TABLES

Table 1 - Selected Material Properties for Static and Seismic Stability Analyses

Material/Interface	Unit Weight	Shear Strength Properties		Shear Wave Velocity (V_s) or Shear Modulus (G) Relation	Modulus Reduction & Damping Curves
		Friction Angle (degree)	Cohesion (psf)		
MSW [2]	see Figure 7 Average ~ 85 pcf	33	100	See Figure 9 (modified after Kavazanjian et al. 1996)	See Figure 10 (Matasovic and Kavazanjian 1998)
Bioreactor MSW [3]	see Figure 7 Average ~ 105 pcf	28	150	Same as MSW	Same as MSW
HW [2]	115 pcf	31	0	$G = 1000\ K_2\ (\sigma'_m)^{1/2}$ $K_2 = 60$ for relatively dense sands (Seed and Idriss, 1970)	See Figure 10 Relatively dense sand (Seed et al., 1984; Seed and Idriss, 1970)
Clay Liner [1, 2]	125 pcf	20	1,150	$G = \frac{1230(2.97-e)^2}{1+e}(OCR)^K\ \sigma_m^{0.5}$ (Hardin and Drenvich, 1972)	See Figure 10 (Vucetic and Dobry, 1991; Sun et al. 1988)
Compacted Fill [4]	125 pcf	33	100	$G = \frac{1230(2.97-e)^2}{1+e}(OCR)^K\ \sigma_m^{0.5}$ (Hardin and Drenvich, 1972)	See Figure 10 (Vucetic and Dobry, 1991; Sun et al. 1988)
Bedrock [2]	150 pcf	40	800	$V_s = 2500$ fps	(Schnabel et al. 1972)
Phase IA Bottom Liner Interface [2]	----	8	0	----	----
Phase IA Side Slope Liner Interface [2]	----	7	100	----	----
Phase IB/II/III Bottom Liner Interface [2]	----	8	0	----	----
Phase IB/II/III Side Slope Liner Interface [2]	----	8.5	0	----	----
HW/MSW Separation Liner [5]	----	17	100	----	----
Final Cover Soil and Interface Properties	110 pcf	See Appendix C	See Appendix C	Same as compacted fill	Same as compacted fill

(1) Modeled as a layer in site dynamic response analysis to include effects of softer clay layer in isolating ground motion.
(2) Rust Environmental & Infrastructure, Inc. (1997). All references are listed in Table 3 of Rust's 1997 Report included in Appendix A.
(3) Fugro South, Inc. (2003). GeoSyntec (1999). Hendron, D.M., Fernandez, G., Prommer, P.J., Giroud, J.P., and Orozco, L.F. (1999). Kavazanjian, E. Jr., Hendron, D.M., and Corcoran, G.T. (2001). Matasovic, N. and E. Kavaznjian Jr. (1998).
(4) Golder Associates, Inc. (2003).
(5) Golder Associates, Inc. (2006).

Table 2a - Summary of Static Slope Stability Analysis Results

Cross Section	Failure Plane Number	Description	Static Factor of Safety	Yield Acceleration k_y (g)
A-A'	I	Deep Block Failure through Bottom Liner	1.85[1]	0.214
	II	Circular Failure through Bioreactor	2.19	0.298
	III	Deep Block Failure through Bottom Liner	2.33	0.124
	IV	Shallow Block Failure through Separation Liner	3.21	0.409
B-B'	I	Deep Block Failure through Bottom Liner	2.44	0.126
	II	Shallow Block Failure through Separation Liner	3.13	0.332
D-D'	I	Deep Block Failure through Bottom Liner	3.85	0.207[2]
G-G'	I	Deep Block Failure through Bottom Liner	2.22	0.126
	II	Shallow Block Failure through Separation Liner	2.67	0.302
	III	Circular Failure through Buttress Fill	1.50	---[3]
	IV	Shallow Block Failure through Separation Liner	1.70	0.240
	110 ft North of G-G'	Shallow Block Failure through Separation Liner	2.12	0.175[1]
	100 ft South of G-G'	Shallow Block Failure through Separation Liner	2.11	0.269[1]
H-H'	I	Deep Block Failure through Bottom Liner	1.94	0.153
	II	Deep Block Failure through Bottom Liner	2.34	0.149
	III	Circular Failure through Bioreactor	2.29	0.322
I-I'	I	Deep Block Failure through Bottom Liner	2.04	0.157
J-J'	I	Deep Block Failure through Bottom Liner	2.34	0.130
K-K'	I	Deep Block Failure through Bottom Liner	2.11	0.121
	II	Shallow Block Failure through Separation Liner	2.71	0.302

(1) Factor of Safety was calculated using Janbu Method. Spencer Method did not converge for the analysis.
(2) k_y value was estimated using Janbu Method. Spencer Method did not converge for the analysis.
(3) For Cross Section G-G', Failure Plane No. III (Buttress Stability Evaluation) a pseudostatic FS of 1.15 was calculated for a horizontal acceleration of 0.15.

Table 2b - Summary of Pseudo-Static Slope Stability Analysis Results

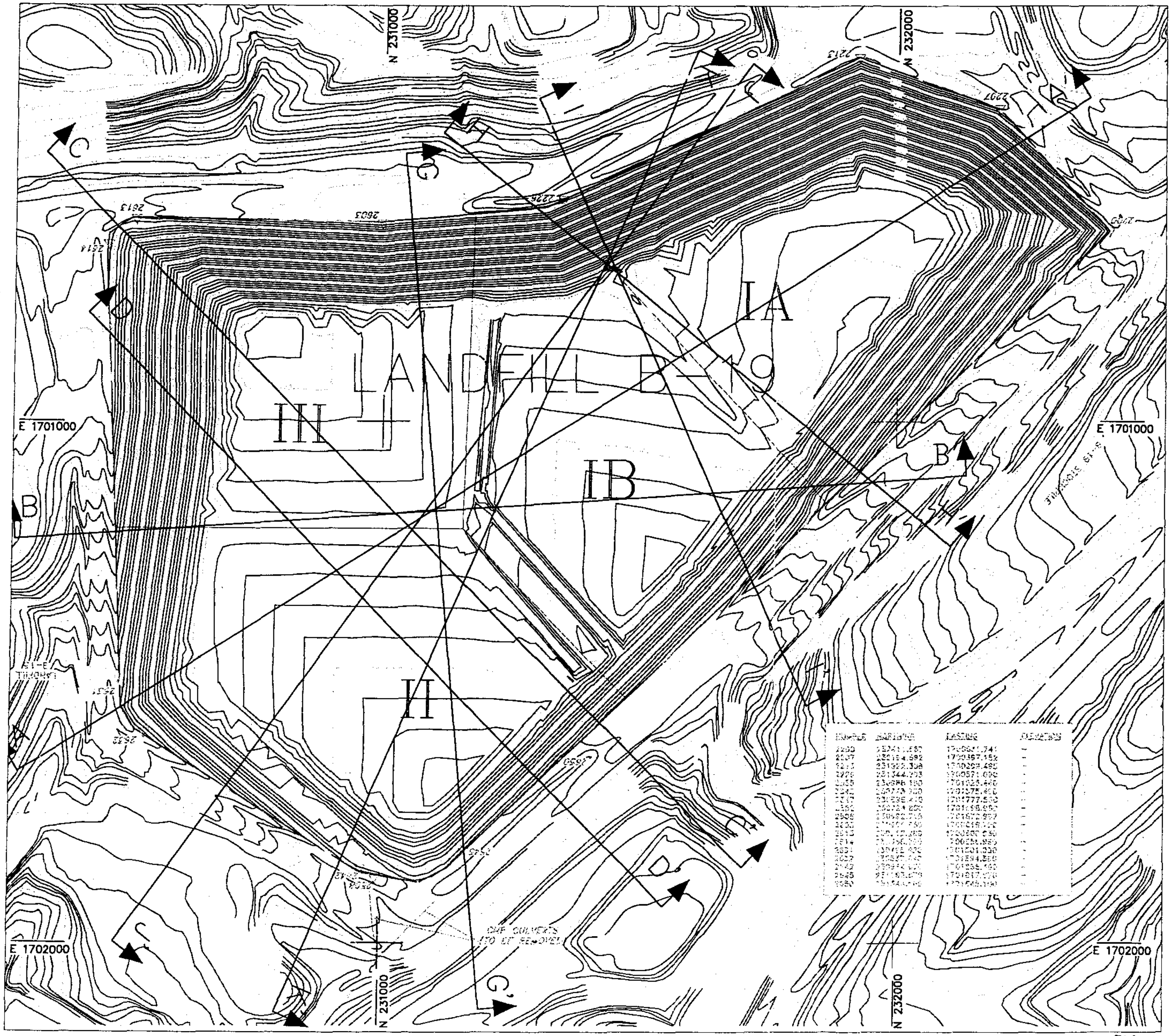
Cross Section	Failure Plane Number	Description	Static Factor of Safety	Yield Acceleration k_y (g)
A-A'	1	Deep Block Failure through Bottom Liner	2.94	0.130
	2	Deep Block Failure through Bottom Liner	2.94	0.139
	3	Circular Failure through Bioreactor	2.23	0.298
	4	Deep Block Failure through Bottom Liner	2.47	0.121
	5	Deep Block Failure through Bottom Liner	2.46	0.124
	6	Shallow Block Failure through Separation Liner	3.29	0.355
B-B'	1	Deep Block Failure through Bottom Liner	2.45	0.126
	2	Shallow Block Failure through Separation Liner	3.13	0.335
D-D'	1	Deep Block Failure through Bottom Liner	4.48	0.168[1]
G-G'	1	Deep Block Failure through Bottom Liner	2.22	0.125
	2	Shallow Block Failure through Separation Liner	2.67	0.298
	3	Circular Failure through Buttress Fill	1.50	---[2]
	4	Relatively Deep Block Failure through Separation Liner	1.71	0.190[1]
H-H'	1	Deep Block Failure through Bottom Liner	1.94	0.145
	2	Deep Block Failure through Bottom Liner	2.22	0.141
	3	Circular Failure through Bioreactor	2.28	0.322
I-I'	1	Deep Block Failure through Bottom Liner	2.07	0.148
J-J'	1	Deep Block Failure through Bottom Liner	2.47	0.126
K-K'	1	Deep Block Failure through Bottom Liner	2.36	0.121
	2	Shallow Block Failure through Separation Liner	2.86	0.290

(1) Factor of Safety was calculated using Janbu Method. Spencer Method did not converge for the analysis.
(2) For Cross Section G-G', Failure Plane No. 3 (Buttress Stability Evaluation) a pseudostatic FS of 1.15 was calculated for a horizontal acceleration of 0.15.

Table 3 - Seismically-Induced Permanent Displacements from Newmark Deformation Analyses

Cross Section	Failure Plane Number	Description	Static Factor of Safety	Yield Acceleration k_y (g)	Maximum Acceleration k_{max} (g)	Permanent Displacement (in)
A-A'	1	Deep Block Failure through Bottom Liner	2.94	0.130	0.25	3.5
	2	Deep Block Failure through Bottom Liner	2.94	0.139	0.27	3.7
	3	Circular Failure through Bioreactor	2.23	0.298	0.68	4.2
	4	Deep Block Failure through Bottom Liner	2.47	0.121	0.22	2.9
	5	Deep Block Failure through Bottom Liner	2.46	0.124	0.23	3.1
	6	Shallow Block Failure through Separation Liner	3.29	0.355	0.68	3.5
B-B'	1	Deep Block Failure through Bottom Liner	2.45	0.126	0.25	4.0
G-G'	1	Deep Block Failure through Bottom Liner	2.22	0.125	0.27	4.6
	2	Shallow Block Failure through Separation Liner	2.67	0.298	0.67	approx. 6
H-H'	1	Deep Block Failure through Bottom L iner	1.94	0.145	0.34	5.3
	2	Deep Block Failure through Bottom Liner	2.22	0.141	0.33	1.9
	3	Circular Failure through Bioreactor	2.28	0.322	0.24	7.8
K-K'	1	Deep Block Failure through Bottom Liner	2.36	0.121	0.80	approx. 6
	2	Shallow Block Failure through Separation Liner	2.86	0.290	0.63	5.9

FIGURES



N

0 100 200
FEET

LEGEND

PHASE LINE

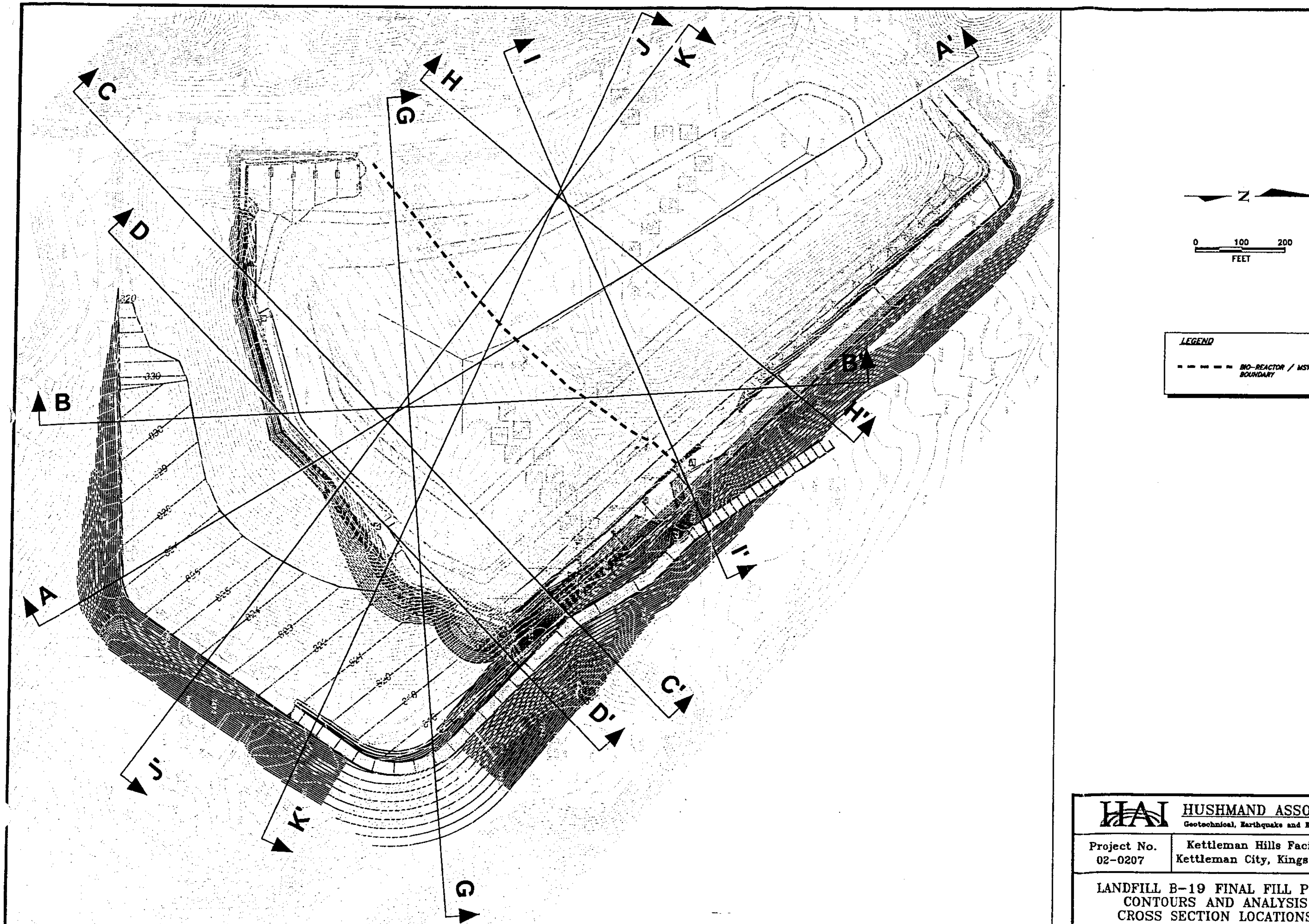
△2632 *SECONDARY ADMIX CONTROL POINT*

SECONDARY ADMIX LINER CONTROL LINE

NOTES:

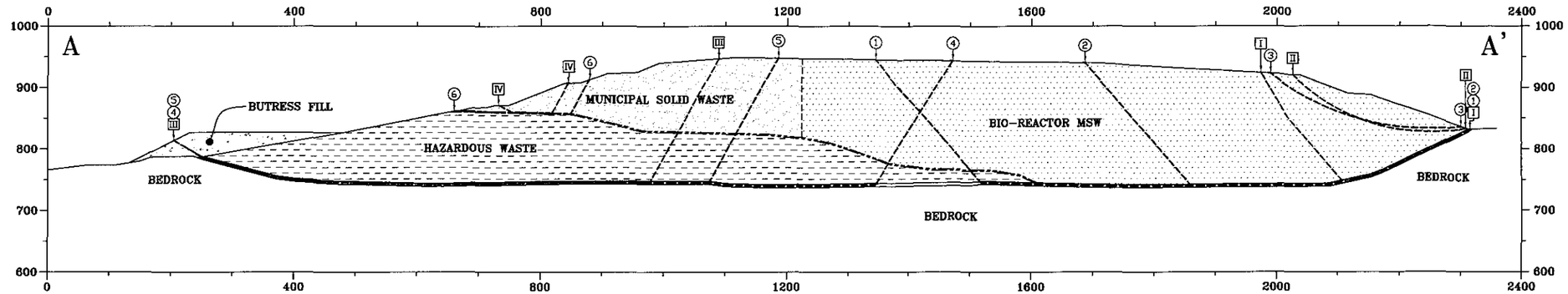
1) BASE TOPOGRAPHY FROM ADVANCED DIGITAL MAPS, INC., DATE OF PHOTOGRAPHY 1/26/90.
2) BASE CONTOURS FOR LANDFILL B-19 WERE GENERATED FROM AS-BUILT SURVEYS FOR TOP OF OPERATIONS LAYER ON BASE AND TOP OF SECONDARY CLAY FOR SIDE SLOPES.
3) ORIGINAL DRAWING REFERENCE: GOLDER ASSOCIATES (1991), "LANDFILL B-19 BASE COUNTROUS AND SURROUNDING TOPOGRAPHY," DRAWING NO. 2, REV. 0.

HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers
Project No. 02-0207	Kettleman Hills Facility – Unit B-19 Kettleman City, Kings County, California
LANDFILL B-19 BASE CONTOURS AND CROSS SECTION LOCATIONS	Figure 1

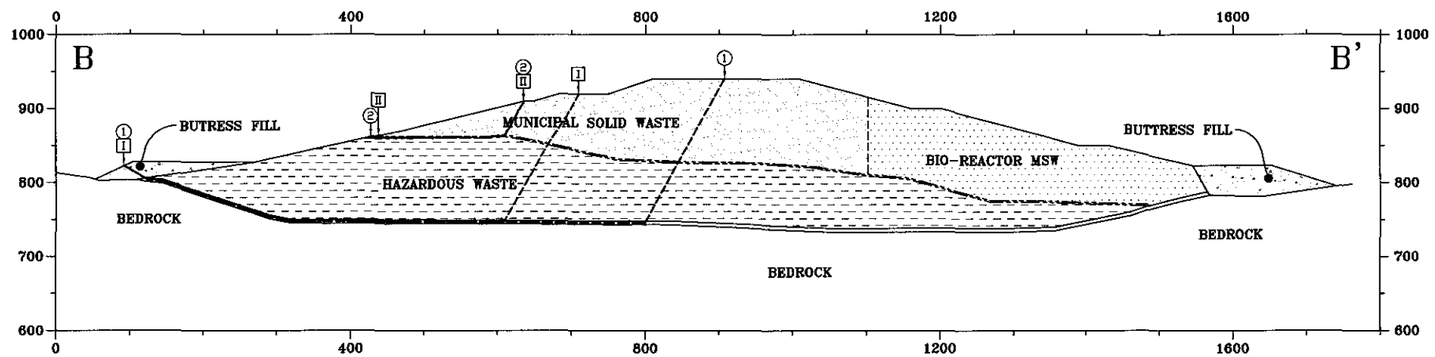


HUSHMAND ASSOCIATES INC.
Geotechnical, Earthquake and Environmental Engineers

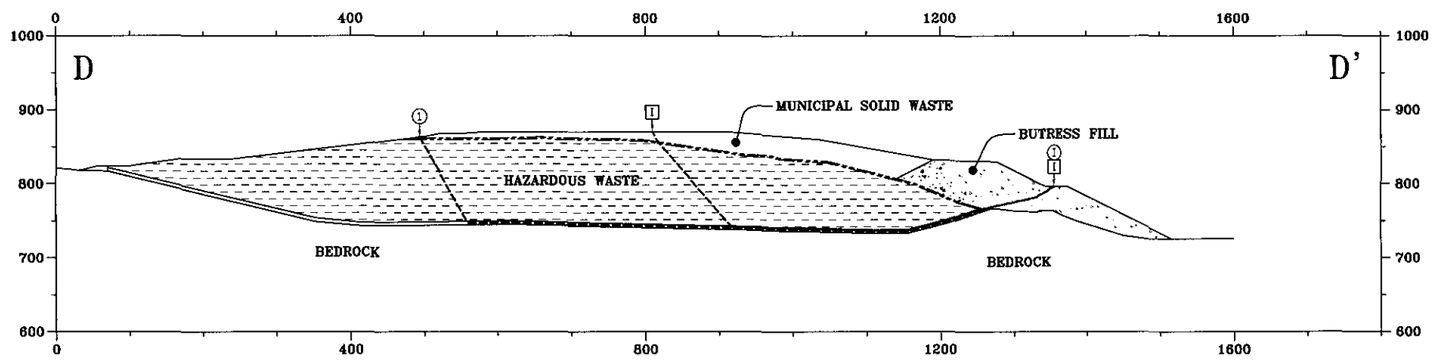
Project No. 02-0207	Kettleman Hills Facility – Unit B-19 Kettleman City, Kings County, California
LANDFILL B-19 FINAL FILL PLAN CONTOURS AND ANALYSIS CROSS SECTION LOCATIONS	Figure 3



SECTION A–A'



SECTION B–B'

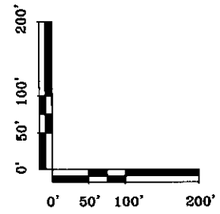


SECTION D–D'

SUMMARY OF
SLOPE STABILITY ANALYSIS RESULTS

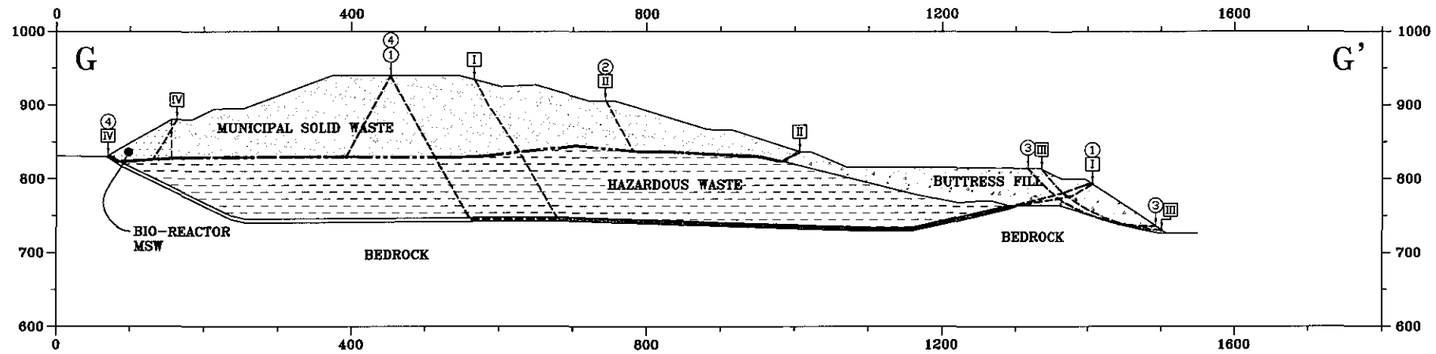
SECTION	CASE NO.	FS	Ky
A–A'	I	1.85	0.214
	II	2.19	0.297
	III	2.40	0.129
	IV	2.87	0.367
	1	2.94	0.130
	2	2.61	0.139
	3	2.23	0.298
	4	2.50	0.124
	5	2.51	0.128
	6	3.16	0.336
B–B'	I	2.56	0.144
	II	2.97	0.316
	1	2.50	0.130
	2	2.97	0.316
D–D'	I	3.62	0.214
	1	4.08	0.171

SEPARATION LINER
STATIC FAILURE PLANE
PSEUDO–STATIC FAILURE PLANE
STATIC PLANE NUMBER
PSEUDO–STATIC PLANE NUMBER

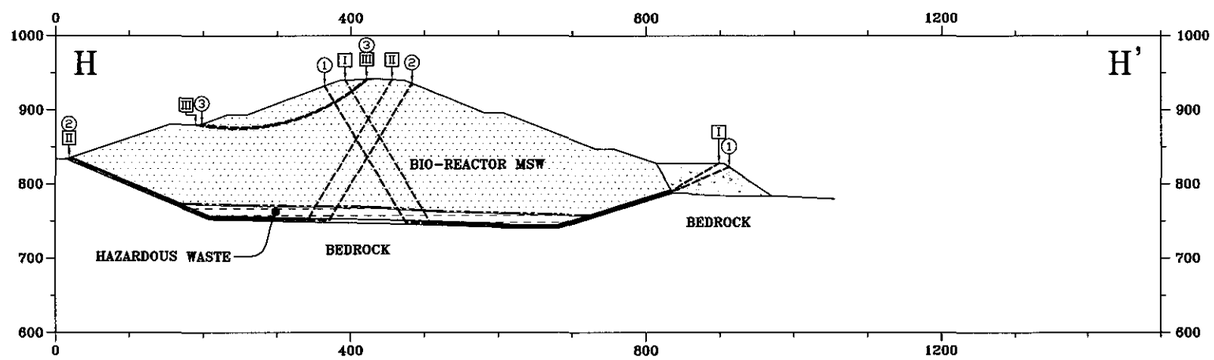


SCALE 1"=200'

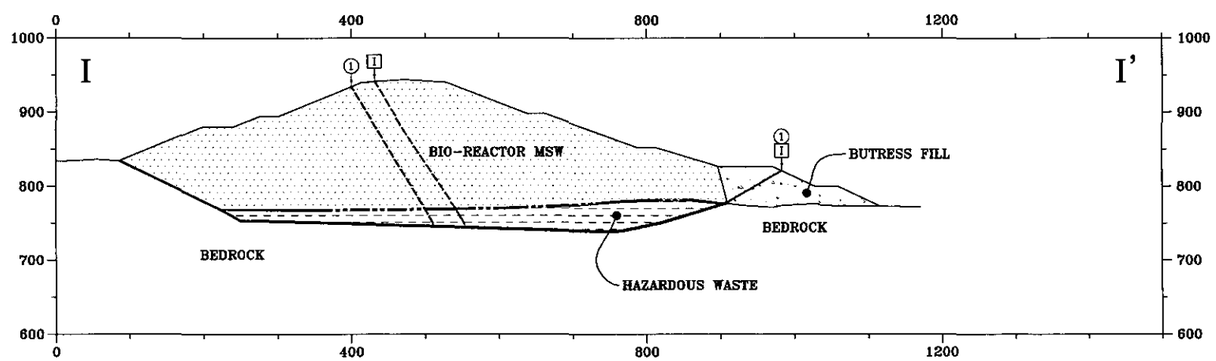
Project No. 02-0207	Kettleman hills Facility - Unit B-19 Kettleman City, Kings County, California	ANALYSIS CROSS SECTIONS A–A', B–B', D–D' AND POTENTIAL FAILURE PLANES	Figure 4
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		



SECTION G–G'



SECTION H–H'

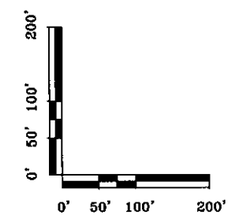


SECTION I–I'

SUMMARY OF
SLOPE STABILITY ANALYSIS RESULTS

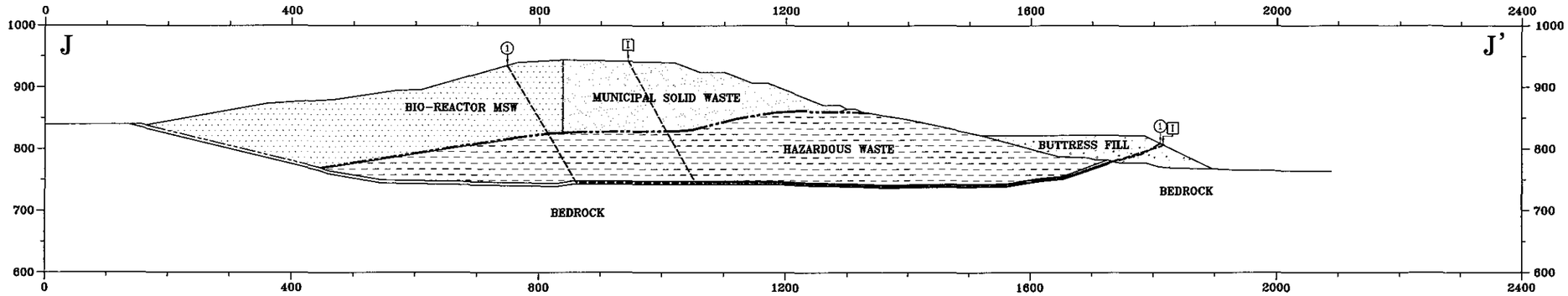
SECTION	CASE NO.	FS	Ky
G–G'	I	2.28	0.136
	II	3.89	>0.43
	III	2.27	0.479
	IV	1.59	>0.30
	1	2.35	0.131
	2	2.93	0.430
	3	2.34	0.465
	4	2.97	0.292
H–H'	I	1.91	0.157
	II	2.34	0.149
	III	2.29	0.322
	1	1.88	0.145
	2	2.22	0.141
	3	2.28	0.322
I–I'	I	1.92	0.148
	1	1.97	0.144

SEPARATION LINER
STATIC FAILURE PLANE
PSEUDO-STATIC FAILURE PLANE
STATIC PLANE NUMBER
PSEUDO-STATIC PLANE NUMBER

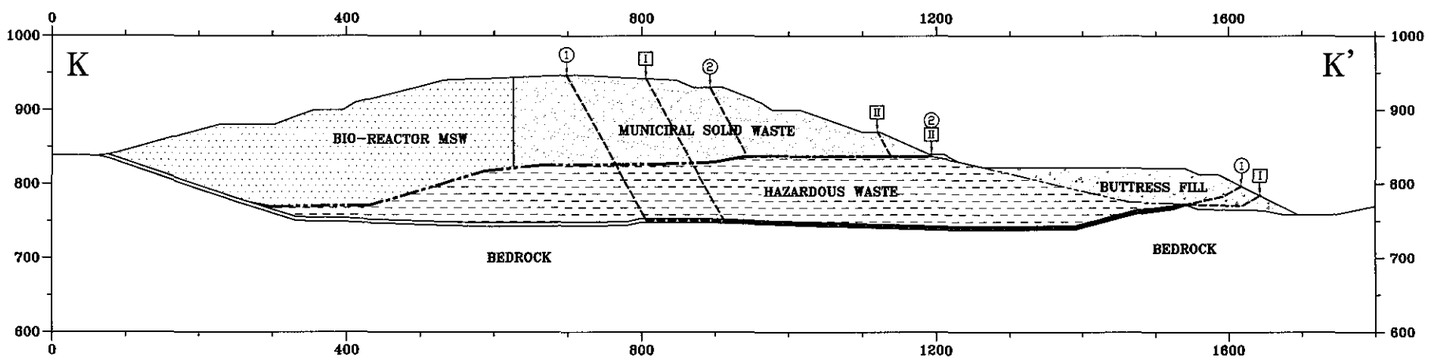


SCALE 1"=200'

Project No. 02-0207	Kettleman hills Facility – Unit B-19 Kettleman City, Kings County, California	ANALYSIS CROSS SECTIONS G–G', H–H', K–K' AND POTENTIAL FAILURE PLANES	Figure 5
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		



SECTION J–J'

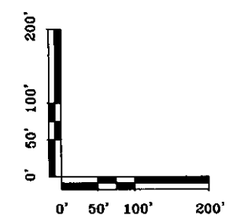


SECTION K–K'

SUMMARY OF
SLOPE STABILITY ANALYSIS RESULTS

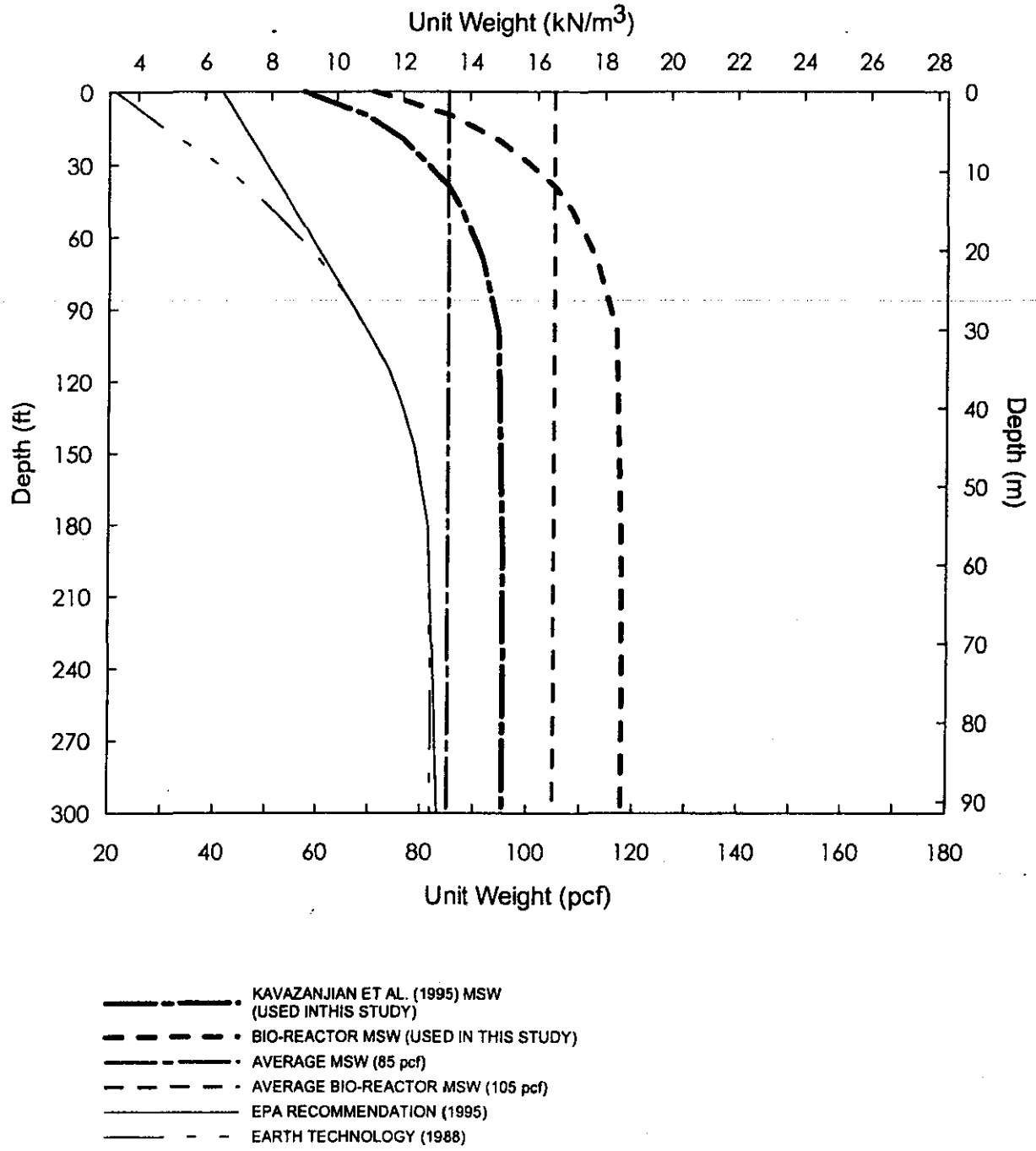
SECTION	CASE NO.	FS	Ky
J–J'	I	2.43	0.138
	1	2.52	0.130
K–K'	I	2.18	0.131
	II	1.86	>0.30
	1	2.39	0.125
	2	2.74	0.305

SEPARATION LINER
STATIC FAILURE PLANE
PSEUDO-STATIC FAILURE PLANE
STATIC PLANE NUMBER
PSEUDO-STATIC PLANE NUMBER

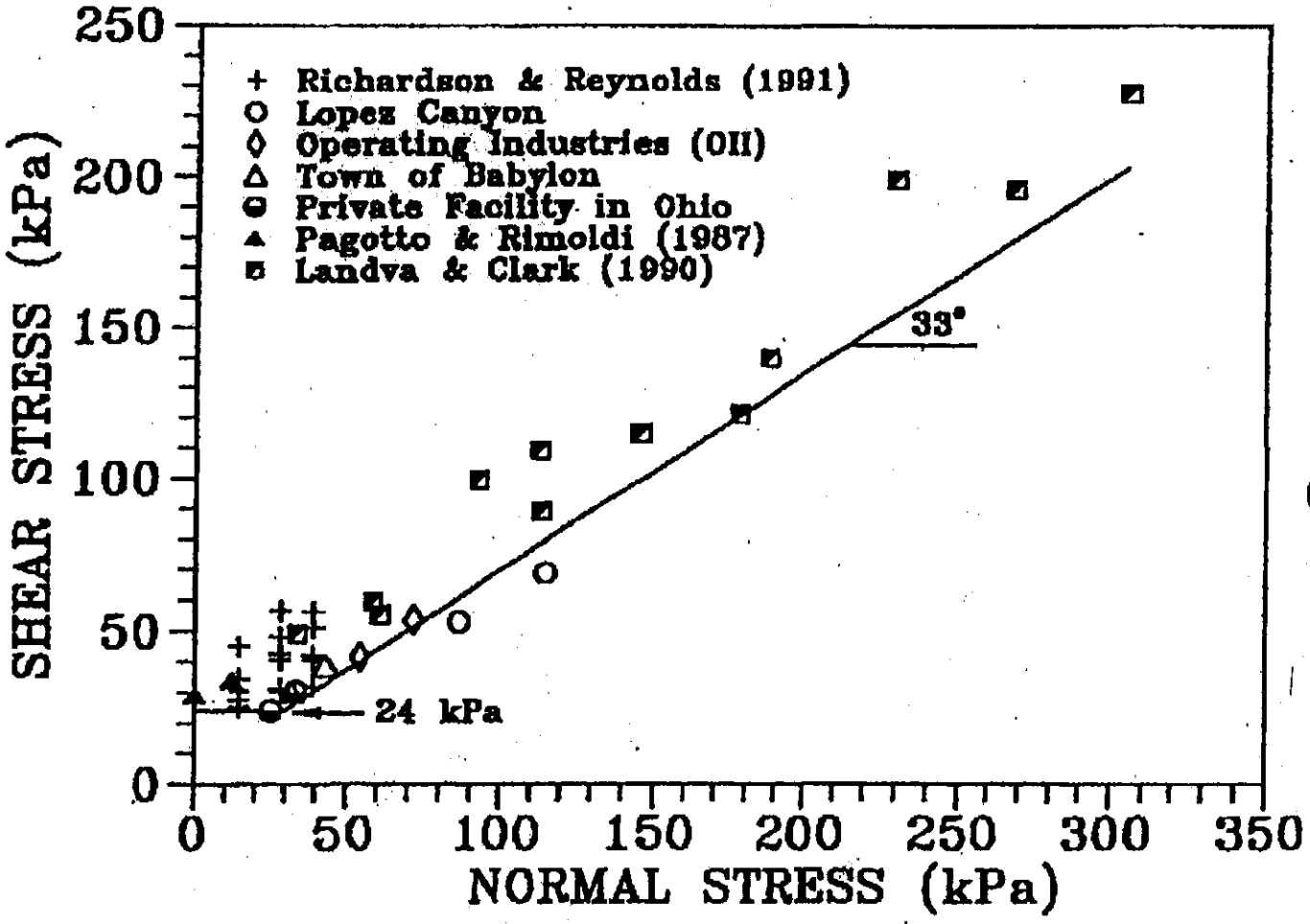


SCALE 1"=200'

Project No. 02-0207	Kettleman hills Facility – Unit B-19 Kettleman City, Kings County, California	ANALYSIS CROSS SECTIONS J–J', K–K' AND POTENTIAL FAILURE PLANES	Figure 6
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		

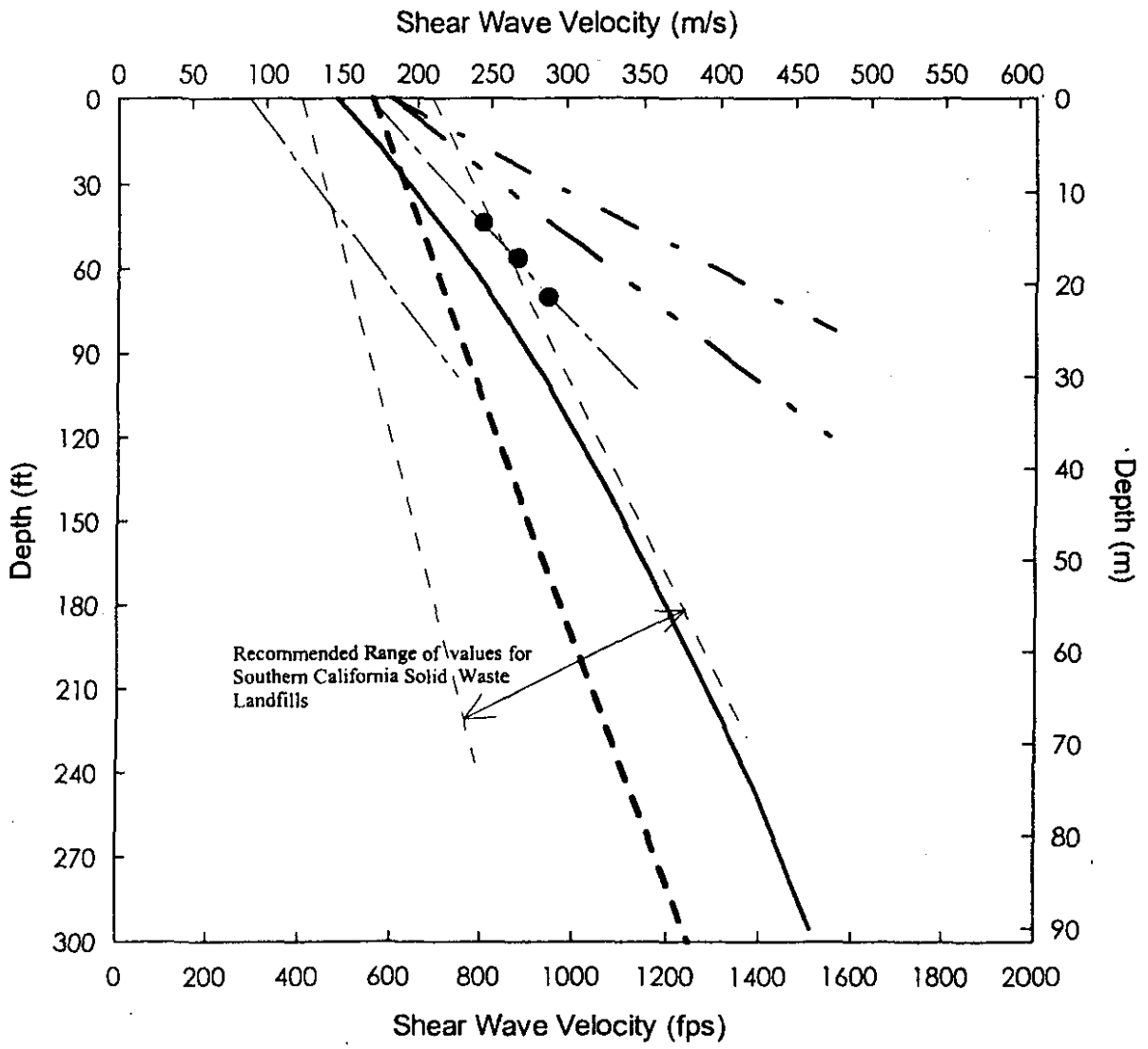


Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	UNIT WEIGHT PROFILE FOR MUNICIPAL SOLID WASTE (MSW) AND BIO-REACTOR MSW	Figure 7
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



Source: Kavazanjian et al. (1995)

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	MSW SHEAR STRENGTH	Figure 8
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



After Kavazanjian et al. (1996) (used in this study)

EPA (1995)

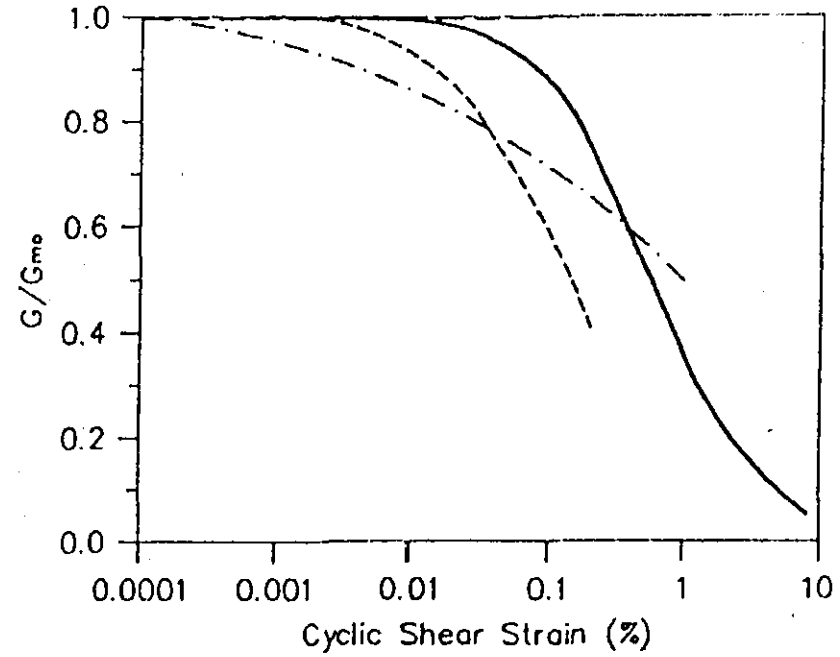
Kavazanjian et al. (1994) (8 sites)

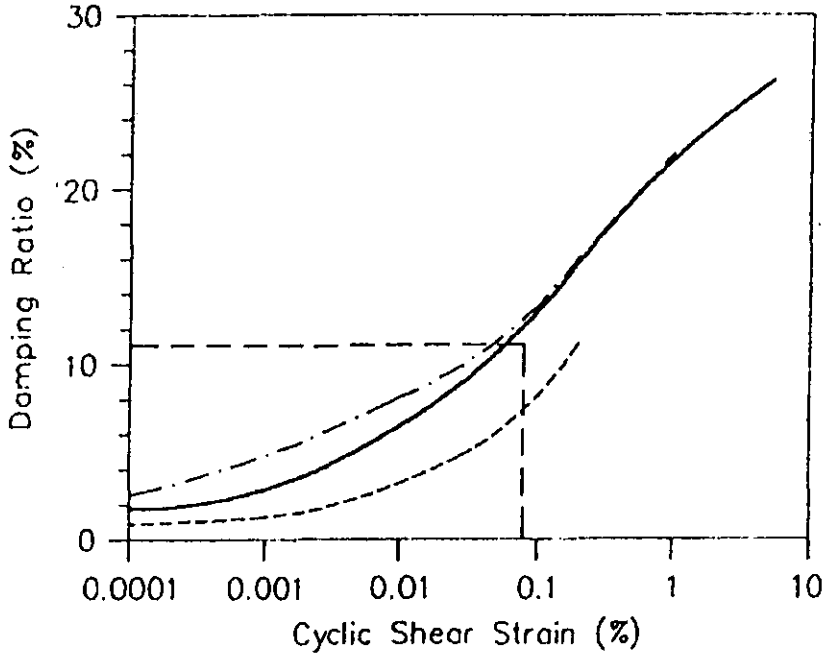
after Earth Technology (1988) (downhole)

after Earth Technology (1988) (crosshole)

after Carey et al. (1993)

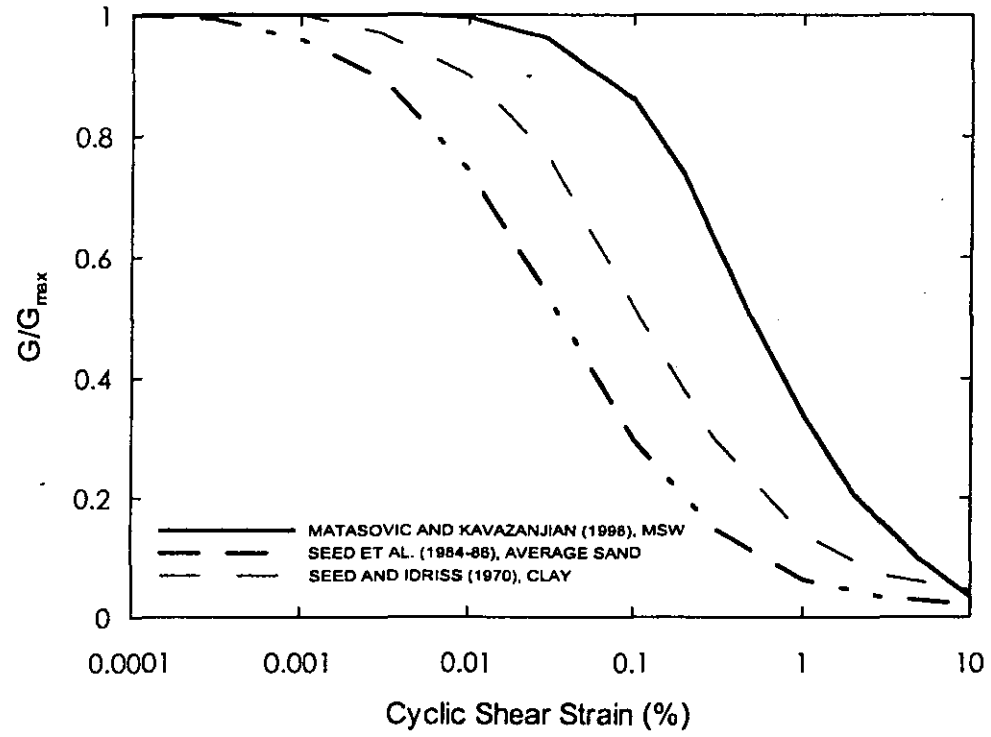
Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	SHEAR WAVE VELOCITY OF MSW	Figure 9
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		

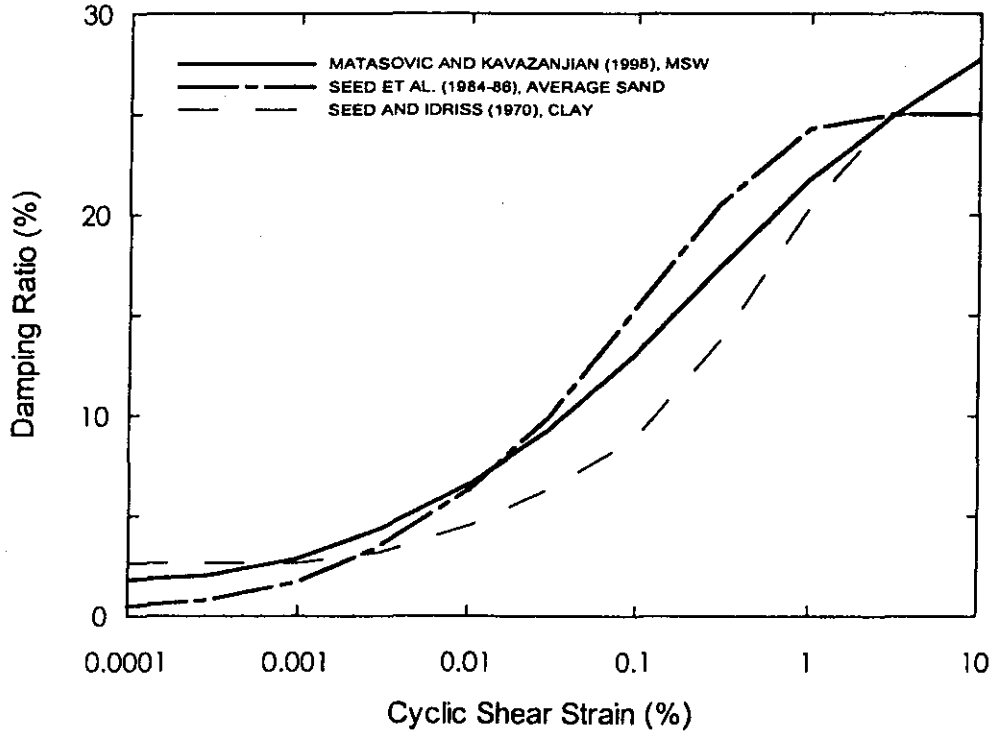




- - - - - - - - Augello et al. (1998)
— — · — Idriss et al. (1995)
— — — — Morochnik et al. (1998)
———— Matasovic and Kavazanjian (1998)

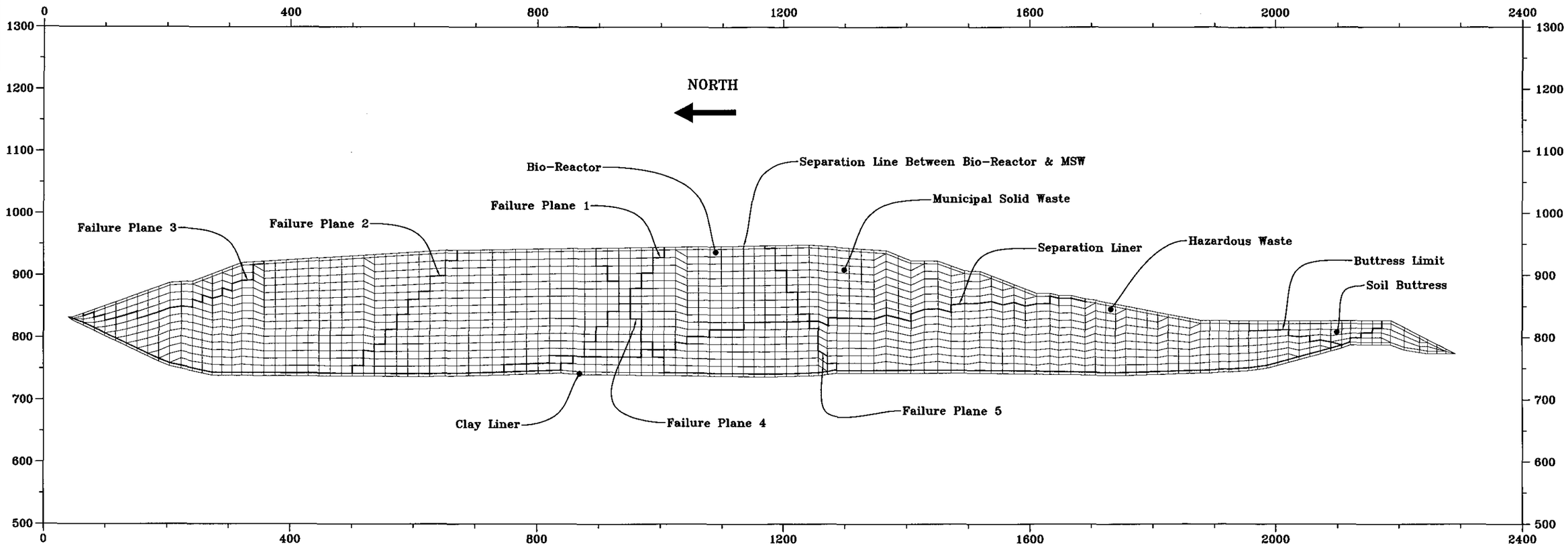
Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	COMPARISON BETWEEN DIFFERENT SHEAR MODULUS REDUCTION AND DAMPING CURVES FOR MUNICIPAL SOLID WASTE	Figure 10A
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



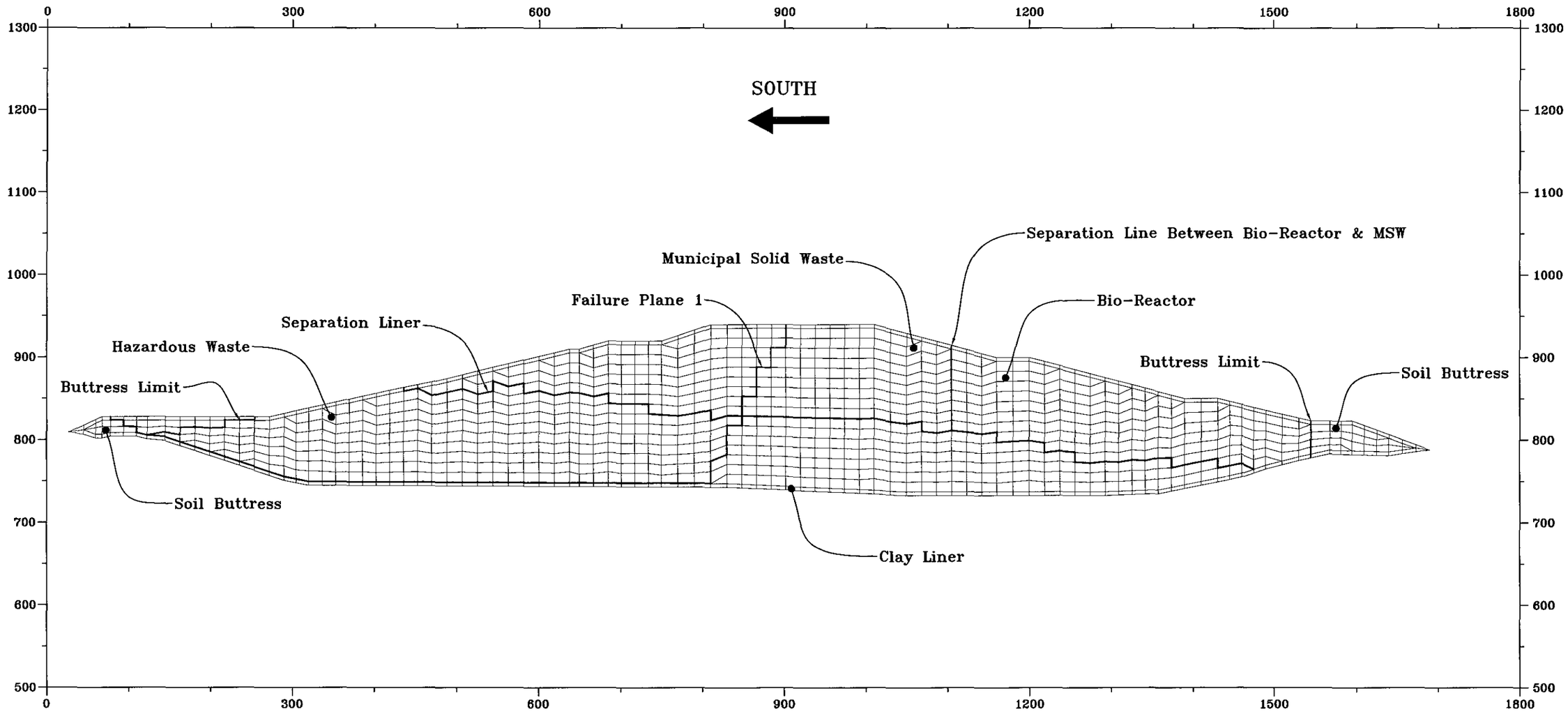


Note: Hazardous waste dynamic material properties are modeled as sand.
Buttress compacted soil and soil liner properties are modeled as clay.

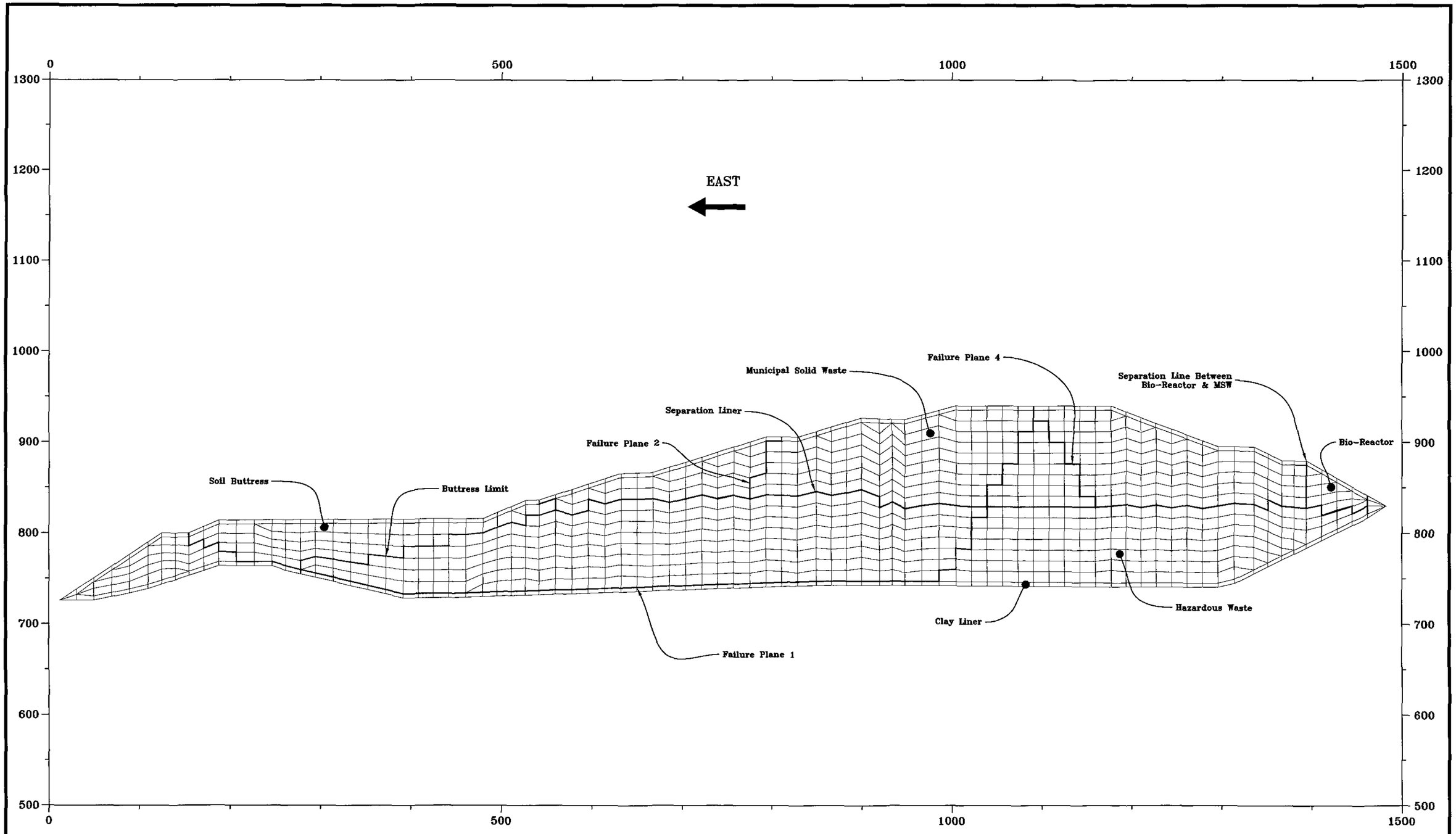
Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	SHEAR MODULUS REDUCTION AND DAMPING CURVES FOR MSW, SAND, AND CLAY USED IN THIS STUDY	Figure 10B
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



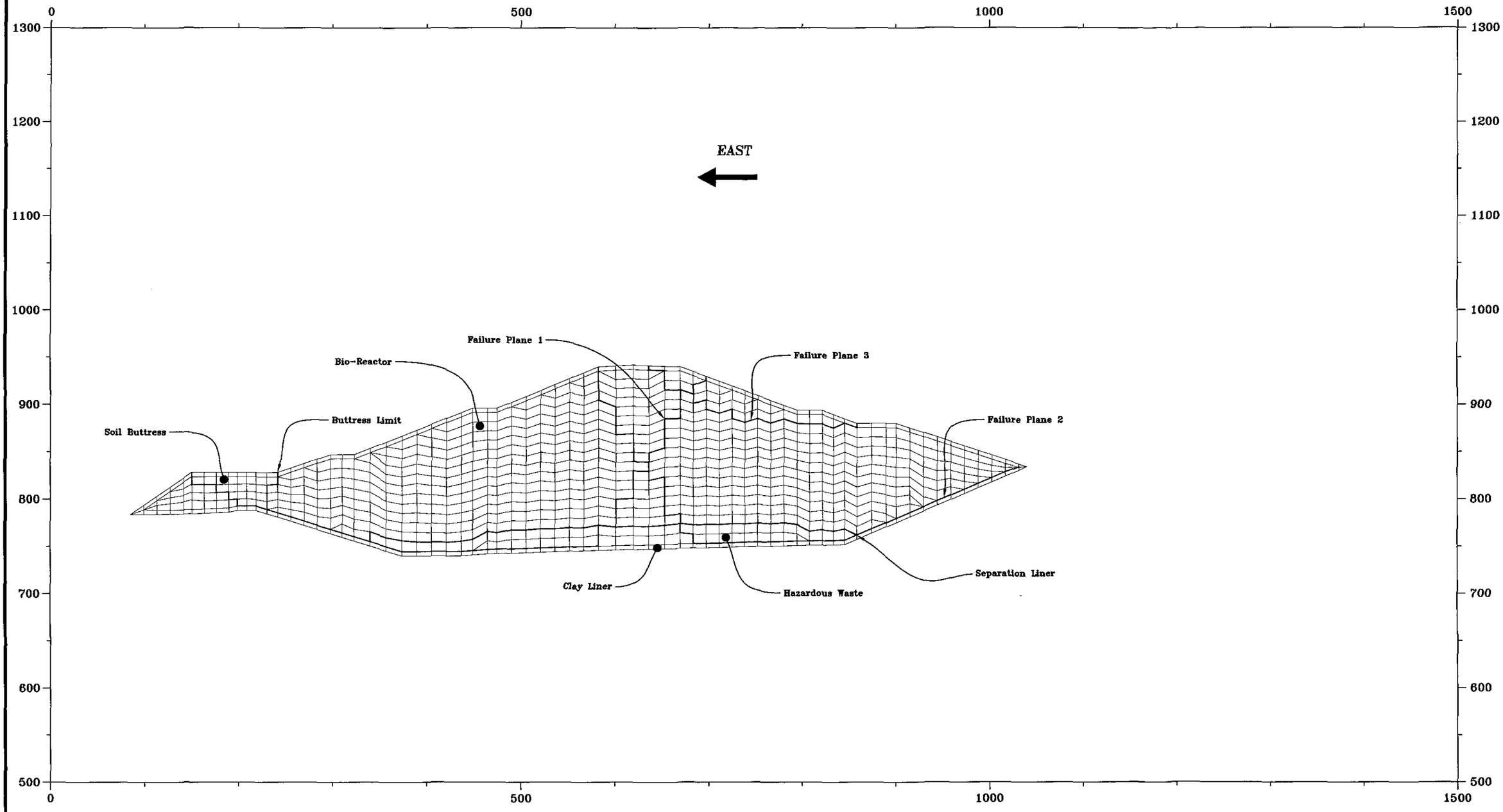
Project No. 02-0207	Kettleman Hills Facility - Unit B-19 Kettleman City, Kings County, California	SECTION A-A' FINITE ELEMENT (QUAD4M) MESH	Figure 11
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		



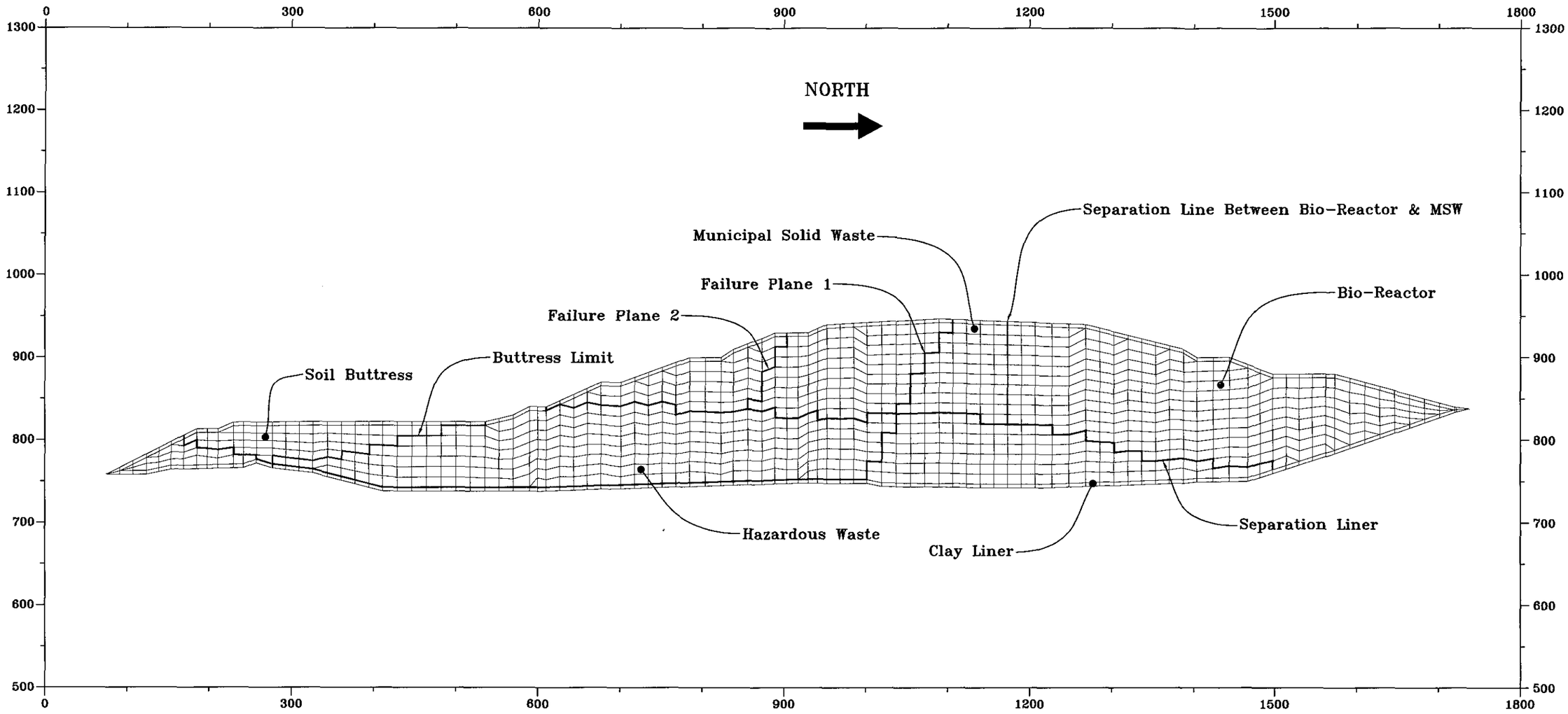
Project No. 02-0207	Kettleman Hills Facility – Unit B-19 Kettleman City, Kings County, California	SECTION B–B' FINITE ELEMENT (QUAD4M) MESH	Figure 12
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		



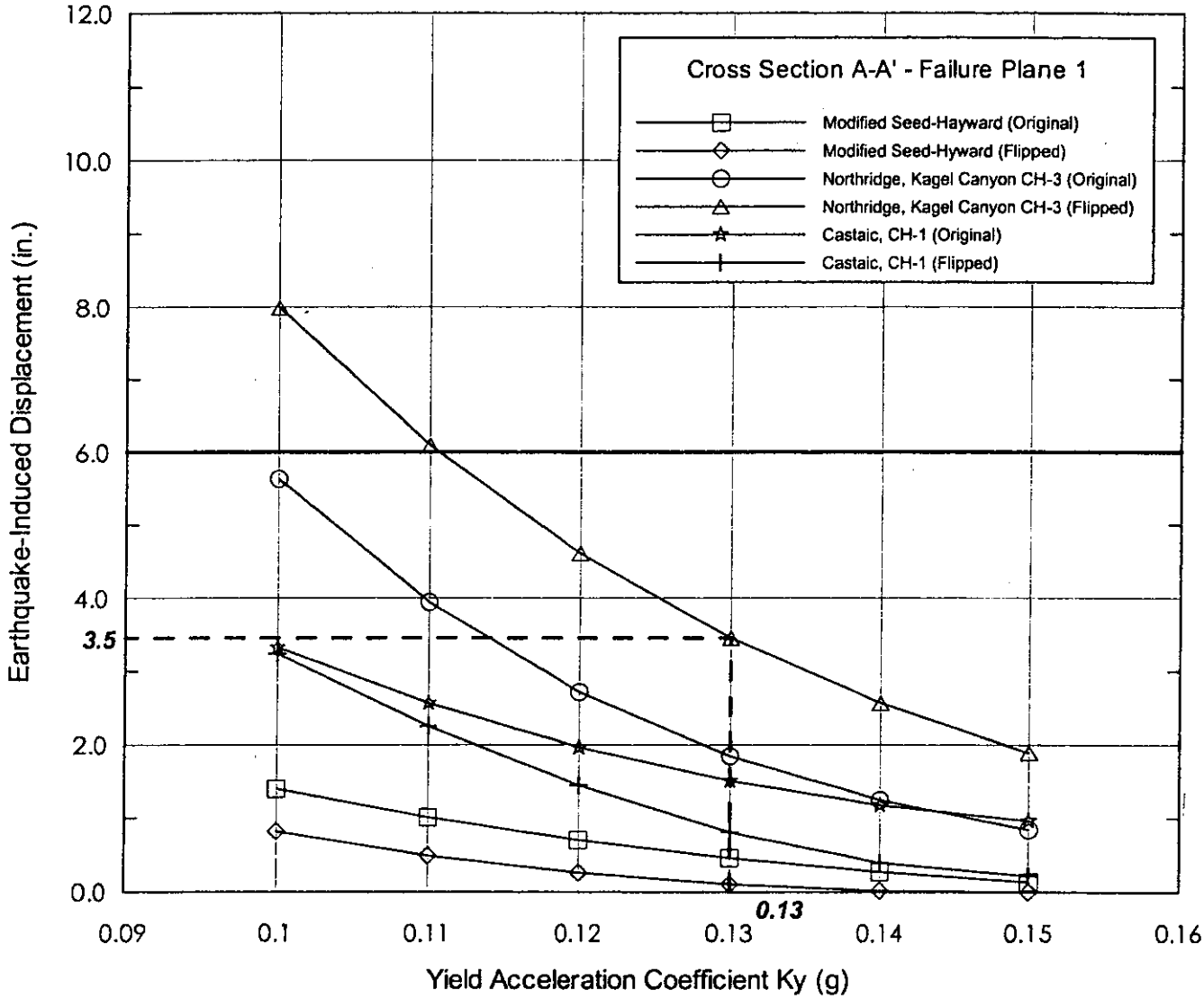
Project No. 02-0207	Kettleman Hills Facility - Unit B-19 Kettleman City, Kings County, California	SECTION G-G' FINITE ELEMENT (QUAD4M) MESH	Figure 13
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		



Project No. 02-0207	Kettleman hills Facility ~ Unit B-19 Kettleman City, Kings County, California	SECTION H-H' (Revised) FINITE ELEMENT (QUAD4M) MESH	Figure 14
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		

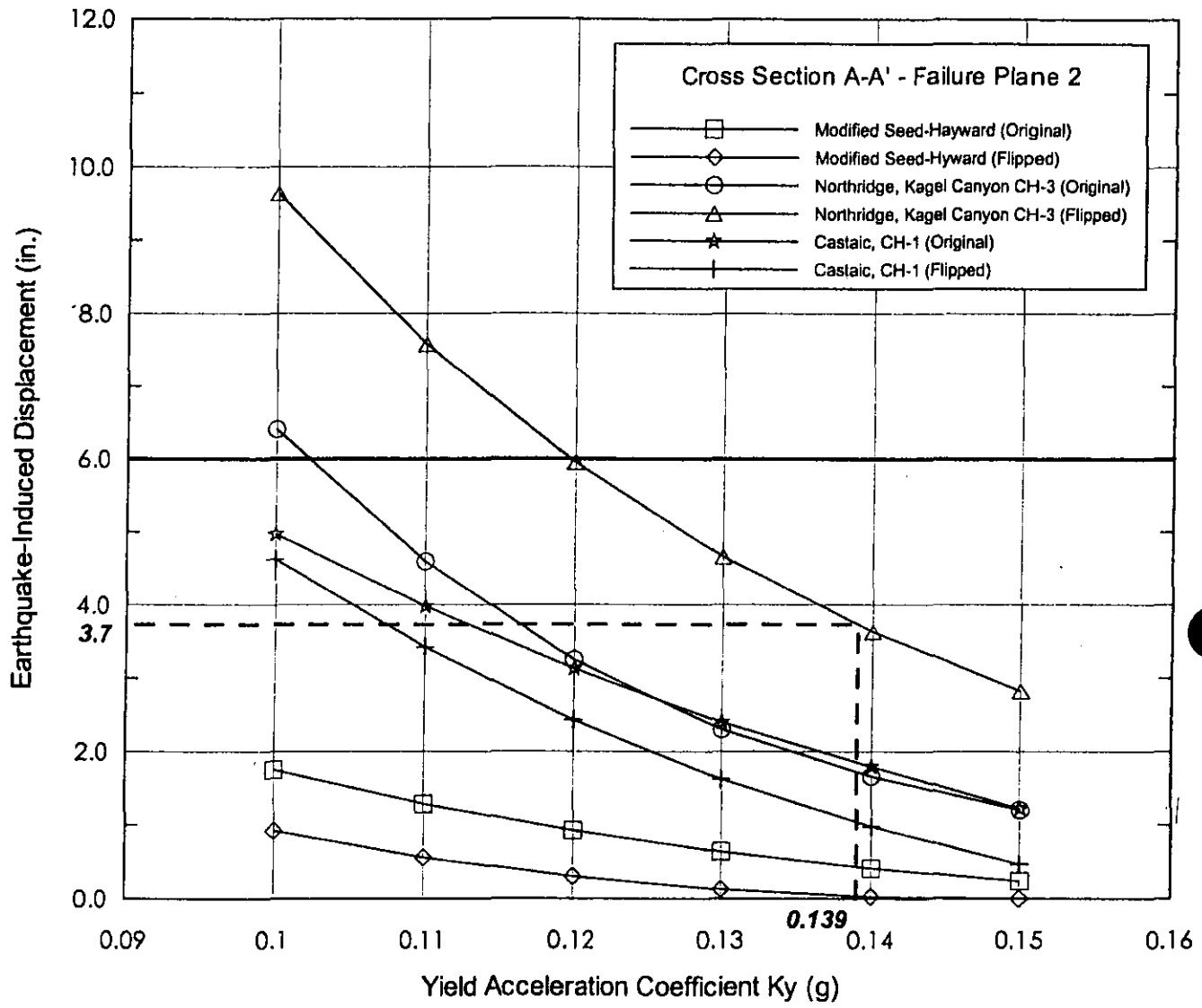


Project No. 02-0207	Kettleman hills Facility – Unit B-19 Kettleman City, Kings County, California	SECTION K-K' FINITE ELEMENT (QUAD4M) MESH	Figure 15
HAI	HUSHMAND ASSOCIATES INC. Geotechnical, Earthquake and Environmental Engineers		



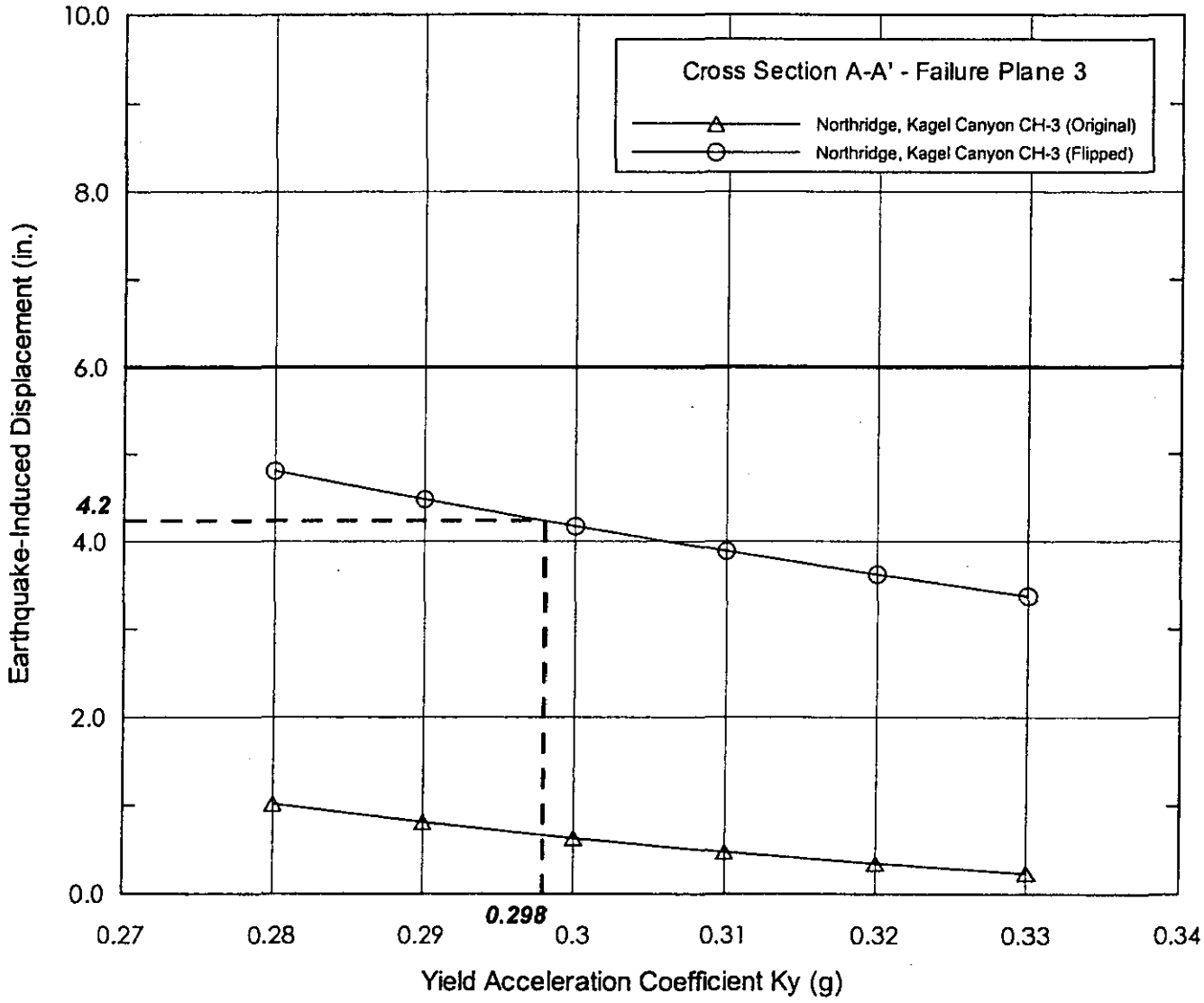
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section A-A' - Failure Plane 1

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION A-A' - FAILURE PLANE 1 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 16
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



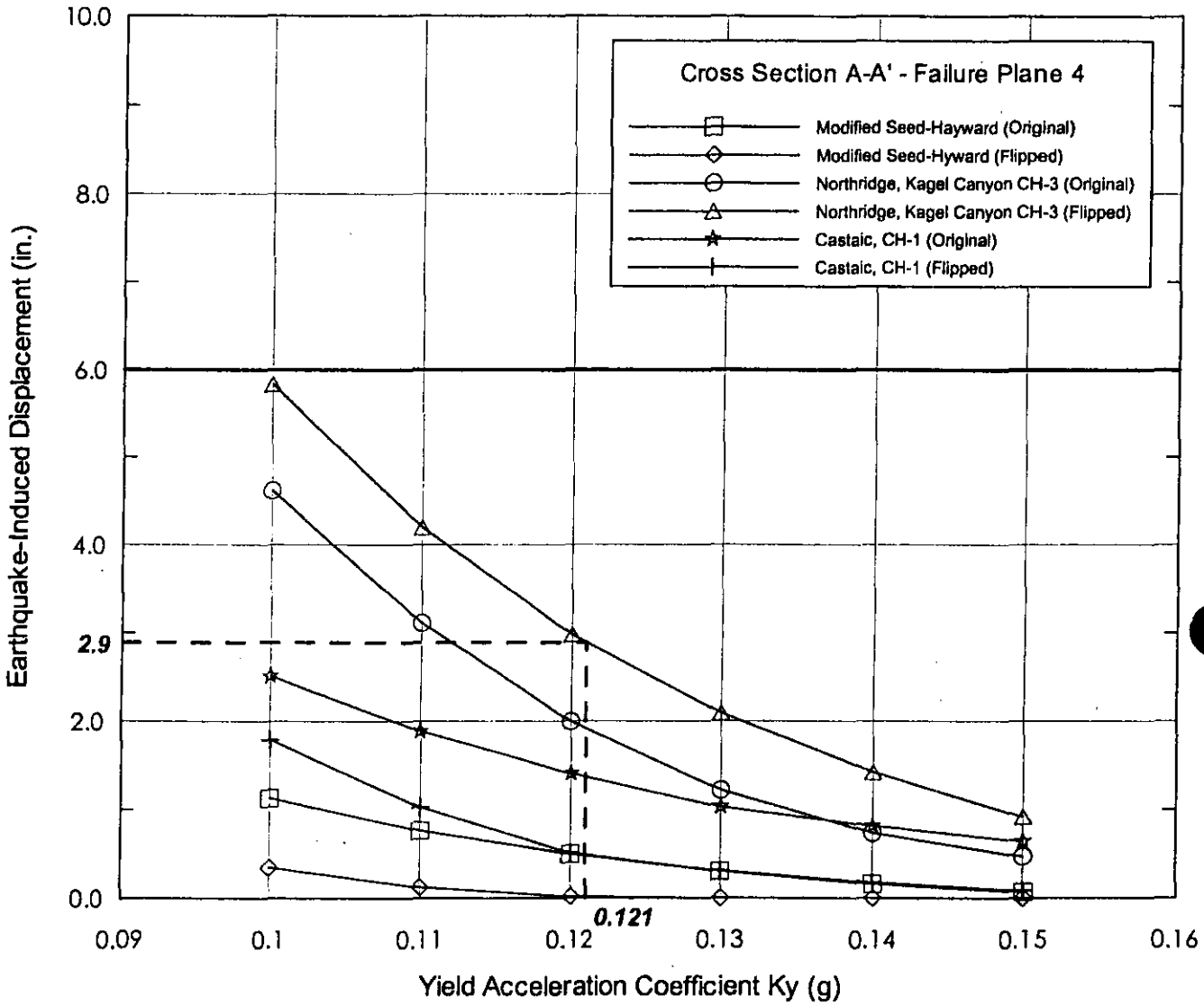
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section A-A' - Failure Plane 2

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION A-A' - FAILURE PLANE 2 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 17
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



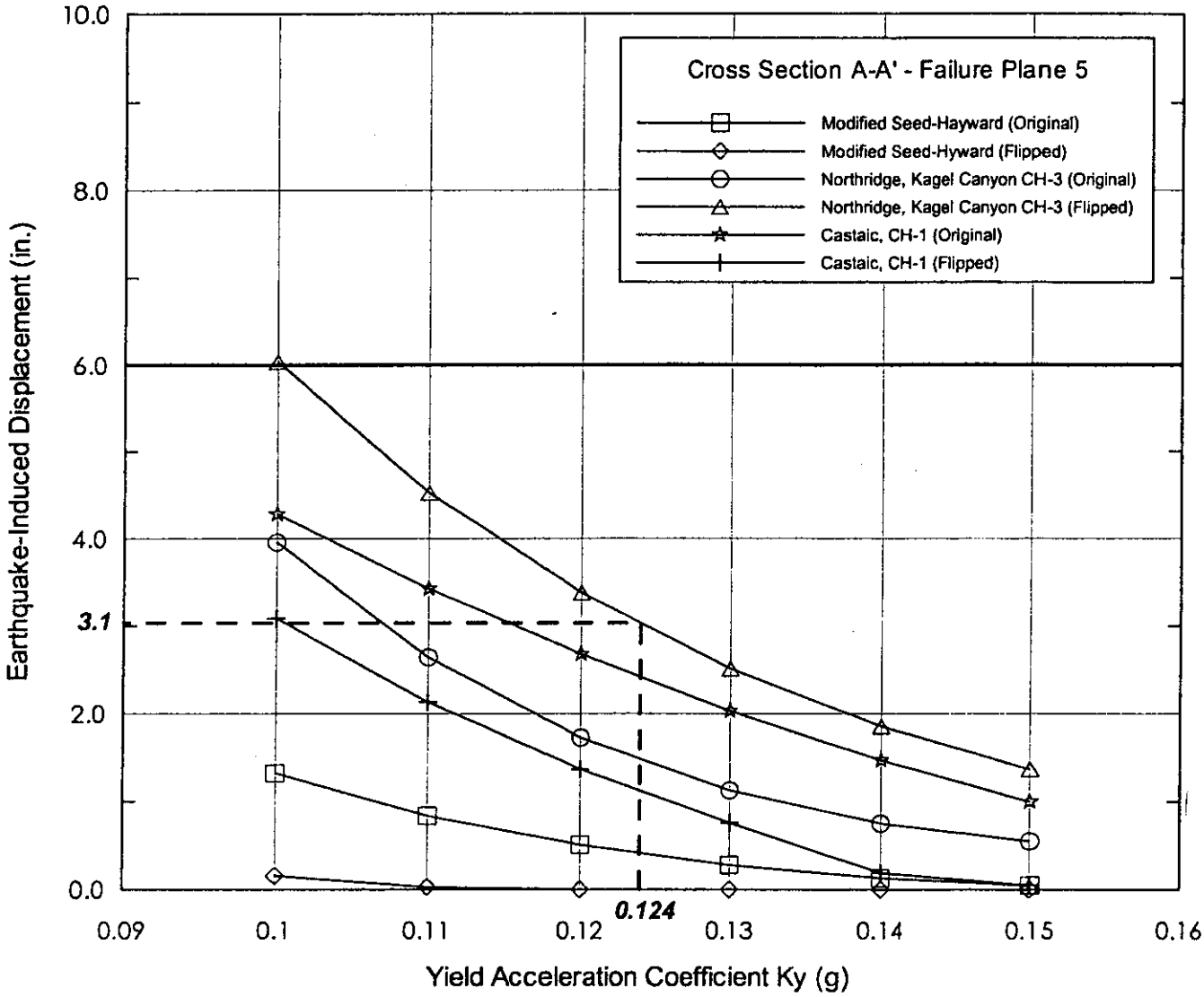
Earthquake-Induced Displacement of Landfill Slope Along Circular Failure Plane vs. Yield Acceleration Coefficient, Ky (g), Cross Section A-A' - Faiure Plane 3

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION A-A' - FAILURE PLANE 3 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 18
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



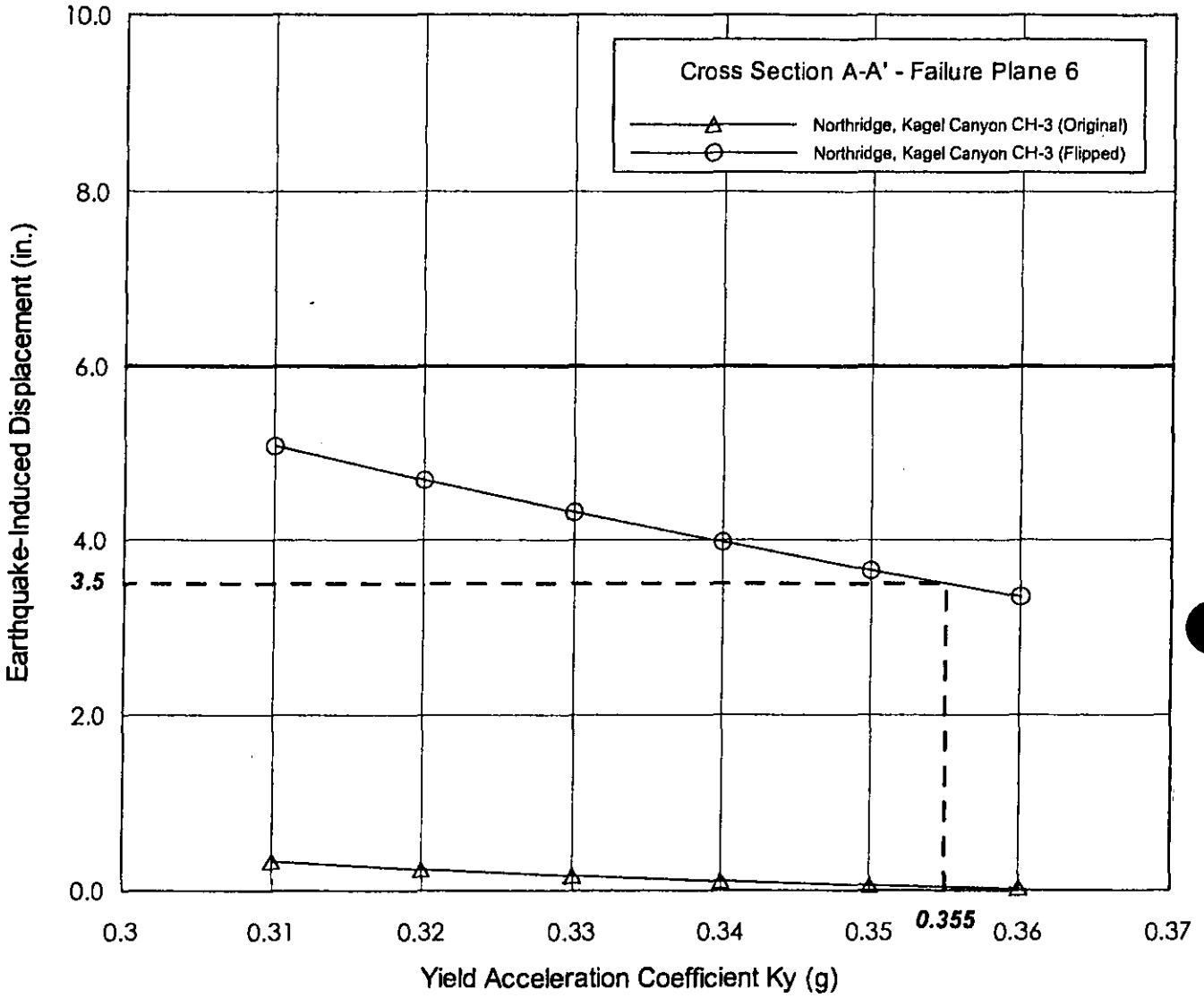
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section A-A' - Failure Plane 4

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION A-A' - FAILURE PLANE 4 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 19
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



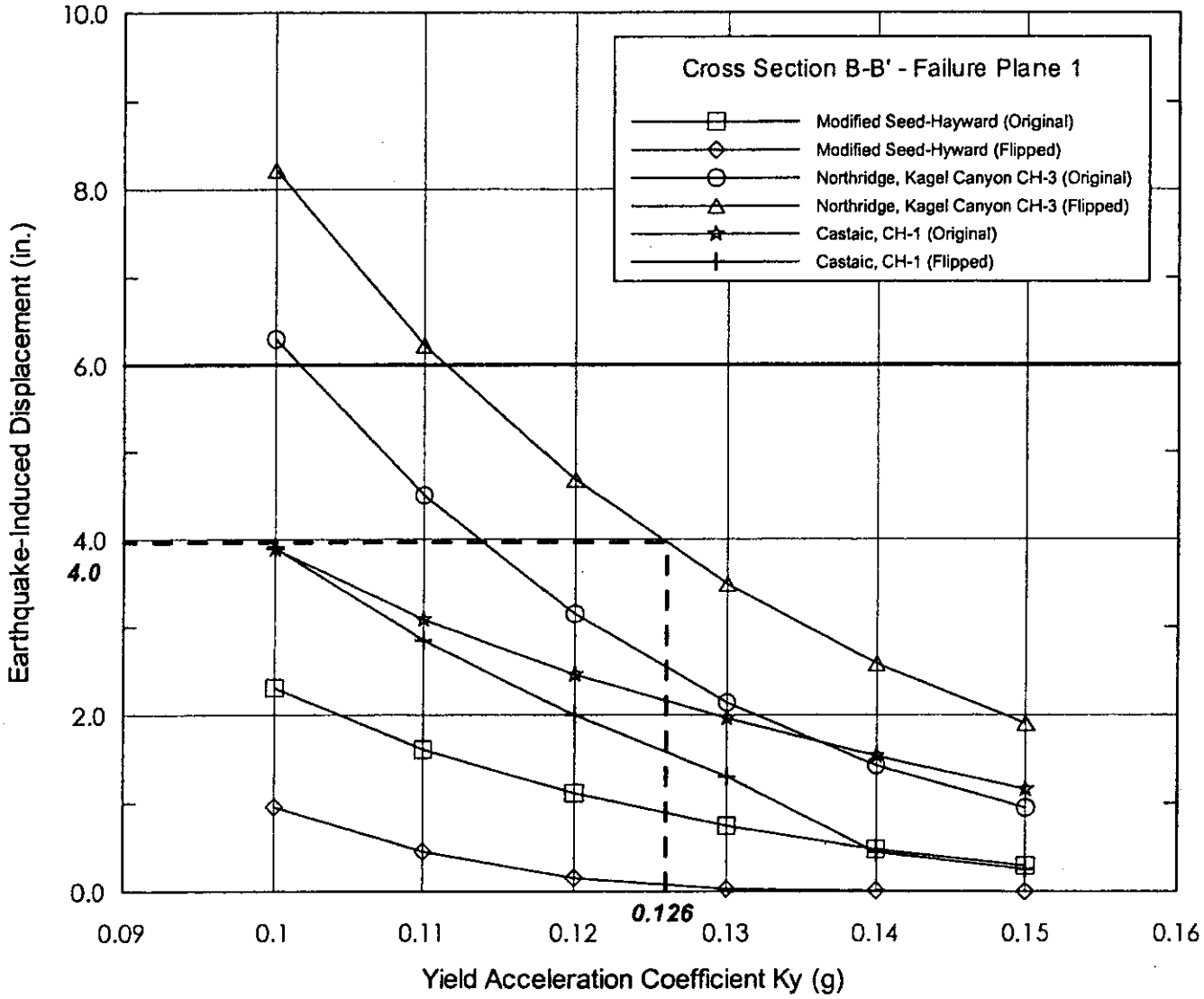
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section A-A' - Failure Plane 5

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION A-A' - FAILURE PLANE 5 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 20
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



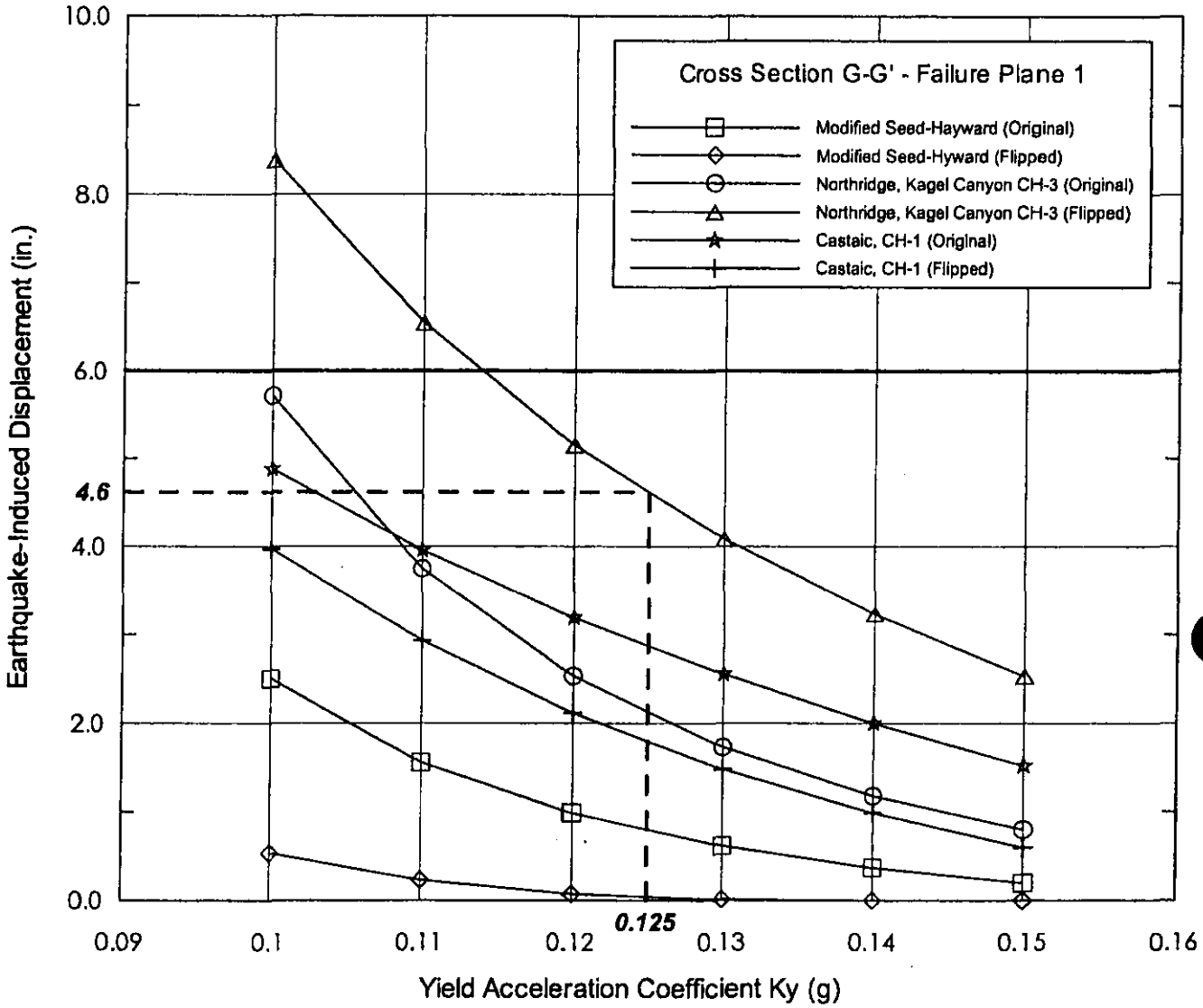
Earthquake-Induced Displacement of Landfill Slope Along Separation Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section A-A' - Faiure Plane 6

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION A-A' - FAILURE PLANE 6 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 21
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



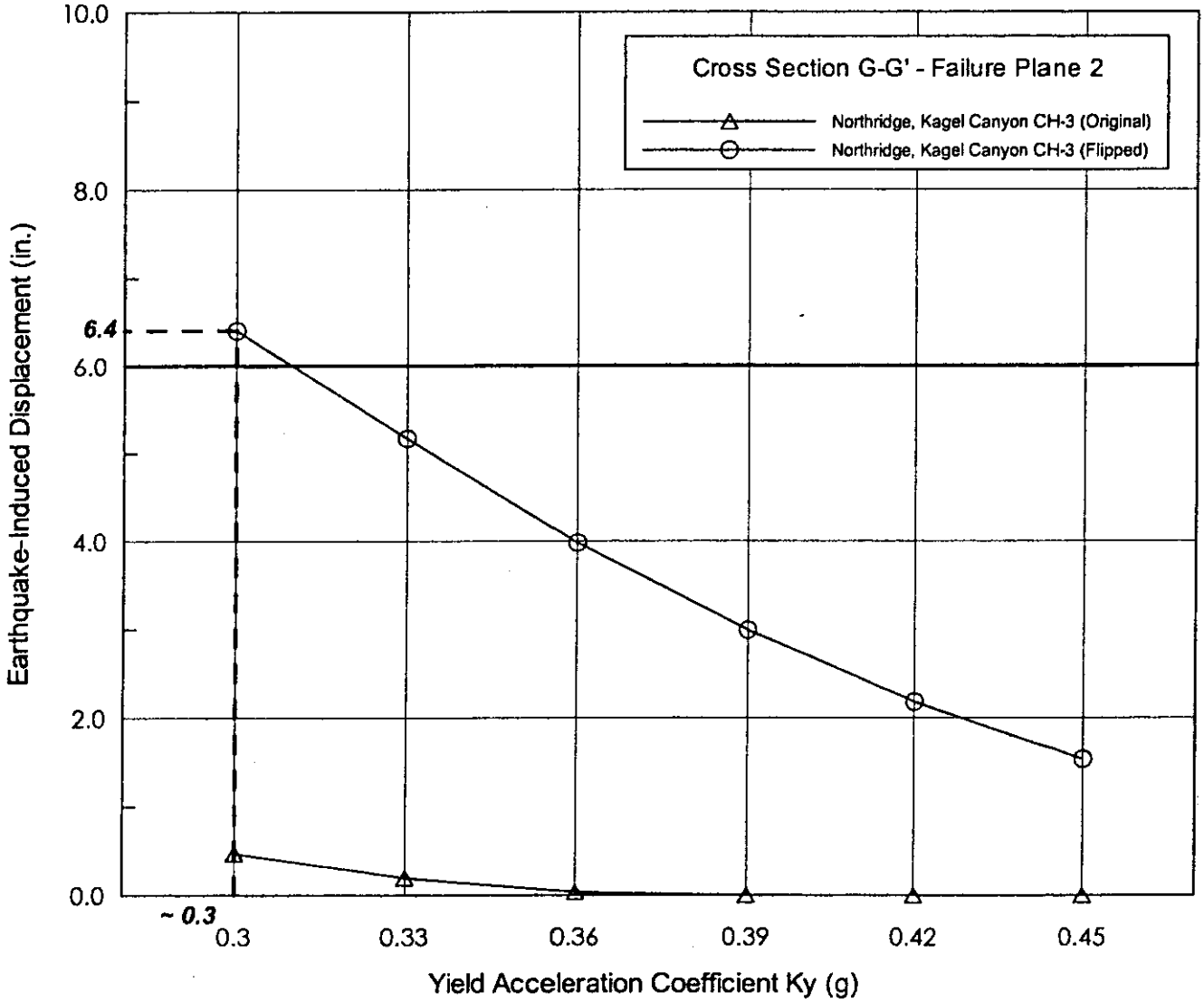
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section B-B' - Failure Plane 1

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION B-B' - FAILURE PLANE 1 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 22
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



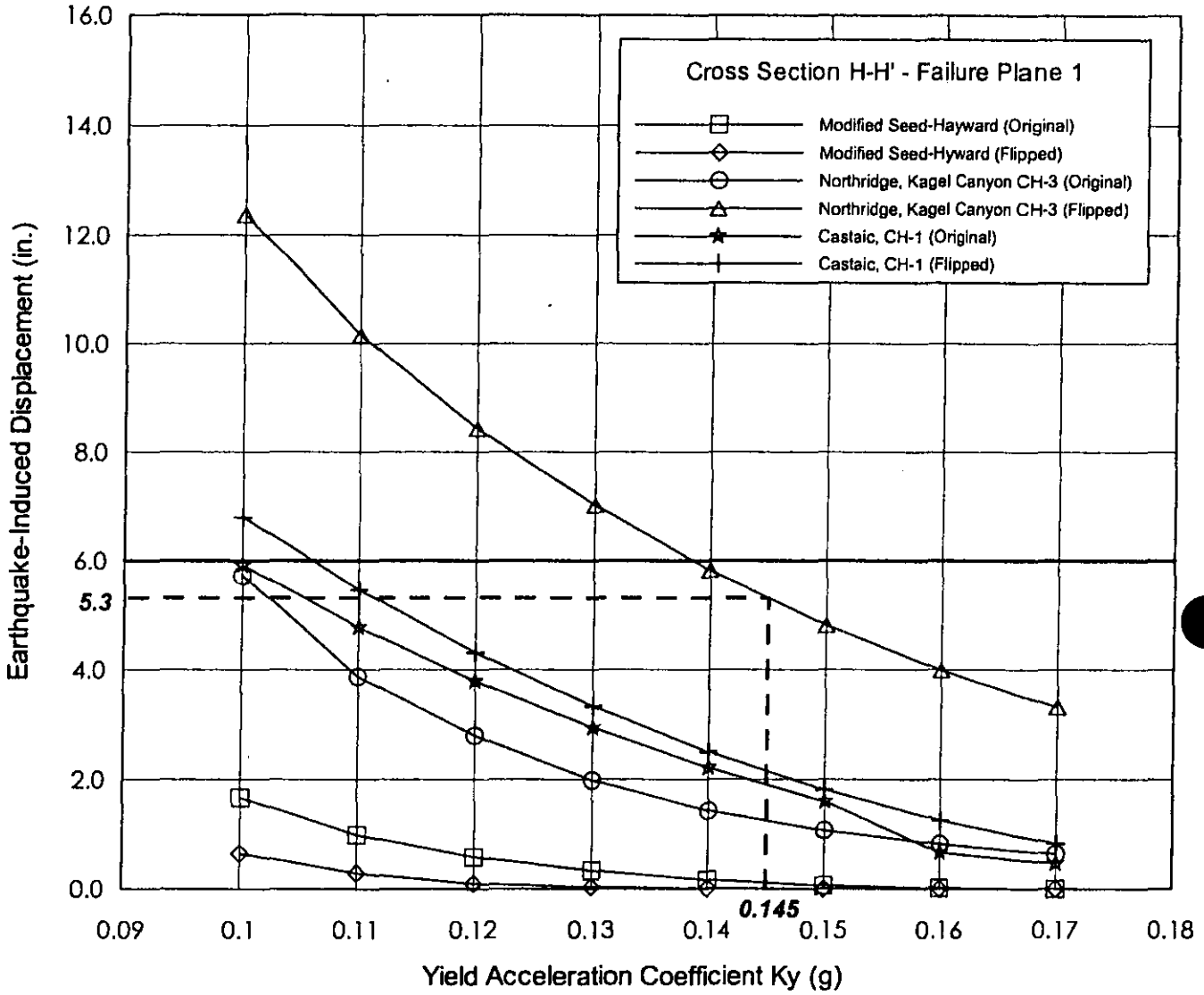
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section G-G' - Failure Plane 1

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION G-G' - FAILURE PLANE 1 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 23
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



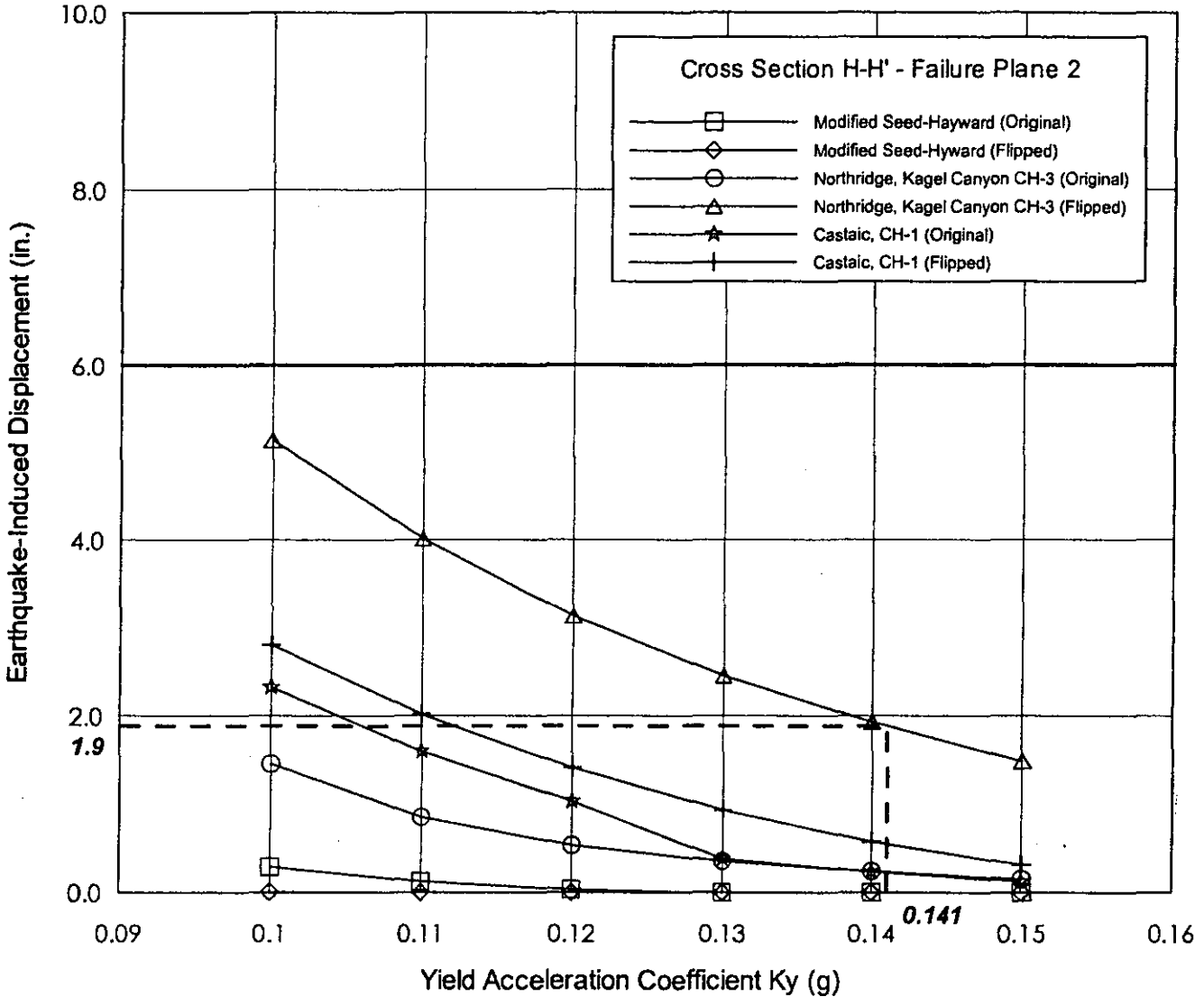
Earthquake-Induced Displacement of Landfill Slope Along Separation Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section G-G' - Failure Plane 2

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION G-G' - FAILURE PLANE 2 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 24
	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



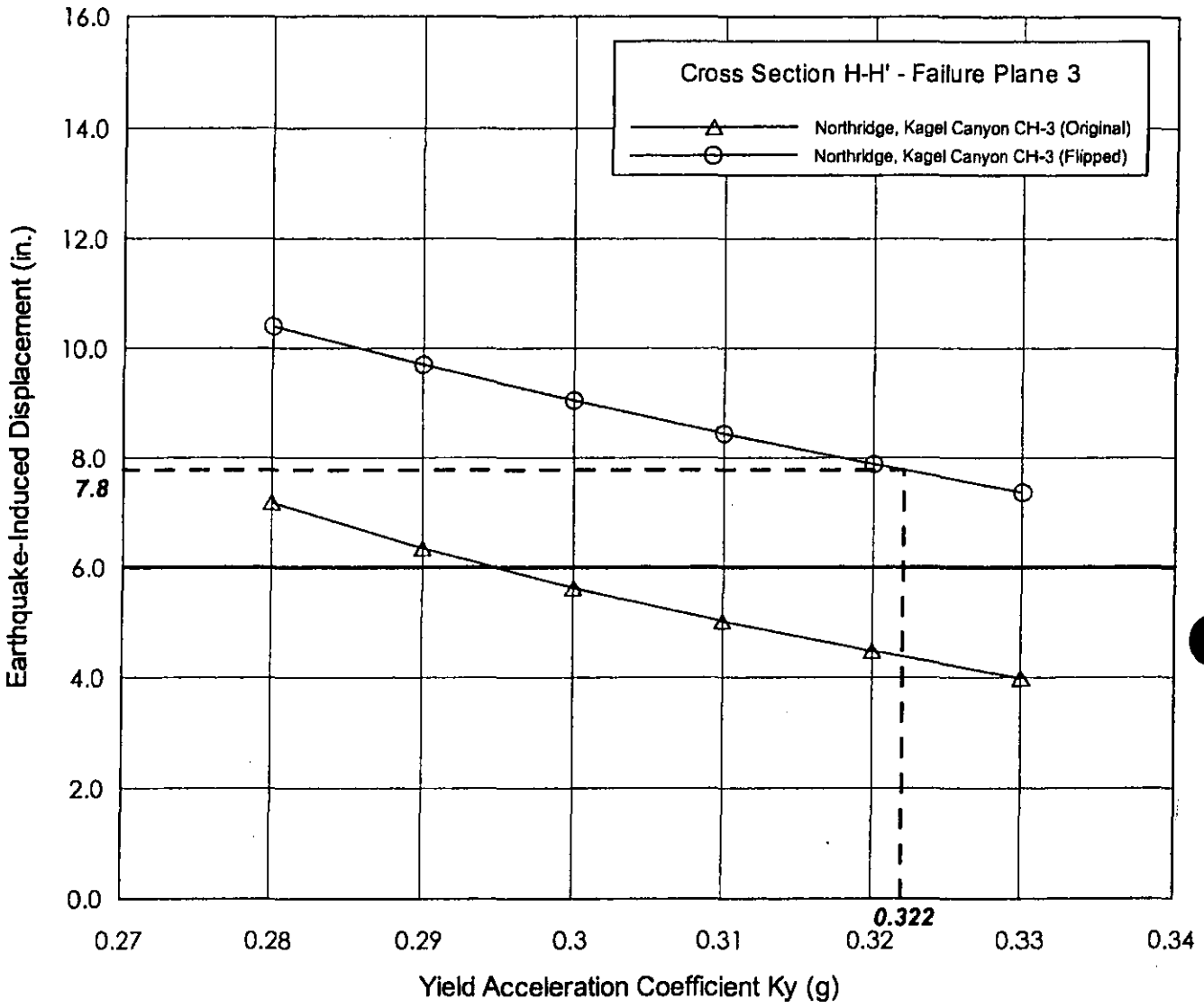
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section H-H' - Failure Plane 1

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION H-H' - FAILURE PLANE 1 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 25
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



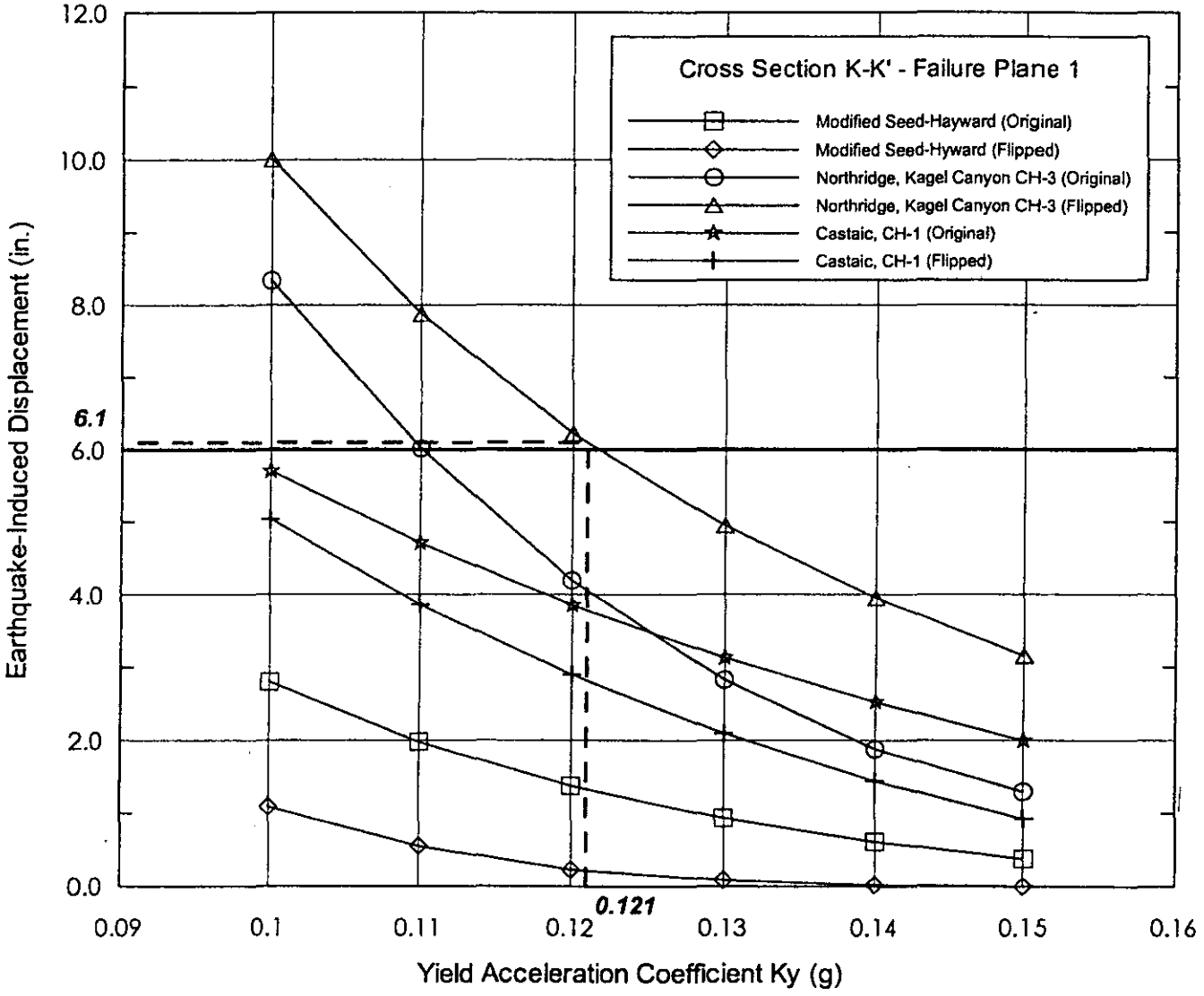
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section H-H' - Failure Plane 2

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION H-H' - FAILURE PLANE 2 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 26
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



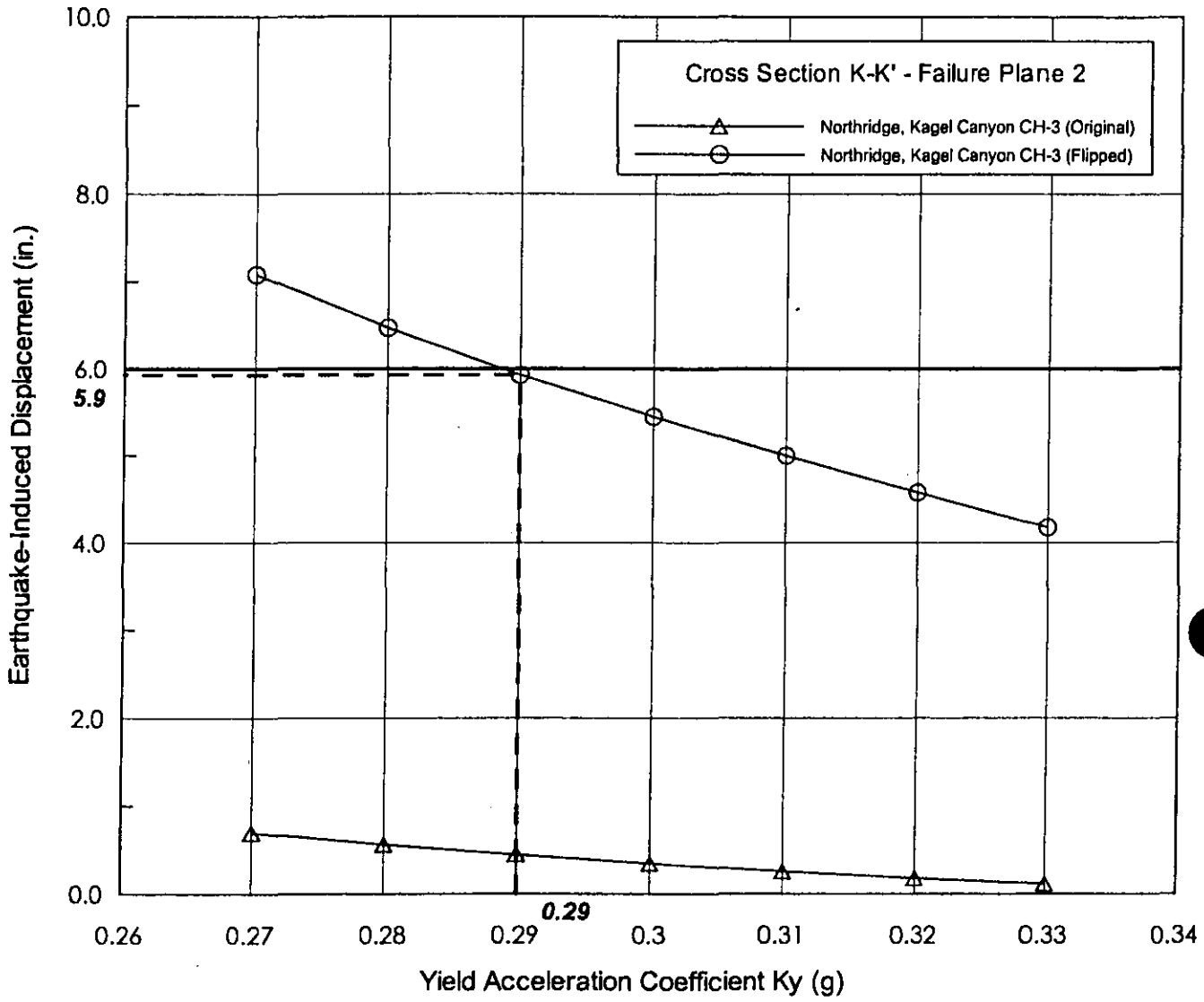
Earthquake-Induced Displacement of Landfill Slope Along Circular Failure Plane vs. Yield Acceleration Coefficient, Ky (g), Cross Section H-H' - Faiure Plane 3

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION H-H' - FAILURE PLANE 3 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 27
	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



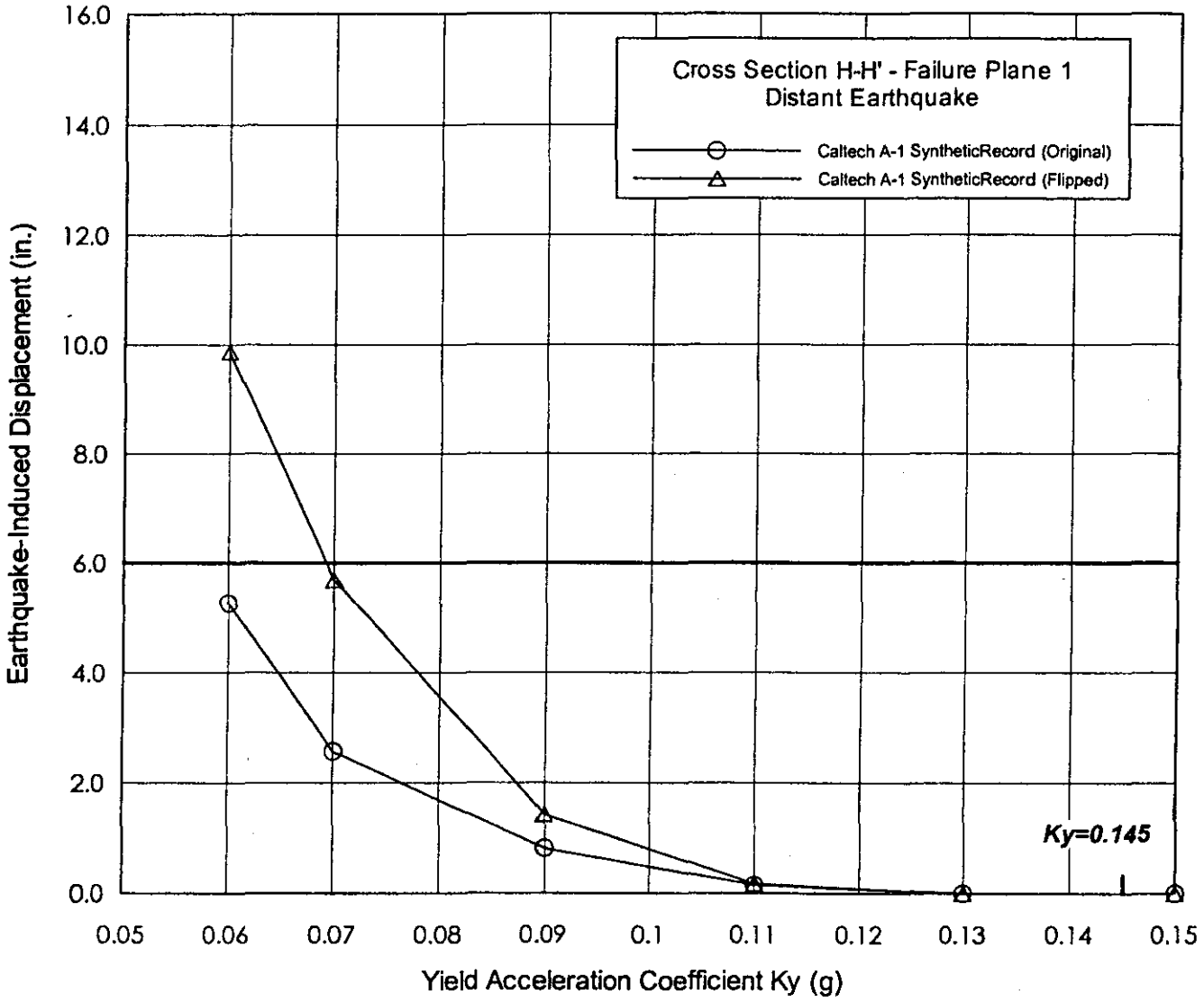
Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section K-K' - Failure Plane 1

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION K-K' - FAILURE PLANE 1 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 28
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



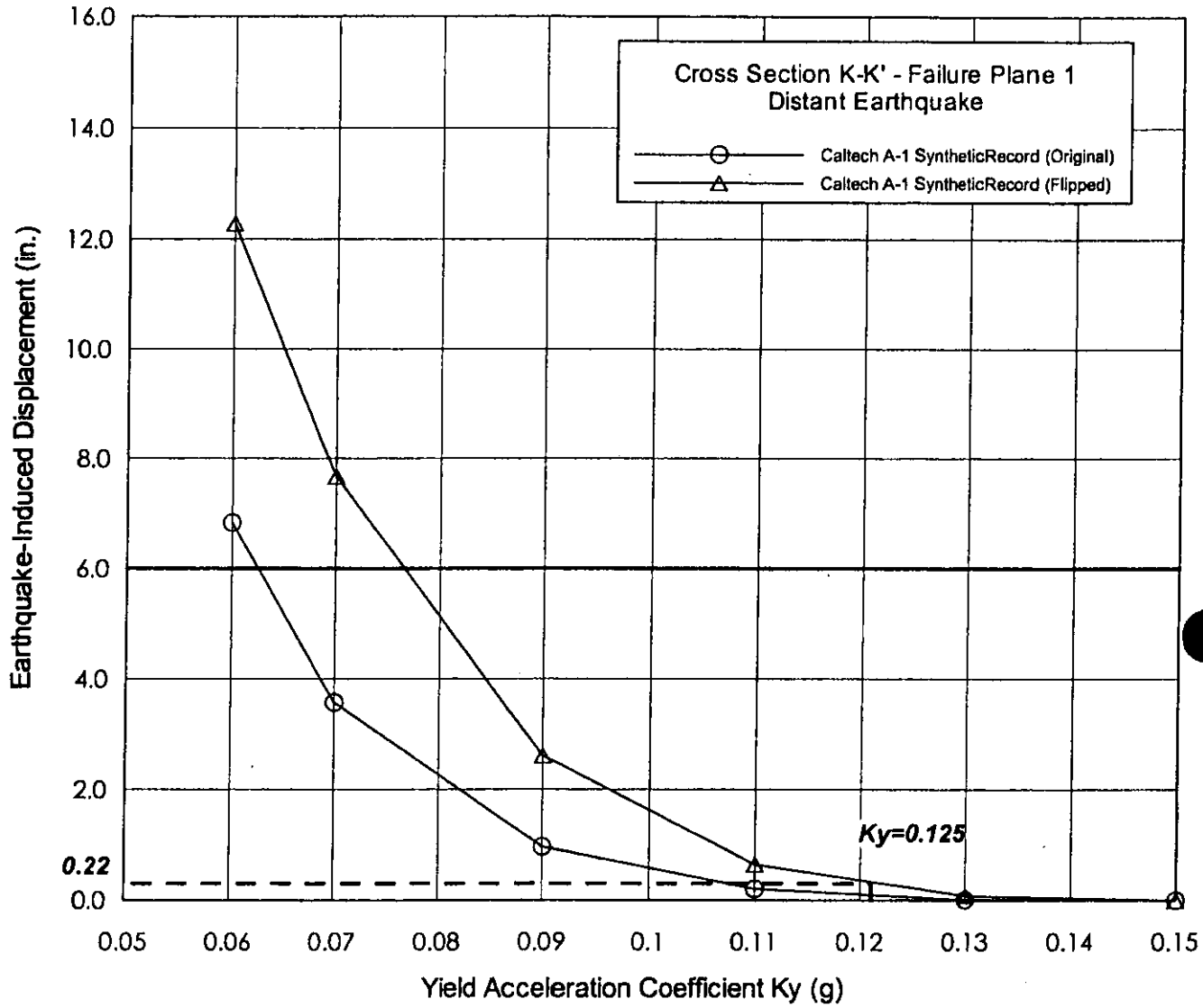
Earthquake-Induced Displacement of Landfill Slope Along Separation Liner vs. Yield Acceleration Coefficient, Ky (g), Cross Section K-K' - Failure Plane 2

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION K-K' - FAILURE PLANE 2 2-D QUAD4M DYNAMIC RESPONSE ANALYSIS	Figure 29
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner
vs. Yield Acceleration Coefficient, Ky (g), Cross Section H-H' - Failure Plane 1
Distant Design Earthquake

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION H-H' - FAILURE PLANE 1 DISTANT DESIGN EARTHQUAKE	Figure 30
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		



Earthquake-Induced Displacement of Landfill Slope Along Bottom Liner
vs. Yield Acceleration Coefficient, Ky (g), Cross Section K-K' - Failure Plane 1
Distant Design Earthquake

Project No. 02-0207	Kettleman Hills Facility- Unit B-19 Kettleman City, Kings County, California	EARTHQUAKE INDUCED DISPLACEMENTS SECTION K-K' - FAILURE PLANE 1 DISTANT DESIGN EARTHQUAKE	Figure 31
HAI	HUSHMAND ASSOCIATES INC. Geotechnical and Earthquake Engineers		

APPENDIX A

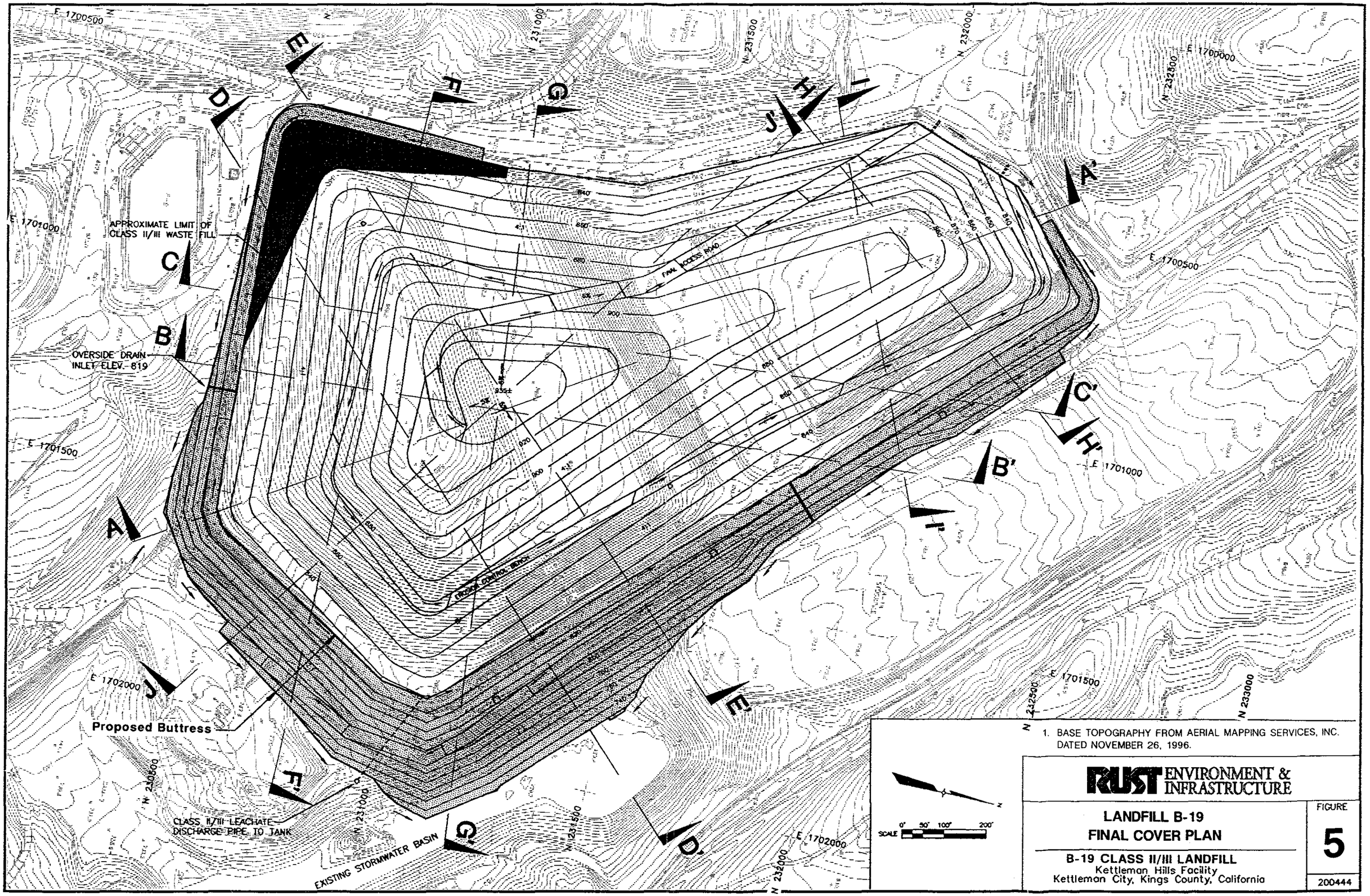
Figures from Rust E&I 1997 Report (Landfill Final Fill Plan, Analysis Cross Sections, Liner Systems, and Design Earthquake Ground Motions)

APPENDIX A

FIGURES FROM RUST E&I 1997 REPORT (LANDFILL FINAL FILL PLAN, ANALYSIS CROSS SECTIONS, LINER SYSTEMS, AND DESIGN EARTHQUAKE GROUND MOTIONS)

A number of figures from the Rust E&I 1997 stability report are presented in this appendix for reference to more clearly illustrate modifications applied to geometry of the B-19 landfill 1997 final fill plan and perimeter stability buttress to arrive at the 2006 revised fill plan and buttress configuration presented and discussed in this report and in the landfill closure plan report prepared by Golder Associates, Inc. (2006). These figures show plan view and cross sections of the 1997 (old) final fill plan geometry (Figures 5, 13, 14, 15, and 16), liner and cover systems used in the 1997 stability analyses (Figures 6, 7, 8, 9, 11, and 12), configuration of the perimeter stability buttress (Figure 10), and information on the design earthquake and selected earthquake ground motions used in the landfill dynamic response analyses (Figures 29 through 33). The only changes applied to the landfill design are those shown in the final fill plan and the buttress geometry (Figures 3, 4, 5, and 6 of this report). Therefore, Figures 5, 10, and 13 thru 16 of the 1997 Rust E&I report are not anymore applicable. However, the 1997 landfill liner and final cover configurations and design earthquake ground motions shown in the rest of figures in Appendix A remain unchanged and are used in the 2006 stability analyses for the new landfill final fill plan geometry.

LANDFILL FINAL FILL PLAN, ANALYSIS CROSS SECTIONS, AND LINER SYSTEMS



1. BASE TOPOGRAPHY FROM AERIAL MAPPING SERVICES, INC. DATED NOVEMBER 26, 1996.

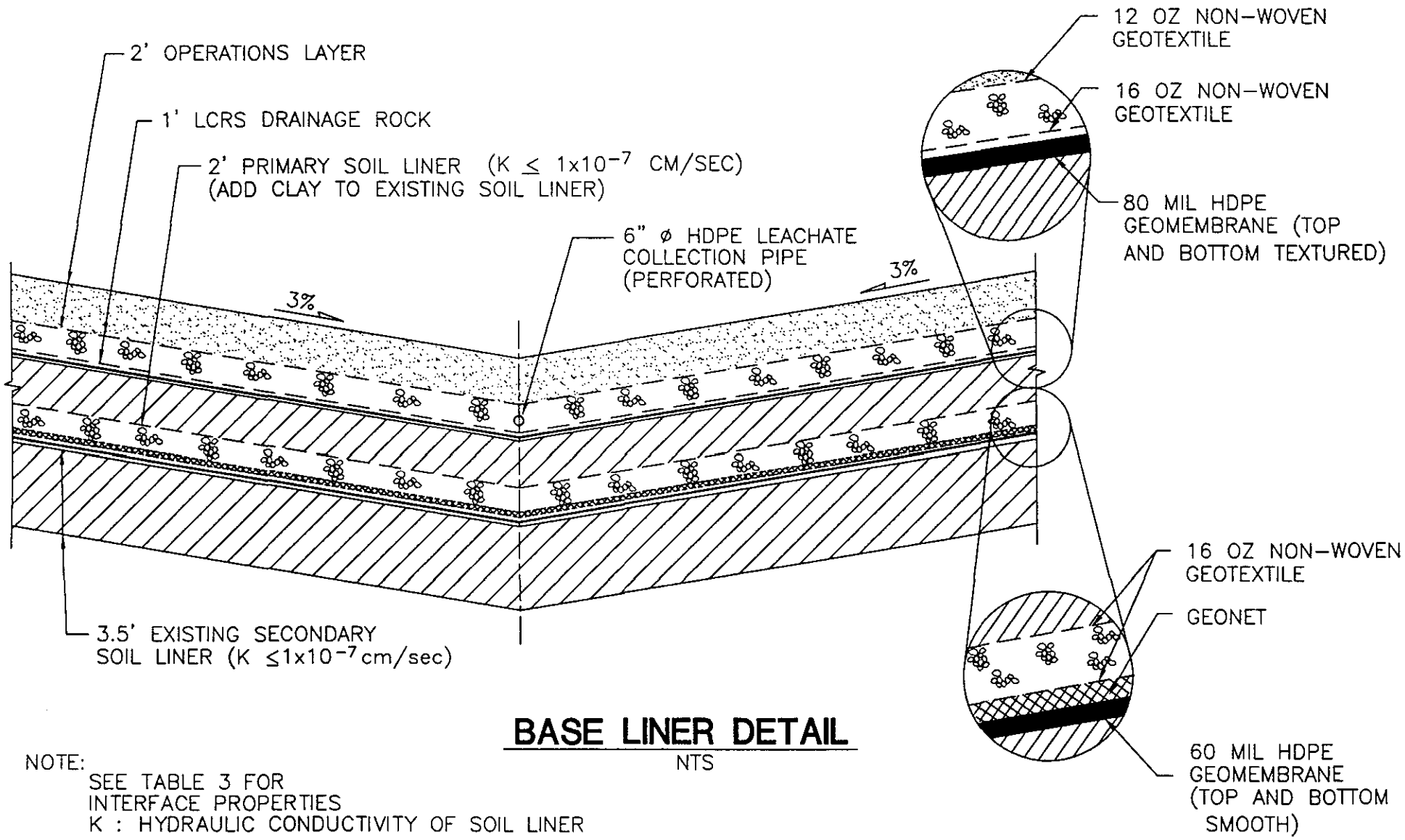
RUST ENVIRONMENT & INFRASTRUCTURE

LANDFILL B-19
FINAL COVER PLAN

B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE
5

200444



BASE LINER DETAIL

NTS

NOTE:
SEE TABLE 3 FOR INTERFACE PROPERTIES
K : HYDRAULIC CONDUCTIVITY OF SOIL LINER

PREPARED BY:

RUST

Rust Environment & Infrastructure Inc.

MODIFIED PHASE IA BOTTOM LINER INTERFACE DETAILS

(INTERFACE 1)

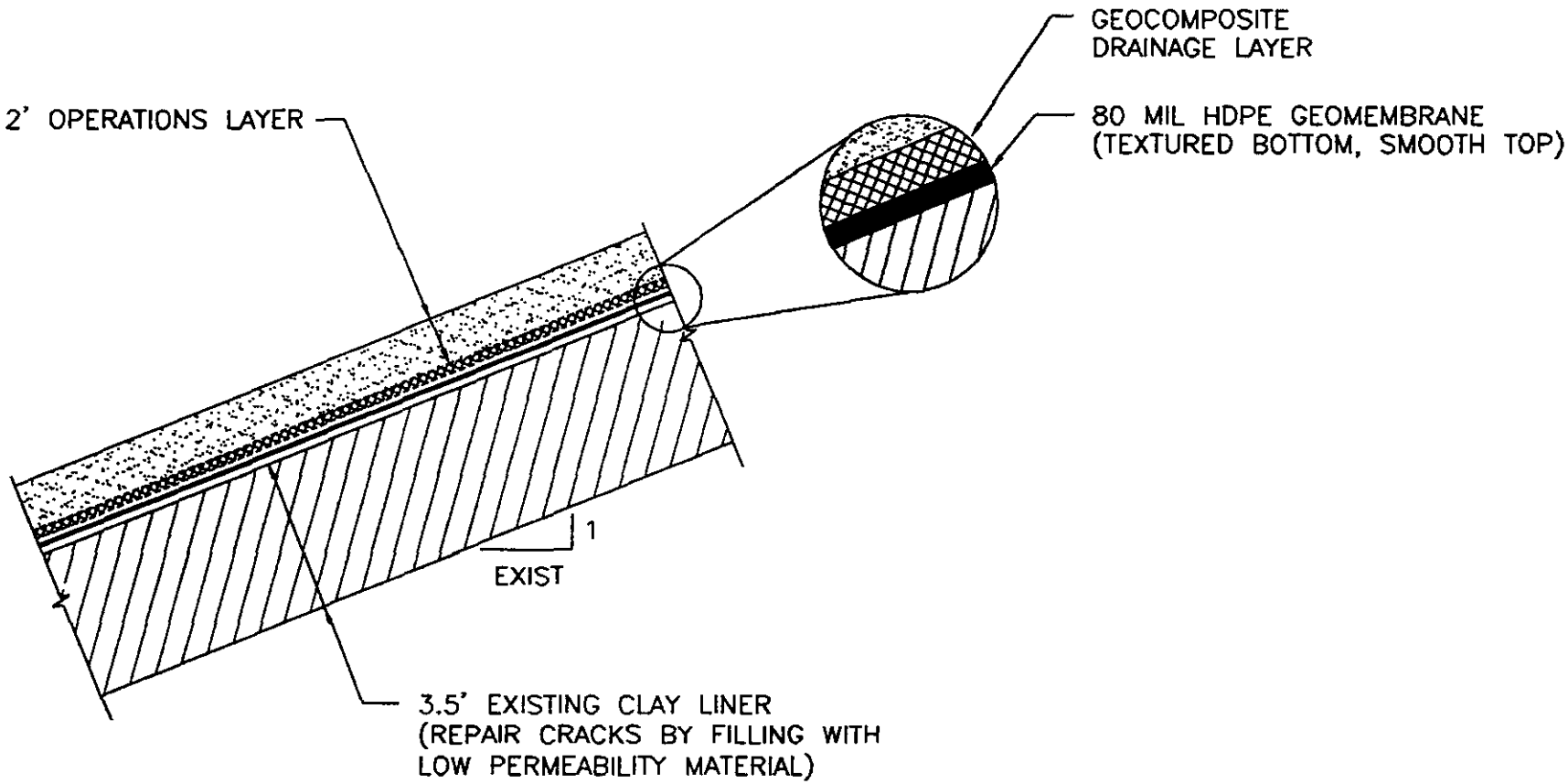
B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE

6

200444

G:\USR3\PROJECT\KETTLEMAN\DETAILS.DWG



SIDESLOPE LINER

NTS

NOTE:
SEE TABLE 3 FOR
INTERFACE PROPERTIES

PREPARED BY:

RUST

Rust Environment & Infrastructure Inc.

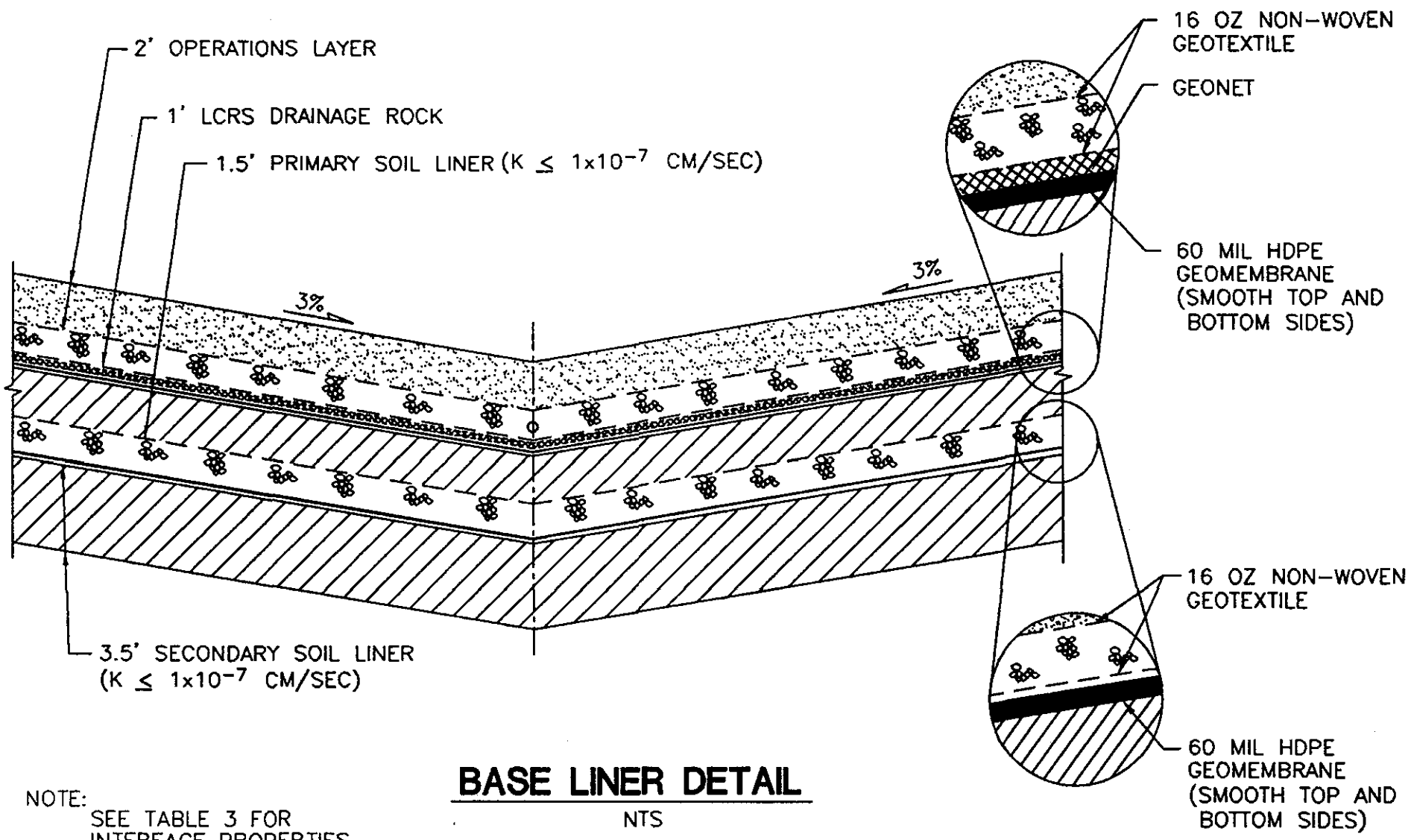
MODIFIED PHASE IA SIDESLOPE LINER INTERFACE DETAILS
(INTERFACE 2)

B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
ttleman City, Kings County, California

FIGURE
7

0444

G:\USR3\PROJECT\KETTLEMAN\DETAILS.DWG



BASE LINER DETAIL

NTS

NOTE:
SEE TABLE 3 FOR INTERFACE PROPERTIES

PREPARED BY:

RUST

Rust Environment & Infrastructure Inc.

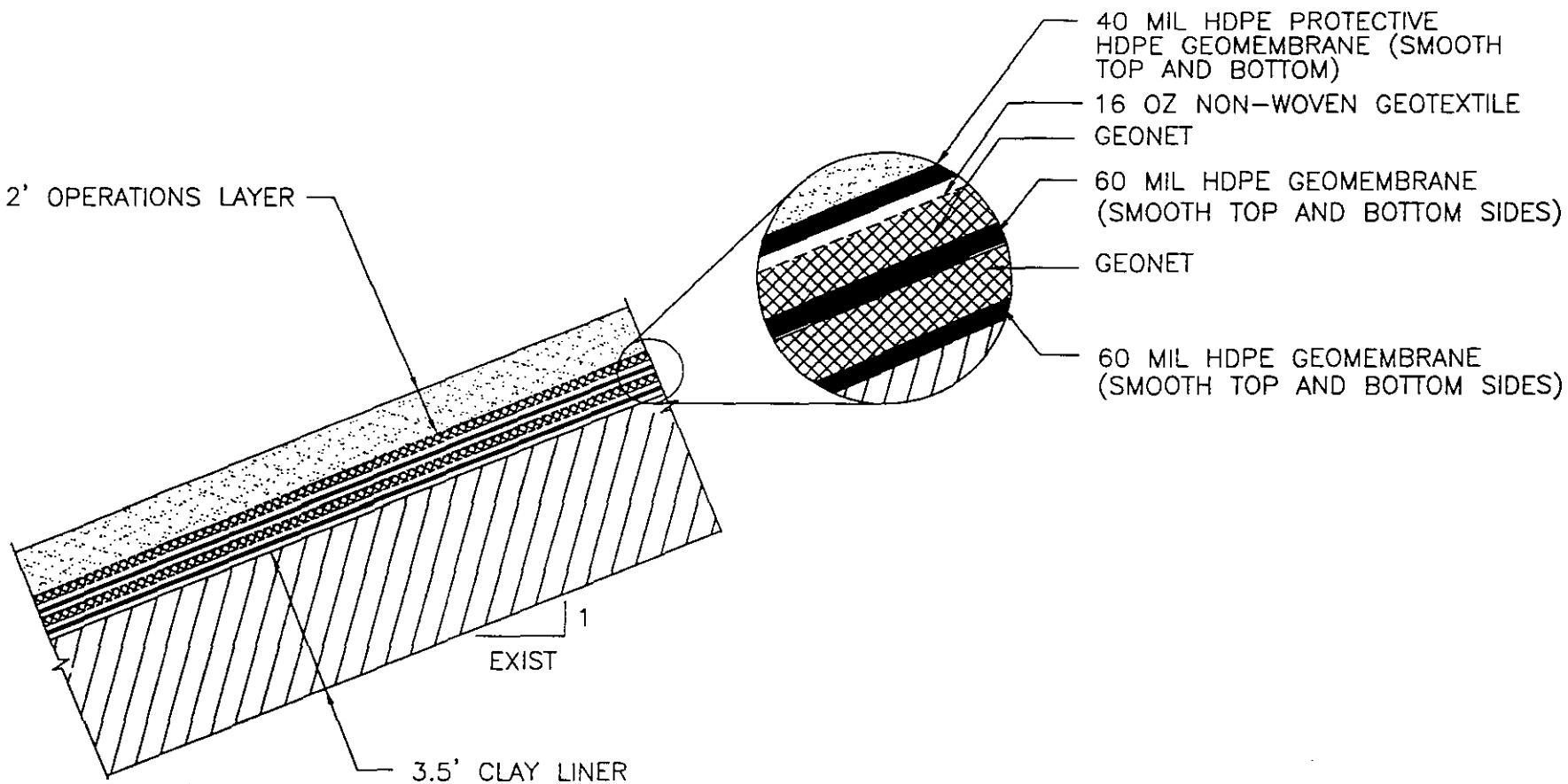
EXISTING PHASE IB BOTTOM LINER INTERFACE DETAILS
(INTERFACE 3)

B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE
8

200444

G:\USR3\PROJECT\KETTLEMAN\DETAILS.DWG



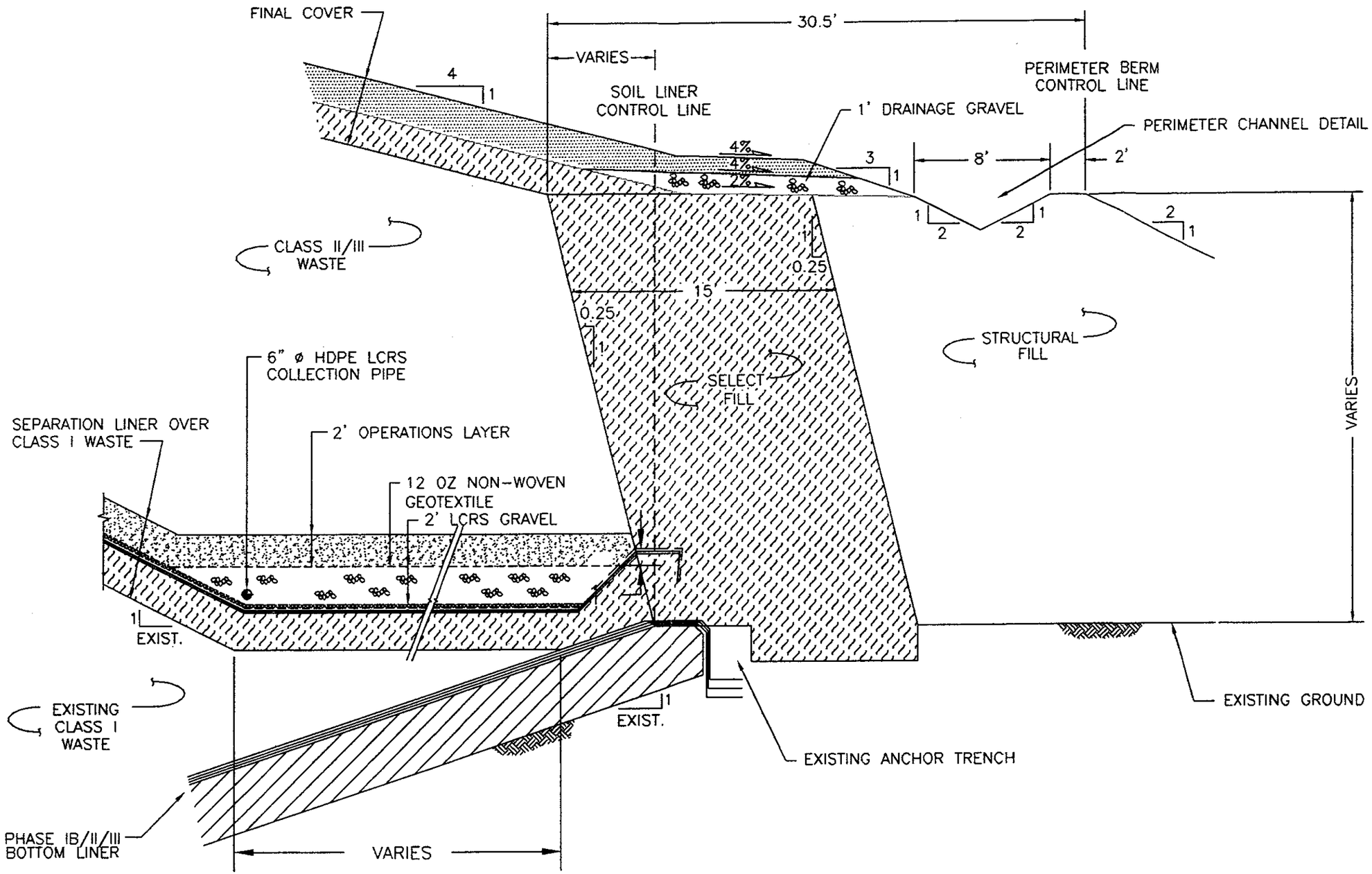
SIDESLOPE LINER

NTS

NOTE:
SEE TABLE 3 FOR INTERFACE PROPERTIES

PREPARED BY:	EXISTING PHASE IB/II/III SIDESLOPE LINER INTERFACE DETAILS (INTERFACE 4)	FIGURE
RUST Rust Environment & Infrastructure Inc.	B-19 CLASS II/III LANDFILL Kettleman Hills Facility Kettleman City, Kings County, California	9 200444

G:\USR3\PROJECT\KETTLEMAN\DETAILS.DWG



PERIMETER BERM DETAIL

NTS

NOTE:
SEE TABLE 3 FOR INTERFACE PROPERTIES

PREPARED BY:

RUST

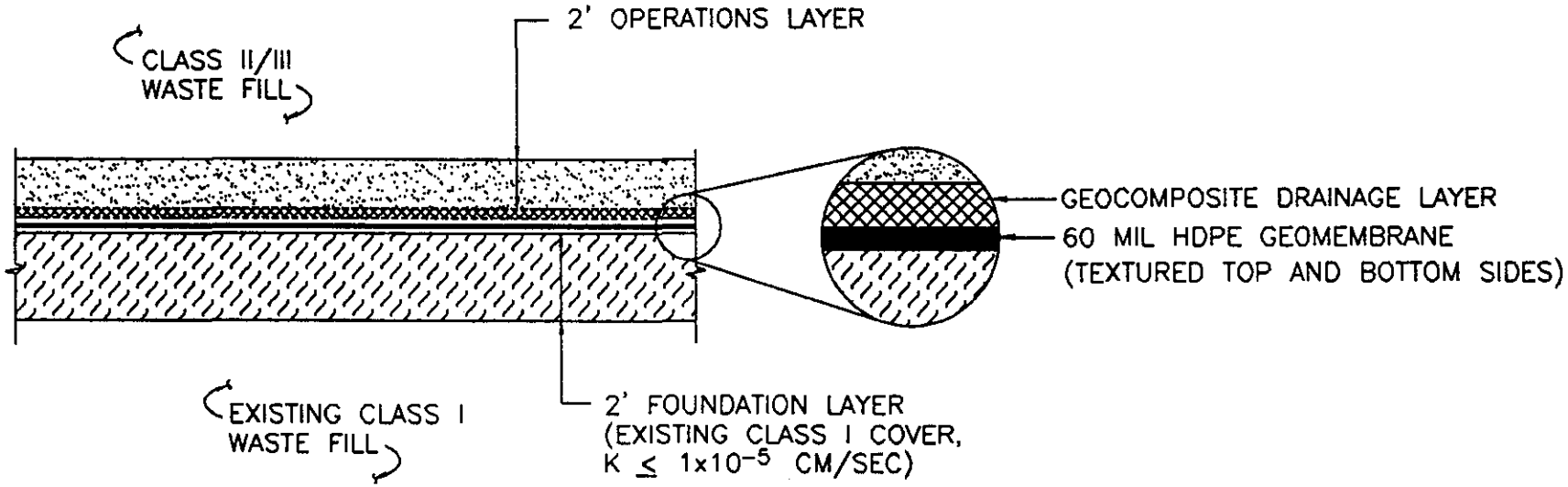
Rust Environment & Infrastructure Inc.

PROPOSED PHASE IB/II/III PERIMETER BERM DETAILS
(INTERFACE 5)

B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE
10

200444



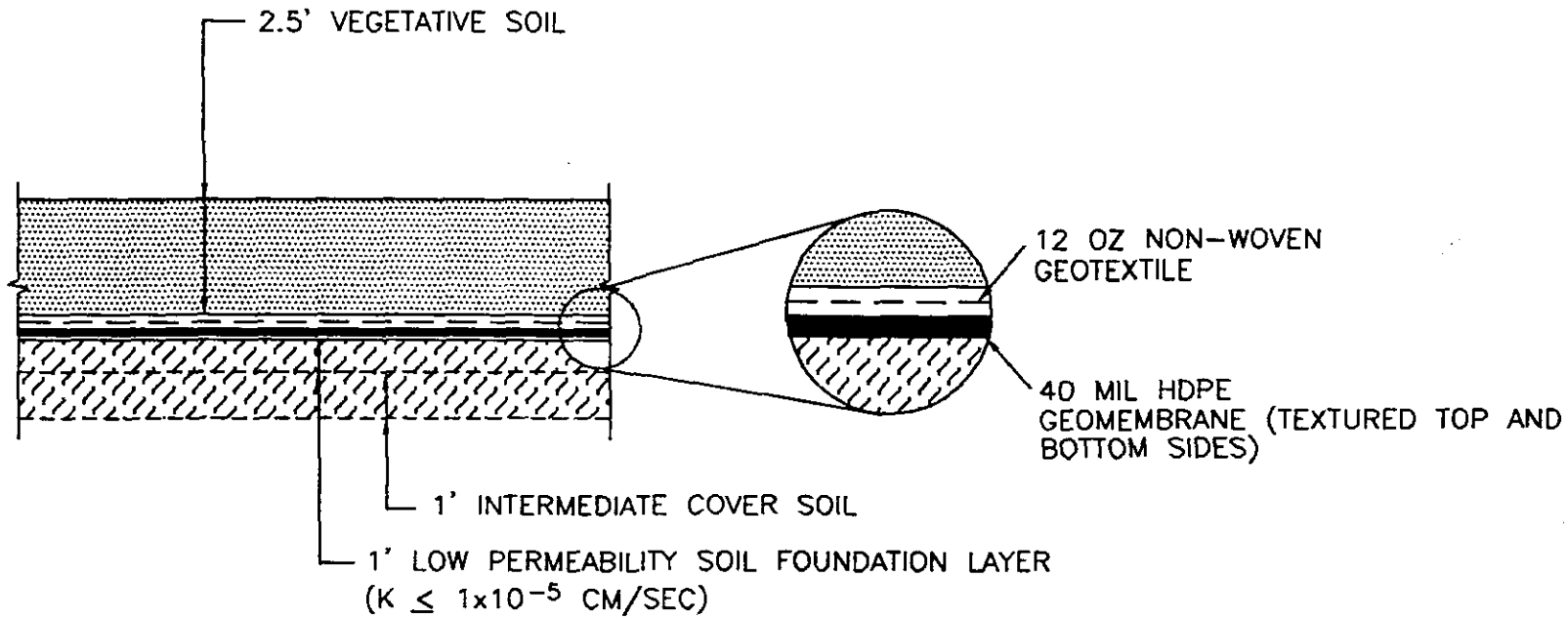
SEPARATION LINER OVER CLASS I WASTE

NTS

NOTE:
SEE TABLE 3 FOR INTERFACE PROPERTIES

PREPARED BY:	PROPOSED PHASE IB/II/III-HW/MSW SEPARATION LINER INTERFACE DETAILS (INTERFACE 6)	FIGURE
RUST Rust Environment & Infrastructure Inc.	B-19 CLASS II/III LANDFILL Kettleman Hills Facility Kettleman City, Kings County, California	11 200444

G:\USR2\PROJECTS\KETTLEMAN\DETAILS.DWG



FINAL COVER

NTS

NOTE:
SEE TABLE 3 FOR
INTERFACE PROPERTIES

PREPARED BY:

RUST

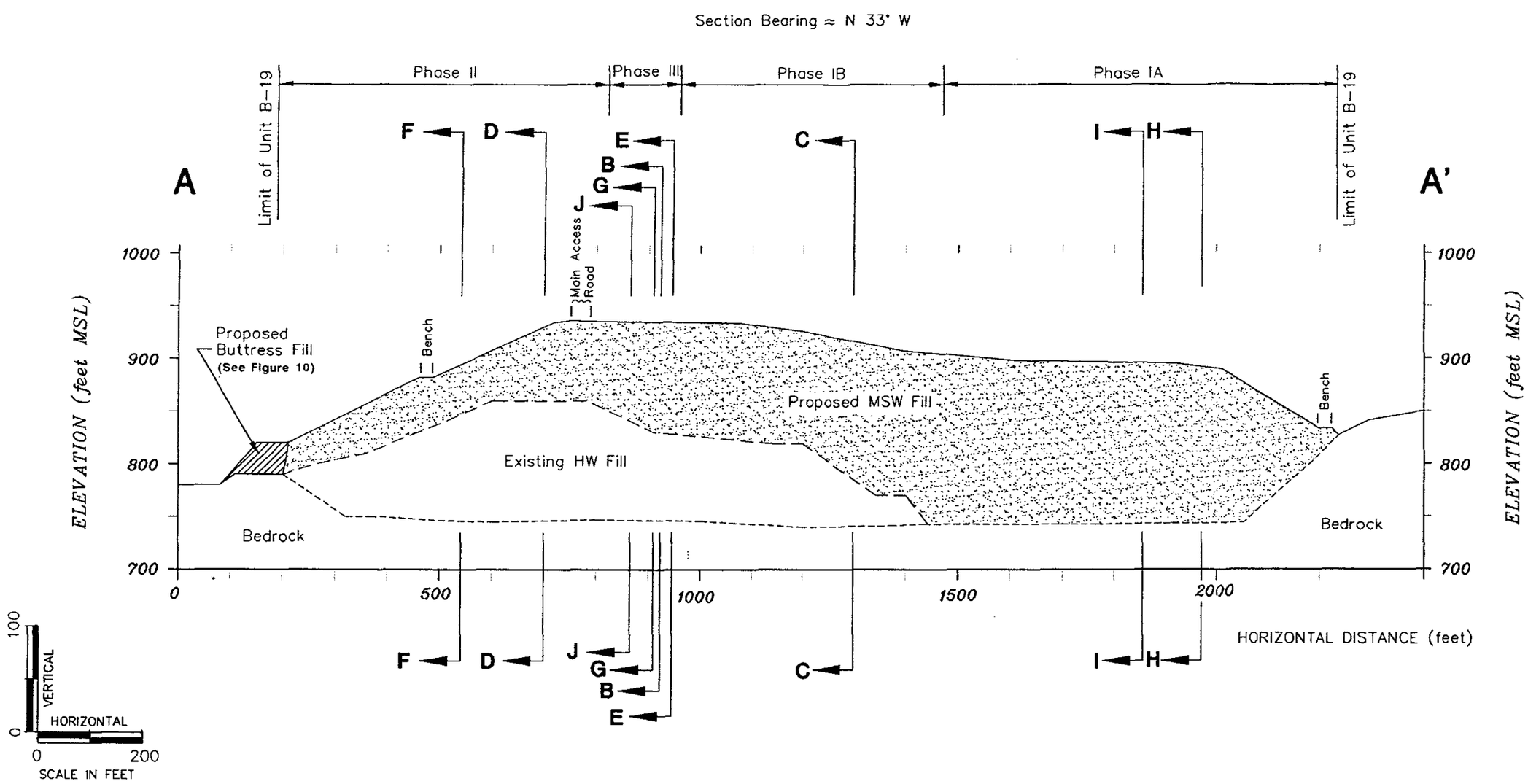
Rust Environment & Infrastructure Inc.

PROPOSED FINAL CLOSURE COVER INTERFACE DETAILS
(INTERFACE 7)

B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE
12

G:\USR3\PROJECT\KETTLEMAN\DETAILS.DWG



LEGEND

- - - - - - Proposed Separation Liner (see Figure 11)

——— Proposed Final Cover (See Figure 12)

- - - - - - - - Existing/Modified Bottom and Sideslope Liner (See Figures 6 to 9)

REFERENCES:

- Golder Associates, "Existing Landfill B-19 Base Contours and Surrounding Topography". Drawing No. 2, Rev. 0, Dated 4/15/91
- RUST E&I, CWMI Kettleman Hills Facility, B-19 Class II/III Landfill, dated August 1997.

PREPARED BY:

RUST

Rust Environment & Infrastructure Inc.

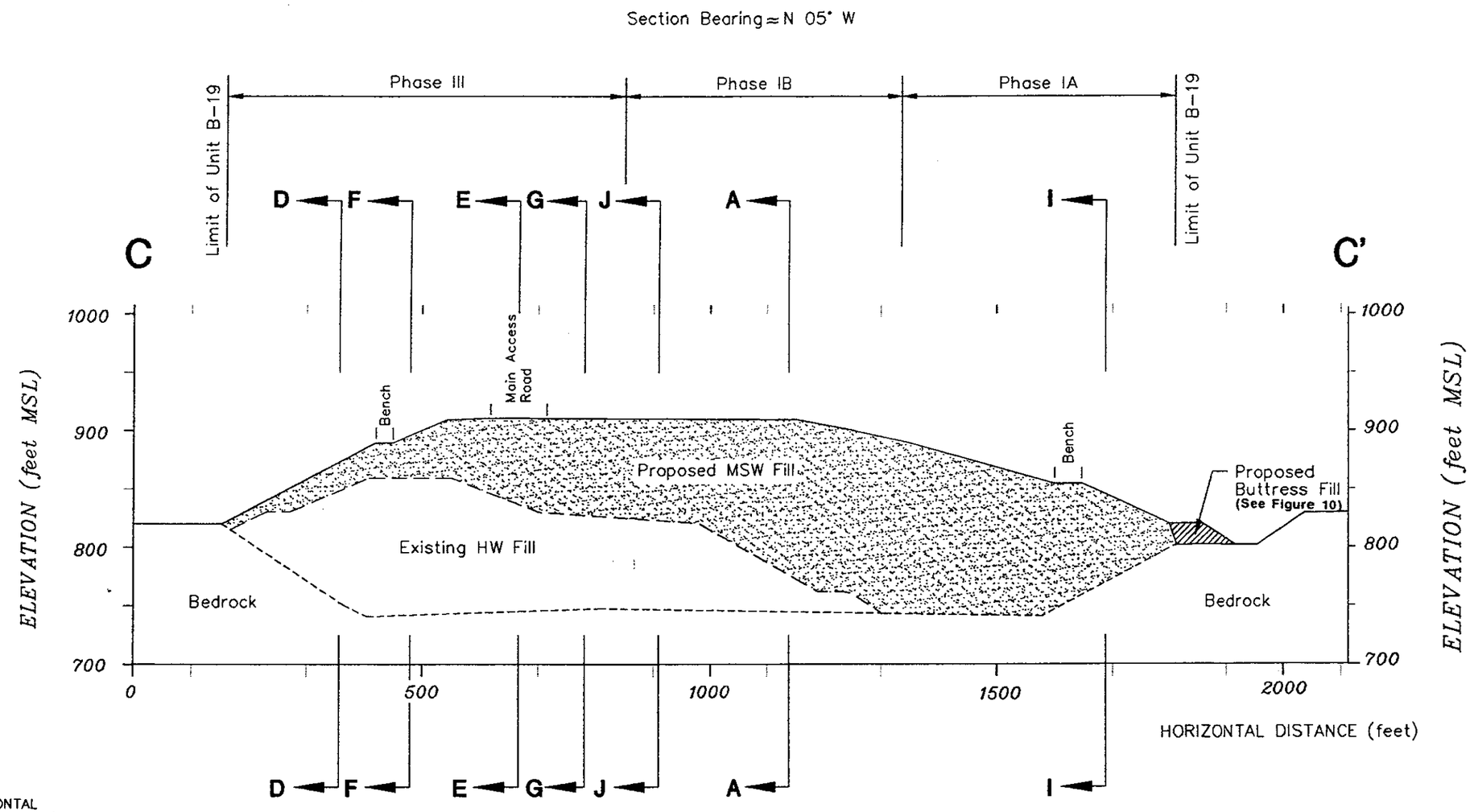
CROSS SECTION A-A'

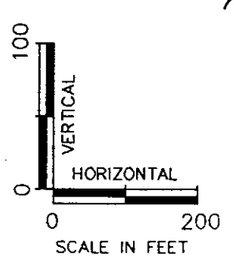
B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE

13

200444





LEGEND

- - - - - - Proposed Separation Liner (see Figure 11)
——— Proposed Final Cover (See Figure 12)
- - - - - - - - Existing/Modified Bottom and Sideslope Liner (See Figures 6 to 9)

REFERENCES:
- Golder Associates, "Existing Landfill B-19 Base Contours and Surrounding Topography". Drawing No. 2, Rev. 0, Dated 4/15/91
- RUST E&I, CWMI Kettleman Hills Facility, B-19 Class II/III Landfill, dated August 1997.

PREPARED BY:

RUST

Rust Environment & Infrastructure Inc.

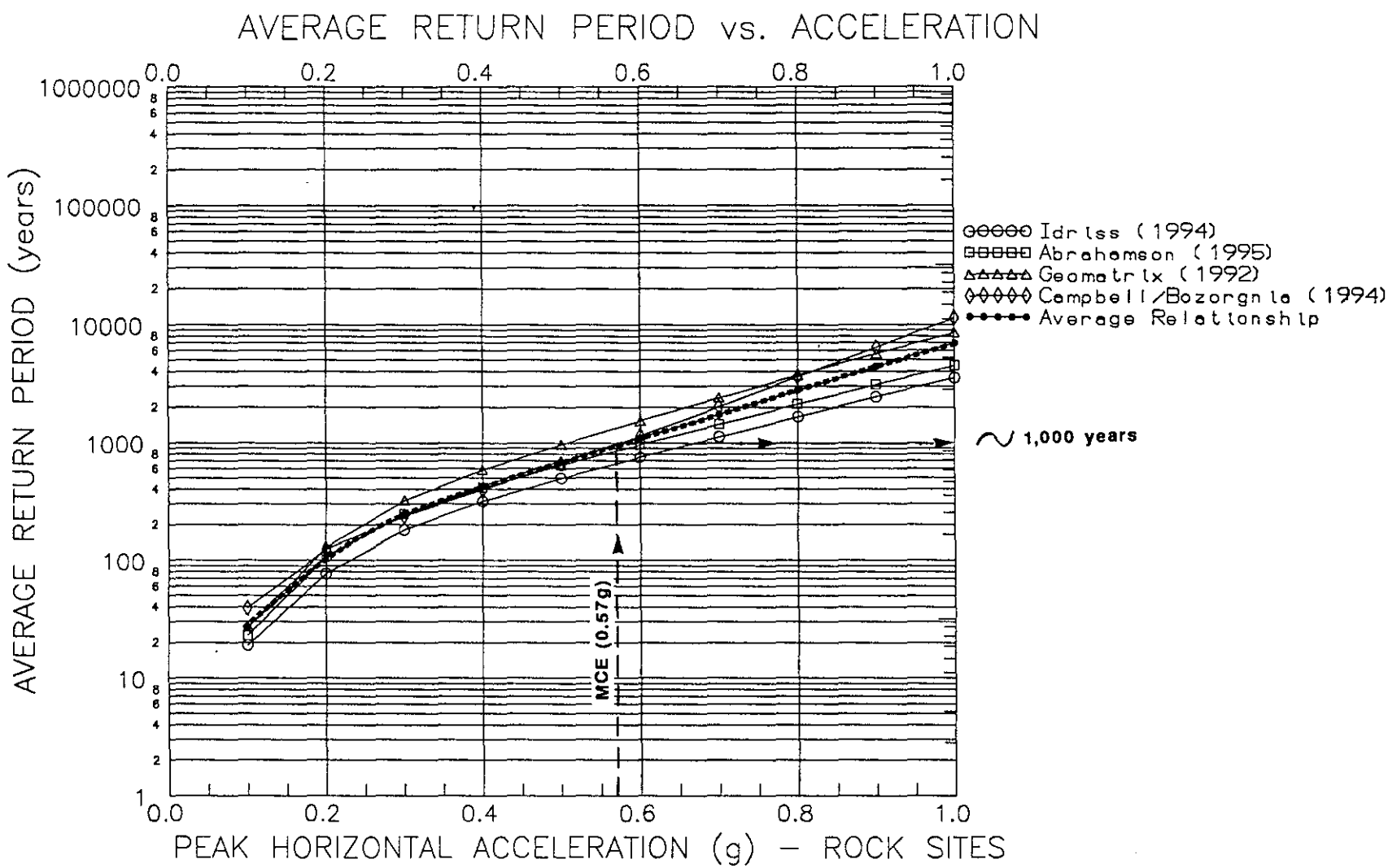
CROSS SECTION C-C'

B-19 CLASS II/III LANDFILL
Kettleman Hills Facility
Kettleman City, Kings County, California

FIGURE
15

200444

EARTHQUAKE DESIGN GROUND MOTIONS



Seismic Hazard Evaluation, Landfill Unit B–19, Kettleman Hills Facility

Attenuation relations for blind thrust faults and rock sites.

PREPARED BY:

RUST ENVIRONMENT & INFRASTRUCTURE

PEAK HORIZONTAL ACCELERATION IN ROCK VERSUS AVERAGE RETURN PERIOD

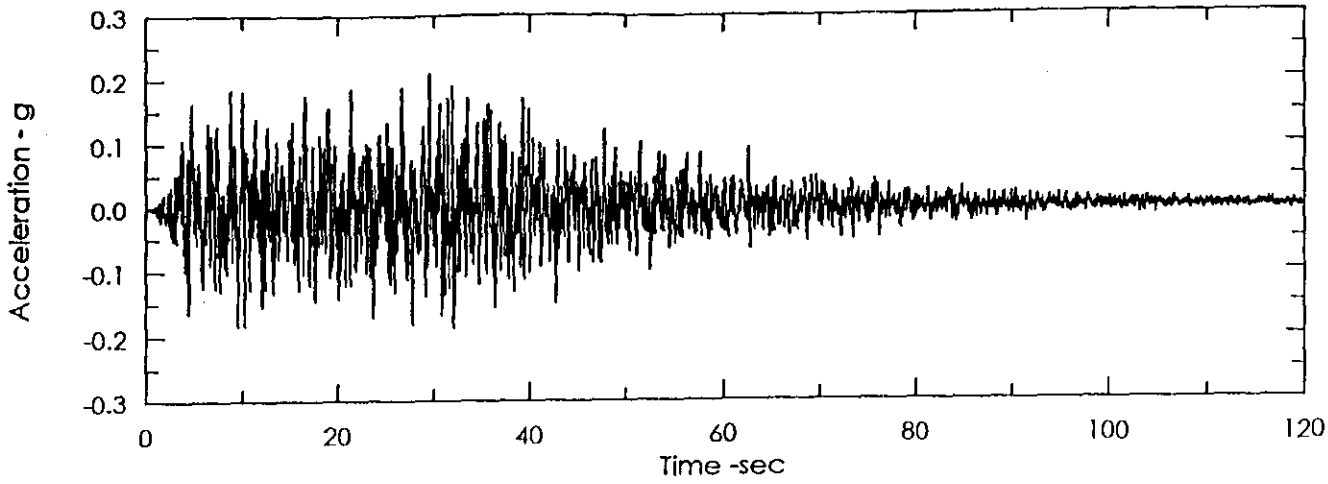
B-19 CLASS II/III LANDFILL

KETTLEMAN HILLS FACILITY
KINGS COUNTY, CALIFORNIA

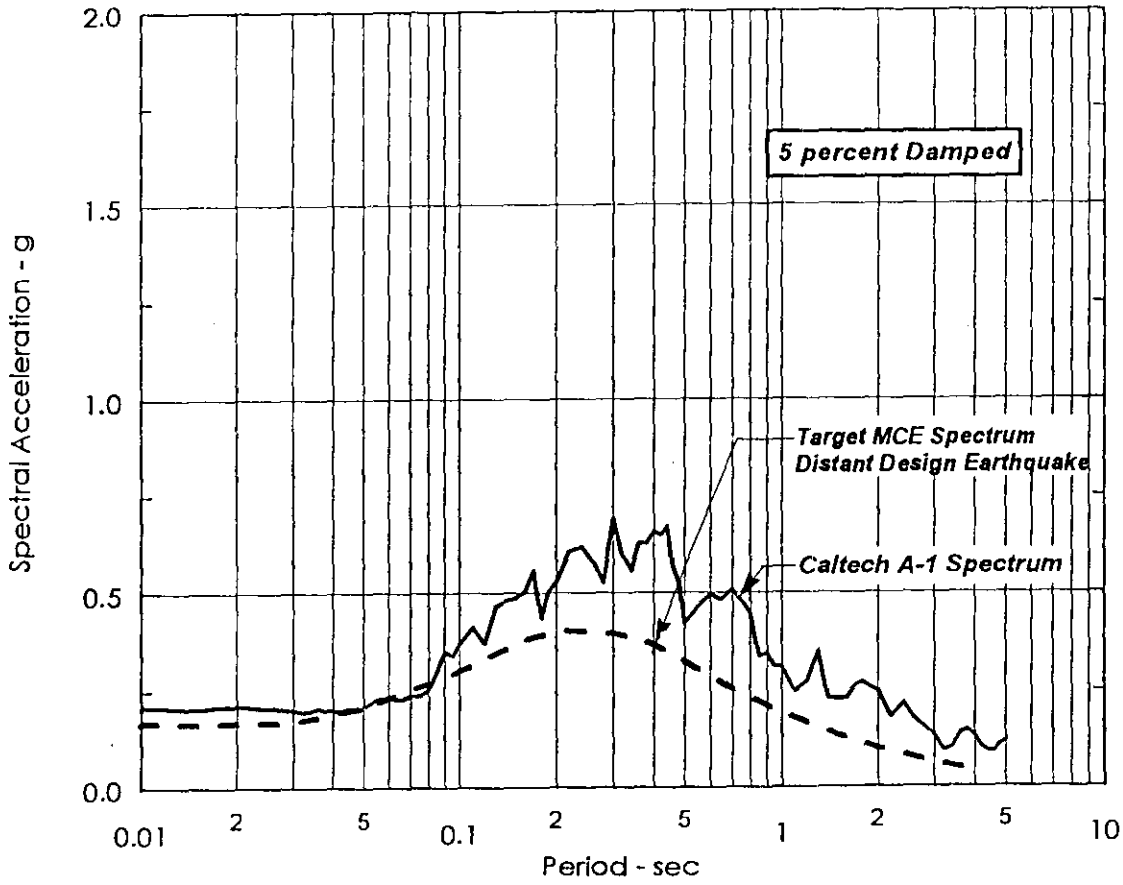
FIGURE

29

200444

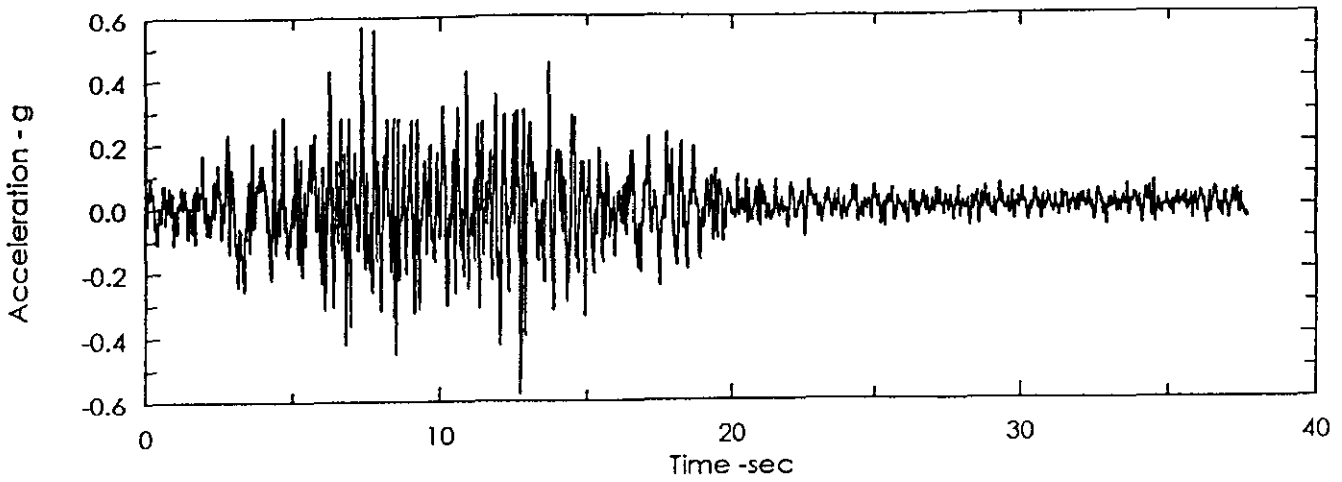


(a) Caltech A-1 Synthetic Record Scaled to 0.21g Peak Acceleration

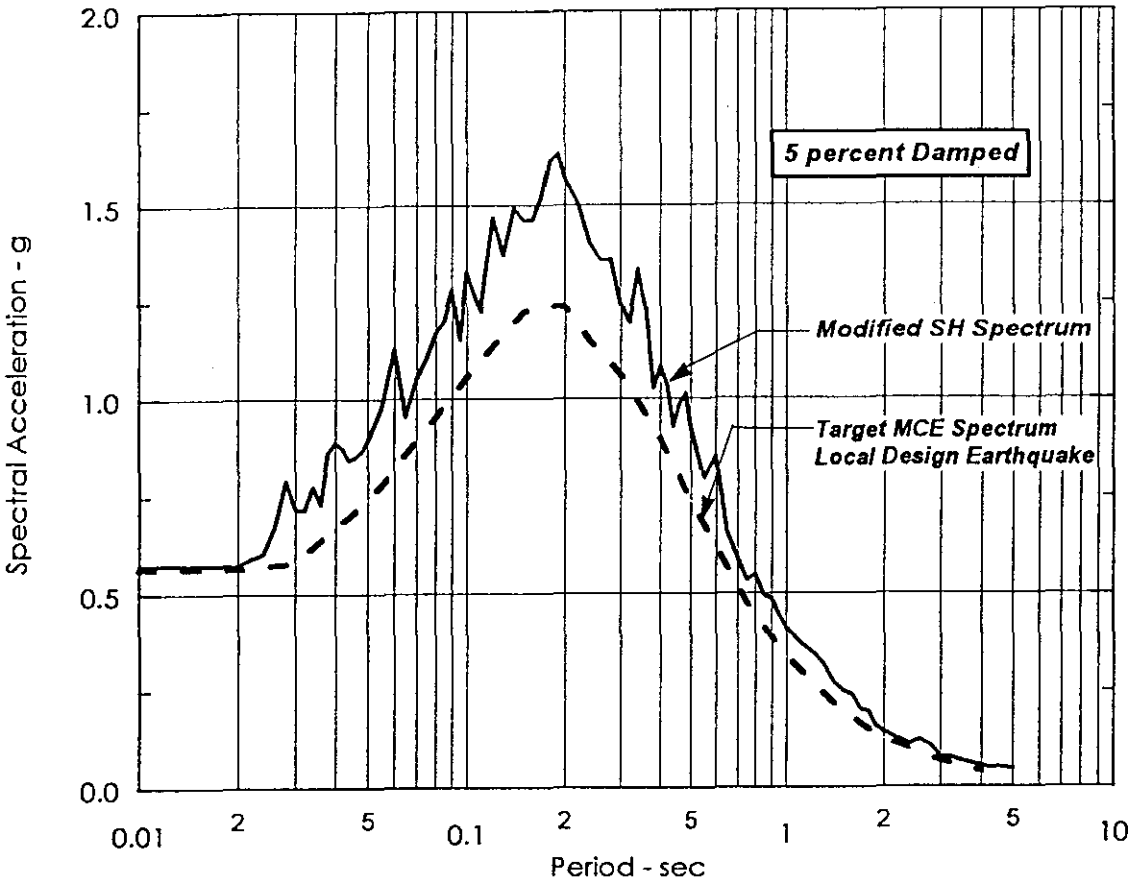


(b) Comparison of Pseudo-Acceleration Response Spectrum of Caltech A-1 Synthetic Earthquake Record and Target Design Spectrum (Peak Acceleration Scaled to 0.21g)

PREPARED BY: RUST ENVIRONMENT & INFRASTRUCTURE	CALTECH A-1 SYNTHETIC ACCELERATION RECORD AND DYNAMIC RESPONSE SPECTRUM - DISTANT DESIGN EARTHQUAKE - B-19 CLASS II/III LANDFILL Kettleman Hills Facility Kettleman City, Kings County, California	FIGURE 30 200444



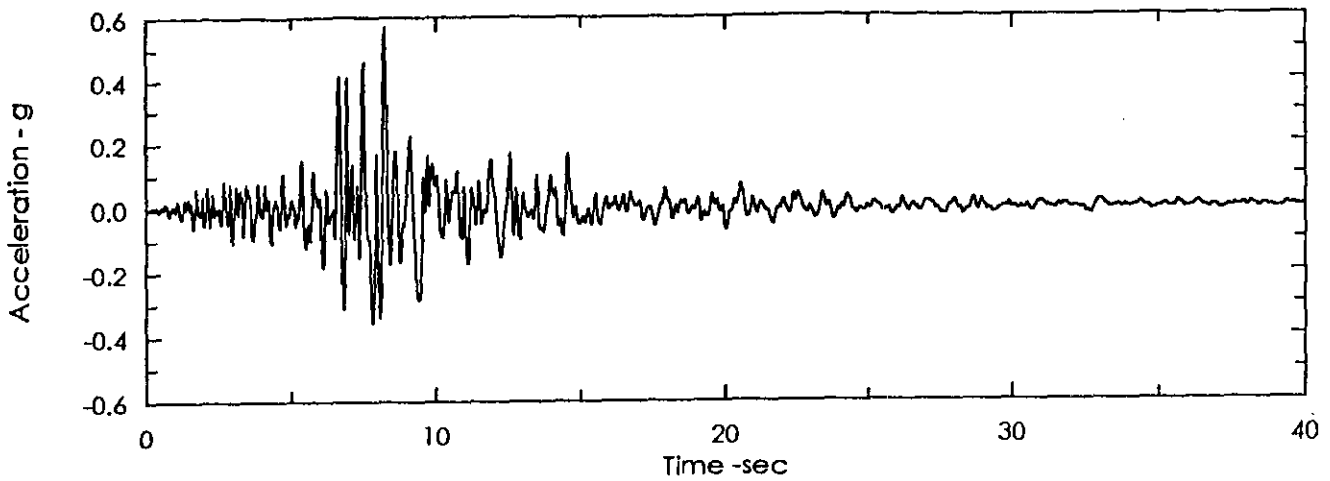
(a) Modified Seed-Hayward Synthetic Record Scaled to 0.57g Peak Acceleration



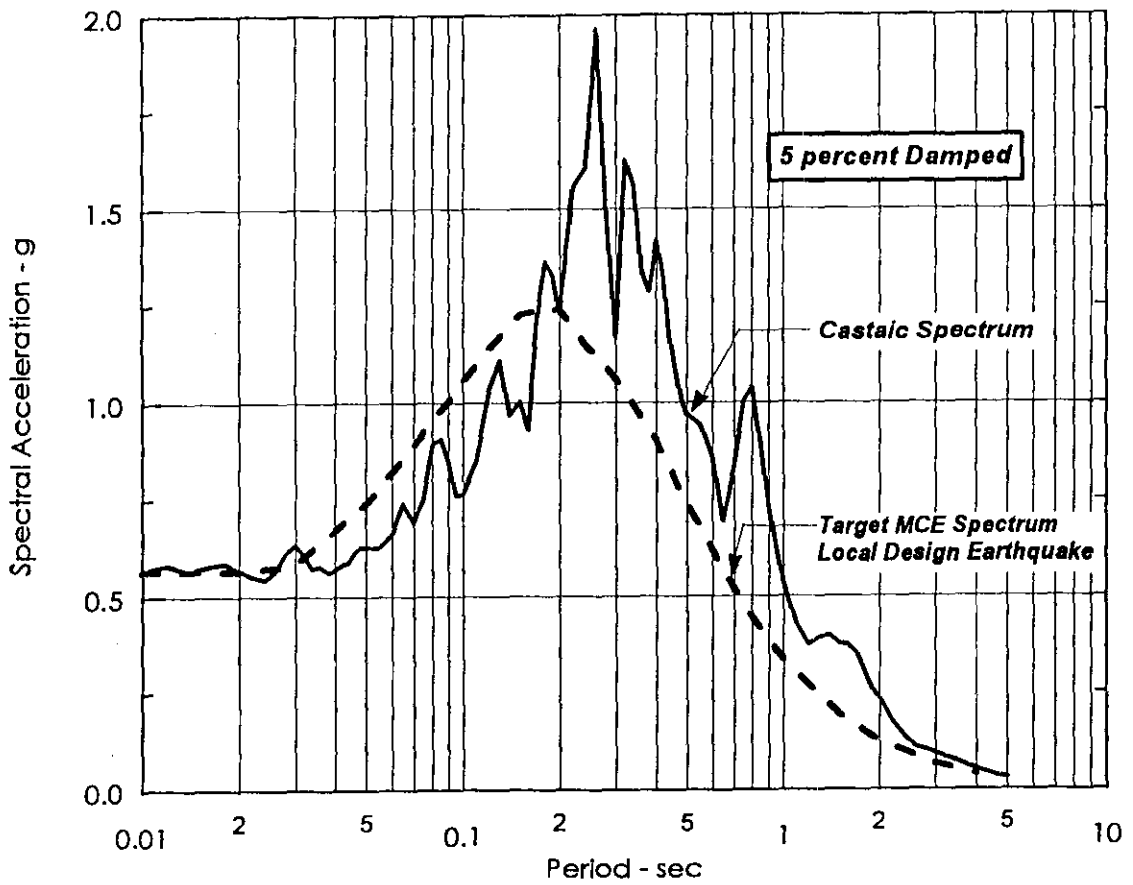
(b) Comparison of Pseudo-Acceleration Response Spectrum of the Modified Seed-Hayward Synthetic Earthquake Accelerogram and Target Design Spectrum (Peak Acceleration of Synthetic Record Scaled to 0.57g)

PREPARED BY:	MODIFIED SEED-HAYWARD SYNTHETIC ACCELERATION RECORD AND DYNAMIC RESPONSE SPECTRUM SCALED TO TARGET MCE RESPONSE SPECTRUM - LOCAL DESIGN EARTHQUAKE - B-19 CLASS II/III LANDFILL Kettleman Hills Facility Kettleman City, Kings County, California	FIGURE 31 200444

RUST ENVIRONMENT & INFRASTRUCTURE

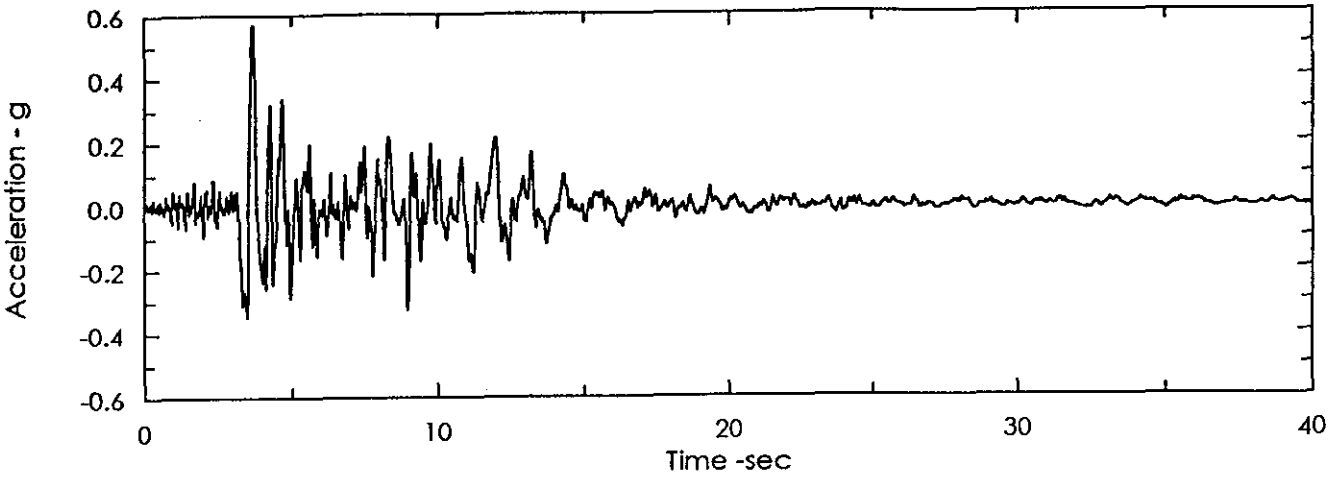


(a) Northridge Castaic Old Ridge Route CH 1 Record Scaled to 0.57g Peak Acceleration

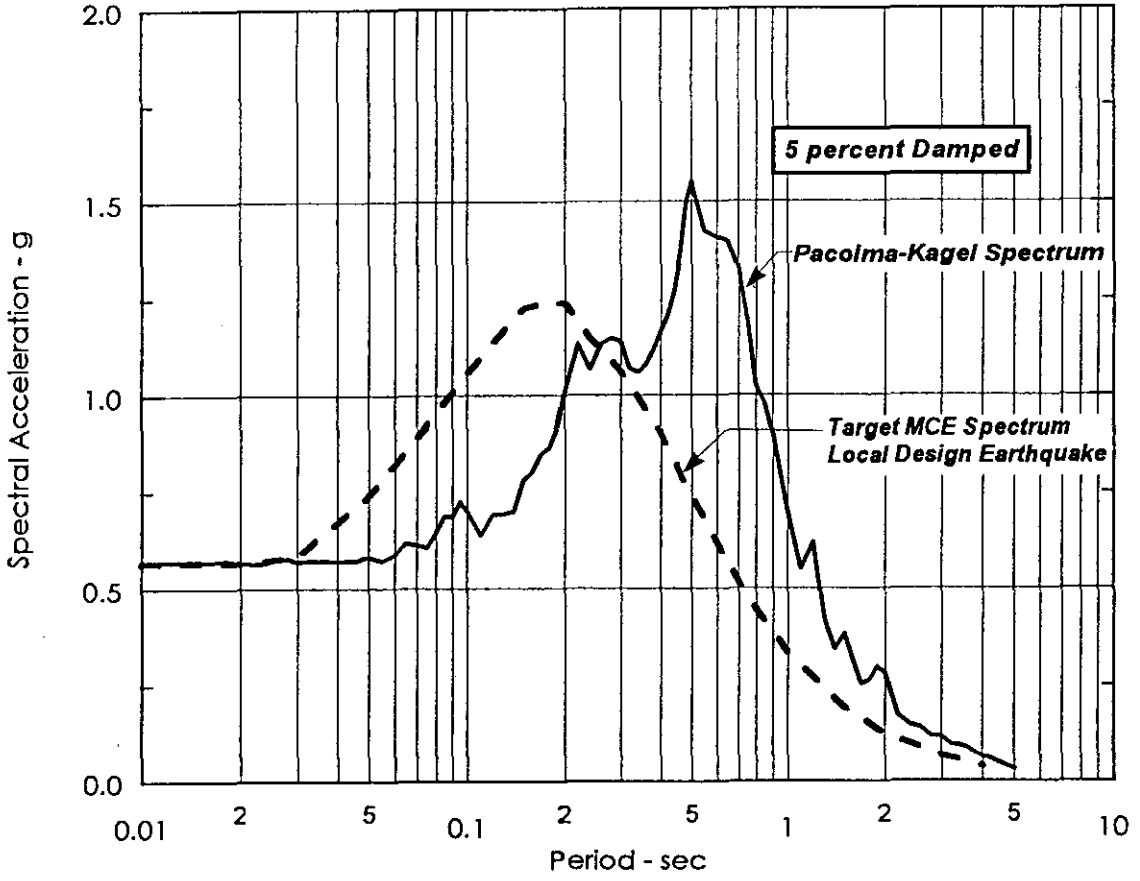


(b) Comparison of Pseudo-Acceleration Response Spectrum of M6.7 January 17, 1994 Northridge Earthquake Castaic - Old Ridge Route, CHN 1:90 DEG Record and Target Design Spectrum (Peak Acceleration Scaled to 0.57g)

PREPARED BY:		FIGURE
RUST ENVIRONMENT & INFRASTRUCTURE	**CASTAIC ACCELERATION RECORD AND DYNAMIC RESPONSE SPECTRUM - LOCAL DESIGN EARTHQUAKE -** **B-19 CLASS II/III LANDFILL** Kettleman Hills Facility Kettleman City, Kings County, California	**32** 200444



(a) Northridge Pacoima - Kagel Canyon CH 3 Record Scaled to 0.57g Peak Acceleration



(b) Comparison of Pseudo-Acceleration Response Spectrum of M6.7 January 17, 1994 Northridge Earthquake Pacoima - Kagel Canyon, CHN 3:360 DEG Record and Target Design Spectrum (Peak Acceleration Scaled to 0.57g)

PREPARED BY:	PACOIMA-KAGEL CANYON ACCELERATION RECORD AND DYNAMIC RESPONSE SPECTRUM - LOCAL DESIGN EARTHQUAKE - B-19 CLASS II/III LANDFILL Kettleman Hills Facility Kettleman City, Kings County, California	FIGURE 33 200444
RUST ENVIRONMENT & INFRASTRUCTURE		

3

Available Material and Interface Properties used for Selection of Design Parameters

Inter-face no.	Liner cross-section	Existing/ Proposed	Thickness	Unit Weight (pcf)	Shear Strength Friction (degrees)	Shear Strength Cohesion (psf)	Remarks	Reference
	Waste Fill							
HW	Class I Waste/ Operations Layer			115	31	0	Deep Slip Surfaces	GAI (1989, 1991), ESI (1993)
					27	300	Shallow Slip Surfaces	GAI (1989, 1991), ESI (1993)
MSW	Class II / III Waste			85	33	100	Deep Slip Surfaces	Kavazanjian et al, 1995
					0	500	Shallow Slip Surfaces	Kavazanjian et al, 1995
	Bedrock Subgrade							
	Claystone/Siltstone/Sandstone - Cross-Bedding Peak Shear Strength			130	40	600	DS tests	D&A (WA, 1988/89), ESI (1990)
	Claystone/Siltstone/Sandstone - Along-Bedding Peak Shear Strength			130	36	0	DS and TxUU tests	D&A (WA, 1988), ESI (1990)
	Engineered Fill Soils							
	Structural Fill (eg. compacted materials from desintegrated bedrock)			125	30	2,000	TxUU	ESI (1990)
					31	500		EMCON (1989?)
					26	600		D&A (1988)
					33	0	Berm materials, saturated DS tests	WA (1989)
					39	410	Berm materials, natural moisture,DS tests	
	Compacted Clay Liner (short term or low confining stress)			125	0	3,600	TxUU	ESI (1990)
					0	2,200		SMS (1988)
					0	1,300	1300 psf (peak), 600 psf (residual)	GAI (1988)
	Compacted Clay Liner (long term)			125	20	1,150	Tx-CU tests, compacted disintegrated claystone	ESI (1990)
	Vegetative Soil Cover			120	26	40	Assumed medium-dense clayey sand	ESI (1990)
1	**Phase IA Bottom Liner Interfaces**							
	Class II/III Waste	P						
	Operations Soil Layer	P	2 feet					
				—	31	0	Deep Slip Surfaces	GAI (1989, 1991), ESI (1993)
				—	27	300	Shallow Slip Surfaces	GAI (1989, 1991), ESI (1993)
	Geotextile Filter (12 oz/sy spunbond nonwoven Trevira 1142 (NSC))	P	165 mils					
				—	25	0		REI, Koerner (1994)
				—	> 14	0	Assumed higher than geotextile/clay	ESI (1993)
	Primary LCRS Granular Layer	P	1 foot					
				—	25	0		REI, Koerner (1994)
				—	> 14	0	Assumed higher than geotextile/clay	ESI (1993)
	Geotextile Cushion (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	P	210 mils					
				—	25	100	Residual	REI
				—	14	0	Tx Tests, Gundle HDPE/Bonded Geotextile	ESI (1992)
				—	15	0	Tx Tests, Gundle HDPE/Unbonded Geotextile	ESI (1992)
	Primary HDPE Geomembrane (Double Textured (NSC))	P	60 mil					
				—	9	400	DS tests (Gundle HDPE), Short Term	ESI (1992)
				—	0	3,600	TxUU tests, short term loading or low confining pressure	ESI (1990)
				—	27	0		Koerner (1986)
				—	26	0		Gundle (1988)
				—	20	1,150	Tx-CU tests, Long Term	ESI (190)
	Primary Clay Liner	E	1.5 feet					
		P	2.0 feet	—	21	0		GAI (June 1990)
	Geotextile Filter (12 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	165 mils					
				—	25	0		REI, Koerner (1994)
				—	> 14	0	Assumed higher than geotextile/clay	ESI (1993)
	Secondary LCRS Granular Layer	E	1 foot					
				—	25	0		REI, Koerner (1994)
				—	> 14	0	Assumed higher than geotextile/clay	ESI (1993)
	Geotextile Cushion (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	19	65	DS tests (Heat bonded geotextile)	ESI (1992)
	Geonet Drainage Layer (Tex-Net TN 3002, Geocomposite PN 3000, (NSC))	E	0.305 inch					
				—	11	100	DS tests (Gundle HDPE)	ESI (1992)
				—	9	805	DS tests (Gundle HDPE/Double-sided geocomposite)	ESI (1992)
				—	6.5	0	Residual	SMS (1988)
	Secondary HDPE Geomembrane (Double Smooth (NSC))	E	60 mil					
				—	0	900	Residual, wet condition (HW thicker than 58 feet)	SMS (1988)
				—	8	0	Residual, dry condition (or wet cond., HW < 58 feet)	SMS (1988)
				—	11	0		GAI (1988)
	Secondary Clay Liner	E	3.5 feet					
	Vadose Zone Monitoring System (12-foot-wide by 2.5-foot-deep trench *) (*) Trench cut below subgrade							
	Geotextile Filter (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	25	0		REI, Koerner (1994)
	Drainage Rock/Gravel Layer	E	1 foot					
				—	25	0		REI, Koerner (1994)
	Geotextile Cushion (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	8	0	Residual, wet condition	SMS (1988)
	HDPE Geomembrane (Double Smooth (Gundle))	E	60 mils					
					11	0	Residual, wet condition	REI
	Subgrade	E						
2	**Phase IA Sideslope Liner Interface**							
	Class II/III Waste	P						
	Operations Soil Layer	P	2 feet					
				—	23	0	Residual	REI
	Geocomposite Drainage /Layer (Tex-Net TN3002 (NSC))	P	0.305 inch					
				—	8	0		SMS (1988)
	Single Textured HDPE Geomembrane (NSC) (textured side Down)	P	60 mil					
				—	15	0	Residual, wet condition (overburden < 600 psf)	GFH (1996)
				—	7	100	Residual, wet condition (overburden > 600 psf)	GFH (1996)
				—	9	400	DS tests (Gundle HDPE), Short Term	ESI (1992)
				—	0	3,600	TxUU tests, short term loading or low confining pressure	ESI (1990)
				—	27	0		Koerner (1986)
				—	26	0		Gundle (1988)
				—	20	1,150	Tx-CU tests, Long Term	ESI (190)
	Clay Liner (Admix, with dry bentonite sprayed in cracks over slope)	E	3.5 feet					
	Subgrade	E						
3	**Phase IB/II/III Bottom Liner Interface**							
	Class I Waste	E						
				—	31	0	Generic evaluation of KHF landfill closures	GAI (1988)
	Operations Soil Layer	E	2 feet					
				—	>> 8	0		SMS (1988)
	Geotextile Filter (16 oz/sy spunbond nonwoven Trevira 1155 (NSC))	E	210 mils					
				—	> 30	0		
	Primary LCRS Granular Layer	E	1 foot					
				—	> 30	0		
	Primary Geotextile Cushion (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	> 12	0	Residual, wet condition	SMS (1988), ESI (1990)*
	Primary Geonet (Polynet PN3000, (NSC))	E	0.2 inch					
				—	6.5	0	Residual, wet condition	SMS (1988), ESI (1990)*
	Primary HDPE Geomembrane (Double Smooth (Gundle))	E	60 mil					
				—	0	900	Residual, saturated clay condition	SMS (1988)
				—	8	0	Residual, dry condition (or wet cond., HW < 58 feet)	SMS (1988)
	Primary Clay Liner (Admix)	E	1.5 feet					
				—	24	0	Residual, wet condition	SMS (1988)
	Secondary Geotextile Filter (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	> 30	0		
	Secondary LCRS Granular Layer	E	1 foot					
				—	> 30	0		
	Secondary Geotextile Cushion (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	8	0	Residual, wet condition	SMS (1988)
	Secondary HDPE Geomembrane (Double Smooth (Gundle))	E	60 mil					
				—	0	900	Residual, saturated clay condition (HW > 58 feet)	SMS (1988)
				—	8	0	Residual, dry condition (or wet cond., HW < 58 feet)	SMS (1988)
	Secondary Clay Liner (Admix)	E	3.5 feet					
				—	24	0	Residual, wet condition	SMS (1988)
	Vadose Zone Monitoring System (12-foot-wide by 2.5-foot-deep trench *) (*) Trench cut below subgrade							
	Geotextile Filter (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	> 30	0		
	Drainage Rock/Gravel Layer	E	1 foot					
				—	> 30	0		
	Geotextile Cushion (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	8	0	Residual, wet condition	SMS (1988)
	HDPE Geomembrane (Double Smooth (Gundle))	E	60 mils					
	Subgrade	E						
4	**Phase IB/II/III Sideslope Liner Interface**							
	Class I Waste	E						
	Operations Soil Layer	E	2 feet					
	Protective HDPE Geomembrane (Double Smooth)	E	40 mil	—	8	0	Residual, wet condition	SMS (1988)
	Primary Geotextile (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	> 20	0	Residual, dry condition	SMS (1988)
	Primary Geonet (Polynet PN3000, (NSC))	E	0.2 inch					
				—	6.5	0	Residual, dry condition	SMS (1988)
	Primary HDPE Geomembrane (Double Smooth (Gundle))	E	60 mil					
				—	9	0	Residual, dry condition	SMS (1988)
	Secondary Geotextile (16 oz/sy spunbond nonwoven, Trevira 1155 (NSC))	E	210 mils					
				—	> 20	0	Residual, dry condition	SMS (1988)
	Secondary Geonet (Polynet PN3000, (NSC))	E	0.2 inch					
				—	6.5	0	Residual, dry or wet condition	SMS (1988)
	Secondary HDPE Geomembrane (Double Smooth (Gundle))	E	60 mil					
				—	0	900	Residual, saturated clay condition	SMS (1988)
				—	8	0	Residual, dry condition (or wet cond., HW < 58 feet)	SMS (1988)
	Clay Liner (Admix)	E	3.5 feet					
	Subgrade	E						
5	**Phase IB/II/III Perimeter Berm (0.25H:1V Butress Fill) Liner/Cover**							
	Class I Waste	E/P						
	Select Foundation Soil Layer	P	10 to 13 feet					
	Select Fill Cover	P	15 feet					
				—	25	100		REI, Koerner (1994)
	HDPE DoubleTextured Cover (NSC)	P	40 mils					
				—	25	100		REI, Koerner (1994)
	Structural Fill Soil	P	Variable					
6	**Phase IB/II/III - HW/MSW Separation Liner Interface**							
	Class II/III Waste	P						
	Operations Soil Layer	P	2 feet					
				—	23	0	Residual	REI
	Geocomposite Drainage /Layer (Tex-Net TN3002 (NSC))	P	0.305 inch					
				—	25	100	Residual	REI
	Double Textured HDPE Geomembrane (NSC)	P	60 mil					
				—	23	0	Residual	REI
	Compacted Low-Permeability Soil Layer	P	2 feet					
	Foundation Soil Layer	P	2 feet					
	Class I Waste	E						
7	**HW/MSW Unit B-19 Final Closure Cover Interface**							
	Class II/III Waste	P						
	Vegetative Soil Cover	P	2.5 feet					
				—	22	100		GAI (1990)
	Geotextile Drainage Layer (12 oz/sy spunbond nonwoven, Trevira 1142 (NSC))	P	165 mils					
				—	24	0 to 50	c= 0 and 50 for deep and shallow slip surfaces, respectively	GAI (1990), ESI (1990)
	Double Textured HDPE Geomembrane (NSC)	P	40 mils					
				—	25	100	Residual	REI
				—	32	0		GAI (1990)
	Low-Permeability Foundation Soil Layer	P	1 foot					
	Class II/III Waste (90%) and Class I (10%)	P						
	g:\wste\wellmn\200444\asprop.wk4							

See Figures 6 to 12 for Interface Component

REFERENCE LIST FROM ROST, 1997

6.0 REFERENCES

Abrahamson, N.A. and W.J. Silva (1997), *Empirical Response Spectral Attenuation Relations for Shallow Crustal Earthquakes*, Seismological Research Letters, Vol. 68, Number 1 January/February.

Achilleos, E. (1988), *User's Guide for PC STABL 5M*, Purdue University, West Lafayette, Indiana, pp. 132.

Blake, Thomas, F. (1996), *Eqsearch-A Computer Program for the Estimation of Peak Horizontal Acceleration From California Historical Earthquake Catalogs*, January.

Bray, J.D., A.J. Augello, G.A. Leonards, P.C. Repetto, and R.J. Byrne (1995) *Seismic Stability Procedures for Solid Waste Landfills*, Journal of Geotechnical Engineering, ASCE, Vol. 121, No.2, February.

California Division of Mines and Geology (1975), *Recommended Guidelines for Determining the Maximum Credible and Maximum Probable Earthquakes*, Note 43.

California Strong Motion Instrumentation Program, CSMIP (1994a,b,c,d,e*), *First through Fifth* Quick Reports on CSMIP Strong-Motion Data from the San Fernando Valley Earthquake of January 17, 1994.*

Caltech *Blue Book* Series (1969-74), *Volume 2: Strong Motion Earthquake Accelerograms - Corrected Accelerograms*, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, California, (25 reports).

Campbell, Kenneth W. (1997), *Empirical Near-Source Attenuation Relationships for Horizontal and Vertical Components of Peak Ground Acceleration, Peak Ground Velocity, and Pseudo-Absolute Acceleration Response Spectra*, Seismological Research Letters, Vol.68, Number 1, January/February.

Carey, P.J., N. Koragappa and J.J. Gurda (1993), *A Case Study of the Brookhaven Landfill-Long Island, New York*, Waste Tech'93, pp.15, Marina Del Rey, California.

CH_2M Hill (1985), *Final Environmental Impact Report, CWM, Inc., for Kings County Planning Agency, Hanford, California.* October

Dames & Moore (1986), *Faulting/Seismicity Report, Kettleman Hills Facility for CWM, Inc.*, November 19.

Duncan (1992), *State-of-the-Art: Static Stability and Deformation Analysis*, ASCE Geotechnical Special Publication No. 31, Stability and Performance of Slopes and Embankments-II, pp. 222-266.

Earth Technology (1988), *In-Place Stability of Landfill Slopes, Puente Hills, Los Angeles, California*, Report No. 88-614-1, Long Beach, California.

Environmental Solutions, Inc. (1994), *Unpublished Results from the Drive Tube Density Tests in OII Refuse,* Technical Memorandum No. 7, January.

Franklin, A. G. and F. K. Chang (1977), *Permanent Displacements of Earth Embankments by Newmark Sliding Block Analysis,* Earthquake Resistance of Earth and Rock-Fill Dams, Report 5, U. S. Department of the Army, Corps of Engineers, Waterways Experiment Station, November.

GeoSyntec Consultants (1996), *Seismic Exposure Evaluation, OII Landfill, Monterey Park, California*, Report No. SWP-1, Huntington Beach, California.

Hall, J.F. (Editor, 1995), *Northridge Earthquake of January 17, 1994 Reconnaissance Report, Volume 1.*" Earthquake Spectra, Supplement C to Volume 11, April 1995.

Hart, E. (1992), *Fault Rupture Hazard Zone in California*, Revised 1992, California Division of Mines and Geology.

Hudson, M., I.M. Idriss, and M. Beikae (1994), *A Computer Program To Evaluate the Seismic Response of Soil Structures Using Finite Element Procedures and Incorporating A Compliant Base,* Report from the Center for Geotechnical Modeling, Department of Civil and Environmental Engineering, University of California, Davis.

Hushmand Associates (1994), *Landfill Response to Seismic Events,* Report Prepared for EPA-Region IX, Irvine, California.

Hynes-Griffin, M.A. and A.G. Franklin (1984), *Rationalizing the Seismic Coefficient, Miscellaneous Paper GL-84-13*, Geotechnical Laboratory, U.S. Department of the Army, Corps of Engineers, Waterways Experiment Station, pp. 37, July.

Idriss, I.M. (1993), *Procedures for Selecting Earthquake Ground Motions at Rock Sites,* National Institute of Standards and Technology, NIST GCR 93-65, pp. 7.

Idriss, I.M., et al. (1973), *QUAD-4, A Computer Program for Evaluating the Seismic Response of Soil Structures by Variable Damping Finite Elements,* Report No. EERC 73 16, Earthquake Engineering Research Center, University of California, Berkeley, California, June.

Idriss, I.M. and Sun, (1991), *A Computer Program for Conducting Equivalent Linear Seismic Response Analyses of Horizontally Layered Soil Deposits- Program modified based on the Original SHAKE program published in December 1972 by Schnabel, Lysmer and Seed.*

Idriss, I.M., Fiegel, G.L, Hudson, M.B., Mundy, P.K., and Herzig, R. (1995), *Seismic Response of the Operating Industries Landfill.* ASCE Special Technical Publication No. 54, edited by M.K.

Yegian and W.D. Liam Finn. Proceeding of the ASCE Convention in San Diego, California of October 23-27, 1995.

Kavazanjian E., Jr., Matasovic, N., Bonaparte, R., and Schmertman, G.R. (1995), *Evaluation of MSW Properties for Seismic Analyses,* Proceedings of the Geoenvironment 2000 Specialty Conference, ASCE, Vol. 2, pp. 1126-1141, New Orleans, Louisiana, 24-26 February 1995.

Lin, J.S. and Whitman, R.V. (1983), *Decoupling Approximation to the Evaluation of Earthquake Induced Plastic Slip in Earth Dams*, J. Earthquake Engineering Structural Dynamics, Vol. 11, pp.667-678.

Makdisi, F. I. and H. B. Seed (1978), *Simplified Procedure for Estimating Dam and Embankment Earthquake-Induced Deformation,* Journal of the Geotechnical Engineering Division, ASCE, Vol. 104, No. GT7, July, pp. 849-868.

Morochnik, V., Bardet, J.P., and Hushmand, B. (1996), *Identification of the Dynamic Properties of the OII Landfill*, Submitted for publication in the Journal of Geotechnical Engineering, ASCE.

Mualchin, L. and Jones, A.L. (1992), *Peak Acceleration from Maximum Credible Earthquakes in California (Rock and Stiff-Soil Sites),* Prepared for Internal Use by Caltrans, California Department of Conservation, Division of Mines and Geology, DMG Open-File Report 92-1.

Newmark, N. M. (1965), *Effects of Earthquakes on Dams and Embankments*, 5th Rankine Lecture, Geotechnique, Vol. 15, No. 2, pp. 139-160.

Sadigh, K., Chang C.-Y., Egan, J.A., Youngs, R.R. (1997), *Attenuation Relationships for Shallow Crustal Earthquakes Based On California Strong Motion Data,* Seismological Research Letters, Vol. 68, Number 1, January/February.

Sadigh, K., Chang, C.-Y., Abrahamson, N.A., Chiou, S.J., and Power, M.S. (1993), *Specification of Long-period ground Motions: Updated Attenuation Relationships for Rock Site Conditions and Adjustment Factors Near-Fault Effects: Proceedings of ATC-17-1 Seminar on Seismic Isolation, Passive Energy Dissipation, and Active Control*, San Francisco, California, pp. 59-70.

Schnabel, P.B., J. Lysmer and H.B. Seed (1972), *SHAKE: A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites,* Report No. EERC 72-12, Earthquake Engineering Research Center, University of California, Berkeley.

Seed, H.B. and Bonaparte, R. (1992), *Seismic Analysis and Design of Lined Waste Fills: Current Practice, Proceeding of Stability and Performance of Slopes and Embankments-II.* Vol, 2, ASCE Geotechnical Special; Publication No.31, Berkeley, California, pp. 1521-1545.

Seed, H. B. and Idriss, I. M. (1970), *Soil Moduli and Damping Factors for Dynamic Response Analyses,* Report No. EERC 70-10, Earthquake Engineering Research Center, University of California, Berkeley, CA.

Seed, H.B., Martin, G,R. (1966), *The Seismic Coefficient In Earth Dam Design*, ASCE, Vol. 92, No. SM3, Proc. Paper 4824, May 1966, pp. 25-58.

Seed, H. B., Wong, R.T., Idriss, I. M., and Tokimatsu, K. (1984), *Moduli and Damping Factors for Dynamic Analyses of Cohesionless Soils*, Report No. EERC 84-14, Earthquake Engineering Research Center, University of California, Berkeley, CA, September.

Sharma, H.D., M.T. Dukes, and D.M. Olsen. (1990), *Field Measurements of Dynamic Moduli and Poisson's Ratio of Refuse and Underlying Soils at a Landfill Site*, Geotechnics of Waste Fill-Theory and Practice, ASTM STP 1070, pp. 57-70.

Silva, W.J. and K. Lee, (1987), *State of the Art for Assessing Earthquake Hazards in the United States, WES RASCAL Code for Synthesizing Earthquake Ground Motions*, Report 24, Prepared by Woodward-Clyde Consultants for Department of the Army, U.S. Army Corps of Engineers under Contract No. DACW39-85-M-1585.

Southern California Earthquake Center, SCEC, Working Group on California Earthquake Probabilities (1995), *Seismic Hazards in Southern California: Probable Earthquakes, 1994 to 2024*, Bulletin of the Seismological Society of America, Vol. 85, No. 2, pp. 379-439, April.

Stewart, J.P., Bray, J.D., Seed, R.B. and Sitar, N. (Editors, 1994), *Preliminary Report on the Principal Geotechnical Aspects of the January 17, 1994 Northridge Earthquake*. Report No. UC/EERC-94/08, June.

Sun, J.I., Golesorkhi, R., and Seed, H.B. (1988), *Dynamic Moduli and Damping Ratios for Cohesive Soils*, Report No. EERC 88-15, Earthquake Engineering Research Center, University of California, Berkeley, CA, August.

U.S. Environmental Protection Agency (EPA), RCRA Subtitle D (258) (1995), *Seismic Design Guidance For Municipal Solid Waste Facilities*, April.

U.S. Environmental Protection Agency (EPA) (1987), *Seismic Stability Evaluation for the Toe Buttress Construction-Operating Industries, Inc. Site, Monterey Park*, Woodward-Clyde Consultants.

U. S. Geological Survey (1988), *Digitized Strong-Motion Accelerograms of North America Through 1986*, Open-File Report 89-83, December.

Vucetic, M. and Dobry, R. (1991), *Effect of Soil Plasticity on Cyclic Response*, Journal of the Geotechnical Engineering, ASCE, Vol. 117, No. 1, pps. 89-107.

Wesnouski, S.G. (1986), *Earthquakes, Quaternary Faults, and Seismic Hazard in California*, Journal of Geophysical Research, Vol. 91, No. B12, pp. 12,587-12,631, November.

Yegian, M.K. and W.D. Finn (1995), *Earthquake Design and Performance of Solid Waste Landfills*, Geotechnical Special Publication No. 54, American Society of Civil Engineers, December.

7.0 PARTIAL LIST OF DOCUMENTATION REPORTS ON KETTLEMAN HILLS FACILITY

Donohue & Associates, Inc. (1988), "*Engineering Report, Kettleman Hills Facility, Landfill B-19, Phases II and III, Kings County, California*", Donohue Project No. 16149, dated October, 1988.

EBA Wastechnologies (1995), "*Kings County Integrated Waste Management Plan*," adopted by the Kings County Board of Supervisors, dated April 1995.

Einarson, Fowler & Watson (1996), "*Site-Specific Groundwater Monitoring Plan, Kettleman Hills Facility, Kings County, California, Project No. KHF 102.*" Report prepared for Chemical Waste Management, Inc. (Revised October, 1996).

Emcon (1995), "*Report of Waste Discharge, Mustang Hills Landfill, Kings County, California, Volume 2, Project No. 20390-010.001.*" Appendix A: Seismicity Report by Norman A. Abrahamson. RWD prepared for Kings Waste and Recycling Authority, dated October 25, 1995.

Environmental Solutions, Inc. (1990), "*Engineering and Design Report, Landfill Unit B-18, Phases I and II and Final Closure, Kettleman Hills Facility, Kings County, California, Including Appendices A through F.*" Report prepared for Chemical Waste Management, Inc. (CWMI), Project No. 89-977, dated August, 1990.

Environmental Solutions, Inc. (1993), "*Revised Intermediate Waste Fill Plan, Landfill Unit B-18, Phases I, Kettleman Hills Facility, Kings County, California.*" Report prepared for Chemical Waste Management, Inc. (CWMI), Project No. 92-222, dated August, 1993.

GeoSyntec Consultants (1991), "*Final Report, Landfill B-19 Phase 1A Investigation, Kettleman Hills Facility, Kettleman City, California.*" Report prepared for Chemical Waste Management, Inc., dated 25 March 1991.
Volume I: Main Text and Appendices A through E
Volume II: Appendices F through K

Golder Associates Inc. (1987), "*Test Fill and Infiltrometer Test Results, Kettleman Hills Facility, Kettleman City, California, Project No. 863-1092.*" Report prepared for Chemical Waste Management Inc., dated January, 1987.

Golder Associates Inc. (1988), "*Updated Evaluation of Site Design Ground Motions for the Kettleman Hills Facility, Kettleman City, California, Project No. 883-7010.*" Report prepared for Chemical Waste Management Inc., dated September, 1988.

Golder Associates Inc. (1989), "*Geologic Conditions of the Subgrade, Landfill B-19, Phase II and III with Summary of Geology and Engineering Properties of Landfill B-19, Kettleman Hills Facility, Kettleman City, California.*" Report prepared for Chemical Waste Management Inc., Project No. 883-1462, dated February, 1989.

Golder Associates Inc. (1990), "*Direct Shear Testing Program for Landfill Cover Design, Kettleman Hills Facility;*" Project No. 893-7015.340. Report prepared for Chemical Waste Management Inc., dated June 29, 1990. Included is also a laboratory test data report dated April 1990, Project No. 892-2078.

Golder Associates Inc. (1991), "*Landfill B-19, Phase IA Redesign and Closure, Kettleman Hills Facility, Kettleman City, California, Project No. 903-1343.610.*" Report prepared for Chemical Waste Management Inc., dated April 15, 1991.

Volume I: Design Report and Design Drawings, Revision 0.
Volume II: Materials Specifications and Construction Requirements, Revision 0.
Volume III: Appendices Supporting Calculations and Laboratory Testing Summary. Appendices A-1 through A-14, Revision 0.
Volume IV: Appendices Supporting Calculations and Laboratory Testing Summary. Appendices A-15 through A-26, Revision 0.

Seed, R.B., J.K. Mitchell and H.B.Seed (1988), "*Slope Stability Failure Investigation: Landfill Unit B-19, Phase I-A, Chemical Waste Management, Inc. Facility, Kettleman Hills, California.*" Report dated June 29,1988.

Volume I: Report of Investigation
Volume II: Appendix A: Result of Direct Shear Interface Tests.

Wahler Associates (1988), "*Geotechnical Investigation, Kettleman Hills Facility, Landfill Unit B-19 - Phases II and III, Kings County, California.*" Report prepared for Donohue and Associates, Project DAA-105H, dated January 16, 1989.

Wahler Associates (1988), "*Supplemental Geotechnical Investigation, Kettleman Hills Facility, Landfill Unit B-19 - Phases II and III, Kings County, California.*" Report prepared for Donohue and Associates, Project DAA-103H, dated January 31, 1989.

Wahler Associates (1988), "As-Built Sections, *Landfill Unit B-19 - Phases II and III, Kettleman Hills Facility, Kings County, California.*" Report prepared for Donohue and Associates, Project DAA-104H, dated February 2, 1989.

Wahler Associates (1989), "*Geotechnical Investigation for Confirmation of Design, Kettleman Hills Facility, Landfill Unit B-19 - Phases II and III, Kings County, California.*" Project DAA-101H; Report dated August 5, 1988.