manufacturing Quality Assurance	3
III.	Manufacturing Quality Assurance Organization	3
IV.	Staff And Scheduling	3
V.	Product Identification And Documentation	4
VI.	Records Retention	4
VII.	Testing Capabilities	4
VIII.	Material Quality Assurance	5
Appendix A -	Minimum Testing Frequencies And Properties for GSE Raw Materials	8
Appendix B -	Minimum Testing Frequencies And Properties For GSE Geomembrane Products	9
Appendix C -	Minimum Weld Properties For GSE Geomembrane Products	18

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

I. QUALITY MANIFEST

GSE Lining Technology, Inc. is committed to providing the highest quality products and services to our customers. This requires a firm, total quality commitment from all individuals within our organization that we will only supply materials that meet or exceed the requirements and specifications of GSE and our customers.

GSE's commitment to quality starts with the highest quality raw materials. The quality of incoming raw materials is controlled at the supplier level with a complete vendor evaluation program in place. This means purchasing only from suppliers who are committed to statistical process control thereby providing a consistent, high level of quality assurance of their products.

II. MANUFACTURING QUALITY ASSURANCE

GSE Lining Technology, Inc. has an on-site Manufacturing Quality Assurance Laboratory at each manufacturing plant. Having a fully equipped, well staffed, dedicated laboratory at each of the manufacturing facilities allows GSE to maintain a high level of quality and up-to-the-minute results on finished products. Each facility follows the same guidelines for evaluating the quality of GSE products and is capable of adapting to market-driven requirements.

A. Objective

The objective of the GSE Quality Assurance program is to define implementation of basic manufacturing quality assurance (MQA) procedures necessary to ensure consistent production of quality products supplied to the geosynthetic market. Note that at this time, these procedures are limited to polyethylene geomembranes.

B. Scope

In order to achieve GSE's stated purpose, a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. These procedures assure that raw materials and process parameters are controlled to provide products complying with GSE's pre-defined minimum characteristics.

III. MANUFACTURING QUALITY ASSURANCE ORGANIZATION

This organization consists of the Manufacturing Quality Assurance Laboratories as well as the manufacturing personnel. The combination of expertise and experience from these groups provides GSE with the proper tools to maintain the highest level of quality and customer service in the industry.

The Quality Assurance Department at GSE is charged by the President to assure that only products meeting both GSE's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. Each member of the Quality Assurance team must participate in detailed training that includes factory exposure.

IV. STAFF AND SCHEDULING

The Quality Assurance Laboratories are staffed whenever manufacturing is occurring; this is usually 24 hours per day, 365 days per year. This minimizes the amount of potentially inferior product produced before a manufacturing problem is identified.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

V. PRODUCT IDENTIFICATION AND DOCUMENTATION

A. Roll Numbering

Each roll of geomembrane is assigned a unique roll number. The Quality Assurance Laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer specifications for compliance. The Quality Assurance Laboratory approves those materials that meet both of these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE minimum standards is given a roll number but is rejected and not placed into inventory. The material is identified as scrap and will not be utilized.

Material that meets GSE minimum standards but does not meet a stricter customer specification is not allocated to that customer but is placed into inventory as GSE standard material.

D. Documentation

Individual Quality Assurance Certificates are generated and supplied for each roll of geomembrane product to include all relevant quality assurance information about the material(s).

VI. RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy according to the item.

MATERIAL	ITEM	YEARS
Raw materials	Resin Supplier Test Reports and Certifications	≥2
	GSE Resin Test Reports	≥2
	Resin Sample Retain (Archive)	≥2
Geomembrane	Raw Test Data (in computer database)	≥5
	Quality Control Certificates (in computer database)	≥5
	Sample Retain (approximately one square foot)	≥5

VII. TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendices A-D. GSE's Houston laboratories are accredited by the GAI-LAP program. GSE's Houston laboratories, as part of GSE's Product Division, also hold ISO certification. The appropriate certificates are maintained for review upon request by authorized parties.

A. Routine Testing

Through careful investigation, GSE has developed a strict and thorough Quality Assurance program that exceeds the vast majority of customer specifications including GRI GM13, "Test Properties, Testing

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes" and GRI GM17 "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes". The testing program covers raw materials (see Appendix A) and finished goods (see Appendix B) and is adhered to at all GSE laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used.

B. *Other Testing Capabilities*

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE Quality Assurance Laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

VIII. MATERIAL QUALITY ASSURANCE

GSE Lining Technology, Inc. has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer specifications.

A. *Raw Material*

GSE primarily uses two types of raw materials, "natural resin" and "masterbatch" in the manufacture of geomembrane products. Natural resin is the base material that is used to make a geomembrane. It contains stabilizers to prevent degradation from occurring during and after extrusion. "Masterbatch" is the term referring to the concentrated carbon black material used with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geomembrane product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE specifications. The material is not accepted unless all standard test requirements are met and the GSE test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE test results for each lot of resin are provided in a separate report upon request.

Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb., 23,000 kg)

B. *Geomembrane Products*

GSE has implemented a strict and thorough Quality Assurance program for all geomembrane products. The geomembrane product line can be broken into two primary categories: smooth and textured products. Tables containing GSE minimum properties and test frequencies for all GSE geomembrane products includ-

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

ing specialty products such as GSE White (light-reflective geomembrane) and GSE Conductive (field spark-testable geomembrane) are in Appendix B.

1. *On-Line Manufacturing Quality Assurance*

The Quality Assurance program for finished product begins during the manufacturing process. Each manufacturing line is equipped with state-of-the-art monitoring devices that provide feedback on the physical quality of the materials being produced. Each geomembrane production line is equipped with both a thickness gage and spark-testing device.

a) Thickness Measurement

As geomembrane is being produced, thickness readings are taken continuously over the length and width of the roll. These data are used to establish the minimum, maximum and average thickness values for each roll and are verified by thickness testing upon sampling of the finished goods.

b) Spark Testing

An electrical spark detector is in place on each manufacturing sheet line. This apparatus provides immediate notification of holes in the finished product. If a hole is detected, an alarm is triggered and the hole is identified. Rolls containing holes are rejected from standard product inventory.

2. *Smooth Geomembrane Materials*

Smooth geomembrane products available include high density and linear low density polyethylene materials with 2-3% carbon black. Specialty materials include White, electrically conductive, green surfaced, and smooth edge textured geomembranes.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens are cut for testing the machine direction and transverse direction. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

b) Evaluation of Results

All data are entered into a computer database for calculation and comparison to GSE and customer-specific specifications. If materials do not meet GSE minimums and/or the customer specifications, the manufacturing personnel are immediately notified in order for the appropriate adjustments to be made. Only products meeting GSE minimums and customer specifications will be approved for shipment.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

c) Reporting

Every roll of material has a quality assurance roll certificate or Roll Test Data Report (RTDR). This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

3. *Coextruded Textured Geomembranes*

Textured geomembrane is produced utilizing a round die with coextrusion technology. The texture is produced in a process in which one or two of the outer layers of a three-layer extrusion are blended with nitrogen gas. Nitrogen bubbles form in the molten resin and escape upon exiting the die, creating a rough, textured surface. Regular, White, green surfaced, and conductive geomembranes are available with coextruded texturing.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens for testing the machine and transverse direction tensile are cut from each of the five positions. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

Evaluation of results and reporting practices are the same as for smooth geomembranes.

C. *Third Party Conformance Sampling*

Some specifications require independent Quality Assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and manufacturing quality assurance operations and/or to collect samples and conduct independent conformance testing prior to shipment of materials.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix A - Minimum Testing Frequencies and Properties for GSE Raw Materials

MINIMUM TESTING FREQUENCIES FOR GSE RAW MATERIALS

Property	Test Method[1]	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
OIT	ASTM D 3895 (1 ATM at 200° C)	once per resin lot
Carbon Black Content	ASTM D 1603, modified	N/A
Carbon Black Dispersion	ASTM D 5596	NA

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method[1]	HDPE	LLDPE
Density [g/cm^3]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 ATM at 200° C)	100	100

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and ITB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A010	HDE 040A010	HDE 060A010	HDE 080A010	HDE 100A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content[1], %	ASTM D 1603, black layer	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1] GSE White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A000	HDC 060A000	HDC 080A000	HDC 100A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive may have an overall carbon black percentage above 3.0% due to the high carbon black loadings in the conductive layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A010	HDC 060A010	HDC 080A010	HDC 100A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive White may have an overall ash content greater than 3.0% due to the white and conductive outer layers.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDT 030A000	HDT 040A000	HDT 060A000	HDT 080A000	HDT 100A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		45 (8)	60 (11)	90 (16)	120(21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		150	150	150	150	150
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (641)	180 (801)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[2], hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)	Standard Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			18,674 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE HD Standard Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]NCTL for HD Textured is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDT 040A010	HDT 060A010	HDT 080A010	HDT 100A010
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		60 (11)	90 (16)	120 (21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		150	150	150	150
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	72 (320)	108 (480)	144 (641)	180 (801)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[3], hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 or 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE White Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]GSE White Textured may have an overall ash content greater than 3.0% due to the white layer.
- [3]NCTL is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			LLD 030A000	LLD 040A000	LLD 060A000	LLD 080A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850	850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (71)	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	46 (205)	62 (276)	92 (409)	123 (547)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C 1 ATM	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex is available in rolls weighing about 3,800 lb (1,724 kg) respectively.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE	
Product Code			LLD040A010	LLD060A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb		
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (27)	228 (40)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	62 (276)	92 (409)
Carbon Black Content[1], %	ASTM D 1603	20,000 lb	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**	
Oxidative Induction Time (minutes)	ASTM D 3895 200° C 0_2 1 atm.	200,000 lb	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex White is available in rolls weighing about 3,800 lb (1,724 kg).
- [1]GSE UltraFlex White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A000	LUT060A000	LUT080A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, minutes	ASTM D 3895, 200° C O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A010	LUT060A010	LUT080A010
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6993, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time (minutes)	ASTM D 3895 200° C, O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex White Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- [2]GSE UltraFlex White Textured may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix C - Minimum Weld Properties for GSE Geomembrane Products

MINIMUM WELD PROPERTIES FOR STANDARD HDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)	120 (3.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	49 (8.6)	65 (11.4)	98 (17.2)	130 (22.8)	162 (28.4)	196 (34.3)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	39 (6.8)	52 (9.1)	78 (13.7)	104 (18.2)	130 (22.8)	157 (27.5)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	61 (10.7)	81 (14.2)	121 (21.2)	162 (28.4)	203 (35.5)	242 (42.4)

[1] These values apply to both coextruded and flat cast produced geomembranes and white-surfaced and conductive products.

MINIMUM WELD PROPERTIES FOR STANDARD LLDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Peel Strength (extrusion) ppi (kN/m)	ASTM D 6392	36 (6.3)	48 (8.4)	72 (12.6)	96 (16.8)	120 (21.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	38 (6.7)	50 (8.8)	75 (13.1)	100 (17.5)	125 (21.9)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	45 (7.9)	60 (10.5)	90 (15.8)	120 (21.0)	150 (26.3)

[1] These values apply to both coextruded and flat cast produced geomembranes to include white-surfaced products.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

GSE

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

www.gseworld.com

Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

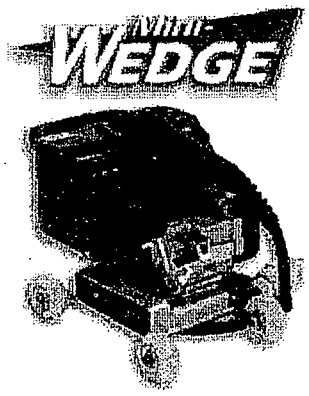
Wedge Welders - for Light, Medium & Heavy Duty Jobs

The "Wedge-It"–Ten years and over a thousand units later, we're still cranking them out. Why? Because Geomembrane manufacturers and installers know the difference between a hard-working welder and hype. With 25 years of combined field experience, we do too. We didn't invent wedge welding. We simply manufacture a high quality welder at a great price, backed by the best service in the business. No false claims. No unproven facts. No high-priced gimmicks.

Features:

- Volt and Hour Meter
- Low Cost-High Performance off the shelf electronics
- New Easy-Out wedge makes changing cartridge heaters a breeze.
- Wedge Assembly with powerful 800 watt Easy-Out cartridge heaters, available up to 3 inches wide.
- Drop out contour roller assembly for easy cleaning and access to wedge assembly
- Can be set-up with rubber rollers, solid or split, for air channel testing.

	Weight (welder only)	Shipping weight	Dimensions (case)	Power supply	Travel speed	Wedge temperature
WEDGE IT	53 Lbs. / 24.1 Kg.	69 Lbs. / 31.5 Kg.	22" x 15" x 15"	115 or 230 V AC, 50/60 Hz, 1200 W	0 to 20 feet per min., adjustable	Up to 800 degrees F, adjustable
	Ambient condition extremes		**Wedge sizes**		**Material capabilities**	
	-20 to 120 degrees F,-9 to 55 degrees C		45mm solid or 45mm split with 15mm Air test channel 15mm x 15mm x 15mm (to meet European standard)		Low/High density Polyethylenes (20 to 120+ mil), Hypalon, XR-5, PVC and other geomembranes	



The "Mini-Wedge" is the ideal wedge welder for overlap seaming of PVC, Polypropylene, Hypalon, XR-5 and other flexible Geomembranes. Its light weight makes it easy to maneuver and control even thin materials in high ambient temperature situations. The "Mini-Wedge" is also great for high speed seaming of non-woven geotextiles and other geosynthetics as an alternative to sewing.

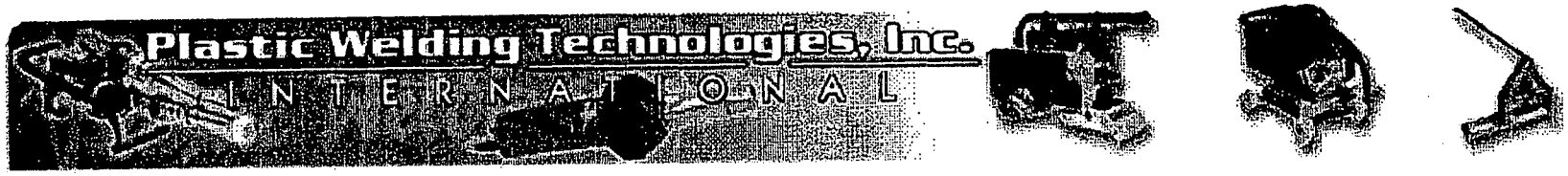
Features:

- Light weight (15 pounds)
- No remote transformer
- Simply plug it in to standard 110 or 220V supply
- Self-contained with on-board temperature and speed controls
- Easy to operate
- Versatile
- Backed by the best service in the business!

	Weight (welder only)	Shipping weight	Dimensions (case)	Power supply	Travel speed
MINI WEDGE	15 Lbs. / 6.8 Kg.	29 Lbs. / 13.5 Kg.	18" x 15" x 13"	120 or 240V AC, 50/60Hz, 1200W	0 to 20 feet (0 - 6 meters) per min., adjustable
	Material thickness range			**Weld width**	
	PE: Up to 40 mil (1.0mm) **PVC**: Up to 100 mil (2.5mm) **PP**: Reinforced-Up to 45 mil (1.2mm) Non-reinforced-Up to 60 mil (1.5mm) **Other** flexible materials up to 100 mil (2.5mm) **Nonwoven** geotextiles up to 16 oz. per sq. yard			2" (50mm) with or without air channel copper or stainless	

Headquarters
West Coast Office: **800 635-6693**
6125 Enterprise Drive #10 • Diamond Springs, CA 95619
Phone: 530 622-2791 • Fax: 530 622-2704
Email: info@plasticweldingtechnologies.com

East Coast Office: **888 793-7333**
4241 Freedom Way • Weirton, WV 26062
Phone: 304 797-7333 • Fax: 304 797-7064
Email: sales@plasticweldingtechnologies.com

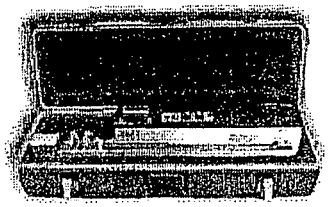


Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

Testing Equipment



The **"Accura-Lite"** is a lightweight machine for on-site destructive testing (peel & shear) of geomembrane seams. It meets all specifications for ASTM D4437, D3083, etc. The Accura-Lite is designed to handle rough job-site conditions but can be used in a labratory environment as well.

Accura-Lite

Features:

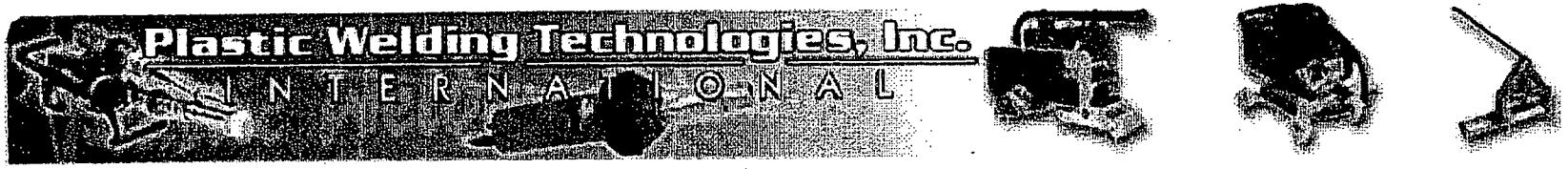
- 500 lb. capacity "S" style load cell is built to hold up under hostile job site environments and maintains its accuracy to +/-1%.
- Easy-to-use cam-lock grips are designed to accommodate up to 2" sample coupons (other custom grips available).
- A "calibration check" feature allows the operator to confirm the accuracy of the machine with the push of a button.
- Peak-hold feature retains highest reading.
- The test speed of the Accura-lite is adjustable from 0 to 20 inches per minute. This has an advantage over pre-set speeds due to inconsistent power supplied by generators in the field.
- Delivery includes: "Accura-Lite" testing machine, calibration report, operations manual, sun visor for readout, shipping/storage case

Specifications:

Weight (tester only)	40 Lbs. / 18 Kg.
Shipping weight	66 Lbs. / 30 Kg.
Dimensions	36" x 9" x 7" high
Power supply	115 or 230 V AC, 50/60 Hz
Test Speed	0 to 20 inches/min. adjustable
Crosshead Stroke	24" Standard
Rated Capacity	500 lbs.

Portable Tensiometer - Examo

Technical Data		Examo 300F	Examo 600F
Power consumption	V ~	120, 230	120, 230



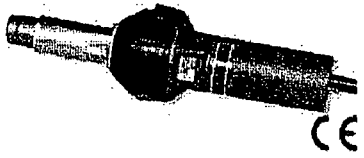
Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

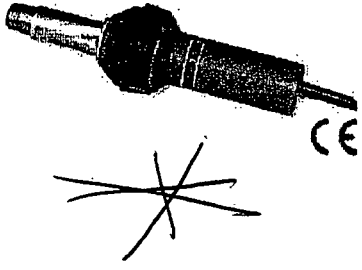
HAND HELD WELDING TOOLS

Repair welding and forming of bumpers, air conditioning systems, heating units, spoilers, batteries, lamps, tanks for petrol, oil and water, together with complete bodyworks sections for motor vehicles. Shrinking and solder shrinking of electronic and electrical interconnect devices and connections.



	Technical Data	Order No.	Voltage V ~	Power consumption W	Frequency Hz	Temperature °C
TRIAC PID		1G2	42, 100, 120, 200, 230	960, 1400, 1600, 1400, 1600	50/60	50-600, steplessly controlled
	Air flow l/m	Pressure stat. Pa	Emission level L_{pA} (dB)	Size mm	Weight kg	Test signs:
	200	ca. 3000 (30 mbar), after 24 h operating time	65	340 x 90, handle Ø 56	1,4 with 3 m cord	CCA certificated

Accessories for the Triac PID



• The proven hand-tool

	Technical Data	Order No.	Voltage V ~	Power consumption W	Frequency Hz	Temperature °C
TRIAC S		1G4	42, 100, 120, 200, 230	960, 1400, 1600, 1400, 1600	50/60	20-700, steplessly controlled
	Air flow l/m	Pressure stat. Pa	Emission level L_{pA} (dB)	Size mm	Weight kg	Test signs:
	max. 230	ca. 3000 (30 mbar), after 24 h operating time	65	340 x 90, handle Ø 56	1,3 with 3 m cord	CCA certificated

Accessories for the Triac S

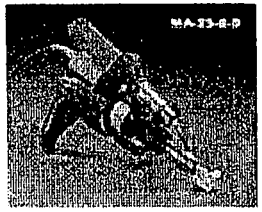
Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

LANDFILL CONSTRUCTION - Hand extruder with integrated air supply (Autoair)

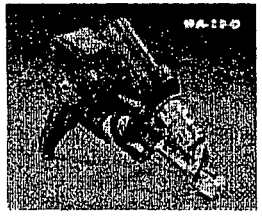
Autoair hand extruders with integrated preheat air supply provide maximum flexibility in workshop and field welding applications. Thanks to the on-board preheat air blower, the machine does not depend on an external air source.



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
MA-25-S-D	2.5 kg/h, Ø 4 mm 1.4 kg/h, Ø 3 mm	PP / PE	round rod Ø 3/4 mm	wall thicknesses 4-15 mm film thicknesses from 1 mm	5	455

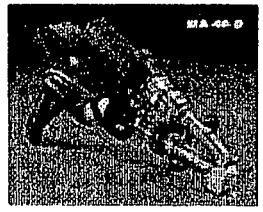
Weld Trimmer | Parts & Accessories



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
MA-25-D	2.5 kg/h, Ø 4 mm 1.4 kg/h, Ø 3 mm	PP / PE / PVDF Special design for welding PVC	round rod Ø 3/4 mm	wall thicknesses 4-15 mm film thicknesses from 1 mm	6	470

Weld Trimmer | Parts & Accessories

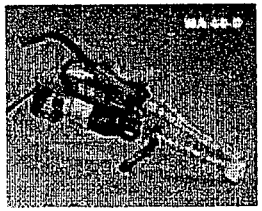


The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]

MA-40-D	3.9 kg/h, Ø 5 mm 2.5 kg/h, Ø 4 mm	PP / PE	round rod Ø 4/5 mm	wall thicknesses 8-30 mm film thicknesses from 1 mm	8	570

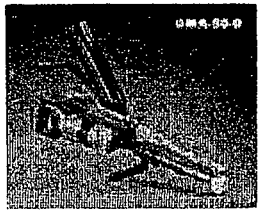
Weld Trimmer | Parts & Accessories



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
MA-60-D	6.0 kg/h, Ø 5 mm 3.8 kg/h, Ø 4 mm	PP / PE	round rod Ø 4/5 mm	wall thicknesses 12-40 mm film thicknesses from 1 mm	10.4	790

Weld Trimmer | Parts & Accessories



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
GMA-50-D	2.0 - 6.2 kg/h dependent on granulate type and size	PP / PE	granulate	wall thicknesses 12-40 mm film thicknesses from 1 mm	12.3	890

Weld Trimmer | Parts & Accessories

The"X3-EX/GEO" Extrusion Welder -- the ultimate extrusion welder for the serious geomembrane installer. The X3-EX/GEO is perfect for high-production patching and is also built to hold up to continuous use applications such as tie-in seams. With its high air volume pre heater, the X3-EX/GEO is also ideal for production welding of HDPE pipe, sheet stock and other thermoplastic structure fabrication.

X3-EX/GEO	Weight (welder only)	Shipping weight	Dimensions (case)	Drive motor	Extrudate Heater
	26 Lbs. / 11.8 Kg.	44 Lbs. / 20 Kg.	32" x 16" x 13"	6 Amps, 1320 Watts, 220 VAC, 50-60 Hz	1000 Watts, 220 VAC, 50-60 Hz
	Pre-heat air system	Overall power	Extrudate output	Welding rod input	Range of application

		requirement			
	2200 Watts, 220 VAC, 50-60 Hz	18 Amps, 4000 Watts, 220 VAC, 50-60 Hz	Up to 12 Lbs. / 5.4 Kg. per hour	4mm or 5mm round rod	20 mil PE liners to 2"+ wall thickness, PE & PP pipe, sheet stock, etc.

Weld Trimmer | Parts & Accessories

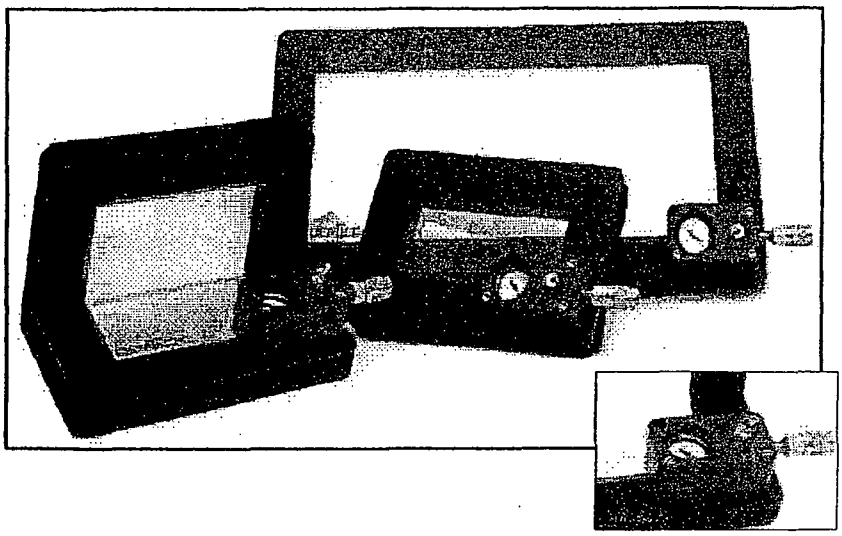
Headquarters
West Coast Office: **800 635-6693**
6125 Enterprise Drive #10 • Diamond Springs, CA 95619
Phone: 530 622-2791 • Fax: 530 622-2704
Email: info@plasticweldingtechnologies.com

East Coast Office: **888 793-7333**
4241 Freedom Way • Welton, WV 26062
Phone: 304 797-7333 • Fax: 304 797-7064
Email: sales@plasticweldingtechnologies.com

© Copyright 2003 Plastic Weldings Technologies, Inc.

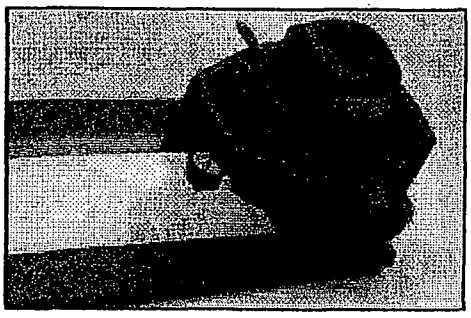
V-Plate

For non-destructive vacuum testing of welded seams.



Exclusive control box with switch to turn vacuum on and off. Sturdy PVC block protects gauge.

The latest in vacuum testing technology



Self contained version available in sizes from 10" X 24" to 10" X 48".

The revolutionary V-Plate is.....

Light:	Making it easy to move from one test to the next with very little effort.
Flexible:	Easily creating an initial vacuum seal over uneven areas and wrinkles.
Low Profile:	Preventing liner from pulling up into the chamber, damaging the material.
Economical:	Low cost replacement sight plates available with pre-attached foam gaskets.
Versatile:	The V-Plate can be used with a vacuum pump or an air compressor and can be ordered in just about any size or shape to fit your testing application. Contact us for information on available sizes and shapes.

Call "Demo" Dave McLaury for more information at (888) 324-WELD

Another quality product by DEMTECH Services Inc.

* Prices vary depending on shape and viewing area size. Custom sizes and shapes available upon request. Contact us for details.

DEMTECH Services, Inc. • P.O. Box 2165, Placerville, CA 95667 • 6414 Capitol Ave., Diamond Springs, CA 95619
www.demtech.net • (888) 324-WELD (9353) • (530) 621-3200 • Fax: (530) 621-0150 • **demodave@demtech.net**

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 7/ 15/ 2004		New Submittal
		X	Resubmittal

Section I — REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 005A
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No. 005

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	GSE Untraflex 60 Mil LLDPE	See Attached	6	02225	N/A		
2	GSE Ultraflex 60 Mil Textured LLDPE	See Attached	6	02225		1	
3	Liner Welding Equipment	See Attached	6	02225			

Rocky Flats Plant

☐ APPROVED ☒ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: John K. Davis DATE: 08/04/2004

Remarks: Asperity Height 10 mil average

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: Paul B. Kreitz 7/15/04

Section II — Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQAE
J.H. Rale Tr

Davis, Robert W.

From: Thompson, Randy [Randy.Thompson@earthtech.com]
Sent: Wednesday, August 04, 2004 4:04 PM
To: Davis, Robert W.
Subject: Submittal Comments

Bob,

Attached are comments on Submittal ~~021, 017, 009 and 010.~~ 008, 005A, 009, 010, 017, 021

<<Submittal Comments.doc>>

Randy Thompson

Submittal Comments.doc

Design Engineer Submittal Comments
August 3, 2004

SUBMITTAL 008 – SILT FENCE

The deviations noted by the subcontractor (4-foot stakes and 0.05/sec permittivity) are acceptable. Specification Section 02228 will be revised to reflect these values for the official project specifications that will be used by the CQAE to approve submittals.

Could not verify that the stakes are 2-inches by 2-inches but it is assumed since this is the industry standard.

SUBMITTAL 00? – 60-mil LLDPE

LLDPE Material Information - During construction, the manufacturer must provide a LLDPE Certification Sheet demonstrating that the rolls supplied meet project specifications.

Weld Equipment Information - The Specifications and QA/QC Plan state that QC destructive testing shall meet ASTM D 6392. The devise is acceptable so long as the stated ASTM D 4437 outlines the use of ASTM D 6392.

The V-Plate vacuum tester is acceptable so long as it meets the requirements of ASTM D 5641 or ASTM D 5820.

SUBMITTAL 021 – TEMPORARY CONSTRUCTION FACILITIES

Section 4.0 – There is no discussion in relation to the Colorado Air Quality Control Commission Regulation 1 as outlined in Section 1.02A of Specification 01500.

Section 7.0 – Specification 01500 Section 1.05 A lists specific requirements for the administrative and storage areas (95% maximum dry density in the top 6-inches, gravel paving course of sub-base material not less than 3-inches thick). It is not clear whether the subcontractor intends to meet this specification.

Section 7.0 – Will the storage areas protect GCL from ultraviolet light exposure, moisture, excessive humidity, puncture, cutting, or other damaging conditions per Specification 02226?

SUBMITTAL 017 – DUST SUPPRESANT

The dust suppressant is acceptable and will help satisfy Specification 01430 Section 1.03C3 which states that no dust emissions from roadways, or construction operations within the project boundary will be allowed.

SUBMITTAL 009 – NONWOVEN GEOTEXTILE

The 6oz geotextile meets the requirements of Specification Section 11100 and also the requirements of Specification 02245 (not referenced on transmittal form). As specified in the QA/QC Plan (Table 4.1), manufacturer's QC data must be reviewed and approved by QA/QC personnel for actual materials delivered to the site.

SUBMITTAL 010 – EROSION CONTROL MAT

Due to erosion control requirements the erosion control mat on the east slope has been changed to C350 not SC250 as previously indicated. Please provide information on C350.

SC150 information provided is acceptable. The manufacturer's quality program outlined will ensure that the SC150 delivered meets specifications.

Attachments:

Line 1 GSE Untraflex Mil LLDPE

- Product Data Sheet (1)
- GSE Ultraflex, 40 Mil, Sample (2)

Line 2 GSE Ultraflex 40 Mil Textured LLDPE

- Product Data Sheet
- GSE Ultraflex Textured 40 Mil, Sample

Line 3 Welding Equipment

- Wedge Welders
- Testing Equipment
- Triac S Hand Held Welder
- MA-40-D Welder
- MA-60-D Welder
- X3-EX/GEO Welder
- V-Plate

Additional Attachments

- Colorado Lining Certification from GSE
- GSE Geomembranes Manufacturing Quality Assurance Manual
- GSE July 13 letter regarding Density, Melt Index and Oxidation Induction Time
- Colorado Lining July 12 letter detailing proposed welding equipment.

Rahe, John -- MFG, Inc.

From: Jim Olsta [jim.olsta@cetco.com]
Sent: Thursday, September 16, 2004 4:35 PM
To: John.rahe@mfgenv.com
Cc: joe@kaulcorp.com
Subject: Rocky Flats Project

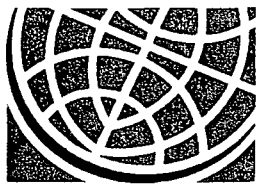
Dear Mr. Rahe,

Per our conversation following is a brief description of the procedure that will be used for needle detection and removal of all Bentomat ST manufactured for the Rocky Flats project.

There is an in-line magnet after the needleboard to remove broken needles laying on the surface of the GCL and loosely imbedded needles. After the magnet the roll will pass an in-line metal detector. If the metal detector detects metal it will tag the roll. The line operator will send all tagged rolls to a separate reroll station. At the reroll station the reroll operator will unwind the roll to the tag. The operator will then visually look for needles and scan the roll with a metal detector. Any protruding needles will be removed.

Sincerely,

Jim Olsta
CETCO
1500 W. Shure Dr.
Arlington Heights, IL 60004
(847) 818-7912 direct
(847) 577-5566 fax
e-mail: jim.olsta@cetco.com



Colorado Lining
Construction,
Inc

July 12, 2004

SM Stoller
Attn: Jim Erickson
Phone: 303-546-4351
Fax: 303-443-1408

RE: RFETS Landfill – Paper Submittal - #1.07-12-04

Jim:

Attached is the requested paper submittal (7 sets), pertaining to the following geosynthetic material (02225 – 60 Mil LLDPE Geomembrane Liner – GSE).

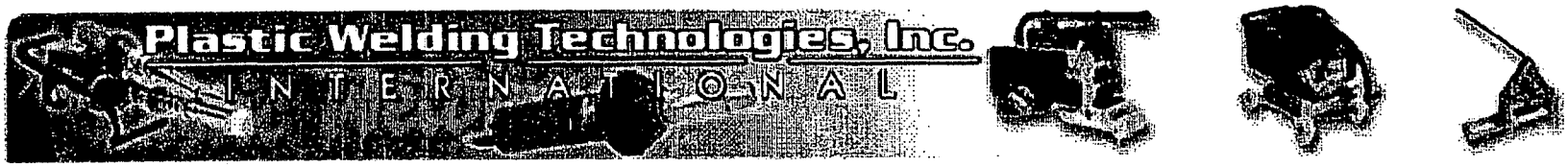
Also, included in this submittal package is information pertaining to the geosynthetic welding equipment that Colorado Lining intends to use on this project. PWT manufactures the "Wedge-It" used for LLDPE material seaming, the "Mini-Wedge" used for welding the geotextile component of the GDN, the "Accura-Lite" tensiometer used for field testing of LLDPE geomembrane seam strength, the "Triac S" hand held welder used for adhering LLDPE patches to the damaged LLDPE geomembrane and various other uses, the "MA-40-D, MA-60-D, X3-EX" extruders used for sealing patches and other detail work involving extrusion welded seaming. The "V-Plate" vacuum box manufactured by DEMTECH will be used for non-destructive seam and patch testing.

Once the 60 Mil LLDPE material in this paper submittal is approved, Colorado Lining Construction (CLC) will send sample materials to TRI testing laboratory for section 02210 – Geosynthetics Interface Testing. Upon completion of final project design and approved Geosynthetics Interface Testing results, Colorado Lining Construction will issue panel layouts, CLC installation QA/QC manual, and all other required submittal information pertinent to our scope of work.

Please let me know if any other paper submittal information is required. Also, please inform me as soon as the paper submittal is approved and final design materials are selected for Geosynthetic Interface Testing.

Regards,

Dan E. Lahr
Senior Estimator

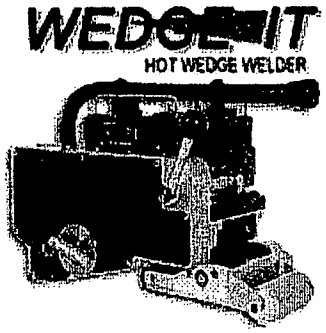


Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

Wedge Welders - for Light, Medium & Heavy Duty Jobs

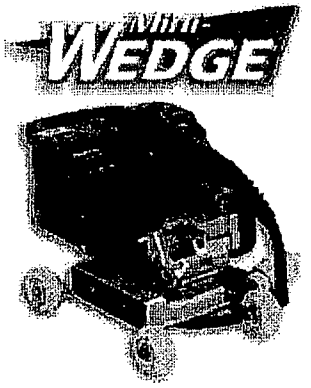


The "Wedge-It"–Ten years and over a thousand units later, we're still cranking them out. Why? Because Geomembrane manufacturers and installers know the difference between a hard-working welder and hype. With 25 years of combined field experience, we do too. We didn't invent wedge welding. We simply manufacture a high quality welder at a great price, backed by the best service in the business. No false claims. No unproven facts. No high-priced gimmicks.

Features:

- Volt and Hour Meter
- Low Cost-High Performance off the shelf electronics
- New Easy-Out wedge makes changing cartridge heaters a breeze.
- Wedge Assembly with powerful 800 watt Easy-Out cartridge heaters, available up to 3 inches wide.
- Drop out contour roller assembly for easy cleaning and access to wedge assembly
- Can be set-up with rubber rollers, solid or split, for air channel testing.

	Weight (welder only)	Shipping weight	Dimensions (case)	Power supply	Travel speed	Wedge temperature
WEDGE IT	53 Lbs. / 24.1 Kg.	69 Lbs. / 31.5 Kg.	22" x 15" x 15"	115 or 230 V AC, 50/60 Hz, 1200 W	0 to 20 feet per min., adjustable	Up to 800 degrees F, adjustable
	Ambient condition extremes		**Wedge sizes**		**Material capabilities**	
	-20 to 120 degrees F,-9 to 55 degrees C		45mm solid or 45mm split with 15mm Air test channel 15mm x 15mm x 15mm (to meet European standard)		Low/High density Polyethylenes (20 to 120+ mil), Hypalon, XR-5, PVC and other geomembranes	



The "Mini-Wedge" is the ideal wedge welder for overlap seaming of PVC, Polypropylene, Hypalon, XR-5 and other flexible Geomembranes. Its light weight makes it easy to maneuver and control even thin materials in high ambient temperature situations. The "Mini-Wedge" is also great for high speed seaming of non-woven geotextiles and other geosynthetics as an alternative to sewing.

Features:

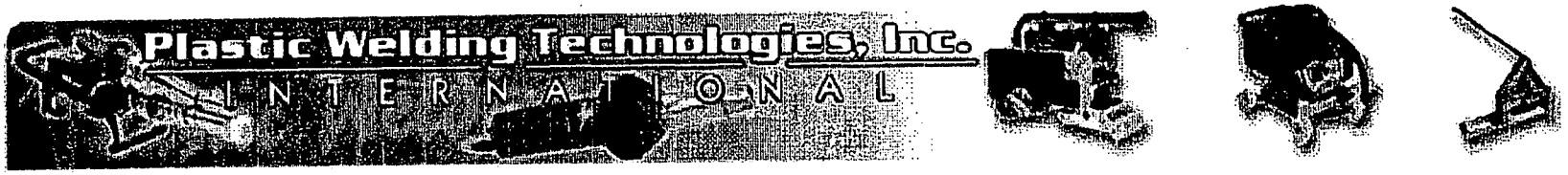
- Light weight (15 pounds)
- No remote transformer
- Simply plug it in to standard 110 or 220V supply
- Self-contained with on-board temperature and speed controls
- Easy to operate
- Versatile
- Backed by the best service in the business!

	Weight (welder only)	Shipping weight	Dimensions (case)	Power supply	Travel speed
MINI WEDGE	15 Lbs. / 6.8 Kg.	29 Lbs. / 13.5 Kg.	18" x 15" x 13"	120 or 240V AC, 50/60Hz, 1200W	0 to 20 feet (0 - 6 meters) per min., adjustable
	Material thickness range			**Weld width**	
	PE: Up to 40 mil (1.0mm) **PVC**: Up to 100 mil (2.5mm) **PP**: Reinforced-Up to 45 mil (1.2mm) Non-reinforced-Up to 60 mil (1.5mm) **Other** flexible materials up to 100 mil (2.5mm) **Nonwoven** geotextiles up to 16 oz. per sq. yard			2" (50mm) with or without air channel copper or stainless	

Headquarters
West Coast Office: **800 635-6693**
6125 Enterprise Drive #10 • Diamond Springs, CA 95619
Phone: 530 622-2791 • Fax: 530 622-2704
Email: info@plasticweldingtechnologies.com

PWT Plastic Welding Technologies

East Coast Office: **888 793-7333**
4241 Freedom Way • Weirton, WV 26062
Phone: 304 797-7333 • Fax: 304 797-7064
Email: sales@plasticweldingtechnologies.com

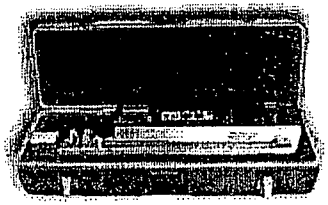


Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

Testing Equipment



The **"Accura-Lite"** is a lightweight machine for on-site destructive testing (peel & shear) of geomembrane seams. It meets all specifications for ASTM D4437, D3083, etc. The Accura-Lite is designed to handle rough job-site conditions but can be used in a labratory environment as well.

Accura-Lite

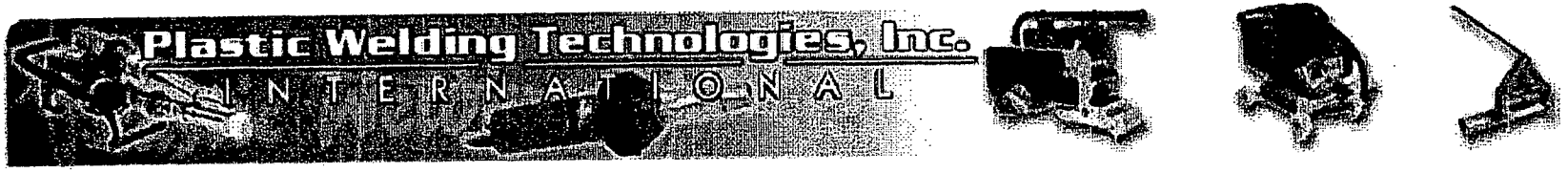
Features:

- 500 lb. capacity "S" style load cell is built to hold up under hostile job site environments and maintains its accuracy to +/-1%.
- Easy-to-use cam-lock grips are designed to accommodate up to 2" sample coupons (other custom grips available).
- A "calibration check" feature allows the operator to confirm the accuracy of the machine with the push of a button.
- Peak-hold feature retains highest reading.
- The test speed of the Accura-lite is adjustable from 0 to 20 inches per minute. This has an advantage over pre-set speeds due to inconsistent power supplied by generators in the field.
- Delivery includes: "Accura-Lite" testing machine, calibration report, operations manual, sun visor for readout, shipping/storage case

Specifications:

Weight (tester only)	40 Lbs. / 18 Kg.
Shipping weight	66 Lbs. / 30 Kg.
Dimensions	36" x 9" x 7" high
Power supply	115 or 230 V AC, 50/60 Hz
Test Speed	0 to 20 inches/min. adjustable
Crosshead Stroke	24" Standard
Rated Capacity	500 lbs.

Portable Tensiometer - Examo			
Technical Data		**Examo 300F**	**Examo 600F**
Power consumption	V ~	120, 230	120, 230



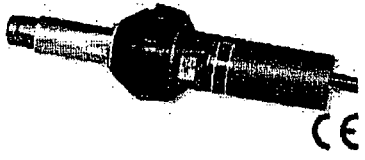
Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

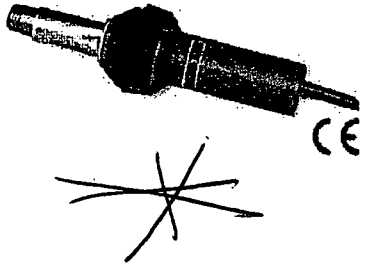
HAND HELD WELDING TOOLS

Repair welding and forming of bumpers, air conditioning systems, heating units, spoilers, batteries, lamps, tanks for petrol, oil and water, together with complete bodyworks sections for motor vehicles. Shrinking and solder shrinking of electronic and electrical interconnect devices and connections.



	Technical Data	Order No.	Voltage V ~	Power consumption W	Frequency Hz	Temperature °C
TRIAC PID		1G2	42, 100, 120, 200, 230	960, 1400, 1600, 1400, 1600	50/60	50-600, steplessly controlled
	Air flow l/m	Pressure stat. Pa	Emission level L_{pA} (dB)	Size mm	Weight kg	Test signs:
	200	ca. 3000 (30 mbar), after 24 h operating time	65	340 x 90, handle Ø 56	1,4 with 3 m cord	CCA certificated

Accessories for the Triac PID



• The proven hand-tool

	Technical Data	Order No.	Voltage V ~	Power consumption W	Frequency Hz	Temperature °C
TRIAC S		1G4	42, 100, 120, 200, 230	960, 1400, 1600, 1400, 1600	50/60	20-700, steplessly controlled
	Air flow l/m	Pressure stat. Pa	Emission level L_{pA} (dB)	Size mm	Weight kg	Test signs:
	max. 230	ca. 3000 (30 mbar), after 24 h operating time	65	340 x 90, handle Ø 56	1,3 with 3 m cord	CCA certificated

Accessories for the Triac S

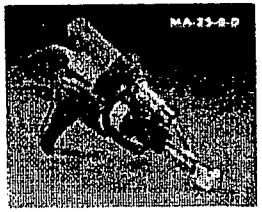
Home
Contact PWT
Products
- Wedge Welders
- Extruders
  - Internal Air Supply
  - External Air Supply
  - Geomembrane Welders
- Hand Held Welding Tools
- Process Technology
- Roofing Products
- Testing Equipment
- Accessories and Parts
- Welding Shoes

Service
- Parts
- Manuals
- Catalogs
- Troubleshooting
- Identification of Thermoplastics

Online Quote Form
UPS Tracking
Related Links

LANDFILL CONSTRUCTION - Hand extruder with integrated air supply (Autoair)

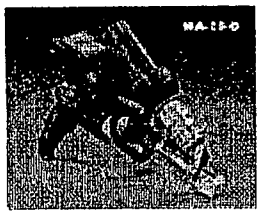
Autoair hand extruders with integrated preheat air supply provide maximum flexibility in workshop and field welding applications. Thanks to the on-board preheat air blower, the machine does not depend on an external air source.



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
MA-25-S-D	2.5 kg/h, Ø 4 mm 1.4 kg/h, Ø 3 mm	PP / PE	round rod Ø 3/4 mm	wall thicknesses 4-15 mm film thicknesses from 1 mm	5	455

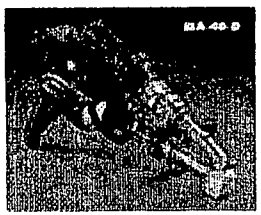
Weld Trimmer | Parts & Accessories



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
MA-25-D	2.5 kg/h, Ø 4 mm 1.4 kg/h, Ø 3 mm	PP / PE / PVDF Special design for welding PVC	round rod Ø 3/4 mm	wall thicknesses 4-15 mm film thicknesses from 1 mm	6	470

Weld Trimmer | Parts & Accessories

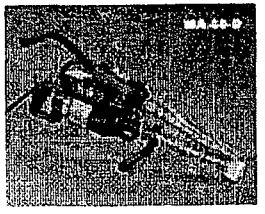


The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]

MA-40-D	3.9 kg/h, Ø 5 mm 2.5 kg/h, Ø 4 mm	PP / PE	round rod Ø 4/5 mm	wall thicknesses 8-30 mm film thicknesses from 1 mm	8	570

Weld Trimmer | Parts & Accessories



The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

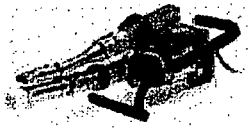
	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
MA-60-D	6.0 kg/h, Ø 5 mm 3.8 kg/h, Ø 4 mm	PP / PE	round rod Ø 4/5 mm	wall thicknesses 12-40 mm film thicknesses from 1 mm	10.4	790

Weld Trimmer | Parts & Accessories

The extruder comes with the following accessories:
1 Power box w/ 50 ft. of cord
1 Welding shoe
1 Set of air nozzles

	Max. welding rate [kg/h]	Welding material	Kind of material	Application range	Weight [kg]	Length [mm]
GMA-50-D	2.0 - 6.2 kg/h dependent on granulate type and size	PP / PE	granulate	wall thicknesses 12-40 mm film thicknesses from 1 mm	12.3	890

Weld Trimmer | Parts & Accessories



The"X3-EX/GEO" Extrusion Welder -- the ultimate extrusion welder for the serious geomembrane installer. The X3-EX/GEO is perfect for high-production patching and is also built to hold up to continuous use applications such as tie-in seams. With its high air volume pre heater, the X3-EX/GEO is also ideal for production welding of HDPE pipe, sheet stock and other thermoplastic structure fabrication.

X3-EX/GEO	Weight (welder only)	Shipping weight	Dimensions (case)	Drive motor	Extrudate Heater
	26 Lbs. / 11.8 Kg.	44 Lbs. / 20 Kg.	32" x 16" x 13"	6 Amps, 1320 Watts, 220 VAC, 50-60 Hz	1000 Watts, 220 VAC, 50-60 Hz
	Pre-heat air system	Overall power	Extrudate output	Welding rod input	Range of application

		requirement			
	2200 Watts, 220 VAC, 50-60 Hz	18 Amps, 4000 Watts, 220 VAC, 50-60 Hz	Up to 12 Lbs. / 5.4 Kg. per hour	4mm or 5mm round rod	20 mil PE liners to 2"+ wall thickness, PE & PP pipe, sheet stock, etc.

Weld Trimmer | Parts & Accessories

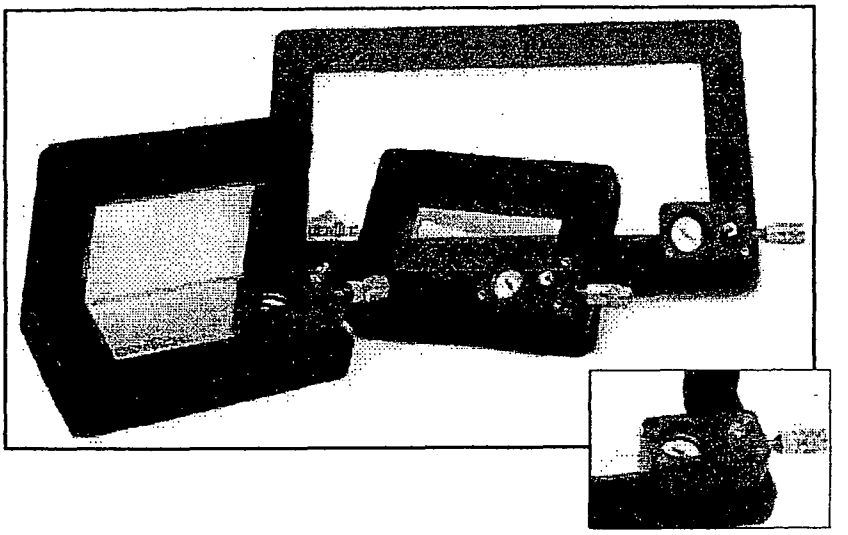
Headquarters
West Coast Office: **800 635-6693**
6125 Enterprise Drive #10 • Diamond Springs, CA 95619
Phone: 530 622-2791 • Fax: 530 622-2704
Email: info@plasticweldingtechnologies.com

East Coast Office: **888 793-7333**
4241 Freedom Way • Wellton, WV 26062
Phone: 304 797-7333 • Fax: 304 797-7064
Email: sales@plasticweldingtechnologies.com

© Copyright 2003 Plastic Weldings Technologies, Inc.

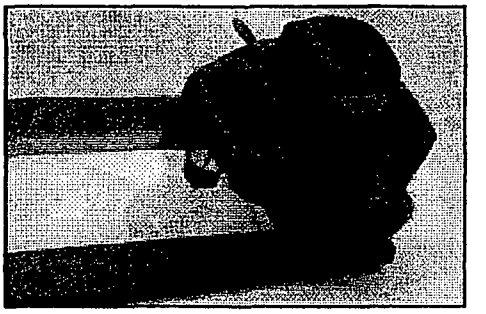
V-Plate

For non-destructive vacuum testing of welded seams.



Exclusive control box with switch to turn vacuum on and off. Sturdy PVC block protects gauge.

The latest in vacuum testing technology



Self contained version available in sizes from 10" X 24" to 10" X 48".

The revolutionary V-Plate is.....

Light:	Making it easy to move from one test to the next with very little effort.
Flexible:	Easily creating an initial vacuum seal over uneven areas and wrinkles.
Low Profile:	Preventing liner from pulling up into the chamber, damaging the material.
Economical:	Low cost replacement sight plates available with pre-attached foam gaskets.
Versatile:	The V-Plate can be used with a vacuum pump or an air compressor and can be ordered in just about any size or shape to fit your testing application. Contact us for information on available sizes and shapes.

Call "Demo" Dave McLaury for more information at (888) 324-WELD

Another quality product by DEMTECH Services Inc.

* Prices vary depending on shape and viewing area size. Custom sizes and shapes available upon request. Contact us for details.

DEMTECH Services, Inc. • P.O. Box 2165, Placerville, CA 95667 • 6414 Capitol Ave., Diamond Springs, CA 95619
www.demtech.net • (888) 324-WELD (9353) • (530) 621-3200 • Fax: (530) 621-0150 • **demodave@demtech.net**

GSE

GSE STANDARD PRODUCTS

Product Data Sheet

GSE UltraFlex Textured

GSE UltraFlex Textured is the coextruded textured version of GSE UltraFlex. It is a high quality, linear low density polyethylene (LLDPE) geomembrane with one or two coextruded, textured surfaces, and consisting of approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no other additives, fillers or extenders are used. The resin used is a specially formulated, proprietary virgin polyethylene and is designed specifically for flexible geomembrane applications. GSE UltraFlex Textured has excellent resistance to UV radiation and is suitable for exposed conditions. This product allows projects with greater slopes to be designed since frictional characteristics are enhanced. *These product specifications meet or exceed GRI GM17.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A000	LUT060A000	LUT080A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, minutes	ASTM D 3895, 200° C O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS016 R03/10/04

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc. certain of which are registered in the U.S.A. and other countries.

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

GSE

GSE STANDARD PRODUCTS

Product Data Sheet

GSE UltraFlex

GSE UltraFlex is a high quality, linear low density polyethylene (LLDPE) geomembrane produced from specially formulated, virgin polyethylene with outstanding flexibility. This polyethylene resin is designed specifically for flexible geomembrane applications. Its high uniaxial and multiaxial elongation characteristics make it very suitable for applications where differential or localized subgrade settlements are expected such as leach pads, landfill closure caps, or any application where elongation or puncture resistance is critical. GSE UltraFlex contains approximately 97.5% polyethylene, 2.5% carbon black and trace amounts of antioxidants and heat stabilizers; no fillers or extenders are used. GSE UltraFlex is the only material of its type on the market with many years of proven performance in applications throughout the world. *These product specifications meet or exceed GRI GM17.*

Product Specifications

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			LLD 030A000	LLD 040A000	LLD 060A000	LLD 080A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850	850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (71)	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	46 (205)	62 (276)	92 (409)	123 (547)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C 1 ATM	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex is available in rolls weighing about 3,800 lb (1,724 kg) respectively.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

DS003 R03/08/04

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc, certain of which are registered in the U.S.A. and other countries.

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

This product data sheet is also available on our website at:

www.gseworld.com

GSE®
GSE Lining Technology, Inc.
19103 Gundle Road
Houston, Texas 77073
800-435-2008

13 July 2004

Dan Lahr
Colorado Lining.
1062 Singing Hills Road
Parker, CO 80138

Re: Rocky Flats Present Closure
GSE Project No. 515122

CERTIFICATION

The undersigned, being qualified and authorized to do so, hereby certifies that standard GSE 60 mil average Double-sided Texture LLDPE geomembrane and the GSE 60 mil average Smooth LLDPE will meet or exceed the following specified property values and/or conditions:

- GSE LLDPE will meet a Density value of ≥ 0.915 g/cc for resin and a density value of ≥ 0.920 g/cc for geomembrane per ASTM D 1505.
- GSE LLDPE will meet a Melt Index value <1.0 g/10 minutes per ASTM D1238.
- GSE LLDPE will meet an Oxidation Induction Time value of ≥100 minutes per ASTM D3895.

Regards,

Jimmy Youngblood
GSE Technical Support Specialist

cc: Mary Cruthirds, GSE Lining Technology, Inc.

GSE Lining Technology, Inc.

19103 Gundle Road
Houston, Texas 77073
800-435-2008
281-443-8564
Fax: 281-230-8650

July 31, 2003

Dan Lahr
Colorado Lining Co.
1062 Singing Hills Road
Parker, CO 80138

CERTIFICATION

This is to certify that **Colorado Lining Co.** is an approved and authorized Dealer and installer of GSE products. As an authorized Dealer of GSE, **Colorado Lining Co.** has been provided with a copy of GSE's proprietary product manual containing the data sheets of all GSE's products, and the GSE Field Installation quality assurance manual. As an authorized Dealer of GSE, **Colorado Lining Co.** has access to GSE's Technical Department representatives who can respond to questions on specifications and installation techniques. Individual employees of authorized GSE Dealer may have participated in training programs sponsored by GSE at its headquarters in Houston, Texas.

Regards,

David Leggett
V.P., Dealer Sales

DL:cdb

GSE Geomembranes

Geomembranes ▫ Geonets ▫ Geocomposites ▫ GCLs ▫ Geotextiles ▫ Concrete Protection ▫ Installation Services ▫ Fabrications

Manufacturing Quality Assurance Manual

www.gseworld.com

Foreword

This manual contains proprietary information belonging to GSE Lining Technology, Inc. This information is intended to provide a summary of standard quality procedures practiced by GSE's Manufacturing Quality Assurance Laboratories in Houston, Texas. These procedures apply to standard geomembrane materials only and do not explicitly address non-conforming materials.

This manual replaces in its entirety and supersedes all earlier versions issued by GSE Lining Technology, Inc. We suggest you maintain contact with your GSE representative to confirm the validity of this version at future dates.

GSE Lining Technology, Inc. reserves the right to change, modify, or discontinue the use of the policies and procedures described herein without notice or prior consent except as contractually obligated otherwise.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Table of Contents

Overview

I.	Quality Manifest	3
II.	Manufacturing Quality Assurance	3
III.	Manufacturing Quality Assurance Organization	3
IV.	Staff And Scheduling	3
V.	Product Identification And Documentation	4
VI.	Records Retention	4
VII.	Testing Capabilities	4
VIII.	Material Quality Assurance	5
Appendix A -	Minimum Testing Frequencies And Properties for GSE Raw Materials	8
Appendix B -	Minimum Testing Frequencies And Properties For GSE Geomembrane Products	9
Appendix C -	Minimum Weld Properties For GSE Geomembrane Products	18

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

I. QUALITY MANIFEST

GSE Lining Technology, Inc. is committed to providing the highest quality products and services to our customers. This requires a firm, total quality commitment from all individuals within our organization that we will only supply materials that meet or exceed the requirements and specifications of GSE and our customers.

GSE's commitment to quality starts with the highest quality raw materials. The quality of incoming raw materials is controlled at the supplier level with a complete vendor evaluation program in place. This means purchasing only from suppliers who are committed to statistical process control thereby providing a consistent, high level of quality assurance of their products.

II. MANUFACTURING QUALITY ASSURANCE

GSE Lining Technology, Inc. has an on-site Manufacturing Quality Assurance Laboratory at each manufacturing plant. Having a fully equipped, well staffed, dedicated laboratory at each of the manufacturing facilities allows GSE to maintain a high level of quality and up-to-the-minute results on finished products. Each facility follows the same guidelines for evaluating the quality of GSE products and is capable of adapting to market-driven requirements.

A. Objective

The objective of the GSE Quality Assurance program is to define implementation of basic manufacturing quality assurance (MQA) procedures necessary to ensure consistent production of quality products supplied to the geosynthetic market. Note that at this time, these procedures are limited to polyethylene geomembranes.

B. Scope

In order to achieve GSE's stated purpose, a rigorous set of minimum standards and an effective test program to assure compliance has been established. These procedures and requirements are frequently reviewed and adjusted to assure compliance with current market demands and/or predetermined project specifications. These procedures assure that raw materials and process parameters are controlled to provide products complying with GSE's pre-defined minimum characteristics.

III. MANUFACTURING QUALITY ASSURANCE ORGANIZATION

This organization consists of the Manufacturing Quality Assurance Laboratories as well as the manufacturing personnel. The combination of expertise and experience from these groups provides GSE with the proper tools to maintain the highest level of quality and customer service in the industry.

The Quality Assurance Department at GSE is charged by the President to assure that only products meeting both GSE's and the customer's requirements are released for shipment. The Quality Assurance personnel are directly responsible for monitoring testing and providing feedback to the manufacturing department to ensure the production of the specified product quality. Each member of the Quality Assurance team must participate in detailed training that includes factory exposure.

IV. STAFF AND SCHEDULING

The Quality Assurance Laboratories are staffed whenever manufacturing is occurring; this is usually 24 hours per day, 365 days per year. This minimizes the amount of potentially inferior product produced before a manufacturing problem is identified.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

V. PRODUCT IDENTIFICATION AND DOCUMENTATION

A. Roll Numbering

Each roll of geomembrane is assigned a unique roll number. The Quality Assurance Laboratory maintains records documenting the raw materials and resulting product quality information.

B. Approval Procedure

Results for each tested roll of product are checked against both GSE and customer specifications for compliance. The Quality Assurance Laboratory approves those materials that meet both of these requirements for shipment.

C. Non-Conformance

Material that does not meet GSE minimum standards is given a roll number but is rejected and not placed into inventory. The material is identified as scrap and will not be utilized.

Material that meets GSE minimum standards but does not meet a stricter customer specification is not allocated to that customer but is placed into inventory as GSE standard material.

D. Documentation

Individual Quality Assurance Certificates are generated and supplied for each roll of geomembrane product to include all relevant quality assurance information about the material(s).

VI. RECORDS RETENTION

GSE maintains reports and/or samples for products produced and sold. Records and/or samples are maintained according to GSE's standard retention policy according to the item.

MATERIAL	ITEM	YEARS
Raw materials	Resin Supplier Test Reports and Certifications	≥2
	GSE Resin Test Reports	≥2
	Resin Sample Retain (Archive)	≥2
Geomembrane	Raw Test Data (in computer database)	≥5
	Quality Control Certificates (in computer database)	≥5
	Sample Retain (approximately one square foot)	≥5

VII. TESTING CAPABILITIES

GSE maintains high capacity, state-of-the-art laboratory equipment suitable for performing the procedures listed in Appendices A-D. GSE's Houston laboratories are accredited by the GAI-LAP program. GSE's Houston laboratories, as part of GSE's Product Division, also hold ISO certification. The appropriate certificates are maintained for review upon request by authorized parties.

A. Routine Testing

Through careful investigation, GSE has developed a strict and thorough Quality Assurance program that exceeds the vast majority of customer specifications including GRI GM13, "Test Properties, Testing

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes" and GRI GM17 "Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes". The testing program covers raw materials (see Appendix A) and finished goods (see Appendix B) and is adhered to at all GSE laboratories. The laboratory equipment used by GSE represents the most modern equipment available and meets or exceeds the requirements of all the test standards used.

B. Other Testing Capabilities

In addition to routine testing, GSE laboratories are equipped to perform a wide variety of other tests as required for unusual requests or product development. Further, although the GSE Quality Assurance Laboratories are fully equipped and able to perform most routinely specified tests in the industry, there are some tests that are more economically performed by a dedicated testing facility. GSE believes requirements for such testing should be carefully considered and defined in terms of specific design requirements if they are found to be necessary.

VIII. MATERIAL QUALITY ASSURANCE

GSE Lining Technology, Inc. has established strict specifications for all raw materials and finished products. Test results must fall within the acceptable limits of GSE and customer specifications.

A. Raw Material

GSE primarily uses two types of raw materials, "natural resin" and "masterbatch" in the manufacture of geomembrane products. Natural resin is the base material that is used to make a geomembrane. It contains stabilizers to prevent degradation from occurring during and after extrusion. "Masterbatch" is the term referring to the concentrated carbon black material used with the natural resin to produce the finished product. The natural resin and masterbatch are blended at the appropriate ratio at the manufacturing stage. The masterbatch can contain other additives depending upon the geomembrane product to be produced. GSE verifies the properties of each lot of raw material prior to their utilization.

When natural resin is received, samples are taken and subjected to the tests outlined in Appendix A. All test data are entered into the computer database and checked for accuracy, consistency and compliance with GSE specifications. The material is not accepted unless all standard test requirements are met and the GSE test values meet the requirements set forth in the raw material specifications.

Copies of the supplier's certificate of analysis (COA) for each lot of resin utilized in the production of the materials supplied to a specific project are supplied as standard documentation. In addition, the GSE test results for each lot of resin are provided in a separate report upon request.

Virgin resin is normally received in rail car lots. If resin is received by other transport and/or in other quantities, an equivalent suitable sampling procedure is provided (i.e. not less than one sample per shipment or one sample for each 50,000 lb., 23,000 kg)

B. Geomembrane Products

GSE has implemented a strict and thorough Quality Assurance program for all geomembrane products. The geomembrane product line can be broken into two primary categories: smooth and textured products. Tables containing GSE minimum properties and test frequencies for all GSE geomembrane products includ-

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

ing specialty products such as GSE White (light-reflective geomembrane) and GSE Conductive (field spark-testable geomembrane) are in Appendix B.

1. *On-Line Manufacturing Quality Assurance*

The Quality Assurance program for finished product begins during the manufacturing process. Each manufacturing line is equipped with state-of-the-art monitoring devices that provide feedback on the physical quality of the materials being produced. Each geomembrane production line is equipped with both a thickness gage and spark-testing device.

a) Thickness Measurement

As geomembrane is being produced, thickness readings are taken continuously over the length and width of the roll. These data are used to establish the minimum, maximum and average thickness values for each roll and are verified by thickness testing upon sampling of the finished goods.

b) Spark Testing

An electrical spark detector is in place on each manufacturing sheet line. This apparatus provides immediate notification of holes in the finished product. If a hole is detected, an alarm is triggered and the hole is identified. Rolls containing holes are rejected from standard product inventory.

2. *Smooth Geomembrane Materials*

Smooth geomembrane products available include high density and linear low density polyethylene materials with 2-3% carbon black. Specialty materials include White, electrically conductive, green surfaced, and smooth edge textured geomembranes.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens are cut for testing the machine direction and transverse direction. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

b) Evaluation of Results

All data are entered into a computer database for calculation and comparison to GSE and customer-specific specifications. If materials do not meet GSE minimums and/or the customer specifications, the manufacturing personnel are immediately notified in order for the appropriate adjustments to be made. Only products meeting GSE minimums and customer specifications will be approved for shipment.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

c) Reporting

Every roll of material has a quality assurance roll certificate or Roll Test Data Report (RTDR). This report identifies the standards on which the GSE approval is based along with the actual test results demonstrated by the material.

3. *Coextruded Textured Geomembranes*

Textured geomembrane is produced utilizing a round die with coextrusion technology. The texture is produced in a process in which one or two of the outer layers of a three-layer extrusion are blended with nitrogen gas. Nitrogen bubbles form in the molten resin and escape upon exiting the die, creating a rough, textured surface. Regular, White, green surfaced, and conductive geomembranes are available with coextruded texturing.

a) Sampling

Geomembrane rolls are sampled for QA testing according to the frequencies in Appendix B. An approximate one-foot by roll width sample is cut for Quality Assurance testing. Specimens for testing are taken from five predetermined positions across the width of the roll. Specimens for testing the machine and transverse direction tensile are cut from each of the five positions. A "retain" or archive sample approximately 12 x 12 inch (30 x 30 cm) is taken from the corresponding transverse direction position from the laboratory sample. The retain is labeled and kept for future reference (see Section VI).

Evaluation of results and reporting practices are the same as for smooth geomembranes.

C. *Third Party Conformance Sampling*

Some specifications require independent Quality Assurance and/or conformance testing. GSE can provide assistance with the sampling of products by arranging for the conformance samples to be taken during production. By taking samples during production rather than on site, the customer can be assured that the samples are clean and available for conformance testing in a timely manner.

GSE encourages customers to audit GSE manufacturing and manufacturing quality assurance operations and/or to collect samples and conduct independent conformance testing prior to shipment of materials.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

MINIMUM TESTING FREQUENCIES FOR GSE RAW MATERIALS

Property	Test Method[1]	Natural Resin
Density	ASTM D 1505	once per rail car compartment
Melt Flow Index	ASTM D 1238 (190/2.16)	once per rail car compartment
OIT	ASTM D 3895 (1 ATM at 200° C)	once per resin lot
Carbon Black Content	ASTM D 1603, modified	N/A
Carbon Black Dispersion	ASTM D 5596	NA

[1] *GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.*

MINIMUM PROPERTIES FOR GSE RAW MATERIALS

Property	Test Method[1]	HDPE	LLDPE
Density [g/cm³]	ASTM D 1505	0.932	0.915
Melt Flow Index [g/10 min]	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT [minutes]	ASTM D 3895 (1 ATM at 200° C)	100	100

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are *trademarks and service marks of* GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A000	HDE 040A000	HDE 060A000	HDE 080A000	HDE 100A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE HD is available in rolls weighing about 3,900 lb (1,769 kg)
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDE 030A010	HDE 040A010	HDE 060A010	HDE 080A010	HDE 100A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		122 (21)	162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	59 (263)	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content[1], %	ASTM D 1603, black layer	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1] GSE White may have an overall ash content greater than 3.0% due to the white layer.
- *All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.*

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A000	HDC 060A000	HDC 080A000	HDC 100A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive may have an overall carbon black percentage above 3.0% due to the high carbon black loadings in the conductive layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE CONDUCTIVE WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDC 040A010	HDC 060A010	HDC 080A010	HDC 100A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		162 (28)	243 (43)	324 (57)	405 (71)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		700	700	700	700
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	79 (352)	119 (530)	158 (703)	198 (881)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Notched Constant Tensile Load, hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)	430 (131)	340 (104)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)	9,675 (899)	7,650 (711)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE Conductive White is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]Due to surface effects caused by the conductive layer, these tensile properties are minimum average values.
- [2]GSE Conductive White may have an overall ash content greater than 3.0% due to the white and conductive outer layers.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and ITB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE HD TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE				
Product Code			HDT 030A000	HDT 040A000	HDT 060A000	HDT 080A000	HDT 100A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb					
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		45 (8)	60 (11)	90 (16)	120(21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			63 (11)	84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		150	150	150	150	150
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	21 (93)	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	54 (240)	72 (320)	108 (480)	144 (641)	180 (801)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[2], hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**				
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100	>100
Roll Length (approximate), ft (m)	Standard Textured		830 (253)	700 (213)	520 (158)	400 (122)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			18,674 (1,735)	15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE HD Standard Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]NCTL for HD Textured is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			HDT 040A010	HDT 060A010	HDT 080A010	HDT 100A010
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)	90 (2.3)
Density, g/cm³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		60 (11)	90 (16)	120 (21)	150 (27)
Strength at Yield, lb/in-width (N/mm)			84 (15)	130 (23)	173 (30)	216 (38)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		150	150	150	150
Elongation at Yield, %	G.L. = 1.3 in (33 mm)		13	13	13	13
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	28 (125)	42 (187)	56 (249)	70 (311)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	72 (320)	108 (480)	144 (641)	180 (801)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2	+Note 2
Notched Constant Tensile Load[3], hrs	ASTM D 5397, Appendix	200,000 lb	400	400	400	400
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C; O_2, 1 atm	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)	330 (101)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)	7,425 (690)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 or 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE White Textured is available in rolls weighing about 4,000 lb (1,800 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are minimum average values.
- [2]GSE White Textured may have an overall ash content greater than 3.0% due to the white layer.
- [3]NCTL is conducted on representative smooth membrane samples.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE			
Product Code			LLD 030A000	LLD 040A000	LLD 060A000	LLD 080A000
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	27 (0.69)	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb				
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		114 (20)	152 (27)	228 (40)	304 (53)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850	850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	16 (71)	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	46 (205)	62 (276)	92 (409)	123 (547)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**			
Oxidative Induction Time, minutes	ASTM D 3895, 200° C 1 ATM	200,000 lb	>100	>100	>100	>100
Roll Length (approximate), ft (m)			1,120 (341)	870 (265)	560 (171)	430 (131)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			25,200 (2,341)	19,575 (1,819)	12,600 (1,171)	9,675 (899)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex is available in rolls weighing about 3,800 lb (1,724 kg) respectively.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE	
Product Code			LLD040A010	LLD060A010
Thickness, mils (mm) or per project specs	ASTM D 5199	every roll	36 (0.91)	54 (1.4)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92
Tensile Properties (each direction)	ASTM D 6693, Type IV	20,000 lb		
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		152 (27)	228 (40)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		850	850
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	62 (276)	92 (409)
Carbon Black Content[1], %	ASTM D 1603	20,000 lb	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**	
Oxidative Induction Time (minutes)	ASTM D 3895 200° C 0_2 1 atm.	200,000 lb	>100	>100
Roll Length (approximate), ft (m)			870 (265)	560 (171)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			19,575 (1,819)	12,600 (1,171)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- GSE UltraFlex White is available in rolls weighing about 3,800 lb (1,724 kg).
- [1]GSE UltraFlex White may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A000	LUT060A000	LUT080A000
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6693, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content, %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time, minutes	ASTM D 3895, 200° C O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

Notes:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils..
- GSE *UltraFlex Textured is available in rolls weighing about 3,900 lb (1,769 kg).*
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix B - Minimum Testing Frequencies and Properties for GSE Geomembranes

MINIMUM PROPERTIES FOR GSE ULTRAFLEX WHITE TEXTURED

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM VALUE		
Product Code			LUT040A010	LUT060A010	LUT080A010
Thickness, mils (mm) or per project specs	ASTM D 5994	every roll	36 (0.91)	54 (1.4)	72 (1.8)
Density, g/cm³	ASTM D 1505	200,000 lb	0.92	0.92	0.92
Tensile Properties (each direction)[1]	ASTM D 6993, Type IV	20,000 lb			
Strength at Break, lb/in-width (N/mm)	Dumbell, 2 ipm		100 (18)	132 (23)	176 (30)
Elongation at Break, %	G.L. = 2.0 in (51 mm)		500	500	500
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	22 (98)	33 (147)	44 (200)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	48 (214)	73 (325)	97 (432)
Carbon Black Content[2], %	ASTM D 1603	20,000 lb	2.0	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	+Note 1	+Note 1	+Note 1
Asperity Height	GRI GM 12	second roll	+Note 2	+Note 2	+Note 2
REFERENCE PROPERTY	**TEST METHOD**	**FREQUENCY**	**NOMINAL VALUE**		
Oxidative Induction Time (minutes)	ASTM D 3895 200° C, O_2, 1 atm	200,000 lb	>100	>100	>100
Roll Length (approximate), ft (m)			700 (213)	520 (158)	400 (122)
Roll Width, ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft² (m²)			15,750 (1,463)	11,700 (1,087)	9,000 (836)

NOTES:

- +Note 1: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- +Note 2: 10 mil average. 8 of 10 readings ≥7 mils. Lowest individual ≥ 5 mils.
- GSE UltraFlex White Textured is available in rolls weighing about 3,900 lb (1,769 kg).
- [1]The combination of stress concentrations due to coextrusion texture geometry and the small specimen size results in large variation of test results. Therefore, these tensile properties are average roll values.
- [2]GSE UltraFlex White Textured may have an overall ash content greater than 3.0% due to the white layer.
- All GSE geomembranes have dimensional stability of ±2% when tested with ASTM D 1204 and LTB of <-77° C when tested with ASTM D 746.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Appendix C - Minimum Weld Properties for GSE Geomembrane Products

MINIMUM WELD PROPERTIES FOR STANDARD HDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)	120 (3.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	49 (8.6)	65 (11.4)	98 (17.2)	130 (22.8)	162 (28.4)	196 (34.3)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	39 (6.8)	52 (9.1)	78 (13.7)	104 (18.2)	130 (22.8)	157 (27.5)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	61 (10.7)	81 (14.2)	121 (21.2)	162 (28.4)	203 (35.5)	242 (42.4)

[1] These values apply to both coextruded and flat cast produced geomembranes and white-surfaced and conductive products.

MINIMUM WELD PROPERTIES FOR STANDARD LLDPE GEOMEMBRANES[1]

Property	Test Method	30 (0.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Peel Strength (extrusion) ppi (kN/m)	ASTM D 6392	36 (6.3)	48 (8.4)	72 (12.6)	96 (16.8)	120 (21.0)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	38 (6.7)	50 (8.8)	75 (13.1)	100 (17.5)	125 (21.9)
Shear Strength (fusion & ext), ppi (kN/m)	ASTM D 6392	45 (7.9)	60 (10.5)	90 (15.8)	120 (21.0)	150 (26.3)

[1] These values apply to both coextruded and flat cast produced geomembranes to include white-surfaced products.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. GSE assumes no liability in connection with the use of this information. Please check with GSE for current, standard minimum quality assurance procedures and specifications.

GSE and other marks used in this document are trademarks and service marks of GSE Lining Technology, Inc; certain of which are registered in the U.S.A. and other countries.

Americas	GSE Lining Technology, Inc.	Houston, Texas	800-435-2008	281-443-8564	Fax: 281-230-8650
Europe/Middle East/Africa	GSE Lining Technology GmbH	Hamburg, Germany		49-40-767420	Fax: 49-40-7674233
Asia/Pacific	GSE Lining Technology Company Ltd.	Bangkok, Thailand		66-2-937-0091	Fax: 66-2-937-0097

www.gseworld.com

Rahe, John -- MFG, Inc.

From: Rahe, John -- MFG, Inc.
Sent: Tuesday, August 17, 2004 7:34 PM
To: Robert.Davis@rfets.gov
Subject: Initial Review of Submittals for Geosynthetics for Present Landfill Cover System

Hello Bob,

The following presents my initial review of the geosynthetics submittals for the landfill cover system, including the Geosynthetic Composite Drainage Net (GDN), the Linear Low Density Polyethylene (LLDPE) geomembrane liner, the Geosynthetic Clay Liner (GCL) and the Non-Woven Geotextile.

GDN Material Submittal Review:

In general, the submittal information supplied by CETCO Lining Technologies conforms to the design specifications for the proposed TexDrain 200 DS 8 (GDN) material. A few clarifications/additional items of information are needed to approve this submittal, as follows:

It is not clear from the submittal whether or not a geotextile is placed on both sides of the geonet drain. For this project the geotextile would likely be required only on the top of the geonet, although the sample I saw previously in your office indicated a geotextile on both sides, and it was not clear to me from the design specifications if geotextile is required on one or both sides (needs to be verified with Earth Tech and CETCO). Also, it is not clear from the submittal that the geotextile is an 8 oz/sy material (Spec.Sec.02224, 2.01D). The carbon black content test presented in the submittal indicated ASTM D 1603, which is a test specified for olefin plastics, while the Spec. Sec. 02224, 2.02B indicates a test method of ASTM D 4218, which is more commonly used for polythylenes. The tensile strength test method is specified as ASTM D 4595, while the submittal indicates ASTM D 1682 (discontinued) or ASTM D 5035 (geotextiles). The proper test methods should be verified. The submittal shows that density and melt index tests be performed once every 50,000 sf, while the specifications indicate one test per lot (which may be less than 50,000 sf). Also, it is not clear from the submittal (or design specifications) whether the GDN will be overlapped or continuously sewn on the 4:1 slopes. I would recommend that they be continuously sewn for all 4:1 side slopes, even the shorter slopes adjacent to the north and south drainage ditches.

LLDPE Geomembrane Submittal Review:

In general, the submittal information supplied by GSE and Colorado Lining Company conforms to the design specifications for the proposed 60-mil LLDPE material and for the installation equipment. A few clarifications/additional items of information are needed to approve this submittal, as follows:

A statement is required certifying no recycled polymer and no more than 10% rework of the same type of material is added to the resin (Spec. Sec. 02225, 1.04A.2). The GSE MQA Manual indicates that the shear strength of seams is 90 lbs/in based on ASTM D 6392, while Spec Sec. 02225, 1.15B (Table 2.1) indicates a minimum value for shear strength of 120 lbs/in. The specifications do not list strength requirements for LLDPE-T (textured), while the submittal gives values for this material (which typically has about 75 to 80 percent of the puncture strength and about 55 to 60 percent of the tensile strength of smooth LLDPE). This should be clarified with the designers if 60-mil LLDPE-T is acceptable if needed on a long 4:1 slope.

The "Wedge-It" hot wedge welder information supplied indicates that either a single 45-mm wide or double (split) 45-mm wide weld could be made with the equipment. The specifications (Spec. Sec. 02225, 1.13C.1.b) indicate that seams will be tested by double seam pressurization, requiring a double (split) seam for the LLDPE. This should be clarified.

GCL Submittal Review:

The following additional information is required from the Bentomat ST GCL manufacturer, CETCO Lining Technologies before the submittal can be approved:

It is not clear from the submittal that the moisture content of the GCL will be limited to 12% (QA/QC Plan Table 4.1, referenced in Spec. Sec.02226, 2.01C). It is not clear from the submittal that the lower geotextile will be a 3.1 oz/sy, minimum and that the top geotextile will be a 6 oz/sy, minimum non-woven geotextile (Spec. Sec. 02226, 2.01C).

CETCO's MQA/MQC Manual does not indicate that the GCL will be inspected continuously for broken needles from the needle-punched NW/GT portion of the material (Spec. Sec. 02226. 1.03A.5). This is very important with GCLs adjacent to and in continuous contact with the primary geomembrane, as in this project, because needles remaining in the GCL would have a high probability of puncturing the geomembrane. This must be performed and verified prior to delivery and placement in the landfill cover system.

Non-Woven Geotextile Submittal Review:

The Nilex NW60 Non-Woven Geotextile submittal specifications meet or exceed the specifications for the separation geotextile presented in Spec. Sec. 02245, 2.01D, with the exception of the maximum elongation of 50% as compared with the specified 30%. Because the submitted grab tensile strength is higher (160 lbs.) than the specification (100 lbs.), this would appear to be acceptable.

I would recommend that the initial lot of landfill cover geosynthetics (GDN, LLDPE and GCL) produced for the project have split samples shipped directly to the QA laboratory (Advanced Terra Testing) for initial QA verifications required by Table 4.1 of the QA/QC Plan. This is important to expedite the QA process and also because a couple of the QA tests (carbon black and carbon black dispersion) may need to be performed by Precision Labs in California, and ATT cannot ship materials to them that have been obtained from Rocky Flats (only directly from the manufacturer).

Let me know if you have any questions regarding these initial geosynthetic material submittal reviews.

Regards,

John

John H. Rahe, P.E.
Tetra Tech/MFG
303-447-0913 (ext. 104)
303-981-2656 (cell)

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 8/ 23/ 2004		New Submittal
		X	Resubmittal

Section I — REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 005B
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No. 005A

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	CLI Aug 19 Cover Letter		6	02225	N/A		
2	CETCO Aug 18 Letter	TR-711, SGI Testing Letter and Figures A-1, C-2,3, and 4	6	02225			

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert W. Davis DATE: 08/26/04

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: Paul Kreitz, 8/23/04

Section II — Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQAE
J.H. Rabe TX

Colorado Lining
INTERNATIONAL

August 19, 2004

SM Stoller
Attn: Jim Erickson
Phone: 303-546-4351
Fax: 303-443-1408

RE: RFETS Landfill – Paper Re-Submittal - #1.08-19-04

Jim:

Attached are (7) copies of CETCO's response to the comments made by Earth Tech in the revise and resubmit paper submittal letter dated July 13, 2004. It is Colorado Lining's understanding that the paper submittal on the 60 Mil Black LLDPE material as submitted previously is approved. If additional information is required, please let me know.

Regards,

Dan E. Lahr
Senior Estimator

CETCO
LINING TECHNOLOGIES
800.527.9948 www.cetco.com

August 18, 2004

Dan Lahr
Colorado Lining
1062 Singing Hills
Parker, CO 80138

RE: Rocky Flats

Dear Dan:

In response to the "Geosynthetic Materials Submittal – July 12, 2004 Comments" memo, please see CETCO's explanation of the items listed.

GDN

1. See attached revised Texdrain 200-2-8 spec sheet to include resin properties.
2. CETCO recommends anchor ties every 12 inches. More frequently is acceptable.
3. CETCO accepts the project specification of 3" overlap on the edges and 6" on the ends. We recommend following the site specific project specification.
4. CETCO will provide a complete GDN MQC package to include all tests provided in Table 4.1 of QA/QC Plan.

GCL

1. CETCO tests Bentomat internal shear one time per year. Periodic = one/year.
2. CETCO test bentonite swell index at a frequency of one per 50 tons.
3. CETCO is not aware of a revised Spec 02226. Please clarify mass per unit area requirement.
4. Please see additional Super Groove performance data.
5. CETCO recommends following the site specific QA/QC plan.
6. Prior to construction CETCO will provide a complete MQC data for the actual rolls shipped to the site.
7. CETCO will provide verification of continuous inspection for broken needles in the aforementioned MQC package.

Please let me know if you need any additional information at this time.

Regards,

Joe Kaul

JK:cp
04-10080

TexDrain™ 200 DS 8
Certified Properties – Rocky Flats

TD 200 DS 8 is a superior quality composite drainage product produced by thermally laminating two 8 ounce per square yard nonwoven geotextiles to a core of high-flow polyethylene drainage net. TexDrain Geocomposites are designed to provide high capacity planar flow of liquids, with integrated protection from clogging and damage protection for adjacent geomembranes.

TD 200 DS 8 and individual components conform to the physical property values listed below:

POLYETHYLENE RESIN PROPERTIES	TEST METHOD	UNITS	VALUE
Polymer Density	ASTM D 1505	g/ml	≥ 0.932
Melt Index Value	ASTM D 1238	g/10 min.	<1.0

200 mil GEONET PROPERTIES	TEST METHOD	UNITS	VALUE
Mass Per Unit Area	ASTM D 5261	lbs/ft^2	0.162
Thickness	ASTM D 5199	mils	200
Polymer Density	ASTM D 1505	g/cm^3	0.940
Transmissivity[1]	ASTM D 4716	$g/min/ft\ (m^2/s)$	4.8 (1.0×10^{-3})
Carbon Black	ASTM D 1603	%	2
Tensile Strength	ASTM D 5035 (mod)	lbs/in	45

1 - Transmissivity measured using water at 20 Degrees C (68 degree F) with a gradient of one, under a confining pressure of 15,000 psf, between two steel plates, after 1 hour. Values may vary based on dimension of the transmissivity specimen and specific laboratory.

GEOTEXTILE PROPERTIES[2]	TEST METHOD	UNITS	VALUE
Weight	ASTM D 5261	oz/yd^2	8.0
Grab Tensile	ASTM D 4632	lbs	203
Puncture	ASTM D 4833	lbs	130
Mullen Burst	ASTM D 3786	psi	450
Water Flow Rate	ASTM D 4491	gpm/ft^2	110
AOS	ASTM D 4751	US Sieve	100 sieve

2 - Prior to lamination to geonet core. Thermal lamination may alter these properties.

GEOCOMPOSITE PROPERTIES	TEST METHOD	UNITS	VALUE
Transmissivity[3]	ASTM D 4716	$g/min/ft\ (m^2/s)$	0.19 (4.0×10^{-5})
Peel Adhesion	ASTM D 413	lbs/in	1

3 - Transmissivity measured under a gradient of one, under a confining pressure of 15,000 psf, between two steel plates, after 1 hour. Values may vary based on dimension of the transmissivity specimen and specific laboratory.

TR-711
Revised 12/02

CETCO® LINING TECHNOLOGIES
1500 West Shure Drive Arlington Heights, IL 60004 USA 800.527.9948 Fax 847.577.5571
For the most up-to-date product information please visit our website, www.cetco.com
A wholly owned subsidiary of AMCOL International Corporation

The information and data contained herein are believed to be accurate and reliable, CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

ROLL DIMENSIONS[4]	WIDTH	LENGTH	AREA	WEIGHT
	13.5 feet	200 feet	2,700 feet	750 lbs

4 - Weight is nominal. Length subject to change based on optimized shipping dimensions.

CETCO® LINING TECHNOLOGIES

1500 West Shure Drive Arlington Heights, IL 60004 USA 800.527.9948 Fax 847.577.5571
For the most up-to-date product information please visit our website, www.cetco.com
A wholly owned subsidiary of AMCOL International Corporation

TR-711
Revised 12/02

The information and data contained herein are believed to be accurate and reliable, CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

SGI TESTING SERVICES, LLC

18 March 2002

Mr. Robert Trauger, P.E.
Colloid Environmental Technologies Co.
1500 West Shure Drive
Arlington Heights, IL 60004-1440

Subject: Laboratory Test Results Transmittal
Large-Scale Flow Rate Testing
Unseamed and Seamed Bentomat ST GCLs

Dear Mr. Trauger,

SGI Testing Services, LLC (SGI®) is pleased to present the attached large-scale flow rate test results on Bentomat ST GCL, Bentomat ST GCL seamed with groove and no bentonite, and Bentomat ST GCL seamed without groove and bentonite. The note section below addresses sample preparation, sample disposal and a disclosure statement.

SGI® appreciates the opportunity to provide laboratory testing services to CETCO. Should you have any questions regarding the attached document(s), or if you require additional information, please do not hesitate to contact the undersigned.

Sincerely,

Zehong Yuan, Ph.D., P.E.
Chief Technical Officer

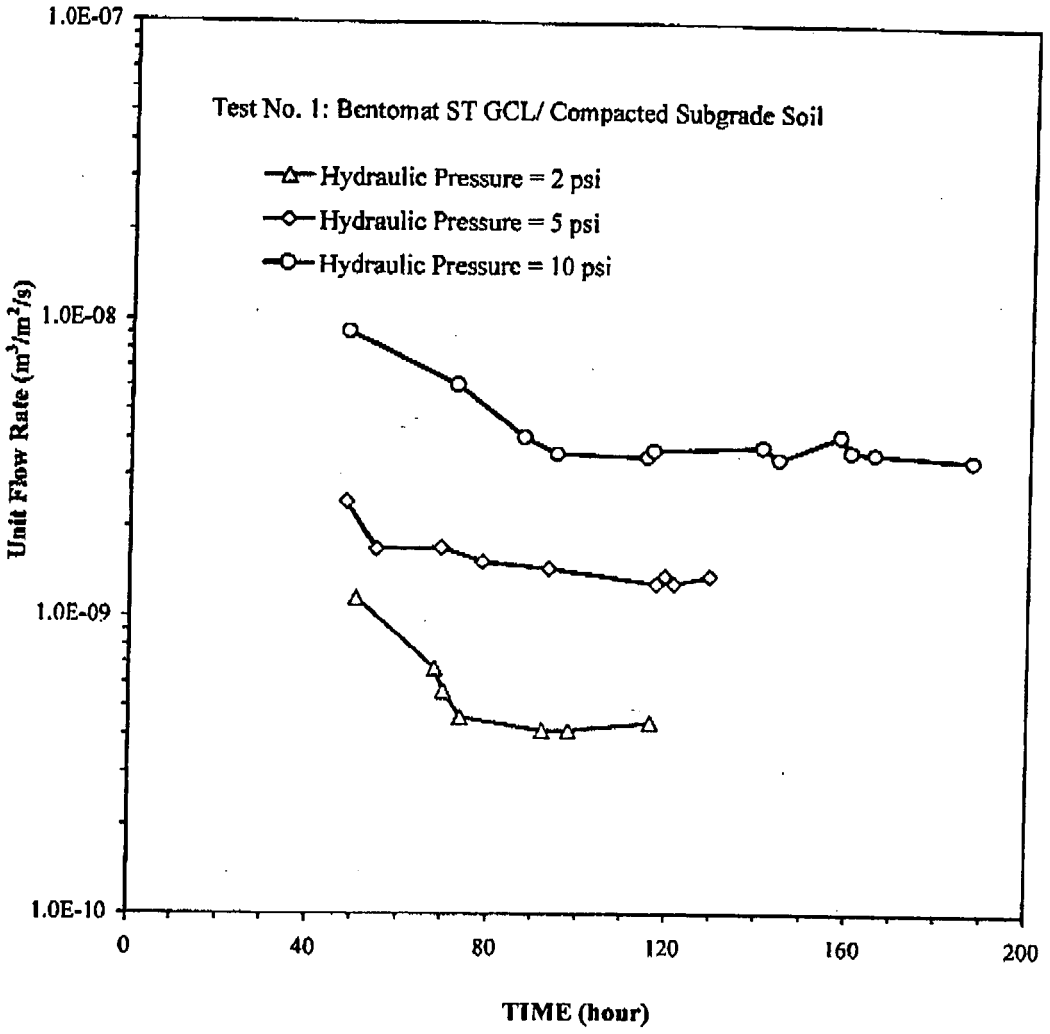
Attachment

Notes:
(1) Unless otherwise noted in the test results the sample(s)/specimen(s) were prepared in accordance with the applicable test standards or generally accepted sampling procedures.
(2) Contaminated/chemical samples and all related laboratory generated waste (i.e., test liquids, PPE, absorbents, etc.) will be returned to the client or designated representative(s), at the client's cost, within 60 days following the completion of the testing program, unless special arrangements for proper disposal are made with SGI®.
(3) Materials that are not contaminated will be discarded after test specimens and archived specimens are obtained. Archived specimens will be discarded 60 days after the samples are received at the laboratory, unless long-term storage arrangements are specifically made with the laboratory.
(4) The reported results apply only to the materials and test conditions used in the laboratory testing program. The results do not necessarily apply to other materials or test conditions. The test results should not be used in engineering analysis unless the test conditions model the anticipated field conditions. The testing was performed in accordance with general engineering testing standards and requirements. The reported results are submitted for the exclusive use of the client to whom they are addressed.

SGI1029/SGI02054

SGI® Testing Services, LLC
5775 Peachtree Dunwoody Road
Suite 11D
Atlanta, Georgia 30342
Phone: 404.256.9939 Fax: 404.705.9300
Web Site: www.interactionspecialists.com

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING
BENTOMAT ST GCL



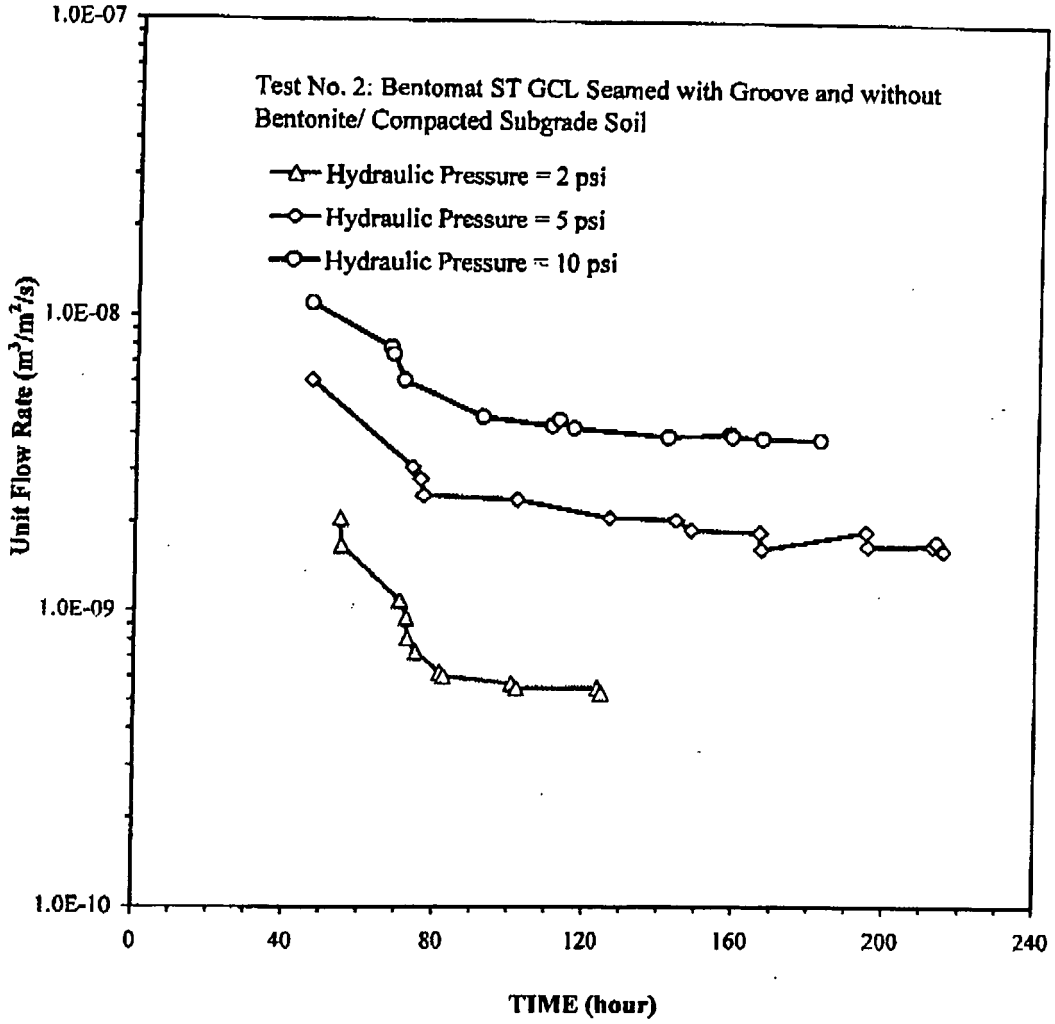
Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Test Duration (hours)	Flow Rate at Completion of Testing ($m^3/m^2/s$)
1	23.5	2.0	116	4.40E-10
2	23.5	5.0	129	1.37E-09
3	23.5	10.0	187	3.41E-09

DATE REPORTED: 17 January 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	A-1
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING
BENTOMAT ST GCL SEAMED WITH GROOVE AND WITHOUT BENTONITE



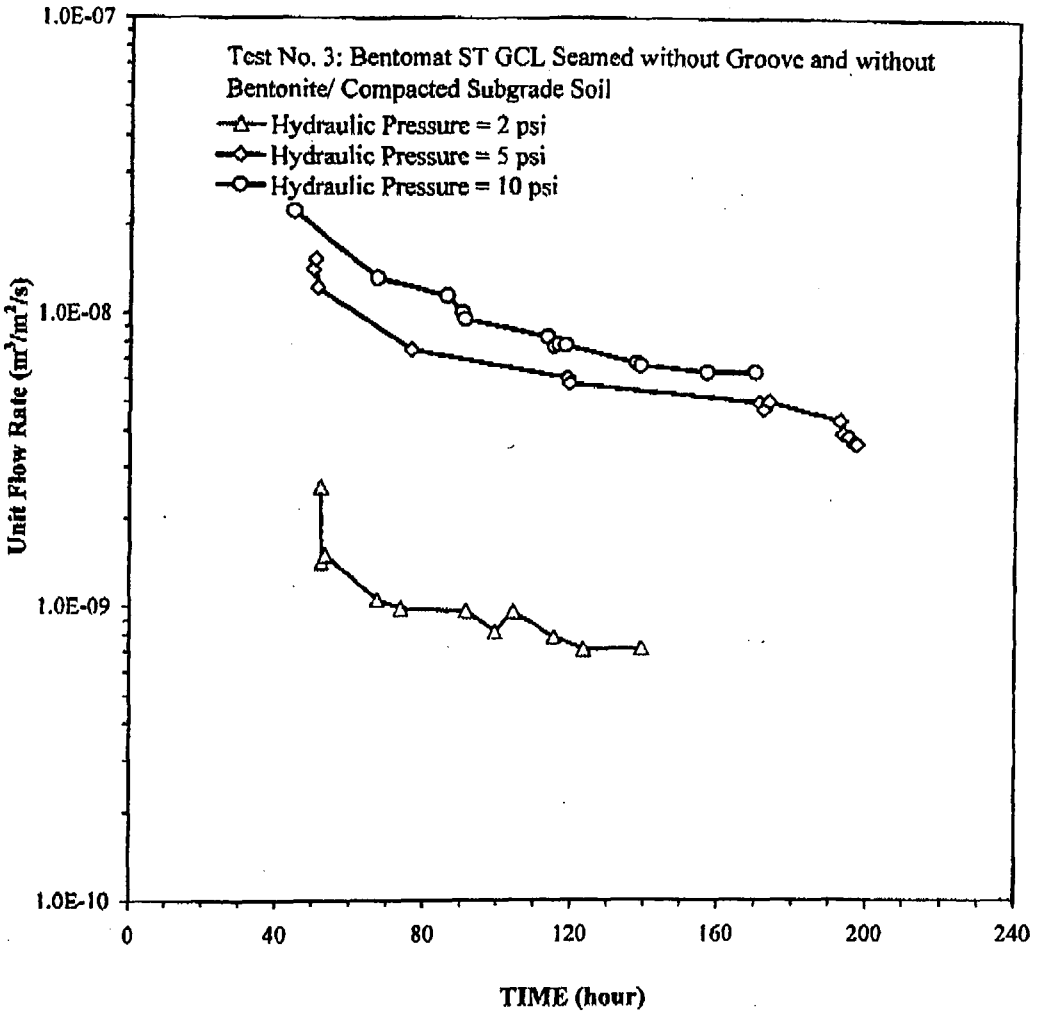
Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Test Duration (hours)	Flow Rate at Completion of Testing ($m^3/m^2/s$)
1	23.5	2.0	125	5.28E-10
2	23.5	5.0	215	1.63E-09
3	23.5	10.0	182	3.85E-09

DATE REPORTED: 4 February 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	C-2
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING
BENTOMAT ST GCL SEAMED WITHOUT GROOVE AND WITHOUT BENTONITE



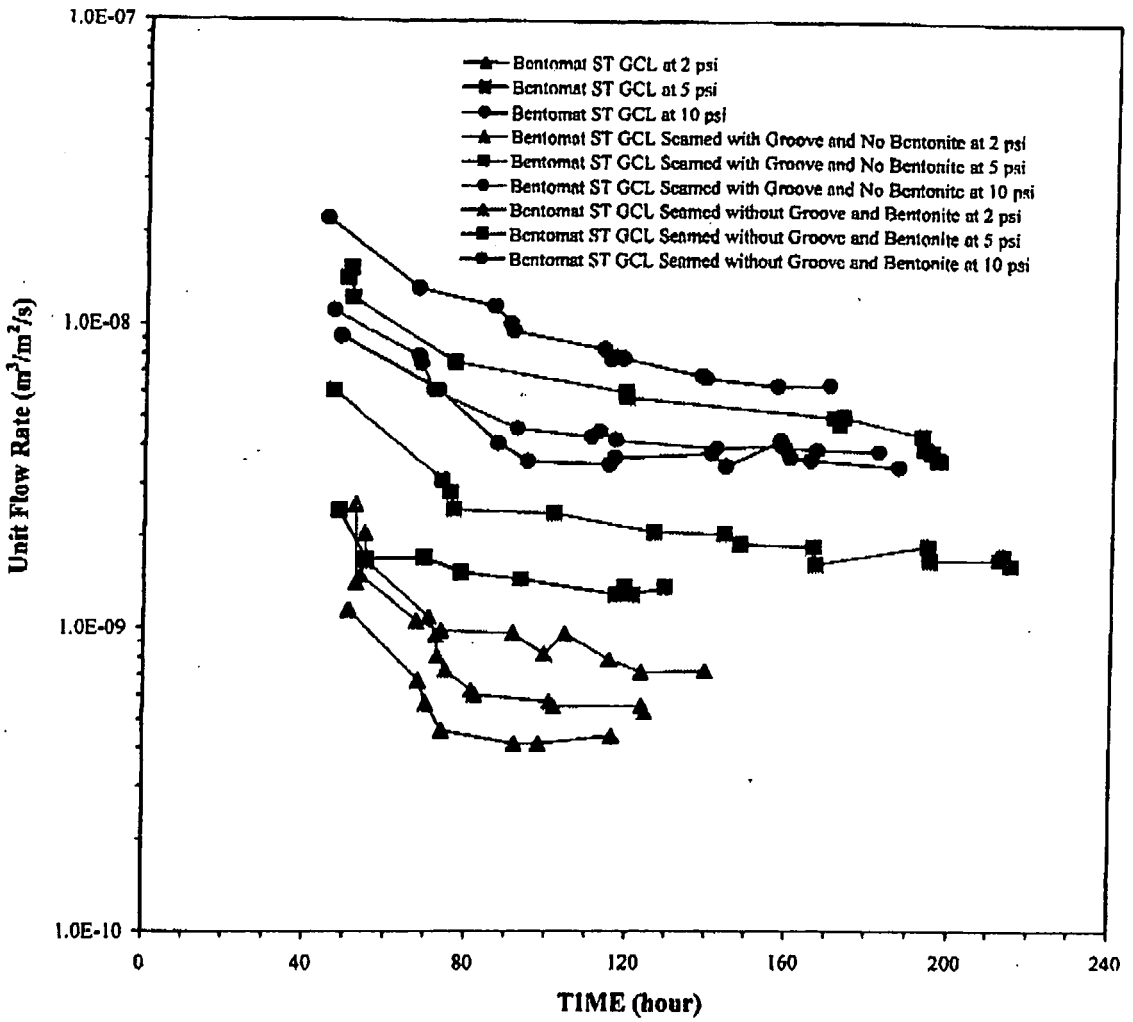
Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Test Duration (hours)	Flow Rate at Completion of Testing ($m^3/m^2/s$)
1	23.5	2.0	139	7.21E-10
2	23.5	5.0	197	3.59E-09
3	23.5	10.0	170	6.34E-09

DATE REPORTED: 15 March 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	C-3
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

COLLOID ENVIRONMENTAL TECHNOLOGIES COMPANY
LARGE-SCALE FLOW RATE TESTING



Test No.	Diameter of Test Specimen (in.)	Hydraulic Pressure (psi)	Bentomat ST GCL		Bentomat ST GCL Seamed with Groove and No Bentoite		Bentomat ST GCL Seamed without Groove and Bentoite	
			Duration (hours)	Flow Rate ($m^3/m^2/s$)	Duration (hours)	Flow Rate ($m^3/m^2/s$)	Duration (hours)	Flow Rate ($m^3/m^2/s$)
1	23.5	2.0	116	4.40E-10	125	5.28E-10	139	7.21E-10
2	23.5	5.0	129	1.37E-09	215	1.63E-09	197	3.59E-09
3	23.5	10.0	187	3.41E-09	182	3.85E-09	170	6.34E-09

Note:
For each test, the flow rate reported in the above table is the flow rate at the completion of test.

DATE REPORTED: 15 March 2002

SGI TESTING SERVICES, LLC

FIGURE NO.	C-4
PROJECT NO.	SGI1029
DOCUMENT NO.	SGI02054
FILE NO.	

Rahe, John -- MFG, Inc.

From: Rahe, John -- MFG, Inc.
Sent: Tuesday, August 24, 2004 3:12 PM
To: 'robert.davis@rfets.gov'
Subject: FW: Review of Recent (8/19) Submittal on GDN and GCL

From: Rahe, John -- MFG, Inc.
Sent: Tuesday, August 24, 2004 1:35 PM
To: 'robert.davis@rfets.com'
Subject: Review of Recent (8/19) Submittal on GDN and GCL

Hello Bob,

I've reviewed the recent submittal from Stoller/Colorado Lining/CETCO dated August 19, 2004 regarding the GDN and GCL geosynthetic materials for the Present Landfill cover system at Rocky Flats, which are in response to a review by Earth Tech on July 13, 2004. I have the following comments regarding the submittal:

GDN Material:

1) The polyethylene geonet resin properties should be acceptable: the material density of 0.932 g/ml (cc) based on ASTM D1505 (although slightly less than the specification of 0.94 g/cc) and the melt index value less than 1.0 based on ASTM D1238 are acceptable for the geonet.

2) Anchor ties at 6" are acceptable as specified, while no individual ties should be more than 12"

3) The 3" overlap on egdes and 6" overlap on the ends should be a minimum, as specified.

4) The GDN MQC submittal reviewed previously appears to be adequate with the exception of the various questions presented in my August 17 submittal to you.

GCL Material:

1) The proposal by CETCO to test the GCL for internal shear strength once per year would not appear to be acceptable for this project. The MQA tests should be performed on actual materials manufactured for this project. The test should be for a saturated material and the confining pressure(s) should simulate field conditions to be encountered at the Present Landfill: I would recommend confining pressures in the range of approximately 300 to 600 psf. The QA/QC Plan requires internal shear strength testing for the GCL at one per 100,000 sf, which would require nine or ten of these tests, which is well in excess of the MQC testing program. I would recommend that we require CETCO to perform at least three internal shear strength MQC tests, and that the QA program require one or two internal shear strength tests. This should provide the required QA/QC for this project.

2) The index swell test frequency of one per 50 tons is acceptable.

3) The specified (and submitted previously) mass per unit area of 0.75 lbs/sf is acceptable.

4) The large scale flow rate tests performed by SGI Testing Services (also in previous submittal) indicate that the long-term (>80 hrs) flow rate for the tests run at 2 psi hydraulic pressure (4.6 ft head, which is likely to be within the potential range of those seen at the landfill cover), using the GCL seamed with "Supergroove" and without additional bentonite, is in the range of approximately 6x10(E-10) m/sec [6x10(E-8)cm/sec]. This is comparable (only slightly higher) to the GCL (Bentomat ST) material without seams, based upon the laboratory testing. Based upon this information, the GCL groove system appears to be effective. One of the QA permeability tests could be performed on a sample containing the "Supergroove" to verify these tests by SGI to demonstrate effectiveness to the regulators.

5 & 6) CETCO proposes to comply with the QA/QC Plan requirements and will provide complete MQC data for the actual rolls shipped to the site. I would add that these data be sent prior to material delivery to the site.

7) CETCO states that they will provide verification of continuous inspection for broken needles in the MQC package, although the MQC Manual provided previously does not detail how this will be performed (as mentioned in my comments of 8/17).

The major issue to be resolved in the comments above is Item No. 1 under the GCL material. Let me know if you have any questions regarding these review comments.

Thanks,
John

John H. Rahe, P.E.
Tetra Tech/MFG
303-447-0913 (ext. 104)
303-981-2656 (cell)

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 7/13/04	X	New Submittal
			Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 008
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No. a.	Description of Item Submitted (Type, size, model number, etc.) b.	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8) c.	No. of Copies d.	Contract Reference Document: Spec. Paragraph No. e.	Contract Reference Document: Drawing Sheet No. f.	Deviation (See Instruction #6) g.	Contractor Action Code (See Instruction #9) h.
1	Silt Fence	Propex 2130`	6	02228	N/A	1, 2	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert McQuain DATE: 07/15/04

Remarks:
1) Fence is manufactured with 4' long oak stakes
2) Ave. Permittivity = .05 Sec $^{-1}$

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Section II — **Reviewed**

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA Jill Kale
Tetra Tech

ProPex®

silt fences

2130

ProPex 2130 is a polypropylene woven fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a pH range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that **ProPex 2130** meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Grab Tensile	ASTM-D-4632	124x124 lb	0.550x 0.550 kN
Grab Elongation	ASTM-D-4632	15% x 20%	15% x 20 %
Mullen Burst	ASTM-D-3786	300 psi	2060 kPa
Puncture	ASTM-D-4833	65 lb	0.285 kN
Trapezoidal Tear	ASTM-D-4533	65 lb	0.285 kN
UV Resistance	ASTM-D-4355	80 %	80 %
AOS(1)	ASTM-D-4751	30 sieve	0.600 mm
Permittivity	ASTM-D-4491	0.05 sec^{-1}	0.05 sec^{-1}
Flow Rate	ASTM-D-4491	10 $gal/min/ft^2$	405 $L/min/m^2$

(1) max. average roll values

Amoco Fabrics and Fibers Company manufacturers the woven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories. A letter certifying the minimum average roll values will be issued from the manufacturing plant by the Quality Control Manager at the time shipment is made.

DATE ISSUED: 01/02/04

Amoco Fabrics and Fibers Company
260 The Bluffs
Austell, GA 30168
PH: 770-944-4569
FX: 770-944-4584

Exclusion of Liability
Information contained in this publication is accurate to the best of the knowledge of Amoco Fabrics and Fibers Company. Any information or advice obtained from BP otherwise than by means of this publication and whether relating to BP materials or other materials, is also given in good faith. However, it remains at all times, the responsibility of the customer to ensure that BP materials are suitable for the particular purpose intended. Insofar as materials not manufactured or supplied by BP are used in conjunction with or instead of BP materials, the customer should ensure that he has received from the manufacturer or supplier all the technical data and other information relating to such materials. BP accepts no liability whatsoever (except as otherwise expressly provided by law) arising out of the use of information supplied, the application of processing of the products described herein, the use of other materials in lieu of BP materials in conjunction with such other materials.

Published by Amoco Fabrics and Fibers Company

bp

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 7/13/04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 009
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Nonwoven Geotextile	Nilex NW60`	6	11100	N/A		

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

Remarks: APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Richard Davis 07/15/04

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA J.H. Rale Tetra Tech

NILEX CORPORTION
15171 East Fremont Drive
Centennial, Colorado 80112
(303) 766-2000 phone
(303) 766-1110 fax
www.nilex.com

Nilex NW60 Nonwoven Geotextile

Nilex NW60 is a superior quality, nonwoven geotextile produced by needlepunching together 100% polypropylene staple fibers in a random network to form a high strength dimensionally stable fabric. The polypropylene fibers are specially formulated to resist ultraviolet light deterioration, and are inert to commonly encountered soil chemicals. The fabric will not rot or mildew, is non-biodegradable, and is resistant to damage from insects and rodents. Polypropylene is stable within a pH range pf 2 to 13. Nilex NW60 conforms to the physical property values listed below:

Fabric Property	Test Method	Units	MARV
Weight	ASTM D-3776	oz/sy	6.0 (203g/ m^2)
Grab Tensile Strength	ASTM D-4632	lbs	160 (0.711kN)
Grab Elongation	ASTM D-4632	%	50
Trapezoidal Tear	ASTM D-4533	lbs	65 (0.289kN)
Puncture Strength	ASTM D-4833	lbs	90 (0.40kN)
Mullen Burst	ASTM D-3786	psi	315 (2170kPa)
Permittivity	ASTM D-4491	sec^{-1}	1.6
Water Flow Rate	ASTM D-4491	gpm/ft^2	110 (4480 l/min/m^2)
AOS	ASTM D-4751	US Sieve	70 (0.212mm)
UV Resistance (Retained, 500 hrs.)	ASTM D-4355	% Strength	70

Note: Values are MARV, reported in weaker principle direction. "MARV" indicates minimum average roll value calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any sample taken during quality assurance testing will exceed the value reported.

Please do not hesitate to contact us at (303) 766-2000 if you have any questions regarding this certification.

SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT FURNISHED HEREUNDER OTHER THAN AT THE TIME OF DELIVERY IT SHALL BE OF THE QUALITY AND SPECIFICATION STATED HEREIN. ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY EXCLUDED, AND, TO THE EXTENT THAT IT IS CONTRARY TO THE FOREGOING SENTENCE, ANY IMPLIED WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED. ANY RECOMMENDATIONS MADE BY SELLER CONCERNING THE USES OR APPLICATIONS OF SAID PRODUCT ARE BELIEVED RELIABLE AND SELLER MAKES NO WARRANTY OF RESULTS TO BE OBTAINED.

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 7/13/04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 010
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	North American Green Quality Program		6	02227	N/A		
2	Installation Guide	Staple Pattern Guide, Slope, Channel and Shoreline Guide	6	02227	N/A		
3	Storage Guide	Storage of NAG Rolled Erosion Control Products	6	02227	N/A		
4	Material Specifications SC 250	Material Specification 1/2004	6	02227	N/A	1	
5	Material Specification SC 150	Material Specification 1/2004	6	02227	N/A		
6	Product Samples	NAG SC 250	6	02227	N/A		
7	Product Samples	NAG SC 150	6	02227	N/A		

Remarks:
1) NAG does not manufacture product C250. NAG product SC 250 is being submitted as an alternate.

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Section II Reviewed

SUBMITTAL TRANSMITTAL FORM

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

Rocky Flats Plant

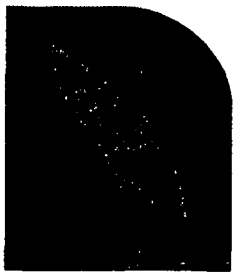
☐ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☒ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Robert Davis DATE: 08/07/2004

NAG SC150 Is Approved

NAG SC250 ⇒ Resubmit @ SC350 Erosion Matper revised specifications 02227.



NORTH
AMERICAN
GREEN

NORTH AMERICAN GREEN, INC.
Quality Program

14649 Hwy 41 North • Evansville, IN 47725 • 800-772-2040 • Fax 812-867-0247 • www.nagreen.com

The text book definition of Quality states that it is a "Degree of Excellence". The "Excellence", in a broad form, can apply to most every aspect of our lives. For the purpose of this discussion, quality or the "Degree of Excellence" will be limited to North American Green's product line, as well as the materials and equipment we use to achieve our product quality goals.

There are two quality activities that must be considered in the manufacturing process:

a. The quality of the raw materials we use to manufacture our products.
b. The quality of the finished product we manufacture.

If the quality of the components of our products is less than satisfactory, the quality of the finished product cannot be satisfactory for selling and performing for the purpose intended.

Raw Materials Quality:

While we deal with a very limited number of raw material components in the manufacture of erosion control blankets, the quality of these components is no less important than that of other manufacturers who produce high-tech finished goods. Each raw material component has a defined specification that must be met by the respective supplier. Suppliers of certain raw materials will be required to provide a certification of conformance for each material type and shipment. These certifications must be checked against North American Green quality control specifications (see attached) to insure compliance. The following are examples of what must be considered when raw materials are received.

Synthetic Netting: The receiving inspection of netting includes: a) color, b) aperture size, c) roll width d) roll weight, e) roll length, f) unit weight lbs/msf, and g) tensile strength/elongation.

a) Color shall be inspected visually and must be as specified for the netting type.
b) Aperture size (mesh openings) shall be periodically (randomly select 1 out of every 10 rolls) measured and checked against supplier certified dimensions. Perform measurements in the middle of the roll and 2 inches from the roll end. Start measurements 3 feet from beginning (loose) end of netting.
c) Roll width shall be periodically (randomly select 1 out of every 10 rolls) physically measured across the transverse direction of the netting roll and checked against the certified width.
d) Roll weight shall be periodically (randomly select 1 out of every 10 rolls) physically measured and checked against the certified weight.
e) Roll length shall be taken from roll tags.
f) The weight ((lbs/msf (1000 sf)) shall be certified by the supplier and provided on the certification which shall accompany each shipment. Weight in (lbs/msf) shall also be periodically (randomly select 1 out of every 10 rolls) physically checked by calculation using the following equation:

Roll Weight (lbs) / ((Roll Length (ft.) x Roll Width (in.)/12) / 1000) = lbs/msf

g) Tensile strength and elongation shall be certified by the netting supplier and provided on the certification, which shall accompany each shipment. **Poor tensile strength will affect the finished product's ability to be installed and thus it's erosion control performance as intended.**

Organic Fiber Netting: At present, organic fiber netting is only being used in the manufacture of our completely biodegradable "BioNet" products. The organic netting is a leno weave product consisting of two jute strands twisted together in the machine direction and a single jute strand woven through but not fixed to the twist openings to form a loose intersection in the transverse (cross machine) direction. Quality considerations of the organic fiber netting include a) Roll Width, b) Wrap Consistency, c) Strand Count and d) tensile strength/elongation.

a) The width of each roll (in.) shall be physically measured from edge to edge and must meet the specified minimum and maximum length.
b) Wrap consistency must be visually checked. The roll ends shall be flush and uniform. Non-uniform roll edges indicate damaged or loosely wrapped material and material will not retain consistent alignment within the machine. This problem is especially prevalent in the double-netted materials in which the top and bottom netting edges must be uniformly square when overlaid.
c) Strand count must be visually checked. There shall be two twisted jute strands forming single ribs in the machine direction spaced approximately 1 inch apart. There shall be one jute strand forming the rib in the cross machine direction spaced approximately .5 inches apart.
d) Tensile strength and elongation shall be certified by the netting supplier and provided on the certification, which shall accompany each shipment. **Poor tensile strength will affect the finished product's ability to be installed and thus it's erosion control performance as intended.**

Agricultural Wheat Straw: The most important qualities of wheat straw are a) moisture content, b) color, c) the presence of mold and/or contamination, and d) mulch content (short fiber). All straw fiber shall be inspected prior to off-loading from the truck. A North American Green quality control check tag shall be placed on all delivered straw raw materials (see raw materials specification).

a) Each bale of straw must be checked for moisture content using the available moisture probe. Moisture content shall not exceed North American Green specifications (see raw materials specification).
b) Color is a visual check. A bright, gold color will indicate a high quality material, while faded color could indicate older more degraded straw and/or the potential for mold. Molded materials are unacceptable. The presence of mold is harmful to the employees and must not be accepted under any circumstances.
c) Mulch content must be measured for each straw shipment (randomly select 1 out of every 10 rolls of same wheat variety and/or lot) using the shake-out test procedure and shall not exceed the specified maximum allowable content.

Coconut Fibers: The quality of coconut fiber may vary from one supplier to another. All coconut fibers are received in the form of bales. The following qualities must be considered when receiving coconut fibers including a) fiber grade, b) moisture content, and c) mulch/dirt content. A North American Green quality control check tag shall be placed on all delivered coconut fiber raw materials after there inpsection and prior to being off-loaded from the truck (see raw materials specification).

a) The fiber grade must be certified by the supplier and must be listed on the certification accompanying each coconut fiber shipment. The fiber grade must be as specified by North American Green (see raw materials specification).
b) Moisture content must be checked by weighing (randomly select 1 out of every 10 bales) in each shipment. Weights exceeding North American Green specifications may indicate high moisture content.
c) Mulch and dirt content must be periodically (randomly select 1 out of every 10 bales) measured using the shake-out test procedure and shall not exceed the specified maximum allowable content. A high degree of dirt in coconut bales contaminates the factory with dust and prevents the manufacturing of a high quality finished product.

Synthetic Fibers: Quality control receiving inspection of synthetic fibers must involve the evaluation of these characteristics a) color, b) fiber length, c) fiber crimp, and d) Oil/anti-stat coating.

a) Color must be consistent through all bales. The supplier color matches the raw material to a color specification provided by the company. Any noticeable color differences must be reported.

b) Fiber length must be certified by the supplier and periodically (randomly select 1 out of every 10 bales) physically measured. Fiber length must meet North American Green specifications (see raw materials specification section).
c) Fiber crimp must be certified by the supplier. The certified amplitude and frequency of crimp shall meet North American Green specifications. Crimp must also be visually inspected to insure conformance.
d) Oil and anti-stat coating of the fiber must be certified by the supplier. During the manufacturing process of the fibers, a light oil substance is used to reduce static electricity.

Sewing/Weaving Yarns: A variety of yarns are currently being used to stitch products together (synthetic/cotton) or to weave into the BioNet nettings (jute). Each of these yarns have specifications regarding a) fiber denier, b) construction type (mono/multifilament, twisted/texturized), and c) cone size.

a) Fiber denier shall be certified by the supplier and must meet North American Green specifications (see raw materials specification section).
b) Construction type shall be certified by the supplier and must meet North American Green specifications. A visual inspection will also determine if construction type is as certified.
c) Cone size (Diameter (in), Weight (lbs), Linear feet of yarn / cone) shall be certified by the supplier and must meet North American Green specifications. A visual inspection will also determine if cone size is as certified.

Cellulose Paper: Lightweight cellulose paper is used in two plies to encapsulate seed when manufacturing a pre-seeded Cell-O-Seed product. Poor quality paper creates problems when pulling the material through the manufacturing equipment and will not sufficiently retain applied seed. Quality control inspections must include a) Paper Weight, b) Roll Width, c) Roll Length, d) Recycled Content, e) Existing Hole size/quantity, and f) Roll Damages.

a) Paper weight (lbs/3000 ft^2) shall be certified by the supplier and must meet North American Green specifications. Paper weight shall also be checked periodically (randomly select 1 out of every 10 rolls) using the following calculation:

Roll Weight (lbs) / ((Roll Length (ft.) x Roll Width (in.)/12) / 3000) = lbs/3000 ft^2

b) Roll width shall be certified by the supplier and periodically (randomly select 1 out of every 10 rolls) physically measured. Roll width must meet North American Green specifications.
c) Roll length shall be certified by the supplier.
d) Recycled content must be certified by the supplier and must meet North American Green specifications (see raw materials specification section).
e) Due to the very thin nature of this material, small holes and rips are common. A visual inspection must be used to insure that no holes exist which are large enough to allow the escape of the seed type being used. There shall be no holes greater than .25 inches in diameter. When using very small seed types such as Bermuda grass, extra care must be taken in evaluating and accepting existing holes.
f) Damages to rolls which occur in shipping include rips and tears caused by improper handling. A visual inspection of each roll will reveal damages. Damaged rolls may be used if the torn layers of paper are removed and discarded. However, if the quantity is significant, the amount of damaged paper should be reported to the plant manager.

Plastic Bags: All finished products are packaged in sheet film plastic bags or shrink wrapped. The bags are perforated to provide air flow through the product. The most important quality inspections for the plastic bags include a) color, and b) printing quality.

a) Each finished product is color coded for identification by the distributor and the end user. An inspection process must provide for the proper color for the product.

b) Printing quality of the information on the outside of the plastic bag must be maintained. The printing must be legible without exception.

Quality Control Inspection Process for Raw Materials

Each of the above raw materials must be visually or mechanically inspected at the time they are received. A certification of compliance from the product's manufacturer will also accompany each shipment of the following raw materials:
1) All Synthetic Nettings
2) Synthetic Fibers (polypropylene staple for P300)
3) Synthetic/Cotton/Jute Yarn
4) Coconut Fiber
5) Cellulose Paper
Material certifications not conforming to North American Green specifications or inspections revealing sub-standard material quality must be reported immediately to the purchasing manager so that proper notifications can be made to the respective supplier. Disposition will be made by the purchasing manager. All defective raw materials must be tagged to prevent their movement into the production area. **The manufacturing manager has the authority to refuse to unload any product suspected of poor quality.**

Finished Goods Quality:
As previously mentioned, the quality of finished products can only be as good as the quality of the raw materials used to manufacture the products. Quality at the time of receipt of raw materials must be checked to insure structural and functional quality of the products.
North American Green rolled erosion control products are designed to control soil erosion under various site conditions. The purpose of the blankets is to reduce rainfall impact and flow induced shear forces upon the underlying soil particles, while providing a mulch layer for optimum seed germination and plant growth. Our products are designed to control erosion and facilitate permanent vegetation growth through their fibrous matrices. Therefore, the blankets must be constructed with relatively dense matrices to deflect erosive forces yet must be open enough to allow uninhibited vegetation growth through.

To insure the optimum performance capabilities of each North American Green product, material specifications have been developed based on performance tests conducted in laboratories and under field conditions. North American Green publishes this performance data and uses it as a basis for materials selection within the Erosion Control Materials Design Software. Since our materials must perform as guaranteed through design software analysis, product performance must be approximately constant. Consistent performance relies on consistent physical properties. Therefore, a finished product must conform to its published specification.

Finished Goods Index/Physical Property Testing:
Material specifications include the product composition, minimum and maximum weights, length and width. Supplemental specifications listing more detailed index test data are also available for each product. Index/Physical testing will occur according to the guidelines established by the Erosion Control Technology Council outlined in the manual entitled "Technical Guidance Manual, Terminology and Index Testing for Rolled Erosion Control Products" released January 1997. The specific physical properties tested for each product vary in both type and frequency based on longevity of product – temporary or permanent). Frequency of physical property testing and lot size is established using ASTM D 4354 – 96 Material Quality Assurance Procedure B. Procedure B testing protocol is established around each of the various products based on amount of material manufactured in each specific run (lot establishment).

Visual Inspection for Quality:
The most critical elements of quality which must be maintained during the manufacturing process include a) material composition, b) fiber distribution, c) material stitching, d) roll weight, e) roll length, f) netting crimp ($Vmax^3$ only), and g) packaging integrity.

a) Material composition includes fiber type/s, netting type/s, yarn type/s and packaging. Each raw material component for each material type is detailed including manufacturers number and/or color codes on the Quality Control specification. Care must be taken to insure the correct components for the product type are obtained from inventory during manufacture. All synthetic nettings are color coded to simplify the pulling of the proper netting rolls from inventory. Additional steps are required in packaging Cell-O-Seed blankets. A seed tag listing the appropriate seed species, germination rate, purity, and date must be affixed to each Cell-O-Seed roll bag.

b) Distribution of the fibers within blanket must be continuously monitored visually. The size and quantity of voids or thin areas and very dense (thick) spots must not exceed quality control specifications. When producing products with combinations of straw and coconut fibers, it must be remembered that the specification calls for 70% straw fiber and 30% coconut fiber. Machine settings will allow for the proper combination of materials. The machine operators must stop machine production if fiber distribution does not conform to the quality control specification. Questions concerning quality must be directed to the plant foreman. Samples of good fiber distribution are available for comparison. **Under no circumstances should foreign materials of any kind be allowed into the finished roll. This includes residual fiber from previous runs (i.e. straw or coconut in P300 or polypropylene fiber in any temporary erosion control blanket).**

c) Material stitching must be continuously monitored visually. Stitching consistency must conform to quality control specifications. Factors affecting the sewing ability of the machinery are yarn tensile strength/elongation and needle tension. Needle tension is controllable by the machine operator. If yarns continue to break, the needle tension of the machine must be checked. The machine must be adjusted to stitch a tight seam without breaking the yarn. When yarns break due to the needle friction during the sewing process they must be re-threaded as quickly as possible to eliminate long gaps in the blanket. Questions concerning the sewing quality must be directed to the plant foreman. Continued yarn breakage must be eliminated to maintain production efficiency and product quality.

d) The weight of each roll shall be physically measured and must conform to North American Green specifications. Weight specifications are of vital importance. Improper weights of products can cause rejection by agency inspectors at job sites. Each roll of product must be weighed and the weight recorded on the daily log sheet. Products not conforming to the specified weight range must be discarded.

e) Roll length must be periodically (randomly select one roll during each production run or shift) physically checked to insure machine counters are functioning properly and the length of finished products conforms to the specification. The first finished roll produced following a product change-over and/or an adjustment of the machine counter must also be physically checked. Measurements have been marked on the plant floor to facilitate this quality assurance check.

f) The crimped netting ($Vmax^3$ products only) is processed by North American Green from heavyweight two dimensional netting using the crimping machine. The crimping machine operator must constantly monitor and inspect the netting as it exits the heating/crimping unit to insure adequate crimping without substantial shrinkage or melting of the netting. All temperatures shall be monitored for the crimping process. If the crimp is inadequate, the machine pull rate must be slowed to allow a longer exposure period within the heating/crimping unit. If substantial shrinkage or melting occurs, the machine pull rate must be increased.

The finished netting must be wound on to the wooden end cardboard spools provided and stood upright to preserve crimp during storage.

g) The integrity of the product packaging must be maintained from initial roll insertion through the roll compaction and storage/handling process. Product bags are manufactured of lightweight polypropylene film. As the bag is pulled over the finished product, caution must be taken to prevent the slitting of the plastic material. Additional caution must be taken with the Vmax[3]. After the plastic bag is pulled over the roll, the end must be secured with the wire loop. Two twine cords are wrapped around the plastic bag and rolls. These cords are important since distributors unloading the materials will use the cords for carrying the finished rolls. A lot number must be permanently affixed to the bag (see "QC Tracking" section below).

All products are compacted to facilitate easier handling and increased quantities in truck shipments. During the compacting process, the rolls are compressed. The perforated holes in the plastic bags allow air to escape from the rolls while the compaction process is being performed. A step-by-step process must be followed during the compaction process to prevent the product bags from splitting.

Quality Inspection of Finished Product:
At the end of each production line resides a reference manual with color photographs illustrating required finished product appearance. The photographs illustrate the appearance of poorly produced material, which must be scrapped; of fair material, which is acceptable for sale but requires the operator to make immediate process adjustments; and of good material requiring no process adjustments. Beside each photograph is a brief statement of the problem, its possible causes, and suggested course of action. The photograph of good material is accompanied by a brief description of the desirable attributes of the superior quality product. The machine operator consults this manual during each material run, comparing the product being produced to the examples within the manual and taking appropriate action. Each roll of material is also weighed and its weight recorded; roll weight must be within 10 % of the product's target weight.

Products of **Good** quality will exhibit the following properties:

- No rips or tears in netting
- Clean, bright matrix material
- Consistent fiber distribution with no extensive thick spots
- Individual roll weight ± 10 %
- At least 45 of the 50 stitches secured with no two adjacent stitches missing

Products of **Fair** quality will exhibit one or more of the following deficiencies:

- Voids up to 2 inches in diameter
- Areas of thinning up to 6 inches in diameter
- 2 adjacent stitches missing
- Small tears in netting, not exceeding 3 inches

Products of **Poor** quality will exhibit one or more of the following deficiencies:

- Numerous voids of excessive size
- Areas of thinning greater than 6 inches in diameter
- Netting tears greater than 3 inches
- Less than 45 stitches per roll width

- More than two sets of adjacent stitches missing

Any material exhibiting poor quality will be considered scrap material and will be disposed or recycled depending on raw materials used in the rolled erosion control products construction.

Quality Control Tracking

Tracking quality control problems which are discovered before or after shipping will be achieved through permanent labeling of each product bag with a lot number consisting of the number of the machine operator and the date (month-day) of production.

Lot Numbering for example purposes only: 1-2-12-99

|	|	| Year
|	| Day	
| Month (February)		
Operator Number		

The lot number must be affixed to the tied end of the roll bag and clearly visible / legible. Quality problems will be tracked to the machine operator and machine when it is suspected materials within the same lot may also be of substandard quality.

Good Quality is Everyone's Responsibility

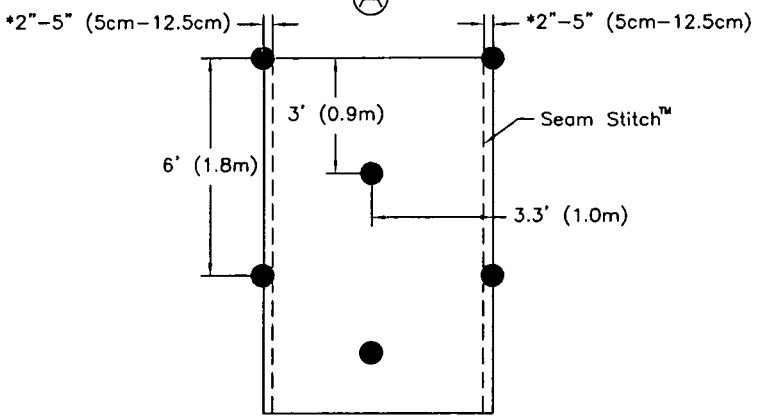
Quality must be the responsibility of every North American Green employee. Poor quality reflects on the employees and the company. Poor quality is a like a disease and can cause irreparable damage to reputation and selling efforts. A reputation for poor quality is something that cannot be cured easily; it must be prevented. Each employee has the authority to stop production at any time should he or she determine that quality standards are not being met.

STAPLE PATTERN GUIDE

NORTH AMERICAN GREEN

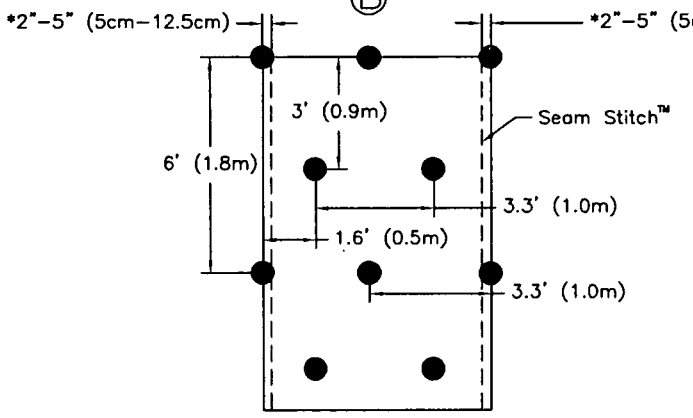
14649 HIGHWAY 41 NORTH
EVANSVILLE, IN 47725
800-772-2040
www.nagreen.com

Ⓐ



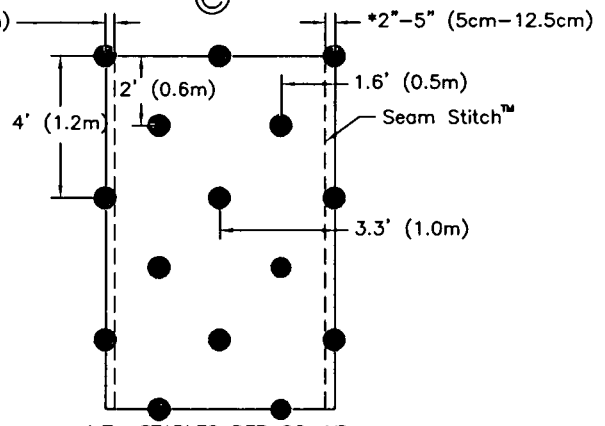
0.7 STAPLES PER SQ. YD.
(0.8 STAPLES PER SQ. M)
For blankets with the North American Green DOT System place staples/stakes ugh each of the BLUE colored dots.

Ⓑ



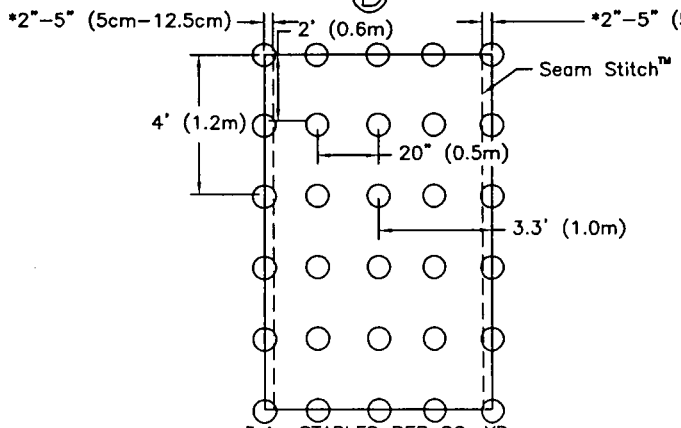
1.15 STAPLES PER SQ. YD.
(1.35 STAPLES PER SQ. M)
For blankets with the North American Green DOT System™ place staples/stakes through each of the RED colored dots.

Ⓒ



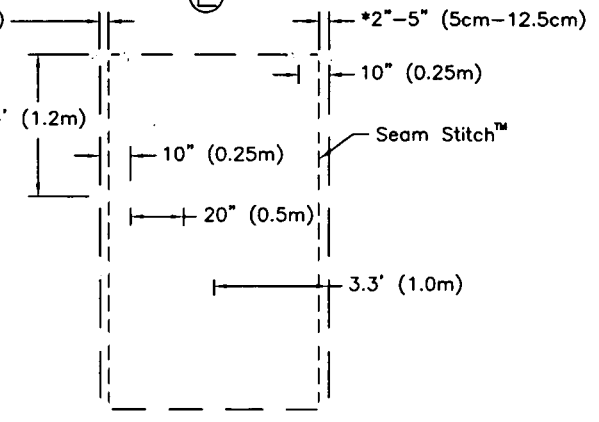
1.7 STAPLES PER SQ. YD.
(2.0 STAPLES PER SQ. M)
For blankets with the North American Green DOT System™ place staples/stakes through each of the GREEN colored dots.

Ⓓ



3.4 STAPLES PER SQ. YD.
(4.1 STAPLES PER SQ. M)
For blankets with the North American Green DOT System™ place staples/stakes through each of the WHITE colored dots.

Ⓔ



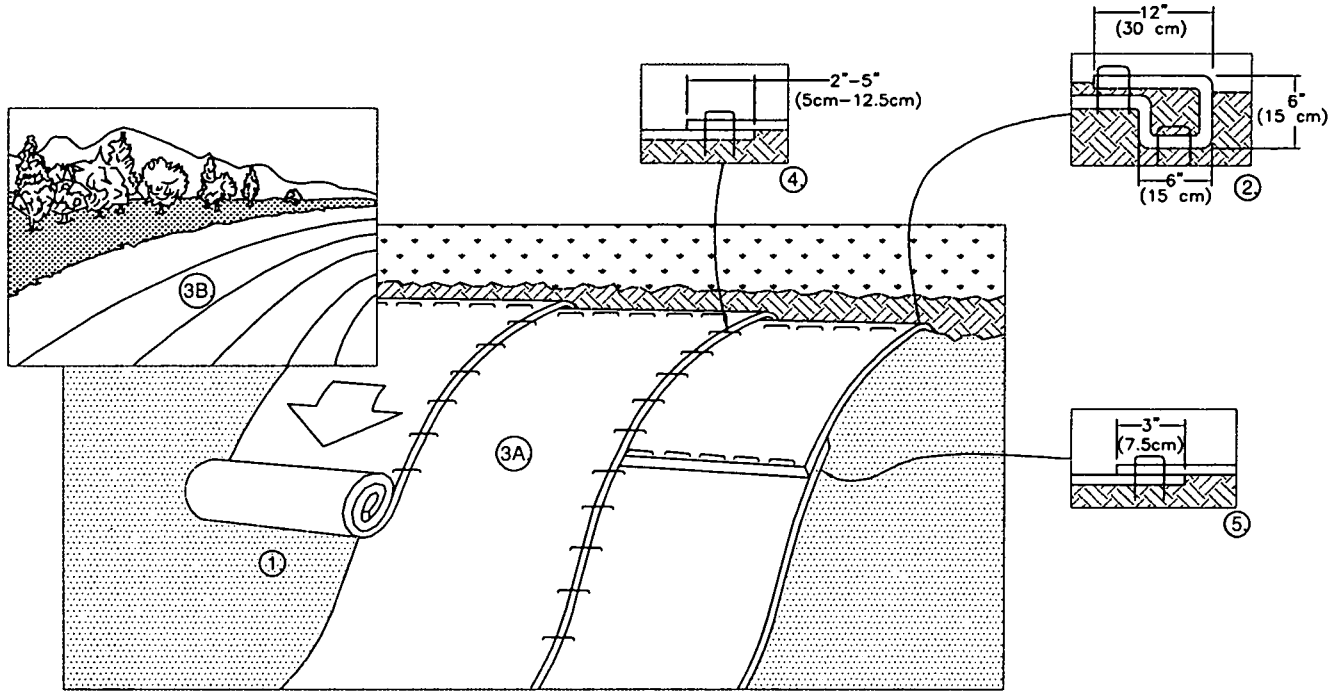
3.75 STAPLES PER SQ. YD.
(4.5 STAPLES PER SQ. M)
For blankets with the North American Green DOT System™ place staples/stakes through each of the YELLOW colored dots.

*Location of Seam Stitch™ will vary depending on North American Green product type:

REV. 732003

SLOPE INSTALLATION

NORTH AMERICAN GREEN



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL THE BLANKETS (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 2"-5" (5cm-12.5cm) OVERLAP DEPENDING ON BLANKET TYPE. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH™ ON THE PREVIOUSLY INSTALLED BLANKET.
5. CONSECUTIVE BLANKETS SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5cm) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30cm) APART ACROSS ENTIRE BLANKET WIDTH.

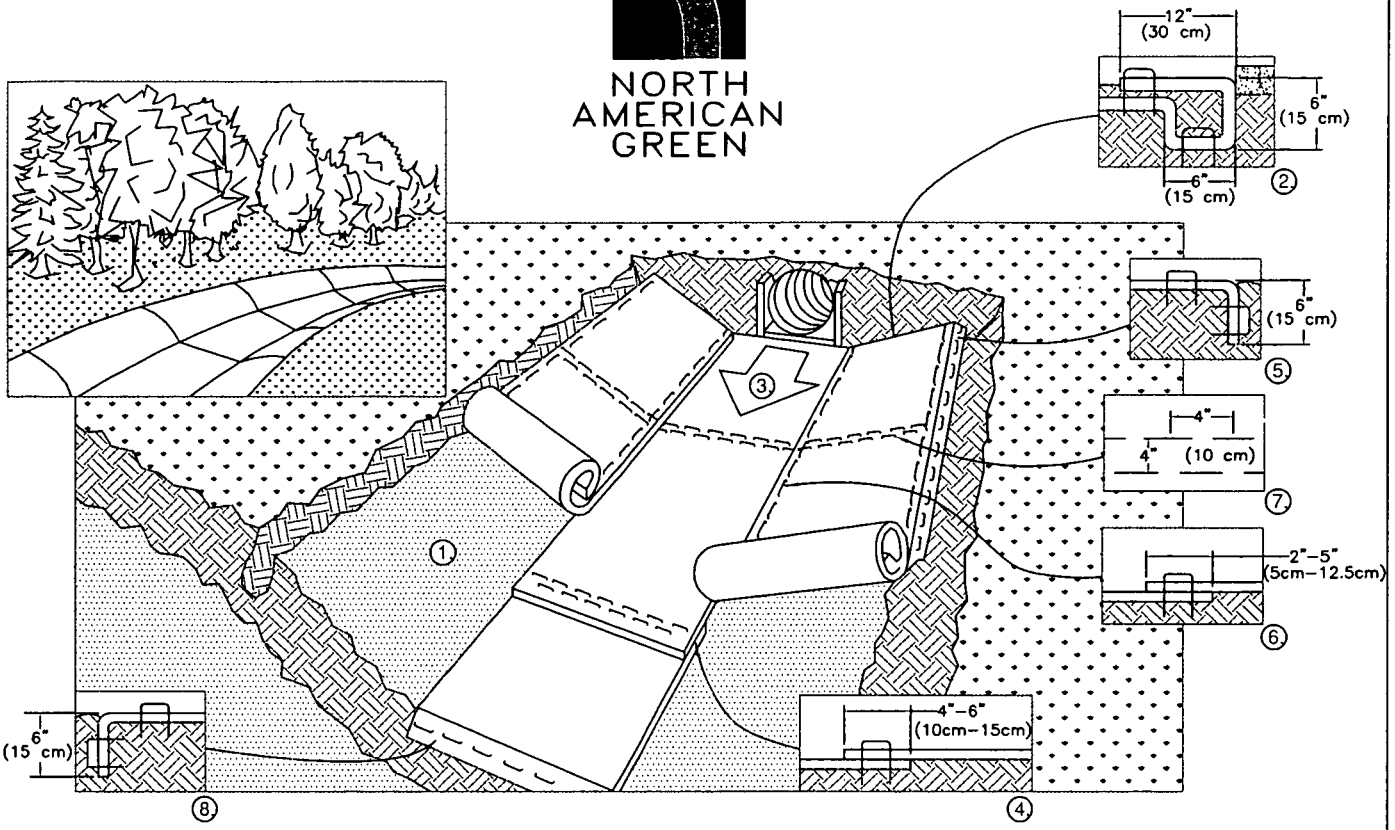
NOTE:
*IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15cm) MAY BE NECESSARY TO PROPERLY SECURE THE BLANKETS.

14649 HIGHWAY 41 NORTH, EVANSVILLE, INDIANA 47725
800-772-2040
www.nagreen.com

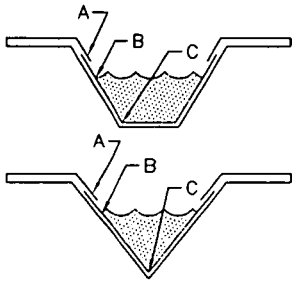
REV. 732003

CHANNEL INSTALLATION

NORTH AMERICAN GREEN



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE BLANKET IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL CENTER BLANKET IN DIRECTION OF WATER FLOW IN BOTTOM OF CHANNEL. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. PLACE CONSECUTIVE BLANKETS END OVER END (SHINGLE STYLE) WITH A 4"-6" (10cm-15cm) OVERLAP. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10cm) APART AND 4" (10cm) ON CENTER TO SECURE BLANKETS.
5. FULL LENGTH EDGE OF BLANKETS AT TOP OF SIDE SLOPES MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. ADJACENT BLANKETS MUST BE OVERLAPPED APPROXIMATELY 2"-5" (5cm-12.5cm) (DEPENDING ON BLANKET TYPE) AND STAPLED. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH™ ON THE BLANKET BEING OVERLAPPED.
7. IN HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT (9m-12m) INTERVALS. USE A DOUBLE ROW OF STAPLES STAGGERED 4" (10cm) APART AND 4" (10cm) ON CENTER OVER ENTIRE WIDTH OF THE CHANNEL.
8. THE TERMINAL END OF THE BLANKETS MUST BE ANCHORED WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.



CRITICAL POINTS

A. OVERLAPS AND SEAMS
B. PROJECTED WATER LINE
C. CHANNEL BOTTOM/SIDE SLOPE VERTICES

NOTE:

- HORIZONTAL STAPLE SPACING SHOULD BE ALTERED IF NECESSARY TO ALLOW STAPLES TO SECURE THE CRITICAL POINTS ALONG THE CHANNEL SURFACE.

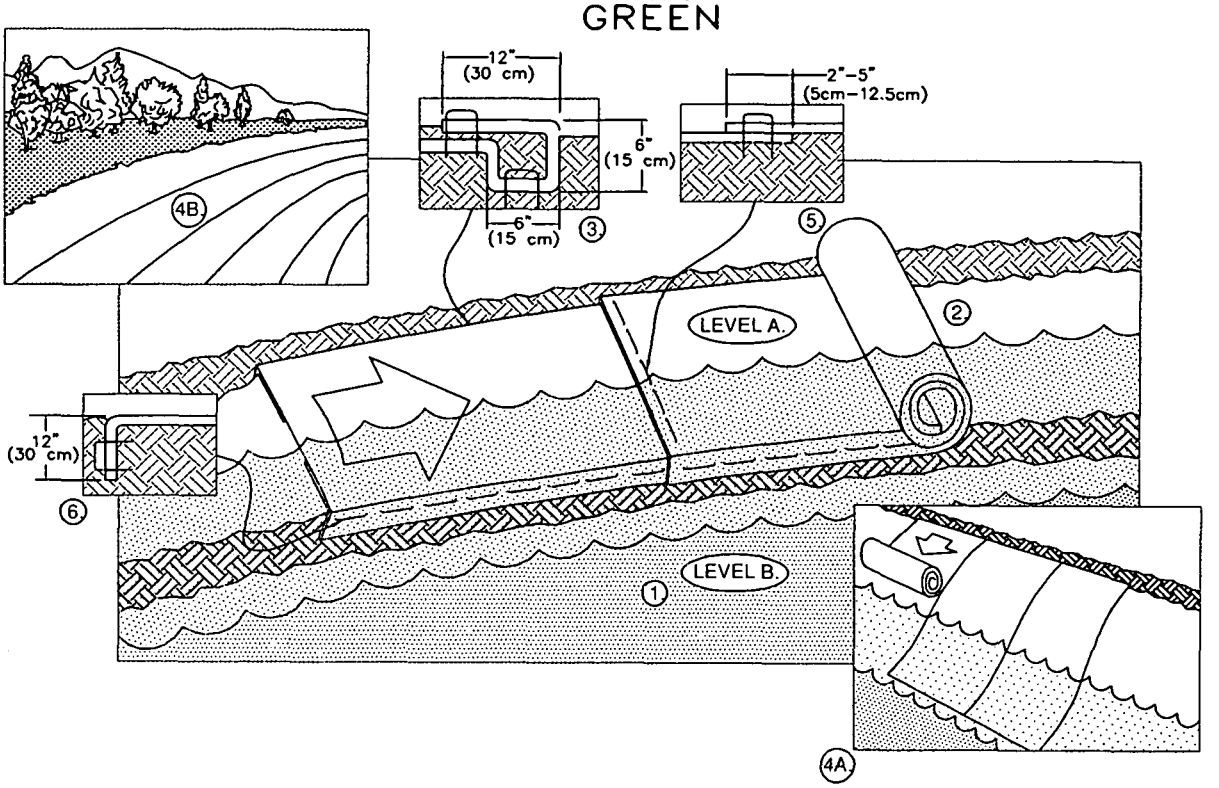
** IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15 cm) MAY BE NECESSARY TO PROPERLY ANCHOR THE BLANKETS.

14649 HIGHWAY 41 NORTH, EVANSVILLE, INDIANA 47725
800-772-2040
www.nagreen.com

REV. 732003

SHORELINE INSTALLATION

NORTH AMERICAN GREEN



1. FOR EASIER INSTALLATION, LOWER WATER FROM LEVEL A TO LEVEL B BEFORE INSTALLATION.
2. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED NOTE: WHEN USING CELL-O-SEED, DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
3. BEGIN AT THE TOP OF THE SHORELINE BY ANCHORING THE BLANKET IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
4. ROLL BLANKETS EITHER (A.) DOWN THE SHORELINE FOR LONG BANKS, (TOP TO BOTTOM) OR (B.) HORIZONTALLY ACROSS THE SHORELINE SLOPE. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
5. THE EDGES OF ALL HORIZONTAL AND VERTICAL BLANKET SEAMS MUST BE STAPLED WITH APPROXIMATELY 2"-5" (5cm-12.5cm) OVERLAP. TO ENSURE PROPER SEAM ALIGNMENT BETWEEN ADJACENT BLANKETS, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH™ ON THE PREVIOUSLY INSTALLED BLANKET. SECURE ALL OVERLAPS WITH STAPLES SPACED 12" (30cm) APART.

   NOTE:
   * SEAM OVERLAP SHOULD BE SHINGLED ACCORDING TO PREDOMINANT EROSIVE ACTION.
6. THE EDGE OF THE BLANKET AT OR BELOW NORMAL WATER LEVEL MUST BE ANCHORED BY PLACING THE BLANKET IN A 12" (30cm) DEEP X 6" (15cm) WIDE ANCHOR TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART IN THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING (STONE OR SOIL MAY BE USED AS BACKFILL.)

   NOTE:
   * IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15cm) MAY BE NECESSARY TO PROPERLY ANCHOR THE BLANKETS.

14649 HIGHWAY 41 NORTH, EVANSVILLE, INDIANA 47725
800-772-2040
www.nagreen.com

REV. 732003

Storage of North American Green Rolled Erosion Control Products

All North American Green rolled erosion control products must be stored under the following conditions. Storage in this manner will maintain the RECP's functional longevity.

- The RECPs should be stored in their original packaging, out of direct sunlight, and protected from moisture (e.g. rain, runoff, and flooding).
- Protection of the RECPs requires the rolls be effectively covered with tarps or stored in a vented container (especially true for RECPs containing straw fibers)
- May require the use of pallets or other materials to ensure the rolls are protected from sunlight and moisture.

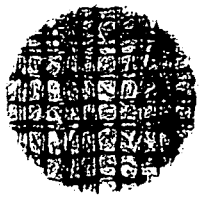
Because the RECPs may contain the North American Green Cell-O-Seed option (seeds incorporated into the product) it is paramount that the RECPs be stored in a location that will also limit seed germination (reduced exposure to light, moisture, extreme temperatures, etc.). However, the RECPs should not be stored under such environmental extremes that may result in the seeds being killed. Specifically, RECPs with the Cell-o-Seed option should be stored where temperatures will induce winter dormancy for the seeds and thus not allow seeds to germinate during storage (temperatures of approximately 20-35° F should suffice).

14649 Hwy 41 North • Evansville, IN 47725 • 800-772-2040 • 812-867-6632 • Fax: 812-867-0247
www.nagreen.com • www.vmax3.com

NORTH AMERICAN GREEN

MATERIAL SPECIFICATION

SC250



The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 70% straw/30% coconut fiber matrix incorporated into a permanent three-dimensional turf reinforcement matting.

The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a heavy duty UV stabilized bottom net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, and covered by a heavy duty UV stabilized top net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent three-dimensional turf reinforcement matting.

The SC250 shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the U.S. Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications For Construction of Roads and Bridges on Federal Highway Projects, FP-03 2003 Section 713.18* as a *Type 5A, B, and C Permanent Turf Reinforcement Mat.*

Installation staple patterns shall be clearly marked on the turf reinforcement mattings with environmentally safe paint. All mats shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The composite turf reinforcement mat shall be the North American Green SC250, or equivalent. The SC250 permanent composite turf reinforcement mat shall have the following physical properties:

Material Content

Matrix	70% Straw Fiber (0.35 lb/yd^2) (0.19 kg/m^2) 30% Coconut Fiber (0.15 lb/yd^2) (0.08 kg/m^2)
Netting	Top and Bottom – Heavy Duty UV Stabilized Polypropylene (5.0 lbs/1,000 ft^2 [2.44 kg/100 m^2] approximate weight) Mid – Corrugated Ultra Heavy Duty UV Stabilized Polypropylene (24 lb/1,000 ft^2 [11.7 kg/100 m^2] approximate weight)
Thread	UV Stabilized Polypropylene

SC250 is Available with the Following Physical Specifications Per Roll [English Units (Metric Units)]

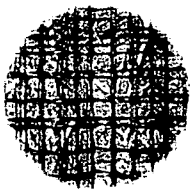
Width	6.50 ft (2.00 m)
Length	55.50 ft (16.90 m)
Weight ± 10%	34.00 lbs (15.42 kg)
Area	40.00 yd^2 (33.40 m^2)

Stitch Spacing for All Rolls = 1.50 inches (3.81 cm)

NORTH AMERICAN GREEN®

SUPPLEMENTAL SPECIFICATION

SC250



The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 70% straw/30% coconut fiber matrix incorporated into a permanent three-dimensional turf reinforcement matting.

The matrix shall be stitch bonded between a heavy duty UV stabilized bottom net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, a ultra heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, and covered by a heavy duty UV stabilized top net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nets shall be stitched together on 1.50 inch (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent three-dimensional turf reinforcement matting.

Property	Test Method	Typical
Thickness	ASTM D6525	0.72 in (18.29 mm)
Resiliency	ASTM D1777	95.20%
Density	ASTM D792	0.529 oz/in³ (0.915 g/cm³)
Mass / Unit Area	ASTM D6566	17.88 oz/yd² (606 g/m²)
Porosity	ECTC Guidelines	99%
Stiffness	ASTM D1388/ECTC	222.65 oz-in (2,485,051 mg-cm)
Light Penetration	ECTC Guidelines	8.90 %
MD Tensile Strength	ASTM D6818 [D5035]	620 lbs/ft (9.05 kN/m) [520 lbs/ft (7.59 kN/m)]
MD Elongation	ASTM D6818 [D5035]	35 % [32%]
TD Tensile Strength	ASTM D6818 [D5035]	737 lbs/ft (10.75 kN/m) [784 lbs/ft (11.44 kN/m)]
TD Elongation	ASTM D6818 [D5035]	16 % [17.50%]

SC250 PERMANENT TURF REINFORCEMENT MATTING ONLY

Property	Test Method	Typical
Thickness	ASTM D6525	0.48 in (12.19 mm)
UV Stability	ASTM D4355*	100%
MD Tensile Strength	ASTM D6818 [D5035]	655 lbs/ft (9.56 kN/m) [500 lbs/ft (7.30 kN/m)]
MD Elongation	ASTM D6818 [D5035]	25% [27%]
TD Tensile Strength	ASTM D6818 [D5035]	666 lbs/ft (9.72 kN/m) [700 lbs/ft (10.21 kN/m)]
TD Elongation	ASTM D6818 [D5035]	16% [15%]

*ASTM D1682 (4 inch strip) Tensile Strength and percent Strength Retention of material following 1000 hrs exposure in Xenon-Arc Weatherometer.
MD – Machine direction; TD – Transverse direction

Bench Scale Testing†

Test Method - Description	Parameters	Results
ECTC Method 2 – Determination of unvegetated RECP's ability to protect soil from rain splash and associated runoff	50 mm (2 in)/hr for 30 min	Soil loss ratio* = 18.25
	100 mm (4 in)/hr for 30 min	Soil loss ratio* = 20.97
	150 mm (6 in)/hr for 30 min	Soil loss ratio* = 22.74
ECTC Method 3 – Determination of unvegetated RECP's ability to protect soil from hydraulically-induced shear stress. **Failure criteria = 0.50 inch soil loss**	Shear: 3.02 lbs/ft² for 30 min	Soil loss: 53g
	Shear: 5.57 lbs/ft² for 30 min	Soil loss: 146g
	Shear: 5.91 lbs/ft² for 30 min	Soil loss: 215g
	Shear at 0.50 inch soil loss (450g)	**7.7 lbs/ft²**
ECTC Draft Method 4 – Determination of temporary RECP performance in encouraging seed germination and plant growth	Top soil; Fescue (Kentucky 31); 21 day incubation 27° C ± 2° & approximately 50% RH	Percent improvement = 523% (increased biomass)
* Soil Loss Ratio = Soil Loss with Bare Soil / Soil Loss with RECP (NOTE: Soil loss based on regression analysis)		

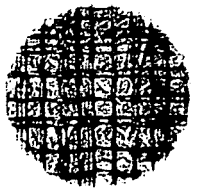
†Bench Scale Performance Testing

Bench scale tests are index property tests. These tests are not indicative of field performance and therefore should not be used in design to establish performance levels for rolled erosion control products. Bench scale tests are performed according to methods developed by the Erosion Control Technology Council (ECTC).

NORTH AMERICAN GREEN®

PERFORMANCE SPECIFICATION

SC250



The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 70% straw/30% coconut fiber matrix incorporated into a permanent three-dimensional turf reinforcement matting.

The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between heavy duty UV stabilized top and bottom nets with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings and an ultra heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent three-dimensional turf reinforcement matting.

Slope Design – Cover Factors

	Slope Gradient (S)		
Slope Length (L)	≤ 3:1	3:1-2:1	≥ 2:1
≤ 20 ft (6 m)	**0.0010**	**0.0209**	**0.0507**
20 – 50 ft	**0.023**	**0.023**	**0.023**
≥ 50 ft (15.2 m)	**0.0455**	**0.0455**	**0.0455**

Channel Design Data

Roughness Coefficients	
Flow Depth	Manning's 'n'
≤ 0.50 ft (0.15 m)	**0.040**
0.50 – 2.00 ft	**0.040-0.012**
≥ 2.00 ft (0.60 m)	**0.011**

Values are approximate, precise values obtained from ECMDS™

Maximum Permissible Shear Stress*		
	Short Duration	Long Duration
Phase 1 UNVEGETATED	**3.0 lbs/ft² (144 Pa)**	**2.5 lbs/ft² (120 Pa)**
Phase 2 PARTIALLY VEGETATED	**8.0 lbs/ft² (384 Pa)**	**8.0 lbs/ft² (384 Pa)**
Phase 3 FULLY VEGETATED	**10.0 lbs/ft² (480 Pa)**	**8.0 lbs/ft² (384 Pa)**

Approximate Permissible Flow Velocity

Unvegetated = 9.5 ft/s (2.9 m/s)
Vegetated = 15 ft/s (4.6 m/s)

*Performance values obtained through third party testing at the Texas Transportation Institute, Colorado State University, and/or Utah State University based on soil loss failure criteria not exceeding 0.50 inches (1.27 cm).

Updated 1/2004

14649 Highway 41 North • Evansville, Indiana 47725 • 812-867-6632
800-772-2040 • FAX 812-8670247 • www.nagreen.com

NORTH AMERICAN GREEN®

MATERIAL SPECIFICATION

SC150

The extended-term erosion control blanket shall be a machine-produced blanket of 70% agricultural straw and 30% coconut fiber matrix with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographic location, and elevation).

The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the blanket. The blanket shall be covered on the top side with heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 inch (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 inch (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread.

The SC150 shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the U.S. Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications For Construction of Roads and Bridges on Federal Highway Projects, FP-03 2003 Section 713.17* as a *Type 3.B Extended-term Erosion Control Blanket.*

The SC150 is also available upon request with the DOT System™. The DOT System™ consists of installation staple patterns clearly marked on the erosion control blanket with environmentally safe paint. The blanket shall be manufactured with a colored line or thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) to ensure proper material overlapping.

The extended-term straw/coconut fiber erosion control blanket shall be SC150 as manufactured by North American Green, or equivalent. The SC150 erosion control blanket shall have the following properties:

Material Content

Matrix	70% Straw Fiber (0.35 lb/yd^2) (0.19 kg/m^2) 30% Coconut Fiber (0.15 lb/yd^2) (0.08 kg/m^2)
Netting	Top side heavyweight photodegradable with UV additives (3.0 lbs/1,000 ft^2 [1.47 kg/100 m^2] approximate weight) Bottom side lightweight photodegradable Minimum netting weight (1.50 lbs/1,000 ft^2 [0.73 kg/100 m^2] approx. weight)
Thread	Degradable

SC150 is Available with the Following Physical Specifications Per Roll [English Units (Metric Units)]

Width	6.67 ft (2.03 m)	16.0 ft (4.87 m)
Length	108.00 ft (32.92 m)	108.0 ft (32.92 m)
Weight ± 10%	44.00 lbs (19.95 kg)	105.6 lbs (47.90 kg)
Area	80.00 yds^2 (66.89 m^2)	192.0 yd^2 (165.53 m^2)

Roll Widths Also Available Upon Special Request

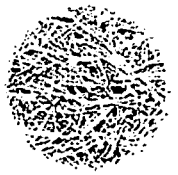
Width	8.0 ft (2.43 m)	13.3 ft (4.05 m)
Length	108.0 ft (32.92 m)	108.0 ft (32.92 m)
Weight ± 10%	52.8 lbs (23.95 kg)	88.0 lbs (39.92 kg)
Area	96.0 yd^2 (80.26 m^2)	160.0 yd^2 (133.78 m^2)

Stitch Spacing for All Rolls = 1.50 inches (3.81 cm)

Updated 1/2004

NORTH AMERICAN GREEN®

SUPPLEMENTAL SPECIFICATION



SC150

The North American Green SC150 extended-term degradable erosion control blanket is constructed with a 70% agricultural straw and 30% coconut fiber matrix and has a functional longevity of up to 24 months (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographic location, and elevation). The straw and coconut fibers shall be evenly distributed over the entire area of the blanket. The blanket shall be covered on the top with a heavyweight polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.625 x 0.625 inch (1.59 x 1.59 cm) mesh size. The blanket shall be covered on the bottom with a lightweight polypropylene net having a 0.50 inch x 0.50 inch (1.27 cm x 1.27 cm) mesh size. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread. The following list contains further physical properties of the SC150 erosion control blanket.

Property	Test Method	Typical
Thickness	ASTM D5199/ECTC	0.34 in (8.64 mm)
Resiliency	ECTC Guidelines	75%
Mass per Unit Area	ASTM D6475	11.44 oz/yd^2 (388 g/m^2)
Water Absorption	ASTM D1117/ECTC	200%
Swell	ECTC Guidelines	30%
Stiffness/Flexibility	ASTM D1388/ECTC	1.11 oz-in (12,397 mg-cm)
Light Penetration	ECTC Guidelines	11.70%
Smolder Resistance	ECTC Guidelines	Yes**
MD Tensile Strength	ASTM D5035	205.20 lbs/ft (2.99 kN/m)
MD Elongation	ASTM D5035	28.00%
TD Tensile Strength	ASTM D5035	152.40 lbs/ft (2.22 kN/m)
TD Elongation	ASTM D5035	23.10%

**Material is smolder resistant according to the specified test
MD – Machine direction
TD – Transverse direction

Bench Scale Testing†

Test Method - Description	Parameters	Results
ECTC Method 3 – Determination of unvegetated RECP's ability to protect soil from hydraulically-induced shear stress. **Failure criteria = 0.50 inch soil loss**	Shear: 1.65 lbs/ft² for 30 min	Soil loss: 47.0 g
	Shear: 2.91 lbs/ft² for 30 min	Soil loss: 193.0 g
	Shear: 4.32 lbs/ft² for 30 min	Soil loss: 561.0 g
	Shear at 0.50 inch soil loss (450g)	**3.9 lbs/ft²**

†Bench Scale Performance Testing

Bench scale tests are index property tests. These tests are not indicative of field performance and therefore should not be used in design to establish performance levels for rolled erosion control products. Bench scale tests are performed according to methods developed by the Erosion Control Technology Council (ECTC).

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 02/02/05		New Submittal
		X	Resubmittal

Section I — REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 010.a
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No. 010

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No. a.	Description of Item Submitted (Type, size, model number, etc.) b.	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8) c.	No. of Copies d.	Contract Reference Document: Spec. Paragraph No. e.	Contract Reference Document: Drawing Sheet No. f.	Deviation (See Instruction #6) g.	Contractor Action Code (See Instruction #9) h.
1	Material Specification C 350	Material Specification 1/2004	6	02227	N/A		
2	Product Data	NAG C 350	6	02227	N/A		
3	Product Sample	NAG C 350	6	02227	N/A		
					N/A		
					N/A		
					N/A		

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

Remarks:
1) APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert K. Davis DATE: 02/20/05

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: For Paul Kreitz

Section II — Reviewed

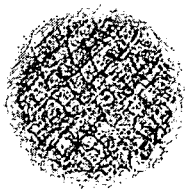
Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQAE (Need MQC data for E350 TRM)
Ft. Polk TX

NORTH AMERICAN GREEN®

MATERIAL SPECIFICATION

C350



The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% coconut fiber matrix incorporated into a permanent three-dimensional turf reinforcement matting.

The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a super heavy duty UV stabilized bottom net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra-heavy duty UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, and covered by a super heavy duty UV stabilized top net with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81 cm) centers with UV stabilized polypropylene thread to form a permanent three-dimensional turf reinforcement matting.

The C350 shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the U.S. Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications For Construction of Roads and Bridges on Federal Highway Projects, FP-03 2003 Section 713.18* as a *Type 5A, B, and C Permanent Turf Reinforcement Mat.*

Installation staple patterns shall be clearly marked on the turf reinforcement matting with environmentally safe paint. All mats shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

The composite turf reinforcement mat shall be the North American Green C350, or equivalent. The C350 permanent composite turf reinforcement mat shall have the following physical properties:

Material Content

Matrix	100% Coconut Fiber (0.50 lb/yd²) (0.27 kg/m²)
Nettings	Top – Super Heavy Duty UV Stabilized Polypropylene 8.00 lbs/1,000 ft² (3.91 kg/100 m²)
	Mid – Corrugated Ultra-Heavy Duty UV Stabilized Polypropylene 24 lb/1,000 ft² (11.7 kg/100 m²)
	Bottom – Super Heavy Duty UV Stabilized Polypropylene 8.00 lbs/1,000 ft² (3.91 kg/100 m²)
Thread	UV Stabilized Polypropylene

C350 is Available with the Following Physical Specifications Per Roll [English Units (Metric Units)]

Width	6.50 ft (2.00 m)
Length	55.50 ft (16.90 m)
Weight ± 10%	37.00 lbs (16.80 kg)
Area	40.00 yd² (33.40 m²)

Stitch Spacing for All Rolls = 1.50 inches (3.81 cm)

Updated 1/2004

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 7-29-04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 020
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Geotechnical testing results – cushion material	N/A	6	02200 – 1.4.A.3	N/A	N/A	

Paul –
Provide Map Showing Location of Samples and Extent of Borrow Area.
Bob Davis

Rocky Flats Plant
☒ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

Robert Davis Date 09/07/2004

Remarks:

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Paul Kreitz 7/30/04

Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA John H. Kahle Tetra Tech 10/19/04

TABLE 1
ROCKY FLATS/FIELD and LAB TESTING/CO
SUMMARY OF SOIL DATA

Sample Type	Sample Number	Sample Depth (ft)	U.S.C.S. Soil Classi-fication	Delivered Moisture (%)	Atterberg Limits			Grain Size Distribution			Specific Gravity	Moist/Den Relationship Standard Proctor		Additional Tests Comments (See Notes)
					LL	PL	PI	% Finer 3/4"	% Finer #4	% Finer #200		PCF (Dry)	Moist (%)	
Bulk	PF-1	1-2	SC	16.1	39	19	20	100	84	30	--	120.6*	10.7*	
Bulk	PF-2	1-2	SC	10.3	43	19	24	100	85	29	--	119.9*	11.7*	
Bulk	PF-3	1-2	SC	18.1	43	18	25	100	81	30	--	121.0*	10.9*	
Bulk	PF-4	1-2	SC	17.4	35	16	19	100	89	30	--	122.9*	10.6*	
Bulk	PF-5	1-2	SC	12.8	37	19	18	100	86	29	--	121.9*	10.8*	
Bulk	PF5-Dup	1-2	SC	11.4	40	19	21	100	87	28	--	122.3*	11.1*	
Bulk	PF-6	1-2	SC	11.5	45	20	25	100	82	30	--	120.3*	12.5*	
Bulk	PF-7	1-2	SC	13.5	35	18	17	100	87	24	--	125.1*	10.3*	
Bulk	PF-8	1-2	SC	14.9	41	19	22	100	82	28	--	117.9*	11.9*	
Bulk	PF-9	1-2	SC	13.8	38	18	20	100	87	25	--	125.1*	10.4*	
Bulk	PF-10	1-2	SC	14.8	43	18	25	100	83	28	--	122.1*	11.0*	
Spec	Foundation	NA	NA	NA	NA	NA	NA	100	81.3	20.5		NA	NA	
Spec	Cushion	NA	NA	NA	NA	NA	NA	100	81.3	20.5		NA	NA	

NOTES:
LL = LIQUID LIMIT
PL = PLASTIC LIMIT
PI = PLASTIC INDEX
SL = SHRINKAGE LIMIT

T = TRIAXIAL TEST
U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
DS = DIRECT SHEAR TEST
PERM = PERMEABILITY

* ASTM D4718

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-1
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	774.19
Wt. Dry Soil & Tare (gm)	680.87
Wt. of Tare (gm)	102.91
Wt. of Water (gm)	93.32
Weight of Dry Soil (gm)	577.96
Moisture Content (%)	16.15

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	27.78	25.86
Weight of Dry Soil & Ta	25.85	24.25
Weight of Tare (gm)	15.59	15.60
Weight of Water (gm)	1.93	1.61
Weight of Dry Soil (gm)	10.26	8.65
Water Content %	18.81	18.61

LIQUID LIMIT DETERMINATION

29	20	15
29.09	24.67	33.01
25.48	21.64	29.52
15.98	14.32	21.81
3.61	3.03	3.49
9.50	7.32	7.71
38.00	41.39	45.27

PLASTIC LIMIT (PL) 19

LIQUID LIMIT (LL) 39

PLASTICITY INDEX (PI) 20

BLOWS	MC		
29	38.00	3.37	25
20	41.39	3.00	0.00
15	45.27	2.71	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
38.00	45.27	39.42	39.42	39
-2	46.00	39.42		19
				20

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	774.19
Wt. Dry Soil & Tare (gm)	680.87
Wt. of Tare (gm)	102.91
Wt. of Water (gm)	93.32
Weight of Dry Soil (gm)	577.96
Moisture Content (%)	16.1

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-1 Depth (ft) -
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	177.89
Dry Soil & Tare (gm)	170.13
Tare Weight (gm)	28.91
Moisture Content (%)	5.5

LL	39
PL	19
PI	20

TEST BY	JR
DATE SET UP	7/15/2004
REVIEW BY	NG

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	21690.40 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	20560.60

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00	
coarse gravel	0.00	
fine gravel	16.46	16.46
coarse sand	5.37	
medium sand	23.88	
fine sand	23.85	53.10
fines	30.44	
		100.00

		(Wt. + Tare)	RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight: 0.00	6.0"	0.00	0.0	100.0
	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	477.10	2.3	97.7
	#4	3383.60	16.5	83.5

				% PASSING
BACK SIEVE	#10	3.14	3.1	6.43	78.2
Tare Weight: 0.00	#20	9.65	9.7	19.75	67.0
	#40	17.11	17.1	35.01	54.3
	#60	22.46	22.5	45.96	45.1
	#100	26.80	26.8	54.85	37.7
	#200	31.06	31.1	63.56	30.4

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.55

DATE	TIME	READING	TEMP	HYD. COR.
7/16/2004	10:12	R	T	Cc
7/16/2004	10:14	21.0	22.90	6.00
7/16/2004	10:17	19.5	22.90	6.00
7/16/2004	10:27	19.0	22.80	6.00
7/16/2004	10:42	18.8	22.40	6.00
7/16/2004	11:12	18.0	22.10	6.00
7/16/2004	14:22	17.3	20.80	6.00
7/17/2004	10:12	16.5	21.50	6.00

(mm)	%Finer
0.034	25.39
0.022	22.85
0.013	22.00
0.009	21.58
0.006	20.31
0.003	19.04
0.001	17.77

!!!!!

2.7 WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

6

Calculated Dry Wt. used in test (gm)	48.86
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	83.5433

HYDROMETER CALCULATIONS

T ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH	A
2.00	0.013126	15.00	13.8	0.99
5.00	0.013126	13.50	14.2	0.99
15.00	0.013126	13.00	14.2	0.99
30.00	0.013126	12.75	14.3	0.99
60.00	0.013126	12.00	14.3	0.99
250.00	0.013446	11.25	14.5	0.99
1440.00	0.013283	10.50	14.7	0.99

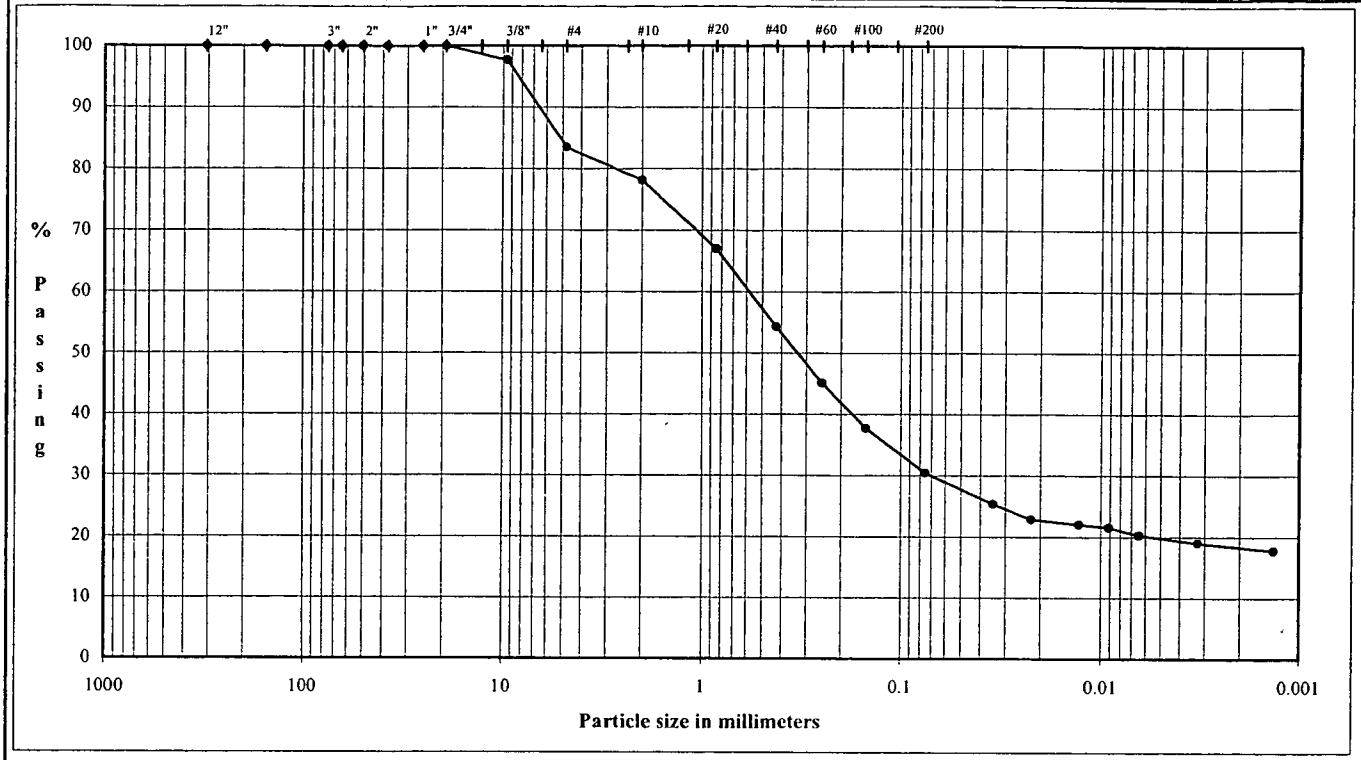
	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	97.7
#4	4.750	83.5
#10	2.000	78.2
#20	0.850	67.0
#40	0.425	54.3
#60	0.250	45.1
#100	0.150	37.7
#200	0.075	30.4
	0.0345	25.4
	0.0221	22.8
	0.0128	22.0
	0.0091	21.6
	0.0064	20.3
	0.0032	19.0
	0.0013	17.8

Check By NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **PF-1** Depth (ft): -
TYPE: **BULK**



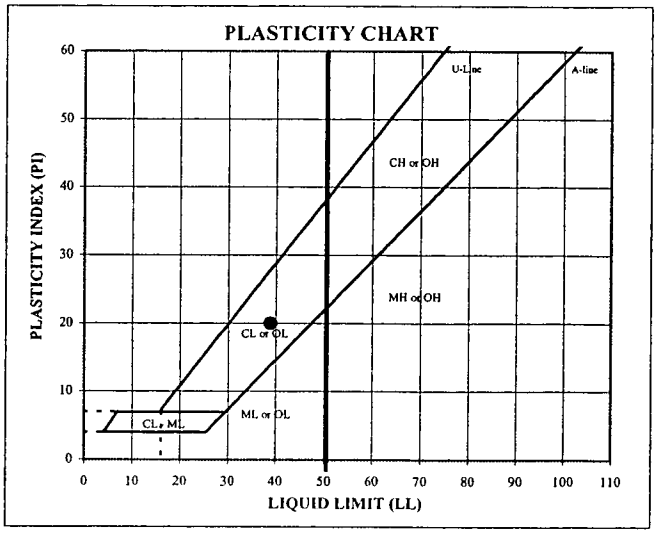
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	97.7		
#4	4.8	83.5	Fine Gravel	16.46
#10	2.00	78.2	Coarse Sand	5.37
#20	0.85	67.0		
#40	0.43	54.3	Medium Sand	23.88
#60	0.25	45.1		
#100	0.15	37.7		
#200	0.075	30.4	Fine Sand	23.85

Hydrometer Analysis

(mm)	%Finer		
0.034	25.4		
0.022	22.8		
0.013	22.0	Fines	
0.0091	21.6	Silt or Clay	30.44
0.0064	20.3		
0.0032	19.0		
0.0013	17.8		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
16.1	39	19	20	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

TECH: JR
DATE: 7/15/2004
REVIEW: NG

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO		
PROJECT NUMBER	043-2246.0001		
SAMPLE IDENTITY	PF-1	-	-
SAMPLE TYPE	BULK		

TEST TYPE: D 698 / D 4718
PROCEDURE: METHOD A

MOLD NUMBER	217
MOLD WEIGHT (gm)	2271.5
MOLD DIAMETER (in)	4.000
MOLD HEIGHT (in)	4.575
MOLD VOLUME (cu.ft)	0.0333

TYPE COMPACTOR: Mechanical
PREPARATION: Wet Method
TYPE PROCTOR: Standard
5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4
METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"
METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	177.89
Dry Wt Tare & Soil	(W2)	492.88	170.13
Wt Tare	(W3)	0.00	28.91
Wt Moisture	(W4=W1-W2)	11.19	7.76
Wt Dry Soil	(W5=W2-W3)	492.88	141.22
Water Content (dec)	(wc=W4/W5)	0.0227	0.0549
Water Content (%)	(W4/W5)*100	2.3%	5.5%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	21690.40
TOTAL WEIGHT, DRY (COARSE & FINE)	20560.60
WEIGHT RETAINED ON #4 SIEVE (WET)	3383.60
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON #4 SIEVE (DRY)	16.09%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4010.3	4194.0	4233.1	4231.4	4189.6		
Weight of Mold	(W2)	2271.50	2271.50	2271.50	2271.50	2271.50		
Wt. Of Wet Soil	(W3=W1-W2)	1738.80	1922.50	1961.60	1959.90	1918.10		
Wet Density, wd (pcf)	(W3/453.6*Vm)	115.22	127.39	129.98	129.87	127.10		
WATER CONTENTS								
Wt Tare & Soil	(W4)	680.59	613.87	697.53	623.27	604.74		
Wt Tare & Soil	(W5)	628.53	561.24	626.08	555.47	533.03		
Wt Tare	(W6)	104.24	101.34	100.46	103.18	100.83		
Wt Moisture	(W7=W4-W5)	52.06	52.63	71.45	67.80	71.71		
Wt Dry Soil	(W8=W5-W6)	524.29	459.90	525.62	452.29	432.20		
Water Content (%)	(W7/W8)*100	9.9%	11.4%	13.6%	15.0%	16.6%		
Dry Density (pcf)	(wd/(1+wc))	104.8	114.3	114.4	112.9	109.0		

MAXIMUM DRY DENSITY (pcf)	115.8
OPTIMUM MOISTURE CONTENT (%)	12.7
Corrected Maximum Dry Density (pcf)	120.6
Corrected Optimum Moisture (%)	10.7

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

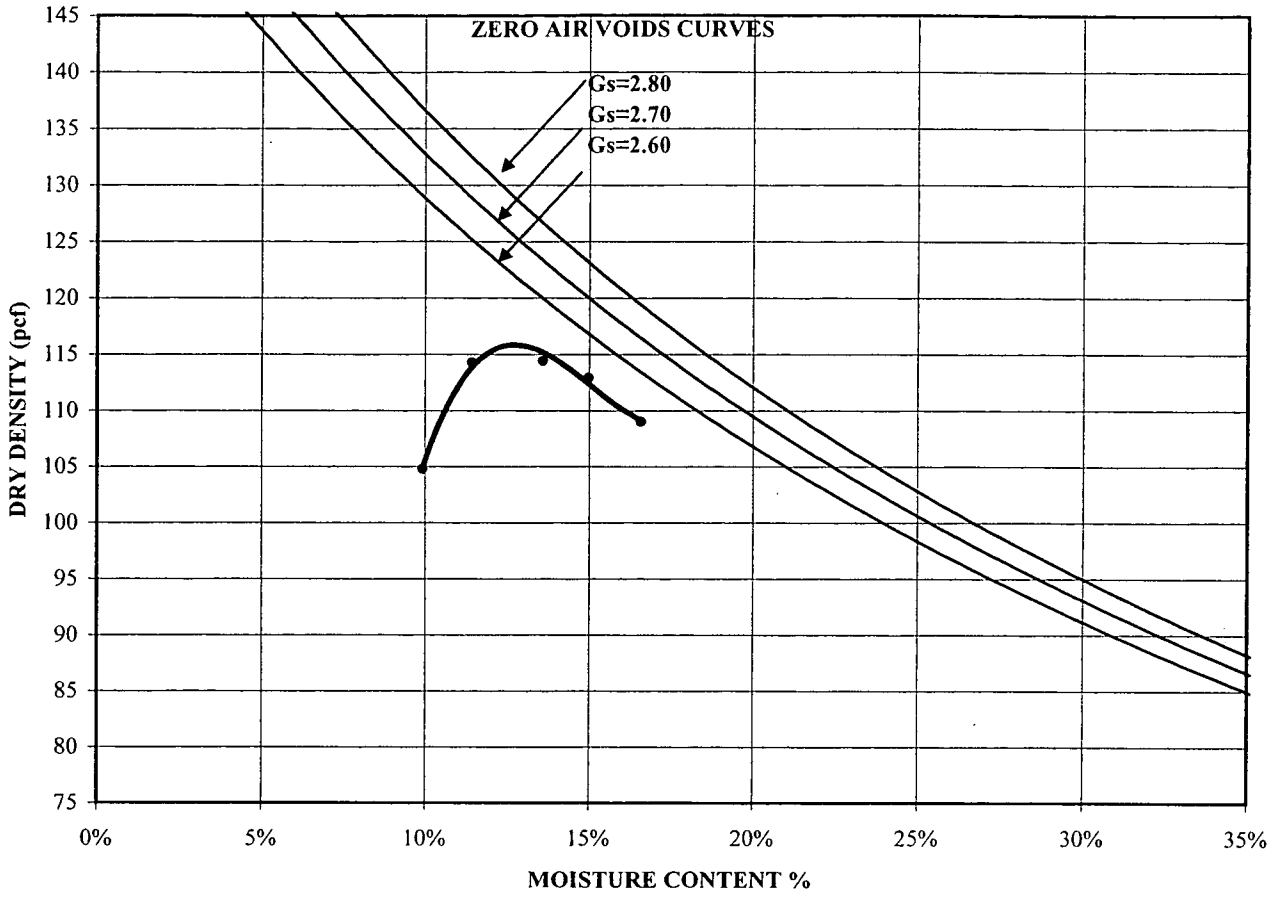
Weight of Oven Dry Sample (gm)		A	504.07		
Weight of Saturated-Surface-Dry (gm)		B	506.40		
Weight of Saturated Sample in Water	(gm)	C	301.90		
Absorption of Oversize Particles (%)	[(B-A)/A]*100		0.46		
Bulk Specific Gravity	A/(B-C)		2.465		

LL	39
PL	19
PI	20
MC	16.1%

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	DT
DATE	7/16/04
REVIEW	NG

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	115.8	Corrected Maximum Dry Density (pcf)	120.6
OPTIMUM MOISTURE (%)	12.7	Corrected Optimum Moisture (%)	10.7

SAMPLE ID	PF-1
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	39
PL	19
PI	20
MC	16.1%

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	DT
DATE	7/16/04
REVIEW	NG

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-2
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	544.40
Wt. Dry Soil & Tare (gm)	503.10
Wt. of Tare (gm)	103.50
Wt. of Water (gm)	41.30
Weight of Dry Soil (gm)	399.60
Moisture Content (%)	10.34

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	22.76	21.69
Weight of Dry Soil & T	21.66	20.75
Weight of Tare (gm)	15.96	15.88
Weight of Water (gm)	1.10	0.94
Weight of Dry Soil (gm)	5.70	4.87
Water Content %	19.30	19.30

LIQUID LIMIT DETERMINATION

32	25	17
23.72	24.10	23.15
20.87	21.11	20.21
13.99	14.13	13.83
2.85	2.99	2.94
6.88	6.98	6.38
41.42	42.84	46.08

PLASTIC LIMIT (PL) 19

LIQUID LIMIT (LL) 43

PLASTICITY INDEX (PI) 24

BLOWS	MC		
32	41.42	3.47	25
25	42.84	3.22	0.00
17	46.08	2.83	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
41.42	46.08	43.10	43.10	43
-2	48.00	43.10		19
				24

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00	
0.00	0.00	
#DIV/0!	#DIV/0!	

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	544.40
Wt. Dry Soil & Tare (gm)	503.10
Wt. of Tare (gm)	103.50
Wt. of Water (gm)	41.30
Weight of Dry Soil (gm)	399.60
Moisture Content (%)	10.3

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-2 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	65.31
Dry Soil & Tare (gm)	64.35
Tare Weight (gm)	13.82
Moisture Content (%)	1.9

LL	43	TEST BY	DT
PL	19	DATE SET UP	7/21/2004
PI	24	REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	20693.40 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	20307.58

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00		
coarse gravel	0.00		
fine gravel	14.78	14.78	
coarse sand	11.45		
medium sand	23.86		
fine sand	21.03	56.35	
fines	28.88		
			100.00

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	421.30	2.1	97.9
	#4	3000.90	14.8	85.2
				% PASSING
BACK SIEVE	#10	6.68	6.7	13.44 73.8
Tare Weight	#20	13.91	13.9	27.98 61.4
0.00	#40	20.60	20.6	41.44 49.9
	#60	25.31	25.3	50.91 41.8
	#100	29.07	29.1	58.47 35.4
	#200	32.87	32.9	66.12 28.9

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.66

DATE	TIME	READING	TEMP	HYD. COR.
7/22/2004	10:11	R	T	Cc
7/22/2004	10:13	20.3	22.70	6.50
7/22/2004	10:16	20.0	22.70	6.50
7/22/2004	10:26	19.0	22.60	6.50
7/22/2004	10:41	18.5	22.50	6.50
7/22/2004	11:11	18.3	22.00	6.50
7/22/2004	14:21	17.3	20.80	6.50
7/23/2004	10:11	16.5	20.10	6.50

(mm)	%Finer
0.035	23.33
0.022	22.91
0.013	21.21
0.009	20.36
0.006	19.94
0.003	18.24
0.001	16.97

1111
2.7
6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt used in test (gm)	49.72
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	85.2228

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH	A
2.00	0.013126	13.75	14.2	0.99
5.00	0.013126	13.50	14.2	0.99
15.00	0.013126	12.50	14.3	0.99
30.00	0.013126	12.00	14.3	0.99
60.00	0.013126	11.75	14.5	0.99
250.00	0.013446	10.75	14.7	0.99
1440.00	0.013446	10.00	14.7	0.99

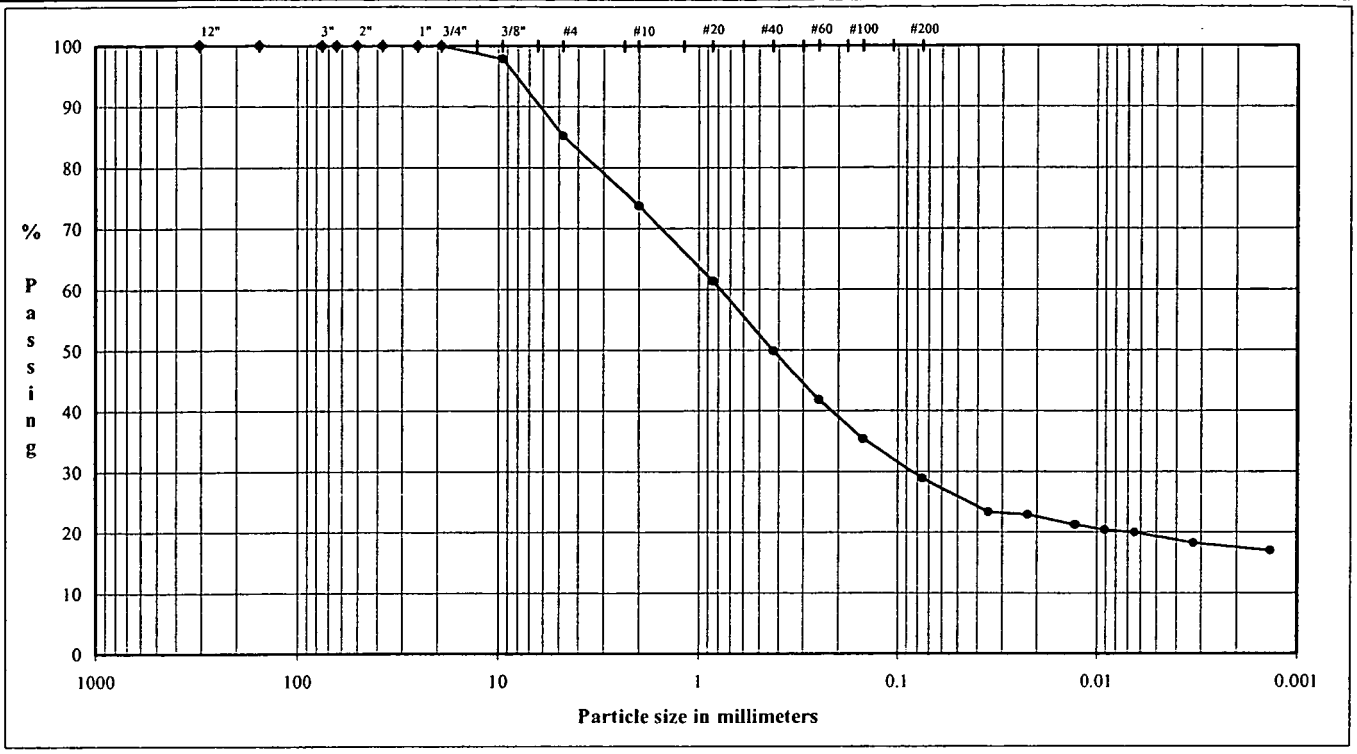
	X AXIS	Y AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	97.9
#4	4.750	85.2
#10	2.000	73.8
#20	0.850	61.4
#40	0.425	49.9
#60	0.250	41.8
#100	0.150	35.4
#200	0.075	28.9
	0.0350	23.3
	0.0221	22.9
	0.0128	21.2
	0.0091	20.4
	0.0065	19.9
	0.0033	18.2
	0.0014	17.0

Check By: NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **PF-2** Depth (ft): -
TYPE: **BULK**



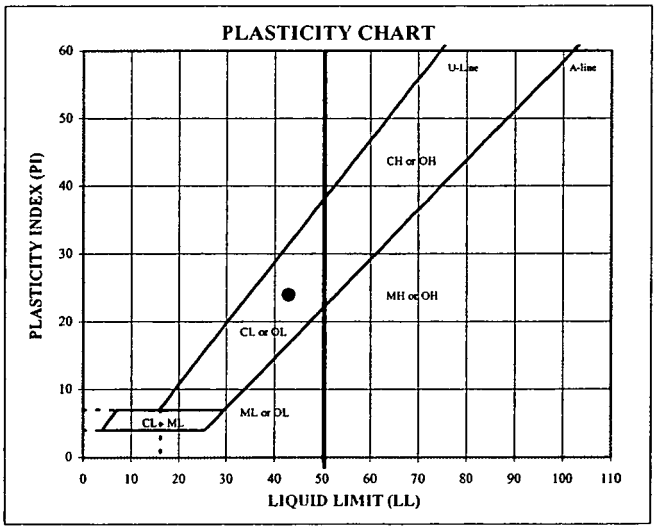
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	97.9		
#4	4.8	85.2	Fine Gravel	14.78
#10	2.00	73.8	Coarse Sand	11.45
#20	0.85	61.4		
#40	0.43	49.9	Medium Sand	23.86
#60	0.25	41.8		
#100	0.15	35.4		
#200	0.075	28.9	Fine Sand	21.03

Hydrometer Analysis

(mm)	%Finer		
0.035	23.3		
0.022	22.9		
0.013	21.2	Fines	
0.0091	20.4	Silt or Clay	28.88
0.0065	19.9		
0.0033	18.2		
0.0014	17.0		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
10.3	43	19	24	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

TECH DT
DATE 7/21/2004
REVIEW MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD A
SAMPLE IDENTITY	PF-2	-	-		
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
	Mechanical	Wet Method	
MOLD NUMBER	AH-1		
MOLD WEIGHT (gm)	2265.0	TYPE PROCTOR	
MOLD DIAMETER (in)	3.991	Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332	5.5 -lbf. RAMMER WITH 12 INCH DROP	

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	65.31
Dry Wt Tare & Soil	(W2)	492.88	64.35
Wt Tare	(W3)	0.00	13.82
Wt Moisture	(W4=W1-W2)	11.19	0.96
Wt Dry Soil	(W5=W2-W3)	492.88	50.53
Water Content (dec)	(wc=W4/W5)	0.0227	0.0190
Water Content (%)	(W4/W5)*100	2.3%	1.9%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	20693.40
TOTAL WEIGHT, DRY (COARSE & FINE)	20307.58
WEIGHT RETAINED ON # 4 SIEVE (WET)	3440.90
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	16.57%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4084.9	4186.2	4229.3	4239.2	4186.3		
Weight of Mold	(W2)	2265.00	2265.00	2265.00	2265.00	2265.00		
Wt. Of Wet Soil	(W3=W1-W2)	1819.90	1921.20	1964.30	1974.20	1921.30		
Wet Density, wd (pcf)	(W3/453.6*Vm)	120.98	127.71	130.58	131.23	127.72		
WATER CONTENTS								
Wt Tare & Soil	(W4)	626.95	622.13	620.65	693.33	636.60		
Wt Tare & Soil	(W5)	576.67	564.98	558.62	615.08	559.97		
Wt Tare	(W6)	104.79	104.36	105.25	101.88	102.18		
Wt Moisture	(W7=W4-W5)	50.28	57.15	62.03	78.25	76.63		
Wt Dry Soil	(W8=W5-W6)	471.88	460.62	453.37	513.20	457.79		
Water Content (%)	(W7/W8)*100	10.7%	12.4%	13.7%	15.2%	16.7%		
Dry Density (pcf)	(wd/(1+wc))	109.3	113.6	114.9	113.9	109.4		

MAXIMUM DRY DENSITY (pcf)	114.9
OPTIMUM MOISTURE CONTENT (%)	13.9
Corrected Maximum Dry Density (pcf)	119.9
Corrected Optimum Moisture (%)	11.7

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

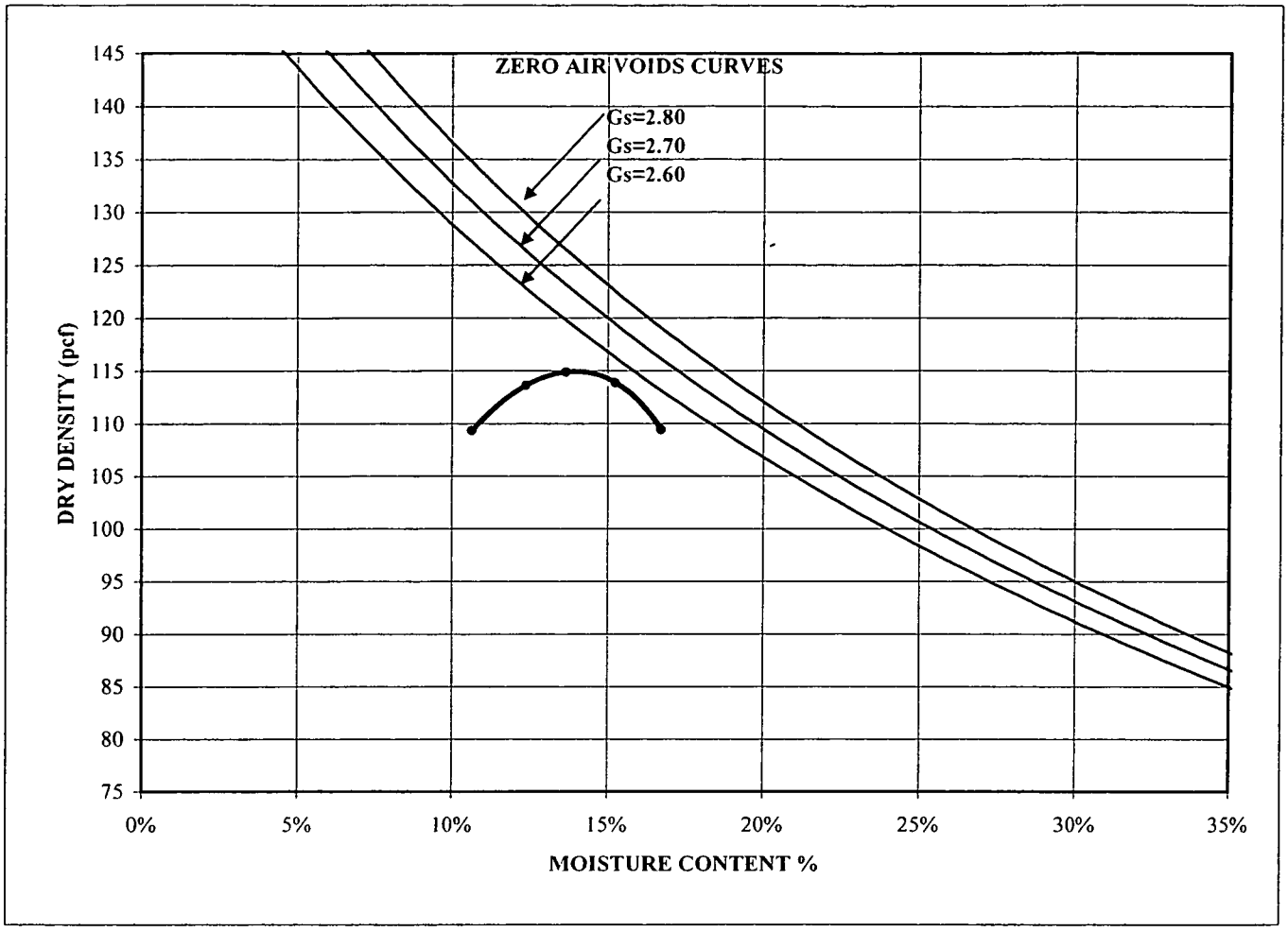
Weight of Oven Dry Sample (gm)	A	504.07			
Weight of Saturated-Surface-Dry (gm)	B	506.40			
Weight of Saturated Sample in Water (gm)	C	301.90			
Absorption of Oversize Particles (%)	[(B-A)/A]*100	0.46			
Bulk Specific Gravity	A/(B-C)	2.465			

LL	43
PL	19
PI	24
MC	10.3

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	DT
DATE	7-22-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	114.9	Corrected Maximum Dry Density (pcf)	119.9
OPTIMUM MOISTURE (%)	13.9	Corrected Optimum Moisture (%)	11.7

SAMPLE ID	PF-2
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	43
PL	19
PI	24
MC	10.3

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	DT
DATE	7-22-04
REVIEW	MB

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-3
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	724.70
Wt. Dry Soil & Tare (gm)	629.18
Wt. of Tare (gm)	101.82
Wt. of Water (gm)	95.52
Weight of Dry Soil (gm)	527.36
Moisture Content (%)	18.11

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	26.00	24.67
Weight of Dry Soil & Ta	24.13	22.99
Weight of Tare (gm)	13.98	13.76
Weight of Water (gm)	1.87	1.68
Weight of Dry Soil (gm)	10.15	9.23
Water Content %	18.42	18.20

LIQUID LIMIT DETERMINATION

30	22	15
28.03	25.68	25.15
23.99	22.09	21.70
14.22	14.03	14.32
4.04	3.59	3.45
9.77	8.06	7.38
41.35	44.54	46.75

PLASTIC LIMIT (PL): 18

LIQUID LIMIT (LL): 43

PLASTICITY INDEX (PI): 25

BLOWS	MC		
30	41.35	3.40	25
22	44.54	3.09	0.00
15	46.75	2.71	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
41.35	46.75	43.04	43.04	43
-2	48.00	43.04		18
				25

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL):

LIQUID LIMIT (LL):

PLASTICITY INDEX (PI):

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL): NP

LIQUID LIMIT (LL): NP

PLASTICITY INDEX (PI): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	724.70
Wt. Dry Soil & Tare (gm)	629.18
Wt. of Tare (gm)	101.82
Wt. of Water (gm)	95.52
Weight of Dry Soil (gm)	527.36
Moisture Content (%)	18.1

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-3 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	193.23
Dry Soil & Tare (gm)	186.84
Tare Weight (gm)	28.14
Moisture Content (%)	4.0

LL	43
PL	18
PI	25

TEST BY	JR
DATE SET UP	7/15/2004
REVIEW BY	NG

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	22098.50 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	21243.15

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00		
coarse gravel	0.00		
fine gravel	18.76	18.76	
coarse sand	6.03		
medium sand	23.07		
fine sand	22.53	51.63	
fines	29.62		
			100.00

		(Wt. + Tare)	RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight: 0.00	6.0"	0.00	0.0	100.0
	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	363.70	1.7	98.3
	#4	3984.40	18.8	81.2

				% PASSING
BACK SIEVE	#10	3.68	3.7	7.43	75.2
Tare Weight: 0.00	#20	10.53	10.5	21.25	64.0
	#40	17.75	17.8	35.82	52.1
	#60	23.01	23.0	46.43	43.5
	#100	27.28	27.3	55.05	36.5
	#200	31.49	31.5	63.55	29.6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.55

DATE	TIME	READING	TEMP	HYD. COR.
7/16/2004	10:08	R	T	Cc
7/16/2004	10:10	20.5	22.80	6.00
7/16/2004	10:13	19.3	22.90	6.00
7/16/2004	10:23	18.8	22.60	6.00
7/16/2004	10:38	18.3	22.50	6.00
7/16/2004	11:08	17.5	22.10	6.00
7/16/2004	14:18	17.3	20.80	6.00
7/17/2004	10:08	16.5	21.50	6.00

(mm)	%Finer
0.035	23.53
0.022	21.51
0.013	20.69
0.009	19.88
0.006	18.67
0.003	18.26
0.001	17.04

!!!!!

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	49.55
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	81.2438

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING R	EFFECTIVE LENGTH L	A
2.00	0.013126	14.50	14.4	0.99
5.00	0.013126	13.25	14.2	0.99
15.00	0.013126	12.75	14.3	0.99
30.00	0.013126	12.25	14.3	0.99
60.00	0.013126	11.50	14.5	0.99
250.00	0.013446	11.25	14.5	0.99
1440.00	0.013283	10.50	14.7	0.99

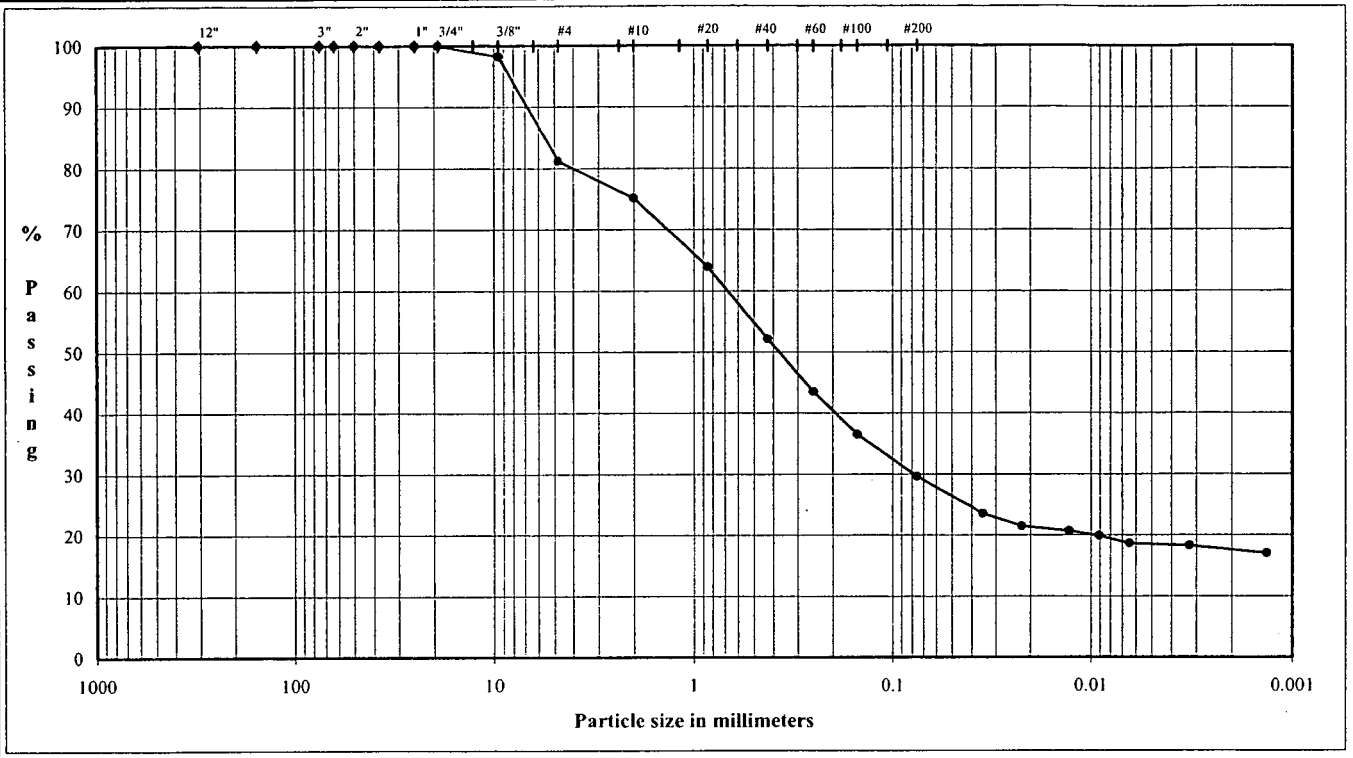
	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	98.3
#4	4.750	81.2
#10	2.000	75.2
#20	0.850	64.0
#40	0.425	52.1
#60	0.250	43.5
#100	0.150	36.5
#200	0.075	29.6
	0.0347	23.5
	0.0221	21.5
	0.0128	20.7
	0.0091	19.9
	0.0065	18.7
	0.0032	18.3
	0.0013	17.0

Check By: NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **PF-3** Depth (ft): -
TYPE: **BULK**



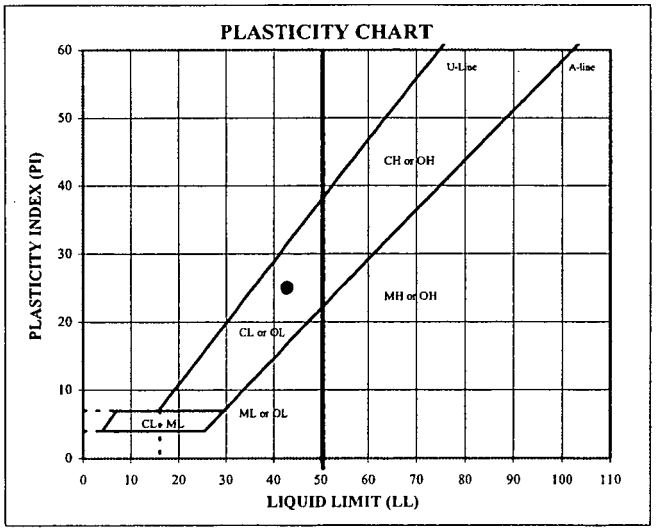
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	98.3		
#4	4.8	81.2	Fine Gravel	18.76
#10	2.00	75.2	Coarse Sand	6.03
#20	0.85	64.0		
#40	0.43	52.1	Medium Sand	23.07
#60	0.25	43.5		
#100	0.15	36.5		
#200	0.075	29.6	Fine Sand	22.53

Hydrometer Analysis

(mm)	%Finer		
0.035	23.5		
0.022	21.5		
0.013	20.7	Fines	
0.0091	19.9	Silt or Clay	29.62
0.0065	18.7		
0.0032	18.3		
0.0013	17.0		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
18.1	43	18	25	–

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

TECH: JR
DATE: 7/15/2004
REVIEW: NG

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO		
PROJECT NUMBER	043-2246.0001		
SAMPLE IDENTITY	PF-3	-	-
SAMPLE TYPE	BULK		

TEST TYPE: D 698 D 4718
PROCEDURE: METHOD A

MOLD NUMBER	217
MOLD WEIGHT (gm)	2271.5
MOLD DIAMETER (in)	4.000
MOLD HEIGHT (in)	4.575
MOLD VOLUME (cu.ft)	0.0333

TYPE COMPACTOR: Mechanical
PREPARATION: Wet Method
TYPE PROCTOR: Standard
5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4
METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"
METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	193.23
Dry Wt Tare & Soil	(W2)	492.88	186.84
Wt Tare	(W3)	0.00	28.14
Wt Moisture	(W4=W1-W2)	11.19	6.39
Wt Dry Soil	(W5=W2-W3)	492.88	158.70
Water Content (dec)	(wc=W4/W5)	0.0227	0.0403
Water Content (%)	(W4/W5)*100	2.3%	4.0%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	22098.50
TOTAL WEIGHT, DRY (COARSE & FINE)	21243.15
WEIGHT RETAINED ON #4 SIEVE (WET)	3984.40
WEIGHT RETAINED ON 3/8" SIEVE (WET)	363.70
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON #4 SIEVE (DRY)	18.34%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	1.67%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4207.5	3977.7	4068.4	4238.3	4257.2	4158.9	
Weight of Mold	(W2)	2271.50	2271.50	2271.50	2271.50	2271.50	2271.50	
Wt. Of Wet Soil	(W3=W1-W2)	1936.00	1706.20	1796.90	1966.80	1985.70	1887.40	
Wet Density, wd (pcf)	(W3/453.6*Vm)	128.28	113.06	119.07	130.33	131.58	125.06	
WATER CONTENTS								
Wt Tare & Soil	(W4)	634.51	662.50	592.22	619.45	615.25	656.04	
Wt Tare & Soil	(W5)	560.41	621.16	548.79	560.57	552.90	601.65	
Wt Tare	(W6)	104.43	101.19	103.76	103.95	103.99	102.31	
Wt Moisture	(W7=W4-W5)	74.10	41.34	43.43	58.88	62.35	54.39	
Wt Dry Soil	(W8=W5-W6)	455.98	519.97	445.03	456.62	448.91	499.34	
Water Content (%)	(W7/W8)*100	16.3%	8.0%	9.8%	12.9%	13.9%	10.9%	
Dry Density (pcf)	(wd/(1+wc))	110.4	104.7	108.5	115.4	115.5	112.8	

MAXIMUM DRY DENSITY (pcf)	115.5
OPTIMUM MOISTURE CONTENT (%)	13.2
Corrected Maximum Dry Density (pcf)	121.0
Corrected Optimum Moisture (%)	10.9

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

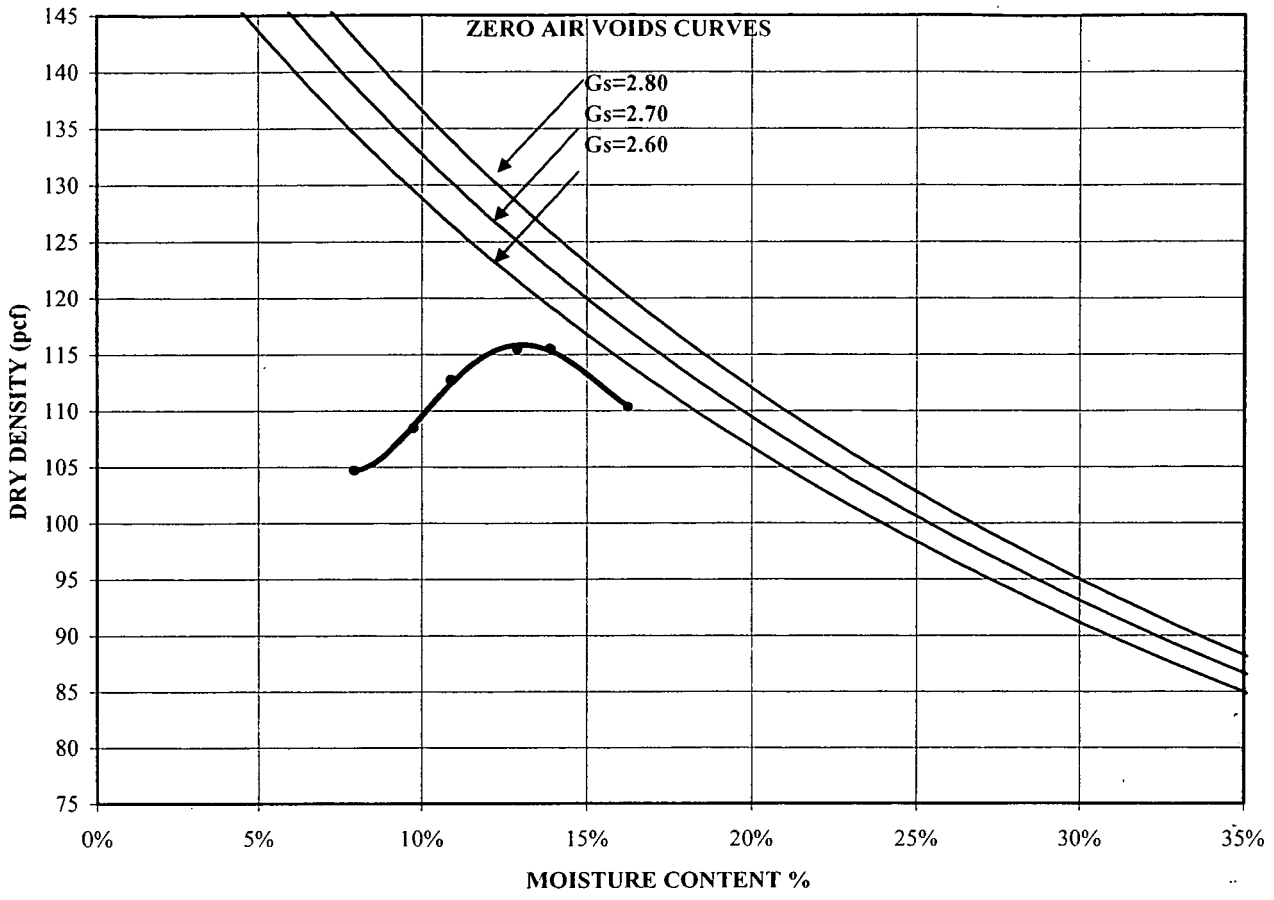
Weight of Oven Dry Sample (gm)		A	504.02		
Weight of Saturated-Surface-Dry (gm)		B	506.40		
Weight of Saturated Sample in Water	(gm)	C	301.90		
Absorption of Oversize Particles (%)		[(B-A)/A]*100	0.47		
Bulk Specific Gravity		A/(B-C)	2.465		

LL	43
PL	18
PI	25
MC	18.10%

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	DT
DATE	7/16/04
REVIEW	NG

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	115.5	Corrected Maximum Dry Density (pcf)	121.0
OPTIMUM MOISTURE (%)	13.2	Corrected Optimum Moisture (%)	10.9

SAMPLE ID	PF-3
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	43
PL	18
PI	25
MC	18.1%

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	DT
DATE	7/16/04
REVIEW	NG

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	827.30
Wt. Dry Soil & Tare (gm)	720.01
Wt. of Tare (gm)	103.55
Wt. of Water (gm)	107.29
Weight of Dry Soil (gm)	616.46
Moisture Content (%)	17.40

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-4
TYPE	BULK

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	19.80	22.30
Weight of Dry Soil & T	18.93	21.39
Weight of Tare (gm)	13.52	15.63
Weight of Water (gm)	0.87	0.91
Weight of Dry Soil (gm)	5.41	5.76
Water Content %	16.08	15.80

LIQUID LIMIT DETERMINATION

30	24	15
33.01	30.48	28.02
28.17	26.63	24.00
13.82	15.87	13.89
4.84	3.85	4.02
14.35	10.76	10.11
33.73	35.78	39.76

PLASTIC LIMIT (PL) 16

LIQUID LIMIT (LL) 35

PLASTICITY INDEX (PI) 19

BLOWS	MC		
30	33.73	3.40	25
24	35.78	3.18	0.00
15	39.76	2.71	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
33.73	39.76	35.36	35.36	35
-2	40.00	35.36		16
				19

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	827.30
Wt. Dry Soil & Tare (gm)	720.01
Wt. of Tare (gm)	103.55
Wt. of Water (gm)	107.29
Weight of Dry Soil (gm)	616.46
Moisture Content (%)	17.4

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-4 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10YR 5/8) clayey sand

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	114.09
Dry Soil & Tare (gm)	113.02
Tare Weight (gm)	21.80
Moisture Content (%)	1.2

LL	35
PL	16
PI	19

TEST BY	JR
DATE SET UP	7/19/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	23483.70 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	23211.43

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00		
coarse gravel	0.34		
fine gravel	10.21	10.55	
coarse sand	10.87		
medium sand	24.43		
fine sand	23.89	59.20	
fines	30.25		
	100.00		

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight: 0.00	6.0"	0.00	0.0	100.0
	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	34.50	0.1	99.9
	0.75"	78.00	0.3	99.7
	0.375"	890.00	3.83	96.2
	#4	2449.00	10.55	89.4

					% PASSING
BACK SIEVE	#10	6.12	6.1	12.16	78.6
Tare Weight: 0.00	#20	12.87	12.9	25.56	66.6
	#40	19.87	19.9	39.46	54.1
	#60	25.02	25.0	49.69	45.0
	#100	29.10	29.1	57.80	37.8
	#200	33.32	33.3	66.18	30.3

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.94

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
7/22/2004	9:26	20.5	22.70	6.50
7/22/2004	9:28	20.5	22.70	6.50
7/22/2004	9:31	18.8	22.70	6.50
7/22/2004	9:41	18.3	22.70	6.50
7/22/2004	9:56	17.5	22.80	6.50
7/22/2004	10:26	17.0	23.10	6.50
7/22/2004	13:36	16.8	21.60	6.50
7/23/2004	9:26	15.8	20.50	6.50

(mm)	%Finer
0.035	24.62
0.022	21.55
0.013	20.67
0.009	19.35
0.006	18.47
0.003	18.03
0.001	16.27

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	50.35
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	89.4492

HYDROMETER CALCULATIONS

ET (min)	TEMP. COR. K	READING C	EFFECTIVE LENGTH L	A
2.00	0.013126	14.00	14	0.99
5.00	0.013126	12.25	14.3	0.99
15.00	0.013126	11.75	14.5	0.99
30.00	0.013126	11.00	14.5	0.99
60.00	0.012973	10.50	14.7	0.99
250.00	0.013283	10.25	14.7	0.99
1440.00	0.013446	9.25	14.8	0.99

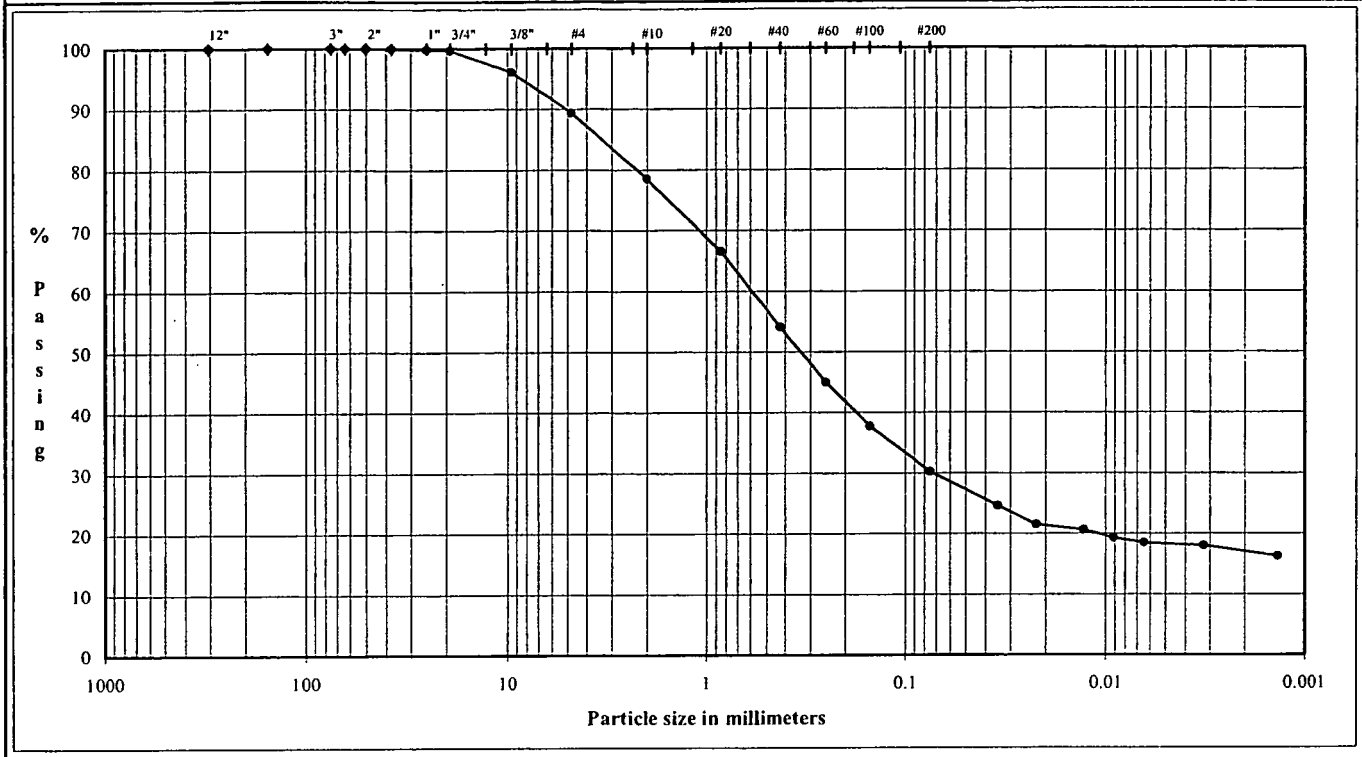
	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	99.9
0.75"	19.000	99.7
0.375"	9.500	96.2
#4	4.750	89.4
#10	2.000	78.6
#20	0.850	66.6
#40	0.425	54.1
#60	0.250	45.0
#100	0.150	37.8
#200	0.075	30.3
	0.0347	24.6
	0.0222	21.5
	0.0129	20.7
	0.0091	19.3
	0.0064	18.5
	0.0032	18.0
	0.0014	16.3

Check By NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: Rocky Flats/Field & Lab Testing/CO
SAMPLE ID: PF-4 Depth (ft): -
TYPE: BULK



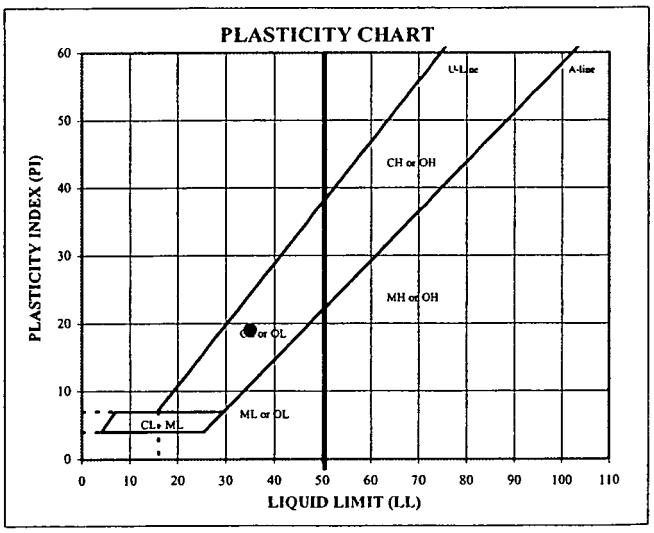
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	99.9	Coarse Gravel	0.34
0.75"	19.0	99.7		
0.375"	9.5	96.2		
#4	4.8	89.4	Fine Gravel	10.21
#10	2.00	78.6	Coarse Sand	10.87
#20	0.85	66.6		
#40	0.43	54.1	Medium Sand	24.43
#60	0.25	45.0		
#100	0.15	37.8		
#200	0.075	30.3	Fine Sand	23.89

Hydrometer Analysis

(mm)	%Finer		
0.035	24.6		
0.022	21.5		
0.013	20.7	Fines	
0.0091	19.3	Silt or Clay	30.25
0.0064	18.5		
0.0032	18.0		
0.0014	16.3		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
17.4	35	16	19	

DESCRIPTION: Yellowish brown (10YR 5/8) clayey sand

USCS: SC

TECH: JR
DATE: 7/19/2004
REVIEW: MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD A
SAMPLE IDENTITY	PF-4	-	-		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR	Mechanical
MOLD WEIGHT (gm)	2265.8	PREPARATION	Wet Method
MOLD DIAMETER (in)	3.991	TYPE PROCTOR	Standard
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	114.09
Dry Wt Tare & Soil	(W2)	492.88	113.02
Wt Tare	(W3)	0.00	21.80
Wt Moisture	(W4=W1-W2)	11.19	1.07
Wt Dry Soil	(W5=W2-W3)	492.88	91.22
Water Content (dec)	(wc=W4/W5)	0.0227	0.0117
Water Content (%)	(W4/W5)*100	2.3%	1.2%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	23483.70
TOTAL WEIGHT, DRY (COARSE & FINE)	23211.43
WEIGHT RETAINED ON # 4 SIEVE (WET)	4348.10
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	18.32%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4070.6	4226.9	4270.5	4242.8	4209.7	4166.9	
Weight of Mold	(W2)	2265.80	2265.80	2265.80	2265.80	2265.80	2265.80	
Wt. Of Wet Soil	(W3=W1-W2)	1804.80	1961.10	2004.70	1977.00	1943.90	1901.10	
Wet Density, wd (pcf)	(W3/453.6*Vm)	119.97	130.36	133.26	131.42	129.22	126.38	
WATER CONTENTS								
Wt Tare & Soil	(W4)	546.43	459.33	425.63	537.69	466.35	504.17	
Wt Tare & Soil	(W5)	510.23	421.84	387.39	480.76	414.14	442.34	
Wt Tare	(W6)	100.45	103.77	105.11	104.61	101.83	99.91	
Wt Moisture	(W7=W4-W5)	36.20	37.49	38.24	56.93	52.21	61.83	
Wt Dry Soil	(W8=W5-W6)	409.78	318.07	282.28	376.15	312.31	342.43	
Water Content (%)	(W7/W8)*100	8.8%	11.8%	13.5%	15.1%	16.7%	18.1%	
Dry Density (pcf)	(wd/(1+wc))	110.2	116.6	117.4	114.1	110.7	107.0	

MAXIMUM DRY DENSITY (pcf)	117.6
OPTIMUM MOISTURE CONTENT (%)	12.9
Corrected Maximum Dry Density (pcf)	122.9
Corrected Optimum Moisture (%)	10.6

DESCRIPTION: Yellowish brown (10YR 5/8) clayey sand

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

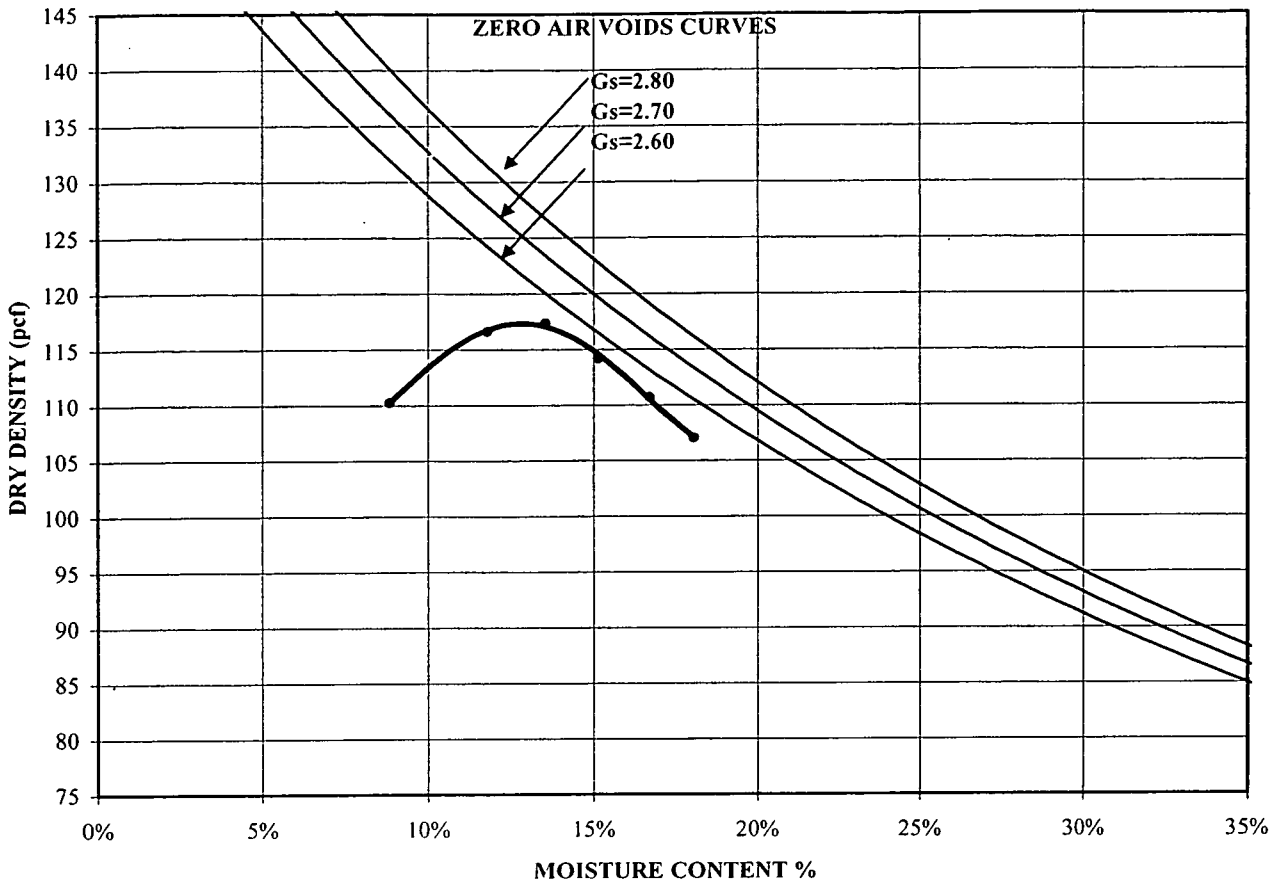
Weight of Oven Dry Sample (gm)		A	504.07		
Weight of Saturated-Surface-Dry (gm)		B	506.40		
Weight of Saturated Sample in Water	(gm)	C	301.90		
Absorption of Oversize Particles (%)	[(B-A)/A]*100		0.46		
Bulk Specific Gravity		A/(B-C)	2.465		

LL	35
PL	16
PI	19
MC	1.2%

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	JR
DATE	7-20-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	117.6	Corrected Maximum Dry Density (pcf)	122.9
OPTIMUM MOISTURE (%)	12.9	Corrected Optimum Moisture (%)	10.6

SAMPLE ID	PF-4
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	35
PL	16
PI	19
MC	1.2%

DESCRIPTION Yellowish brown (10YR 5/8) clayey sand -

USCS SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	JR
DATE	7-20-04
REVIEW	MB

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-5
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	586.89
Wt. Dry Soil & Tare (gm)	532.23
Wt. of Tare (gm)	103.94
Wt. of Water (gm)	54.66
Weight of Dry Soil (gm)	428.29
Moisture Content (%)	12.76

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	30.39	25.73
Weight of Dry Soil & T	28.10	23.84
Weight of Tare (gm)	15.97	13.56
Weight of Water (gm)	2.29	1.89
Weight of Dry Soil (gm)	12.13	10.28
Water Content %	18.88	18.39

LIQUID LIMIT DETERMINATION

35	26	19
26.48	25.44	26.62
23.22	22.48	23.15
14.30	14.53	14.11
3.26	2.96	3.47
8.92	7.95	9.04
36.55	37.23	38.38

PLASTIC LIMIT (PL) 19

LIQUID LIMIT (LL) 37

PLASTICITY INDEX (PI) 18

BLOWS	MC		
35	36.55	3.56	25
26	37.23	3.26	0.00
19	38.38	2.94	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
36.55	38.38	37.49	37.49	37
-2	40.00	37.49		19
				18

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	586.89
Wt. Dry Soil & Tare (gm)	532.23
Wt. of Tare (gm)	103.94
Wt. of Water (gm)	54.66
Weight of Dry Soil (gm)	428.29
Moisture Content (%)	12.8

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-5 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10 YR 5/8)

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	157.87
Dry Soil & Tare (gm)	153.29
Tare Weight (gm)	32.34
Moisture Content (%)	3.8

LL	37
PL	19
PI	18

TEST BY	JR
DATE SET UP	7/19/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	18706.10 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	18023.60

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00	
coarse gravel	0.00	
fine gravel	14.49	14.49
coarse sand	6.66	
medium sand	25.79	
fine sand	24.21	56.67
fines	28.84	
		100.00

PLUS #4 MATERIAL SIEVE — Tare Weight: 0.00

	(Wt. + Tare)	RETAINED	% PASSING
12.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
3.0"	0.00	0.0	100.0
2.5"	0.00	0.0	100.0
2.0"	0.00	0.0	100.0
1.5"	0.00	0.0	100.0
1.0"	0.00	0.0	100.0
0.75"	0.00	0.0	100.0
0.375"	258.90	1.44	98.6
#4	2612.40	14.49	85.5

BACK SIEVE — Tare Weight: 0.00

				% PASSING
#10	3.72	3.7	7.79	78.8
#20	10.65	10.7	22.31	66.4
#40	18.12	18.1	37.95	53.1
#60	23.38	23.4	48.97	43.6
#100	27.52	27.5	57.64	36.2
#200	31.64	31.6	66.27	28.8

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 49.55

DATE	TIME	READING	TEMP	HYD. COR.
7/22/2004	9:59	R	T	Cc
7/22/2004	10:01	20.3	22.80	6.50
7/22/2004	10:04	19.0	22.90	6.50
7/22/2004	10:14	18.8	23.00	6.50
7/22/2004	10:29	18.0	23.00	6.50
7/22/2004	10:59	17.5	22.50	6.50
7/22/2004	14:09	17.0	21.10	6.50
7/23/2004	9:59	16.3	20.20	6.50

(mm)	%Finer
0.035	24.38
0.022	22.16
0.013	21.72
0.009	20.39
0.006	19.50
0.003	18.62
0.001	17.29

!!!!!

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	47.74
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	85.5057

HYDROMETER CALCULATIONS

ET (min)^.5	TEMP COR K	READING R'	EFFECTIVE LENGTH	A
2.00	0.013126	13.75	14.2	0.99
5.00	0.013126	12.50	14.3	0.99
15.00	0.012973	12.25	14.3	0.99
30.00	0.012973	11.50	14.5	0.99
60.00	0.013126	11.00	14.5	0.99
250.00	0.013283	10.50	14.7	0.99
1440.00	0.013446	9.75	14.8	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	98.6
#4	4.750	85.5
#10	2.000	78.8
#20	0.850	66.4
#40	0.425	53.1
#60	0.250	43.6
#100	0.150	36.2
#200	0.075	28.8
	0.0350	24.4
	0.0222	22.2
	0.0127	21.7
	0.0090	20.4
	0.0065	19.5
	0.0032	18.6
	0.0014	17.3

Check By NG

July-04

043-2246.0001

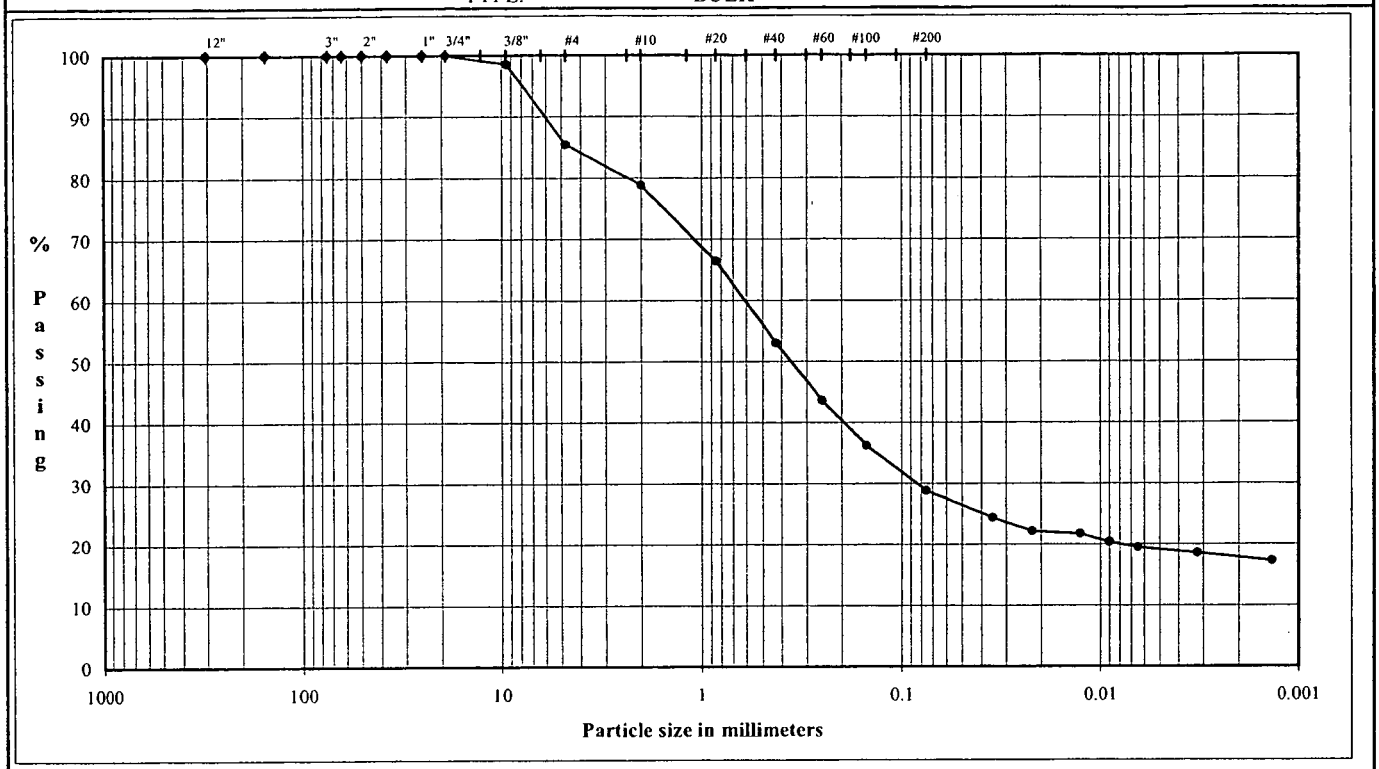
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **PF-5** Depth (ft): -

TYPE: **BULK**



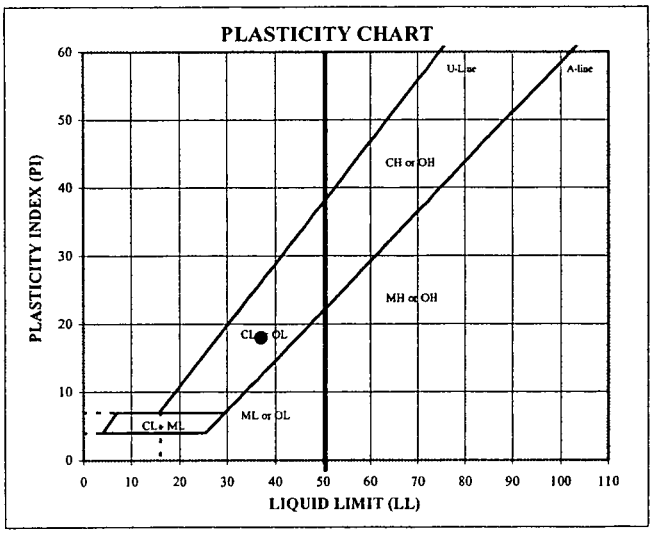
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	98.6		
#4	4.8	85.5	Fine Gravel	14.49
#10	2.00	78.8	Coarse Sand	6.66
#20	0.85	66.4		
#40	0.43	53.1	Medium Sand	25.79
#60	0.25	43.6		
#100	0.15	36.2		
#200	0.075	28.8	Fine Sand	24.21

Hydrometer Analysis

(mm)	%Finer		
0.035	24.4		
0.022	22.2		
0.013	21.7	Fines	
0.0090	20.4	Silt or Clay	28.84
0.0065	19.5		
0.0032	18.6		
0.0014	17.3		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
12.8	37	19	18	

DESCRIPTION: Yellowish brown (10 YR 5/8)

USCS: SC

TECH: JR

DATE: 7/19/2004

REVIEW: MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD A
SAMPLE IDENTITY	PF-5	-	-		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR	Mechanical
MOLD WEIGHT (gm)	2265.0	PREPARATION	Wet Method
MOLD DIAMETER (in)	3.991	TYPE PROCTOR	Standard
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332	5.5 -lbf. RAMMER WITH 12 INCH DROP	

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	157.87
Dry Wt Tare & Soil	(W2)	492.88	153.29
Wt Tare	(W3)	0.00	32.34
Wt Moisture	(W4=W1-W2)	11.19	4.58
Wt Dry Soil	(W5=W2-W3)	492.88	120.95
Water Content (dec)	(wc=W4/W5)	0.0227	0.0379
Water Content (%)	(W4/W5)*100	2.3%	3.8%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	18706.10
TOTAL WEIGHT, DRY (COARSE & FINE)	18023.60
WEIGHT RETAINED ON # 4 SIEVE (WET)	2871.30
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	15.58%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4032.1	4118.9	4238.1	4253.8	4244.5		
Weight of Mold	(W2)	2265.00	2265.00	2265.00	2265.00	2265.00		
Wt. Of Wet Soil	(W3=W1-W2)	1767.10	1853.90	1973.10	1988.80	1979.50		
Wet Density, wd (pcf)	(W3/453.6*Vm)	117.47	123.24	131.16	132.21	131.59		
WATER CONTENTS								
Wt Tare & Soil	(W4)	643.01	612.82	649.00	658.69	647.98		
Wt Tare & Soil	(W5)	598.18	563.91	589.34	592.03	577.19		
Wt Tare	(W6)	103.94	102.20	101.89	103.14	104.41		
Wt Moisture	(W7=W4-W5)	44.83	48.91	59.66	66.66	70.79		
Wt Dry Soil	(W8=W5-W6)	494.24	461.71	487.45	488.89	472.78		
Water Content (%)	(W7/W8)*100	9.1%	10.6%	12.2%	13.6%	15.0%		
Dry Density (pcf)	(wd/(1+wc))	107.7	111.4	116.9	116.3	114.5		

MAXIMUM DRY DENSITY (pcf)	117.4
OPTIMUM MOISTURE CONTENT (%)	12.7
Corrected Maximum Dry Density (pcf)	121.9
Corrected Optimum Moisture (%)	10.8

DESCRIPTION: Yellowish brown (10 YR 5/8)

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

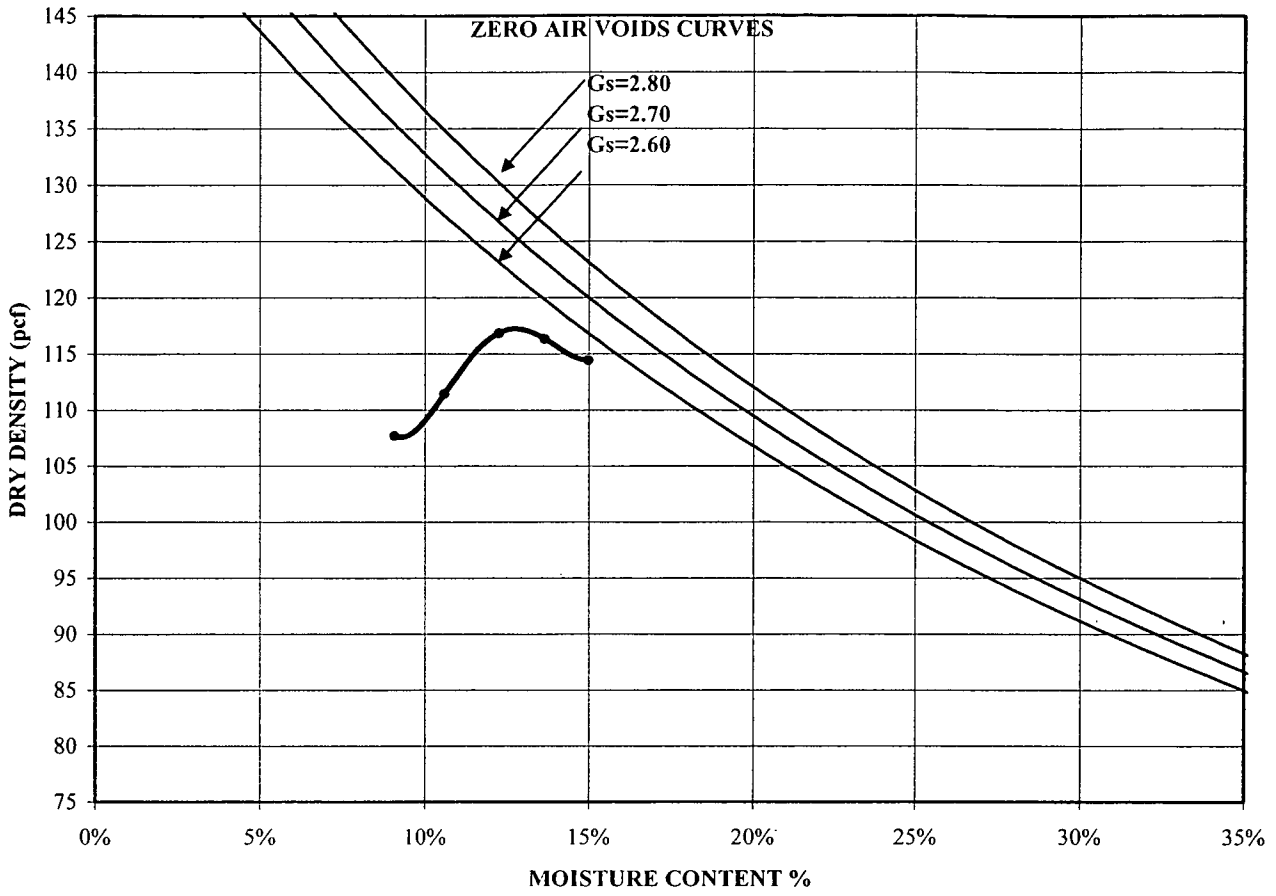
Weight of Oven Dry Sample (gm)		A	504.07		
Weight of Saturated-Surface-Dry (gm)		B	506.40		
Weight of Saturated Sample in Water	(gm)	C	301.90		
Absorption of Oversize Particles (%)	[(B-A)/A]*100		0.46		
Bulk Specific Gravity		A/(B-C)	2.465		

LL	37
PL	19
PI	18
MC	12.8

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	JR
DATE	7-20-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	117.4	Corrected Maximum Dry Density (pcf)	121.9
OPTIMUM MOISTURE (%)	12.7	Corrected Optimum Moisture (%)	10.8

SAMPLE ID	PF-5
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	37
PL	19
PI	18
MC	12.8

DESCRIPTION	Yellowish brown (10 YR 5/8)
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	JR
DATE	7-20-04
REVIEW	MB

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-5 Dup
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	732.79
Wt. Dry Soil & Tare (gm)	668.31
Wt. of Tare (gm)	103.82
Wt. of Water (gm)	64.48
Weight of Dry Soil (gm)	564.49
Moisture Content (%)	11.42

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	25.67	22.76
Weight of Dry Soil & T	24.17	21.36
Weight of Tare (gm)	15.89	13.98
Weight of Water (gm)	1.50	1.40
Weight of Dry Soil (gm)	8.28	7.38
Water Content %	18.12	18.97

LIQUID LIMIT DETERMINATION

35	23	16
24.47	23.64	23.70
21.59	20.85	20.92
14.01	13.98	14.52
2.88	2.79	2.78
7.58	6.87	6.40
37.99	40.61	43.44

PLASTIC LIMIT (PL) 19

LIQUID LIMIT (LL) 40

PLASTICITY INDEX (PI) 21

BLOWS	MC		
35	37.99	3.56	25
23	40.61	3.14	0.00
16	43.44	2.77	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
37.99	43.44	40.23	40.23	40
-2	44.00	40.23		19
				21

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	732.79
Wt. Dry Soil & Tare (gm)	668.31
Wt. of Tare (gm)	103.82
Wt. of Water (gm)	64.48
Weight of Dry Soil (gm)	564.49
Moisture Content (%)	11.4

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-5 Dup Depth (ft) -
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	83.44
Dry Soil & Tare (gm)	81.65
Tare Weight (gm)	21.77
Moisture Content (%)	3.0

LL	40
PL	19
PI	21

TEST BY	JR
DATE SET UP	7/21/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	19173.70 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	18617.17

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00		
coarse gravel	0.00		
fine gravel	12.78	12.78	
coarse sand	10.68		
medium sand	26.21		
fine sand	21.97	58.86	
fines	28.36		
	100.00		

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight: 0.00	6.0"	0.00	0.0	100.0
	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	263.40	1.4	98.6
	#4	2378.50	12.8	87.2

				% PASSING
BACK SIEVE	#10	5.97	6.0	12.25	76.5
Tare Weight: 0.00	#20	13.69	13.7	28.08	62.7
	#40	20.62	20.6	42.30	50.3
	#60	25.44	25.4	52.18	41.7
	#100	29.21	29.2	59.91	35.0
	#200	32.90	32.9	67.48	28.4

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.21

DATE	TIME	READING	TEMP	HYD. COR.
7/22/2004	10:43	R	T	Cc
7/22/2004	10:45	19.8	22.50	6.50
7/22/2004	10:48	18.5	22.50	6.50
7/22/2004	10:58	18.3	22.10	6.50
7/22/2004	11:13	17.8	22.00	6.50
7/22/2004	11:43	17.3	21.60	6.50
7/22/2004	14:53	16.8	20.30	6.50
7/23/2004	10:43	15.8	19.80	6.50

(mm)	%Finer
0.035	23.47
0.022	21.25
0.013	20.81
0.009	19.93
0.007	19.04
0.003	18.16
0.001	16.38

!!!!!

2.7 **WEIGHT OF SAMPLE USED FOR HYDROMETER TEST**

6

Calculated Dry Wt. used in test (gm)	48.75
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	87.2242

HYDROMETER CALCULATIONS

ET (min)	TEMP. COR. K	READING R'	EFFECTIVE LENGTH L	A
2.00	0.013126	13.25	14.2	0.99
5.00	0.013126	12.00	14.3	0.99
15.00	0.013126	11.75	14.5	0.99
30.00	0.013126	11.25	14.5	0.99
60.00	0.013283	10.75	14.7	0.99
250.00	0.013446	10.25	14.7	0.99
1440.00	0.013613	9.25	14.8	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	98.6
#4	4.750	87.2
#10	2.000	76.5
#20	0.850	62.7
#40	0.425	50.3
#60	0.250	41.7
#100	0.150	35.0
#200	0.075	28.4
	0.0350	23.5
	0.0222	21.3
	0.0129	20.8
	0.0091	19.9
	0.0066	19.0
	0.0033	18.2
	0.0014	16.4

Check BJ NG

July-04

043-2246.0001

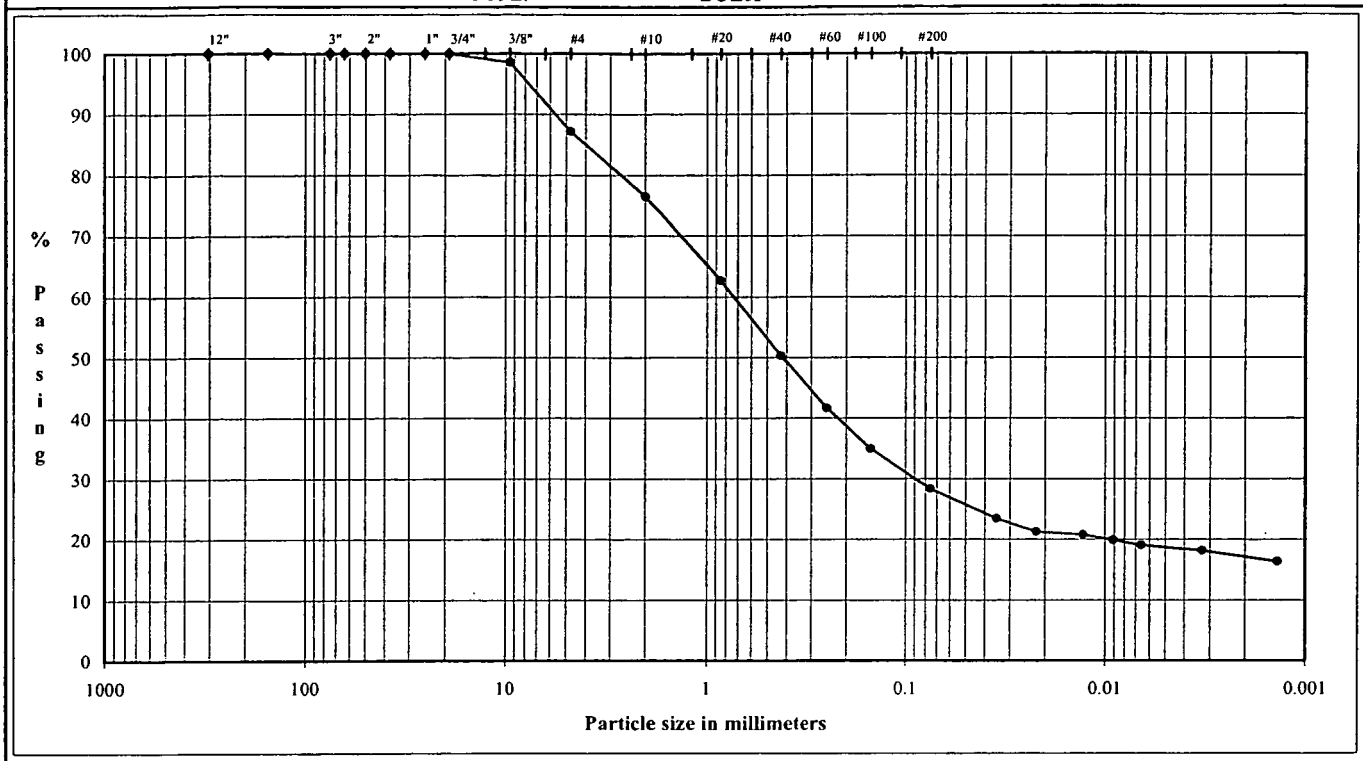
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **PF-5 Dup** Depth (ft): -

TYPE: **BULK**



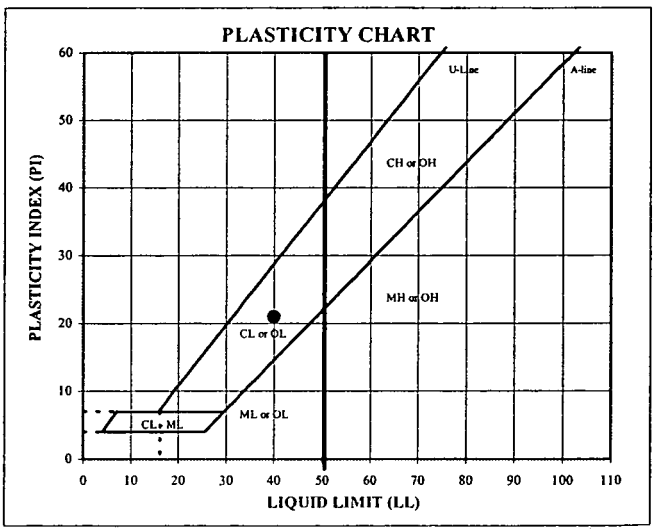
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	98.6		
#4	4.8	87.2	Fine Gravel	12.78
#10	2.00	76.5	Coarse Sand	10.68
#20	0.85	62.7		
#40	0.43	50.3	Medium Sand	26.21
#60	0.25	41.7		
#100	0.15	35.0		
#200	0.075	28.4	Fine Sand	21.97

Hydrometer Analysis

(mm)	%Finer		
0.035	23.5		
0.022	21.3		
0.013	20.8	Fines	
0.0091	19.9	Silt or Clay	28.36
0.0066	19.0		
0.0033	18.2		
0.0014	16.4		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
11.4	40	19	21	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

TECH	JR
DATE	7/21/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD A
SAMPLE IDENTITY	PF-5 Dup	-	-		
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
	Mechanical	Wet Method	
	TYPE PROCTOR		
	Standard		
	5.5 -lbf. RAMMER WITH 12 INCH DROP		

MOLD NUMBER	AH-1
MOLD WEIGHT (gm)	2265.0
MOLD DIAMETER (in)	3.991
MOLD HEIGHT (in)	4.581
MOLD VOLUME (cu.ft)	0.0332

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	83.44
Dry Wt Tare & Soil	(W2)	492.88	81.65
Wt Tare	(W3)	0.00	21.77
Wt Moisture	(W4=W1-W2)	11.19	1.79
Wt Dry Soil	(W5=W2-W3)	492.88	59.88
Water Content (dec)	(wc=W4/W5)	0.0227	0.0299
Water Content (%)	(W4/W5)*100	2.3%	3.0%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	19173.70
TOTAL WEIGHT, DRY (COARSE & FINE)	18617.17
WEIGHT RETAINED ON # 4 SIEVE (WET)	2641.90
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	13.88%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4084.2	4195.2	4276.4	4264.4	4224.3		
Weight of Mold	(W2)	2265.00	2265.00	2265.00	2265.00	2265.00		
Wt. Of Wet Soil	(W3=W1-W2)	1819.20	1930.20	2011.40	1999.40	1959.30		
Wet Density, wd (pcf)	(W3/453.6*Vm)	120.93	128.31	133.71	132.91	130.24		
WATER CONTENTS								
Wt Tare & Soil	(W4)	608.70	619.31	612.87	617.89	607.36		
Wt Tare & Soil	(W5)	564.88	567.90	554.51	553.19	537.89		
Wt Tare	(W6)	102.14	100.28	101.59	100.18	103.17		
Wt Moisture	(W7=W4-W5)	43.82	51.41	58.36	64.70	69.47		
Wt Dry Soil	(W8=W5-W6)	462.74	467.62	452.92	453.01	434.72		
Water Content (%)	(W7/W8)*100	9.5%	11.0%	12.9%	14.3%	16.0%		
Dry Density (pcf)	(wd/(1+wc))	110.5	115.6	118.4	116.3	112.3		

MAXIMUM DRY DENSITY (pcf)	118.4
OPTIMUM MOISTURE CONTENT (%)	12.8
Corrected Maximum Dry Density (pcf)	122.3
Corrected Optimum Moisture (%)	11.1

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

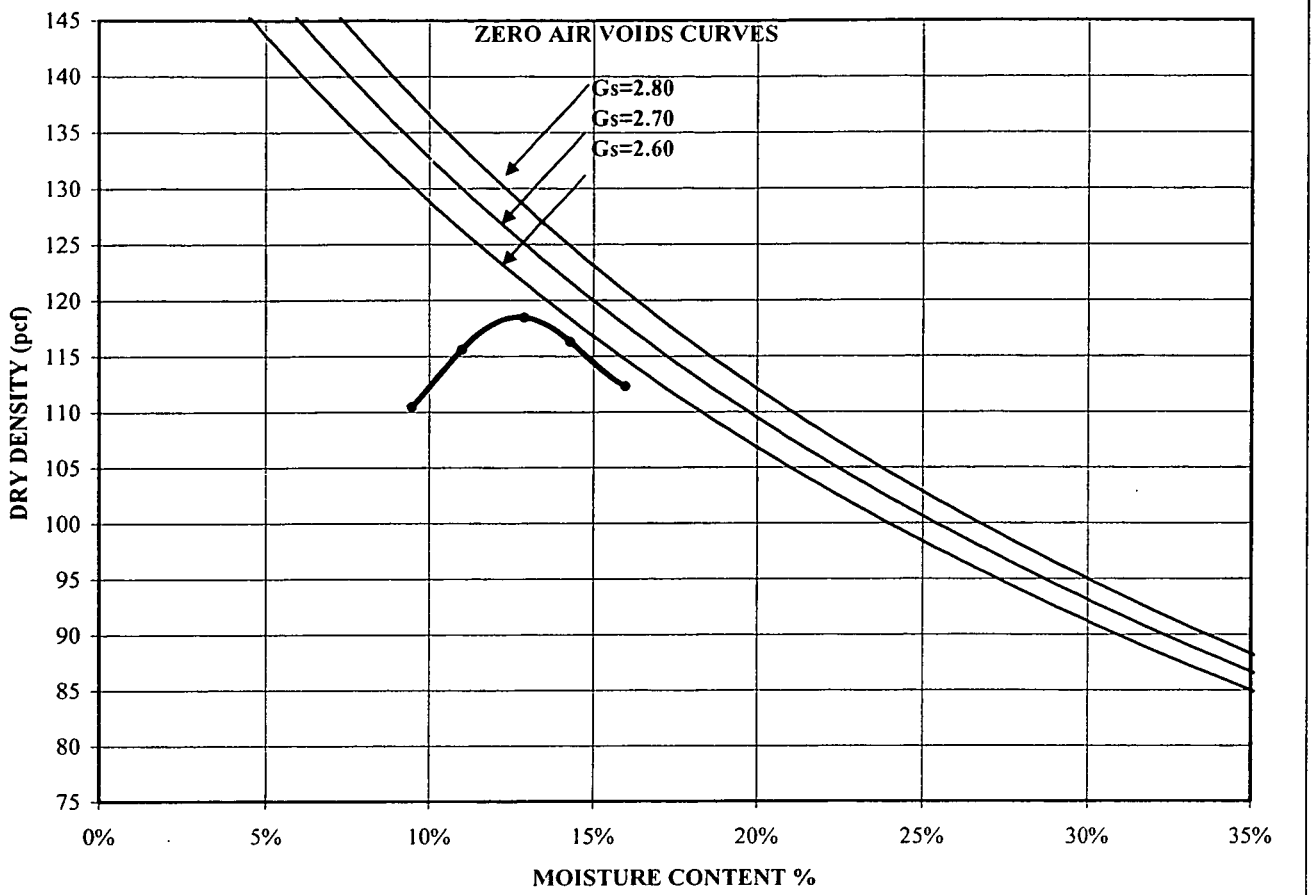
Weight of Oven Dry Sample (gm)	A	504.07			
Weight of Saturated-Surface-Dry (gm)	B	506.40			
Weight of Saturated Sample in Water (gm)	C	301.90			
Absorption of Oversize Particles (%)	[(B-A)/A]*100	0.46			
Bulk Specific Gravity	A/(B-C)	2.465			

LL	40
PL	19
PI	21
MC	11.4

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	DT
DATE	7-22-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	118.4	Corrected Maximum Dry Density (pcf)	122.3
OPTIMUM MOISTURE (%)	12.8	Corrected Optimum Moisture (%)	11.1

SAMPLE ID	PF-5 Dup
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	40
PL	19
PI	21
MC	11.4

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	DT
DATE	7-22-04
REVIEW	MB

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-6
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	656.82
Wt. Dry Soil & Tare (gm)	599.96
Wt. of Tare (gm)	104.75
Wt. of Water (gm)	56.86
Weight of Dry Soil (gm)	495.21
Moisture Content (%)	11.48

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	20.16	20.55
Weight of Dry Soil & T	19.12	19.53
Weight of Tare (gm)	13.72	14.53
Weight of Water (gm)	1.04	1.02
Weight of Dry Soil (gm)	5.40	5.00
Water Content %	19.26	20.40

LIQUID LIMIT DETERMINATION

35	27	17
27.43	26.25	26.47
23.94	22.56	22.34
15.81	14.27	13.79
3.49	3.69	4.13
8.13	8.29	8.55
42.93	44.51	48.30

PLASTIC LIMIT (PL): 20

LIQUID LIMIT (LL): 45

PLASTICITY INDEX (PI): 25

BLOWS	MC		
35	42.93	3.56	25
27	44.51	3.30	0.00
17	48.30	2.83	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
42.93	48.30	45.32	45.32	45
-2	50.00	45.32		20
				25

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00	
0.00	0.00	
#DIV/0!	#DIV/0!	

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL):

LIQUID LIMIT (LL):

PLASTICITY INDEX (PI):

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL): NP

LIQUID LIMIT (LL): NP

PLASTICITY INDEX (PI): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	656.82
Wt. Dry Soil & Tare (gm)	599.96
Wt. of Tare (gm)	104.75
Wt. of Water (gm)	56.86
Weight of Dry Soil (gm)	495.21
Moisture Content (%)	11.5

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-6 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	92.59
Dry Soil & Tare (gm)	91.44
Tare Weight (gm)	21.82
Moisture Content (%)	1.7

LL	45
PL	20
PI	25

TEST BY	JR
DATE SET UP	7/19/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	19522.40 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	19205.16

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00		
coarse gravel	0.00		
fine gravel	17.91	17.91	
coarse sand	9.58		
medium sand	22.15		
fine sand	20.38	52.11	
fines	29.98		
			100.00

PLUS #4 MATERIAL SIEVE — Tare Weight: 0.00

BACK SIEVE — Tare Weight: 0.00

	(Wt. + Tare)	RETAINED	% PASSING	% PASSING
12.0"	0.00	0.0	100.0	
6.0"	0.00	0.0	100.0	
3.0"	0.00	0.0	100.0	
2.5"	0.00	0.0	100.0	
2.0"	0.00	0.0	100.0	
1.5"	0.00	0.0	100.0	
1.0"	0.00	0.0	100.0	
0.75"	0.00	0.0	100.0	
0.375"	261.70	1.36	98.6	
#4	3439.70	17.91	82.1	
#10	5.69	5.7	11.67	72.5
#20	12.05	12.1	24.71	61.8
#40	18.85	18.9	38.65	50.4
#60	23.53	23.5	48.24	42.5
#100	26.24	26.2	53.80	37.9
#200	30.96	31.0	63.48	30.0

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 49.58

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
7/22/2004	10:07			
7/22/2004	10:09	21.5	22.80	6.50
7/22/2004	10:12	20.3	22.80	6.50
7/22/2004	10:22	19.8	22.90	6.50
7/22/2004	10:37	19.0	22.60	6.50
7/22/2004	11:07	18.8	22.40	6.50
7/22/2004	14:17	18.0	21.00	6.50
7/23/2004	10:07	17.3	20.10	6.50

(mm)	%Finer
0.034	24.99
0.022	22.91
0.013	22.08
0.009	20.83
0.006	20.41
0.003	19.16
0.001	17.91

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	48.77
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	82.0897

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH	A
2.00	0.013126	15.00	13.8	0.99
5.00	0.013126	13.75	14.2	0.99
15.00	0.013126	13.25	14.2	0.99
30.00	0.013126	12.50	14.3	0.99
60.00	0.013126	12.25	14.3	0.99
250.00	0.013283	11.50	14.5	0.99
1440.00	0.013446	10.75	14.7	0.99

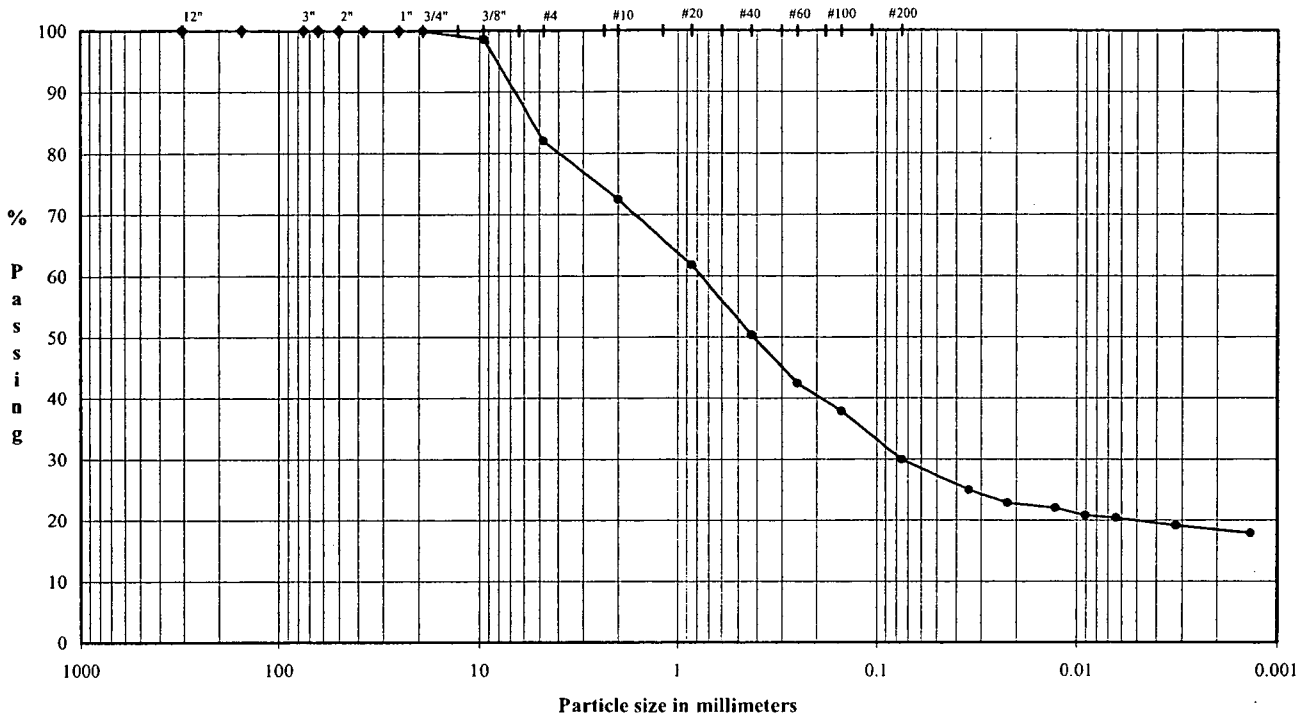
	X AXIS	Y AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	98.6
#4	4.750	82.1
#10	2.000	72.5
#20	0.850	61.8
#40	0.425	50.4
#60	0.250	42.5
#100	0.150	37.9
#200	0.075	30.0
	0.0345	25.0
	0.0221	22.9
	0.0128	22.1
	0.0091	20.8
	0.0064	20.4
	0.0032	19.2
	0.0014	17.9

Check By: NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: Rocky Flats/Field & Lab Testing/CO
SAMPLE ID: PF-6 Depth (ft): -
TYPE: BULK



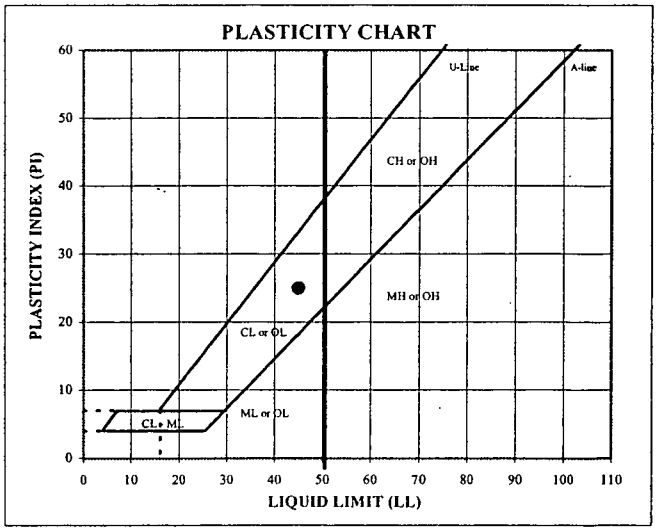
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	98.6		
#4	4.8	82.1	Fine Gravel	17.91
#10	2.00	72.5	Coarse Sand	9.58
#20	0.85	61.8		
#40	0.43	50.4	Medium Sand	22.15
#60	0.25	42.5		
#100	0.15	37.9		
#200	0.075	30.0	Fine Sand	20.38

Hydrometer Analysis

(mm)	%Finer		
0.034	25.0		
0.022	22.9		
0.013	22.1	Fines	
0.0091	20.8	Silt or Clay	29.98
0.0064	20.4		
0.0032	19.2		
0.0014	17.9		



ATTERBERG LIMITS

M,	LL	PL	PI	SpG
11.5	45	20	25	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

TECH	JR
DATE	7/19/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD B
SAMPLE IDENTITY	PF-6	-	-		
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
	Mechanical	Wet Method	
MOLD NUMBER	AH-1		
MOLD WEIGHT (gm)	2265.8		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR	
MOLD HEIGHT (in)	4.581	Standard	
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	656.82
Dry Wt Tare & Soil	(W2)	492.88	599.96
Wt Tare	(W3)	0.00	104.75
Wt Moisture	(W4=W1-W2)	11.19	56.86
Wt Dry Soil	(W5=W2-W3)	492.88	495.21
Water Content (dec)	(wc=W4/W5)	0.0227	0.1148
Water Content (%)	(W4/W5)*100	2.3%	11.5%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	19522.40
TOTAL WEIGHT, DRY (COARSE & FINE)	17511.71
WEIGHT RETAINED ON # 4 SIEVE (WET)	3701.40
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	20.67%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4078.5	4224.4	4287.2	4293.9	4283.1		
Weight of Mold	(W2)	2265.80	2265.80	2265.80	2265.80	2265.80		
Wt. Of Wet Soil	(W3=W1-W2)	1812.70	1958.60	2021.40	2028.10	2017.30		
Wet Density, wd (pcf)	(W3/453.6*Vm)	120.50	130.20	134.37	134.82	134.10		
WATER CONTENTS								
Wt Tare & Soil	(W4)	719.66	750.24	738.64	527.43	662.30		
Wt Tare & Soil	(W5)	670.73	686.65	671.13	476.83	587.82		
Wt Tare	(W6)	101.16	102.62	101.61	100.97	103.19		
Wt Moisture	(W7=W4-W5)	48.93	63.59	67.51	50.60	74.48		
Wt Dry Soil	(W8=W5-W6)	569.57	584.03	569.52	375.86	484.63		
Water Content (%)	(W7/W8)*100	8.6%	10.9%	11.9%	13.5%	15.4%		
Dry Density (pcf)	(wd/(1+wc))	111.0	117.4	120.1	118.8	116.2		

MAXIMUM DRY DENSITY (pcf)	120.3
OPTIMUM MOISTURE CONTENT (%)	12.5
Corrected Maximum Dry Density (pcf)	120.3
Corrected Optimum Moisture (%)	12.5

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

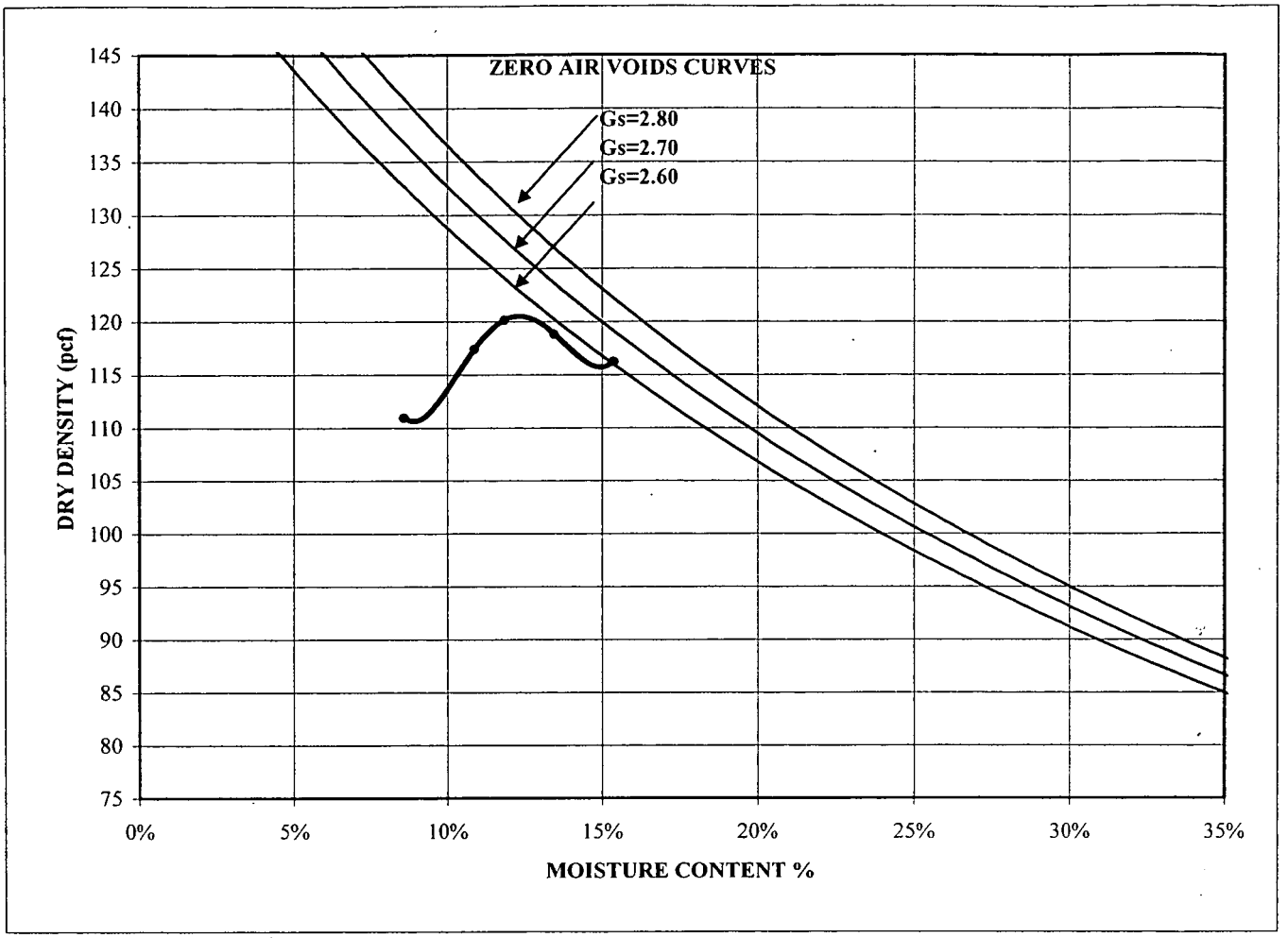
Weight of Oven Dry Sample (gm)		A	504.07		
Weight of Saturated-Surface-Dry (gm)		B	506.40		
Weight of Saturated Sample in Water	(gm)	C	301.90		
Absorption of Oversize Particles (%)	[(B-A)/A]*100		0.46		
Bulk Specific Gravity		A/(B-C)	2.465		

LL	45
PL	20
PI	25
MC	11.5%

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	JR
DATE	7-20-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD B



MAXIMUM DRY DENSITY (pcf)	120.3	Corrected Maximum Dry Density (pcf)	120.3
OPTIMUM MOISTURE (%)	12.5	Corrected Optimum Moisture (%)	12.5

SAMPLE ID	PF-6
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	45
PL	20
PI	25
MC	11.5%

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	JR
DATE	7-20-04
REVIEW	MB

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT	
Tare No.	
Wt. Wet Soil & Tare (gm)	688.89
Wt. Dry Soil & Tare (gm)	619.14
Wt. of Tare (gm)	102.36
Wt. of Water (gm)	69.75
Weight of Dry Soil (gm)	516.78
Moisture Content (%)	13.50

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-7
TYPE	BULK

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	21.55	24.36
Weight of Dry Soil & Ta	20.41	23.06
Weight of Tare (gm)	13.91	16.10
Weight of Water (gm)	1.14	1.30
Weight of Dry Soil (gm)	6.50	6.96
Water Content %	17.54	18.68

LIQUID LIMIT DETERMINATION

27	25	16
23.92	24.86	23.40
21.35	22.44	20.85
13.79	15.69	14.23
2.57	2.42	2.55
7.56	6.75	6.62
33.99	35.85	38.52

PLASTIC LIMIT (PL) 18

LIQUID LIMIT (LL) 35

PLASTICITY INDEX (PI) 17

BLOWS	MC		
27	33.99	3.30	25
25	35.85	3.22	0.00
16	38.52	2.77	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
33.99	38.52	35.17	35.17	35
-2	40.00	35.17		18
				17

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00	
0.00	0.00	
#DIV/0!	#DIV/0!	

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	688.89
Wt. Dry Soil & Tare (gm)	619.14
Wt. of Tare (gm)	102.36
Wt. of Water (gm)	69.75
Weight of Dry Soil (gm)	516.78
Moisture Content (%)	13.5

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	71.56
Dry Soil & Tare (gm)	70.96
Tare Weight (gm)	24.84
Moisture Content (%)	1.3

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	24507.30 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	24192.57

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	217.30	0.90	99.1
	#4	3117.80	12.89	87.1

				% PASSING
BACK SIEVE	#10	4.68	4.7	9.58	78.8
Tare Weight	#20	12.94	12.9	26.49	64.0
0.00	#40	21.53	21.5	44.07	48.7
	#60	27.29	27.3	55.86	38.5
	#100	31.56	31.6	64.60	30.8
	#200	35.48	35.5	72.62	23.8

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-7 Depth (ft) -
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

LL	35
PL	18
PI	17

TEST BY	JR
DATE SET UP	7/19/2004
REVIEW BY	MB

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00	
coarse gravel	0.00	
fine gravel	12.89	12.89
coarse sand	8.34	
medium sand	30.05	
fine sand	24.87	63.26
fines	23.85	
		100.00

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 49.49

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
7/22/2004	9:35	17.5	22.70	6.50
7/22/2004	9:37	17.5	22.70	6.50
7/22/2004	9:40	16.5	22.70	6.50
7/22/2004	9:50	16.3	22.80	6.50
7/22/2004	10:05	15.8	22.90	6.50
7/22/2004	10:35	15.5	23.00	6.50
7/22/2004	13:45	15.3	21.40	6.50
7/23/2004	9:35	14.3	20.40	6.50

(mm)	%Finer
0.035	19.42
0.023	17.65
0.013	17.21
0.009	16.33
0.006	15.89
0.003	15.45
0.001	13.68

!!!!!

2.7

#6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt used in test (gm)	48.85
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	87.1126

HYDROMETER CALCULATIONS

ET (min)	TEMP COR: K	READING: C	EFFECTIVE LENGTH	A:
2.00	0.013126	11.00	14.5	0.99
5.00	0.013126	10.00	14.7	0.99
15.00	0.013126	9.75	14.8	0.99
30.00	0.013126	9.25	14.8	0.99
60.00	0.012973	9.00	14.8	0.99
250.00	0.013283	8.75	15	0.99
1440.00	0.013446	7.75	15.2	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	99.1
#4	4.750	87.1
#10	2.000	78.8
#20	0.850	64.0
#40	0.425	48.7
#60	0.250	38.5
#100	0.150	30.8
#200	0.075	23.8
	0.0353	19.4
	0.0225	17.7
	0.0130	17.2
	0.0092	16.3
	0.0064	15.9
	0.0033	15.4
	0.0014	13.7

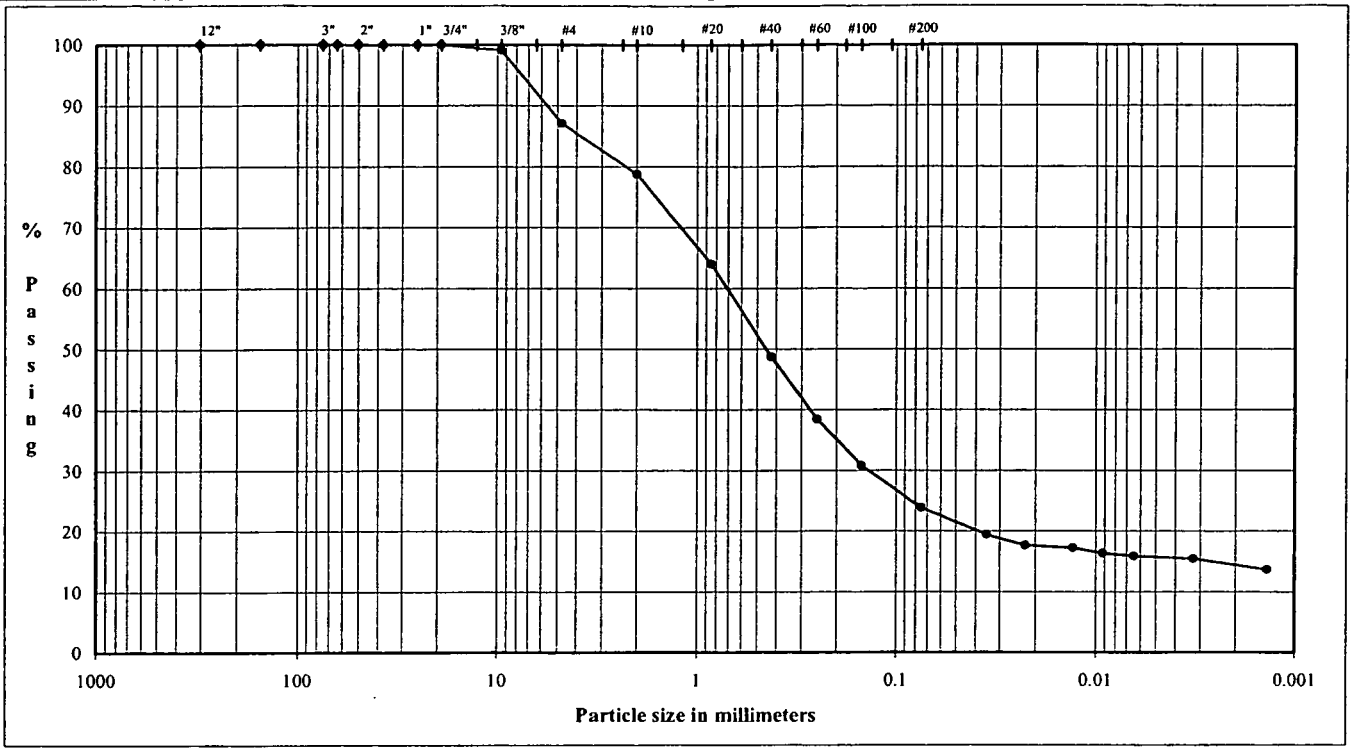
Check By: NG

July-04 043-2246.0001

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **PF-7** Depth (ft): -
TYPE: **BULK**



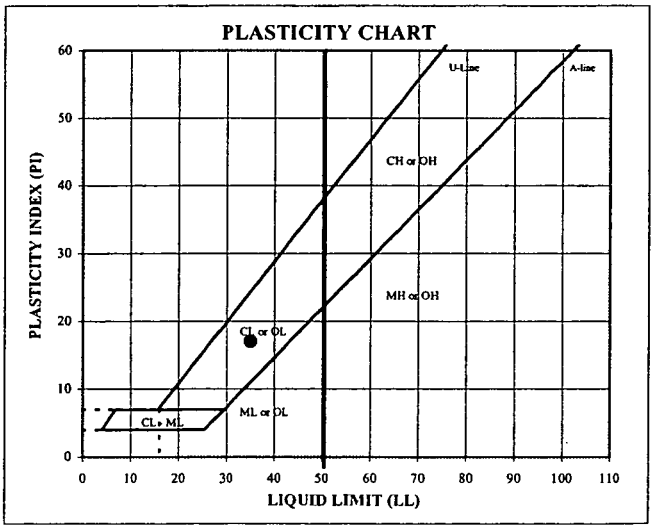
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	99.1		
#4	4.8	87.1	Fine Gravel	12.89
#10	2.00	78.8	Coarse Sand	8.34
#20	0.85	64.0		
#40	0.43	48.7	Medium Sand	30.05
#60	0.25	38.5		
#100	0.15	30.8		
#200	0.075	23.8	Fine Sand	24.87

Hydrometer Analysis

(mm)	%Finer		
0.035	19.4		
0.023	17.7		
0.013	17.2	Fines	
0.0092	16.3	Silt or Clay	23.85
0.0064	15.9		
0.0033	15.4		
0.0014	13.7		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
13.5	35	18	17	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

TECH	JR
DATE	7/19/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD A
SAMPLE IDENTITY	PF-7	-	-		
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
	Mechanical	Wet Method	
MOLD NUMBER	AH-1	TYPE PROCTOR	
MOLD WEIGHT (gm)	2265.8	Standard	
MOLD DIAMETER (in)	3.991		
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	688.89
Dry Wt Tare & Soil	(W2)	492.88	619.14
Wt Tare	(W3)	0.00	102.36
Wt Moisture	(W4=W1-W2)	11.19	69.75
Wt Dry Soil	(W5=W2-W3)	492.88	516.78
Water Content (dec)	(wc=W4/W5)	0.0227	0.1350
Water Content (%)	(W4/W5)*100	2.3%	13.5%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	24507.30
TOTAL WEIGHT, DRY (COARSE & FINE)	21592.90
WEIGHT RETAINED ON # 4 SIEVE (WET)	3334.60
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	15.10%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4169.7	4256.5	4307.6	4280.3	4235.0		
Weight of Mold	(W2)	2265.80	2265.80	2265.80	2265.80	2265.80		
Wt. Of Wet Soil	(W3=W1-W2)	1903.90	1990.70	2041.80	2014.50	1969.20		
Wet Density, wd (pcf)	(W3/453.6*Vm)	126.56	132.33	135.73	133.91	130.90		
WATER CONTENTS								
Wt Tare & Soil	(W4)	448.82	530.22	572.48	449.13	519.70		
Wt Tare & Soil	(W5)	418.71	488.84	520.15	407.59	463.88		
Wt Tare	(W6)	100.42	103.49	102.37	102.96	102.26		
Wt Moisture	(W7=W4-W5)	30.11	41.38	52.33	41.54	55.82		
Wt Dry Soil	(W8=W5-W6)	318.29	385.35	417.78	304.63	361.62		
Water Content (%)	(W7/W8)*100	9.5%	10.7%	12.5%	13.6%	15.4%		
Dry Density (pcf)	(wd/(1+wc))	115.6	119.5	120.6	117.8	113.4		

MAXIMUM DRY DENSITY (pcf)	121.1
OPTIMUM MOISTURE CONTENT (%)	12.0
Corrected Maximum Dry Density (pcf)	125.1
Corrected Optimum Moisture (%)	10.3

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

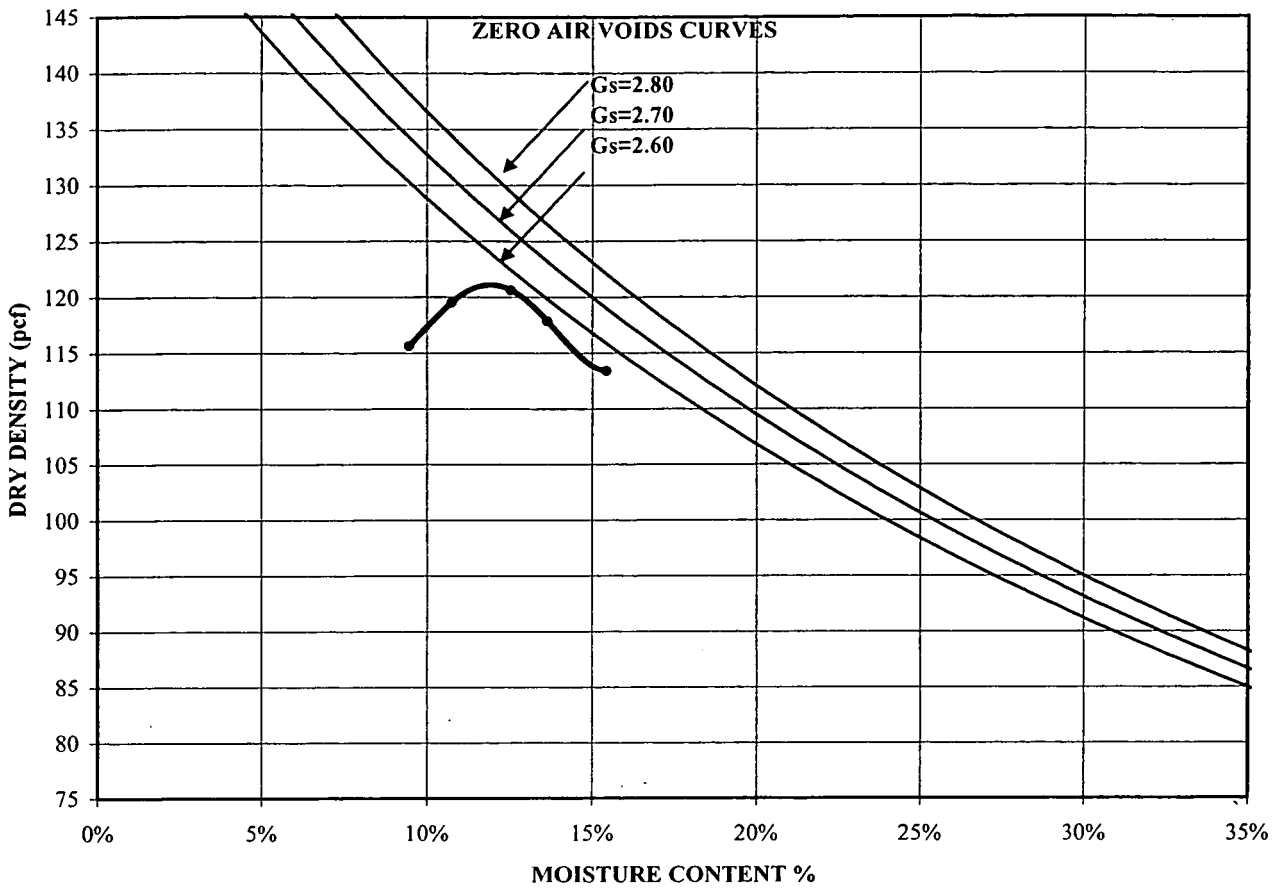
Weight of Oven Dry Sample (gm)	A	504.07			
Weight of Saturated-Surface-Dry (gm)	B	506.40			
Weight of Saturated Sample in Water (gm)	C	301.90			
Absorption of Oversize Particles (%)	[(B-A)/A]*100	0.46			
Bulk Specific Gravity	A/(B-C)	2.465			

LL	35
PL	18
PI	17
MC	13.5

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	JR
DATE	7-20-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	121.1	Corrected Maximum Dry Density (pcf)	125.1
OPTIMUM MOISTURE (%)	12.0	Corrected Optimum Moisture (%)	10.3

SAMPLE ID	PF-7
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	35
PL	18
PI	17
MC	13.5

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	JR
DATE	7-20-04
REVIEW	MB

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-8
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	765.57
Wt. Dry Soil & Tare (gm)	679.38
Wt. of Tare (gm)	102.55
Wt. of Water (gm)	86.19
Weight of Dry Soil (gm)	576.83
Moisture Content (%)	14.94

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	26.90	24.78
Weight of Dry Soil & T	24.85	23.05
Weight of Tare (gm)	13.73	13.83
Weight of Water (gm)	2.05	1.73
Weight of Dry Soil (gm)	11.12	9.22
Water Content %	18.44	18.76

LIQUID LIMIT DETERMINATION

35	30	21
26.34	24.33	24.98
22.91	21.25	21.69
13.86	13.57	13.89
3.43	3.08	3.29
9.05	7.68	7.80
37.90	40.10	42.18

PLASTIC LIMIT (PL) 19

LIQUID LIMIT (LL) 41

PLASTICITY INDEX (PI) 22

BLOWS	MC		
35	37.90	3.56	25
30	40.10	3.40	0.00
21	42.18	3.04	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
37.90	42.18	40.97	40.97	41
-2	44.00	40.97		19
				22

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00	BLOWS:
0.00	0.00	K VALUE:
#DIV/0!	#DIV/0!	

TRIAL 1	TRIAL 2
0	0
#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	765.57
Wt. Dry Soil & Tare (gm)	679.38
Wt. of Tare (gm)	102.55
Wt. of Water (gm)	86.19
Weight of Dry Soil (gm)	576.83
Moisture Content (%)	14.9

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-8 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	201.32
Dry Soil & Tare (gm)	193.36
Tare Weight (gm)	27.98
Moisture Content (%)	4.8

LL	41
PL	19
PI	22

TEST BY	JR
DATE SET UP	7/15/2004
REVIEW BY	NG

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	22528.80 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	21494.25

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00		
coarse gravel	0.00		
fine gravel	17.65	17.65	
coarse sand	7.03		
medium sand	25.41		
fine sand	21.57	54.01	
fines	28.34		
			100.00

		(Wt. + Tare)	% RETAINED	% PASSING	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0	
Tare Weight: 0.00	6.0"	0.00	0.0	100.0	
	3.0"	0.00	0.0	100.0	
	2.5"	0.00	0.0	100.0	
	2.0"	0.00	0.0	100.0	
	1.5"	0.00	0.0	100.0	
	1.0"	0.00	0.0	100.0	
	0.75"	0.00	0.0	100.0	
	0.375"	584.30	2.7	97.3	
	#4	3793.30	17.6	82.4	
BACK SIEVE	#10	4.15	4.2	8.54	75.3
Tare Weight: 0.00	#20	11.85	11.9	24.38	62.3
	#40	19.15	19.2	39.39	49.9
	#60	23.95	24.0	49.27	41.8
	#100	27.85	27.9	57.29	35.2
	#200	31.88	31.9	65.58	28.3

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.95

DATE 7/16/2004	TIME 10:16	READING R	TEMP T	HYD. COR. Cc
7/16/2004	10:18	22.3	22.20	6.00
7/16/2004	10:21	19.8	22.30	6.00
7/16/2004	10:31	19.3	22.10	6.00
7/16/2004	10:46	18.5	22.00	6.00
7/16/2004	11:16	18.0	21.70	6.00
7/16/2004	14:26	17.8	20.80	6.00
7/17/2004	10:16	16.8	21.50	6.00

(mm)	%Finer
0.034	27.25
0.022	23.06
0.013	22.22
0.009	20.96
0.006	20.13
0.003	19.71
0.001	18.03

!!!!!

2.7 **WEIGHT OF SAMPLE USED FOR HYDROMETER TEST**

6

Calculated Dry Wt. used in test (gm)	48.61
Hydrometer Bulb Number	624378
% Pass #4 Sieve for whole sample	82.352

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH	A
2.00	0.013126	16.25	13.7	0.99
5.00	0.013126	13.75	14.2	0.99
15.00	0.013126	13.25	14.2	0.99
30.00	0.013126	12.50	14.3	0.99
60.00	0.013283	12.00	14.3	0.99
250.00	0.013446	11.75	14.5	0.99
1440.00	0.013283	10.75	14.7	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	97.3
#4	4.750	82.4
#10	2.000	75.3
#20	0.850	62.3
#40	0.425	49.9
#60	0.250	41.8
#100	0.150	35.2
#200	0.075	28.3
	0.0344	27.3
	0.0221	23.1
	0.0128	22.2
	0.0091	21.0
	0.0065	20.1
	0.0032	19.7
	0.0013	18.0

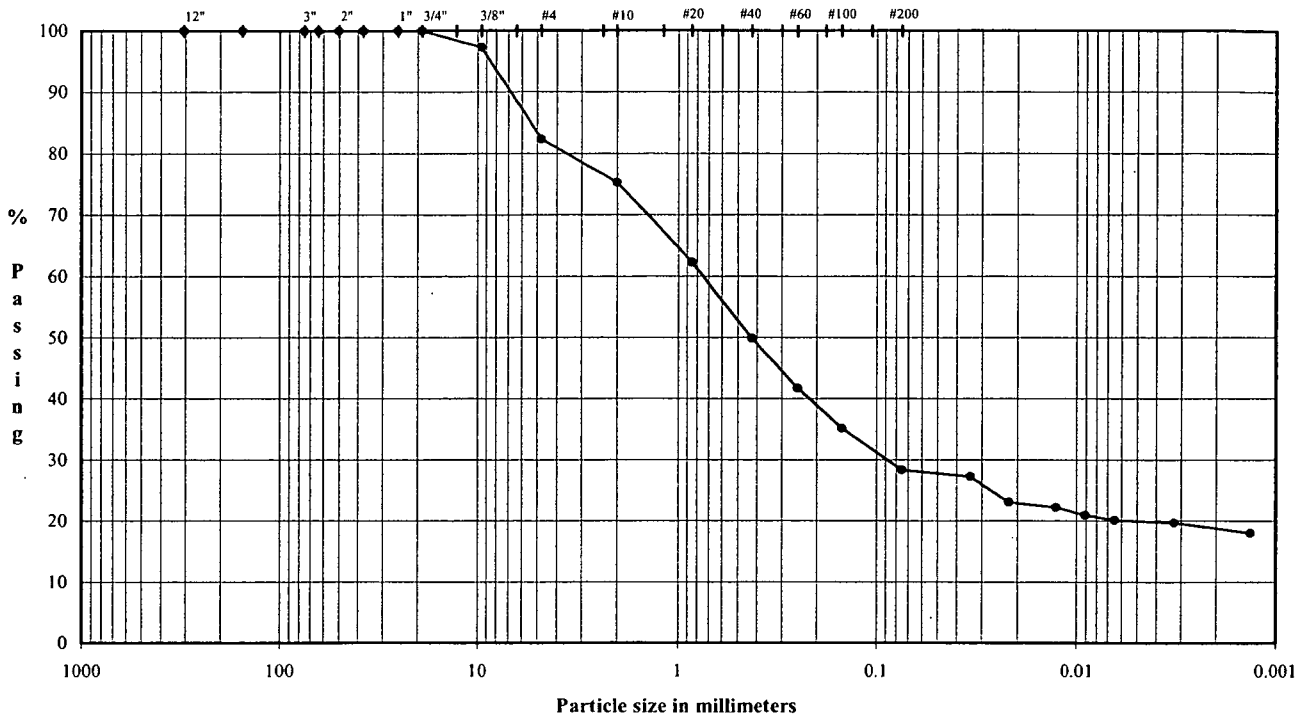
Check By NG

July-04 043-2246.0001

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **PF-8** Depth (ft): -
TYPE: **BULK**



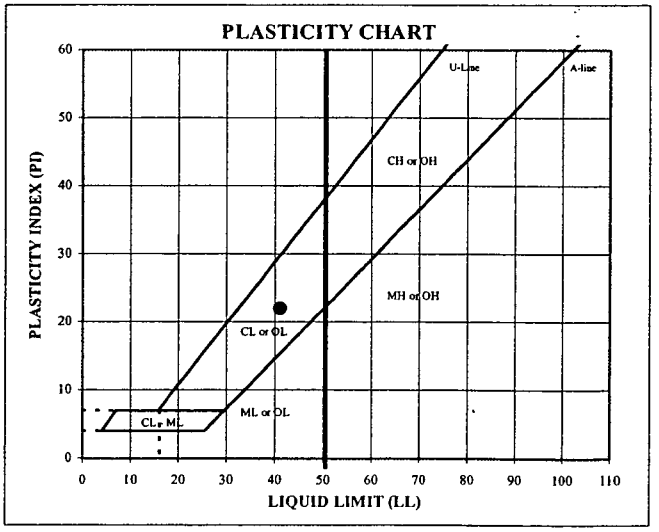
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	97.3		
#4	4.8	82.4	Fine Gravel	17.65
#10	2.00	75.3	Coarse Sand	7.03
#20	0.85	62.3		
#40	0.43	49.9	Medium Sand	25.41
#60	0.25	41.8		
#100	0.15	35.2		
#200	0.075	28.3	Fine Sand	21.57

Hydrometer Analysis

(mm)	%Finer		
0.034	27.3		
0.022	23.1		
0.013	22.2	Fines	
0.0091	21.0	Silt or Clay	28.34
0.0065	20.1		
0.0032	19.7		
0.0013	18.0		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
14.9	41	19	22	--

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

TECH: JR
DATE: 7/15/2004
REVIEW: NG

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD B
SAMPLE IDENTITY	PF-8	-	-		
SAMPLE TYPE	BULK				

MOLD NUMBER	217	TYPE COMPACTOR	Mechanical
MOLD WEIGHT (gm)	2271.5	PREPARATION	Wet Method
MOLD DIAMETER (in)	4.000	TYPE PROCTOR	Standard
MOLD HEIGHT (in)	4.575		
MOLD VOLUME (cu.ft)	0.0333		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	201.32
Dry Wt Tare & Soil	(W2)	492.88	193.36
Wt Tare	(W3)	0.00	27.98
Wt Moisture	(W4=W1-W2)	11.19	7.96
Wt Dry Soil	(W5=W2-W3)	492.88	165.38
Water Content (dec)	(wc=W4/W5)	0.0227	0.0481
Water Content (%)	(W4/W5)*100	2.3%	4.8%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	22528.80
TOTAL WEIGHT, DRY (COARSE & FINE)	21494.25
WEIGHT RETAINED ON # 4 SIEVE (WET)	3793.30
WEIGHT RETAINED ON 3/8" SIEVE (WET)	584.30
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	17.26%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	2.66%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4025.7	4181.1	4248.1	4254.7	4237.2		
Weight of Mold	(W2)	2271.50	2271.50	2271.50	2271.50	2271.50		
Wt. Of Wet Soil	(W3=W1-W2)	1754.20	1909.60	1976.60	1983.20	1965.70		
Wet Density, wd (pcf)	(W3/453.6*Vm)	116.24	126.54	130.98	131.41	130.25		
WATER CONTENTS								
Wt Tare & Soil	(W4)	705.92	707.97	637.96	628.56	640.23		
Wt Tare & Soil	(W5)	656.51	650.42	580.68	564.04	569.73		
Wt Tare	(W6)	102.19	101.58	101.86	100.81	103.29		
Wt Moisture	(W7=W4-W5)	49.41	57.55	57.28	64.52	70.50		
Wt Dry Soil	(W8=W5-W6)	554.32	548.84	478.82	463.23	466.44		
Water Content (%)	(W7/W8)*100	8.9%	10.5%	12.0%	13.9%	15.1%		
Dry Density (pcf)	(wd/(1+wc))	106.7	114.5	117.0	115.3	113.2		

MAXIMUM DRY DENSITY (pcf)	117.2
OPTIMUM MOISTURE CONTENT (%)	12.2
Corrected Maximum Dry Density (pcf)	117.9
Corrected Optimum Moisture (%)	11.9

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

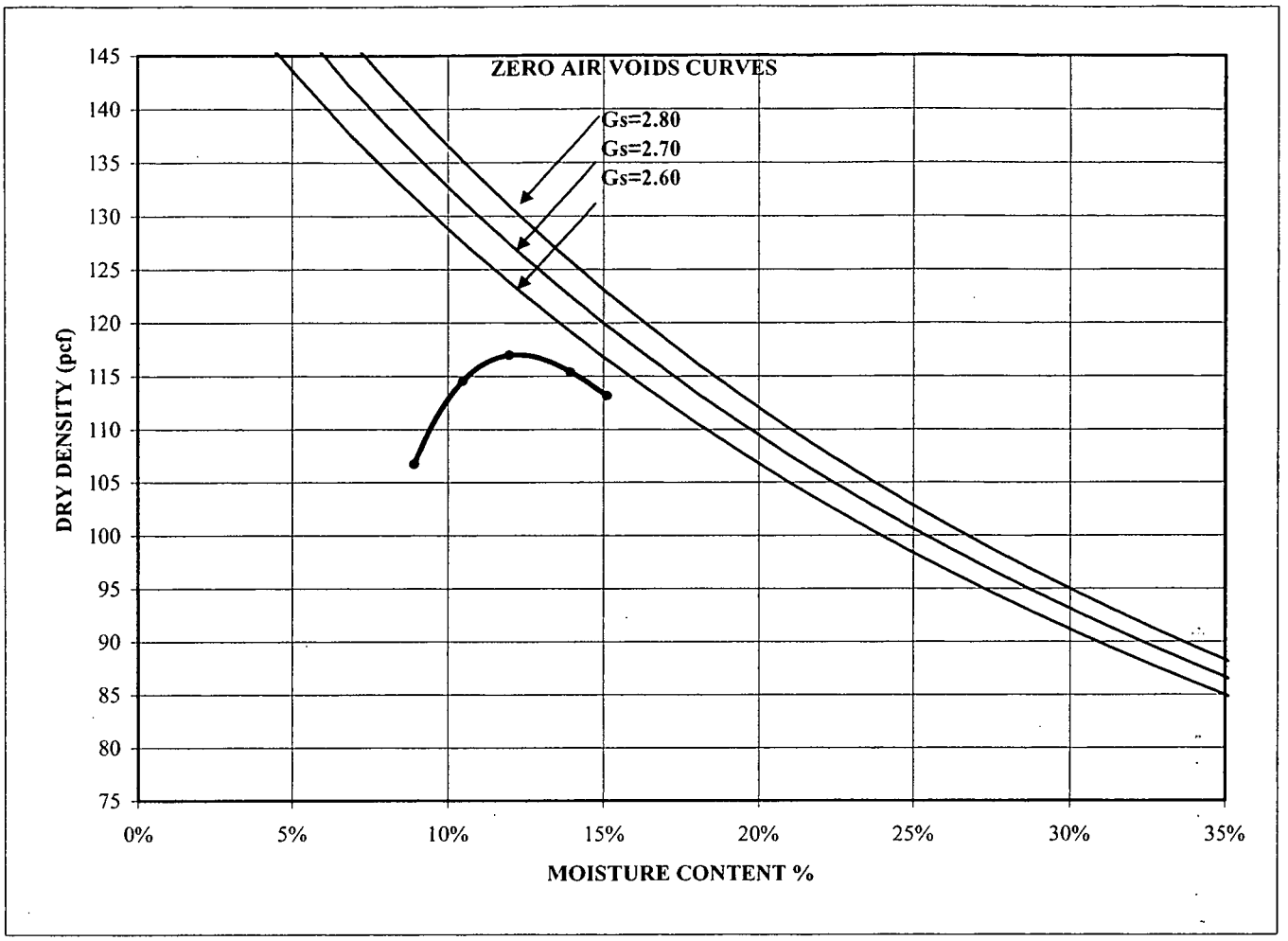
Weight of Oven Dry Sample (gm)		A	504.07		
Weight of Saturated-Surface-Dry (gm)		B	506.40		
Weight of Saturated Sample in Water	(gm)	C	301.90		
Absorption of Oversize Particles (%)	[(B-A)/A]*100		0.46		
Bulk Specific Gravity	A/(B-C)		2.465		

LL	41
PL	19
PI	22
MC	14.9%

AVERAGE ABSORPTION	0.5
AVERAGE BULK SPECIFIC GRAVITY	2.46

TECH	DT
DATE	7/16/04
REVIEW	NG

MOISTURE / DRY DENSITY CURVE
D 698 METHOD B



MAXIMUM DRY DENSITY (pcf)	117.2	Corrected Maximum Dry Density (pcf)	117.9
OPTIMUM MOISTURE (%)	12.2	Corrected Optimum Moisture (%)	11.9

SAMPLE ID	PF-8
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	41
PL	19
PI	22
MC	14.9%

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	DT
DATE	7/16/04
REVIEW	NG

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-9
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	836.00
Wt. Dry Soil & Tare (gm)	747.14
Wt. of Tare (gm)	101.30
Wt. of Water (gm)	88.86
Weight of Dry Soil (gm)	645.84
Moisture Content (%)	13.76

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	22.40	23.40
Weight of Dry Soil & T	21.13	22.27
Weight of Tare (gm)	14.26	15.86
Weight of Water (gm)	1.27	1.13
Weight of Dry Soil (gm)	6.87	6.41
Water Content %	18.49	17.63

LIQUID LIMIT DETERMINATION

35	24	17
24.30	24.69	25.96
21.54	22.22	23.09
13.89	15.81	15.89
2.76	2.47	2.87
7.65	6.41	7.20
36.08	38.53	39.86

PLASTIC LIMIT (PL) 18

LIQUID LIMIT (LL) 38

PLASTICITY INDEX (PI) 20

BLOWS	MC		
35	36.08	3.56	25
24	38.53	3.18	0.00
17	39.86	2.83	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
36.08	39.86	38.00	38.00	38
-2	40.00	38.00		18
				20

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	836.00
Wt. Dry Soil & Tare (gm)	747.14
Wt. of Tare (gm)	101.30
Wt. of Water (gm)	88.86
Weight of Dry Soil (gm)	645.84
Moisture Content (%)	13.8

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	108.14
Dry Soil & Tare (gm)	107.10
Tare Weight (gm)	21.80
Moisture Content (%)	1.2

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	24033.23 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	23743.74

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	232.20	0.98	99.0
	#4	3050.30	12.85	87.2
				% PASSING
BACK SIEVE	#10	5.45	5.5	10.77	77.8
Tare Weight	#20	12.87	12.9	25.43	65.0
0.00	#40	21.40	21.4	42.28	50.3
	#60	27.43	27.4	54.20	39.9
	#100	31.87	31.9	62.97	32.3
	#200	36.14	36.1	71.40	24.9

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-9 Depth (ft) -
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

LL	38
PL	18
PI	20

TEST BY	JR
DATE SET UP	7/19/2004
REVIEW BY	MB

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00	
coarse gravel	0.00	
fine gravel	12.85	12.85
coarse sand	9.38	
medium sand	27.47	
fine sand	25.38	62.23
fines	24.92	
	100.00	

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.23

DATE	TIME	READING	TEMP	HYD. COR.
7/22/2004	9:18	R	T	Cc
7/22/2004	9:20	17.5	22.70	6.50
7/22/2004	9:23	16.3	22.70	6.50
7/22/2004	9:33	16.3	22.70	6.50
7/22/2004	9:48	16.0	22.60	6.50
7/22/2004	10:18	15.5	23.10	6.50
7/22/2004	13:28	15.3	21.60	6.50
7/23/2004	9:18	14.1	20.50	6.50

(mm)	%Finer
0.035	18.75
0.023	16.62
0.013	16.62
0.009	16.20
0.006	15.34
0.003	14.92
0.001	12.96

1111

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	50.61
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	87.1532

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH L	A
2.00	0.013126	11.00	14.5	0.99
5.00	0.013126	9.75	14.8	0.99
15.00	0.013126	9.75	14.8	0.99
30.00	0.013126	9.50	14.8	0.99
60.00	0.012973	9.00	14.8	0.99
250.00	0.013283	8.75	15	0.99
1440.00	0.013446	7.60	15.2	0.99

	X AXIS	Y AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	99.0
#4	4.750	87.2
#10	2.000	77.8
#20	0.850	65.0
#40	0.425	50.3
#60	0.250	39.9
#100	0.150	32.3
#200	0.075	24.9
	0.0353	18.8
	0.0226	16.6
	0.0130	16.6
	0.0092	16.2
	0.0064	15.3
	0.0033	14.9
	0.0014	13.0

Check By NG

July-04

043-2246.0001

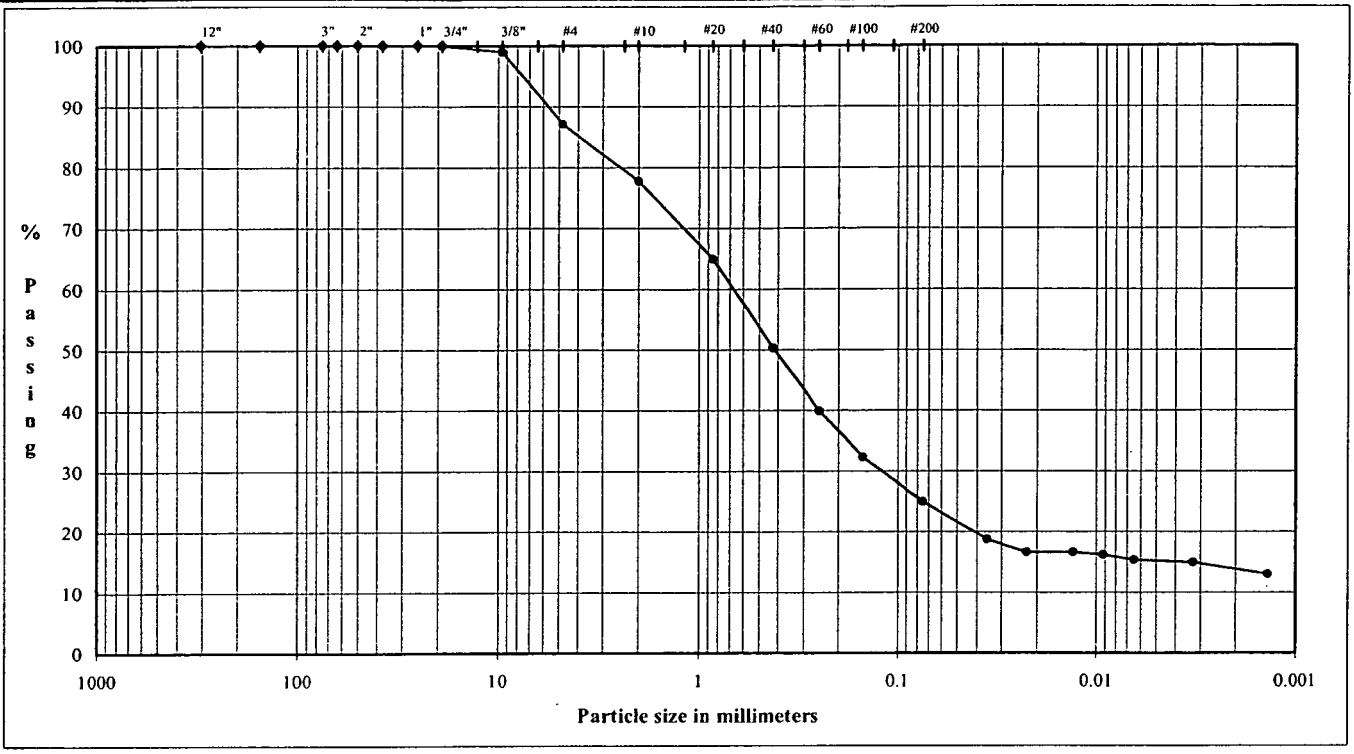
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **PF-9** Depth (ft): -

TYPE: **BULK**



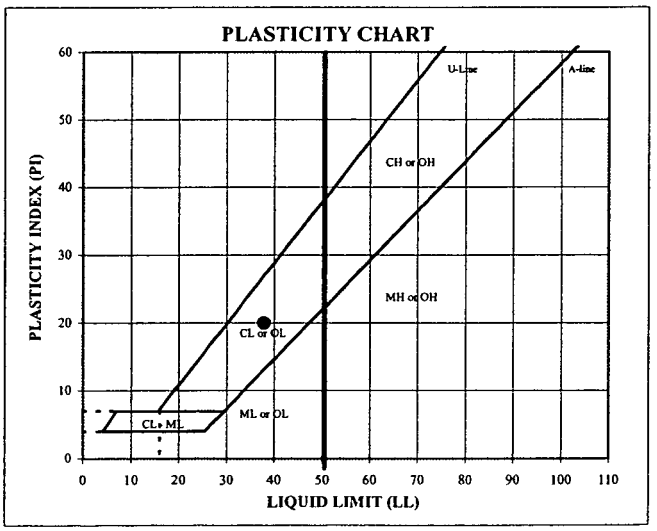
COBBLES	Coarse GRAVEL	Fine GRAVEL	Coarse SAND	Medium SAND	Fine SAND	Silt or Clay FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
3.0"	75.0	100.0		
2.5"	63.5	100.0		
2.0"	50.0	100.0		
1.5"	37.5	100.0		
1.0"	25.0	100.0	Coarse Gravel	0.00
0.75"	19.0	100.0		
0.375"	9.5	99.0		
#4	4.8	87.2	Fine Gravel	12.85
#10	2.00	77.8	Coarse Sand	9.38
#20	0.85	65.0		
#40	0.43	50.3	Medium Sand	27.47
#60	0.25	39.9		
#100	0.15	32.3		
#200	0.075	24.9	Fine Sand	25.38

Hydrometer Analysis

(mm)	%Finer		
0.035	18.8		
0.023	16.6		
0.013	16.6	Fines	
0.0092	16.2	Silt or Clay	24.92
0.0064	15.3		
0.0033	14.9		
0.0014	13.0		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
13.8	38	18	20	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

TECH	JR
DATE	7/19/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO		TEST TYPE	D 698	D 4718
PROJECT NUMBER	043-2246.0001		PROCEDURE	METHOD A	
SAMPLE IDENTITY	PF-9	- -			
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
MOLD NUMBER	AH-1	Mechanical	Wet Method
MOLD WEIGHT (gm)	2265.8		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR	
MOLD HEIGHT (in)	4.581	Standard	
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	108.14
Dry Wt Tare & Soil	(W2)	492.88	107.10
Wt Tare	(W3)	0.00	21.80
Wt Moisture	(W4=W1-W2)	11.19	1.04
Wt Dry Soil	(W5=W2-W3)	492.88	85.30
Water Content (dec)	(wc=W4/W5)	0.0227	0.0122
Water Content (%)	(W4/W5)*100	2.3%	1.2%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	24033.23
TOTAL WEIGHT, DRY (COARSE & FINE)	23743.74
WEIGHT RETAINED ON # 4 SIEVE (WET)	3282.23
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	13.52%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4151.7	4253.3	4315.8	4294.8	4260.4		
Weight of Mold	(W2)	2265.80	2265.80	2265.80	2265.80	2265.80		
Wt. Of Wet Soil	(W3=W1-W2)	1885.90	1987.50	2050.00	2029.00	1994.60		
Wet Density, wd (pcf)	(W3/453.6*Vm)	125.36	132.12	136.27	134.88	132.59		
WATER CONTENTS								
Wt Tare & Soil	(W4)	469.40	615.07	610.13	490.54	487.21		
Wt Tare & Soil	(W5)	439.34	565.63	555.65	444.01	437.71		
Wt Tare	(W6)	104.80	102.26	102.55	100.64	100.34		
Wt Moisture	(W7=W4-W5)	30.06	49.44	54.48	46.53	49.50		
Wt Dry Soil	(W8=W5-W6)	334.54	463.37	453.10	343.37	337.37		
Water Content (%)	(W7/W8)*100	9.0%	10.7%	12.0%	13.6%	14.7%		
Dry Density (pcf)	(wd/(1+wc))	115.0	119.4	121.6	118.8	115.6		

MAXIMUM DRY DENSITY (pcf)	121.6
OPTIMUM MOISTURE CONTENT (%)	12.0
Corrected Maximum Dry Density (pcf)	125.1
Corrected Optimum Moisture (%)	10.4

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

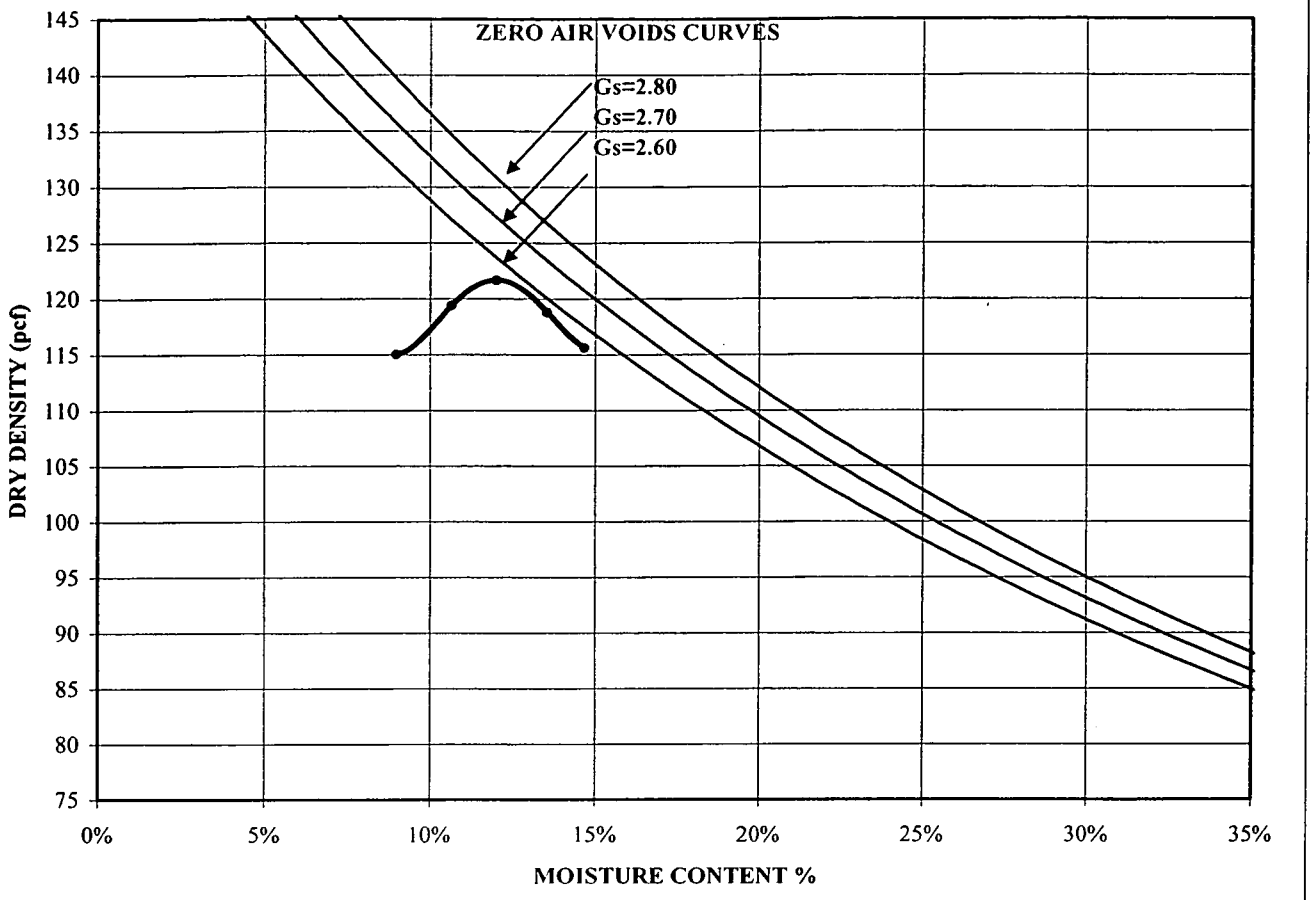
Weight of Oven Dry Sample (gm)	A	504.07			
Weight of Saturated-Surface-Dry (gm)	B	506.40			
Weight of Saturated Sample in Water (gm)	C	301.90			
Absorption of Oversize Particles (%)	[(B-A)/A]*100	0.46			
Bulk Specific Gravity	A/(B-C)	2.465			

LL	38
PL	18
PI	20
MC	13.8%

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	JR
DATE	7-20-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	121.6	Corrected Maximum Dry Density (pcf)	125.1
OPTIMUM MOISTURE (%)	12.0	Corrected Optimum Moisture (%)	10.4

SAMPLE ID	PF-9
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	38
PL	18
PI	20
MC	13.8%

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	JR
DATE	7-20-04
REVIEW	MB

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT	
Tare No.	
Wt. Wet Soil & Tare (gm)	731.59
Wt. Dry Soil & Tare (gm)	650.49
Wt. of Tare (gm)	102.96
Wt. of Water (gm)	81.10
Weight of Dry Soil (gm)	547.53
Moisture Content (%)	14.81

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-10
TYPE	BULK

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	20.72	21.47
Weight of Dry Soil & T	19.68	20.37
Weight of Tare (gm)	13.78	14.22
Weight of Water (gm)	1.04	1.10
Weight of Dry Soil (gm)	5.90	6.15
Water Content %	17.63	17.89

LIQUID LIMIT DETERMINATION

32	23	16
25.31	24.69	23.65
22.00	21.36	20.57
13.94	13.84	13.86
3.31	3.33	3.08
8.06	7.52	6.71
41.07	44.28	45.90

PLASTIC LIMIT (PL) 18

LIQUID LIMIT (LL) 43

PLASTICITY INDEX (PI) 25

BLOWS	MC		
32	41.07	3.47	25
23	44.28	3.14	0.00
16	45.90	2.77	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
41.07	45.90	43.10	43.10	43
-2	46.00	43.10		18
				25

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	731.59
Wt. Dry Soil & Tare (gm)	650.49
Wt. of Tare (gm)	102.96
Wt. of Water (gm)	81.10
Weight of Dry Soil (gm)	547.53
Moisture Content (%)	14.8

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	69.25
Dry Soil & Tare (gm)	67.73
Tare Weight (gm)	13.80
Moisture Content (%)	2.8

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	2057.30 (before separating on the #4 sieve)
Tare Weight (gm)	
Total Weight (gm)	20007.40

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	3.0"	0.00	0.0	100.0
	2.5"	0.00	0.0	100.0
	2.0"	0.00	0.0	100.0
	1.5"	0.00	0.0	100.0
	1.0"	0.00	0.0	100.0
	0.75"	0.00	0.0	100.0
	0.375"	421.30	2.1	97.9
	#4	3468.50	17.3	82.7

				% PASSING
BACK SIEVE	#10	5.26	5.3	10.79	73.7
Tare Weight	#20	12.53	12.5	25.70	61.4
0.00	#40	19.47	19.5	39.94	49.6
	#60	24.20	24.2	49.64	41.6
	#100	28.07	28.1	57.58	35.1
	#200	31.93	31.9	65.50	28.5

MONTH AND YEAR	July-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	PF-10 Depth (ft)
TYPE	BULK

Description: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

LL	43
PL	18
PI	25

TEST BY	JR
DATE SET UP	7/21/2004
REVIEW BY	MB

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00	
coarse gravel	0.00	
fine gravel	17.34	17.34
coarse sand	8.92	
medium sand	24.10	
fine sand	21.13	54.15
fines	28.52	
		100.00

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.12

DATE	TIME	READING	TEMP	HYD. COR.
7/22/2004	9:22	R	T	Cc
7/22/2004	9:24	21.3	22.80	6.50
7/22/2004	9:27	20.3	22.80	6.50
7/22/2004	9:37	19.3	22.80	6.50
7/22/2004	9:52	18.5	22.80	6.50
7/22/2004	10:22	17.8	23.10	6.50
7/22/2004	13:32	17.3	21.60	6.50
7/23/2004	9:22	16.5	20.60	6.50

(mm)	%Finer
0.035	24.76
0.022	23.08
0.013	21.41
0.009	20.15
0.006	18.89
0.003	18.05
0.001	16.79

!!!!!

2.7 **WEIGHT OF SAMPLE USED FOR HYDROMETER TEST**

6

Calculated Dry Wt used in test (gm)	48.75
Hydrometer Bulb Number	624378
%Pass. #4 Sieve for whole sample	82.6639

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH	A
2.00	0.013126	14.75	14	0.99
5.00	0.013126	13.75	14.2	0.99
15.00	0.013126	12.75	14.3	0.99
30.00	0.013126	12.00	14.3	0.99
60.00	0.012973	11.25	14.5	0.99
250.00	0.013283	10.75	14.7	0.99
1440.00	0.013446	10.00	14.7	0.99

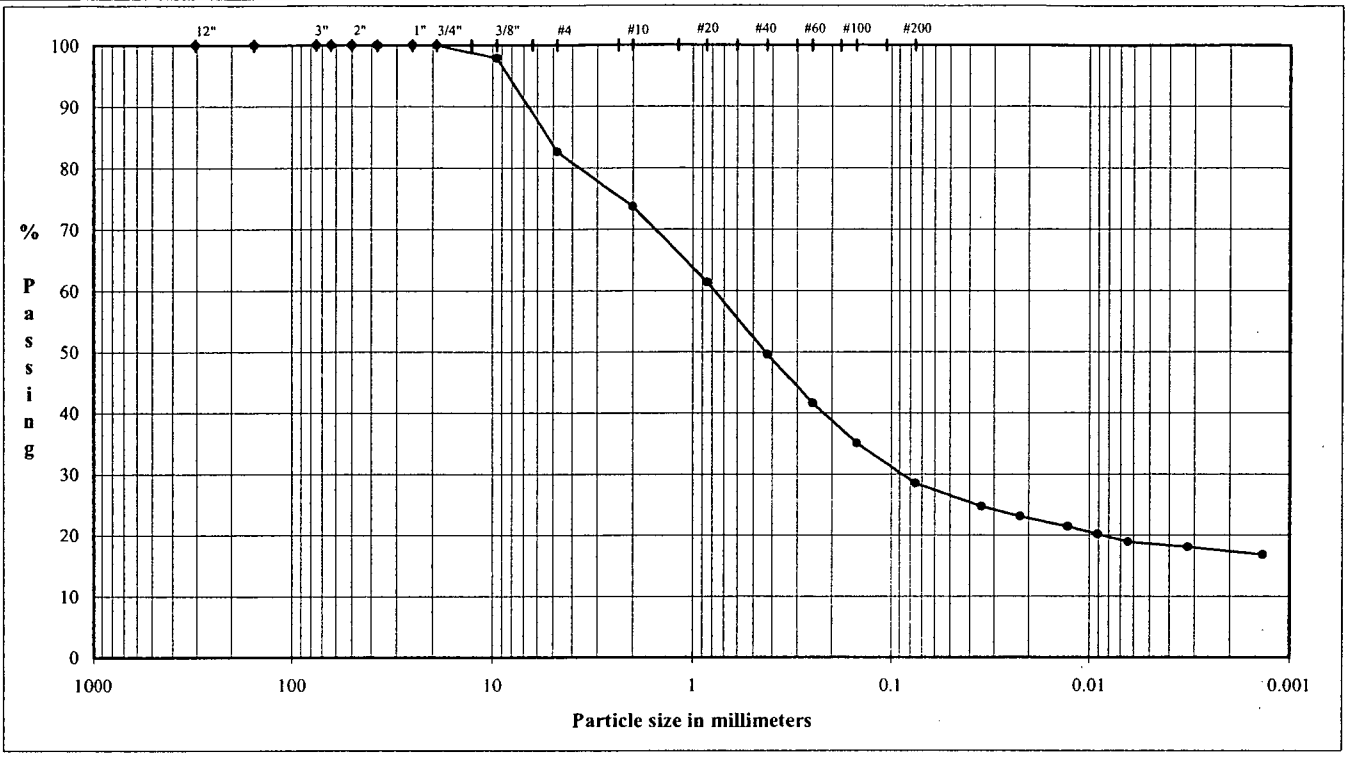
	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
2.5"	63.500	100.0
2.0"	50.000	100.0
1.5"	37.500	100.0
1.0"	25.000	100.0
0.75"	19.000	100.0
0.375"	9.500	97.9
#4	4.750	82.7
#10	2.000	73.7
#20	0.850	61.4
#40	0.425	49.6
#60	0.250	41.6
#100	0.150	35.1
#200	0.075	28.5
	0.0347	24.8
	0.0221	23.1
	0.0128	21.4
	0.0091	20.1
	0.0064	18.9
	0.0032	18.0
	0.0014	16.8

Check By NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **PF-10** Depth (ft): -
TYPE: **BULK**



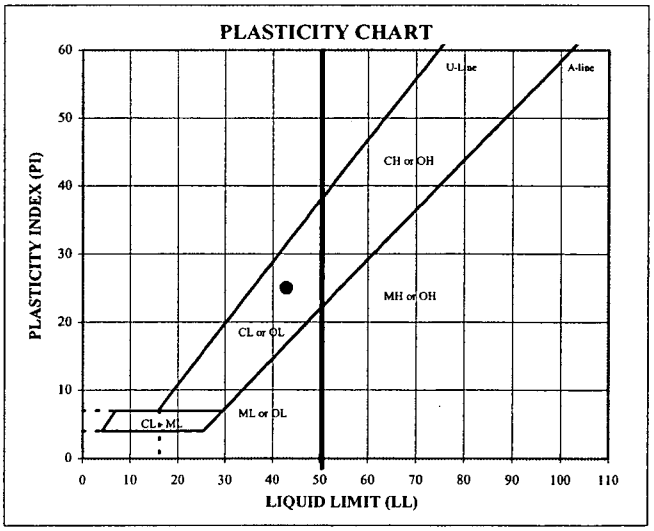
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	**100.0**		
6.0"	154.2	**100.0**	Cobbles	**0.00**
3.0"	75.0	**100.0**		
2.5"	63.5	**100.0**		
2.0"	50.0	**100.0**		
1.5"	37.5	**100.0**		
1.0"	25.0	**100.0**	Coarse Gravel	**0.00**
0.75"	19.0	**100.0**		
0.375"	9.5	**97.9**		
#4	4.8	**82.7**	Fine Gravel	**17.34**
#10	2.00	**73.7**	Coarse Sand	**8.92**
#20	0.85	**61.4**		
#40	0.43	**49.6**	Medium Sand	**24.10**
#60	0.25	**41.6**		
#100	0.15	**35.1**		
#200	0.075	**28.5**	Fine Sand	**21.13**

Hydrometer Analysis

(mm)	%Finer		
0.035	**24.8**		
0.022	**23.1**		
0.013	**21.4**	Fines	
0.0091	**20.1**	Silt or Clay	**28.52**
0.0064	**18.9**		
0.0032	**18.0**		
0.0014	**16.8**		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
14.8	**43**	**18**	**25**	

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS: SC

TECH: JR
DATE: 7/21/2004
REVIEW: MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 D 4718
PROJECT NUMBER	043-2246.0001			PROCEDURE	METHOD A
SAMPLE IDENTITY	PF-10	-	-		
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
	Mechanical	Wet Method	
MOLD NUMBER	AH-1		
MOLD WEIGHT (gm)	2265.0		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR	
MOLD HEIGHT (in)	4.581	Standard	
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)	504.07	69.25
Dry Wt Tare & Soil	(W2)	492.88	67.73
Wt Tare	(W3)	0.00	13.80
Wt Moisture	(W4=W1-W2)	11.19	1.52
Wt Dry Soil	(W5=W2-W3)	492.88	53.93
Water Content (dec)	(wc=W4/W5)	0.0227	0.0282
Water Content (%)	(W4/W5)*100	2.3%	2.8%

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	20571.30
TOTAL WEIGHT, DRY (COARSE & FINE)	20007.40
WEIGHT RETAINED ON # 4 SIEVE (WET)	3889.80
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	19.01%
PERCENT RETAINED ON 3/8" SIEVE (DRY)	0.00%
PERCENT RETAINED ON 3/4" SIEVE (DRY)	0.00%

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)	4039.4	4136.7	4240.6	4243.1	4216.1		
Weight of Mold	(W2)	2265.00	2265.00	2265.00	2265.00	2265.00		
Wt. Of Wet Soil	(W3=W1-W2)	1774.40	1871.70	1975.60	1978.10	1951.10		
Wet Density, wd (pcf)	(W3/453.6*Vm)	117.95	124.42	131.33	131.49	129.70		
WATER CONTENTS								
Wt Tare & Soil	(W4)	679.64	620.58	634.98	615.78	671.62		
Wt Tare & Soil	(W5)	626.89	566.98	573.43	550.55	592.60		
Wt Tare	(W6)	103.88	100.42	101.25	103.12	102.16		
Wt Moisture	(W7=W4-W5)	52.75	53.60	61.55	65.23	79.02		
Wt Dry Soil	(W8=W5-W6)	523.01	466.56	472.18	447.43	490.44		
Water Content (%)	(W7/W8)*100	10.1%	11.5%	13.0%	14.6%	16.1%		
Dry Density (pcf)	(wd/(1+wc))	107.1	111.6	116.2	114.8	111.7		

MAXIMUM DRY DENSITY (pcf)	116.4
OPTIMUM MOISTURE CONTENT (%)	13.5
Corrected Maximum Dry Density (pcf)	122.1
Corrected Optimum Moisture (%)	11.0

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel

USCS: SC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

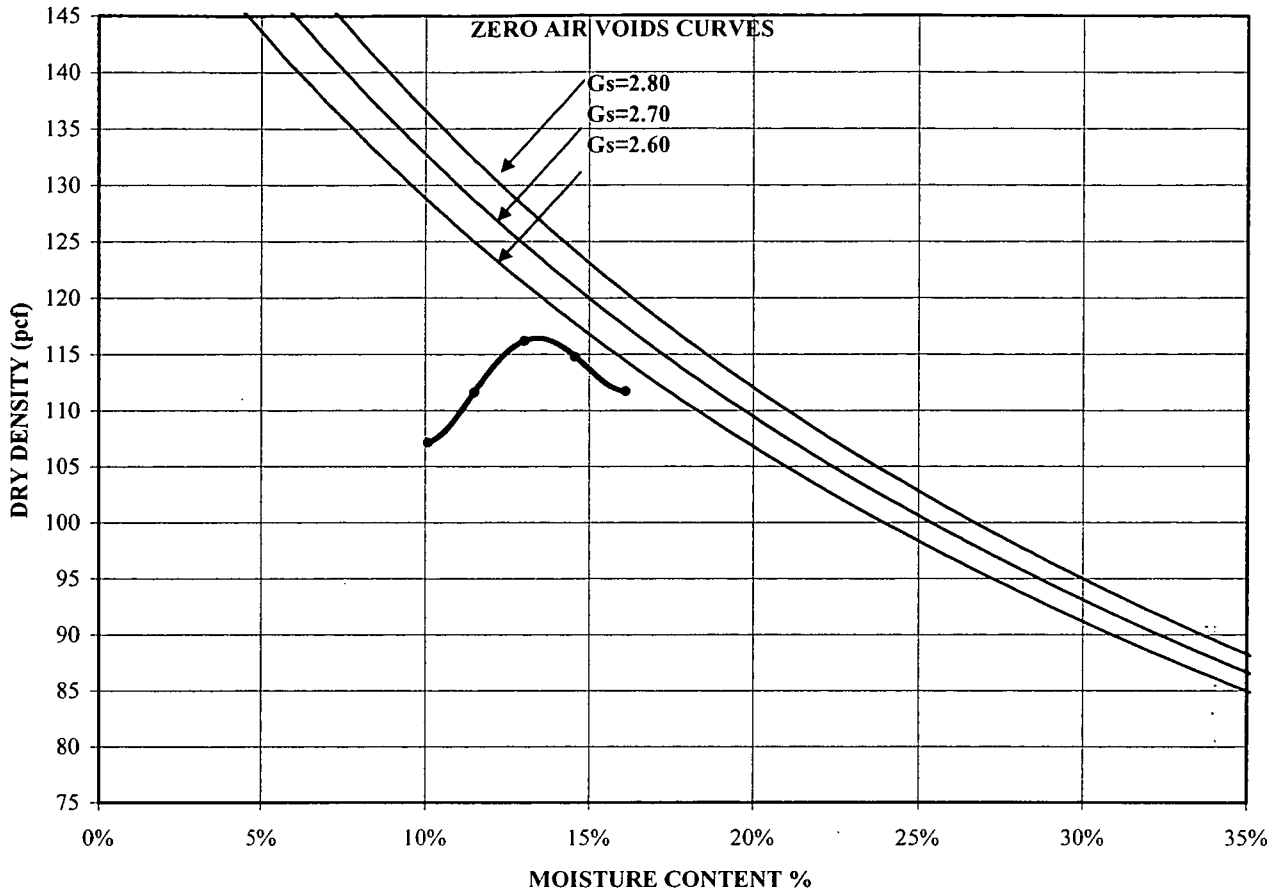
Weight of Oven Dry Sample (gm)		A	504.07			
Weight of Saturated-Surface-Dry (gm)		B	506.40			
Weight of Saturated Sample in Water	(gm)	C	301.90			
Absorption of Oversize Particles (%)	[(B-A)/A]*100		0.46			
Bulk Specific Gravity		A/(B-C)	2.465			

LL	43
PL	18
PI	25
MC	14.8

AVERAGE ABSORPTION (assumed)	0.5
AVERAGE BULK SPECIFIC GRAVITY (assumed)	2.46

TECH	DT
DATE	7-22-04
REVIEW	MB

MOISTURE / DRY DENSITY CURVE
D 698 METHOD A



MAXIMUM DRY DENSITY (pcf)	116.4	Corrected Maximum Dry Density (pcf)	122.1
OPTIMUM MOISTURE (%)	13.5	Corrected Optimum Moisture (%)	11.0

SAMPLE ID	PF-10
SAMPLE TYPE	BULK
SAMPLE DEPTH	-

LL	43
PL	18
PI	25
MC	14.8

DESCRIPTION	Yellowish brown (10 YR 5/8) clayey sand with gravel
USCS	SC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	DT
DATE	7-22-04
REVIEW	MB

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 09-08-04		New Submittal
		X	Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 020A
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.
Specification Sec. No. (Cover only one section with each Submittal)		Project Title: Construction of the Present Landfill Accelerated Action	

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Consolidation and triaxial test results from Golder Associates, Inc.	N/A	6		N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

Remarks: APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert T. Davis DATE: 10/07/04

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK COA J.H. Rale Tetra Tech

Golder Associates Inc.

44 Union Boulevard, Suite 300
Lakewood, CO USA 80228
Telephone (303) 980-0540
Fax (303) 985-2080
www.golder.com

Golder Associates

TRANSMITTAL LETTER

DATE: 043-2246

PROJECT NO.: September 2, 2004

TO: S.M. Stoller Corporation
990 S. Public Rd., Suite A
Lafayette, Colorado 80226

Attention: Steve Brinkman

SENT VIA: Federal Express (priority)

QUANTITY	ITEM	DESCRIPTION
1	Set	Consolidation and Triaxial Test Results

REMARKS: Please find one set of consolidation and triaxial test results for the cushion stockpile at Rocky Flats.

Per Mark McClain

I:\04\2246\0100\0432246.0100.12058.DOC

GEOTECHNICAL LABORATORY SAMPLE TEST REQUEST

DATE SUBMITTED: SAMPLED BY: [X] = Requested Test

PROJECT NAME (SHORT TITLE): PROJECT NUMBER:

SAMPLE TYPE (J) - Jar (T) - Tube (CR)-Core (b) - bag (B) - 5-gal Bucket (O) - Other	TEST	WATER CONTENT	ATTERBERG LIMITS	SIEVE (3" THRU #200)	- #200 SIEVE (Passing)	HYDROMETER & SIEVE	UNIT WEIGHT	SPECIFIC GRAVITY	PROCTOR (Standard)	PROCTOR (Modified)	UNCONFINED COMPRESSION*	TRIAXIAL UU*	TRIAXIAL CU* with Pore Press	DIRECT SHEAR*	PERMEABILITY (Flex Wall)*	PERMEABILITY (Rigid Wall)*	CONSOLIDATION*	SWELL *	EXPANSION INDEX	pH LEVEL	ORGANIC CONTENT	RESISTIVITY				SPECIAL INSTRUCTIONS TO LAB (★ Include Test Parameters)
	TEST METHOD	D 2216	D 4318		D 1140	D 422		D 854	D 698	D 1557	D 2166	D 2850	D 4767	D 3080	D 5084	D 2434	D 2435	D 4546			D 2974	G 57				
SAMPLE #/Time Collected	SAMPLE TYPE																									
PF-1 11:00	Bulk	X	X			X			X				X				X									Hold Bucket 2
PF-2 11:05	Bulk	X	X			X			X				X				X									
PF-3 11:15	Bulk	X	X			X			X				X				X									Hold Buck 2
PF-4 11:20	Bulk	X	X			X			X				X				X									
PF-5 11 22	Bulk	X	X			X			X				X				X									
PF-5Dup 11:22	Bulk	X	X			X			X				X				X									
PF-6 11:35	Bulk	X	X			X			X				X				X									
PF-7 11:40	Bulk	X	X			X			X				X				X									
PF-8 11:45	Bulk	X	X			X			X				X				X									Hold Bucket 2
PF-9 11:48	Bulk	X	X			X			X				X				X									
PF-10 11:53	Bulk	X	X			X			X				X				X									

SEND RESULTS TO: Phone:

Collected by: Date: 7/9/04 Time: 11:48 AM Accepted By (Lab): mBarnes Date: 7/9/04 Time: 1330 hrs

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-1	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9960
diameter (in)	2.497
area (in^2)	4.897
volume (in^3)	4.877
specimen weight,wet (g)	165.18
specimen weight,dry (g)	148.17
water weight (g)	17.01

SAMPLE DATA, INITIAL

total height (in)	0.996
height of solids (in)	0.691
height of voids (in)	0.305
void ratio	0.441
dry density (pcf)	115.47
moist density (pcf)	129.01

SAMPLE DATA, FINAL

total height (in)	0.9600
height of solids (in)	0.691
height of voids (in)	0.269
void ratio	0.389
dry density (pcf)	120.07
moist density (pcf)	139.70

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand with gravel

LL:	39	
PL:	19	
PI:	20	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	F3
wt soil&tare,moist	49.69
wt soil&tare,dry	47.55
wt tare	28.91
wt moisture	2.14
wt dry soil	18.64
% moisture	11.48%

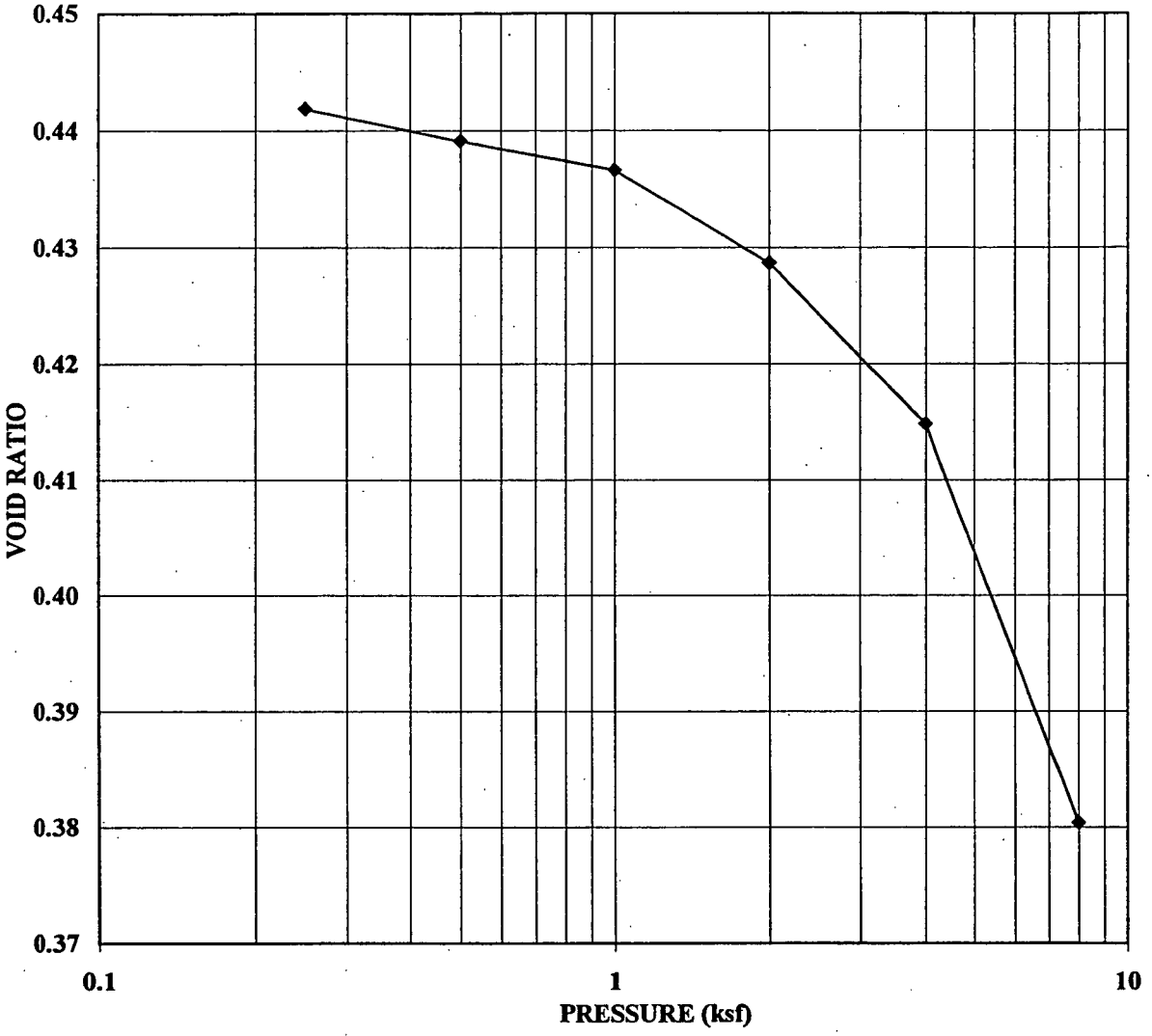
MOISTURE CONTENT, FINAL

tare #	F19
wt soil&tare,moist	203.26
wt soil&tare,dry	179.25
wt tare	32.38
wt moisture	24.01
wt dry soil	146.87
% moisture	16.35%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.25	0.9953	-	-	115.6	0.442	-	-	-	-	-	-	
0.50	0.9934	-	-	115.8	0.439	-	-	-	-	-	-	
0.50	0.9934	-	-	115.8	0.439	-	-	-	-	-	-	
1.0	0.9917	0.9920	0.197	116.0	0.437	0.4960	1.2598	0.2460	1.5872	2.64E-02	2.46E+00	0.008
2.0	0.9862	0.9871	0.227	116.6	0.429	0.4935	1.2536	0.2436	1.5715	2.27E-02	2.12E+00	0.026
4.0	0.9766	0.9783	0.204	117.8	0.415	0.4892	1.2425	0.2393	1.5438	2.49E-02	2.32E+00	0.046
8.0	0.9529	0.9564	0.209	120.7	0.380	0.4782	1.2146	0.2287	1.4752	2.31E-02	2.16E+00	0.114

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



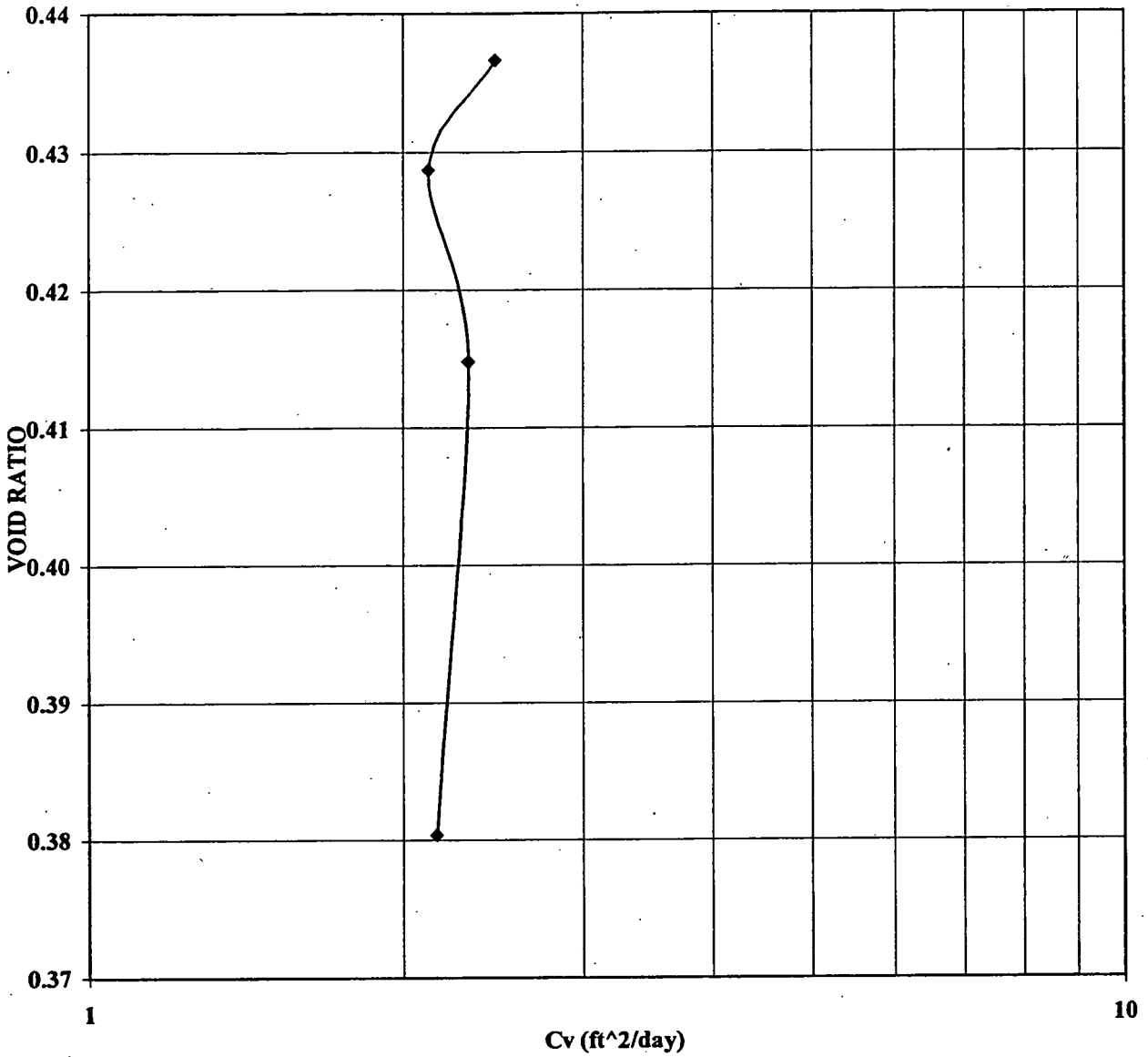
SAMPLE #:	**PF-1**
DESCRIPTION:	Yellowish brown (10 YR 5/8) clayey sand with gravel

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-1

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-2	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9960
diameter (in)	2.497
area (in^2)	4.897
volume (in^3)	4.877
specimen weight,wet (g)	166.16
specimen weight,dry (g)	148.18
water weight (g)	17.98

SAMPLE DATA, INITIAL

total height (in)	0.996
height of solids (in)	0.684
height of voids (in)	0.312
void ratio	0.457
dry density (pcf)	115.48
moist density (pcf)	129.78

SAMPLE DATA, FINAL

total height (in)	0.9634
height of solids (in)	0.684
height of voids (in)	0.280
void ratio	0.409
dry density (pcf)	119.65
moist density (pcf)	138.39

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand

LL:	43	
PL:	19	
PI:	24	
Gs:	2.70	Assumed

MOISTURE CONTENT, INITIAL

tare #	S5
wt soil&tare,moist	99.05
wt soil&tare,dry	91.33
wt tare	27.72
wt moisture	7.72
wt dry soil	63.61
% moisture	12.14%

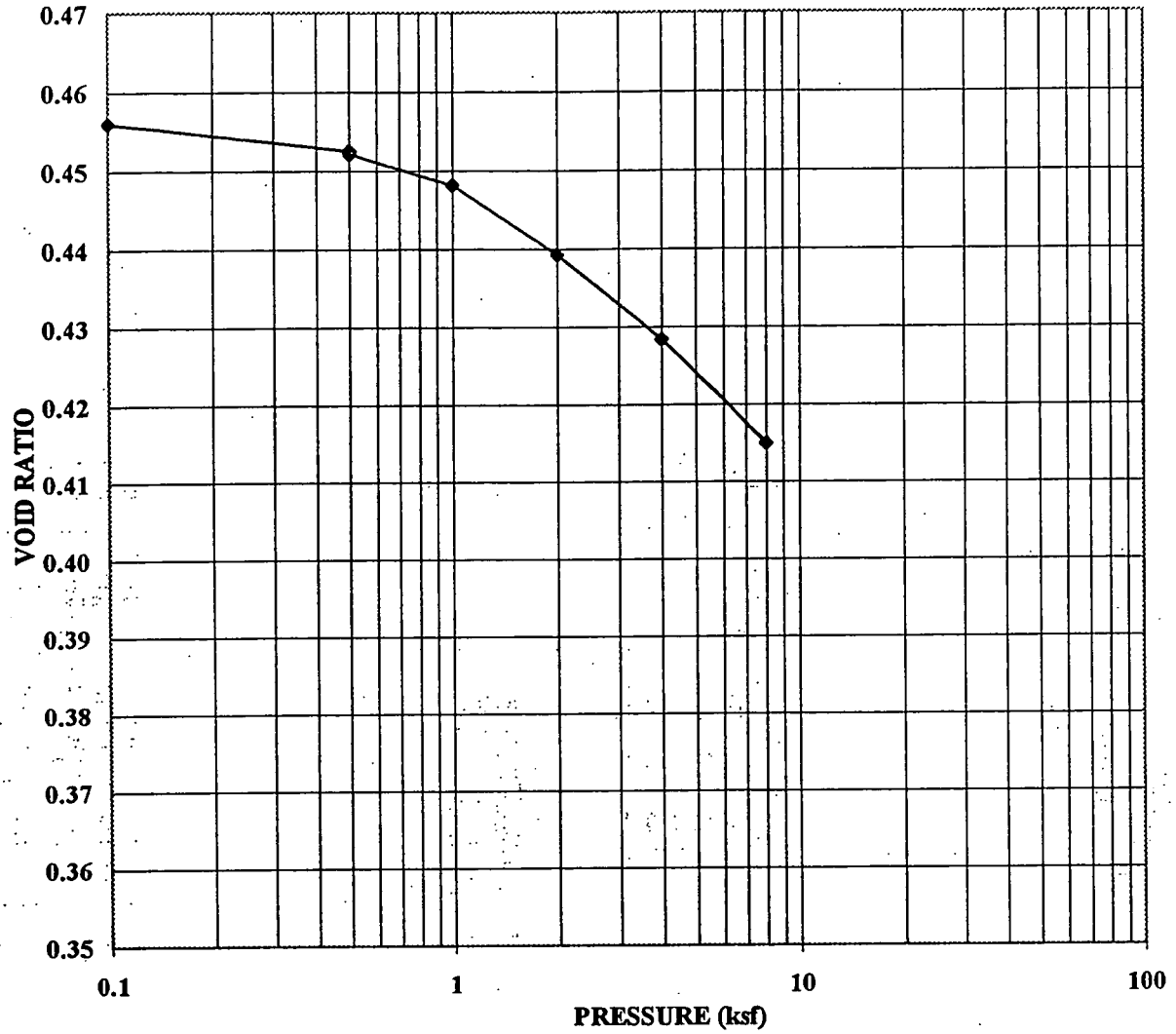
MOISTURE CONTENT, FINAL

tare #	8A
wt soil&tare,moist	204.64
wt soil&tare,dry	181.44
wt tare	33.29
wt moisture	23.20
wt dry soil	148.15
% moisture	15.66%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9940	-	-	115.7	0.456	-	-	-	-	-	-	
0.500	0.9916	-	-	116.0	0.453	-	-	-	-	-	-	
0.500	0.9913	-	-	116.0	0.452	-	-	-	-	-	-	
1.0	0.9886	0.9892	0.217	116.3	0.448	0.4946	1.2563	0.2446	1.5782	2.39E-02	2.23E+00	0.013
2.0	0.9825	0.9836	0.236	117.1	0.439	0.4918	1.2492	0.2419	1.5604	2.17E-02	2.03E+00	0.030
4.0	0.9751	0.9763	0.257	118.0	0.428	0.4882	1.2400	0.2383	1.5375	1.96E-02	1.83E+00	0.036
8.0	0.9660	0.9672	0.208	119.1	0.415	0.4836	1.2284	0.2339	1.5089	2.38E-02	2.22E+00	0.044

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-2

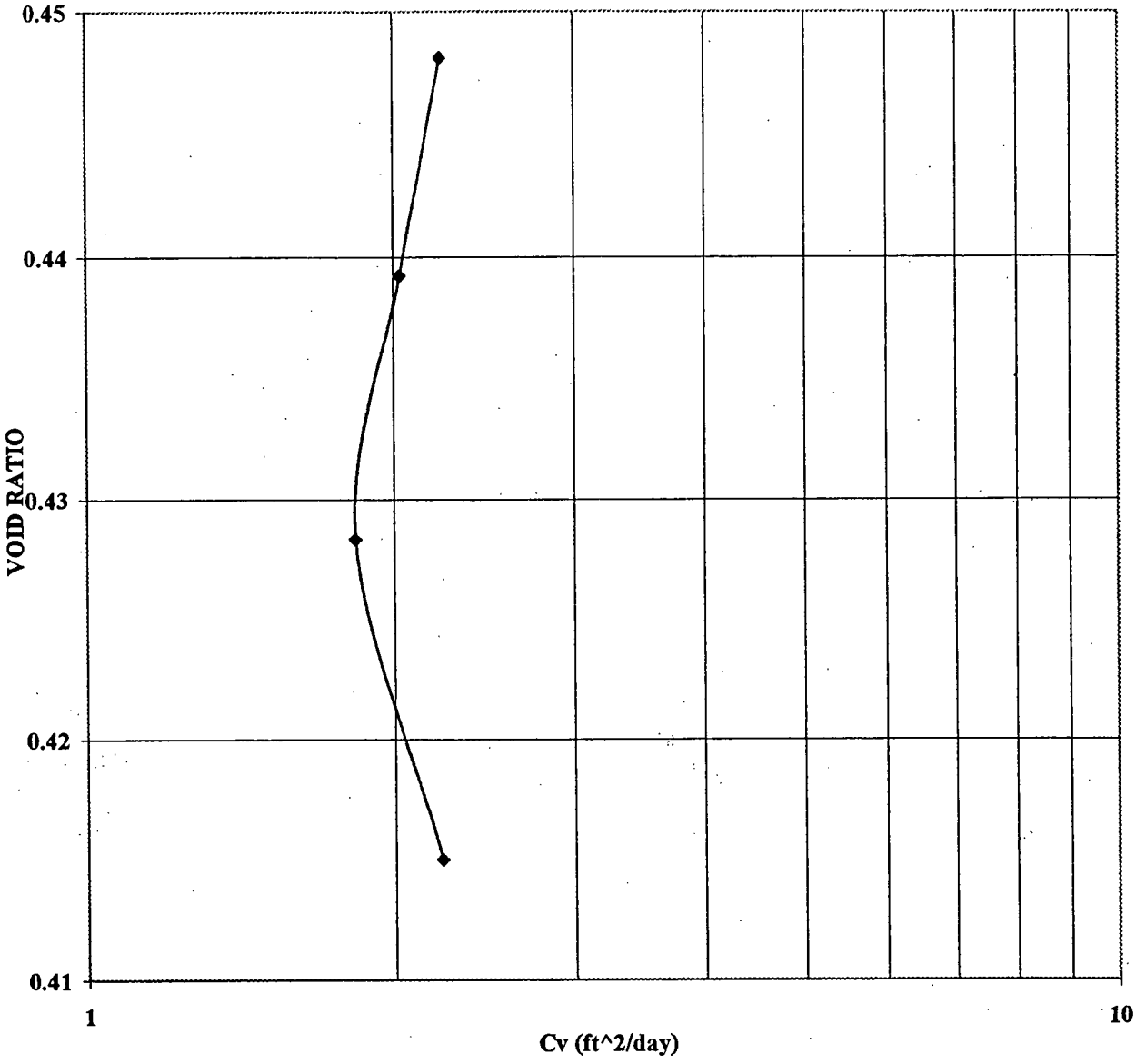
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-2

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO

043-2246-0001

GOLDER ASSOCIATES INC.

LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-3	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9980
diameter (in)	2.500
area (in^2)	4.909
volume (in^3)	4.899
specimen weight,wet (g)	167.08
specimen weight,dry (g)	148.28
water weight (g)	18.80

SAMPLE DATA, INITIAL

total height (in)	0.998
height of solids (in)	0.690
height of voids (in)	0.308
void ratio	0.446
dry density (pcf)	115.05
moist density (pcf)	129.92

SAMPLE DATA, FINAL

total height (in)	0.9700
height of solids (in)	0.690
height of voids (in)	0.280
void ratio	0.406
dry density (pcf)	118.64
moist density (pcf)	136.94

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand with gravel

LL:	43	
PL:	18	
PI:	25	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	K10
wt soil&tare,moist	59.28
wt soil&tare,dry	55.06
wt tare	21.77
wt moisture	4.22
wt dry soil	33.29
% moisture	12.68%

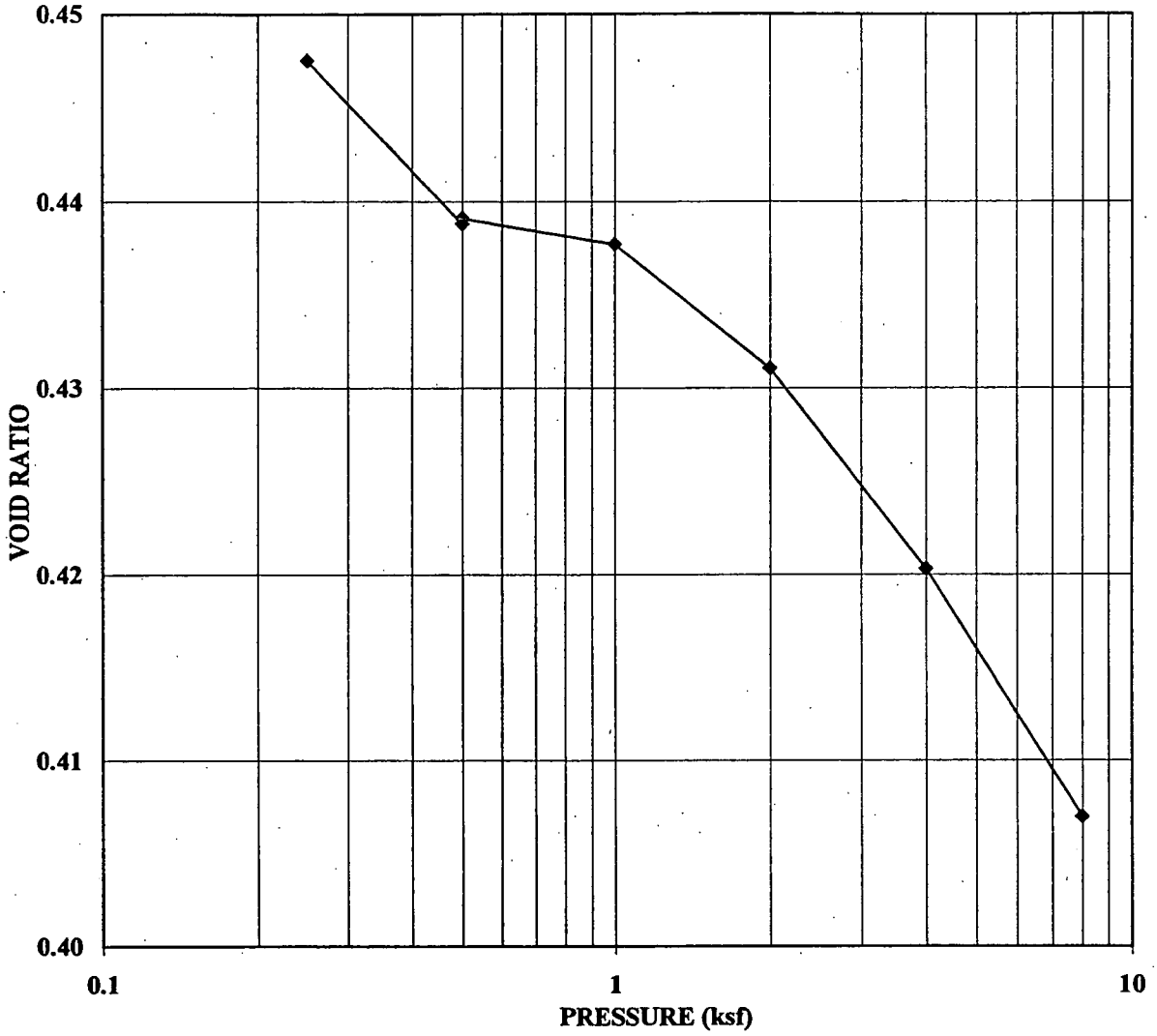
MOISTURE CONTENT, FINAL

tare #	F22
wt soil&tare,moist	204.05
wt soil&tare,dry	181.10
wt tare	32.38
wt moisture	22.95
wt dry soil	148.72
% moisture	15.43%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.25	0.9976	-	-	115.1	0.448	-	-	-	-	-	-	
0.50	0.9916	-	-	115.8	0.439	-	-	-	-	-	-	
0.50	0.9918	-	-	115.8	0.439	-	-	-	-	-	-	
1.0	0.9908	0.9910	0.2011	115.9	0.438	0.4955	1.2586	0.2455	1.5841	2.59E-02	2.41E+00	0.005
2.0	0.9863	0.9870	0.2262	116.4	0.431	0.4935	1.2534	0.2435	1.5711	2.28E-02	2.13E+00	0.022
4.0	0.9788	0.9800	0.2470	117.3	0.420	0.4900	1.2446	0.2401	1.5489	2.06E-02	1.92E+00	0.036
8.0	0.9696	0.9710	0.2131	118.4	0.407	0.4855	1.2332	0.2357	1.5207	2.34E-02	2.19E+00	0.044

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-3

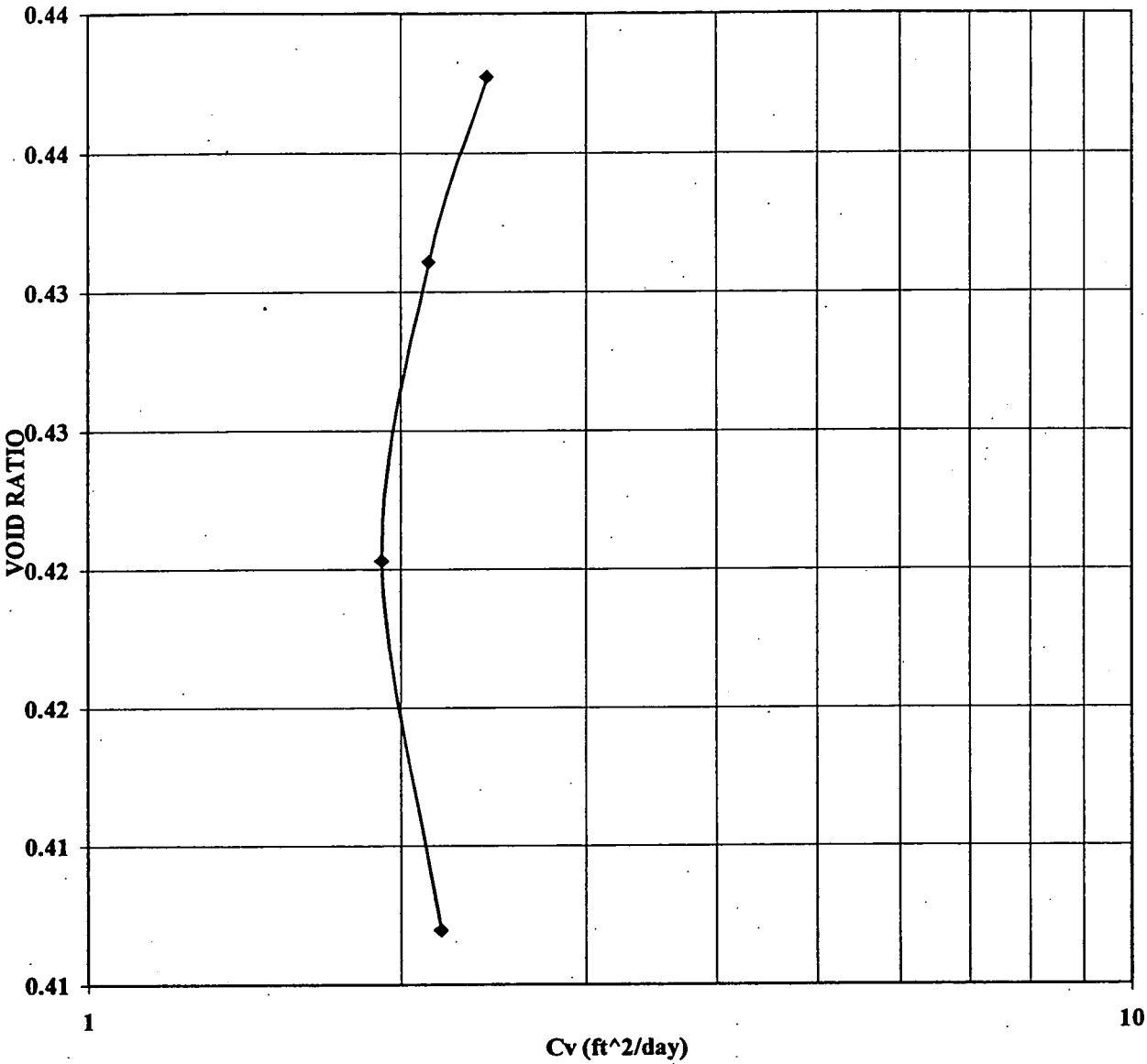
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-3

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-4	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9980
diameter (in)	2.497
area (in^2)	4.897
volume (in^3)	4.887
specimen weight,wet (g)	169.32
specimen weight,dry (g)	150.10
water weight (g)	19.22

SAMPLE DATA, INITIAL

total height (in)	0.998
height of solids (in)	0.700
height of voids (in)	0.298
void ratio	0.425
dry density (pcf)	116.74
moist density (pcf)	131.98

SAMPLE DATA, FINAL

total height (in)	0.9547
height of solids (in)	0.700
height of voids (in)	0.255
void ratio	0.364
dry density (pcf)	122.31
moist density (pcf)	140.81

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand (SC)

LL:	35	
PL:	16	
PI:	19	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	Z2
wt soil&tare,moist	108.21
wt soil&tare,dry	99.13
wt tare	28.22
wt moisture	9.08
wt dry soil	70.91
% moisture	12.80%

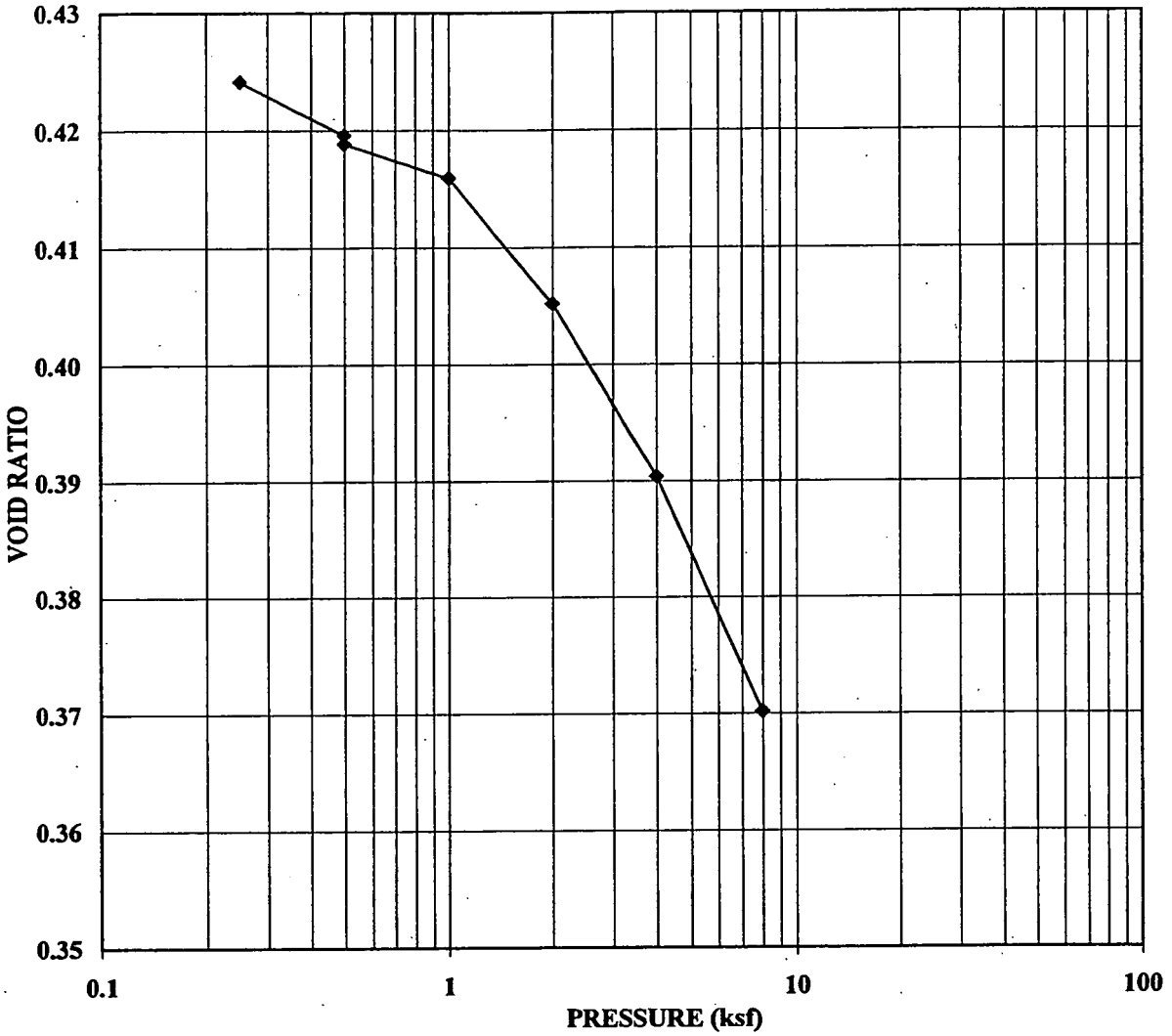
MOISTURE CONTENT, FINAL

tare #	F19
wt soil&tare,moist	205.94
wt soil&tare,dry	183.10
wt tare	32.11
wt moisture	22.84
wt dry soil	150.99
% moisture	15.13%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.25	0.9959	-	-	117.0	0.424	-	-	-	-	-	-	
0.50	0.9927	-	-	117.4	0.420	-	-	-	-	-	-	
0.50	0.9922	-	-	117.4	0.419	-	-	-	-	-	-	
1.0	0.9902	0.9906	0.2544	117.7	0.416	0.4953	1.2581	0.2453	1.5828	2.04E-02	1.91E+00	0.010
2.0	0.9826	0.9836	0.1999	118.6	0.405	0.4918	1.2492	0.2419	1.5605	2.56E-02	2.39E+00	0.036
4.0	0.9723	0.9736	0.2905	119.8	0.390	0.4868	1.2364	0.2369	1.5287	1.73E-02	1.61E+00	0.049
8.0	0.9582	0.9601	0.1989	121.6	0.370	0.4801	1.2194	0.2305	1.4868	2.45E-02	2.29E+00	0.067

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-4

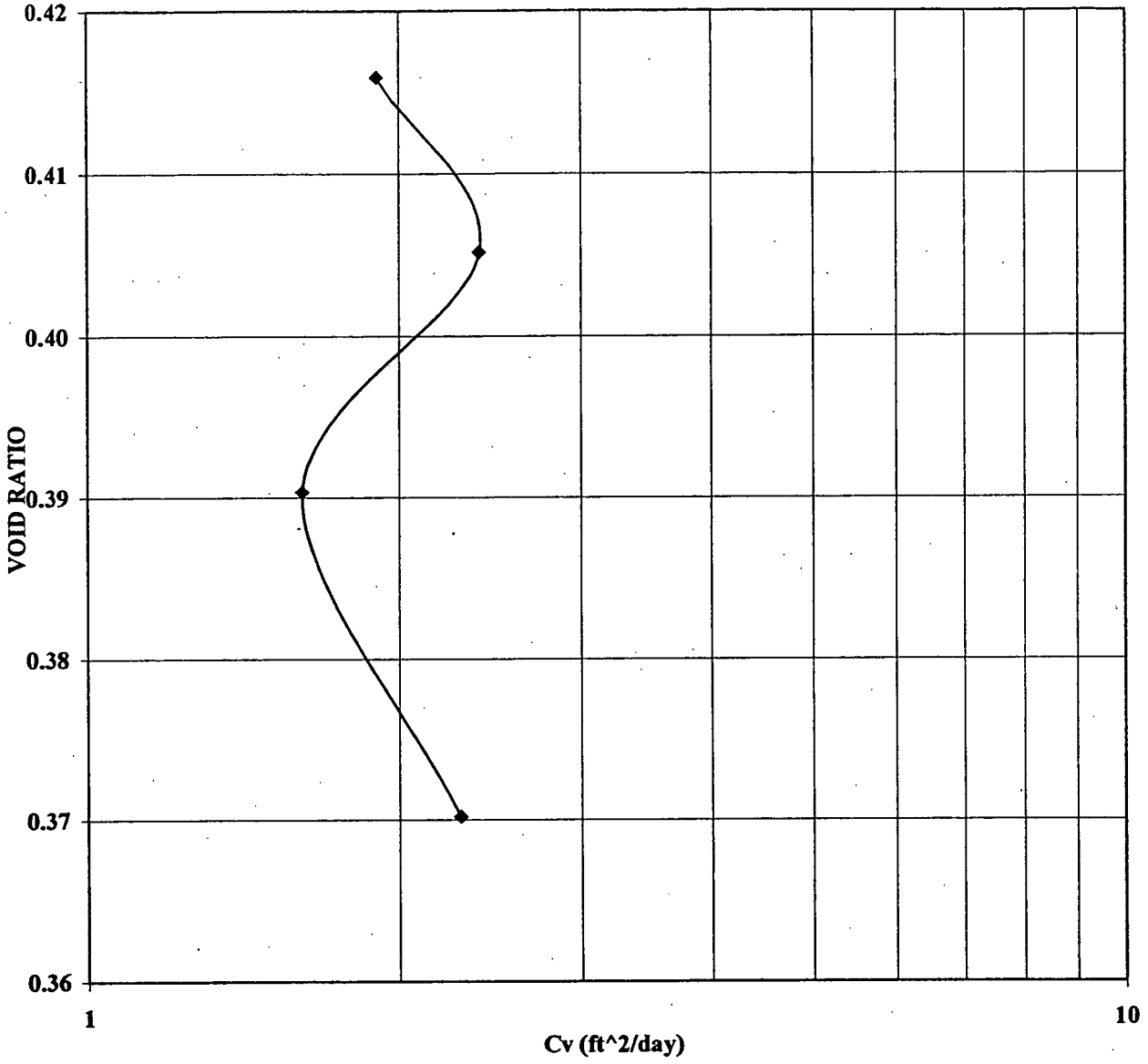
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand (SC)

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-4

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand (SC)

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-5	DATE	8/12/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9970
diameter (in)	2.499
area (in^2)	4.905
volume (in^3)	4.890
specimen weight,wet (g)	168.40
specimen weight,dry (g)	150.37
water weight (g)	18.03

SAMPLE DATA, INITIAL

total height (in)	0.997
height of solids (in)	0.700
height of voids (in)	0.297
void ratio	0.424
dry density (pcf)	116.89
moist density (pcf)	131.19

SAMPLE DATA, FINAL

total height (in)	0.9547
height of solids (in)	0.700
height of voids (in)	0.254
void ratio	0.363
dry density (pcf)	122.33
moist density (pcf)	140.32

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

LL:	37	
PL:	19	
PI:	18	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	AZ
wt soil&tare,moist	96.11
wt soil&tare,dry	88.94
wt tare	29.13
wt moisture	7.17
wt dry soil	59.81
% moisture	11.99%

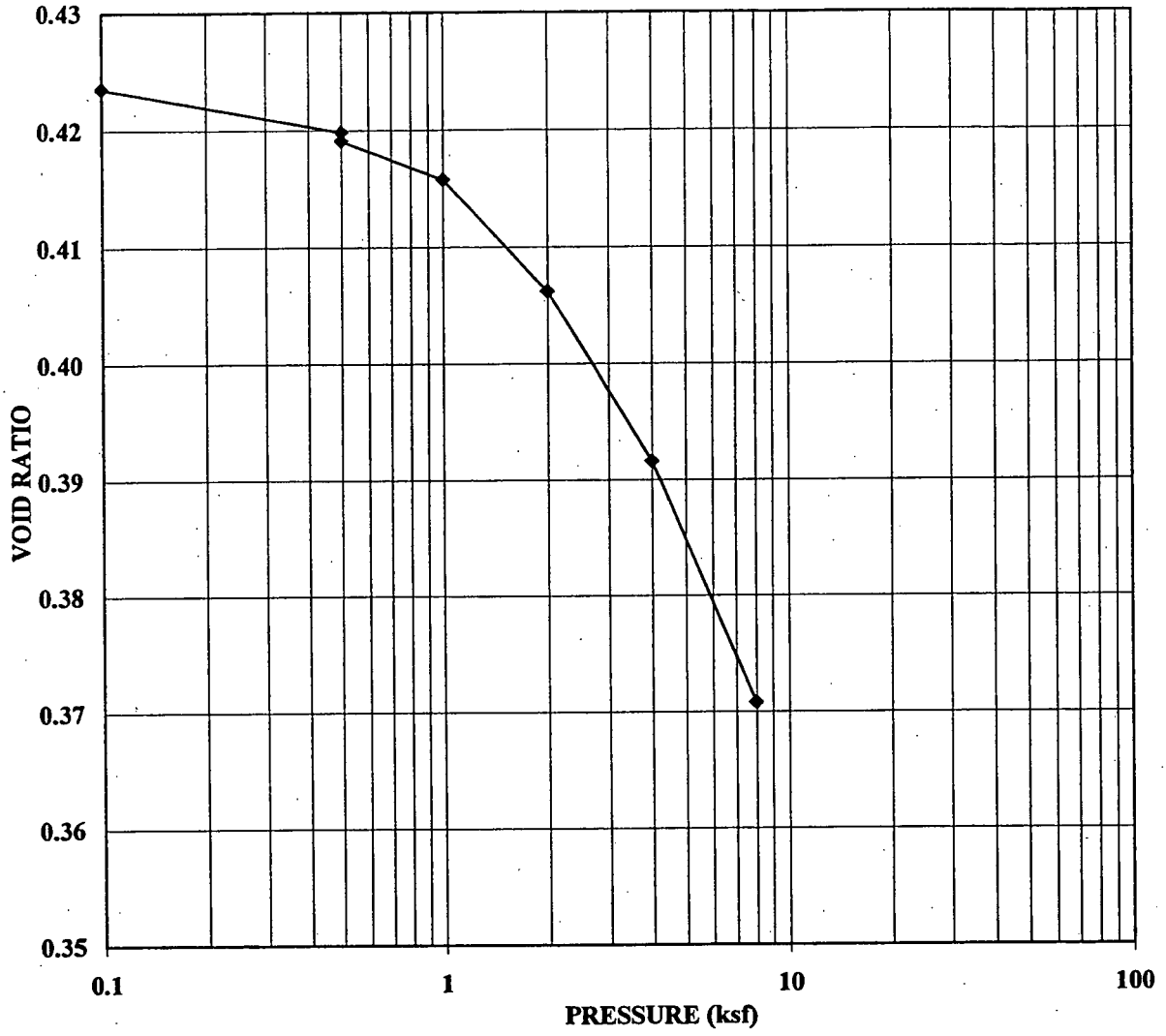
MOISTURE CONTENT, FINAL

tare #	F24
wt soil&tare,moist	201.73
wt soil&tare,dry	179.65
wt tare	29.48
wt moisture	22.08
wt dry soil	150.17
% moisture	14.70%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9957	-	-	117.0	0.424	-	-	-	-	-	-	
0.500	0.9931	-	-	117.3	0.420	-	-	-	-	-	-	
0.500	0.9926	-	-	117.4	0.419	-	-	-	-	-	-	
1.0	0.9903	0.9909	0.421	117.7	0.416	0.4954	1.2584	0.2455	1.5836	1.24E-02	1.15E+00	0.011
2.0	0.9836	0.9846	0.210	118.5	0.406	0.4923	1.2505	0.2424	1.5638	2.44E-02	2.28E+00	0.032
4.0	0.9733	0.9747	0.222	119.7	0.392	0.4874	1.2379	0.2375	1.5325	2.27E-02	2.11E+00	0.049
8.0	0.9588	0.9609	0.180	121.5	0.371	0.4804	1.2203	0.2308	1.4892	2.71E-02	2.53E+00	0.069

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-5

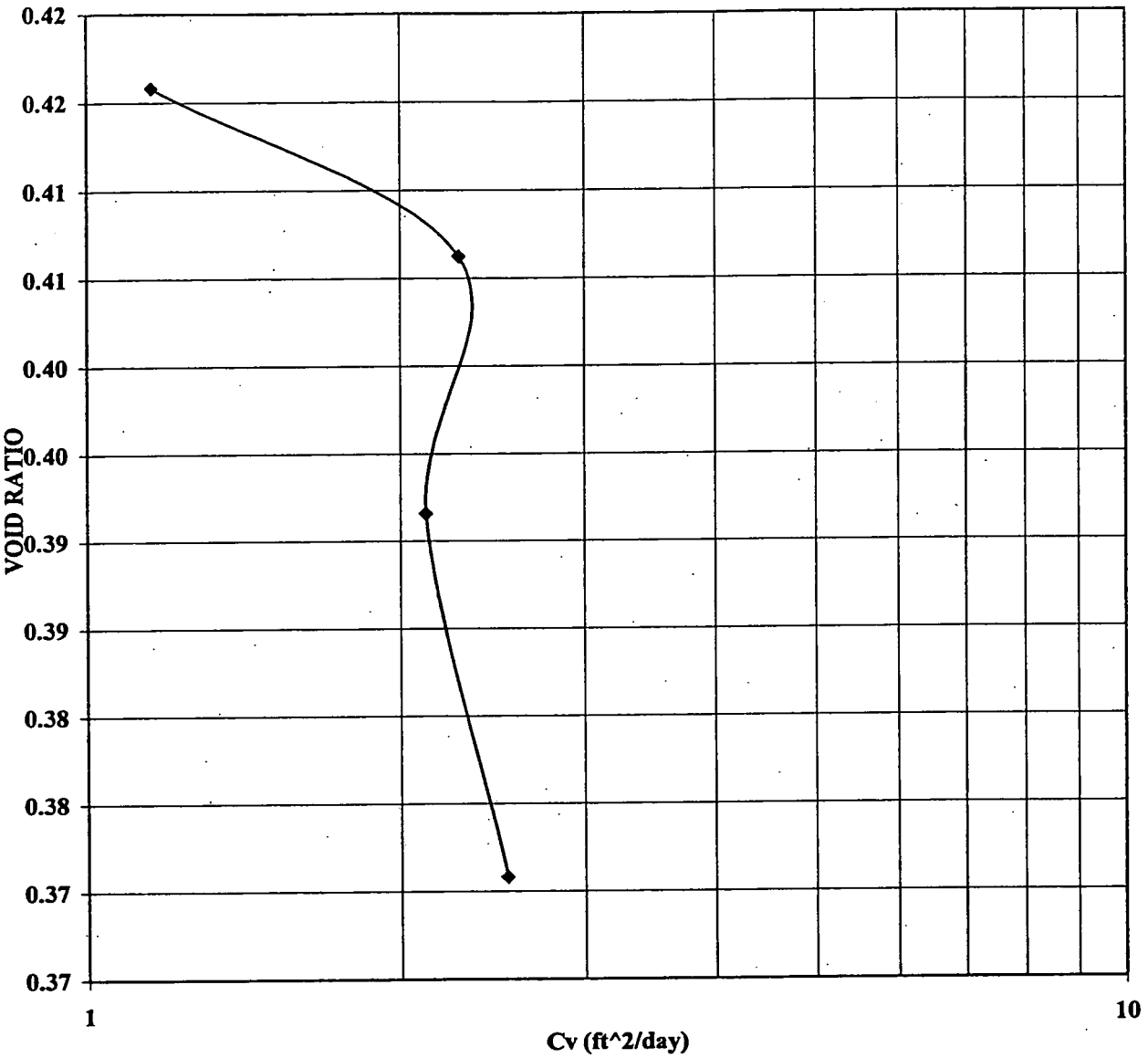
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-5

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-5 Dup	DATE	8/12/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9960
diameter (in)	2.498
area (in^2)	4.901
volume (in^3)	4.881
specimen weight,wet (g)	168.10
specimen weight,dry (g)	148.03
water weight (g)	20.07

SAMPLE DATA, INITIAL

total height (in)	0.996
height of solids (in)	0.690
height of voids (in)	0.306
void ratio	0.444
dry density (pcf)	115.27
moist density (pcf)	131.19

SAMPLE DATA, FINAL

total height (in)	0.9450
height of solids (in)	0.690
height of voids (in)	0.255
void ratio	0.370
dry density (pcf)	121.76
moist density (pcf)	139.81

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand (SC)

LL:	40	
PL:	19	
PI:	21	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	R3
wt soil&tare,moist	90.94
wt soil&tare,dry	83.94
wt tare	32.31
wt moisture	7.00
wt dry soil	51.63
% moisture	13.56%

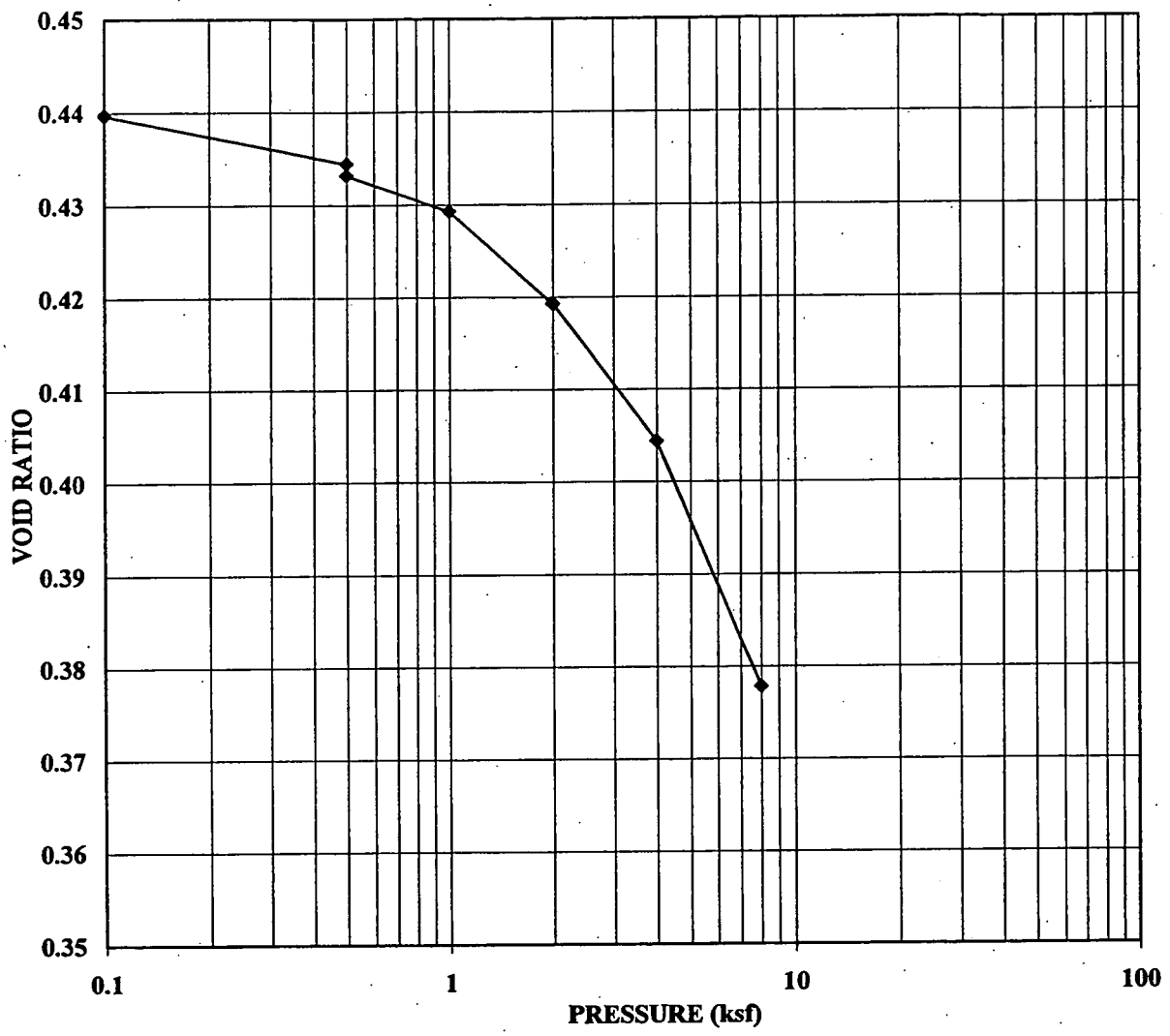
MOISTURE CONTENT, FINAL

tare #	DC3
wt soil&tare,moist	204.30
wt soil&tare,dry	182.30
wt tare	33.86
wt moisture	22.00
wt dry soil	148.44
% moisture	14.82%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9921	-	-	115.7	0.440	-	-	-	-	-	-	
0.500	0.9885	-	-	116.1	0.434	-	-	-	-	-	-	
0.500	0.9876	-	-	116.3	0.433	-	-	-	-	-	-	
1.0	0.9849	0.9854	0.218	116.6	0.429	0.4927	1.2514	0.2427	1.5660	2.35E-02	2.20E+00	0.013
2.0	0.9780	0.9790	0.227	117.4	0.419	0.4895	1.2434	0.2396	1.5460	2.24E-02	2.09E+00	0.033
4.0	0.9678	0.9694	0.214	118.6	0.404	0.4847	1.2312	0.2350	1.5158	2.33E-02	2.17E+00	0.049
8.0	0.9495	0.9529	0.327	120.9	0.378	0.4765	1.2102	0.2270	1.4646	1.47E-02	1.37E+00	0.088

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



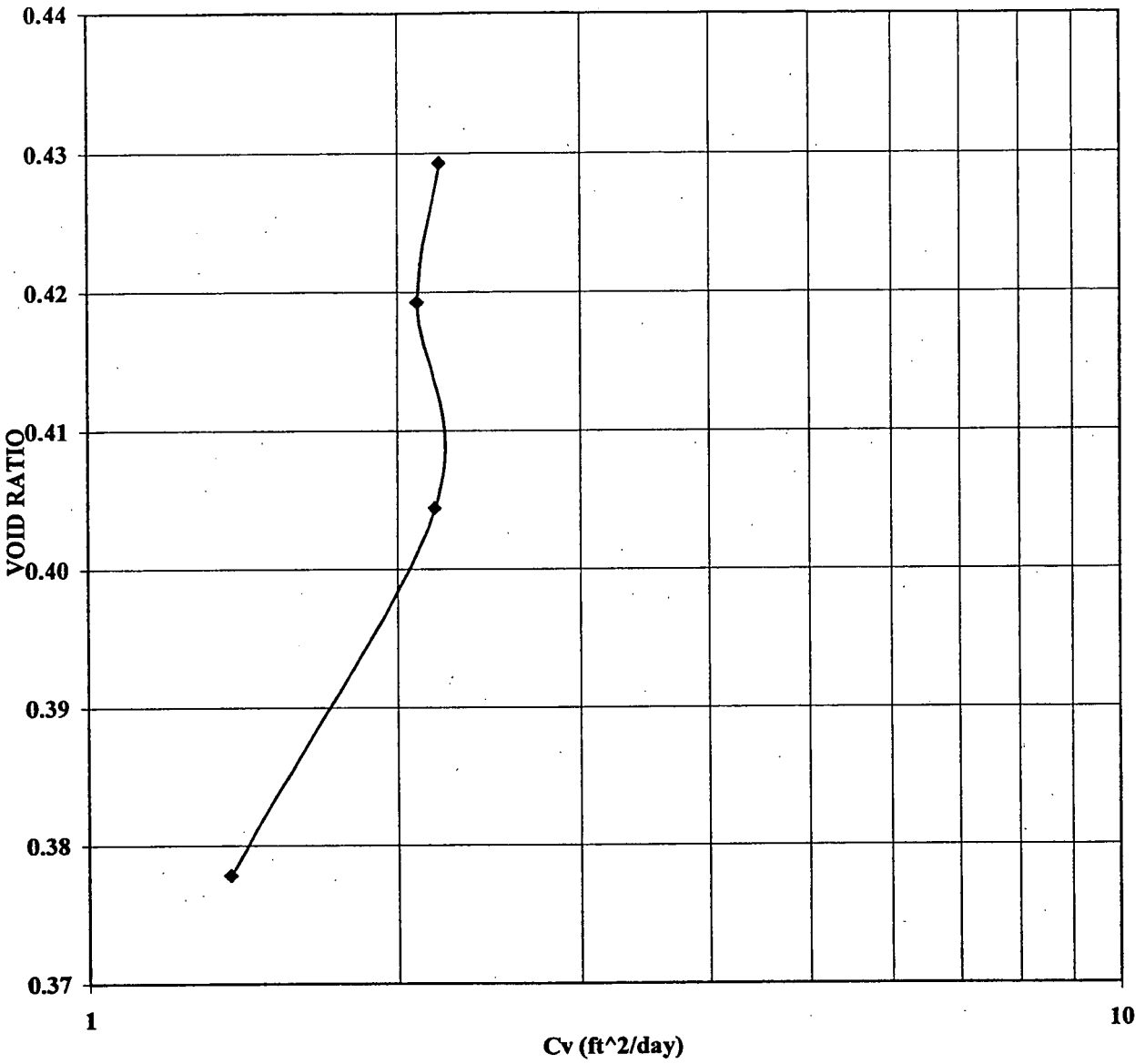
SAMPLE #:	**PF-5 Dup**
DESCRIPTION:	Yellowish brown (10 YR 5/8) clayey sand (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-5 Dup

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-6	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9950
diameter (in)	2.497
area (in^2)	4.897
volume (in^3)	4.872
specimen weight,wet (g)	167.67
specimen weight,dry (g)	146.07
water weight (g)	21.60

SAMPLE DATA, INITIAL

total height (in)	0.995
height of solids (in)	0.681
height of voids (in)	0.314
void ratio	0.460
dry density (pcf)	113.95
moist density (pcf)	131.09

SAMPLE DATA, FINAL

total height (in)	0.9400
height of solids (in)	0.681
height of voids (in)	0.259
void ratio	0.380
dry density (pcf)	120.89
moist density (pcf)	140.53

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand with gravel

LL:	45	
PL:	20	
PI:	25	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	19B
wt soil&tare,moist	105.86
wt soil&tare,dry	95.40
wt tare	24.65
wt moisture	10.46
wt dry soil	70.75
% moisture	14.78%

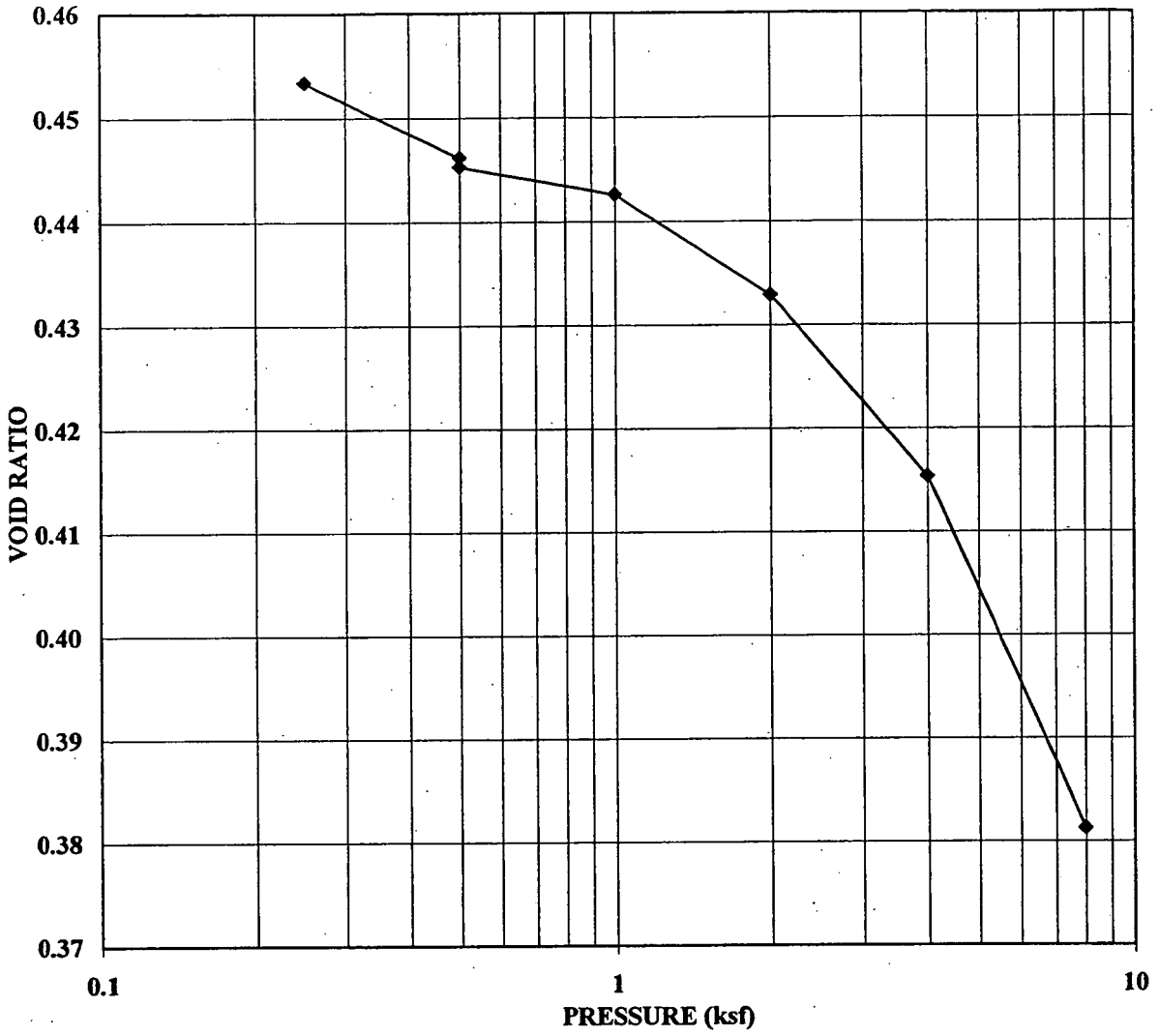
MOISTURE CONTENT, FINAL

tare #	C5L
wt soil&tare,moist	203.43
wt soil&tare,dry	179.67
wt tare	33.45
wt moisture	23.76
wt dry soil	146.22
% moisture	16.25%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.250	0.9891	-	-	114.6	0.453	-	-	-	-	-	-	
0.500	0.9842	-	-	115.2	0.446	-	-	-	-	-	-	
0.500	0.9836	-	-	115.3	0.445	-	-	-	-	-	-	
1.0	0.9818	0.9822	0.2545	115.5	0.443	0.4911	1.2474	0.2412	1.5561	2.01E-02	1.87E+00	0.009
2.0	0.9752	0.9763	0.1780	116.3	0.433	0.4881	1.2398	0.2383	1.5372	2.84E-02	2.65E+00	0.032
4.0	0.9632	0.9655	0.2242	117.7	0.415	0.4828	1.2262	0.2331	1.5036	2.20E-02	2.05E+00	0.058
8.0	0.9400	0.9444	0.4444	120.6	0.381	0.4722	1.1995	0.2230	1.4387	1.06E-02	9.92E-01	0.113

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



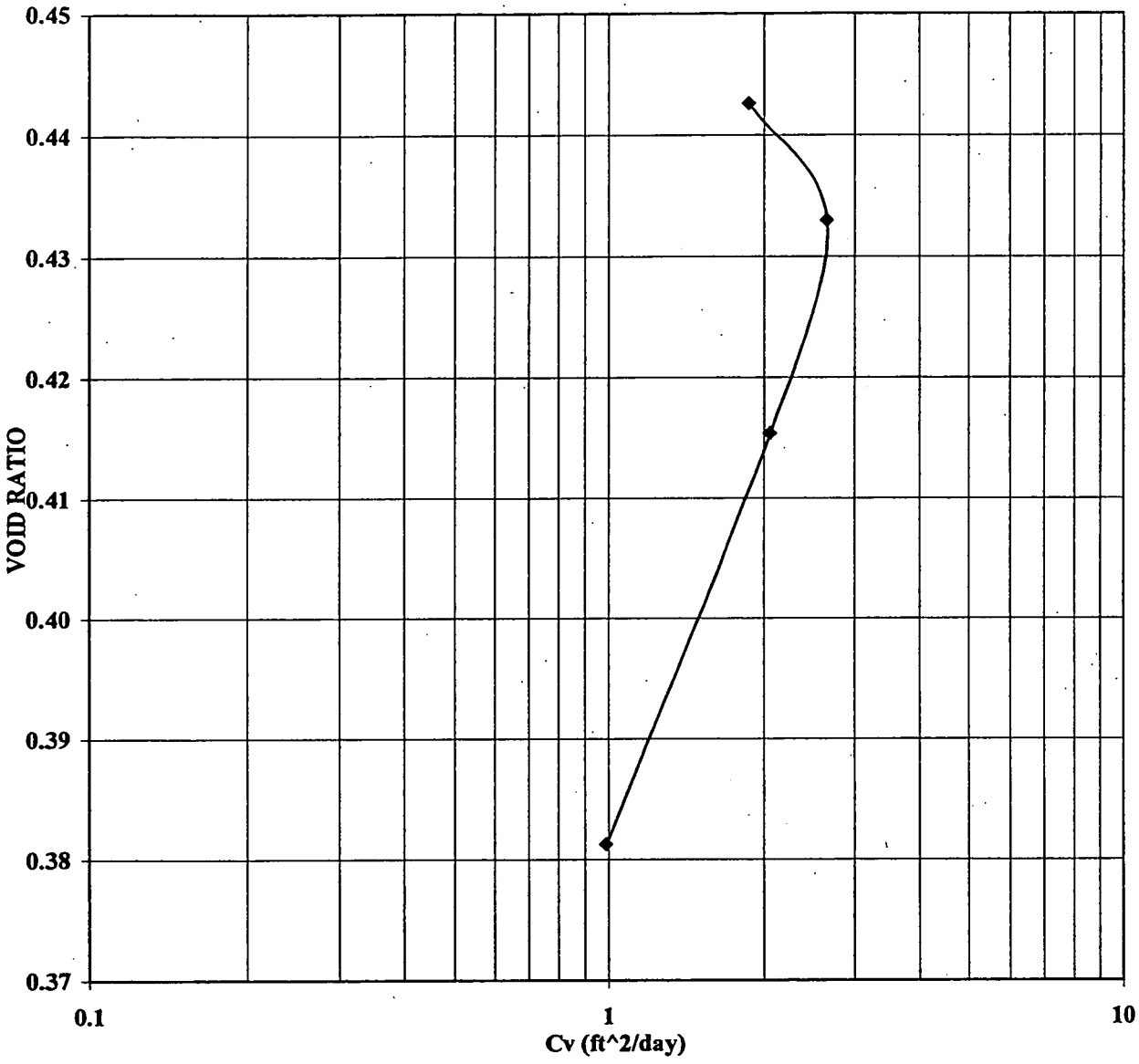
SAMPLE #:	**PF-6**
DESCRIPTION:	Yellowish brown (10 YR 5/8) clayey sand with gravel

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #:	**PF-6**
DESCRIPTION:	Yellowish brown (10 YR 5/8) clayey sand with gravel

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-7	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9960
diameter (in)	2.498
area (in^2)	4.901
volume (in^3)	4.881
specimen weight,wet (g)	172.91
specimen weight,dry (g)	154.21
water weight (g)	18.70

SAMPLE DATA, INITIAL

total height (in)	0.996
height of solids (in)	0.719
height of voids (in)	0.277
void ratio	0.386
dry density (pcf)	120.09
moist density (pcf)	134.94

SAMPLE DATA, FINAL

total height (in)	0.9682
height of solids (in)	0.719
height of voids (in)	0.249
void ratio	0.347
dry density (pcf)	123.81
moist density (pcf)	141.03

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand (SC)

LL:	35	
PL:	18	
PI:	17	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	K3
wt soil&tare,moist	75.07
wt soil&tare,dry	69.33
wt tare	21.99
wt moisture	5.74
wt dry soil	47.34
% moisture	12.13%

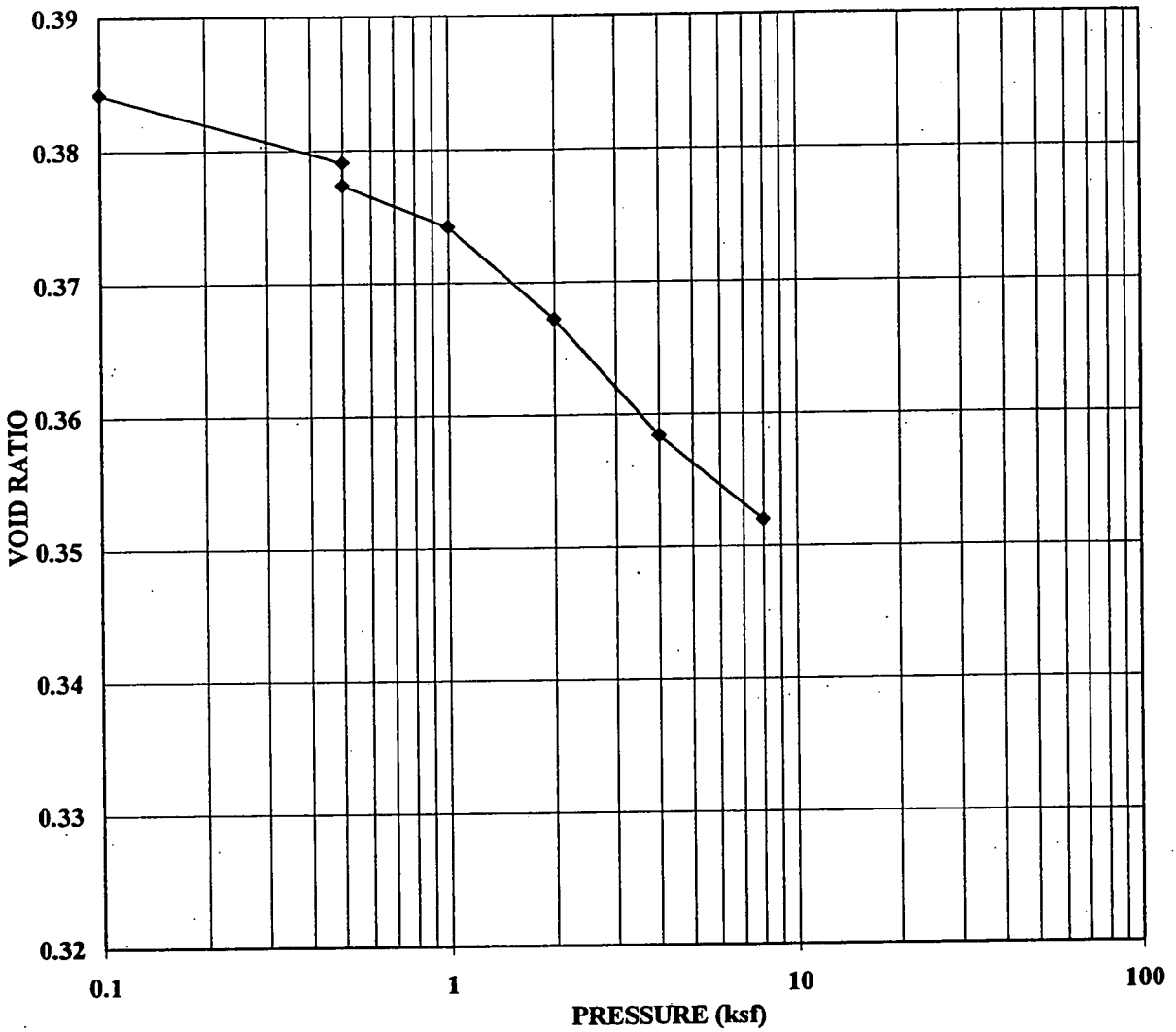
MOISTURE CONTENT, FINAL

tare #	F18
wt soil&tare,moist	210.79
wt soil&tare,dry	189.27
wt tare	34.56
wt moisture	21.52
wt dry soil	154.71
% moisture	13.91%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9937	-	-	120.4	0.384	-	-	-	-	-	-	
0.500	0.9900	-	-	120.8	0.379	-	-	-	-	-	-	
0.500	0.9888	-	-	121.0	0.377	-	-	-	-	-	-	
1.0	0.9865	0.9869	0.3428	121.2	0.374	0.4935	1.2534	0.2435	1.5710	1.50E-02	1.40E+00	0.011
2.0	0.9815	0.9821	0.2173	121.9	0.367	0.4911	1.2473	0.2411	1.5557	2.35E-02	2.19E+00	0.023
4.0	0.9751	0.9760	0.2546	122.7	0.358	0.4880	1.2395	0.2381	1.5364	1.98E-02	1.85E+00	0.030
8.0	0.9706	0.9717	0.2321	123.2	0.352	0.4858	1.2340	0.2360	1.5229	2.15E-02	2.01E+00	0.021

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



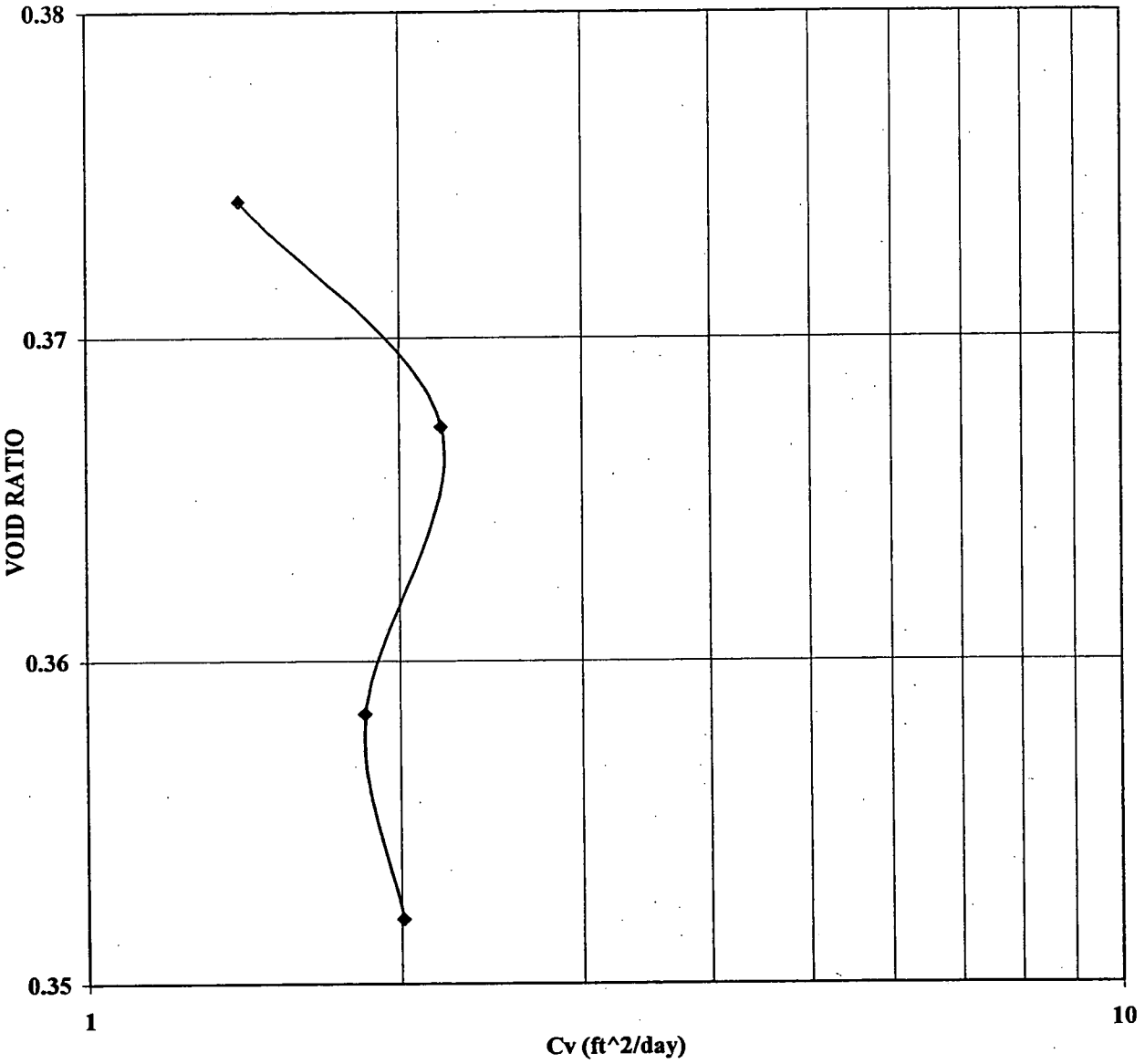
SAMPLE #:	PF-7
DESCRIPTION:	Yellowish brown (10 YR 5/8) clayey sand (SC)

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-7

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand (SC)

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-8	DATE	8/12/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9970
diameter (in)	2.498
area (in^2)	4.901
volume (in^3)	4.886
specimen weight,wet (g)	163.81
specimen weight,dry (g)	143.39
water weight (g)	20.42

SAMPLE DATA, INITIAL

total height (in)	0.997
height of solids (in)	0.668
height of voids (in)	0.329
void ratio	0.492
dry density (pcf)	111.54
moist density (pcf)	127.71

SAMPLE DATA, FINAL

total height (in)	0.9368
height of solids (in)	0.668
height of voids (in)	0.268
void ratio	0.402
dry density (pcf)	118.97
moist density (pcf)	137.85

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

LL:	41	
PL:	19	
PI:	22	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	19B
wt soil&tare,moist	87.78
wt soil&tare,dry	79.91
wt tare	24.66
wt moisture	7.87
wt dry soil	55.25
% moisture	14.24%

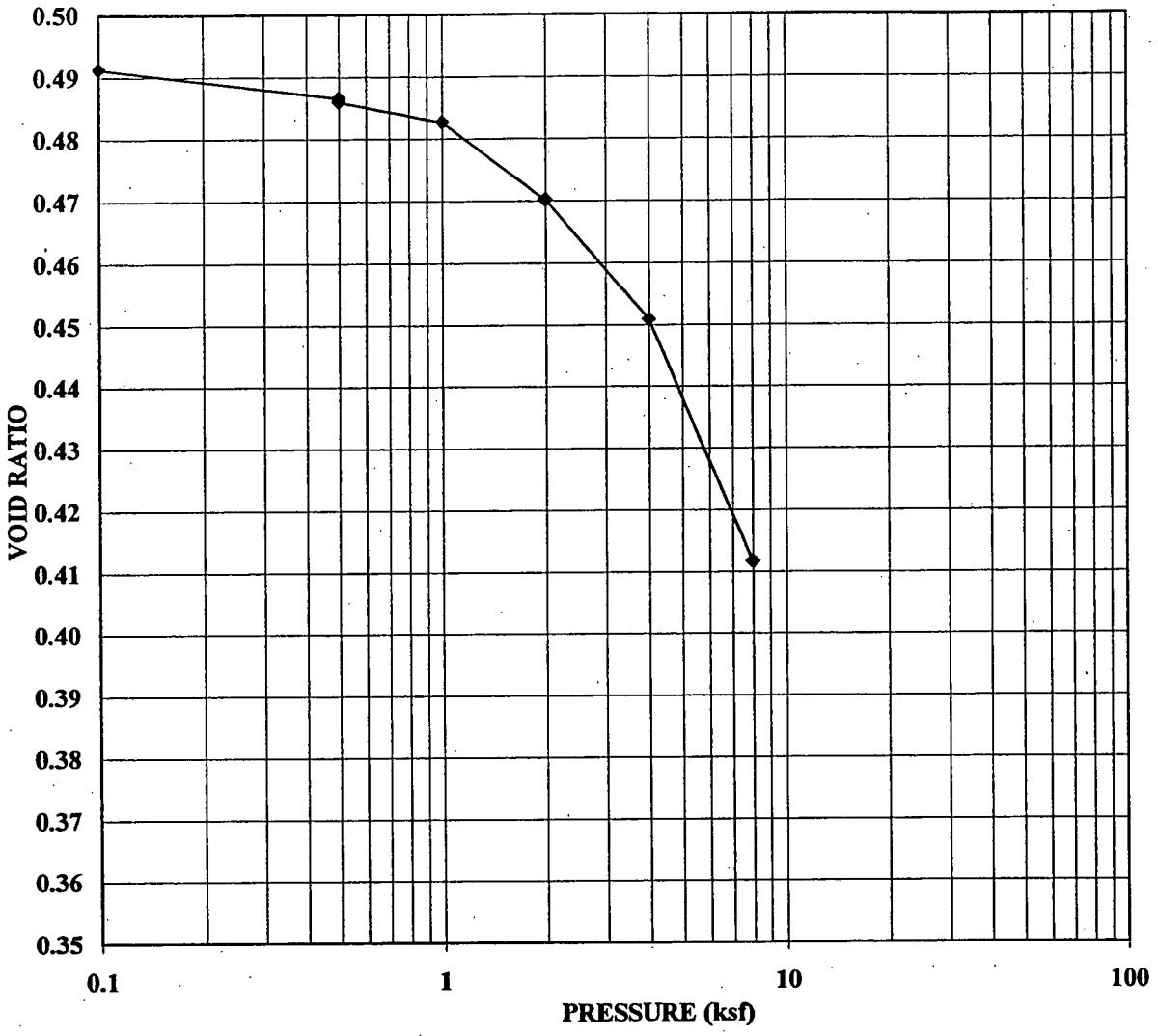
MOISTURE CONTENT, FINAL

tare #	3A
wt soil&tare,moist	199.91
wt soil&tare,dry	177.12
wt tare	33.51
wt moisture	22.79
wt dry soil	143.61
% moisture	15.87%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9954	-	-	111.7	0.491	-	-	-	-	-	-	
0.500	0.9923	-	-	112.1	0.487	-	-	-	-	-	-	
0.500	0.9919	-	-	112.1	0.486	-	-	-	-	-	-	
1.0	0.9897	0.9903	0.255	112.4	0.483	0.4951	1.2576	0.2452	1.5817	2.04E-02	1.90E+00	0.011
2.0	0.9813	0.9828	0.255	113.3	0.470	0.4914	1.2482	0.2415	1.5580	2.01E-02	1.87E+00	0.042
4.0	0.9684	0.9710	0.194	114.8	0.451	0.4855	1.2332	0.2357	1.5207	2.57E-02	2.40E+00	0.064
8.0	0.9423	0.9462	0.207	118.0	0.412	0.4731	1.2017	0.2238	1.4440	2.29E-02	2.14E+00	0.130

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-8

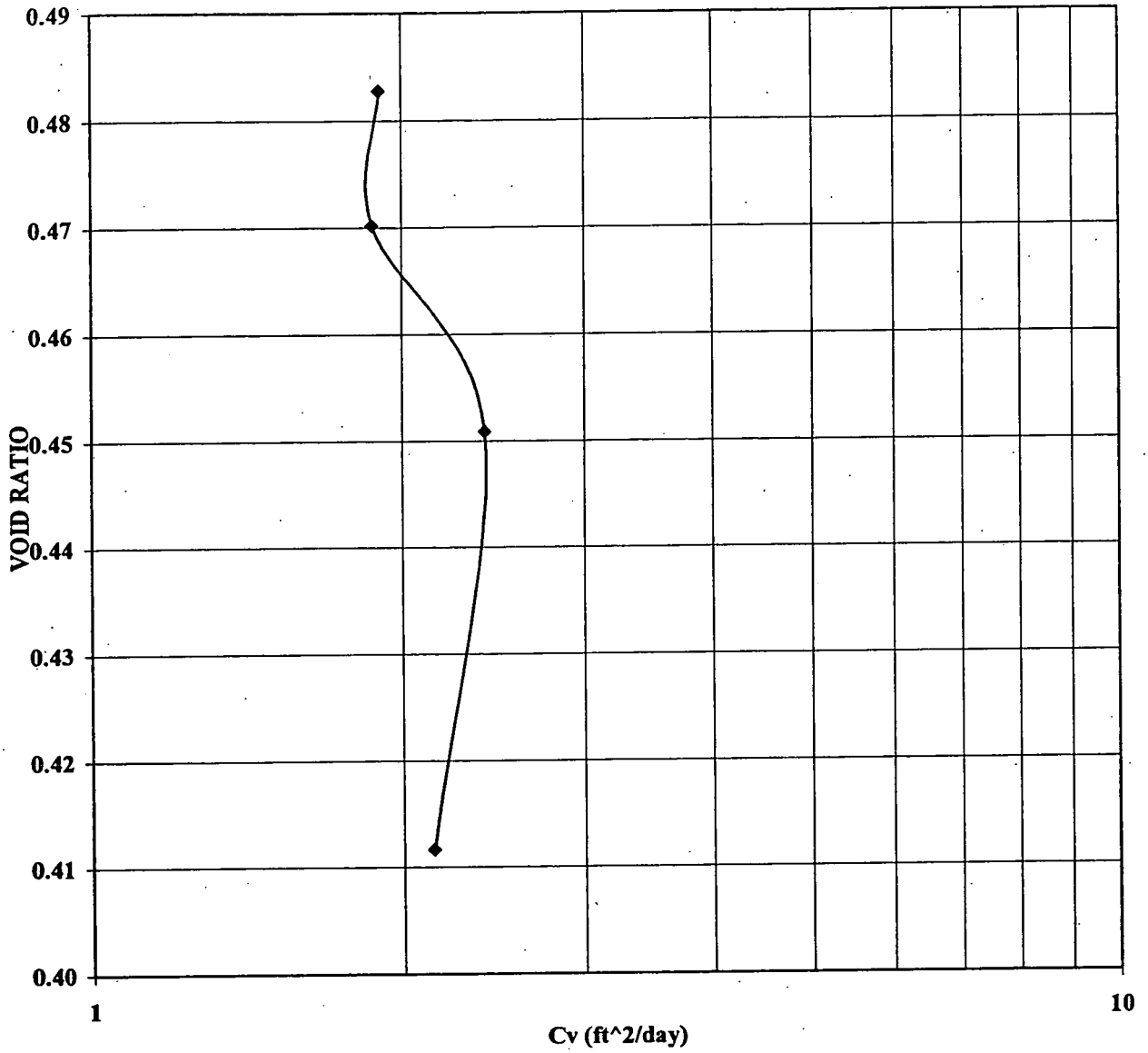
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-8

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO	SAMPLE:	PF-9	DATE	8/4/2004
043-2246-0001			TECH	NG
			REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9920
diameter (in)	2.498
area (in^2)	4.901
volume (in^3)	4.862
specimen weight,wet (g)	171.10
specimen weight,dry (g)	152.84
water weight (g)	18.26

SAMPLE DATA, INITIAL

total height (in)	0.992
height of solids (in)	0.712
height of voids (in)	0.280
void ratio	0.392
dry density (pcf)	119.50
moist density (pcf)	134.07

SAMPLE DATA, FINAL

total height (in)	0.9714
height of solids (in)	0.712
height of voids (in)	0.259
void ratio	0.364
dry density (pcf)	122.30
moist density (pcf)	138.47

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand

LL:	38	
PL:	18	
PI:	20	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	K20
wt soil&tare,moist	102.29
wt soil&tare,dry	93.70
wt tare	21.79
wt moisture	8.59
wt dry soil	71.91
% moisture	11.95%

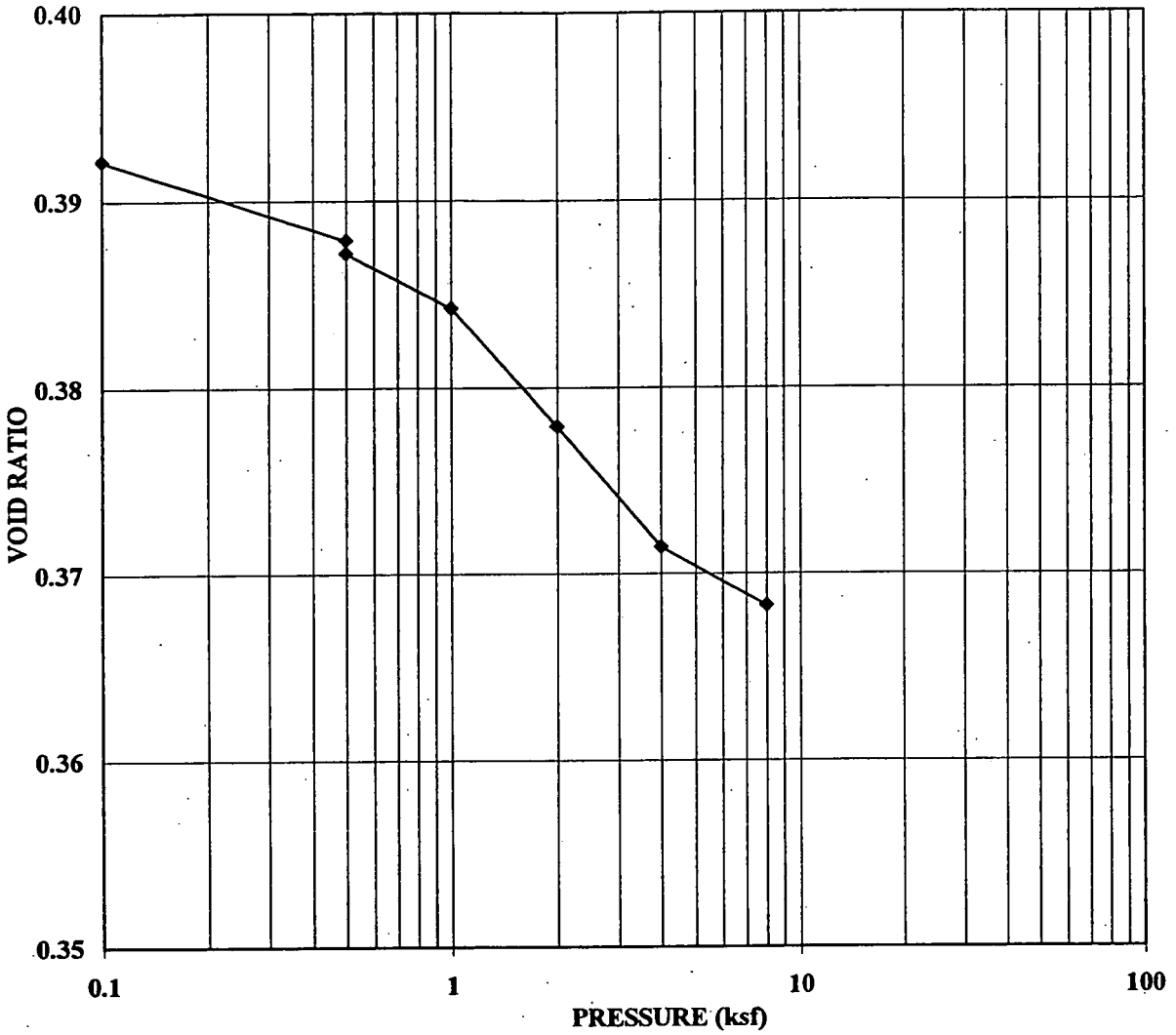
MOISTURE CONTENT, FINAL

tare #	4A
wt soil&tare,moist	206.51
wt soil&tare,dry	186.28
wt tare	33.19
wt moisture	20.23
wt dry soil	153.09
% moisture	13.21%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9905	-	-	119.7	0.392	-	-	-	-	-	-	
0.500	0.9875	-	-	120.0	0.388	-	-	-	-	-	-	
0.500	0.9870	-	-	120.1	0.387	-	-	-	-	-	-	
1.0	0.9849	0.9854	0.2185	120.4	0.384	0.4927	1.2514	0.2427	1.5660	2.35E-02	2.20E+00	0.010
2.0	0.9804	0.9810	0.2546	120.9	0.378	0.4905	1.2459	0.2406	1.5523	2.00E-02	1.87E+00	0.021
4.0	0.9758	0.9762	0.2599	121.5	0.371	0.4881	1.2398	0.2383	1.5371	1.94E-02	1.81E+00	0.021
8.0	0.9735	0.9743	0.1964	121.8	0.368	0.4872	1.2374	0.2373	1.5311	2.56E-02	2.39E+00	0.010

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-9

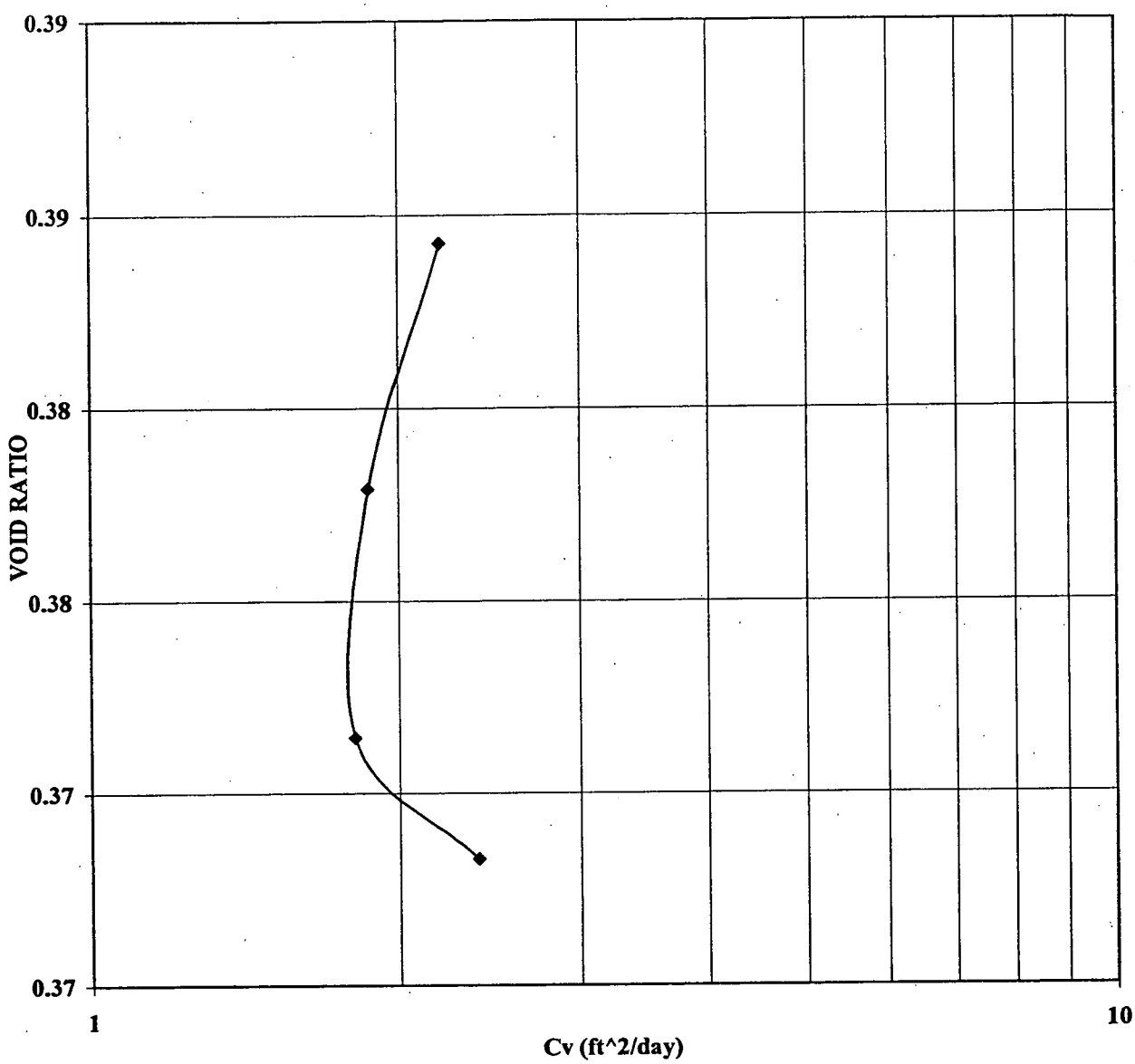
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-9

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand

DATE	8/4/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION

ASTM D 2435

ROCKY FLATS/FIELD & LAB TEST/CO 043-2246-0001	SAMPLE: PF-10	DATE	8/12/2004
		TECH	NG
		REVIEW	JEO

SAMPLE DATA, GENERAL

height (in)	0.9980
diameter (in)	2.498
area (in^2)	4.901
volume (in^3)	4.891
specimen weight,wet (g)	168.18
specimen weight,dry (g)	149.12
water weight (g)	19.06

SAMPLE DATA, INITIAL

total height (in)	0.998
height of solids (in)	0.695
height of voids (in)	0.303
void ratio	0.436
dry density (pcf)	115.89
moist density (pcf)	130.99

SAMPLE DATA, FINAL

total height (in)	0.9362
height of solids (in)	0.695
height of voids (in)	0.241
void ratio	0.347
dry density (pcf)	123.81
moist density (pcf)	142.30

DESCRIPTION

Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

LL:	43	
PL:	18	
PI:	25	
Gs:	2.67	Assumed

MOISTURE CONTENT, INITIAL

tare #	D4
wt soil&tare,moist	90.35
wt soil&tare,dry	83.39
wt tare	28.94
wt moisture	6.96
wt dry soil	54.45
% moisture	12.78%

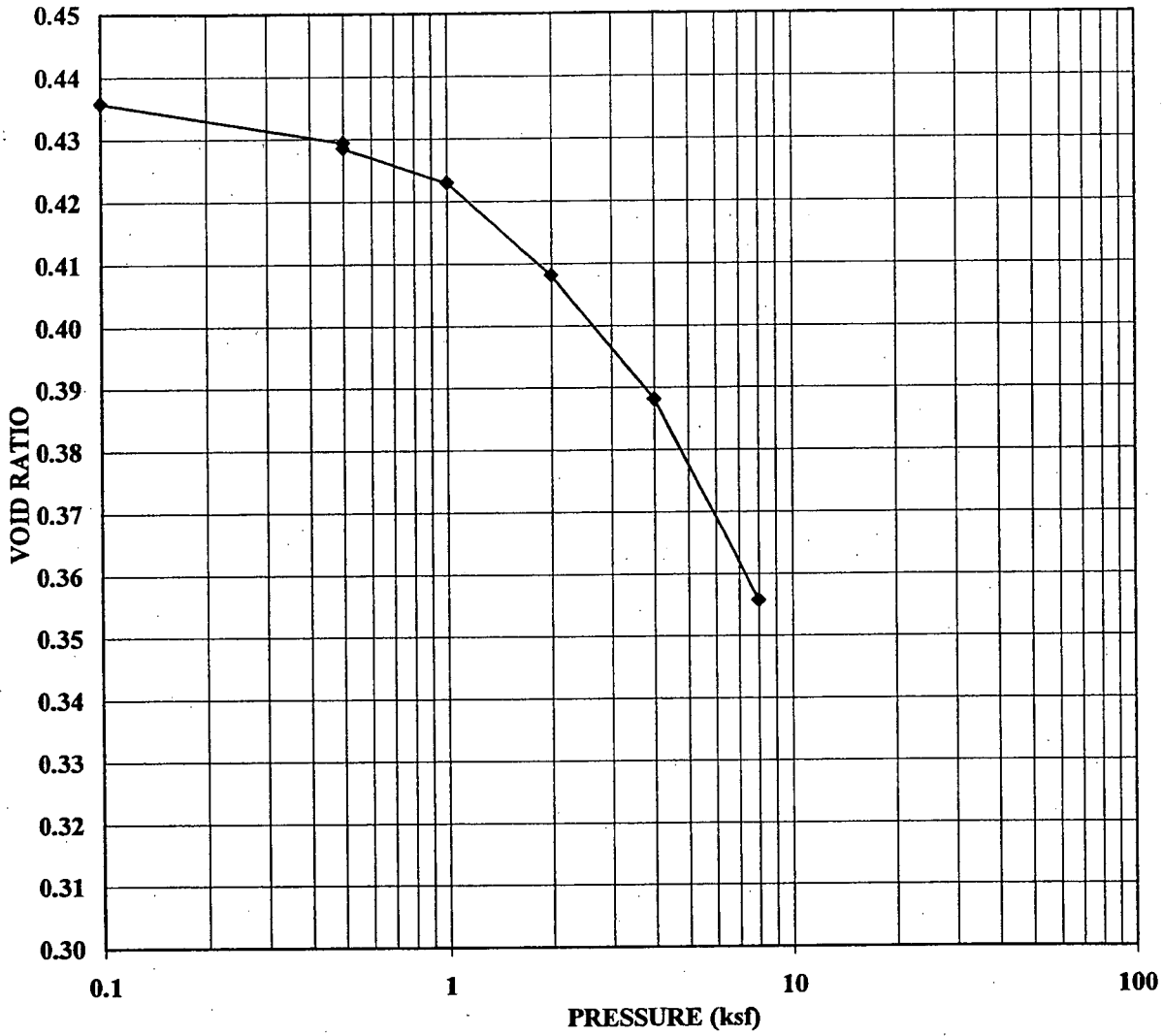
MOISTURE CONTENT, FINAL

tare #	X15
wt soil&tare,moist	204.16
wt soil&tare,dry	181.88
wt tare	32.70
wt moisture	22.28
wt dry soil	149.18
% moisture	14.93%

PRESSURE (ksf)	h100 Sample Height	D50 Sample Height	t50 TIME (min)	Sample Density (pcf)	VOID RATIO e	DRAINAGE PATH (DOUBLE DRAINAGE) H (in)	DRAINAGE PATH (DOUBLE DRAINAGE) H (cm)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (in^2)	DRAINAGE PATH (DOUBLE DRAINAGE) H^2 (cm^2)	COEFFICIENT OF CONSOLIDATION Cv (cm^2/sec)	COEFFICIENT OF CONSOLIDATION (ft^2/day)	Cc
0.100	0.9967	-	-	116.0	0.436	-	-	-	-	-	-	
0.500	0.9923	-	-	116.6	0.429	-	-	-	-	-	-	
0.500	0.9917	-	-	116.6	0.429	-	-	-	-	-	-	
1.0	0.9878	0.9886	0.343	117.1	0.423	0.4943	1.2556	0.2444	1.5765	1.51E-02	1.41E+00	0.019
2.0	0.9775	0.9789	0.254	118.3	0.408	0.4894	1.2432	0.2396	1.5455	2.00E-02	1.86E+00	0.050
4.0	0.9636	0.9656	0.191	120.0	0.388	0.4828	1.2264	0.2331	1.5040	2.58E-02	*2.41E+00*	*0.066*
8.0	0.9411	0.9439	0.208	122.9	0.356	0.4719	1.1987	0.2227	1.4369	2.26E-02	2.11E+00	0.108

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-10

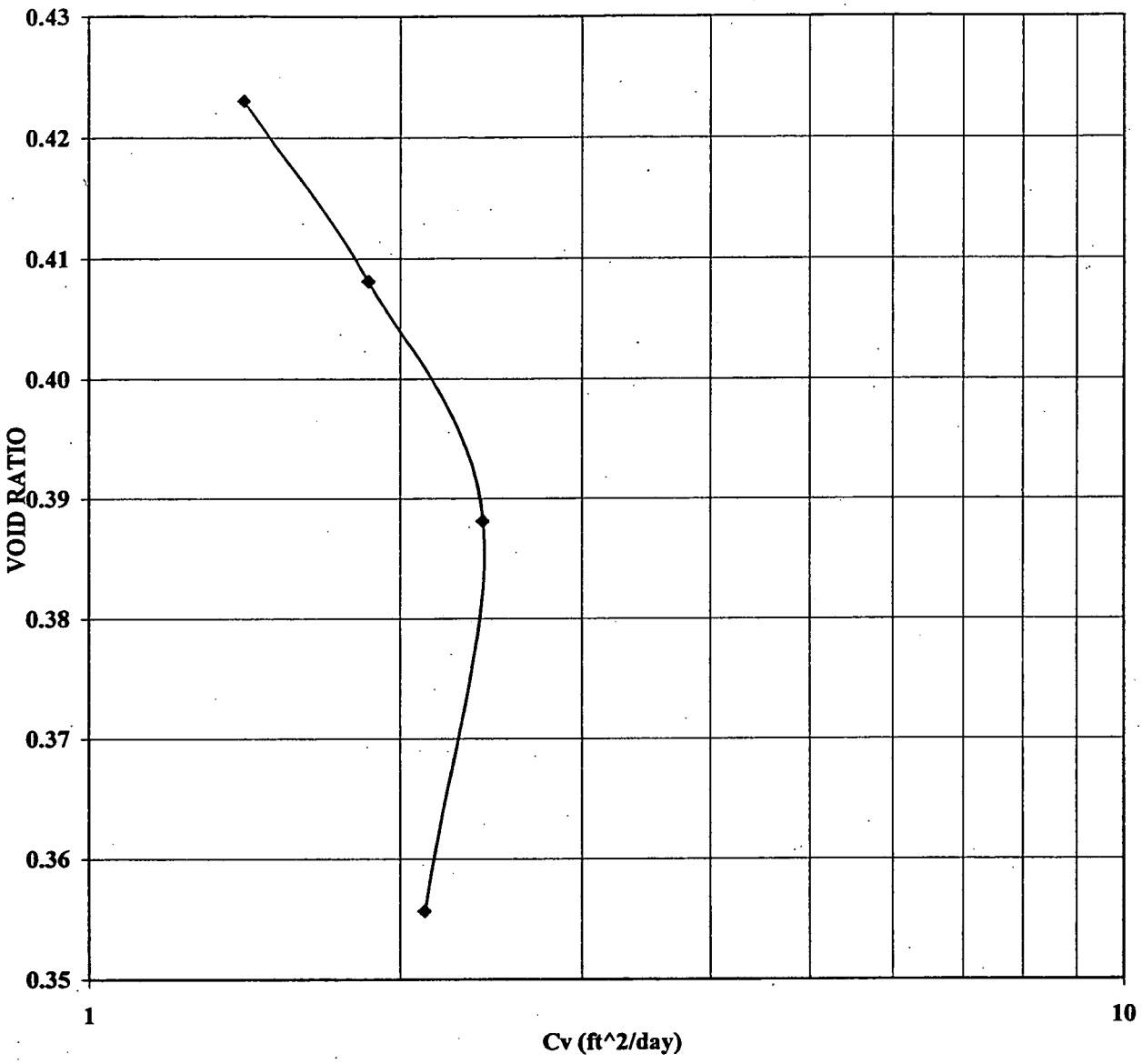
DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

ONE-DIMENSIONAL CONSOLIDATION



SAMPLE #: PF-10

DESCRIPTION: Yellowish brown (10 YR 5/8) clayey sand with gravel (SC)

DATE	8/12/2004
TECH	NG
REVIEW	JEO

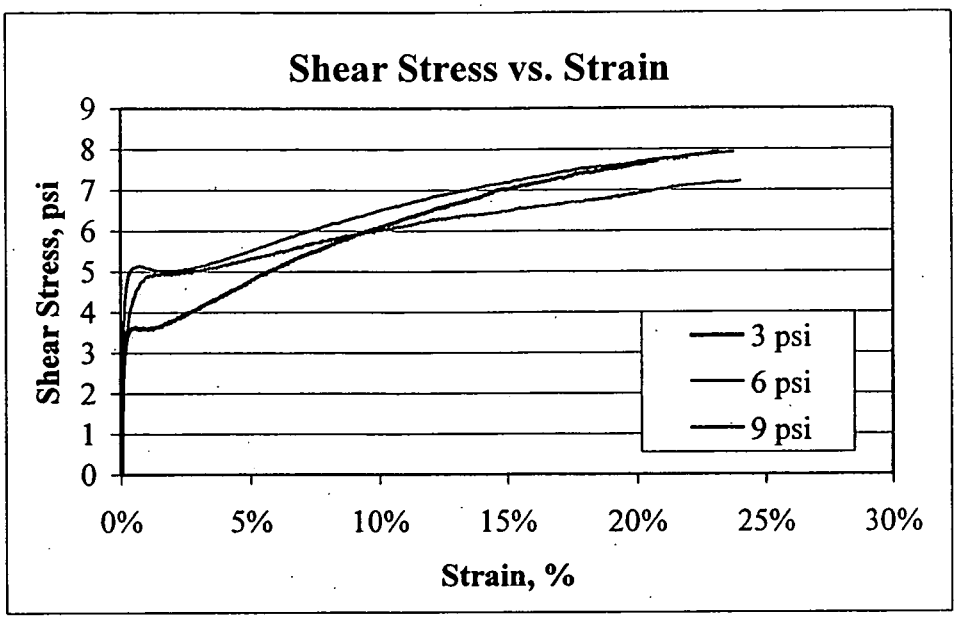
ROCKY FLATS/FIELD & LAB TEST/CO
043-2246-0001

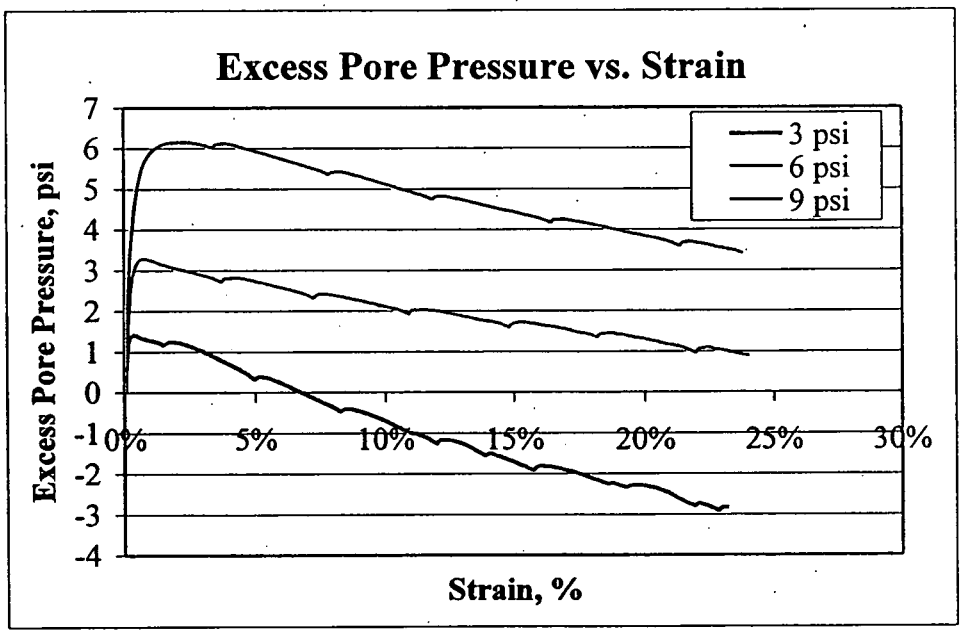
GOLDER ASSOCIATES INC.
LAKEWOOD, COLORADO

Sample # =	PF-1		Sample # =	PF-1		Sample # =	PF-1	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	14.66	cm	Length =	14.72	cm	Length =	14.76	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	1274.70	g	Wet Weight =	1273.80	g	Wet Weight =	1273.70	g
Area =	41.9	sq.cm	Area =	41.9	sq.cm	Area =	41.9	sq.cm
Sample Area =	6.49	sq. in.	Sample Area =	6.49	sq. in.	Sample Area =	6.49	sq. in.
Volume =	613.6	cc	Volume =	616.1	cc	Volume =	617.7	cc
Moisture Content =	12.7%		Moisture Content =	12.7%		Moisture Content =	12.7%	
Specific Gravity =	na		Specific Gravity =	na		Specific Gravity =	na	
Dry Weight of Solids =	1131.06	g	Dry Weight of Solids =	1130.26	g	Dry Weight of Solids =	1130.17	g
Wet Density =	2.08	g/cc	Wet Density =	2.07	g/cc	Wet Density =	2.06	g/cc
Dry Density =	1.84	g/cc	Dry Density =	1.83	g/cc	Dry Density =	1.83	g/cc
Wet Density =	129.6	pcf	Wet Density =	129.0	pcf	Wet Density =	128.7	pcf
Dry Density =	115.0	pcf	Dry Density =	114.5	pcf	Dry Density =	114.2	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	100	psi
Back Pressure =	97	psi	Back Pressure =	94	psi	Back Pressure =	91	psi
Confining Pressure =	3	psi	Confining Pressure =	6	psi	Confining Pressure =	9	psi

Notes: 1. Sample remolded to 95% of maximum dry density (120.6 pcf) and +2% of optimum (12.7%) moisture content
2. Yellowish brown (10 YR 5/8) clayey sand with gravel SC

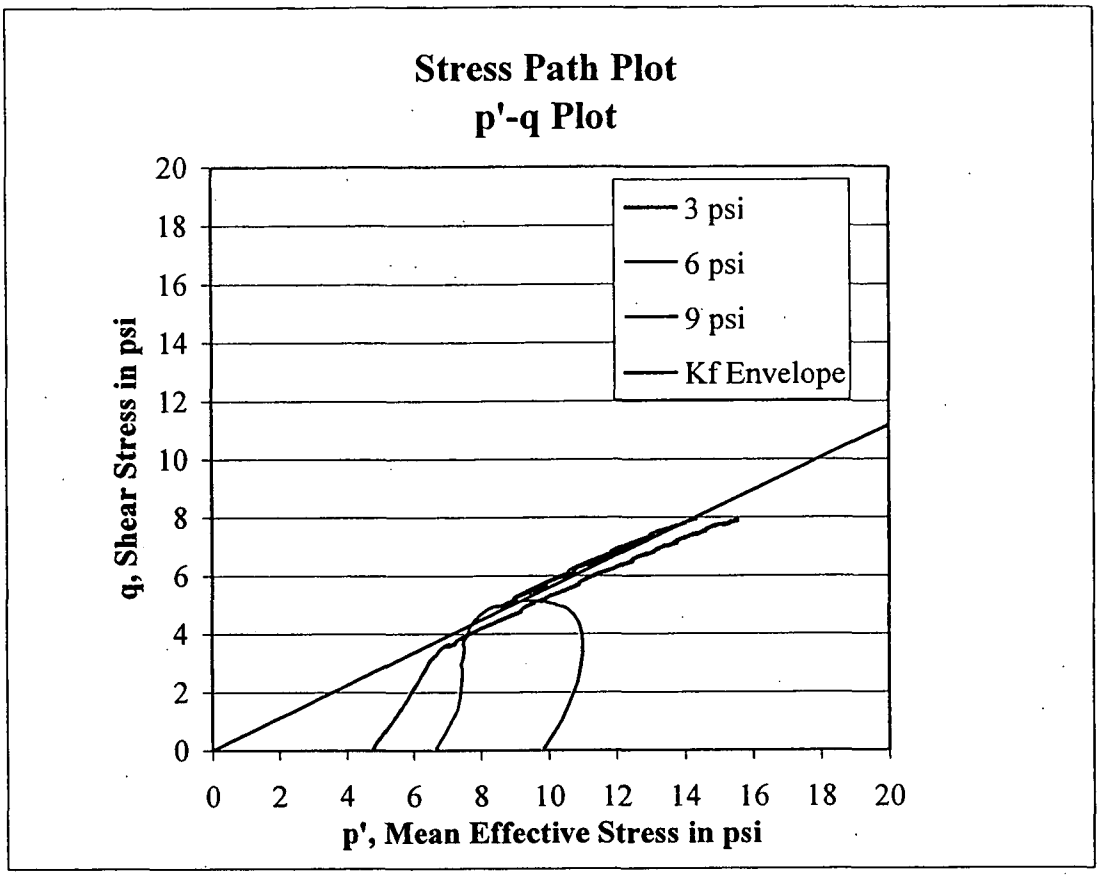
Golder Associates, Inc. **Denver, Colorado**	Title: **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**			
Job Short Title: ROCKY FLATS/FIELD & LAB TESTING/CO				
Sample No. **PF-1**	Reviewed: TJS	Date: 7/29/2004	Job Number: 043-2246.0001	Figure: 1





Golder Associates, Inc. **Denver, Colorado**	**Title:** **CU TRIAXIAL SHEAR DATA** **STRESS AND Δ PORE PRESSURE PLOTS**
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**	

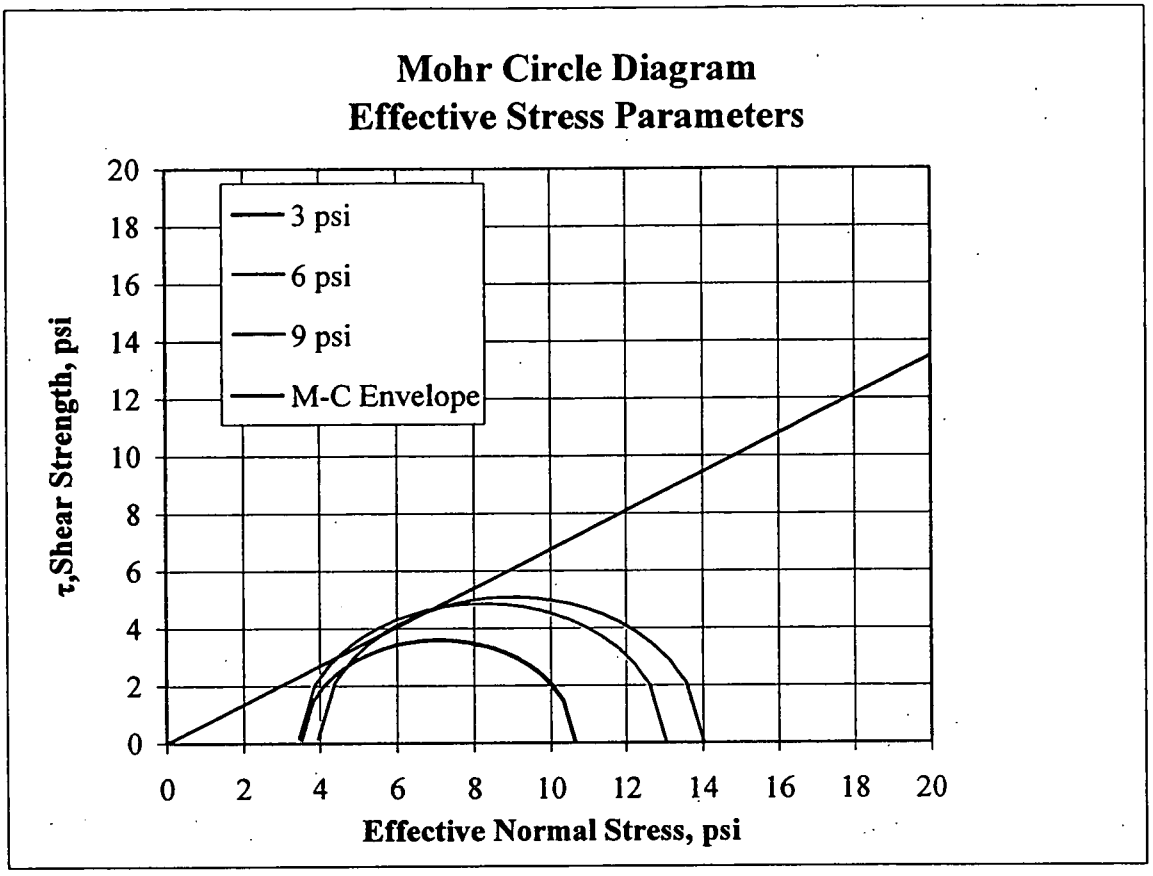
Sample No.	Reviewed:	Date:	Job Number:	Figure:
PF-1	**TJS**	**07/29/04**	**043-2246.0001**	2



Stress Path Parameters

ψ' = 29.2 degrees
a' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	**Title:** CU TRIAXIAL SHEAR DATA STRESS PATH PLOT			
Job Short Title: ROCKY FLATS/FIELD & LAB TESTING/CO				
Sample No. **PF-1**	Reviewed: **TJS**	Date: **7/29/2004**	Job Number: **043-2246.0001**	Figure: **3**



Mohr-Coulomb Parameters

$\phi' =$ 34.0 degrees
$c' =$ 0.0 psi

Golder Associates, Inc. **Denver, Colorado**			**Title:** **CU TRIAXIAL SHEAR DATA** **MOHR CIRCLE DIAGRAM**		
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**					
Sample No. **PF-1**	Depth **0**	Reviewed: **TJS**	Date: **7/29/2004**	Job Number: **043-2246.0001**	Figure: **4**

Consolidated Undrained Triaxial Lab Data

From: GOLDER ASSOCIATES INC.

Project: ROCKY FLATS/FIELD & LAB TESTING/CO

Project Number: 043-2246.0001

Sample Number	PF-1
Depth	0
Effective Stress Analysis	

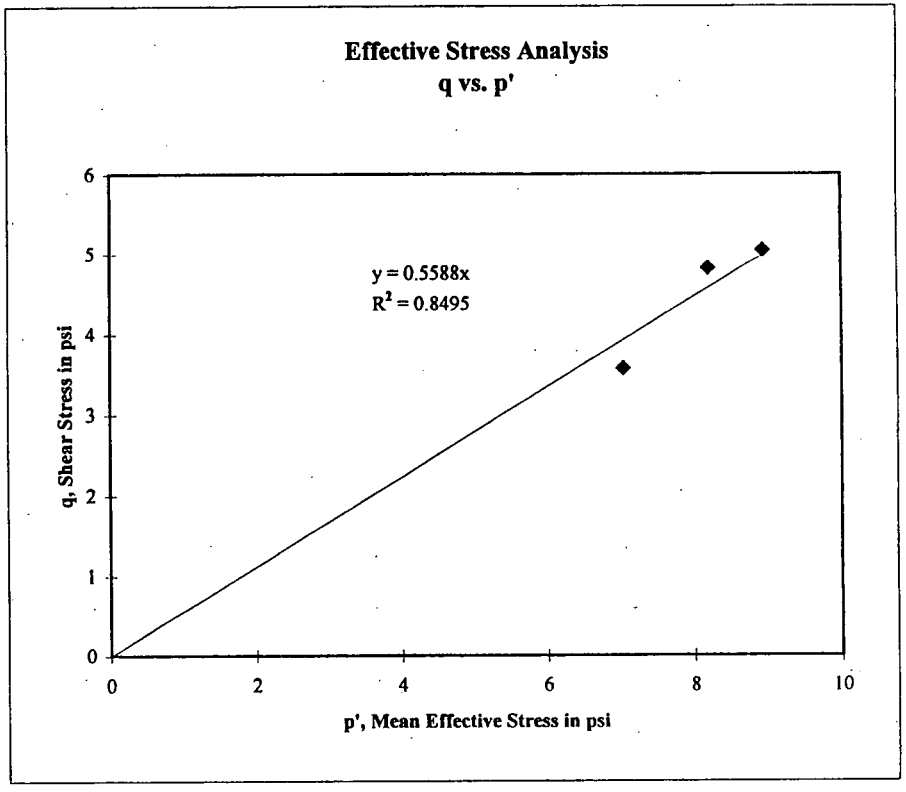
Point Number	P' (psi)	q (psi)
1	7	4
2	8	5
3	9	5

$\tan(\psi') =$ 0.5588

$a' =$ 0

$\phi' =$ 34.0 degrees

$c' =$ 0.0 psi



Notes: 1. Failure is taken to corespond to the maximum deviator stress at an axial strain of 1%. This small strain failure criteria was chosen due to the dilative nature of the material.

Consolidated Undrained Triaxial Lab Data

From: GOLDER ASSOCIATES INC.

Project: **ROCKY FLATS/FIELD & LAB TESTING/CO**

Project Number: **043-2246.0001**

Sample Number	PF-1
Depth	0
Total Stress Analysis	

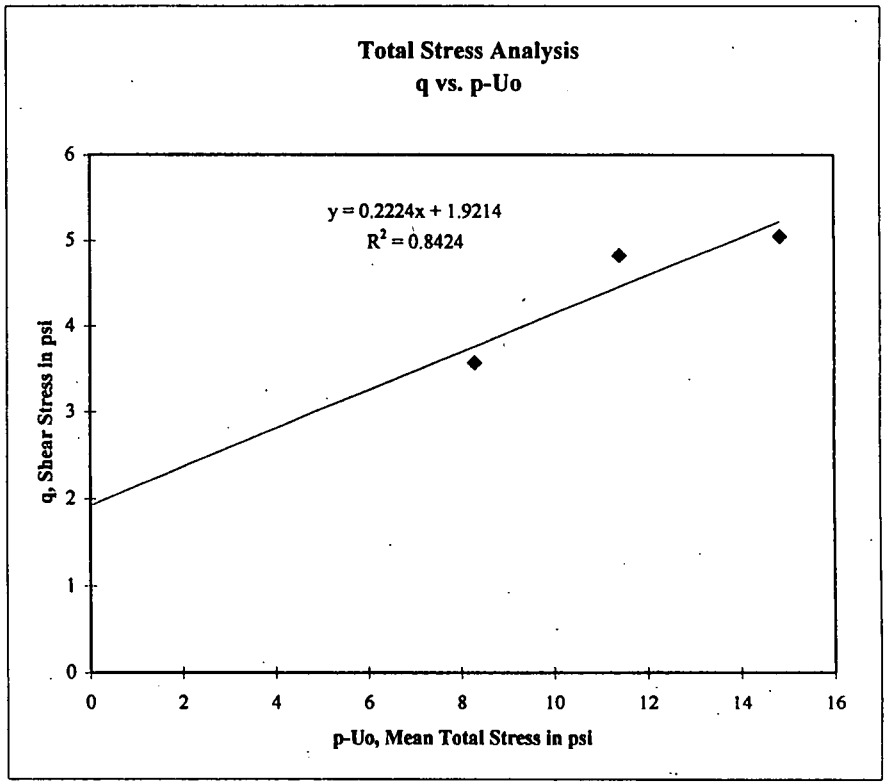
Point Number	P-Uo (psi)	q (psi)
1	8	4
2	11	5
3	15	5

$\tan(\psi) =$ 0.2224

a = 1.9214

$\phi =$ 12.9 degrees

c = 2.0 psi



Notes: 1. Failure is taken to corespond to the maximum deviator stress at an axial strain of 1%.
This small strain failure criteria was chosen due to the dilative nature of the material.

Consolidated Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: **ROCKY FLATS/FIELD & LAB TESTING/CO**
Project Number: 043-2246.0001
Explination of Terminology

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma_{ff}' \tan \phi'$$
$$\tau_{ff} = c + \sigma_{ff} \tan \phi$$

Where:
c', c = effective and total cohesive intercept
ϕ', ϕ = effective and total friction angle
τ^{ff} = Shear Strength on the failure surface at failure
σ'^{ff}, σ^{ff} = effective and total normal stress on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \qquad p' = \frac{\sigma'_1 + \sigma'_3}{2} \qquad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:
q = shear stress
p', p = mean effective and total stress
σ'^{1} , σ^{1} = Effective and Total Axial Stress
σ'^{3} , σ^{3} = Effective and Total Confining Stress

$$q = a + p' \tan \psi$$
$$q = a + (p - u_0) \tan \psi$$

Where:
a', a = intercept of the q-axis in effective stress of total stress space
ψ', ψ = angle of the failure line in effective stress of total stress space
p' = mean effective stress
p-Uo = mean total minus the initial pore pressure

with the relationship between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$

$$a = c * \cos(\phi)$$

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 2
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.21
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.248	6.003	5.987
DIAMETER	7.087	2.790	2.785
AREA	39.44	6.11	6.09
VOLUME	601.41	36.70	36.47
WEIGHT (g)	1246.76		1282.06
% MOISTURE	13.7		16.95
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	129.4		
DRY DENSITY, calc (pcf)	113.7		
VOLUME OF SOLIDS	406.02		
VOLUME OF VOIDS	195.38		
VOID RATIO	0.481		
SATURATION	77.0		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	114.4
VOLUME OF SOLIDS	406.02
VOLUME OF VOIDS	191.68
VOID RATIO	0.472

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1282.06
WT SOIL & TARE, DRY (g)	1096.26
WT TARE (g)	0.00
WT MOISTURE (g)	185.80
WT DRY SOIL (g)	1096.26
% MOISTURE	16.95

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	22	80.1	0.0	0.00	1.00	6.09	5.987	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.5	0.003	32	80.6	72.0	0.05	1.00	6.10	5.984	236.2	668.2	596.2	360.0	1.66	478.1	118.1	0.30
1.0	0.006	38	80.8	100.8	0.10	1.00	6.10	5.981	377.8	809.8	709.0	331.2	2.14	520.1	188.9	0.27
1.5	0.009	43	81.0	129.6	0.15	1.00	6.10	5.978	495.6	927.6	798.0	302.4	2.64	550.2	247.8	0.26
2.0	0.012	47	81.1	144.0	0.20	1.00	6.10	5.975	589.7	1021.7	877.7	288.0	3.05	582.9	294.9	0.24
2.5	0.015	50	81.2	158.4	0.25	1.00	6.11	5.972	660.2	1092.2	933.8	273.6	3.41	603.7	330.1	0.24
4.2	0.025	60	81.3	172.8	0.42	1.00	6.12	5.962	894.4	1326.4	1153.6	259.2	4.45	706.4	447.2	0.19
8.3	0.050	69	81.0	129.6	0.84	0.99	6.14	5.937	1101.6	1533.6	1404.0	302.4	4.64	853.2	550.8	0.12
12.5	0.075	72	80.6	72.0	1.25	0.99	6.17	5.912	1167.0	1599.0	1527.0	360.0	4.24	943.5	583.5	0.06
17.3	0.104	74	80.3	28.8	1.74	0.98	6.20	5.883	1207.8	1639.8	1611.0	403.2	4.00	1007.1	603.9	0.02
21.5	0.129	75	80.2	14.4	2.15	0.98	6.23	5.858	1225.7	1657.7	1643.3	417.6	3.94	1030.5	612.9	0.01
26.7	0.160	75	80.0	-14.4	2.67	0.97	6.26	5.827	1219.3	1651.3	1665.7	446.4	3.73	1056.0	609.6	-0.01
29.2	0.175	75	80.0	-14.4	2.92	0.97	6.28	5.812	1216.1	1648.1	1662.5	446.4	3.72	1054.5	608.1	-0.01
34.8	0.209	77	79.9	-28.8	3.49	0.97	6.31	5.778	1254.6	1686.6	1715.4	460.8	3.72	1088.1	627.3	-0.02
41.7	0.250	79	79.8	-43.2	4.18	0.96	6.36	5.737	1291.0	1723.0	1766.2	475.2	3.72	1120.7	645.5	-0.03
51.7	0.310	79	79.7	-57.6	5.18	0.95	6.42	5.677	1277.5	1709.5	1767.1	489.6	3.61	1128.4	638.8	-0.05
58.3	0.350	80	79.7	-57.6	5.85	0.94	6.47	5.637	1290.8	1722.8	1780.4	489.6	3.64	1135.0	645.4	-0.04
66.7	0.400	83	79.6	-72.0	6.68	0.93	6.53	5.587	1345.5	1777.5	1849.5	504.0	3.67	1176.8	672.8	-0.05
75.0	0.450	85	79.5	-86.4	7.52	0.92	6.59	5.537	1377.2	1809.2	1895.6	518.4	3.66	1207.0	688.6	-0.06
83.3	0.500	87	79.4	-100.8	8.35	0.92	6.65	5.487	1408.1	1840.1	1940.9	532.8	3.64	1236.8	704.0	-0.07
91.7	0.550	90	79.3	-115.2	9.19	0.91	6.71	5.437	1459.6	1891.6	2006.8	547.2	3.67	1277.0	729.8	-0.08
100.0	0.600	92	79.2	-129.6	10.02	0.90	6.77	5.387	1488.7	1920.7	2050.3	561.6	3.65	1306.0	744.4	-0.09
108.3	0.650	94	79.2	-129.6	10.86	0.89	6.83	5.337	1517.1	1949.1	2078.7	561.6	3.70	1320.1	758.5	-0.09
116.7	0.700	95	79.1	-144.0	11.69	0.88	6.90	5.287	1523.7	1955.7	2099.7	576.0	3.65	1337.9	761.9	-0.09
125.0	0.750	99	79.1	-144.0	12.53	0.87	6.96	5.237	1592.0	2024.0	2168.0	576.0	3.76	1372.0	796.0	-0.09
133.3	0.800	100	79.0	-158.4	13.36	0.87	7.03	5.187	1597.3	2029.3	2187.7	590.4	3.71	1389.1	798.7	-0.10
141.7	0.850	102	78.9	-172.8	14.20	0.86	7.10	5.137	1622.5	2054.5	2227.3	604.8	3.68	1416.0	811.2	-0.11
150.0	0.900	104	78.9	-172.8	15.03	0.85	7.17	5.087	1646.8	2078.8	2251.6	604.8	3.72	1428.2	823.4	-0.10
158.3	0.950	105	78.8	-187.2	15.87	0.84	7.24	5.037	1650.5	2082.5	2269.7	619.2	3.67	1444.5	825.3	-0.11
166.7	1.000	107	78.8	-187.2	16.70	0.83	7.31	4.987	1673.5	2105.5	2292.7	619.2	3.70	1456.0	836.8	-0.11

DU @ FAILURE	129.60	DEVIATORIC STRESS @ FAILURE	1101.64	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.64

TECH	PWM/DA
DATE	8/2/04
CHEC	
REVIEW	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 2
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.26
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.250	6.004	5.975
DIAMETER	7.087	2.790	2.780
AREA	39.44	6.11	6.07
VOLUME	601.51	36.71	36.27
WEIGHT (g)	1247.27		1278.17
% MOISTURE	13.9		16.70
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	129.4		
DRY DENSITY, calc (pcf)	113.6		
VOLUME OF SOLIDS	405.64		
VOLUME OF VOIDS	195.86		
VOID RATIO	0.483		
SATURATION	77.6		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	115.0
VOLUME OF SOLIDS	405.64
VOLUME OF VOIDS	188.76
VOID RATIO	0.465
WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1278.17
WT SOIL & TARE, DRY (g)	1095.24
WT TARE (g)	0.00
WT MOISTURE (g)	182.93
WT DRY SOIL (g)	1095.24
% MOISTURE	16.70

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	17	80.6	0.0	0.00	1.00	6.07	5.975	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.5	0.003	40	82.3	244.8	0.05	1.00	6.07	5.972	545.3	1409.3	1164.5	619.2	1.88	891.8	272.6	0.45
0.8	0.005	46	82.6	288.0	0.08	1.00	6.08	5.970	687.3	1551.3	1263.3	576.0	2.19	919.7	343.7	0.42
1.5	0.009	52	82.9	331.2	0.15	1.00	6.08	5.966	829.0	1693.0	1361.8	532.8	2.56	947.3	414.5	0.40
2.0	0.012	60	83.2	374.4	0.20	1.00	6.08	5.963	1017.9	1881.9	1507.5	489.6	3.08	998.6	509.0	0.37
2.5	0.015	62	83.3	388.8	0.25	1.00	6.09	5.960	1064.7	1928.7	1539.9	475.2	3.24	1007.6	532.4	0.37
4.2	0.025	69	83.4	403.2	0.42	1.00	6.10	5.950	1228.3	2092.3	1689.1	460.8	3.67	1074.9	614.1	0.33
8.3	0.050	73	83.5	417.6	0.84	0.99	6.12	5.925	1317.2	2181.2	1763.6	446.4	3.95	1105.0	658.6	0.32
12.5	0.075	77	83.5	417.6	1.26	0.99	6.15	5.900	1405.3	2269.3	1851.7	446.4	4.15	1149.1	702.7	0.30
17.5	0.105	79	83.5	417.6	1.76	0.98	6.18	5.870	1444.8	2308.8	1891.2	446.4	4.24	1168.8	722.4	0.29
22.2	0.133	79	83.5	417.6	2.23	0.98	6.21	5.842	1437.9	2301.9	1884.3	446.4	4.22	1165.4	719.0	0.29
25.0	0.150	80	83.5	417.6	2.51	0.97	6.23	5.825	1456.9	2320.9	1903.3	446.4	4.26	1174.8	728.4	0.29
29.2	0.175	80	83.3	388.8	2.93	0.97	6.25	5.800	1450.6	2314.6	1925.8	475.2	4.05	1200.5	725.3	0.27
33.3	0.200	82	83.3	388.8	3.35	0.97	6.28	5.775	1490.2	2354.2	1965.4	475.2	4.14	1220.3	745.1	0.26
41.7	0.250	84	83.2	374.4	4.18	0.96	6.34	5.725	1522.8	2386.8	2012.4	489.6	4.11	1251.0	761.4	0.25
50.0	0.300	86	83.0	345.6	5.02	0.95	6.39	5.675	1554.5	2418.5	2072.9	518.4	4.00	1295.7	777.3	0.22
58.3	0.350	89	82.9	331.2	5.86	0.94	6.45	5.625	1607.8	2471.8	2140.6	532.8	4.02	1336.7	803.9	0.21
66.7	0.400	90	82.9	331.2	6.69	0.93	6.51	5.575	1615.7	2479.7	2148.5	532.8	4.03	1340.6	807.8	0.20
75.0	0.450	92	82.8	316.8	7.53	0.92	6.57	5.525	1645.0	2509.0	2192.2	547.2	4.01	1369.7	822.5	0.19
84.7	0.508	94	82.7	302.4	8.50	0.91	6.63	5.467	1671.2	2535.2	2232.8	561.6	3.98	1397.2	835.6	0.18
91.7	0.550	95	82.6	288.0	9.21	0.91	6.69	5.425	1679.9	2543.9	2255.9	576.0	3.92	1415.9	839.9	0.17
100.0	0.600	97	82.5	273.6	10.04	0.90	6.75	5.375	1707.1	2571.1	2297.5	590.4	3.89	1443.9	853.5	0.16
108.3	0.650	100	82.5	273.6	10.88	0.89	6.81	5.325	1754.6	2618.6	2345.0	590.4	3.97	1467.7	877.3	0.16
116.7	0.700	102	82.5	273.6	11.72	0.88	6.88	5.275	1780.0	2644.0	2370.4	590.4	4.01	1480.4	890.0	0.15
125.0	0.750	104	82.4	259.2	12.55	0.87	6.94	5.225	1804.6	2668.6	2409.4	604.8	3.98	1507.1	902.3	0.14
133.3	0.800	105	82.3	244.8	13.39	0.87	7.01	5.175	1807.9	2671.9	2427.1	619.2	3.92	1523.1	903.9	0.14
141.7	0.850	107	82.3	244.8	14.23	0.86	7.08	5.125	1831.1	2695.1	2450.3	619.2	3.96	1534.8	915.6	0.13
151.3	0.908	110	82.3	244.8	15.20	0.85	7.16	5.067	1870.7	2734.7	2489.9	619.2	4.02	1554.6	935.4	0.13
158.3	0.950	110	82.2	230.4	15.90	0.84	7.22	5.025	1855.2	2719.2	2488.8	633.6	3.93	1561.2	927.6	0.12
166.7	1.000	114	82.1	216.0	16.74	0.83	7.29	4.975	1915.8	2779.8	2563.8	648.0	3.96	1605.9	957.9	0.11

DU @ FAILURE	417.6	DEVIATORIC STRESS @ FAILURE	1444.8	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.24

TECH	PWM/DA
DATE	8/2/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 3
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.28
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.286	6.018	6.014
DIAMETER	7.087	2.790	2.786
AREA	39.44	6.11	6.09
VOLUME	602.91	36.79	36.65
WEIGHT (g)	1249.48		1289.18
% MOISTURE	12.7		16.28
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	129.3		
DRY DENSITY, calc (pcf)	114.7		
VOLUME OF SOLIDS	410.61		
VOLUME OF VOIDS	192.29		
VOID RATIO	0.468		
SATURATION	73.2		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	115.2
VOLUME OF SOLIDS	410.61
VOLUME OF VOIDS	189.99
VOID RATIO	0.463

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1289.18
WT SOIL & TARE, DRY (g)	1108.66
WT TARE (g)	0.00
WT MOISTURE (g)	180.52
WT DRY SOIL (g)	1108.66
% MOISTURE	16.28

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	18	79.9	0.0	0.00	1.00	6.09	6.014	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.5	0.003	33	80.6	100.8	0.05	1.00	6.10	6.011	354.3	786.3	685.5	331.2	2.07	508.3	177.1	0.28
1.0	0.006	43	80.9	144.0	0.10	1.00	6.10	6.008	590.1	1022.1	878.1	288.0	3.05	583.1	295.1	0.24
1.5	0.009	48	81.0	158.4	0.15	1.00	6.10	6.005	707.8	1139.8	981.4	273.6	3.59	627.5	353.9	0.22
2.0	0.012	52	81.1	172.8	0.20	1.00	6.11	6.002	801.8	1233.8	1061.0	259.2	4.09	660.1	400.9	0.22
2.5	0.015	55	81.1	172.8	0.25	1.00	6.11	5.999	872.1	1304.1	1131.3	259.2	4.36	695.2	436.0	0.20
4.2	0.025	54	81.1	172.8	0.42	1.00	6.12	5.989	847.1	1279.1	1106.3	259.2	4.27	682.7	423.5	0.20
8.3	0.050	53	81.2	187.2	0.83	0.99	6.15	5.964	820.1	1252.1	1064.9	244.8	4.35	654.9	410.1	0.23
12.5	0.075	52	81.3	201.6	1.25	0.99	6.17	5.939	793.3	1225.3	1023.7	230.4	4.44	627.1	396.7	0.25
16.7	0.100	50	81.4	216.0	1.66	0.98	6.20	5.914	743.5	1175.5	959.5	216.0	4.44	587.8	371.8	0.29
20.8	0.125	48	81.5	230.4	2.08	0.98	6.22	5.889	694.1	1126.1	895.7	201.6	4.44	548.7	347.1	0.33
25.0	0.150	48	81.6	244.8	2.49	0.98	6.25	5.864	691.2	1123.2	878.4	187.2	4.69	532.8	345.6	0.35
29.2	0.175	48	81.6	244.8	2.91	0.97	6.28	5.839	688.2	1120.2	875.4	187.2	4.68	531.3	344.1	0.36
33.3	0.200	47	81.7	259.2	3.33	0.97	6.30	5.814	662.4	1094.4	835.2	172.8	4.83	504.0	331.2	0.39
41.7	0.250	47	81.7	259.2	4.16	0.96	6.36	5.764	656.7	1088.7	829.5	172.8	4.80	501.2	328.4	0.39
50.0	0.300	48	81.7	259.2	4.99	0.95	6.41	5.714	673.5	1105.5	846.3	172.8	4.90	509.5	336.7	0.38
58.3	0.350	48	81.7	259.2	5.82	0.94	6.47	5.664	667.6	1099.6	840.4	172.8	4.86	506.6	333.8	0.39
66.7	0.400	48	81.7	259.2	6.65	0.93	6.53	5.614	661.7	1093.7	834.5	172.8	4.83	503.7	330.9	0.39
75.0	0.450	48	81.7	259.2	7.48	0.93	6.59	5.564	655.8	1087.8	828.6	172.8	4.80	500.7	327.9	0.40
83.3	0.500	50	81.7	259.2	8.31	0.92	6.65	5.514	693.2	1125.2	866.0	172.8	5.01	519.4	346.6	0.37
91.7	0.550	50	81.7	259.2	9.15	0.91	6.71	5.464	687.0	1119.0	859.8	172.8	4.98	516.3	343.5	0.38
100.0	0.600	52	81.7	259.2	9.98	0.90	6.77	5.414	723.2	1155.2	896.0	172.8	5.19	534.4	361.6	0.36
108.3	0.650	53	81.7	259.2	10.81	0.89	6.83	5.364	737.6	1169.6	910.4	172.8	5.27	541.6	368.8	0.35
116.7	0.700	53	81.7	259.2	11.64	0.88	6.90	5.314	730.7	1162.7	903.5	172.8	5.23	538.2	365.4	0.35
125.0	0.750	55	81.7	259.2	12.47	0.88	6.96	5.264	765.2	1197.2	938.0	172.8	5.43	555.4	382.6	0.34
133.3	0.800	58	81.6	244.8	13.30	0.87	7.03	5.214	819.4	1251.4	1006.6	187.2	5.38	596.9	409.7	0.30
141.7	0.850	58	81.6	244.8	14.13	0.86	7.10	5.164	811.6	1243.6	998.8	187.2	5.34	593.0	405.8	0.30
150.0	0.900	60	81.6	244.8	14.97	0.85	7.17	5.114	843.9	1275.9	1031.1	187.2	5.51	609.1	421.9	0.29
158.3	0.950	62	81.5	230.4	15.80	0.84	7.24	5.064	875.4	1307.4	1077.0	201.6	5.34	639.3	437.7	0.26
166.7	1.000	64	81.5	230.4	16.63	0.83	7.31	5.014	906.2	1338.2	1107.8	201.6	5.49	654.7	453.1	0.25

DU @ FAILURE	172.80	DEVIATORIC STRESS @ FAILURE	872.07	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.36

TECH	PWM/SDM
DA	7/28/04
CHEC	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 2
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.31

Mounting Method: Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.250	6.004	5.976
DIAMETER	7.087	2.790	2.775
AREA	39.44	6.11	6.05
VOLUME	601.51	36.71	36.13
WEIGHT (g)	1247.03		1275.63
% MOISTURE	14.0		16.62
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	129.4		
DRY DENSITY, calc (pcf)	113.5		
VOLUME OF SOLIDS	405.12		
VOLUME OF VOIDS	196.38		
VOID RATIO	0.485		
SATURATION	78.0		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	115.3
VOLUME OF SOLIDS	405.12
VOLUME OF VOIDS	186.98
VOID RATIO	0.462

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1275.63
WT SOIL & TARE, DRY (g)	1093.83
WT TARE (g)	0.00
WT MOISTURE (g)	181.80
WT DRY SOIL (g)	1093.83
% MOISTURE	16.62

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	81.2	0.0	0.00	1.00	6.05	5.976	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.5	0.003	31	82.3	158.4	0.05	1.00	6.05	5.973	433.2	1729.2	1570.8	1137.6	1.38	1354.2	216.6	0.37
1.0	0.006	43	83.0	259.2	0.10	1.00	6.05	5.970	723.3	2019.3	1760.1	1036.8	1.70	1398.4	361.6	0.36
1.3	0.008	52	83.5	331.2	0.13	1.00	6.05	5.968	925.2	2221.2	1890.0	964.8	1.96	1427.4	462.6	0.36
2.0	0.012	59	83.9	388.8	0.20	1.00	6.06	5.964	1081.5	2377.5	1988.7	907.2	2.19	1447.9	540.7	0.36
2.5	0.015	64	84.1	417.6	0.25	1.00	6.06	5.961	1199.7	2495.7	2078.1	878.4	2.37	1478.3	599.9	0.35
3.5	0.021	70	84.5	475.2	0.35	1.00	6.07	5.955	1348.0	2644.0	2168.8	820.8	2.64	1494.8	674.0	0.35
7.7	0.046	80	85.4	604.8	0.77	0.99	6.09	5.930	1571.6	2867.6	2262.8	691.2	3.27	1477.0	785.8	0.38
11.7	0.070	81	85.9	676.8	1.17	0.99	6.12	5.906	1591.1	2887.1	2210.3	619.2	3.57	1414.8	795.6	0.43
15.2	0.091	82	86.2	720.0	1.52	0.98	6.14	5.885	1606.6	2902.6	2182.6	576.0	3.79	1379.3	803.3	0.45
20.3	0.122	83	86.3	734.4	2.04	0.98	6.17	5.854	1621.4	2917.4	2183.0	561.6	3.89	1372.3	810.7	0.45
24.3	0.146	83	86.3	734.4	2.44	0.98	6.20	5.830	1628.7	2924.7	2190.3	561.6	3.90	1376.0	814.4	0.45
28.5	0.171	84	86.3	734.4	2.86	0.97	6.22	5.805	1637.9	2933.9	2199.5	561.6	3.92	1380.6	819.0	0.45
32.7	0.196	85	86.2	720.0	3.28	0.97	6.25	5.780	1653.9	2949.9	2229.9	576.0	3.87	1403.0	827.0	0.44
36.2	0.217	86	86.2	720.0	3.63	0.96	6.27	5.759	1666.3	2962.3	2242.3	576.0	3.89	1409.1	833.1	0.43
45.3	0.272	88	86.1	705.6	4.55	0.95	6.33	5.704	1709.5	3005.5	2299.9	590.4	3.90	1445.1	854.7	0.41
53.5	0.321	90	86.0	691.2	5.37	0.95	6.39	5.655	1733.1	3029.1	2337.9	604.8	3.87	1471.3	866.5	0.40
62.0	0.372	93	85.9	676.8	6.22	0.94	6.45	5.604	1777.8	3073.8	2397.0	619.2	3.87	1508.1	888.9	0.38
70.5	0.423	94	85.8	662.4	7.08	0.93	6.51	5.553	1801.4	3097.4	2435.0	633.6	3.84	1534.3	900.7	0.37
78.2	0.469	96	85.7	648.0	7.85	0.92	6.56	5.507	1821.6	3117.6	2469.6	648.0	3.81	1558.8	910.8	0.36
87.0	0.522	99	85.7	648.0	8.73	0.91	6.62	5.454	1860.6	3156.6	2508.6	648.0	3.87	1578.3	930.3	0.35
95.3	0.572	101	85.6	633.6	9.57	0.90	6.69	5.404	1884.5	3180.5	2546.9	662.4	3.84	1604.6	942.2	0.34
103.8	0.623	103	85.6	633.6	10.43	0.90	6.75	5.353	1924.3	3220.3	2586.7	662.4	3.91	1624.5	962.1	0.33
112.2	0.673	105	85.5	619.2	11.26	0.89	6.81	5.303	1952.8	3248.8	2629.6	676.8	3.89	1653.2	976.4	0.32
120.0	0.720	107	85.4	604.8	12.05	0.88	6.87	5.256	1966.9	3262.9	2658.1	691.2	3.85	1674.7	983.5	0.31
129.0	0.774	110	85.4	604.8	12.95	0.87	6.95	5.202	2006.8	3302.8	2698.0	691.2	3.90	1694.6	1003.4	0.30
137.0	0.822	111	85.3	590.4	13.76	0.86	7.01	5.154	2015.0	3311.0	2720.6	705.6	3.86	1713.1	1007.5	0.29
145.8	0.875	114	85.2	576.0	14.64	0.85	7.08	5.101	2053.2	3349.2	2773.2	720.0	3.85	1746.6	1026.6	0.28
154.0	0.924	116	85.1	561.6	15.46	0.85	7.15	5.052	2079.8	3375.8	2814.2	734.4	3.83	1774.3	1039.9	0.27
166.7	1.000	119	85.0	547.2	16.73	0.83	7.26	4.976	2102.1	3398.1	2850.9	748.8	3.81	1799.8	1051.0	0.26

DU @ FAILURE	734.4	DEVIATORIC STRESS @ FAILURE	1637.9	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.92

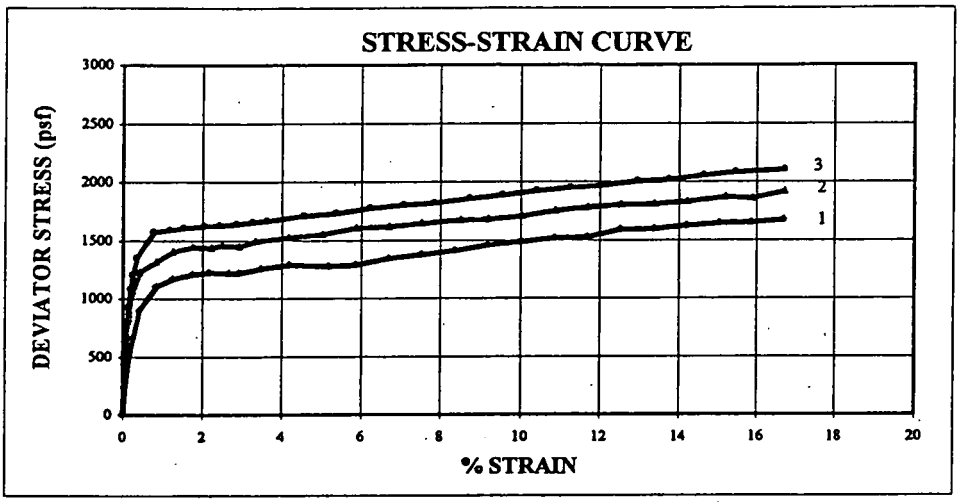
TECH	PWM/DA
DATE	8/2/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE

ASTM D 4767

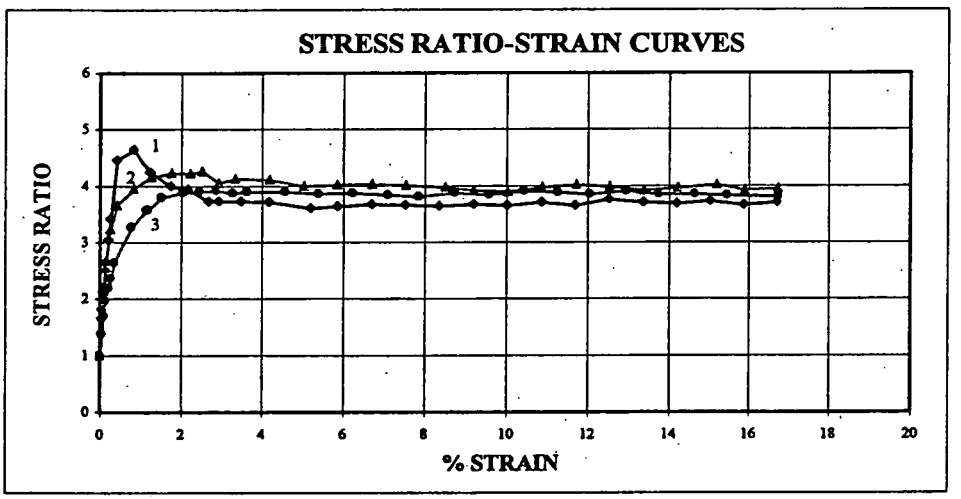
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 2 DEPTH: - Sample Type: Bulk

STRESS-STRAIN CURVE

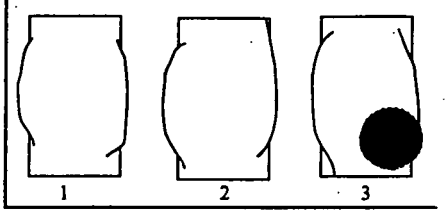


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	113.7	13.7
2	864	113.6	13.9
3	1296	113.5	14.0
	Average	113.6	13.9

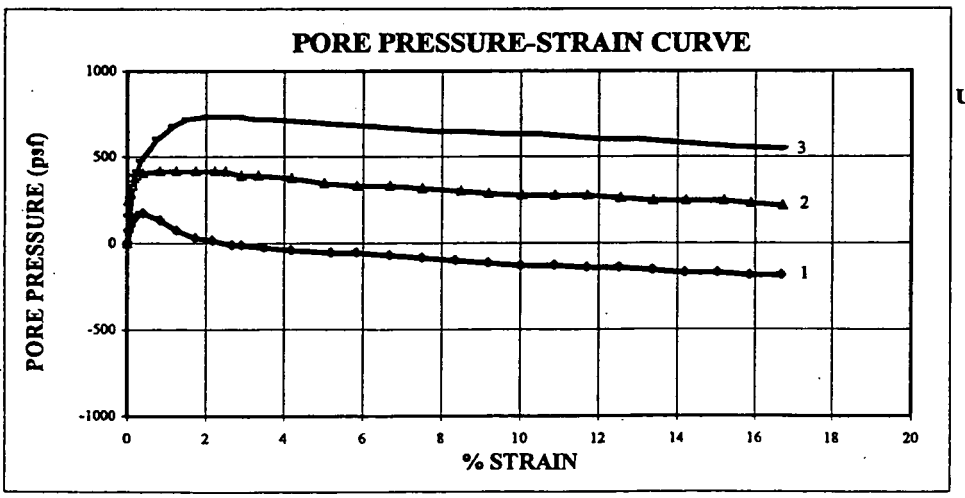
STRESS RATIO-STRAIN CURVES



FAILURE SKETCH



PORE PRESSURE-STRAIN CURVE



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

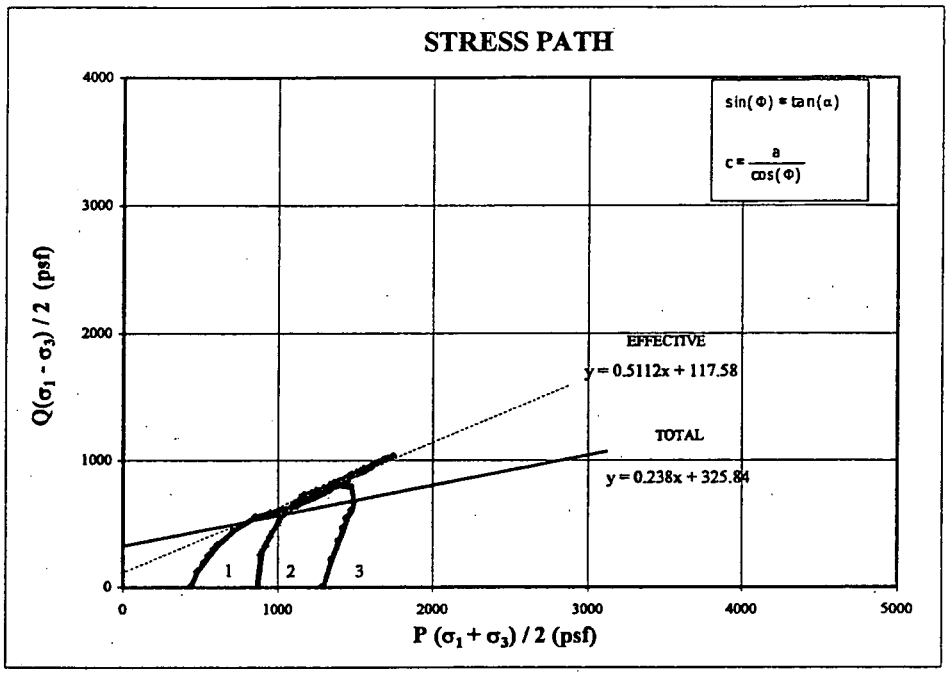
Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

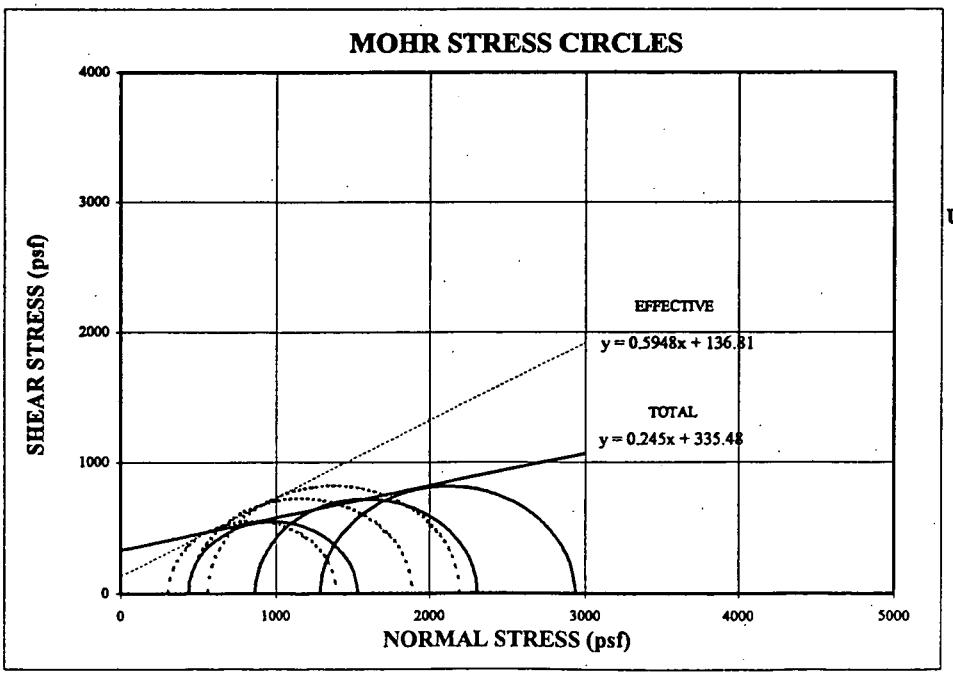
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 2 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	113.7	13.7
2	864	113.6	13.9
3	1296	113.5	14.0

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	77.0	96.9
2	0.10	77.6	96.9
3	0.10	78.0	97.2

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	13.4 °	ϕ	=	13.8 °
a	=	325.8 psf	c	=	335.5 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	27.1 °	ϕ'	=	30.7 °
a'	=	117.6 psf	c'	=	136.8 psf



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

CONSOLIDATED UNDRAINED TRIAXIAL STRENGTH								CONSOLIDATED UNDRAINED TRI		
MOHR CIRCLE GENERATION SPREADSHEET								MOHR CIRCLE GENERATION SPRI		
	PF - 2	-	B	C	A				PF - 2	-
CONFINING PRESSURE USED (S3)			432	864	1296	psf		CONFINING PRESSURE USED (S3)		
CONFINING PRESSURE USED (S3)			432	864	1296	psi		CONFINING PRESSURE USED (S3)		
MAXIMUM DEVIATOR STRESS (PS			1101.6	1444.8	1637.9	psf		MAXIMUM DEVIATOR STRESS (PS		
(or load at 15% strain)								(or load at 15% strain)		
dU AT FAIL	(S1-S3)/2	(S1'+S3')/2		coh	sin phi	phi		dU AT FAIL	(S1-S3)/2	(S1'+S3')/2
129.6	550.8	853.2	COH 1&2	90	0.543700758	33		129.6	550.8	982.8
417.6	722.4	1168.8	COH 1&3	120	0.508487048	31		417.6	722.4	1586.4
734.4	819.0	1380.6	COH 2&3	190	0.456010858	27		734.4	819.0	2115.0
	EFFECTIVE									TOTAL
TA POINTS	A	B	C					DATA POINTS	A	B
	MOHR,1	MOHR,2	MOHR,3						MOHR,1	MOHR,2
X	Y,1	Y,2	Y,3					X	Y,1	Y,2
0	#NUM!	#NUM!	#NUM!					0	#NUM!	#NUM!
10	#NUM!	#NUM!	#NUM!					10	#NUM!	#NUM!
20	#NUM!	#NUM!	#NUM!					20	#NUM!	#NUM!
30	#NUM!	#NUM!	#NUM!					30	#NUM!	#NUM!
40	#NUM!	#NUM!	#NUM!					40	#NUM!	#NUM!
50	#NUM!	#NUM!	#NUM!					50	#NUM!	#NUM!
60	#NUM!	#NUM!	#NUM!					60	#NUM!	#NUM!
70	#NUM!	#NUM!	#NUM!					70	#NUM!	#NUM!
80	#NUM!	#NUM!	#NUM!					80	#NUM!	#NUM!
90	#NUM!	#NUM!	#NUM!					90	#NUM!	#NUM!
100	#NUM!	#NUM!	#NUM!					100	#NUM!	#NUM!
110	#NUM!	#NUM!	#NUM!					110	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!					120	#NUM!	#NUM!
130	#NUM!	#NUM!	#NUM!					130	#NUM!	#NUM!
140	#NUM!	#NUM!	#NUM!					140	#NUM!	#NUM!
150	#NUM!	#NUM!	#NUM!					150	#NUM!	#NUM!
160	#NUM!	#NUM!	#NUM!					160	#NUM!	#NUM!
170	#NUM!	#NUM!	#NUM!					170	#NUM!	#NUM!
180	#NUM!	#NUM!	#NUM!					180	#NUM!	#NUM!
190	#NUM!	#NUM!	#NUM!					190	#NUM!	#NUM!
200	#NUM!	#NUM!	#NUM!					200	#NUM!	#NUM!
210	#NUM!	#NUM!	#NUM!					210	#NUM!	#NUM!
220	#NUM!	#NUM!	#NUM!					220	#NUM!	#NUM!
230	#NUM!	#NUM!	#NUM!					230	#NUM!	#NUM!
240	#NUM!	#NUM!	#NUM!					240	#NUM!	#NUM!
250	#NUM!	#NUM!	#NUM!					250	#NUM!	#NUM!
260	#NUM!	#NUM!	#NUM!					260	#NUM!	#NUM!
270	#NUM!	#NUM!	#NUM!					270	#NUM!	#NUM!
280	#NUM!	#NUM!	#NUM!					280	#NUM!	#NUM!
290	#NUM!	#NUM!	#NUM!					290	#NUM!	#NUM!
300	#NUM!	#NUM!	#NUM!					300	#NUM!	#NUM!
310	91	#NUM!	#NUM!					310	#NUM!	#NUM!
320	138	#NUM!	#NUM!					320	#NUM!	#NUM!
330	172	#NUM!	#NUM!					330	#NUM!	#NUM!
340	200	#NUM!	#NUM!					340	#NUM!	#NUM!
350	224	#NUM!	#NUM!					350	#NUM!	#NUM!
360	245	#NUM!	#NUM!					360	#NUM!	#NUM!

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 3
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.23
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.253	6.005	5.992
DIAMETER	7.087	2.790	2.780
AREA	39.44	6.11	6.07
VOLUME	601.61	36.71	36.38
WEIGHT (g)	1249.09		1285.69
% MOISTURE	12.9		16.25
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	129.6		
DRY DENSITY, calc (pcf)	114.7		
VOLUME OF SOLIDS	409.60		
VOLUME OF VOIDS	192.00		
VOID RATIO	0.469		
SATURATION	74.6		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	115.7
VOLUME OF SOLIDS	409.60
VOLUME OF VOIDS	186.60
VOID RATIO	0.456
WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1285.69
WT SOIL & TARE, DRY (g)	1105.93
WT TARE (g)	0.00
WT MOISTURE (g)	179.76
WT DRY SOIL (g)	1105.93
% MOISTURE	16.25

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	17	80.5	0.0	0.00	1.00	6.07	5.992	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.5	0.003	40	81.9	201.6	0.05	1.00	6.07	5.989	545.2	1409.2	1207.6	662.4	1.82	935.0	272.6	0.37
1.0	0.006	48	82.4	273.6	0.10	1.00	6.08	5.986	734.5	1598.5	1324.9	590.4	2.24	957.6	367.2	0.37
1.5	0.009	52	82.6	302.4	0.15	1.00	6.08	5.983	828.8	1692.8	1390.4	561.6	2.48	976.0	414.4	0.36
2.0	0.012	58	82.9	345.6	0.20	1.00	6.08	5.980	970.4	1834.4	1488.8	518.4	2.87	1003.6	485.2	0.36
2.5	0.015	62	83.0	360.0	0.25	1.00	6.09	5.977	1064.5	1928.5	1568.5	504.0	3.11	1036.3	532.3	0.34
4.2	0.025	67	83.3	403.2	0.42	1.00	6.10	5.967	1180.8	2044.8	1641.6	460.8	3.56	1051.2	590.4	0.34
8.3	0.050	65	83.7	460.8	0.83	0.99	6.12	5.942	1128.9	1992.9	1532.1	403.2	3.80	967.6	564.4	0.41
12.5	0.075	62	84.1	518.4	1.25	0.99	6.15	5.917	1053.9	1917.9	1399.5	345.6	4.05	872.5	526.9	0.49
16.7	0.100	58	84.4	561.6	1.67	0.98	6.17	5.892	956.1	1820.1	1258.5	302.4	4.16	780.5	478.1	0.59
20.8	0.125	58	84.6	590.4	2.09	0.98	6.20	5.867	952.1	1816.1	1225.7	273.6	4.48	749.6	476.0	0.62
25.0	0.150	55	84.7	604.8	2.50	0.97	6.23	5.842	878.6	1742.6	1137.8	259.2	4.39	698.5	439.3	0.69
29.2	0.175	55	84.8	619.2	2.92	0.97	6.25	5.817	874.9	1738.9	1119.7	244.8	4.57	682.2	437.4	0.71
33.3	0.200	55	84.8	619.2	3.34	0.97	6.28	5.792	871.1	1735.1	1115.9	244.8	4.56	680.4	435.6	0.71
41.7	0.250	55	84.9	633.6	4.17	0.96	6.34	5.742	863.6	1727.6	1094.0	230.4	4.75	662.2	431.8	0.73
50.0	0.300	55	84.9	633.6	5.01	0.95	6.39	5.692	856.1	1720.1	1086.5	230.4	4.72	658.4	428.0	0.74
58.3	0.350	58	84.9	633.6	5.84	0.94	6.45	5.642	915.6	1779.6	1146.0	230.4	4.97	688.2	457.8	0.69
66.7	0.400	58	84.9	633.6	6.68	0.93	6.51	5.592	907.4	1771.4	1137.8	230.4	4.94	684.1	453.7	0.70
75.0	0.450	60	84.9	633.6	7.51	0.92	6.56	5.542	943.2	1807.2	1173.6	230.4	5.09	702.0	471.6	0.67
83.3	0.500	62	84.8	619.2	8.34	0.92	6.62	5.492	978.2	1842.2	1223.0	244.8	5.00	733.9	489.1	0.63
91.7	0.550	64	84.8	619.2	9.18	0.91	6.69	5.442	1012.3	1876.3	1257.1	244.8	5.14	751.0	506.2	0.61
100.0	0.600	65	84.7	604.8	10.01	0.90	6.75	5.392	1024.4	1888.4	1283.6	259.2	4.95	771.4	512.2	0.59
108.3	0.650	67	84.6	590.4	10.85	0.89	6.81	5.342	1057.2	1921.2	1330.8	273.6	4.86	802.2	528.6	0.56
116.7	0.700	67	84.6	590.4	11.68	0.88	6.88	5.292	1047.3	1911.3	1320.9	273.6	4.83	797.2	523.6	0.56
125.0	0.750	70	84.5	576.0	12.52	0.87	6.94	5.242	1099.6	1963.6	1387.6	288.0	4.82	837.8	549.8	0.52
133.3	0.800	70	84.4	561.6	13.35	0.87	7.01	5.192	1089.1	1953.1	1391.5	302.4	4.60	847.0	544.6	0.52
141.7	0.850	72	84.4	561.6	14.19	0.86	7.08	5.142	1119.3	1983.3	1421.7	302.4	4.70	862.1	559.7	0.50
150.0	0.900	74	84.3	547.2	15.02	0.85	7.15	5.092	1148.8	2012.8	1465.6	316.8	4.63	891.2	574.4	0.48
158.3	0.950	75	84.2	532.8	15.85	0.84	7.22	5.042	1157.4	2021.4	1488.6	331.2	4.49	909.9	578.7	0.46
166.7	1.000	77	84.2	532.8	16.69	0.83	7.29	4.992	1185.5	2049.5	1516.7	331.2	4.58	923.9	592.7	0.45

DU @ FAILURE	590.4	DEVIATORIC STRESS @ FAILURE	952.1	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.48

TECH	PWM/SDM
DATE	7/28/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 3
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.11
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.174	5.974	5.949
DIAMETER	7.087	2.790	2.774
AREA	39.44	6.11	6.04
VOLUME	598.50	36.52	35.95
WEIGHT (g)	1251.14		1286.74
% MOISTURE	12.7		15.92
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	130.4		
DRY DENSITY, calc (pcf)	115.7		
VOLUME OF SOLIDS	411.10		
VOLUME OF VOIDS	187.40		
VOID RATIO	0.456		
SATURATION	75.3		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	117.6
VOLUME OF SOLIDS	411.10
VOLUME OF VOIDS	178.00
VOID RATIO	0.433
WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1286.74
WT SOIL & TARE, DRY (g)	1109.98
WT TARE (g)	0.00
WT MOISTURE (g)	176.76
WT DRY SOIL (g)	1109.98
% MOISTURE	15.92

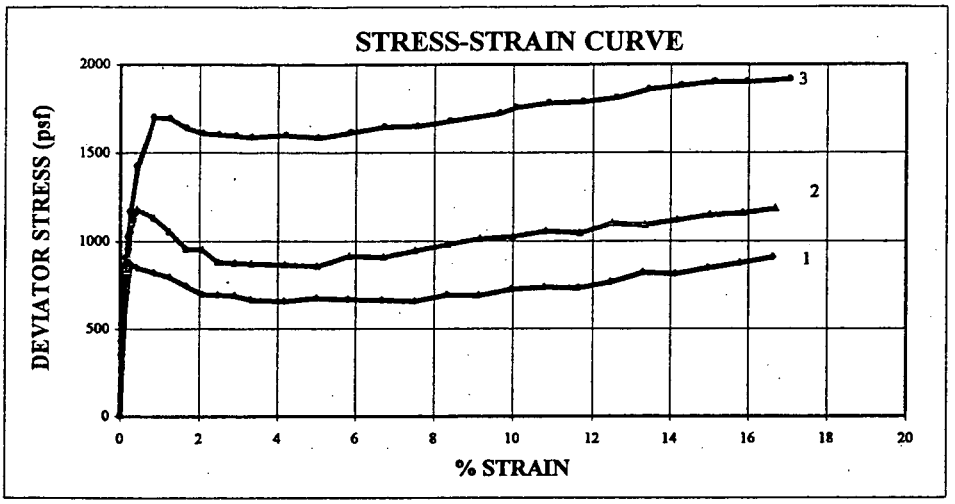
TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	20	80.9	0.0	0.00	1.00	6.04	5.949	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.5	0.003	38	82.1	172.8	0.05	1.00	6.05	5.946	428.7	1724.7	1551.9	1123.2	1.38	1337.6	214.4	0.40
1.0	0.006	56	83.5	374.4	0.10	1.00	6.05	5.943	857.0	2153.0	1778.6	921.6	1.93	1350.1	428.5	0.44
1.5	0.009	58	83.6	388.8	0.15	1.00	6.05	5.940	904.2	2200.2	1811.4	907.2	2.00	1359.3	452.1	0.43
2.0	0.012	63	83.9	432.0	0.20	1.00	6.06	5.937	1022.6	2318.6	1886.6	864.0	2.18	1375.3	511.3	0.42
2.5	0.015	69	84.3	489.6	0.25	1.00	6.06	5.934	1164.7	2460.7	1971.1	806.4	2.44	1388.8	582.4	0.42
4.2	0.025	80	84.7	547.2	0.42	1.00	6.07	5.924	1423.8	2719.8	2172.6	748.8	2.90	1460.7	711.9	0.38
8.3	0.050	92	85.1	604.8	0.84	0.99	6.09	5.899	1701.3	2997.3	2392.5	691.2	3.46	1541.9	850.7	0.36
12.5	0.075	92	85.3	633.6	1.26	0.99	6.12	5.874	1694.1	2990.1	2356.5	662.4	3.56	1509.5	847.1	0.37
16.7	0.100	90	85.4	648.0	1.68	0.98	6.15	5.849	1640.0	2936.0	2288.0	648.0	3.53	1468.0	820.0	0.40
20.8	0.125	89	85.6	676.8	2.10	0.98	6.17	5.824	1609.7	2905.7	2228.9	619.2	3.60	1424.0	804.8	0.42
25.0	0.150	89	85.7	691.2	2.52	0.97	6.20	5.799	1602.8	2898.8	2207.6	604.8	3.65	1406.2	801.4	0.43
29.2	0.175	89	85.8	705.6	2.94	0.97	6.23	5.774	1595.9	2891.9	2186.3	590.4	3.70	1388.3	797.9	0.44
33.3	0.200	89	85.8	705.6	3.36	0.97	6.25	5.749	1589.0	2885.0	2179.4	590.4	3.69	1384.9	794.5	0.44
41.7	0.250	90	85.8	705.6	4.20	0.96	6.31	5.699	1598.0	2894.0	2188.4	590.4	3.71	1389.4	799.0	0.44
50.0	0.300	90	85.8	705.6	5.04	0.95	6.36	5.649	1584.0	2880.0	2174.4	590.4	3.68	1382.4	792.0	0.45
58.3	0.350	92	85.9	720.0	5.88	0.94	6.42	5.599	1614.8	2910.8	2190.8	576.0	3.80	1383.4	807.4	0.45
66.7	0.400	94	85.8	705.6	6.72	0.93	6.48	5.549	1644.8	2940.8	2235.2	590.4	3.79	1412.8	822.4	0.43
75.0	0.450	95	85.8	705.6	7.56	0.92	6.54	5.499	1652.0	2948.0	2242.4	590.4	3.80	1416.4	826.0	0.43
83.3	0.500	97	85.7	691.2	8.40	0.92	6.60	5.449	1680.7	2976.7	2285.5	604.8	3.78	1445.1	840.3	0.41
95.8	0.575	100	85.6	676.8	9.67	0.90	6.69	5.374	1722.1	3018.1	2341.3	619.2	3.78	1480.3	861.1	0.39
100.0	0.600	102	85.6	676.8	10.09	0.90	6.72	5.349	1757.0	3053.0	2376.2	619.2	3.84	1497.7	878.5	0.39
108.3	0.650	104	85.5	662.4	10.93	0.89	6.78	5.299	1783.0	3079.0	2416.6	633.6	3.81	1525.1	891.5	0.37
116.7	0.700	105	85.5	662.4	11.77	0.88	6.85	5.249	1787.2	3083.2	2420.8	633.6	3.82	1527.2	893.6	0.37
125.0	0.750	107	85.4	648.0	12.61	0.87	6.91	5.199	1811.8	3107.8	2459.8	648.0	3.80	1553.9	905.9	0.36
133.3	0.800	110	85.3	633.6	13.45	0.87	6.98	5.149	1856.3	3152.3	2518.7	662.4	3.80	1590.5	928.1	0.34
141.7	0.850	112	85.2	619.2	14.29	0.86	7.05	5.099	1879.1	3175.1	2555.9	676.8	3.78	1616.3	939.5	0.33
150.0	0.900	114	85.1	604.8	15.13	0.85	7.12	5.049	1901.1	3197.1	2592.3	691.2	3.75	1641.8	950.6	0.32
158.3	0.950	115	85.0	590.4	15.97	0.84	7.19	4.999	1902.3	3198.3	2607.9	705.6	3.70	1656.8	951.2	0.31
169.2	1.015	117	84.9	576.0	17.06	0.83	7.29	4.934	1917.1	3213.1	2637.1	720.0	3.66	1678.6	958.6	0.30

DU @ FAILURE	633.6	DEVIATORIC STRESS @ FAILURE	1694.1	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.56

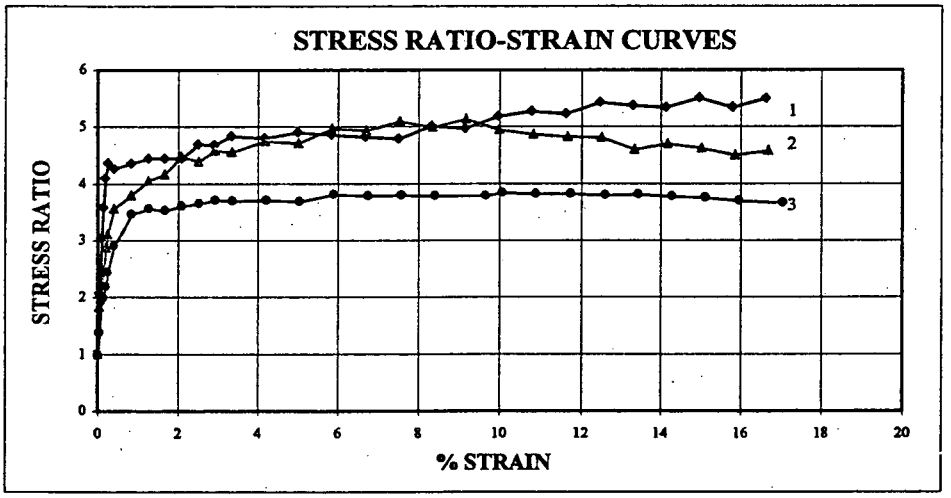
TECH	PWM/SDM
D[redacted]	7/28/2004
CHE[redacted]	
REVIEWED	

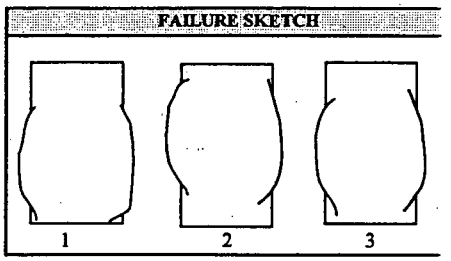
TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

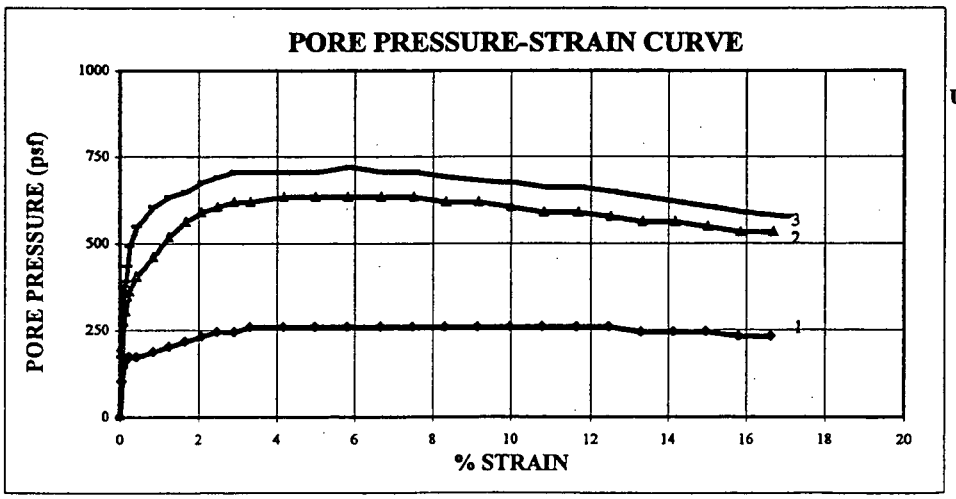
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 3 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	114.7	12.7
2	864	114.7	12.9
3	1296	115.7	12.7
	Average	115.1	12.8







Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

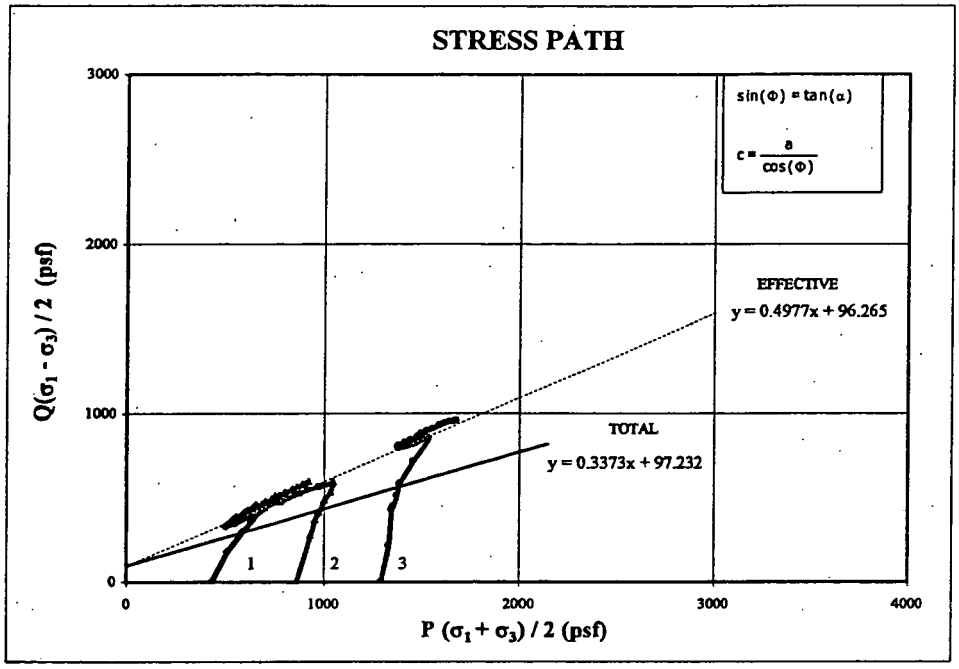
Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

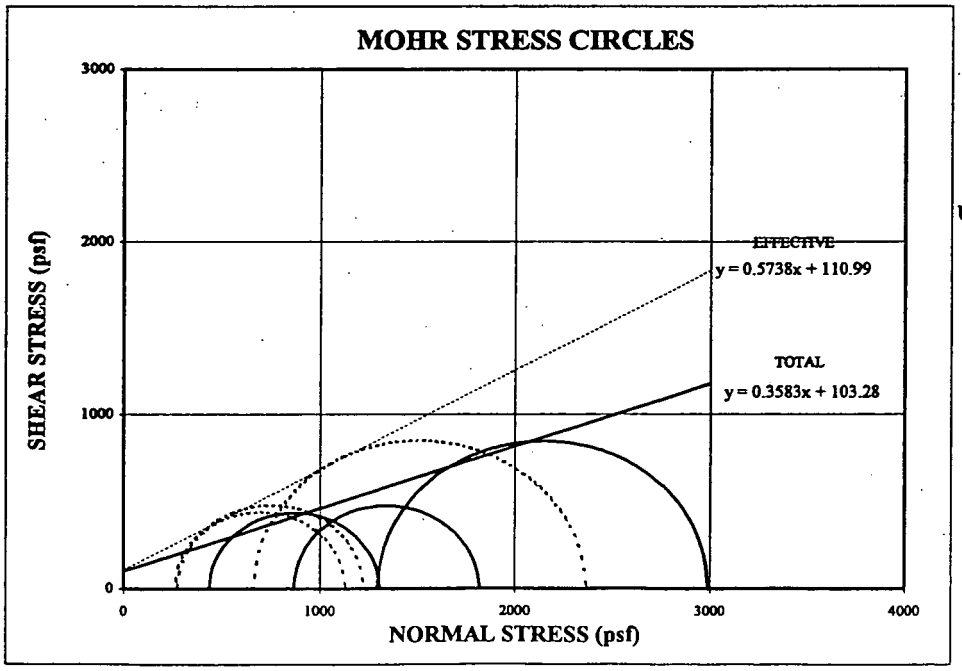
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 3 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	114.7	12.7
2	864	114.7	12.9
3	1296	115.7	12.7

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	73.2	95.0
2	0.10	74.6	96.3
3	0.10	75.3	99.3

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	18.6 °	ϕ	=	19.7 °
a	=	97.2 psf	c	=	103.3 psf
*EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	26.5 °	ϕ'	=	29.8 °
a'	=	96.3 psf	c'	=	111.0 psf



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

CONSOLIDATED UNDRAINED TRIAXIAL STRENGTH								CONSOLIDATED UNDRAINED TRI		
MOHR CIRCLE GENERATION SPREADSHEET								MOHR CIRCLE GENERATION SPRE		
	PF - 3	-	B	C	A				PF - 3	-
CONFINING PRESSURE USED (S3)			432	864	1296	psf		CONFINING PRESSURE USED (S3)		
CONFINING PRESSURE USED (S3)			432	864	1296	psi		CONFINING PRESSURE USED (S3)		
MAXIMUM DEVIATOR STRESS (PS			872.1	952.1	1694.1	psf		MAXIMUM DEVIATOR STRESS (PS		
(or load at 15% strain)								(or load at 15% strain)		
dU AT FAIL	(S1-S3)/2	(S1'+S3')/2		coh	sin phi	phi		dU AT FAIL	(S1-S3)/2	(S1'+S3')/2
172.8	436.0	695.2	COH 1&2	-80	0.735278001	47		172.8	436.0	868.0
590.4	476.0	749.6	COH 1&3	90	0.504800156	30		590.4	476.0	1340.0
633.6	847.1	1509.5	COH 2&3	110	0.488299892	29		633.6	847.1	2143.1
		EFFECTIVE								TOTAL
TA POINTS	A	B	C					DATA POINTS	A	B
	MOHR,1	MOHR,2	MOHR,3						MOHR,1	MOHR,2
X	Y,1	Y,2	Y,3					X	Y,1	Y,2
0	#NUM!	#NUM!	#NUM!					0	#NUM!	#NUM!
10	#NUM!	#NUM!	#NUM!					10	#NUM!	#NUM!
20	#NUM!	#NUM!	#NUM!					20	#NUM!	#NUM!
30	#NUM!	#NUM!	#NUM!					30	#NUM!	#NUM!
40	#NUM!	#NUM!	#NUM!					40	#NUM!	#NUM!
50	#NUM!	#NUM!	#NUM!					50	#NUM!	#NUM!
60	#NUM!	#NUM!	#NUM!					60	#NUM!	#NUM!
70	#NUM!	#NUM!	#NUM!					70	#NUM!	#NUM!
80	#NUM!	#NUM!	#NUM!					80	#NUM!	#NUM!
90	#NUM!	#NUM!	#NUM!					90	#NUM!	#NUM!
100	#NUM!	#NUM!	#NUM!					100	#NUM!	#NUM!
110	#NUM!	#NUM!	#NUM!					110	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!					120	#NUM!	#NUM!
130	#NUM!	#NUM!	#NUM!					130	#NUM!	#NUM!
140	#NUM!	#NUM!	#NUM!					140	#NUM!	#NUM!
150	#NUM!	#NUM!	#NUM!					150	#NUM!	#NUM!
160	#NUM!	#NUM!	#NUM!					160	#NUM!	#NUM!
170	#NUM!	#NUM!	#NUM!					170	#NUM!	#NUM!
180	#NUM!	#NUM!	#NUM!					180	#NUM!	#NUM!
190	#NUM!	#NUM!	#NUM!					190	#NUM!	#NUM!
200	#NUM!	#NUM!	#NUM!					200	#NUM!	#NUM!
210	#NUM!	#NUM!	#NUM!					210	#NUM!	#NUM!
220	#NUM!	#NUM!	#NUM!					220	#NUM!	#NUM!
230	#NUM!	#NUM!	#NUM!					230	#NUM!	#NUM!
240	#NUM!	#NUM!	#NUM!					240	#NUM!	#NUM!
250	#NUM!	#NUM!	#NUM!					250	#NUM!	#NUM!
260	26	#NUM!	#NUM!					260	#NUM!	#NUM!
270	96	#NUM!	#NUM!					270	#NUM!	#NUM!
280	133	78	#NUM!					280	#NUM!	#NUM!
290	161	124	#NUM!					290	#NUM!	#NUM!
300	184	156	#NUM!					300	#NUM!	#NUM!
310	204	183	#NUM!					310	#NUM!	#NUM!
320	222	205	#NUM!					320	#NUM!	#NUM!
330	238	225	#NUM!					330	#NUM!	#NUM!
340	253	243	#NUM!					340	#NUM!	#NUM!
350	266	259	#NUM!					350	#NUM!	#NUM!
360	279	273	#NUM!					360	#NUM!	#NUM!

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 4
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.21

Mounting Method: Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.225	5.994	5.982
DIAMETER	7.087	2.790	2.785
AREA	39.44	6.11	6.09
VOLUME	600.50	36.65	36.45
WEIGHT (g)	1266.11		1300.91
% MOISTURE	12.8		15.91
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	131.6		
DRY DENSITY, calc (pcf)	116.6		
VOLUME OF SOLIDS	415.68		
VOLUME OF VOIDS	184.83		
VOID RATIO	0.445		
SATURATION	77.8		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	117.2
VOLUME OF SOLIDS	415.68
VOLUME OF VOIDS	181.63
VOID RATIO	0.437

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1300.91
WT SOIL & TARE, DRY (g)	1122.33
WT TARE (g)	0.00
WT MOISTURE (g)	178.58
WT DRY SOIL (g)	1122.33
% MOISTURE	15.91

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	81.4	0.0	0.00	1.00	6.09	5.982	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.5	0.003	34	82.8	201.6	0.05	1.00	6.10	5.979	507.8	939.8	738.2	230.4	3.20	484.3	253.9	0.40
1.3	0.008	42	83.0	230.4	0.13	1.00	6.10	5.974	691.5	1123.5	893.1	201.6	4.43	547.4	345.8	0.33
1.8	0.011	46	83.1	244.8	0.18	1.00	6.10	5.971	780.8	1212.8	968.0	187.2	5.17	577.6	390.4	0.31
2.3	0.014	49	83.2	259.2	0.23	1.00	6.11	5.968	858.2	1290.2	1031.0	172.8	5.97	601.9	429.1	0.30
2.7	0.016	52	83.2	259.2	0.27	1.00	6.11	5.966	926.3	1358.3	1099.1	172.8	6.36	635.9	463.1	0.28
3.2	0.019	54	83.1	244.8	0.32	1.00	6.11	5.963	980.0	1412.0	1167.2	187.2	6.24	677.2	490.0	0.25
3.8	0.023	57	83.1	244.8	0.38	1.00	6.12	5.959	1038.2	1470.2	1225.4	187.2	6.55	706.3	519.1	0.24
8.0	0.048	71	82.4	144.0	0.80	0.99	6.14	5.934	1380.8	1812.8	1668.8	288.0	5.79	978.4	690.4	0.10
12.2	0.073	80	81.5	14.4	1.22	0.99	6.17	5.909	1578.1	2010.1	1995.7	417.6	4.78	1206.6	789.0	0.01
15.8	0.095	85	80.8	-86.4	1.59	0.98	6.19	5.887	1683.8	2115.8	2202.2	518.4	4.25	1360.3	841.9	-0.05
20.2	0.121	87	80.4	-144.0	2.02	0.98	6.22	5.861	1734.3	2166.3	2310.3	576.0	4.01	1443.1	867.1	-0.08
24.7	0.148	89	80.2	-172.8	2.47	0.98	6.25	5.834	1770.1	2202.1	2374.9	604.8	3.93	1489.8	885.0	-0.10
28.8	0.173	91	80.1	-187.2	2.89	0.97	6.27	5.809	1801.5	2233.5	2420.7	619.2	3.91	1520.0	900.8	-0.10
33.2	0.199	92	80.0	-201.6	3.33	0.97	6.30	5.783	1825.4	2257.4	2459.0	633.6	3.88	1546.3	912.7	-0.11
37.0	0.222	94	80.0	-201.6	3.71	0.96	6.33	5.760	1854.6	2286.6	2488.2	633.6	3.93	1560.9	927.3	-0.11
45.5	0.273	96	79.8	-230.4	4.56	0.95	6.38	5.709	1878.8	2310.8	2541.2	662.4	3.84	1601.8	939.4	-0.12
54.0	0.324	98	79.6	-259.2	5.42	0.95	6.44	5.658	1906.7	2338.7	2597.9	691.2	3.76	1644.5	953.3	-0.14
62.2	0.373	100	79.6	-259.2	6.24	0.94	6.50	5.609	1932.3	2364.3	2623.5	691.2	3.80	1657.3	966.1	-0.13
70.5	0.423	102	79.5	-273.6	7.07	0.93	6.56	5.559	1965.6	2397.6	2671.2	705.6	3.79	1688.4	982.8	-0.14
78.5	0.471	104	79.5	-273.6	7.87	0.92	6.61	5.511	1998.7	2430.7	2704.3	705.6	3.83	1704.9	999.3	-0.14
87.2	0.523	106	79.3	-302.4	8.74	0.91	6.68	5.459	2016.5	2448.5	2750.9	734.4	3.75	1742.6	1008.2	-0.15
95.7	0.574	108	79.3	-302.4	9.60	0.90	6.74	5.408	2029.7	2461.7	2764.1	734.4	3.76	1749.2	1014.8	-0.15
104.0	0.624	110	79.3	-302.4	10.43	0.90	6.80	5.358	2057.5	2489.5	2791.9	734.4	3.80	1763.1	1028.7	-0.15
112.5	0.675	112	79.1	-331.2	11.28	0.89	6.87	5.307	2086.1	2518.1	2849.3	763.2	3.73	1806.3	1043.1	-0.16
120.2	0.721	115	79.0	-345.6	12.05	0.88	6.93	5.261	2134.6	2566.6	2912.2	777.6	3.75	1844.9	1067.3	-0.16
129.0	0.774	117	79.0	-345.6	12.94	0.87	7.00	5.208	2139.8	2571.8	2917.4	777.6	3.75	1847.5	1069.9	-0.16
137.5	0.825	119	78.8	-374.4	13.79	0.86	7.07	5.157	2159.6	2591.6	2966.0	806.4	3.68	1886.2	1079.8	-0.17
145.8	0.875	121	78.8	-374.4	14.63	0.85	7.14	5.107	2183.0	2615.0	2989.4	806.4	3.71	1897.9	1091.5	-0.17
154.5	0.927	123	78.8	-374.4	15.50	0.85	7.21	5.055	2208.7	2640.7	3015.1	806.4	3.74	1910.8	1104.4	-0.17

DU @ FAILURE	244.80	DEVIATORIC STRESS @ FAILURE	1038.20	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	6.55

TECH	PWM/SDM
DATE	8/5/04
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 4
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.19
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.243	6.001	5.989
DIAMETER	7.087	2.790	2.778
AREA	39.44	6.11	6.06
VOLUME	601.21	36.69	36.31
WEIGHT (g)	1266.07		1297.87
% MOISTURE	12.9		15.70
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	131.4		
DRY DENSITY, calc (pcf)	116.4		
VOLUME OF SOLIDS	415.45		
VOLUME OF VOIDS	185.76		
VOID RATIO	0.447		
SATURATION	77.7		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	117.6
VOLUME OF SOLIDS	415.45
VOLUME OF VOIDS	179.56
VOID RATIO	0.432

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1297.87
WT SOIL & TARE, DRY (g)	1121.71
WT TARE (g)	0.00
WT MOISTURE (g)	176.16
WT DRY SOIL (g)	1121.71
% MOISTURE	15.70

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	81.1	0.0	0.00	1.00	6.06	5.989	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.5	0.003	41	82.7	230.4	0.05	1.00	6.07	5.986	662.3	1526.3	1295.9	633.6	2.05	964.8	331.2	0.35
0.8	0.005	46	83.0	273.6	0.08	1.00	6.07	5.984	776.0	1640.0	1366.4	590.4	2.31	978.4	388.0	0.35
1.3	0.008	54	83.4	331.2	0.13	1.00	6.07	5.981	972.5	1836.5	1505.3	532.8	2.83	1019.1	486.3	0.34
2.2	0.013	65	83.9	403.2	0.22	1.00	6.08	5.976	1239.5	2103.5	1700.3	460.8	3.69	1080.6	619.8	0.33
2.8	0.017	70	84.0	417.6	0.28	1.00	6.08	5.972	1342.9	2206.9	1789.3	446.4	4.01	1117.9	671.5	0.31
3.3	0.020	74	84.1	432.0	0.33	1.00	6.08	5.969	1446.4	2310.4	1878.4	432.0	4.35	1155.2	723.2	0.30
3.8	0.023	78	84.1	432.0	0.38	1.00	6.09	5.966	1533.2	2397.2	1965.2	432.0	4.55	1198.6	766.6	0.28
8.2	0.049	99	83.5	345.6	0.82	0.99	6.11	5.940	2033.0	2897.0	2551.4	518.4	4.92	1534.9	1016.5	0.17
12.3	0.074	107	82.8	244.8	1.24	0.99	6.14	5.915	2198.0	3062.0	2817.2	619.2	4.55	1718.2	1099.0	0.11
16.0	0.096	107	82.5	201.6	1.60	0.98	6.16	5.893	2210.9	3074.9	2873.3	662.4	4.34	1767.9	1105.5	0.09
20.7	0.124	109	82.3	172.8	2.07	0.98	6.19	5.865	2228.3	3092.3	2919.5	691.2	4.22	1805.4	1114.2	0.08
24.8	0.149	110	82.2	158.4	2.49	0.98	6.22	5.840	2239.7	3103.7	2945.3	705.6	4.17	1825.4	1119.8	0.07
29.0	0.174	110	82.1	144.0	2.91	0.97	6.24	5.815	2243.9	3107.9	2963.9	720.0	4.12	1842.0	1122.0	0.06
33.0	0.198	110	82.0	129.6	3.31	0.97	6.27	5.791	2241.5	3105.5	2975.9	734.4	4.05	1855.2	1120.8	0.06
36.8	0.221	111	81.9	115.2	3.69	0.96	6.29	5.768	2253.2	3117.2	3002.0	748.8	4.01	1875.4	1126.6	0.05
45.7	0.274	113	82.0	129.6	4.58	0.95	6.35	5.715	2271.0	3135.0	3005.4	734.4	4.09	1869.9	1135.5	0.06
53.8	0.323	115	81.9	115.2	5.39	0.95	6.41	5.666	2289.8	3153.8	3038.6	748.8	4.06	1893.7	1144.9	0.05
62.5	0.375	117	81.9	115.2	6.26	0.94	6.47	5.614	2317.7	3181.7	3066.5	748.8	4.10	1907.7	1158.9	0.05
70.8	0.425	119	81.8	100.8	7.10	0.93	6.53	5.564	2332.4	3196.4	3095.6	763.2	4.06	1929.4	1166.2	0.04
78.5	0.471	120	81.8	100.8	7.86	0.92	6.58	5.518	2354.7	3218.7	3117.9	763.2	4.09	1940.6	1177.4	0.04
87.3	0.524	123	81.7	86.4	8.75	0.91	6.64	5.465	2390.6	3254.6	3168.2	777.6	4.07	1972.9	1195.3	0.04
95.8	0.575	125	81.6	72.0	9.60	0.90	6.71	5.414	2404.8	3268.8	3196.8	792.0	4.04	1994.4	1202.4	0.03
104.2	0.625	128	81.5	57.6	10.44	0.90	6.77	5.364	2448.5	3312.5	3254.9	806.4	4.04	2030.7	1224.3	0.02
112.7	0.676	131	81.3	28.8	11.29	0.89	6.83	5.313	2484.3	3348.3	3319.5	835.2	3.97	2077.3	1242.1	0.01
120.5	0.723	132	81.2	14.4	12.07	0.88	6.90	5.266	2481.1	3345.1	3330.7	849.6	3.92	2090.1	1240.5	0.01
129.3	0.776	136	81.1	0.0	12.96	0.87	6.97	5.213	2538.8	3402.8	3402.8	864.0	3.94	2133.4	1269.4	0.00
137.7	0.826	137	80.9	-28.8	13.79	0.86	7.03	5.163	2547.2	3411.2	3440.0	892.8	3.85	2166.4	1273.6	-0.01
146.2	0.877	140	80.9	-28.8	14.64	0.85	7.10	5.112	2586.9	3450.9	3479.7	892.8	3.90	2186.3	1293.5	-0.01
154.7	0.928	143	80.8	-43.2	15.50	0.85	7.17	5.061	2613.3	3477.3	3520.5	907.2	3.88	2213.9	1306.7	-0.02

DU @ FAILURE	345.6	DEVIATORIC STRESS @ FAILURE	2033.0	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.92

TECH	PWM/SDM
DATE	8/5/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 4
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	0.97
t_{50} (minutes)	0.43
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.253	6.005	5.981
DIAMETER	7.087	2.790	2.778
AREA	39.44	6.11	6.06
VOLUME	601.61	36.71	36.24
WEIGHT (g)	1266.20		1296.50
% MOISTURE	12.6		15.32
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	131.3		
DRY DENSITY, calc (pcf)	116.6		
VOLUME OF SOLIDS	416.38		
VOLUME OF VOIDS	185.23		
VOID RATIO	0.445		
SATURATION	76.7		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	118.1
VOLUME OF SOLIDS	416.38
VOLUME OF VOIDS	177.53
VOID RATIO	0.426

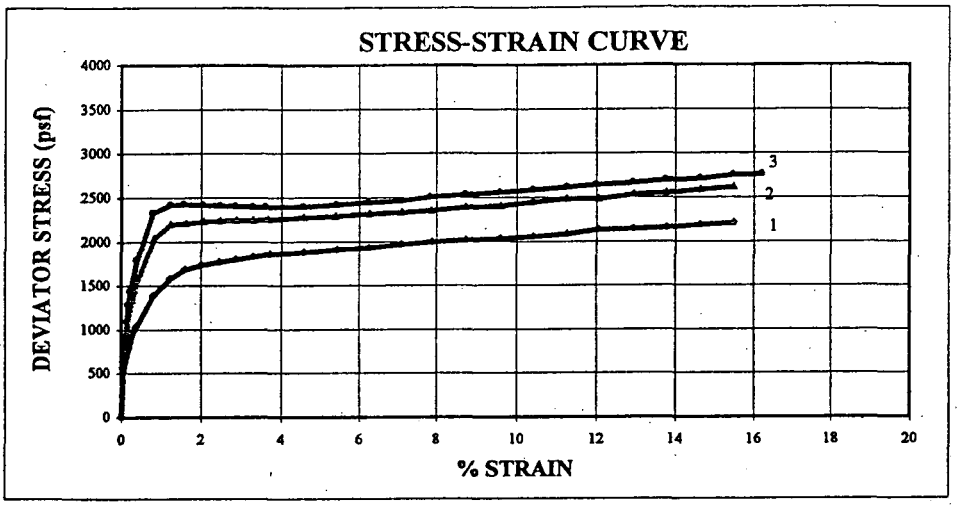
WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1296.50
WT SOIL & TARE, DRY (g)	1124.22
WT TARE (g)	0.00
WT MOISTURE (g)	172.28
WT DRY SOIL (g)	1124.22
% MOISTURE	15.32

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	80.8	0.0	0.00	1.00	6.06	5.981	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.5	0.003	37	82.5	244.8	0.05	1.00	6.06	5.978	562.9	1858.9	1614.1	1051.2	1.54	1332.7	281.5	0.43
1.0	0.006	49	83.1	331.2	0.10	1.00	6.07	5.975	849.9	2145.9	1814.7	964.8	1.88	1389.7	424.9	0.39
1.5	0.009	59	83.7	417.6	0.15	1.00	6.07	5.972	1091.5	2387.5	1969.9	878.4	2.24	1424.1	545.7	0.38
1.8	0.011	67	84.1	475.2	0.18	1.00	6.07	5.970	1283.3	2579.3	2104.1	820.8	2.56	1462.4	641.6	0.37
2.3	0.014	74	84.4	518.4	0.23	1.00	6.07	5.967	1434.4	2730.4	2212.0	777.6	2.84	1494.8	717.2	0.36
4.0	0.024	89	84.8	576.0	0.40	1.00	6.08	5.957	1791.7	3087.7	2511.7	720.0	3.49	1615.9	895.9	0.32
7.8	0.047	112	84.4	518.4	0.79	0.99	6.11	5.934	2327.1	3623.1	3104.7	777.6	3.99	1941.1	1163.5	0.22
12.2	0.073	116	83.9	446.4	1.22	0.99	6.13	5.908	2417.8	3713.8	3267.4	849.6	3.85	2058.5	1208.9	0.18
15.5	0.093	117	83.8	432.0	1.55	0.98	6.16	5.888	2426.0	3722.0	3290.0	864.0	3.81	2077.0	1213.0	0.18
20.3	0.122	117	83.7	417.6	2.04	0.98	6.19	5.859	2416.4	3712.4	3294.8	878.4	3.75	2086.6	1208.2	0.17
24.8	0.149	117	83.7	417.6	2.49	0.98	6.21	5.832	2409.9	3705.9	3288.3	878.4	3.74	2083.3	1204.9	0.17
28.7	0.172	117	83.7	417.6	2.88	0.97	6.24	5.809	2402.7	3698.7	3281.1	878.4	3.74	2079.7	1201.3	0.17
33.0	0.198	118	83.7	417.6	3.31	0.97	6.27	5.783	2394.2	3690.2	3272.6	878.4	3.73	2075.5	1197.1	0.17
36.2	0.217	118	83.7	417.6	3.63	0.96	6.29	5.764	2400.1	3696.1	3278.5	878.4	3.73	2078.5	1200.1	0.17
45.5	0.273	119	83.7	417.6	4.56	0.95	6.35	5.708	2399.5	3695.5	3277.9	878.4	3.73	2078.1	1199.7	0.17
53.8	0.323	121	83.7	417.6	5.40	0.95	6.41	5.658	2418.9	3714.9	3297.3	878.4	3.75	2087.9	1209.5	0.17
62.2	0.373	123	83.7	417.6	6.24	0.94	6.46	5.608	2446.6	3742.6	3325.0	878.4	3.79	2101.7	1223.3	0.17
70.3	0.422	125	83.6	403.2	7.06	0.93	6.52	5.559	2462.7	3758.7	3355.5	892.8	3.76	2124.2	1231.4	0.16
78.0	0.468	128	83.5	388.8	7.82	0.92	6.57	5.513	2508.1	3804.1	3415.3	907.2	3.76	2161.2	1254.0	0.16
87.2	0.523	130	83.5	388.8	8.74	0.91	6.64	5.458	2537.3	3833.3	3444.5	907.2	3.80	2175.8	1268.6	0.15
95.5	0.573	132	83.4	374.4	9.58	0.90	6.70	5.408	2557.0	3853.0	3478.6	921.6	3.77	2200.1	1278.5	0.15
104.0	0.624	135	83.3	360.0	10.43	0.90	6.77	5.357	2586.1	3882.1	3522.1	936.0	3.76	2229.0	1293.0	0.14
112.5	0.675	138	83.1	331.2	11.29	0.89	6.83	5.306	2618.4	3914.4	3583.2	964.8	3.71	2274.0	1309.2	0.13
119.7	0.718	140	83.0	316.8	12.00	0.88	6.89	5.263	2643.2	3939.2	3622.4	979.2	3.70	2300.8	1321.6	0.12
129.0	0.774	142	82.9	302.4	12.94	0.87	6.96	5.207	2668.8	3964.8	3662.4	993.6	3.69	2328.0	1334.4	0.11
137.3	0.824	145	82.7	273.6	13.78	0.86	7.03	5.157	2692.4	3988.4	3714.8	1022.4	3.63	2368.6	1346.2	0.10
145.8	0.875	147	82.7	273.6	14.63	0.85	7.10	5.106	2712.4	4008.4	3734.8	1022.4	3.65	2378.6	1356.2	0.10
154.3	0.926	150	82.6	259.2	15.48	0.85	7.17	5.055	2753.6	4049.6	3790.4	1036.8	3.66	2413.6	1376.8	0.09
161.7	0.970	152	82.5	244.8	16.22	0.84	7.23	5.011	2763.5	4059.5	3814.7	1051.2	3.63	2433.0	1381.8	0.09

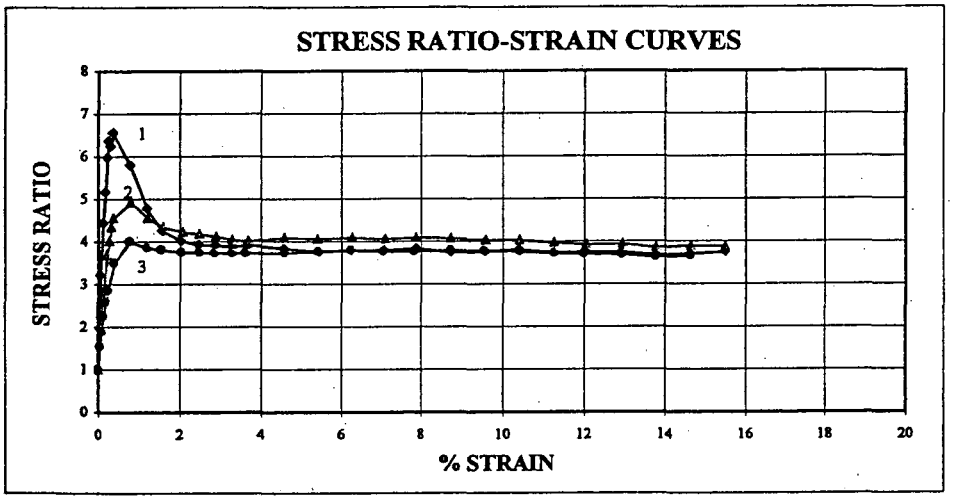
DU @ FAILURE	DEVIATORIC STRESS @ FAILURE	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	TECH	PWM/SDM
518.4	2327.1	3.99	DATE	8/5/2004
			CHECKED	
			REVIEWED	

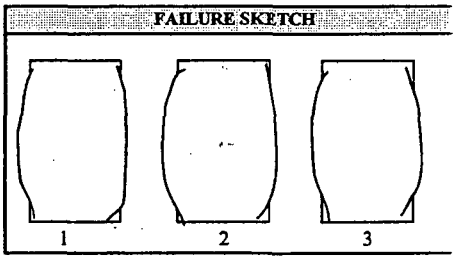
TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

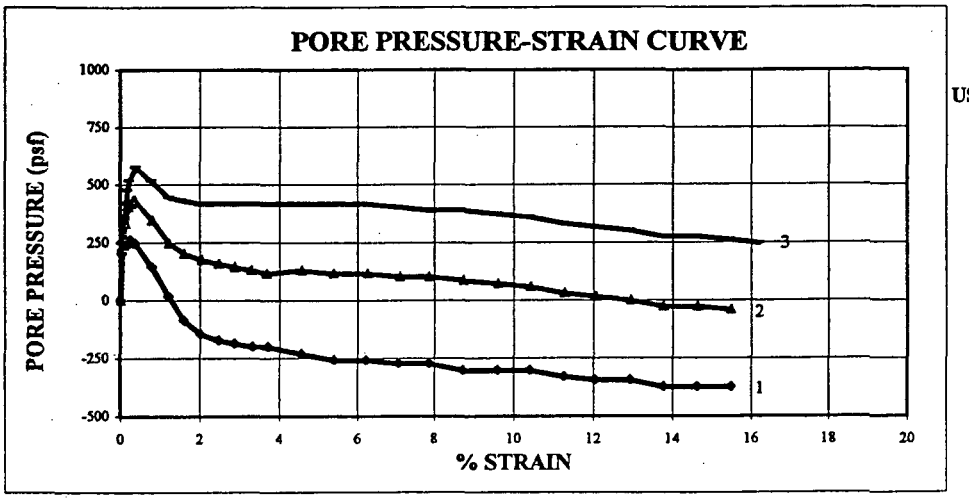
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 4 DEPTH: - Sample Type: **Bulk**



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	116.6	12.8
2	864	116.4	12.9
3	1296	116.6	12.6
	Average	**116.6**	**12.8**







Soil Description

Reddish Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

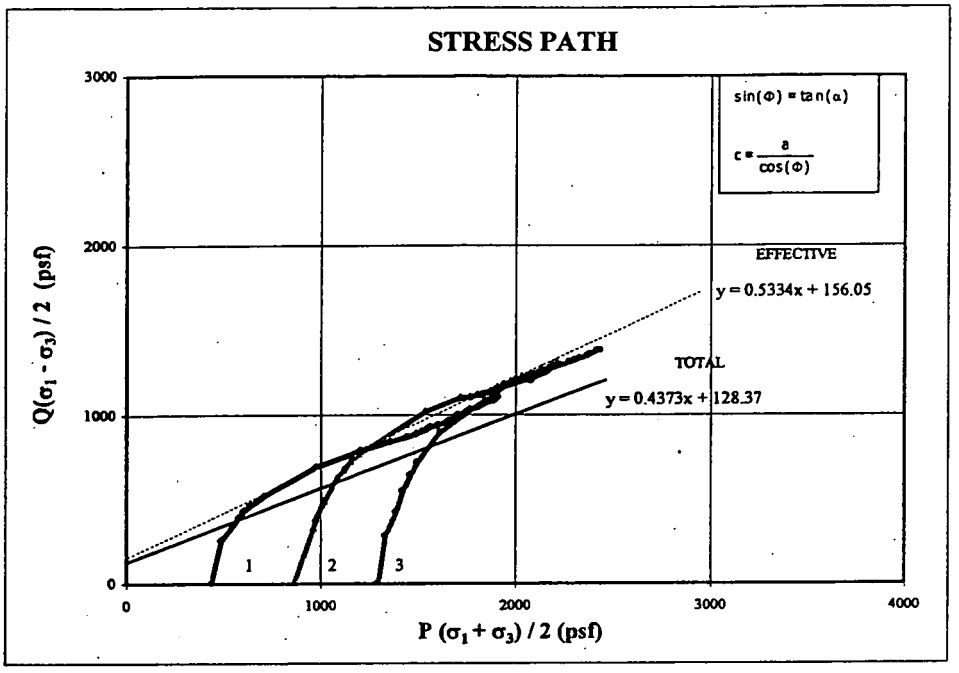
*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE

ASTM D 4767

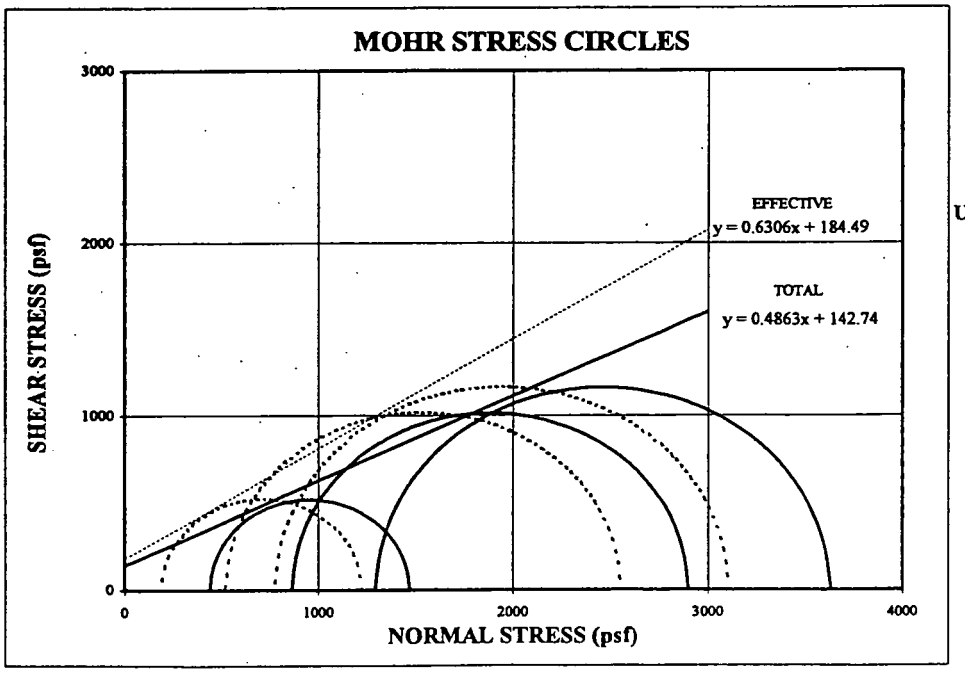
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 4 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	116.6	12.8
2	864	116.4	12.9
3	1296	116.6	12.6

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	77.8	98.3
2	0.10	77.7	98.1
3	0.10	76.7	97.0

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	23.6 °	ϕ	=	25.9 °
a	=	128.4 psf	c	=	142.7 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	28.1 °	ϕ'	=	32.2 °
a'	=	156.1 psf	c'	=	184.5 psf



Soil Description

Reddish Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

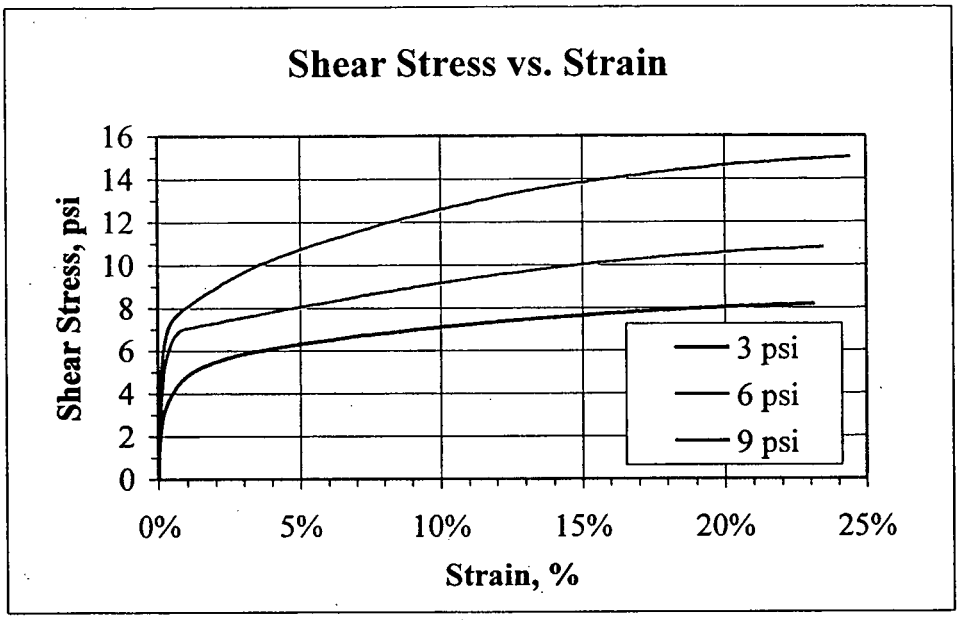
CHECK
REVIEW

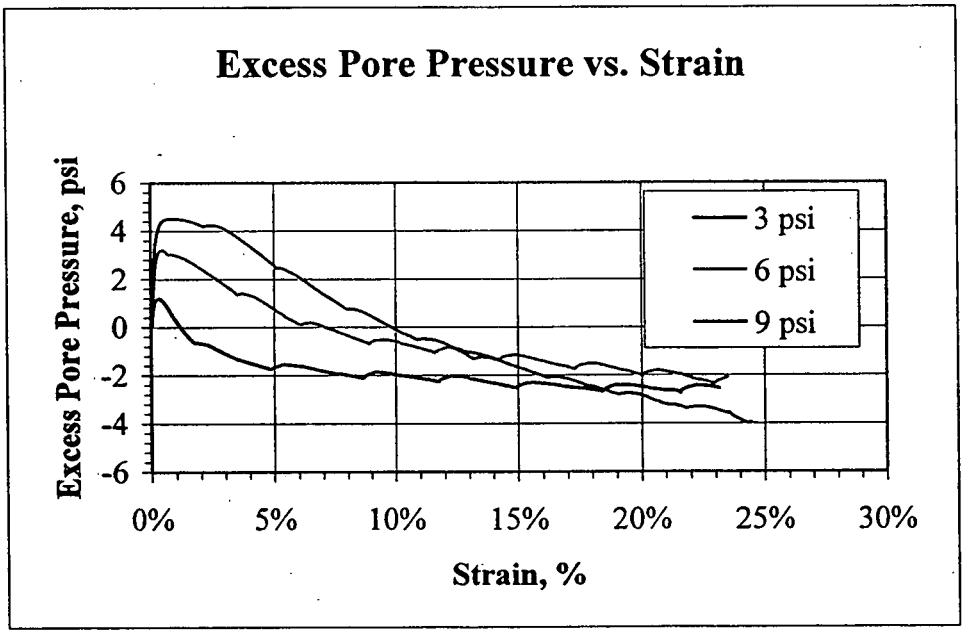
CONSOLIDATED UNDRAINED TRIAXIAL STRENGTH								CONSOLIDATED UNDRAINED TRI		
MOHR CIRCLE GENERATION SPREADSHEET								MOHR CIRCLE GENERATION SPRE		
	PF - 4	-	B	C	A				PF - 4	-
CONFINING PRESSURE USED (S3)			432	864	1296	psf		CONFINING PRESSURE USED (S3)		
CONFINING PRESSURE USED (S3)			432	864	1296	psi		CONFINING PRESSURE USED (S3)		
MAXIMUM DEVIATOR STRESS (PS			1038.2	2033.0	2327.1	psf		MAXIMUM DEVIATOR STRESS (PS		
(or load at 15% strain)								(or load at 15% strain)		
dU AT FAIL	(S1-S3)/2	(S1'+S3')/2		coh	sin phi	phi		dU AT FAIL	(S1-S3)/2	(S1'+S3')/2
244.8	519.1	706.3	COH 1&2	100	0.600292991	37		244.8	519.1	951.1
345.6	1016.5	1534.9	COH 1&3	150	0.521880864	31		345.6	1016.5	1880.5
518.4	1163.5	1941.1	COH 2&3	460	0.361940546	21		518.4	1163.5	2459.5
	EFFECTIVE									TOTAL
TA POINTS	A	B	C					DATA POINTS	A	B
	MOHR,1	MOHR,2	MOHR,3						MOHR,1	MOHR,2
X	Y,1	Y,2	Y,3					X	Y,1	Y,2
0	#NUM!	#NUM!	#NUM!					0	#NUM!	#NUM!
10	#NUM!	#NUM!	#NUM!					10	#NUM!	#NUM!
20	#NUM!	#NUM!	#NUM!					20	#NUM!	#NUM!
30	#NUM!	#NUM!	#NUM!					30	#NUM!	#NUM!
40	#NUM!	#NUM!	#NUM!					40	#NUM!	#NUM!
50	#NUM!	#NUM!	#NUM!					50	#NUM!	#NUM!
60	#NUM!	#NUM!	#NUM!					60	#NUM!	#NUM!
70	#NUM!	#NUM!	#NUM!					70	#NUM!	#NUM!
80	#NUM!	#NUM!	#NUM!					80	#NUM!	#NUM!
90	#NUM!	#NUM!	#NUM!					90	#NUM!	#NUM!
100	#NUM!	#NUM!	#NUM!					100	#NUM!	#NUM!
110	#NUM!	#NUM!	#NUM!					110	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!					120	#NUM!	#NUM!
130	#NUM!	#NUM!	#NUM!					130	#NUM!	#NUM!
140	#NUM!	#NUM!	#NUM!					140	#NUM!	#NUM!
150	#NUM!	#NUM!	#NUM!					150	#NUM!	#NUM!
160	#NUM!	#NUM!	#NUM!					160	#NUM!	#NUM!
170	#NUM!	#NUM!	#NUM!					170	#NUM!	#NUM!
180	#NUM!	#NUM!	#NUM!					180	#NUM!	#NUM!
190	54	#NUM!	#NUM!					190	#NUM!	#NUM!
200	115	#NUM!	#NUM!					200	#NUM!	#NUM!
210	152	#NUM!	#NUM!					210	#NUM!	#NUM!
220	182	#NUM!	#NUM!					220	#NUM!	#NUM!
230	206	#NUM!	#NUM!					230	#NUM!	#NUM!
240	228	#NUM!	#NUM!					240	#NUM!	#NUM!
250	247	#NUM!	#NUM!					250	#NUM!	#NUM!
260	265	#NUM!	#NUM!					260	#NUM!	#NUM!
270	281	#NUM!	#NUM!					270	#NUM!	#NUM!
280	296	#NUM!	#NUM!					280	#NUM!	#NUM!
290	310	#NUM!	#NUM!					290	#NUM!	#NUM!
300	323	#NUM!	#NUM!					300	#NUM!	#NUM!
310	335	#NUM!	#NUM!					310	#NUM!	#NUM!
320	347	#NUM!	#NUM!					320	#NUM!	#NUM!
330	358	#NUM!	#NUM!					330	#NUM!	#NUM!
340	368	#NUM!	#NUM!					340	#NUM!	#NUM!
350	378	#NUM!	#NUM!					350	#NUM!	#NUM!
360	387	#NUM!	#NUM!					360	#NUM!	#NUM!

Sample # =	PF-5		Sample # =	PF-5		Sample # =	PF-5	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	14.74	cm	Length =	14.80	cm	Length =	14.75	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	1287.10	g	Wet Weight =	1286.90	g	Wet Weight =	1287.60	g
Area =	41.9	sq.cm	Area =	41.9	sq.cm	Area =	41.9	sq.cm
Sample Area =	6.49	sq. in.	Sample Area =	6.49	sq. in.	Sample Area =	6.49	sq. in.
Volume =	616.9	cc	Volume =	619.4	cc	Volume =	617.3	cc
Moisture Content =	12.1%		Moisture Content =	12.1%		Moisture Content =	12.1%	
Specific Gravity =	na		Specific Gravity =	na		Specific Gravity =	na	
Dry Weight of Solids =	1148.17	g	Dry Weight of Solids =	1147.99	g	Dry Weight of Solids =	1148.62	g
Wet Density =	2.09	g/cc	Wet Density =	2.08	g/cc	Wet Density =	2.09	g/cc
Dry Density =	1.86	g/cc	Dry Density =	1.85	g/cc	Dry Density =	1.86	g/cc
Wet Density =	130.2	pcf	Wet Density =	129.6	pcf	Wet Density =	130.2	pcf
Dry Density =	116.1	pcf	Dry Density =	115.6	pcf	Dry Density =	116.1	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	100	psi
Back Pressure =	97	psi	Back Pressure =	94	psi	Back Pressure =	91	psi
Confining Pressure =	3	psi	Confining Pressure =	6	psi	Confining Pressure =	9	psi

Notes: 1. Sample remolded to 95% of corrected maximum dry density (121.9 pcf) and +2% of corrected optimum moisture content (10.8%).
2. Yellowish brown (10 YR 5/8) clayey sand with gravel (SC).

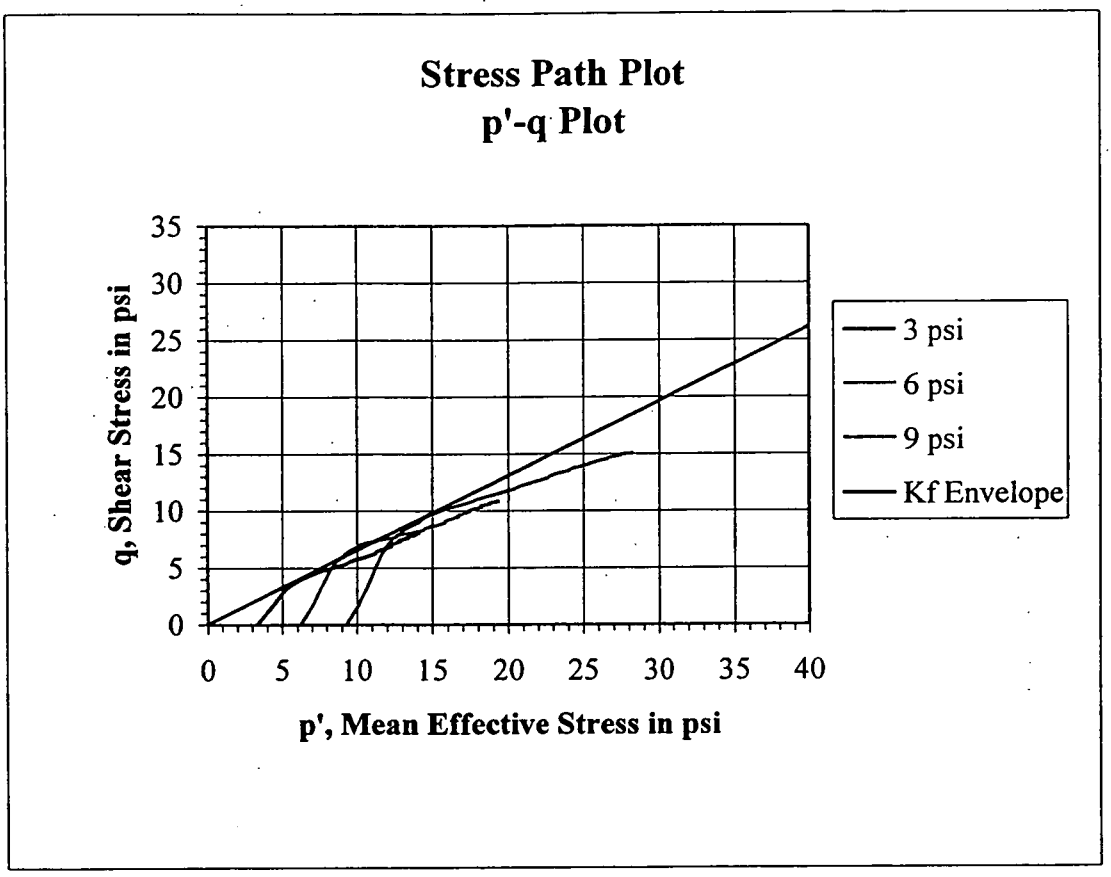
Golder Associates, Inc. **Denver, Colorado**	**Title:** **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**			
Job Short Title: ROCKY FLATS/FIELD & LAB TESTING/CO				
Sample No. **PF-5**	**Reviewed:** JEO	**Date:** 8/8/2004	**Job Number:** 043-2246.0001	**Figure:** 1





Golder Associates, Inc. **Denver, Colorado**	**Title:** **CU TRIAXIAL SHEAR DATA** **STRESS AND Δ PORE PRESSURE PLOTS**
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**	

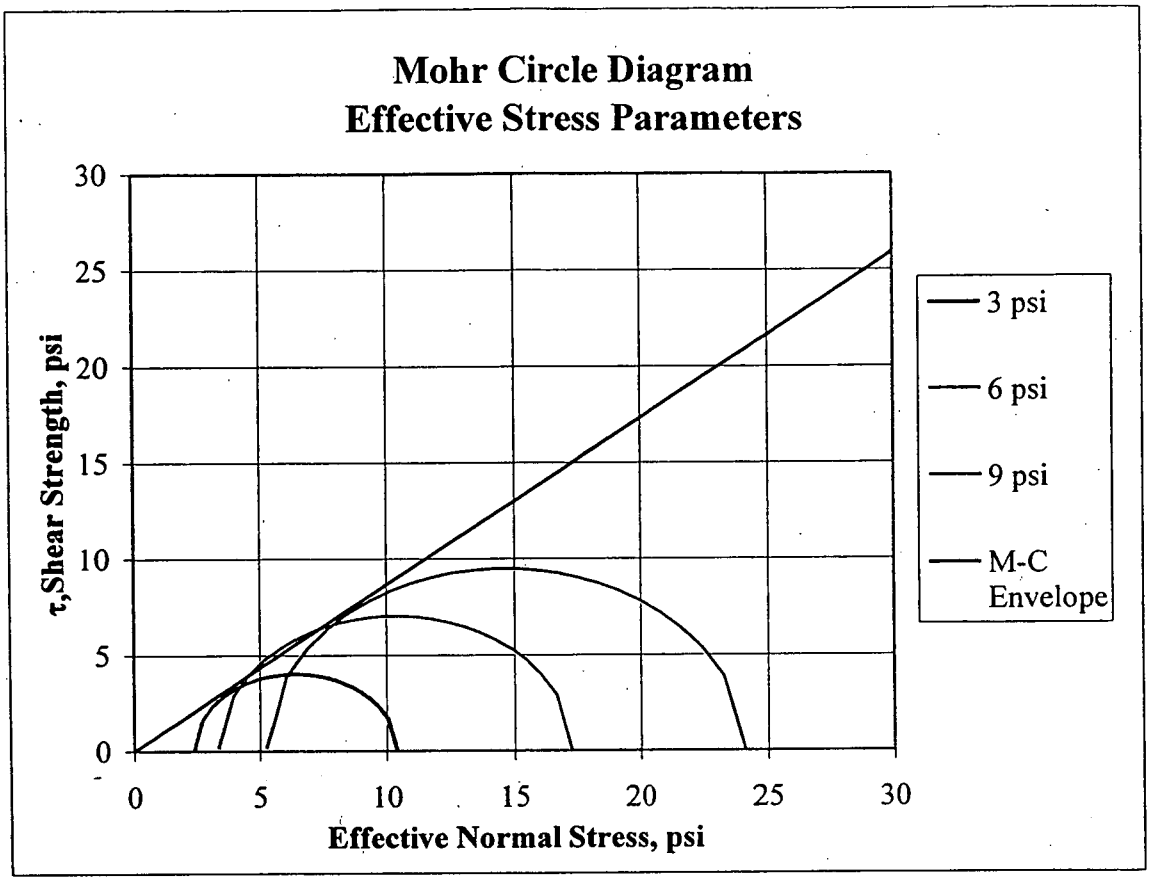
Sample No.	Reviewed:	Date:	Job Number:	Figure:
PF-5	**JEO**	**08/08/04**	**043-2246.0001**	**2**



Stress Path Parameters

ψ' = 33.2 degrees
a' = 0.0 psi

Golder Associates, Inc. Denver, Colorado	**Title:** CU TRIAXIAL SHEAR DATA STRESS PATH PLOT			
Job Short Title: ROCKY FLATS/FIELD & LAB TESTING/CO				
Sample No. **PF-5**	Reviewed: **JEO**	Date: **8/8/2004**	Job Number: **043-2246.0001**	Figure: **3**



Mohr-Coulomb Parameters

$\phi' =$ 40.8 degrees
$c' =$ 0.0 psi

Golder Associates, Inc. **Denver, Colorado**			**Title:** **CU TRIAXIAL SHEAR DATA** **MOHR CIRCLE DIAGRAM**		
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**					
Sample No. **PF-5**	Depth	Reviewed: **JEO**	Date: **8/8/2004**	Job Number: **043-2246.0001**	Figure: **4**

Consolidated Undrained Triaxial Lab Data

From: GOLDER ASSOCIATES INC.

Project: ROCKY FLATS/FIELD & LAB TESTING/CO

Project Number: 043-2246.0001

Sample Number	PF-5
Depth	
Effective Stress Analysis	

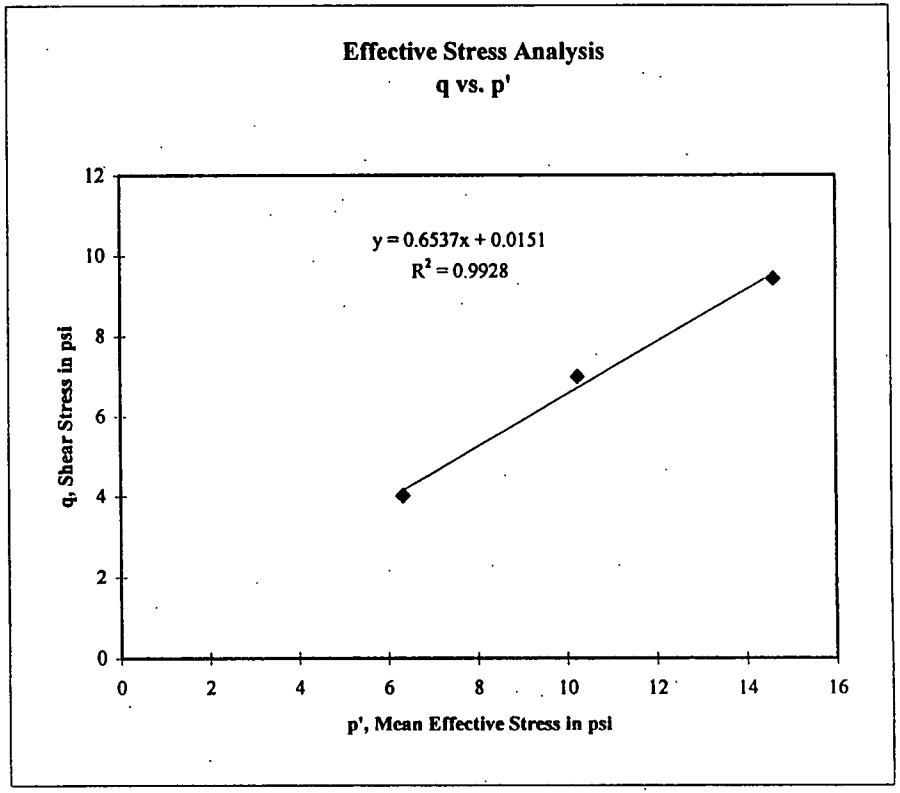
Point Number	P' (psi)	q (psi)
1	6.3	4.0
2	10.3	7.0
3	14.6	9.4

tan(ψ') = 0.6537

a' = 0.0151

ϕ ' = 40.8 degrees

c' = 0.0 psi



Consolidated Undrained Triaxial Lab Data

From: GOLDER ASSOCIATES INC.

Project: ROCKY FLATS/FIELD & LAB TESTING/CO

Project Number: 043-2246.0001

Sample Number	PF-5
Depth	
Total Stress Analysis	

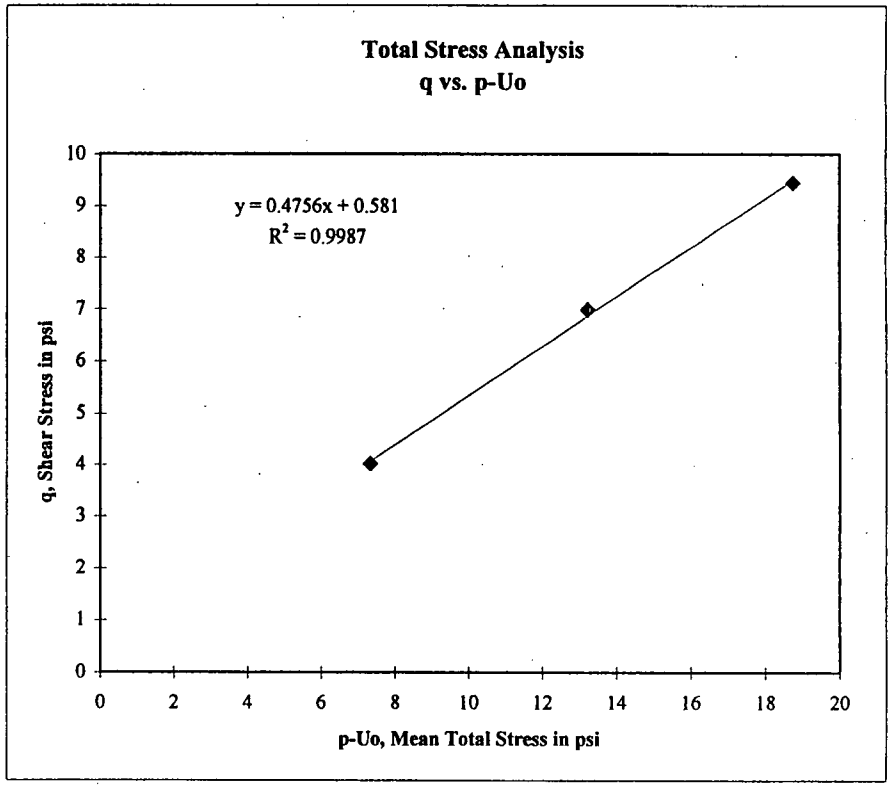
Point Number	P-Uo (psi)	q (psi)
1	7.3	4.0
2	13.2	7.0
3	18.8	9.4

tan(ψ) = 0.4756

a = 0.581

ϕ = 28.4 degrees

c = 0.7 psi



Consolidated Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: ROCKY FLATS/FIELD & LAB TESTING/CO
Project Number: 043-2246.0001
Explination of Terminology

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma_{ff}' \tan\phi'$$
$$\tau_{ff} = c + \sigma_{ff} \tan\phi$$

Where:
c', c = effective and total cohesive intercept
ϕ', ϕ = effective and total friction angle
τ^{ff} = Shear Strength on the failure surface at failure
σ'^{ff}, σ^{ff} = effective and total normal stress on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \qquad p' = \frac{\sigma'_1 + \sigma'_3}{2} \qquad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:
q = shear stress
p', p = mean effective and total stress
σ'^{1}, σ^{1} = Effective and Total Axial Stress
σ'^{3}, σ^{3} = Effective and Total Confining Stress

$$q = a + p' \tan\psi$$
$$q = a + (p - u_0) \tan\psi$$

Where:
a', a = intercept of the q-axis in effective stress of total stress space
ψ', ψ = angle of the failure line in effective stress of total stress space
p' = mean effective stress
p-Uo = mean total minus the initial pore pressure

with the relationship between ψ and ϕ and a and c are as follows:

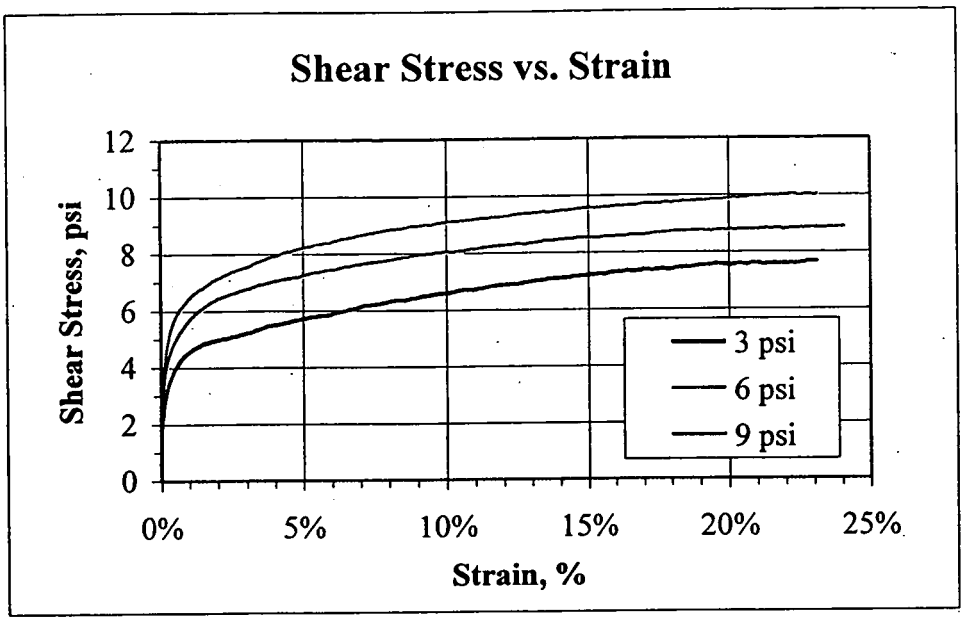
$$\tan(\psi) = \sin(\phi)$$

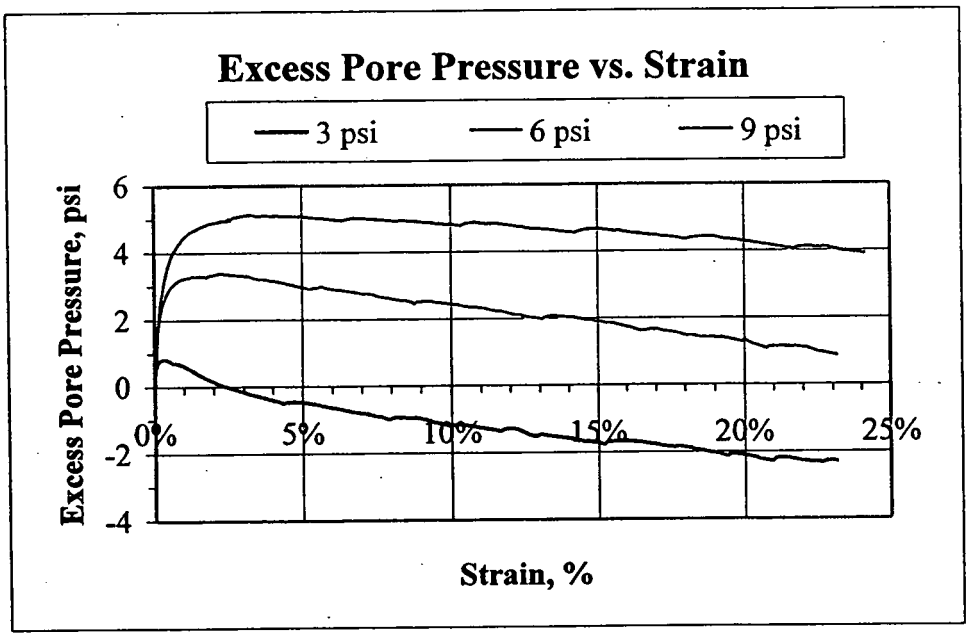
$$a = c * \cos(\phi)$$

Sample # =	PF-6		Sample # =	PF-6		Sample # =	PF-6	
Point # =	1		Point # =	2		Point # =	3	
	Initial			**Initial**			**Initial**	
Length =	14.68	cm	Length =	14.68	cm	Length =	14.83	cm
Diameter =	7.30	cm	Diameter =	7.30	cm	Diameter =	7.30	cm
Wet Weight =	1291.00	g	Wet Weight =	1290.50	g	Wet Weight =	1294.00	g
Area =	41.9	sq.cm	Area =	41.9	sq.cm	Area =	41.9	sq.cm
Sample Area =	6.49	sq. in.	Sample Area =	6.49	sq. in.	Sample Area =	6.49	sq. in.
Volume =	614.4	cc	Volume =	614.4	cc	Volume =	620.7	cc
Moisture Content =	14.0%		Moisture Content =	14.0%		Moisture Content =	14.0%	
Specific Gravity =	na		Specific Gravity =	na		Specific Gravity =	na	
Dry Weight of Solids =	1132.46	g	Dry Weight of Solids =	1132.02	g	Dry Weight of Solids =	1135.09	g
Wet Density =	2.10	g/cc	Wet Density =	2.10	g/cc	Wet Density =	2.08	g/cc
Dry Density =	1.84	g/cc	Dry Density =	1.84	g/cc	Dry Density =	1.83	g/cc
Wet Density =	131.1	pcf	Wet Density =	131.1	pcf	Wet Density =	130.1	pcf
Dry Density =	115.0	pcf	Dry Density =	115.0	pcf	Dry Density =	114.1	pcf
Cell Pressure =	100	psi	Cell Pressure =	100	psi	Cell Pressure =	100	psi
Back Pressure =	97	psi	Back Pressure =	94	psi	Back Pressure =	91	psi
Confining Pressure =	3	psi	Confining Pressure =	6	psi	Confining Pressure =	9	psi

Notes: 1. Sample remolded to 95% of maximum dry density (120.3 pcf) and +2% of optimum (12.5%) moisture content
2. Yellowish brown (10 YR 5/8) clayey sand with gravel SC

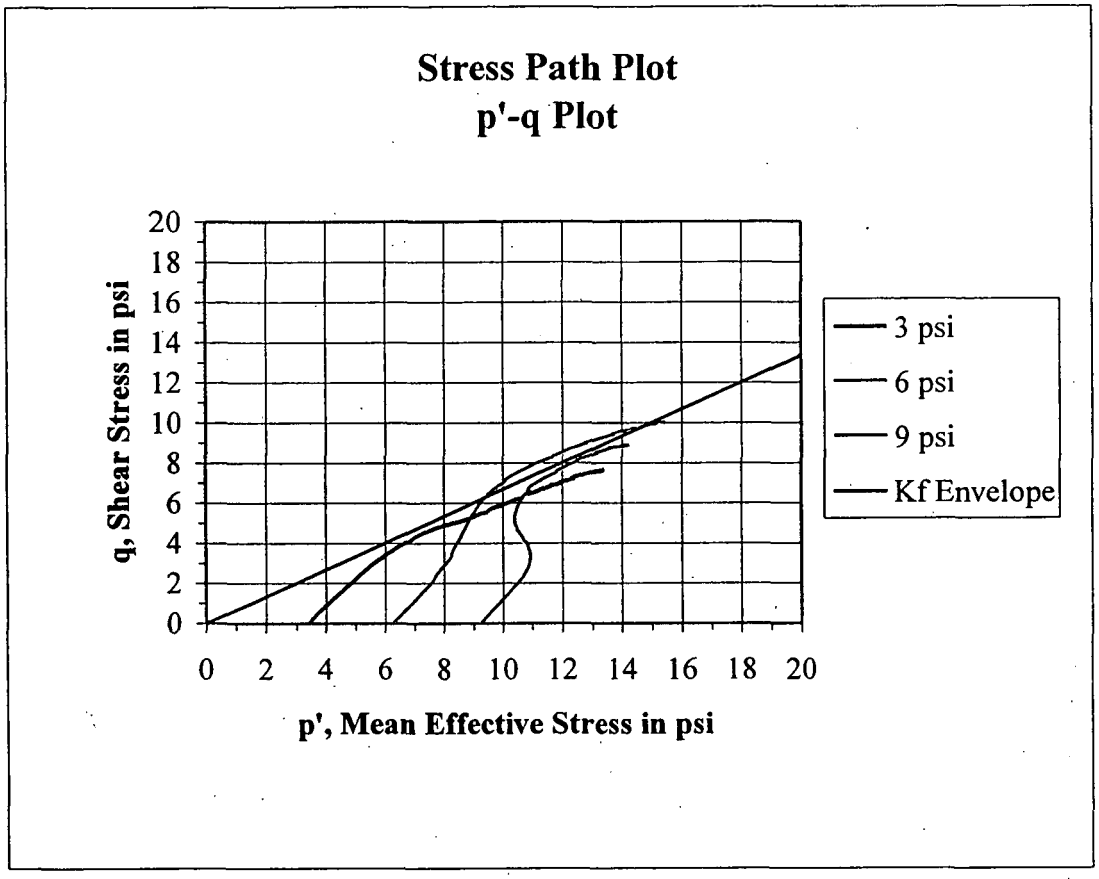
Golder Associates, Inc. **Denver, Colorado**	Title: **TRIAXIAL SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**			
Job Short Title: ROCKY FLATS/FIELD & LAB TESTING/CO				
Sample No. **PF-6**	Reviewed: JEO	Date: 8/1/2004	Job Number: 043-2246.0001	Figure: 1





Golder Associates, Inc. **Denver, Colorado**	**Title:** **CU TRIAXIAL SHEAR DATA** **STRESS AND Δ PORE PRESSURE PLOTS**
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**	

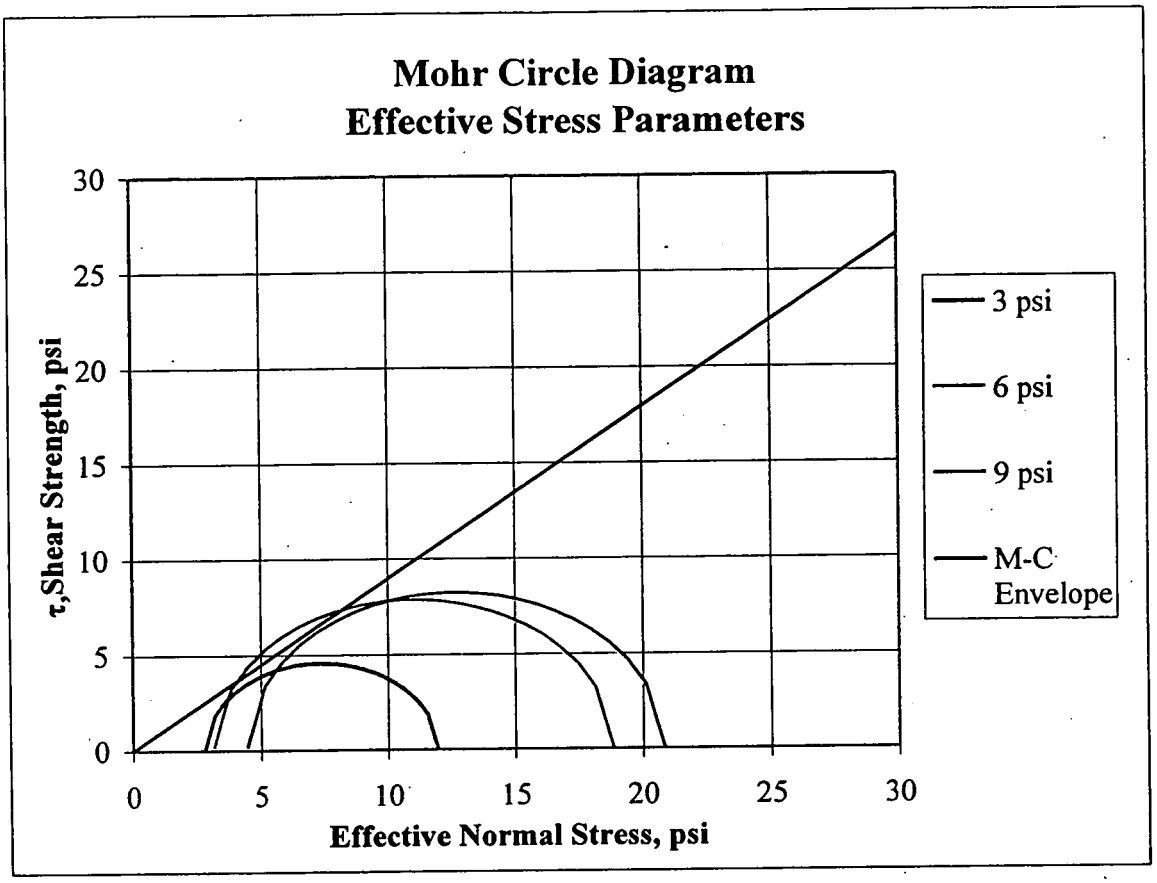
Sample No.	Reviewed:	Date:	Job Number:	Figure:
PF-6	**JEO**	**08/01/04**	**043-2246.0001**	2



Stress Path Parameters

ψ' = 33.7 degrees
a' = 0.0 psi

Golder Associates, Inc. **Denver, Colorado**	Title: **CU TRIAXIAL SHEAR DATA STRESS PATH PLOT**			
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**				
Sample No. **PF-6**	Reviewed: **JEO**	Date: **8/1/2004**	Job Number: **043-2246.0001**	Figure: **3**



Mohr-Coulomb Parameters

$\phi' =$ 41.9 degrees
$c' =$ 0.0 psi

Golder Associates, Inc. **Denver, Colorado**			**Title:** **CU TRIAXIAL SHEAR DATA** **MOHR CIRCLE DIAGRAM**		
Job Short Title: **ROCKY FLATS/FIELD & LAB TESTING/CO**					
Sample No. **PF-6**	Depth **0**	Reviewed: **JEO**	Date: **8/1/2004**	Job Number: **043-2246.0001**	Figure: **4**

Consolidated Undrained Triaxial Lab Data

From: GOLDER ASSOCIATES INC.

Project: ROCKY FLATS/FIELD & LAB TESTING/CO

Project Number: 043-2246.0001

Sample Number	PF-6
Depth	
Effective Stress Analysis	

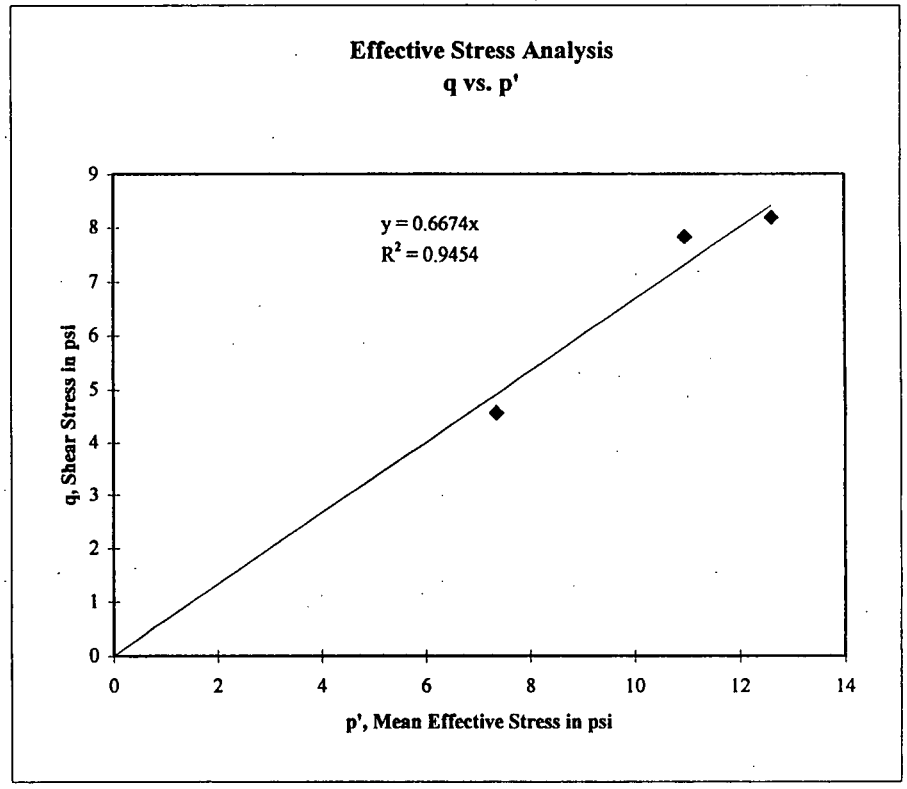
Point Number	P' (psi)	q (psi)
1	7.4	4.6
2	11.0	7.8
3	12.6	8.2

tan(ψ') = 0.6674

a' =

ϕ' = 41.9 degrees

c' = 0.0 psi



Consolidated Undrained Triaxial Lab Data

From: GOLDER ASSOCIATES INC.

Project: ROCKY FLATS/FIELD & LAB TESTING/CO

Project Number: 043-2246.0001

Sample Number	PF-6
Depth	
Total Stress Analysis	

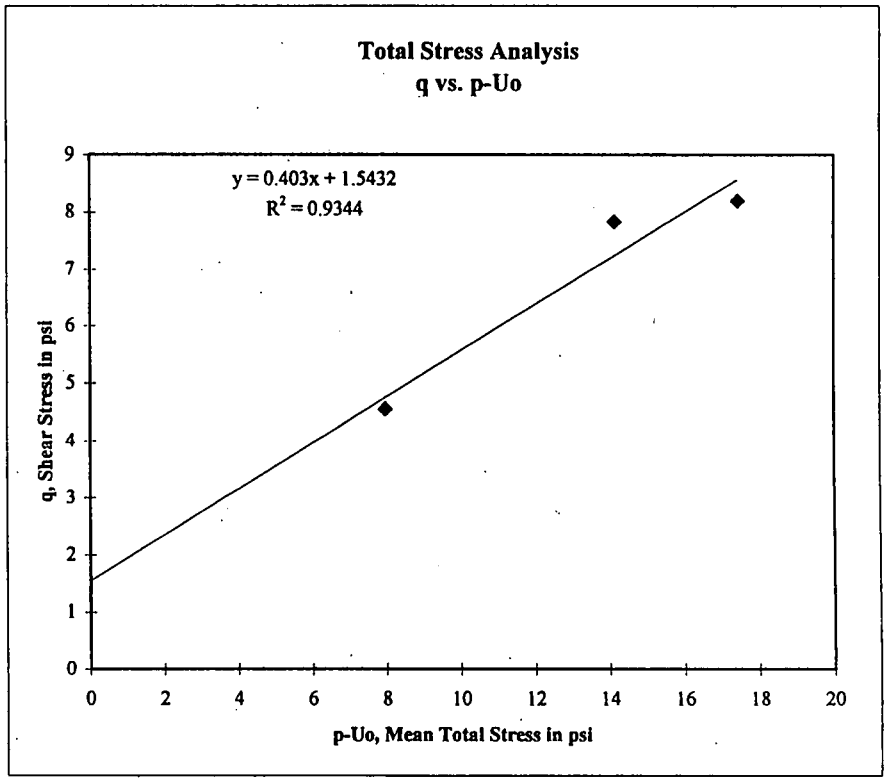
Point Number	P-Uo (psi)	q (psi)
1	8.0	4.6
2	14.1	7.8
3	17.4	8.2

$\tan(\psi) =$ 0.403

a = 1.5432

$\phi =$ 23.8 degrees

c = 1.7 psi



Consolidated Undrained Triaxial Lab Data
From: GOLDER ASSOCIATES INC.
Project: ROCKY FLATS/FIELD & LAB TESTING/CO
Project Number: 043-2246.0001
Explination of Terminology

Mohr-Coulomb Failure Criteria:

$$\tau_{ff} = c' + \sigma_{ff}' \tan \phi'$$
$$\tau_{ff} = c + \sigma_{ff} \tan \phi$$

Where:
c', c = effective and total cohesive intercept
ϕ', ϕ = effective and total friction angle
τ^{ff} = Shear Strength on the failure surface at failure
σ'^{ff}, σ^{ff} = effective and total normal stress on the failure surface at failure

Stress Path Space:

$$q = \frac{\sigma_1 - \sigma_3}{2} \quad p' = \frac{\sigma'_1 + \sigma'_3}{2} \quad p = \frac{\sigma_1 + \sigma_3}{2}$$

Where:
q = shear stress
p', p = mean effective and total stress
σ'^{1}, σ^{1} = Effective and Total Axial Stress
σ'^{3}, σ^{3} = Effective and Total Confining Stress

$$q = a + p' \tan \psi$$
$$q = a + (p - u_0) \tan \psi$$

Where:
a', a = intercept of the q-axis in effective stress of total stress space
ψ', ψ = angle of the failure line in effective stress of total stress space
p' = mean effective stress
p-Uo = mean total minus the initial pore pressure

with the relationship between ψ and ϕ and a and c are as follows:

$$\tan(\psi) = \sin(\phi)$$

$$a = c * \cos(\phi)$$

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 7
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	0.98
t_{50} (minutes)	0.15
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.248	6.003	5.983
DIAMETER	7.087	2.790	2.788
AREA	39.44	6.11	6.11
VOLUME	601.41	36.70	36.54
WEIGHT (g)	1285.27		1312.57
% MOISTURE	12.3		14.66
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	133.4		
DRY DENSITY, calc (pcf)	118.8		
VOLUME OF SOLIDS	423.99		
VOLUME OF VOIDS	177.41		
VOID RATIO	0.418		
SATURATION	79.2		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	119.3
VOLUME OF SOLIDS	423.99
VOLUME OF VOIDS	174.71
VOID RATIO	0.412

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1312.57
WT SOIL & TARE, DRY (g)	1144.78
WT TARE (g)	0.00
WT MOISTURE (g)	167.79
WT DRY SOIL (g)	1144.78
% MOISTURE	14.66

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1'-\sigma_3')}{2}$ (Q)	(A)
0.0	0.000	17	79.9	0.0	0.00	1.00	6.11	5.983	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.5	0.003	33	80.8	129.6	0.05	1.00	6.11	5.980	377.1	809.1	679.5	302.4	2.25	491.0	188.6	0.34
1.0	0.006	40	81.0	158.4	0.10	1.00	6.11	5.977	541.8	973.8	815.4	273.6	2.98	544.5	270.9	0.29
1.5	0.009	45	81.2	187.2	0.15	1.00	6.12	5.974	659.3	1091.3	904.1	244.8	3.69	574.4	329.6	0.28
2.0	0.012	50	81.3	201.6	0.20	1.00	6.12	5.971	776.6	1208.6	1007.0	230.4	4.37	618.7	388.3	0.26
2.5	0.015	53	81.3	201.6	0.25	1.00	6.12	5.968	846.8	1278.8	1077.2	230.4	4.68	653.8	423.4	0.24
4.2	0.025	65	81.2	187.2	0.42	1.00	6.13	5.958	1127.2	1559.2	1372.0	244.8	5.60	808.4	563.6	0.17
8.3	0.050	89	80.2	43.2	0.84	0.99	6.16	5.933	1683.7	2115.7	2072.5	388.8	5.33	1230.6	841.8	0.03
12.5	0.075	102	79.2	-100.8	1.25	0.99	6.18	5.908	1979.3	2411.3	2512.1	532.8	4.71	1522.4	989.6	-0.05
16.7	0.100	107	78.8	-158.4	1.67	0.98	6.21	5.883	2086.9	2518.9	2677.3	590.4	4.53	1633.8	1043.4	-0.08
22.5	0.135	112	78.3	-230.4	2.26	0.98	6.25	5.848	2189.7	2621.7	2852.1	662.4	4.31	1757.2	1094.8	-0.11
25.0	0.150	115	78.0	-273.6	2.51	0.97	6.26	5.833	2253.0	2685.0	2958.6	705.6	4.19	1832.1	1126.5	-0.12
29.2	0.175	119	77.7	-316.8	2.92	0.97	6.29	5.808	2334.9	2766.9	3083.7	748.8	4.12	1916.3	1167.5	-0.14
33.3	0.200	122	77.5	-345.6	3.34	0.97	6.32	5.783	2393.3	2825.3	3170.9	777.6	4.08	1974.2	1196.6	-0.14
41.7	0.250	125	77.0	-417.6	4.18	0.96	6.37	5.733	2440.4	2872.4	3290.0	849.6	3.87	2069.8	1220.2	-0.17
52.5	0.315	129	76.9	-432.0	5.26	0.95	6.45	5.668	2502.1	2934.1	3366.1	864.0	3.90	2115.0	1251.0	-0.17
58.3	0.350	134	76.7	-460.8	5.85	0.94	6.49	5.633	2597.6	3029.6	3490.4	892.8	3.91	2191.6	1298.8	-0.18
66.7	0.400	137	76.5	-489.6	6.69	0.93	6.54	5.583	2640.6	3072.6	3562.2	921.6	3.87	2241.9	1320.3	-0.19
75.0	0.450	140	76.4	-504.0	7.52	0.92	6.60	5.533	2682.4	3114.4	3618.4	936.0	3.87	2277.2	1341.2	-0.19
83.3	0.500	142	76.3	-518.4	8.36	0.92	6.66	5.483	2701.3	3133.3	3651.7	950.4	3.84	2301.1	1350.7	-0.19
99.0	0.594	149	76.1	-547.2	9.93	0.90	6.78	5.389	2803.7	3235.7	3782.9	979.2	3.86	2381.1	1401.9	-0.20
100.0	0.600	149	76.0	-561.6	10.03	0.90	6.79	5.383	2800.6	3232.6	3794.2	993.6	3.82	2393.9	1400.3	-0.20
108.3	0.650	154	76.0	-561.6	10.86	0.89	6.85	5.333	2879.7	3311.7	3873.3	993.6	3.90	2433.4	1439.8	-0.20
116.7	0.700	157	75.9	-576.0	11.70	0.88	6.92	5.283	2915.1	3347.1	3923.1	1008.0	3.89	2465.6	1457.6	-0.20
125.0	0.750	159	75.8	-590.4	12.54	0.87	6.98	5.233	2928.8	3360.8	3951.2	1022.4	3.86	2486.8	1464.4	-0.20
133.3	0.800	162	75.7	-604.8	13.37	0.87	7.05	5.183	2962.1	3394.1	3998.9	1036.8	3.86	2517.8	1481.0	-0.20
141.7	0.850	164	75.7	-604.8	14.21	0.86	7.12	5.133	2974.0	3406.0	4010.8	1036.8	3.87	2523.8	1487.0	-0.20
150.0	0.900	167	75.6	-619.2	15.04	0.85	7.19	5.083	3005.1	3437.1	4056.3	1051.2	3.86	2553.8	1502.6	-0.21
158.3	0.950	171	75.5	-633.6	15.88	0.84	7.26	5.033	3054.9	3486.9	4120.5	1065.6	3.87	2593.1	1527.5	-0.21
166.7	1.000	172	75.4	-648.0	16.71	0.83	7.33	4.983	3044.2	3476.2	4124.2	1080.0	3.82	2602.1	1522.1	-0.21

DU @ FAILURE	187.20	DEVIATORIC STRESS @ FAILURE	1127.18	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	5.60

TECH	PWM/SDM
D[redacted]	8/4/04
CHEC[redacted]	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 7
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.64
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.243	6.001	5.975
DIAMETER	7.087	2.790	2.781
AREA	39.44	6.11	6.07
VOLUME	601.21	36.69	36.30
WEIGHT (g)	1284.57		1308.17
% MOISTURE	12.3		14.36
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	133.3		
DRY DENSITY, calc (pcf)	118.7		
VOLUME OF SOLIDS	423.68		
VOLUME OF VOIDS	177.52		
VOID RATIO	0.419		
SATURATION	79.2		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	120.0
VOLUME OF SOLIDS	423.68
VOLUME OF VOIDS	171.12
VOID RATIO	0.404
WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1308.17
WT SOIL & TARE, DRY (g)	1143.94
WT TARE (g)	0.00
WT MOISTURE (g)	164.23
WT DRY SOIL (g)	1143.94
% MOISTURE	14.36

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	20	80.8	0.0	0.00	1.00	6.07	5.975	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.5	0.003	43	82.3	216.0	0.05	1.00	6.08	5.972	544.9	1408.9	1192.9	648.0	1.84	920.5	272.5	0.40
1.0	0.006	52	82.6	259.2	0.10	1.00	6.08	5.969	757.8	1621.8	1362.6	604.8	2.25	983.7	378.9	0.34
1.5	0.009	58	82.8	288.0	0.15	1.00	6.08	5.966	899.4	1763.4	1475.4	576.0	2.56	1025.7	449.7	0.32
2.0	0.012	64	83.0	316.8	0.20	1.00	6.09	5.963	1040.9	1904.9	1588.1	547.2	2.90	1067.6	520.4	0.30
2.5	0.015	67	83.1	331.2	0.25	1.00	6.09	5.960	1111.3	1975.3	1644.1	532.8	3.09	1088.5	555.7	0.30
4.2	0.025	79	83.1	331.2	0.42	1.00	6.10	5.950	1392.7	2256.7	1925.5	532.8	3.61	1229.1	696.3	0.24
8.3	0.050	95	82.6	259.2	0.84	0.99	6.13	5.925	1762.9	2626.9	2367.7	604.8	3.91	1486.3	881.5	0.15
12.5	0.075	105	82.1	187.2	1.26	0.99	6.15	5.900	1989.6	2853.6	2666.4	676.8	3.94	1671.6	994.8	0.09
16.7	0.100	112	81.6	115.2	1.67	0.98	6.18	5.875	2144.3	3008.3	2893.1	748.8	3.86	1820.9	1072.1	0.05
20.8	0.125	115	81.5	100.8	2.09	0.98	6.20	5.850	2204.8	3068.8	2968.0	763.2	3.89	1865.6	1102.4	0.05
25.0	0.150	119	81.3	72.0	2.51	0.97	6.23	5.825	2287.8	3151.8	3079.8	792.0	3.89	1935.9	1143.9	0.03
29.2	0.175	122	81.1	43.2	2.93	0.97	6.26	5.800	2347.0	3211.0	3167.8	820.8	3.86	1994.3	1173.5	0.02
33.3	0.200	125	81.0	28.8	3.35	0.97	6.29	5.775	2405.6	3269.6	3240.8	835.2	3.88	2038.0	1202.8	0.01
41.7	0.250	129	80.8	0.0	4.18	0.96	6.34	5.725	2475.7	3339.7	3339.7	864.0	3.87	2101.8	1237.8	0.00
50.0	0.300	134	80.5	-43.2	5.02	0.95	6.40	5.675	2566.6	3430.6	3473.8	907.2	3.83	2190.5	1283.3	-0.02
58.3	0.350	137	80.3	-72.0	5.86	0.94	6.45	5.625	2610.9	3474.9	3546.9	936.0	3.79	2241.5	1305.5	-0.03
66.7	0.400	142	80.1	-100.8	6.69	0.93	6.51	5.575	2698.3	3562.3	3663.1	964.8	3.80	2314.0	1349.2	-0.04
75.0	0.450	145	80.0	-115.2	7.53	0.92	6.57	5.525	2739.9	3603.9	3719.1	979.2	3.80	2349.1	1369.9	-0.04
83.3	0.500	149	79.8	-144.0	8.37	0.92	6.63	5.475	2802.0	3666.0	3810.0	1008.0	3.78	2409.0	1401.0	-0.05
91.7	0.550	155	79.6	-172.8	9.21	0.91	6.69	5.425	2905.5	3769.5	3942.3	1036.8	3.80	2489.6	1452.8	-0.06
100.0	0.600	160	79.4	-201.6	10.04	0.90	6.75	5.375	2985.3	3849.3	4050.9	1065.6	3.80	2558.3	1492.7	-0.07
110.0	0.660	164	79.3	-216.0	11.05	0.89	6.83	5.315	3036.4	3900.4	4116.4	1080.0	3.81	2598.2	1518.2	-0.07
116.7	0.700	167	79.1	-244.8	11.72	0.88	6.88	5.275	3076.3	3940.3	4185.1	1108.8	3.77	2646.9	1538.1	-0.08
125.0	0.750	172	78.8	-288.0	12.55	0.87	6.95	5.225	3150.8	4014.8	4302.8	1152.0	3.74	2727.4	1575.4	-0.09
133.3	0.800	176	78.7	-302.4	13.39	0.87	7.01	5.175	3202.8	4066.8	4369.2	1166.4	3.75	2767.8	1601.4	-0.09
143.7	0.862	179	78.5	-331.2	14.43	0.86	7.10	5.113	3225.2	4089.2	4420.4	1195.2	3.70	2807.8	1612.6	-0.10
150.0	0.900	182	78.4	-345.6	15.06	0.85	7.15	5.075	3261.7	4125.7	4471.3	1209.6	3.70	2840.4	1630.8	-0.11
158.3	0.950	186	78.2	-374.4	15.90	0.84	7.22	5.025	3309.3	4173.3	4547.7	1238.4	3.67	2893.0	1654.6	-0.11
166.7	1.000	189	78.2	-374.4	16.74	0.83	7.30	4.975	3335.6	4199.6	4574.0	1238.4	3.69	2906.2	1667.8	-0.11

DU @ FAILURE	187.2	DEVIATORIC STRESS @ FAILURE	1989.6	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.94

TECH	PWM/SDM
DATE	8/4/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 7
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.23
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.258	6.007	5.962
DIAMETER	7.087	2.790	2.787
AREA	39.44	6.11	6.10
VOLUME	601.81	36.72	36.36
WEIGHT (g)	1284.97		1308.97
% MOISTURE	12.2		14.32
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	133.2		
DRY DENSITY, calc (pcf)	118.7		
VOLUME OF SOLIDS	424.09		
VOLUME OF VOIDS	177.72		
VOID RATIO	0.419		
SATURATION	78.7		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	119.9
VOLUME OF SOLIDS	424.09
VOLUME OF VOIDS	171.72
VOID RATIO	0.405

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1308.97
WT SOIL & TARE, DRY (g)	1145.03
WT TARE (g)	0.00
WT MOISTURE (g)	163.94
WT DRY SOIL (g)	1145.03
% MOISTURE	14.32

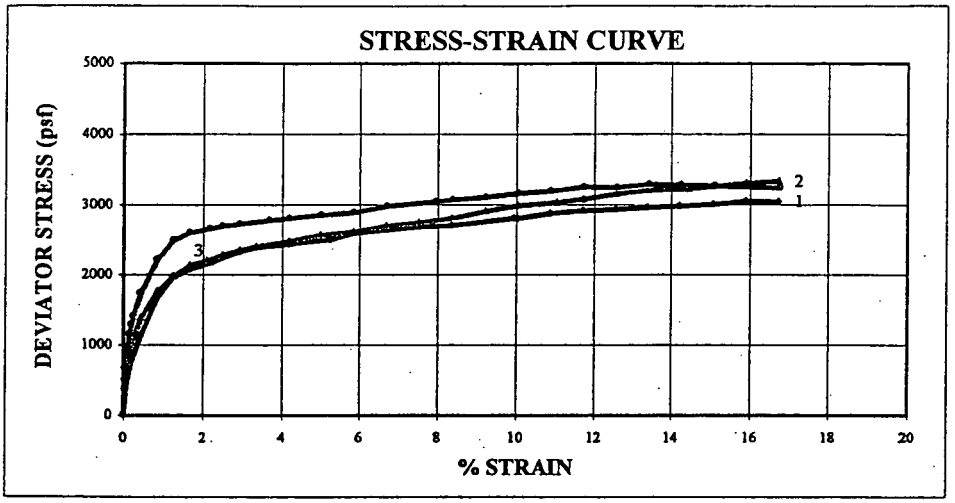
TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	20	80.7	0.0	0.00	1.00	6.10	5.962	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.5	0.003	48	82.6	273.6	0.05	1.00	6.10	5.959	660.8	1956.8	1683.2	1022.4	1.65	1352.8	330.4	0.41
1.0	0.006	60	83.1	345.6	0.10	1.00	6.10	5.956	943.6	2239.6	1894.0	950.4	1.99	1422.2	471.8	0.37
1.5	0.009	69	83.5	403.2	0.15	1.00	6.11	5.953	1155.3	2451.3	2048.1	892.8	2.29	1470.4	577.6	0.35
2.0	0.012	75	83.7	432.0	0.20	1.00	6.11	5.950	1296.1	2592.1	2160.1	864.0	2.50	1512.0	648.0	0.33
2.5	0.015	80	83.9	460.8	0.25	1.00	6.11	5.947	1413.2	2709.2	2248.4	835.2	2.69	1541.8	706.6	0.33
4.2	0.025	94	84.2	504.0	0.42	1.00	6.12	5.937	1740.0	3036.0	2532.0	792.0	3.20	1662.0	870.0	0.29
8.3	0.050	115	84.0	475.2	0.84	0.99	6.15	5.912	2224.4	3520.4	3045.2	820.8	3.71	1933.0	1112.2	0.21
12.5	0.075	127	83.6	417.6	1.26	0.99	6.18	5.887	2494.8	3790.8	3373.2	878.4	3.84	2125.8	1247.4	0.17
16.7	0.100	132	83.3	374.4	1.68	0.98	6.20	5.862	2600.3	3896.3	3521.9	921.6	3.82	2221.7	1300.1	0.14
21.7	0.130	135	83.2	360.0	2.18	0.98	6.23	5.832	2656.3	3952.3	3592.3	936.0	3.84	2264.1	1328.1	0.14
25.0	0.150	137	83.1	345.6	2.52	0.97	6.26	5.812	2693.2	3989.2	3643.6	950.4	3.83	2297.0	1346.6	0.13
29.2	0.175	139	83.0	331.2	2.94	0.97	6.28	5.787	2727.5	4023.5	3692.3	964.8	3.83	2328.5	1363.7	0.12
36.7	0.220	142	82.9	316.8	3.69	0.96	6.33	5.742	2774.5	4070.5	3753.7	979.2	3.83	2366.4	1387.2	0.11
41.7	0.250	144	82.8	302.4	4.19	0.96	6.37	5.712	2805.2	4101.2	3798.8	993.6	3.82	2396.2	1402.6	0.11
50.0	0.300	147	82.7	288.0	5.03	0.95	6.42	5.662	2847.9	4143.9	3855.9	1008.0	3.83	2432.0	1424.0	0.10
58.3	0.350	150	82.5	259.2	5.87	0.94	6.48	5.612	2889.5	4185.5	3926.3	1036.8	3.79	2481.5	1444.7	0.09
66.7	0.400	155	82.3	230.4	6.71	0.93	6.54	5.562	2973.9	4269.9	4039.5	1065.6	3.79	2552.5	1486.9	0.08
79.2	0.475	160	82.2	216.0	7.97	0.92	6.63	5.487	3042.4	4338.4	4122.4	1080.0	3.82	2601.2	1521.2	0.07
83.3	0.500	162	82.1	201.6	8.39	0.92	6.66	5.462	3071.8	4367.8	4166.2	1094.4	3.81	2630.3	1535.9	0.07
91.7	0.550	165	81.9	172.8	9.23	0.91	6.72	5.412	3108.0	4404.0	4231.2	1123.2	3.77	2677.2	1554.0	0.06
100.0	0.600	169	81.8	158.4	10.06	0.90	6.78	5.362	3164.3	4460.3	4301.9	1137.6	3.78	2719.7	1582.1	0.05
108.3	0.650	172	81.7	144.0	10.90	0.89	6.84	5.312	3197.9	4493.9	4349.9	1152.0	3.78	2750.9	1598.9	0.05
116.7	0.700	176	81.6	129.6	11.74	0.88	6.91	5.262	3251.1	4547.1	4417.5	1166.4	3.79	2792.0	1625.6	0.04
125.0	0.750	177	81.5	115.2	12.58	0.87	6.98	5.212	3240.9	4536.9	4421.7	1180.8	3.74	2801.2	1620.4	0.04
133.3	0.800	181	81.4	100.8	13.42	0.87	7.04	5.162	3291.6	4587.6	4486.8	1195.2	3.75	2841.0	1645.8	0.03
141.7	0.850	182	81.4	100.8	14.26	0.86	7.11	5.112	3279.9	4575.9	4475.1	1195.2	3.74	2835.2	1640.0	0.03
150.0	0.900	183	81.3	86.4	15.10	0.85	7.18	5.062	3267.9	4563.9	4477.5	1209.6	3.70	2843.5	1633.9	0.03
158.3	0.950	184	81.3	86.4	15.93	0.84	7.25	5.012	3255.5	4551.5	4465.1	1209.6	3.69	2837.3	1627.7	0.03
166.7	1.000	185	81.2	72.0	16.77	0.83	7.33	4.962	3242.6	4538.6	4466.6	1224.0	3.65	2845.3	1621.3	0.02

DU @ FAILURE	417.6	DEVIATORIC STRESS @ FAILURE	2494.8	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.84

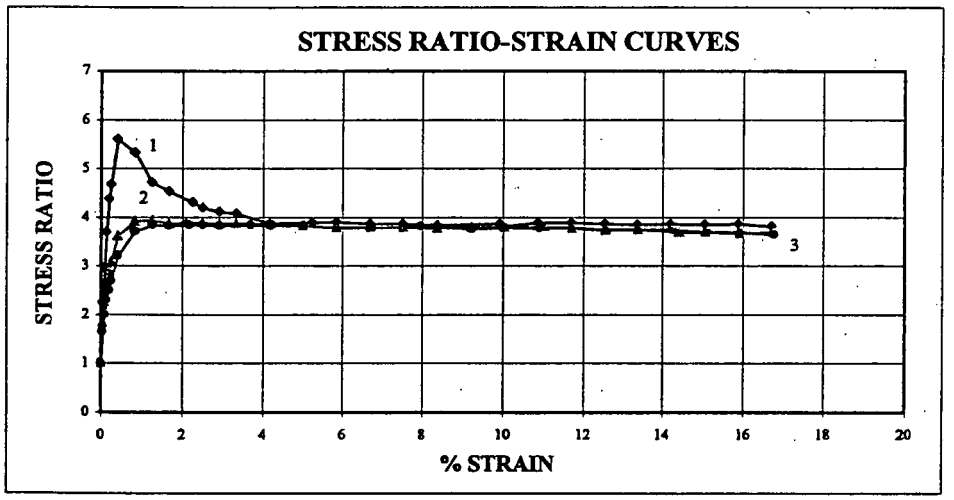
TECH	PWM/SDM
DATE	8/4/2004
CHEC	
REVIE	

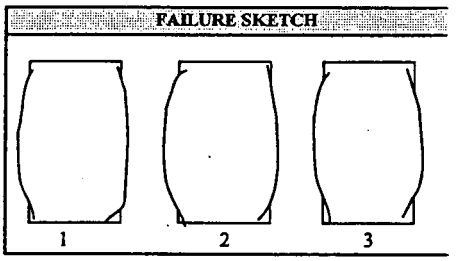
TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

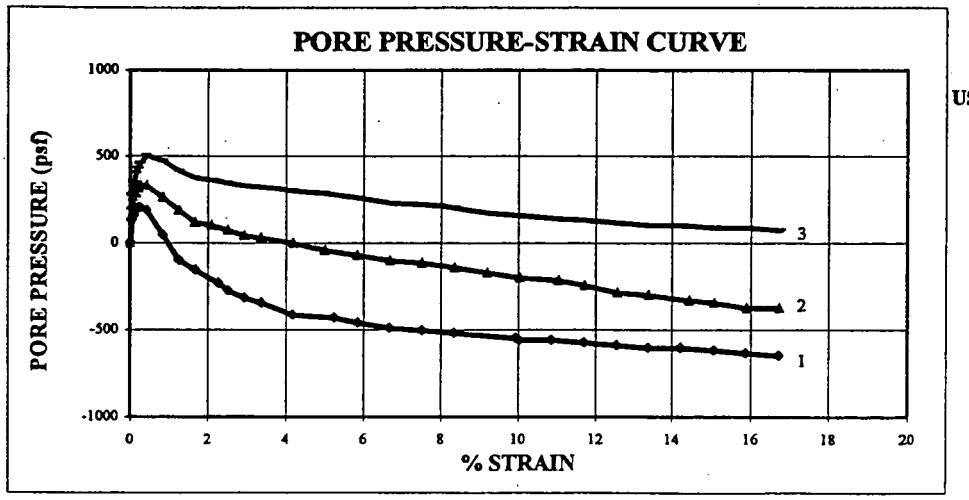
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 7 DEPTH: - Sample Type: **Bulk**



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	118.8	12.3
2	864	118.7	12.3
3	1296	118.7	12.2
	Average	118.7	12.3







Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

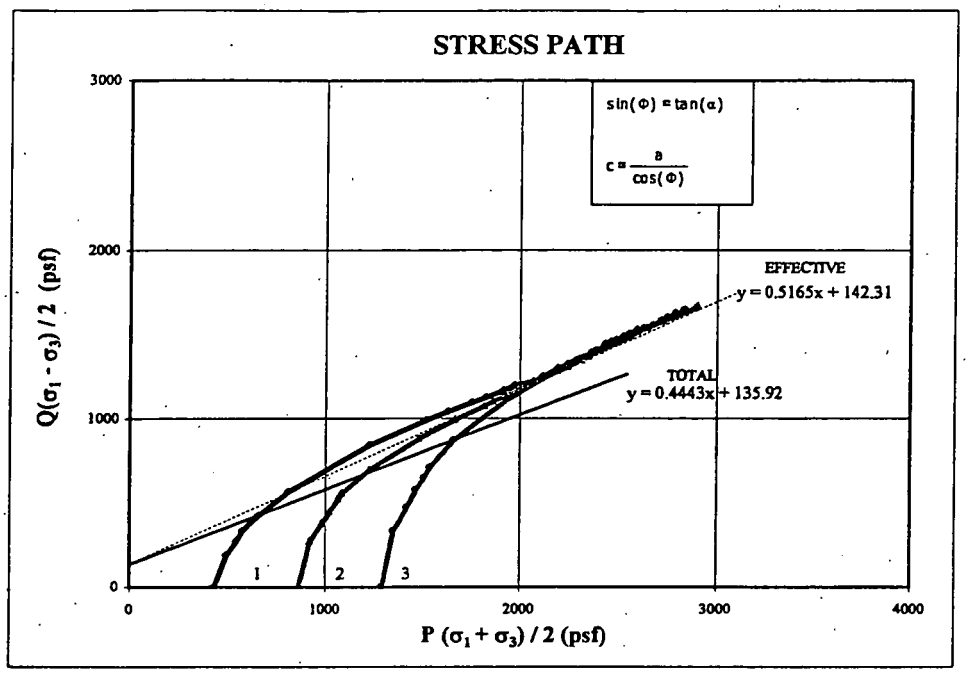
Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

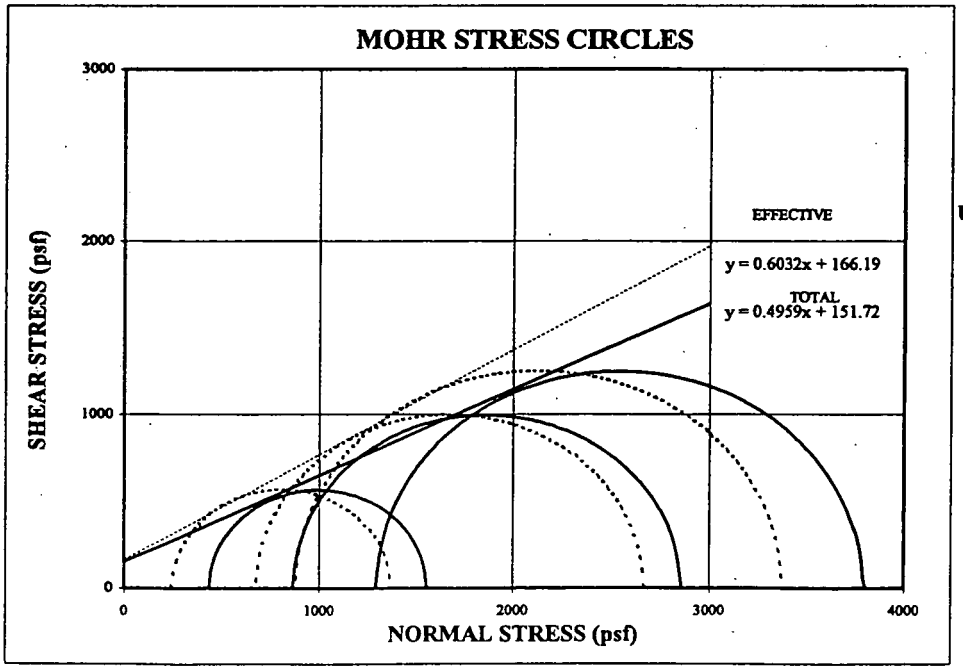
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 7 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	118.8	12.3
2	864	118.7	12.3
3	1296	118.7	12.2

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	79.2	96.0
2	0.10	79.2	96.0
3	0.10	78.7	95.5

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	24.0 °	ϕ	=	26.4 °
a	=	135.9 psf	c	=	151.7 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	27.3 °	ϕ'	=	31.1 °
a'	=	142.3 psf	c'	=	166.2 psf



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

CONSOLIDATED UNDRAINED TRIAXIAL STRENGTH								CONSOLIDATED UNDRAINED TRI		
MOHR CIRCLE GENERATION SPREADSHEET								MOHR CIRCLE GENERATION SPRE		
	PF - 7	-	B	C	A				PF - 7	-
CONFINING PRESSURE USED (S3)			432	864	1296	psf		CONFINING PRESSURE USED (S3)		
CONFINING PRESSURE USED (S3)			432	864	1296	psi		CONFINING PRESSURE USED (S3)		
MAXIMUM DEVIATOR STRESS (PS			1127.2	1989.6	2494.8	psf		MAXIMUM DEVIATOR STRESS (PS		
(or load at 15% strain)								(or load at 15% strain)		
dU AT FAIL	(S1-S3)/2	(S1'+S3')/2		coh	sin phi	phi		dU AT FAIL	(S1-S3)/2	(S1'+S3')/2
187.2	563.6	808.4	COH 1&2	160	0.499535201	30		187.2	563.6	995.6
187.2	994.8	1671.6	COH 1&3	140	0.519057351	31		187.2	994.8	1858.8
417.6	1247.4	2125.8	COH 2&3	70	0.556157545	34		417.6	1247.4	2543.4
	EFFECTIVE									TOTAL
TA POINTS	A	B	C					DATA POINTS	A	B
	MOHR,1	MOHR,2	MOHR,3						MOHR,1	MOHR,2
X	Y,1	Y,2	Y,3					X	Y,1	Y,2
0	#NUM!	#NUM!	#NUM!					0	#NUM!	#NUM!
10	#NUM!	#NUM!	#NUM!					10	#NUM!	#NUM!
20	#NUM!	#NUM!	#NUM!					20	#NUM!	#NUM!
30	#NUM!	#NUM!	#NUM!					30	#NUM!	#NUM!
40	#NUM!	#NUM!	#NUM!					40	#NUM!	#NUM!
50	#NUM!	#NUM!	#NUM!					50	#NUM!	#NUM!
60	#NUM!	#NUM!	#NUM!					60	#NUM!	#NUM!
70	#NUM!	#NUM!	#NUM!					70	#NUM!	#NUM!
80	#NUM!	#NUM!	#NUM!					80	#NUM!	#NUM!
90	#NUM!	#NUM!	#NUM!					90	#NUM!	#NUM!
100	#NUM!	#NUM!	#NUM!					100	#NUM!	#NUM!
110	#NUM!	#NUM!	#NUM!					110	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!					120	#NUM!	#NUM!
130	#NUM!	#NUM!	#NUM!					130	#NUM!	#NUM!
140	#NUM!	#NUM!	#NUM!					140	#NUM!	#NUM!
150	#NUM!	#NUM!	#NUM!					150	#NUM!	#NUM!
160	#NUM!	#NUM!	#NUM!					160	#NUM!	#NUM!
170	#NUM!	#NUM!	#NUM!					170	#NUM!	#NUM!
180	#NUM!	#NUM!	#NUM!					180	#NUM!	#NUM!
190	#NUM!	#NUM!	#NUM!					190	#NUM!	#NUM!
200	#NUM!	#NUM!	#NUM!					200	#NUM!	#NUM!
210	#NUM!	#NUM!	#NUM!					210	#NUM!	#NUM!
220	#NUM!	#NUM!	#NUM!					220	#NUM!	#NUM!
230	#NUM!	#NUM!	#NUM!					230	#NUM!	#NUM!
240	#NUM!	#NUM!	#NUM!					240	#NUM!	#NUM!
250	76	#NUM!	#NUM!					250	#NUM!	#NUM!
260	130	#NUM!	#NUM!					260	#NUM!	#NUM!
270	167	#NUM!	#NUM!					270	#NUM!	#NUM!
280	196	#NUM!	#NUM!					280	#NUM!	#NUM!
290	221	#NUM!	#NUM!					290	#NUM!	#NUM!
300	243	#NUM!	#NUM!					300	#NUM!	#NUM!
310	263	#NUM!	#NUM!					310	#NUM!	#NUM!
320	281	#NUM!	#NUM!					320	#NUM!	#NUM!
330	298	#NUM!	#NUM!					330	#NUM!	#NUM!
340	313	#NUM!	#NUM!					340	#NUM!	#NUM!
350	328	#NUM!	#NUM!					350	#NUM!	#NUM!
360	341	#NUM!	#NUM!					360	#NUM!	#NUM!

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 8
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.11

Mounting Method: Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.187	5.979	5.954
DIAMETER	7.087	2.790	2.783
AREA	39.44	6.11	6.08
VOLUME	599.00	36.55	36.22
WEIGHT (g)	1229.25		1261.25
% MOISTURE	13.8		16.77
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	128.1		
DRY DENSITY, calc (pcf)	112.5		
VOLUME OF SOLIDS	400.05		
VOLUME OF VOIDS	198.95		
VOID RATIO	0.497		
SATURATION	75.0		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	113.6
VOLUME OF SOLIDS	400.05
VOLUME OF VOIDS	193.45
VOID RATIO	0.484

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1261.25
WT SOIL & TARE, DRY (g)	1080.13
WT TARE (g)	0.00
WT MOISTURE (g)	181.12
WT DRY SOIL (g)	1080.13
% MOISTURE	16.77

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	81.3	0.0	0.00	1.00	6.08	5.954	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.3	0.002	30	81.8	72.0	0.03	1.00	6.08	5.952	411.8	843.8	771.8	360.0	2.14	565.9	205.9	0.17
1.0	0.006	35	82.0	100.8	0.10	1.00	6.09	5.948	534.5	966.5	865.7	331.2	2.61	598.4	267.2	0.19
1.5	0.009	38	82.1	115.2	0.15	1.00	6.09	5.945	609.8	1041.8	926.6	316.8	2.92	621.7	304.9	0.19
2.0	0.012	42	82.2	129.6	0.20	1.00	6.10	5.942	692.2	1124.2	994.6	302.4	3.29	648.5	346.1	0.19
2.5	0.015	45	82.2	129.6	0.25	1.00	6.10	5.939	758.0	1190.0	1060.4	302.4	3.51	681.4	379.0	0.17
3.5	0.021	49	82.2	129.6	0.35	1.00	6.10	5.933	853.9	1285.9	1156.3	302.4	3.82	729.4	427.0	0.15
7.7	0.046	55	81.9	86.4	0.77	0.99	6.13	5.908	1007.7	1439.7	1353.3	345.6	3.92	849.5	503.9	0.09
11.7	0.070	55	81.9	86.4	1.18	0.99	6.16	5.884	1001.3	1433.3	1346.9	345.6	3.90	846.2	500.6	0.09
15.3	0.092	56	81.8	72.0	1.55	0.98	6.18	5.862	1002.2	1434.2	1362.2	360.0	3.78	861.1	501.1	0.07
20.2	0.121	56	81.7	57.6	2.03	0.98	6.21	5.833	1001.9	1433.9	1376.3	374.4	3.68	875.3	500.9	0.06
24.3	0.146	56	81.7	57.6	2.45	0.98	6.24	5.808	993.0	1425.0	1367.4	374.4	3.65	870.9	496.5	0.06
28.7	0.172	56	81.7	57.6	2.89	0.97	6.26	5.782	1009.2	1441.2	1383.6	374.4	3.70	879.0	504.6	0.06
32.5	0.195	56	81.6	43.2	3.28	0.97	6.29	5.759	1005.2	1437.2	1394.0	388.8	3.59	891.4	502.6	0.04
36.5	0.219	57	81.5	28.8	3.68	0.96	6.32	5.735	1019.3	1451.3	1422.5	403.2	3.53	912.8	509.6	0.03
45.0	0.270	58	81.3	0.0	4.53	0.95	6.37	5.684	1035.0	1467.0	1467.0	432.0	3.40	949.5	517.5	0.00
53.2	0.319	59	81.3	0.0	5.36	0.95	6.43	5.635	1041.8	1473.8	1473.8	432.0	3.41	952.9	520.9	0.00
61.7	0.370	60	81.3	0.0	6.21	0.94	6.49	5.584	1061.2	1493.2	1493.2	432.0	3.46	962.6	530.6	0.00
70.3	0.422	61	81.2	-14.4	7.09	0.93	6.55	5.532	1075.6	1507.6	1522.0	446.4	3.41	984.2	537.8	-0.01
78.3	0.470	63	81.2	-14.4	7.89	0.92	6.60	5.484	1101.1	1533.1	1547.5	446.4	3.47	997.0	550.6	-0.01
86.7	0.520	63	81.2	-14.4	8.73	0.91	6.67	5.434	1091.1	1523.1	1537.5	446.4	3.44	991.9	545.5	-0.01
94.5	0.567	64	81.2	-14.4	9.52	0.90	6.72	5.387	1107.3	1539.3	1553.7	446.4	3.48	1000.1	553.7	-0.01
103.5	0.621	66	81.2	-14.4	10.43	0.90	6.79	5.333	1125.9	1557.9	1572.3	446.4	3.52	1009.4	563.0	-0.01
111.8	0.671	67	81.2	-14.4	11.27	0.89	6.86	5.283	1142.7	1574.7	1589.1	446.4	3.56	1017.7	571.3	-0.01
120.0	0.720	68	81.2	-14.4	12.09	0.88	6.92	5.234	1157.0	1589.0	1603.4	446.4	3.59	1024.9	578.5	-0.01
128.8	0.773	69	81.0	-43.2	12.98	0.87	6.99	5.181	1155.6	1587.6	1630.8	475.2	3.43	1053.0	577.8	-0.04
136.2	0.817	71	81.0	-43.2	13.72	0.86	7.05	5.137	1184.6	1616.6	1659.8	475.2	3.49	1067.5	592.3	-0.04
145.5	0.873	70	81.0	-43.2	14.66	0.85	7.13	5.081	1169.7	1601.7	1644.9	475.2	3.46	1060.0	584.8	-0.04
153.8	0.923	71	81.0	-43.2	15.50	0.84	7.20	5.031	1176.2	1608.2	1651.4	475.2	3.48	1063.3	588.1	-0.04
166.7	1.000	72	80.9	-57.6	16.80	0.83	7.31	4.954	1172.0	1604.0	1661.6	489.6	3.39	1075.6	586.0	-0.05

DU @ FAILURE	86.40	DEVIATORIC STRESS @ FAILURE	1007.72	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.92

TECH PWM/SDM
DATE 7/30/04
CHECK
REVIEW

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 8
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.41
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.240	6.000	5.968
DIAMETER	7.087	2.790	2.777
AREA	39.44	6.11	6.06
VOLUME	601.11	36.68	36.14
WEIGHT (g)	1229.05		1261.25
% MOISTURE	13.6		16.56
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	127.6		
DRY DENSITY, calc (pcf)	112.3		
VOLUME OF SOLIDS	400.75		
VOLUME OF VOIDS	200.36		
VOID RATIO	0.500		
SATURATION	73.4		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	114.0
VOLUME OF SOLIDS	400.75
VOLUME OF VOIDS	191.56
VOID RATIO	0.478
WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1261.25
WT SOIL & TARE, DRY (g)	1082.02
WT TARE (g)	0.00
WT MOISTURE (g)	179.23
WT DRY SOIL (g)	1082.02
% MOISTURE	16.56

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	14	81.4	0.0	0.00	1.00	6.06	5.968	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.3	0.002	36	82.6	172.8	0.03	1.00	6.06	5.966	520.5	1384.5	1211.7	691.2	1.75	951.5	260.3	0.33
0.8	0.005	44	83.0	230.4	0.08	1.00	6.06	5.963	722.2	1586.2	1355.8	633.6	2.14	994.7	361.1	0.32
1.3	0.008	50	83.3	273.6	0.13	1.00	6.06	5.960	861.9	1725.9	1452.3	590.4	2.46	1021.4	431.0	0.32
1.8	0.011	55	83.5	302.4	0.18	1.00	6.07	5.957	968.3	1832.3	1529.9	561.6	2.72	1045.7	484.1	0.31
2.3	0.014	58	83.6	316.8	0.23	1.00	6.07	5.954	1057.9	1921.9	1605.1	547.2	2.93	1076.2	529.0	0.30
2.8	0.017	61	83.7	331.2	0.28	1.00	6.07	5.951	1121.4	1985.4	1654.2	532.8	3.10	1093.5	560.7	0.30
3.3	0.020	63	83.8	345.6	0.34	1.00	6.08	5.948	1165.9	2029.9	1684.3	518.4	3.25	1101.3	582.9	0.30
7.5	0.045	67	84.1	388.8	0.75	0.99	6.10	5.923	1255.4	2119.4	1730.6	475.2	3.64	1102.9	627.7	0.31
11.5	0.069	66	84.2	403.2	1.16	0.99	6.13	5.899	1222.1	2086.1	1682.9	460.8	3.65	1071.8	611.0	0.33
15.5	0.093	65	84.2	403.2	1.56	0.98	6.15	5.875	1210.1	2074.1	1670.9	460.8	3.63	1065.8	605.0	0.33
20.0	0.120	64	84.3	417.6	2.01	0.98	6.18	5.848	1178.9	2042.9	1625.3	446.4	3.64	1035.8	589.4	0.35
24.2	0.145	65	84.3	417.6	2.43	0.98	6.21	5.823	1183.1	2047.1	1629.5	446.4	3.65	1038.0	591.6	0.35
28.3	0.170	64	84.3	417.6	2.85	0.97	6.23	5.798	1168.8	2032.8	1615.2	446.4	3.62	1030.8	584.4	0.36
32.3	0.194	64	84.3	417.6	3.25	0.97	6.26	5.774	1166.3	2030.3	1612.7	446.4	3.61	1029.5	583.1	0.36
36.2	0.217	65	84.3	417.6	3.64	0.96	6.28	5.751	1173.1	2037.1	1619.5	446.4	3.63	1032.9	586.5	0.36
45.0	0.270	65	84.4	432.0	4.52	0.95	6.34	5.698	1157.7	2021.7	1589.7	432.0	3.68	1010.9	578.9	0.37
53.2	0.319	66	84.4	432.0	5.35	0.95	6.40	5.649	1165.8	2029.8	1597.8	432.0	3.70	1014.9	582.9	0.37
61.5	0.369	66	84.4	432.0	6.18	0.94	6.46	5.599	1159.9	2023.9	1591.9	432.0	3.69	1012.0	580.0	0.37
70.3	0.422	67	84.3	417.6	7.07	0.93	6.52	5.546	1168.8	2032.8	1615.2	446.4	3.62	1030.8	584.4	0.36
78.3	0.470	67	84.4	432.0	7.88	0.92	6.57	5.498	1174.1	2038.1	1606.1	432.0	3.72	1019.0	587.0	0.37
86.7	0.520	68	84.4	432.0	8.71	0.91	6.63	5.448	1178.6	2042.6	1610.6	432.0	3.73	1021.3	589.3	0.37
95.0	0.570	69	84.4	432.0	9.55	0.90	6.70	5.398	1182.8	2046.8	1614.8	432.0	3.74	1023.4	591.4	0.37
103.7	0.622	69	84.4	432.0	10.42	0.90	6.76	5.346	1182.1	2046.1	1614.1	432.0	3.74	1023.0	591.0	0.37
112.0	0.672	70	84.4	432.0	11.26	0.89	6.82	5.296	1185.8	2049.8	1617.8	432.0	3.74	1024.9	592.9	0.36
120.2	0.721	70	84.3	417.6	12.08	0.88	6.89	5.247	1181.1	2045.1	1627.5	446.4	3.65	1036.9	590.5	0.35
128.7	0.772	71	84.4	432.0	12.94	0.87	6.96	5.196	1190.3	2054.3	1622.3	432.0	3.76	1027.1	595.1	0.36
136.8	0.821	72	84.4	432.0	13.76	0.86	7.02	5.147	1201.6	2065.6	1633.6	432.0	3.78	1032.8	600.8	0.36
145.5	0.873	73	84.3	417.6	14.63	0.85	7.09	5.095	1201.7	2065.7	1648.1	446.4	3.69	1047.2	600.8	0.35
162.2	0.973	75	84.3	417.6	16.30	0.84	7.24	4.995	1215.9	2079.9	1662.3	446.4	3.72	1054.3	607.9	0.34

DU @ FAILURE	403.2	DEVIATORIC STRESS @ FAILURE	1222.1	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.65	TECH: PWM/SDM
						DATE: 7/30/2004
						CHECKED:
						REVIEWED:

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 8
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.13
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.245	6.002	5.961
DIAMETER	7.087	2.790	2.763
AREA	39.44	6.11	5.99
VOLUME	601.31	36.69	35.74
WEIGHT (g)	1229.74		1262.04
% MOISTURE	13.5		16.45
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	127.6		
DRY DENSITY, calc (pcf)	112.5		
VOLUME OF SOLIDS	401.38		
VOLUME OF VOIDS	199.93		
VOID RATIO	0.498		
SATURATION	73.0		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	115.5
VOLUME OF SOLIDS	401.38
VOLUME OF VOIDS	184.23
VOID RATIO	0.459

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1262.04
WT SOIL & TARE, DRY (g)	1083.72
WT TARE (g)	0.00
WT MOISTURE (g)	178.32
WT DRY SOIL (g)	1083.72
% MOISTURE	16.45

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	14	81.3	0.0	0.00	1.00	5.99	5.961	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.3	0.002	45	83.2	273.6	0.03	1.00	6.00	5.959	761.2	2057.2	1783.6	1022.4	1.74	1403.0	380.6	0.36
0.8	0.005	53	83.6	331.2	0.08	1.00	6.00	5.956	948.0	2244.0	1912.8	964.8	1.98	1438.8	474.0	0.35
1.3	0.008	59	83.9	374.4	0.13	1.00	6.00	5.953	1081.9	2377.9	2003.5	921.6	2.17	1462.5	540.9	0.35
1.8	0.011	63	84.1	403.2	0.18	1.00	6.01	5.950	1177.2	2473.2	2070.0	892.8	2.32	1481.4	588.6	0.34
2.3	0.014	65	84.3	432.0	0.23	1.00	6.01	5.947	1241.3	2537.3	2105.3	864.0	2.44	1484.7	620.7	0.35
2.8	0.017	68	84.5	460.8	0.29	1.00	6.01	5.944	1293.4	2589.4	2128.6	835.2	2.55	1481.9	646.7	0.36
3.2	0.019	69	84.7	489.6	0.32	1.00	6.01	5.942	1333.7	2629.7	2140.1	806.4	2.65	1473.2	666.8	0.37
7.3	0.044	73	85.4	590.4	0.74	0.99	6.04	5.917	1428.2	2724.2	2133.8	705.6	3.02	1419.7	714.1	0.41
11.5	0.069	72	85.7	633.6	1.16	0.99	6.07	5.892	1388.9	2684.9	2051.3	662.4	3.10	1356.9	694.5	0.46
14.7	0.088	71	85.9	662.4	1.48	0.99	6.08	5.873	1365.5	2661.5	1999.1	633.6	3.16	1316.4	682.8	0.49
19.7	0.118	71	86.0	676.8	1.98	0.98	6.12	5.843	1356.2	2652.2	1975.4	619.2	3.19	1297.3	678.1	0.50
23.8	0.143	70	86.1	691.2	2.40	0.98	6.14	5.818	1324.6	2620.6	1929.4	604.8	3.19	1267.1	662.3	0.52
28.2	0.169	70	86.2	705.6	2.84	0.97	6.17	5.792	1311.7	2607.7	1902.1	590.4	3.22	1246.2	655.8	0.54
32.0	0.192	69	86.2	705.6	3.22	0.97	6.19	5.769	1283.2	2579.2	1873.6	590.4	3.17	1232.0	641.6	0.55
35.8	0.215	69	86.3	720.0	3.61	0.96	6.22	5.746	1275.8	2571.8	1851.8	576.0	3.21	1213.9	637.9	0.56
40.5	0.243	69	86.3	720.0	4.08	0.96	6.25	5.718	1276.5	2572.5	1852.5	576.0	3.22	1214.2	638.2	0.56
44.5	0.267	69	86.4	734.4	4.48	0.96	6.28	5.694	1271.1	2567.1	1832.7	561.6	3.26	1197.2	635.6	0.58
52.8	0.317	69	86.4	734.4	5.32	0.95	6.33	5.644	1266.8	2562.8	1828.4	561.6	3.26	1195.0	633.4	0.58
61.3	0.368	70	86.4	734.4	6.17	0.94	6.39	5.593	1280.1	2576.1	1841.7	561.6	3.28	1201.7	640.1	0.57
69.8	0.419	70	86.4	734.4	7.03	0.93	6.45	5.542	1268.4	2564.4	1830.0	561.6	3.26	1195.8	634.2	0.58
77.5	0.465	71	86.4	734.4	7.80	0.92	6.50	5.496	1262.4	2558.4	1824.0	561.6	3.25	1192.8	631.2	0.58
86.3	0.518	71	86.4	734.4	8.69	0.91	6.57	5.443	1265.5	2561.5	1827.1	561.6	3.25	1194.4	632.8	0.58
94.7	0.568	72	86.4	734.4	9.53	0.90	6.63	5.393	1277.8	2573.8	1839.4	561.6	3.28	1200.5	638.9	0.57
103.3	0.620	72	86.4	734.4	10.40	0.90	6.69	5.341	1256.9	2552.9	1818.5	561.6	3.24	1190.0	628.4	0.58
150.0	0.900	72	86.4	734.4	15.10	0.85	7.06	5.061	1193.0	2489.0	1754.6	561.6	3.12	1158.1	596.5	0.62
158.3	0.950	72	86.4	734.4	15.94	0.84	7.13	5.011	1181.2	2477.2	1742.8	561.6	3.10	1152.2	590.6	0.62
166.7	1.000	72	86.4	734.4	16.78	0.83	7.20	4.961	1169.5	2465.5	1731.1	561.6	3.08	1146.3	584.7	0.63
0.0				-11707.2	0.00	1.00	5.99	5.961	-324.3	971.7	12678.9	13003.2	0.98	12841.1	-162.1	36.10
0.0				-11707.2	0.00	1.00	5.99	5.961	-324.3	971.7	12678.9	13003.2	0.98	12841.1	-162.1	36.10

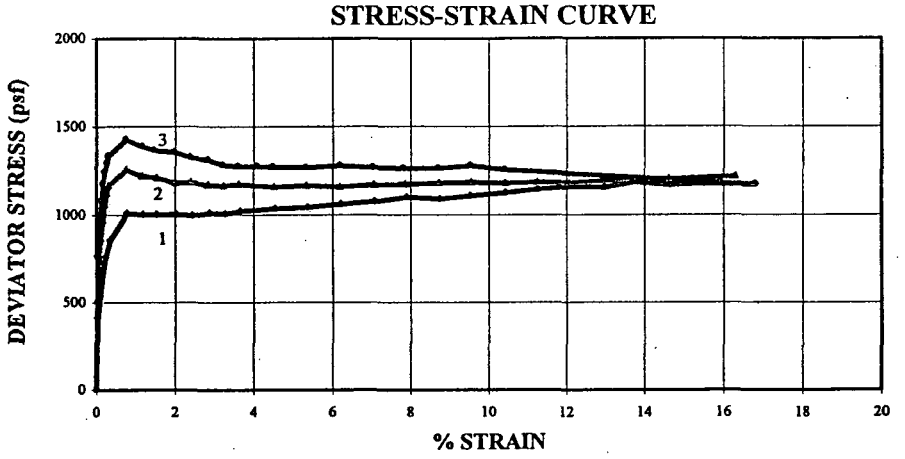
DU @ FAILURE	676.8	DEVIATORIC STRESS @ FAILURE	1356.2	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	3.19

TECH	PWM/SDM
DATE	7/30/2004
CHEC	
REVIE	

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

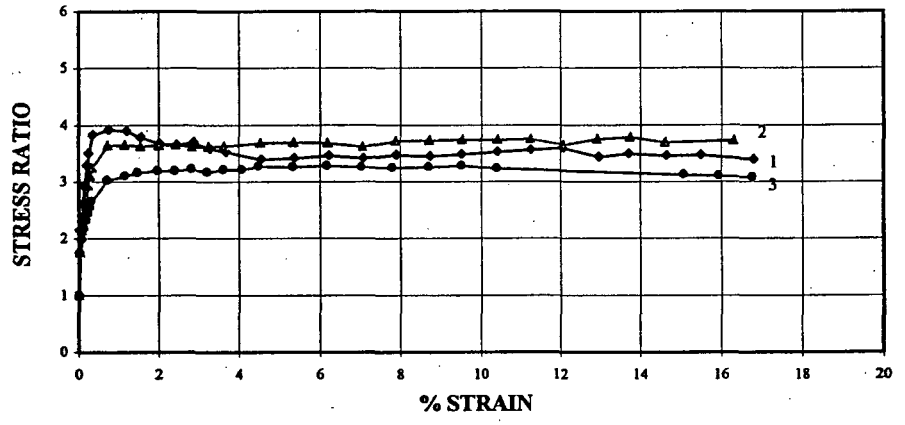
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 8 DEPTH: - Sample Type: Bulk

STRESS-STRAIN CURVE

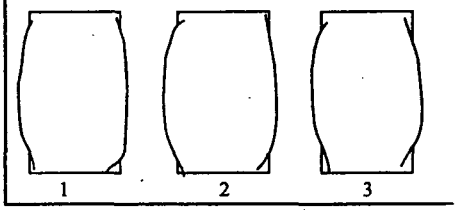


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	112.5	13.8
2	864	112.3	13.6
3	1296	112.5	13.5
	Average	**112.4**	**13.6**

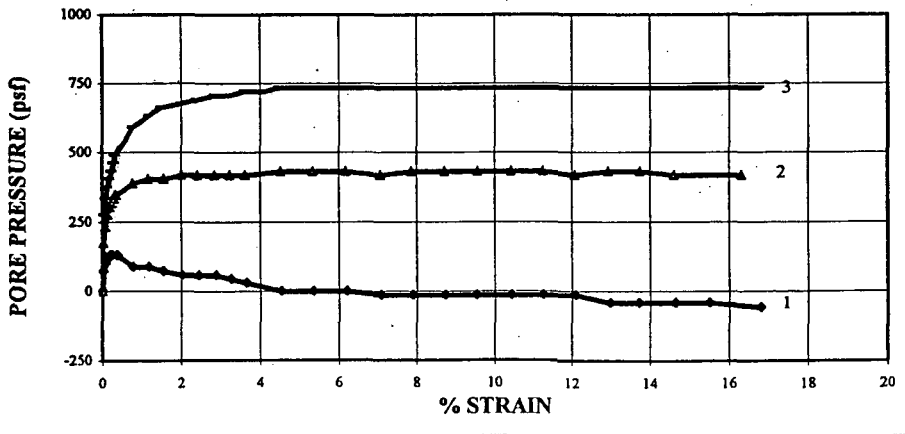
STRESS RATIO-STRAIN CURVES



FAILURE SKETCH



PORE PRESSURE-STRAIN CURVE



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

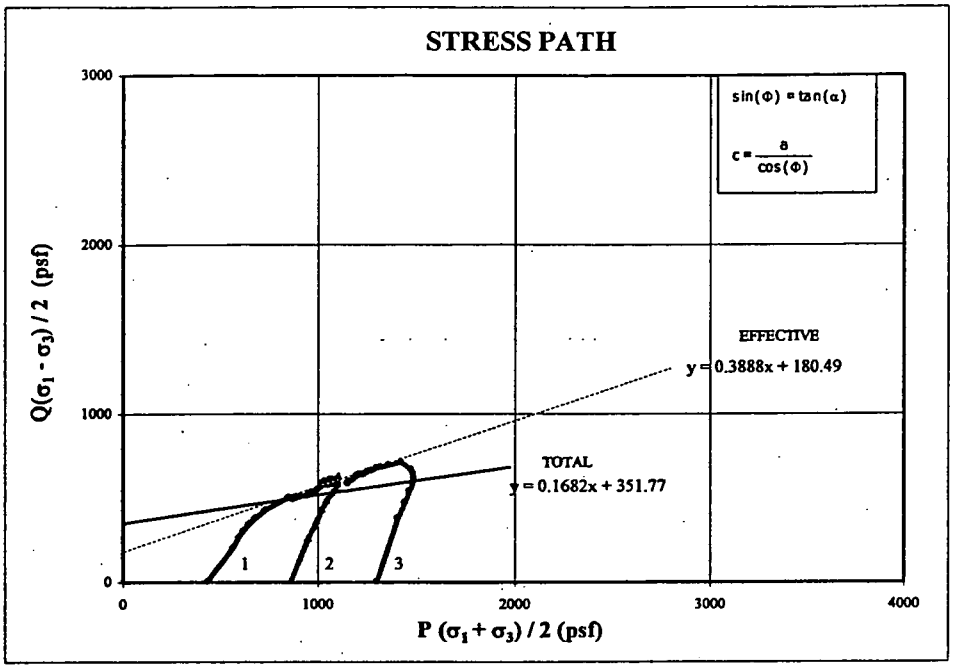
* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 8 DEPTH: - Sample Type: Bulk

STRESS PATH

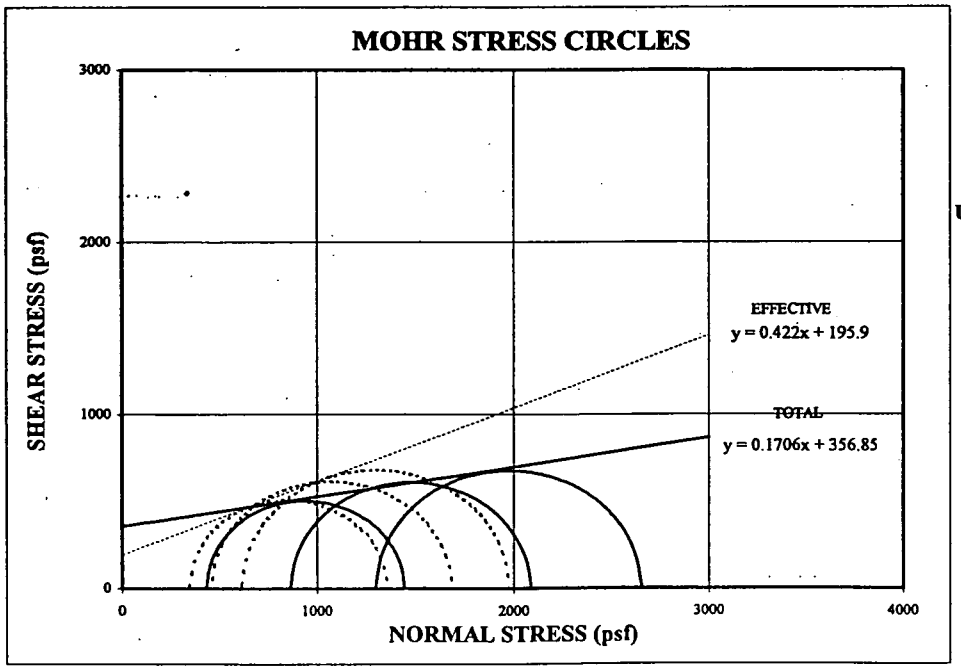


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	112.5	13.8
2	864	112.3	13.6
3	1296	112.5	13.5

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	75.0	93.6
2	0.10	73.4	93.6
3	0.10	73.0	96.8

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	9.5 *	ϕ	=	9.7 *
a	=	351.8 psf	c	=	356.9 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	21.2 *	ϕ'	=	22.9 *
a'	=	180.5 psf	c'	=	195.9 psf

MOHR STRESS CIRCLES



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

CONSOLIDATED UNDRAINED TRIAXIAL STRENGTH								CONSOLIDATED UNDRAINED TRI		
MOHR CIRCLE GENERATION SPREADSHEET								MOHR CIRCLE GENERATION SPRE		
	PF - 8	-	B	C	A				PF - 8	-
CONFINING PRESSURE USED (S3)			432	864	1296	psf		CONFINING PRESSURE USED (S3)		
CONFINING PRESSURE USED (S3)			432	864	1296	psi		CONFINING PRESSURE USED (S3)		
MAXIMUM DEVIATOR STRESS (PS			1007.7	1222.1	1356.2	psf		MAXIMUM DEVIATOR STRESS (PS		
(or load at 15% strain)								(or load at 15% strain)		
dU AT FAIL	(S1-S3)/2	(S1'+S3')/2		coh	sin phi	phi		dU AT FAIL	(S1-S3)/2	(S1'+S3')/2
86.4	503.9	849.5	COH 1&2	90	0.481968751	29		86.4	503.9	935.9
403.2	611.0	1071.8	COH 1&3	170	0.389052893	23		403.2	611.0	1475.0
676.8	678.1	1297.3	COH 2&3	290	0.297401663	17		676.8	678.1	1974.1
	EFFECTIVE									TOTAL
TA POINTS	A	B	C					DATA POINTS	A	B
	MOHR,1	MOHR,2	MOHR,3						MOHR,1	MOHR,2
X	Y,1	Y,2	Y,3					X	Y,1	Y,2
0	#NUM!	#NUM!	#NUM!					0	#NUM!	#NUM!
10	#NUM!	#NUM!	#NUM!					10	#NUM!	#NUM!
20	#NUM!	#NUM!	#NUM!					20	#NUM!	#NUM!
30	#NUM!	#NUM!	#NUM!					30	#NUM!	#NUM!
40	#NUM!	#NUM!	#NUM!					40	#NUM!	#NUM!
50	#NUM!	#NUM!	#NUM!					50	#NUM!	#NUM!
60	#NUM!	#NUM!	#NUM!					60	#NUM!	#NUM!
70	#NUM!	#NUM!	#NUM!					70	#NUM!	#NUM!
80	#NUM!	#NUM!	#NUM!					80	#NUM!	#NUM!
90	#NUM!	#NUM!	#NUM!					90	#NUM!	#NUM!
100	#NUM!	#NUM!	#NUM!					100	#NUM!	#NUM!
110	#NUM!	#NUM!	#NUM!					110	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!					120	#NUM!	#NUM!
130	#NUM!	#NUM!	#NUM!					130	#NUM!	#NUM!
140	#NUM!	#NUM!	#NUM!					140	#NUM!	#NUM!
150	#NUM!	#NUM!	#NUM!					150	#NUM!	#NUM!
160	#NUM!	#NUM!	#NUM!					160	#NUM!	#NUM!
170	#NUM!	#NUM!	#NUM!					170	#NUM!	#NUM!
180	#NUM!	#NUM!	#NUM!					180	#NUM!	#NUM!
190	#NUM!	#NUM!	#NUM!					190	#NUM!	#NUM!
200	#NUM!	#NUM!	#NUM!					200	#NUM!	#NUM!
210	#NUM!	#NUM!	#NUM!					210	#NUM!	#NUM!
220	#NUM!	#NUM!	#NUM!					220	#NUM!	#NUM!
230	#NUM!	#NUM!	#NUM!					230	#NUM!	#NUM!
240	#NUM!	#NUM!	#NUM!					240	#NUM!	#NUM!
250	#NUM!	#NUM!	#NUM!					250	#NUM!	#NUM!
260	#NUM!	#NUM!	#NUM!					260	#NUM!	#NUM!
270	#NUM!	#NUM!	#NUM!					270	#NUM!	#NUM!
280	#NUM!	#NUM!	#NUM!					280	#NUM!	#NUM!
290	#NUM!	#NUM!	#NUM!					290	#NUM!	#NUM!
300	#NUM!	#NUM!	#NUM!					300	#NUM!	#NUM!
310	#NUM!	#NUM!	#NUM!					310	#NUM!	#NUM!
320	#NUM!	#NUM!	#NUM!					320	#NUM!	#NUM!
330	#NUM!	#NUM!	#NUM!					330	#NUM!	#NUM!
340	#NUM!	#NUM!	#NUM!					340	#NUM!	#NUM!
350	66	#NUM!	#NUM!					350	#NUM!	#NUM!
360	120	#NUM!	#NUM!					360	#NUM!	#NUM!

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 9
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.15

Mounting Method: Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.240	6.000	5.983
DIAMETER	7.087	2.790	2.788
AREA	39.44	6.11	6.10
VOLUME	601.11	36.68	36.52
WEIGHT (g)	1286.68		1313.98
% MOISTURE	12.4		14.80
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	133.6		
DRY DENSITY, calc (pcf)	118.8		
VOLUME OF SOLIDS	423.90		
VOLUME OF VOIDS	177.20		
VOID RATIO	0.418		
SATURATION	80.2		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	119.3
VOLUME OF SOLIDS	423.90
VOLUME OF VOIDS	174.50
VOID RATIO	0.412

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1313.98
WT SOIL & TARE, DRY (g)	1144.54
WT TARE (g)	0.00
WT MOISTURE (g)	169.44
WT DRY SOIL (g)	1144.54
% MOISTURE	14.80

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	81.4	0.0	0.00	1.00	6.10	5.983	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.3	0.002	26	81.9	72.0	0.03	1.00	6.11	5.981	316.0	748.0	676.0	360.0	1.88	518.0	158.0	0.23
1.3	0.008	42	82.4	144.0	0.13	1.00	6.11	5.975	695.1	1127.1	983.1	288.0	3.41	635.5	347.5	0.21
2.0	0.012	47	82.5	158.4	0.20	1.00	6.12	5.971	810.0	1242.0	1083.6	273.6	3.96	678.6	405.0	0.20
3.0	0.018	54	82.5	158.4	0.30	1.00	6.12	5.965	976.2	1408.2	1249.8	273.6	4.57	761.7	488.1	0.16
4.0	0.024	60	82.4	144.0	0.40	1.00	6.13	5.959	1120.9	1552.9	1408.9	288.0	4.89	848.4	560.4	0.13
8.3	0.050	83	81.4	0.0	0.84	0.99	6.15	5.933	1642.4	2074.4	2074.4	432.0	4.80	1253.2	821.2	0.00
11.7	0.070	98	80.4	-144.0	1.17	0.99	6.18	5.913	2002.9	2434.9	2578.9	576.0	4.48	1577.5	1001.5	-0.07
15.7	0.094	110	79.5	-273.6	1.57	0.98	6.20	5.889	2261.9	2693.9	2967.5	705.6	4.21	1836.5	1130.9	-0.12
20.5	0.123	119	79.2	-316.8	2.06	0.98	6.23	5.860	2456.4	2888.4	3205.2	748.8	4.28	1977.0	1228.2	-0.13
24.7	0.148	125	78.9	-360.0	2.47	0.98	6.26	5.835	2586.3	3018.3	3378.3	792.0	4.27	2085.1	1293.1	-0.14
29.2	0.175	130	78.4	-432.0	2.92	0.97	6.29	5.808	2682.0	3114.0	3546.0	864.0	4.10	2205.0	1341.0	-0.16
32.5	0.195	133	77.9	-504.0	3.26	0.97	6.31	5.788	2750.3	3182.3	3686.3	936.0	3.94	2311.2	1375.2	-0.18
36.8	0.221	135	77.6	-547.2	3.69	0.96	6.34	5.762	2783.4	3215.4	3762.6	979.2	3.84	2370.9	1391.7	-0.20
45.7	0.274	141	77.5	-561.6	4.58	0.95	6.40	5.709	2892.9	3324.9	3886.5	993.6	3.91	2440.0	1446.4	-0.19
53.3	0.320	145	77.4	-576.0	5.35	0.95	6.45	5.663	2967.8	3399.8	3975.8	1008.0	3.94	2491.9	1483.9	-0.19
62.2	0.373	150	77.3	-590.4	6.23	0.94	6.51	5.610	3035.2	3467.2	4057.6	1022.4	3.97	2540.0	1517.6	-0.19
70.7	0.424	153	76.9	-648.0	7.09	0.93	6.57	5.559	3084.3	3516.3	4164.3	1080.0	3.86	2622.2	1542.2	-0.21
78.8	0.473	156	76.8	-662.4	7.91	0.92	6.63	5.510	3122.3	3554.3	4216.7	1094.4	3.85	2655.6	1561.2	-0.21
87.2	0.523	160	76.7	-676.8	8.74	0.91	6.69	5.460	3171.5	3603.5	4280.3	1108.8	3.86	2694.5	1585.7	-0.21
95.0	0.570	163	76.6	-691.2	9.53	0.90	6.75	5.413	3216.8	3648.8	4340.0	1123.2	3.86	2731.6	1608.4	-0.21
104.0	0.624	167	76.4	-720.0	10.43	0.90	6.81	5.359	3260.8	3692.8	4412.8	1152.0	3.83	2782.4	1630.4	-0.22
112.5	0.675	170	76.2	-748.8	11.28	0.89	6.88	5.308	3300.9	3732.9	4481.7	1180.8	3.80	2831.2	1650.4	-0.23
120.5	0.723	173	76.0	-777.6	12.08	0.88	6.94	5.260	3318.7	3750.7	4528.3	1209.6	3.74	2869.0	1659.4	-0.23
129.3	0.776	177	75.9	-792.0	12.97	0.87	7.01	5.207	3379.8	3811.8	4603.8	1224.0	3.76	2913.9	1689.9	-0.23
136.7	0.820	179	75.8	-806.4	13.71	0.86	7.07	5.163	3398.0	3830.0	4636.4	1238.4	3.74	2937.4	1699.0	-0.24
146.2	0.877	183	75.8	-806.4	14.66	0.85	7.15	5.106	3424.9	3856.9	4663.3	1238.4	3.77	2950.9	1712.5	-0.24
154.3	0.926	186	75.8	-806.4	15.48	0.85	7.22	5.057	3453.9	3885.9	4692.3	1238.4	3.79	2965.3	1726.9	-0.23
160.0	0.960	187	75.6	-835.2	16.05	0.84	7.27	5.023	3464.3	3896.3	4731.5	1267.2	3.73	2999.4	1732.2	-0.24
165.3	0.992	189	75.4	-864.0	16.58	0.83	7.32	4.991	3471.8	3903.8	4767.8	1296.0	3.68	3031.9	1735.9	-0.25

DU @ FAILURE	144.00	DEVIATORIC STRESS @ FAILURE	1120.88	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.89

TECH	PWM/SDM
DATE	8/2/04
CHEC	
REVIE	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 9
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.16
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.248	6.003	5.981
DIAMETER	7.087	2.790	2.780
AREA	39.44	6.11	6.07
VOLUME	601.41	36.70	36.31
WEIGHT (g)	1286.57		1310.17
% MOISTURE	12.5		14.60
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	133.5		
DRY DENSITY, calc (pcf)	118.6		
VOLUME OF SOLIDS	423.44		
VOLUME OF VOIDS	177.97		
VOID RATIO	0.420		
SATURATION	80.5		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	119.9
VOLUME OF SOLIDS	423.44
VOLUME OF VOIDS	171.57
VOID RATIO	0.405

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1310.17
WT SOIL & TARE, DRY (g)	1143.28
WT TARE (g)	0.00
WT MOISTURE (g)	166.89
WT DRY SOIL (g)	1143.28
% MOISTURE	14.60

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	13	81.5	0.0	0.00	1.00	6.07	5.981	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.5	0.003	38	83.1	230.4	0.05	1.00	6.07	5.978	597.4	1461.4	1231.0	633.6	1.94	932.3	298.7	0.39
0.8	0.005	43	83.3	259.2	0.08	1.00	6.08	5.976	701.5	1565.5	1306.3	604.8	2.16	955.6	350.8	0.37
1.5	0.009	52	83.7	316.8	0.15	1.00	6.08	5.972	921.3	1785.3	1468.5	547.2	2.68	1007.9	460.7	0.34
2.0	0.012	59	83.9	345.6	0.20	1.00	6.08	5.969	1086.6	1950.6	1605.0	518.4	3.10	1061.7	543.3	0.32
2.5	0.015	65	84.1	374.4	0.25	1.00	6.09	5.966	1230.4	2094.4	1720.0	489.6	3.51	1104.8	615.2	0.30
3.0	0.018	70	84.1	374.4	0.30	1.00	6.09	5.963	1340.9	2204.9	1830.5	489.6	3.74	1160.0	670.4	0.28
4.0	0.024	79	84.2	388.8	0.40	1.00	6.10	5.957	1554.5	2418.5	2029.7	475.2	4.27	1252.5	777.3	0.25
8.3	0.050	106	83.4	273.6	0.84	0.99	6.12	5.931	2178.1	3042.1	2768.5	590.4	4.69	1679.5	1089.1	0.13
11.8	0.071	119	82.4	129.6	1.19	0.99	6.14	5.910	2489.2	3353.2	3223.6	734.4	4.39	1979.0	1244.6	0.05
15.8	0.095	129	81.7	28.8	1.59	0.98	6.17	5.886	2700.8	3564.8	3536.0	835.2	4.23	2185.6	1350.4	0.01
20.3	0.122	134	81.2	-43.2	2.04	0.98	6.20	5.859	2809.3	3673.3	3716.5	907.2	4.10	2311.8	1404.6	-0.02
24.5	0.147	137	80.9	-86.4	2.46	0.98	6.22	5.834	2873.6	3737.6	3824.0	950.4	4.02	2387.2	1436.8	-0.03
28.8	0.173	139	80.7	-115.2	2.89	0.97	6.25	5.808	2900.0	3764.0	3879.2	979.2	3.96	2429.2	1450.0	-0.04
32.7	0.196	140	80.6	-129.6	3.28	0.97	6.28	5.785	2902.3	3766.3	3895.9	993.6	3.92	2444.7	1451.1	-0.04
37.0	0.222	142	80.5	-144.0	3.71	0.96	6.30	5.759	2941.7	3805.7	3949.7	1008.0	3.92	2478.9	1470.9	-0.05
45.5	0.273	144	80.4	-158.4	4.56	0.95	6.36	5.708	2954.2	3818.2	3976.6	1022.4	3.89	2499.5	1477.1	-0.05
53.5	0.321	145	80.4	-158.4	5.37	0.95	6.42	5.660	2954.0	3818.0	3976.4	1022.4	3.89	2499.4	1477.0	-0.05
62.3	0.374	148	80.3	-172.8	6.25	0.94	6.48	5.607	2999.7	3863.7	4036.5	1036.8	3.89	2536.7	1499.9	-0.06
70.7	0.424	150	80.3	-172.8	7.09	0.93	6.53	5.557	3017.1	3881.1	4053.9	1036.8	3.91	2545.3	1508.5	-0.06
78.8	0.473	152	80.2	-187.2	7.91	0.92	6.59	5.508	3038.5	3902.5	4089.7	1051.2	3.89	2570.5	1519.3	-0.06
87.5	0.525	154	80.2	-187.2	8.78	0.91	6.65	5.456	3057.4	3921.4	4108.6	1051.2	3.91	2579.9	1528.7	-0.06
95.3	0.572	156	80.0	-216.0	9.56	0.90	6.71	5.409	3074.0	3938.0	4154.0	1080.0	3.85	2617.0	1537.0	-0.07
104.2	0.625	160	80.0	-216.0	10.45	0.90	6.78	5.356	3126.7	3990.7	4206.7	1080.0	3.90	2643.4	1563.4	-0.07
112.7	0.676	163	79.9	-230.4	11.30	0.89	6.84	5.305	3151.7	4015.7	4246.1	1094.4	3.88	2670.2	1575.8	-0.07
120.7	0.724	166	79.8	-244.8	12.10	0.88	6.91	5.257	3189.9	4053.9	4298.7	1108.8	3.88	2703.7	1594.9	-0.08
129.5	0.777	169	79.7	-259.2	12.99	0.87	6.98	5.204	3219.6	4083.6	4342.8	1123.2	3.87	2733.0	1609.8	-0.08
137.2	0.823	171	79.6	-273.6	13.76	0.86	7.04	5.158	3232.1	4096.1	4369.7	1137.6	3.84	2753.6	1616.0	-0.08
146.0	0.876	175	79.5	-288.0	14.65	0.85	7.11	5.105	3277.8	4141.8	4429.8	1152.0	3.85	2790.9	1638.9	-0.09
154.5	0.927	178	79.4	-302.4	15.50	0.85	7.18	5.054	3305.2	4169.2	4471.6	1166.4	3.83	2819.0	1652.6	-0.09

DU @ FAILURE	273.6	DEVIATORIC STRESS @ FAILURE	2178.1	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.69

TECH	PWM/SDM
DATE	8/2/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 9
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.34

Mounting Method: Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.250	6.004	5.977
DIAMETER	7.087	2.790	2.782
AREA	39.44	6.11	6.08
VOLUME	601.51	36.71	36.34
WEIGHT (g)	1286.60		1310.60
% MOISTURE	12.5		14.57
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	133.5		
DRY DENSITY, calc (pcf)	118.7		
VOLUME OF SOLIDS	423.68		
VOLUME OF VOIDS	177.82		
VOID RATIO	0.420		
SATURATION	80.2		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	119.9
VOLUME OF SOLIDS	423.68
VOLUME OF VOIDS	171.82
VOID RATIO	0.406

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1310.60
WT SOIL & TARE, DRY (g)	1143.94
WT TARE (g)	0.00
WT MOISTURE (g)	166.66
WT DRY SOIL (g)	1143.94
% MOISTURE	14.57

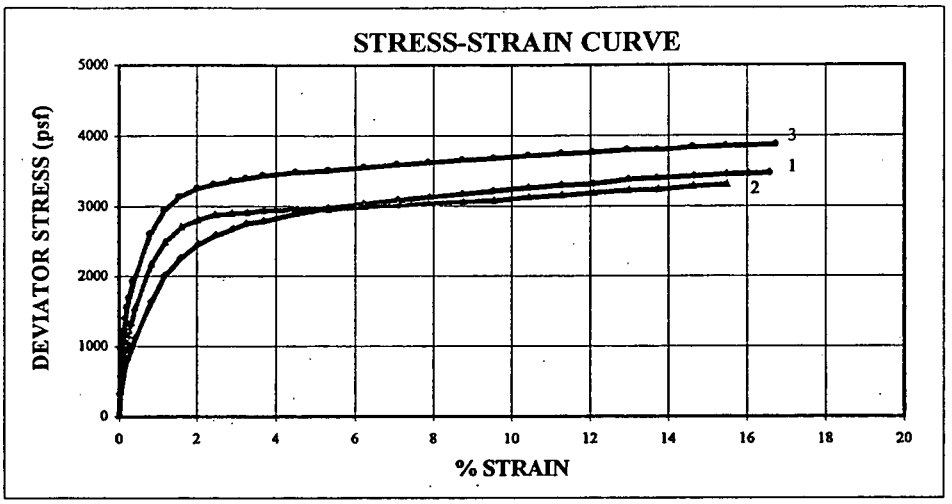
TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	14	80.3	0.0	0.00	1.00	6.08	5.977	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.5	0.003	55	82.8	360.0	0.05	1.00	6.08	5.974	963.5	2259.5	1899.5	936.0	2.03	1417.7	481.7	0.37
1.0	0.006	65	83.4	446.4	0.10	1.00	6.09	5.971	1204.3	2500.3	2053.9	849.6	2.42	1451.8	602.2	0.37
1.7	0.010	74	83.7	489.6	0.17	1.00	6.09	5.967	1399.8	2695.8	2206.2	806.4	2.74	1506.3	699.9	0.35
2.0	0.012	80	84.0	532.8	0.20	1.00	6.09	5.965	1552.9	2848.9	2316.1	763.2	3.03	1539.7	776.5	0.34
2.5	0.015	86	84.2	561.6	0.25	1.00	6.10	5.962	1693.9	2989.9	2428.3	734.4	3.31	1581.4	847.0	0.33
3.5	0.021	96	84.4	590.4	0.35	1.00	6.10	5.956	1932.9	3228.9	2638.5	705.6	3.74	1672.1	966.5	0.31
8.0	0.048	125	83.8	504.0	0.80	0.99	6.13	5.929	2603.1	3899.1	3395.1	792.0	4.29	2093.6	1301.6	0.19
11.7	0.070	140	82.9	374.4	1.17	0.99	6.15	5.907	2944.6	4240.6	3866.2	921.6	4.20	2393.9	1472.3	0.13
15.3	0.092	149	82.3	288.0	1.54	0.98	6.18	5.885	3136.5	4432.5	4144.5	1008.0	4.11	2576.3	1568.3	0.09
20.2	0.121	155	81.9	230.4	2.02	0.98	6.21	5.856	3251.0	4547.0	4316.6	1065.6	4.05	2691.1	1625.5	0.07
24.2	0.145	157	81.6	187.2	2.43	0.98	6.23	5.832	3302.4	4598.4	4411.2	1108.8	3.98	2760.0	1651.2	0.06
28.5	0.171	161	81.4	158.4	2.86	0.97	6.26	5.806	3363.6	4659.6	4501.2	1137.6	3.96	2819.4	1681.8	0.05
32.3	0.194	162	81.3	144.0	3.25	0.97	6.28	5.783	3389.2	4685.2	4541.2	1152.0	3.94	2846.6	1694.6	0.04
36.5	0.219	165	81.1	115.2	3.66	0.96	6.31	5.758	3436.2	4732.2	4617.0	1180.8	3.91	2898.9	1718.1	0.03
45.0	0.270	168	81.0	100.8	4.52	0.95	6.37	5.707	3482.6	4778.6	4677.8	1195.2	3.91	2936.5	1741.3	0.03
53.2	0.319	171	80.9	86.4	5.34	0.95	6.42	5.658	3504.3	4800.3	4713.9	1209.6	3.90	2961.7	1752.1	0.02
62.0	0.372	174	80.8	72.0	6.22	0.94	6.48	5.605	3553.6	4849.6	4777.6	1224.0	3.90	3000.8	1776.8	0.02
70.3	0.422	178	80.7	57.6	7.06	0.93	6.54	5.555	3592.4	4888.4	4830.8	1238.4	3.90	3034.6	1796.2	0.02
78.3	0.470	180	80.6	43.2	7.86	0.92	6.60	5.507	3615.9	4911.9	4868.7	1252.8	3.89	3060.7	1807.9	0.01
87.0	0.522	184	80.5	28.8	8.73	0.91	6.66	5.455	3655.2	4951.2	4922.4	1267.2	3.88	3094.8	1827.6	0.01
95.0	0.570	186	80.4	14.4	9.54	0.90	6.72	5.407	3676.6	4972.6	4958.2	1281.6	3.87	3119.9	1838.3	0.00
103.8	0.623	190	80.3	0.0	10.42	0.90	6.79	5.354	3714.9	5010.9	5010.9	1296.0	3.87	3153.4	1857.4	0.00
112.3	0.674	193	80.2	-14.4	11.28	0.89	6.85	5.303	3744.6	5040.6	5055.0	1310.4	3.86	3182.7	1872.3	0.00
120.2	0.721	195	80.1	-28.8	12.06	0.88	6.91	5.256	3761.4	5057.4	5086.2	1324.8	3.84	3205.5	1880.7	-0.01
128.8	0.773	199	80.0	-43.2	12.93	0.87	6.98	5.204	3798.4	5094.4	5137.6	1339.2	3.84	3238.4	1899.2	-0.01
136.7	0.820	200	80.0	-43.2	13.72	0.86	7.05	5.157	3796.8	5092.8	5136.0	1339.2	3.84	3237.6	1898.4	-0.01
145.7	0.874	204	79.9	-57.6	14.62	0.85	7.12	5.103	3833.9	5129.9	5187.5	1353.6	3.83	3270.6	1917.0	-0.02
154.0	0.924	207	79.8	-72.0	15.46	0.85	7.19	5.053	3852.4	5148.4	5220.4	1368.0	3.82	3294.2	1926.2	-0.02
166.7	1.000	211	79.7	-86.4	16.73	0.83	7.30	4.977	3871.4	5167.4	5253.8	1382.4	3.80	3318.1	1935.7	-0.02

DU @ FAILURE	504.0	DEVIATORIC STRESS @ FAILURE	2603.1	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.29

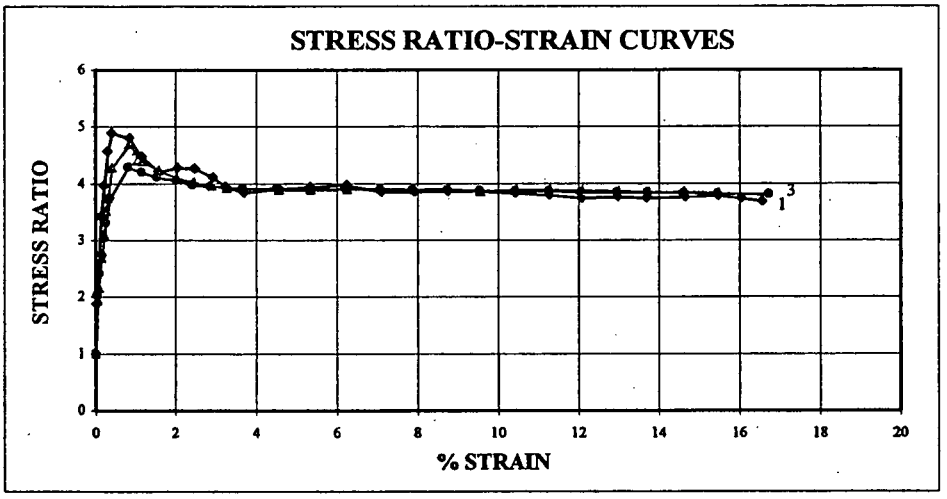
TECH	PWM/SDM
DATE	8/2/2004
CHEC	
REVIEW	

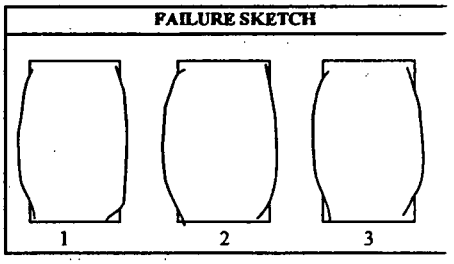
TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

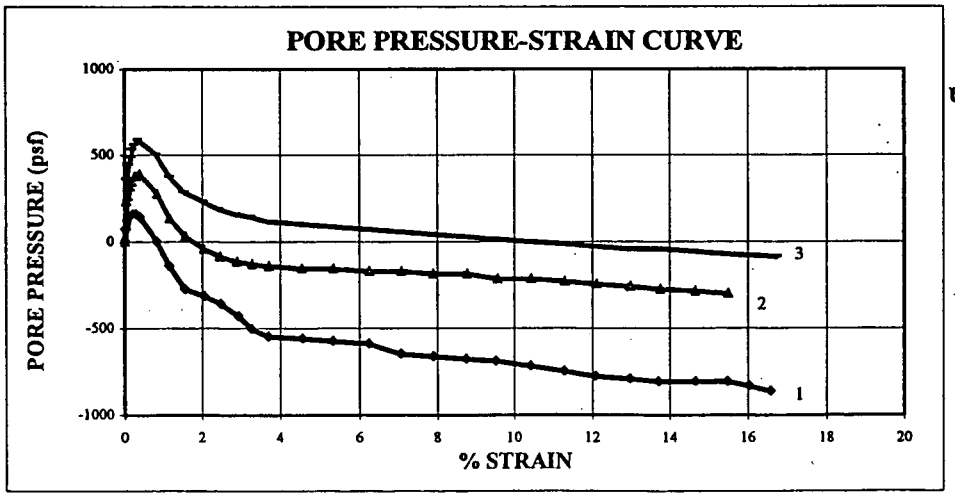
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 9 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	118.8	12.4
2	864	118.6	12.5
3	1296	118.7	12.5
	Average	118.7	12.5







Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

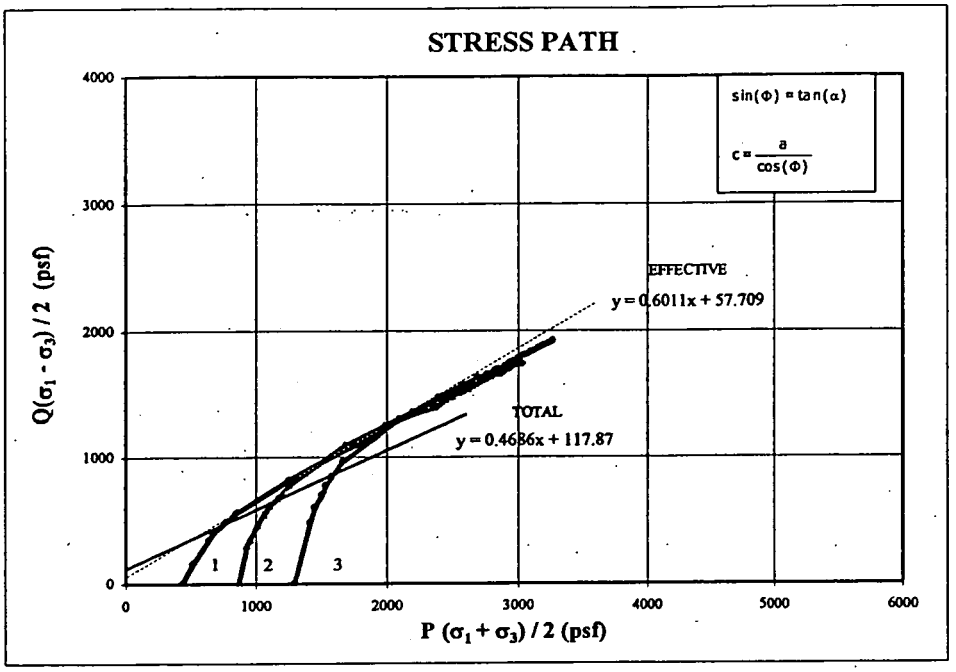
CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE

ASTM D 4767

PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 9 DEPTH: - Sample Type: Bulk

STRESS PATH

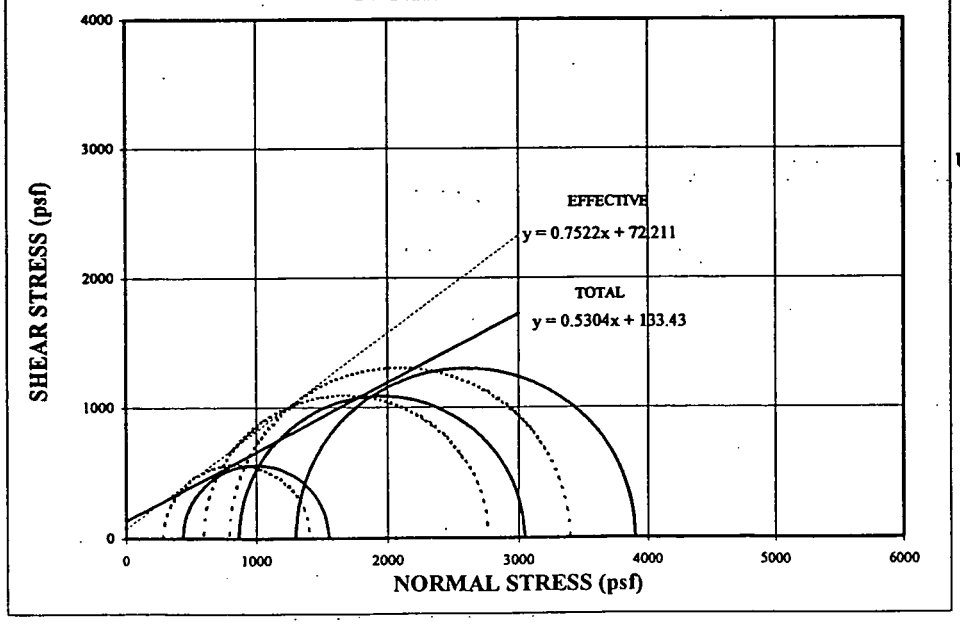


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	118.8	12.4
2	864	118.6	12.5
3	1296	118.7	12.5

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	80.2	97.1
2	0.10	80.5	97.3
3	0.10	80.2	97.0

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	25.1 °	ϕ	=	27.9 °
a	=	117.9 psf	c	=	133.4 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	31.0 °	ϕ'	=	37.0 *
a'	=	57.7 psf	c'	=	72.2 psf

MOHR STRESS CIRCLES



Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

CONSOLIDATED UNDRAINED TRIAXIAL STRENGTH								CONSOLIDATED UNDRAINED TRI		
MOHR CIRCLE GENERATION SPREADSHEET								MOHR CIRCLE GENERATION SPRE		
	PF - 9	-	B	C	A				PF - 9	-
CONFINING PRESSURE USED (S3)			432	864	1296	psf		CONFINING PRESSURE USED (S3)		
CONFINING PRESSURE USED (S3)			432	864	1296	psi		CONFINING PRESSURE USED (S3)		
MAXIMUM DEVIATOR STRESS (PS			1120.9	2178.1	2603.1	psf		MAXIMUM DEVIATOR STRESS (PS		
(or load at 15% strain)								(or load at 15% strain)		
dU AT FAIL	(S1-S3)/2	(S1'+S3')/2		coh	sin phi	phi		dU AT FAIL	(S1-S3)/2	(S1'+S3')/2
144.0	560.4	848.4	COH 1&2	20	0.636108748	40		144.0	560.4	992.4
273.6	1089.1	1679.5	COH 1&3	60	0.595223682	37		273.6	1089.1	1953.1
504.0	1301.6	2093.6	COH 2&3	230	0.513178269	31		504.0	1301.6	2597.6
	EFFECTIVE									TOTAL
TA POINTS	A	B	C					DATA POINTS	A	B
	MOHR,1	MOHR,2	MOHR,3						MOHR,1	MOHR,2
X	Y,1	Y,2	Y,3					X	Y,1	Y,2
0	#NUM!	#NUM!	#NUM!					0	#NUM!	#NUM!
10	#NUM!	#NUM!	#NUM!					10	#NUM!	#NUM!
20	#NUM!	#NUM!	#NUM!					20	#NUM!	#NUM!
30	#NUM!	#NUM!	#NUM!					30	#NUM!	#NUM!
40	#NUM!	#NUM!	#NUM!					40	#NUM!	#NUM!
50	#NUM!	#NUM!	#NUM!					50	#NUM!	#NUM!
60	#NUM!	#NUM!	#NUM!					60	#NUM!	#NUM!
70	#NUM!	#NUM!	#NUM!					70	#NUM!	#NUM!
80	#NUM!	#NUM!	#NUM!					80	#NUM!	#NUM!
90	#NUM!	#NUM!	#NUM!					90	#NUM!	#NUM!
100	#NUM!	#NUM!	#NUM!					100	#NUM!	#NUM!
110	#NUM!	#NUM!	#NUM!					110	#NUM!	#NUM!
120	#NUM!	#NUM!	#NUM!					120	#NUM!	#NUM!
130	#NUM!	#NUM!	#NUM!					130	#NUM!	#NUM!
140	#NUM!	#NUM!	#NUM!					140	#NUM!	#NUM!
150	#NUM!	#NUM!	#NUM!					150	#NUM!	#NUM!
160	#NUM!	#NUM!	#NUM!					160	#NUM!	#NUM!
170	#NUM!	#NUM!	#NUM!					170	#NUM!	#NUM!
180	#NUM!	#NUM!	#NUM!					180	#NUM!	#NUM!
190	#NUM!	#NUM!	#NUM!					190	#NUM!	#NUM!
200	#NUM!	#NUM!	#NUM!					200	#NUM!	#NUM!
210	#NUM!	#NUM!	#NUM!					210	#NUM!	#NUM!
220	#NUM!	#NUM!	#NUM!					220	#NUM!	#NUM!
230	#NUM!	#NUM!	#NUM!					230	#NUM!	#NUM!
240	#NUM!	#NUM!	#NUM!					240	#NUM!	#NUM!
250	#NUM!	#NUM!	#NUM!					250	#NUM!	#NUM!
260	#NUM!	#NUM!	#NUM!					260	#NUM!	#NUM!
270	#NUM!	#NUM!	#NUM!					270	#NUM!	#NUM!
280	#NUM!	#NUM!	#NUM!					280	#NUM!	#NUM!
290	47	#NUM!	#NUM!					290	#NUM!	#NUM!
300	115	#NUM!	#NUM!					300	#NUM!	#NUM!
310	155	#NUM!	#NUM!					310	#NUM!	#NUM!
320	187	#NUM!	#NUM!					320	#NUM!	#NUM!
330	213	#NUM!	#NUM!					330	#NUM!	#NUM!
340	236	#NUM!	#NUM!					340	#NUM!	#NUM!
350	256	#NUM!	#NUM!					350	#NUM!	#NUM!
360	275	#NUM!	#NUM!					360	#NUM!	#NUM!

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 10
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	83.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	3.0
PRESSURE, σ_3 (psf)	432.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.07
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.265	6.010	6.002
DIAMETER	7.087	2.790	2.786
AREA	39.44	6.11	6.09
VOLUME	602.11	36.74	36.58
WEIGHT (g)	1262.36		1294.66
% MOISTURE	13.2		16.05
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	130.8		
DRY DENSITY, calc (pcf)	115.6		
VOLUME OF SOLIDS	413.18		
VOLUME OF VOIDS	188.93		
VOID RATIO	0.457		
SATURATION	77.7		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	116.1
VOLUME OF SOLIDS	413.18
VOLUME OF VOIDS	186.23
VOID RATIO	0.451

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1294.66
WT SOIL & TARE, DRY (g)	1115.59
WT TARE (g)	0.00
WT MOISTURE (g)	179.07
WT DRY SOIL (g)	1115.59
% MOISTURE	16.05

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	15	79.9	0.0	0.00	1.00	6.09	6.002	0.0	432.0	432.0	432.0	1.00	432.0	0.0	0.00
0.5	0.003	30	80.7	115.2	0.05	1.00	6.10	5.999	354.3	786.3	671.1	316.8	2.12	493.9	177.1	0.33
1.0	0.006	38	81.0	158.4	0.10	1.00	6.10	5.996	542.9	974.9	816.5	273.6	2.98	545.1	271.5	0.29
1.5	0.009	43	81.2	187.2	0.15	1.00	6.10	5.993	660.6	1092.6	905.4	244.8	3.70	575.1	330.3	0.28
2.0	0.012	48	81.4	216.0	0.20	1.00	6.11	5.990	778.2	1210.2	994.2	216.0	4.60	605.1	389.1	0.28
2.5	0.015	50	81.5	230.4	0.25	1.00	6.11	5.987	824.9	1256.9	1026.5	201.6	5.09	614.1	412.5	0.28
4.2	0.025	60	81.5	230.4	0.42	1.00	6.12	5.977	1058.9	1490.9	1260.5	201.6	6.25	731.0	529.4	0.22
8.3	0.050	69	81.1	172.8	0.83	0.99	6.15	5.952	1265.3	1697.3	1524.5	259.2	5.88	891.9	632.7	0.14
12.5	0.075	72	80.7	115.2	1.25	0.99	6.17	5.927	1330.0	1762.0	1646.8	316.8	5.20	981.8	665.0	0.09
16.7	0.100	74	80.5	86.4	1.67	0.98	6.20	5.902	1370.9	1802.9	1716.5	345.6	4.97	1031.0	685.4	0.06
22.5	0.135	75	80.2	43.2	2.25	0.98	6.23	5.867	1385.8	1817.8	1774.6	388.8	4.56	1081.7	692.9	0.03
25.0	0.150	75	80.2	43.2	2.50	0.98	6.25	5.852	1382.3	1814.3	1771.1	388.8	4.56	1079.9	691.1	0.03
29.2	0.175	77	80.1	28.8	2.92	0.97	6.28	5.827	1422.3	1854.3	1825.5	403.2	4.53	1114.3	711.1	0.02
33.3	0.200	79	80.0	14.4	3.33	0.97	6.30	5.802	1461.8	1893.8	1879.4	417.6	4.50	1148.5	730.9	0.01
41.7	0.250	82	79.8	-14.4	4.17	0.96	6.36	5.752	1517.2	1949.2	1963.6	446.4	4.40	1205.0	758.6	-0.01
52.5	0.315	85	79.5	-57.6	5.25	0.95	6.43	5.687	1567.2	1999.2	2056.8	489.6	4.20	1273.2	783.6	-0.04
58.3	0.350	87	79.4	-72.0	5.83	0.94	6.47	5.652	1602.1	2034.1	2106.1	504.0	4.18	1305.0	801.0	-0.04
66.7	0.400	90	79.3	-86.4	6.66	0.93	6.53	5.602	1654.0	2086.0	2172.4	518.4	4.19	1345.4	827.0	-0.05
75.0	0.450	92	79.1	-115.2	7.50	0.93	6.59	5.552	1683.0	2115.0	2230.2	547.2	4.08	1388.7	841.5	-0.07
83.3	0.500	94	79.0	-129.6	8.33	0.92	6.65	5.502	1711.2	2143.2	2272.8	561.6	4.05	1417.2	855.6	-0.08
91.7	0.550	95	79.0	-129.6	9.16	0.91	6.71	5.452	1717.1	2149.1	2278.7	561.6	4.06	1420.1	858.5	-0.08
100.0	0.600	97	78.9	-144.0	10.00	0.90	6.77	5.402	1743.9	2175.9	2319.9	576.0	4.03	1447.9	871.9	-0.08
108.3	0.650	100	78.8	-158.4	10.83	0.89	6.83	5.352	1790.9	2222.9	2381.3	590.4	4.03	1485.9	895.5	-0.09
116.7	0.700	102	78.7	-172.8	11.66	0.88	6.90	5.302	1815.9	2247.9	2420.7	604.8	4.00	1512.8	908.0	-0.10
125.0	0.750	104	78.7	-172.8	12.50	0.88	6.96	5.252	1840.2	2272.2	2445.0	604.8	4.04	1524.9	920.1	-0.09
133.3	0.800	105	78.6	-187.2	13.33	0.87	7.03	5.202	1843.1	2275.1	2462.3	619.2	3.98	1540.8	921.6	-0.10
141.7	0.850	107	78.5	-201.6	14.16	0.86	7.10	5.152	1866.0	2298.0	2499.6	633.6	3.95	1566.6	933.0	-0.11
150.0	0.900	110	78.4	-216.0	15.00	0.85	7.17	5.102	1908.1	2340.1	2556.1	648.0	3.94	1602.1	954.1	-0.11
158.3	0.950	112	78.4	-216.0	15.83	0.84	7.24	5.052	1929.2	2361.2	2577.2	648.0	3.98	1612.6	964.6	-0.11
166.7	1.000	114	78.3	-230.4	16.66	0.83	7.31	5.002	1949.5	2381.5	2611.9	662.4	3.94	1637.1	974.7	-0.12

DU @ FAILURE	230.40	DEVIATORIC STRESS @ FAILURE	1058.86	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	6.25

TECH	PWM/SDM
DATE	8/2/04
CHECK	
REVIEW	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 10
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	86.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	6.0
PRESSURE, σ_3 (psf)	864.0
FINAL "B" VALUE	1.00
t_{50} (minutes)	0.52
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.235	5.998	5.983
DIAMETER	7.087	2.790	2.779
AREA	39.44	6.11	6.06
VOLUME	600.91	36.67	36.28
WEIGHT (g)	1262.55		1291.15
% MOISTURE	13.3		15.82
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	131.1		
DRY DENSITY, calc (pcf)	115.8		
VOLUME OF SOLIDS	412.89		
VOLUME OF VOIDS	188.01		
VOID RATIO	0.455		
SATURATION	78.6		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	117.0
VOLUME OF SOLIDS	412.89
VOLUME OF VOIDS	181.61
VOID RATIO	0.440

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1291.15
WT SOIL & TARE, DRY (g)	1114.81
WT TARE (g)	0.00
WT MOISTURE (g)	176.34
WT DRY SOIL (g)	1114.81
% MOISTURE	15.82

TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	17	80.5	0.0	0.00	1.00	6.06	5.983	0.0	864.0	864.0	864.0	1.00	864.0	0.0	0.00
0.5	0.003	43	82.1	230.4	0.05	1.00	6.07	5.980	617.1	1481.1	1250.7	633.6	1.97	942.2	308.6	0.37
1.0	0.006	52	82.5	288.0	0.10	1.00	6.07	5.977	830.3	1694.3	1406.3	576.0	2.44	991.2	415.2	0.35
1.5	0.009	62	83.0	360.0	0.15	1.00	6.07	5.974	1067.1	1931.1	1571.1	504.0	3.12	1037.5	533.5	0.34
2.0	0.012	68	83.2	388.8	0.20	1.00	6.08	5.971	1208.7	2072.7	1683.9	475.2	3.54	1079.6	604.4	0.32
2.5	0.015	72	83.3	403.2	0.25	1.00	6.08	5.968	1302.9	2166.9	1763.7	460.8	3.83	1112.2	651.4	0.31
4.2	0.025	82	83.4	417.6	0.42	1.00	6.09	5.958	1537.2	2401.2	1983.6	446.4	4.44	1215.0	768.6	0.27
8.3	0.050	100	82.7	316.8	0.84	0.99	6.11	5.933	1954.6	2818.6	2501.8	547.2	4.57	1524.5	977.3	0.16
12.5	0.075	107	82.1	230.4	1.25	0.99	6.14	5.908	2110.5	2974.5	2744.1	633.6	4.33	1688.9	1055.3	0.11
16.7	0.100	114	81.6	158.4	1.67	0.98	6.17	5.883	2265.1	3129.1	2970.7	705.6	4.21	1838.1	1132.5	0.07
20.8	0.125	117	81.2	100.8	2.09	0.98	6.19	5.858	2325.2	3189.2	3088.4	763.2	4.05	1925.8	1162.6	0.04
25.0	0.150	119	81.0	72.0	2.51	0.97	6.22	5.833	2361.6	3225.6	3153.6	792.0	3.98	1972.8	1180.8	0.03
29.2	0.175	122	80.7	28.8	2.92	0.97	6.25	5.808	2420.6	3284.6	3255.8	835.2	3.90	2045.5	1210.3	0.01
33.3	0.200	124	80.5	0.0	3.34	0.97	6.27	5.783	2456.1	3320.1	3320.1	864.0	3.84	2092.0	1228.0	0.00
41.7	0.250	129	80.3	-28.8	4.18	0.96	6.33	5.733	2548.6	3412.6	3441.4	892.8	3.85	2167.1	1274.3	-0.01
50.0	0.300	130	80.1	-57.6	5.01	0.95	6.38	5.683	2549.0	3413.0	3470.6	921.6	3.77	2196.1	1274.5	-0.02
58.3	0.350	134	79.9	-86.4	5.85	0.94	6.44	5.633	2616.0	3480.0	3566.4	950.4	3.75	2258.4	1308.0	-0.03
66.7	0.400	137	79.8	-100.8	6.69	0.93	6.50	5.583	2659.2	3523.2	3624.0	964.8	3.76	2294.4	1329.6	-0.04
75.0	0.450	140	79.6	-129.6	7.52	0.92	6.56	5.533	2701.3	3565.3	3694.9	993.6	3.72	2344.3	1350.7	-0.05
83.3	0.500	142	79.5	-144.0	8.36	0.92	6.62	5.483	2720.4	3584.4	3728.4	1008.0	3.70	2368.2	1360.2	-0.05
91.7	0.550	145	79.4	-158.4	9.19	0.91	6.68	5.433	2760.3	3624.3	3782.7	1022.4	3.70	2402.6	1380.2	-0.06
100.0	0.600	148	79.3	-172.8	10.03	0.90	6.74	5.383	2799.0	3663.0	3835.8	1036.8	3.70	2436.3	1399.5	-0.06
110.0	0.660	150	79.1	-201.6	11.03	0.89	6.82	5.323	2810.1	3674.1	3875.7	1065.6	3.64	2470.6	1405.0	-0.07
116.7	0.700	155	79.0	-216.0	11.70	0.88	6.87	5.283	2893.8	3757.8	3973.8	1080.0	3.68	2526.9	1446.9	-0.07
125.0	0.750	157	78.9	-230.4	12.54	0.87	6.93	5.233	2907.9	3771.9	4002.3	1094.4	3.66	2548.4	1454.0	-0.08
133.3	0.800	160	78.8	-244.8	13.37	0.87	7.00	5.183	2941.9	3805.9	4050.7	1108.8	3.65	2579.7	1470.9	-0.08
141.7	0.850	162	78.7	-259.2	14.21	0.86	7.07	5.133	2954.3	3818.3	4077.5	1123.2	3.63	2600.3	1477.1	-0.09
150.0	0.900	165	78.6	-273.6	15.04	0.85	7.14	5.083	2986.0	3850.0	4123.6	1137.6	3.62	2630.6	1493.0	-0.09
158.3	0.950	167	78.5	-288.0	15.88	0.84	7.21	5.033	2996.6	3860.6	4148.6	1152.0	3.60	2650.3	1498.3	-0.10
166.7	1.000	169	78.4	-302.4	16.71	0.83	7.28	4.983	3006.4	3870.4	4172.8	1166.4	3.58	2669.6	1503.2	-0.10

DU @ FAILURE	316.8	DEVIATORIC STRESS @ FAILURE	1954.6	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.57

TECH	PWM/SDM
DATE	8/2/2004
CHECKED	
REVIEWED	

TRIAXIAL COMPRESSION TEST (ASTM D 4767) CONSOLIDATED UNDRAINED WITH PORE PRESSURE

PROJECT TITLE	ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER	043-2246-0001
SAMPLE ID	PF - 10
SAMPLE TYPE	Bulk
DEPTH INTERVAL	-
MACHINE SPEED (in/min)	0.006
STRAIN RATE (%/min)	0.10
CELL PRESSURE (psi)	89.0
SAMPLE PRESSURE (psi)	80.0
EFF. CONSOLIDATION PRESSURE, σ_3 (psi)	9.0
PRESSURE, σ_3 (psf)	1296.0
FINAL "B" VALUE	0.99
t_{50} (minutes)	0.34
Mounting Method	Wet

INITIAL SAMPLE DATA	cm	in	corrected
HEIGHT	15.253	6.005	5.988
DIAMETER	7.087	2.790	2.780
AREA	39.44	6.11	6.07
VOLUME	601.61	36.71	36.35
WEIGHT (g)	1262.28		1291.28
% MOISTURE	13.0		15.58
SPECIFIC GRAVITY	2.70		
MOIST DENSITY (pcf)	130.9		
DRY DENSITY, calc (pcf)	115.9		
VOLUME OF SOLIDS	413.79		
VOLUME OF VOIDS	187.81		
VOID RATIO	0.454		
SATURATION	77.2		

CORRECTED SAMPLE DATA	
DRY DENSITY, calc (pcf)	117.1
VOLUME OF SOLIDS	413.79
VOLUME OF VOIDS	181.81
VOID RATIO	0.439

WATER CONTENT (% MOISTURE)	
WT SOIL & TARE, MOIST (g)	1291.28
WT SOIL & TARE, DRY (g)	1117.24
WT TARE (g)	0.00
WT MOISTURE (g)	174.04
WT DRY SOIL (g)	1117.24
% MOISTURE	15.58

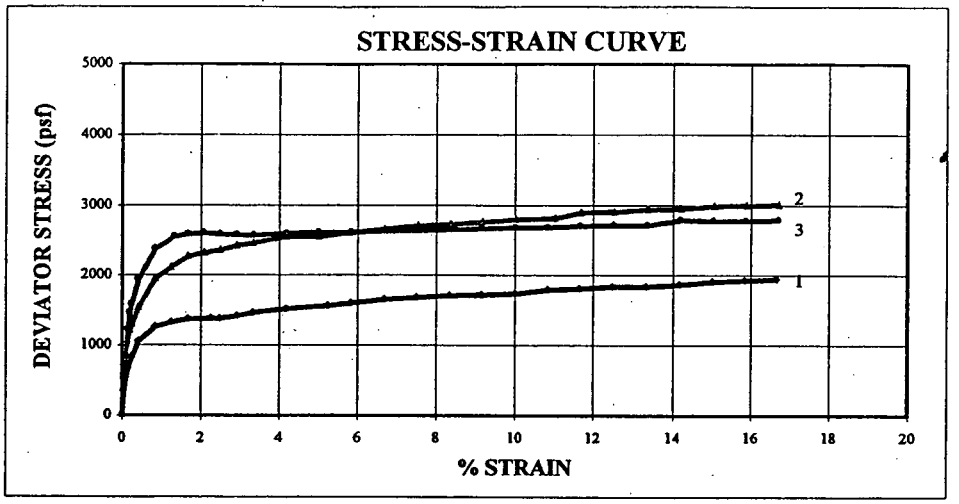
TIME (MIN)	ACCUM. DEFLECT. (inches)	AXIAL LOAD (lbs)	PORE PRESS. (psi)=U	PWP change DU (psf) (acc)	ε % STRAIN (%)	(1-ε)	CORR. AREA (in 2)	CORR. HEIGHT (in)	DEV. STRESS (psf)	SIGMA 1 devstr+cp (σ_1)	SIGMA 1 EFF. (σ_1-dU)	SIGMA 3 EFF. (σ_3-dU)	EFF.PRN STR RATIO (σ_1'/σ_3')	$\frac{(\sigma_1'+\sigma_3')}{2}$ (P)	$\frac{(\sigma_1-\sigma_3)}{2}$ (Q)	(A)
0.0	0.000	18	80.5	0.0	0.00	1.00	6.07	5.988	0.0	1296.0	1296.0	1296.0	1.00	1296.0	0.0	0
0.5	0.003	40	82.1	230.4	0.05	1.00	6.07	5.985	521.7	1817.7	1587.3	1065.6	1.49	1326.4	260.8	0.44
1.0	0.006	53	82.9	345.6	0.10	1.00	6.08	5.982	829.5	2125.5	1779.9	950.4	1.87	1365.2	414.8	0.42
1.5	0.009	70	83.7	460.8	0.15	1.00	6.08	5.979	1231.8	2527.8	2067.0	835.2	2.47	1451.1	615.9	0.37
2.0	0.012	80	84.3	547.2	0.20	1.00	6.08	5.976	1467.9	2763.9	2216.7	748.8	2.96	1482.8	734.0	0.37
2.5	0.015	85	84.6	590.4	0.25	1.00	6.09	5.973	1585.5	2881.5	2291.1	705.6	3.25	1498.4	792.8	0.37
4.2	0.025	100	85.0	648.0	0.42	1.00	6.10	5.963	1937.2	3233.2	2585.2	648.0	3.99	1616.6	968.6	0.33
8.3	0.050	119	84.5	576.0	0.84	0.99	6.12	5.938	2376.1	3672.1	3096.1	720.0	4.30	1908.1	1188.1	0.24
13.3	0.080	127	83.8	475.2	1.34	0.99	6.15	5.908	2551.4	3847.4	3372.2	820.8	4.11	2096.5	1275.7	0.19
16.7	0.100	129	83.6	446.4	1.67	0.98	6.17	5.888	2589.4	3885.4	3439.0	849.6	4.05	2144.3	1294.7	0.17
20.8	0.125	130	83.4	417.6	2.09	0.98	6.20	5.863	2601.6	3897.6	3480.0	878.4	3.96	2179.2	1300.8	0.16
25.0	0.150	130	83.3	403.2	2.51	0.97	6.23	5.838	2590.5	3886.5	3483.3	892.8	3.90	2188.1	1295.3	0.16
29.2	0.175	130	83.2	388.8	2.92	0.97	6.25	5.813	2579.4	3875.4	3486.6	907.2	3.84	2196.9	1289.7	0.15
33.3	0.200	130	83.1	374.4	3.34	0.97	6.28	5.788	2568.3	3864.3	3489.9	921.6	3.79	2205.8	1284.2	0.15
41.7	0.250	132	83.1	374.4	4.18	0.96	6.33	5.738	2591.6	3887.6	3513.2	921.6	3.81	2217.4	1295.8	0.14
50.0	0.300	134	83.0	360.0	5.01	0.95	6.39	5.688	2614.1	3910.1	3550.1	936.0	3.79	2243.0	1307.0	0.14
58.3	0.350	135	83.0	360.0	5.85	0.94	6.45	5.638	2613.5	3909.5	3549.5	936.0	3.79	2242.7	1306.7	0.14
66.7	0.400	137	82.9	345.6	6.68	0.93	6.50	5.588	2634.6	3930.6	3585.0	950.4	3.77	2267.7	1317.3	0.13
79.2	0.475	139	82.8	331.2	7.93	0.92	6.59	5.513	2642.9	3938.9	3607.7	964.8	3.74	2286.2	1321.4	0.13
83.3	0.500	140	82.8	331.2	8.35	0.92	6.62	5.488	2652.6	3948.6	3617.4	964.8	3.75	2291.1	1326.3	0.12
91.7	0.550	142	82.7	316.8	9.19	0.91	6.68	5.438	2671.6	3967.6	3650.8	979.2	3.73	2315.0	1335.8	0.12
100.0	0.600	144	82.6	302.4	10.02	0.90	6.75	5.388	2689.7	3985.7	3683.3	993.6	3.71	2338.4	1344.8	0.11
108.3	0.650	145	82.6	302.4	10.86	0.89	6.81	5.338	2685.9	3981.9	3679.5	993.6	3.70	2336.5	1342.9	0.11
116.7	0.700	147	82.6	302.4	11.69	0.88	6.87	5.288	2702.6	3998.6	3696.2	993.6	3.72	2344.9	1351.3	0.11
125.0	0.750	149	82.5	288.0	12.53	0.87	6.94	5.238	2718.6	4014.6	3726.6	1008.0	3.70	2367.3	1359.3	0.11
133.3	0.800	150	82.5	288.0	13.36	0.87	7.01	5.188	2713.2	4009.2	3721.2	1008.0	3.69	2364.6	1356.6	0.11
141.7	0.850	155	82.4	273.6	14.20	0.86	7.07	5.138	2788.8	4084.8	3811.2	1022.4	3.73	2416.8	1394.4	0.10
150.0	0.900	156	82.4	273.6	15.03	0.85	7.14	5.088	2781.8	4077.8	3804.2	1022.4	3.72	2413.3	1390.9	0.10
158.3	0.950	157	82.4	273.6	15.87	0.84	7.21	5.038	2774.5	4070.5	3796.9	1022.4	3.71	2409.6	1387.2	0.10
166.7	1.000	159	82.3	259.2	16.70	0.83	7.29	4.988	2786.4	4082.4	3823.2	1036.8	3.69	2430.0	1393.2	0.09

DU @ FAILURE	576.0	DEVIATORIC STRESS @ FAILURE	2376.1	EFFECTIVE PRINCIPLE STRESS RATIO @ FAILURE	4.30

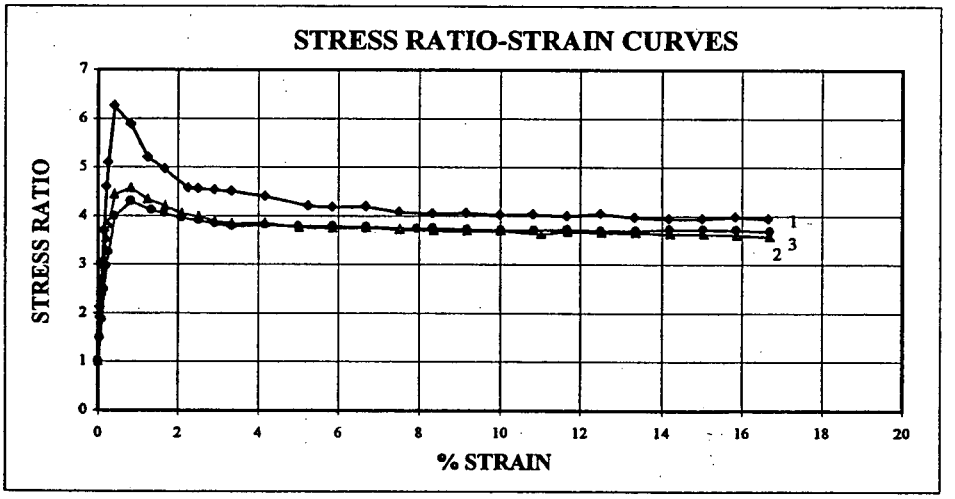
TECH	PWM/SDM
DATE	8/2/2004
CHECK	
REVIEW	

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

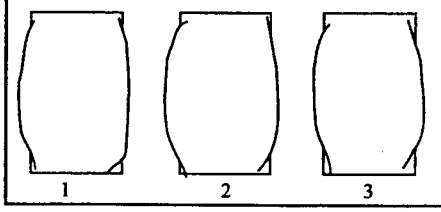
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 10 DEPTH: - Sample Type: Bulk

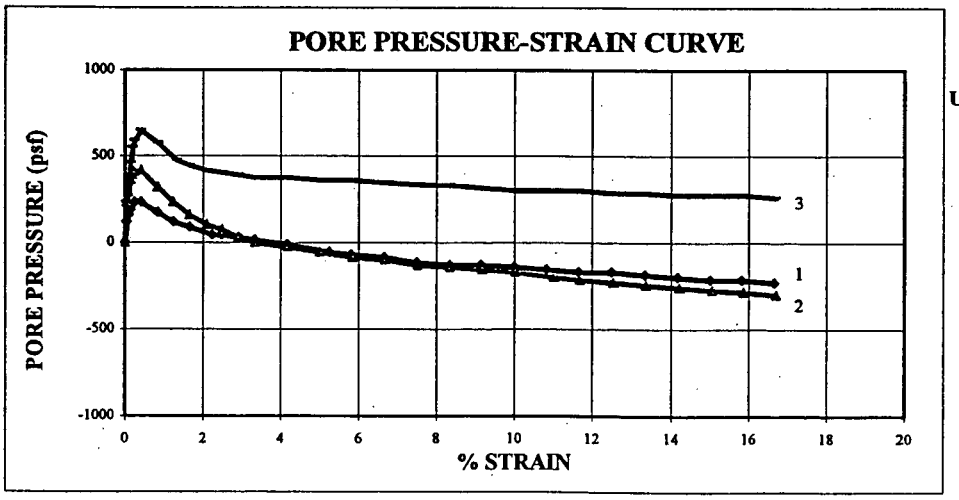


Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	115.6	13.2
2	864	115.8	13.3
3	1296	115.9	13.0
	Average	**115.8**	**13.1**



FAILURE SKETCH





Soil Description

Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments

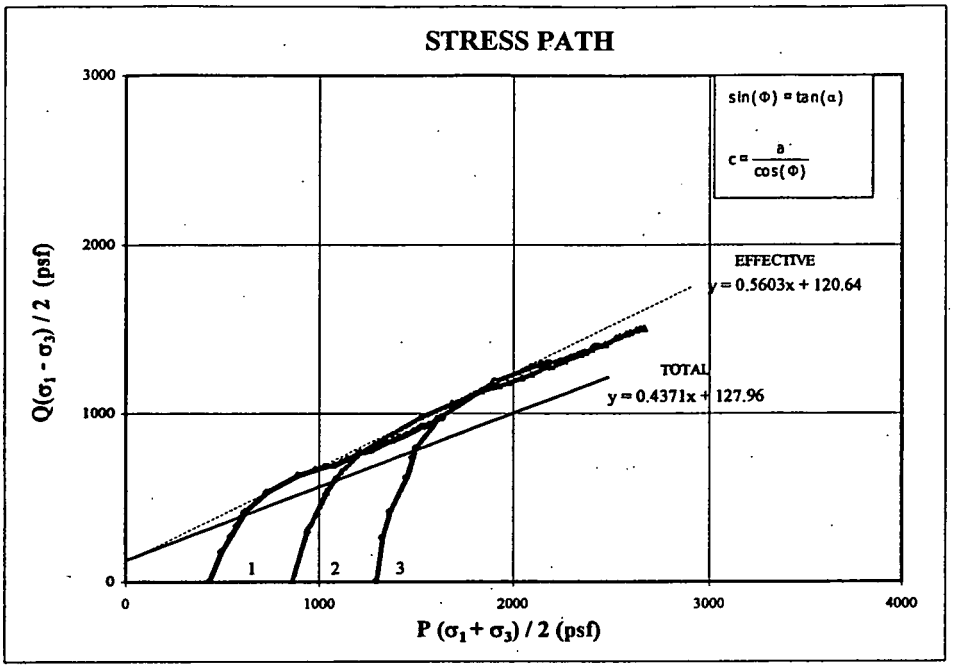
Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

* Failure based on effective stress ratio or 15% strain.

CHECK
REVIEW

TRIAXIAL COMPRESSION TEST - CONSOLIDATED UNDRAINED WITH PORE PRESSURE
ASTM D 4767

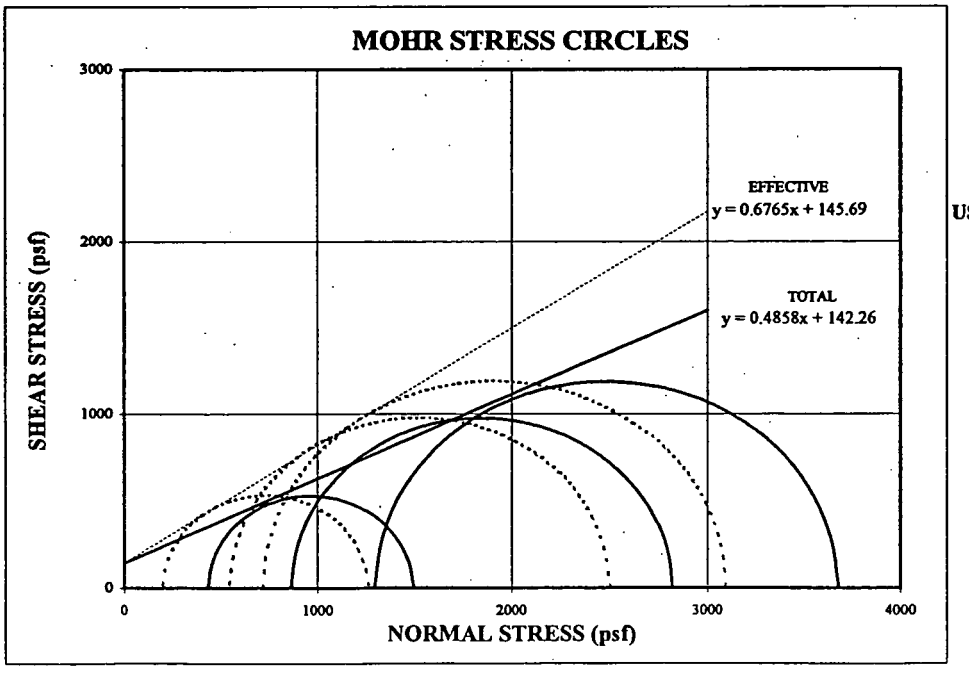
PROJECT NAME: ROCKY FLATS/FIELD AND LAB TESTING/CO
PROJECT NUMBER: 043-2246-0001
SAMPLE ID: PF - 10 DEPTH: - Sample Type: Bulk



Specimen	Effective Confining Pressure (psf)	Initial Dry Density (pcf)	Initial Moisture Content (%)
1	432	115.6	13.2
2	864	115.8	13.3
3	1296	115.9	13.0

Specimen	Strain Rate (%)	Initial Saturation (%)	Saturation Before Shearing (%)
1	0.10	77.7	96.2
2	0.10	78.6	97.1
3	0.10	77.2	95.7

STRESS PATH			MOHR CIRCLES		
*TOTAL STRESS PARAMETER			*TOTAL STRENGTH PARAMETER		
α	=	23.6 °	ϕ	=	25.9 °
a	=	128.0 psf	c	=	142.3 psf
* EFFECTIVE STRESS PARAMETER			*EFFECTIVE STRENGTH PARAMETER		
α'	=	29.3 °	ϕ'	=	34.1 °
a'	=	120.7 psf	c'	=	145.7 psf



Soil Description
Brown, COARSE TO FINE SAND, some fine gravel, some silty clay.

USCS (SC)

LL	PL	PI
-	-	-

Comments
Sample was remolded to approx. 95% of the Max. Dry Density, @ Opt. Moisture Content +2%.

*** Failure based on effective stress ratio or 15% strain.**

CHECK
REVIEW

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 7/30/04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 21
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No. 20

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Site Plan – Temporary Construction Facilities	N/A	4	01500 Temporary Construction Facilities	N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

Remarks: APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert K. Davis DATE: 07/31/04

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Paul Kreitz 7/30/04

Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

Construction of the Present Landfill Accelerated Action
Rocky Flats Environmental Technology Site
Contract No. KH020577

Site Plan
Temporary Construction Facilities
July 28, 2004

Submitted to:
Kaiser-Hill Company, LLC
Rocky Flats Environmental Technology Site
10808 Highway 93, Unit B
Golden, CO 80403-8200

Submitted by:
The S.M. Stoller Corporation
990 S. Public Road, Suite A
Lafayette, CO 80026

Approvals:

Kaiser-Hill, LLC Landfill Cap Project Manager Date

Paul Kay 7/30/04

Stoller Landfill Cap Project Manager Date

Table of Contents

1.0 Introduction 4
2.0 Site Description 4
3.0 General Requirements 5
4.0 Availability and Use of Utility Services 5
5.0 Bulletin Board and Project Sign 6
6.0 Protection and Maintenance of Traffic 6
7.0 Contractor/Subcontractor's Temporary Facilities 7
8.0 Cleanup 8
9.0 Restoration of Storage Area 8
10.0 References 9

List of Figures

Figure 1.0 Site Layout and Truck Haul Route
Figure 2.0 Site Layout and Scraper Haul Route
Figure 3.0 Laydown Yards Detail Layout

Appendices

Appendix A Specification Section – 01500 Temporary Construction Facilities

Acronyms

KH	Kaiser Hill, LLC
mph	Miles per hour
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site

1.0 Introduction

Rocky Flats Environmental Technology Site (RFETS) is located on a 6,550-acre site, approximately 16 miles northwest of Denver, Colorado, in northern Jefferson County. With suspension of weapons production operations at RFETS in 1989, and subsequent discontinuation of the Site's nuclear weapons production mission in 1991, activities at RFETS have been re-directed to support Site cleanup and closure.

As part of the Site cleanup and closure, the interim cover to the Present Landfill is to be replaced with an engineered landfill cap. In accordance with Specification No 01500 – Temporary Construction Facilities, a Site Plan is to be generated which indicates the proposed location and dimension of any areas to be graveled and used by the Subcontractor. Elements of the Site Plan include the number of trailers to be used, avenues of ingress/egress, details of the fence installation, graveled employee parking areas to prevent the tracking of mud, the use of supplemental or other staging areas and operational (power, trash, portable restroom) logistics. Details of each of the elements are described in the following narrative.

This Site Plan presents the requirements detailed in Specification Section 01500 – Temporary Construction Facilities, a copy of which is presented in Appendix A.

2.0 Site Description

The Present Landfill is located immediately due north of the Industrial Area of RFETS. The landfill area encompasses approximately 22.1 acres and the project area, including the Subcontractor Staging Area will encompass a total of approximately 30 acres.

The landfill was placed into service in August 1968 for the disposal of uncontaminated solid wastes, including office trash, paper, rags, personal protective equipment, construction and demolition debris, scrap metal, empty waste containers, used filters, and electrical components. The Present Landfill remained in operation until March 1998, at which time a soil cover was placed and seeded to stabilize soils pending final closure with an engineered cap or cover. The landfill is a Resource Conservation and Recovery Act (RCRA) interim status unit that must be closed with the installation of a Subtitle C type cover.

3.0 General Requirements

Subcontractor laydown yards will be located at the western end of the project area at two locations. The southeast laydown yard will be closest to the work area and will have a lunch trailer/meeting room, office trailer, three restrooms, one hand wash station, one generator, and a household trash dumpster. The second, westernmost laydown yard, here-in-after referred to as the field office trailer yard, will have three office trailers, two restrooms, one hand wash station, two generators and a household trash dumpster. Visitor sign-in/sign-out sheets, access control points, health and safety briefings and project administration will occur at the field office trailer area.

Both laydown yards will be graveled and will provide for employee parking.

A temporary fuel depot center will be erected to the south of the field office trailer yard. The fuel depot will be bermed with an impervious, one-piece liner placed within the bermed area.

A vehicle clean-up area to control mud from dirt surfaces to paved surfaces will be located next to the fuel depot center. Hand tools to remove excess mud from vehicle tires and vehicle wheel wells will be provided.

Liner material for the landfill cover will be staged at three different areas around the perimeter of the Present Landfill. The liner staging areas will be located on the southwest, northwest, and north sides of the landfill. Each of the staging areas will be graveled. The liner material will not be allowed to rest directly on the ground surface but will be supported entirely on pallets or similar material that will keep the rolls of liner off of the ground.

Figure 1.0 presents the locations of the laydown yards, haul roads, proposed roadway signage, weigh station and security check location, and liner material staging areas.

4.0 Availability and Use of Utility Services

Electricity from RFETS will not be provided. Contractor project specifications require that self-contained generators be brought on-site to provide sufficient power for heating, air conditioning, lights, instrument calibration, etc. Two generators will be located at the field office trailer area and one generator will be located at the laydown yard area.

A temporary fuel depot center will be erected to the south of the field office trailer area. The fuel depot will be bermed with an impervious, one-piece liner placed within the bermed area. Each of the self-contained generators at the staging areas will be placed within shallow pans that will provide for secondary containment.

Site sanitation will be through the use of portable toilets. Sufficient individual portable toilets will be provided for each gender at both the field office trailer yard and the second laydown yard. The portable toilets will be serviced on a regular or as needed basis.

Hand-wash stations will be located outside each group of portable toilets and will provide fresh water, disinfecting soap, and paper towels. The hand-wash stations will be foot pump operated and rinse water will be retained within the hand-wash station.

Telephone service will not be provided by RFETS. Wireless cell telephones will be used for all communication, email, and faxes. Radios will be provided by RFETS that will allow for emergency communication with RFETS personnel and for receiving of emergency notices.

5.0 Bulletin Board and Project Sign

A glass-covered bulletin board will be constructed and posted adjacent to the lunch room trailer. The bulletin board will measure not less than 36-inches by 48-inches in size for displaying Equal Employment Opportunity poster, wage decision documents, and other information provided by Kaiser Hill, LLC (KH). Upon completion of the Present Landfill project, Stoller will remove the bulletin board.

A project sign will be erected within 15 days of notice to proceed. The sign will be located adjacent to the field office trailers and will provide for safety signage. The project sign will be of similar size to the bulletin board. Upon completion of the Present Landfill project, Stoller will remove the project sign.

6.0 Protection and Maintenance of Traffic

The Centennial Pit, the primary source for native material for the landfill cover, is located approximately two miles southwest of the Present Landfill. The haul roads will be posted with speed limit signs and appropriate traffic warning signs at all intersections with general public roads. The maximum speed limit will be 25 miles per hour (mph) at all times with slower speeds at posted locations. Haul

road routes to and from the Centennial Pit have been identified and are presented on Figure 1.0. Due to the narrow nature of the existing roads, truck traffic flow direction to and from the pit has been segregated to the extent possible to allow for increased safety. Road upgrades will be made to safely accommodate anticipated traffic.

A secondary source for aggregate material will be a stockpile of Rocky Flats Alluvium identified on Figure 1.0. This material will be transported to the Landfill using scrapers. The haul route for these is shown on Figure 2.0. Issues associated with using scrapers to haul this material include wear and tear on the roads and access to the alluvium stockpile. The asphalt section of the road will require special attention to allow scraper travel. The asphalt will be destroyed unless preventative measures are taken prior to scraper travel. A motor grader will constantly maintain the dirt roads during scraper use. Required access to the alluvium stockpile will be determined well in advance of when scrapers are to be used.

An environmentally-friendly dust suppression agent (water or chemical) will be applied to the road surface to minimize the generation of dust. Sufficient lighting through the use of mobile light-plants will be provided on an as-needed basis should work continue past dusk.

A weigh station/security check station will be erected at the western property line of RFETS to record the weights for each truck leaving the Centennial Pit destined for the Landfill. Haul trucks will be individually weighed and recorded as to the date and time of entry. RFETS badges will be checked prior to entry into the property.

Upon completion of the project, the haul roads will be restored and revegetated to the extent necessary to return them to their pre-improvement condition. The weigh station/security check station will be removed and property boundary fencing will be replaced.

7.0 Contractor/Subcontractor's Temporary Facilities

The laydown yard and the field office trailer yard will be graded level, well-drained, compacted with a gravel surface. An area of 100 feet by 100 feet will be set-aside for each trailer at each yard. Figure 3.0 presents a detail plan view of the laydown yard and office trailer yard showing the proposed location and orientation of the office trailers, generators, fuel depot, graveled parking lot and restrooms/hand-wash stations.

Trailers will be neat in exterior appearance with stairs and handrails to allow ingress and egress. Each trailer will be tied down through the use of cement

jersey barriers. If trailer skirting is not installed around each trailer, then the undersides of each trailer will be inspected weekly for debris, trash, etc. Lightning protection will be installed on each trailer and appropriately sized fire extinguishers installed within each trailer.

Temporary self-contained generators will provide power to each of the two yards. The generators will be placed in a shallow pan for secondary containment.

Access control fencing will be erected between the field operations trailer yard and the lunch trailer/laydown yard. Personnel visiting and entering the project area will need to sign-in at the field operations trailer yard and receive a daily safety briefing before passing through the control fencing and into the landfill project area.

8.0 Cleanup

Construction debris, packaging material and waste materials will be placed in the dumpsters or removed on a daily basis. Any dirt or mud that is not removed at the Clean-up Facility and is tracked onto paved surfaces will be cleaned away daily. All salvaged or stored material will be neatly stacked when stored.

9.0 Restoration of Storage Area

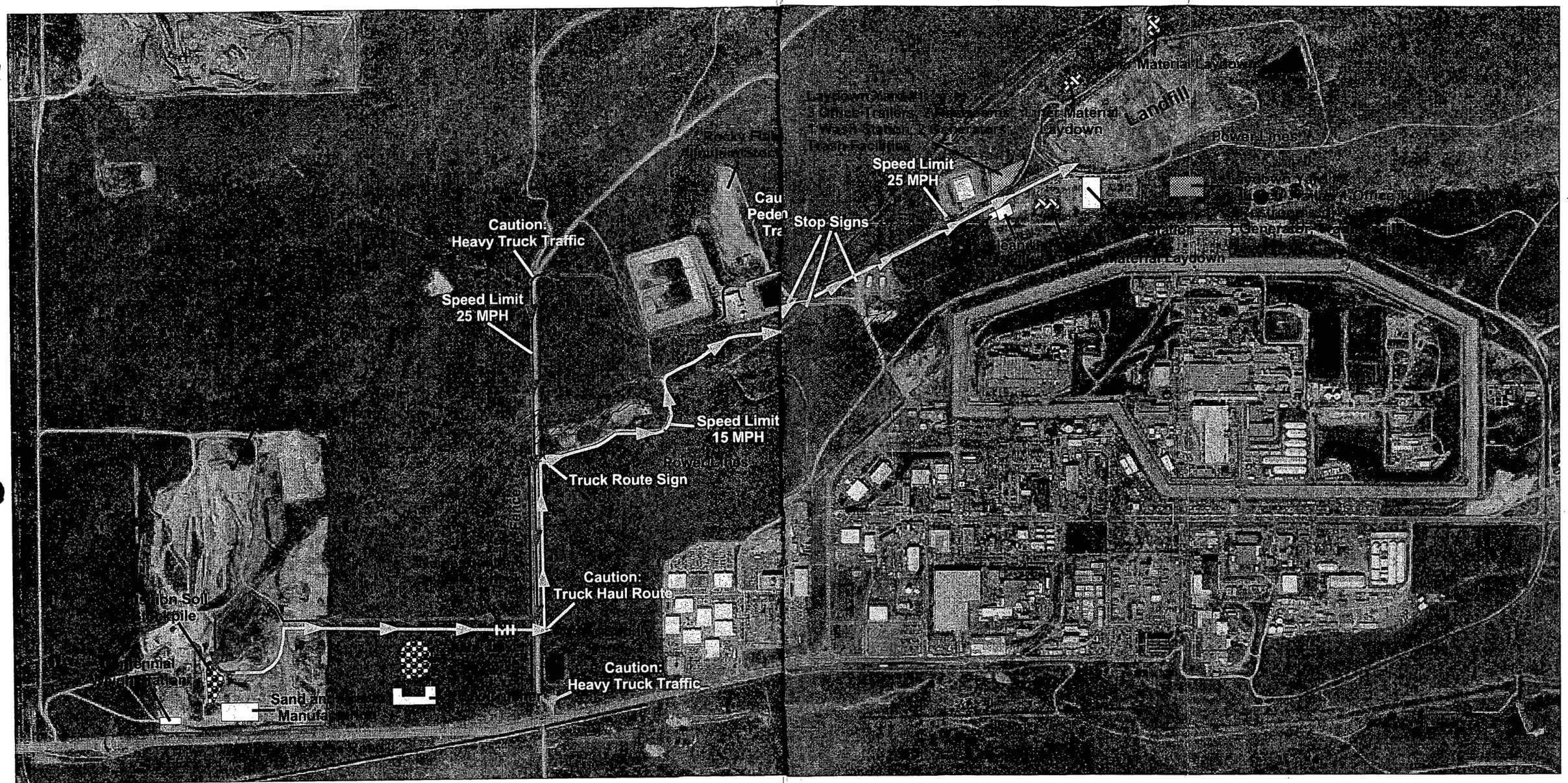
Upon completion of the project, demobilization of equipment will commence. Heavy equipment, trailers, generators, dumpsters, and portable toilets/hand-wash stations will be removed. Gravel used at the storage yards will be either scraped up and removed or tilled into the native soil, and the berms created for the fuel depot will be knocked down and regraded. The staging yards and haul roads will be regraded and all disturbed areas will be revegetated.

10.0 References

Kaiser Hill, 2004. *Accelerated Action Design for the Present Landfill, Rocky Flats Environmental Technology Site, 95% Design Submittal, Revision 1, Construction Quality Assurance/Quality Control Plan*. March

Kaiser Hill, 2004. *Accelerated Action Design for the Present Landfill, Rocky Flats Environmental Technology Site, 95% Design Submittal, Revision 1, RFP*. March

Kaiser Hill, 2004. *Accelerated Action Design for the Present Landfill, Rocky Flats Environmental Technology Site, 95% Design Submittal, Revision 1, Specifications*. March



Present Landfill
Accelerated Action

N

Explanation:

- Path to the Landfill
- Path from the Landfill
- Power Lines
- Preble's Protection Area

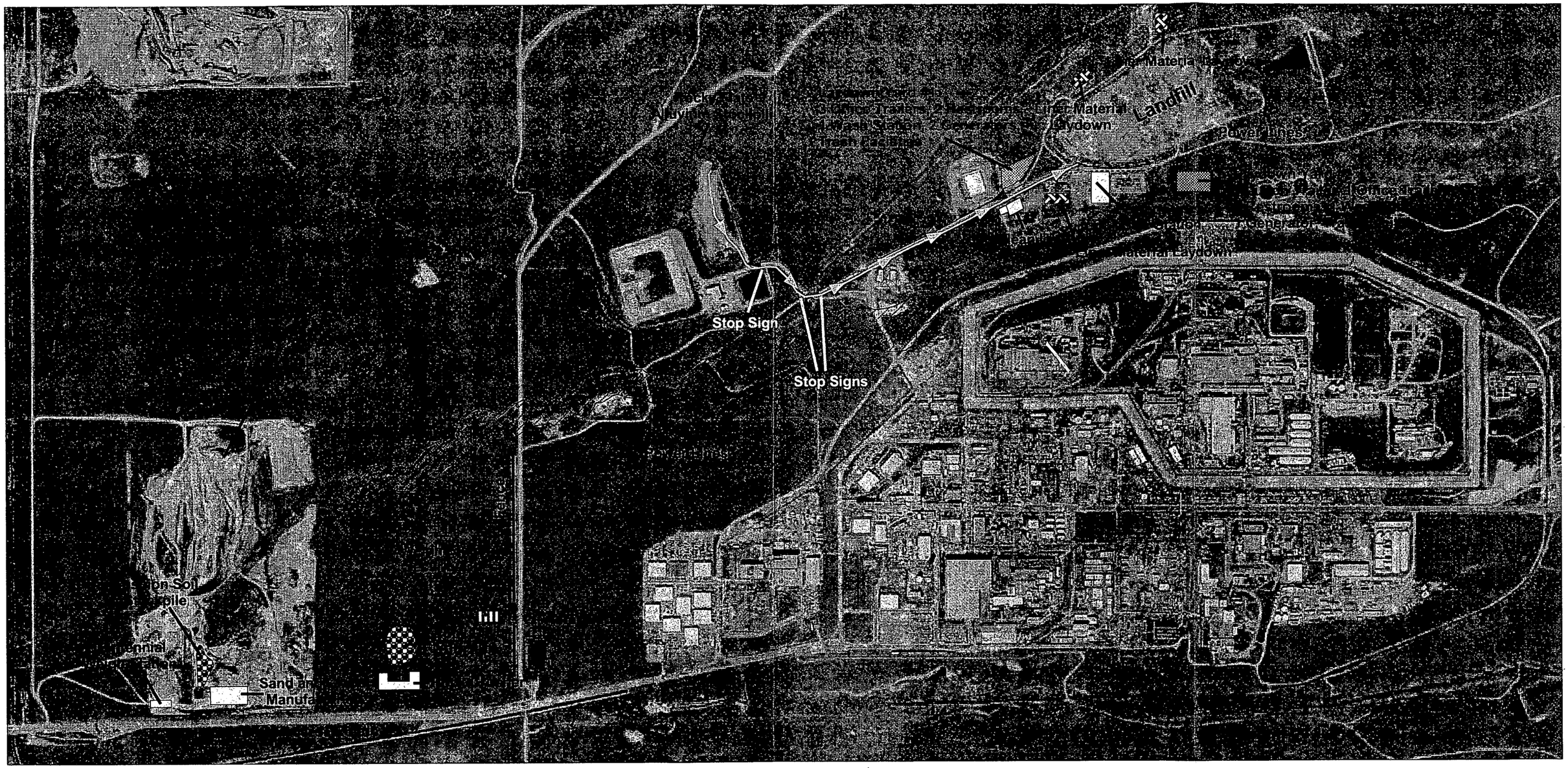
Scale:
500 0 500 Feet

ack-and-white satellite photo obtained from
p://www.terraserver.com

Figure 1.0

Proposed Landfill Aggregate
Haul Road

Stoller



Present Landfill
Accelerated Action

N

Explanation:

- Traffic Control Signs
- Path to the Landfill
- Path from the Landfill
- Power Lines
- Preble's Protection Area

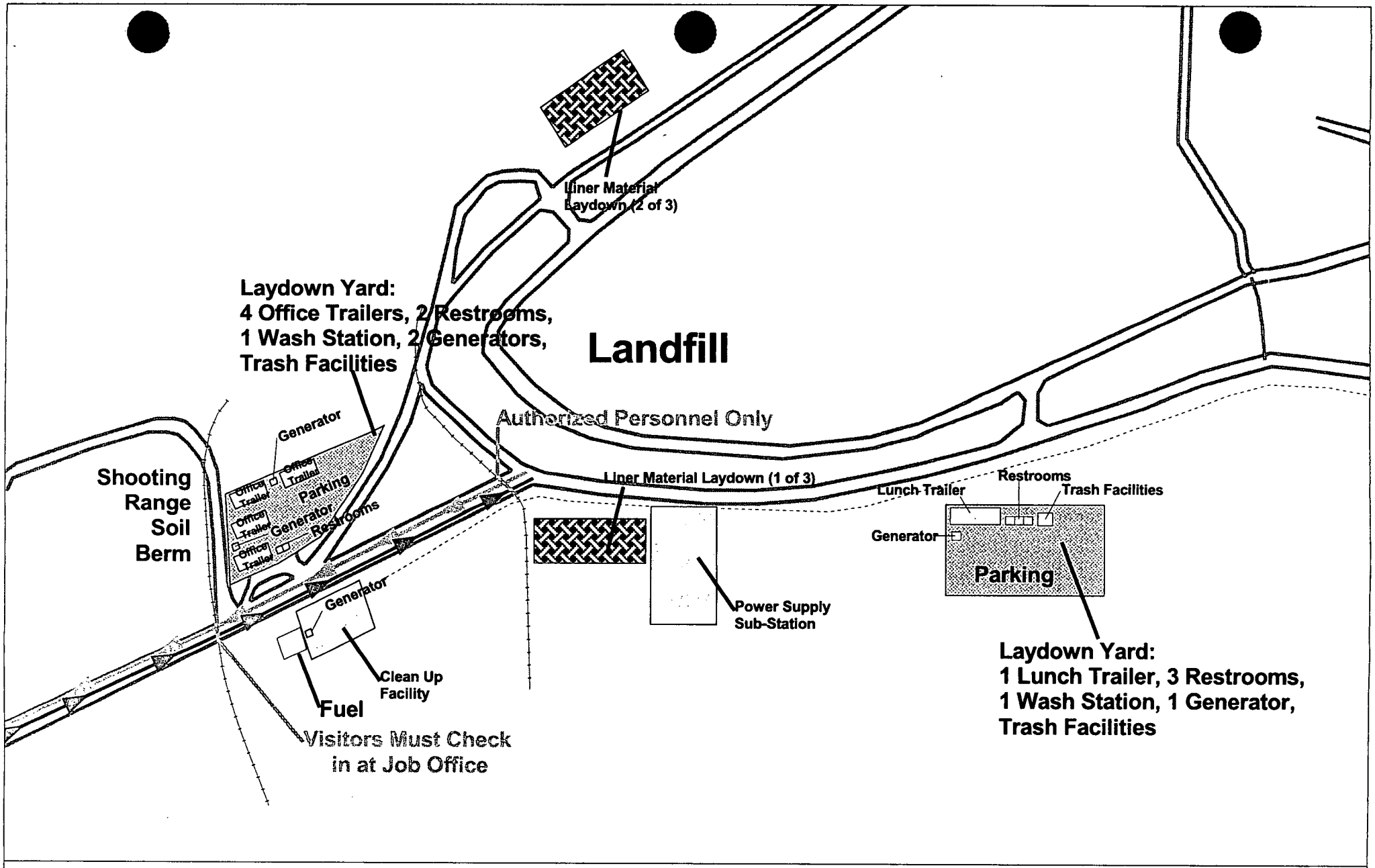
Scale:
500 0 500 Feet

Black-and-white satellite photo obtained from
http://www.terraserver.com

Figure 2.0

Site Layout
and Scraper
Haul Route

Stoller



Present Landfill
Accelerated Action

N

Explanation:

- Access Control Fence
- Traffic Control Signs
- Path to the Landfill
- Path from the Landfill
- Power Lines
- Buildings and Facilities

Scale:

500 0 500 Feet

Figure 3.0

Laydown Area Detail

Stoller

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 8/31/04	XX	New Submittal
			Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. ~~026~~ 027 Rev
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Bentonite specifications for Landfill gas vent well abandonment	N/A	4	Division 2 Specifications 01110-2, paragraph 4a	N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert Davis DATE: 09/17/2004

Remarks:

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted. Paul Kreitz, 8/31/04

Signature of Subcontractor:

Section II — **Reviewed**

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

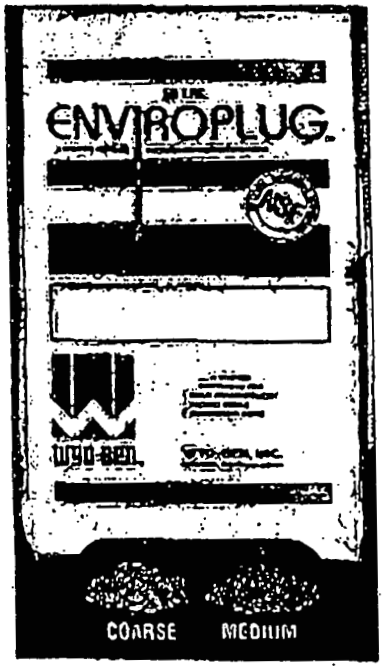
OK CQA J.H. Rale Tetra Tech

ENVIROPLUG®

NSF®

a wyoming bentonite for water and mineral exploration

MEDIUM & COARSE



PURE WYOMING BENTONITE CHIPS

SPECIAL NOTATION: Though current techniques appear simple, the importance of properly placed seals cannot be overstated. These products should be applied by ***GROUNDWATER PROFESSIONALS ONLY.*** A poorly sealed hole is a worse condition than no seal at all!!!

- **HOLE ABANDONMENT**
- **CASING SEALS**
- **GROUNDING RODS**
- **HEAT PUMP CONDUCTOR HOLES**
- **FLOWING HOLES**

Gives high concentration of solids for hole abandonment and casing seals.

More effective seal than cement.

When contacted by water, forms a flexible semi-solid gel-like mass.

Falls through standing water.

More expansion fills into formation voids limiting water movement.

Prevents surface water from migrating downward.

Copyright © 1999

WYO-BEN, INC. ◇ P. O. Box 1979 ◇ Billings, Montana 59103 ◇ 800-548-7055 ◇ 406-652-6351

AUG-31-2004 10:27 FROM:ENVIRONMENTAL MANUFAT 785 539 1349 TO:303 980 6157 P.1/8

ENVIROPLUG® MEDIUM and COARSE were the FIRST bentonite chips developed and marketed. They are pure Wyoming bentonite designed for use as sealants for hole abandonment, casing seals or any vertical seal to prevent water movement up or down a bore hole. When absorbing water, ENVIROPLUG® MEDIUM and COARSE swell to fill voids, exerting pressure against all surfaces to create a flexible low permeability seal. In most conditions a seal capable of stopping fluid migration is established within 1 hour. Since ENVIROPLUG® is introduced in a "dry" state, shrinkage cannot occur and there is a reserve expansion capacity.

HOLE ABANDONMENT AND APPLICATION GUIDELINES

ENVIROPLUG® COARSE has been used for abandoning drill holes since 1983. It easily falls through standing water and thin drilling fluids filling the column from the bottom upward. A fall rate of 1 foot/second can be expected. It has been successfully applied through water to depths of over 1600 feet.

Always know the hole you are going to abandon. Gather as much information as possible: Depth? Diameter? Formations intersected? Water producing zones? Casing? Before starting, verify the depth!! Using a bob or other weight, confirm the depth and calculate the volumes needed. Periodically during the sealing process, measure the advancement up the hole. Compare with calculated volumes. Consult local regulations before beginning any abandonment procedure.

CASED HOLES OR UNCASED HOLES: For decommissioning cased or uncased holes larger than 3" diameter, use ENVIROPLUG® COARSE. If static water is present, pour chips from the bag at a rate of 1½ to 2 minutes per 50 pounds. A funneling device with a 2" opening can be used to insure a constant flow of material into the hole. Should the water level be quite low a screen can be used to drop out "fines" from the material before entering the hole.

Holes less than 3" in diameter use ENVIROPLUG® MEDIUM. The technique is the same but a funnel with a 1" to 1½" opening is recommended to regulate the flow. Holes with less than a 1" diameter should be plugged with a pumpable material such as ENVIROPLUG® GROUT or GROUT-WELL DF.

"STAGING" ENVIROPLUG®: Some regulatory agencies allow for staging of plugs throughout the bore hole. This can be done by alternating sections of ENVIROPLUG® MEDIUM or COARSE with pea gravel, cement grouts, ENVIROPLUG® GROUT, or sand. Positioning of the ENVIROPLUG® chips is critical to an effective seal, however. The ENVIROPLUG® chips should be placed a minimum of 10' below to 10' above any water bearing or unstable formations.

AUG-31-2004 10:28 FROM:ENVIRONMENTAL MANUFAT 785 539 1349 TO:303 980 6157 P.2/8

ABANDONING DUG WELLS: Completely filling dug wells with bentonite chips can be very expensive and unnecessary. To economically decommission and stabilize dug wells, **ENVIROPLUG® COARSE** should be placed from the bottom section upward to 3 feet above the water bearing zone. Alternate sections of sand, fine gravel, or clay upward with a 12" layer of **ENVIROPLUG® COARSE** or **MEDIUM** every 5 to 6 feet.

Any of the above methods should be finished off approximately 3 feet below the surface, then filled with native soil or cement depending upon local regulatory requirements.

SEALING CASING: Slowly pour **ENVIROPLUG® MEDIUM** into annulus and allow to drop to the gravel pack. For bentonite grouting, continue to pour **ENVIROPLUG® MEDIUM** directly into annulus, alternating from one side of the casing to the other. This aids in even distribution of particles around the casing. To avoid bridging problems pour at a rate of 1¼ to 2 minutes per bag. If available, a funnel-type device with a 1½" bottom opening has proven very successful in regulating the flow into the hole and thus reducing the chances for bridging. When used in conjunction with pumpable grouts, **MEDIUM** can be used immediately above the sand or gravel pack and at the top of the hole for a more rigid seal. In unsaturated zones, **ENVIROPLUG® MEDIUM** or **COARSE** can be added to the column, followed by the addition of fresh water.

GROUNDING ROD AND HEAT PUMP CONDUCTOR HOLES: After drilling a 4½" to 5" diameter hole the desired depth, simply center the grounding rod with the ground wire attached or the circulating loop from the heat pump in the bore hole. In the case of a wet hole condition, pour **ENVIROPLUG® MEDIUM** slowly (1½-2 minutes per bag) down the bore alternating each bag from one side of the hole to the other. In dry hole conditions, fill the hole with water, then add the **ENVIROPLUG® MEDIUM** displacing the water upward. If the water dissipates into formations while filling the hole, continue to add water while adding **ENVIROPLUG® MEDIUM** until the hole is sealed.

SEISMIC SHOT HOLES: After the hole is drilled and charge is placed, pour **ENVIROPLUG® COARSE** slowly into the hole (1½ to 2 minutes per bag). In wet hole conditions add enough **ENVIROPLUG® COARSE** to fill up to the static water level. In a dry hole, add 2 to 4 bags directly over charge. Where auger drills are used or where water is injected, pour 2 bags per 50 feet of hole depth.

Using **ENVIROPLUG® COARSE** as recommended:

- Virtually eliminates hole blow-out
- Eliminates return trip to the line after shooting
- Improves seismic shot data

PRODUCT SPECIFICATIONS

	Sizing	Bulk Density	Moisture Content	Permeability
Enviroplug® Medium	-3/8" + 1/4"	68#/ft^3	15% ± 2	1 x 10^{-6} cm/sec
Enviroplug® Coarse	-3/4" + 3/8"	64#/ft^3	15% ± 2	1 x 10^{-5} cm/sec

AUG-31-2004 10:28 FROM:ENVIROMENTAL MANUFAT 785 539 1349 TO:303 980 6157 P.3/8

TYPICAL E.P. TOXICITY ANALYSIS		
	E.P.A. Standard (ppm)	Typical Analysis (ppm)
Arsenic	5.0	<0.1
Barium	100.0	0.5
Cadmium	1.0	<0.05
Chromium	5.0	<0.1
Lead	5.0	<0.1
Mercury	0.2	<0.02
Selenium	1.0	<0.05
Silver	5.0	<0.1

CHEMICAL ANAYLSIS %	
SiO_2	61.4
Al_2O_3	18.1
Fe_2O_3	3.5
Na_2O	2.3
MgO	1.7
CaO	.4
TiO_2	.2
K_2O	.10
Other	.07
H_2O	7.8
L.O.I.	4.4

APPLICATION RATE FOR ENVIROPLUG® PRODUCTS

The Chart below gives approximate Application Rates for ENVIROPLUG® COARSE, MEDIUM, AND GROUT in Abandonment Operations. Since no hole is perfectly in-guage actual application rates will vary.

Hole Diameter	COARSE		MEDIUM		GROUT (@ 30% Solids)	
	Pounds Per Foot of Hole	Feet of Hole/Bag	Pounds Per Foot of Hole	Feet of Hole/Bag	Gallons Per Foot of Hole	Feet of Hole/Bag
2½	NR	NR	2½	20	.25	68.0
3½	4¼	11¾	5	10	.50	34.0
4	5½	9	6¾	7½	.65	26.0
4½	7	7	8½	5¾	.83	20.5
5	8¾	5¾	10¾	5	1.00	17.0
5½	10½	5½	12½	4	1.23	13.8
6	12½	4	15½	3¼	1.50	11.3
6½	14¾	3½	20½	2½	1.70	10.0
8	22½	2¼	28	1¾	2.60	6.5
8½	25¼	2	32	1½	2.90	5.9
10	34¾	1½	41	1¼	4.10	4.1
12	50	1	80	¾	5.90	2.9
16	89	½	94	½	10.40	1.6
24	201	¼	213	¼	23.50	.7

ENVIROPLUG® COARSE weighs approximately 64 lbs/cu. ft.
ENVIROPLUG® MEDIUM weighs approximately 68 lbs/cu. ft.
ENVIROPLUG® GROUT yields 17 gallons of slurry when mixed at 30% solids.

ENVIROPLUG® MEDIUM and COURSE should be applied at about 2 minutes per bag. Product flow into the hole can be regulated through a funnel device with a 1½" to 2" orifice.

ENVIROPLUG® MEDIUM & COARSE were the FIRST bentonite chips developed and marketed. They are pure "Wyoming Bentonite" designed for use as sealants for hole abandonment, casing seals or any vertical seal to prevent water movement up or down a bore hole. When absorbing water, ENVIROPLUG® MEDIUM and COARSE swell to fill voids, exerting pressure against all surfaces to create a flexible low permeability seal. Since ENVIROPLUG® is introduced in a "dry" state, shrinkage cannot occur and there is a reserve expansion capacity. Generally hydration takes 1 to 2 hours.

HOLE ABANDONMENT AND APPLICATION GUIDELINES

ENVIROPLUG® COARSE has been used for abandoning drill holes since 1983. It easily falls through standing water and thin drilling fluids filling the column from the bottom upward. A fall rate of 1 foot/second can be expected and has been successfully applied through water to depths of over 1600 feet. Consult local regulations before beginning any abandonment procedure. Hole abandonment should be done by "Groundwater Professionals Only."

CASED HOLES OR UNCASED HOLES: For decommissioning cased or uncased holes larger than 3" diameter, use ENVIROPLUG® COARSE. If static water is present, pour chips from the bag at a rate of 1 1/2 to 2 minutes per 50 pounds. A funneling device with a 2" opening can be used to insure a constant flow of material into the hole. Should the water level be quite low - a screen can be used to drop out "fines" from the material before entering the hole.

For holes less than 3" in diameter use ENVIROPLUG® MEDIUM. The technique is the same but a funnel with a 1" to 1 1/2" opening is recommended to regulate the flow. Holes with less than a 1" diameter should be plugged with a pumpable material such as ENVIROPLUG® GROUT.

ABANDONING DUG WELLS: Completely filling dug wells with bentonite chips can be very expensive and unnecessary. To economically decommission and stabilize dug wells, ENVIROPLUG® COARSE should be placed from the bottom section upward to 3 feet above the water bearing zone. Alternate sections of sand, fine gravel, or clay upward with a 12" layer of ENVIROPLUG® COARSE or MEDIUM every 5 to 6 feet.

Any of the above methods should be finished off approximately 3 feet below the surface, then filled with native soil or cement depending upon local regulatory requirements.

SEALING CASING: Slowly pour ENVIROPLUG® MEDIUM into annulus and allow to drop to the gravel pack. For bentonite grouting, continue to pour ENVIROPLUG® MEDIUM directly into annulus, alternating from one side of the casing to the other. This aids in even distribution of particles around the casing. To avoid bridging problems pour at a rate of 1½ to 2 minutes per bag. If available, a funnel-type device with a 1½ " bottom opening has proven very successful in regulating the flow into the hole and thus reducing the chances for bridging. When used in conjunction with pumpable grouts, MEDIUM can be used immediately above the sand or gravel pack and at the top of the hole for a more rigid seal.

WYO-BEN, INC. 550 S. 24th St. West P.O. Box 1979 Billings, Montana 59103 USA
406-652-6351 Fax: 406-656-0748 Toll Free: 1-800-548-7055 www.wyoben.com email@wyoben.com

ENVIROPLUG® MEDIUM & COARSE

GROUNDING ROD AND HEAT PUMP CONDUCTOR HOLES: After drilling a 4½" to 5" diameter hole to the desired depth, simply center the grounding rod with the ground wire attached or the circulating loop from the heat pump in the bore hole. In the case of a wet hole condition, pour hole ENVIROPLUG® MEDIUM slowly (1½ - 2 minutes per bag) down the bore alternating each bag from one side of the hole to the other. In dry hole conditions, fill the hole with water, then add the ENVIROPLUG® MEDIUM displacing the water upward. If the water dissipates into formations while filling the hole, continue to add water while adding ENVIROPLUG® MEDIUM until the hole is sealed. Adding 5 gallons of water per 50 pound bag is usually adequate to provide hydration.

SEISMIC SHOT HOLES: After the hole is drilled and charge is placed, pour ENVIROPLUG® COARSE slowly into the hole (1½ - 2 minutes per bag). In wet hole conditions add enough ENVIROPLUG® COARSE to fill up to the static water level. In a dry hole, add 2 to 4 bags directly over the charge. Where auger drills are used or where water is injected, pour 2 bags per 50 feet of hole depth.

PRODUCT SPECIFICATIONS

	SIZING	BULK DENSITY	MOISTURE CONTENT	PERMEABILITY
Enviroplug® Medium	-3/8" + 1/4"	68#/ft^3	15% ± 2	1 x 10^{-9} cm/sec
Enviroplug® Coarse	-3/4" + 3/8"	64#/ft^3	15% ± 2	1 x 10^{-9} cm/sec

TYPICAL E. P. TOXICITY ANALYSIS

	E.P.A. Standard (ppm)	Set Grout (ppm)
Arsenic	5.0	<0.1
Barium	100.0	0.5
Cadmium	1.0	<0.05
Chromium	5.0	<0.1
Lead	5.0	<0.1
Mercury	0.2	<0.02
Selenium	1.0	<0.05
Silver	5.0	<0.1

TYPICAL CHEMICAL ANALYSIS %

SiO_2	61.4
Al_2O_3	18.1
Fe_2O_3	3.5
Na_2O	2.3
MgO	1.7
CaO_3	.4
TiO_2	.2
K_2O	0.10
Other	.07
H_2O	7.8
L.O.I.	4.4

*Loss on Ignition

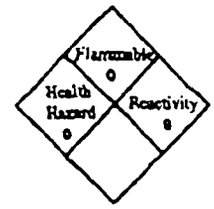
ENVIROPLUG® MEDIUM & COARSE are available in 50 pound bags and 2,800 pound bulk bags.

WYO-BEN, INC. 550 S. 24th St. West P.O. Box 1979 Billings, Montana 59103 USA
406~652-6351 Fax: 406~656-0748 Toll Free: 1~800-548-7055 www.wyoben.com email@wyoben.com

HUG-31-2004 10:34 FROM:ENVIRDMENTAL MANUFAT 785 539 1349 T0:303 980 6157 P.6/8

WYO-BEN, INC.

MATERIAL SAFETY DATA SHEET



NFPA FIRE HAZARD IDENTIFICATION SYSTEM

I. PRODUCT IDENTIFICATION	
Trade Name(s): ENVIROPLUG® MEDIUM	
Generic Name(s): Wyoming (Western) Bentonite; Bentonite Clay (CAS No. 1302-78-9)	
Chemical Name(s): Sodium Montmorillonite (CAS No. 1318-93-0)	
Manufacturer: WYO-BEN, INC. Address: P.O. Box 1979 Billings, Montana 59103	Telephone Numbers: Information: (406) 652-6351 EMERGENCY: (406) 652-6351

II. HAZARDOUS INGREDIENTS			
Ingredient	CAS NO.	%	Hazard
Crystalline Silica (SiO_2) as Quartz	14808-60-7	See Note	Low concentrations of crystalline silica (SiO_2) in the form of quartz, may be present in airborne bentonite dust. See Section VI for discussion of health hazard.

Note: Although the typical quartz content of western bentonite is in the range of 2 to 6% most of the quartz particles are larger than the 10 μ respirable threshold size. The actual respirable quartz concentration in airborne bentonite dust will depend upon bentonite source, fineness of product, moisture content of product, local humidity and wind conditions at point of use and other use specific factors.

III. PHYSICAL DATA	
Boiling Point (°F): NA	Specific Gravity (H_2O=1): 2.45-2.55
Vapor Pressure (mm. Hg): NA	Melting Point: Approx. 1450°C
Vapor Density (Air = 1): NA	Evaporation Rate (Butyl Acetate = 1): NA
Solubility in Water: Insoluble, forms colloidal suspension.	pH: 8-10 (5% aqueous suspension)
Density (at 20° C): 68 lbs/cu.ft. as product.	
Appearance and Odor: Bluegray to green as moist solid, light tan to gray as dry powder. No odor.	

IV. FIRE AND EXPLOSION DATA	
Flash Point: NA	Flammable Limits: LEL: NA UEL: NA
Special Fire Fighting Procedures: NA	
Unusual Fire and Explosion Hazards: None. Product will not support combustion.	
Extinguishing Media: None for product. Any media can be used for the packaging. Product becomes slippery when wet.	

V. REACTIVITY	
Stability: Stable	
Hazardous Polymerization: None	
Incompatibility: None	
Hazardous Decomposition Products: None	
NA = Not Applicable ND = Not Determined	

Date Prepared: March 10, 1999

Doc #: 40382-01

P.7/8 6157 986 505:10 1349 655 CAS TH.JONIEN.ENVIRON.ME FROM:ENVIRONMENTAL 12-07-1999 10:04

HEALTH HAZARD INFORMATION

Routes of Exposure and Effects:

Skin: Possible drying resulting in dermatitis.

Eyes: Mechanical irritant.

Inhalation: Acute (short term) exposure to dust levels exceeding the PEL may cause irritation of respiratory tract resulting in a dry cough.

Chronic (long term) exposure to airborne bentonite dust containing respirable size ($\leq 10\ \mu$) quartz particles, where respirable quartz particle levels are higher than TLV's, may lead to development of silicosis or other respiratory problems. Persistent dry cough and labored breathing upon exertion maybe are symptomatic.

Ingestion: No adverse effects.

Permissible Exposure Limits: (for air contaminants)	OSHA PEL (8hr. TWA)	ACGIH TLV
Bentonite as "Particulates not otherwise regulated" (formerly nuisance dust)		
Total dust	15mg/m^3	ND
Respirable dust	5mg/m^3	ND
Crystalline Quartz (respirable)	0.1mg/m^3	0.1mg/m^3

Carcinogenicity: Bentonite is not listed by NTP or OSHA. IARC, 1997, concludes that there is sufficient evidence in humans for the carcinogenicity of inhaled crystalline silica from occupational sources (IARC Class 1), that carcinogenicity was not detected in all industrial circumstances studied and that carcinogenicity may depend on characteristics of the crystalline silica or on external factors affecting its biological activity.

Acute Oral LD_{50}: ND	Acute Dermal LD_{50}: ND	Aquatic Toxicology LC_{50}: ND

Emergency and First Aid Procedures:

Skin: Wash with soap and water until clean.

Eyes: Flush with water until irritation ceases.

Inhalation: Move to area free from dust. If symptoms of irritation persist contact physician. Inhalation may aggravate existing respiratory illness.

PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled: Avoid breathing dust; wear respirator approved for silica bearing dust. Vacuum up to avoid generating airborne dust. Avoid using water. Product slippery when wetted.

Waste Disposal Methods: Product should be disposed of in accordance with applicable local, state and federal regulations.

Handling and Storage Precautions: Use NIOSH/MSHA respirators approved for silica bearing dust when free silica containing airborne bentonite dust levels exceed PEL/TLV's. Clean up spills promptly to avoid making dust. Storage area floors may become slippery if wetted.

ENVIRONMENTAL CONTROL MEASURES

Ventilation Requirements: Mechanical, general room ventilation. Use local ventilation to maintain PEL's/TLV's.

Respirator: Use respirators approved by NIOSH/MSHA for silica bearing dust.

Eye Protection: Generally not necessary. Personal preference.

Gloves: Generally not necessary. Personal preference.

Other Protective Clothing or Equipment: None

OTHER SPECIAL PRECAUTIONS

Avoid prolonged inhalation of airborne dust.

DEPARTMENT OF TRANSPORTATION HAZARDS MATERIAL FORMATION

Shipping Name: NA (Not Regulated)	Hazard Class: NA
Hazardous Substance: NA	Caution Labeling: NA

Date Prepared: March 10, 1999

Doc #: 40382-01

All information presented herein is believed to be accurate, however, it is the user's responsibility to determine in advance of need that the information is current and suitable for their circumstances. No warranty or guarantee, expressed or implied is made by WYO-BEN, INC. as to this information, or as to the safety, toxicity or effect of the use of this product.

HUG-31-2004 10:35 FROM:ENVIRONMENTAL MANUFAC 785 539 1349 TO:303 980 6157 P.8/8

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 09-09-04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 028A
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No. 028

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Panel Layout 60-mil LLDPE smooth	N/A	6	02225	N/A	N/A	
2	Panel Layout Geocomposite		6	02224			
3	Panel Layout Bentomat ST-GCL		6	02226			
	Rocky Flats Plant						
	☒ APPROVED ☐ APPROVED AS CORRECTED						
	☐ NOT APPROVED ☐ REVISE AND RESUBMIT						

Remarks: APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

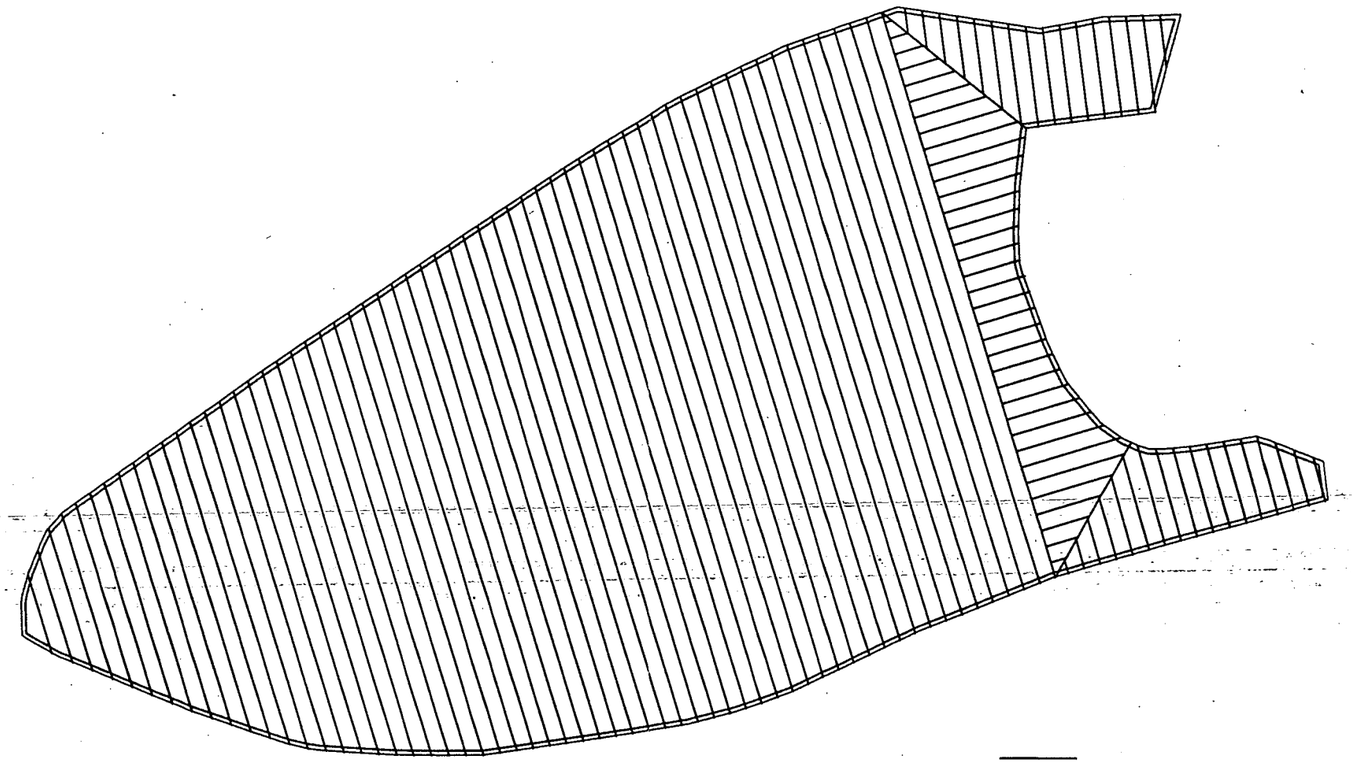
Signature of Subcontractor:

Section II BY: Robert Davis DATE: 10/09/04 Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA J.H. Rala Tetra Tech

60 MIL BLACK SMOOTH LLDPE QUANTITY EXPLANANTION
43,879 LF OF MATERIAL NEEDED X 22.5' WIDE = 984,353 SF - NOTE: LF INCLUDES 12" OVERLAP FOR ROLL END SEAMS
ORDER 79 ROLLS 22.5' X 560' = 995,400 SF OR 110,600 SY



100 SCALE

Notes :
1) BLUE lines represent approximate location of panel limits.
2) RED line represents offset from anchor trench to allow extra material for anchoring and slope loss.

PANEL LAYOUT MAY DIFFER DUE TO VARIOUS SITE SPECIFIC CONDITIONS.

Submitted By:
COLORADO LINING INTERNATIONAL

ROCKY FLATS PRESENT LF

PANEL LAYOUT
60 MIL LLDPE SMOOTH
GOLDEN, CO

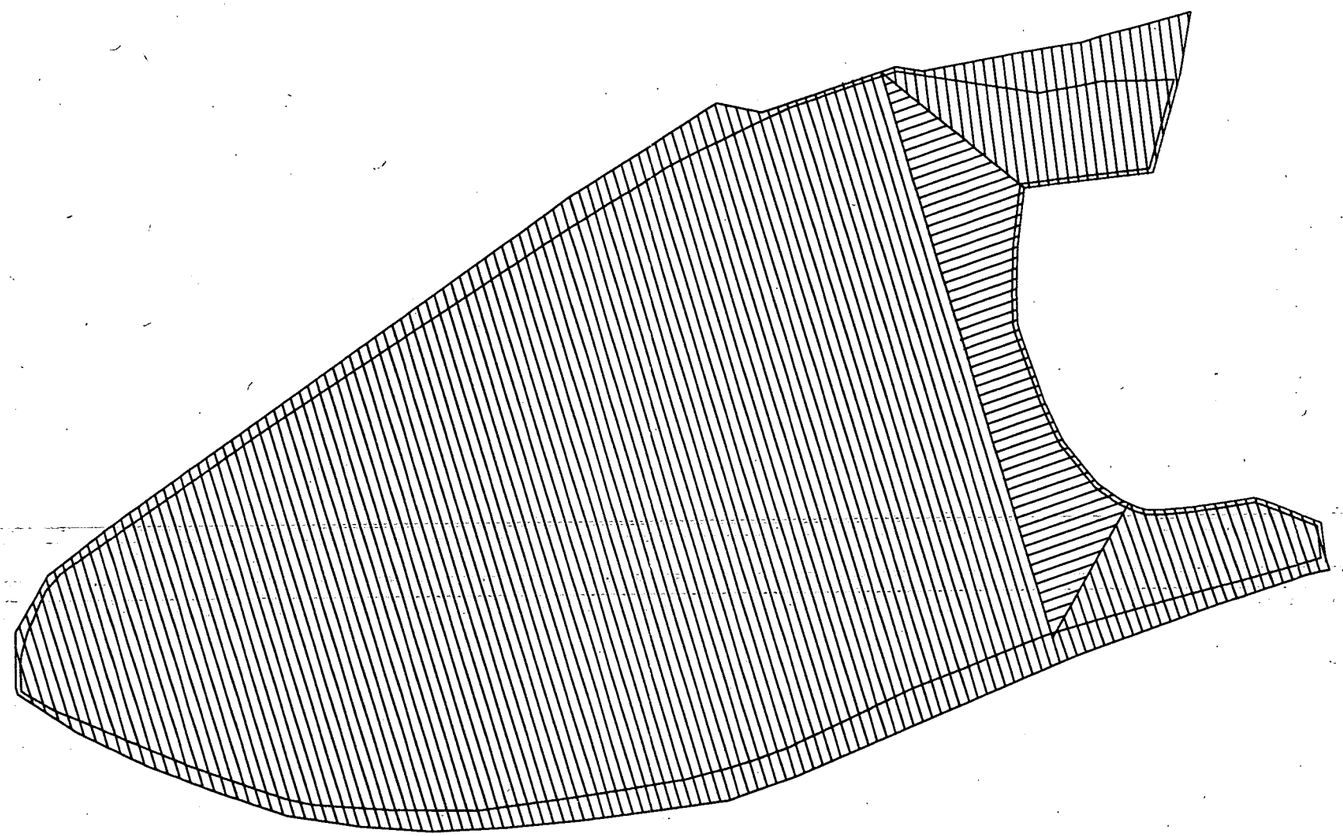
DATE
AUGUST 25, 2004

Engineer: EARTH TECH
Contractor: KAISER HILL / STOLLER

REV
0

Scale: 1"=200'
Drawn By: D. LAHR
Drawing Name: RF LLDPE LYT

GEOCOMPOSITE - QUANTITY EXPLANANTION
79,851 LF OF MATERIAL NEEDED X 13.5' WIDE = 1,077,989 SF - NOTE: LF INCLUDES 6" OVERLAP FOR ROLL END SEAMS
ORDER 402 ROLLS 13.5' X 200' = 1,085,400 SF OR 120,600 SY - TOTAL INCLUDES 2 EXTRA ROLLS.



100 SCALE

Notes :
1) BLUE lines represent approximate location of panel limits.
2) RED line represents offset from anchor trench to allow extra material for anchoring and slope loss.
3) BLUE PERIMETER line represents length of run out to inside edge of perimeter drainage channel.
PANEL LAYOUT MAY DIFFER DUE TO VARIOUS SITE SPECIFIC CONDITIONS.

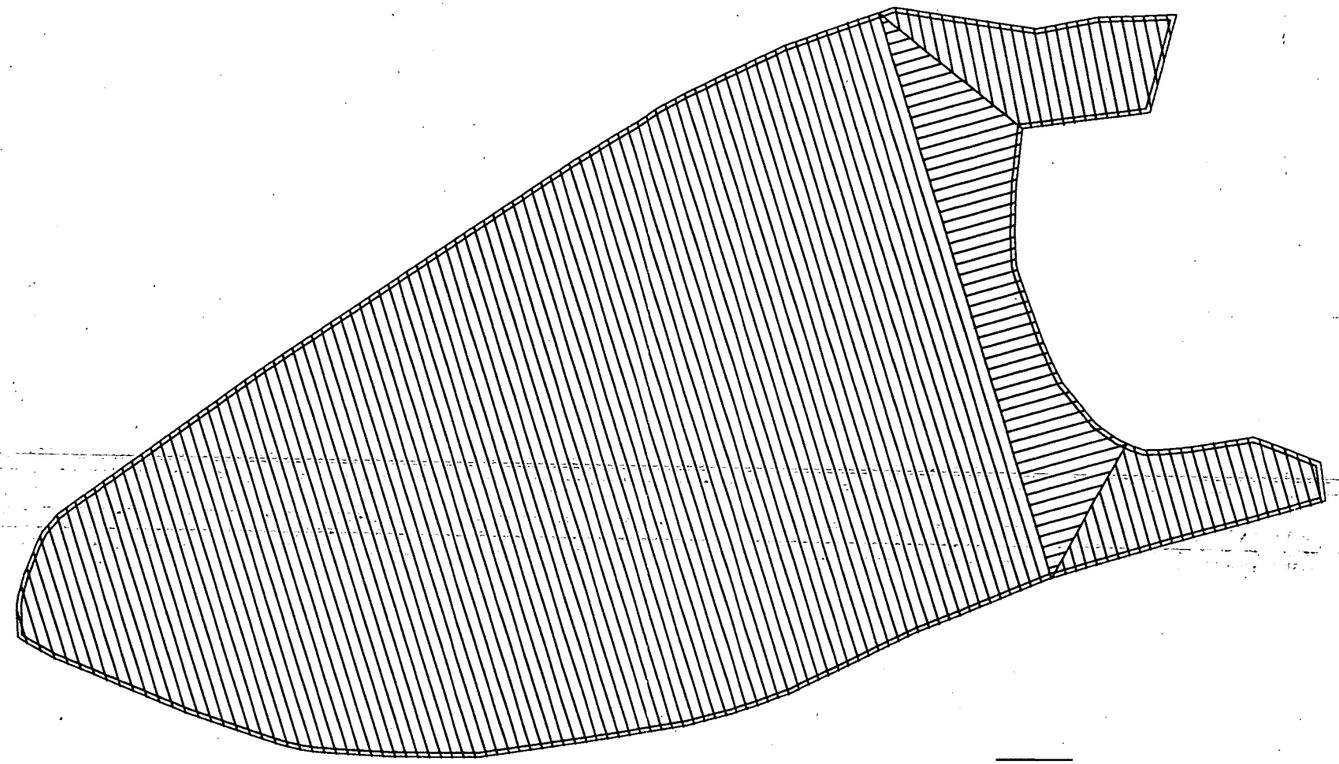
ROCKY FLATS PRESENT LF

PANEL LAYOUT
GEOCOMPOSITE
GOLDEN, CO

Submitted By:
COLORADO LINING INTERNATIONAL

DATE: AUGUST 25, 2004
Engineer: EARTH TECH
Contractor: KAISER HILL / STOLLER
REV: 0
Scale 1"=200' | Drawn By: D. LAHR | Drawing Name - RF GEOCOMP LYT

BENTOMAT ST - GCL QUANTITY EXPLANANTION
66,388 LF OF MATERIAL NEEDED X 15' WIDE = 995,820 SF - NOTE: LF INCLUDES 24" OVERLAP FOR ROLL END SEAMS
ORDER 445 ROLLS 15' X 150' = 1,001,250 SF OR 111,250 SY - TOTAL INCLUDES 2 EXTRA ROLLS.



100 SCALE

Notes:
1) BLUE lines represent approximate location of panel limits.
2) RED line represents offset from anchor trench to allow extra material for anchoring and slope loss.

PANEL LAYOUT MAY DIFFER DUE TO VARIOUS SITE SPECIFIC CONDITIONS.

Submitted By:
COLORADO LINING INTERNATIONAL

ROCKY FLATS PRESENT LF

PANEL LAYOUT
BENTOMAT ST - GCL
GOLDEN, CO

DATE: AUGUST 25, 2004
Engineer: EARTH TECH
Contractor: KAISER HILL / STOLLER
REV: 0
Scale: 1"=200'
Drawn By: D. LAMB
Drawing Name - RF LLDPE LYT

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 09-08-04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 031
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Kiln dust to solidify pond sludge	N/A	1 jar	N/A	N/A	N/A	

☒ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

Remarks: APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

Verbal Direction/ Approval Provided to Stoller on or about Sept. 28, 2004 RMD

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Paul Kreitz 9/8/04
Signature of Subcontractor:

Section II BY: Roberta Davis DATE: 09/16/05 Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQAE
J.H. Fabe TK

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Engineering
Materials Analysis and Research Laboratory
23 Town Engineering
Ames, Iowa 50011-3232
515 294-8752 or 8761
FAX 515 294-8216

ANALYSIS OF KILN DUST

TO: Tim Cheever DATE: 03/10/95

LAB ID: AD021095 DATE RECEIVED: 02/15/95
CKD

SAMPLE: Alkali dust from Southwestern Portland, week of 2/10/95

MAJOR/MINOR ELEMENTS
(expressed as oxides)

Oxide	Mass%
CaO	53.8
MgO	1.1
Al_2O_3	4.9
Fe_2O_3	2.2
SiO_2	19.2
TiO_2	0.2
Na_2O	1.0
K_2O	2.0
SO_3	10.5
P_2O_5	0.2
SrO	0.17
BaO	0.03

TRACE ELEMENTS
(See attached page)

TEMPERATURE RISE

ΔT, °C = 17.3

SIEVE ANALYSIS (% Passing)

#100	88.8
#200	74.3
#325	48.8

Others:

Loss on Ignition*, %	5.56
Tap Density, pcf	66
Calcium Carbonate Equivalent (CCE), %	84.6

REMARKS: *@ 950°

Lyons, Colorado

Materials Analysis Research Laboratory (MARL) - Participants in the Cement & Concrete Reference Laboratory cement and pozzolan testing programs.

Approved: Scott S.

Fax 970-565-0188

ith Miles
iron Cut
R: CKD Analysis

ERIC LEIGH
12/18/2003 08:33 AM

To: GERRIT P LANSING/Colo/Usa/Cemex@CEMEX
cc:
Subject: CKD

Here ya go...

Typical Lyons CKD

SID1	Al2O3	CaO	Fe2O3	K2O	MgO	Na2O	SO3	SiO2
CKD	4.00	45.11	1.64	1.93	1.13	0.97	3.59	14.79

CEMEX
United States Operations
1805 Shea Center Drive, Suite 270
Highlands Ranch, Colorado 80129
USA

September 16, 2004

Bulk Materials
7301 SW Frontage Road
Suite # 3
Fort Collins, CO. 80528

Attn: Curt W. Burgener

Re: Summary of fuel usage at CEMEX, Lyons facility
Project: Rocky Flats DOE

Dear Mr. Burgener,

We are corresponding per your request to inform all entities related to the above-mentioned project as to the exact fuel sources used at our Lyons facility for kiln production of Portland cement clinker. This plant burns coal as a main fuel source and at times will burn limited amounts of natural gas. These are the only combustion materials fired in this facility's kiln.

If you have any further questions or would like additional support or clarification please do not hesitate to call us.

Respectfully,

Gerrit Lansing

Gerrit P. Lansing
Technical Services Manager – South Central Region
CEMEX - Cement Division
303-263-1345
Gerritp.lansing@cemexusa.com

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 9/15/04	XX	New Submittal
			Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 034
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Sieve Analysis for Rock Layer	N/A	6	02222, Part 2	N/A	N/A	

Rocky Flats Plant

☐ APPROVED ☒ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Robert K. Davis DATE: 10/09/04

See Notes on Gradation Analysis

Remarks:

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted. Paul Kreitz, 9/15/04

Signature of Subcontractor:

Section II — Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK COR John H. Rale Tetra Tech 10/19/04

Golder Associates Inc.

44 Union Boulevard, Suite 300
Lakewood, CO USA 80228
Telephone (303) 980-0540
Fax (303) 985-2080
www.golder.com

Golder Associates

BULK GRADATION

DATE	September-04
PROJECT NAME	Rocky Flats
PROJECT NUMBER:	043-22461
SAMPLE ID:	ERF-182 Depth (ft)
TYPE	Bulk

Total Weight of Sample: 2106165

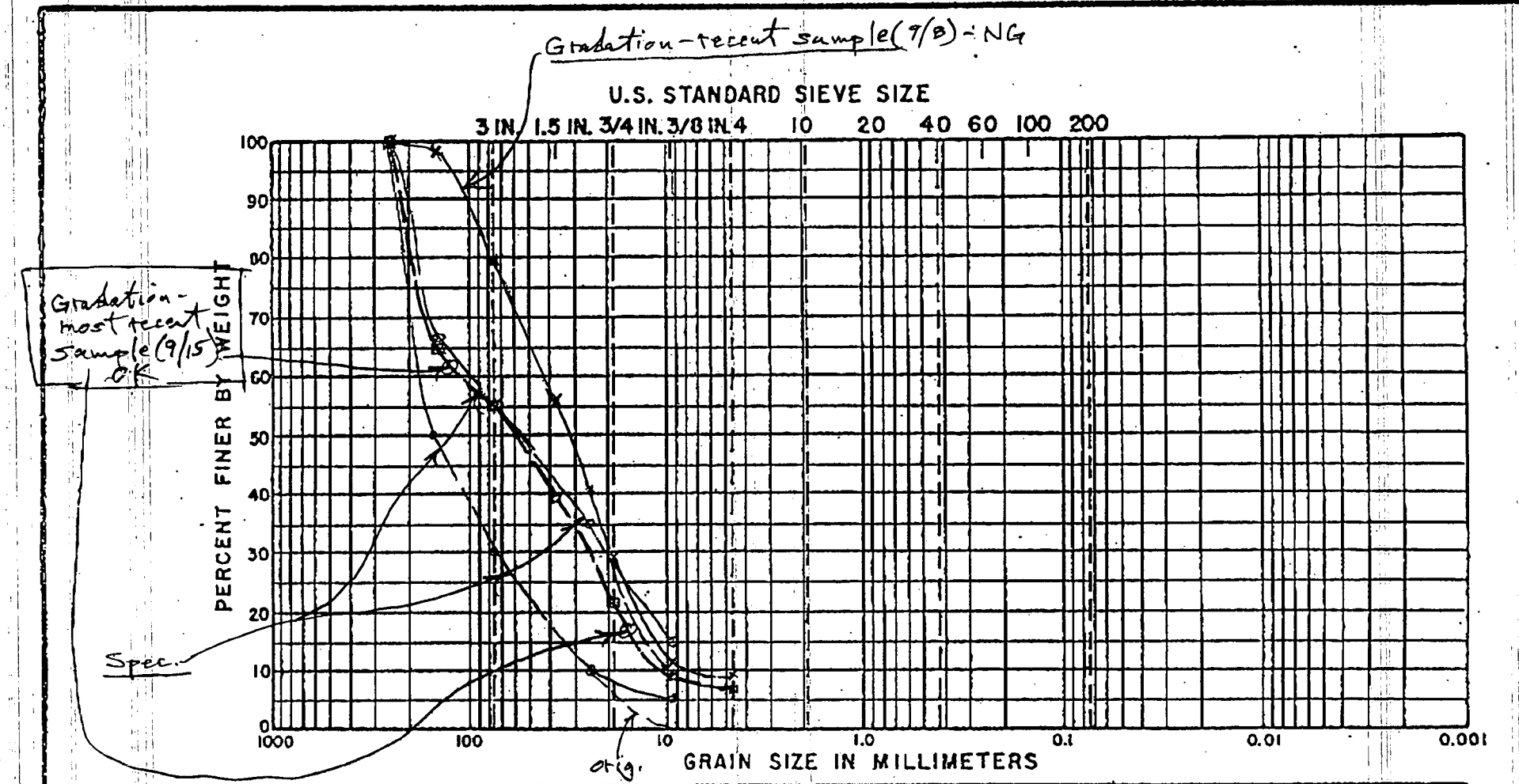
Ratio (3"-:total 3"-)	19.15

	Wt Retained	Cumulative Wt. Retained	Percent Retained	Percent Passing
10.0"	0.00	0.0	0.00	100.00
6.0"	739899.90	739899.9	35.13	64.87
3.0"	212281.20	952181.1	45.21	54.79
Total Passing 3"	1153984.30	2106165.4		
2"	740.4	966361.0	45.88	54.12
1.5"	16445.90	1281326.5	60.84	39.16
1.0"	10834.90	1488832.3	70.69	29.31
.75"	8562.70	1652821.8	78.48	21.52
.375"	13551.90	1912362.6	90.80	9.20
#4	2067.40	1951956.6	92.68	7.32
Total Passing #4	8052.00	2106165.4	100.00	0.00

Gradation meets Specification
However final Approval is dependent on two items

1) Consistent Reproducibility by Centennial
2) Approval by EPA/CDPHE & USFWS

Robert Davis
10/09/2004



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT WC	LL	PL	PI	

GRADATION CURVE

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 10/8/04	XXX	New Submittal Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:		
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026	Subcontract No: KH020577	Submittal No. 035 Rev 1 Previous Submittal No. - 035

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document: Spec. Paragraph No.	Contract Reference Document: Drawing Sheet No.	Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
a.	b.	c.	d.	e.	f.	g.	h.
1	Design of Temporary Seep Recovery System	N/A			N/A	N/A	

Rocky Flats Plant

☐ APPROVED ☒ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert W. Davis DATE: 10/12/04

(1) Excavated Material must be stockpiled with the boundary of pond sediment removal

Remarks: ~~Work Package in Progress.~~

Revised due to D&D of power source (change from etemp. hook-up to generator.)

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: Paul Kreitz

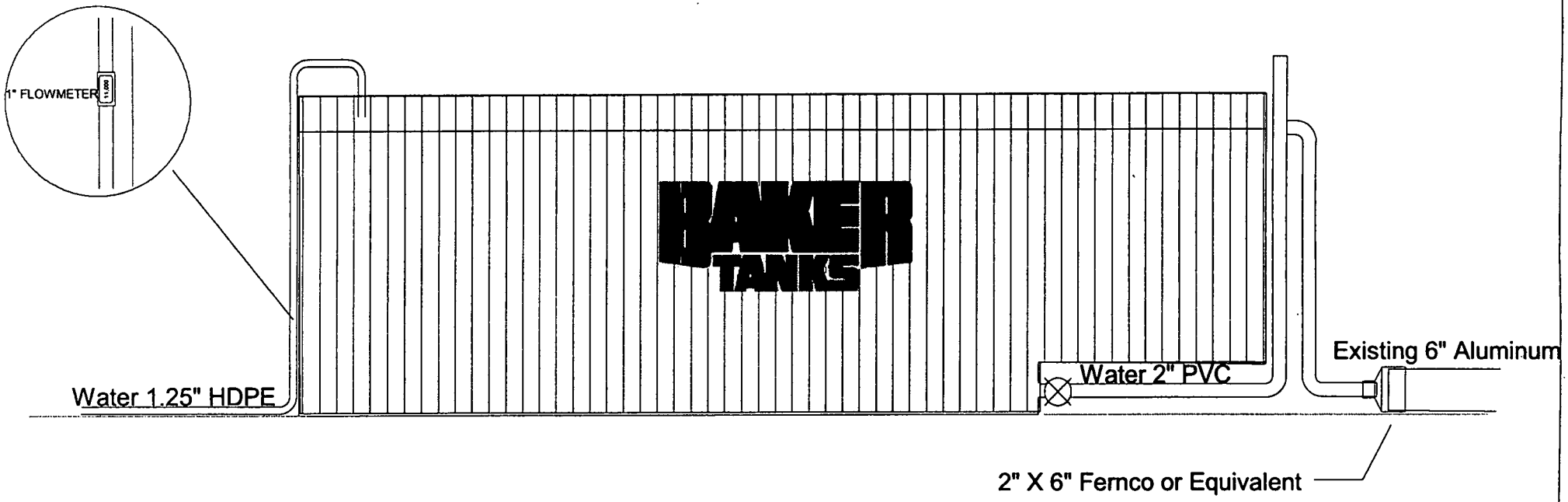
Section II — Reviewed

(2) How will flow be managed during construction of the sump area?

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA / H Fale 10/19/04
Tetra Tech

Robert W. Davis
10/12/04



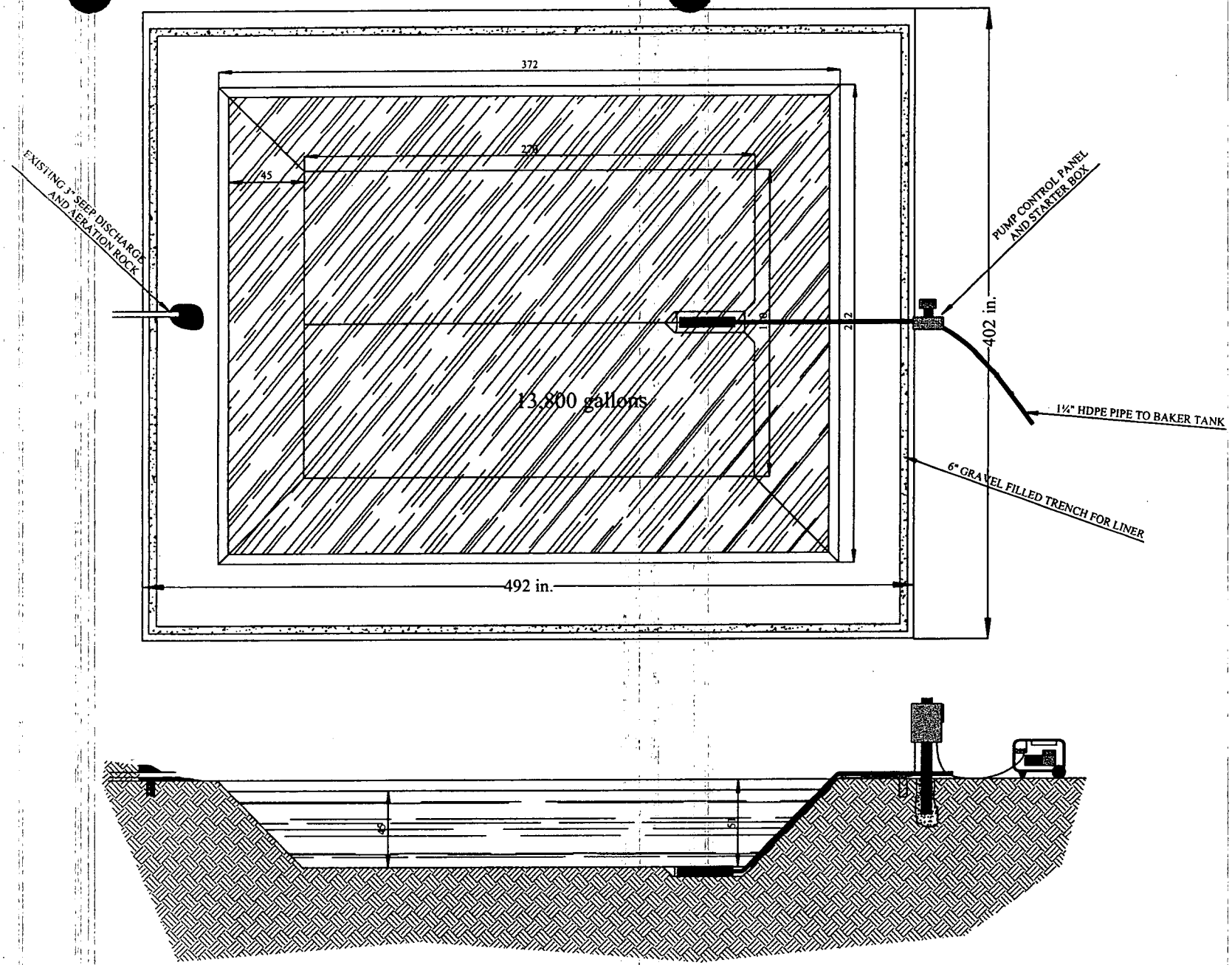
Present Landfill
Accelerated Action

N

Baker Tank Plumbing

Printed on: (10.6.2004) 12:7

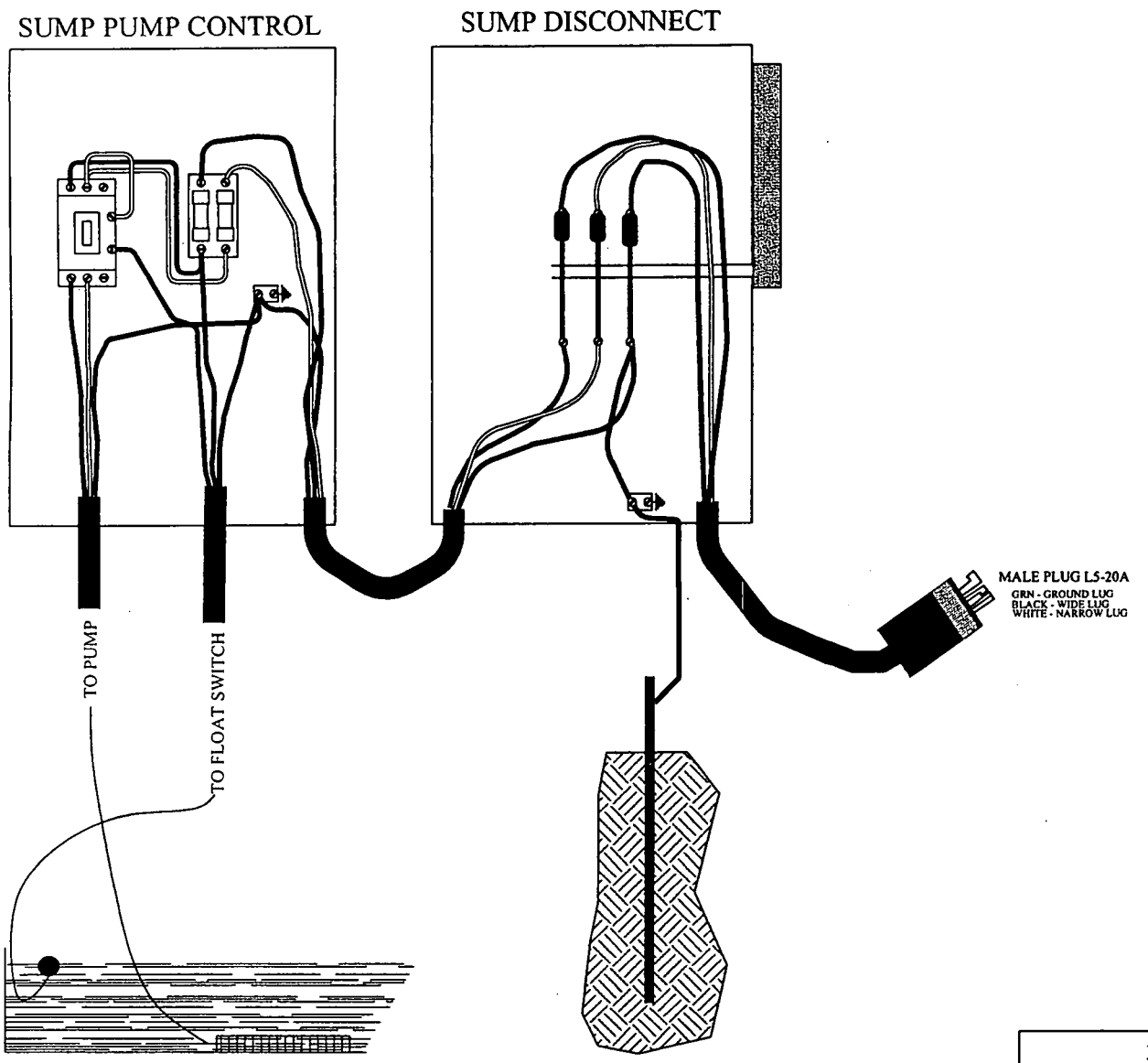
Stoller



Present Landfill
Accelerated Action

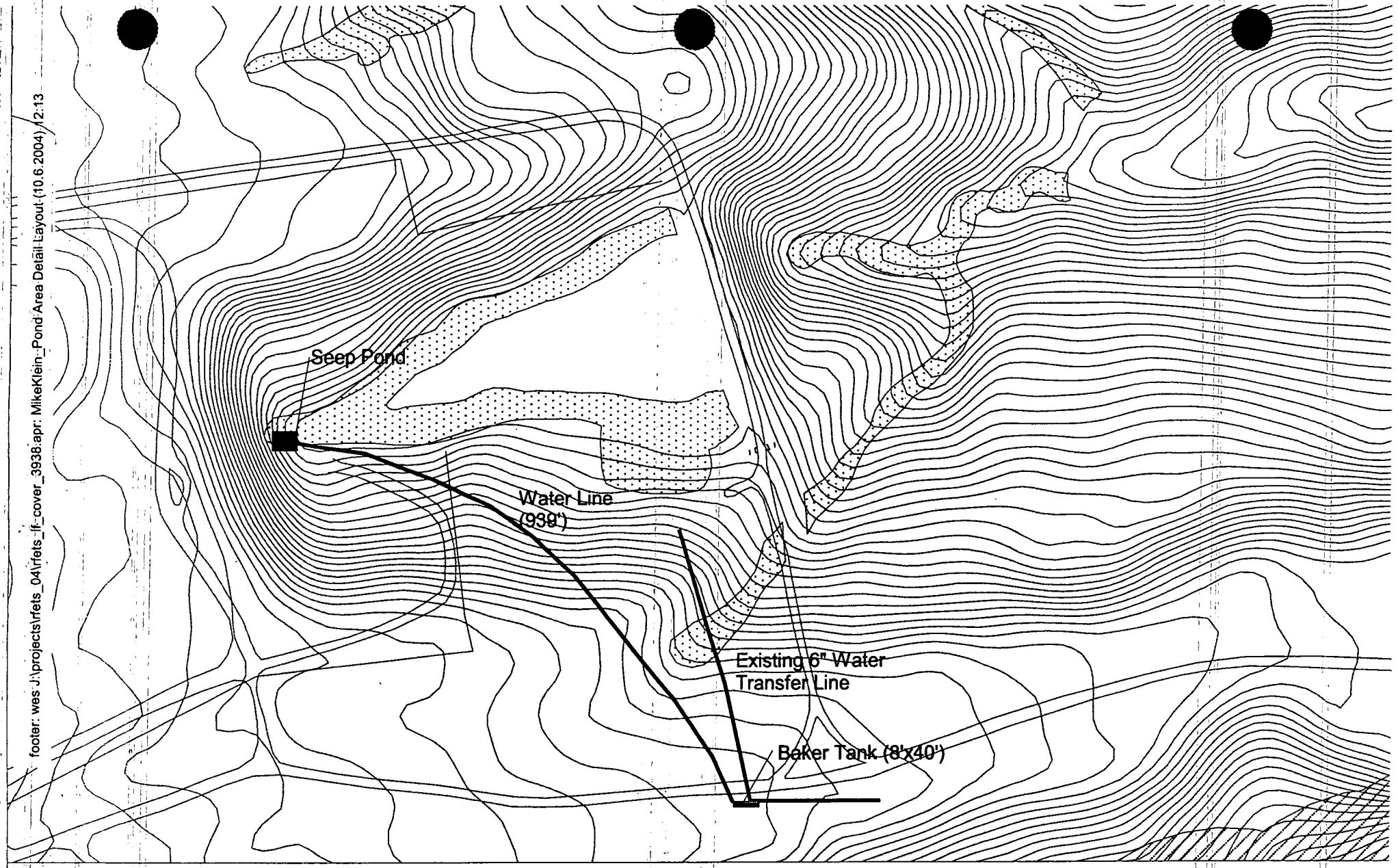
Sump Pump System
General Arrangment

Stoller



3938-503-003		
Seep Pump Control Wiring		
09/08/2004		

Stoller



footer: wes J:\projects\rfets_04\rfets_ff_cover_3938.apr: MikeKlein_Pond Area Detail Layout (10.6.2004) 12:13

Present Landfill
Accelerated Action

N

Explanation:

- 2ft. Contours
- Traffic Control Signs
- Fences
- Buildings and Facilities
- Preble's Protection Area
- Wetlands Protection Areas

Scale:

100 0 100 Feet

Printed on: (10.6.2004) 12:13

Pond Area Detail

Stoller

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 9/17/04	XXX	New Submittal
			Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 035
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)	Project Title: Construction of the Present Landfill Accelerated Action

Item No. a.	Description of Item Submitted (Type, size, model number, etc.) b.	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8) c.	No. of Copies d.	Contract Reference Document: Spec. Paragraph No. e.	Contract Reference Document: Drawing Sheet No. f.	Deviation (See Instruction #6) g.	Contractor Action Code (See Instruction #9) h.
1	Design of Temporary Seep Recovery System	Rocky Flats Plain	6	NA	N/A	N/A	

☐ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☒ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert Davis DATE: 10/09/2004

Remarks: Work Package in Progress.

• Pls advise ASAP, if this is OK.

Thx
Paul K.

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: Paul Kreitz

Section II — **Reviewed**

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

Temporary Seep Recovery System

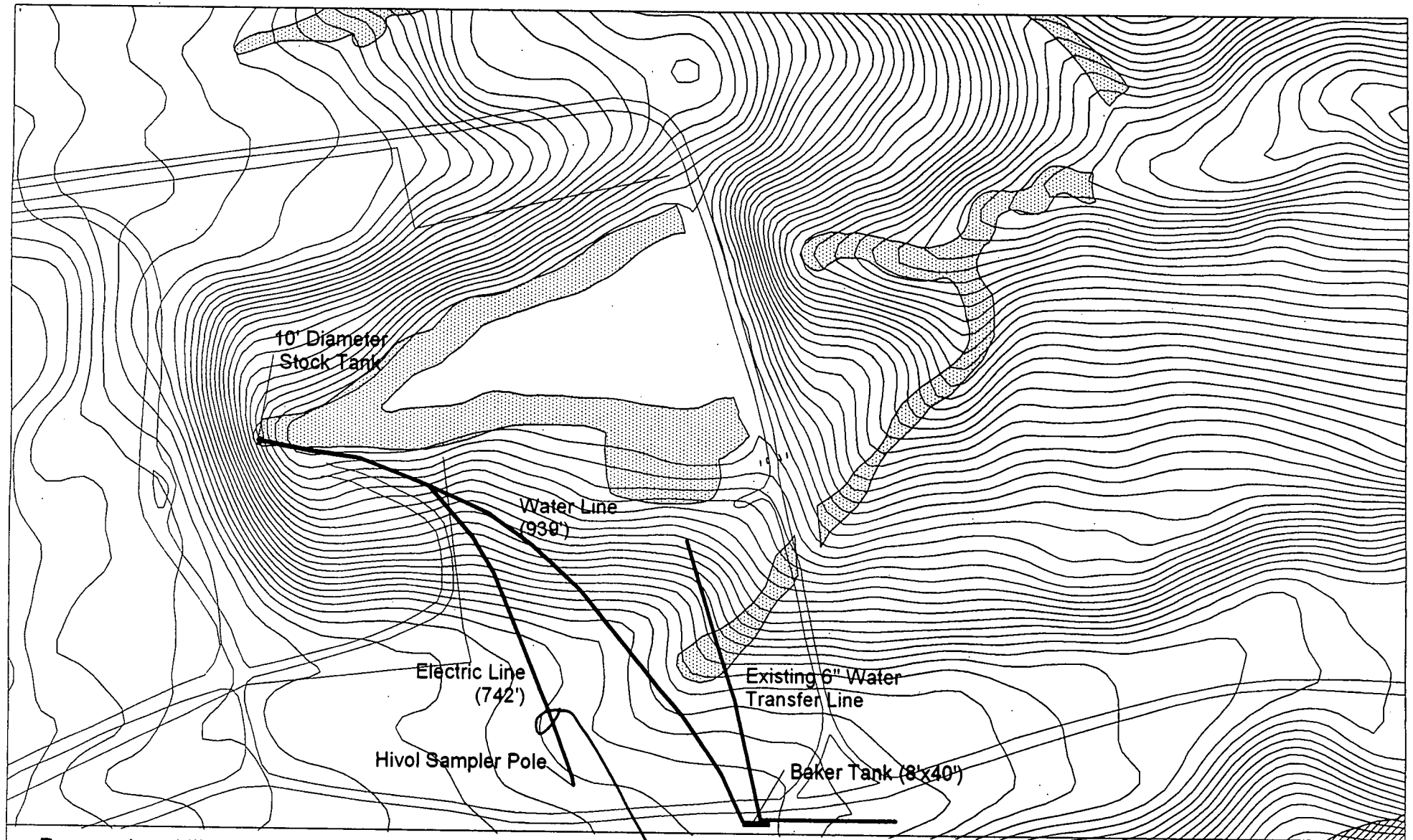
Water seeping from the base of the east face of the present landfill will be temporarily pumped to a 21,000-gallon portable tank located approximately 750 feet SE from seep with a vertical rise of 30 ft. A Seep Pumpout Station, consisting of a pump, 1500 gallon tank, pump control station, 750 ft of 1¼" HDPE pipe, and 750 ft of rubber SO 10/3 cord will be used to pump water from the Seep to the water tank. The pump and controls will be located on the south side of the seep treatment system. The pump is a 240 V submersible pump that is capable of pumping 10 GPM at the anticipated discharge conditions. Float switches will be used to automatically turn on and off the pump to maintain the water level in the collection tank. The 1500-gallon tank will store water temporarily, be located below the aeration stair steps of the seep treatment system, and will be placed within a shallow excavation of sufficient size to hold the tank at the proper elevation to capture the water flow.

Figure 3938-503-001 is a map showing the location of the tanks, piping, and electrical line.

Figure 3938-503-002 shows the layout of the tank located at the seep and associated seep recovery system.

Figure 3938-503-003 shows the system layout at the Baker tank located at the top of the hill.

Note: Electrical Power No Longer Available from RFETS



Present Landfill
Accelerated Action

N

Explanation:

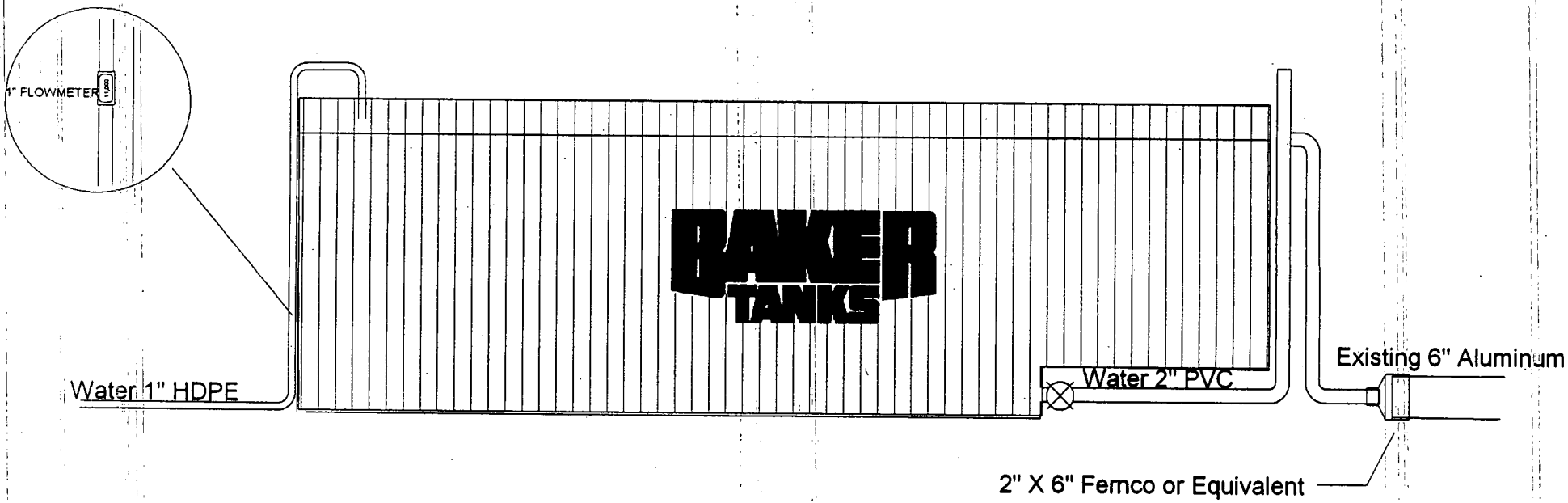
- 2ft. Contours
- Traffic Control Signs
- Fences
- Buildings and Facilities
- Preble's Protection Area
- Wetlands Protection Areas

Scale:
100 0 100 Feet

Electrical Supply
No Longer Available

3938-503-001
Pond Area Detail

Stoller

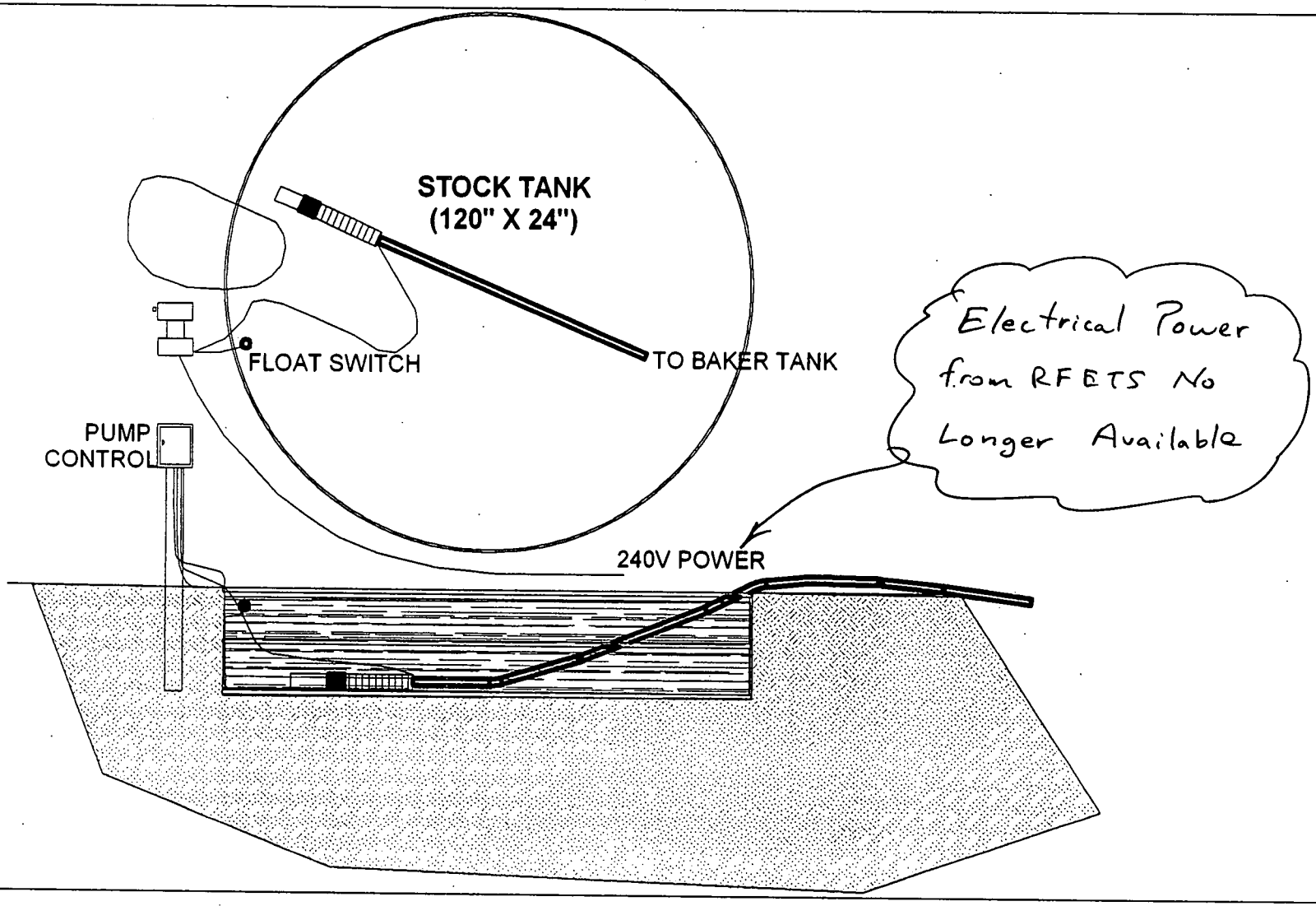


Present Landfill
Accelerated Action

N

3938-503-003
Baker Tank Plumbing

Stoller



Present Landfill
Accelerated Action

N

3938-503-002
Sump Pump System
General Arrangement

Stoller

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 09-23-04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:		
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026	Subcontract No: KH020577	Submittal No. 037 Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document: Spec. Paragraph No.	Contract Reference Document: Drawing Sheet No.	Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
a.	b.	c.	d.	e.	f.	g.	h.
1	Product samples	Tensar BX1200	2	N/A	N/A	N/A	
2	Product specification – Structural Geogrid BX1200	Tensar BX1200	1	N/A	N/A	N/A	
3	Subgrade Installation Guide	Tensar BX1200		N/A	N/A	N/A	
4	Base Reinforcement Installation Guide	Tensar BX1200		N/A	N/A	N/A	

Rocky Flats Plant

☐ APPROVED ☒ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert W. Davis DATE: 10/1/2004

Remarks:

Incorrectly submitted previously as [illegible] should be RFI-037

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK, CQA J H Rale 10/19/04 Tetra Tech

INSTALL AS DESCRIBED IN ATTACHED

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

TECHNICAL MEMORANDUM

DATE: September 21, 2004

TO: Bob Davis, RFETS

FROM: Randy Thompson, Earth Tech, Inc.

SUBJECT: Soft Spot Repair Procedures – Present Landfill

Proof-rolling on the present landfill has revealed 18 soft spots or areas of unsuitable deflection that will need to be remedied prior to subgrade surface acceptance. Several of the soft spots have been investigated and generally fall into three categories:

- Small, isolated soft spots likely due to the type of waste material below (SS5, SS9, SS11, and SS12)
- Clay soft spots characterized by over 10 feet of reworked, and likely improperly compacted, clay cover above the waste (SS3, SS6, SS7).
- Wet soft spots characterized by saturated conditions immediately below cover (SS4).

Please note that SS1, SS2, SS8, SS13, SS14, SS15, SS16, SS17, and SS18 have yet to be investigated.

Remedy for each type of soft spot is discussed below. In each case, the area will be proof-rolled following the remedy to ensure less than 1-inch of deflection.

Small Soft Spots (SS5, SS9, SS10, SS11, SS12)

- Roll area with sheep's foot compactor until minimal deflection is noted at the discretion of the Field Engineering Team (SQAM, QCSM, Design Engineer's Representative).
- Excavate surrounding soils to the depth of the deflected area. Laterally, the width of the surrounding excavations should be at least the radius of the soft area to a maximum of 10 feet (i.e. if the soft area has a diameter of 8 feet, excavate soil 4 feet laterally around the soft spot). This will allow the edges of the geogrid to be placed on stable material facilitating bridging.
- Inspect the surface of the excavation to ensure that it is suitable for geogrid (i.e. no foreign substances such as debris or large rocks are present). Inspection will be conducted by the Field Engineering Team.
- Install Tensar BX1200 or equivalent biaxial geogrid on the inspected surface. The geogrid shall be laid smooth and free of tension, stress, folds, wrinkles, or

creases. If more than one strip is necessary, the geogrid strips shall be overlapped a minimum of 24-inches and tied together with hog rings or cable ties every 5 feet. Hog rings and cable ties must meet geogrid manufacturer's recommendations.

- Backfill over geogrid with Rocky Flats Alluvium in 1-foot lifts compacted with a minimum of 6 passes with the sheep's foot compactor.
- Proof-roll area with loaded scraper per Specifications to ensure less than 1-inch of deflection.

Clay Soft Spots (SS3, SS6, SS7)

- Excavate soft area and surrounding soils until waste is encountered (or a maximum of 4-feet below ground surface). Laterally, the width of the surrounding excavations should be at least the radius of the soft area to a maximum of 10 feet (i.e. if the soft area has a diameter of 8 feet, excavate soil 4 feet laterally around the soft spot). This will allow the edges of the geogrid and bridging soils to be placed on stable material.
- Inspect the surface of the excavation to ensure that it is suitable for geogrid (i.e. no foreign substances such as debris or large rocks are present). Inspection will be conducted by the Field Engineering Team.
- Install Tensar BX1200 or equivalent biaxial geogrid on the inspected surface. The geogrid shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. If more than on strip is necessary, the geogrid strips shall be overlapped a minimum of 24-inches and tied together with cable ties every 5 feet. Hog rings and cable ties must meet geogrid manufacturer's recommendations.
- Backfill over geogrid with Rocky Flats Alluvium in 1-foot lifts compacted with a minimum of 6 passes with the sheep's foot compactor.
- Proof-roll area with loaded scraper per Specifications to ensure less than 1-inch of deflection.

Wet Soft Spots (SS4)

The wet spot investigated shows water and waste material at a shallow depth (0.5 to 1 foot). Excavating into the waste/water is discouraged, as the RCT cannot survey under wet conditions. Due to this, the method of repair varies from the other soft spot repair methods. SS4 is located within a fill area and suspect wet spots SS2 and SS13 are as well. Therefore, the fill material will be laid over geogrid in these areas to bridge the soft spot as follows:

- If possible (without creating muddy, unworkable conditions), level the soft spot area to facilitate placement of the geogrid at the discretion of the Field Engineering Team.

- If necessary, excavate surrounding soils to match the depth of the smoothed-out soft area. Laterally, the width of the surrounding excavations should be at least the radius of the soft area to a maximum of 10 feet (i.e. if the soft area has a diameter of 8 feet, excavate soil 4 feet laterally around the soft spot). This will allow the edges of the geogrid and bridging soils to be placed on stable material.
- Inspect the surface of the excavation to ensure that it is suitable for geogrid (i.e. no foreign substances such as debris or large rocks are present). Inspection will be conducted by the Field Engineering Team.
- Install Tensar BX1200 or equivalent biaxial geogrid on the inspected surface. The geogrid shall be laid smooth and free of tension, stress, folds, wrinkles, or creases. If more than on strip is necessary, the geogrid strips shall be overlapped a minimum of 24-inches and tied together with cable ties every 5 feet. Hog rings and cable ties must meet geogrid manufacturer's recommendations.
- Backfill over geogrid with Rock Layer material (as defined in Specification 02222). The thickness of the rock layer material will very depending on the thickness of fill required to achieve the regrade surface in the area on the soft spot repair. Follow the revised grading plan to determine how much fill can be placed, and place rock material equal to one half of the design regrade fill.
- Backfill over the rock material with Rocky Flats Alluvium (or approved fill material) in 1-foot lifts compacted with a minimum of 6 passes with the sheep's foot compactor. Follow the revised grading plan to determine how much fill can be placed, and place Rocky Flats Alluvium in a thickness required to meet regrade design surface elevations.
- Proof-roll area with loaded scraper per Specifications to ensure less than 1-inch of deflection.

Product Specification - Structural Geogrid BX1200

Tensar Earth Technologies, Inc. reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance. Please contact Tensar Earth Technologies, Inc. at 800-836-7271 for assistance

The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant polypropylene material with molecular weight and molecular characteristics which impart: (a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation; (b) high resistance to deformation when the geogrid is subjected to applied force in use; and (c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with: (a) compacted soil or construction fill materials; (b) contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and (c) rigid mechanical connectors such as bodkins, pins or hooks. The structural geogrid shall possess sufficient cross sectional profile to present a substantial abutment interface to compacted soil or particulate construction fill materials and to resist movement relative to such materials when subject to applied force. The structural geogrid shall possess sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for reinforcement of compacted soil or particulate construction fill materials to improve their long term stability in structural load bearing applications such as earth retention systems. The structural geogrid shall otherwise have the following characteristics:

Product Type: **Integrally Formed Structural Geogrid**
Load Transfer Mechanism: **Positive Mechanical Interlock**

Product Properties

Index Properties	**Units**	**MD Values[1]**	**XMD Values[1]**
• Aperture Dimensions[2]	mm (in)	25 (1.0)	33 (1.3)
• Minimum Rib Thickness[2]	mm (in)	1.27 (0.05)	1.27 (0.05)
Load Capacity			
• True Initial Modulus in Use[3]	kN/m(lb/ft)	400 (27,420)	650 (44,550)
• True Tensile Strength @2% Strain[3]	kN/m(lb/ft)	6.0 (410)	9.0 (620)
• True Tensile Strength @5% Strain[3]	kN/m(lb/ft)	11.8 (810)	19.6 (1,340)
Structural Integrity			
• Junction Efficiency[4]	%	93	
• Flexural Stiffness[5]	mg-cm	750,000	
• Aperture Stability[6]	kg-cm/deg	6.5	
Durability			
• Resistance to Installation Damage[7]	%SC / %SW / %GP	95 / 89 / 86	
• Resistance to Long Term Degradation[8]	%	100	

Dimensions and Delivery

The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 3.0 meters (9.8 feet) or 4.0 meters (13.1 feet) in width and 50.0 meters (164 feet) in length. A typical truckload quantity is 165 to 220 rolls. On special request, the structural geogrid may also be custom cut to specific lengths or widths to suit site specific engineering designs.

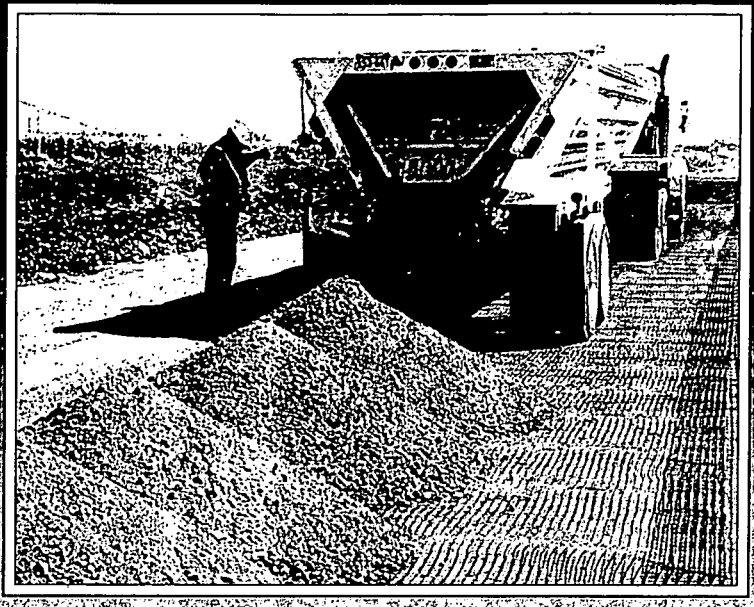
Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D-4759. Brief descriptions of test procedures are given in the following notes. Complete descriptions of test procedures are available on request from Tensar Earth Technologies, Inc.
2. Nominal Dimensions.
3. True resistance to elongation when initially subjected to a load measured via ASTM D6637 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability measured via GRI-GG2-87. Expressed as a percentage of ultimate tensile strength.
5. Resistance to bending force measured via ASTM D-5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of machine-and cross-machine-direction Flexural Stiffness values.
6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm moment to the central junction of a 9 inch x 9 inch specimen restrained at its perimeter (U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity).
7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818 and load capacity shall be measured in accordance with ASTM D6637.
8. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via EPA 9090 immersion testing.

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328-5363
(800) 836-7271

February 1, 2004
This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped prior to February 1, 2004.

SPECTRA



Subgrade Installation Guide

Tensar Earth Technologies, Inc.

INTRODUCTION

Tensar® Biaxial (BX) Geogrids have proven their performance and cost-effectiveness in thousands of soft ground applications. They improve the effective bearing capacity of subgrade by distributing loads over a wider area, similar to the way a snowshoe works to distribute a man's weight over soft snow.

Remarkable results can be achieved by using geogrids over soft ground. Undercutting can often be eliminated, and, unlike chemical stabilization methods, site access is improved in all types of weather. Firm construction platforms can even be built over ground too soft to support a man's weight.

However, proper performance is dependent upon proper installation. This guide is provided to assist the contractor in correctly installing Tensar BX Geogrids over soft subgrades (CBR of approximately 3 or less). Procedures for more competent subgrades are covered in the *"Spectra Base Reinforcement Installation Guide"*.

1. SITE PREPARATION

Debris, trees, stumps, and other large plant growth should be removed from the site. The surface should be graded smoothly. Backdrag, if possible, to smooth out ruts. Sometimes smooth grading is not practical, as may be the case in swampland, peat, muskeg, or marshes. The BX Geogrid may then be placed directly on the unprepared subgrade after cutting vegetation to geogrid level.

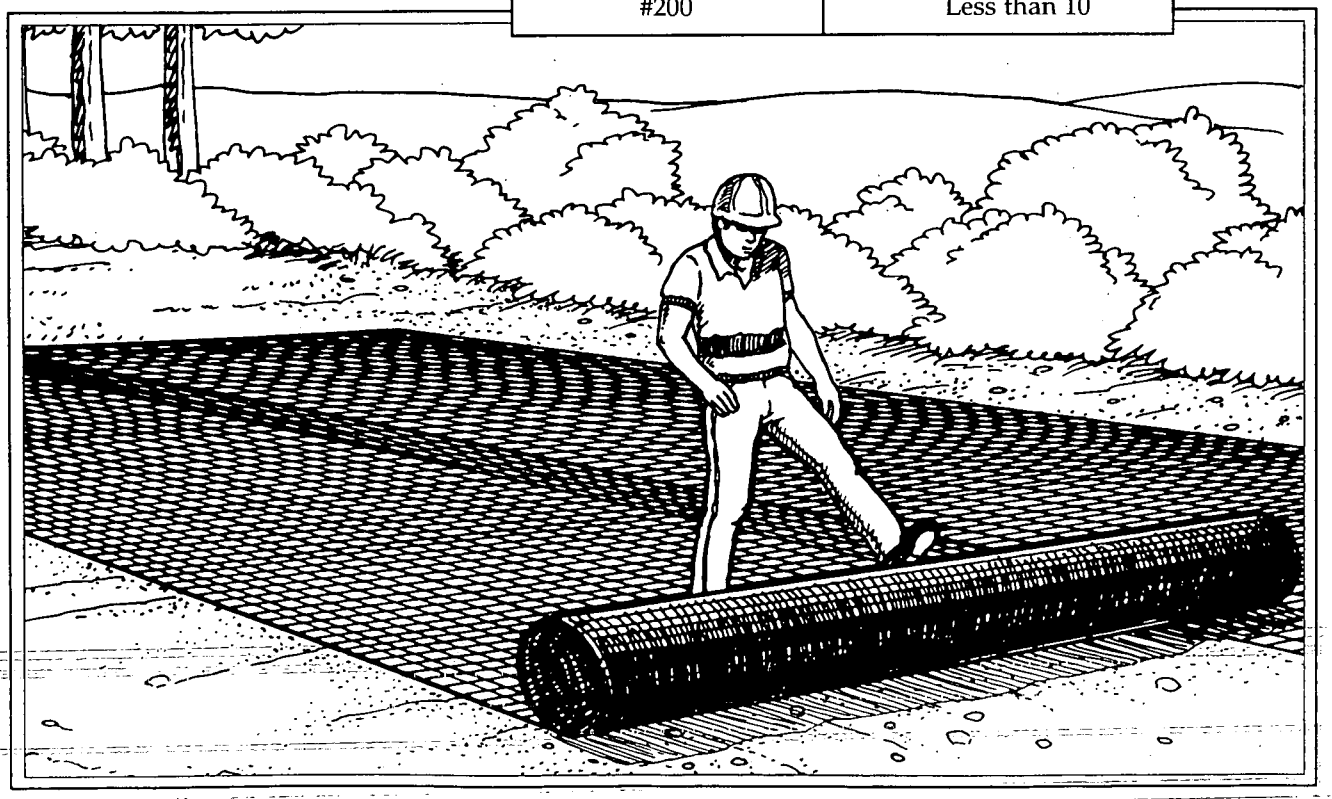
Care should be taken to avoid disturbing any surface crust overlying softer soil. In these cases, the geogrid should be placed directly on the unprepared subgrade.

The preferred gradation listed in Table 1 provides good stability and low moisture susceptibility. For other fill, a graded filter analysis would be prudent to check against potential contamination of underlying subgrade. See the *"Spectra Contractor Separation Flyer"* for additional information regarding Tensar BX Geogrid's ability to effectively separate subgrade soils from fill soils.

Table 1: Preferred Fill Gradation

Size	% Finer
1-½"	100
¾"	50-100
#4	25-50
#40	10-20
#100	5-15
#200	Less than 10

▼ Figure 1: Placing BX Geogrid



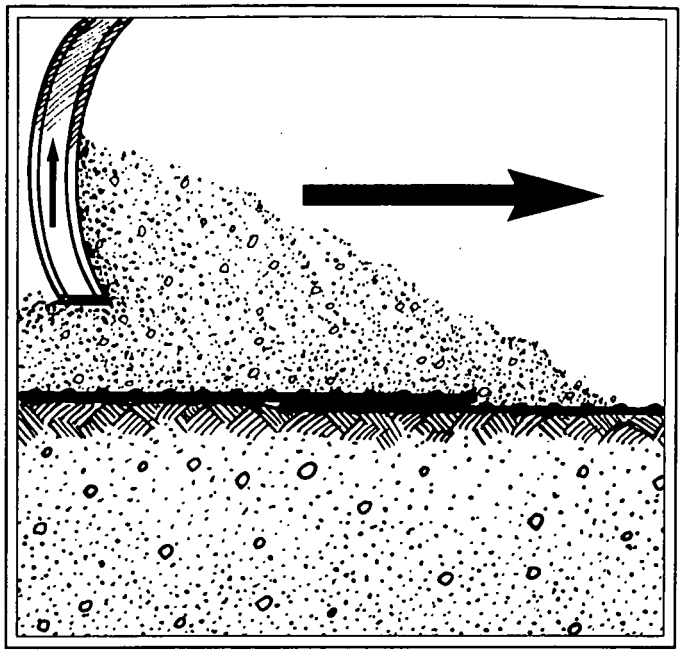
2. GEOGRID TYPE AND PLACEMENT

The type of Tensar BX Geogrid recommended depends on the strength of the subgrade, the weight of the equipment and vehicles operating on the reinforced fill, the performance required, etc. It is recommended that the contractor use Tensar Earth Technologies' SpectraPave2 Software to determine the appropriate type of Tensar BX Geogrid to use. (See *SpectraPave2 Software* for more information.)

Place the geogrid in position and manually roll it out over the subgrade (Figure 1). Adjacent rolls of geogrid should be overlapped in accordance with Table 2. Overlap (shingle) geogrids in the direction that the fill will be spread (Figure 2). Adjacent rolls of geogrid should be tied together as recommended in Table 2 and illustrated in Figure 3. The geogrid corners may be held down with shovelfuls of fill, pins, sandbags, etc.

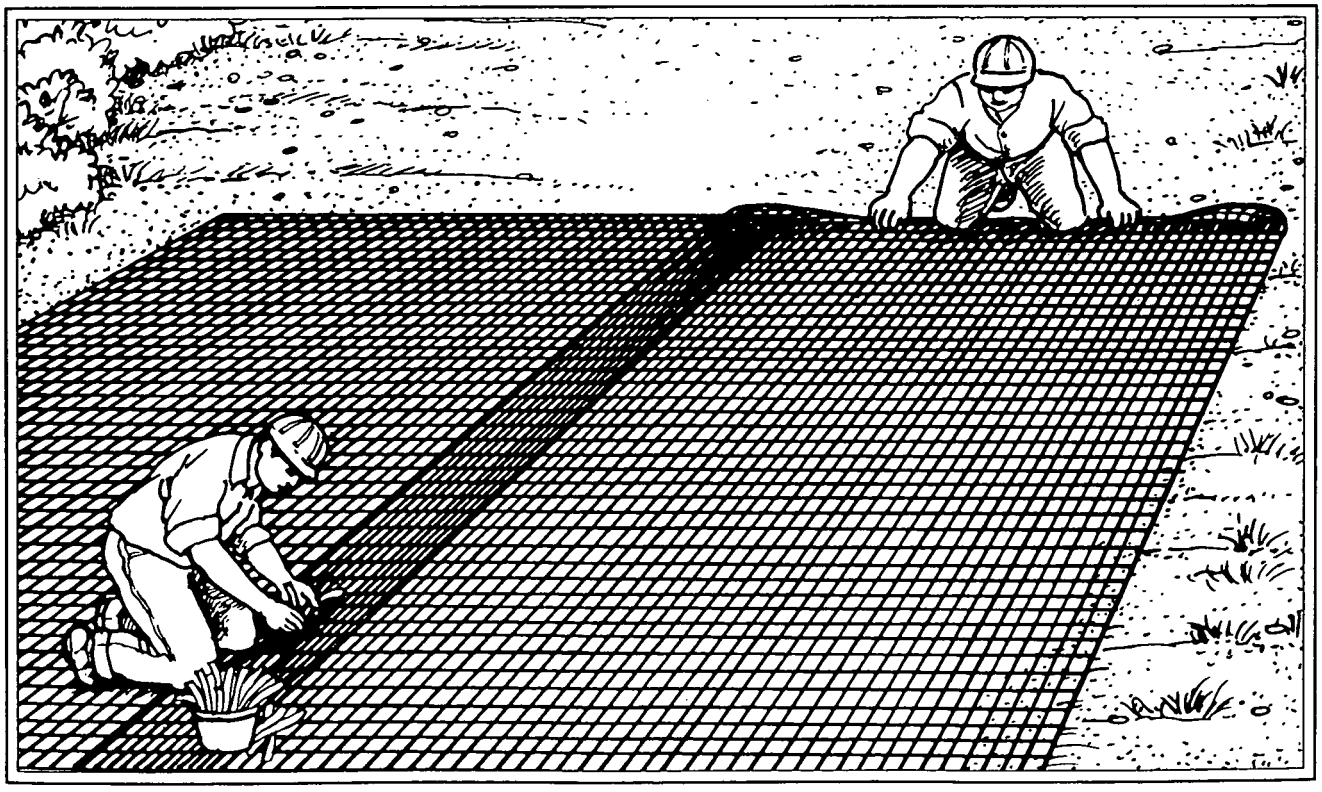
Table 2: Recommended Overlaps

Soil Type	CBR	Overlap	Tie Spacing
Firm	> 3	1 ft.	—
Soft Ground	1-3	2 ft.	20 ft.
Very Soft Ground	< 1	3 ft.	5 ft.



▲ Figure 2: Overlapping BX Geogrids

▼ Figure 3: Anchoring geogrid with hog rings or plastic ties



3. DUMPING AND SPREADING FILL

Do not operate equipment directly on the geogrid over soft ground.

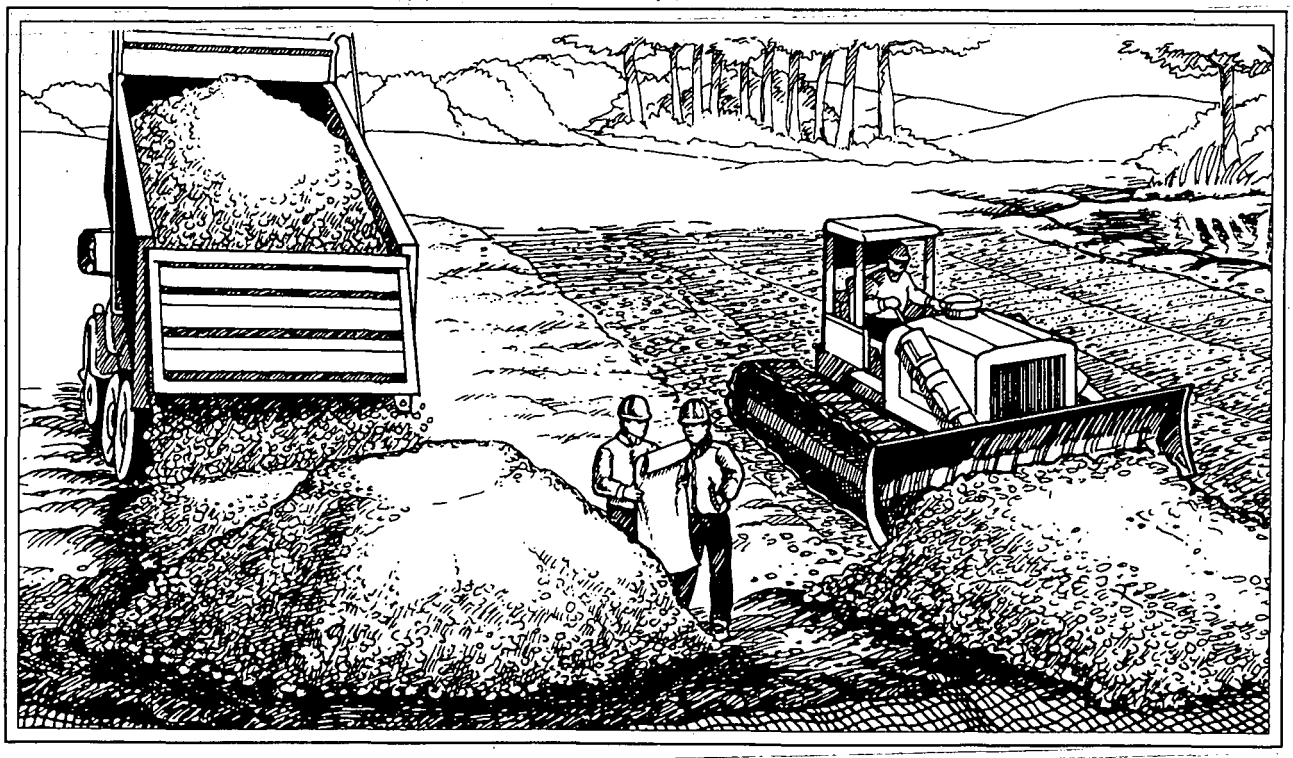
Thin fill lifts over soft subgrades may not be sufficient to support equipment. In general, an initial fill lift of no less than six inches is required. For very soft conditions, the required fill thickness is a function of subgrade strength and construction procedure, usually it will be significantly greater than six inches. Please contact your local Tensar representative for assistance or call 800-TENSAR-1.

Over relatively competent subgrades (CBR > 2), fill may be dumped onto the geogrid. In softer conditions, fill should be dumped over ground that will bear its weight and then pushed out over the geogrid. Work from stronger to weaker subgrade areas. In very soft conditions, fill should be placed by a lightweight, low ground pressure (LGP) dozer (Figure 4).

The dozer blade should be feathered as each lift is pushed out. In other words, the blade should be gradually raised as the fill is pushed out over the Tensar Geogrid. This will cause much of the fill to roll out onto the geogrid and will reduce stress on the subgrade. Back dump subsequent loads onto the leveled fill and advance forward by spreading with a dozer. Be aware of the direction of the overlaps of the geogrid, and don't work against the shingle pattern. If wrinkles or waves develop in the geogrid, they will usually roll forward with the fill and out at the end of the geogrid roll. Care should be taken not to catch the dozer blade or other equipment on the BX Geogrid.

Standard compaction methods can be used unless the soils are very soft. In these cases, static rather than vibratory compaction should be used. Compaction is normally accomplished with a light roller and moisture. (Water spray is especially efficient with sand fill.) If rutting or severe pumping occurs under truck or dozer traffic, fill should be added immediately to strengthen the section.

▼ Figure 4: Dumping and spreading fill



SPECTRAPAVE2™ SOFTWARE

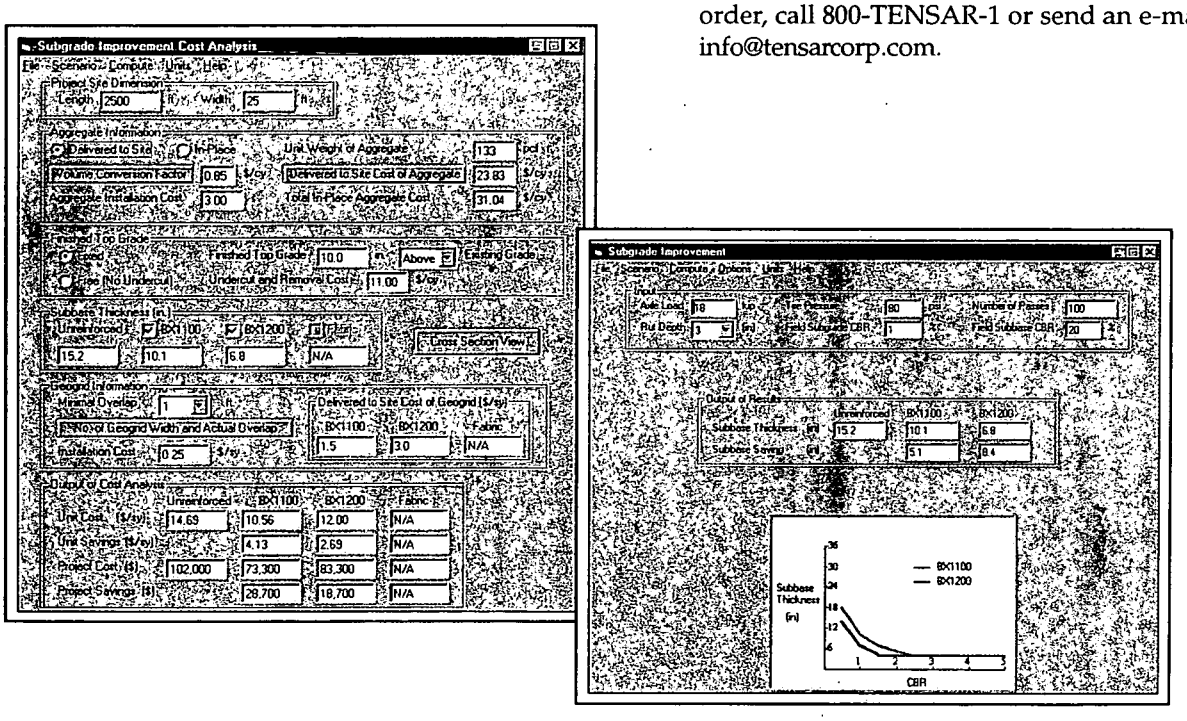
Dr. J.P. Giroud and Dr. Jie Han recently released new technology developed for subgrade improvement design. Their work is the most comprehensive advancement in the design of unpaved roads in the last 20 years.

Tensar Earth Technologies has taken this technology a step further by upgrading SpectraPave™ Software to SpectraPave2. This upgrade has broken new ground with signifigant advancements over any other program available and features four modules including:

- *Project Information*
- *Subgrade Improvement* (with state-of-the-practice detailed analysis)
- *NEW Subgrade Improvement Cost Analysis*
- *Base Course Reinforcement*

Subgrade Improvement Module

Based on Dr. J.P. Giroud and Dr. Jie Han's latest study, the Subgrade Improvement module incorporates the just-released performance-based Giroud-Han Design Technology, which supports the use of certain geosynthetics to reduce aggregate requirements and improve subgrade performance. The module indicates the required thickness for an unreinforced subbase and for a subbase reinforced with Tensar BX Geogrids.



NEW Subgrade Improvement Cost Analysis

A Spectra System, reinforced with Tensar BX Geogrids or a conventional section? The new comprehensive Cost Analysis module provides cost comparisons between an unreinforced subbase and a subbase reinforced with Tensar BX Geogrids. Comparative cross-sections indicating required fill are also generated. Output includes unit cost, unit savings, project cost, and project savings.

Available in CD-ROM format supporting Windows® 95, 98, 2000, or NT, SpectraPave2 Software may be downloaded at no charge from our web site at www.tensarcorp.com. For more information or to order, call 800-TENSAR-1 or send an e-mail to info@tensarcorp.com.

To investigate a specific project application, to receive a copy of the Spectra Pavement Systems Brochure, or to receive general or technical information, contact a Tensar Technology Engineer by calling 800-TENSAR-1, sending an e-mail to info@tensarcorp.com, or via our web site at www.tensarcorp.com.

We can quickly provide you with:

- ► Information on products and services in your area
- ► Preliminary cost estimates, conceptual designs, and specs
- ► Summaries of completed projects
- ► SpectraPave2 Software

Tensar®

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328
800-TENSAR-1
www.tensarcorp.com

©2002, Tensar Earth Technologies, Inc. *TENSAR* and *SPECTRA* are registered trademarks. *SPECTRAPAVE* is a trademark. The information contained herein has been carefully compiled by Tensar Earth Technologies, Inc. and to the best of its knowledge accurately represents Tensar product use in the applications which are illustrated. Final determination of the suitability of any information or material for the use contemplated and its manner of use is the sole responsibility of the user. The products and/or applications illustrated herein are covered by one or more of the following U.S. patents: 5156495, 5419659, 4590029, 4743486, 559546, 5632571. Other U.S. or foreign patents may apply or are pending. Printed in the U.S.A.

IG-SI-1.02

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)

Date: 9/29/04

New Submittal / Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 038
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No. a.	Description of Item Submitted (Type, size, model number, etc.) b.	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8) c.	No. of Copies d.	Contract Reference Document: Spec. Paragraph No. e.	Contract Reference Document: Drawing Sheet No. f.	Deviation (See Instruction #6) g.	Contractor Action Code (See Instruction #9) h.
1	Temporary Seep Capture System – material cut sheets	N/A	1	N/A	N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

Remarks: Requesting approval to procure and install.

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert Davis DATE: 10/07/2004

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted. Paul B. Kreitz

Signature of Subcontractor:

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA H. Rala Tetra Tech 10/19/04

LOG IN

User ID

Password

Go

more

Item Details

< Back

Pumps & Plumbing > Well > Submersible Pumps

Pump,Deep Well,1/2 HP

Submersible Deep Well Pump, Power Rating 1/2 HP, Voltage Rating 230 Volts, Flow Rating 10 GPM, Number of Wires 3, SF Current 4.2 Amps, Stages 6, Control Box Required 4P843, Cast Iron

Grainger Item:	4P856	Ship Qty :	1
Price (ea) :	$269.25	Sell Qty (Will-Call) :	1
Manufacturer:	TEEL	Usually Ships :	Today
Mfg. Model#:	4P856	Catalog 395 Page:	3151

Qty.

Add to Order

Compare Alternates

Price shown may not reflect your price.*Log-in* above,or click here to register.

NOTES & RESTRICTIONS

Repair Parts Info available for this product.

See Catalog 395 Page for application and/or safety information.

TECHNICAL SPECIFICATIONS

Type	Assembled
HP	1/2
Number of Wires	3
Control Box Required	4P843
Volts 60 Hz	230
Stages	6
SF Amps	4.2

REQUIRED ACCESSORIES

Subm-Pump Pipe Package

Submersible Pump Control Installation Package, for up to 2 horsepower Pump, Pre-Pressurized Water Tank

Price (ea): $70.20 Usually Ships : 1-3 Days

Grainger Item#: 1P920

Qty.

Stock No.	Well Capacity	HP	Tank psi	GPM @ Vertical Depth to Water (Ft.) 20	40	60	80	100	125	150	175	200	250	300	350	400	450	500	550	Recommended Tank†
4P848	Low	1/3	20	#	#	5.7	5.3	5.0	4.7	4.2	3.2	2.3	—	—	—	—	—	—	—	4R834
4P847			30	5.7	5.5	5.3	5.0	4.7	4.2	3.7	2.2	1.7	—	—	—	—	—	—	—	3YA56
			40	5.5	5.2	4.8	4.5	4.2	3.7	3.0	1.0	—	—	—	—	—	—	—	—	
			50	5.0	4.8	4.5	4.2	3.7	3.0	2.3	—	—	—	—	—	—	—	—	—	
			60	4.8	4.5	4.0	3.7	3.0	2.3	1.3	—	—	—	—	—	—	—	—	—	
4P849	Low	1/2	20	#	#	#	7.4	7.3	7.0	6.7	6.3	5.7	4.5	2.8	—	—	—	—	—	4P835
4P850			30	#	#	7.4	7.2	7.1	6.8	6.3	5.8	5.2	3.6	1.5	—	—	—	—	—	4P836
4RG99			40	#	7.4	7.2	7.0	6.8	6.4	5.8	5.3	4.6	2.9	—	—	—	—	—	—	3YA56
4RH03			50	7.3	7.2	7.0	6.7	6.4	5.9	5.3	4.7	3.7	1.7	—	—	—	—	—	—	
4RH04			60	7.2	6.9	6.7	6.3	5.9	5.3	4.7	3.8	3.0	—	—	—	—	—	—	—	
4P851	Low	3/4	20	#	#	#	#	#	7.4	7.3	7.1	6.9	6.5	5.7	4.8	3.5	2.2	—	—	4P835
4RH01			30	#	#	#	#	7.4	7.3	7.1	7.0	6.7	6.1	5.3	4.2	3.0	1.1	—	—	4P836
4RH05			40	#	#	#	7.4	7.3	7.2	7.0	6.8	6.5	5.7	4.9	3.6	2.4	—	—	—	3YA56
			50	#	#	7.4	7.3	7.2	7.0	6.8	6.5	6.2	5.4	4.3	3.1	1.3	—	—	—	
			60	7.5	7.4	7.3	7.1	7.0	6.8	6.5	6.2	5.8	4.9	3.6	2.4	—	—	—	—	
4RH02	Low	1	20	#	#	#	#	#	#	7.5	7.4	7.2	7.0	6.6	6.0	5.3	4.5	3.5	2.5	4P835
4RH06			30	#	#	#	#	#	7.5	7.4	7.3	7.2	6.9	6.3	5.8	5.1	4.1	3.1	1.7	4P836
			40	#	#	#	#	7.5	7.4	7.3	7.2	7.0	3.7	6.1	5.4	4.6	3.6	2.6	0.3	3YA56
			50	#	#	#	7.5	7.4	7.3	7.2	7.0	6.9	6.4	5.8	5.1	4.1	3.1	1.9	—	
			60	#	#	7.5	7.4	7.3	7.2	7.0	6.9	6.7	6.1	5.5	4.7	3.6	2.7	0.7	—	
4P852	Avg.	1/3	20	11.0	11.0	10.0	8.0	5.0	—	—	—	—	—	—	—	—	—	—	—	3WA39
4P853			30	11.0	9.7	7.9	4.7	—	—	—	—	—	—	—	—	—	—	—	—	3YA57
4P854			40	9.5	7.5	4.3	—	—	—	—	—	—	—	—	—	—	—	—	—	
			50	7.2	3.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
			60	3.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
4P855, 4P856	Avg.	1/2	20	15.6	14.8	14.0	13.0	11.8	10.2	8.2	5.7	2.1	—	—	—	—	—	—	—	3WA39
4P857, 4P858			30	14.6	13.7	12.8	11.6	10.3	8.3	6.0	2.5	—	—	—	—	—	—	—	—	3YA57
4RG76			40	13.6	12.6	11.5	10.1	8.6	6.1	2.8	—	—	—	—	—	—	—	—	—	
4RG80			50	12.5	11.3	9.9	8.2	6.2	3.0	—	—	—	—	—	—	—	—	—	—	
4RG81			60	11.0	9.6	8.0	6.0	3.2	—	—	—	—	—	—	—	—	—	—	—	
4P859	Avg.	3/4	20	#	15.8	15.0	14.4	13.7	12.8	11.7	10.5	9.2	5.7	—	—	—	—	—	—	4P838
4P860			30	15.5	15.0	14.3	13.5	12.8	11.8	10.6	9.3	7.7	3.5	—	—	—	—	—	—	3YA58
4RG77			40	14.9	14.2	13.5	12.7	11.9	10.7	9.4	7.9	6.0	—	—	—	—	—	—	—	3YA59
4RG82			50	14.1	13.4	12.5	11.7	10.8	9.4	8.0	6.1	4.1	—	—	—	—	—	—	—	
			60	13.2	12.4	11.6	10.6	9.5	8.1	6.3	4.2	—	—	—	—	—	—	—	—	
4P861	Avg.	1	20	#	#	15.7	15.3	14.8	14.2	13.4	12.6	11.8	9.8	7.2	3.8	—	—	—	—	4P838
4RG78			30	#	15.6	15.2	14.7	14.2	13.5	12.8	11.8	10.8	8.5	5.8	2.0	—	—	—	—	3YA58
4RG83			40	15.6	15.1	14.6	14.1	13.5	12.9	11.9	10.9	9.8	7.4	4.2	—	—	—	—	—	3YA59
			50	15.1	14.5	14.0	13.4	12.9	11.9	10.9	9.9	8.8	5.9	2.2	—	—	—	—	—	
			60	14.4	13.9	13.3	12.8	12.0	11.0	10.0	8.8	7.5	4.5	—	—	—	—	—	—	
4P862	Avg.	1½	20	#	#	#	#	15.8	15.4	14.9	14.4	14.9	12.8	11.6	10.3	8.7	6.9	4.4	—	4P838
4RG79			30	#	#	#	15.7	15.4	14.9	14.5	14.9	13.4	12.3	11.0	9.6	7.9	5.8	2.9	—	3YA58
4RG84			40	#	16.0	15.6	15.3	15.0	14.5	14.0	13.5	12.9	11.7	10.4	8.9	7.1	4.6	1.0	—	3YA59
			50	15.9	15.5	15.3	14.9	14.5	14.0	13.5	12.9	12.4	11.0	9.7	8.0	6.0	3.2	—	—	
			60	15.5	15.2	14.8	14.4	14.0	13.5	13.0	12.4	11.7	10.5	9.0	7.3	4.7	1.2	—	—	
4RC09	Avg.	1/2	20	14.7	14.1	13.3	12.5	11.7	10.6	8.3	6.1	3.4	—	—	—	—	—	—	—	3WA39
4RC10			30	13.7	12.8	11.7	10.9	9.8	8.7	6.1	4.8	—	—	—	—	—	—	—	—	
4RC11			40	12.3	11.4	10.4	9.1	8.5	5.9	4.2	—	—	—	—	—	—	—	—	—	
4RC12			50	11.3	10.2	8.8	8.2	6.2	5.5	—	—	—	—	—	—	—	—	—	—	
			60	10.9	9.9	8.6	6.1	4.5	—	—	—	—	—	—	—	—	—	—	—	
4RC13	Avg.	3/4	20	#	15.4	14.8	14.3	13.7	13.0	12.0	11.5	10.7	8.9	6.1	—	—	—	—	—	4P838
4RC14			30	14.5	14.2	13.7	13.1	12.7	12.1	11.5	10.8	9.7	7.0	4.0	—	—	—	—	—	
			40	14.0	13.4	13.0	12.5	12.0	11.5	10.5	10.2	8.5	6.0	—	—	—	—	—	—	
			50	13.5	13.0	12.5	12.0	11.5	10.8	10.1	8.5	7.0	2.4	—	—	—	—	—	—	
			60	13.0	12.5	12.0	11.5	11.0	10.5	8.5	8.0	6.0	—	—	—	—	—	—	—	
4RC15	Avg.	1	20	#	#	15.0	14.6	14.3	13.8	13.2	12.8	12.2	10.9	9.0	7.0	4.8	—	—	—	4P838
			30	#	14.9	14.2	13.8	13.6	12.9	12.5	12.0	11.8	9.8	8.2	6.0	4.2	—	—	—	
			40	14.9	14.5	14.0	13.7	13.2	12.4	12.0	11.7	10.9	9.5	7.2	4.4	—	—	—	—	
			50	14.2	13.7	13.3	12.9	12.4	12.0	11.7	12.3	9.7	8.8	6.3	—	—	—	—	—	
			60	13.7	13.2	12.8	12.3	12.0	11.7	10.7	10.0	9.3	7.1	5.0	—	—	—	—	—	
4RC16	Avg.	1½	20	#	#	#	15.0	14.0	14.4	14.3	14.0	13.7	12.5	12.0	11.0	10.0	8.9	7.0	—	4P838
			30	#	#	15.2	14.9	14.5	14.0	13.8	13.6	12.8	12.0	11.3	10.2	9.0	8.0	6.0	—	
			40	#	15.2	15.0	14.7	14.7	13.9	13.5	13.3	12.6	11.8	11.0	10.2	8.7	7.0	4.2	—	
			50	15.3	15.0	14.6	14.3	13.9	13.5	13.0	12.8	12.3	11.4	10.5	9.5	8.0	6.0	2.0	—	
			60	14.8	14.6	14.3	14.0	13.6	13.2	12.8	12.5	11.0	11.0	10.2	9.0	7.3	4.9	—	—	
4RC17	High	1	20	33.0	31.5	29.0	26.2	24.3	18.5	17.0	7.9	—	—	—	—	—	—	—	—	4P839
4RC18			30	31.5	29.9	27.5	25.2	22.0	16.5	8.1	—	—	—	—	—	—	—	—	—	
			40	28.5	25.6	23.1	19.9	17.6	15.0	—	—	—	—	—	—	—	—	—	—	
			50	26.1	24.3	21.2	17.5	13.1	12.0	—	—	—	—	—	—	—	—	—	—	
			60	22.1	18.9	15.5	12.5	—	—	—	—	—	—	—	—	—	—	—	—	
4RC19	High	1½	20	35.2	33.2	32.5	31.1	29.0	27.5	26.0	23.6	19.0	10.5	—	—	—	—	—	—	4P839(2)
			30	33.5	31.9	29.9	30.0	28.5	26.2	23.0	20.1	12.9	—	—	—	—	—	—	—	
			40	31.9	30.8	28.6	27.2	26.1	23.5	20.5	17.2	11.4	—	—	—	—	—	—	—	
			50	30.5	29.1	27.2	25.5	24.2	22.4	12.5	10.5	—	—	—	—	—	—	—	—	
			60	28.0	26.4	24.3	20.5	20.0	17.5	10.6	—	—	—	—	—	—	—	—	—	
4P863	High	1	20	30.2	28.8	27.0	25.1	23.3	20.8	17.9	12.5	4.5	—	—	—	—	—	—	—	4P839
4P864			30	28.4	26.7	24.8	22.9	20.9	18.0	13.0	5.0	—	—	—	—	—	—	—	—	3YA55
4RG94			40	26.4	24.7	22.7	20.7	18.4	14.0	5.9	—	—	—	—	—	—	—	—	—	
4RG96			50	24.2	22.4	20.1	17.9	14.1	6.1	—	—	—	—	—	—	—	—	—	—	
			60	21.9	19.9	17.2	13.0	6.7	—	—	—	—	—	—	—	—	—	—	—	

(#) Pump motors will overload depths less than 20 ft. or at depths indicated. See "Caution" in Guide for "Submersible Pumps Selection" on page 3148. (†) Suggested tanks are sized to provide drawdown sufficient to allow approximately 2-minute cycling at 80 ft. depth to water, daily peak use. For shallower wells, use next size larger tank. Tank models with extra number shown indicate the number of tanks needed to provide sufficient drawdown at pressure setting shown.

CONTINUED

= Shipped Directly from Manufacturer ✓= Extended Warranty Available ★= New Item

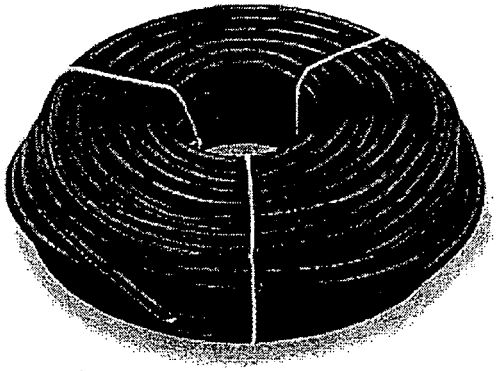
Item Details

< Back

Electrical > Wire and Cable > Electrical Wire and Cable

Cord,Portable,250ft

All Purpose Cord, Conductor Gauge 10/3, Maximum Voltage 300, Maximum Current Rating 30 Amps, Nominal OD 0.570 Inch, Coiled in Carton Length 250 Feet, Cord Type SJOOW, Color Black, Stranded Copper Conductors



Grainger Item:	3ZK61	Ship Qty :	1
Price (ea) :	$286.75	Sell Qty (Will-Call) :	1
Manufacturer:	CAROL	Usually Ships :	Today
Mfg. Model#:	01383.85.01	Catalog 395 Page:	571

Qty. [ ]

Add to Personal List | Add to Order

Compare Alternates

Price shown may not reflect your price.*Log-in* above,or click here to register.

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

OPTIONAL ACCESSORIES

Accesstrak Kit

Cable Protector Kit, Channel Height 1.31 Inches, Channel Width 1.34 Inches, Height 4.00 Inches, Length 41.06 Inches, Width 42.90 Inches, 5 Channels, For

Price (ea): $982.50 Usually Ships : 1-3 Days

Grainger Item#: 3BY36

Qty. [ ]

Add to Personal List | Add to Order

Duct,Cable Positioning

TECHNICAL SPECIFICATIONS

Item	Portable Cord
Gauge Conductor	10/3
Max. Voltage	300
Max. Amps @ 120V	30
Nominal Outside Dia. (In.)	0.610
Spool/Coil Length (Ft.)	250
Jacket Type	SJOOW
Color	Black
Conductor	Stranded Copper
Temp. Range	-40 to 90°C
Resists	Oil, Moisture and Abrasion

LOG IN

User ID

Password Go

more

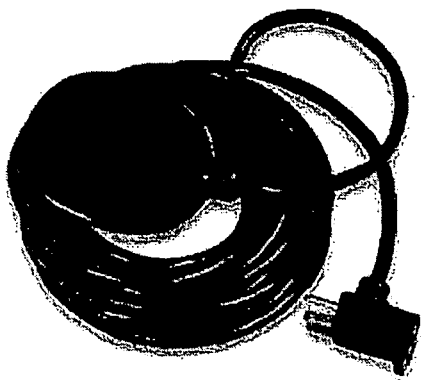
Item Details

< Back

Pumps & Plumbing > Controls > Float Switches

Float Switch Extra HD

Extra Heavy Duty Float Switch, Voltage @ 60 Hz 115, Cord Length 20 Feet, Wire Gauge 14, Starting Current 60 Amps, Maximum Running Current 15 Amps, Pumping Range Minimum/Maximum 6 To 20 Inches, Tether Length Range 3 1/2 To Unlimited Inches, Maximum Temp



Grainger Item:	3BY63	Ship Qty :	1
Price (ea) :	$70.00	Sell Qty (Will-Call) :	1
Manufacturer:	DAYTON	Usually Ships :	Today
Mfg. Model#:	3BY63	Catalog 395 Page:	3100

Qty.

Add to Personal List | Add to Order

Compare Alternates

Price shown may not reflect your price. *Log-in* above, or click here to register.

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

ALTERNATE PRODUCTS

Float Switch Extra HD

Extra Heavy Duty Float Switch, Voltage @ 60 Hz 115, Cord Length 30 Feet, Wire Gauge 14, Starting Current 60 Amps, Maximum Running Current 15 Amps, Pumping

Price (ea): $75.00 Usually Ships : Today

Grainger Item#: 3BY67

Qty.

Add to Personal List | Add to Order

TECHNICAL SPECIFICATIONS

Item	Mechanical Float Switch
Volts	115
Cord Length (Ft.)	20
Wire Gauge	14
Starting Amps	96
Max. Amps Running	15
Pumping Range Min./Max.	5-30
Tether Length Min.-Max. (In.)	3-22
Max. Temp. (F)	140
Type	Extra Heavy Duty
Included	Mounting Strap

LOG IN

User ID

Password

Go

more

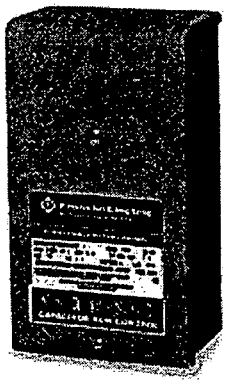
Item Details

< Back

Pumps & Plumbing > Controls > Submersible Motor and Pump Control Boxes

Pump Control Box,1/2hp

Submersible Pump Control Box, Motor/Pump Power 1/2 HP, Voltage @ 60 hz 230 Volts, Control Box Type CSCR, Phase Single, Height 8 1/2 Inches, Depth 2 7/8 Inches, Width 4 7/8 Inches, For 3 Wire Motor and Well Pumps 1D131, 4P849 and 4P856



Grainger Item:	4P843	Ship Qty :	1
Price (ea) :	$79.15	Sell Qty (Will-Call) :	1
Manufacturer:	FRANKLIN	Usually Ships :	Today
Mfg. Model#:	282405-50	Catalog 395 Page:	3156

Qty.

Add to Personal List | Add to Order

Compare Alternates

Price shown may not reflect your price. *Log-in* above, or click here to register.

NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

ALTERNATE PRODUCTS

Pump Control Box,1/2hp

Submersible Pump Control Box, Motor/Pump Power 1/2 HP, Voltage @ 60 hz 230 Volts, Control Box Type CSIR, For Use With Motor Numbers 1D131, Phase Single,

Price (ea): $53.70
Grainger Item#: 1D146

Usually Ships : Today

Qty.

Add to Order

TECHNICAL SPECIFICATIONS

Motor/Pump HP	1/2
Volts 60 Hz	230V
Control Box Type	CSCR
For Use with Motor Number	1D131
Phase	1
Height (In.)	8 1/2
Depth (In.)	2 7/8
Width (In.)	4 7/8
Application	Recommended for Water Systems that Utilize a Pressure Switch and Safety Relief Valve, For 3 Wire Motor and Well Pump
	Type 3R, Allows for

LOG IN

User ID

Password
Go

more

Item Details

< Back

Pumps & Plumbing > Controls > Pump Control Boxes

Pump Control,230 V

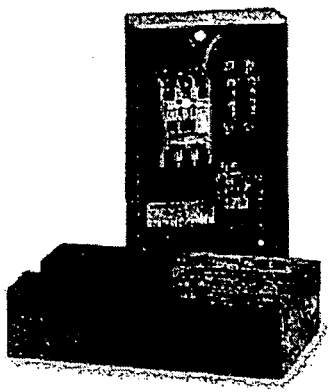
Simplex Pump Control, Voltage Rating 230 Volts, Phase Single, Current Rating 32 Amps, Enclosure Type NEMA 1, Height 10 1/4 Inches, Width 5 1/2 Inches, Depth 5 Inches

Grainger Item:	4BA65	Ship Qty :	1
Price (ea) :	$122.15	Sell Qty (Will-Call) :	1
Manufacturer:	DAYTON	Usually Ships :	Today
Mfg. Model#:	ECON1	Catalog 395 Page:	3101

Qty.

Add to Personal List | Add to Order

Price shown may not reflect your price. *Log-in* above, or click here to register.



NOTES & RESTRICTIONS

See Catalog 395 Page for application and/or safety information.

TECHNICAL SPECIFICATIONS

Volts	230
Phase	1
Amps	32
Enclosure Type	NEMA 1
Thermal Unit Size	N/A
Height (In.)	10 1/4
Width (In.)	5 1/2
Application	For Residential, Commercial and Industrial Uses, Controlling Surface Water, Underground Water, Sewage and Waste Water Systems, Lift Stations, Pump Chambers, Pump Basins, Irrigation

Add to Personal List

Compare Alternates

Enclosure	Outdoor Use
Mounting	Pole or Wall
Characteristics	For Greater Electrical Efficiency and Longer Pump Life, Recommended for Water Systems that Utilize a Pressure Switch and Safety Relief Valve, Has Pre-punched Holes
Accepts	Up to #10 AWG Wire
Includes	Magnetic Contactor Eliminating the Need for Auxiliary Boxes, Contactors and a Heavy Duty Pressure Switch

---

Home | Services | Resources | Company Info | Contact Us | Find A Branch | Help | Site Map
Investor Relations | Terms of Access | Terms of Purchase | Privacy Policy (Rev:10/20/2002)
© 1994 - 2004 W.W. Grainger, Inc. All rights reserved.

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date:	10/1/04	New Submittal
			Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 39
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No. a.	Description of Item Submitted (Type, size, model number, etc.) b.	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8) c.	No. of Copies d.	Contract Reference Document: Spec. Paragraph No. e.	Contract Reference Document: Drawing Sheet No. f.	Deviation (See Instruction #6) g.	Contractor Action Code (See Instruction #9) h.
1	Geo-technical data – Rocky Flats Alluvium soil	N/A	4	N/A	N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED
☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS.

BY: Robert K. Davis DATE: 10/10/2004

Remarks:
Incorrectly submitted as RFI 38; should be RFI 39.

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Paul Kreitz

Signature of Subcontractor:

Section II — **Reviewed**

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK COA Jack H. Rale Tetra Tech 10/19/04

TABLE 1
ROCKY FLATS/FIELD and LAB TESTING/CO
SUMMARY OF SOIL DATA

ROCKY FLATS ALLUVIUM

Sample Type	Sample Number	Sample Depth (ft)	U.S.C.S. Soil Classification	Delivered Moisture (%)	Atterberg Limits			Grain Size Distribution			Specific Gravity	Moist/Den Relationship Standard Proctor		Additional Tests Comments (See Notes)
					LL	PL	PI	% Finer 3/4"	% Finer #4	% Finer #200		PCF (Dry)	Moist (%)	
Bulk	A-1	3	GC	13.8	52	20	32	63	42	16	--	P	P	
Bulk	A-2	3	GC	9.2	43	16	27	60	47	20	--	P	P	
Bulk	A-3	6	GC	8.0	45	18	27	68	46	18	--	P	P	
Bulk	A-4	12	GC	14.3	47	16	31	69	48	21	--	P	P	
Bulk	A-5	3	GC	11.2	40	16	24	64	43	14	--	P	P	
Bulk	A-6	2	GC	10.2	45	17	28	58	40	16	--	P	P	
Bulk	A-7	6	GC	13.1	48	16	32	59	41	16	--	P	P	
Bulk	A-7Dup	6	GC	14.1	47	18	29	59	41	15	--	P	P	
Bulk	A-8	3	GC	11.6	47	18	29	64	44	18	--	P	P	
Bulk	A-9	10	GC	9.2	48	18	30	71	51	22	--	P	P	
Bulk	A-10	4	GC	7.8	52	21	31	52	34	16	--	P	P	

NOTES:
LL = LIQUID LIMIT
PL = PLASTIC LIMIT
PI = PLASTIC INDEX
SL = SHRINKAGE LIMIT

T = TRIAXIAL TEST
U = UNCONFINED COMPRESSION TEST
C = CONSOLIDATION TEST
DS = DIRECT SHEAR TEST
PERM = PERMEABILITY

* ASTM D4718

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-1
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	393.60
Wt. Dry Soil & Tare (gm)	358.16
Wt. of Tare (gm)	100.81
Wt. of Water (gm)	35.44
Weight of Dry Soil (gm)	257.35
Moisture Content (%)	13.77

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	20.80	23.66
Weight of Dry Soil & T	19.80	22.35
Weight of Tare (gm)	14.35	15.89
Weight of Water (gm)	1.10	1.31
Weight of Dry Soil (gm)	5.47	6.46
Water Content %	20.11	20.28

LIQUID LIMIT DETERMINATION

32	25	19
25.84	23.87	23.96
27.60	26.40	26.44
15.98	16.91	13.81
3.24	3.42	3.52
6.62	6.49	6.63
48.94	52.70	53.09

PLASTIC LIMIT (PL): 20

LIQUID LIMIT (LL): 52

PLASTICITY INDEX (PI): 32

BLOWS	MC		
32	48.94	3.47	25
25	52.70	3.22	0.00
19	53.09	2.94	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
48.94	53.09	51.50	51.50	52
-2	54.00	51.50		20
				32

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00	
0.00	0.00	
#DIV/0!	#DIV/0!	

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL):

LIQUID LIMIT (LL):

PLASTICITY INDEX (PI):

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL): NP

LIQUID LIMIT (LL): NP

PLASTICITY INDEX (PI): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	393.60
Wt. Dry Soil & Tare (gm)	358.16
Wt. of Tare (gm)	100.81
Wt. of Water (gm)	35.44
Weight of Dry Soil (gm)	257.35
Moisture Content (%)	13.8

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-1 Depth (ft) 3
TYPE	BULK

Description: Light to moderate yellowish brown (5 YR 5/6, 4/4) clayey gravel with sand

USCS: GC

LL	52
PL	20
PI	32

TEST BY	DT
DATE SET UP	7/29/2004
REVIEW BY	MB

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	151.70
Dry Soil & Tare (gm)	144.47
Tare Weight (gm)	27.83
Moisture Content (%)	6.2

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	46015.16
Tare Weight (gm)	
Total Weight (gm)	46015.16

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	3.03	
coarse gravel	33.87	
fine gravel	20.79	57.68
coarse sand	5.07	
medium sand	12.19	
fine sand	8.84	26.10
fines	16.22	
		100.00

PLUS #4 MATERIAL SIEVE		(Wt. + Tare)	% RETAINED	% PASSING
Tare Weight: 0.00	12.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	1392.00	3.0	97.0
	1.5"	9932.00	21.6	78.4
	1.0"	14632.00	31.8	68.2
	0.75"	16977.60	36.9	63.1
	0.375"	22370.20	48.6	51.4
	#4	26543.50	57.7	42.3

BACK SIEVE				% PASSING
Tare Weight: 0.00	#10	5.68	5.7	11.97	37.2
	#20	12.98	13.0	27.36	30.7
	#40	19.35	19.4	40.79	25.1
	#60	23.40	23.4	49.33	21.4
	#100	26.34	26.3	55.52	18.8
	#200	29.26	29.3	61.68	16.2

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.38

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/2/2004	12:24			
8/2/2004	12:26	21.8	25.00	5.25
8/2/2004	12:29	21.0	25.00	5.25
8/2/2004	12:39	20.5	25.00	5.25
8/2/2004	12:54	20.0	25.20	5.25
8/2/2004	13:24	19.3	25.90	5.25
8/2/2004	16:34	17.3	27.40	5.25
8/3/2004	12:24	17.0	25.20	5.25

(mm)	%Finer
0.033	14.57
0.021	13.91
0.012	13.47
0.009	13.03
0.006	12.36
0.003	10.60
0.001	10.38

2.7

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	47.44
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	42.3157

HYDROMETER CALCULATIONS

ET (mm)	TEMP COR K	READING R	EFFECTIVE LENGTH L	A
2.00	0.012677	16.50	13.7	0.99
5.00	0.012677	15.75	13.8	0.99
15.00	0.012677	15.25	13.8	0.99
30.00	0.012677	14.75	14	0.99
60.00	0.012677	14.00	14	0.99
250.00	0.012396	12.00	14.3	0.99
1440.00	0.012677	11.75	14.5	0.99

X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	97.0
1.5"	37.500	78.4
1.0"	25.000	68.2
0.75"	19.000	63.1
0.375"	9.500	51.4
#4	4.750	42.3
#10	2.000	37.2
#20	0.850	30.7
#40	0.425	25.1
#60	0.250	21.4
#100	0.150	18.8
#200	0.075	16.2
	0.0332	14.6
	0.0211	13.9
	0.0122	13.5
	0.0087	13.0
	0.0061	12.4
	0.0030	10.6
	0.0013	10.4

Check By NG

August-04

043-2246.0001

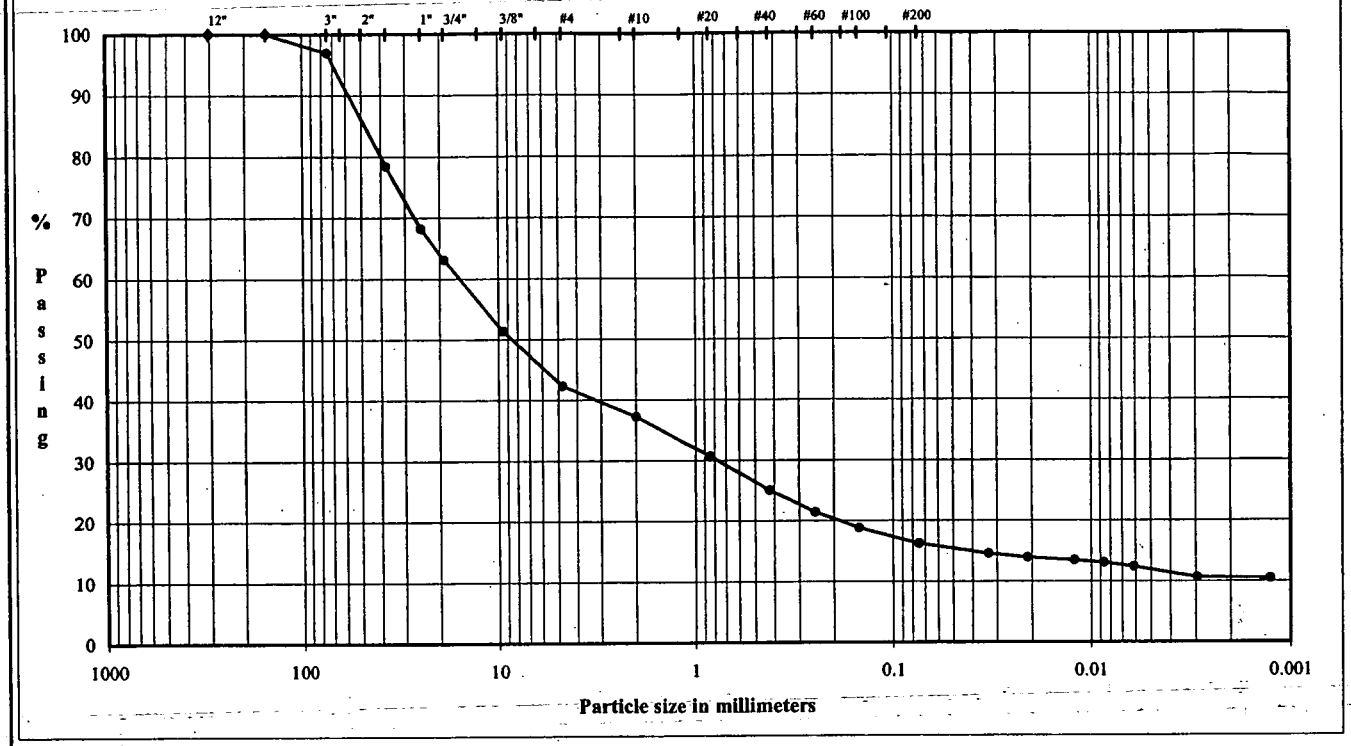
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **A-1** Depth (ft): **3**

TYPE: **BULK**



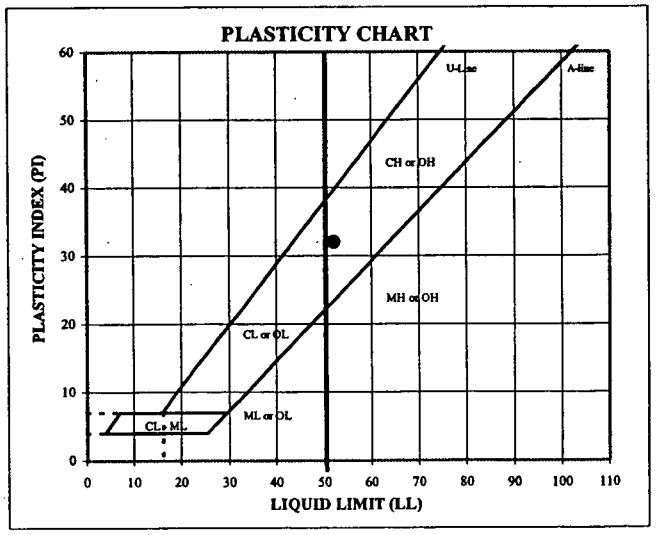
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	3.03
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	97.0		
1.5"	37.5	78.4		
1.0"	25.0	68.2	Coarse Gravel	33.87
0.75"	19.0	63.1		
0.375"	9.5	51.4		
#4	4.8	42.3	Fine Gravel	20.79
#10	2.00	37.2	Coarse Sand	5.07
#20	0.85	30.7		
#40	0.43	25.1	Medium Sand	12.19
#60	0.25	21.4		
#100	0.15	18.8		
#200	0.075	16.2	Fine Sand	8.84

Hydrometer Analysis

(mm)	%Finer		
0.033	14.6		
0.021	13.9		
0.012	13.5	Fines	
0.0087	13.0	Silt or Clay	16.22
0.0061	12.4		
0.0030	10.6		
0.0013	10.4		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
13.8	52	20	32	

DESCRIPTION: Light to moderate yellowish brown (5 YR 5/6, 4/4) clayey gravel with sand

USCS: GC

TECH	DT
DATE	7/29/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-1	-	3.0		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR: Mechanical	PREPARATION: Wet Method
MOLD WEIGHT (gm)	2265.0		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR: Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332	5.5 -lbf. RAMMER WITH 12 INCH DROP	

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Light to moderate yellowish brown (5 YR 5/6, 4/4) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

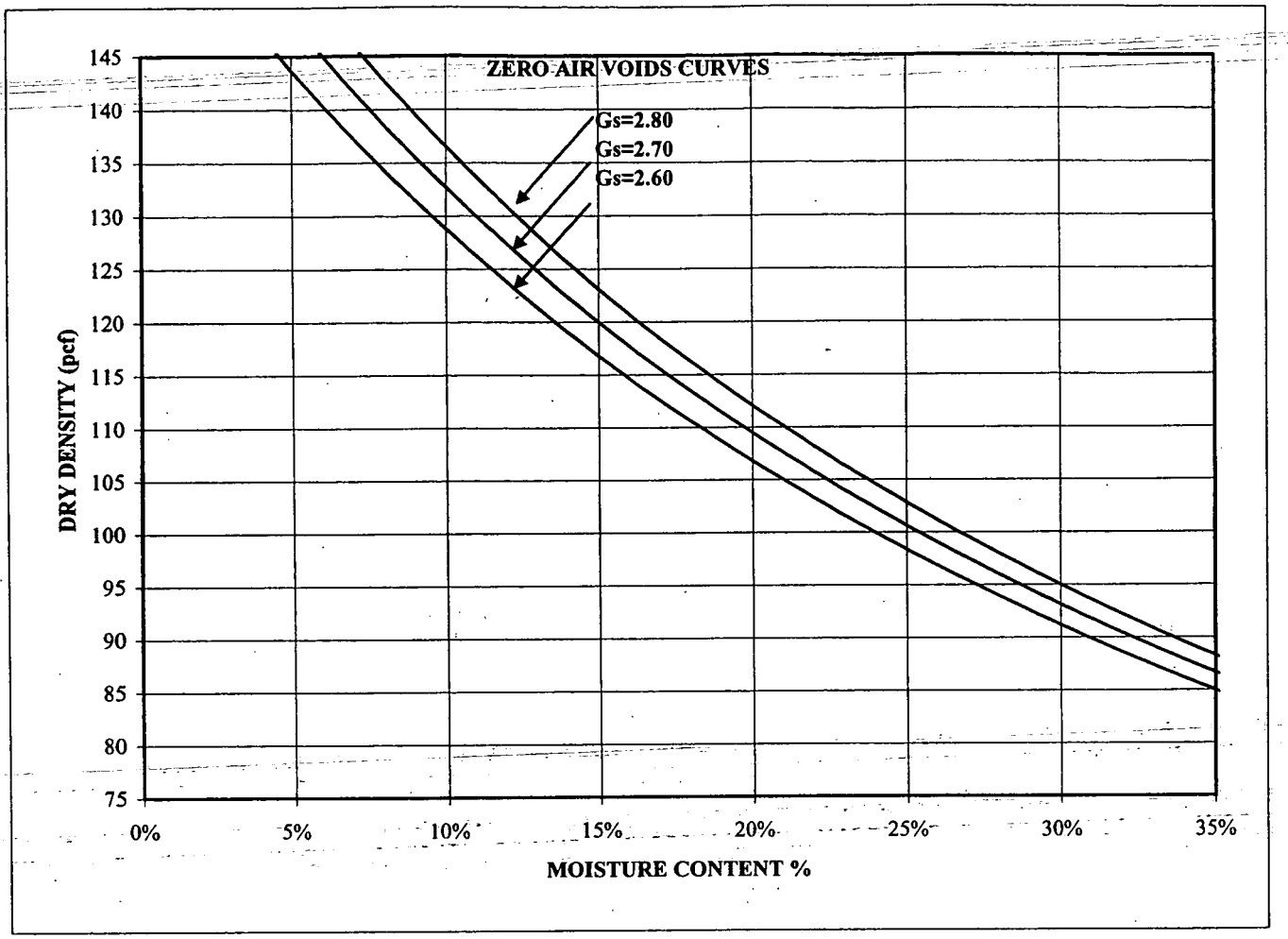
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)	[(B-A)/A]*100				
Bulk Specific Gravity		A/(B-C)			

LL	52
PL	20
PI	32
MC	13.8

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-1
SAMPLE TYPE	BULK
SAMPLE DEPTH	3

LL	52
PL	20
PI	32
MC	13.8

DESCRIPTION	Light to moderate yellowish brown (5 YR 5/6, 4/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

PROJECT NAME:	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-2
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	394.59
Wt. Dry Soil & Tare (gm)	370.04
Wt. of Tare (gm)	102.76
Wt. of Water (gm)	24.55
Weight of Dry Soil (gm)	267.28
Moisture Content (%)	9.19

4 OR 3 POINT ATTERBERG

	PLASTIC LIMIT DETERMINATION		LIQUID LIMIT DETERMINATION		
Number of Blows			35	24	15
Weight of Wet Soil & T	19.75	19.85	26.44	24.20	23.22
Weight of Dry Soil & T	18.93	19.06	22.68	21.06	20.24
Weight of Tare (gm)	13.73	13.88	13.51	13.77	13.79
Weight of Water (gm)	0.82	0.79	3.76	3.14	2.98
Weight of Dry Soil (gm)	5.20	5.18	9.17	7.29	6.45
Water Content %	15.77	15.25	41.00	43.07	46.20

PLASTIC LIMIT (PL) 16

LIQUID LIMIT (LL) 43

PLASTICITY INDEX (PI) 27

BLOWS	MC		
35	41.00	3.56	25
24	43.07	3.18	0.00
15	46.20	2.71	-2
0	0.00	#NUM!	

	3 POINTS			3-POINTS
	25.00	25.00	10.00	43
41.00	46.20	42.98	42.98	16
-2	48.00	42.98		27

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS		LIQUID LIMITS	
Weight of Wet Soil & Tare (gm)				
Weight of Dry Soil & Tare (gm)				
Weight of Tare (gm)				
Weight of Water (gm)	0.00	0.00		
Weight of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	0.00	0.00
			#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS		LIQUID LIMITS	
Weight of Wet Soil & Tare (gm)				
Weight of Dry Soil & Tare (gm)				
Weight of Tare (gm)				
Weight of Water (gm)	0.00	0.00	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			NP	

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	394.59
Wt. Dry Soil & Tare (gm)	370.04
Wt. of Tare (gm)	102.76
Wt. of Water (gm)	24.55
Weight of Dry Soil (gm)	267.28
Moisture Content (%)	9.2

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-2 Depth (ft) 3
TYPE	BULK

Description: Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS: GC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	116.28
Dry Soil & Tare (gm)	112.74
Tare Weight (gm)	21.85
Moisture Content (%)	3.9

LL	43	TEST BY	DT
PL	16	DATE SET UP	7/30/2004
PI	27	REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	43095.38
Tare Weight (gm)	
Total Weight (gm)	43095.38

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	7.87	
coarse gravel	32.66	
fine gravel	12.11	52.63
coarse sand	3.11	
medium sand	10.05	
fine sand	14.48	27.63
fines	19.73	
		100.00

PLUS #4 MATERIAL SIEVE		(Wt. + Tare)	% RETAINED	% PASSING
Tare Weight	12.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	3389.70	7.9	92.1
	1.5"	11135.70	25.8	74.2
	1.0"	15013.00	34.8	65.2
	0.75"	17464.20	40.5	59.5
	0.375"	22765.90	52.8	47.2
	#4	22682.20	52.6	47.37

BACK SIEVE				% PASSING
Tare Weight	#10	3.22	3.2	6.56	44.3
0.00	#20	7.81	7.8	15.90	39.8
	#40	13.64	13.6	27.78	34.2
	#60	18.84	18.8	38.36	29.2
	#100	23.62	23.6	48.10	24.6
	#200	28.65	28.7	58.34	19.7

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.02

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/2/2004	12:35	21.0	25.20	5.25
8/2/2004	12:37	21.0	25.20	5.25
8/2/2004	12:40	20.3	25.10	5.25
8/2/2004	12:50	19.3	25.10	5.25
8/2/2004	13:05	19.0	25.50	5.25
8/2/2004	13:35	18.5	26.30	5.25
8/2/2004	16:45	16.5	27.10	5.25
8/3/2004	12:35	16.0	25.40	5.25

(mm)	%Finer
0.033	15.04
0.021	14.32
0.012	13.37
0.009	13.13
0.006	12.65
0.003	10.74
0.001	10.27

2.7

6

4

2

1

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	49.1
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	47.3674

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING R'	EFFECTIVE LENGTH L	A
2.00	0.012677	15.75	13.8	0.99
5.00	0.012677	15.00	13.8	0.99
15.00	0.012677	14.00	14	0.99
30.00	0.012677	13.75	14.2	0.99
60.00	0.012534	13.25	14.2	0.99
250.00	0.012396	11.25	14.5	0.99
1440.00	0.012677	10.75	14.7	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	92.1
1.5"	37.500	74.2
1.0"	25.000	65.2
0.75"	19.000	59.5
0.375"	9.500	47.2
#4	4.750	47.4
#10	2.000	44.3
#20	0.850	39.8
#40	0.425	34.2
#60	0.250	29.2
#100	0.150	24.6
#200	0.075	19.7
	0.0333	15.0
	0.0211	14.3
	0.0122	13.4
	0.0087	13.1
	0.0061	12.7
	0.0030	10.7
	0.0013	10.3

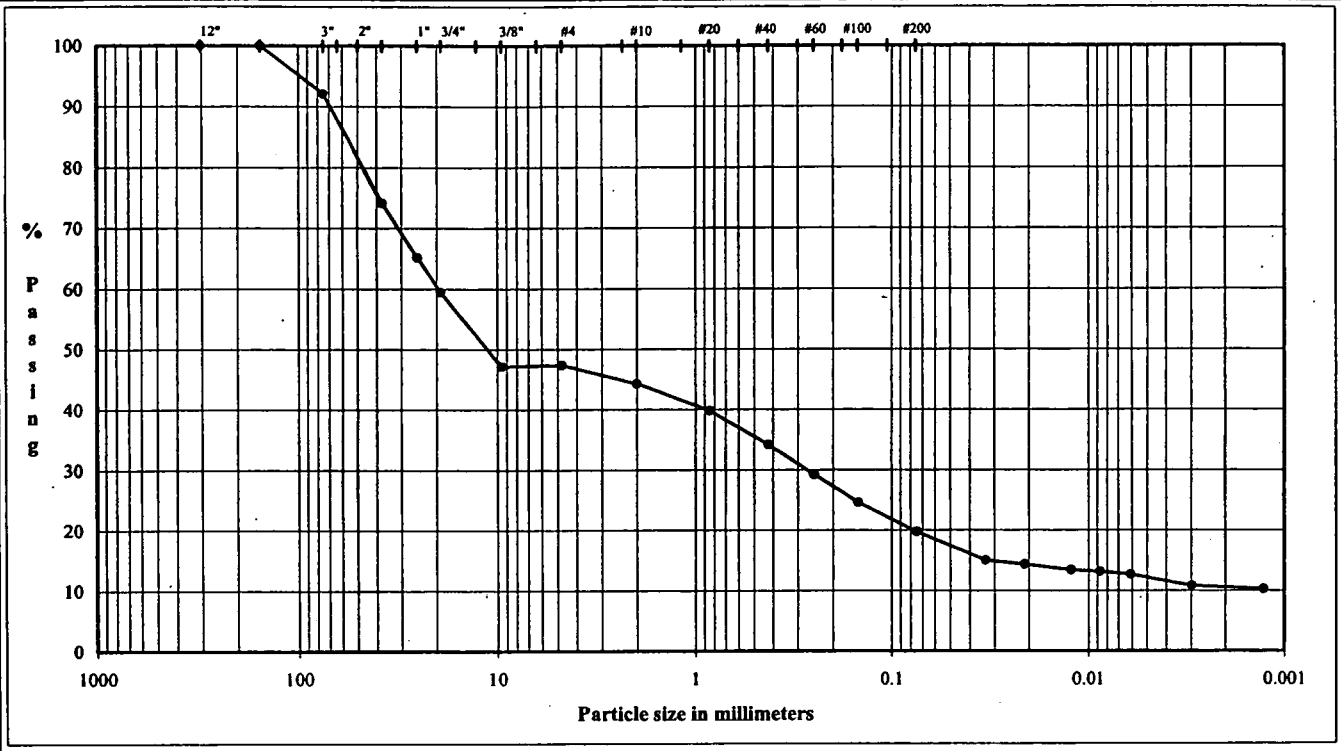
Check By: NG

August-04 | 043-2246.0001

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **A-2** Depth (ft): **3**
TYPE: **BULK**



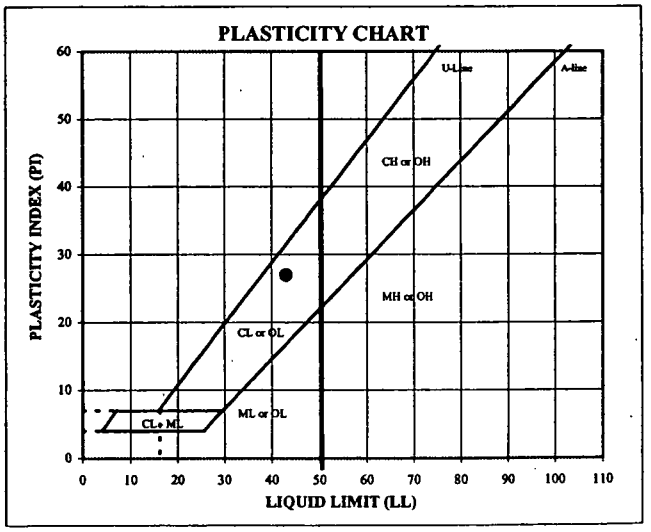
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	7.87
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	92.1		
1.5"	37.5	74.2		
1.0"	25.0	65.2	Coarse Gravel	32.66
0.75"	19.0	59.5		
0.375"	9.5	47.2		
#4	4.8	47.4	Fine Gravel	12.11
#10	2.00	44.3	Coarse Sand	3.11
#20	0.85	39.8		
#40	0.43	34.2	Medium Sand	10.05
#60	0.25	29.2		
#100	0.15	24.6		
#200	0.075	19.7	Fine Sand	14.48

Hydrometer Analysis

(mm)	%Finer		
0.033	15.0		
0.021	14.3		
0.012	13.4	Fines	
0.0087	13.1	Silt or Clay	19.73
0.0061	12.7		
0.0030	10.7		
0.0013	10.3		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
9.2	43	16	27	--

DESCRIPTION: Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS: GC

TECH	DT
DATE	7/30/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-2	-	3.0		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR: Mechanical	PREPARATION: Wet Method
MOLD WEIGHT (gm)	2265.0		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR: Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

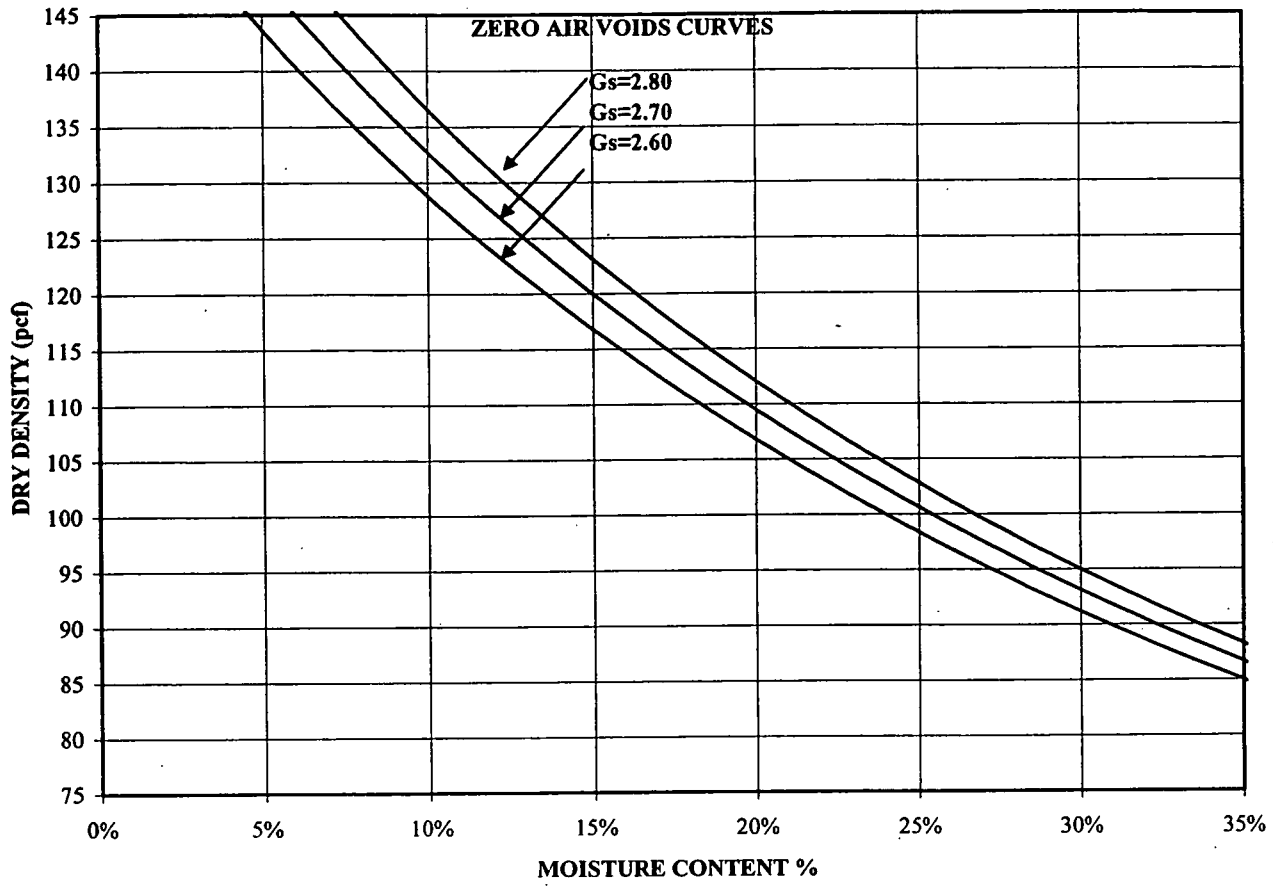
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)		[(B-A)/A]*100			
Bulk Specific Gravity		A/(B-C)			

LL	43
PL	16
PI	27
MC	9.2

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-2
SAMPLE TYPE	BULK
SAMPLE DEPTH	3

LL	43
PL	16
PI	27
MC	9.2

DESCRIPTION Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/190
REVIEW	0

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	542.21
Wt. Dry Soil & Tare (gm)	509.57
Wt. of Tare (gm)	100.37
Wt. of Water (gm)	32.64
Weight of Dry Soil (gm)	409.20
Moisture Content (%)	7.98

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-3
TYPE	BULK

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	20.57	20.23
Weight of Dry Soil & T	19.59	19.24
Weight of Tare (gm)	14.20	13.85
Weight of Water (gm)	0.98	0.99
Weight of Dry Soil (gm)	5.39	5.39
Water Content %	18.18	18.37

LIQUID LIMIT DETERMINATION

35	23	16
25.90	26.61	26.27
22.06	22.57	22.71
18.56	19.05	19.34
3.64	3.56	3.56
8.50	8.02	7.37
42.82	44.39	48.30

PLASTIC LIMIT (PL): 18

LIQUID LIMIT (LL): 45

PLASTICITY INDEX (PI): 27

BLOWS	MC		
35	42.82	3.56	25
23	44.39	3.14	0.00
16	48.30	2.77	-2
0	0.00	#NUM!	

	3 POINTS			
	25.00	25.00	10.00	3-POINTS
42.82	48.30	44.73	44.73	25
-2	50.00	44.73		18
				27

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL):

LIQUID LIMIT (LL):

PLASTICITY INDEX (PI):

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL): NP

LIQUID LIMIT (LL): NP

PLASTICITY INDEX (PI): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	542.21
Wt. Dry Soil & Tare (gm)	509.57
Wt. of Tare (gm)	100.37
Wt. of Water (gm)	32.64
Weight of Dry Soil (gm)	409.20
Moisture Content (%)	8.0

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A3 Depth (ft) 6
TYPE	BULK

Description: Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS: GC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	108.08
Dry Soil & Tare (gm)	105.03
Tare Weight (gm)	21.60
Moisture Content (%)	3.7

LL	45	TEST BY	DT
PL	18	DATE SET UP	7/29/2004
PI	27	REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	42396.59
Tare Weight (gm)	
Total Weight (gm)	42396.59

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	0.00	
coarse gravel	31.98	
fine gravel	21.67	53.65
coarse sand	2.71	
medium sand	13.52	
fine sand	12.32	28.55
fines	17.80	
		100.00

PLUS #4 MATERIAL SIEVE		(Wt. + Tare)	% RETAINED	% PASSING
Tare Weight	12.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	0.00	0.0	100.0
	1.5"	6406.20	15.1	84.9
	1.0"	10639.20	25.1	74.9
	0.75"	13556.50	32.0	68.0
	0.375"	18615.20	43.9	56.1
	#4	22744.90	53.6	46.4

BACK SIEVE				% PASSING
Tare Weight	#10	2.92	2.9	5.85	43.6
0.00	#20	9.66	9.7	19.35	37.4
	#40	17.49	17.5	35.03	30.1
	#60	22.89	22.9	45.84	25.1
	#100	26.87	26.9	53.81	21.4
	#200	30.76	30.8	61.60	17.8

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.76

DATE	TIME	READING	TEMP	HYD. COR.
8/2/2004	12:47	R	T	Cc
8/2/2004	12:49	23.3	25.50	5.25
8/2/2004	12:52	22.8	25.40	5.25
8/2/2004	13:02	22.0	25.70	5.25
8/2/2004	13:17	21.8	26.00	5.25
8/2/2004	13:47	20.0	26.70	5.25
8/2/2004	16:57	19.5	27.30	5.25
8/3/2004	12:47	19.3	25.50	5.25

(mm)	%Finer
0.033	16.54
0.021	16.08
0.012	15.39
0.008	15.16
0.006	13.55
0.003	13.10
0.001	12.87

2.7 **WEIGHT OF SAMPLE USED FOR HYDROMETER TEST**

Calculated Dry Wt. used in test (gm)	49.93
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	46.3521

HYDROMETER CALCULATIONS

ET Sq. (min)	TEMP. COR. K	READING R	EFFECTIVE LENGTH L	A
2.00	0.012677	18.00	13.35	0.99
5.00	0.012677	17.50	13.5	0.99
15.00	0.012677	16.75	13.7	0.99
30.00	0.012534	16.50	13.7	0.99
60.00	0.012534	14.75	14	0.99
250.00	0.012396	14.25	14	0.99
1440.00	0.012677	14.00	14	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	100.0
1.5"	37.500	84.9
1.0"	25.000	74.9
0.75"	19.000	68.0
0.375"	9.500	56.1
#4	4.750	46.4
#10	2.000	43.6
#20	0.850	37.4
#40	0.425	30.1
#60	0.250	25.1
#100	0.150	21.4
#200	0.075	17.8
	0.0327	16.5
	0.0208	16.1
	0.0121	15.4
	0.0085	15.2
	0.0061	13.6
	0.0029	13.1
	0.0012	12.9

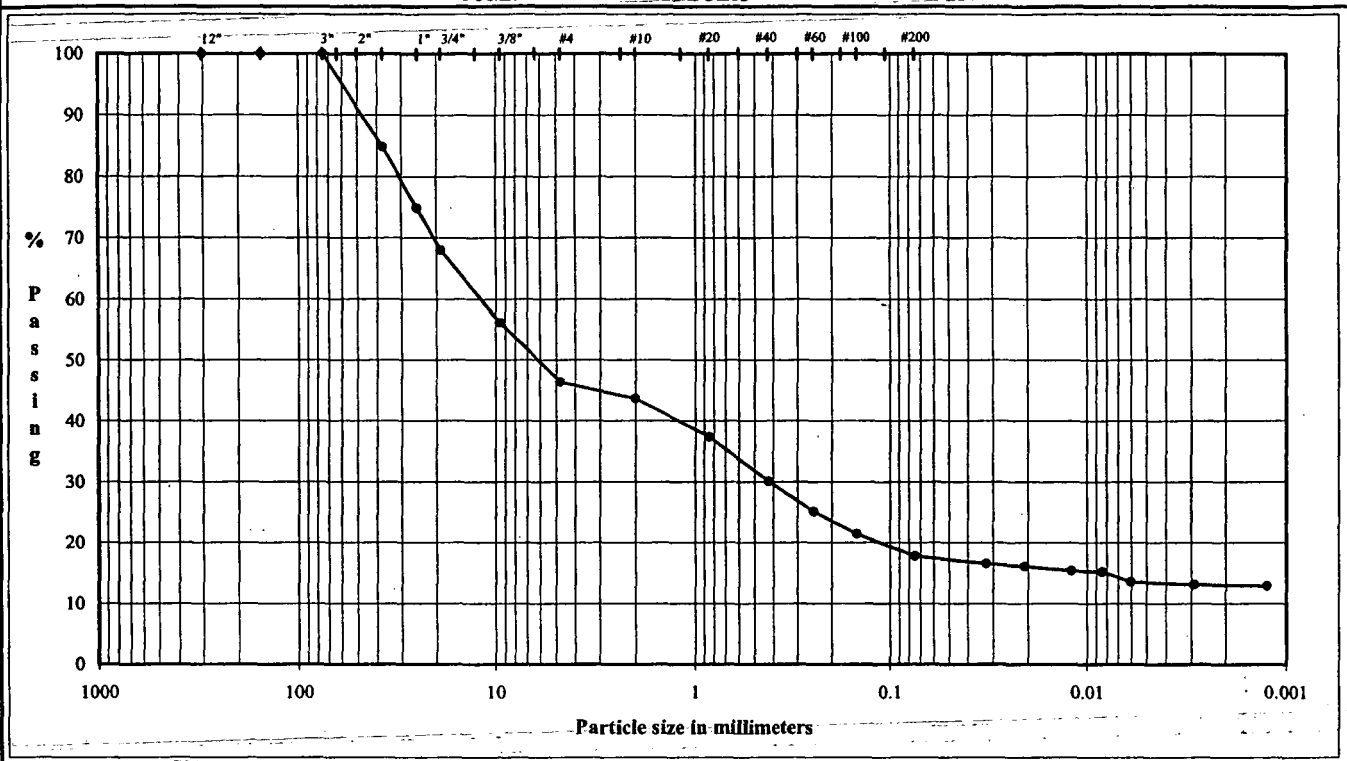
Check By: NG

August-04 043-2246.0001

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **A-3** Depth (ft): **6**
TYPE: **BULK**



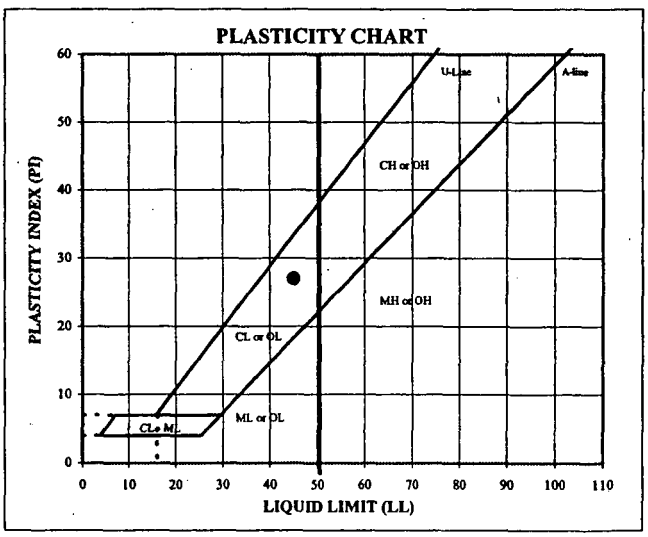
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	0.00
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	100.0		
1.5"	37.5	84.9		
1.0"	25.0	74.9	Coarse Gravel	31.98
0.75"	19.0	68.0		
0.375"	9.5	56.1		
#4	4.8	46.4	Fine Gravel	21.67
#10	2.00	43.6	Coarse Sand	2.71
#20	0.85	37.4		
#40	0.43	30.1	Medium Sand	13.52
#60	0.25	25.1		
#100	0.15	21.4		
#200	0.075	17.8	Fine Sand	12.32

Hydrometer Analysis

(mm)	%Finer		
0.033	16.5		
0.021	16.1		
0.012	15.4	Fines	
0.0085	15.2	Silt or Clay	17.80
0.0061	13.6		
0.0029	13.1		
0.0012	12.9		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
8.0	45	18	27	

DESCRIPTION: Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS: GC

TECH	DT
DATE	7/29/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-3	-	6.0		
SAMPLE TYPE	BULK				

TYPE COMPACTOR: Mechanical
PREPARATION: Wet Method
TYPE PROCTOR: Standard
5.5 -lbf. RAMMER WITH 12 INCH DROP

MOLD NUMBER	AH-1
MOLD WEIGHT (gm)	2265.0
MOLD DIAMETER (in)	3.991
MOLD HEIGHT (in)	4.581
MOLD VOLUME (cu.ft)	0.0332

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED

TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Moderate yellowish brown (10 YR 5/4) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

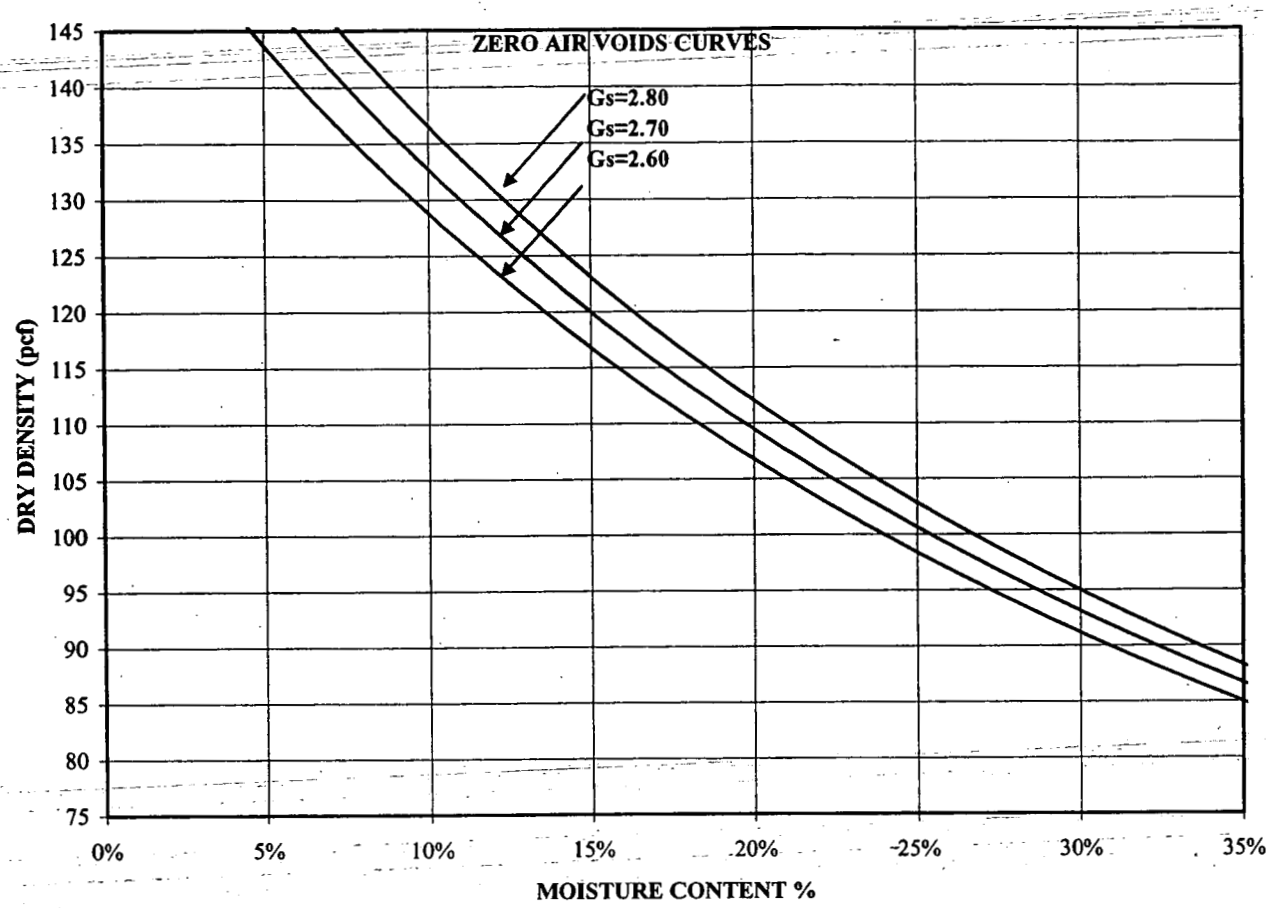
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)	[(B-A)/A]*100				
Bulk Specific Gravity		A/(B-C)			

LL	45
PL	18
PI	27
MC	8.0

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-3
SAMPLE TYPE	BULK
SAMPLE DEPTH	6

LL	45
PL	18
PI	27
MC	8.0

DESCRIPTION	Moderate yellowish brown (10 YR 5/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	460.82
Wt. Dry Soil & Tare (gm)	416.07
Wt. of Tare (gm)	103.67
Wt. of Water (gm)	44.75
Weight of Dry Soil (gm)	312.40
Moisture Content (%)	14.32

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-4
TYPE	BULK

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	22.65	21.68
Weight of Dry Soil & T	21.72	20.84
Weight of Tare (gm)	15.88	15.64
Weight of Water (gm)	0.93	0.84
Weight of Dry Soil (gm)	5.84	5.20
Water Content %	15.92	16.15

LIQUID LIMIT DETERMINATION

33	25	18
23.90	25.03	27.46
20.80	22.16	23.17
14.03	15.96	14.23
3.10	2.87	4.29
6.77	6.20	8.94
45.79	46.29	47.99

PLASTIC LIMIT (PL) 16

LIQUID LIMIT (LL) 47

PLASTICITY INDEX (PI) 31

BLOWS	MC		
33	45.79	3.50	25
25	46.29	3.22	0.00
18	47.99	2.89	-2
0	0.00	#NUM!	

	3 POINTS			3-POINTS
	25.00	25.00	10.00	47
45.79	47.99	46.63	46.63	16
-2	48.00	46.63		31

ONE POINT ATTERBERG

	PLASTIC LIMITS	
Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

	PLASTIC LIMITS	
Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	460.82
Wt. Dry Soil & Tare (gm)	416.07
Wt. of Tare (gm)	103.67
Wt. of Water (gm)	44.75
Weight of Dry Soil (gm)	312.40
Moisture Content (%)	14.3

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats Field & Lab Testing CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-4 Depth (ft) 12
TYPE	BULK

Description: Pale olive and moderate yellowish brown (10YR 6/2 and 10YR 5/4) clayey gravel with sand

USCS: GC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	123.94
Dry Soil & Tare (gm)	118.85
Tare Weight (gm)	21.90
Moisture Content (%)	5.3

LL	47
PL	16
PI	31

TEST BY	DT
DATE SET UP	8/2/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	43418.37
Tare Weight (gm)	
Total Weight (gm)	43418.37

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	5.69	
coarse gravel	25.73	
fine gravel	20.23	51.65
coarse sand	3.96	
medium sand	12.27	
fine sand	11.22	27.45
fines	20.90	
		100.00

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	2470.70	5.7	94.3
	1.5"	8489.00	19.6	80.4
	1.0"	11803.20	27.2	72.8
	0.75"	13640.60	31.4	68.6
	0.375"	18505.90	42.6	57.4
	#4	22425.40	51.6	48.4

				% PASSING
BACK SIEVE	#10	3.92	3.9	8.19	44.4
Tare Weight	#20	9.73	9.7	20.32	38.5
0.00	#40	16.07	16.1	33.57	32.1
	#60	20.29	20.3	42.38	27.9
	#100	23.62	23.6	49.34	24.5
	#200	27.18	27.2	56.77	20.9

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.39

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/3/2004	9:24	22.8	24.40	5.50
8/3/2004	9:26	22.8	24.40	5.50
8/3/2004	9:29	22.0	24.30	5.50
8/3/2004	9:39	21.8	24.40	5.50
8/3/2004	9:54	20.8	24.50	5.50
8/3/2004	10:24	20.0	24.70	5.50
8/3/2004	13:34	19.3	26.10	5.50
8/4/2004	9:24	18.0	24.70	5.50

(mm)	%Finer
0.033	17.25
0.021	16.50
0.012	16.25
0.009	15.25
0.006	14.50
0.003	13.75
0.001	12.50

2.7

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	47.88
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	48.3504

HYDROMETER CALCULATIONS

K ET (mm)	TEMP COR K	READING R	EFFECTIVE LENGTH L	A
2.00	0.012819	17.25	15.5	0.99
5.00	0.012819	16.50	13.7	0.99
15.00	0.012819	16.25	13.7	0.99
30.00	0.012819	15.25	13.8	0.99
60.00	0.012819	14.50	14	0.99
250.00	0.012534	13.75	14.2	0.99
1440.00	0.012819	12.50	14.3	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	94.3
1.5"	37.500	80.4
1.0"	25.000	72.8
0.75"	19.000	68.6
0.375"	9.500	57.4
#4	4.750	48.4
#10	2.000	44.4
#20	0.850	38.5
#40	0.425	32.1
#60	0.250	27.9
#100	0.150	24.5
#200	0.075	20.9
	0.0333	17.2
	0.0212	16.5
	0.0123	16.2
	0.0087	15.2
	0.0062	14.5
	0.0030	13.7
	0.0013	12.5

Check By NG

August-04

043-2246.0001

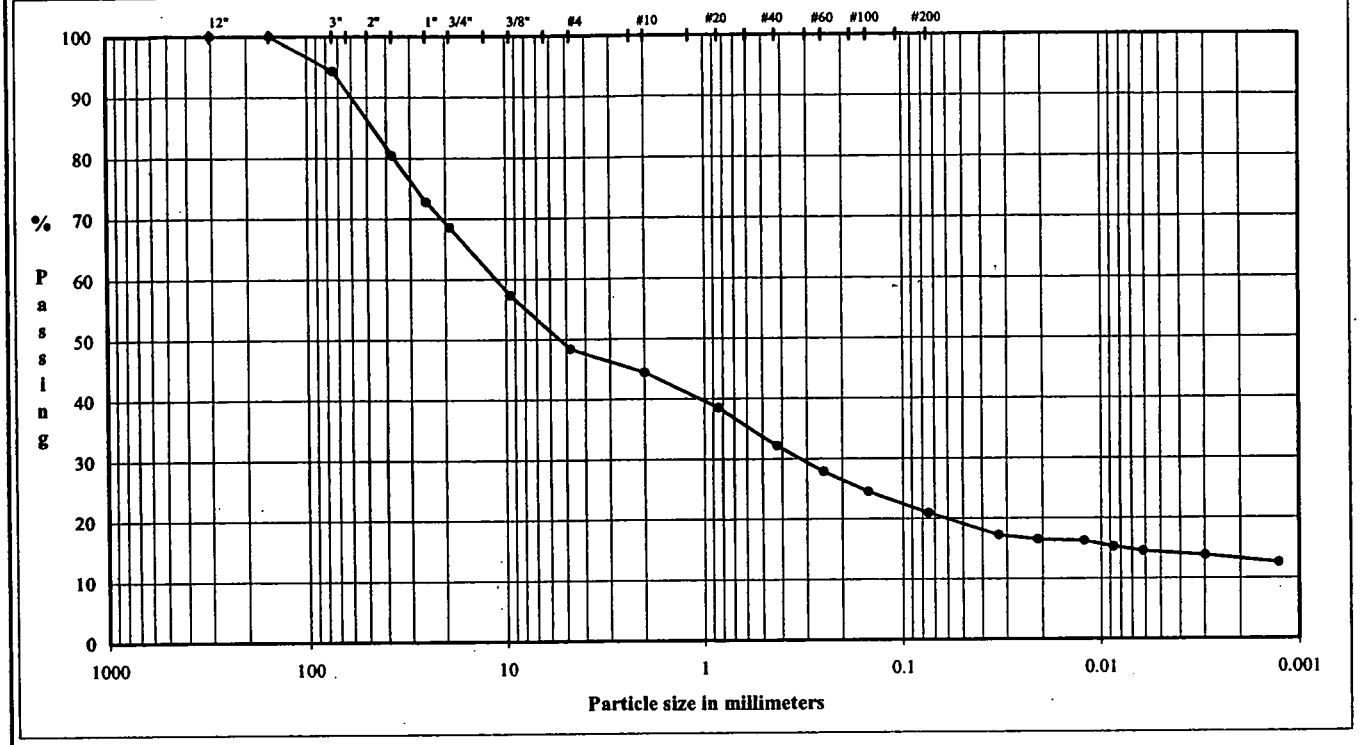
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **A-4** Depth (ft): **12**

TYPE: **BULK**



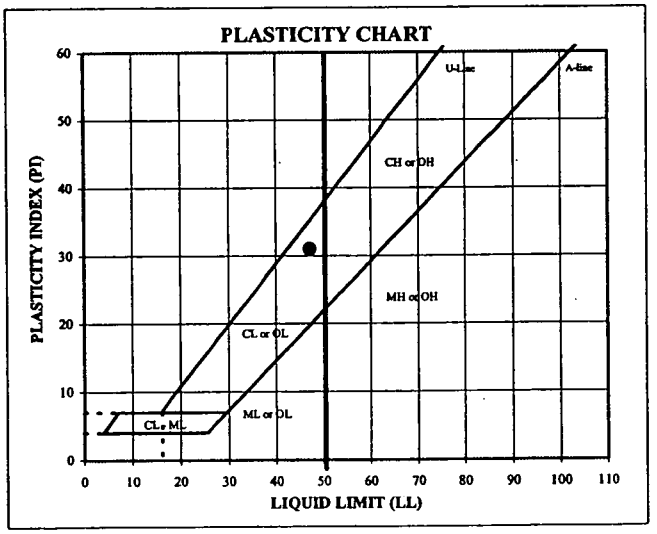
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	5.69
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	94.3		
1.5"	37.5	80.4		
1.0"	25.0	72.8	Coarse Gravel	25.73
0.75"	19.0	68.6		
0.375"	9.5	57.4		
#4	4.8	48.4	Fine Gravel	20.23
#10	2.00	44.4	Coarse Sand	3.96
#20	0.85	38.5		
#40	0.43	32.1	Medium Sand	12.27
#60	0.25	27.9		
#100	0.15	24.5		
#200	0.075	20.9	Fine Sand	11.22

Hydrometer Analysis

(mm)	%Finer		
0.033	17.2		
0.021	16.5		
0.012	16.2	Fines	
0.0087	15.2	Silt or Clay	20.90
0.0062	14.5		
0.0030	13.7		
0.0013	12.5		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
14.3	47	16	31	--

DESCRIPTION: Pale olive and moderate yellowish brown (10YR 6/2 and 10YR 5/4) clayey gravel with sand

USCS: GC

TECH	DT
DATE	8/2/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO		TEST TYPE	D 698	#DIV/0!
PROJECT NUMBER	043-2246.0001		PROCEDURE	#DIV/0!	#DIV/0!
SAMPLE IDENTITY	A-4	12.0			
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1
MOLD WEIGHT (gm)	2265.0
MOLD DIAMETER (in)	3.991
MOLD HEIGHT (in)	4.581
MOLD VOLUME (cu.ft)	0.0332

TYPE COMPACTOR: Mechanical

PREPARATION: Wet Method

TYPE PROCTOR: Standard

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT

		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED

TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)

		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							

WATER CONTENTS

Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Pale olive and moderate yellowish brown (10YR 6/2 and 10YR 5/4) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)	[(B-A)/A]*100				
Bulk Specific Gravity		A/(B-C)			

LL	47
PL	16
PI	31
MC	14.3

AVERAGE ABSORPTION (assumed)

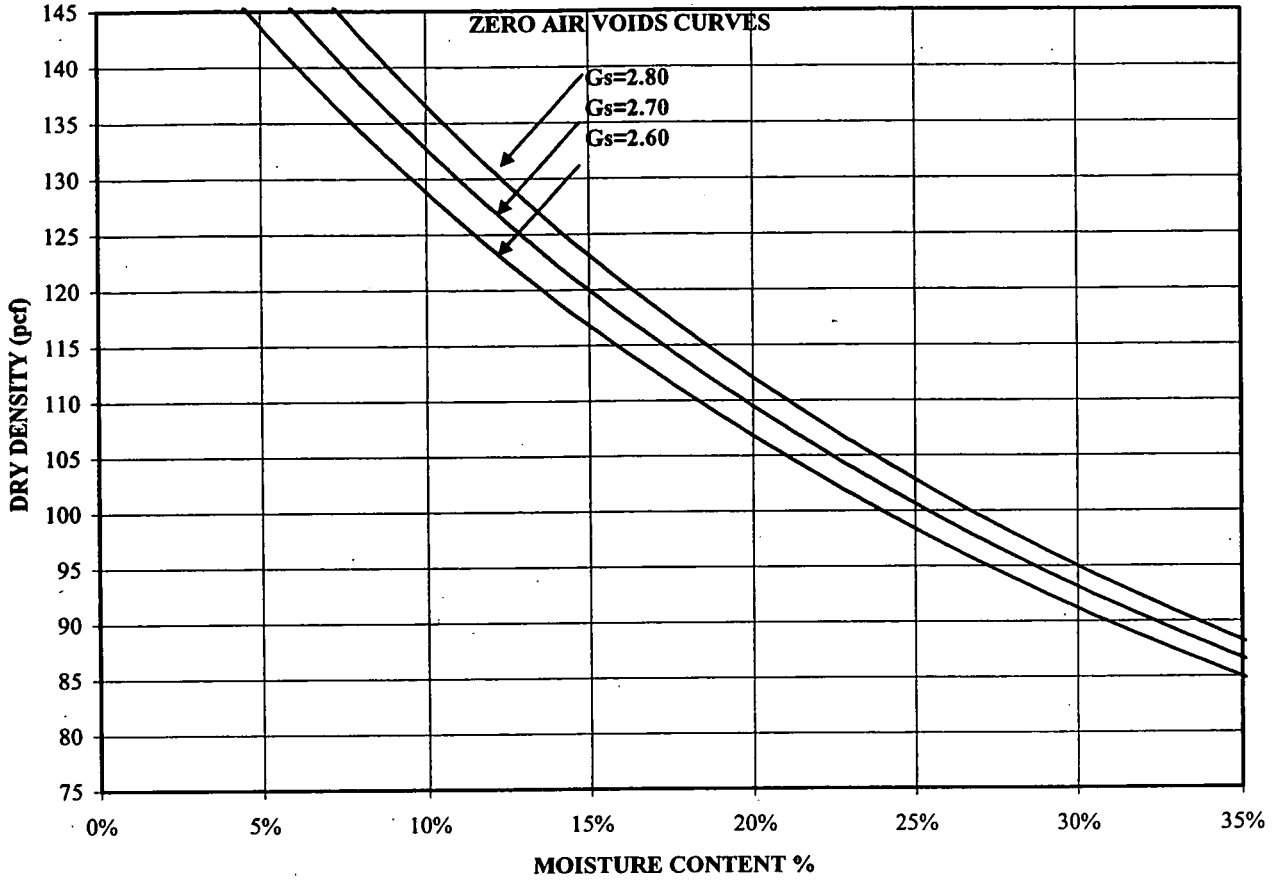
AVERAGE BULK SPECIFIC GRAVITY (assumed)

TECH

DATE

REVIEW

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-4
SAMPLE TYPE	BULK
SAMPLE DEPTH	12

LL	47
PL	16
PI	31
MC	14.3

DESCRIPTION	Pale olive and moderate yellowish brown (10YR 6/2 and 10YR 5/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/190
REVIEW	0

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-5
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	394.47
Wt. Dry Soil & Tare (gm)	365.10
Wt. of Tare (gm)	102.49
Wt. of Water (gm)	29.37
Weight of Dry Soil (gm)	262.61
Moisture Content (%)	11.18

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	22.46	22.58
Weight of Dry Soil & T	21.26	21.36
Weight of Tare (gm)	14.03	13.77
Weight of Water (gm)	1.20	1.22
Weight of Dry Soil (gm)	7.23	7.59
Water Content %	16.60	16.07

LIQUID LIMIT DETERMINATION

35	28	18
27.80	27.57	25.48
24.97	24.43	22.15
15.89	15.89	14.10
3.23	3.32	3.33
8.68	8.36	7.96
37.21	39.71	41.83

PLASTIC LIMIT (PL) 16

LIQUID LIMIT (LL) 40

PLASTICITY INDEX (PI) 24

BLOWS	MC		
35	37.21	3.56	25
28	39.71	3.33	0.00
18	41.83	2.89	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
37.21	41.83	39.86	39.86	40
-2	42.00	39.86		16
				24

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	394.47
Wt. Dry Soil & Tare (gm)	365.10
Wt. of Tare (gm)	102.49
Wt. of Water (gm)	29.37
Weight of Dry Soil (gm)	262.61
Moisture Content (%)	11.2

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-5 Depth (ft) 3
TYPE	BULK

Description: Moderate brown (5YR 4/4) clayey gravel with sand

USCS: GC

LL: 40
PL: 16
PI: 24

TEST BY: DT
DATE SET UP: 8/4/2004
REVIEW BY: MB

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	151.20
Dry Soil & Tare (gm)	146.42
Tare Weight (gm)	29.44
Moisture Content (%)	4.1

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	56785.37
Tare Weight (gm)	
Total Weight (gm)	56785.37

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	7.99		
coarse gravel	28.49		
fine gravel	20.43	56.90	
coarse sand	5.42		
medium sand	13.48		
fine sand	10.42	29.32	
fines	13.78		
			100.00

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	4534.50	8.0	92.0
	1.5"	11549.40	20.3	79.7
	1.0"	16875.40	29.7	70.3
	0.75"	20710.00	36.5	63.5
	0.375"	26793.50	47.2	52.8
	#4	32311.40	56.9	43.1

				% PASSING
BACK SIEVE	#10	6.20	6.2	12.58	37.7
Tare Weight	#20	14.18	14.2	28.78	30.7
0.00	#40	21.61	21.6	43.86	24.2
	#60	26.35	26.4	53.48	20.0
	#100	30.01	30.0	60.91	16.8
	#200	33.52	33.5	68.04	13.8

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.28

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/5/2004	10:28	19.3	25.50	5.50
8/5/2004	10:30	19.3	25.50	5.50
8/5/2004	10:33	18.5	25.40	5.50
8/5/2004	10:43	17.3	25.40	5.50
8/5/2004	10:58	17.0	25.40	5.50
8/5/2004	11:32	16.0	25.40	5.50
8/5/2004	14:38	14.0	26.20	5.50
8/6/2004	10:28	13.3	25.30	5.50

(mm)	%Finer
0.034	11.91
0.021	11.26
0.012	10.18
0.009	9.96
0.006	9.09
0.003	7.36
0.001	6.71

2.7 WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

G

Calculated Dry Wt. used in test (gm)	49.27
Hydrometer Bulb Number	6243783
%Pass #4 Sieve for whole sample	43.099

HYDROMETER CALCULATIONS

ET (mm)	TEMP COR K	READING R	EFFECTIVE LENGTH L	A
2.00	0.012677	13.75	14.2	0.99
5.00	0.012677	13.00	14.2	0.99
15.00	0.012677	11.75	14.5	0.99
30.00	0.012677	11.50	14.5	0.99
64.00	0.012677	10.50	14.7	0.99
250.00	0.012534	8.50	15	0.99
1440.00	0.012677	7.75	15.2	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	92.0
1.5"	37.500	79.7
1.0"	25.000	70.3
0.75"	19.000	63.5
0.375"	9.500	52.8
#4	4.750	43.1
#10	2.000	37.7
#20	0.850	30.7
#40	0.425	24.2
#60	0.250	20.0
#100	0.150	16.8
#200	0.075	13.8
	0.0338	11.9
	0.0214	11.3
	0.0125	10.2
	0.0088	10.0
	0.0061	9.1
	0.0031	7.4
	0.0013	6.7

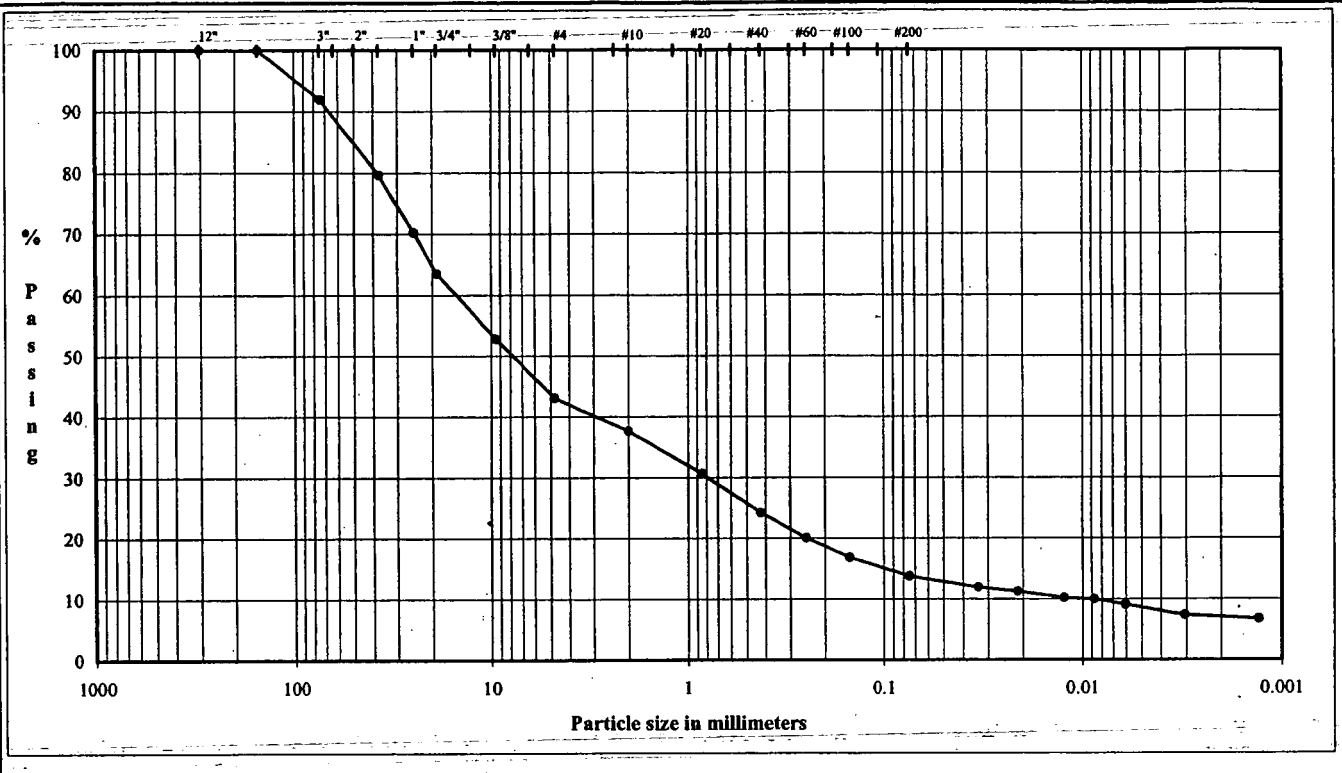
Check By: NG

August-04 043-2246.0001

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **A-5** Depth (ft): **3**
TYPE: **BULK**



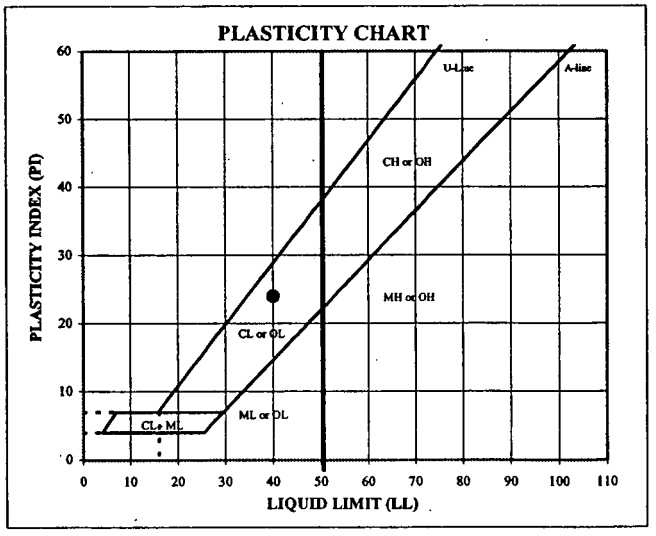
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	7.99
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	92.0		
1.5"	37.5	79.7		
1.0"	25.0	70.3	Coarse Gravel	28.49
0.75"	19.0	63.5		
0.375"	9.5	52.8		
#4	4.8	43.1	Fine Gravel	20.43
#10	2.00	37.7	Coarse Sand	5.42
#20	0.85	30.7		
#40	0.43	24.2	Medium Sand	13.48
#60	0.25	20.0		
#100	0.15	16.8		
#200	0.075	13.8	Fine Sand	10.42

Hydrometer Analysis

(mm)	%Finer		
0.034	11.9		
0.021	11.3		
0.012	10.2	Fines	
0.0088	10.0	Silt or Clay	13.78
0.0061	9.1		
0.0031	7.4		
0.0013	6.7		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
11.2	40	16	24	–

DESCRIPTION: Moderate brown (5YR 4/4) clayey gravel with sand

USCS: GC

TECH: DT
DATE: 8/4/2004
REVIEW: MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-5	-	3.0		
SAMPLE TYPE	BULK				

	TYPE COMPACTOR	PREPARATION	
	Mechanical	Wet Method	
MOLD NUMBER	AH-1		
MOLD WEIGHT (gm)	2265.0	TYPE PROCTOR	
MOLD DIAMETER (in)	3.991	Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

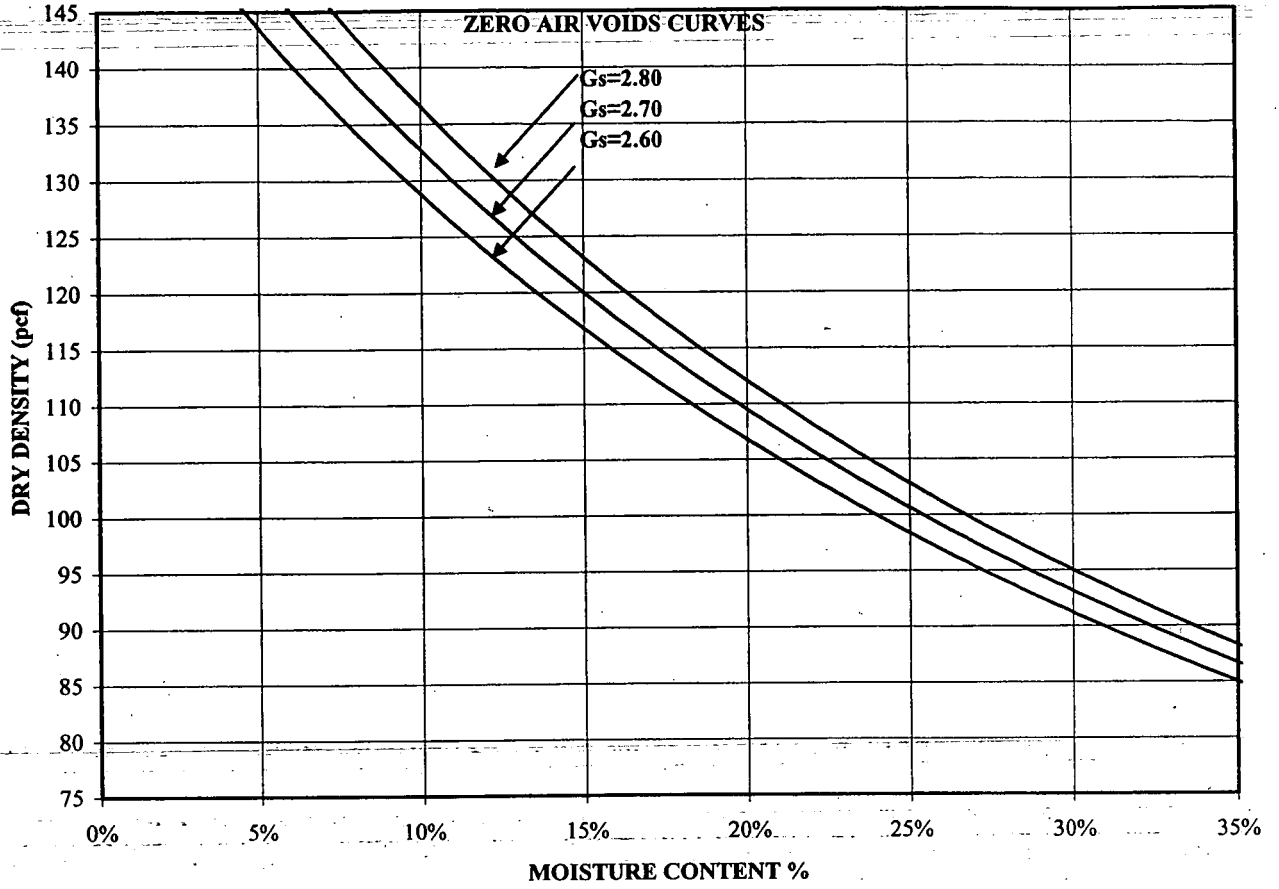
MAXIMUM DRY DENSITY (pcf)	0.0	DESCRIPTION	Moderate brown (5YR 4/4) clayey gravel with sand
OPTIMUM MOISTURE CONTENT (%)	0.0		
Corrected Maximum Dry Density (pcf)			
Corrected Optimum Moisture (%)		USCS	GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

Weight of Oven Dry Sample (gm)		A				LL	40
Weight of Saturated-Surface-Dry (gm)		B				PL	16
Weight of Saturated Sample in Water	(gm)	C				PI	24
Absorption of Oversize Particles (%)		[(B-A)/A]*100				MC	11.2
Bulk Specific Gravity		A/(B-C)					

AVERAGE ABSORPTION (assumed)		TECH	
AVERAGE BULK SPECIFIC GRAVITY (assumed)		DATE	
		REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-5
SAMPLE TYPE	BULK
SAMPLE DEPTH	3

LL	40
PL	16
PI	24
MC	11.2

DESCRIPTION	Moderate brown (5YR 4/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	441.87
Wt. Dry Soil & Tare (gm)	410.45
Wt. of Tare (gm)	101.80
Wt. of Water (gm)	31.42
Weight of Dry Soil (gm)	308.65
Moisture Content (%)	10.18

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-6
TYPE	BULK

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	21.81	22.15
Weight of Dry Soil & T	20.95	21.21
Weight of Tare (gm)	15.81	15.95
Weight of Water (gm)	0.86	0.94
Weight of Dry Soil (gm)	5.14	5.26
Water Content %	16.73	17.87

LIQUID LIMIT DETERMINATION

32	25	17
26.67	23.44	24.62
23.49	20.49	21.16
16.12	13.82	13.86
3.18	2.95	3.46
7.37	6.67	7.30
43.15	44.23	47.40

PLASTIC LIMIT (PL) 17

LIQUID LIMIT (LL) 45

PLASTICITY INDEX (PI) 28

BLOWS	MC		
32	43.15	3.47	25
25	44.23	3.22	0.00
17	47.40	2.83	-2
0	0.00	#NUM!	

	3 POINTS			3-POINTS
	25.00	25.00	10.00	45
43.15	47.40	44.61	44.61	17
-2	48.00	44.61		28

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	441.87
Wt. Dry Soil & Tare (gm)	410.45
Wt. of Tare (gm)	101.80
Wt. of Water (gm)	31.42
Weight of Dry Soil (gm)	308.65
Moisture Content (%)	10.2

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	137.18
Dry Soil & Tare (gm)	131.08
Tare Weight (gm)	21.63
Moisture Content (%)	5.6

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	40734.31
Tare Weight (gm)	
Total Weight (gm)	38583.91

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	3923.40	10.2	89.8
	1.5"	10223.90	26.5	73.5
	1.0"	14319.40	37.1	62.9
	0.75"	16361.60	42.4	57.6
	0.375"	20166.80	52.3	47.7
	#4	23191.70	60.1	39.9

				% PASSING
BACK SIEVE	#10	4.57	4.6	9.58	36.1
Tare Weight	#20	10.78	10.8	22.59	30.9
0.00	#40	17.56	17.6	36.80	25.2
	#60	22.18	22.2	46.48	21.4
	#100	25.60	25.6	53.65	18.5
	#200	28.94	28.9	60.64	15.7

MONTH AND YEAR: August-04
PROJECT NAME: Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER: 043-2246.0001
SAMPLE ID: A-6 Depth (ft) 2
TYPE: BULK

Description: Pale greenish yellow and light brown (10YR 8/2, 5YR 5/6) clayey gravel with sand

USCS: GC

LL	45
PL	17
PI	28

TEST BY	DT
DATE SET UP	8/5/2004
REVIEW BY	MB

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	10.17	
coarse gravel	32.24	
fine gravel	17.70	60.11
coarse sand	3.82	
medium sand	10.86	
fine sand	9.51	24.19
fines	15.70	
		100.00

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.38

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/6/2004	9:27	22.3	24.10	5.50
8/6/2004	9:29	22.3	24.10	5.50
8/6/2004	9:32	21.5	24.10	5.50
8/6/2004	9:42	21.0	24.20	5.50
8/6/2004	9:57	20.5	24.30	5.50
8/6/2004	10:27	19.8	24.40	5.50
8/6/2004	13:37	18.8	25.80	5.50
8/7/2004	9:27	17.5	24.80	5.50

(mm)	%Finer
0.034	13.86
0.021	13.24
0.012	12.83
0.009	12.41
0.006	11.79
0.003	10.97
0.001	9.93

2.7 **WEIGHT OF SAMPLE USED FOR HYDROMETER TEST**

Calculated Dry Wt. used in test (gm)	47.72
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	39.8928

HYDROMETER CALCULATIONS

ET-t (min)	TEMP COR K	READING R'	EFFECTIVE LENGTH L	A
2:00.00	0.012819	16.75	13.7	0.99
5:00	0.012819	16.00	13.7	0.99
15:00	0.012819	15.50	13.9	0.99
30:00	0.012819	15.00	13.8	0.99
60:00	0.012819	14.25	14	0.99
250:00	0.012677	13.25	14.2	0.99
1440:00	0.012819	12.00	14.3	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	89.8
1.5"	37.500	73.5
1.0"	25.000	62.9
0.75"	19.000	57.6
0.375"	9.500	47.7
#4	4.750	39.9
#10	2.000	36.1
#20	0.850	30.9
#40	0.425	25.2
#60	0.250	21.4
#100	0.150	18.5
#200	0.075	15.7
	0.0336	13.9
	0.0212	13.2
	0.0123	12.8
	0.0087	12.4
	0.0062	11.8
	0.0030	11.0
	0.0013	9.9

Check By NG

August-04

043-2246.0001

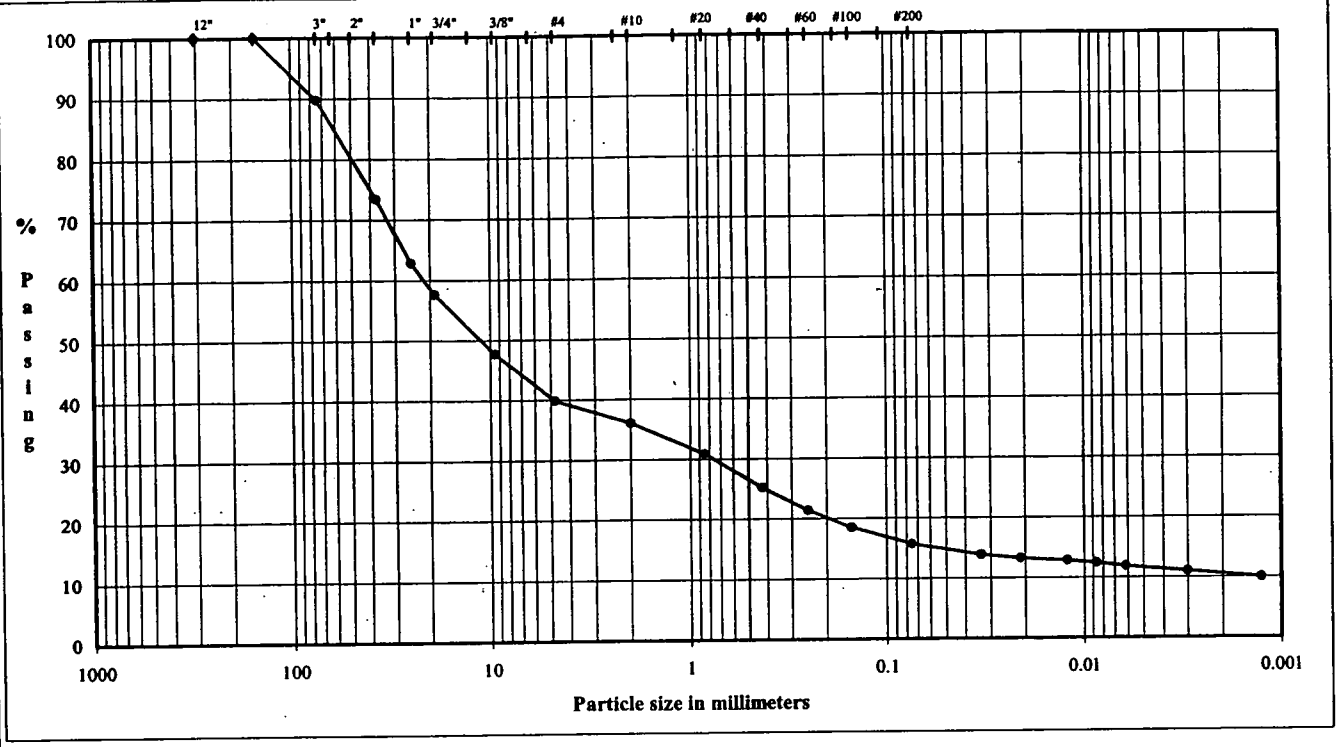
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **A-6** Depth (ft): **2**

TYPE: **BULK**



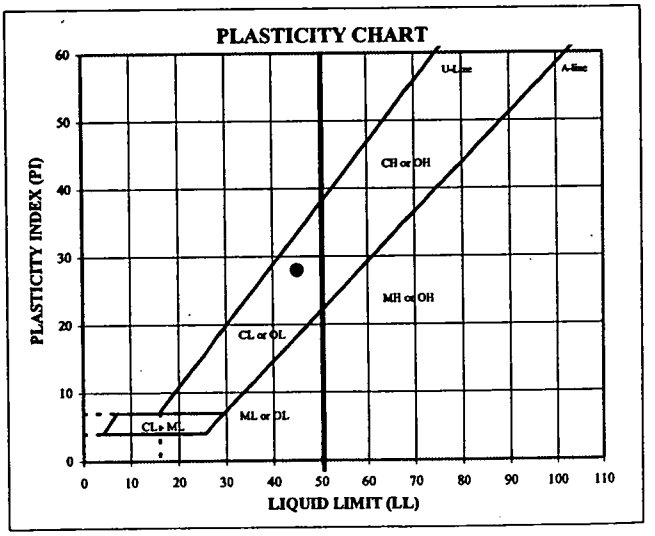
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	10.17
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	89.8		
1.5"	37.5	73.5		
1.0"	25.0	62.9	Coarse Gravel	32.24
0.75"	19.0	57.6		
0.375"	9.5	47.7		
#4	4.8	39.9	Fine Gravel	17.70
#10	2.00	36.1	Coarse Sand	3.82
#20	0.85	30.9		
#40	0.43	25.2	Medium Sand	10.86
#60	0.25	21.4		
#100	0.15	18.5		
#200	0.075	15.7	Fine Sand	9.51

Hydrometer Analysis

(mm)	%Finer		
0.034	13.9		
0.021	13.2		
0.012	12.8	Fines	
0.0087	12.4	Silt or Clay	15.70
0.0062	11.8		
0.0030	11.0		
0.0013	9.9		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
10.2	45	17	28	–

DESCRIPTION: Pale greenish yellow and light brown (10YR 8/2, 5YR 5/6) clayey gravel with sand

USCS: GC

TECH	DT
DATE	8/5/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO	TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001	PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-6 - 2.0		
SAMPLE TYPE	BULK		

MOLD NUMBER	AH-1	TYPE COMPACTOR	Mechanical
MOLD WEIGHT (gm)	2265.0	PREPARATION	Wet Method
MOLD DIAMETER (in)	3.991	TYPE PROCTOR	Standard
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED

TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Pale greenish yellow and light brown (10YR 8/2, 5YR 5/6) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

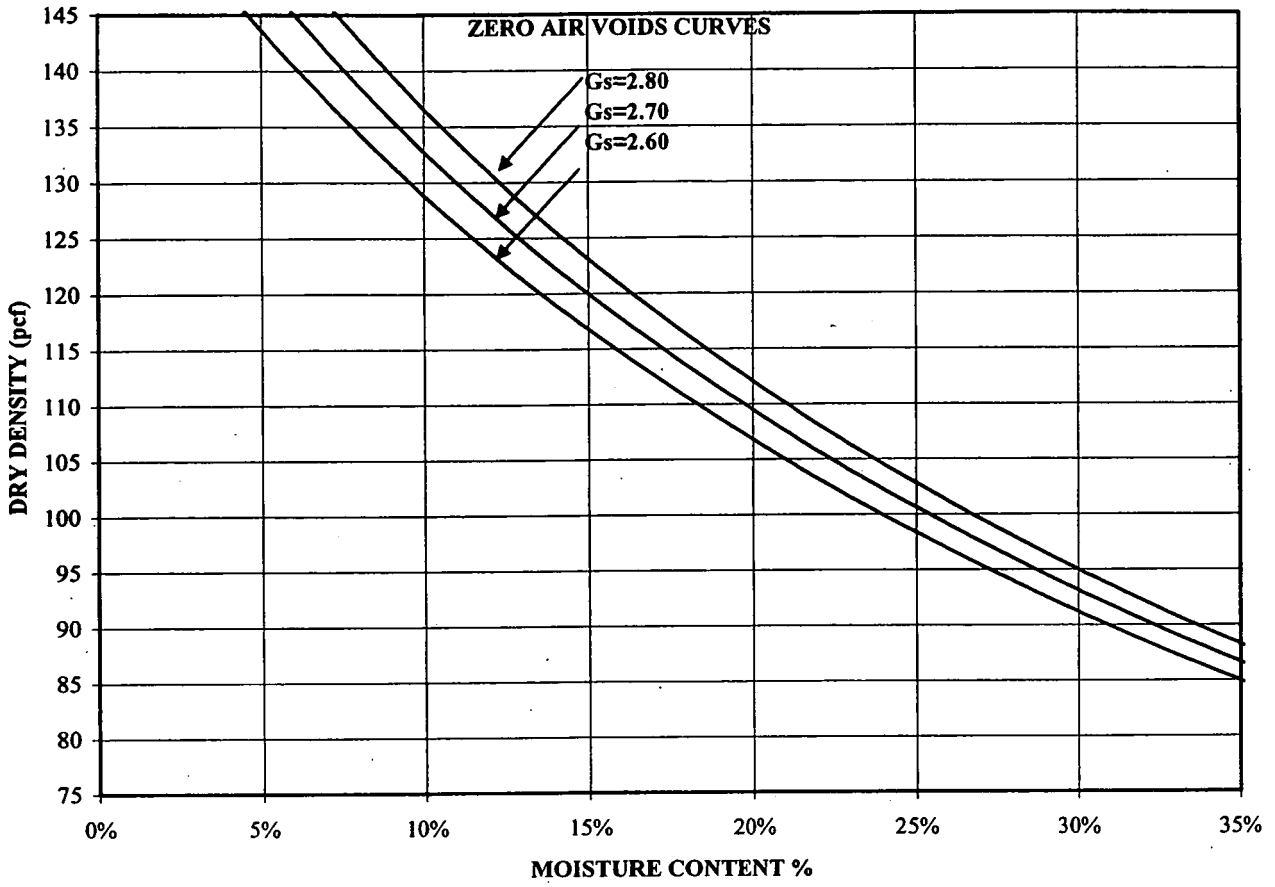
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)		[(B-A)/A]*100			
Bulk Specific Gravity		A/(B-C)			

LL	45
PL	17
PI	28
MC	10.2

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-6
SAMPLE TYPE	BULK
SAMPLE DEPTH	2

LL	45
PL	17
PI	28
MC	10.2

DESCRIPTION	Pale greenish yellow and light brown (10YR 8/2, 5YR 5/6) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/190
REVIEW	0

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-7
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	360.34
Wt. Dry Soil & Tare (gm)	330.64
Wt. of Tare (gm)	104.77
Wt. of Water (gm)	29.70
Weight of Dry Soil (gm)	225.87
Moisture Content (%)	13.15

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	24.95	27.86
Weight of Dry Soil & T	23.85	26.70
Weight of Tare (gm)	16.75	19.64
Weight of Water (gm)	1.10	1.16
Weight of Dry Soil (gm)	6.72	7.06
Water Content %	16.37	16.43

LIQUID LIMIT DETERMINATION

32	22	17
27.06	29.00	26.80
22.91	24.67	21.74
13.90	15.67	14.83
4.17	4.33	5.06
9.01	9.00	9.91
46.28	48.11	51.06

PLASTIC LIMIT (PL): 16

LIQUID LIMIT (LL): 48

PLASTICITY INDEX (PI): 32

BLOWS	MC		
32	46.28	3.47	25
22	48.11	3.09	0.00
17	51.06	2.83	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
46.28	51.06	47.83	47.83	48
-2	52.00	47.83		16
				32

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL):

LIQUID LIMIT (LL):

PLASTICITY INDEX (PI):

NON-PLASTIC

Number of Blows	PLASTIC LIMITS	
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL): NP

LIQUID LIMIT (LL): NP

PLASTICITY INDEX (PI): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	360.34
Wt. Dry Soil & Tare (gm)	330.64
Wt. of Tare (gm)	104.77
Wt. of Water (gm)	29.70
Weight of Dry Soil (gm)	225.87
Moisture Content (%)	13.1

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-7 Depth (ft) 6
TYPE	BULK

Description: Dark yellowish orange (10YR 6/6) clayey gravel with sand

USCS: GC

LL	48
PL	16
PI	32

TEST BY	DT
DATE SET UP	8/5/2004
REVIEW BY	MB

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	157.08
Dry Soil & Tare (gm)	151.92
Tare Weight (gm)	27.94
Moisture Content (%)	4.2

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	46903.43
Tare Weight (gm)	
Total Weight (gm)	46903.43

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	11.44		
coarse gravel	29.94		
fine gravel	17.70	59.09	
coarse sand	3.37		
medium sand	11.58		
fine sand	10.06	25.00	
fines	15.91		
			100.00

		(Wt. + Tare)	% RETAINED	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	5366.30	11.4	88.6
	1.5"	13015.20	27.7	72.3
	1.0"	16750.00	35.7	64.3
	0.75"	19410.80	41.4	58.6
	0.375"	24313.70	51.8	48.2
	#4	27713.70	59.1	40.9

				% PASSING
BACK SIEVE	#10	4.01	4.0	8.23	37.5
Tare Weight	#20	10.70	10.7	21.97	31.9
0.00	#40	17.79	17.8	36.53	26.0
	#60	22.69	22.7	46.59	21.9
	#100	26.02	26.0	53.43	19.1
	#200	29.76	29.8	61.11	15.9

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 50.73

DATE	TIME	READING	TEMP	HYD. COR.
8/6/2004	9:31	R	T	Cc
8/6/2004	9:33	22.5	24.00	5.50
8/6/2004	9:36	21.3	24.40	5.50
8/6/2004	9:46	21.0	24.60	5.50
8/6/2004	10:01	20.5	24.60	5.50
8/6/2004	10:31	19.8	24.60	5.50
8/6/2004	13:41	18.0	26.10	5.50
8/7/2004	9:31	17.5	24.80	5.50

(mm)	%Finer
0.033	14.14
0.021	13.10
0.012	12.89
0.009	12.47
0.006	11.85
0.003	10.40
0.001	9.98

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt used in test (gm)	48.70
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	40.9133

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING G'	EFFECTIVE LENGTH L	A
2.00	0.012819	17.00	13.5	0.99
5.00	0.012819	15.75	13.8	0.99
15.00	0.012819	15.50	13.8	0.99
30.00	0.012819	15.00	13.8	0.99
60.00	0.012819	14.25	14	0.99
250.00	0.012534	12.50	14.3	0.99
1440.00	0.012819	12.00	14.3	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	88.6
1.5"	37.500	72.3
1.0"	25.000	64.3
0.75"	19.000	58.6
0.375"	9.500	48.2
#4	4.750	40.9
#10	2.000	37.5
#20	0.850	31.9
#40	0.425	26.0
#60	0.250	21.9
#100	0.150	19.1
#200	0.075	15.9
	0.0333	14.1
	0.0213	13.1
	0.0123	12.9
	0.0087	12.5
	0.0062	11.9
	0.0030	10.4
	0.0013	10.0

Check By NG

August-04

043-2246.0001

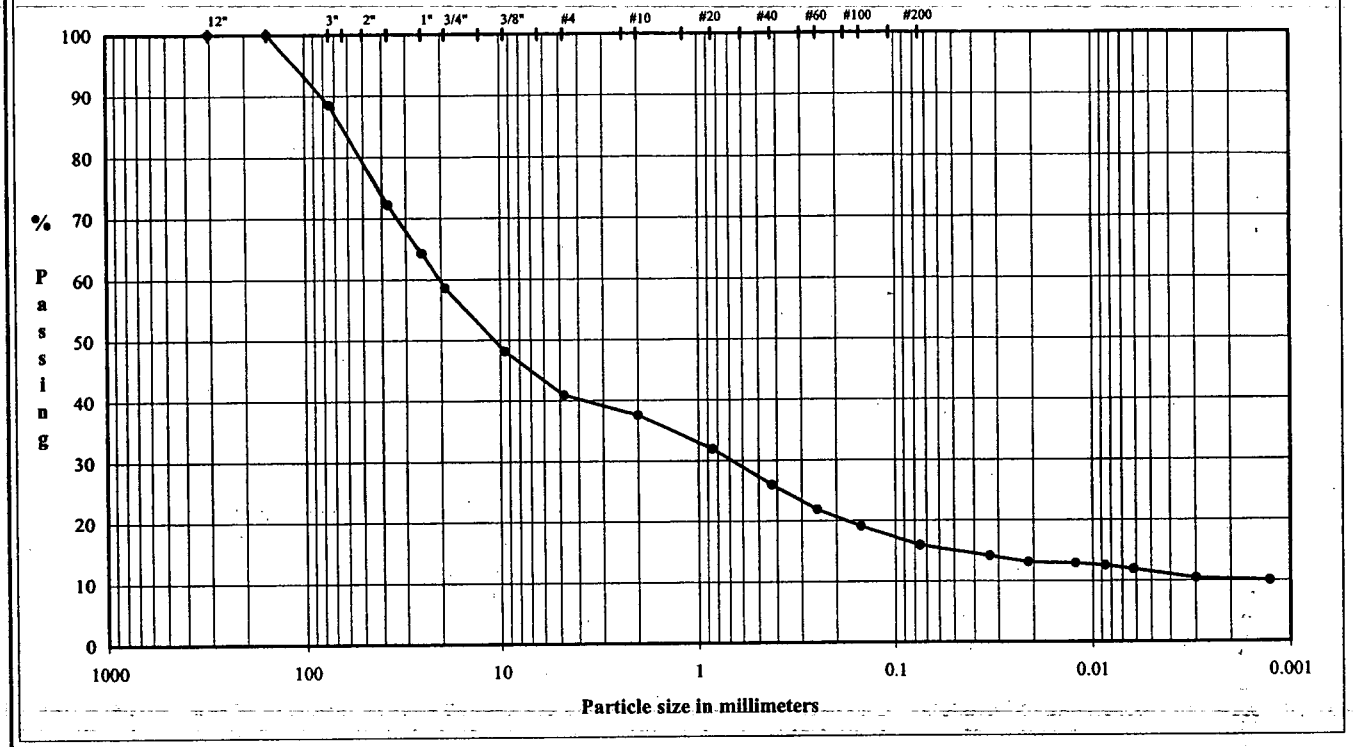
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **A-7** Depth (ft): **6**

TYPE: **BULK**



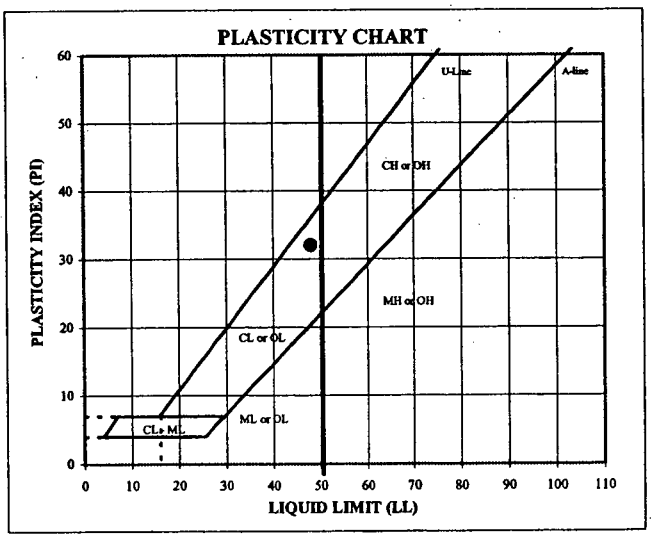
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	11.44
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	88.6		
1.5"	37.5	72.3		
1.0"	25.0	64.3	Coarse Gravel	29.94
0.75"	19.0	58.6		
0.375"	9.5	48.2		
#4	4.8	40.9	Fine Gravel	17.70
#10	2.00	37.5	Coarse Sand	3.37
#20	0.85	31.9		
#40	0.43	26.0	Medium Sand	11.58
#60	0.25	21.9		
#100	0.15	19.1		
#200	0.075	15.9	Fine Sand	10.06

Hydrometer Analysis

(mm)	%Finer		
0.033	14.1		
0.021	13.1		
0.012	12.9	Fines	
0.0087	12.5	Silt or Clay	15.91
0.0062	11.9		
0.0030	10.4		
0.0013	10.0		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
13.1	48	16	32	–

DESCRIPTION: Dark-yellowish orange (10YR 6/6) clayey gravel with sand

USCS: GC

TECH: DT

DATE: 8/5/2004

REVIEW: MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-7	-	6.0		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR: Mechanical	PREPARATION: Wet Method
MOLD WEIGHT (gm)	2265.0		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR: Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332	5.5 -lbf. RAMMER WITH 12 INCH DROP	

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Dark yellowish orange (10YR 6/6) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

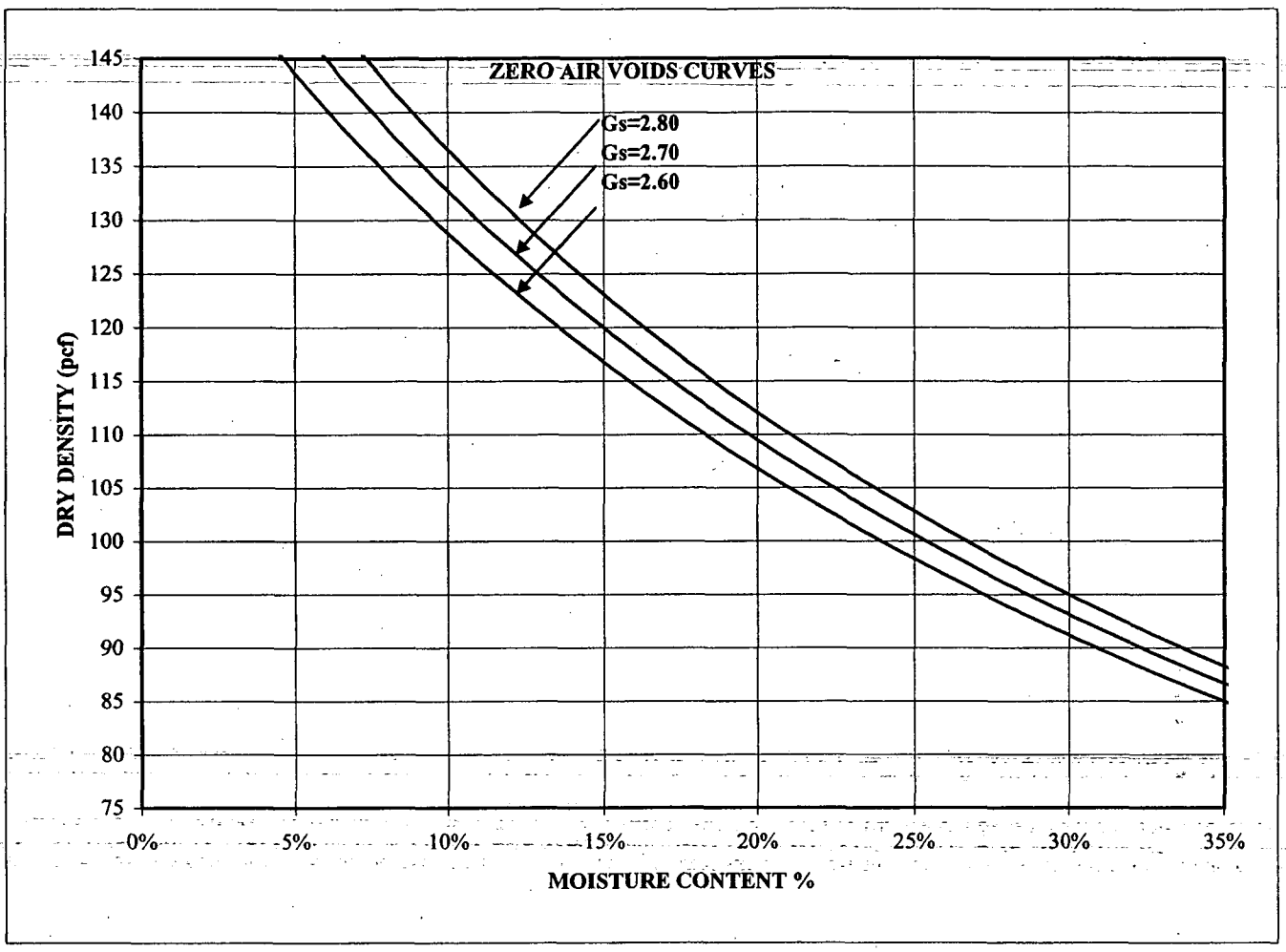
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)	[(B-A)/A]*100				
Bulk Specific Gravity	A/(B-C)				

LL	48
PL	16
PI	32
MC	13.1

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-7
SAMPLE TYPE	BULK
SAMPLE DEPTH	6

LL	48
PL	16
PI	32
MC	13.1

DESCRIPTION	Dark yellowish orange (10YR 6/6) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-7 Dup
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	326.51
Wt. Dry Soil & Tare (gm)	298.66
Wt. of Tare (gm)	101.42
Wt. of Water (gm)	27.85
Weight of Dry Soil (gm)	197.24
Moisture Content (%)	14.12

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	21.54	21.31
Weight of Dry Soil & T	20.35	20.16
Weight of Tare (gm)	13.87	14.12
Weight of Water (gm)	1.19	1.13
Weight of Dry Soil (gm)	6.48	6.36
Water Content %	18.36	17.77

LIQUID LIMIT DETERMINATION

29	21	19
25.17	26.74	23.59
21.56	22.30	21.37
13.40	13.11	13.20
3.56	3.25	4.02 -
7.76	6.78	7.97
45.88	47.94	50.44

PLASTIC LIMIT (PL)

18

LIQUID LIMIT (LL)

47

PLASTICITY INDEX (PI)

29

BLOWS	MC		
29	45.88	3.37	25
21	47.94	3.04	0.00
19	50.44	2.94	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
45.88	50.44	47.11	47.11	47
-2	52.00	47.11		18
				29

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00	
0.00	0.00	
#DIV/0!	#DIV/0!	

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL)

NP

LIQUID LIMIT (LL)

NP

PLASTICITY INDEX (PI)

NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	326.51
Wt. Dry Soil & Tare (gm)	298.66
Wt. of Tare (gm)	101.42
Wt. of Water (gm)	27.85
Weight of Dry Soil (gm)	197.24
Moisture Content (%)	14.1

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/GO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-7 Dup Depth (ft) 6
TYPE	BULK

Description: Dark yellowish orange (10YR 6/6) clayey gravel with sand

USCS: GC

LL	47
PL	18
PI	29

TEST BY	JR
DATE SET UP	8/9/2004
REVIEW BY	MB

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	79.09
Dry Soil & Tare (gm)	77.08
Tare Weight (gm)	15.98
Moisture Content (%)	3.3

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	46903.43
Tare Weight (gm)	
Total Weight (gm)	46903.43

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	11.44	
coarse gravel	29.94	
fine gravel	17.70	59.09
coarse sand	3.23	
medium sand	12.20	
fine sand	10.16	25.58
fines	15.33	
		100.00

PLUS #4 MATERIAL SIEVE

Tare Weight: 0.00

	(Wt. + Tare)	% RETAINED	% PASSING
12.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
3.0"	5366.30	11.4	88.6
1.5"	13015.20	27.7	72.3
1.0"	16750.00	35.7	64.3
0.75"	19410.80	41.4	58.6
0.375"	24313.70	51.8	48.2
#4	27713.70	59.1	40.9

BACK SIEVE

Tare Weight: 0.00

			% PASSING	
#10	3.77	-3.8	7.89	37.7
#20	10.61	10.6	22.21	31.8
#40	18.01	18.0	37.70	25.5
#60	22.67	22.7	47.46	21.5
#100	26.27	26.3	54.99	18.4
#200	29.87	29.9	62.53	15.3

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 49.34

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/10/2004	9:17	21.5	24.50	5.00
8/10/2004	9:19	21.5	24.50	5.00
8/10/2004	9:22	21.0	24.50	5.00
8/10/2004	9:32	20.5	24.60	5.00
8/10/2004	9:47	19.5	24.60	5.00
8/10/2004	10:17	19.0	24.60	5.00
8/10/2004	13:27	18.0	25.50	5.00
8/11/2004	9:17	17.0	25.00	5.00

(mm)	%Finer
0.034	13.99
0.021	13.57
0.012	13.14
0.009	12.29
0.006	11.87
0.003	11.02
0.001	10.18

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm)	47.77
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	40.9133

HYDROMETER CALCULATIONS

ET (min)	TEMP. COR. K	READING C	EFFECTIVE LENGTH	A
2.00	0.012819	16.50	13.7	0.99
5.00	0.012819	16.00	13.7	0.99
15.00	0.012819	15.50	13.8	0.99
30.00	0.012819	14.50	14	0.99
60.00	0.012819	14.00	14	0.99
250.00	0.012677	13.00	14.2	0.99
1440.00	0.012677	12.00	14.3	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	88.6
1.5"	37.500	72.3
1.0"	25.000	64.3
0.75"	19.000	58.6
0.375"	9.500	48.2
#4	4.750	40.9
#10	2.000	37.7
#20	0.850	31.8
#40	0.425	25.5
#60	0.250	21.5
#100	0.150	18.4
#200	0.075	15.3
	0.0336	14.0
	0.0212	13.6
	0.0123	13.1
	0.0088	12.3
	0.0062	11.9
	0.0030	11.0
	0.0013	10.2

Check By NG

August-04

043-2246.0001

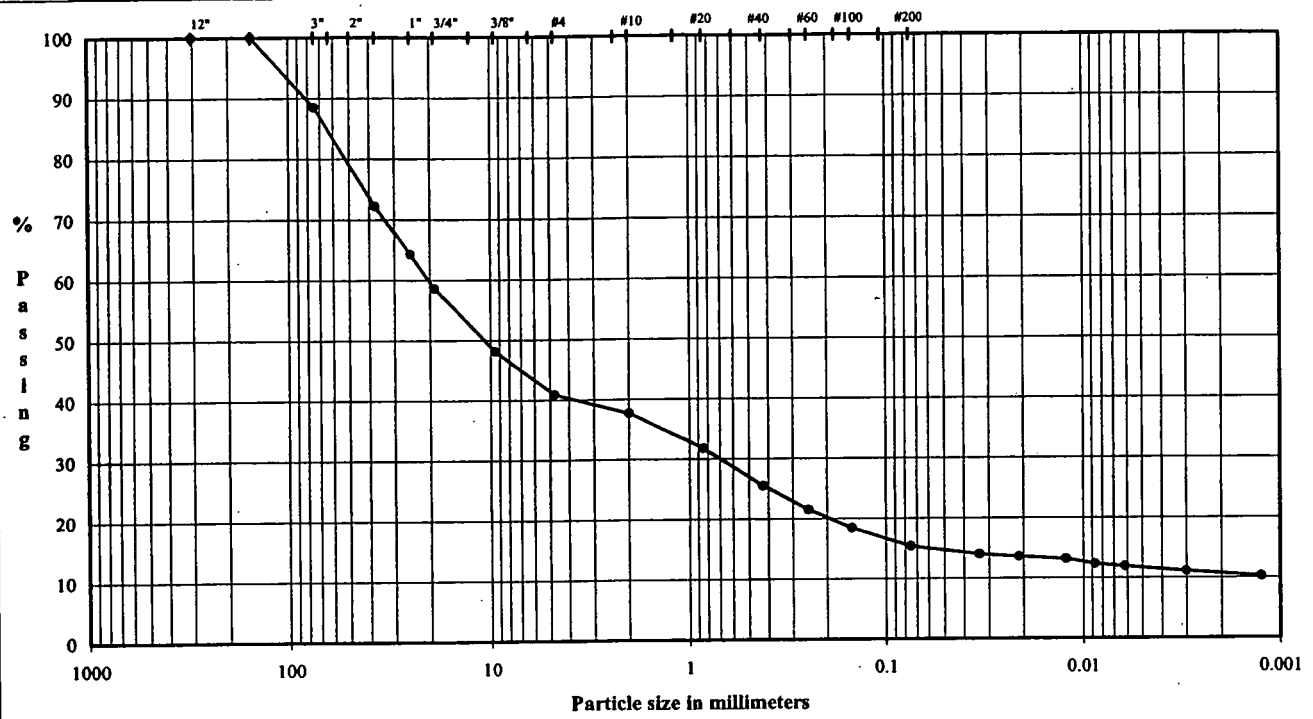
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **A-7 Dup** Depth (ft): **6**

TYPE: **BULK**



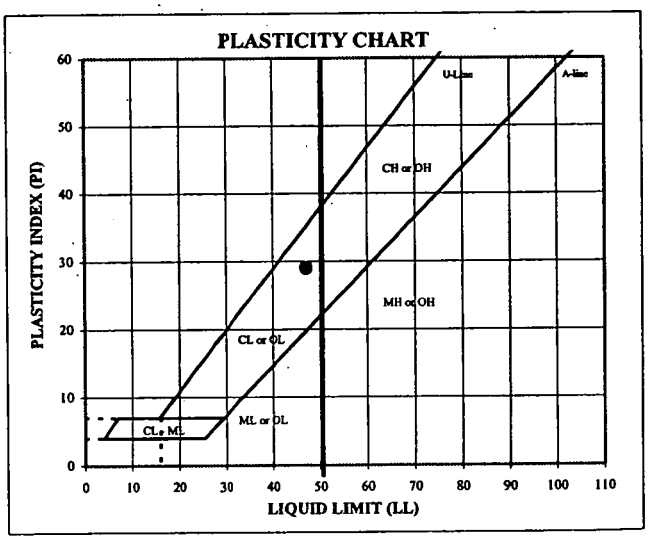
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	11.44
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	88.6		
1.5"	37.5	72.3		
1.0"	25.0	64.3	Coarse Gravel	29.94
0.75"	19.0	58.6		
0.375"	9.5	48.2		
#4	4.8	40.9	Fine Gravel	17.70
#10	2.00	37.7	Coarse Sand	3.23
#20	0.85	31.8		
#40	0.43	25.5	Medium Sand	12.20
#60	0.25	21.5		
#100	0.15	18.4		
#200	0.075	15.3	Fine Sand	10.16

Hydrometer Analysis

(mm)	%Finer		
0.034	14.0		
0.021	13.6		
0.012	13.1	Fines	
0.0088	12.3	Silt or Clay	15.33
0.0062	11.9		
0.0030	11.0		
0.0013	10.2		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
14.1	47	18	29	–

DESCRIPTION: Dark yellowish orange (10YR 6/6) clayey gravel with sand

USCS: GC

TECH	JR
DATE	8/9/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-7 Dup	-	6.0		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR: Mechanical	PREPARATION: Wet Method
MOLD WEIGHT (gm)	2265.0		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR: Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332	5.5 -lbf. RAMMER WITH 12 INCH DROP	

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Dark yellowish orange (10YR 6/6) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

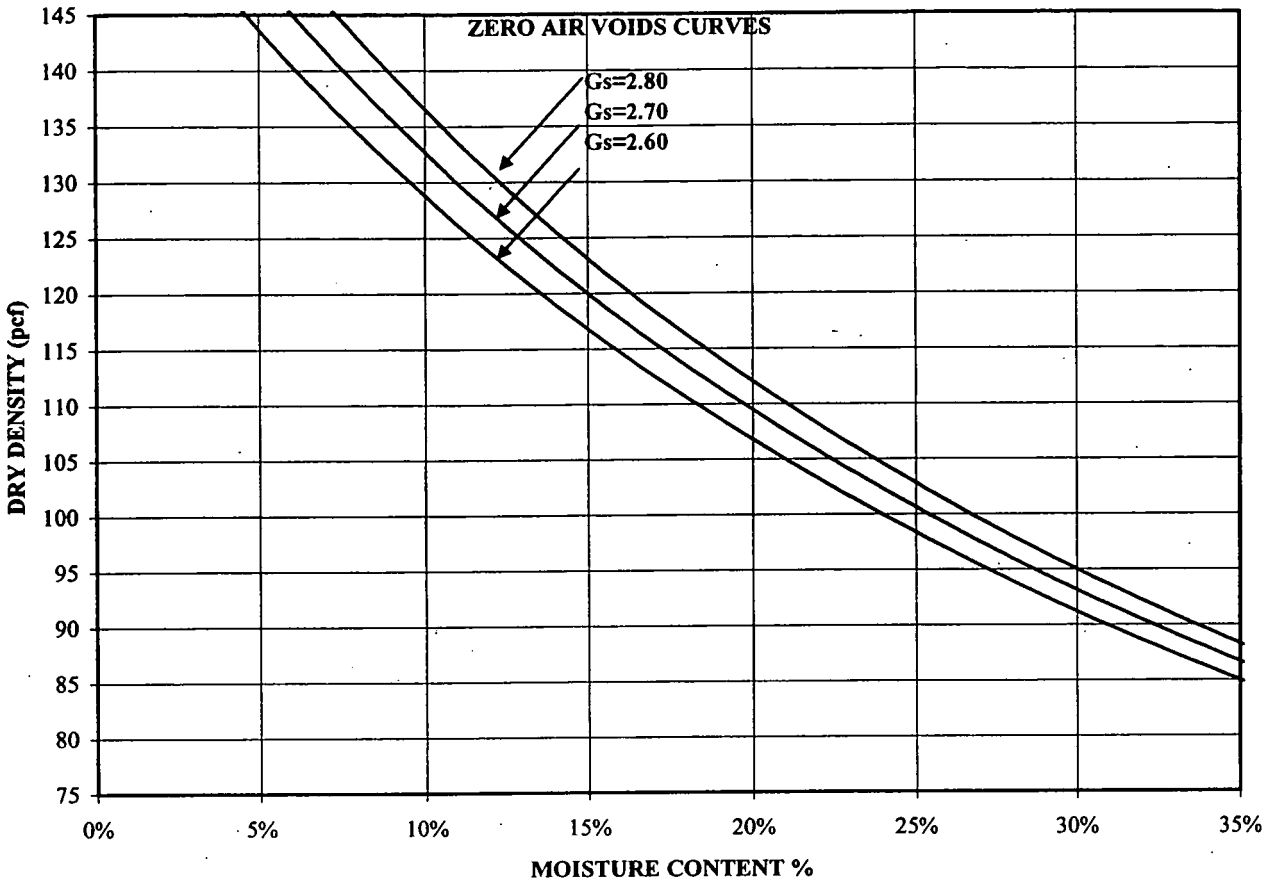
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)		[(B-A)/A]*100			
Bulk Specific Gravity		A/(B-C)			

LL	47
PL	18
PI	29
MC	14.1

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-7 Dup
SAMPLE TYPE	BULK
SAMPLE DEPTH	6

LL	47
PL	18
PI	29
MC	14.1

DESCRIPTION	Dark yellowish orange (10YR 6/6) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-8
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	457.66
Wt. Dry Soil & Tare (gm)	420.85
Wt. of Tare (gm)	103.17
Wt. of Water (gm)	36.81
Weight of Dry Soil (gm)	317.68
Moisture Content (%)	11.59

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	21.37	20.80
Weight of Dry Soil & T	20.51	19.70
Weight of Tare (gm)	15.66	13.80
Weight of Water (gm)	0.86	1.10
Weight of Dry Soil (gm)	4.85	5.90
Water Content %	17.73	18.64

LIQUID LIMIT DETERMINATION

32	27	15
26.04	24.06	27.05
22.26	20.83	23.15
14.80	13.51	15.60
3.58	3.18	3.97
8.16	6.97	7.52
43.87	45.62	52.79

PLASTIC LIMIT (PL): 18

LIQUID LIMIT (LL): 47

PLASTICITY INDEX (PI): 29

BLOWS	MC		
32	43.87	3.47	25
27	45.62	3.30	0.00
15	52.79	2.71	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
43.87	52.79	46.69	46.69	47
-2	54.00	46.69		18
				29

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS		LIQUID LIMITS			TRIAL 1	TRIAL 2
Weight of Wet Soil & Tare (gm)							
Weight of Dry Soil & Tare (gm)							
Weight of Tare (gm)					BLOWS:	0	0
Weight of Water (gm)	0.00	0.00					
Weight of Dry Soil (gm)	0.00	0.00	0.00	0.00	K VALUE:	#N/A	#N/A
Water Content %	#DIV/0!	#DIV/0!	0.00	0.00			
			#DIV/0!	#DIV/0!			

PLASTIC LIMIT (PL):

LIQUID LIMIT (LL):

PLASTICITY INDEX (PI):

NON-PLASTIC

Number of Blows	PLASTIC LIMITS		LIQUID LIMITS	
Weight of Wet Soil & Tare (gm)				
Weight of Dry Soil & Tare (gm)				
Weight of Tare (gm)				
Weight of Water (gm)	0.00	0.00	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

NP

PLASTIC LIMIT (PL): NP

LIQUID LIMIT (LL): NP

PLASTICITY INDEX (PI): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	457.66
Wt. Dry Soil & Tare (gm)	420.85
Wt. of Tare (gm)	103.17
Wt. of Water (gm)	36.81
Weight of Dry Soil (gm)	317.68
Moisture Content (%)	11.6

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-8 Depth (ft) 3
TYPE	BULK

Description: Dark yellowish orange to moderate brown (10YR6/6, 5YR4/4) clayey gravel with sand

USCS: GC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	158.21
Dry Soil & Tare (gm)	154.55
Tare Weight (gm)	28.12
Moisture Content (%)	2.9

LL	47
PL	18
PI	29

TEST BY	DT
DATE SET UP	8/6/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	44605.77
Tare Weight (gm)	
Total Weight (gm)	44605.77

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	4.33		
coarse gravel	31.89		
fine gravel	19.74	55.96	
coarse sand	4.25		
medium sand	11.83		
fine sand	10.06	26.15	
fines	17.89		
			100.00

PLUS #4 MATERIAL SIEVE

Tare Weight: 0.00

	(Wt. + Tare)	% RETAINED	% PASSING
12.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
6.0"	0.00	0.0	100.0
3.0"	1929.30	4.3	95.7
1.5"	9789.90	21.9	78.1
1.0"	13484.30	30.2	69.8
0.75"	16155.90	36.2	63.8
0.375"	21506.00	48.2	51.8
#4	24959.90	56.0	44.0

BACK SIEVE

Tare Weight: 0.00

			% PASSING
#10	4.79	4.8	9.66	39.8
#20	11.35	11.4	22.89	34.0
#40	18.11	18.1	36.52	28.0
#60	22.32	22.3	45.01	24.2
#100	26.15	26.2	52.74	20.8
#200	29.44	29.4	59.37	17.9

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.02

DATE	TIME	READING	TEMP	HYD. COR.
8/7/2004	9:35	R	T	Cc
8/7/2004	9:37	23.3	24.30	5.50
8/7/2004	9:40	22.5	24.40	5.50
8/7/2004	9:50	22.3	24.50	5.50
8/7/2004	10:05	21.8	24.40	5.50
8/7/2004	10:35	20.8	24.60	5.50
8/7/2004	13:45	19.3	26.10	5.50
8/8/2004	9:35	19.0	24.80	5.50

(mm)	%Finer
0.033	15.61
0.021	14.95
0.012	14.73
0.009	14.29
0.006	13.41
0.003	12.09
0.001	11.87

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt used in test (gm)	49.58
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample	44.0433

HYDROMETER CALCULATIONS

ET (min)	TEMP COR K	READING C	EFFECTIVE LENGTH L	A
2.00	0.012819	17.75	13.5	0.99
5.00	0.012819	17.00	13.5	0.99
15.00	0.012819	16.75	13.7	0.99
30.00	0.012819	16.25	13.7	0.99
60.00	0.012819	15.25	13.8	0.99
250.00	0.012534	13.75	14.2	0.99
1440.00	0.012819	13.50	14.2	0.99

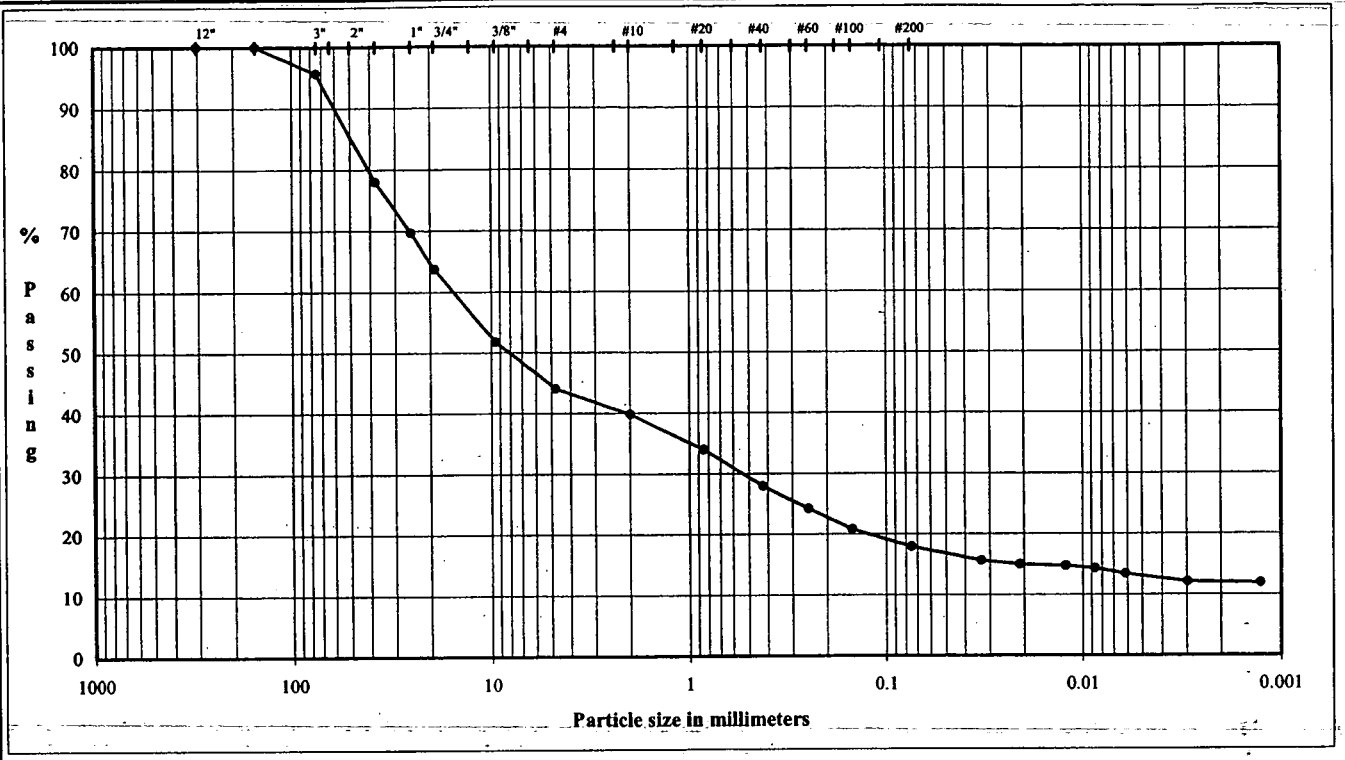
	X AXIS	Y AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	95.7
1.5"	37.500	78.1
1.0"	25.000	69.8
0.75"	19.000	63.8
0.375"	9.500	51.8
#4	4.750	44.0
#10	2.000	39.8
#20	0.850	34.0
#40	0.425	28.0
#60	0.250	24.2
#100	0.150	20.8
#200	0.075	17.9
	0.0333	15.6
	0.0211	14.9
	0.0123	14.7
	0.0087	14.3
	0.0061	13.4
	0.0030	12.1
	0.0013	11.9

Check By NG

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **A-8** Depth (ft): **3**
TYPE: **BULK**



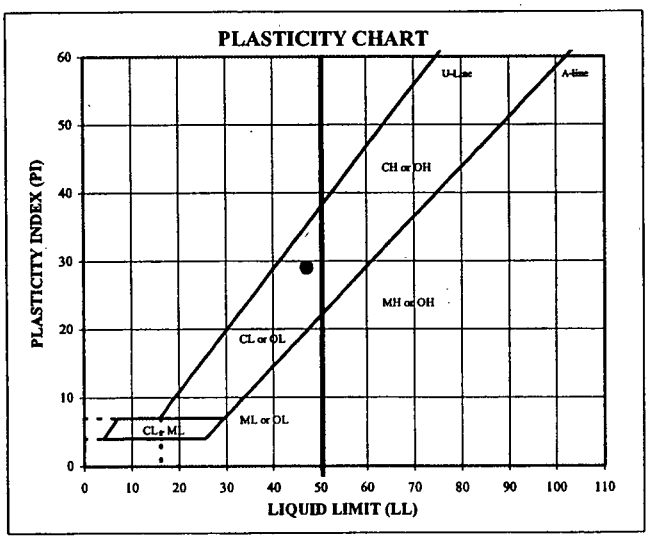
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
COBBLES	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	4.33
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	95.7		
1.5"	37.5	78.1		
1.0"	25.0	69.8	Coarse Gravel	31.89
0.75"	19.0	63.8		
0.375"	9.5	51.8		
#4	4.8	44.0	Fine Gravel	19.74
#10	2.00	39.8	Coarse Sand	4.25
#20	0.85	34.0		
#40	0.43	28.0	Medium Sand	11.83
#60	0.25	24.2		
#100	0.15	20.8		
#200	0.075	17.9	Fine Sand	10.06

Hydrometer Analysis

(mm)	%Finer		
0.033	15.6		
0.021	14.9		
0.012	14.7	Fines	
0.0087	14.3	Silt or Clay	17.89
0.0061	13.4		
0.0030	12.1		
0.0013	11.9		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
11.6	47	18	29	–

DESCRIPTION: Dark yellowish orange to moderate brown (10YR6/6, 5YR4/4) clayey gravel with sand

USCS: GC

TECH: DT
DATE: 8/6/2004
REVIEW: MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-8	-	3.0		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1	TYPE COMPACTOR: Mechanical	PREPARATION: Wet Method
MOLD WEIGHT (gm)	2265.0		
MOLD DIAMETER (in)	3.991	TYPE PROCTOR: Standard	
MOLD HEIGHT (in)	4.581		
MOLD VOLUME (cu.ft)	0.0332		

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Dark yellowish orange to moderate brown (10YR6/6, 5YR4/4) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

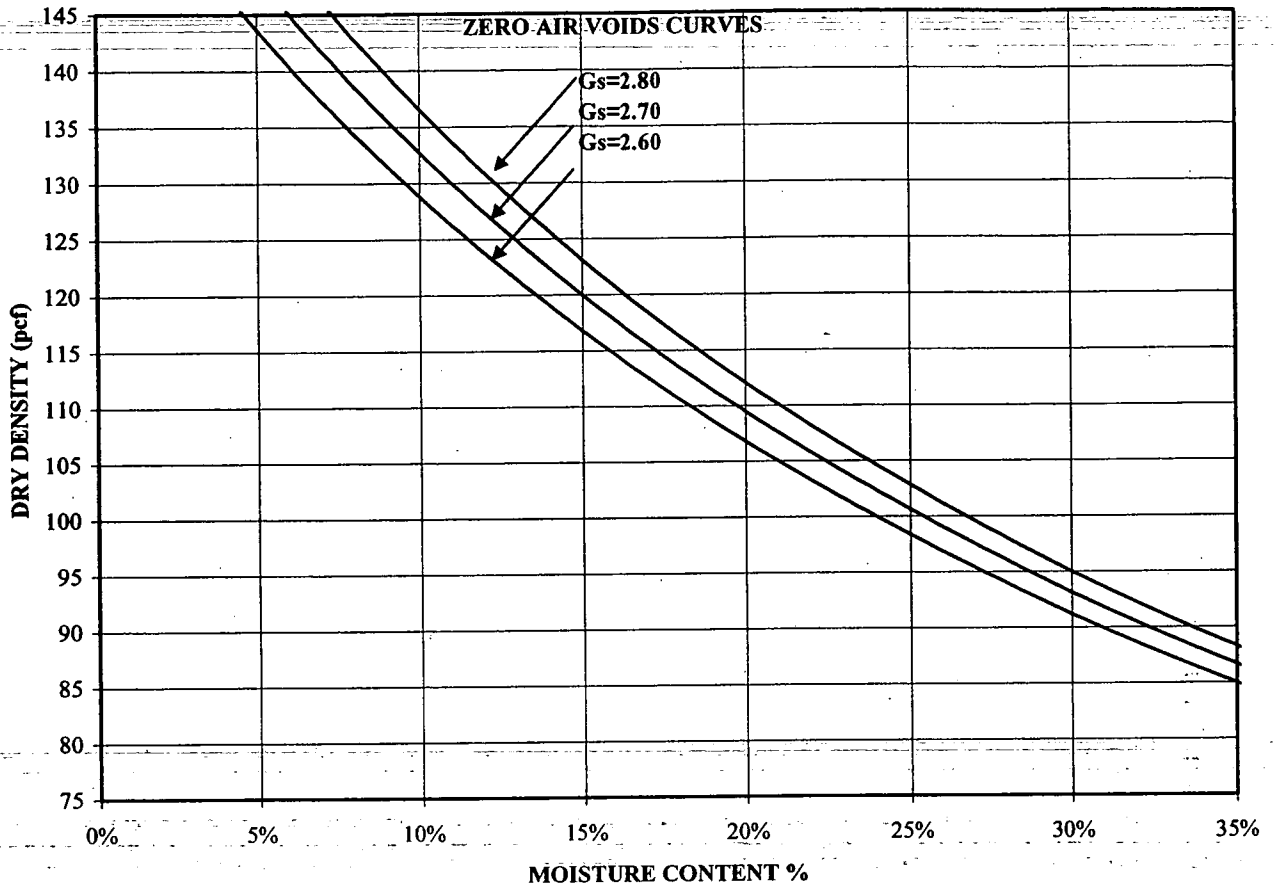
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)		[(B-A)/A]*100			
Bulk Specific Gravity		A/(B-C)			

LL	47
PL	18
PI	29
MC	11.6

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-8
SAMPLE TYPE	BULK
SAMPLE DEPTH	3

LL	47
PL	18
PI	29
MC	11.6

DESCRIPTION	Dark yellowish orange to moderate brown (10YR6/6, 5YR4/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-9
TYPE	BULK

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	421.31
Wt. Dry Soil & Tare (gm)	394.22
Wt. of Tare (gm)	99.94
Wt. of Water (gm)	27.09
Weight of Dry Soil (gm)	294.28
Moisture Content (%)	9.21

4 OR 3 POINT ATTERBERG

PLASTIC LIMIT DETERMINATION

Number of Blows		
Weight of Wet Soil & T	24.88	20.46
Weight of Dry Soil & T	23.43	19.37
Weight of Tare (gm)	15.66	14.32
Weight of Water (gm)	1.45	0.92
Weight of Dry Soil (gm)	7.77	5.05
Water Content %	18.66	18.22

PLASTIC LIMIT (PL): 18

LIQUID LIMIT DETERMINATION

33	23	16
26.67	24.07	23.88
23.30	20.83	20.62
13.86	13.29	14.24
3.37	3.19	3.25
7.42	6.59	6.39
45.42	48.41	50.86

LIQUID LIMIT (LL): 48

PLASTICITY INDEX (PI): 30

BLOWS	MC		
33	45.42	3.50	25
23	48.41	3.14	0.00
16	50.86	2.77	-2
0	0.00	#NUM!	

3 POINTS

	25.00	25.00	10.00	3-POINTS
45.42	50.86	47.60	47.60	48
-2	52.00	47.60		18
				30

ONE POINT ATTERBERG

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL):

PLASTICITY INDEX (PI):

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

LIQUID LIMIT (LL):

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

NON-PLASTIC

PLASTIC LIMITS

Number of Blows		
Weight of Wet Soil & Tare (gm)		
Weight of Dry Soil & Tare (gm)		
Weight of Tare (gm)		
Weight of Water (gm)	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!

PLASTIC LIMIT (PL): NP

PLASTICITY INDEX (PI): NP

LIQUID LIMITS

0.00	0.00
0.00	0.00
#DIV/0!	#DIV/0!

NP

LIQUID LIMIT (LL): NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	421.31
Wt. Dry Soil & Tare (gm)	394.22
Wt. of Tare (gm)	99.94
Wt. of Water (gm)	27.09
Weight of Dry Soil (gm)	294.28
Moisture Content (%)	9.2

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-9 Depth (ft) 10
TYPE	BULK

Description: Moderate yellowish brown (5YR 4/4) clayey gravel with sand

USCS: GC

LL	48
PL	18
PI	30

TEST BY	DT
DATE SET UP	8/4/2004
REVIEW BY	MB

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	99.07
Dry Soil & Tare (gm)	97.08
Tare Weight (gm)	21.36
Moisture Content (%)	2.6

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	40025.36
Tare Weight (gm)	
Total Weight (gm)	40025.36

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	2.06		
coarse gravel	27.27		
fine gravel	20.12	49.45	
coarse sand	4.66		
medium sand	13.20		
fine sand	11.05	28.91	
fines	21.64		
			100.00

		(Wt. + Tare)	% RETAINED	% PASSING	% PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0	
Tare Weight	6.0"	0.00	0.0	100.0	
0.00	6.0"	0.00	0.0	100.0	
	6.0"	0.00	0.0	100.0	
	3.0"	823.90	2.1	97.9	
	1.5"	5543.10	13.8	86.2	
	1.0"	9021.90	22.5	77.5	
	0.75"	11740.30	29.3	70.7	
	0.375"	16056.20	40.1	59.9	
	#4	19793.10	49.5	50.5	
BACK SIEVE	#10	4.60	4.6	9.22	45.9
Tare Weight	#20	11.29	11.3	22.62	39.1
0.00	#40	17.63	17.6	35.32	32.7
	#60	21.94	21.9	43.96	28.3
	#100	25.26	25.3	50.61	25.0
	#200	28.54	28.5	57.18	21.6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm): 51.22

DATE	TIME	READING R	TEMP T	HYD. COR. Cc
8/5/2004	10:20	24.0	25.60	5.50
8/5/2004	10:22	23.0	25.50	5.50
8/5/2004	10:25	22.8	325.50	5.50
8/5/2004	10:35	22.0	25.50	5.50
8/5/2004	10:50	21.3	25.60	5.50
8/5/2004	11:24	20.0	26.40	5.50
8/5/2004	14:30	19.8	25.10	5.50
8/6/2004	10:20			

(mm)	%Finer
0.033	18.55
0.021	17.55
0.011	17.30
0.009	16.54
0.006	15.79
0.003	14.54
0.001	14.29

2.7

6

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt used in test (gm)	49.91
Hydrometer Bulb Number	624378
%Pass #4 Sieve for whole sample:	50.5486

HYDROMETER CALCULATIONS

DT (min)	TEMP COR K	READING R	EFFECTIVE LENGTH	A
2.00	0.012677	18.50	13.7	0.99
4.00	0.012677	17.50	13.9	0.99
15.00	0.011995	17.25	13.9	0.99
30.00	0.012677	16.50	13.7	0.99
60.00	0.012677	15.75	13.8	0.99
250.00	0.012534	14.50	14	0.99
1440.00	0.012677	14.25	14	0.99

	X-AXIS	Y-AXIS
12.0"	304.800	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
6.0"	154.200	100.0
3.0"	75.000	97.9
1.5"	37.500	86.2
1.0"	25.000	77.5
0.75"	19.000	70.7
0.375"	9.500	59.9
#4	4.750	50.5
#10	2.000	45.9
#20	0.850	39.1
#40	0.425	32.7
#60	0.250	28.3
#100	0.150	25.0
#200	0.075	21.6
	0.0327	18.5
	0.0208	17.5
	0.0114	17.3
	0.0086	16.5
	0.0059	15.8
	0.0030	14.5
	0.0012	14.3

Check By NG:

August-04

043-2246.0001

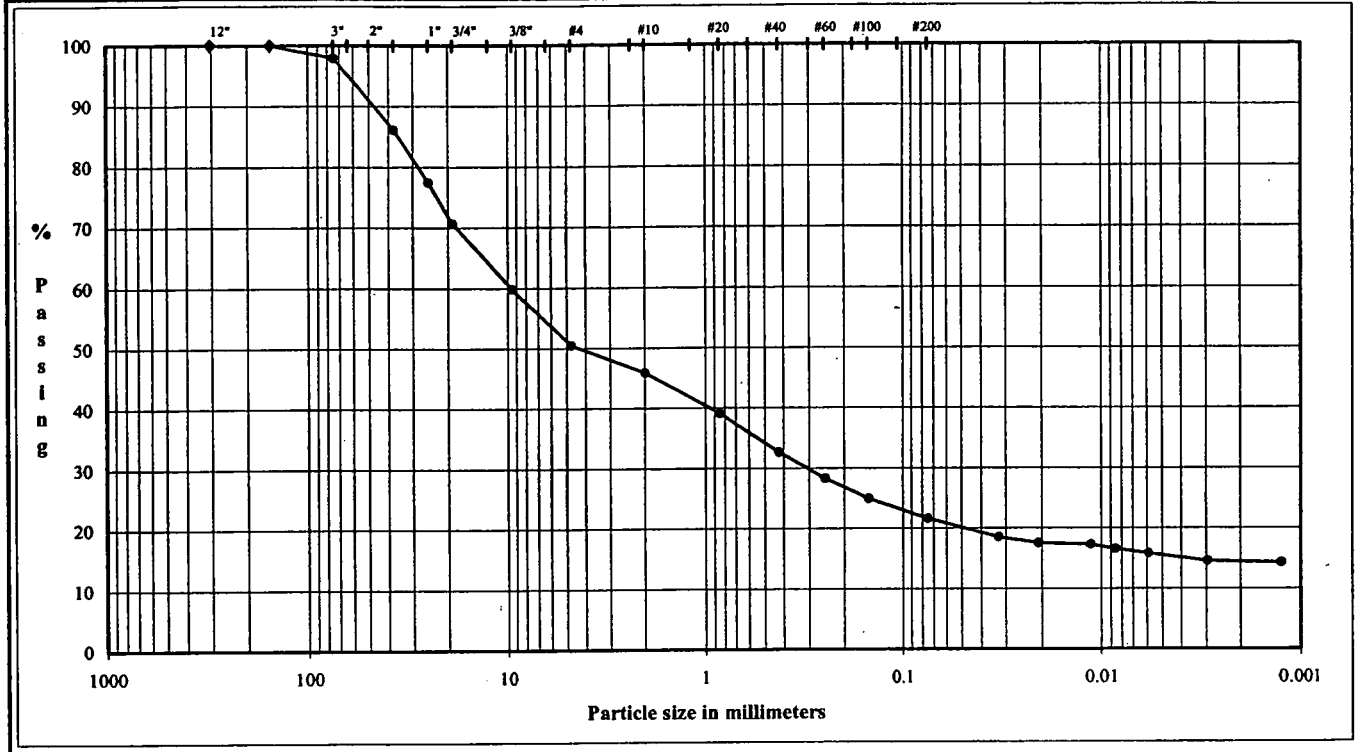
PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**

SAMPLE ID: **A-9** Depth (ft): **10**

TYPE: **BULK**



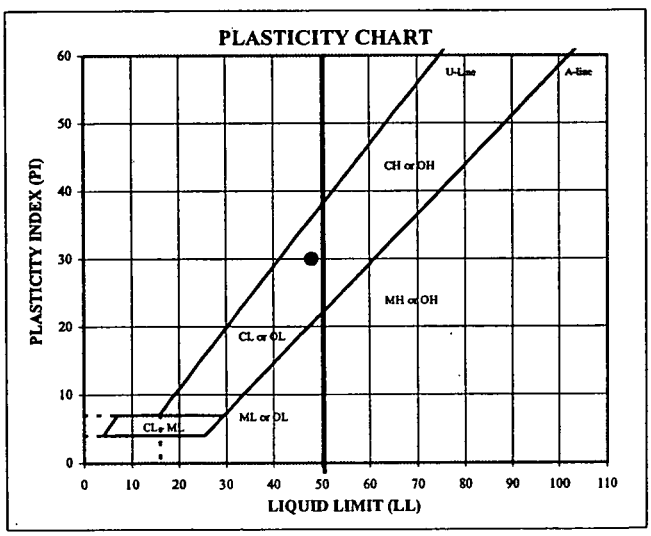
COBBLES	GRAVEL		SAND			FINES
	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	2.06
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	97.9		
1.5"	37.5	86.2		
1.0"	25.0	77.5	Coarse Gravel	27.27
0.75"	19.0	70.7		
0.375"	9.5	59.9		
#4	4.8	50.5	Fine Gravel	20.12
#10	2.00	45.9	Coarse Sand	4.66
#20	0.85	39.1		
#40	0.43	32.7	Medium Sand	13.20
#60	0.25	28.3		
#100	0.15	25.0		
#200	0.075	21.6	Fine Sand	11.05

Hydrometer Analysis

(mm)	%Finer		
0.033	18.5		
0.021	17.5		
0.011	17.3	Fines	
0.0086	16.5	Silt or Clay	21.64
0.0059	15.8		
0.0030	14.5		
0.0012	14.3		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
9.2	48	18	30	–

DESCRIPTION: Moderate yellowish brown (5YR 4/4) clayey gravel with sand

USCS: GC

TECH	DT
DATE	8/4/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-9	-	10.0		
SAMPLE TYPE	BULK				

TYPE COMPACTOR: Mechanical
PREPARATION: Wet Method
TYPE PROCTOR: Standard
5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4
METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"
METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

MOLD NUMBER		AH-1
MOLD WEIGHT (gm)		2265.0
MOLD DIAMETER (in)		3.991
MOLD HEIGHT (in)		4.581
MOLD VOLUME (cu.ft)		0.0332

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON # 4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON # 4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Moderate yellowish brown (5YR 4/4) clayey gravel with sand
USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

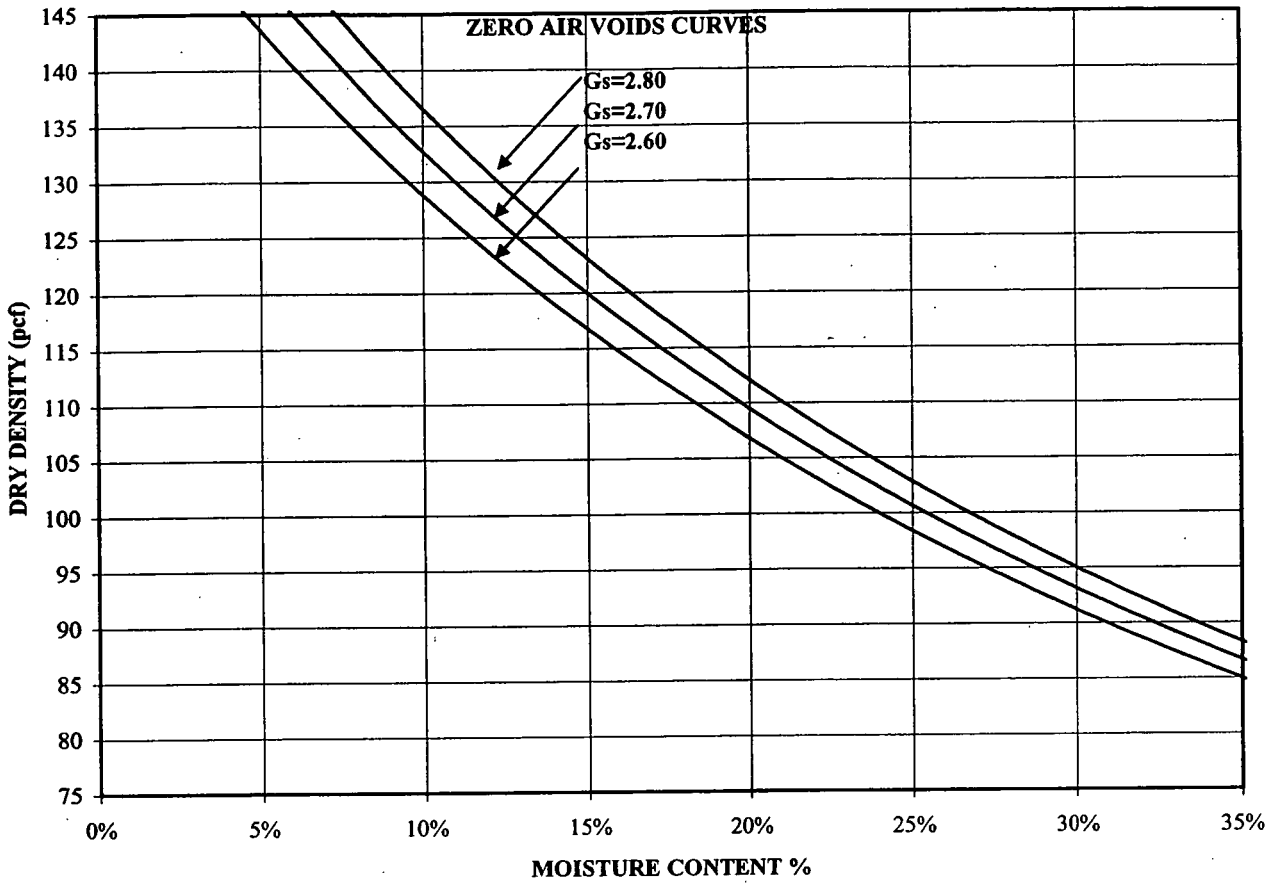
Weight of Oven Dry Sample (gm)		A		
Weight of Saturated-Surface-Dry (gm)		B		
Weight of Saturated Sample in Water	(gm)	C		
Absorption of Oversize Particles (%)		[(B-A)/A]*100		
Bulk Specific Gravity		A/(B-C)		

LL	48
PL	18
PI	30
MC	9.2

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-9
SAMPLE TYPE	BULK
SAMPLE DEPTH	10

LL	48
PL	18
PI	30
MC	9.2

DESCRIPTION	Moderate yellowish brown (5YR 4/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

ATTERBERG LIMITS

AS RECEIVED WATER CONTENT	
Tare No.	
Wt. Wet Soil & Tare (gm)	515.15
Wt. Dry Soil & Tare (gm)	485.41
Wt. of Tare (gm)	104.26
Wt. of Water (gm)	29.74
Weight of Dry Soil (gm)	381.15
Moisture Content (%)	7.80

PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-10
TYPE	BULK

4 OR 3 POINT ATTERBERG

	PLASTIC LIMIT DETERMINATION		LIQUID LIMIT DETERMINATION		
Number of Blows			32	26	17
Weight of Wet Soil & T	20.75	20.11	23.11	23.77	24.31
Weight of Dry Soil & T	19.57	18.99	19.99	20.37	20.73
Weight of Tare (gm)	13.91	13.77	13.79	13.98	14.12
Weight of Water (gm)	1.18	1.14	3.12	3.40	3.58
Weight of Dry Soil (gm)	5.66	5.22	6.20	6.39	6.61
Water Content %	20.85	21.84	50.32	53.21	54.16

PLASTIC LIMIT (PL) 21

LIQUID LIMIT (LL) 52

PLASTICITY INDEX (PI) 31

BLOWS	MC		
32	50.32	3.47	25
26	53.21	3.26	0.00
17	54.16	2.83	-2
0	0.00	#NUM!	

	3 POINTS			3-POINTS
	25.00	25.00	10.00	
50.32	54.16	52.38	52.38	52
-2	56.00	52.38		21
				31

ONE POINT ATTERBERG

Number of Blows	PLASTIC LIMITS		LIQUID LIMITS	
Weight of Wet Soil & Tare (gm)				
Weight of Dry Soil & Tare (gm)				
Weight of Tare (gm)				
Weight of Water (gm)	0.00	0.00		
Weight of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	0.00	0.00
			#DIV/0!	#DIV/0!

	TRIAL 1	TRIAL 2
BLOWS:	0	0
K VALUE:	#N/A	#N/A

PLASTIC LIMIT (PL)

LIQUID LIMIT (LL)

PLASTICITY INDEX (PI)

NON-PLASTIC

Number of Blows	PLASTIC LIMITS		LIQUID LIMITS	
Weight of Wet Soil & Tare (gm)				
Weight of Dry Soil & Tare (gm)				
Weight of Tare (gm)				
Weight of Water (gm)	0.00	0.00	0.00	0.00
Weight of Dry Soil (gm)	0.00	0.00	0.00	0.00
Water Content %	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			NP	

PLASTIC LIMIT (PL) NP

LIQUID LIMIT (LL) NP

PLASTICITY INDEX (PI) NP

HYDROMETER DATA ENTRY SHEET

AS RECEIVED WATER CONTENT

Tare No.	
Wt. Wet Soil & Tare (gm)	515.15
Wt. Dry Soil & Tare (gm)	485.41
Wt. of Tare (gm)	104.26
Wt. of Water (gm)	29.74
Weight of Dry Soil (gm)	381.15
Moisture Content (%)	7.8

MONTH AND YEAR	August-04
PROJECT NAME	Rocky Flats/Field & Lab Testing/CO
PROJECT NUMBER:	043-2246.0001
SAMPLE ID:	A-10 Depth (ft) 4
TYPE	BULK
Description	Moderate brown (5YR 3/4) clayey gravel with sand
USCS	GC

HYDROSCOPIC MOISTURE FOR SIEVE SAMPLE

Wt. Soil & Tare (gm)	153.16
Dry Soil & Tare (gm)	149.76
Tare Weight (gm)	27.52
Moisture Content (%)	2.8

LL	52
PL	21
PI	31
TEST BY	DT
DATE SET UP	8/3/2004
REVIEW BY	MB

Total Weight of Sample Used For Sieve Analysis Corrected for Hydroscopic Moisture

Wt. + Tare (gm)	46311.03
Tare Weight (gm)	
Total Weight (gm)	46311.03

HYDROMETER ANALYSIS

Specific Gravity (ass'd)	2.7
Specific Gravity (tested)	
Amount Dispersing Agent (ml)	125.00
Type Dispersion Device	Mechanical
Length of Dispersion Period	1 Minute

cobbles	6.87	
coarse gravel	41.37	
fine gravel	18.31	66.54
coarse sand	3.60	
medium sand	7.22	
fine sand	6.89	17.71
fines	15.75	
		100.00

		(Wt. + Tare)	RETAINED	PASSING
PLUS #4 MATERIAL SIEVE	12.0"	0.00	0.0	100.0
Tare Weight	6.0"	0.00	0.0	100.0
0.00	6.0"	0.00	0.0	100.0
	6.0"	0.00	0.0	100.0
	3.0"	3179.50	6.9	93.1
	1.5"	15460.40	33.4	66.6
	1.0"	19563.90	42.2	57.8
	0.75"	22336.40	48.2	51.8
	0.375"	27272.00	58.9	41.1
	#4	30815.80	66.5	33.5

					% PASSING
BACK SIEVE	#10	5.29	5.3	10.77	29.9
Tare Weight	#20	10.84	10.8	22.08	26.1
0.00	#40	15.88	15.9	32.34	22.6
	#60	19.49	19.5	39.69	20.2
	#100	22.62	22.6	46.07	18.0
	#200	25.99	26.0	52.93	15.7

WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Wt. of Sample Wet or Dry (gm) 50.47

DATE	TIME	READING	TEMP	HYD. COR.
8/4/2004	10:15	R	T	Cc
8/4/2004	10:17	25.8	25.10	5.50
8/4/2004	10:20	25.3	24.90	5.50
8/4/2004	10:30	24.3	24.90	5.50
8/4/2004	10:45	23.0	24.80	5.50
8/4/2004	11:19	22.0	25.20	5.50
8/4/2004	14:25	21.0	26.10	5.50
8/5/2004	10:15	20.3	25.00	5.50

(mm)	%Finer
0.032	13.66
0.021	13.32
0.012	12.65
0.009	11.81
0.006	11.13
0.003	10.46
0.001	9.95

Sp. Gr. 2.7 — WEIGHT OF SAMPLE USED FOR HYDROMETER TEST

Calculated Dry Wt. used in test (gm) 49.10

Hydrometer Bulb Number 624378

%Pass # Sieve for whole sample 33.459

HYDROMETER CALCULATIONS

ET (mm)	TEMP COR. (K)	READING (C)	EFFECTIVE LENGTH (L)	a/A
2.00	0.012671	20.25	13.1	0.99
5.00	0.012819	19.75	13.2	0.99
15.00	0.012819	18.75	13.3	0.99
30.00	0.012819	17.50	13.5	0.99
64.00	0.012671	16.50	13.7	0.99
250.00	0.012534	15.50	13.8	0.99
1440.00	0.012671	14.75	14	0.99

	X-AXIS	Y-AXIS
12.0	304.800	100.0
6.0	154.200	100.0
6.0	154.200	100.0
6.0	154.200	100.0
3.0	75.000	93.1
1.5	37.500	66.6
1.0	25.000	57.8
0.75	19.000	51.8
0.375	9.500	41.1
#4	4.750	33.5
#10	2.000	29.9
#20	0.850	26.1
#40	0.425	22.6
#60	0.250	20.2
#100	0.150	18.0
#200	0.075	15.7
	0.0323	13.7
	0.0208	13.3
	0.0121	12.6
	0.0086	11.8
	0.0059	11.1
	0.0029	10.5
	0.0012	9.9

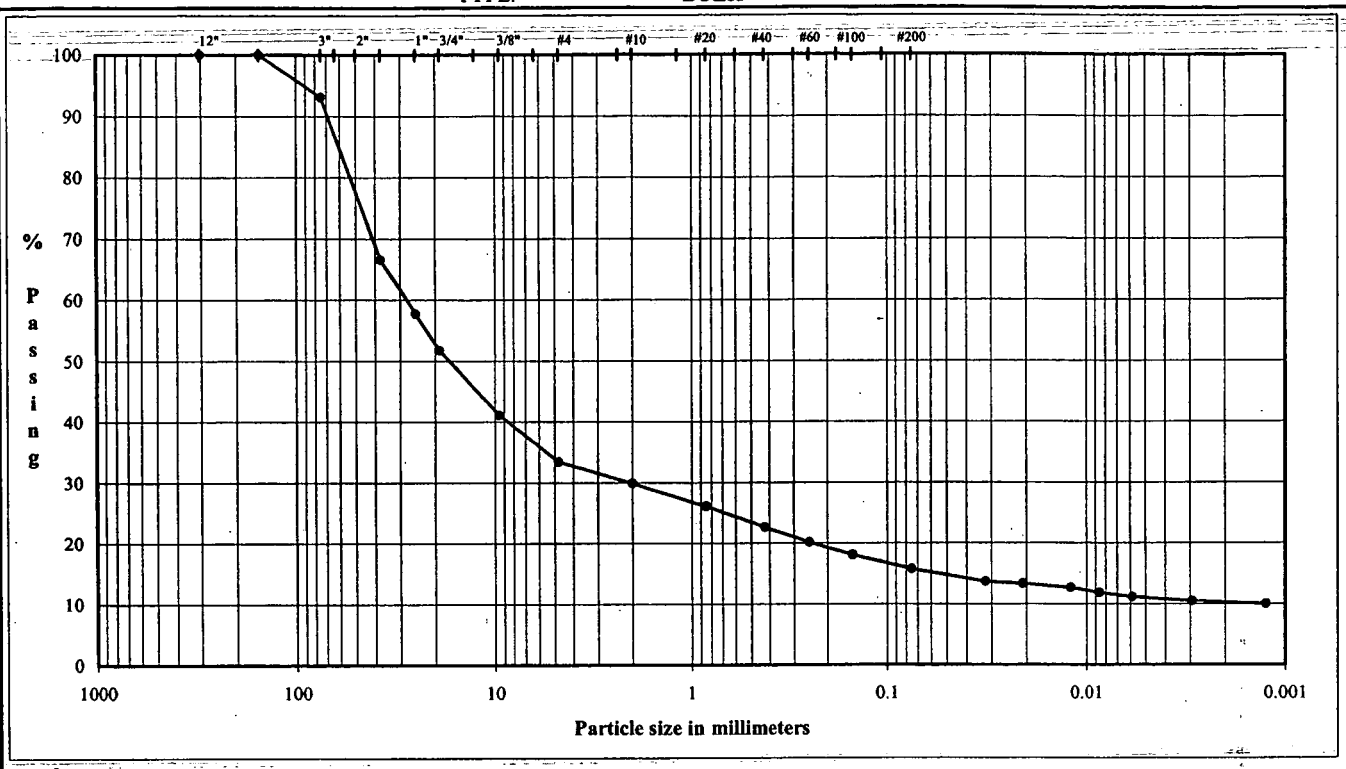
Check By NG

August-04 | 043-2246.0001

PARTICLE SIZE DISTRIBUTION & ATTERBERG LIMITS

ASTM D421, D422, D4318

PROJECT NAME: **Rocky Flats/Field & Lab Testing/CO**
SAMPLE ID: **A-10** Depth (ft): **4**
TYPE: **BULK**



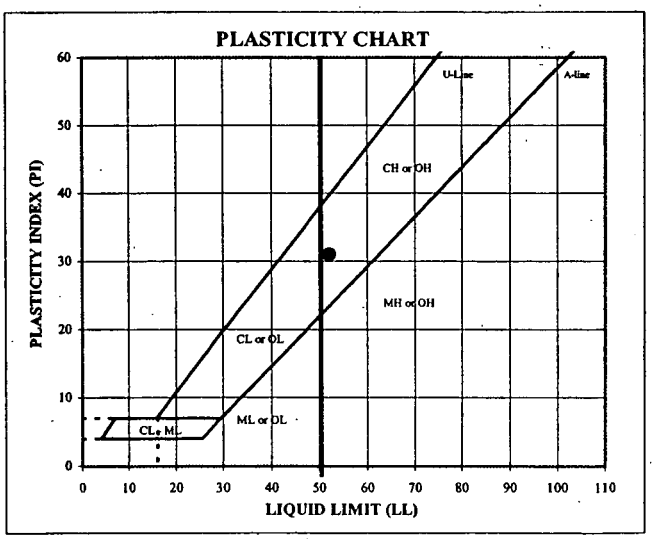
COBBLES	Coarse	Fine	Coarse	Medium	Fine	Silt or Clay
	GRAVEL		SAND			FINES

U.S. Standard Sieves Sizes and Numbers

	Particle Size (mm)	% Passing	Particle Size Classification	Percentage
12.0"	304.8	100.0		
6.0"	154.2	100.0	Cobbles	6.87
6.0"	154.2	100.0		
6.0"	154.2	100.0		
3.0"	75.0	93.1		
1.5"	37.5	66.6		
1.0"	25.0	57.8	Coarse Gravel	41.37
0.75"	19.0	51.8		
0.375"	9.5	41.1		
#4	4.8	33.5	Fine Gravel	18.31
#10	2.00	29.9	Coarse Sand	3.60
#20	0.85	26.1		
#40	0.43	22.6	Medium Sand	7.22
#60	0.25	20.2		
#100	0.15	18.0		
#200	0.075	15.7	Fine Sand	6.89

Hydrometer Analysis

(mm)	%Finer		
0.032	13.7		
0.021	13.3		
0.012	12.6	Fines	
0.0086	11.8	Silt or Clay	15.75
0.0059	11.1		
0.0029	10.5		
0.0012	9.9		



ATTERBERG LIMITS

M_c	LL	PL	PI	SpG
7.8	52	21	31	--

DESCRIPTION: Moderate brown (5YR 3/4) clayey gravel with sand

USCS: GC

TECH	DT
DATE	8/3/2004
REVIEW	MB

MOISTURE DENSITY CURVES
ASTM D 698 & 1557

PROJECT TITLE	Rocky Flats/Field & Lab Testing/CO			TEST TYPE	D 698 #DIV/0!
PROJECT NUMBER	043-2246.0001			PROCEDURE	#DIV/0! #DIV/0!
SAMPLE IDENTITY	A-10	-	4.0		
SAMPLE TYPE	BULK				

MOLD NUMBER	AH-1
MOLD WEIGHT (gm)	2265.0
MOLD DIAMETER (in)	3.991
MOLD HEIGHT (in)	4.581
MOLD VOLUME (cu.ft)	0.0332

TYPE COMPACTOR: Mechanical

PREPARATION: Wet Method

TYPE PROCTOR: Standard

5.5 -lbf. RAMMER WITH 12 INCH DROP

METHOD A: 20% OR LESS RETAINED ON #4

METHOD B: > 20% RETAINED ON #4 AND 20% OR LESS RETAINED ON 3/8"

METHOD C: > 20% RETAINED ON 3/8" AND < 30% RETAINED ON 3/4"

WATER CONTENT		COARSE FRACTION	TOTAL SAMPLE
Wet Wt Tare & Soil	(W1)		
Dry Wt Tare & Soil	(W2)		
Wt Tare	(W3)		
Wt Moisture	(W4=W1-W2)	0.00	0.00
Wt Dry Soil	(W5=W2-W3)	0.00	0.00
Water Content (dec)	(wc=W4/W5)		#DIV/0!
Water Content (%)	(W4/W5)*100		#DIV/0!

TOTAL WEIGHT BEFORE PROCESSING AND PERCENT RETAINED	
TOTAL WEIGHT, WET (COARSE & FINE)	
TOTAL WEIGHT, DRY (COARSE & FINE)	#DIV/0!
WEIGHT RETAINED ON #4 SIEVE (WET)	
WEIGHT RETAINED ON 3/8" SIEVE (WET)	
WEIGHT RETAINED ON 3/4" SIEVE (WET)	
PERCENT RETAINED ON #4 SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/8" SIEVE (DRY)	#DIV/0!
PERCENT RETAINED ON 3/4" SIEVE (DRY)	#DIV/0!

POINT RESULTS (FINE)		1	2	3	4	5	6	7
Wt. Soil & Mold	(W1)							
Weight of Mold	(W2)							
Wt. Of Wet Soil	(W3=W1-W2)							
Wet Density, wd (pcf)	(W3/453.6*Vm)							
WATER CONTENTS								
Wt Tare & Soil	(W4)							
Wt Tare & Soil	(W5)							
Wt Tare	(W6)							
Wt Moisture	(W7=W4-W5)							
Wt Dry Soil	(W8=W5-W6)							
Water Content (%)	(W7/W8)*100							
Dry Density (pcf)	(wd/(1+wc))							

MAXIMUM DRY DENSITY (pcf)	0.0
OPTIMUM MOISTURE CONTENT (%)	0.0
Corrected Maximum Dry Density (pcf)	
Corrected Optimum Moisture (%)	

DESCRIPTION: Moderate brown (5YR 3/4) clayey gravel with sand

USCS: GC

Specific Gravity And Absorption of Coarse Aggregate - ASTM C 127-88

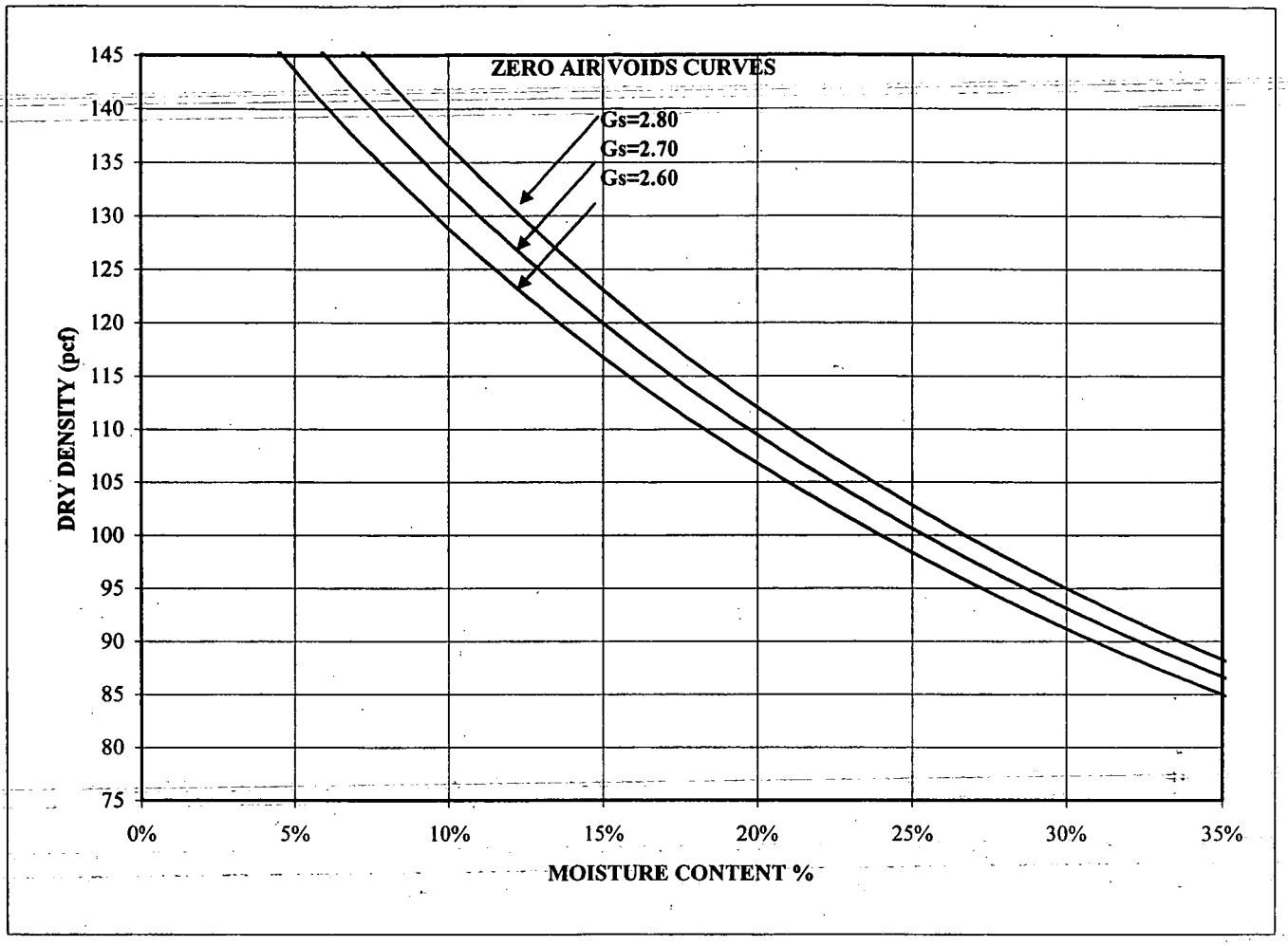
Weight of Oven Dry Sample (gm)		A			
Weight of Saturated-Surface-Dry (gm)		B			
Weight of Saturated Sample in Water	(gm)	C			
Absorption of Oversize Particles (%)	[(B-A)/A]*100				
Bulk Specific Gravity		A/(B-C)			

LL	52
PL	21
PI	31
MC	7.8

AVERAGE ABSORPTION (assumed)	
AVERAGE BULK SPECIFIC GRAVITY (assumed)	

TECH	
DATE	
REVIEW	

MOISTURE / DRY DENSITY CURVE
#DIV/0!



MAXIMUM DRY DENSITY (pcf)	#DIV/0!	#DIV/0!
OPTIMUM MOISTURE (%)	#DIV/0!	#DIV/0!

SAMPLE ID	A-10
SAMPLE TYPE	BULK
SAMPLE DEPTH	4

LL	52
PL	21
PI	31
MC	7.8

DESCRIPTION	Moderate brown (5YR 3/4) clayey gravel with sand
USCS	GC

Rocky Flats/Field & Lab Testing/CO
043-2246.0001

TECH	0
DATE	1/0/1900
REVIEW	0

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date:	10/1/04	New Submittal X Resubmittal

Section I — **REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS** *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 40
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Soft Spot Repair Material for "wet" spots – Non-woven geotextile	N/A	6	N/A	N/A	N/A	
	As Approved Previously Under Submittal #039						

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Robert Davis DATE: 10/10/2004

Remarks:
Incorrectly submitted as RFI 39; should be RFI

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: Paul Kreitz

Section II — **Reviewed**

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CAA Jack H. Fuller Jr. Tetra Tech 10/11/04

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date:	10/1/04	New Submittal X Resubmittal

Section I — REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 39
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.
Specification Sec. No. (Cover only one section with each Submittal)		Project Title: Construction of the Present Landfill Accelerated Action	

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document		Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
				Spec. Paragraph No.	Drawing Sheet No.		
a.	b.	c.	d.	e.	f.	g.	h.
1	Soft Spot Repair Material for "wet" spots – Non-woven geotextile	N/A	6	N/A	N/A	N/A	

Rocky Flats Plant

☒ APPROVED ☐ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Robert L. Davis DATE: 10/09/2004

Remarks:	I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted. Paul Kreitz Signature of Subcontractor:

Section II — Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

ATTN: PAUL KREITZ
JIM ERICKSON
FROM: DAN LAHR
303-443-1408
8 ROLLS

GEOTEX® NONWOVEN GEOTEXTILE

SI 801

Physical Properties (Typical Roll Values)

PROPERTY	ASTM TEST METHOD	UNITS	SI 801
Mass Per Unit Area	D5261	Oz/sy (g/m²)	N/a
Thickness	D 5199	Mils	85(2.1)
Tensile Strength	D 4632	Lbs	230(1020)
Elongation	D 4632	%	60
Trapezoid Tear	D 4533	Lbs.	95(420)
Mullen Burst	D3786	Psi	390(2685)
Puncture Strength	D4833	Lbs	130(575)
AOS	D4751	US Sieve (mm)	100(0.150)
Permittivity	D 4491	Sec-1	1.8
Permeability	D4491	Cm/sec	.48
Flow Rate	D4491	Gpm/ft² (1pm/m²)	120(4885)
UV Resistance	D4355	% Retained	N/a
Wide Width Tensile	D4595	Lbs/in (kNm)	100(17.5)

PACKAGING

Roll Dimensions – Feet	15x300
Square Yards Per Roll	500
Estimated Roll Weight - Pounds	209

FAXED
SEP 30 2004
BY: BOB DAVIS

FAXED
SEP 30 2004
BY: STOLLER

Colorado Lining

Construction, Inc

Price Quotation

October 1, 2004

SM Stoller
Attn: Jim Erickson
Fax: 303-443-1408
Phone: 303-546-4300

RE: ***8 oz. Nonwoven Geotextile – Rocky Flats Project***

Colorado Lining is pleased to submit the following quotation for the above referenced project:

Material	Quantity	Price	Total
8 oz. Nonwoven Geotextile	8 Rolls (15' x 300') = 4,000 SY	$ 0.68 / SY	$ 2,720.00
Total			$ 2,720.00

Prices are for material only, valid for 30 days and are FOB Shipping point with freight allowed.

Prices include delivery to *Rocky Flats*.

Prices exclude any and all taxes, fees, permits, unloading and storage, installation, pipe boots, and mechanical fastening.

Payment terms are per contract terms with SM Stoller.

We appreciate the opportunity to offer this proposal and look forward to doing business with you. Please call should you have any questions or need additional information.

Regards,

Dan E. Lahr
Senior Estimator

SUBMITTAL TRANSMITTAL FORM

For Submittal of Shop Drawings, Equipment Data, Material Samples, Manufacturer's Certificates of Compliance, or Other (Read Instructions prior to initiating this form.)	Date: 10/13/04	X	New Submittal
			Resubmittal

Section I REQUEST FOR ACCEPTANCE OF THE FOLLOWING ITEMS *(This section to be initiated by the Subcontractor)*

To:	From:	Subcontract No: KH020577	Submittal No. 043
Mr. Bob Davis RFETS 10808 Highway 93, Unit B Bldg 116 Golden, CO 80403-8300	Paul Kreitz S.M. Stoller Corporation 990 South Public Road, Suite A Lafayette, CO 80026		Previous Submittal No.

Specification Sec. No. (Cover only one section with each Submittal)

Project Title: Construction of the Present Landfill Accelerated Action

Item No.	Description of Item Submitted (Type, size, model number, etc.)	MFG. Or Contr. Cat., Curve Drawing or Brochure No. (See Instruction #8)	No. of Copies	Contract Reference Document: Spec. Paragraph No.	Contract Reference Document: Drawing Sheet No.	Deviation (See Instruction #6)	Contractor Action Code (See Instruction #9)
a.	b.	c.	d.	e.	f.	g.	h.
1	Liner certifications – 60-mil LLDPE	N/A	6	N/A	N/A	N/A	

Certification will be compared to delivered rolls by QA. Any deviations will be transmitted to Stoller

Rocky Flats Plant

☐ APPROVED ☒ APPROVED AS CORRECTED

☐ NOT APPROVED ☐ REVISE AND RESUBMIT

APPROVAL IS FOR CONFORMANCE WITH THE DESIGN CONCEPT OF THE PLANS AND SPECIFICATIONS AND FOR COMPLIANCE WITH THE INFORMATION GIVEN THEREIN. THE CONTRACTOR IS RESPONSIBLE FOR CONFIRMATION AND CORRELATION OF ALL DIMENSIONS AT THE CONSTRUCTION SITE; FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION; AND FOR COORDINATION OF THE WORK OF ALL CRAFTS

BY: Robert K. Davis DATE 10/18/04

Remarks:

I certify that the above submittal items have been received in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise noted.

Signature of Subcontractor: Paul Kreitz, 10/13/04

Vendor test data will also be compared to specifications and deviations noted & transmitted to Stoller

Section II Reviewed

Enclosures Returned (List by Item No.):	Title and Signature of Accepting Authority:	Date:

OK CQA J.H. Tate Tetra Tech 11/15/04

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON,TEXAS Shippers No. 44689

Received at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/28/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 24 hrs prior to delivery

Sales Order .36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
1	104123244	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,740.0
2	104123249	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,690.0
3	104123259	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,698.0
4	104123263	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,658.0
5	104123264	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,670.0
6	104123268	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,718.0
7	104123269	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,738.0
8	104123270	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,734.0
9	104123272	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,728.0
10	104123273	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,716.0
11	104123275	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,720.0
12	104123276	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,717.0

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

_____
Signature of Consignor

Local Verification Signed:

X _____

Pick Up #

Seal #

Truckers P.O. #

Total Quantity: 151,250 Total Weight: 45,277.00

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____

CARRIER SIGNATURE: _____

DATE: _____

ORIGINAL

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON,TEXAS

Shippers No. 44689

ceived at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, d destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion of said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/28/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 24 hrs prior to delivery

Sales Order 36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
13	121000713	45	BX	VFROD5MM UltraFlex Welding Rod UltraFlex Welding Rod	675.0
14	121000716	5	BX	VFROD5MM 5 mm VF Welding Rod UltraFlex Welding Rod	75.0

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up #

Seal #

Truckers P.O. #

Total Quantity: 151,250 Total Weight: 45,277.00

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____

CARRIER SIGNATURE: _____

DATE: _____

ORIGINAL

Chevron Phillips Chemical Company LP

CoA Date: 09/01/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86708432
PO #: 30131
Weight: 184350 LB
Ship Date: 09/01/2004
Package: BULK
Mode: Hopper Car
Car #: PSPX002072
Seal No: 429520

Product: PE 7104 BULK

Lot Number: CRG812060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.35	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		08/01/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Chevron Phillips Chemical Company LP

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86711033
PO #: 30131
Weight: 183300 LB
Ship Date: 09/03/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058103
Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123244

ROLL IDENTIFICATION

Roll Number	104123244	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,740 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		281	
- MD		every 4th	228		285	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		935	
- MD	(51 mm)	every 4th	800		927	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(185)
- MD		every 4th	33	(147)	43	(192)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	124	(551)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123249

ROLL IDENTIFICATION

Roll Number	104123249	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,690 1,674	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		273	
- MD		every 4th	228		277	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		901	
- MD	(51 mm)	every 4th	800		923	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(178)
- MD		every 4th	33	(147)	40	(179)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(546)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

*Modified

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
K.A.
9/26/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123259

ROLL IDENTIFICATION

Roll Number	104123259
Product Name	LLD060A000
Production Date	9/26/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,698 1,677	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		271	
- MD		every 4th	228		274	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		913	
- MD	(51 mm)	every 4th	800		922	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(180)
- MD		every 4th	33	(147)	40	(177)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	111	(496)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.3	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

**Modified

APPROVED
K.A.
9/27/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123263

ROLL IDENTIFICATION

Roll Number	104123263	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,658 1,659	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		271	
- MD		every 4th	228		274	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		913	
- MD	(51 mm)	every 4th	800		922	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(180)
- MD		every 4th	33	(147)	40	(177)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	111	(496)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.3	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
K.A.
9/27/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123264

ROLL IDENTIFICATION

Roll Number	104123264	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,670 1,665	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		324	
- MD		every 4th	228		351	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		916	
- MD	(51 mm)	every 4th	800		1102	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	44	(195)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	115	(512)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
L.H.
9/27/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123268

ROLL IDENTIFICATION

Roll Number	104123268
Product Name	LLD060A000
Production Date	9/27/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,718 1,686	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		336	
- MD		every 4th	228		320	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		937	
- MD	(51 mm)	every 4th	800		1018	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	45	(200)
- MD		every 4th	33	(147)	45	(202)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	122	(543)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
L.H.
9/27/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123269

ROLL IDENTIFICATION

Roll Number	104123269	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,738 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		336	
- MD		every 4th	228		320	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		937	
- MD	(51 mm)	every 4th	800		1018	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	45	(200)
- MD		every 4th	33	(147)	45	(202)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	122	(543)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
L.H.
9/27/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123270

ROLL IDENTIFICATION

Roll Number	104123270	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,734 1,694	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		336	
- MD		every 4th	228		320	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		937	
- MD	(51 mm)	every 4th	800		1018	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	45	(200)
- MD		every 4th	33	(147)	45	(202)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	122	(543)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
L.H.
9/27/2004

GSE *Lining Technology, Inc.*

Roll Test Data Report

Roll No. 104123272

ROLL IDENTIFICATION

Roll Number	104123272	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length *≈(+/- 1%)*	560 171	feet meters
Width *(Nominal)*	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,728 1,691	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		317	
- MD		every 4th	228		329	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		905	
- MD	(51 mm)	every 4th	800		1054	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(194)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	121	(540)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.3	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
T.W.
9/28/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123273

ROLL IDENTIFICATION

Roll Number	104123273	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,716 1,686	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		317	
- MD		every 4th	228		329	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		905	
- MD	(51 mm)	every 4th	800		1054	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(194)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	121	(540)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.3	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123275

ROLL IDENTIFICATION

Roll Number	104123275	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,720 1,687	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		330	
- MD		every 4th	228		338	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		926	
- MD	(51 mm)	every 4th	800		1061	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(546)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123276

ROLL IDENTIFICATION

Roll Number	104123276	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,717 1,686	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		330	
- MD		every 4th	228		338	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		926	
- MD	(51 mm)	every 4th	800		1061	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(546)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
T.W.
9/28/2004

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at **HOUSTON,TEXAS**

Shippers No. 44854

Received at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, and destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. *It is mutually agreed as to each Carrier of all or any said property, over all or any portion* said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Roll Certifications Included

Date: 09/30/04

Branch Plant: 1500 .621811

Shipping Instructions:
Contact Dan L. 303 841-2022 24 hrs prior to delivery

Sales Order
36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions		Weight
1	104123292	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,716.0
2	104123293	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,670.0
3	104123297	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,738.0
4	104123298	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,736.0
5	104123299	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,736.0
6	104123300	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,736.0
7	104123301	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,744.0
8	104123302	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,732.0
9	104123303	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,730.0
10	104123304	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,712.0
11	104123305	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,702.0
12	104123306	12600	SF	LLD060A000	60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,686.0

Total Quantity: 151,200 Total Weight: 44,638.00

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #:
30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

_____
Signature of Consignor

Local Verification Signed:
X _____

Pick Up #
6365RR

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____
CARRIER SIGNATURE: _____
DATE: _____

Chevron Phillips Chemical Company LP

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86711033
PO #: 30131
Weight: 183300 LB
Ship Date: 09/03/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058103
Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123292

ROLL IDENTIFICATION

Roll Number	104123292	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,716 1,686	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		316	
- MD		every 4th	228		318	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		920	
- MD	(51 mm)	every 4th	800		1015	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(190)
- MD		every 4th	33	(147)	44	(197)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	120	(534)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123293

ROLL IDENTIFICATION

Roll Number	104123293	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,670 1,665	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	60	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		316	
- MD		every 4th	228		318	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		920	
- MD	(51 mm)	every 4th	800		1015	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(190)
- MD		every 4th	33	(147)	44	(197)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	120	(534)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123297

ROLL IDENTIFICATION

Roll Number	104123297	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,738 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	63	(1.6)
Minimum		every roll	54	(1.4)	61	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		271	
- MD		every 4th	228		272	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		935	
- MD	(51 mm)	every 4th	800		888	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	41	(183)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(547)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123298

ROLL IDENTIFICATION

Roll Number	104123298	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,736 1,695	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		274	
- MD		every 4th	228		281	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		911	
- MD	(51 mm)	every 4th	800		879	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	41	(183)
- MD		every 4th	33	(147)	43	(189)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	127	(564)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RA
9/30/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123299

ROLL IDENTIFICATION

Roll Number	104123299	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,736 1,695	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	61	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		274	
- MD		every 4th	228		281	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		911	
- MD	(51 mm)	every 4th	800		879	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	41	(183)
- MD		every 4th	33	(147)	43	(189)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	127	(564)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/30/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123300

ROLL IDENTIFICATION

Roll Number	104123300	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,736 1,695	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		274	
- MD		every 4th	228		281	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		911	
- MD	(51 mm)	every 4th	800		879	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	41	(183)
- MD		every 4th	33	(147)	43	(189)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	127	(564)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO
Modified	

APPROVED
RH
9/30/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123301

ROLL IDENTIFICATION

Roll Number	104123301	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,744 1,698	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		272	
- MD		every 4th	228		280	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		928	
- MD	(51 mm)	every 4th	800		913	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	42	(188)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(549)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/30/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123302

ROLL IDENTIFICATION

Roll Number	104123302
Product Name	LLD060A000
Production Date	9/30/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,732 1,693	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		272	
- MD		every 4th	228		280	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		928	
- MD	(51 mm)	every 4th	800		913	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	42	(188)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	123	(549)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/30/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123303

ROLL IDENTIFICATION

Roll Number	104123303	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,730 1,692	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		272	
- MD		every 4th	228		280	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		928	
- MD	(51 mm)	every 4th	800		913	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	42	(188)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(549)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED RH 9/30/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123304

ROLL IDENTIFICATION

Roll Number	104123304	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,712 1,684	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		258	
- MD		every 4th	228		318	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		951	
- MD	(51 mm)	every 4th	800		1003	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(193)
- MD		every 4th	33	(147)	44	(196)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	114	(508)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/30/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123305

ROLL IDENTIFICATION

Roll Number	104123305	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,702 1,679	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th		228		258
- MD		every 4th		228		318
Break Elongation, % - TD	gauge length = 2.0"	every 4th		800		951
- MD	(51 mm)	every 4th		800		1003
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(193)
- MD		every 4th	33	(147)	44	(196)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	114	(508)
Density, g/cc	ASTM D 1505	every 4th		0.920		0.929
Carbon Black Content, %	ASTM D 1603*	every 4th		2.0		2.5
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th		9		10

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/30/2004
QA

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123306

ROLL IDENTIFICATION

Roll Number	104123306	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,686 1,672	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		258	
- MD		every 4th	228		318	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		951	
- MD	(51 mm)	every 4th	800		1003	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(193)
- MD		every 4th	33	(147)	44	(196)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	114	(508)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion Views in Cat1 - Cat2	ASTM D 5596	every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/30/2004

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON,TEXAS

Shippers No. 44879

eived at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, cons destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any por said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/30/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 24 hrs prior to delivery

Sales Order 36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
1	101110562	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,812.0
2	101110570	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,806.0
3	101110574	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,710.0
4	101110575	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,690.0
5	101110576	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,710.0
6	104123307	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,674.0
7	104123308	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,668.0

Total Quantity: 88,200 Total Weight: 26,070.00

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6366RR

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____

CARRIER SIGNATURE: _____

DATE: _____

ORIGINAL

Chevron Phillips Chemical Company LP

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86711033
PO #: 30131
Weight: 183300 LB
Ship Date: 09/03/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058103
Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

CoA Date: 06/24/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax: 281-230-8630

CPC Delivery #: 86657240
PO #: 30131
Weight: 186850 LB
Ship Date: 06/24/2004
Package: BULK
Mode: Hopper Car
Car #: CHVX891155
Seal No: 428053

Product: PE 7104 BULK

Lot Number: CRE810070

Property	Test Method	Value	Unit
Melt Index	ST-103	0.36	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		5/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Carol Meza at 713-475-3625

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 101110562

ROLL IDENTIFICATION

Roll Number	101110562	
Product Name	LLD060A000	
Production Date	7/14/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,812 1,729	pounds kilograms

RESIN INFORMATION

Lot Number	CRE810070
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.36

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		324	
- MD		every 4th	228		331	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		963	
- MD	(51 mm)	every 4th	800		1079	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	37	(165)
- MD		every 4th	33	(147)	38	(169)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	113	(502)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.7	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
7/15/2004

GSE *Lining Technology, Inc.*

Roll Test Data Report

Roll No. 101110570

ROLL IDENTIFICATION

Roll Number	101110570	
Product Name	LLD060A000	
Production Date	7/15/2004	
Length *≈(+/- 1%)*	560 171	feet meters
Width *(Nominal)*	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,806 1,726	pounds kilograms

RESIN INFORMATION

Lot Number	CRE810070
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.36

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		329	
- MD		every 4th	228		327	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		986	
- MD	(51 mm)	every 4th	800		1095	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	37	(165)
- MD		every 4th	33	(147)	39	(174)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	113	(501)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.8	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
7.W.
7/16/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 101110574

ROLL IDENTIFICATION

Roll Number	101110574	
Product Name	LLD060A000	
Production Date	7/16/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,710 1,683	pounds kilograms

RESIN INFORMATION

Lot Number	CRE810070
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.36

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	60	(1.5)
Minimum		every roll	54	(1.4)	56	(1.4)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		318	
- MD		every 4th	228		332	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		962	
- MD	(51 mm)	every 4th	800		1094	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	39	(175)
- MD		every 4th	33	(147)	39	(174)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	112	(498)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
T.W.
7/16/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 101110575

ROLL IDENTIFICATION

Roll Number	101110575
Product Name	LLD060A000
Production Date	7/16/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,690 1,674	pounds kilograms

RESIN INFORMATION

Lot Number	CRE810070
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.36

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	57	(1.4)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		318	
- MD		every 4th	228		332	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		962	
- MD	(51 mm)	every 4th	800		1094	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	39	(175)
- MD		every 4th	33	(147)	39	(174)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	112	(498)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
7/16/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 101110576

ROLL IDENTIFICATION

Roll Number	101110576	
Product Name	LLD060A000	
Production Date	7/16/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,710 1,683	pounds kilograms

RESIN INFORMATION

Lot Number	CRE810070
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.36

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		318	
- MD		every 4th	228		332	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		962	
- MD	(51 mm)	every 4th	800		1094	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	39	(175)
- MD		every 4th	33	(147)	39	(174)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	112	(498)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
7.W.
7/16/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123307

ROLL IDENTIFICATION

Roll Number	104123307	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,674 1,667	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		286	
- MD		every 4th	228		306	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		931	
- MD	(51 mm)	every 4th	800		903	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(189)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	121	(539)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/30/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123308

ROLL IDENTIFICATION

Roll Number	104123308	
Product Name	LLD060A000	
Production Date	9/30/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,668 1,664	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		286	
- MD		every 4th	228		306	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		931	
- MD	(51 mm)	every 4th	800		903	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(189)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	121	(539)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/30/2004

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON,TEXAS Shippers No. 44779

Received at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consi ' destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any po aid route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in .rting by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/30/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 — 24 hrs prior to delivery

Sales Order 36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
1	104123233	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,644.0
2	104123234	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,676.0
3	104123235	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,672.0
4	104123240	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,700.0
5	104123243	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,740.0
6	104123247	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,660.0
7	104123251	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,700.0
8	104123252	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,694.0
9	104123287	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,720.0
10	104123288	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,716.0
11	104123289	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,706.0
12	104123290	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,722.0

Total Quantity: 151,200 Total Weight: 44,350.00

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

_____
Signature of Consignor

Local Verification Signed:
X _____

Pick Up # 6364RR

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____
CARRIER SIGNATURE: _____
DATE: _____

Chevron Phillips Chemical Company LP

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86711033
PO #: 30131
Weight: 183300 LB
Ship Date: 09/03/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058103
Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Chevron Phillips Chemical Company LP

CoA Date: 09/01/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86708432
PO #: 30131
Weight: 184350 LB
Ship Date: 09/01/2004
Package: BULK
Mode: Hopper Car
Car #: PSPX002072
Seal No: 429520

Product: PE 7104 BULK

Lot Number: CRG812060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.35	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		08/01/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123233

ROLL IDENTIFICATION

Roll Number	104123233	
Product Name	LLD060A000	
Production Date	9/24/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,644 1,653	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		261	
- MD		every 4th	228		274	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		920	
- MD	(51 mm)	every 4th	800		930	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(179)
- MD		every 4th	33	(147)	41	(184)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	115	(510)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123234

ROLL IDENTIFICATION

Roll Number	104123234
Product Name	LLD060A000
Production Date	9/25/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,676 1,667	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		261	
- MD		every 4th	228		274	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		920	
- MD	(51 mm)	every 4th	800		930	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(179)
- MD		every 4th	33	(147)	41	(184)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	115	(510)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123235

ROLL IDENTIFICATION

Roll Number	104123235	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,672 1,666	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	60	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		262	
- MD		every 4th	228		276	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		906	
- MD	(51 mm)	every 4th	800		932	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(196)
- MD		every 4th	33	(147)	45	(200)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	125	(555)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123240

ROLL IDENTIFICATION

Roll Number	104123240	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,700 1,678	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		314	
- MD		every 4th	228		320	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		991	
- MD	(51 mm)	every 4th	800		1028	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	44	(197)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	125	(558)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123243

ROLL IDENTIFICATION

Roll Number	104123243	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,740 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.918
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.35

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		301	
- MD		every 4th	228		316	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		965	
- MD	(51 mm)	every 4th	800		1011	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(190)
- MD		every 4th	33	(147)	45	(198)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	118	(523)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123247

ROLL IDENTIFICATION

Roll Number	104123247	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,660 1,660	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		273	
- MD		every 4th	228		277	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		901	
- MD	(51 mm)	every 4th	800		923	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(178)
- MD		every 4th	33	(147)	40	(179)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(546)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123251

ROLL IDENTIFICATION

Roll Number	104123251	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,700 1,678	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.918
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.35

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	57	(1.4)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		313	
- MD		every 4th	228		327	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1043	
- MD	(51 mm)	every 4th	800		1029	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(179)
- MD		every 4th	33	(147)	43	(193)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(547)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		9	

Order No:	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123252

ROLL IDENTIFICATION

Roll Number	104123252	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,694 1,676	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		313	
- MD		every 4th	228		327	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1043	
- MD	(51 mm)	every 4th	800		1029	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(179)
- MD		every 4th	33	(147)	43	(193)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(547)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123287

ROLL IDENTIFICATION

Roll Number	104123287	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,720 1,687	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		289	
- MD		every 4th	228		309	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		868	
- MD	(51 mm)	every 4th	800		991	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	45	(201)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	119	(530)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
T.W.
9/29/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123288

ROLL IDENTIFICATION

Roll Number	104123288
Product Name	LLD060A000
Production Date	9/29/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,716 1,686	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		289	
- MD		every 4th	228		309	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		868	
- MD	(51 mm)	every 4th	800		991	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	45	(201)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	119	(530)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
T.W.
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123289

ROLL IDENTIFICATION

Roll Number	104123289	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,706 1,681	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		296	
- MD		every 4th	228		308	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		895	
- MD	(51 mm)	every 4th	800		1000	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(188)
- MD		every 4th	33	(147)	44	(195)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	119	(530)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/29/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123290

ROLL IDENTIFICATION

Roll Number	104123290	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,722 1,688	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		296	
- MD		every 4th	228		308	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		895	
- MD	(51 mm)	every 4th	800		1000	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(188)
- MD		every 4th	33	(147)	44	(195)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	119	(530)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

APPROVED
RH
9/29/2004

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON,TEXAS Shippers No. 44776

-eived at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/30/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 — 24 hrs prior to delivery

Sales Order 36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
1	104123239	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,702.0
2	104123267	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,690.0
3	104123280	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,692.0
4	104123282	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,732.0
5	104123283	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,828.0
6	104123284	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,760.0
7	104123285	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,738.0
8	104123286	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,734.0
9	104123291	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,738.0
10	104123294	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,680.0
11	104123295	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,680.0
12	104123296	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,640.0

Total Quantity: 151,200 Total Weight: 44,614.00

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6363RR

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____

CARRIER SIGNATURE: _____

DATE: _____

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC 19103 GUNDLE ROAD WESTFIELD TX 77090 USA	CPC Delivery #: 86711033 PO #: 30131 Weight: 183300 LB Ship Date: 09/03/2004 Package: BULK
Recipient: DON BOHAC Fax:	Mode: Hopper Car Car #: GOCX058103 Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Chevron Phillips Chemical Company LP

CoA Date: 09/01/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86708432
PO #: 30131
Weight: 184350 LB
Ship Date: 09/01/2004
Package: BULK
Mode: Hopper Car
Car #: PSPX002072
Seal No: 429520

Product: PE 7104 BULK

Lot Number: CRG812060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.35	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		08/01/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123239

ROLL IDENTIFICATION

Roll Number	104123239	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,702 1,679	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		314	
- MD		every 4th	228		320	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		991	
- MD	(51 mm)	every 4th	800		1028	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	44	(197)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	125	(558)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123267

ROLL IDENTIFICATION

Roll Number	104123267	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,690 1,674	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		324	
- MD		every 4th	228		351	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		916	
- MD	(51 mm)	every 4th	800		1102	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	44	(195)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	115	(512)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
L.H.
9/27/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123280

ROLL IDENTIFICATION

Roll Number	104123280	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,692 1,675	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		330	
- MD		every 4th	228		333	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		946	
- MD	(51 mm)	every 4th	800		926	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	47	(207)
- MD		every 4th	33	(147)	46	(204)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	116	(516)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004
QA

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123282

ROLL IDENTIFICATION

Roll Number	104123282	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,732 1,693	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	63	(1.6)
Minimum		every roll	54	(1.4)	61	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		330	
- MD		every 4th	228		333	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		946	
- MD	(51 mm)	every 4th	800		926	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	47	(207)
- MD		every 4th	33	(147)	46	(204)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	116	(516)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123283

ROLL IDENTIFICATION

Roll Number	104123283
Product Name	LLD060A000
Production Date	9/28/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,828 1,736	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	63	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		313	
- MD		every 4th	228		323	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		924	
- MD	(51 mm)	every 4th	800		1026	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	47	(211)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	124	(551)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/29/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123284

ROLL IDENTIFICATION

Roll Number	104123284
Product Name	LLD060A000
Production Date	9/28/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,760 1,706	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		313	
- MD		every 4th	228		323	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		924	
- MD	(51 mm)	every 4th	800		1026	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	47	(211)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	124	(551)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/29/2004

GSE *Lining Technology, Inc.*

Roll Test Data Report

Roll No. 104123285

ROLL IDENTIFICATION

Roll Number	104123285	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length *≈(+/- 1%)*	560 171	feet meters
Width *(Nominal)*	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,738 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.919
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.34

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		313	
- MD		every 4th	228		323	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		924	
- MD	(51 mm)	every 4th	800		1026	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	47	(211)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	124	(551)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

**Modified

APPROVED
T.W.
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123286

ROLL IDENTIFICATION

Roll Number	104123286
Product Name	LLD060A000
Production Date	9/28/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,734 1,694	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		289	
- MD		every 4th	228		309	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		868	
- MD	(51 mm)	every 4th	800		991	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	45	(201)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	119	(530)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123291

ROLL IDENTIFICATION

Roll Number	104123291	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,738 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		296	
- MD		every 4th	228		308	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		895	
- MD	(51 mm)	every 4th	800		1000	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(188)
- MD		every 4th	33	(147)	44	(195)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	119	(530)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/29/2004
QA

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123294

ROLL IDENTIFICATION

Roll Number	104123294	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,680 1,669	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		316	
- MD		every 4th	228		318	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		920	
- MD	(51 mm)	every 4th	800		1015	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(190)
- MD		every 4th	33	(147)	44	(197)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	120	(534)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123295

ROLL IDENTIFICATION

Roll Number	104123295	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,680 1,669	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		271	
- MD		every 4th	228		272	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		935	
- MD	(51 mm)	every 4th	800		888	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	41	(183)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(547)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/29/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123296

ROLL IDENTIFICATION

Roll Number	104123296	
Product Name	LLD060A000	
Production Date	9/29/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,640 1,651	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		271	
- MD		every 4th	228		272	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		935	
- MD	(51 mm)	every 4th	800		888	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	41	(183)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	123	(547)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
RH
9/29/2004

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON,TEXAS

Shippers No. 44769

Received at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in writing by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/29/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 — 24 hrs prior to delivery

Sales Order 36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
1	104123231	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,658.0
2	104123232	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,668.0
3	104123236	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,664.0
4	104123238	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,675.0
5	104123241	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,710.0
6	104123242	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,729.0
7	104123245	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,740.0
8	104123248	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,660.0
9	104123250	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,696.0
10	104123277	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,706.0
11	104123278	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,708.0
12	104123279	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,706.0

Total Quantity: 151,200 Total Weight: 44,320.00

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement. Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6362RR

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____

CARRIER SIGNATURE: _____

DATE: _____

Chevron Phillips Chemical Company LP

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86711033
PO #: 30131
Weight: 183300 LB
Ship Date: 09/03/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058103
Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Chevron Phillips Chemical Company LP

CoA Date: 09/01/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86708432
PO #: 30131
Weight: 184350 LB
Ship Date: 09/01/2004
Package: BULK
Mode: Hopper Car
Car #: PSPX002072
Seal No: 429520

Product: PE 7104 BULK

Lot Number: CRG812060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.35	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		08/01/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123231

ROLL IDENTIFICATION

Roll Number	104123231	
Product Name	LLD060A000	
Production Date	9/24/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,658 1,659	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.918
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.35

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		329	
- MD		every 4th	228		314	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		952	
- MD	(51 mm)	every 4th	800		1074	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(192)
- MD		every 4th	33	(147)	45	(200)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	119	(529)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No. 36824
Customer Name Colorado Lining International
Project Name Rocky Flats Present Closure
Location Golden, CO
*Modified

APPROVED
K.A.
9/25/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123232

ROLL IDENTIFICATION

Roll Number	104123232	
Product Name	LLD060A000	
Production Date	9/24/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,668 1,664	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		261	
- MD		every 4th	228		274	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		920	
- MD	(51 mm)	every 4th	800		930	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(179)
- MD		every 4th	33	(147)	41	(184)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	115	(510)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123236

ROLL IDENTIFICATION

Roll Number	104123236	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,664 1,662	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		262	
- MD		every 4th	228		276	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		906	
- MD	(51 mm)	every 4th	800		932	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(196)
- MD		every 4th	33	(147)	45	(200)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	125	(555)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No. 36824
Customer Name Colorado Lining International
Project Name Rocky Flats Present Closure
Location Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123238

ROLL IDENTIFICATION

Roll Number	104123238	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,675 1,667	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		314	
- MD		every 4th	228		320	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		991	
- MD	(51 mm)	every 4th	800		1028	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	44	(197)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	125	(558)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123241

ROLL IDENTIFICATION

Roll Number	104123241	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,710 1,683	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		301	
- MD		every 4th	228		316	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		965	
- MD	(51 mm)	every 4th	800		1011	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(190)
- MD		every 4th	33	(147)	45	(198)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	118	(523)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123242

ROLL IDENTIFICATION

Roll Number	104123242	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560	feet
	171	meters
Width (Nominal)	22.5	feet
	6.9	meters
Sheet Area	12,600	sq. feet
	1,170	sq. meters
Weight	3,729	pounds
	1,691	kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		301	
- MD		every 4th	228		316	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		965	
- MD	(51 mm)	every 4th	800		1011	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(190)
- MD		every 4th	33	(147)	45	(198)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	118	(523)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123245

ROLL IDENTIFICATION

Roll Number	104123245	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,740 1,696	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.918
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.35

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		281	
- MD		every 4th	228		285	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		935	
- MD	(51 mm)	every 4th	800		927	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(185)
- MD		every 4th	33	(147)	43	(192)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	124	(551)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123248

ROLL IDENTIFICATION

Roll Number	104123248	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,660 1,660	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	57	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		273	
- MD		every 4th	228		277	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		901	
- MD	(51 mm)	every 4th	800		923	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(178)
- MD		every 4th	33	(147)	40	(179)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(546)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004
QA

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123250

ROLL IDENTIFICATION

Roll Number	104123250	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560	feet
	171	meters
Width (Nominal)	22.5	feet
	6.9	meters
Sheet Area	12,600	sq. feet
	1,170	sq. meters
Weight	3,696	pounds
	1,677	kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		313	
- MD		every 4th	228		327	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1043	
- MD	(51 mm)	every 4th	800		1029	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(179)
- MD		every 4th	33	(147)	43	(193)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(547)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		9	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123277

ROLL IDENTIFICATION

Roll Number	104123277	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,706 1,681	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		317	
- MD		every 4th	228		285	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1040	
- MD	(51 mm)	every 4th	800		937	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(197)
- MD		every 4th	33	(147)	45	(201)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	117	(521)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123278

ROLL IDENTIFICATION

Roll Number	104123278	
Product Name	LLD060A000	
Production Date	9/28/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,708 1,682	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		317	
- MD		every 4th	228		285	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1040	
- MD	(51 mm)	every 4th	800		937	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(197)
- MD		every 4th	33	(147)	45	(201)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	117	(521)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No. 36824
Customer Name Colorado Lining International
Project Name Rocky Flats Present Closure
Location Golden, CO

*Modified

APPROVED
T.W.
9/28/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123279

ROLL IDENTIFICATION

Roll Number	104123279
Product Name	LLD060A000
Production Date	9/28/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,706 1,681	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	63	(1.6)
Minimum		every roll	54	(1.4)	60	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		317	
- MD		every 4th	228		285	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1040	
- MD	(51 mm)	every 4th	800		937	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(197)
- MD		every 4th	33	(147)	45	(201)
Puncture Resistance, lb. (N)	ASTM D 4833	every 4th	84	(374)	117	(521)
Density, g/cc	ASTM D 1505	every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*	every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004
QA

Shipping Order - Packing List - Original - Not Negotiable

GSE Lining Technology, Inc. at HOUSTON, TEXAS

Shippers No: 44661

Received at Houston, Texas from GSE Lining Technology, Inc. the property described below, in apparent good order, except as noted (contents and condition of packages unknown), marked, consigned, d destined as indicated below, which said Carrier agrees to carry to the place of delivery at said destination. It is mutually agreed as to each Carrier of all or any said property, over all or any portion said route to destination, and as to each party at any time interested in all or any of said property, that every service performed hereunder shall be subject to the rates and contract agreed to in riting by GSE Lining Technology and Carrier. GSE Lining Technology's obligation to pay freight charges for the shipment is conditioned on (1) the existence of a separate written contract with the carrier transporting the freight and (2) the carrier's name appearing on this Bill of Lading, and other carriers must look solely to a party other than GSE Lining technology, Inc. for payment.

Ship To: Colorado Lining/Rocky Flats Present
10808 Hwy 93, Unit B MV72
Golden CO 80403

Date: 09/28/04

Roll Certifications Included

Branch Plant: 1500 .621811

Shipping Instructions: Contact Dan L. 303 841-2022 — 24 hrs prior to delivery

Sales Order 36824 SO

No. Line	Roll #	QTY Shipped	UM	Kind of Package, Description of Articles, Special Marks, and Exceptions	Weight
1	104123237	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,656.0
2	104123246	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,705.0
3	104123253	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,698.0
4	104123254	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,705.0
5	104123255	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,710.0
6	104123256	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,708.0
7	104123257	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,706.0
8	104123258	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,702.0
9	104123260	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,694.0
10	104123266	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,696.0
11	104123271	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,734.0
12	104123274	12600	SF	LLD060A000 60 mil Avg UltraFlex Blk, VF, Smooth, 22.5'	3,720.0

Total Quantity: 151,200

Total Weight: 44,434.00

Project# 515122

Freight charges are prepaid unless marked collect.
Check box if collect. ☐

Customer P.O. #: 30966

If this shipment is to be delivered to consignor, consignor shall sign the following statement: Carrier may decline to deliver this shipment without payment of freight and all other lawful charges.

Signature of Consignor

Local Verification Signed:

X

Pick Up # 6361RR

Seal #

Truckers P.O. #

Driver Requirements:

1) Driver must pre call 24 hrs prior to delivery and on Friday for Monday delivery.
2) Driver must call (281) 230-6781 when unloaded.
3) Driver must call and advise any delay in transit.
4) A copy of this B/L must accompany Freight Invoice.

CARRIER NAME: _____

CARRIER SIGNATURE: _____

DATE: _____

Chevron Phillips
Chemical Company LP

CoA Date: 09/01/200

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86708432
PO #: 30131
Weight: 184350 LB
Ship Date: 09/01/2004
Package: BULK
Mode: Hopper Car
Car #: PSPX002072
Seal No: 429520

Product: PE 7104 BULK

Lot Number: CRG812060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.35	g/10mi
Density	ST-292	0.918	g/cm3
Production Date		08/01/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

Chevron Phillips

CoA Date: 09/03/2004

Certificate of Analysis

Shipped To: GSE LINING TECHNOLOGY INC HC
19103 GUNDLE ROAD
WESTFIELD TX 77090
USA

Recipient: DON BOHAC
Fax:

CPC Delivery #: 86711033
PO #: 30131
Weight: 183300 LB
Ship Date: 09/03/2004
Package: BULK
Mode: Hopper Car
Car #: GOCX058103
Seal No: 429778

Product: PE 7104 BULK

Lot Number: CRH810060

Property	Test Method	Value	Unit
Melt Index	ST-103	0.34	g/10mi
Density	ST-292	0.919	g/cm3
Production Date		8/2/2004	

The data set forth herein have been carefully compiled by Chevron Phillips Chemical Company LP. **However, there is no warranty of any kind, either expressed or implied, applicable to its use, and the user assumes all risk and liability in connection therewith.**

Kay F. Donaldson
Quality Control Supervisor

For CoA questions contact Peter Scheirman at 713-289-4799

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123237

ROLL IDENTIFICATION

Roll Number	104123237	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,656 1,658	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th		228		262
- MD		every 4th		228		276
Break Elongation, % - TD	gauge length = 2.0"	every 4th		800		906
- MD	(51 mm)	every 4th		800		932
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(196)
- MD		every 4th	33	(147)	45	(200)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	125	(555)
Density, g/cc	ASTM D 1505					
		every 4th		0.920		0.930
Carbon Black Content, %	ASTM D 1603*					
		every 4th		2.0		2.5
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th		9		10

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123246

ROLL IDENTIFICATION

Roll Number	104123246	
Product Name	LLD060A000	
Production Date	9/25/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,705 1,681	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	*Test Method*	*Results*
Density, g/cc	*ASTM D 1505*	0.918
Melt index, g/10 min.	*ASTM D 1238 (190/2.16)*	0.35

Physical Property	*Test Method*	*Test Frequency*	*Customer Minimum* English	Metric	*Test Results* English	Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		281	
- MD		every 4th	228		285	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		935	
- MD	(51 mm)	every 4th	800		927	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(185)
- MD		every 4th	33	(147)	43	(192)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	124	(551)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.929	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/25/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123253

ROLL IDENTIFICATION

Roll Number	104123253	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,698 1,677	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		325	
- MD		every 4th	228		341	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1057	
- MD	(51 mm)	every 4th	800		1075	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(192)
- MD		every 4th	33	(147)	44	(194)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	122	(541)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 104123254

ROLL IDENTIFICATION

Roll Number	104123254
Product Name	LLD060A000
Production Date	9/26/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,705 1,681	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		325	
- MD		every 4th	228		341	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1057	
- MD	(51 mm)	every 4th	800		1075	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(192)
- MD		every 4th	33	(147)	44	(194)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	122	(541)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123255

ROLL IDENTIFICATION

Roll Number	104123255	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,710 1,683	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		325	
- MD		every 4th	228		341	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		1057	
- MD	(51 mm)	every 4th	800		1075	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	43	(192)
- MD		every 4th	33	(147)	44	(194)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	122	(541)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views In Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123256

ROLL IDENTIFICATION

Roll Number	104123256	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,708 1,682	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		269	
- MD		every 4th	228		273	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		925	
- MD	(51 mm)	every 4th	800		930	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(176)
- MD		every 4th	33	(147)	39	(171)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	120	(533)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123257

ROLL IDENTIFICATION

Roll Number	104123257
Product Name	LLD060A000
Production Date	9/26/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,706 1,681	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		269	
- MD		every 4th	228		273	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		925	
- MD	(51 mm)	every 4th	800		930	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(176)
- MD		every 4th	33	(147)	39	(171)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	120	(533)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123258

ROLL IDENTIFICATION

Roll Number	104123258	
Product Name	LLD060A000	
Production Date	9/26/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,702 1,679	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		269	
- MD		every 4th	228		273	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		925	
- MD	(51 mm)	every 4th	800		930	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(176)
- MD		every 4th	33	(147)	39	(171)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	120	(533)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.4	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/26/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123260

ROLL IDENTIFICATION

Roll Number	104123260	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,694 1,676	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	60	(1.5)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		271	
- MD		every 4th	228		274	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		913	
- MD	(51 mm)	every 4th	800		922	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	40	(180)
- MD		every 4th	33	(147)	40	(177)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	111	(496)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.3	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
K.A.
9/27/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123266

ROLL IDENTIFICATION

Roll Number	104123266	
Product Name	LLD060A000	
Production Date	9/27/2004	
Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,696 1,677	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	60	(1.5)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		324	
- MD		every 4th	228		351	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		916	
- MD	(51 mm)	every 4th	800		1102	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	42	(186)
- MD		every 4th	33	(147)	44	(195)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	115	(512)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.930	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.5	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
L.W.
9/27/2004

Roll Test Data Report

GSE Lining Technology, Inc.

Roll No. 10412327I

ROLL IDENTIFICATION

Roll Number	104123271
Product Name	LLD060A000
Production Date	9/27/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,734 1,694	pounds kilograms

RESIN INFORMATION

Lot Number	CRG812060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.918
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.35

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	62	(1.6)
Minimum		every roll	54	(1.4)	59	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		317	
- MD		every 4th	228		329	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		905	
- MD	(51 mm)	every 4th	800		1054	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(194)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	121	(540)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.3	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004

GSE Lining Technology, Inc.

Roll Test Data Report

Roll No. 104123274

ROLL IDENTIFICATION

Roll Number	104123274
Product Name	LLD060A000
Production Date	9/28/2004

Length ≈(+/- 1%)	560 171	feet meters
Width (Nominal)	22.5 6.9	feet meters
Sheet Area	12,600 1,170	sq. feet sq. meters
Weight	3,720 1,687	pounds kilograms

RESIN INFORMATION

Lot Number	CRH810060
Type	7104
Supplier	Chevron Phillips

GSE RESIN TEST DATA

Property	Test Method	Results
Density, g/cc	ASTM D 1505	0.919
Melt index, g/10 min.	ASTM D 1238 (190/2.16)	0.34

Physical Property	Test Method	Test Frequency	Customer Minimum English	Customer Minimum Metric	Test Results English	Test Results Metric
Thickness, mil (mm)	ASTM D 5199					
Average		every roll	60	(1.5)	61	(1.6)
Minimum		every roll	54	(1.4)	58	(1.5)
Tensile Properties:	ASTM D638,Type IV / D6693					
Break Strength, ppi (N/cm) - TD		every 4th	228		330	
- MD		every 4th	228		338	
Break Elongation, % - TD	gauge length = 2.0"	every 4th	800		926	
- MD	(51 mm)	every 4th	800		1061	
Tear Resistance, lb. (N)	ASTM D 1004					
- TD		every 4th	33	(147)	44	(195)
- MD		every 4th	33	(147)	46	(205)
Puncture Resistance, lb. (N)	ASTM D 4833					
		every 4th	84	(374)	123	(546)
Density, g/cc	ASTM D 1505					
		every 4th	0.920		0.928	
Carbon Black Content, %	ASTM D 1603*					
		every 4th	2.0		2.6	
Carbon Black Dispersion	ASTM D 5596					
Views in Cat1 - Cat2		every 4th	9		10	

Order No.	36824
Customer Name	Colorado Lining International
Project Name	Rocky Flats Present Closure
Location	Golden, CO

*Modified

APPROVED
T.W.
9/28/2004