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D-33-11-5-8
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FEASIBILITY STUDY OF ALTERNATIVES

VOLUME II
APPENDICES

KALAMAZOO RIVER PCB PROJECT
KALAMAZOO AND ALLEGAN COUNTIES, MICHIGAN

STATE OF MICHIGAN CONTRACT NUMBER 1611

NUS PROJECT NUMBER 7339

MARCH 1986

NUS CORPORATION
A Halliburton Company

NUS CORPORATION

Park West Two
Cliff Mine Road
Pittsburgh, PA 15275
412-788-1080

D-33-11-5-8
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SUBMITTED FOR NUS BY:

JOSEPH G. YEASTED, Ph.D., P.E.
PROJECT MANAGER

APPROVED:

GEORGE GARDNER
MANAGER
MICHIGAN REGIONAL OFFICE

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APPENDIX A

PCB DATA FOR SEDIMENT AND FISH
KALAMAZOO RIVER STUDY AREA

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TABLE A-1

KALAMAZOO RIVER SEDIMENT DATA

BRYANT MILL PONDS
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
B1	42.00	1971	Lauer 1972	Lower pond
B1	86.95	1972	Lauer 1972	Lower pond
B1	135.00	1983	Creal 1983	Lower pond
B1	144.00	1983	Creal 1983	Lower pond
*B1	37.00	1983	Creal 1983	Lower pond
*B1	3.30	1983	MDNR, November 1983	Lower pond (dark gray paper wastes, very oily)
*B1	3.20	1983	MDNR, November 1983	Lower pond (gray-black sticky, very oily)
*B1	105.00	1983	MDNR, November 1983	Lower pond (gray oily sediment)
B1	23.00	1983	MDNR, November 1983	Silty, no oils
B1	344.00	1983	MDNR, November 1983	Dried, crumbly gray paper wastes
B1	36.90	1983	MDNR, November 1983	Silty loose sediments, musty odor
B1	333.00	1983	Unpublished MDNR November 1983	50 meters upstream of dam, 7 meters east of river; top 2" gray and oily
B1	582.00	1983	Unpublished MDNR November 1983	30 meters upstream of dam, east of river; top 4" gray and oily
B1	97.00	1983	Unpublished MDNR November 1983	30 meters upstream of dam, 7 meters west of river light gray sediments, 2-4" below surface; not oily
*B1	36.40	1985	Unpublished MDNR October 15, 1985	200' upstream Bryant Dam
B1	530.00	1985	Unpublished MDNR October 15, 1985	200' upstream Bryant Dam (east bank)
B1	510.00	1985	Unpublished MDNR October 15, 1985	200' upstream Bryant Dam (west bank)
B2	190.00	1971	Lauer 1972	Upper pond
*B2	85.00	1985	Unpublished MDNR October 15, 1985	Instream flocculent sediment, 200' upstream of Bryant Dam
*B3	56.90	1984	Unpublished MDNR April 3, 1984	Instream sediment, 3,500' downstream of Cork Street; gray, no oil odor
*B3	0.22	1984	Unpublished MDNR April 3, 1984	Instream sediment, 3,500' downstream of Cork Street; black, oil odor
B3	5.99	1984	Unpublished MDNR April 3, 1984	Delta on west streambank; 3500' downstream of Cork Street, fine gray sediment

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TABLE A-1
KALAMAZOO RIVER SEDIMENT DATA
PAGE TWO

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
B4	0.94	1984	Unpublished MDNR April 3, 1984	West stream bank, 3000' downstream of Cork Street at groundwater seep; reddish brown clay
B4	2.32	1984	Unpublished MDNR April 3, 1984	East streambank, 3000' downstream of Cork Street; black silt
B5	54.10	1985	Unpublished MDNR, October 15, 1985	Streambank, 2,400' downstream of Cork Street; gray sediment
B5	1.40	1985	Unpublished MDNR, October 15, 1985	Streambank, 2,400' downstream of Cork Street
B6	1.30	1985	Unpublished MDNR, October 15, 1985	Streambank, 1,800' downstream of Cork Street
B7	1.10	1985	Unpublished MDNR, October 15, 1985	Streambank in front of seep #2
B7	898.00	1984	Unpublished MDNR, April 3, 1984	West side streambank; 1,600' downstream of Cork Street; crumbling, grayish, claylike
B8	0.50 (background)	1976	Unpublished MDNR August 9-10, 1976	Cork Street (Kalamazoo)
*MM1	0.71 (background)	1984	Unpublished MDNR, April 3, 1984	Monarch Mill Pond, 100' upstream of dam; brown/black silt, no odor or oils
*MM1	0.40 (background)	1984	Unpublished MDNR, April 3, 1984	Monarch Mill Pond, 100 yards upstream of dam; brown/black silt, no odor or oils
*MM1	0.35 (background)	1984	Unpublished MDNR, April 3, 1984	Monarch Mill Pond, 300 yards upstream of dam; brown black silt, no odor or oils

BRYANT MILL PONDS
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
B1	107.5 (0-2.5") 79.6 (2.5-5") 61.0 (5-7.5") 65.6 (7.5-10")	1972	Lauer, 1972	Northeast side, lower pond, 10" core

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TABLE A-1
KALAMAZOO RIVER SEDIMENT DATA
PAGE THREE

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
B1	88.0 (0-3.5")	1972	Lauer, 1972	Northwest side, lower pond, 14" core
	5.1 (3.5-7")			
	5.0 (7-10.5")			
	6.6 (10.5-14")			
B1	8.5 (0-2.5")	1972	Lauer, 1972	Southwest side, lower pond, 14" core
	28.3 (2.5-5")			
	6.4 (5-8")			
	75.6 (8-11")			
	13.4 (11-14")			
B1	8.1 (0-6")	1983	Unpublished MDNR, November 2, 1983	50 mile downstream of upper basin constriction, east side; brown color
	1.4 (9")			1" sand layer
	212.0 (16-18")			Gray sediment
	32.8 (24")			Gray sediment
B1	27.5 (0-2")	1983	Unpublished MDNR, November 2, 1983	200 mile upstream of Bryant Dam, 10 meters east of river, high ground; brown-gray
	1.2 (16")			Light gray
B2	368.7 (0-2")	1972	Lauer, 1972	West side, upper Bryant Mill Pond, 14" core
	10.0 (6-8")			
	0.5 (12-18")			

* *Represents instream samples*

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TABLE A-2

KALAMAZOO RIVER SEDIMENT DATA

PORTAGE CREEK: REACH 1
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
PC4	117.61	1972	Lauer, 1972	Lake Street
PC1	0.50	1976	Unpublished, MDNR August, 1976	Michigan Avenue
PC3	55.58	1976	Unpublished, MDNR August, 1976	Vine Street
PC3	54.50	1976	Wuycheck, 1976	Vine street
PC1	85.00	1982	MDNR, November 1982	Michigan Avenue
PC1	15.00	1983	MDNR, November 1983	Michigan Avenue; instream, silty, slight oils
PC1	14.50	1983	MDNR, November 1983	Michigan Avenue; stream banks, silt, resembles paper waste deposits
PC2	10.00	1983	MDNR, November 1983	Portage Road; instream, sandy silt, slight oils
PC2	11.00	1983	MDNR, November 1983	Portage Road; stream bank, loosely consolidated brown silt

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TABLE A-3

KALAMAZOO RIVER SEDIMENT DATA

PORTAGE CREEK CONFLUENCE TO MAIN STREET, PLAINWELL: REACH 2
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
K1	6.28	1976	Unpublished, MDNR, August 9-10, 1976	Fourth Street
K2	10.30	1976	Unpublished, MDNR August 9-10, 1976	D Avenue
K3	8.17	1976	Unpublished, MDNR, August 9-10, 1976	R.R. trestle (Parchment)
K5	12.34	1976	Unpublished MDNR, August 9-10, 1976	Gull Street
K6	7.73	1976	Unpublished MDNR, August 9-10, 1976	Michigan Avenue (Portage Creek Confluence)
K2	1.60	1982	MDNR, November 1982	D Avenue
K3	1.00	1982	MDNR, November 1982	Commerce Street & R.R. crossing
K4	57.00	1982	MDNR, November 1982	Patterson Avenue
K4	13.00	1984	Creal, 1984	Patterson Avenue

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TABLE A-4

KALAMAZOO RIVER SEDIMENT DATA

MAIN STREET, PLAINWELL TO PLAINWELL DAM: REACH 3
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
P8	7.61	1976	Unpublished MDNR, August 1976	Route 131, Plainwell
P10	2.56	1976	Unpublished MDNR, August 1976	R.R. trestle, Plainwell
P8	3.50	1982	MDNR, November 1982	Route 131 Bridge
P10	14.00	1982	MDNR, November 1982	R.R. crossing
*P1	25.60	1983	MDNR, November 1983	50' upstream of dam, south side, active depositional area, 18" grab sample in river
P5	15.60	1983	MDNR, November 1983	0.3 miles upstream of dam, north side, grab near present river level; top 1/4"
P5	24.50	1983	MDNR, November 1983	0.3 miles upstream of dam, north side, grab near present river level; sample without top 1/4"

MAIN STREET, PLAINWELL TO PLAINWELL DAM: REACH 3
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
P2	3.01 (0-4") 26.95 (6-10")	1983	MDNR, November 1983	100' upstream of dam, north side of river, 10" core; 2' above river level
P5	55.90 (0-4") 29.20 (8-12")	1983	MDNR, November 1983	0.15 miles upstream of dam, north side of river, 12" core; 4' below present river level
P5	37.40 (0-10")	1983	MDNR, November 1983	0.3 miles upstream of dam, north side of river, 10" core; 2' above river level; composite
P7	25.00 (0-10")	1983	MDNR, November 1983	0.75 miles upstream of dam, south side, 10" core; 2' above water level; composite

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TABLE A-10

KALAMAZOO RIVER SEDIMENT DATA

ALLEGAN DAM TO SAUGATUCK: REACH 10
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
L1	0.04	1982	Horvath, 1984	North side of channel
L2	0.10	1982	Horvath, 1984	Mid-channel near F&W service dock
L3	1.74	1982	Horvath, 1984	Deepest part of Kalamazoo Lake
L4	0.10	1982	Horvath, 1984	Downstream of U.S. 131 Bridge
L5	0.08	1982	Horvath, 1984	Midstream, downstream of Tyler Bayou
L6	0.10	1982	Horvath, 1984	Midstream in large wetland
L7	0.04	1982	Horvath, 1984	Midstream in large wetland
L8	0.07	1982	Horvath, 1984	Midstream, downstream of Indian Cut
L9	0.12	1982	Horvath, 1984	At side of channel, downstream of gun club
L10	0.10	1982	Horvath, 1984	Inside of bend out of main channel in a deposition zone
L11	0.03	1982	Horvath, 1984	Inside of first bend downstream of old R.R. bridge at New Richmond
L12	0.45	1985	Unpublished MDNR June 1985	20.3 km below dam; depositional area; top 2cm
L13	1.40	1985	Unpublished MDNR, June 1985	17.6 km below dam; north shore
L14	0.30	1985	Unpublished MDNR June 1985	14.8 km below dam; downstream end of island
L15	0.10	1985	Unpublished MDNR June 1985	12.8 km below dam, north shore
L17	0.06	1985	Unpublished MDNR June 1985	8.1 km below dam; backwater area at bayou
L18	0.73	1985	Unpublished MDNR, June 1985	7.4 km below dam; 30' from river before confluence
L19	0.35	1985	Unpublished MDNR, January 1985	6.5 km downstream of dam; Allegan Game Area, 50 mile north of M-89
L19	0.14	1985	Unpublished MDNR, January 1985	6.7 km downstream of Allegan Dam; 0.4 km north of M-89
L20	0.13	1985	Unpublished MDNR, June 1985	6.15 km below dam; backwater area

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TABLE A-10
KALAMAZOO RIVER SEDIMENT DATA
PAGE TWO

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
L20	0.05	1985	Unpublished MDNR, June 1985	6.0 km below dam; west shore
L21	0.18	1985	Unpublished MDNR, June 1985	4.75 km below dam, on inside of bend
L22	0.06	1985	Unpublished MDNR, June 1985	4.3 km below dam, east shore
L23	0.25	1985	Unpublished MDNR, June 1985	4.0 km below dam, east of Swan Creek Marsh, upland ~26' from river
L24	0.15	1985	Unpublished MDNR, January 1985	2.2 km downstream of dam; Koopman Marsh, west side of river, near river
L24	0.20	1985	Unpublished MDNR, January 1985	2.2 km downstream of dam; Koopman Marsh, west side, 100 miles from river
L24	1.11	1985	Unpublished MDNR, January 1985	2.1 km downstream of dam, Koopman Marsh, 60 miles from river
L25	0.47	1985	Unpublished MDNR, June 1985	2.0 km downstream of dam; on inside of bend
L26	0.04	1985	Unpublishd MDNR, June 1985	1.7 km downstream of dam; north shroe
L27	0.10	1985	Unpublished MDNR, June 1985	0.8 km downstream of Allegan Dam; north shore
L28	0.13	1985	Unpublished MDNR, January 1985	0.6 km downstream of dam; Koopman Marsh; east side by public launch

ALLEGAN DAM TO SAUGATUCK: REACH 10
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
L12	0.62 (4-6")	1985	Unpublished MDNR, June 1985	20.3 km below dam, depositional area, 10-15 cm deep
L16	0.38 (0-2")	1985	Unpublished MDNR, June 1985	10.9 km below dam, depositional area, surface 5 cm
L16	0.24 (4-6")	1985	Unpublished MDNR, June 1985	10.9 km below dam, depositional area, 10-15 cm deep

TABLE A-11

MORROW POND
CARP DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1971					1.49	5.07	3.40
June 1976	52		5		0.40	2.10	5.25
Sept 1981	63	3990		F	1.50	2.60	1.73
	68	4540		M	3.80	2.45	0.64
	64	3660		F	0.98	0.10	0.10
	54	3925		F	2.00	1.10	0.55
	60	2225		F	3.50	0.29	0.08
	49	1820		F	0.45	0.10	0.22*
	52	2225		F	0.36	0.10	0.28
	52	2180		F	3.45	8.10	2.35
	63	3415			0.20	0.56	2.80
Mean =	58	3109			1.80	1.71	0.95
July 1985	47	1450	3	M	2.70	1.80	0.67*
	45	1250	4	F	1.20	1.40	1.17
	46	1230	3	F	1.20	0.87	0.73*
	43	1150	2	M	2.80	1.40	0.50*
	51	1600	4	M	1.20	1.30	1.08
	49	1520	3	F	1.35	1.65	1.22*
	49	1800	3	M	1.50	1.40	0.93*
	48	1610	3	F	1.30	1.80	1.38*
	46	1340	3	M	0.10	0.22	2.20*
	47	1440	3	F	0.70	0.50	0.71*
	48	1030	3	F	1.30	2.40	1.85*
	49	1700	3	M	5.60	8.90	1.59*
	47	1310	3	M	1.40	2.20	1.57*
	44	1280	3	M	2.10	2.00	0.95*
	51	1790	4	F	0.80	0.52	0.65
	51	1860	3	F	2.50	2.10	0.84*
	46	1220	3	M	0.80	0.55	0.69*
	51	1680	4	M	0.85	0.65	0.76
	51	1840	4	M	1.60	2.20	1.38
	49	1510	3	F	1.30	2.10	1.62*
Mean =	48	1481	3		1.62	1.80	1.11

* Included in size-restricted carp data base.

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TABLE A-12

MORROW POND
BASS DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
June 1976	21		3		0.70	0.20	0.29
Sept 1981	32	522		F	0.21	0.17	0.81
	35	595		F	0.16	0.10	0.63
	23	175		F	0.18	0.10	0.56
	20	155			0.59	0.51	0.86
	17	115			0.23	0.15	0.65
	33	760		M	1.40	1.80	1.29
	33	725		F	0.38	0.79	2.08
	34	625		F	0.28	0.14	0.50
	30	420		F	0.14	0.10	0.71
	27	330		F	0.25	0.29	1.16
	27	330		F	0.09	0.10	1.11
	27	320		F	0.10	0.10	1.00
	27	275		F	0.19	0.17	0.89
	26	285		F	0.15	0.15	1.00
	25	240		M	0.42	0.10	0.24
	23	195		M	0.11	0.10	0.91
	22	165			0.30	0.39	1.30
	21	155			0.21	0.10	0.48
	21	145			0.98	0.90	0.92
	22	145			0.48	0.54	1.13
	20	110			0.64	0.61	0.95
	44	1740			0.16	0.22	1.38
	32	680			1.02	0.25	0.25
Mean =	27	400			0.38	0.34	0.91
July 1985	35	600	4	M	2.00	1.50	0.75
	30	360	3	M	1.10	1.00	0.91
	30	340	3	M	0.30	0.90	3.00
	33	480	4	M	0.80	1.30	1.63
	24	150	2	M	0.50	0.52	1.04
	26	200	3	M	0.40	0.92	2.30
	26	200	3	M	0.70	0.85	1.21
Mean =	29	333	3		0.84	1.00	1.19

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TABLE A-13

PORTAGE CREEK
CARP DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1985	43	1000	3	M	0.35	0.58	1.66*
	45	1380	3	M	0.80	0.76	0.95*
	46	1450	3	F	0.40	0.74	1.85*
	42	1050	3	F	0.35	0.53	1.51*
	46	1460	3	M	0.65	0.91	1.40*
	47	1500	2	M	0.70	1.20	1.71*
	48	1560	3	F	0.60	0.41	0.68*
	48	1500	3	F	0.95	1.30	1.37*
	42	1000	2	F	0.55	0.65	1.18*
	48	1440	3	F	0.68	0.96	1.41*
Mean =	46	1334	3		0.60	0.80	1.33

* Included in size-restricted carp data base.

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TABLE A-14

MOSEL AVENUE
CARP DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1971					20.78	164.50	7.92
June 1976	53		4		2.60	8.00	3.08
Sept. 1981	61	3485		F	0.72	3.30	4.58
	44	1655		M	2.70	2.50	0.93*
	42	1390		M	2.60	3.50	1.35*
	44	1585		M	3.40	3.80	1.12*
	47	2050		F	2.90	3.50	1.21*
	45	1420		M	1.40	1.50	1.07*
	40	1420		M	1.60	1.80	1.13
	41	1245		M	1.30	1.30	1.00
	37	1000		M	0.53	0.46	0.87
	41	1225		F	3.60	2.35	0.65
	40	1070		M	0.34	0.48	1.41
	42	1495		F	1.20	1.20	1.00*
	44	1390		F	2.50	1.20	0.48*
	48	1820		F	1.90	0.89	0.47*
	49	2160		F	6.40	5.60	0.88*
	45	1290		F	0.10	0.33	3.30*
	40	1125		F	0.78	0.33	0.42*
	70	6395		F	3.03	8.03	2.65
Mean =	46	1846			2.06	2.34	1.14
July 1983	48	2500		F	2.20	3.24	1.47*
	47	2300		F	2.40	3.06	1.28*
	47	1650		M	4.00	6.53	1.63*
	43	1300		F	1.00	1.57	1.57*
	38	1000		M	0.64	1.46	2.28
	46	2100		F	4.30	6.04	1.40*
	51	2850		F	2.50	4.30	1.72
	43	1650		F	1.40	0.98	0.70*
	48	2650		F	4.30	3.84	0.89*
	51	2300			2.20	1.90	0.86
	53	2850		F	0.59	1.78	3.02
Mean =	47	2100			2.30	3.50	1.52

TABLE A-14
MOSEL AVENUE
CARP DATA
PAGE TWO

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1985	46	1530	3	M	1.25	3.50	2.80*
	44	1470	3	M	0.50	2.70	5.40*
	50	2210	3	F	3.55	4.20	1.18*
	46	1800	3	F	1.90	2.70	1.42*
	45	1460	3	M	1.20	3.60	3.00*
	44	1300	3	F	1.00	4.60	4.60*
	48	1800	3	M	3.10	3.50	1.13*
	47	1550	3	M	3.35	4.00	1.19*
	50	2130	4	F	4.85	6.40	1.32*
	45	1460	3	M	1.35	4.90	3.63*
	47	1850	3	F	1.50	2.20	1.47*
	47	1710	3	M	0.25	3.20	12.80*
	46	1850	3	M	9.45	5.20	0.55*
	42	1050	3	M	0.20	1.00	5.00*
	46	1700	3	M	0.70	1.70	2.43*
	48	1800	3	M	0.20	2.20	11.00*
	43	1200	3	M	1.05	1.80	1.71*
	46	1520	3	M	0.80	3.60	4.50*
	46	1960	3	M	0.30	2.40	8.00*
Mean =	46	1650	3		1.92	3.34	1.74

* Included in size-restricted carp data base.

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TABLE A-7
KALAMAZOO RIVER SEDIMENT DATA
PAGE TWO

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
T2	3.61 (12")	1984	Unpublished MDNR, August 1984	0.2 km upstream of dam on streambank next to existing channel; water level at 4'
	2.04 (3')			
	1.00 (4')			
	1.10 (5')			
	0.88 (6')			
	1.18 (7')			
	0.54 (8')			
T4	1.68 (12")	1984	Unpublished MDNR, August 1984	2.4 km upstream of dam on streambank next to existing channel; water level at 4'
	64.00 (2')			
	30.00 (3')			
	4.90 (4')			
	1.19 (5')			
	0.13 (6')			
	0.13 (7')			
	0.46 (8')			
	0.56 (9')			
	0.28 (10')			
	0.12 (11')			
	0.25 (12')			
T4	0.70 (12")	1985	Unpublished MDNR, August 1985	Upstream portion of downstream basin, 1.4 miles upstream of dam
	2.90 (2')			
	3.90 (3')			
	3.00 (4')			
	4.10 (5')			
	1.10 (6')			
	1.40 (7')			
	1.10 (8')			
	0.96 (9')			
	0.96 (10')			
	0.92 (11')			

* Represents instream samples

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TABLE A-8

KALAMAZOO RIVER SEDIMENT DATA

CITY LINE OF ALLEGAN TO ALLEGAN CITY DAM: REACH 8
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
AC2	24.67	1976	Unpublished MDNR, August 9-10, 1976	Route 40-89
AC3	3.61	1985	Unpublished MDNR, January 1985	0.7 km upstream of dam, south of M-89, west side of river
AC4	6.47	1985	Unpublished MDNR, January 1985	1.4 km upstream of dam, east side in bay

CITY LINE OF ALLEGAN TO ALLEGAN CITY DAM: REACH 8
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
AC1	47.30 (0-2') 38.30 (3') 46.80 (4') 57.40 (5') 46.50 (6') 29.30 (7') 2.23 (8')	1985	Unpublished MDNR, May 29, 1985	0.4 km upstream of dam on east shore
AC2	4.99 (0-6")	1985	Unpublished MDNR, May 1985	0.6 km upstream of dam, composite of 6 samples taken of top 15 cm from east/west transect across river
AC2	45.50 (12") 15.20 (24") 13.90 (3') 0.95 (4')	1985	Unpublished MDNR, May 1985	0.6 km upstream of dam on west shore

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TABLE A-9

KALAMAZOO RIVER SEDIMENT DATA

LAKE ALLEGAN: REACH 9
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
A1	5.58	1976	Unpublished MDNR, August 9-10, 1976	Lake Allegan; near dam
A1	2.26	1976	Unpublished MDNR, August 9-10, 1976	Route 89 (Lake Allegan)
A6	24.67	1976	Unpublished MDNR, August 9-10, 1976	Route 40-89 (Lake Allegan)

LAKE ALLEGAN: REACH 9
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
A_t2	13.90 (12-16")	1983	MDNR, November 1983	0.8 miles upstream of dam, 16" cores; transect
A3	11.00 (0-4")	1983	MDNR, November 1983	1.25 miles upstream of dam, in bay, 10" core
A_t4	14.10 (0-4") 25.20 (12-16")	1983	MDNR, November 1983	2 miles upstream of dam, 16" cores
A5	24.40 (0-4") 41.70 (4-8")	1983	MDNR, November 1983	2.1 miles upstream of dam, in bay; 8" core
A7	17.80 (0-4") 28.30 (8-12")	1983	MDNR, November 1983	Directly west of fairgrounds; about 4.75 miles upstream of dam, 12" core
A_t8	15.60 (0-4") 20.20 (8-12")	1983	MDNR, November 1983	Directly north of fairgrounds; about 5 miles upstream of dam, 12" cores

Note: Subscript t indicates samples were composites taken from transects.

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TABLE A-4
KALAMAZOO RIVER SEDIMENT DATA
PAGE TWO

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
P9	0.60 (0-4") 8.20 (6-10")	1983	MDNR, November 1983	1 mile upstream of dam, upstream of 131 Bridge, south side of river, 10" core; 2' above water level
*P1	0.81 (12") 0.64 (2') 0.18 (3') 0.21 (4') 0.21 (5') 0.08 (6') 0.08 (7') 0.37 (8') 0.08 (9') 0.21 (10')	1984	Unpublished MDNR, June 1984	3 meters upstream of dam; overlying water depth -- 0.3 meters
*P3	0.34 (12") 0.94 (2') 0.61 (3')	1984	Unpublished MDNR, June 1984	0.1 km upstream of dam on first bend, 3 meters from shore, overlying water depth -- 1.0 meter
*P5	0.18 (12") 0.13 (2') 0.17 (3') 0.17 (4-5')	1984	Unpublished MDNR, June 1984	0.4 km upstream of dam, 35' from left bank (north); overlying water depth -- 1.6 meters
*P6	0.08 (12") 0.08 (2') 0.08 (3')	1984	Unpublished MDNR, June 1984	0.5 km upstream of dam, on right bank(south); overlying water depth -- 1.6 meters

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TABLE A-4
KALAMAZOO RIVER SEDIMENT DATA
PAGE THREE

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
P4	13.20 (12")	1985	Unpublished MDNR, August 1, 1985	
	14.60 (2')			
	1.30 (3')			
	1.20 (4')			
	1.10 (5')			
	1.20 (6')			
	1.20 (7')			
	0.83 (8')			

* Represents instream samples

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TABLE A-5

KALAMAZOO RIVER SEDIMENT DATA

PLAINWELL DAM TO OTSEGO CITY DAM: REACH 4
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
M2	7.86	1985	Unpublished MDNR, January 1985	0.6 km upstream of dam, south side of river; east of Platt and Court Streets
M3	25.10	1985	Unpublished MDNR, January 1985	2.3 km upstream of dam, north side of river; 100 meters east of R.R. and 106 Street

PLAINWELL DAM TO OTSEGO CITY DAM: REACH 4
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
M1	57.00 (12")	1985	Unpublished MDNR, May 29, 1985	0.1 km upstream of dam; instream sample
	30.30 (2')			
	5.90 (3')			
	4.24 (4')			
	0.91 (5')			

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TABLE A-6

KALAMAZOO RIVER SEDIMENT DATA

OTSEGO CITY DAM TO OTSEGO DAM: REACH 5
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
O8	66.60	1976	Unpublished MDNR, August 1976	M-89 Otsego
O8	27.00	1982	MDNR, 1982	M-89; down from 131 Bridge

OTSEGO CITY DAM TO OTSEGO DAM: REACH 5
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
O2	11.00 (20")	1983	USFWS, May 20, 1983	
O3	26.00 (20")	1983	USFWS, May 20, 1983	
O3	28.00 (20")	1983	USFWS, May 20, 1983	
O4	1.10 (0-6")	1983	USFWS, May 20, 1983	
O4	13.00 (20")	1983	USFWS, May 20, 1983	
O5	8.40 (20")	1983	USFWS, May 20, 1983	
O5	6.50 (20")	1983	USFWS, May 20, 1983	
O6	0.79 (20")	1983	USFWS, May 20, 1983	
O7	8.30 (0-6")	1983	USFWS, May 20, 1983	
O7	5.00 (20")	1983	USFWS, May 20, 1983	
*O1	0.08 (12")	1984	Unpublished MDNR	0.1 km upstream of dam in existing river channel
	0.08 (3')			
	0.29 (4')			
	0.17 (5')			
	0.06 (6')			
	0.20 (7')			

* Represents instream samples

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TABLE A-7

KALAMAZOO RIVER SEDIMENT DATA

OTSEGO DAM TO TROWBRIDGE DAM: REACH 6
SURFACE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
T3	64.9	1983	Unpublished MDNR, June 1983	Grab sample at present water level
T3	81.0	1983	Unpublished MDNR, June 1983	Grab sample at present water level
T7	23.8	1983	Unpublished MDNR, June 1983	Grab sample 4' above water level

OTSEGO DAM TO TROWBRIDGE DAM: REACH 6
CORE SAMPLES

Sample Number	PCB Concentration (ppm)	Year	Reference	Comments
*T1	8.4 (0-2") 13.3 (17-18")	1983	MDNR, November 1983	South side of river channel, 150' upstream of dam; active depositional zone, 18" Eckman, 3' below river level
T4	16.7 (0-4") 50.9 (14-18")	1983	MDNR, November 1983	Upstream portion of downstream basin, 1.4 miles upstream; 18" core at river level
T4	3.8 (0-4") 7.4 (11-15")	1983	MDNR, November 1983	Upstream portion of downstream basin, 1.4 miles upstream; 15" core; 3' above water level
T5	44.2 (0-15")	1983	MDNR, November 1983	Channel between reservoir basins, 2.2 miles upstream of dam; 15" composited core
T6	3.9 (0-4") 8.9 (6-10")	1983	MDNR, November 1983	Middle portion of upstream reservoir basin; 10" core; 1' above river level; 2.5 miles upstream of dam

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TABLE A-15

MOSEL AVENUE
BASS DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
Sept. 1981	24	185		F	1.40	2.10	1.50
	18	155		M	1.30	1.50	1.15
	39	990		F	0.72	0.37	0.51
	25	265		F	0.62	0.35	0.56
Mean =	27	399			1.01	1.08	1.07
July 1985	42	900	4	M	0.13	1.24	9.54
	26	280	3	M	0.21	1.60	7.62
Mean =	34	590	4		0.17	1.42	8.35

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TABLE A-16

DOWNSTREAM OF PLAINWELL DAM
CARP DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
June 1971	28				1.70	18.75	11.03
					1.94	22.31	11.50
Mean =					1.82	20.53	11.28
June 1976	53		5		6.60	12.90	1.95
Sept. 1981	44	1495			0.48	2.40	5.00*
	21	155			0.81	1.30	1.60
	21	155		F	0.49	0.83	1.69
	46	1565		F	2.25	4.20	1.87*
	57	4365		F	1.90	9.20	4.84
	20	175			0.74	0.90	1.22
Mean =	35	1318			1.11	3.14	2.82
July 1983	53	2300		M	1.20	3.60	3.00
	53	1850		M	0.06	0.92	15.25
	46	1550		M	1.70	3.71	2.18*
	57	2750		M	1.00	3.47	3.47
	47	1450		M	2.30	4.13	1.80*
	42	1200		M	1.50	3.08	2.05*
	46	1550		M	2.60	5.21	2.00*
	51	1750		M	3.30	7.59	2.30
	57	2750		M	1.20	0.88	0.73
	61	3900		M	8.60	11.70	1.36
	43	1850		M	6.80	15.90	2.34*
Mean =	51	2100			2.80	5.50	1.96
July 1985	42	1000	2	F	3.00	1.60	0.53*
	48	1500	3	M	0.30	1.10	3.67*
	47	1340	3	M	2.80	2.90	1.04*
	42	1460	4	M	1.45	2.00	1.38*
	47	1740	3	F	2.20	3.50	1.59*
	47	1510	3	M	1.90	1.50	0.79*
	42	1460	3	M	11.00	1.40	0.13*
	41	1200	3	M	0.40	1.10	2.75*

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TABLE A-16
DOWNSTREAM OF PLAINWELL DAM
CARP DATA
PAGE TWO

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
	44	1200	3	M	4.30	3.90	0.91*
	47	1240	3	M	2.20	0.40	0.18*
	44	1340	3	M	2.50	1.90	0.76*
	47	1650	4	F	4.40	2.10	0.48
Mean =	45	1387	3		3.04	1.95	0.64

* Included in size-restricted carp data base

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TABLE A-17

DOWNSTREAM OF PLAINWELL DAM
BASS DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
Sept. 1981	24	240		F	0.14	0.47	3.36
July 1985	27	220	3	F	1.20	2.00	1.67

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TABLE A-18

LAKE ALLEGAN
CARP DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1971					0.68	7.32	10.76
July 1976	46		4		0.80	7.40	9.25
Sept. 1981	38	880		F	2.00	4.30	2.15*
	61	3745		M	6.00	12.00	2.00
	35	835		M	0.37	1.20	3.24
	37	1015		M	0.88	3.00	3.41
	36	815		M	4.00	17.00	4.25
	41	1290		F	7.50	47.00	6.27*
	36	880		M	4.20	5.10	1.21
	43	1400		F	0.54	1.30	2.41*
	41	1300		F	3.30	5.10	1.55*
	40	1190		M	1.80	3.70	2.06*
	39	1025		F	1.90	4.60	2.42*
	35	880		F	3.00	8.00	2.67
	36	945		M	2.90	9.90	3.41
	64	4080		M	11.00	5.70	0.52
	65	9680		F	19.00	10.00	0.53
	39	990		M	1.20	3.20	2.67*
	35	835		M	0.74	1.90	2.57
	39	1125		M	1.60	2.50	1.56*
	42	1410		M	1.50	2.60	1.73*
	38	1100		F	5.00	12.00	2.40*
Mean =	42	1771			3.92	8.01	2.04
July 1983	43	1200		M	0.83	5.03	6.06*
	43	1100		F	1.10	1.60	1.45*
	47	1450		M	0.46	1.69	3.67
Mean =	44	1250			0.80	2.80	3.50
July 1985	41	1070	2	F	0.85	1.50	1.76*
	42	1120	2	F	1.20	2.20	1.83*
	39	850	3	M	0.45	2.30	5.11*
	42	1050	2	F	1.55	3.70	2.39*
	46	1370	3	M	0.88	1.70	1.94*
	38	920	2	F	3.00	5.90	1.97*

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TABLE A-18
LAKE ALLEGAN
CARP DATA
PAGE TWO

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
	39	870		M	1.25	1.60	1.28*
	41	930	2	M	3.65	11.00	3.01*
	41	1000	2	F	1.70	2.60	1.53*
	41	950	2	M	1.60	2.40	1.50*
	39	1100	2	F	1.85	3.00	1.62*
	39	860	2	M	2.70	2.10	0.78*
	43	900	2	M	2.50	5.10	2.04*
	44	1060	2	M	2.35	4.80	2.04*
	42	1200	2	F	0.85	1.50	1.76*
	42	1100	2	F	0.70	1.00	1.43*
	46	1280	2	M	1.05	1.20	1.14*
	40	840	2	F	1.00	1.40	1.40*
	45	1340	2	F	0.90	1.50	1.67*
Mean =	42	1043	2		1.58	2.97	1.88

* Included in size-restricted carp data base.

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TABLE A-19

LAKE ALLEGAN
BASS DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1976	25		3		0.40	2.40	6.00
Sept. 1981	22	175		F	0.18	0.61	3.39
	22	165		F	0.45	0.84	1.87
	19	100		F	0.22	0.48	2.18
	38	880		F	0.35	0.99	2.83
	30	660			0.54	1.30	2.41
	23	420		F	0.42	0.79	1.88
	20	155		F	0.45	1.30	2.92
	22	140		F	0.66	2.20	3.33
	30	385		M	0.44	1.30	2.95
Mean =	25	342			0.41	1.09	2.65
July 1985	39	850	2	M	0.25	1.85	7.40
	30	400	2	M	0.60	1.60	2.67
	30	400	2	M	0.75	1.90	2.53
	33	660	2	M	0.65	1.60	2.46
	28	330	2	M	1.55	2.40	1.55
	30	400	2		2.65	4.30	1.62
	40	650	3	M	1.00	1.80	1.80
	40	780	4	M	0.20	3.90	19.50
	35	610	3	M	0.75	2.00	2.67
	31	300	2	M	0.68	0.67	0.99
Mean =	34	538	2		0.91	2.20	2.43

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TABLE A-20

SAUGATUCK
CARP DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
July 1971					2.10	45.43	21.63
July 1978	61				12.70	37.00	2.91
Sept. 1981	52	2095	3	M		8.40	*
	51	2140	3	F		5.20	*
	56	2555		F		3.40	
	57	2445		M		16.00	
	53	2315		M		9.10	
	53	1960	2	F		7.90	*
	48	1655	3	M		5.00	*
	51	1895	2	M		2.90	*
Mean =	53	2133	3			7.24	
July 1983	58	2650		F	1.30	1.16	0.89
	61	3200		F	13.00	25.70	1.98
	53	2300		M	7.70	13.80	1.79
	46	1650		F	3.10	2.63	0.85*
	55	2300		F	3.90	1.14	0.29
	50	1650		M	7.00	10.30	1.47*
	48	1750		M	2.40	4.91	2.05*
	41	1000		M	1.80	1.39	0.77
	48	1750		M	16.00	24.20	1.51*
	42	1200		M	1.40	1.03	0.74
	52	2000		F	4.00	7.15	1.79*
Mean =	50	1950			5.60	8.50	1.52
July 1985	48	1630	3	F	6.90	2.00	0.29*
	45	1380	2	M	6.90	1.10	0.16*
	46	1380	2	M	3.40	0.97	0.29*
	45	1360	2	M	3.40	2.40	0.71*
	44	1100	2	M	1.30	0.18	0.14*
	50	1740	3	M	5.40	2.70	0.50*
	50	1740	2	M	4.70	1.10	0.23*

TABLE A-20
SAUGATUCK
CARP DATA
PAGE TWO

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
	50	1740	3	F	3.30	1.70	0.52*
	47	1520	2	M	5.10	1.50	0.29*
	44	1120	2	M	2.70	0.45	0.17*
	50	1840	2	M	3.30	2.30	0.70*
	49	1820	2	F	12.70	2.60	0.20*
	49	1680	2	M	10.10	2.60	0.26*
	47	1360	3	M	4.80	1.30	0.27*
	48	1480	3	M	3.90	2.00	0.51*
	48	1640	2	M	0.95	0.78	0.82*
	49	1710	3	M	11.50	3.60	0.31*
	47	1780	3	F	7.20	2.10	0.29*
	51	2020	3	F	7.40	4.30	0.58*
	52	2000	3	M	5.80	6.40	1.10*
Mean =	48	1602	2		5.54	2.10	0.38

* Included in site-restricted carp data base.

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TABLE A-21

SAUGATUCK
BASS DATA

Date	LNTH (cm)	Wt (g)	Age	Sex	Fat (%)	PCB (ppm)	Fat Normalized PCB (ppm)
Sept. 1981	45	1830	5	M		15.00	
	30	465	2	M		1.50	
	31	505	3	M		1.60	
	30	420	2	F		4.40	
Mean =	34	805	3			5.63	
July 1985	33	520	3	M	1.70	1.70	1.00
	33	560	3	M	0.80	0.41	0.51
	36	760	4	F	0.64	0.70	1.09
	40	560	3	M	1.15	1.00	0.87
	31	400	2	M	0.30	0.35	1.17
	40	1080	4	M	0.80	0.90	1.13
	47	820	3	M	0.80	0.96	1.20
	36	740	3	M	0.50	0.54	1.08
	33	520	3	F	0.50	0.33	0.66
	30	280	2	F	0.79	0.90	1.14
Mean =	35	664	3		0.80	0.78	0.98

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APPENDIX B

EFFECTS OF LIPID CONTENT AND BODY WEIGHT ON THE PCB CONCENTRATION OF FISH IN THE KALAMAZOO RIVER USING LINEAR REGRESSION ANALYSIS

APPENDIX B

EFFECTS OF LIPID CONTENT AND BODY WEIGHT ON THE PCB CONCENTRATION OF FISH IN THE KALAMAZOO RIVER USING LINEAR REGRESSION ANALYSIS

PCB concentration in fish can be influenced by various factors such as PCB concentration in the water, rank of fish in the foodchain, PCB concentration in the fish food, and PCB assimilation efficiency and PCB excretion rate of fish. Also, some biological factors are considered to have certain effects on the retention of PCBs in the fish. Age, weight, and lipid content of the fish are considered to be the biological factors that are most strongly related to the PCB concentration in the fish. Brown et al. (1985) found that there was a strong correlation between PCB and lipid concentrations for all Hudson River resident fish species except the anadromous species (i.e., species that ascend rivers to breed). However, the strength of the correlation between PCB concentration and the above mentioned biological factors is greatly site-specific.

The technique of least square curve fitting, or simple regression, was used to analyze the fish data from different years and locations in the Kalamazoo River. Based on the availability of data, the PCB concentration in the fish versus fat content and the PCB concentration in the fish versus body weight were selected to determine the linear equations that represent the relationship between the selected paired variables.

The coefficient of determination (γ^2) is used to represent how closely the paired variables are correlated and to determine how well the linear equation expresses the relationship between the paired variables. The regression coefficients for the linear equations represent the interception point and the slope of each equation. The higher the slope, the more sensitive one variable is relative to the other. The coefficient of determination (γ^2) can range from 0 to 1. The higher the value of γ^2, the better the linear relationship can represent the data set, and the higher the degree of correlation between the selected paired variables.

The purpose of the following presentation is to determine whether significant correlations exist between the selected variables. When the value of γ^2 approaches 1, this indicates a strong linear relationship between of either lipid content or body weight and the retention of PCB in the fish.

Based on the linear regression analysis presented on pages B-3 through B-20 for the sampled data for 1978, 1981, 1983, and 1985, the following general conclusions can be drawn:

(1) Fat content has a stronger correlation with PCB concentration than does the weight of fish.

(2) The correlation of fat content with PCB concentration was better indicated by carp than by bass.

(3) Conclusions (1) and (2) were more appropriate for reaches below, and including, Lake Allegan.

(4) The conclusions of (1), (2), and (3) are more adequate for fish sampled in 1978, 1981, and 1983. The results obtained from the sampling in 1985 were quite different from those determined in the previous years.

(A)

Date: May 1978

Species	Location	Fat (%)	PCB (ppm)
Carp	M-89, below Allegan	20.1	51.3
White Sucker	M-89, below Allegan	1.2	6.3
Northern Pike	M-89, below Allegan	0.21	4.1
Carp	New Richmond	23.4	63.0
Northern Pike	New Richmond	0.31	3.5
Northern Pike	New Richmond	0.74	10.9
Carp	US31, Saugatuck	12.7	37.0
White Sucker	US31, Saugatuck	0.94	6.4
Northern Pike	US31, Saugatuck	1.4	4.9

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 4.13 + 2.46 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.99)$$

(B)

Date: September 1981

Location: Mosel Avenue

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
44	1655	2.70	2.50
42	1390	2.60	3.50
44	1585	3.40	3.80
47	2050	2.90	3.50
45	1420	1.40	1.50
40	1420	1.60	1.80
41	1245	1.30	1.30
41	1225	3.60	2.35
42	1495	1.20	1.20
44	1390	2.50	1.20
48	1820	1.90	0.89
49	2160	6.40	5.60
45	1290	0.10	0.33
40	1125	0.78	0.33

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 0.10 + 0.88 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.81)$$

$$\text{PCB (ppm)} = -2.92 + 3.32 \times 10^{-3} \bullet \text{Weight (g)} \qquad (\gamma^2 = 0.46)$$

(C)

Date: September 1981

Location: Mosel Avenue

Species: Bass

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
24	185	1.40	2.10
18	155	1.30	1.50
39	990	0.72	0.37
25	265	0.62	0.35

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -1.08 + 2.14 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.96)$$

(D)

Date: September 1981

Location: Morrow Pond

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
63	3990	1.50	2.60
68	4540	3.80	2.45
64	3660	0.98	0.10
54	3925	2.00	1.00
60	2225	3.50	0.29
49	1820	0.45	0.10
52	2225	0.36	0.10
52	2180	3.45	0.10
63	3415	0.20	0.56

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -0.10 + 1.00 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.31)$$

(E)

Date: September 1981

Location: Morrow Pond

Species: Bass

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
32	522	0.21	0.17
35	595	0.16	0.10
23	175	0.18	0.10
20	155	0.59	0.51
17	115	0.23	0.15
33	760	1.40	1.80
33	725	0.38	0.79
34	625	0.28	0.14
30	420	0.14	0.10
27	330	0.25	0.29
27	330	0.09	0.10
27	320	0.10	0.10
27	275	0.19	0.17
26	285	0.15	0.15
25	240	0.42	0.10
23	195	0.11	0.10
22	165	0.30	0.39
21	155	0.21	0.10
21	145	0.98	0.90
22	145	0.48	0.54
20	110	0.64	0.61
44	1740	0.16	0.22
32	680	1.02	0.25

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -0.02 + 0.96 \cdot \text{Fat (\%)} \qquad (\gamma^2 = 0.69)$$

(F)

Date: September 1981

Location: Downstream of Plainwell Dam

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
44	1495	0.48	2.40
21	155	0.61	1.30
21	155	0.49	0.83
46	1565	2.25	4.20
57	4365	1.90	9.20
20	175	0.74	0.90

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -0.38 + 3.16 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.56)$$

$$\text{PCB (ppm)} = 0.58 + 1.94 \times 10^{-3} \bullet \text{Weight (g)} \qquad (\gamma^2 = 0.97)$$

(G)

Date: September 1981

Location: Lake Allegan

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
38	880	2.00	4.30
37	1015	0.88	3.00
41	1290	7.50	47.00
43	1400	0.54	1.30
41	1300	3.30	5.10
40	1190	1.80	3.70
39	1025	1.90	4.60
39	990	1.20	3.20
39	1125	1.60	2.50
42	1410	1.50	2.60
38	1100	5.00	12.00

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -6.14 + 5.76 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.82)$$

(H)

Date: September 1981

Location: Lake Allegan

Species: Bass

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
22	175	0.18	0.61
22	165	0.45	0.84
19	100	0.22	0.48
38	880	0.35	0.99
30	660	0.54	1.30
23	420	0.42	0.79
20	155	0.45	1.30
22	140	0.66	2.20
30	385	0.44	1.30

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -0.17 + 3.06 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.77)$$

(I)

Date: July 1983

Location: Mosel Avenue

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
48	2268	2.2	3.24
47	2087	2.4	3.06
47	1497	4.0	6.53
43	1179	1.0	1.57
38	907	0.64	1.46
46	1905	4.3	6.04
51	2585	2.5	4.30
43	1487	1.4	0.98
48	2404	4.3	3.84
51	2087	2.2	1.90
53	2585	0.59	1.78

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 0.44 + 1.17 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.75)$$

(J)

Date: July 1983

Location: Downstream of Plainwell Dam

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
53	2087	1.2	3.60
53	1678	0.06	0.92
46	1406	1.7	3.71
57	2495	1.0	3.47
47	1315	2.3	4.13
42	1089	1.5	3.08
46	1406	2.6	5.21
51	1588	3.3	7.59
57	2495	1.2	0.88
61	3538	8.6	11.7
43	1678	6.8	15.9

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 1.04 + 1.61 \cdot \text{Fat (\%)} \qquad (\gamma^2 = 0.84)$$

(K)

Date: July 1983

Location: Saugatuck

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
58	2650	1.30	1.16
61	3200	13.00	25.70
53	2300	7.70	13.80
46	1650	3.10	2.63
55	2300	3.90	1.14
50	1650	7.00	10.30
48	1750	2.40	4.91
41	1000	1.80	1.39
48	1750	16.00	24.20
42	1200	1.40	1.03
52	2000	4.00	7.15

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -1.58 + 1.80 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.93)$$

$$\text{PCB (ppm)} = -4.46 + 6.64 \times 10^{-3} \bullet \text{Weight (g)} \qquad (\gamma^2 = 0.21)$$

(L)

Date: July 1985

Location: Morrow Pond

Species: Carp

Length (cm)		Weight (g)		Fat (%)	PCB (ppm)
47	÷ 2.54 = 18.5	3.2	1450 / 454 = lbs	2.70	1.80
45	= 17.7	2.8	1250	1.20	1.40
46	18.1	2.7	1230	1.20	0.87
43	16.9	2.5	1150	2.80	1.40
51	20.1	3.5	1600	1.20	1.30
49	19.3	3.3	1520	1.35	1.65
49	19.3	3.96	1800	1.50	1.40
48	18.9	3.55	1610	1.30	1.80
46	18.1	2.95	1340	0.10	0.22
47	18.5	3.2	1440	0.70	0.50
48	18.9	2.3	1030	1.30	2.40
49	19.3	3.7	1700	5.60	8.90
47	18.5	2.9	1310	1.40	2.20
44	17.3	2.6	1200	2.10	2.00
51	20.1	3.94	1790	0.80	0.52
51	20.1	4.1	1860	2.50	2.10
46	18.1	2.7	1220	0.80	0.55
51	20.1	3.7	1680	0.85	0.65
51	20.1	4.1	1840	1.60	2.20
49	19.3	3.3	1510	1.30	2.10

Best-Fit Linear Correlation:

PCB (ppm) = -0.43 + 1.38 • Fat (%) (r^2 = 0.79)

(M)

Date: July 1985

Location: Morrow Pond

Species: Bass

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
35	600	2.00	1.50
30	360	1.10	1.00
30	340	0.30	0.90
33	480	0.80	1.30
24	150	0.50	0.52
26	200	0.40	0.92
26	200	0.70	0.85

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 0.66 + 0.41 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.57)$$

(N)

Date: July 1985

Location: Mosel Avenue

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
46	1530	1.25	3.50
44	1470	0.50	2.70
50	2210	3.55	4.20
46	1800	1.90	2.70
45	1460	1.20	3.60
44	1300	1.00	4.60
48	1800	3.10	3.50
47	1550	3.35	4.00
50	2130	4.85	6.40
45	1460	1.35	4.90
47	1850	1.50	2.20
47	1710	0.25	3.20
46	1850	9.45	5.20
42	1050	0.20	1.00
46	1700	0.70	1.70
48	1800	0.20	2.20
43	1200	1.05	1.80
46	1520	0.80	3.60
46	1960	0.30	2.40

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 2.59 + 0.39 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.42)$$

(O)

Date: July 1985

Location: Lake Allegan

Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
41	1070	0.85	1.50
42	1120	1.20	2.20
39	850	0.45	2.30
42	1050	1.55	3.70
46	1370	0.88	1.70
38	920	3.00	5.90
39	870	1.25	1.60
41	930	3.65	11.00
41	1000	1.70	2.60
41	950	1.60	2.40
39	1100	1.85	3.00
39	860	2.70	2.10
43	900	2.50	5.10
44	1060	2.35	4.80
42	1200	0.85	1.50
42	1100	0.70	1.00
46	1280	1.05	1.20
40	840	1.00	1.40
45	1340	0.90	1.50

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = -0.66 + 2.30 \cdot \text{Fat (\%)} \qquad (\gamma^2 = 0.72)$$

(P)

Date: July 1985

Location: Lake Allegan

Species: Bass

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
39	850	0.25	1.85
30	400	0.60	1.60
30	400	0.75	1.90
33	660	0.65	1.60
28	330	1.55	2.40
30	400	2.65	4.30
40	650	1.00	1.80
40	780	0.20	3.90
35	610	0.75	2.00
31	300	0.68	0.67

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 1.51 + 0.76 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.25)$$

DRAFT

Date: July 1985
Location: Saugatuck
Species: Carp

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
48	1630	6.90	2.00
45	1380	6.90	1.10
46	1380	3.40	0.97
45	1360	3.40	2.40
44	1100	1.30	0.18
50	1740	5.40	2.70
50	1740	4.70	1.10
50	1740	3.30	1.70
47	1520	5.10	1.50
44	1120	2.70	0.45
50	1840	3.30	2.30
49	1820	12.70	2.60
49	1680	10.10	2.60
47	1360	4.80	1.30
48	1480	3.90	2.00
48	1640	0.95	0.78
49	1710	11.50	3.60
47	1790	7.20	2.10
51	2020	7.40	4.30
52	2000	5.80	6.40

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 0.88 + 0.22 \bullet \text{Fat (\%)} \qquad (r^2 = 0.23)$$

$$\text{PCB (ppm)} = -4.52 + 4.13 \times 10^{-3} \bullet \text{Weight (g)} \qquad (r^2 = 0.55)$$

(R)

Date: July 1985

Location: Saugatuck

Species: Bass

Length (cm)	Weight (g)	Fat (%)	PCB (ppm)
33	520	1.70	1.70
33	560	0.80	0.41
36	760	0.64	0.70
40	960	1.15	1.00
31	400	0.30	0.35
40	1080	0.80	0.90
37	820	0.80	0.96
36	740	0.50	0.54
33	520	0.50	0.33
30	280	0.79	0.90

Best-Fit Linear Correlation:

$$\text{PCB (ppm)} = 9.50 \times 10^{-3} + 0.96 \bullet \text{Fat (\%)} \qquad (\gamma^2 = 0.84)$$

DRAFT

APPENDIX C

LABORATORY EXAMINATION OF KALAMAZOO RIVER FISH

PRECISION AND ACCURACY SUMMARY - KALAMAZOO RIVER FISH ANALYSES

REPORT OF LABORATORY EXAMINATION

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
Phone (517) 353-1683

PRIVILEGED INFORMATION
NOT FOR PUBLICATION

Accession No. 534295-300
Clinic No. --
Date Shipped --
Date Received July 9, 1985
Final Report August 7, 1985

Veterinarian

Owner James Rossio 6238
Michigan Department of Natural Resou
Fisheries Division
Post Office Box 30028
Lansing, MI 48909

Specimen 6 fish **Breed** Carp **Age** ? **Sex** 4M/2F

Preliminary reports None

HISTORY:

The history was that the carp were collected in the Kalamazoo River in area where the river was quite contaminated. There was a nearby source of pollution or contamination which was reportedly in the process of being altered so that there would be less pollution. The fish were submitted for evaluation and work-up and because they had fairly markedly eroded hyperemic fins.

GROSS LESIONS:

The general condition of the carcasses was judged as fair to good with the primary external lesion noted being evidence of moderate to severe erosion of the pectoral fins, caudal fins and dorsal and pelvic fins. One of the fish, identified as #534300, had 2 fleshy growths or pinkish protrusions of a rather villous-appearing material on the caudal portion of the body just ahead of the tail fin. One of these was approximately 1.5 to 2 cm in diameter and extended 3 to 4 mm above the surface of the scales. A second area was approximately 4 mm in diameter and protruded approximately 2 to 3 mm above the adjoining scales. All fish had varying amounts of peritonitis with adhesions of most of the abdominal viscera to one another and to the body wall. There were considerable quantities of a black particulate material in the gills of all fish. Fish #534300 also had elevated greenish-white protrusions on the gill cover with greatest size being raised approximately 3 mm above the surface and a total diameter of approximately 3.5 to 4 cm. When the tissues were trimmed, the protrusions on the surface of the body appeared to be limited to the skin and did not continue down into the subcutis or muscle.

LABORATORY FINDINGS:

Bacteriologic examination: *Aeromonas hydrophila* was isolated from the swab taken from the skin, or fins, of all fish. In addition, *Enterobacter*

Continued . . .

OWNER: You are advised to consult your veterinarian for his analysis of this report and for any treatment tha might be indicated. Fees for services of the lab will follow under separate cover and will not includ professional service fees of the veterinarian.

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REPORT OF LABORATORY EXAMINATION

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
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PRIVILEGED INFORMATION
NOT FOR PUBLICATION

Accession No. 534295-300 cont.

Clinic No. _____

Date Shipped _____

Date Received _____

Final Report _____

Veterinarian

Owner

Specimen _____ **Breed** _____ **Age** _____ **Sex** _____

Preliminary reports _____

aerogenes was recovered from the liver and spleen of #534295 and *Klebsiella oxytoca* was isolated from the swab taken from the skin of that particular fish. *Aeromonas hydrophila, Enterobacteria aerogenes, Pseudomonas putrefaciens* and *Proteus vulgaris* were isolated from kidney, liver, spleen and a swab taken from the skin of #534298. *Aeromonas hydrophila* were also isolated from the intestine of that particular fish.

Toxicologic examination: Please refer to the attached report. It was felt that the 3.6 ppm cadmium identified in the tissues of one of the fish was interpreted as a likely reflection of the bottom-feeding habits of this type of fish.

Histopathologic examination: On microscopic examination the growths that appeared on the surface of the skin of #534300 were classified as papillomas or squamous papillomas which were limited to the epithelial surface. There were moderate to large numbers of cells with granular cytoplasm. These were similar to the so-called "alarm cells". The change on the gill cover was very similar with a marked thickening of the epithelium with a very abrupt onset of an epithelium changing from 4 to 5 cell layers thick to one which was 12 to 15 cell layers thick. In both of the areas there were also cells with many eosinophilic granules within the cytoplasm similar to the eosinophilic granulocytes. In the mass on the gill cover there appeared to be some increase in the thickness of the subepithelial connective tissue but the basal layer of columnar cells of the epithelium appeared to be intact. There were, however, finger-like projections of connective tissue extending varying distances into the hyperplastic or neoplastic epithelium with some of the fingers of connective tissue extending all the way to the surface of the growth. Changes noted in other tissues included lesions of a chronic peritonitis characterized by the finding of fairly well-organized connective tissue on the surfaces of the heart, liver, intestine and gonad. In some locations there was primarily accumulation of fibrin on the surface of the abdominal organs rather than organized fibrous connective tissue. In

Continued . . .

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Veterinarian

Owner

Specimen _____ **Breed** _____ **Age** _____ **Sex** _____

Preliminary reports _____

addition, there were considerable increases in connective tissue around some of the bile ducts and pancreatic ducts. These were accompanied by cellular accumulations on the adventitial or serosal surfaces of the ducts as they progressed into and through the liver and pancreas. The increased cellularity was a mixture of cells, including granulocytes and lymphocytes as well as a few scattered plasma cells. There were quite numerous melanomacrophage centers, both in the spleen and, to a lesser extent, in the liver. Thyroid follicle contained much colloid and had a very flattened epithelium. Postmortem change somewhat hampered evaluation of gills as there was sloughing of the gill epithelium. There were some differences between fish and between gills from individual fish. In general, there appeared to be hyperplasia of epithelium of the gills near the bases of gill lamellae. There also appeared to be increases in numbers of chloride cells within the gill epithelium. There were areas of necrosis, erosion and ulceration of the skin surface over the fin with infiltration of inflammatory cells in some locations, but in general, a relative lack of marked inflammatory cellular infiltrate. There were some areas of accumulation of edema fluid in the connective tissue under the ulcerated areas of the skin, some without much infiltration of granulocytes or lymphocytes. In some sections taken deep through the base of the fin, there was considerable segmental degeneration in muscle fibers in the section, but it was felt that this was probably due to exertion during capture of the fish. In one or two locations there appeared to be moderate numbers of markedly enlarged cells in the superficial epithelium over the fins or at the base of the fins. Special stains are being employed on these particular cells to try to further define their identity. If they are definitively identified, a supplemental report will be sent. There were areas of hyperplasia of epithelium over the ventral surface of the chin below the gills on #539299. This particular fish also had hyperplasia of epithelium at the base of the gills and infiltration of granulocytes into the epithelium and the superficial connective tissue immediately under the epithelium at the base of the gills. Both of these changes were very focal in nature and limited to small areas on the fish. Fish #534298 had a

Continued . . .

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REPORT OF LABORATORY EXAMINATION

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
Phone (517) 353-1683

PRIVILEGED INFORMATION
NOT FOR PUBLICATION

Accession No. 534295-300 cont.

Clinic No. _____

Date Shipped _____

Date Received _____

Final Report _____

Veterinarian

Owner

Specimen _____ **Breed** _____ **Age** _____ **Sex** _____

Preliminary reports _____

fairly markedly vacuolated liver with most of the vacuolation being either hydrophic change or glycogen. It was felt that it was probably hydrophic degeneration from the character of the vacuolation and the distribution. The lesions in the gills in this particular fish were also somewhat more severe than noted in other fish with fairly marked hyperplasia of epithelium and fusion of gill lamellae in the proximal 1/3 of the lamellae, particularly at the base of the gill filament. The remaining fish had essentially similar lesions to those described under the general lesions noted. There were some minor variations but it was in severity rather than type of lesion. The basic change noted in the fins was essentially variable amounts of hyperplasia of epithelium adjacent to ulceration. There were variable amounts of infiltrations of inflammatory cells into the connective tissue under the area of ulceration and somewhat variable amounts of infiltration of inflammatory cells into the epithelium immediately adjacent to the areas of ulceration. Definitive evidence of causative agents were not noted in the areas of ulceration.

CONCLUSIONS:

There was alteration of the epithelium over the fins with variable amounts of inflammatory response. In addition, one of the fish had multiple papillomas, one on the gill cover, or operculum, and 2 on the lateral surface of the body anterior to the tail. These were fairly typical papillomas, or squamous papillomas.

(These types of tumors and skin changes have been described as a result of polluted sediments in the fish's environment. The pollutant has not been consistently identified and it is felt that the change is not a specific change to a single chemical but a change which may occur with several different chemicals. The lesions are also similar to carp pox.)

A. L. Trapp
kd
copies to: Mr. Rossio, Dr. Slanker, AHDL + 1

OWNER: You are advised to consult your veterinarian for his analysis of this report and for any treatment th might be indicated. Fees for services of the lab will follow under separate cover and will not inclu professional service fees of the veterinarian.

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REPORT OF LABORATORY EXAMINATION

TOXICOLOGY

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
Phone (517) 353-1683

ACCESSION : 534300
CLINIC ID : ----
DATE REP'T : 07/19/85
DATE REC'D : 7/ 9/85
PATHOLOGIST : ALT

PRIVILEGED INFORMATION
NOT FOR PUBLICATION

CLIENT ACCOUNT NUMBER: 6238

ROSSIO, JAMES
MICHIGAN DEPT. OF NAT. RES.
DNR FISHERIES DIVISION
P.O. BOX 30028
LANSING MI 48909
DR. H. WESTERS, HCH/PL/SP
PHONE: 800-292-4706

OWNER: MICHIGAN DEPT. NATURAL RES.
SURFACE WATER QUALITY DIV.
P.O. BOX 30028
LANSING MI 48909
ATTENTION JOHN WUYCHECK

SPECIES: ----
BREED : FISH OTHER
AGE : ----
NAME :
SEX : UNDETERMINED

HISTORY: ABNORMAL FINS

TEST ANALYSES REQUESTED

B) LIVER

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	(	NDA)	BA	(	.2)	CA	(	213.)	CU	(	4.5)
CO	(	NDA)	FE	(	286.)	MG	(	131.)	MN	(	3.2)
MO	(	NDA)	P	(	2300.)	ZN	(	64.)			
NA(H)	(	1200.)	K	(	2100.)	AL	(	6.0)	SB	(	NDA)
AS	(	NDA)	CR	(	NDA)	CD	(	.3)	HG	(	NDA)
PB	(	NDA)	SE	(	NDA)	TL	(	NDA)			

C) KIDNEY

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	(	NDA)	BA	(	NDA)	CA	(	71.)	CU	(	1.5)
CO	(	.9)	FE	(	361.)	MG	(	93.)	MN	(	.6)
MO	(	NDA)	P	(	1900.)	ZN	(	53.)			
NA(H)	(	1400.)	K	(	1800.)	AL	(	1.1)	SB	(	NDA)
AS	(	NDA)	CR	(	NDA)	CD	(	1.3)	HG	(	NDA)
PB	(	NDA)	SE	(	NDA)	TL	(	NDA)			

COMMENTS FROM THE LABORATORY:

TISSUE ELEMENT CONCENTRATIONS ARE WITHIN EXPECTED RANGES.
MICHAEL SLANKER, DVM 07/19/85
CLINICAL TOXICOLOGIST 517-353-1683

REPORT OF LABORATORY EXAMINATION

TOXICOLOGY

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
Phone (517) 353-1683

ACCESSION : 534297
CLINIC ID : ---
DATE REP'T : 07/19/85
DATE REC'D : 7/ 9/85
PATHOLOGIST : ALT

PRIVILEGED INFORMATION
NOT FOR PUBLICATION

CLIENT ACCOUNT NUMBER: 6238

ROSSIO, JAMES
MICHIGAN DEPT. OF NAT. RES.
DNR FISHERIES DIVISION
P.O. BOX 30028
LANSING MI 48909
DR. H. WESTERS, HCH/PL/SP
PHONE: 800-292-4706

OWNER: MICHIGAN DEPT. NATURAL RES.
SURFACE WATER QUALITY DIV.
P.O. BOX 30028
LANSING MI 48909
ATTENTION JOHN WUYCHECK

SPECIES: ----
BREED : FISH OTHER
AGE : ----
NAME :
SEX : UNDETERMINED

HISTORY: ABNORMAL FINS

TEST ANALYSES REQUESTED

B) LIVER

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	NDA	BA	.2	CA	410.	CU	1.8
CO	NDA	FE	270.	MG	139.	MN	2.0
MO	NDA	P	2100.	ZN	77.		
NA(H)	1200.	K	2300.	AL	9.2	SB	NDA
AS	NDA	CR	NDA	CD	NDA	HG	NDA
PB	NDA	SE	NDA	TL	NDA		

C) KIDNEY

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	NDA	BA	NDA	CA	63.	CU	1.0
CO	.5	FE	604.	MG	90.	MN	.2
MO	NDA	P	1800.	ZN	75.		
NA(H)	1400.	K	1400.	AL	1.1	SB	NDA
AS	NDA	CR	NDA	CD	.6	HG	NDA
PB	NDA	SE	NDA	TL	NDA		

COMMENTS FROM THE LABORATORY:

TISSUE ELEMENT CONCENTRATIONS ARE WITHIN EXPECTED RANGES.
MICHAEL SLANKER, DVM 07/19/85
CLINICAL TOXICOLOGIST 517-353-1683

REPORT OF LABORATORY EXAMINATION

TOXICOLOGY

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
Phone (517) 353-1683

ACCESSION : 534298
CLINIC ID : ----
DATE REP'T : 07/19/85
DATE REC'D : 7/ 9/85
PATHOLOGIST : ALT

PRIVILEGED INFORMATION
NOT FOR PUBLICATION

CLIENT ACCOUNT NUMBER: 6238

ROSSIO, JAMES
MICHIGAN DEPT. OF NAT. RES.
DNR FISHERIES DIVISION
P.O. BOX 30028
LANSING MI 48909
DR. H. WESTERS, HCH/PL/SP
PHONE: 800-292-4706

OWNER: MICHIGAN DEPT. NATURAL RES.
SURFACE WATER QUALITY DIV.
P.O. BOX 30028
LANSING MI 48909
ATTENTION JOHN WUYCHECK

SPECIES: ----
BREED : FISH OTHER
AGE : ----
NAME :
SEX : UNDETERMINED

HISTORY: ABNORMAL FINS

TEST ANALYSES REQUESTED

B) LIVER

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	1.0	BA	.1	CA	158.	CU	5.5
CO	NDA	FE	320.	MG	125.	MN	1.3
MO	NDA	P	2200.	ZN	170.		
NA(H)	1300.	K	1900.	AL	6.7	SB	NDA
AS	NDA	CR	NDA	CD	.1	HG	NDA
PB	NDA	SE	NDA	TL	NDA		

C) KIDNEY

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	NDA	BA	NDA	CA	65.	CU	1.5
CO	.6	FE	99.	MG	87.	MN	.6
MO	NDA	P	2000.	ZN	118.		
NA(H)	1400.	K	1500.	AL	NDA	SB	NDA
AS	NDA	CR	NDA	CD	1.6	HG	NDA
PB	NDA	SE	NDA	TL	NDA		

COMMENTS FROM THE LABORATORY:

TISSUE ELEMENT CONCENTRATIONS ARE WITHIN EXPECTED RANGES.
MICHAEL SLANKER, DVM 07/19/85
CLINICAL TOXICOLOGIST 517-353-1683

REPORT OF LABORATORY EXAMINATION

TOXICOLOGY

ANIMAL HEALTH DIAGNOSTIC LABORATORY
P.O. Box 30076
Lansing, MI 48909
Phone (517) 353-1683

ACCESSION : 534295
CLINIC ID : ----
DATE REP'T : 07/19/85
DATE REC'D : 7/ 9/85
PATHOLOGIST : ALT

PRIVILEGED INFORMATION
NOT FOR PUBLICATION

CLIENT ACCOUNT NUMBER: 6238

ROSSIO, JAMES
MICHIGAN DEPT. OF NAT. RES.
DNR FISHERIES DIVISION
P.O. BOX 30028
LANSING MI 48909
DR. H. WESTERS, HCH/PL/SP
PHONE: 800-292-4706

OWNER: MICHIGAN DEPT. NATURAL RES.
SURFACE WATER QUALITY DIV.
P.O. BOX 30028
LANSING MI 48909
ATTENTION JOHN WUYCHECK

SPECIES: ----
BREED : FISH OTHER
AGE : ----
NAME : CARP
SEX : UNDETERMINED

HISTORY: ABNORMAL FINS

TEST ANALYSES REQUESTED

B) LIVER

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	NDA	BA	NDA	CA	93.	CU	6.7		
CO	NDA	FE	309.	MG	148.	MN	1.9		
MO	NDA	P	2800.	ZN	28.				
NA(H)	1200.	K	1900.	AL	2.6	SB	NDA		
AS	NDA	CR	NDA	CD	.5	HG	NDA		
PB	NDA	SE	NDA	TL	NDA				

C) KIDNEY

TISSUE MINERAL ANALYSIS (PPM : WET-WEIGHT)

B	NDA	BA	NDA	CA	100.	CU	2.1		
CO	.8	FE	96.	MG	83.	MN	.9		
MO	.2	P	1700.	ZN	59.				
NA(H)	1600.	K	1700.	AL	NDA	SB	NDA		
AS	NDA	CR	NDA	CD	3.6	HG	NDA		
PB	NDA	SE	NDA	TL	NDA				

COMMENTS FROM THE LABORATORY:

TISSUE ELEMENT CONCENTRATIONS ARE WITHIN EXPECTED RANGES.
THE CADMIUM AT 3.6 PPM REFLECTS THE BOTTOM FEEDING HABITS.

MICHAEL SLANKER, DVM 07/19/85
CLINICAL TOXICOLOGIST 517-353-1683

ADD C

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

JAN 15 1986

January 9, 1986

TO: Bill Creal, Water Quality Surveillance Section, SWQD

FROM: Fernando Calera, Environmental Laboratory Section, ESD

SUBJECT: Precision and Accuracy Summary of the Kalamazoo River PCB Fish Study

Fish samples from the Kalamazoo River were analyzed in 14 batches (#'s 1353-1366). Each batch of samples consisted of one reagent blank, one matrix blank, two matrix spikes (A & B), one universal control, a maximum of 10 actual samples plus one field duplicate.

The reagent blank contained everything but an actual fish matrix. The matrix blank is an actual fish matrix that contains very low levels of PCB's. Matrix spikes (A & B) are from the same source as the matrix blank, however, they are dosed with a known amount of PCB's (as Aroclor 1254). Results obtained from the matrix spikes are corrected for the matrix blank. The universal control is an actual fish sample that contains high levels of PCB's. Its true value is being established by repetitive analysis over a period of time.

Fourteen pairs of matrix spikes were analyzed for Aroclor 1254. The mean % recovery and standard deviation is 100.3% ± 8.5% (n=26). Between run precision is 0.9 mg/kg (ppm) (n=12) when the concentration of the spike added was 5.0 ppm. Two spike values (in batches #1354 and #1358) were discarded due to identifiable analytical problems. Average percent fat recoveries for the matrix spikes is 6.09% ± 0.58% (n=26). The between run precision is 0.88% (n=12).

Quality control audits for the universal control have not been established yet. The average percent fat and PCB (as 1254) concentration is 15.4% ± 0.9% and 10.1 mg/kg ± 1.5 mg/kg, respectively (n=12). Between run precision is 2.3% for percent fat and 4.0 mg/kg for PCB (n=12). Batch #1356 didn't have a universal control and batch #1360 was an outlier for both % fat and PCB.

All samples and controls were spiked with a known amount of decachlorobiphenyl (DCB). DCB is used as a surrogate compound to monitor the extraction efficiency of every sample. The addition of DCB was implemented starting with batch #1358. The mean % recovery and standard deviation for samples only (blanks and controls not included is 87.7% ± 15.6% (n=93). The DCB recovery for spikes is 87.1% ± 12.8% (n=17).

1 STD DEV Pick Fernando 1-14-86

With only fourteen pairs of field duplicates for analysis, a linear regression analysis for precision of 0.15 times the concentration plus 0.15 mg/kg (up to concentrations of 3.6 mg/kg) was obtained. The r value is 0.52.

Should you require any further information, please feel free to contact me.

FC:dk

Fernando Calera

cc: G. Su
J. Peck
G. Jackson
P. Priniski
S. Wadle

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

RECEIVED

OCT 8 1985

SWQD
W. Q. SURVEILLANCE

October 2, 1985

TO: Bill Creal, Water Quality Surveillance Section, SWQD

FROM: John Peck, Environmental Laboratory Section, ESD

SUBJECT: Kalamazoo River PCB Project - Precision and Accuracy

I have reviewed the quality control audits associated with the water samples for PCB from the Kalamazoo River project. Although there is not enough field replicate data for a linear regression estimate of precision (n=4), these pairs can be used to support other audits. Twenty or more pairs would have been required for a reasonable estimate of regression.

A couple routine QC audits are of particular value for estimating precision and accuracy. With each batch of samples, one reagent blank, one matrix blank (in this case distilled water), and two spiked matrix blanks were analyzed. The spikes contained 20 ng/L Aroclors 1242 and 1260. Recoveries of the Aroclors demonstrate the ability to recover low level PCB within the analytical system.

Sixteen pairs of spikes were analyzed (n=32). From them, there was one outlier for Aroclor 1242 (45.8 ng/L) and one for Aroclor 1260 (33 ng/L). The mean % recovery and standard deviation for Aroclor 1242 is 106.8% $\pm$ 14.5% (n=31) and is 99.8% $\pm$ 12.8% for Aroclor 1260 (n=31). No bias is indicated.

Precision at 20 ng/L can also be estimated from the spike pairs. Between-run precision is 2.9 and 2.6 ng/L for Aroclors 1242 and 1260, respectively (n=31). Within-run precision is 2.3 and 2.4 ng/L for Aroclors 1242 and 1260, respectively (n=15). The within-run precision should be better than between-run, as found. Also, the reported detection limit of 10 ng/L appears to be supportable from the precision. As concentration increases, the absolute precision will increase (and relative decrease). As mentioned, there is inadequate data to estimate a line of regression for precision.

Another QC audit of potential value is the addition of 4,4'-dibromobiphenyl (DBB) to all samples and QC audits. DBB is used as a surrogate compound to monitor potential recovery problems which may have resulted somewhere during the extraction and analytical processes. DBB, which should behave similarly to the various PCB's, was spiked at 300 ng/L. Recovery of DBB in the four batch QC audits (reagent blank, matrix blank and two spiked matrix blanks) was 76.6% $\pm$ 10.9% (n=64, no outliers). Recovery of DBB in the actual samples was 74.2% $\pm$ 12.9 (n=86, two outliers). Very low DBB recoveries (10 and 14%, respectively) were obtained on the initial analysis of the Mead Paper and Menasha Paper outfalls (Log 6672, Samples 51247 and 51248). Actual PCB levels would be significantly higher than those reported for these two samples. (These samples required centrifuging to break up emulsions, which normally reduces recovery.)

The DBB recoveries are equivalent for QC audits and samples. The approximately seventy-five percent recovery indicates a possible low recovery problem. However, due to the agreement between DBB recoveries for QC audits and samples and the excellent recovery of PCB on QC audits, I do not feel that a PCB recovery problem routinely existed. Any recovery problem appears to be with the DBB QC audit.

We will evaluate other matrices similarly, depending on available QC audits. Let me know if you have any questions with how this data has been presented.

John Peck

JHP:cjc

cc: G. Su
F. Calera
J. Vanderhoof
L. Hallifax
G. Jackson

MICHIGAN DEPARTMENT OF NATURAL RESOURCES

INTEROFFICE COMMUNICATION

RECEIVED
OCT 11 1985
SWQD
W. Q. SURVEILLANCE

October 9, 1985

TO: William Creal, Water Quality Surveillance, SWQD

FROM: John Peck, Laboratory, ESD

SUBJECT: Line of Regression - PCB in Water

For a line of regression for PCB in water samples from the Kalamazoo River project, I recommend 0.075 times the concentration plus 2ng/L (up to concentration of 300 ng/L). This was determined by averaging estimates of standard deviation at four concentration levels (10, 50, 150 and 300 ng/L) by Fernando Calera, John Vanderhoof and myself. Our individual estimates agreed quite well.

Also, the low recovery of DBB noticed (75%) may be due to partitioning of DBB during the liquid/liquid extraction step. This normally happens, but would be affected by the increased water volumes we used for your samples. This hypothesis is being experimentally evaluated.

John Peck

JP:dk
cc: F. Calera
J. Vanderhoof
G. Jackson

Sediment sampling results from the Kalamazoo River.Trowbridge and Plainwell impoundments. August 1, 1985.

Trowbridge impoundment

Depth ft	Total solids %	Phenols mg/kg	Mercury mg/kg	Acenaphthylene ug/kg	Anthracene ug/kg	Benz(a) anthracene ug/kg	Benzo(k) fluoranthene ug/kg	Benzo(a) pyrene ug/kg	Chrysene ug/kg	Fluoranthene ug/kg	Fluorene ug/kg	Phenanthrene ug/kg	Pyrene ug/kg	PCB mg/k
1	73.2	1.4	int	<87	<87	110	M	<87	250	640	<87	450	690	10.
2	77.3	2.1	<0.5	<130	<130	310	M	<130	330	350	<130	330	220	2.
3	68.3	5.7	0.3	<980	<980	<980	<980	<980	1200	1200	<980	<980	<980	3.
4	70.2	4.4	0.3	<890	<890	<890	<890	<890	<890	<890	<890	<890	<890	3.
5	59.4	4.5	1.3	<1100	<1100	1100	<1100	<1100	1500	<1100	<1100	<1100	<1100	4.
6	46.8	2.6	1.7	<1400	<1400	<1400	<1400	<1400	3300	4000	<1400	<1400	<1400	<1.
7	44.3	6.4	3.1	<1800	<1800	<1800	<1800	<1800	3100	4700	<1800	<1800	M	1.
8	45.0	8.2	3.9	<1400	<1400	<1400	<1400	<1400	3600	4200	<1400	1500	M	<1.
9	54.2	4.1	1.7	<1200	<1200	<1200	<1200	<1200	2100	1700	<1200	<1200	M	<0.3
10	49.2	2.5	4.1	<240	<240	<240	<240	<240	360	300	<240	260	M	<0.5
11	51.6	4.5	5.3	<230	<230	1000	<230	<230	360	230	<230	400	M	<0.3

Plainwell impoundment

1	64.3	1.8	1.0	<200	<200	<200	<200	<200	800	M	<200	320	M	13.
2	47.4	5.6	2.6	<1500	<1500	<1500	<1500	<1500	2100	<1500	<1500	<1500	5800	14.
3	48.4	4.9	2.0	<1300	<1300	<1300	<1300	<1300	7000	6500	<1300	<1300	M	1.
4	42.9	5.9	3.2	<1500	M	<1500	<1500	<1500	M	6000	<1500	2400	M	<1.
5	43.3	2.1	3.2	2000	M	1000	<1400	<1400	M	6100	1500	2300	M	<1.
6	43.6	1.8	4.3	M	M	<1500	<1500	<1500	M	7100	<1500	2800	M	<1.
7	45.3	1.6	4.6	M	M	<1500	<1500	<1500	M	8700	<1500	3000	M	<1.
8	59.2	1.0	2.4	<1000	M	<1000	<1000	1100	M	6600	<1000	1200	M	<0.2

M=presence of material verified but not quantified

All other scan 3 or 7 compounds not detected

APPENDIX D

INPUT VARIABLES FOR MODEL

TABLE D-1

LIST OF INPUT VARIABLES FOR THE PROGRAM

Variable	Description
DX	Spacial increment for solving the system differential equations (m)
NSIZE	Number of subdivision of DX to improve the accuracy of the solution
NM	Number of monthly flows used for simulation
NR	Number of reaches in the river
RL(I)	Length of reach I (m)
W(I,J)	Average width of reach I and month J (m)
D(I,J)	Average depth of reach I and month J (m)
WP(I,J)	Wetted perimeter of the representative cross-section for reach I and month J (m)
ASD(I)	Cross-section area of the active sediment layer (m^2)
SLOPE(I)	Bed slope of reach I (fraction)
D_{50}(I)	Mean particle size for the suspended solids of reach I (m)
PCW(I)	Fraction of clay in the suspended solids of reach I
PCS(I)	Fraction of clay in the sediment layer of reach I
DD(I)	Benthic diffusion velocity of PCB of reach I (m/min)
B(I)	Sediment burial velocity of reach I (m/min)
RB(I)	PCB benthic release rate of reach I ($g/m^2/min$)
RR(I)	Sediment suspension velocity of reach I (m/min)
S(I)	Average settling velocity of suspended solids for reach I (m/min)

TABLE D-1
LIST OF INPUT VARIABLE FOR THE PROGRAM
PAGE TWO

Variable	Description
SS(I)	Volume fraction of sediment in the active sediment layer of reach I (m^3 sed/m^3)
SI(J)	Concentration of suspended solids in the first reach of month J (g/m^3)
RAO	Sediment density (g/m^3)
VIS	Kinematic viscosity of water (m^2/hr)
RKO	PCB first-order biodegradation rate at 20°C (min^{-1})
RKR	Oxygen reaeration rate (min^{-1})
RA	Atmospheric PCB fallout rate ($g/m^2/min$)
RAR	Reaeration coefficient ratio for PCB (dimensionless)
THETA	Thermal factor for PCB biodegradation (dimensionless)
RKPS	PCB partition coefficient for sand (m^3 water/10^6 g solid)
RKPC	PCB partition coefficient for clayey materials (m^3 water/10^6 g solid)
TAOC	Critical shear stress of the cohesive bed materials ($kg/m/hr^2$)
ER(I)	Erosion rate constant of the cohesive bed materials of reach I ($g/m^2/min$)
QS(I,J)	Discharge of point PCB loading of reach I and month J (m^3/min)
QX(I,J)	Distributed water discharge along reach I and month J ($m^3/min/m$)
QSDX(I,J)	Distributed sediment discharge along reach I and month J (m^3 sed/min/m)

TABLE D-1
LIST OF INPUT VARIABLE FOR THE PROGRAM
PAGE THREE

Variable	Description
QSDP(I,J)	Point sediment loading rate within reach I and month J (g sed/min)
QW(J)	Average monthly flow of the headwater of month J (m^3/min)
WT(I,J)	Average monthly water temperature for reach I and month J (°C)
CI(J)	PCB concentration of the headwater of month J (g/m^3 or ppm)
CS(I)	PCB concentration in sediment of reach I (mg/kg sed)
CP(I,J)	Dissolved PCB concentration of the point loading within reach I and month J (g/m^3 or ppm)
CPS(I,J)	PCB concentration of the point sediment loading within reach I and month J (mg/kg sed)

TABLE D-1
LIST OF INPUT VARIABLE FOR THE PROGRAM
PAGE FOUR

Values of all the input available shown in Table B-1 were entered through Subroutine READIN of the computer program of this model. The input sequences are indicated in the following read statements.

```
READ (IN,*)   DX,NM,NR
READ (IN,*)   NSIZE

READ (IN,*)   (RL(I),I=1,NR)
READ (IN,*)   ((W(I,J),J=1,NM),I=1,NR)
READ (IN,*)   ((D(I,J),J=1,NM),I=1,NR)
READ (IN,*)   ((WP(I,J),J=1,NM),I=1,NR)
READ (IN,*)   (ASD(I),I=1,NR)
READ (IN,*)   (SLOPE(I),I=1,NR)
READ (IN,*)   (D50(I),I=1,NR)
READ (IN,*)   (PCW(I),I=1,NR)
READ (IN,*)   (PCS(I),I=1,NR)

READ (IN,*)   (DD(I),I=1,NR)
READ (IN,*)   (B(I),I=1,NR)
READ (IN,*)   (RB(I),I=1,NR)
READ (IN,*)   (RR(I),I=1,NR)
READ (IN,*)   (ER(I),I=1,NR)
READ (IN,*)   (S(I),I=1,NR)
READ (IN,*)   (SS(I),I=1,NR)
READ (IN,*)   (SI(I),I=1,NR)
READ (IN,*)   RAO,VIS

READ (IN,*)   RKO,RKR,RA,RAR,THETA,RKPS,RKPC,TAOC

READ (IN,*)   ((QS(I,J),J=1,NM),I=1,NR)
READ (IN,*)   ((QX(I,J),J=1,NM),I=1,NR)
READ (IN,*)   ((QSDX(I,J),J=1,NM),I=1,NR)
READ (IN,*)   ((QSDP(I,J),J=1,NM),I=1,NR)

READ (IN,*)   (QW(I),I=1,NM)

READ (IN,*)   ((WT(I,J),J=1,NM),I=1,NR)

READ (IN,*)   (CI(J),J=1,NM)
READ (IN,*)   (CS(I),I=1,NR)
READ (IN,*)   ((CP(I,J),J=1,NM),I=1,NR)
READ (IN,*)   ((CPS(I,J),J=1,NM),I=1,NR)
```

Calibrated input data for the No-Action alternative are also listed on the following pages.

```
100.,6,10
1
2800.,23000.,3200.,2800.,5242.,6500.,11750.,2650.,16829.,45122.
5.,5.,5.,5.,5.,5.,
43.7,43.9,46.,46.,44.6,43.7,
69.4,71.5,93.3,93.3,79.5,71.5,
82.6,82.6,82.6,82.6,82.6,82.6,
75.,75.,94.,94.,85.,75.,
98.,98.,200.,200.,150.,98.,
70.2,70.2,70.2,70.2,70.2,70.2,
210.,210.,210.,210.,210.,210.,
381.,381.,381.,381.,381.,381.,
55.,55.,75.,75.,55.,55.
0.6,0.6,0.6,0.6,0.6,0.6,
1.15,1.18,1.42,1.42,1.26,1.15,
0.95,1.06,1.65,1.65,1.42,0.95,
1.23,1.23,1.23,1.23,1.23,1.23,
1.2,1.2,1.5,1.5,1.2,1.2,
1.2,1.2,1.5,1.5,1.3,1.2,
1.4,1.4,1.7,1.7,1.4,1.4,
1.9,1.9,1.9,1.9,1.9,1.9,
3.35,3.35,3.35,3.35,3.35,3.35,
2.6,2.6,3.,3.,2.6,2.6
6.2,6.2,6.2,6.2,6.2,6.2,
46.,46.3,48.8,48.8,47.1,46.,
71.3,73.6,97.4,97.4,96.1,73.4,
85.1,85.1,85.1,85.1,85.1,85.1,
77.4,77.4,97.,97.,77.4,77.4,
100.4,100.4,203.,203.,152.6,100.4,
73.,73.,73.6,73.6,73.,73.,
213.8,213.8,213.8,213.8,213.8,213.8,
387.7,387.7,387.7,387.7,387.7,387.7,
60.2,60.2,81.,81.,60.2,60.2
ASD 0.62,4.61,7.48,25.5,8.1,12.2,7.3,64.1,116.3,6.4
SLOPE 1.E-3,5.E-4,6.8E-4,2.E-4,7.4E-4,6.9E-4,5.E-4,1.2E-4,2.E-4,3.78E-4
DSC 4.E-6,4.E-6,4.E-6,4.E-6,4.E-6,4.E-6,4.E-6,4.E-6,4.E-6,4.E-6
PCU- 0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5
PCS 0.3,0.4,0.5,0.5,0.4,0.5,0.4,0.6,0.5,0.6
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B 1.9E-7,1.5E-7,2.5E-7,2.5E-7,2.0E-7,2.8E-7,2.5E-7,1.4E-7,3.5E-7,4.E-7
RB 1.E-10,1.E-10,1.7E-8,4.E-8,4.8E-8,2.1E-8,0.7E-7,0.,2.2E-8,0.
RK .45E-8,.4E-10,3.15E-8,.39E-10,.42E-7,2.34E-8,.54E-9,.65E-8,.63E-8,.55E-10
ER 5.E-5,4.E-5,5.E-5,5.E-5,5.E-5,5.E-5,4.5E-5,1.E-4,1.E-4,1.E-4
S 2.71E-5,2.41E-4,1.6E-5,4.75E-5,3.05E-5,2.07E-5,1.15E-3,1.5E-5,1.33E-5,4.6
SS 0.45,0.4,0.42,0.39,0.35,0.45,0.45,0.65,0.33,0.55
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RHO,VSS 2.E+6,0.005
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APPENDIX E

COST ESTIMATES

KALAMAZOO RIVER
Portage Creek - Channel Lining / Soil Cap
(KAL-B)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	11000	CY		8.00	4.98	4.97		88000	54780	54670	197450	
b. Gravel Bed - 6"	6000	CY		10.50	2.20	6.11		63000	13200	36660	112860	
c. Filter Fabric	36800	SY		1.20	.16			44160	5888		50048	
d. Excavation & Spread.	27000	CY			.39	1.77			10530	47790	58320	
2) SOIL CAP												
a. Regrading	11000	CY			.41	1.66			4510	18260	22770	
b. Soil Layer - 18"	32700	CY		1.50	1.80	4.90		49050	58860	160230	268140	
c. Topsoil Layer - 6"	11000	CY		5.50	1.80	4.90		60500	19800	53900	134200	
d. Revegetation	590	MSF		24.60	5.60	4.45		14514	3304	2626	20444	
e. Silt Fence	5600	LF		2.30	.27			12880	1512		14392	
							0	332104	172384	374136	878624	
Burden @ 13% of Labor Cost									22410		22410	
Labor @ 15% of Labor Cost									25858		25858	
Material @ 5% of Material Cost								16605			16605	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	348709	220652	374136	943496	
Indirects @ 50% of Total Direct Labor Cost									110326		110326	
Profit @ 10% Total Direct Cost											94350	
											1148172	
Health & Safety Monitoring @ .08											91854	
Total Field Cost											1240025	
Contingency @ 20% of Total Field Cost											248005	
Engineering @ 6% of Total Field Cost											74402	
TOTAL COST THIS PAGE											1562432	

KALAMAZOO RIVER
Otsego Dam - Channel Excavation / Impermeable Cap
(KAL-F01)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	429600	CY			.39	1.77			167544	760392	927936	
2) IMPERMEABLE CAP												
a. Regrading	160800	CY			.41	1.66			65928	266928	332856	
b. Sand Base - 6"	160800	CY		6.50	2.50	6.48		1045200	402000	1041984	2489184	
c. Liner - 30 mil	8681500	SF		.30	.20			2604450	1736300		4340750	
d. Sand Cover - 6"	160800	CY		6.50	2.50	6.48		1045200	402000	1041984	2489184	
e. Soil Layer - 18"	482300	CY		1.50	1.80	4.90		723450	868140	2363270	3954860	
f. Topsoil Layer - 6"	160800	CY		5.50	1.80	4.90		884400	289440	787920	1961760	
g. Revegetation	8680	MSF		24.60	5.60	4.45		213528	48608	38626	300762	
h. Silt Fence	23200	LF		2.30	.27			53360	6264		59624	
							0	6569588	3986224	6301104	16856916	
Burden @ 13% of Labor Cost									518209		518209	
Labor @ 15% of Labor Cost									597934		597934	
Material @ 5% of Material Cost								328479			328479	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	6898067	5102367	6301104	18301538	
Indirects @ 50% of Total Direct Labor Cost									2551183		2551183	
Profit @ 10% Total Direct Cost											1830154	
											22682875	
Health & Safety Monitoring @ .04											907315	
Total Field Cost											23590190	
Contingency @ 20% of Total Field Cost											4718038	
Engineering @ 4% of Total Field Cost											943608	
TOTAL COST THIS PAGE											29251836	

KALAMAZOO RIVER
Trowbridge dam - Channel Lining / Impermeable Cap
(KAL-FT)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	123700	CY		8.00	4.98	4.97		989600	616026	614789	2220415	
b. Gravel Bed - 6"	63900	CY		10.50	2.20	6.11		670950	140580	390429	1201959	
c. Filter Fabric	387700	SY		1.20	.16			465240	62032		527272	
d. Excavation & Spread.	859300	CY			.39	1.77			335127	1520961	1856088	
2) IMPERMEABLE CAP												
a. Regrading	368300	CY			.41	1.66			151003	611378	762381	
b. Sand Base - 6"	368300	CY		6.50	2.50	6.48		2393950	920750	2386584	5701284	
c. Liner - 30 mil	19889500	SF		.30	.20			5966850	3977900		9944750	
d. Sand Cover - 6"	368300	CY		6.50	2.50	6.48		2393950	920750	2386584	5701284	
e. Soil Layer - 18"	1105000	CY		1.50	1.80	4.90		1657500	1989000	5414500	9061000	
f. Topsoil Layer - 6"	368300	CY		5.50	1.80	4.90		2025650	662940	1804670	4493260	
g. Revegetation	19890	MSF		24.60	5.60	4.45		489294	111384	88511	689189	
h. Silt Fence	46400	LF		2.30	.27			106720	12528		119248	
							0	17159704	9900020	15218406	42278130	
Burden @ 13% of Labor Cost									1287003		1287003	
Labor @ 15% of Labor Cost									1485003		1485003	
Material @ 5% of Material Cost								857985			857985	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	18017689	12672026	15218406	45908120	
Indirects @ 50% of Total Direct Labor Cost									6336013		6336013	
Profit @ 10% Total Direct Cost											4590812	
											56834945	
Health & Safety Monitoring @ .04											2273398	
Total Field Cost											59108343	
Contingency @ 20% of Total Field Cost											11821669	
Engineering @ 4% of Total Field Cost											2364334	
TOTAL COST THIS PAGE											73294345	

KALAMAZOO RIVER
Trowbridge dam - Channel Excavation / Impermeable Cap
(KAL-F11)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	859300	CY			.39	1.77			335127	1520961	1856088	
2) IMPERMEABLE CAP												
a. Regrading	368300	CY			.41	1.66			151003	611378	762381	
b. Sand Base - 6"	368300	CY		6.50	2.50	6.48		2393950	920750	2386584	5701284	
c. Liner - 30 mil	19889500	SF		.30	.20			5966850	3977900		9944750	
d. Sand Cover - 6"	368300	CY		6.50	2.50	6.48		2393950	920750	2386584	5701284	
e. Soil Layer - 18"	1105000	CY		1.50	1.80	4.90		1657500	1989000	5414500	9061000	
f. Topsoil Layer - 6"	368300	CY		5.50	1.80	4.90		2025650	662940	1804670	4493260	
g. Revegetation	19890	MSF		24.60	5.60	4.45		489294	111384	88511	689189	
h. Silt Fence	46400	LF		2.30	.27			106720	12528		119248	
							0	15033914	9081382	14213188	38328484	
Burden @ 13% of Labor Cost									1180580		1180580	
Labor @ 15% of Labor Cost									1362207		1362207	
Material @ 5% of Material Cost								751696			751696	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	15785610	11624169	14213188	41622966	
Indirects @ 50% of Total Direct Labor Cost									5812084		5812084	
Profit @ 10% Total Direct Cost											4162297	
											51597347	
Health & Safety Monitoring @ .04											2063894	
Total Field Cost											53661241	
Contingency @ 20% of Total Field Cost											10732248	
Engineering @ 4% of Total Field Cost											2146450	
TOTAL COST THIS PAGE											66539939	

KALAMAZOO RIVER
Plainwell Dam - Excavation & Onsite Disposal
(KAL-GP)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CONTAMINATED SEDIMENT EXCAVATION	523000	CY			.39	1.77			203970	925710	1129680	
2) HAULING CONTAM. SED.	523000	CY			.42	1.24			219660	648520	868180	
3) CONTAINMENT AREA												
a. Excavation	209000	CY			.39	1.77			81510	369930	451440	
b. Dike	19000	CY			.80	1.38			15200	26220	41420	
c. Backfill	190000	CY			.31	.76			58900	144400	203300	
d. Topsoil - 6"	53500	CY		5.50	1.80	4.90			96300	262150	358450	
e. Revegetation	2900	MSF		24.60	5.60	4.45		71340	16240	12905	100485	
4) SILT FENCE	17600	LF		2.30	.27			40480	4752		45232	
5) EXCAVATED AREA BACKFILL												
a. Backfill	436000	CY		1.50	1.80	4.90		654000	784800	2136400	3575200	
b. Topsoil Layer - 6"	87000	CY		5.50	1.80	4.90		478500	156600	426300	1061400	
c. Revegetation	4700	MSF		24.60	5.60	4.45		115620	26320	20915	162855	
							0	1359940	1664252	4973450	7997642	
Burden @ 13% of Labor Cost									216353		216353	
Labor @ 15% of Labor Cost									249638		249638	
Material @ 5% of Material Cost								67997			67997	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	1427937	2130243	4973450	8531630	
Indirects @ 50% of Total Direct Labor Cost									1065121		1065121	
Profit @ 10% Total Direct Cost											853163	
											10449914	
Health & Safety Monitoring @ .04											417997	
Total Field Cost											10867910	
Contingency @ 20% of Total Field Cost											2173582	
Engineering @ 5% of Total Field Cost											543396	
TOTAL COST THIS PAGE											13584888	

KALAMAZOO RIVER
Otsego Dam - Excavation & Onsite Disposal
(KAL-GO)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CONTAMINATED SEDIMENT EXCAVATION	1157000	CY			.39	1.77			451230	2047890	2499120	
2) HAULING CONTAM. SED.	1157000	CY			.42	1.24			485940	1434680	1920620	
3) CONTAINMENT AREA												
a. Excavation	392000	CY			.39	1.77			152880	693840	846720	
b. Dike	35000	CY			.80	1.38			28000	48300	76300	
c. Backfill	357000	CY			.31	.76			110670	271320	381990	
d. Topsoil - 6"	100500	CY		5.50	1.80	4.90		552750	180900	492450	1226100	
e. Revegetation	5430	MSF		24.60	5.60	4.45		133578	30408	24164	188150	
4) SILT FENCE	23200	LF		2.30	.27			53360	6264		59624	
5) EXCAVATED AREA BACKFILL												
a. Backfill	964000	CY		1.50	1.80	4.90		1446000	1735200	4723600	7904800	
b. Topsoil Layer - 6"	193000	CY		5.50	1.80	4.90		1061500	347400	945700	2354600	
c. Revegetation	10400	MSF		24.60	5.60	4.45		255840	58240	46280	360360	
							0	3503028	3587132	10728224	17818384	
Burden @ 13% of Labor Cost									466327		466327	
Labor @ 15% of Labor Cost									538070		538070	
Material @ 5% of Material Cost								175151			175151	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	3678179	4591529	10728224	18997932	
Indirects @ 50% of Total Direct Labor Cost									2295764		2295764	
Profit @ 10% Total Direct Cost											1899793	
											23193490	
Health & Safety Monitoring @ .04											927740	
Total Field Cost											24121229	
Contingency @ 20% of Total Field Cost											4824246	
Engineering @ 4% of Total Field Cost											964849	
TOTAL COST THIS PAGE											29910324	

KALAMAZOO RIVER
Trowbridge Dam - Excavation & Onsite Disposal
(KAL-GI)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CONTAMINATED SEDIMENT EXCAVATION	2594000	CY			.39	1.77			1011660	4591380	5603040	
2) HAULING CONTAM. SED.	2594000	CY			.42	1.24			1089480	3216560	4306040	
3) CONTAINMENT AREA												
a. Excavation	670000	CY			.39	1.77			261300	1185900	1447200	
b. Dike	75000	CY			.80	1.38			60000	103500	163500	
c. Backfill	595000	CY			.31	.76			184450	452200	636650	
d. Topsoil - 6"	170000	CY		5.50	1.80	4.90		935000	306000	833000	2074000	
e. Revegetation	9200	MSF		24.60	5.60	4.45		226320	51520	40940	318780	
4) SILT FENCE	46400	LF		2.30	.27			106720	12528		119248	
5) EXCAVATED AREA BACKFILL												
a. Backfill	2161000	CY		1.50	1.80	4.90		3241500	3889800	10588900	17720200	
b. Topsoil Layer - 6"	433000	CY		5.50	1.80	4.90		2381500	779400	2121700	5282600	
c. Revegetation	23300	MSF		24.60	5.60	4.45		573180	130480	103685	807345	
							0	7464220	7776618	23237765	38478603	
Burden @ 13% of Labor Cost									1010960		1010960	
Labor @ 15% of Labor Cost									1166493		1166493	
Material @ 5% of Material Cost								373211			373211	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	7837431	9954071	23237765	41029267	
Indirects @ 50% of Total Direct Labor Cost									4977036		4977036	
Profit @ 10% Total Direct Cost											4102927	
											50109229	
Health & Safety Monitoring @ .04											2004369	
Total Field Cost											52113598	
Contingency @ 20% of Total Field Cost											10422720	
Engineering @ 4% of Total Field Cost											2084544	
TOTAL COST THIS PAGE											64620862	

KALAMAZOO RIVER
Otsego City Dam - Dredging and Excavation - Upland Disposal
(KAL-HOC)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) DREDGING CHANNEL AREA	159000	CY	5.65				898350				898350	
a. Mob. & Demob.		LS	15000.00				15000				15000	
2) CONTAMINATED SEDIMENT EXCAVATION	1588000	CY			.39	1.77			619320	2810760	3430080	
3) HAULING CONTAM. SED.	1588000	CY			.42	1.24			666960	1969120	2636080	
4) CONTAINMENT AREA												
a. Excavation	501000	CY			.39	1.77			195390	886770	1082160	
b. Dike	65000	CY			.80	1.38			52000	89700	141700	
c. Backfill	436000	CY			.31	.76			135160	331360	466520	
d. Topsoil - 6"	128000	CY		5.50	1.80	4.90		704000	230400	627200	1561600	
e. Revegetation	6900	MSF		24.60	5.60	4.45		169740	38640	30705	239085	
5) SILT FENCE	19200	LF		2.30	.27			44160	5184		49344	
6) EXCAVATED AREA BACKFILL												
a. Backfill	1456000	CY		1.50	1.80	4.90		2184000	2620800	7134400	11939200	
b. Topsoil Layer - 6"	291000	CY		5.50	1.80	4.90		1600500	523800	1425900	3550200	
c. Revegetation	15700	MSF		24.60	5.60	4.45		386220	87920	69865	544005	
							913350	5088620	5175574	15375780	26553324	
Burden @ 13% of Labor Cost									672825		672825	
Labor @ 15% of Labor Cost									776336		776336	
Material @ 5% of Material Cost								254431			254431	
Subcontract @ 10% of Sub. Cost							91335				91335	
Total Direct Cost							1004685	5343051	6624735	15375780	28348251	
Indirects @ 50% of Total Direct Labor Cost									3312367		3312367	
Profit @ 10% Total Direct Cost											2834825	
											34495443	
Health & Safety Monitoring @ .04											1379818	
Total Field Cost											35875261	
Contingency @ 20% of Total Field Cost											7175052	
Engineering @ 4% of Total Field Cost											1435010	
TOTAL COST THIS PAGE											44485323	

KALAMAZOO RIVER
City of Allegan Dam - Dredging - Upland Disposal
(KAL-HA)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) DREDGING SEDIMENT AREA	2823000	CY	5.65				15949950				15949950	
a. Mob. & Demob.		LS	25000.00				25000				25000	
2) CONTAINMENT AREA												
a. Excavation	712000	CY			.39	1.77			277680	1260240	1537920	
b. Dike	98000	CY			.80	1.38			78400	135240	213640	
c. Backfill	614000	CY			.31	.76			190340	466640	656980	
d. Topsoil - 6"	182000	CY		5.50	1.80	4.90		1001000	327600	891800	2220400	
e. Revegetation	9800	MSF		24.60	5.60	4.45		241080	54880	43610	339570	
							15974950	1242080	928900	2797530	20943460	
Burden @ 13% of Labor Cost									120757		120757	
Labor @ 15% of Labor Cost									139335		139335	
Material @ 5% of Material Cost								62104			62104	
Subcontract @ 10% of Sub. Cost							1597495				1597495	
Total Direct Cost							17572445	1304184	1188992	2797530	22863151	
Indirects @ 50% of Total Direct Labor Cost									594496		594496	
Profit @ 10% Total Direct Cost											2286315	
											25743962	
Health & Safety Monitoring @ .04											1029758	
Total Field Cost											26773721	
Contingency @ 20% of Total Field Cost											5354744	
Engineering @ 4% of Total Field Cost											1070949	
TOTAL COST THIS PAGE											33199414	

KALAMAZOO RIVER
Lake Allegan Dam - Dredging - Upland Disposal
(KAL-HLA)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) DREDGING SEDIMENT AREA	2752000	CY	5.65				15548800				15548800	
a. Mob. & Demob.		LS	25000.00				25000				25000	
2) CONTAINMENT AREA												
a. Excavation	694000	CY			.39	1.77			270660	1228380	1499040	
b. Dike	96000	CY			.80	1.38			76800	132480	209280	
c. Backfill	598000	CY			.31	.76			185380	454480	639860	
d. Topsoil - 6"	177000	CY		5.50	1.80	4.90		973500	318600	867300	2159400	
e. Revegetation	9600	MSF		24.60	5.60	4.45		236160	53760	42720	332640	
							15573800	1209660	905200	2725360	20414020	
Burden @ 13% of Labor Cost									117676		117676	
Labor @ 15% of Labor Cost									135780		135780	
Material @ 5% of Material Cost								60483			60483	
Subcontract @ 10% of Sub. Cost							1557380				1557380	
Total Direct Cost							17131180	1270143	1158656	2725360	22285339	
Indirects @ 50% of Total Direct Labor Cost									579328		579328	
Profit @ 10% Total Direct Cost											2228534	
											25093201	
Health & Safety Monitoring @ .04											1003728	
Total Field Cost											26096929	
Contingency @ 20% of Total Field Cost											5219386	
Engineering @ 4% of Total Field Cost											1043877	
TOTAL COST THIS PAGE											32360192	

KALAMAZOO RIVER
Otsego City Dam - Channel Dredging, Lining & Soil Cap
(KAL-I)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) DREDGING SEDIMENT AREA	159000	CY	5.65				898350				898350	
a. Mob. & Demob.		LS	15000.00				15000				15000	
2) CONTAINMENT AREA												
a. Excavation	69400	CY			.39	1.77			27066	122838	149904	
b. Dike	9200	CY			.80	1.38			7360	12696	20056	
c. Backfill	60200	CY			.31	.76			18662	45752	64414	
d. Topsoil - 6"	20500	CY		5.50	1.80	4.90		112750	36900	100450	250100	
e. Revegetation	1100	MSF		24.60	5.60	4.45		27060	6160	4895	38115	
3) CHANNEL LINING												
a. Rip Rap - 12"	51200	CY		8.00	4.98	4.97		409600	254976	254464	919040	
b. Gravel Bed - 6"	26500	CY		10.50	2.20	6.11		278250	58300	161915	498465	
c. Filter Fabric	160400	SY		1.20	.16			192480	25664		218144	
d. Excavation & Spread.	197000	CY			.39	1.77			76830	348690	425520	
4) SOIL CAP												
a. Soil Layer - 18"	794000	CY		1.50	1.80	4.90		1191000	1429200	3890600	6510800	
b. Topsoil Layer - 6"	265000	CY		5.50	1.80	4.90		1457500	477000	1298500	3233000	
c. Revegetation	14300	MSF		24.60	5.60	4.45		351780	80080	63635	495495	
d. Silt Fence	19200	LF		2.30	.27			44160	5184		49344	
e. Regrading	265000	CY			.41	1.66			108650	439900	548550	
							913350	4064580	2612032	6744335	14334297	
Burden @ 13% of Labor Cost									339564		339564	
Labor @ 15% of Labor Cost									391805		391805	
Material @ 5% of Material Cost								203229			203229	
Subcontract @ 10% of Sub. Cost							91335				91335	
Total Direct Cost							1004685	4267809	3343401	6744335	15360230	
Indirects @ 50% of Total Direct Labor Cost									1671700		1671700	
Profit @ 10% Total Direct Cost											1536023	
											18567953	
Health & Safety Monitoring @ .04											742718	
Total Field Cost											19310672	
Contingency @ 20% of Total Field Cost											3862134	
Engineering @ 4% of Total Field Cost											772427	
TOTAL COST THIS PAGE											23945233	

KALAMAZOO RIVER
Portage Creek - Channel Lining / Impermeable Cap
(KAL-C)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	11000	CY		8.00	4.98	4.97		88000	54780	54670	197450	
b. Gravel Bed - 6"	6000	CY		10.50	2.20	6.11		63000	13200	36660	112860	
c. Filter Fabric	36800	SY		1.20	.16			44160	5888		50048	
d. Excavation & Spread.	27000	CY			.39	1.77			10530	47790	58320	
2) IMPERMEABLE CAP												
a. Regrading	11000	CY			.41	1.66			4510	18260	22770	
b. Sand Base - 6"	11000	CY		6.50	2.50	6.48		71500	27500	71280	170280	
c. Liner - 30 mil	587600	SF		.30	.20			176280	117520		293800	
d. Sand Cover - 6"	11000	CY		6.50	2.50	6.48		71500	27500	71280	170280	
e. Soil Layer - 18"	32700	CY		1.50	1.80	4.90		49050	58860	160230	268140	
f. Topsoil Layer - 6"	11000	CY		5.50	1.80	4.90		60500	19800	53900	134200	
g. Revegetation	590	MSF		24.60	5.60	4.45		14514	3304	2626	20444	
h. Silt Fence	5600	LF		2.30	.27			12880	1512		14392	
							0	651384	344904	516696	1512984	
Burden @ 13% of Labor Cost									44838		44838	
Labor @ 15% of Labor Cost									51736		51736	
Material @ 5% of Material Cost								32569			32569	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	683953	441477	516696	1642126	
Indirects @ 50% of Total Direct Labor Cost									220739		220739	
Profit @ 10% Total Direct Cost											164213	
											2027077	
Health & Safety Monitoring @ .06											121625	
Total Field Cost											2148702	
Contingency @ 20% of Total Field Cost											429740	
Engineering @ 6% of Total Field Cost											128922	
TOTAL COST THIS PAGE											2707364	

KALAMAZOO RIVER
Portage Creek - Excavation & Disposal
(KAL-D)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) TEMP. STREAM DIVERSION												
a. Excavation	16600	CY			.39	1.77			6474	29382	35856	
b. Shoring	56000	SF		.40	.50			22400	28000		50400	
c. Culvert Pipe-(2) 84"	100	LF		135.00	39.96	16.04		13500	3996	1604	19100	
d. Bedding - gravel	17	CY		10.50	2.20	6.11		179	37	104	320	
e. Backfill	300	CY		1.50	1.80	4.90			540	1470	2010	
f. Dewatering		LS	72000.00				72000				72000	
2) CONTAMINATED SEDIMENT												
a. Excavation	83000	CY			.68	1.78			56440	147740	204180	
3) HAULING CONTAM. SED.	1245000	LM	3.00				3735000				3735000	
4) DISPOSAL	101000	TON	205.00				20705000				20705000	
5) BACKFILL	69000	CY		1.50	1.80	4.90		103500	124200	338100	565800	
6) TOPSOIL - 6"	14000	CY		5.50	1.80	4.90		77000	25200	68600	170800	
7) REVEGETATION	750	MSF		24.60	5.60	4.45		18450	4200	3338	25988	
8) SILT FENCE	2800	LF		2.30	.27			6440	756		7196	
							24512000	241469	249843	590337	25593649	
Burden @ 13% of Labor Cost									32480		32480	
Labor @ 15% of Labor Cost									37477		37477	
Material @ 5% of Material Cost								12073			12073	
Subcontract @ 10% of Sub. Cost							2451200				2451200	
Total Direct Cost							26963200	253542	319800	590337	28126879	
Indirects @ 50% of Total Direct Labor Cost									159900		159900	
Profit @ 10% Total Direct Cost											2812688	
											31099467	
Health & Safety Monitoring @ .04											1243979	
Total Field Cost											32343445	
Contingency @ 20% of Total Field Cost											6468689	
Engineering @ 3% of Total Field Cost											970303	
TOTAL COST THIS PAGE											39782438	

KALAMAZOO RIVER
Portage Creek - Permanent Diversion
(KAL-D1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL DIVERSION & LINING												
a. Rip Rap - 12"	7800	CY		8.00	4.98	4.97		62400	38844	38766	140010	
b. Gravel Bed - 6"	4300	CY		10.50	2.20	6.11		45150	9460	26273	80883	
c. Filter Fabric	26300	SY		1.20	.16			31560	4208		35768	
d. Excavation & Spread.	38000	CY			.39	1.77			14820	67260	82080	
2) SOIL CAP												
a. Regrading	13900	CY			.41	1.66			5699	23074	28773	
b. Soil Layer - 18"	41700	CY		1.50	1.80	4.90		62550	75060	204330	341940	
c. Topsoil Layer - 6"	13900	CY		5.50	1.80	4.90		76450	25020	68110	169580	
d. Revegetation	750	MSF		24.60	5.60	4.45		18450	4200	3338	25988	
e. Silt Fence	8000	LF		2.30	.27			18400	2160		20560	
							0	314960	179471	431151	925582	
Burden @ 13% of Labor Cost									23331		23331	
Labor @ 15% of Labor Cost									26921		26921	
Material @ 5% of Material Cost								15748			15748	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	330708	229723	431151	991581	
Indirects @ 50% of Total Direct Labor Cost									114861		114861	
Profit @ 10% Total Direct Cost											99158	
											1205601	
Health & Safety Monitoring @ .08											96448	
Total Field Cost											1302049	
Contingency @ 20% of Total Field Cost											260410	
Engineering @ 6% of Total Field Cost											78123	
TOTAL COST THIS PAGE											1640582	

KALAMAZOO RIVER
Plainwell Dam - Channel Lining / Soil Cap
(KAL-EP)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	46900	CY		8.00	4.98	4.97		375200	233562	233093	841855	
b. Gravel Bed - 6"	24250	CY		10.50	2.20	6.11		254625	53350	148168	456143	
c. Filter Fabric	147100	SY		1.20	.16			176520	23536		200056	
d. Excavation & Spread.	326000	CY			.39	1.77			127140	577020	704160	
2) SOIL CAP												
a. Regrading	62800	CY			.41	1.66			25748	104248	129996	
b. Soil Layer - 18"	188500	CY		1.50	1.80	4.90		282750	339300	923650	1545700	
c. Topsoil Layer - 6"	62800	CY		5.50	1.80	4.90		345400	113040	307720	766160	
d. Revegetation	3390	MSF		24.60	5.60	4.45		83394	18984	15086	117464	
e. Silt Fence	17600	LF		2.30	.27			40480	4752		45232	
							0	1558369	939412	2308984	4806765	
Burden @ 13% of Labor Cost									122124		122124	
Labor @ 15% of Labor Cost									140912		140912	
Material @ 5% of Material Cost								77918			77918	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	1636287	1202447	2308984	5147719	
Indirects @ 50% of Total Direct Labor Cost									601224		601224	
Profit @ 10% Total Direct Cost											514772	
											6263714	
Health & Safety Monitoring @ .06											375823	
Total Field Cost											6639537	
Contingency @ 20% of Total Field Cost											1327907	
Engineering @ 6% of Total Field Cost											398372	
TOTAL COST THIS PAGE											8365817	

KALAMAZOO RIVER
Plainwell Dam - Channel Excavation / Soil Cap
(KAL-EP1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	326000	CY			.39	1.77			127140	577020	704160	
2) SOIL CAP												
a. Regrading	62800	CY			.41	1.66			25748	104248	129996	
b. Soil Layer - 18"	188500	CY		1.50	1.80	4.90		282750	339300	923650	1545700	
c. Topsoil Layer - 6"	62800	CY		5.50	1.80	4.90		345400	113040	307720	766160	
d. Revegetation	3390	MSF		24.60	5.60	4.45		83394	18984	15086	117464	
e. Silt Fence	17600	LF		2.30	.27			40480	4752		45232	
							0	752024	628964	1927724	3308712	
Burden @ 13% of Labor Cost									81765		81765	
Labor @ 15% of Labor Cost									94345		94345	
Material @ 5% of Material Cost								37601			37601	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	789625	805074	1927724	3522423	
Indirects @ 50% of Total Direct Labor Cost									402537		402537	
Profit @ 10% Total Direct Cost											352242	
											4277202	
Health & Safety Monitoring @ .06											256632	
Total Field Cost											4533834	
Contingency @ 20% of Total Field Cost											906767	
Engineering @ 6% of Total Field Cost											272030	
TOTAL COST THIS PAGE											5712631	

KALAMAZOO RIVER
Otsego Dam - Channel Lining / Soil Cap
(KAL-EO)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	61900	CY		8.00	4.98	4.97		495200	308262	307643	1111105	
b. Gravel Bed - 6"	32000	CY		10.50	2.20	6.11		336000	70400	195520	601920	
c. Filter Fabric	193800	SY		1.20	.16			232560	31008		263568	
d. Excavation & Spread.	429600	CY			.39	1.77			167544	760392	927936	
2) SOIL CAP												
a. Regrading	160800	CY			.41	1.66			65928	266928	332856	
b. Soil Layer - 18"	482300	CY		1.50	1.80	4.90		723450	868140	2363270	3954860	
c. Topsoil Layer - 6"	160800	CY		5.50	1.80	4.90		884400	289440	787920	1961760	
d. Revegetation	8680	MSF		24.60	5.60	4.45		213528	48608	38626	300762	
e. Silt Fence	23200	LF		2.30	.27			53360	6264		59624	
							0	2938498	1855594	4720299	9514391	
Burden @ 13% of Labor Cost									241227		241227	
Labor @ 15% of Labor Cost									278339		278339	
Material @ 5% of Material Cost								146925			146925	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	3085423	2375160	4720299	10180882	
Indirects @ 50% of Total Direct Labor Cost									1187580		1187580	
Profit @ 10% Total Direct Cost											1018088	
											12386551	
Health & Safety Monitoring @ .04											495462	
Total Field Cost											12882013	
Contingency @ 20% of Total Field Cost											2576403	
Engineering @ 5% of Total Field Cost											644101	
TOTAL COST THIS PAGE											16102516	

KALAMAZOO RIVER
Otsego Dam - Channel Excavation / Soil Cap
(KAL-E01)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	429600	CY			.39	1.77			167544	760392	927936	
2) SOIL CAP												
a. Regrading	160800	CY			.41	1.66			65928	266928	332856	
b. Soil Layer - 18"	482300	CY		1.50	1.80	4.90		723450	868140	2363270	3954860	
c. Topsoil Layer - 6"	160800	CY		5.50	1.80	4.90		884400	289440	787920	1961760	
d. Revegetation	8680	MSF		24.60	5.60	4.45		213528	48608	38626	300762	
e. Silt Fence	23200	LF		2.30	.27			53360	6264		59624	
							0	1874738	1445924	4217136	7537798	
Burden @ 13% of Labor Cost									187970		187970	
Labor @ 15% of Labor Cost									216889		216889	
Material @ 5% of Material Cost								93737			93737	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	1968475	1850783	4217136	8036394	
Indirects @ 50% of Total Direct Labor Cost									925391		925391	
Profit @ 10% Total Direct Cost											803639	
											9765424	
Health & Safety Monitoring @ .06											585925	
Total Field Cost											10351350	
Contingency @ 20% of Total Field Cost											2070270	
Engineering @ 5% of Total Field Cost											517567	
TOTAL COST THIS PAGE											12939187	

KALAMAZOO RIVER
Trowbridge Dam - Channel Lining / Soil Cap
(KAL-ET)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	123700	CY		8.00	4.98	4.97		989600	616026	614789	2220415	
b. Gravel Bed - 6"	63900	CY		10.50	2.20	6.11		670950	140580	390429	1201959	
c. Filter Fabric	387700	SY		1.20	.16			465240	62032		527272	
d. Excavation & Spread.	859300	CY			.39	1.77			335127	1520961	1856088	
2) SOIL CAP												
a. Regrading	368300	CY			.41	1.66			151003	611378	762381	
b. Soil Layer - 18"	1105000	CY		1.50	1.80	4.90		1657500	1989000	5414500	9061000	
c. Topsoil Layer - 6"	368300	CY		5.50	1.80	4.90		2025650	662940	1804670	4493260	
d. Revegetation	19890	MSF		24.60	5.60	4.45		489294	111384	88511	689189	
e. Silt Fence	46400	LF		2.30	.27			106720	12528		119248	
							0	6404954	4080620	10445238	20930812	
Burden @ 13% of Labor Cost									530481		530481	
Labor @ 15% of Labor Cost									612093		612093	
Material @ 5% of Material Cost								320248			320248	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	6725202	5223194	10445238	22393633	
Indirects @ 50% of Total Direct Labor Cost									2611597		2611597	
Profit @ 10% Total Direct Cost											2239363	
											27244593	
Health & Safety Monitoring @ .04											1089784	
Total Field Cost											28334377	
Contingency @ 20% of Total Field Cost											5666875	
Engineering @ 4% of Total Field Cost											1133375	
TOTAL COST THIS PAGE											35134627	

KALAMAZOO RIVER
Trowbridge Dam - Channel Excavation / Soil Cap
(KAL-ET1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	859300	CY			.39	1.77			335127	1520961	1856088	
2) SOIL CAP												
a. Regrading	368300	CY			.41	1.66			151003	611378	762381	
b. Soil Layer - 18"	1105000	CY		1.50	1.80	4.90		1657500	1989000	5414500	9061000	
c. Topsoil Layer - 6"	368300	CY		5.50	1.80	4.90		2025650	662940	1804670	4493260	
d. Revegetation	19890	MSF		24.60	5.60	4.45		489294	111384	88511	689189	
e. Silt Fence	46400	LF		2.30	.27			106720	12528		119248	
							0	4279164	3261982	9440020	16981166	
Burden @ 13% of Labor Cost									424058		424058	
Labor @ 15% of Labor Cost									489297		489297	
Material @ 5% of Material Cost								213958			213958	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	4493122	4175337	9440020	18108479	
Indirects @ 50% of Total Direct Labor Cost									2087668		2087668	
Profit @ 10% Total Direct Cost											1810848	
											22006995	
Health & Safety Monitoring @ .04											880280	
Total Field Cost											22887275	
Contingency @ 20% of Total Field Cost											4577455	
Engineering @ 4% of Total Field Cost											915491	
TOTAL COST THIS PAGE											28380221	

KALAMAZOO RIVER
Plainwell Dam - Channel Lining - Buffer Zone
(KAL-EIP)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	46900	CY		8.00	4.98	4.97		375200	233562	233093	841855	
b. Gravel Bed - 6"	24250	CY		10.50	2.20	6.11		254625	53350	148168	456143	
c. Filter Fabric	147100	SY		1.20	.16			176520	23536		200056	
d. Excavation & Spread.	326000	CY			.39	1.77			127140	577020	704160	
2 BUFFER ZONE												
a. Excavation & Spread.	24500	CY			.39	1.77			9555	43365	52920	
b. Backfill - 30"	20400	CY		1.50	1.80	4.90		30600	36720	99960	167280	
c. Topsoil Layer - 6"	4100	CY		5.50	1.80	4.90		22550	7380	20090	50020	
d. Revegetation	220	MSF		24.60	5.60	4.45		5412	1232	979	7623	
e. Silt Fence	17600	LF		2.30	.27			40480	4752		45232	
							0	905387	497227	1122675	2525289	
Burden @ 13% of Labor Cost									64640		64640	
Labor @ 15% of Labor Cost									74584		74584	
Material @ 5% of Material Cost								45269			45269	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	950656	636451	1122675	2709781	
Indirects @ 50% of Total Direct Labor Cost									318225		318225	
Profit @ 10% Total Direct Cost											270978	
											3298985	
Health & Safety Monitoring @ .06											197939	
Total Field Cost											3496924	
Contingency @ 20% of Total Field Cost											699385	
Engineering @ 6% of Total Field Cost											209815	
TOTAL COST THIS PAGE											4406124	

KALAMAZOO RIVER
Plainwell Dam - Channel Excavation - Buffer Zone
(KAL-E1P1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	326000	CY			.39	1.77			127140	577020	704160	
2) BUFFER ZONE												
a. Excavation & Spread.	24500	CY			.39	1.77			9555	43365	52920	
b. Backfill - 30"	20400	CY		1.50	1.80	4.90		30600	36720	99960	167280	
c. Topsoil Layer - 6"	4100	CY		5.50	1.80	4.90		22550	7380	20090	50020	
d. Revegetation	220	MSF		24.60	5.60	4.45		5412	1232	979	7623	
e. Silt Fence	17600	LF		2.30	.27			40480	4752		45232	
							0	99042	186779	741414	1027235	
Burden @ 13% of Labor Cost									24281		24281	
Labor @ 15% of Labor Cost									28017		28017	
Material @ 5% of Material Cost								4952			4952	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	103994	239077	741414	1084485	
Indirects @ 50% of Total Direct Labor Cost									119539		119539	
Profit @ 10% Total Direct Cost											108449	
											1312472	
Health & Safety Monitoring @ .08											104998	
Total Field Cost											1417470	
Contingency @ 20% of Total Field Cost											283494	
Engineering @ 6% of Total Field Cost											85048	
TOTAL COST THIS PAGE											1786012	

KALAMAZOO RIVER
Otsego Dam - Channel Lining - Buffer Zone
(KAL-E10)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	61900	CY		8.00	4.98	4.97		495200	308262	307643	1111105	
b. Gravel Bed - 6"	32000	CY		10.50	2.20	6.11		336000	70400	195520	601920	
c. Filter Fabric	193800	SY		1.20	.16			232560	31008		263568	
d. Excavation & Spread.	429600	CY			.39	1.77			167544	760392	927936	
2) BUFFER ZONE												
a. Excavation & Spread.	32200	CY			.39	1.77			12558	56994	69552	
b. Backfill - 30"	26900	CY		1.50	1.80	4.90		40350	48420	131810	220580	
c. Topsoil Layer - 6"	5300	CY		5.50	1.80	4.90		29150	9540	25970	64660	
d. Revegetation	290	MSF		24.60	5.60	4.45		7134	1624	1291	10049	
e. Silt Fence	23200	LF		2.30	.27			53360	6264		59624	
							0	1193754	655620	1479620	3328994	
Burden @ 13% of Labor Cost									85231		85231	
Labor @ 15% of Labor Cost									98343		98343	
Material @ 5% of Material Cost								59688			59688	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	1253442	839194	1479620	3572255	
Indirects @ 50% of Total Direct Labor Cost									419597		419597	
Profit @ 10% Total Direct Cost											357225	
											4349077	
Health & Safety Monitoring @ .06											260945	
Total Field Cost											4610022	
Contingency @ 20% of Total Field Cost											922004	
Engineering @ 6% of Total Field Cost											276601	
TOTAL COST THIS PAGE											5808627	

KALAMAZOO RIVER
Otsego Dam - Channel Excavation - Buffer Zone
(KAL-E101)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	429600	CY			.39	1.77			167544	760392	927936	
2) BUFFER ZONE												
a. Excavation & Spread.	32200	CY			.39	1.77			12558	56994	69552	
b. Backfill - 30"	26900	CY		1.50	1.80	4.90		40350	48420	131810	220580	
c. Topsoil Layer - 6"	5300	CY		5.50	1.80	4.90		29150	9540	25970	64660	
d. Revegetation	290	MSF		24.60	5.60	4.45		7134	1624	1291	10049	
e. Silt Fence	23200	LF		2.30	.27			53360	6264		59624	
							0	129994	245950	976457	1352401	
Burden @ 13% of Labor Cost									31974		31974	
Labor @ 15% of Labor Cost									36893		36893	
Material @ 5% of Material Cost								6500			6500	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	136494	314816	976457	1427766	
Indirects @ 50% of Total Direct Labor Cost									157408		157408	
Profit @ 10% Total Direct Cost											142777	
											1727951	
Health & Safety Monitoring @ .08											138236	
Total Field Cost											1866187	
Contingency @ 20% of Total Field Cost											373237	
Engineering @ 6% of Total Field Cost											111971	
TOTAL COST THIS PAGE											2351395	

KALAMAZOO RIVER
Trowbridge Dam - Channel Lining - Buffer Zone
(KAL-E1T)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	123700	CY		8.00	4.98	4.97		989600	616026	614789	2220415	
b. Gravel Bed - 6"	63900	CY		10.50	2.20	6.11		670950	140580	390429	1201959	
c. Filter Fabric	387700	SY		1.20	.16			465240	62032		527272	
d. Excavation & Spread.	859300	CY			.39	1.77			335127	1520961	1856088	
2) BUFFER ZONE												
a. Excavation & Spread.	64400	CY			.39	1.77			25116	113988	139104	
b. Backfill - 30"	53700	CY		1.50	1.80	4.90		80550	96660	263130	440340	
c. Topsoil Layer - 6"	10700	CY		5.50	1.80	4.90		58850	19260	52430	130540	
d. Revegetation	580	MSF		24.60	5.60	4.45		14268	3248	2581	20097	
e. Silt Fence	46400	LF		2.30	.27			106720	12528		119248	
							0	2386178	1310577	2958308	6655063	
Burden @ 13% of Labor Cost									170375		170375	
Labor @ 15% of Labor Cost									196587		196587	
Material @ 5% of Material Cost								119309			119309	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	2505487	1677539	2958308	7141333	
Indirects @ 50% of Total Direct Labor Cost									838769		838769	
Profit @ 10% Total Direct Cost											714133	
											8694236	
Health & Safety Monitoring @ .06											521654	
Total Field Cost											9215890	
Contingency @ 20% of Total Field Cost											1843178	
Engineering @ 5% of Total Field Cost											460795	
TOTAL COST THIS PAGE											11519863	

KALAMAZOO RIVER
Trowbridge Dam - Channel Excavation - Buffer Zone
(KAL-E1T1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	859300	CY			.39	1.77			335127	1520961	1856088	
2) BUFFER ZONE												
a. Excavation & Spread.	64400	CY			.39	1.77			25116	113988	139104	
b. Backfill - 30"	53700	CY		1.50	1.80	4.90		80550	96660	263130	440340	
c. Topsoil Layer - 6"	10700	CY		5.50	1.80	4.90		58850	19260	52430	130540	
d. Revegetation	580	MSF		24.60	5.60	4.45		14268	3248	2581	20097	
e. Silt Fence	46400	LF		2.30	.27			106720	12528		119248	
							0	260388	491939	1953090	2705417	
Burden @ 13% of Labor Cost									63952		63952	
Labor @ 15% of Labor Cost									73791		73791	
Material @ 5% of Material Cost								13019			13019	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	273407	629682	1953090	2856179	
Indirects @ 50% of Total Direct Labor Cost									314841		314841	
Profit @ 10% Total Direct Cost											285618	
											3456638	
Health & Safety Monitoring @ .06											207398	
Total Field Cost											3664037	
Contingency @ 20% of Total Field Cost											732807	
Engineering @ 5% of Total Field Cost											183202	
TOTAL COST THIS PAGE											4580046	

KALAMAZOO RIVER
Plainwell Dam - Channel Lining / Impermeable Cap
(KAL-FP)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	46900	CY		8.00	4.98	4.97		375200	233562	233093	841855	
b. Gravel Bed - 6"	24250	CY		10.50	2.20	6.11		254625	53350	148168	456143	
c. Filter Fabric	147100	SY		1.20	.16			176520	23536		200056	
d. Excavation & Spread.	326000	CY			.39	1.77			127140	577020	704160	
2) IMPERMEABLE CAP												
a. Regrading	62800	CY			.41	1.66			25748	104248	129996	
b. Sand Base - 6"	62800	CY		6.50	2.50	6.48		408200	157000	406944	972144	
c. Liner - 30 mil	3393000	SF		.30	.20			1017900	678600		1696500	
d. Sand Cover - 6"	62800	CY		6.50	2.50	6.48		408200	157000	406944	972144	
e. Soil Layer - 18"	188500	CY		1.50	1.80	4.90		282750	339300	923650	1545700	
f. Topsoil Layer - 6"	62800	CY		5.50	1.80	4.90		345400	113040	307720	766160	
g. Revegetation	3390	MSF		24.60	5.60	4.45		83394	18984	15086	117464	
h. Silt Fence	17600	LF		2.30	.27			40480	4752		45232	
							0	3392669	1932012	3122872	8447553	
Burden @ 13% of Labor Cost									251162		251162	
Labor @ 15% of Labor Cost									289802		289802	
Material @ 5% of Material Cost								169633			169633	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	3562302	2472975	3122872	9158150	
Indirects @ 50% of Total Direct Labor Cost									1236488		1236488	
Profit @ 10% Total Direct Cost											915815	
											11310452	
Health & Safety Monitoring @ .04											452418	
Total Field Cost											11762871	
Contingency @ 20% of Total Field Cost											2352574	
Engineering @ 5% of Total Field Cost											588144	
TOTAL COST THIS PAGE											14703588	

KALAMAZOO RIVER
Plainwell Dam - Channel Excavation / Impermeable Cap
(KAL-FP1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL												
a. Excavation & Spread.	326000	CY			.39	1.77			127140	577020	704160	
2) IMPERMEABLE CAP												
a. Regrading	62800	CY			.41	1.66			25748	104248	129996	
b. Sand Base - 6"	62800	CY		6.50	2.50	6.48		408200	157000	406944	972144	
c. Liner - 30 mil	3393000	SF		.30	.20			1017900	678600		1696500	
d. Sand Cover - 6"	62800	CY		6.50	2.50	6.48		408200	157000	406944	972144	
e. Soil Layer - 18"	188500	CY		1.50	1.80	4.90		282750	339300	923650	1545700	
f. Topsoil Layer - 6"	62800	CY		5.50	1.80	4.90		345400	113040	307720	766160	
g. Revegetation	3390	MSF		24.60	5.60	4.45		83394	18984	15086	117464	
h. Silt Fence	17600	LF		2.30	.27			40480	4752		45232	
							0	2586324	1621564	2741612	6949500	
Burden @ 13% of Labor Cost									210803		210803	
Labor @ 15% of Labor Cost									243235		243235	
Material @ 5% of Material Cost								129316			129316	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	2715640	2075602	2741612	7532854	
Indirects @ 50% of Total Direct Labor Cost									1037801		1037801	
Profit @ 10% Total Direct Cost											753285	
											9323940	
Health & Safety Monitoring @ .06											559436	
Total Field Cost											9883376	
Contingency @ 20% of Total Field Cost											1976675	
Engineering @ 5% of Total Field Cost											494169	
TOTAL COST THIS PAGE											12354220	

KALAMAZOO RIVER
Otsego Dam - Channel Lining / Impermeable Cap
(KAL-F0)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) CHANNEL LINING												
a. Rip Rap - 12"	61900	CY		8.00	4.98	4.97		495200	308262	307643	1111105	
b. Gravel Bed - 6"	32000	CY		10.50	2.20	6.11		336000	70400	195520	601920	
c. Filter Fabric	193800	SY		1.20	.16			232560	31008		263568	
d. Excavation & Spread.	429600	CY			.39	1.77			167544	760392	927936	
2) IMPERMEABLE CAP												
a. Regrading	160800	CY			.41	1.66			65928	266928	332856	
b. Sand Base - 6"	160800	CY		6.50	2.50	6.48		1045200	402000	1041984	2489184	
c. Liner - 30 mil	8681500	SF		.30	.20			2604450	1736300		4340750	
d. Sand Cover - 6"	160800	CY		6.50	2.50	6.48		1045200	402000	1041984	2489184	
e. Soil Layer - 18"	482300	CY		1.50	1.80	4.90		723450	868140	2363270	3954860	
f. Topsoil Layer - 6"	160800	CY		5.50	1.80	4.90		884400	289440	787920	1961760	
g. Revegetation	8680	MSF		24.60	5.60	4.45		213528	48608	38626	300762	
h. Silt Fence	23200	LF		2.30	.27			53360	6264		59624	
							0	7633348	4395894	6804267	18833509	
Burden @ 13% of Labor Cost									571466		571466	
Labor @ 15% of Labor Cost									659384		659384	
Material @ 5% of Material Cost								381667			381667	
Subcontract @ 10% of Sub. Cost							0				0	
Total Direct Cost							0	8015015	5626744	6804267	20446027	
Indirects @ 50% of Total Direct Labor Cost									2813372		2813372	
Profit @ 10% Total Direct Cost											2044603	
											25304002	
Health & Safety Monitoring @ .04											1012160	
Total Field Cost											26316162	
Contingency @ 20% of Total Field Cost											5263232	
Engineering @ 4% of Total Field Cost											1052646	
TOTAL COST THIS PAGE											32632040	

KALAMAZOO RIVER
Otsego City Dam - Channel Dredging, Lining & Impermeable Cap
(KAL-J)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
1) DREDGING SEDIMENT AREA	159000	CY	5.65				898350				898350	
a. Mob. & Demob.		LS	15000.00				15000				15000	
2) CONTAINMENT AREA												
a. Excavation	69400	CY			.39	1.77			27066	122838	149904	
b. Dike	9200	CY			.80	1.38			7360	12696	20056	
c. Backfill	60200	CY			.31	.76			18662	45752	64414	
d. Topsoil - 6"	20500	CY		5.50	1.80	4.90		112750	36900	100450	250100	
e. Revegetation	1100	MSF		24.60	5.60	4.45		27060	6160	4895	38115	
3) CHANNEL LINING												
a. Rip Rap - 12"	51200	CY		8.00	4.98	4.97		409600	254976	254464	919040	
b. Gravel Bed - 6"	26500	CY		10.50	2.20	6.11		278250	58300	161915	498465	
c. Filter Fabric	160400	SY		1.20	.16			192480	25664		218144	
d. Excavation & Spread.	197000	CY			.39	1.77			76830	348690	425520	
4) IMPERMEABLE CAP												
a. Sand Base - 6"	265000	CY		6.50	2.50	6.48		1722500	662500	1717200	4102200	
b. Liner - 30 mil	14296000	SF		.30	.20			4288800	2859200		7148000	
c. Sand Cover - 6"	265000	CY		6.50	2.50	6.48		1722500	662500	1717200	4102200	
d. Soil Layer - 18"	794000	CY		1.50	1.80	4.90		1191000	1429200	3890600	6510800	
e. Topsoil Layer - 6"	265000	CY		5.50	1.80	4.90		1457500	477000	1298500	3233000	
f. Revegetation	14300	MSF		24.60	5.60	4.45		351780	80080	63635	495495	
g. Silt Fence	19200	LF		2.30	.27			44160	5184		49344	
h. Regrading	265000	CY			.41	1.66			108650	439900	548550	
							913350	11798380	6796232	10178735	29686697	
Burden @ 13% of Labor Cost									883510		883510	
Labor @ 15% of Labor Cost									1019435		1019435	
Material @ 5% of Material Cost								589919			589919	
Subcontract @ 10% of Sub. Cost							91335				91335	
Total Direct Cost							1004685	12388299	8699177	10178735	32270896	
Indirects @ 50% of Total Direct Labor Cost									4349588		4349588	
Profit @ 10% Total Direct Cost											3227090	
											39847574	
Health & Safety Monitoring @ .04											1593903	
Total Field Cost											41441477	
Contingency @ 20% of Total Field Cost											8288295	
Engineering @ 4% of Total Field Cost											1657659	
TOTAL COST THIS PAGE											51387431	

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APPENDIX B

FOUNDATION EVALUATION

Cell Volume Calculations

URS Greiner Woodward Clyde

Job Solutia - Sauget | Project No. C10003899 | Sheet ___ of ___

Description Approximate Volume of Containment Cell | Computed by Bill Weber | Date 6/27/2000

Checked by [illegible] | Date 27 June 00

Reference

Problem: Calculate the approximate volume of containment cell.

Given: Plan drawings

Volume of Prismatoid = $\frac{1}{6}h(B_1 + 4M + B_2)$.

Volume of Pyramid = $\frac{1}{3}bh$

Assumptions: As stated in calculations

Conclusion: THE APPROXIMATE VOLUME OF THE CONTAINMENT CELL = ~~514,000~~ 51,400 yd^3

URS Greiner Woodward Clyde

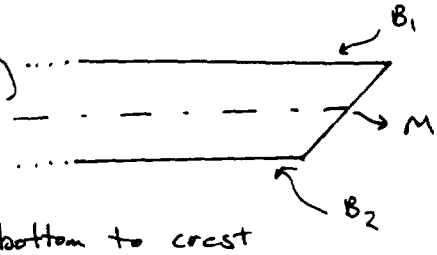
Job Solutia Sauget | Project No. C10000 3899.00 | Sheet ___ of ___

Description Approximate Volume of Containment Cell | Computed by Bill Weber | Date 6/27/2000

Checked by [illegible] | Date 27 Jun 00

Reference

(b) $\forall$ of prismatoid $= \frac{1}{6} h (B_1 + 4M + B_2)$



From AutoCAD.

$B_1 = 131697\ ft^2$

$M = 105418.9\ ft^2$

$B_2 = 81797.2\ ft^2$

h from bottom to crest $= 12\ ft$

$$\forall = \frac{1}{6}\, 12\,ft\,(131697\,ft^2 + 4(105418.9\,ft^2) + 81797.2\,ft^2)$$

$$= \boxed{1270339.6\ ft^3}$$

Total Volume $= \forall_{(a)} + \forall_{(b)}$

$$= 118527.3 + 1270339.6 = 1388866.9\ ft^3$$

$$= 51439\ yd^3$$

$$= \boxed{51400\ yd^3}$$

Bearing Capacity

URS

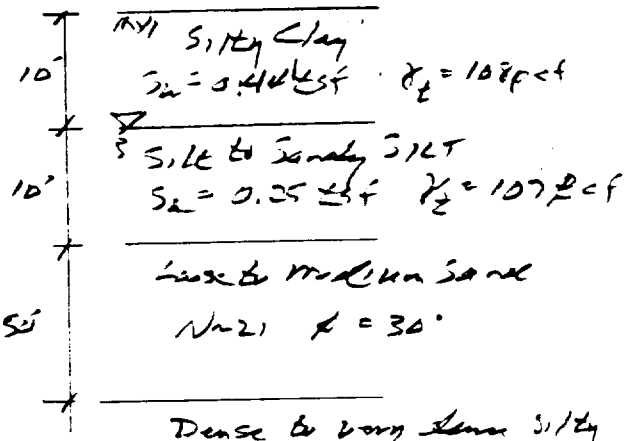
Job: Solutia Sauget
Description:

Project No. 01-3855.00
Computed by: Gmw
Checked by: JDH

Page ___ of ___
Sheet 1 of 9
Date: 10 Jan 02
Date: 11 Jan 02
Reference

Problem: Re-evaluate site Bearing capacity using updated soil investigation

Soil Profile and Loading



$q_{ult} = cN_c + \gamma D_f N_q + \frac{1}{2}\gamma B N_\gamma$

for $\phi = 0$ & $D_f = 0$ $q_{ult} = cN_c$

for square surface load

$q_{ult} = cN_c(1.3\,B/L)$

- Evaluate upper clayey strata

Global Bearing Capacity

$q_{ult} = 5.14(.44\ ksf)\,1.3 = \underline{3.89\ ksf}$

Local Bearing Capacity

$q_{ult} = 0.67\,c\,N_c(1.3) = \underline{3.95\ ksf}$

- Evaluate layer effect

$\frac{c_2}{c_1} = \frac{0.25}{0.44} = 0.57 \therefore N_c = 3$ (Navfac, 1982)

$\therefore q_{ult} = cN_c = 3(.25\ ksf)\,1.3(2) = \underline{1.95\ ksf}$

Local Failure

$q_{ult} = 0.67(3)(.25)\,1.3(2) = \underline{1.37\ ksf}$

Table 1
Summary of Data for Key Strata

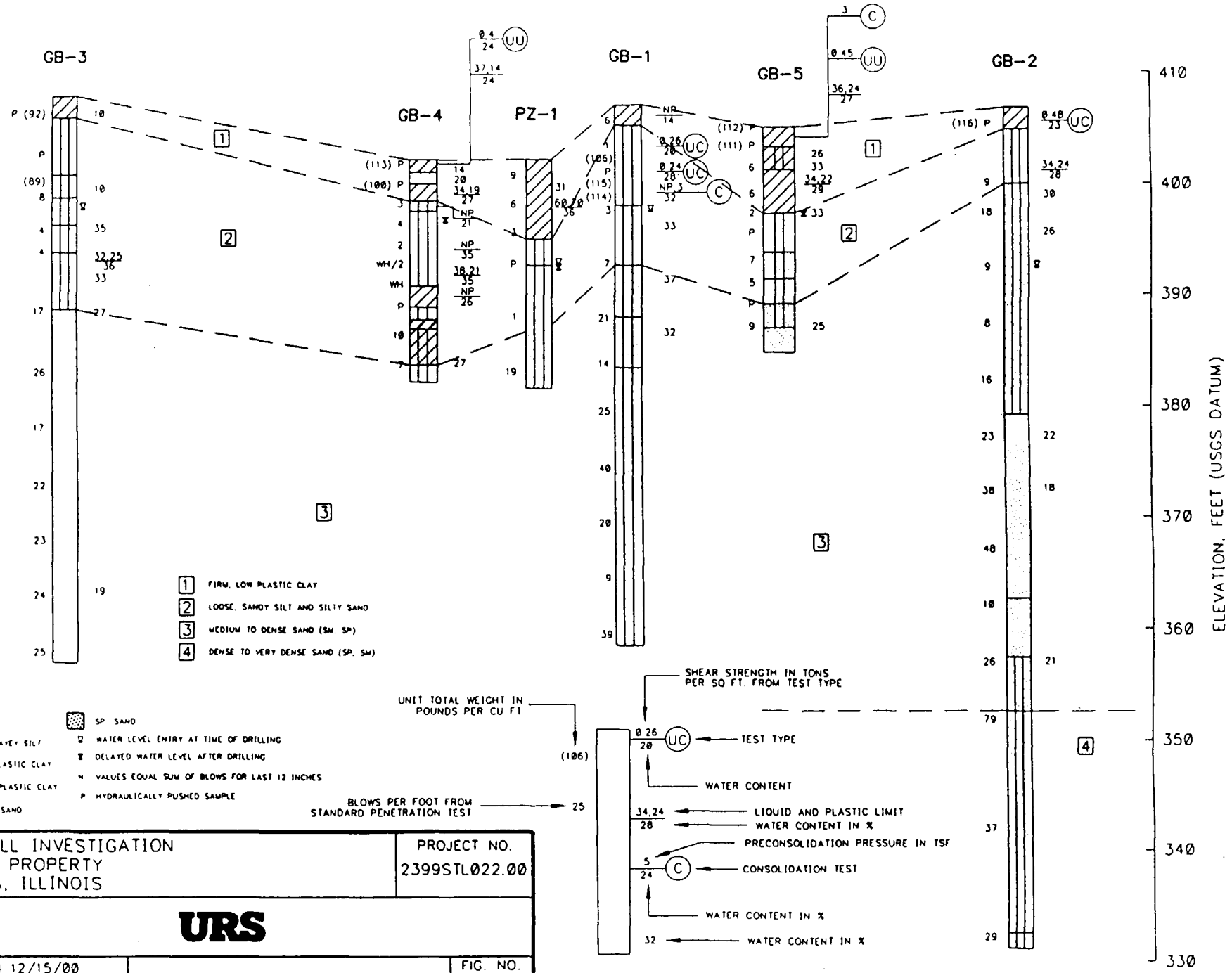
Solutia Inc. - Sauget Area 1
Cahokia, Illinois

Stratum	N (blows/ft)			w_{nat} (%)			LL (%)			PL (%)			γ_{tot} (pcf)			s_u (tsf)	P_c (tsf)	$C_c/(1+e_0)$	$C_r/(1+e_0)$	Minus	D_{10} (mm)	K (cm/sec)
	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg					No. 200 (%)		
1	9	3	6	36	6	23	60	34	42	24	14	20	116	92	108	0.44	3	0.08	0.009	65-98	< 0.001	10^{-6} - 10^{-7}
2	10	0	5	37	6	26	38	32	35	25	19	22	115	89	107	0.25	3	0.10	0.012	18-99	< 0.001 - 0.02	10^{-4} - 10^{-6}
3	48	7	21	32	18	24	-	-	-	-	-	-	-	-	-	-	-	-	-	2-46	< 0.001 - 0.1	10^{-3} - 10^{-4}
4	79	37	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Description of Soil Strata:

1. Firm, moist, low to medium plastic, Silty CLAY (CL)
2. Very loose to loose, dry to wet, SILT to Sandy SILT (ML) with possibly some Clay lenses
3. Loose to medium dense, wet, Silty SAND to SAND (SM,SP)
4. Dense to very dense, wet, Silty SAND to SAND (SM, SP) with a trace of gravel

N - Number of blows per inch from standard penetration test
w_{nat} - Natural water content
LL - Liquid limit of material
PL - Plastic limit of material
g_{tot} - Total unit weight of material
s_u - Undrained shear strength
P_c - Preconsolidation pressure
$C_c/(1+e_o)$ - Compression raio, strain per log of stress beyond preconsolidation pressure
$C_r/(1+e_o)$ - Recompression ratio, strain per log of stress below preconsolidation pressure
No. 200 - Percentage passing the 200 sieve
D_{10} - Diameter at which 10% of the soil finer
K - Coefficient of permeability from consolidation test or estimate from gradation



NOTES THESE GRAPHIC LOGS DEPICT GENERALIZED SOIL CONDITIONS REFER TO INDIVIDUAL LOGS FOR DETAILS

TSCA CELL INVESTIGATION SOLUTIA PROPERTY CAHOKIA, ILLINOIS	PROJECT NO. 2399STL022.00
URS	
DRN. BY djd 12/15/00 DSGN. BY tlc CHKD. BY:	Subsurface Profile — FIG. NO. 2

File: E:\99STL022\BORING PROFILE.DWG Last edited: 12/21/00 @ 11:02 a.m. WC-ST.LOUIS, MO

Settlement Potential

URS Greiner Woodward Clyde

Job: Solutia Sauget
Description: Landfill Settlement Calculations
Project No. C10004051.00
Computed by: M. Brungard
Checked by: R. Haydon
Page ___ of ___
Sheet 1 of 3
Date 11/3/00
Date 11/3/00
Reference

Purpose: These calculations are enhanced versions of the general settlement calculated for the landfill in calculations dated 5/4/00 by M. Brungard titled "Settlement Potential". These calculations will explain the selection of soil properties, existing ground elevations, settlement of individual landfill components during construction, maximum differential settlement and the justification for the consolidation settlement model.

Soil Properties:

Limited boring and laboratory information for the site are available at this time. The 4 borings at the site show that sandy silt extends to about EL 390 with a thin veneer of clay at ground surface. Silty sand was found below EL 390. Geologic estimates for the depth to rubble or bedrock were taken from experience in this region. EL 290 was assumed as the top of non-compressible bedrock or rubble. No borings extended this deep.

The soil density for the foundation soils is calculated in relation to the SPT blow count at each depth interval. The methodology is taken from: Schmertmann (1978), Guidelines for Cone Penetration Test, Performance & Design, Federal Highway Administration. The methodology has been computerized and used to create the results attached.

The waste and fill soil density are conservatively estimated at 125 pcf (moist). Textbook estimates for various soil types show that this is equivalent to a moist, dense well graded soil.

Ground Surface:

The regional topography indicates that the region is generally flat. It can be assumed that low portions of the site have been previously level with the surrounding ground and therefore have been prestressed by that over burden weight. Use EL. 407 as the current ground level. Because the low areas of the site are assumed to be prestressed, it is not necessary to consider the actual ground surface elevation changes of the site.

The water table was estimated at EL. 397' from piezometer readings at the site. (10' depth)

URS Greiner Woodward Clyde

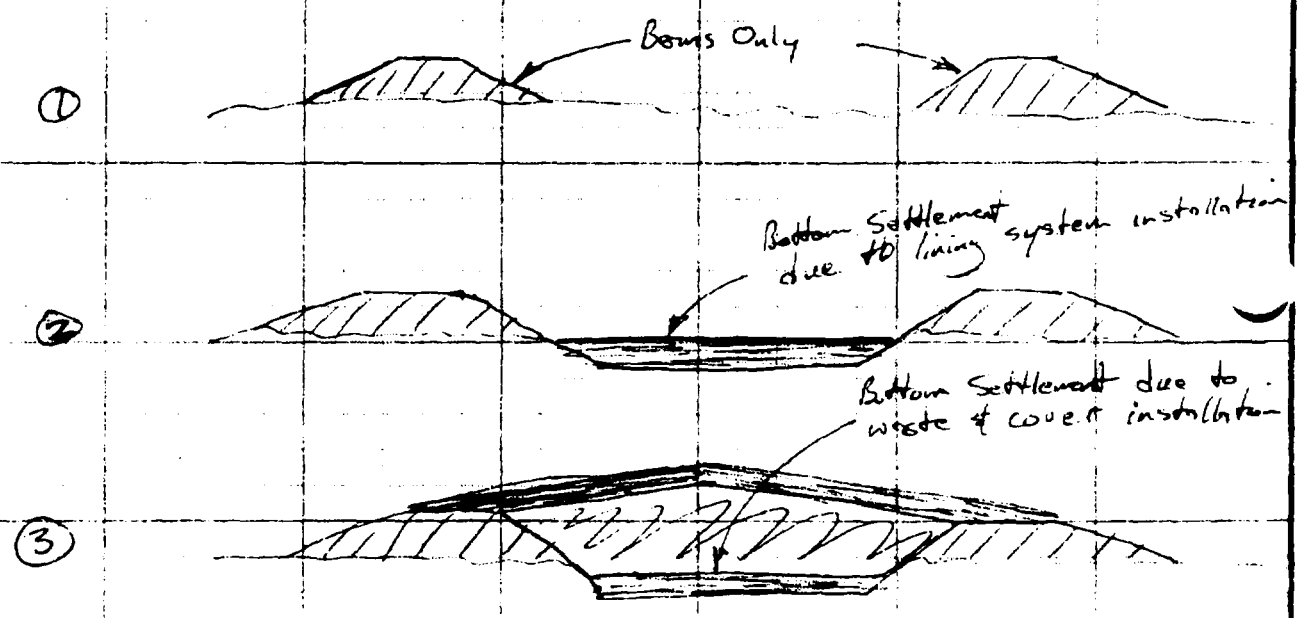
Job: Solutia Sauget
Description: Landfill Settlement Calculations

Project No: CLAN04051.00
Computed by: M. Brungard
Checked by: R. Haydon

Page ___ of ___
Sheet 2 of 8
Date 11/3/00
Date 11/3/00
Reference

The elastic settlement characteristics for each soil layer in the subsurface profile is correlated to the SPT blow counts from the borings. That information is calculated within the computer program.

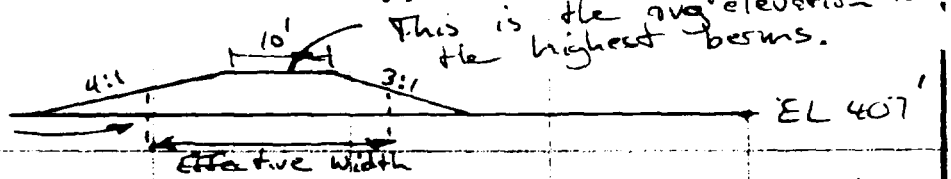
Settlement: The settlement of the landfill components will be estimated in a sequential manner. The sequence is divided into 3 configurations as shown below



The computerized Schmertmann settlement analysis does not include settlements due to clay or silt consolidation. These settlements will be added & calculated by hand.

Berm Settlement

Use EL 420' for top of Berm. This is the avg elevation for the highest berms.



Assume effective width extends to center of slopes.

$\Delta H = 420 - 407 = 13'$

Applied Pressure $= 13' \times$ ___ $= \underline{1625 \text{ psf}}$

Effective Width $= \left(\frac{13'}{2} \times 3\right) + 10' + \left(\frac{13'}{2} \times 4\right) = \underline{55.5'}$ say $\underline{56'}$

nt By: URS; 18505741313; 3 Nov'00 4:53PM; Job 937;Page 3/9

URS Greiner Woodward Clyde

Job: Solutia Sauget
Description: Landfill Settlement Calculations

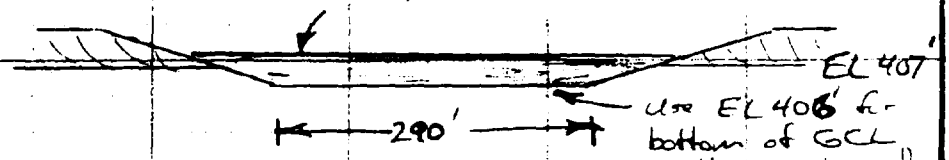
Project No. C10004051.00
Computed by: M. Brungard
Checked by: R. Hayden

Page ___ of ___
Sheet 3 of 8
Date 11/3/00
Date 11/3/00
Reference

Berm Settlement = 2.99 say 3" (see attached sheet)

Use EL. 409' for top of Primary Collection at the center of the cell.

Bottom Settlement:



Use EL 406' for bottom of GCL at the center of the cell.

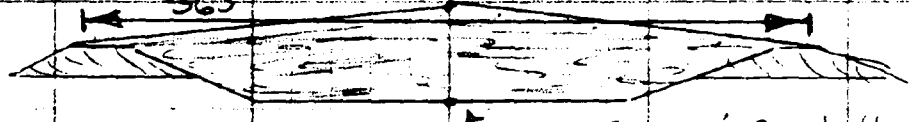
$\Delta H = 409' - 406' = 3'$

Applied Pressure = 3' × 125 pcf = 375 psf

Bottom Settlement = 0.29" say 0.3" (see attached sheet)

Final Filled Bottom Settlement:

Use EL 422 for top of cover at the center of cell.



Use EL 406' for bottom of GCL at the center of cell.

$\Delta H = 422' - 406' = 16'$

Applied Pressure = 16' × 125 pcf = 2000 psf ← highly conservative since this is the peak, not average

Assume the effective width & length are 400'

Bottom Settlement = 2.34" (see attached sheet.)

* less Bottom Settlement above = 0.3

2.04" say 2"

Consolidation Settlement:

The consolidation settlement for the landfill will be calculated using a correlation with the liquid limit for the surficial clays & silts. No other consolidation information is available for the site. LL = 40 for silts observed in borings

For normally consolidated clays, the Compression Index correlation is:

Terzaghi & Peck (1967) $C_c = 0.009\,(LL - 10)$ where LL = liquid limit

URS Greiner Woodward Clyde

Job: Solutia Sauget
Description: Landfill Settlement Calculations

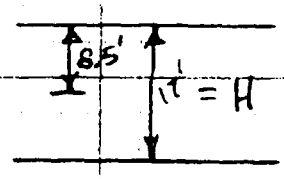
Project No. C100004051.00
Computed by: M. Brungard
Checked by: R. Hayden

Page ___ of ___
Sheet 4 of 8
Date 11/3/00
Date 11/3/00
Reference

Berm

$\Delta H = 407' - 390' = \underline{17'}$

$C_c = (40-10)0.009 = \underline{0.27}$



assume $e_o = 0.6$

Stress at center of layer = 8.5' × 125 pcf = 1062 psf = σ_{vc}'

Berm Applied Pressure = 1625 psf

$$\text{Settlement} = C_c \frac{H}{1+e_o} \log \frac{\sigma_{vc}' + \Delta\sigma_v'}{\sigma_{vc}'}$$

$$= 0.27 \frac{17'}{1+0.6} \log \frac{1062+1625}{1062}$$

$$= \underline{1.15 \text{ feet}} \approx \underline{13.8 \text{ inches}}$$

Typical coefficient of consolidation $C_v = 5\times10^{-3}$ cm²/sec for normally consolidated material w/ LL = 30

5×10^{-3} cm²/sec = $\underline{0.46 \text{ ft}^2/\text{day}}$

$$\text{Consolidation time } (t) = \frac{H^2}{C_v} T$$

for 50% consolidation $T = 0.2$
90% consolidation $T = 0.85$

$$t_{50} = \frac{(17')^2}{0.46 \frac{ft^2}{day}} \cdot 0.2 = \underline{125 \text{ days}} \rightarrow \underline{7''} \text{ settlement}$$

$$t_{90} = \frac{(17)^2}{0.46} \times 0.85 = \underline{534 \text{ days}} \rightarrow \underline{12''} \text{ settlement}$$

nt By: URS; 18505741313; 3 Nov'00 4:55PM; Job 937;Page 5/9

URS Greiner Woodward Clyde

Job: Solutia Sauget
Description: Landfill Settlement Calculation

Project No. C10004051.00
Computed by: M. Brungard
Checked by: R. Hayden

Page ___ of ___
Sheet 5 of 8
Date 11/3/00
Date 11/3/00
Reference

Bottom

$\Delta H = 406' - 390' = 16'$

Filled Cell Applied Pressure = 2000 psf

Stress at center of Silt = 8' × 125 pcf = 1000 psf

$$\text{Settlement} = 0.27 \frac{16'}{1+0.6} \log \frac{1000+2000}{1000}$$

$= 1.28$ feet $= 15.5$ inches

Consolidation Time (t)

$$t_{50} = \frac{(16)^2}{0.46\ ft^2/day} \cdot 0.2 = 111 \text{ days} \longrightarrow 8''$$

$$t_{90} = \frac{(16)^2}{0.46\ ft^2/day} \cdot 0.85 = 473 \text{ days} \longrightarrow 14''$$

Total Settlements:

	Elastic	Consolidation	Total
Berm	3"	13.8"	16.8"
Bottom	2.4"	15.5"	17.9"

Edge to Center Differential Δ = 1.1"

Summary:

This analysis confirms that differential settlement for the landfill will be small and lining system distress should not occur due to settlement. Due to the stress distributions and large depth of influence for the landfill stresses, the use of the averaged maximum stress used in this analysis is appropriate.

Solutia Sauget 11/3/00 M. Brungard 6 of 8

Berm Settlement

DATE: 11/ 3/2000
TIME: 15: 0:53

FILE NAME: boringc.txt
DESCRIPTION: Solutia Sauget Boring Corrected Average

FOOTING PROPERTIES		GENERAL INFORMATION	
Width	56.00 FT	Groundwater Depth	10.00 FT
Length	300.00 FT	Qc/N Ratio	4.00
Depth	0.00 FT		
Total Pressure	1625.00 PSF		

SUBSURFACE INFORMATION AND LAYER SETTLEMENTS BY SCHMERTMANN'S METHOD

LAYER BOTTOM DEPTH (FT)	DUTCH CONE Qc (TSF)	USCS	UNDRAIN STRNGTH Su (PSF)	UNIT WEIGHT (PCF)	COMP. SLOPE C	RECOMP. SLOPE Cr	CONS. RATIO OCR	SETTLE-MENT (IN)
5.00	44			119.50				0.09
10.00	36			118.50				0.14
15.00	32			55.60				0.19
20.00	52			58.23				0.14
25.00	76			61.98				0.11
30.00	76			61.98				0.12
35.00	104			64.10				0.10
40.00	48			57.60				0.24
45.00	40			56.60				0.31
50.00	80			62.60				0.15
55.00	224			70.40				0.05
65.00	96			63.60				0.22
75.00	72			61.35				0.27
120.00	72			61.35				0.86

Total Settlement 2.99

Solutia Sauget 11/3/00 M. Bringgold 7 of 8

Bottom Settlement

DATE: 11/ 3/2000
TIME: 15: 6:50

FILE NAME: boringc.txt
DESCRIPTION: Solutia Sauget Boring Corrected Average

FOOTING PROPERTIES		GENERAL INFORMATION	
Width	290.00 FT	Groundwater Depth	10.00 FT
Length	290.00 FT	Qc/N Ratio	4.00
Depth	1.00 FT		
Total Pressure	375.00 PSF		

SUBSURFACE INFORMATION AND LAYER SETTLEMENTS BY SCHMERTMANN'S METHOD

LAYER BOTTOM DEPTH (FT)	DUTCH CONE Qc (TSF)	USCS	UNDRAIN STRNGTH Su (PSF)	UNIT WEIGHT (PCF)	COMP. SLOPE C	RECOMP. SLOPE Cr	CONS. RATIO OCR	SETTLE-MENT (IN)
5.00	44			119.50				0.01
10.00	36			118.50				0.01
15.00	32			55.60				0.01
20.00	52			58.23				0.01
25.00	76			61.98				0.01
30.00	76			61.98				0.01
35.00	104			64.10				0.01
40.00	48			57.60				0.01
45.00	40			56.60				0.02
50.00	80			62.60				0.01
55.00	224			70.40				0.00
65.00	96			63.60				0.02
75.00	72			61.35				0.03
120.00	72			61.35				0.15

Total Settlement 0.29

Solutia Sauget 11/3/00 M. Brungard 8 of 8

Bottom Settlement (Cell Filled)

DATE: 11/ 3/2000
TIME: 15:16:20

FILE NAME: boringc.txt
DESCRIPTION: Solutia Sauget Boring Corrected Average

FOOTING PROPERTIES		GENERAL INFORMATION	
Width	400.00 FT	Groundwater Depth	10.00 FT
Length	400.00 FT	Qc/N Ratio	4.00
Depth	1.00 FT		
Total Pressure	2000.00 PSF		

SUBSURFACE INFORMATION AND LAYER SETTLEMENTS BY SCHMERTMANN'S METHOD

LAYER BOTTOM DEPTH (FT)	DUTCH CONE Qc (TSF)	USCS	UNDRAIN STRNGTH Su (PSF)	UNIT WEIGHT (PCF)	COMP. SLOPE C	RECOMP. SLOPE Cr	CONS. RATIO OCR	SETTLE-MENT (IN)
5.00	44			119.50				0.06
10.00	36			118.50				0.09
15.00	32			55.60				0.11
20.00	52			58.23				0.08
25.00	76			61.98				0.06
30.00	76			61.98				0.06
35.00	104			64.10				0.05
40.00	48			57.60				0.11
45.00	40			56.60				0.14
50.00	80			62.60				0.07
55.00	224			70.40				0.03
65.00	96			63.60				0.14
75.00	72			61.35				0.20
120.00	72			61.35				1.14

Total Settlement 2.34

Hydrostatic Uplift Calculations

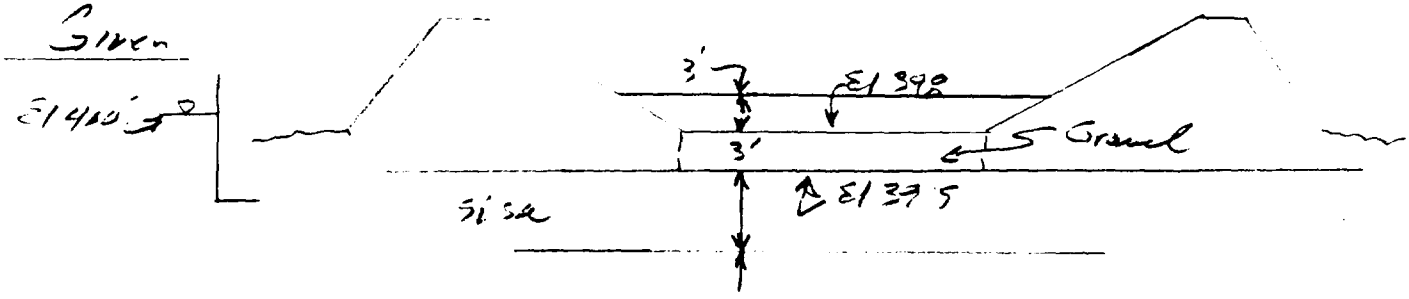
URS

Job: Solvita Landfill	Project No. C1-3799.30	Page ___ of ___	
Description: Hydrostatic Uplift	Computed by: Gross	Sheet 1 of 1	Date: 10 Jan 01
	Checked by: QPH		Date: 10-1-01

Reference

Problem: Evaluate the potential for uplift on the liner system

Given



Max observed water elevation = El 400'

Evaluate uplift potential for liner system without waste in landfill

γ soil liner = 110 pcf

Load on gravel layer = 110 pcf × 3' = 330 psf

Uplift force from water = 62.4 × 2' = 124 psf

Net downward force = 205 psf

Slope Stability

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-04-00
Time of Run:	2:09pm
Run By:	Martin Brungard
Input Data Filename:	C:SAUGET.IN
Output Filename:	C:SAUGET.OUT
Plotted Output Filename:	C:SAUGET.PLT

PROBLEM DESCRIPTION Solutia Sauget Landfill
-Exterior Slope Seismic Condition

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	40.00	30.00	40.00	3
2	30.00	40.00	110.00	60.00	1
3	110.00	60.00	150.00	60.00	1
4	30.00	40.00	150.00	40.00	3
5	0.00	30.00	150.00	30.00	2

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	1000.0	0.0	0.00	0.0	0
2	120.0	120.0	0.0	30.0	0.00	0.0	1
3	120.0	120.0	480.0	0.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	30.00
2	150.00	30.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	110.00	150.00	200.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient
Of0.100 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

800 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 20.00 ft.
and X = 30.00 ft.

Each Surface Terminates Between X = 120.00 ft.
and X = 150.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.23	40.00
2	33.73	37.82
3	38.35	35.90
4	43.07	34.25
5	47.88	32.88
6	52.75	31.78
7	57.69	30.96
8	62.66	30.42
9	67.65	30.17
10	72.65	30.20
11	77.64	30.53
12	82.60	31.13
13	87.52	32.02
14	92.39	33.19
15	97.17	34.63
16	101.87	36.35
17	106.46	38.33
18	110.93	40.57
19	115.26	43.07
20	119.45	45.80
21	123.47	48.77
22	127.31	51.97
23	130.97	55.38
24	134.42	59.00
25	135.27	60.00

Circle Center At X = 69.5 ; Y = 117.5 and Radius, 87.4

*** 1.354 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.10	40.00
2	28.73	38.11
3	33.43	36.41
4	38.21	34.91
5	43.04	33.63
6	47.92	32.54
7	52.84	31.67
8	57.80	31.00
9	62.78	30.55
10	67.77	30.31
11	72.77	30.29
12	77.77	30.47
13	82.75	30.87
14	87.71	31.48
15	92.65	32.30
16	97.54	33.33
17	102.38	34.57
18	107.17	36.01
19	111.89	37.66
20	116.54	39.50
21	121.10	41.55
22	125.58	43.78
23	129.95	46.20
24	134.22	48.81
25	138.37	51.59
26	142.40	54.55
27	146.30	57.68
28	148.95	60.00

Circle Center At X = 70.9 ; Y = 147.7 and Radius, 117.4

*** 1.356 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.85	40.00
2	28.48	38.12
3	33.19	36.43
4	37.96	34.95
5	42.79	33.66

6	47.67	32.58
7	52.60	31.70
8	57.55	31.03
9	62.53	30.57
10	67.52	30.32
11	72.52	30.28
12	77.52	30.44
13	82.51	30.81
14	87.47	31.40
15	92.41	32.19
16	97.31	33.18
17	102.16	34.38
18	106.96	35.79
19	111.70	37.39
20	116.37	39.19
21	120.95	41.18
22	125.45	43.36
23	129.85	45.73
24	134.15	48.28
25	138.34	51.01
26	142.41	53.91
27	146.36	56.98
28	149.93	60.00

Circle Center At X = 71.1 ; Y = 149.7 and Radius, 119.4

*** 1.357 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.95	40.00
2	32.52	37.97
3	37.18	36.17
4	41.93	34.61
5	46.76	33.29
6	51.64	32.22
7	56.57	31.39
8	61.54	30.82
9	66.53	30.50
10	71.53	30.43
11	76.52	30.61
12	81.51	31.04
13	86.46	31.73
14	91.37	32.67
15	96.23	33.85
16	101.02	35.27
17	105.74	36.94
18	110.36	38.84
19	114.88	40.98
20	119.29	43.33
21	123.57	45.91

22	127.72	48.71
23	131.72	51.70
24	135.57	54.90
25	139.25	58.29
26	140.93	60.00

Circle Center At X = 70.4 ; Y = 129.4 and Radius, 98.9

*** 1.358 ***

Failure Surface Specified By 29 Coordinate Points

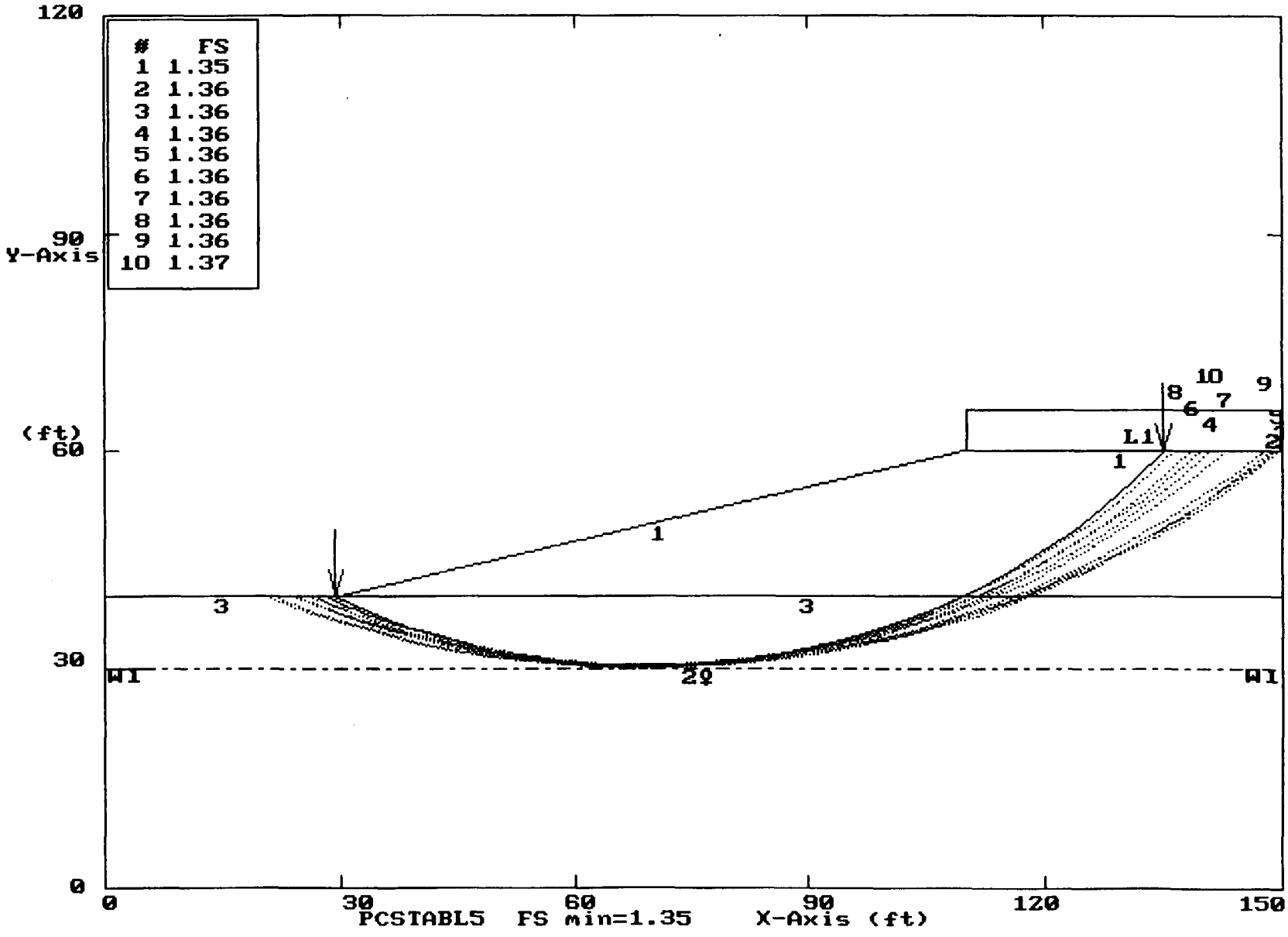
Point No.	X-Surf (ft)	Y-Surf (ft)
1	20.51	40.00
2	25.15	38.12
3	29.85	36.43
4	34.62	34.93
5	39.45	33.63
6	44.33	32.53
7	49.25	31.62
8	54.20	30.92
9	59.17	30.42
10	64.16	30.12
11	69.16	30.02
12	74.16	30.13
13	79.15	30.44
14	84.12	30.95
15	89.07	31.67
16	93.99	32.58
17	98.86	33.70
18	103.69	35.01
19	108.45	36.52
20	113.16	38.21
21	117.79	40.10
22	122.33	42.18
23	126.80	44.44
24	131.16	46.88
25	135.42	49.49
26	139.57	52.28
27	143.61	55.23
28	147.52	58.34
29	149.44	60.00

Circle Center At X = 69.0 ; Y = 153.0 and Radius, 122.9

*** 1.359 ***

Failure Surface Specified By 26 Coordinate Points

Solutia Sauget Landfill Exterior Slope Seismic Condition
Ten Most Critical. C:SAUGET.PLT By: Martin Brungard 5-04-00 :09pm



--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-04-00
Time of Run:	2:06pm
Run By:	Martin Brungard
Input Data Filename:	C:SAUGET5.IN
Output Filename:	C:SAUGET5.OUT
Plotted Output Filename:	C:SAUGET5.PLT

PROBLEM DESCRIPTION Solutia Sauget Landfill
-Exterior Slope Static Condition

BOUNDARY COORDINATES

3 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	40.00	30.00	40.00	3
2	30.00	40.00	110.00	60.00	1
3	110.00	60.00	150.00	60.00	1
4	30.00	40.00	150.00	40.00	3
5	0.00	30.00	150.00	30.00	2

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	1000.0	0.0	0.00	0.0	0
2	120.0	120.0	0.0	30.0	0.00	0.0	1
3	120.0	120.0	480.0	0.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	30.00
2	150.00	30.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	110.00	150.00	200.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

800 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 20.00 ft.
and X = 30.00 ft.

Each Surface Terminates Between X = 120.00 ft.
and X = 150.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	29.23	40.00
2	33.73	37.82
3	38.35	35.90
4	43.07	34.25
5	47.88	32.88
6	52.75	31.78
7	57.69	30.96
8	62.66	30.42
9	67.65	30.17
10	72.65	30.20
11	77.64	30.53
12	82.60	31.13
13	87.52	32.02
14	92.39	33.19
15	97.17	34.63
16	101.87	36.35
17	106.46	38.33
18	110.93	40.57
19	115.26	43.07
20	119.45	45.80
21	123.47	48.77
22	127.31	51.97
23	130.97	55.38
24	134.42	59.00
25	135.27	60.00

Circle Center At X = 69.5 ; Y = 117.5 and Radius, 87.4

*** 1.943 ***

Failure Surface Specified By 25 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	26.67	40.00
2	31.20	37.88
3	35.83	36.01
4	40.56	34.38
5	45.37	33.02
6	50.25	31.91
7	55.18	31.07
8	60.14	30.50
9	65.13	30.19
10	70.13	30.16
11	75.13	30.39
12	80.10	30.89
13	85.04	31.65
14	89.94	32.68
15	94.77	33.97
16	99.52	35.52
17	104.18	37.33
18	108.74	39.38
19	113.19	41.67
20	117.50	44.20
21	121.67	46.96
22	125.69	49.94
23	129.54	53.13
24	133.21	56.52
25	136.60	60.00

Circle Center At X = 68.3 ; Y = 123.1 and Radius, 93.0

*** 1.956 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	28.21	40.00
2	32.75	37.92
3	37.41	36.09
4	42.15	34.50
5	46.97	33.17
6	51.85	32.09
7	56.78	31.27
8	61.75	30.71
9	66.74	30.41
10	71.74	30.37
11	76.73	30.60
12	81.71	31.09
13	86.65	31.85
14	91.55	32.86
15	96.39	34.12
16	101.15	35.64
17	105.83	37.41
18	110.40	39.42

19	114.87	41.68
20	119.21	44.16
21	123.41	46.87
22	127.47	49.79
23	131.36	52.92
24	135.09	56.26
25	138.63	59.79
26	138.83	60.00

Circle Center At X = 69.9 ; Y = 125.3 and Radius, 95.0

*** 1.966 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	27.95	40.00
2	32.52	37.97
3	37.18	36.17
4	41.93	34.61
5	46.76	33.29
6	51.64	32.22
7	56.57	31.39
8	61.54	30.82
9	66.53	30.50
10	71.53	30.43
11	76.52	30.61
12	81.51	31.04
13	86.46	31.73
14	91.37	32.67
15	96.23	33.85
16	101.02	35.27
17	105.74	36.94
18	110.36	38.84
19	114.88	40.98
20	119.29	43.33
21	123.57	45.91
22	127.72	48.71
23	131.72	51.70
24	135.57	54.90
25	139.25	58.29
26	140.93	60.00

Circle Center At X = 70.4 ; Y = 129.4 and Radius, 98.9

*** 1.976 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	24.36	40.00
2	28.94	37.98
3	33.60	36.19
4	38.35	34.63
5	43.18	33.31
6	48.06	32.22
7	52.98	31.37
8	57.95	30.76
9	62.93	30.40
10	67.93	30.28
11	72.93	30.40
12	77.92	30.77
13	82.88	31.38
14	87.81	32.23
15	92.68	33.32
16	97.51	34.65
17	102.26	36.21
18	106.92	38.00
19	111.50	40.02
20	115.97	42.26
21	120.33	44.71
22	124.56	47.37
23	128.65	50.24
24	132.60	53.30
25	136.40	56.56
26	140.04	59.99
27	140.04	60.00

Circle Center At X = 67.9 ; Y = 132.7 and Radius, 102.4

*** 1.987 ***

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	25.90	40.00
2	30.49	38.01
3	35.16	36.25
4	39.92	34.71
5	44.75	33.40
6	49.63	32.32
7	54.56	31.47
8	59.52	30.86
9	64.50	30.48
10	69.50	30.35
11	74.50	30.45
12	79.49	30.79

13	84.46	31.37
14	89.39	32.18
15	94.28	33.23
16	99.11	34.51
17	103.88	36.01
18	108.57	37.75
19	113.17	39.70
20	117.68	41.87
21	122.07	44.26
22	126.35	46.85
23	130.50	49.64
24	134.51	52.62
25	138.37	55.80
26	142.08	59.15
27	142.94	60.00

Circle Center At X = 69.9 ; Y = 135.3 and Radius, 104.9

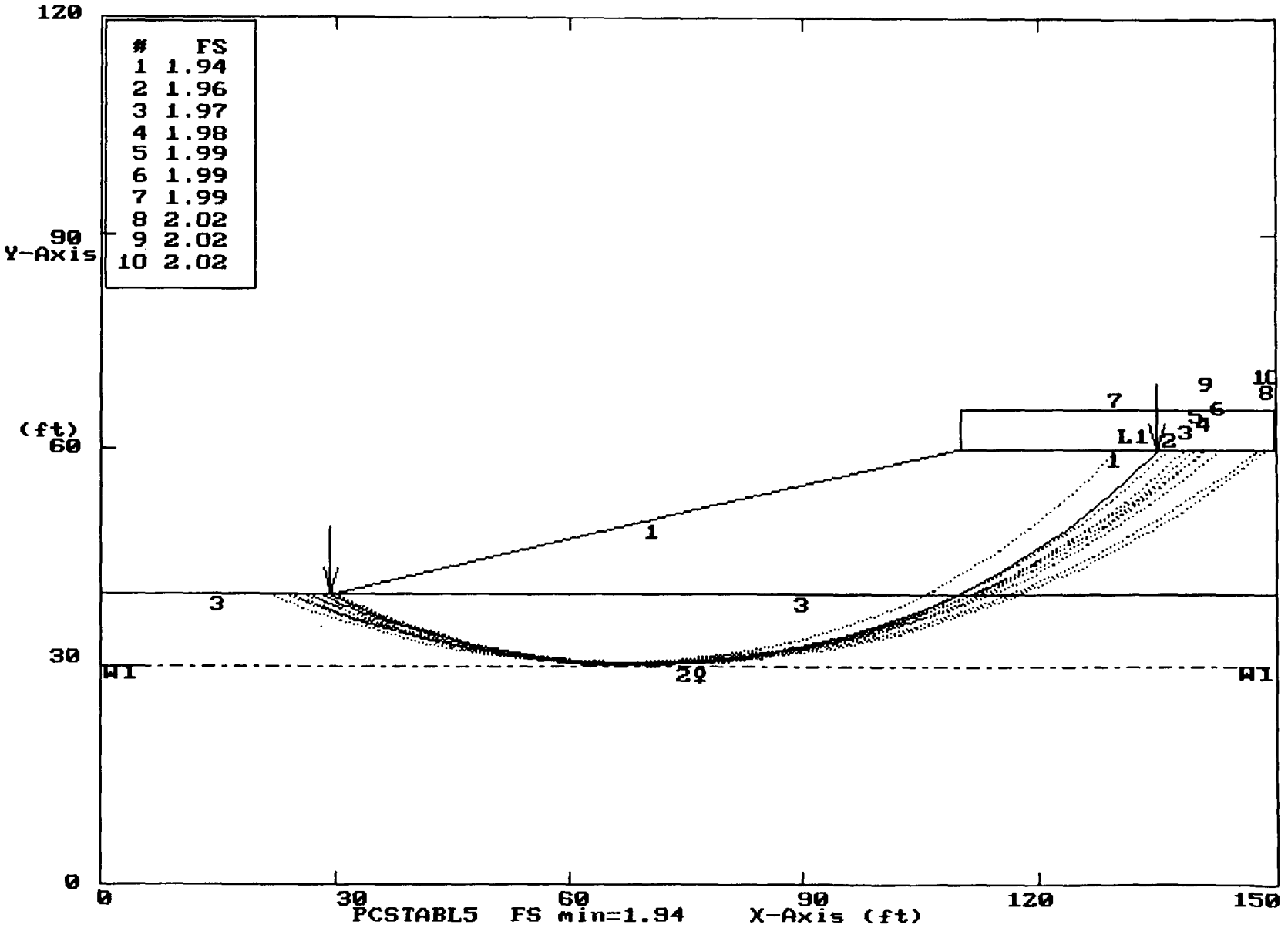
*** 1.988 ***

Failure Surface Specified By 24 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	30.00	40.00
2	34.49	37.79
3	39.10	35.87
4	43.83	34.24
5	48.65	32.90
6	53.54	31.87
7	58.49	31.14
8	63.47	30.73
9	68.47	30.62
10	73.46	30.83
11	78.44	31.34
12	83.37	32.17
13	88.24	33.30
14	93.03	34.73
15	97.72	36.46
16	102.29	38.48
17	106.73	40.78
18	111.02	43.35
19	115.14	46.18
20	119.08	49.26
21	122.82	52.59
22	126.34	56.14
23	129.63	59.90
24	129.71	60.00

Circle Center At X = 67.7 ; Y = 110.8 and Radius, 80.2

Solutia Sauget Landfill Exterior Slope Static Condition
Ten Most Critical. C:SAUGET5.PLT By: Martin Brungard 5-04-00 :06pm



--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-05-00
Time of Run:	3:28pm
Run By:	Martin Brungard
Input Data Filename:	C:SAUGET4.IN
Output Filename:	C:SAUGET4.OUT
Plotted Output Filename:	C:SAUGET4.PLT

PROBLEM DESCRIPTION Solutia Sauget
-2' cover thickness, 12% slope, seismic

BOUNDARY COORDINATES

1 Top Boundaries
3 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	35.00	180.00	56.60	1
2	10.00	34.20	180.00	54.60	2
3	10.00	34.00	180.00	54.40	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	120.0	300.0	0.0	0.00	0.0	0
2	110.0	120.0	0.0	11.0	0.00	0.0	0

A Horizontal Earthquake Loading Coefficient
Of0.100 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

25 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 1.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	4.00	33.40	12.00	34.34	0.20
2	170.00	53.30	178.00	54.30	0.20

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.22	35.15
2	1.50	34.95
3	2.48	34.74
4	3.21	34.06
5	4.05	33.50
6	176.68	54.18
7	177.25	55.00
8	177.93	55.73
9	178.17	56.38

*** 1.194 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	8.44	36.01
2	9.26	35.86
3	10.21	35.54
4	11.11	35.11
5	11.83	34.42
6	176.58	54.18
7	177.29	54.89
8	177.80	55.75
9	178.39	56.41

*** 1.203 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.52	35.66
2	5.90	35.32
3	6.79	34.88
4	7.77	34.65
5	8.65	34.18
6	9.63	34.00
7	172.21	53.53
8	172.69	54.40
9	173.40	55.11
10	173.97	55.88

*** 1.213 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.61	35.67
2	6.29	35.13
3	7.18	34.67
4	8.16	34.44
5	9.02	33.94

6	170.22	53.35
7	170.89	54.10
8	171.46	54.92
9	172.07	55.65

*** 1.218 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.84	35.58
2	4.92	35.55
3	5.90	35.36
4	6.61	34.65
5	7.57	34.38
6	8.44	33.89
7	173.61	53.66
8	174.30	54.38
9	174.98	55.11
10	175.54	55.94
11	175.59	56.07

*** 1.236 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	8.46	36.02
2	8.56	35.97
3	9.39	35.42
4	10.26	34.92
5	11.03	34.28
6	176.04	54.07
7	176.32	55.03
8	176.73	55.95
9	176.89	56.23

*** 1.242 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.29	35.87
2	7.38	35.80
3	8.38	35.78
4	9.14	35.13
5	10.09	34.82
6	10.86	34.18
7	172.95	53.62
8	173.27	54.57
9	173.71	55.47
10	173.88	55.87

*** 1.251 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.88	35.71
2	6.59	35.34
3	7.42	34.79
4	8.14	34.10
5	9.14	34.02
6	170.57	53.42
7	170.98	54.34
8	171.33	55.28
9	171.62	55.59

*** 1.276 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	3.54	35.43
2	4.13	34.85
3	4.85	34.14
4	5.62	33.51
5	176.57	54.08
6	177.27	54.79
7	177.95	55.52
8	178.64	56.25
9	178.78	56.45

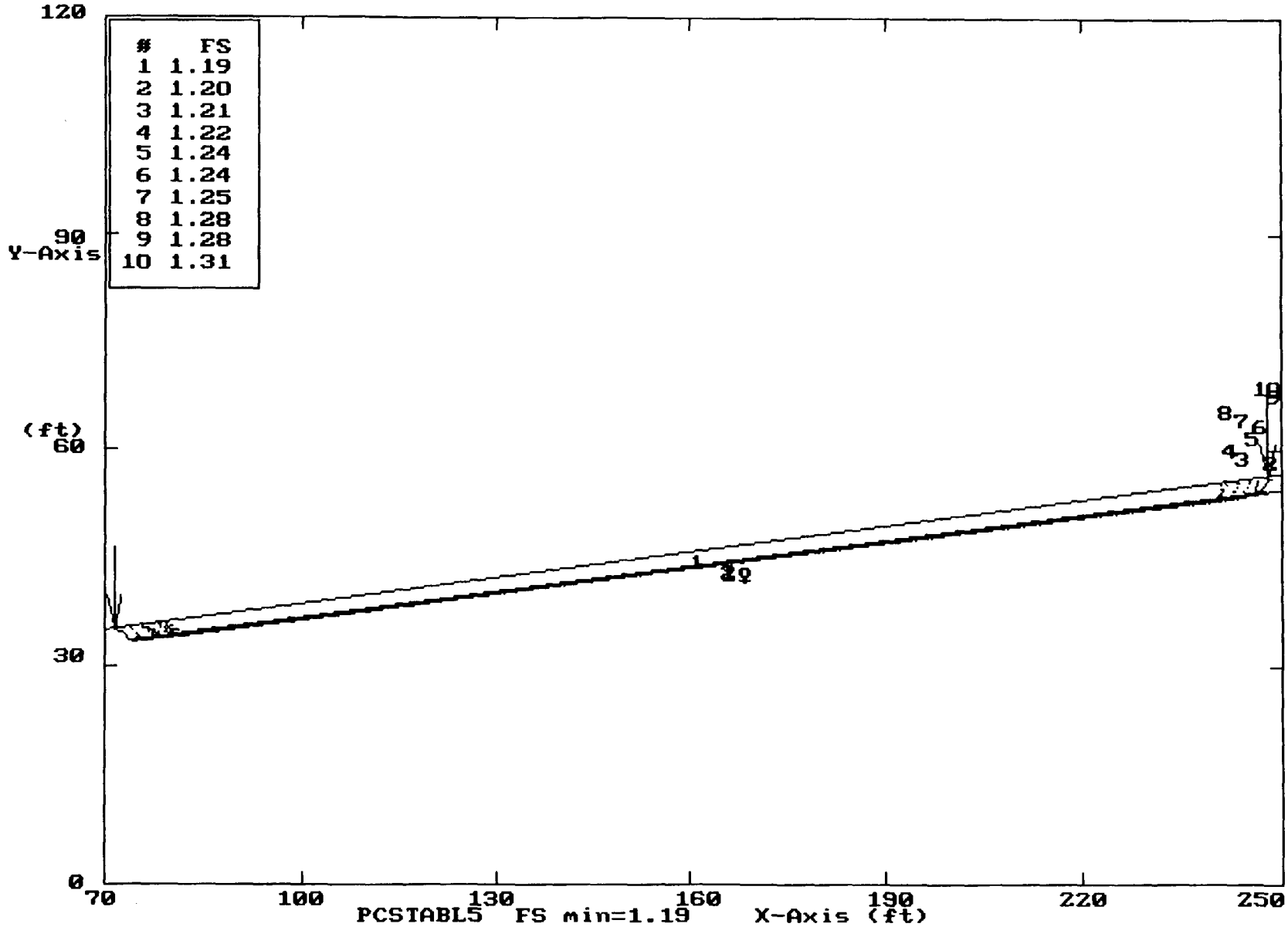
*** 1.278 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.66	35.92
2	8.35	35.24
3	9.23	34.76
4	10.22	34.62
5	11.16	34.28
6	176.03	54.00
7	176.34	54.95
8	176.56	55.93
9	176.75	56.21

*** 1.308 ***

Solutia Sauget 2' cover thickness, 12% slope, seismic
Ten Most Critical. C:SAUGET4.PLT By: Martin Brungard 5-05-00 :28pm



--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-04-00
Time of Run:	2:47pm
Run By:	Martin Brungard
Input Data Filename:	C:SAUGET3.IN
Output Filename:	C:SAUGET3.OUT
Plotted Output Filename:	C:SAUGET3.PLT

PROBLEM DESCRIPTION Solutia Sauget
-2' cover thickness, 12% slope, static

BOUNDARY COORDINATES

1 Top Boundaries
3 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	35.00	180.00	56.60	1
2	10.00	34.20	180.00	54.60	2
3	10.00	34.00	180.00	54.40	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	120.0	300.0	0.0	0.00	0.0	0
2	110.0	120.0	0.0	11.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

25 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 1.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	4.00	33.40	12.00	34.34	0.20
2	170.00	53.30	178.00	54.30	0.20

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.22	35.15
2	1.50	34.95
3	2.48	34.74
4	3.21	34.06
5	4.05	33.50
6	176.68	54.18
7	177.25	55.00
8	177.93	55.73
9	178.17	56.38

*** 2.203 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	8.44	36.01

2	9.26	35.86
3	10.21	35.54
4	11.11	35.11
5	11.83	34.42
6	176.58	54.18
7	177.29	54.89
8	177.80	55.75
9	178.39	56.41

*** 2.220 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.52	35.66
2	5.90	35.32
3	6.79	34.88
4	7.77	34.65
5	8.65	34.18
6	9.63	34.00
7	172.21	53.53
8	172.69	54.40
9	173.40	55.11
10	173.97	55.88

*** 2.238 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.61	35.67
2	6.29	35.13
3	7.18	34.67
4	8.16	34.44
5	9.02	33.94
6	170.22	53.35
7	170.89	54.10
8	171.46	54.92
9	172.07	55.65

*** 2.246 ***

Failure Surface Specified By 11 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.84	35.58
2	4.92	35.55
3	5.90	35.36
4	6.61	34.65
5	7.57	34.38
6	8.44	33.89
7	173.61	53.66
8	174.30	54.38
9	174.98	55.11
10	175.54	55.94
11	175.59	56.07

*** 2.280 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	8.46	36.02
2	8.56	35.97
3	9.39	35.42
4	10.26	34.92
5	11.03	34.28
6	176.04	54.07
7	176.32	55.03
8	176.73	55.95
9	176.89	56.23

*** 2.291 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.29	35.87
2	7.38	35.80
3	8.38	35.78
4	9.14	35.13
5	10.09	34.82
6	10.86	34.18

7	172.95	53.62
8	173.27	54.57
9	173.71	55.47
10	173.88	55.87

*** 2.307 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.88	35.71
2	6.59	35.34
3	7.42	34.79
4	8.14	34.10
5	9.14	34.02
6	170.57	53.42
7	170.98	54.34
8	171.33	55.28
9	171.62	55.59

*** 2.352 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	3.54	35.43
2	4.13	34.85
3	4.85	34.14
4	5.62	33.51
5	176.57	54.08
6	177.27	54.79
7	177.95	55.52
8	178.64	56.25
9	178.78	56.45

*** 2.355 ***

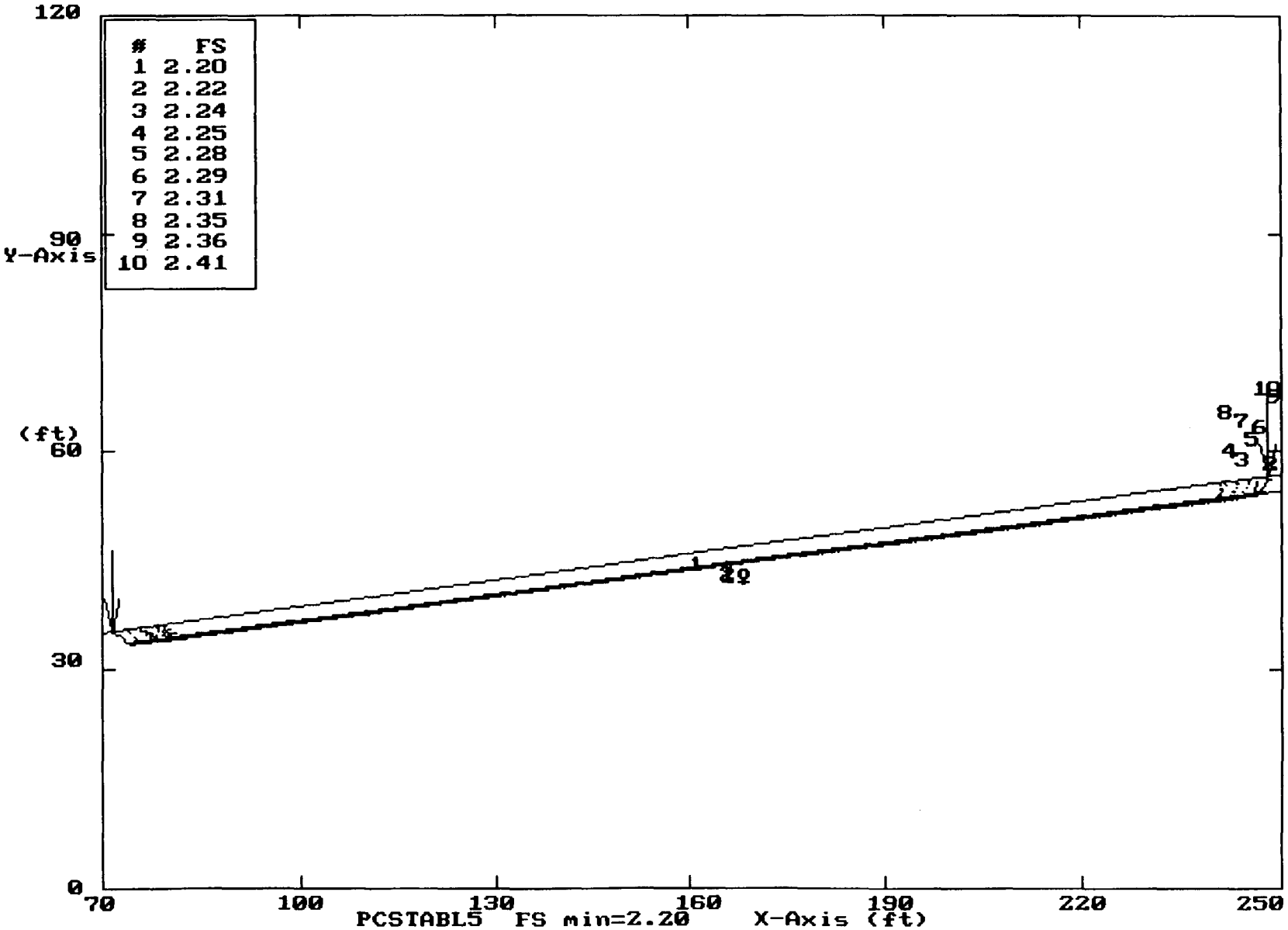
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	7.66	35.92
2	8.35	35.24
3	9.23	34.76
4	10.22	34.62
5	11.16	34.28
6	176.03	54.00
7	176.34	54.95
8	176.56	55.93
9	176.75	56.21

*** 2.411 ***

Solutia Sauget 2' cover thickness, 12% slope, static
Ten Most Critical. C:SAUGET3.PLT By: Martin Brungard 5-04-00 :47pm



--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-04-00
Time of Run:	2:14pm
Run By:	Martin Brungard
Input Data Filename:	C:SAUGET6.IN
Output Filename:	C:SAUGET6.OUT
Plotted Output Filename:	C:SAUGET6.PLT

PROBLEM DESCRIPTION Solutia Sauget Landfill
-Interior Slope Seismic Condition

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	20.00	20.00	20.00	3
2	20.00	20.00	63.50	34.50	1
3	63.50	34.50	73.50	34.50	1
4	73.50	34.50	131.00	20.00	1
5	20.00	20.00	131.00	20.00	3
6	0.00	16.00	131.00	16.00	2

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	1000.0	0.0	0.00	0.0	0
2	120.0	120.0	0.0	30.0	0.00	0.0	1

3	120.0	120.0	480.0	0.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	16.00
2	131.00	16.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	63.50	73.50	200.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Horizontal Earthquake Loading Coefficient Of0.100 Has Been Assigned

A Vertical Earthquake Loading Coefficient Of0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

800 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 40 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.

and X = 10.00 ft.

Each Surface Terminates Between X = 75.00 ft.
and X = 85.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.28	20.00
2	5.47	17.26
3	9.89	14.93
4	14.51	13.02
5	19.29	11.56
6	24.19	10.54
7	29.16	9.99
8	34.16	9.91
9	39.14	10.30
10	44.07	11.15
11	48.89	12.45
12	53.58	14.21
13	58.07	16.39
14	62.35	18.99
15	66.36	21.97
16	70.07	25.32
17	73.46	29.00
18	76.48	32.98
19	76.90	33.64

Circle Center At X = 32.5 ; Y = 63.2 and Radius, 53.4

*** 2.091 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	0.00	20.00
2	4.01	17.01
3	8.28	14.41
4	12.79	12.24
5	17.48	10.52
6	22.31	9.25
7	27.25	8.45
8	32.24	8.14
9	37.24	8.30
10	42.20	8.95
11	47.07	10.06
12	51.81	11.64
13	56.38	13.68
14	60.73	16.14
15	64.83	19.00
16	68.63	22.25
17	72.10	25.85
18	75.21	29.77
19	77.60	33.47

Circle Center At X = 33.0 ; Y = 60.0 and Radius, 51.9

*** 2.096 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.10	20.00
2	8.24	17.19
3	12.64	14.81
4	17.25	12.89
5	22.04	11.43
6	26.94	10.46
7	31.92	9.99
8	36.92	10.02
9	41.89	10.55
10	46.78	11.57
11	51.55	13.08
12	56.14	15.06
13	60.51	17.49
14	64.62	20.35
15	68.41	23.60
16	71.87	27.22
17	74.94	31.16
18	76.55	33.73

Circle Center At X = 34.1 ; Y = 59.8 and Radius, 49.8

*** 2.097 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.28	20.00
2	5.45	17.24
3	9.87	14.90
4	14.50	13.00
5	19.28	11.56
6	24.19	10.58
7	29.16	10.08
8	34.16	10.07
9	39.14	10.54
10	44.05	11.49
11	48.84	12.91
12	53.48	14.78
13	57.91	17.10
14	62.10	19.83
15	66.00	22.95
16	69.58	26.44
17	72.81	30.26
18	75.41	34.02

Circle Center At X = 31.8 ; Y = 61.7 and Radius, 51.6

*** 2.097 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.03	20.00
2	5.11	17.11
3	9.44	14.62
4	13.99	12.54
5	18.71	10.89
6	23.56	9.69
7	28.51	8.94
8	33.50	8.66
9	38.49	8.84
10	43.45	9.48
11	48.33	10.59
12	53.08	12.14

13	57.67	14.13
14	62.05	16.54
15	66.19	19.34
16	70.05	22.52
17	73.60	26.04
18	76.81	29.88
19	79.03	33.10

Circle Center At X = 34.0 ; Y = 62.4 and Radius, 53.7

*** 2.099 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.05	20.00
2	6.11	17.08
3	10.43	14.56
4	14.97	12.46
5	19.69	10.82
6	24.54	9.63
7	29.49	8.91
8	34.49	8.68
9	39.48	8.92
10	44.43	9.64
11	49.28	10.84
12	54.00	12.50
13	58.54	14.60
14	62.85	17.12
15	66.91	20.05
16	70.66	23.36
17	74.07	27.01
18	77.12	30.97
19	78.54	33.23

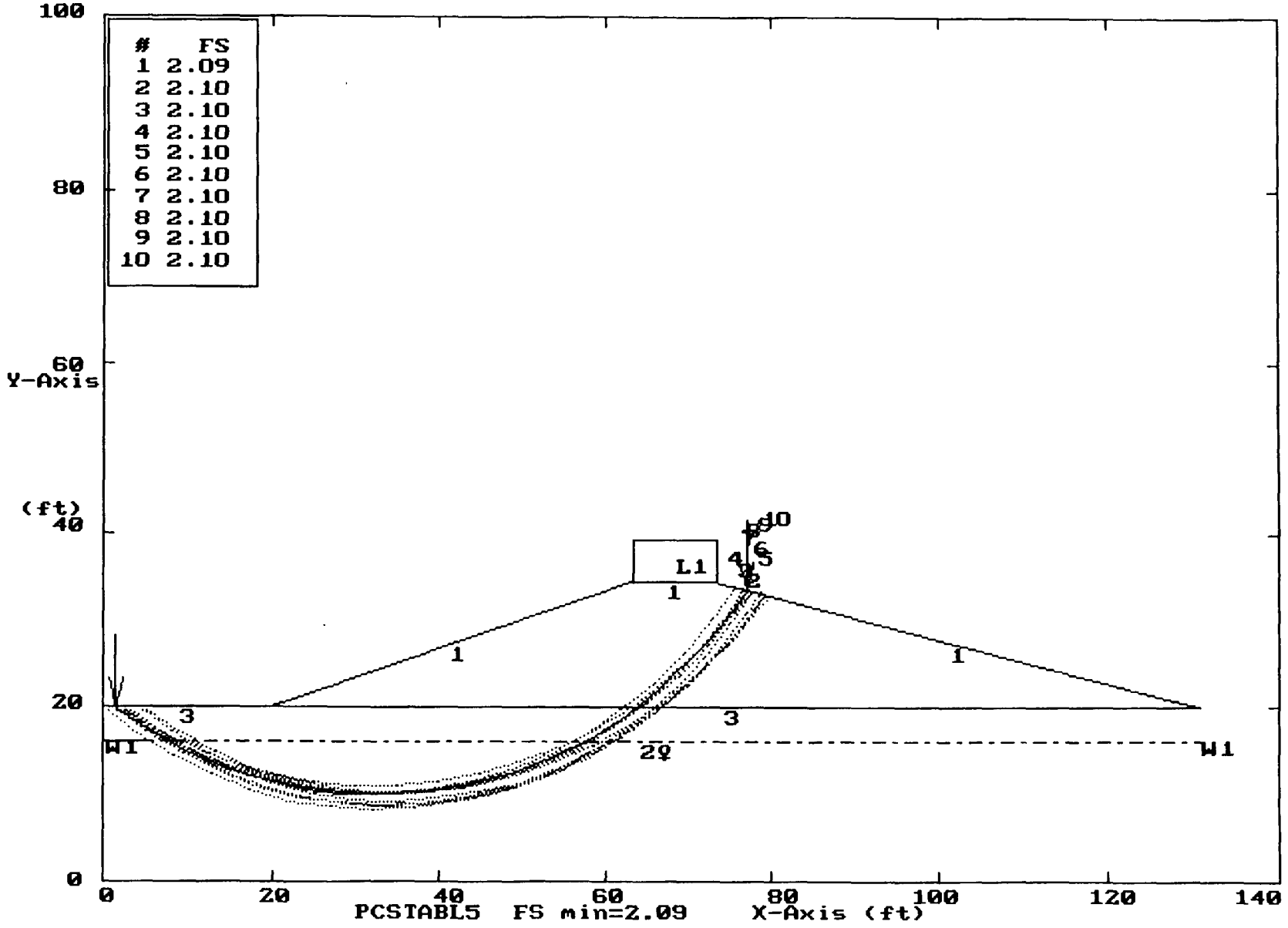
Circle Center At X = 34.4 ; Y = 60.7 and Radius, 52.0

*** 2.099 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.62	20.00
2	8.78	17.23
3	13.20	14.89

Solutia Sauget Landfill Interior Slope Seismic Condition
Ten Most Critical. C:SAUGET6.PLT By: Martin Brungard 5-04-00 :14pm



--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-04-00
Time of Run:	2:17pm
Run By:	Martin Brungard
Input Data Filename:	C:SAUGET7.IN
Output Filename:	C:SAUGET7.OUT
Plotted Output Filename:	C:SAUGET7.PLT

PROBLEM DESCRIPTION Solutia Sauget Landfill
-Interior Slope Static Condition

BOUNDARY COORDINATES

4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	20.00	20.00	20.00	3
2	20.00	20.00	63.50	34.50	1
3	63.50	34.50	73.50	34.50	1
4	73.50	34.50	131.00	20.00	1
5	20.00	20.00	131.00	20.00	3
6	0.00	16.00	131.00	16.00	2

ISOTROPIC SOIL PARAMETERS

3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	1000.0	0.0	0.00	0.0	0
2	120.0	120.0	0.0	30.0	0.00	0.0	1

3	120.0	120.0	480.0	0.0	0.00	0.0	0

1 PIEZOMETRIC SURFACE(S) HAVE BEEN SPECIFIED

Unit Weight of Water = 62.40

Piezometric Surface No. 1 Specified by 2 Coordinate Points

Point No.	X-Water (ft)	Y-Water (ft)
1	0.00	16.00
2	131.00	16.00

BOUNDARY LOAD(S)

1 Load(s) Specified

Load No.	X-Left (ft)	X-Right (ft)	Intensity (lb/sqft)	Deflection (deg)
1	63.50	73.50	200.0	0.0

NOTE - Intensity Is Specified As A Uniformly Distributed Force Acting On A Horizontally Projected Surface.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

800 Trial Surfaces Have Been Generated.

20 Surfaces Initiate From Each Of 40 Points Equally Spaced
Along The Ground Surface Between X = 0.00 ft.
and X = 15.00 ft.

Each Surface Terminates Between X = 65.00 ft.
and X = 80.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Bishop Method * *

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	10.39	20.00
2	14.55	17.24
3	19.02	14.99
4	23.71	13.27
5	28.58	12.11
6	33.54	11.52
7	38.54	11.52
8	43.51	12.10
9	48.37	13.26
10	53.07	14.98
11	57.53	17.23
12	61.70	19.99
13	65.52	23.22
14	68.94	26.87
15	71.91	30.89
16	73.91	34.40

Circle Center At X = 36.0 ; Y = 54.2 and Radius, 42.8

*** 2.837 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	8.08	20.00
2	12.13	17.07
3	16.49	14.63
4	21.11	12.70
5	25.91	11.30
6	30.84	10.46
7	35.83	10.19
8	40.82	10.48

9	45.74	11.35
10	50.54	12.76
11	55.14	14.72
12	59.49	17.18
13	63.53	20.12
14	67.22	23.51
15	70.49	27.29
16	73.31	31.42
17	74.76	34.18

Circle Center At X = 35.7 ; Y = 54.1 and Radius, 43.9

*** 2.838 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.00	20.00
2	9.10	17.14
3	13.49	14.74
4	18.11	12.83
5	22.91	11.43
6	27.83	10.56
7	32.82	10.23
8	37.82	10.44
9	42.76	11.19
10	47.60	12.48
11	52.26	14.27
12	56.70	16.57
13	60.87	19.33
14	64.72	22.52
15	68.20	26.11
16	71.27	30.06
17	73.89	34.32
18	73.92	34.39

Circle Center At X = 33.4 ; Y = 56.3 and Radius, 46.1

*** 2.839 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.00	20.00
2	9.10	17.13

3	13.47	14.72
4	18.09	12.79
5	22.88	11.37
6	27.80	10.47
7	32.79	10.11
8	37.78	10.28
9	42.73	10.99
10	47.58	12.23
11	52.26	13.98
12	56.73	16.22
13	60.93	18.93
14	64.82	22.08
15	68.34	25.62
16	71.47	29.53
17	74.15	33.75
18	74.41	34.27

Circle Center At X = 33.7 ; Y = 56.6 and Radius, 46.5

*** 2.839 ***

Failure Surface Specified By 17 Coordinate Points

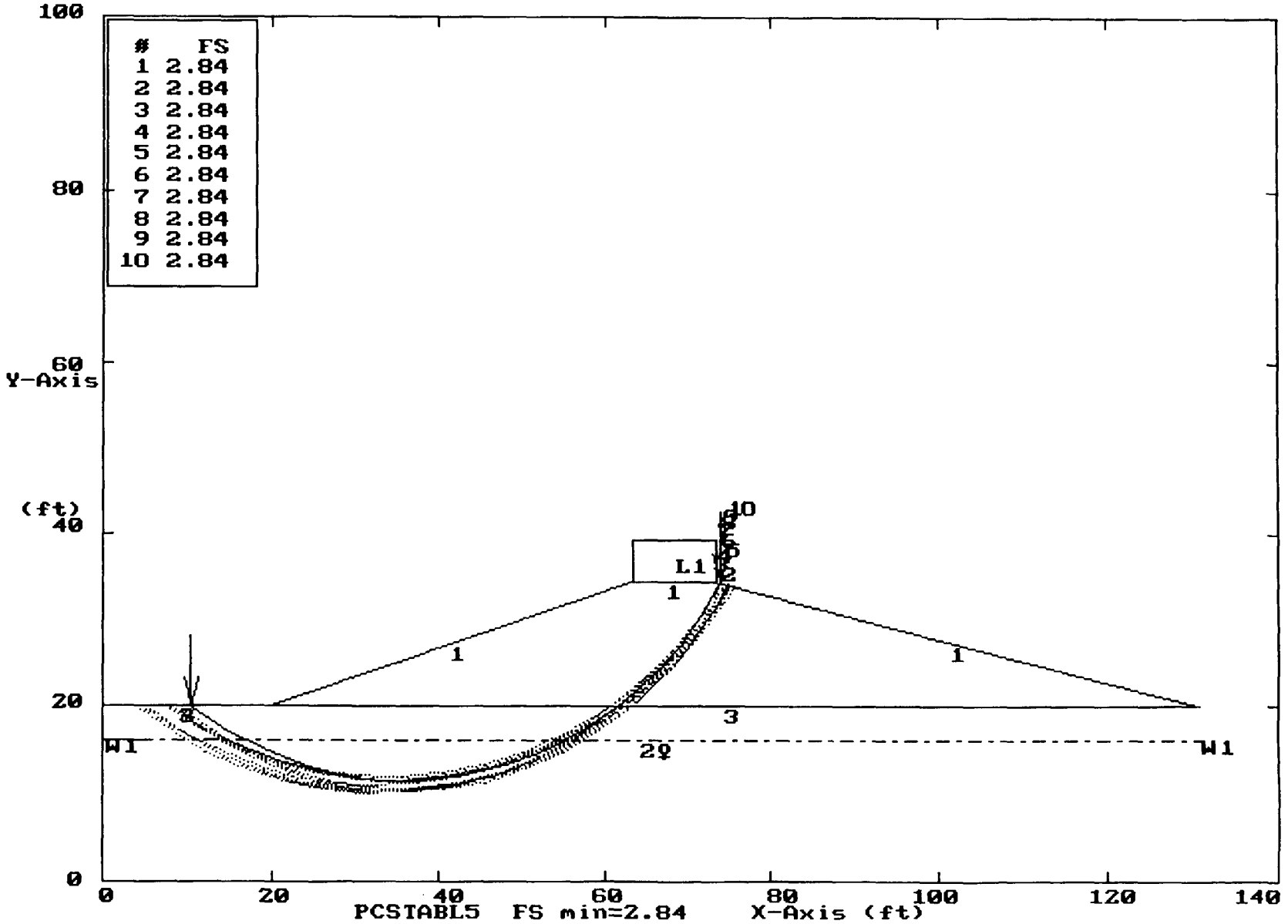
Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.31	20.00
2	11.57	17.38
3	16.08	15.22
4	20.79	13.54
5	25.64	12.36
6	30.60	11.69
7	35.60	11.54
8	40.58	11.92
9	45.50	12.81
10	50.30	14.21
11	54.93	16.10
12	59.34	18.46
13	63.48	21.27
14	67.30	24.49
15	70.76	28.10
16	73.83	32.05
17	75.11	34.09

Circle Center At X = 34.5 ; Y = 59.5 and Radius, 47.9

*** 2.840 ***

Failure Surface Specified By 17 Coordinate Points

Solutia Sauget Landfill Interior Slope Static Condition
Ten Most Critical. C:SAUGET7.PLT By: Martin Brungard 5-04-00 :17pm



--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-05-00
Time of Run:	3:31pm
Run By:	Martin Brungard
Input Data Filename:	C:SOUGET2.IN
Output Filename:	C:SOUGET2.OUT
Plotted Output Filename:	C:SOUGET2.PLT

PROBLEM DESCRIPTION Solutia Sauget
-2' cover thickness, 3% slope seismic

BOUNDARY COORDINATES

1 Top Boundaries
3 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	35.00	180.00	40.40	1
2	10.00	33.30	180.00	38.40	2
3	10.00	33.10	180.00	38.20	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	120.0	300.0	0.0	0.00	0.0	0
2	110.0	120.0	0.0	11.0	0.00	0.0	0

A Horizontal Earthquake Loading Coefficient
Of0.100 Has Been Assigned

A Vertical Earthquake Loading Coefficient
Of0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

25 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 1.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	4.00	33.20	12.00	33.40	0.20
2	170.00	38.00	178.00	38.20	0.20

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.42	35.16
2	5.51	35.08
3	6.29	34.46
4	7.18	34.01
5	8.16	33.77
6	9.02	33.27
7	170.22	38.03
8	170.79	38.85
9	171.43	39.62
10	171.97	40.16

*** 2.031 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	7.28	35.22
2	7.44	35.10
3	8.42	34.90
4	9.15	34.21
5	9.98	33.66
6	10.90	33.27
7	177.96	38.27
8	178.53	39.09
9	179.21	39.82
10	179.42	40.38

*** 2.047 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.27	35.16
2	5.90	34.60
3	6.79	34.16
4	7.77	33.93
5	8.65	33.46
6	9.63	33.27
7	172.21	38.01
8	172.69	38.88
9	173.40	39.59
10	173.86	40.22

*** 2.080 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.68	35.14
2	5.52	34.88
3	6.24	34.18

4	7.22	33.98
5	7.94	33.29
6	176.15	38.21
7	176.36	39.19
8	176.98	39.98
9	177.25	40.32

*** 2.187 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	6.62	35.20
2	7.23	34.66
3	8.03	34.06
4	9.02	33.94
5	9.79	33.30
6	171.48	38.11
7	172.10	38.89
8	172.61	39.75
9	172.64	40.18

*** 2.392 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.04	35.06
2	2.44	34.83
3	3.34	34.38
4	4.17	33.83
5	4.90	33.14
6	170.05	37.94
7	170.76	38.65
8	171.08	39.60
9	171.12	40.13

*** 2.672 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.64	35.08
2	2.89	34.83
3	3.63	34.16
4	4.61	33.95
5	5.61	33.88
6	6.37	33.23
7	176.27	38.10
8	176.88	38.89
9	177.36	39.76
10	177.73	40.33

*** 3.588 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.50	35.04
2	1.60	35.01
3	2.51	34.61
4	3.42	34.18
5	4.36	33.85
6	5.16	33.25
7	6.16	33.23
8	176.17	38.11
9	176.87	38.83
10	177.56	39.55
11	178.25	40.27
12	178.33	40.35

*** 3.706 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.73	35.05
2	1.82	34.96
3	2.69	34.47
4	3.66	34.26
5	4.40	33.58
6	5.34	33.23
7	175.03	38.16

8	175.06	39.16
9	175.74	39.89
10	176.05	40.28

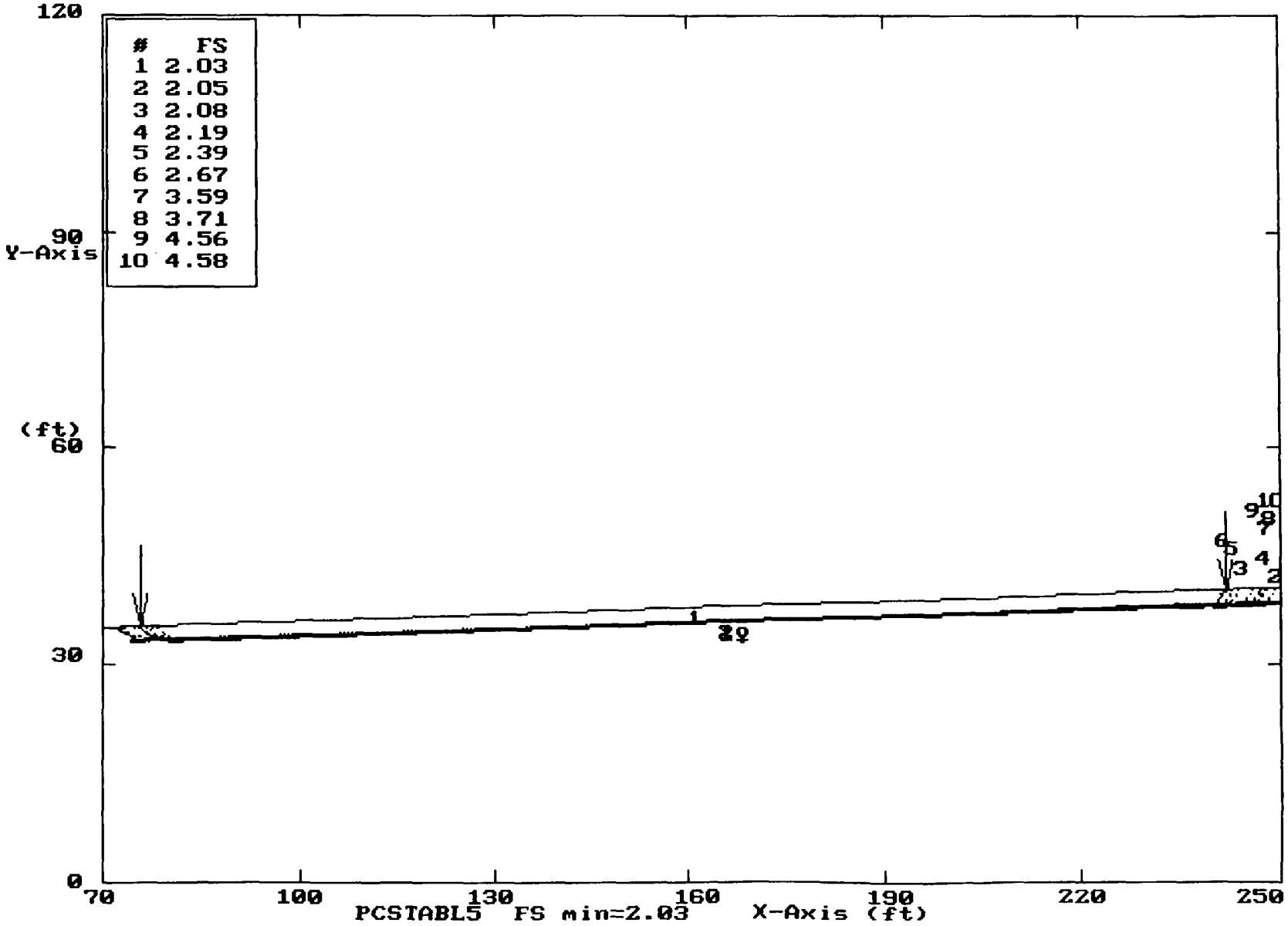
*** 4.556 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.31	35.07
2	2.94	34.82
3	3.72	34.19
4	4.63	33.77
5	5.47	33.24
6	175.98	38.10
7	176.19	39.08
8	176.89	39.79
9	177.33	40.32

*** 4.576 ***

Solutia Sauget 2' cover thickness, 3% slope seismic
Ten Most Critical. C:SOUGETZ.PLT By: Martin Brungard 5-05-00 :31pm



PCSTABL5 FS min=2.03

--Slope Stability Analysis--
Simplified Janbu, Simplified Bishop
or Spencer`s Method of Slices

Run Date:	05-04-00
Time of Run:	2:45pm
Run By:	Martin Brungard
Input Data Filename:	C:SOUGET2A.IN
Output Filename:	C:SOUGET2A.OUT
Plotted Output Filename:	C:SOUGET2A.PLT

PROBLEM DESCRIPTION Solutia Sauget
-2' cover thickness, 3% slope static

BOUNDARY COORDINATES

1 Top Boundaries
3 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	35.00	180.00	40.40	1
2	10.00	33.30	180.00	38.40	2
3	10.00	33.10	180.00	38.20	1

ISOTROPIC SOIL PARAMETERS

2 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	110.0	120.0	300.0	0.0	0.00	0.0	0
2	110.0	120.0	0.0	11.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.

25 Trial Surfaces Have Been Generated.

2 Boxes Specified For Generation Of Central Block Base

Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 1.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	4.00	33.20	12.00	33.40	0.20
2	170.00	38.00	178.00	38.20	0.20

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

* * Safety Factors Are Calculated By The Modified Janbu Method * *

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.42	35.16
2	5.51	35.08
3	6.29	34.46
4	7.18	34.01
5	8.16	33.77
6	9.02	33.27
7	170.22	38.03
8	170.79	38.85
9	171.43	39.62
10	171.97	40.16

*** 8.817 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	7.28	35.22
2	7.44	35.10
3	8.42	34.90
4	9.15	34.21
5	9.98	33.66
6	10.90	33.27
7	177.96	38.27
8	178.53	39.09
9	179.21	39.82
10	179.42	40.38

*** 8.884 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	5.27	35.16
2	5.90	34.60
3	6.79	34.16
4	7.77	33.93
5	8.65	33.46
6	9.63	33.27
7	172.21	38.01
8	172.69	38.88
9	173.40	39.59
10	173.86	40.22

*** 9.027 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	4.68	35.14
2	5.52	34.88
3	6.24	34.18
4	7.22	33.98
5	7.94	33.29
6	176.15	38.21
7	176.36	39.19
8	176.98	39.98
9	177.25	40.32

*** 9.492 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	6.62	35.20
2	7.23	34.66
3	8.03	34.06
4	9.02	33.94
5	9.79	33.30
6	171.48	38.11
7	172.10	38.89
8	172.61	39.75
9	172.64	40.18

*** 10.376 ***

Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.04	35.06
2	2.44	34.83
3	3.34	34.38
4	4.17	33.83
5	4.90	33.14
6	170.05	37.94
7	170.76	38.65
8	171.08	39.60
9	171.12	40.13

*** 11.588 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.64	35.08
2	2.89	34.83
3	3.63	34.16
4	4.61	33.95
5	5.61	33.88
6	6.37	33.23

7	176.27	38.10
8	176.88	38.89
9	177.36	39.76
10	177.73	40.33

*** 15.553 ***

Failure Surface Specified By 12 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.50	35.04
2	1.60	35.01
3	2.51	34.61
4	3.42	34.18
5	4.36	33.85
6	5.16	33.25
7	6.16	33.23
8	176.17	38.11
9	176.87	38.83
10	177.56	39.55
11	178.25	40.27
12	178.33	40.35

*** 16.064 ***

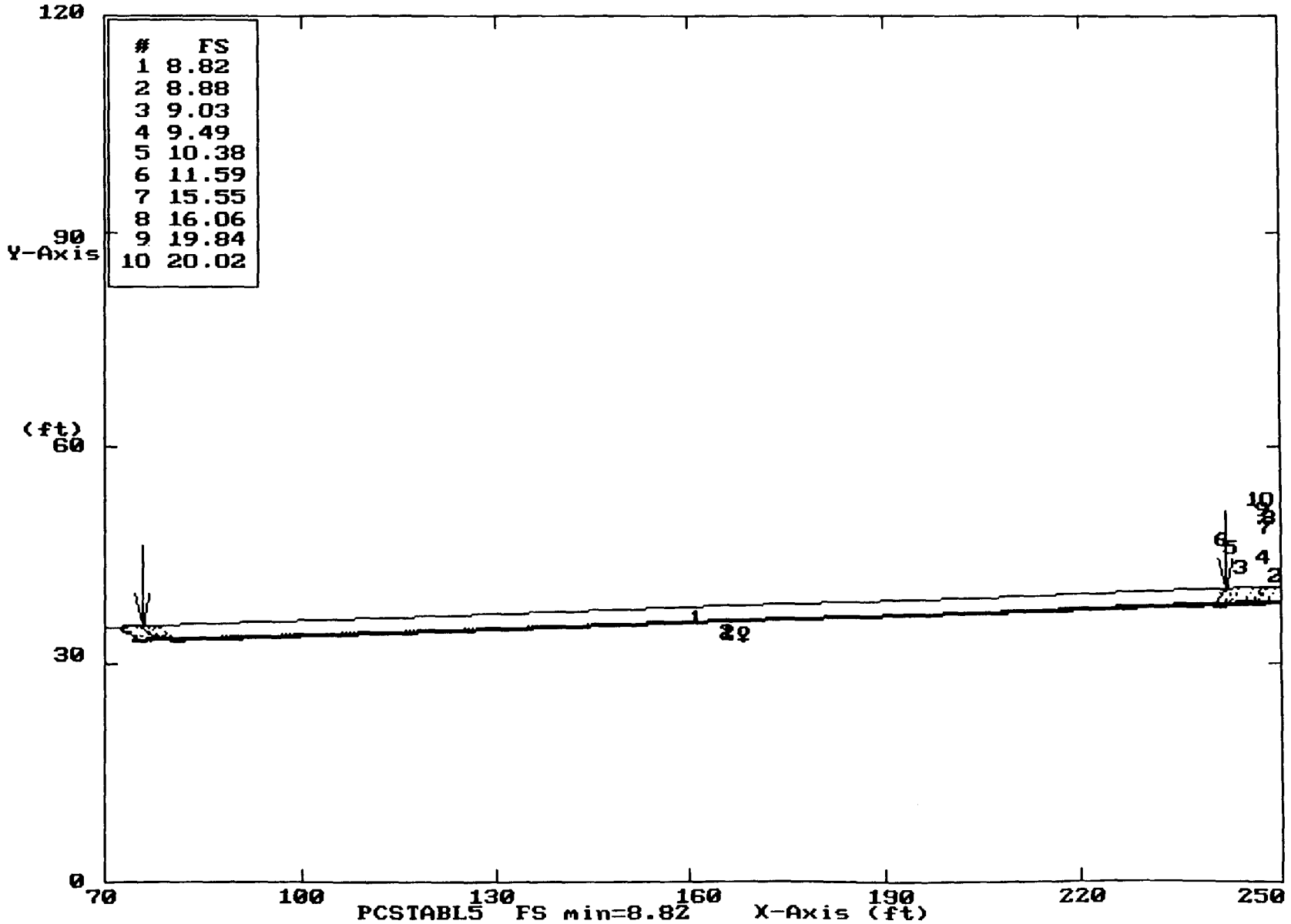
Failure Surface Specified By 9 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	2.31	35.07
2	2.94	34.82
3	3.72	34.19
4	4.63	33.77
5	5.47	33.24
6	175.98	38.10
7	176.19	39.08
8	176.89	39.79
9	177.33	40.32

*** 19.836 ***

Failure Surface Specified By 10 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	1.73	35.05
2	1.82	34.96
3	2.69	34.47
4	3.66	34.26
5	4.40	33.58
6	5.34	33.23
7	175.03	38.16
8	175.06	39.16
9	175.74	39.89
10	176.05	40.28

*** 20.023 ***

Solutia Sauget 2' cover thickness, 3% slope static
Ten Most Critical. C:SOUGETZA.PLT By: Martin Brungard 5-04-00 :45pm