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Ser 6225EG/L9321-2
17 Nov 1998

From: Commanding Officer, Engineering Field Activity, West, Naval Facilities Engineering Command

Subj: REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS) FOR NAVAL STATION TREASURE ISLAND (NAVSTA TI)

Encl: (1) Site 12 TPH and Dioxin Data Initial Statistical Summaries and Notes dated 6 June 1998
(1) Site 12 TPH Data Estimated Means Concentrations dated 6 August 1998

1. Enclosures (1) and (2) are provided for your information. These two reports were prepared for the Navy by Battelle to assist the navy in the evaluation of TPH and Dioxin at Naval Station Treasure Island IR Site 12.

2. Thank you for your guidance and involvement in this project. For further information, please call me at (650) 244-2560.

ERNESTO M. GALANG
Remedial Project Manager
By direction

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California Department of Toxic Substances Control (Attn: Mr. David Rist)
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Treasure Island Site 12, TPH and Dioxin Data
Initial Statistical Summaries and Notes
(6/16/98)

On May 19, we discussed several objectives for this statistical review which were documented in an email from Paul West. Among these objectives are the following: (1) evaluate whether the data are representative of one or more statistical populations, (2) estimate descriptive statistics and spatial distributions for the populations, (3) identify whether correlations exist between soil and groundwater contaminant concentrations, and (4) identify whether significant data gaps are present. The informal results presented here address only the TPH data, and are intended to help meet objectives 1 and 2. The dioxin data are currently being keypunched from hardcopy listings; this is a necessary step before statistical summaries can be done.

a. The TPH data were first separated into two files, one for soil data and the second for groundwater data. The three separate TPH measures (diesel, motor oil, and gasoline) were summed into a total TPH measurement. Each record in these files can be identified by a sampling location ID; northing, easting and depth coordinates (in feet); and a sampling date. Listings of the data, sorted by location ID and depth or date, are provided in Attachments 1 and 2.

b. To see whether different subpopulations might be represented in the data, we considered dividing the data both spatially, in either the horizontal plane or vertically, and temporally by sampling date. Note: In the vertical direction we considered only sampling depth, rather than elevation above mean sea level, since no surface topography measurements were available.

Soil TPH

c. Attachment 3 shows an initial summary of the horizontal distribution of the soil TPH data, color coded into three classes – less than 26,000 ug/kg, between 26,000 and 260,000 ug/kg, and above 260,000 ug/kg. When TPH measured at more than one depth, this figure shows the maximum concentration measured at each given sampling location. The figure shows more high measured concentrations in the northern part of the property. However, it also shows more clustered sampling in high concentration zones in the northern area, so that the true spatial distribution of TPH in the property may not be significantly different in the northern and southern areas.

d. To see how the data might be split temporally, Attachment 4 shows where soil sampling was done in 1997 and prior to 1997. This figure shows that 1997 sampling generally provided a roughly uniform characterization of a boomerang-shaped area. It also shows that 1997 sampling did not revisit locations that were sampled previously.

e. Attachment 5 provides overall statistical summaries of the soil TPH data broken down by sampling depth and date. Two depths are considered, shallow depths less-than-or-equal-to 1.5 feet, and all greater depths more than 1.5 feet. Two sampling times are also considered, sampling date in 1997 or prior to 1997. Two findings seem to be indicated by these summaries: (i) Data collected prior to 1997 had higher mean TPH concentrations with roughly equivalent

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means for shallow and deeper samples, and (ii) Data collected in 1997 had lower mean TPH concentrations with a higher mean for shallow samples (i.e., near surface) than for deeper samples.

f. Attachments 6 through 9 provide histograms corresponding to the four data breakdowns used in Attachment 5.

Groundwater TPH

g. Attachment 10 shows an initial summary of the horizontal distribution of the groundwater TPH data, color coded into three classes – less than 250 ug/l, between 250 and 500 ug/l, and above 500 ug/l. When TPH was measured on more than one date, this figure shows the maximum concentration measured over time. This figure appears similar to the soil figure (Attachment 3) with clustered high concentrations in the northern part of the property. However, also as with soil, if the clusters were removed, then the true spatial distribution of TPH may not be significantly different in the northern and southern areas.

h. To see how the data might be split temporally, Attachment 11 shows where groundwater sampling was done in 1997, in 1996, and prior to 1996. Note that data were never listed for two different depths within a single well, although the groundwater depth data may be questionable because there are so many records which list a depth of zero. This figure shows that 1997 sampling generally characterized the same boomerang-shaped area as the soil sampling. Similar to the soil sampling, it also shows that 1997 sampling did not revisit locations that were sampled previously, although multiple measurements in time were frequently collected in the same well prior to 1997.

i. Attachment 12 provides overall statistical summaries of the groundwater TPH data broken down by sampling date. Three sampling times are considered (sampling date in 1997, in 1996, or prior to 1996). These results seem to indicate a significant decrease in the mean TPH concentration from samples collected prior to 1996 until the 1997 sampling.

j. Attachments 13 through 15 provide histograms corresponds to the three data breakdowns used in Attachment 12.

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/kg)	Motor Oil (ug/kg)	Gasoline (ug/kg)	Total TPH (ug/kg)
12-HP002	2128856.65	6019113.63	3.000	0.50	08/23/95	270000	900000	220000.0	1390000
12-HP003	2128980.61	6019124.72	3.000	0.50	08/23/95	15000	150000	370.0	165370
12-HP004	2130734.95	6021111.23	0.500	0.50	08/29/95	32000	360000	510.0	392510
12-HP006	2129038.50	6019113.36	2.500	0.50	08/29/95	28000	140000	550.0	168550
12-HP008	2129059.85	6019193.15	2.750	0.50	08/29/95	15000	220000	540.0	235540
12-HP009	2130711.00	6020975.17	1.000	0.50	08/30/95	10000	36000	510.0	46510
			5.500	0.50	08/30/95	12000	12000	580.0	24580
12-HP010	2128856.59	6019200.64	4.500	0.50	08/30/95	13000	13000	640.0	26640
12-HP012	2129258.84	6019162.98	2.500	0.50	08/30/95	54000	280000	290.0	334290
12-HP014	2129348.49	6019200.18	4.500	0.50	08/30/95	37000	60000	390.0	97390
12-HP017	2129627.65	6020119.71	3.500	0.50	08/31/95	12000	12000	590.0	24590
12-HP018	2129662.46	6020168.13	0.500	0.50	08/31/95	25000	210000	530.0	235530
12-HP021	2130734.39	6020855.21	1.500	0.50	09/01/95	36000	310000	390.0	346390
12-HP022	2130749.40	6020451.86	5.000	0.50	09/01/95	12000	12000	580.0	24580
12-HP023	2130072.66	6019945.48	7.000	0.50	09/05/95	11000	11000	550.0	22550
12-HP027	2130450.97	6020093.45	1.250	0.50	09/06/95	88000	550000	510.0	638510
			3.500	0.50	09/06/95	190000	1400000	550.0	1590550
12-HP028	2130488.39	6020205.71	0.000	0.00	09/07/95	11000	10000	570.0	21570
12-HP031	2130570.35	6020399.32	3.625	0.75	09/07/95	55000	260000	550.0	315550
12-HP032	2130663.11	6020479.35	4.750	0.50	09/07/95	880000	6100000	2800.0	6982800
12-HP033	2130636.76	6020532.39	1.250	0.50	09/08/95	260000	1600000	520.0	1860520
12-HP035	2130678.36	6020742.75	4.500	0.50	09/14/95	12000	12000	580.0	24580
12-HP036	2130382.02	6019729.44	1.250	0.50	09/14/95	46000	3500000	560.0	3546560
12-HP038	2130354.18	6019726.44	1.250	0.50	09/14/95	53000	200000	530.0	253530
12-HP066	2128839.42	6019121.33	1.000	0.50	09/29/95	62000	440000	560.0	502560
			3.500	0.50	09/29/95	290000	1400000	66000.0	1756000
12-HP067	2128875.33	6019104.93	1.250	0.50	09/29/95	36000	400000	550.0	436550
			3.500	0.50	09/29/95	850000	1200000	73000.0	2123000
12-HP069	2129212.27	6019240.62	3.500	0.50	09/29/95	11000	11000	540.0	22540
12-HP071	2129417.66	6019263.31	3.500	0.50	09/29/95	260000	430000	400.0	690400
12-HP072	2130761.36	6020481.59	3.500	0.50	10/02/95	150000	1800000	570.0	1950570
12-HP075	2130505.87	6019991.18	1.750	0.50	10/02/95	600000	6000000	560.0	6600560
12-HP076	2130422.51	6020065.27	3.500	0.50	10/02/95	160000	890000	570.0	1050570
12-HP078	2129937.15	6020067.26	2.500	0.50	10/03/95	15000	110000	560.0	125560
12-HP080	2129830.26	6019877.40	1.750	0.50	10/03/95	30000	420000	510.0	450510
12-HP082	2130312.97	6019743.04	3.500	0.50	10/03/95	62000	600000	330.0	662330

Attachment 1

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/kg)	Motor Oil (ug/kg)	Gasoline (ug/kg)	Total TPH (ug/kg)
12-HP083	2130302.91	6019780.16	2.250	0.50	10/03/95	82000	510000	430.0	592430
12-HP084	2130282.54	6019738.37	3.500	0.50	10/03/95	130000	1300000	440.0	1430440
12-HP093	2130796.24	6020552.77	2.500	0.50	10/05/95	40000	560000	430.0	600430
12-HP096	2129442.37	6019442.67	3.750	0.50	10/05/95	14000	11000	700.0	25700
12-HP099	2130108.73	6020380.08	3.250	0.50	10/26/95	10000	10000	520.0	20520
12-HP100	2130066.21	6020412.94	1.500	0.50	10/26/95	43000	540000	540.0	583540
12-HP101	2130028.44	6020368.71	2.125	0.75	10/26/95	32000	460000	310.0	492310
12-HP110	2130116.42	6020576.93	4.125	0.25	09/23/96	11000	11000	560.0	22560
12-HP112	2130228.29	6020551.18	1.125	0.25	09/23/96	10000	10000	520.0	20520
			1.500	0.50	09/23/96	10000	10000	520.0	20520
12-HP113	2130145.51	6020469.00	1.125	0.25	09/23/96	260000	2200000	510.0	2460510
			4.375	0.25	09/23/96	11000	11000	530.0	22530
			4.750	0.50	09/23/96	11000	11000	530.0	22530
12-HP115	2130286.06	6020442.02	3.375	0.25	09/23/96	110000	330000	550.0	440550
			3.750	0.50	09/23/96	110000	330000	550.0	440550
12-HP116	2130160.06	6020318.07	3.125	0.25	09/23/96	520000	2000000	520.0	2520520
12-MW01	2130821.78	6020599.82	1.750	0.50	08/08/92	14500	.	63.8	.
			2.750	0.50	08/08/92	25400	.	75.8	.
			6.250	0.50	08/08/92	14400	.	57.9	.
12-MW02	2130566.42	6020200.48	1.750	0.50	08/08/92	14200	.	56.1	.
			2.750	0.50	08/08/92	45700	.	344.0	.
			4.250	0.50	08/08/92	14300	.	57.9	.
12-MW03	2130029.38	6019961.95	1.750	0.50	08/08/92	12700	.	51.0	.
			2.750	0.50	08/08/92	13400	.	53.8	.
			3.750	0.50	08/08/92	13200	.	52.9	.
			4.250	0.50	08/08/92	19300	.	78.3	.
12-MW04	2130442.00	6020613.97	1.750	0.50	08/08/92	13000	.	52.2	.
			2.750	0.50	08/08/92	13300	.	53.9	.
			4.250	0.50	08/08/92	14700	.	70.6	.
12HP118	2127856.10	6019596.40	1.000	1.00	10/30/97	7900	17000	65.0	24965
			3.000	1.00	10/30/97	7300	14000	59.0	21359
12HP119	2127946.70	6019781.10	1.000	1.00	10/29/97	29000	1200000	51.0	1229051
			3.000	1.00	10/29/97	32000	390000	60.0	422060
12HP120	2128033.40	6019984.60	1.000	1.00	10/29/97	6400	13000	52.0	19452
			4.000	1.00	10/29/97	6600	13000	35.0	19635
12HP121	2128025.80	6019513.40	1.000	1.00	10/30/97	6500	38000	53.0	44553
			2.500	1.00	10/30/97	7000	27000	58.0	34058
12HP122	2128119.90	6019670.00	1.000	1.00	10/29/97	6500	96000	53.0	102553
			4.000	1.00	10/29/97	6900	14000	52.0	20952
12HP123	2128220.00	6019893.80	1.500	1.00	10/31/97	6700	210000	53.0	216753
			3.000	1.00	10/31/97	6900	120000	56.0	126956
12HP124	2128217.70	6019424.70	1.000	1.00	10/30/97	6400	13000	53.0	19453
			3.000	1.00	10/30/97	17000	69000	75.0	86075
12HP125	2128311.10	6019623.80	1.000	1.00	10/29/97	69000	2900000	57.0	2969057

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/kg)	Motor Oil (ug/kg)	Gasoline (ug/kg)	Total TPH (ug/kg)
12HP125	2128311.10	6019623.80	4.000	1.00	10/29/97	6500	18000	52.0	24552
12HP126	2128403.10	6019799.50	1.000	1.00	10/31/97	6300	52000	50.0	58350
			3.500	1.00	10/31/97	6700	42000	54.0	48754
12HP127	2128428.50	6019367.00	1.000	1.00	10/31/97	6500	220000	52.0	226552
			3.500	1.00	10/31/97	6700	76000	54.0	82754
12HP128	2128476.60	6019551.50	1.000	1.00	10/29/97	8500	710000	66.0	718566
			4.000	1.00	10/29/97	6600	13000	54.0	19654
12HP129	2128584.90	6019722.60	1.000	1.00	10/31/97	6100	210000	52.0	216152
			3.500	1.00	10/31/97	6200	41000	52.0	47252
12HP130	2128576.50	6019251.30	1.000	1.00	10/31/97	6800	160000	44.0	166844
			3.000	1.00	10/31/97	7200	17000	59.0	24259
12HP131	2128693.10	6019466.20	1.500	1.00	10/30/97	6400	13000	52.0	19452
			3.000	1.00	10/30/97	6600	13000	53.0	19653
12HP132	2128758.90	6019638.50	1.000	1.00	11/03/97	6200	63000	51.0	69251
			3.000	1.00	11/03/97	6900	260000	51.0	266951
12HP133	2128745.10	6019166.80	1.000	1.00	11/03/97	22000	400000	52.0	422052
			2.500	1.00	11/03/97	38000	460000	30.0	498030
12HP134	2128884.10	6019365.20	1.000	1.00	11/03/97	7300	310000	53.0	317353
			3.000	1.00	11/03/97	7600	15000	62.0	22662
12HP135	2128963.00	6019529.40	1.000	1.00	11/03/97	6500	68000	52.0	74552
			3.000	1.00	11/03/97	6200	12000	52.0	18252
12HP136	2129117.60	6019457.20	1.000	1.00	11/03/97	6400	120000	52.0	126452
			3.000	1.00	11/03/97	6400	13000	53.0	19453
12HP139	2129328.70	6019420.60	1.500	1.00	11/04/97	6400	81000	51.0	87451
			3.500	1.00	11/04/97	6500	27000	52.0	33552
12HP140	2129406.90	6019602.30	1.000	1.00	11/04/97	6400	92000	52.0	98452
			3.500	1.00	11/04/97	6200	12000	52.0	18252
12HP141	2129477.70	6019778.80	1.000	1.00	11/05/97	3300000	3700000	160.0	7000160
			3.500	1.00	11/05/97	6600	13000	54.0	19654
12HP142	2129560.40	6019960.10	1.000	1.00	11/10/97	6200	83000	52.0	89252
			3.000	1.00	11/10/97	6100	12000	51.0	18151
12HP143	2129770.60	6020304.30	1.500	1.00	11/10/97	10000	300000	54.0	310054
			3.500	1.00	11/10/97	6400	13000	52.0	19452
12HP144	2129882.60	6020499.70	1.000	1.00	11/11/97	6800	19000	55.0	25855
			3.500	1.00	11/11/97	6600	13000	53.0	19653
12HP145	2129923.30	6020681.60	1.000	1.00	11/11/97	6400	9700	51.0	16151
			3.500	1.00	11/11/97	6700	13000	54.0	19754
12HP146	2130071.50	6020811.80	1.000	1.00	11/11/97	6300	15000	31.0	21331
			3.500	1.00	11/11/97	6300	13000	28.0	19328
12HP147	2130140.00	6021031.20	1.000	1.00	11/12/97	6200	24000	51.0	30251
			3.500	1.00	11/12/97	6300	13000	51.0	19351
12HP148	2130198.10	6021177.90	1.000	1.00	11/13/97	6900	39000	35.0	45935
			4.500	1.00	11/13/97	6000	210000	53.0	216053
12HP150	2129548.20	6019509.80	1.500	1.00	11/05/97	7000	14000	56.0	21056
			3.500	1.00	11/05/97	6500	13000	53.0	19553

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/kg)	Motor Oil (ug/kg)	Gasoline (ug/kg)	Total TPH (ug/kg)
12HP151	2129643.40	6019679.30	1.000	1.00	11/06/97	8000	170000	52.0	178052
			3.000	1.00	11/06/97	6600	19000	54.0	25654
12HP153	2129863.30	6020080.00	1.000	1.00	11/10/97	33000	230000	54.0	263054
			3.500	1.00	11/10/97	720000	1600000	56.0	2320056
12HP154	2129924.00	6020201.00	1.000	1.00	11/11/97	8200	280000	52.0	288252
			3.000	1.00	11/11/97	19000	460000	53.0	479053
12HP156	2130211.10	6020740.50	1.000	1.00	11/13/97	6200	11000	51.0	17251
			5.000	1.00	11/13/97	6000	7400	51.0	13451
12HP157	2130249.40	6020886.50	1.000	1.00	11/12/97	6800	30000	55.0	36855
			3.500	1.00	11/12/97	6400	13000	51.0	19451
12HP158	2130329.80	6021044.10	1.000	1.00	11/12/97	4100	150000	51.0	154151
			4.500	1.00	11/12/97	6300	20000	27.0	26327
12HP159	2129653.20	6019274.60	1.000	1.00	11/05/97	7300	20000	47.0	27347
			2.500	1.00	11/05/97	10000	160000	73.0	170073
12HP160	2129731.00	6019406.70	1.000	1.00	11/05/97	11000	170000	37.0	181037
			3.500	1.00	11/05/97	180000	970000	54.0	1150054
12HP161	2129835.90	6019586.30	1.000	1.00	11/06/97	6400	120000	35.0	126435
			3.500	1.00	11/06/97	7000	140000	39.0	147039
12HP162	2129882.70	6019764.10	1.000	1.00	11/10/97	6700	90000	54.0	96754
			3.500	1.00	11/10/97	6600	46000	53.0	52653
12HP163	2130104.40	6020122.70	1.000	1.00	11/11/97	10000	160000	54.0	170054
			3.000	1.00	11/11/97	11000	300000	52.0	311052
12HP166	2130467.50	6020842.20	1.000	1.00	11/13/97	4200	13000	52.0	17252
			5.000	1.00	11/13/97	6300	12000	51.0	18351
12HP167	2130533.50	6020995.90	1.000	1.00	11/14/97	28000	770000	51.0	798051
			3.250	0.50	11/14/97	6300	52000	52.0	58352
12HP168	2129931.90	6019388.40	1.000	1.00	11/07/97	6600	210000	45.0	216645
			4.000	1.00	11/07/97	51000	470000	54.0	521054
12HP169	2130014.90	6019504.70	1.000	1.00	11/07/97	14000	310000	53.0	324053
			3.500	1.00	11/07/97	12000	180000	55.0	192055
12HP170	2130116.20	6019682.60	1.000	1.00	11/07/97	6700	270000	52.0	276752
			3.000	1.00	11/07/97	6400	120000	52.0	126452
12HP171	2130192.30	6019863.10	1.000	1.00	11/11/97	6500	55000	52.0	61552
			2.000	1.00	11/11/97	6900	17000	57.0	23957
12HP172	2130281.40	6020045.80	1.000	1.00	11/10/97	6400	45000	53.0	51453
			2.500	1.00	11/10/97	6700	13000	55.0	19755
12HP173	2130388.40	6020159.50	0.500	1.00	11/13/97	14000	210000	53.0	224053
			1.500	1.00	11/13/97	14000	310000	56.0	324056
12HP174	2130470.70	6020376.70	1.000	1.00	11/13/97	7100	110000	58.0	117158
			2.000	1.00	11/13/97	6300	38000	29.0	44329
12HP176	2130162.50	6019449.20	1.000	1.00	11/12/97	6500	7900	53.0	14453
			3.000	1.00	11/12/97	46000	300000	56.0	346056
12HP177	2130250.40	6019606.60	1.000	1.00	11/07/97	15000	280000	54.0	295054
			3.500	1.00	11/07/97	15000	450000	53.0	465053
12HP178	2130651.50	6020298.40	1.000	1.00	11/13/97	14000	300000	50.0	314050

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/kg)	Motor Oil (ug/kg)	Gasoline (ug/kg)	Total TPH (ug/kg)
12HP178	2130651.50	6020298.40	2.000	1.00	11/13/97	7100	240000	28.0	247128

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/l)	Motor Oil (ug/l)	Gasoline (ug/l)	Total TPH (ug/l)
12-HP003	2128980.61	6019124.72	6.00	2	08/23/95	100	100	180	380
12-HP004	2130734.95	6021111.23	7.00	2	08/29/95	100	100	50	250
12-HP006	2129038.50	6019113.36	5.00	2	08/29/95	160	85	410	655
12-HP008	2129059.85	6019193.15	5.25	2	08/29/95	100	100	50	250
12-HP009	2130711.00	6020975.17	6.00	2	08/30/95	100	87	50	237
12-HP015	2130774.78	6020995.29	5.00	2	08/31/95	100	100	50	250
12-HP016	2129474.71	6019218.77	5.00	2	08/31/95	96	110	50	256
12-HP019	2129698.05	6020065.63	4.50	2	08/31/95	82	160	50	292
12-HP023	2130072.66	6019945.48	7.00	2	09/05/95	100	100	69	269
12-HP024	2130054.65	6019930.33	7.00	2	09/05/95	100	61	50	211
12-HP027	2130450.97	6020093.45	5.00	2	09/06/95	5200	6700	330	12230
12-HP030	2130654.66	6020284.42	5.00	2	09/07/95	100	520	50	670
12-HP033	2130636.76	6020532.39	4.00	2	09/08/95	100	230	50	380
12-HP037	2130364.67	6019702.32	5.00	2	09/14/95	55	57	50	162
12-HP038	2130354.18	6019726.44	5.00	2	09/14/95	250	160	50	450
12-HP044	2128381.28	6019359.31	4.50	2	09/26/95	620	98	110	828
12-HP048	2128419.72	6019416.47	5.00	2	09/27/95	110000	10000	110000	230000
12-HP051	2128535.90	6019473.52	5.75	2	09/27/95	100	130	50	280
12-HP058	2128519.89	6019581.02	4.25	2	09/28/95	76	140	42	258
12-HP060	2128398.90	6019618.62	5.00	2	09/28/95	54	170	50	274
12-HP063	2128144.18	6019555.75	5.00	2	09/28/95	100	100	50	250
12-HP064	2128116.31	6019470.31	5.00	2	09/28/95	100	100	50	250
12-HP067	2128875.33	6019104.93	4.25	2	09/29/95	1400	1900	130	3430
12-HP072	2130761.36	6020481.59	3.50	2	10/02/95	100	190	50	340
12-HP074	2130599.22	6020467.56	5.00	2	10/02/95	59	130	50	239
12-HP076	2130422.51	6020065.27	6.00	2	10/02/95	18000	36000	96	54096
12-HP079	2129971.74	6019916.14	3.25	2	10/03/95	94	230	50	374
12-HP081	2130068.60	6020372.75	5.75	2	10/03/95	310	230	69	609
12-HP085	2130342.36	6019657.08	4.00	2	10/03/95	67	94	50	211
12-HP087	2130372.05	6020044.06	4.00	2	10/04/95	100	140	50	290
12-HP091	2130468.19	6020224.81	4.50	2	10/04/95	100	170	50	320
12-HP095	2130510.12	6020546.39	4.50	2	10/05/95	100	100	50	250
12-HP105	2130145.33	6020377.89	7.50	2	10/27/95	61	110	25	196
12-HP110	2130116.42	6020576.93	5.00	2	09/23/96	100	92	50	242

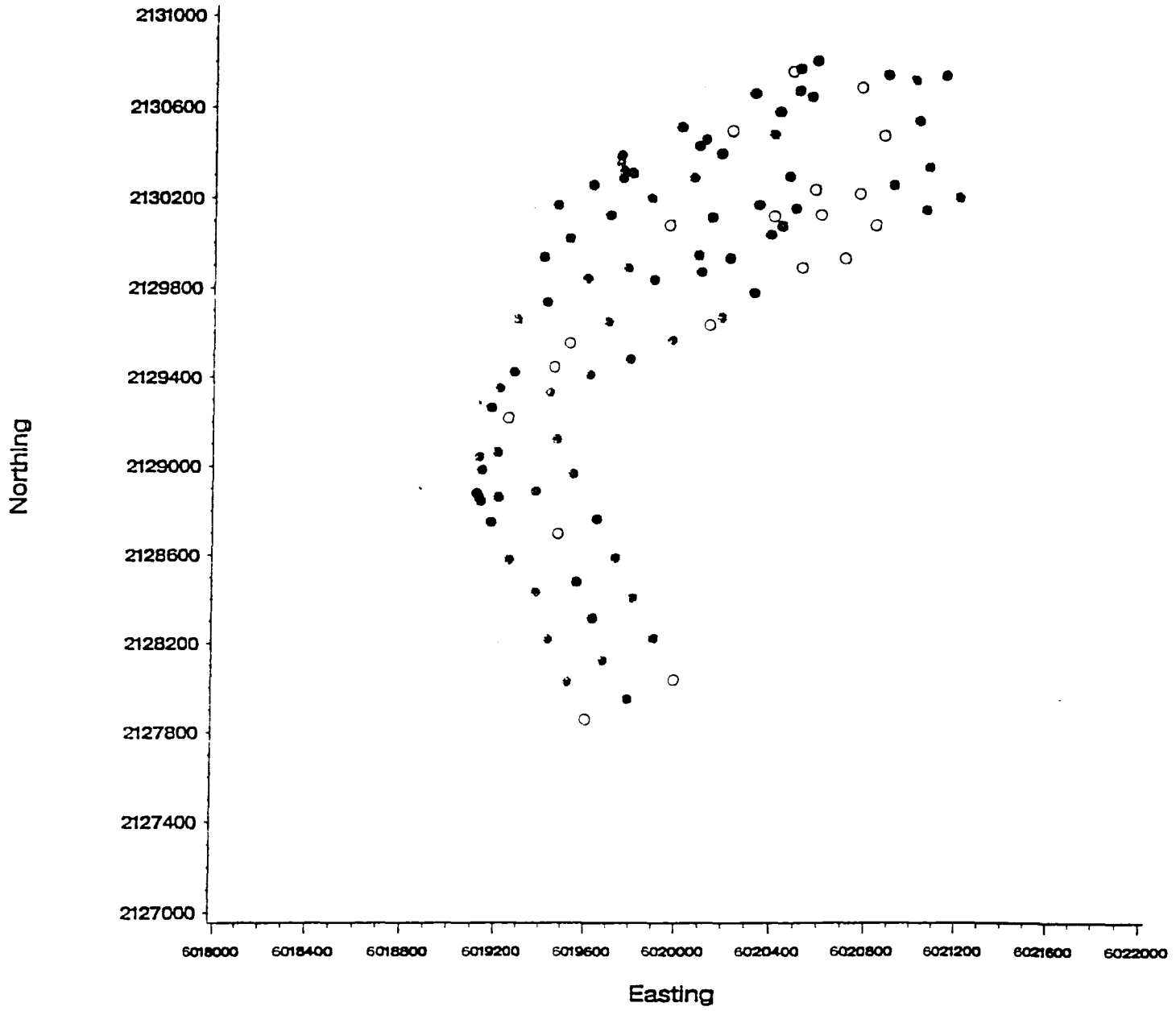
Attachment 2

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/l)	Motor Oil (ug/l)	Gasoline (ug/l)	Total TPH (ug/l)
12-HP111	2130214.42	6020606.18	5.00	2	09/23/96	100	110	50	260
12-HP112	2130228.29	6020551.18	5.00	2	09/23/96	100	100	50	250
12-HP113	2130145.51	6020469.00	7.00	2	09/23/96	130	98	50	278
12-HP114	2130220.08	6020429.20	5.00	2	09/23/96	95	260	.	.
12-HP115	2130286.06	6020442.02	7.00	2	09/23/96	210	1500	.	.
12-HP116	2130160.06	6020318.07	5.00	2	09/23/96	89	120	50	259
12-HP117	2130304.05	6020331.75	5.00	2	09/23/96	120	160	.	.
12-MW01	2130821.78	6020599.82	0.00	0	09/04/92	250	.	.	.
			0.00	0	11/11/94	51	510	50	611
			0.00	0	02/10/95	50	500	50	600
			0.00	0	05/01/95	50	500	50	600
			0.00	0	12/01/95	73	370	50	493
12-MW02	2130566.42	6020200.48	0.00	0	09/04/92	250	.	.	.
			0.00	0	11/11/94	50	500	50	600
			0.00	0	02/10/95	50	500	50	600
			0.00	0	05/01/95	50	500	50	600
			0.00	0	12/01/95	80	180	50	310
12-MW03	2130029.38	6019961.95	0.00	0	09/04/92	250	.	.	.
			0.00	0	11/11/94	55	550	50	655
			0.00	0	02/10/95	50	500	50	600
			0.00	0	02/10/95	50	500	50	600
			0.00	0	05/01/95	50	500	50	600
			0.00	0	12/01/95	100	120	50	270
12-MW04	2130442.00	6020613.97	0.00	0	09/04/92	250	.	.	.
			0.00	0	11/11/94	50	500	50	600
			0.00	0	02/10/95	57	570	50	677
			0.00	0	05/01/95	50	500	50	600
			0.00	0	12/01/95	100	72	50	222
12-MW05	2128371.82	6019345.22	0.00	0	11/21/95	650	170	80	900
			0.00	0	02/27/96	130	96	50	276
			0.00	0	06/06/96	860	170	33	1063
			0.00	0	09/09/96	1100	190	50	1340
			0.00	0	09/09/96	1100	150	51	1301
12-MW06	2128480.77	6019355.04	0.00	0	11/21/95	160	150	50	360
			0.00	0	02/27/96	100	84	50	234
			0.00	0	06/06/96	170	100	50	320
			0.00	0	09/09/96	83	83	50	216
12-MW07	2128492.13	6019616.39	0.00	0	11/21/95	53	170	28	251
			0.00	0	02/27/96	100	77	50	227
			0.00	0	06/06/96	100	77	50	227
			0.00	0	09/09/96	100	86	50	236
12-MW08	2128847.68	6019116.00	0.00	0	11/21/95	1200	2500	83	3783
			0.00	0	02/27/96	290	750	41	1081
			0.00	0	02/27/96	270	730	43	1043
			0.00	0	06/06/96	340	600	42	982
			0.00	0	09/09/96	360	750	50	1160
12-MW09	2129013.79	6019329.10	0.00	0	11/28/95	90	70	25	185
			0.00	0	11/28/95	52	100	50	202
			0.00	0	02/27/96	130	150	50	330
			0.00	0	06/06/96	85	65	50	200
			0.00	0	09/09/96	100	94	50	244

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/l)	Motor Oil (ug/l)	Gasoline (ug/l)	Total TPH (ug/l)
12-MW10	2129356.36	6019174.99	0.00	0	11/28/95	66	240	50	356
			0.00	0	02/27/96	99	600	50	749
			0.00	0	06/05/96	94	210	50	354
			0.00	0	09/09/96	100	93	50	243
12-MW11	2130369.29	6019721.49	0.00	0	11/28/95	58	140	50	248
			0.00	0	02/27/96	78	140	50	268
			0.00	0	06/05/96	85	53	50	188
			0.00	0	09/09/96	100	100	50	250
12-MW12	2130532.23	6020029.76	0.00	0	11/29/95	53	99	50	202
			0.00	0	02/27/96	100	190	50	340
			0.00	0	06/05/96	55	61	50	166
			0.00	0	09/09/96	100	79	50	229
12-MW13	2130738.95	6020438.13	0.00	0	11/29/95	95	390	28	513
			0.00	0	02/28/96	120	480	50	650
			0.00	0	06/05/96	100	200	50	350
			0.00	0	09/09/96	94	350	50	494
12-MW14	2130029.00	6020366.27	0.00	0	11/30/95	2100	2100	380	4580
			0.00	0	02/28/96	3800	2900	200	6900
			0.00	0	06/05/96	19000	18000	160	37160
			0.00	0	09/09/96	2500	3000	190	5690
			0.00	0	09/09/96	1600	1800	140	3540
12-MW15	2130135.79	6020202.40	0.00	0	11/30/95	100	300	50	450
			0.00	0	02/28/96	100	120	50	270
			0.00	0	06/05/96	76	160	50	286
			0.00	0	06/05/96	58	89	50	197
			0.00	0	09/09/96	81	380	50	511
12-MW16	2130129.01	6020536.81	0.00	0	11/30/95	970	1500	320	2790
			0.00	0	02/28/96	450	370	190	1010
			0.00	0	06/05/96	730	710	280	1720
			0.00	0	09/09/96	540	970	73	1583
12HP118	2127856.10	6019596.40	0.00	0	10/30/97	120	100	50	270
12HP119	2127946.70	6019781.10	0.00	0	10/29/97	120	100	50	270
12HP120	2128033.40	6019984.60	0.00	0	10/29/97	120	100	50	270
12HP122	2128119.90	6019670.00	0.00	0	10/29/97	120	100	50	270
12HP123	2128220.00	6019893.80	0.00	0	10/31/97	120	100	50	270
			0.00	0	10/31/97	120	100	50	270
12HP124	2128217.70	6019424.70	0.00	0	10/30/97	2000	370	100	2470
12HP126	2128403.10	6019799.50	0.00	0	10/31/97	120	100	50	270
12HP129	2128584.90	6019722.60	0.00	0	11/06/97	120	100	50	270
12HP130	2128576.50	6019251.30	0.00	0	11/06/97	120	100	50	270
12HP131	2128693.10	6019466.20	0.00	0	10/30/97	120	100	50	270
12HP132	2128758.90	6019638.50	0.00	0	11/03/97	120	100	50	270
12HP133	2128745.10	6019166.80	0.00	0	11/03/97	120	100	26	246
12HP134	2128884.10	6019365.20	0.00	0	11/03/97	120	100	50	270
12HP135	2128963.00	6019529.40	0.00	0	11/03/97	120	100	50	270
12HP136	2129117.60	6019457.20	0.00	0	11/03/97	120	100	50	270

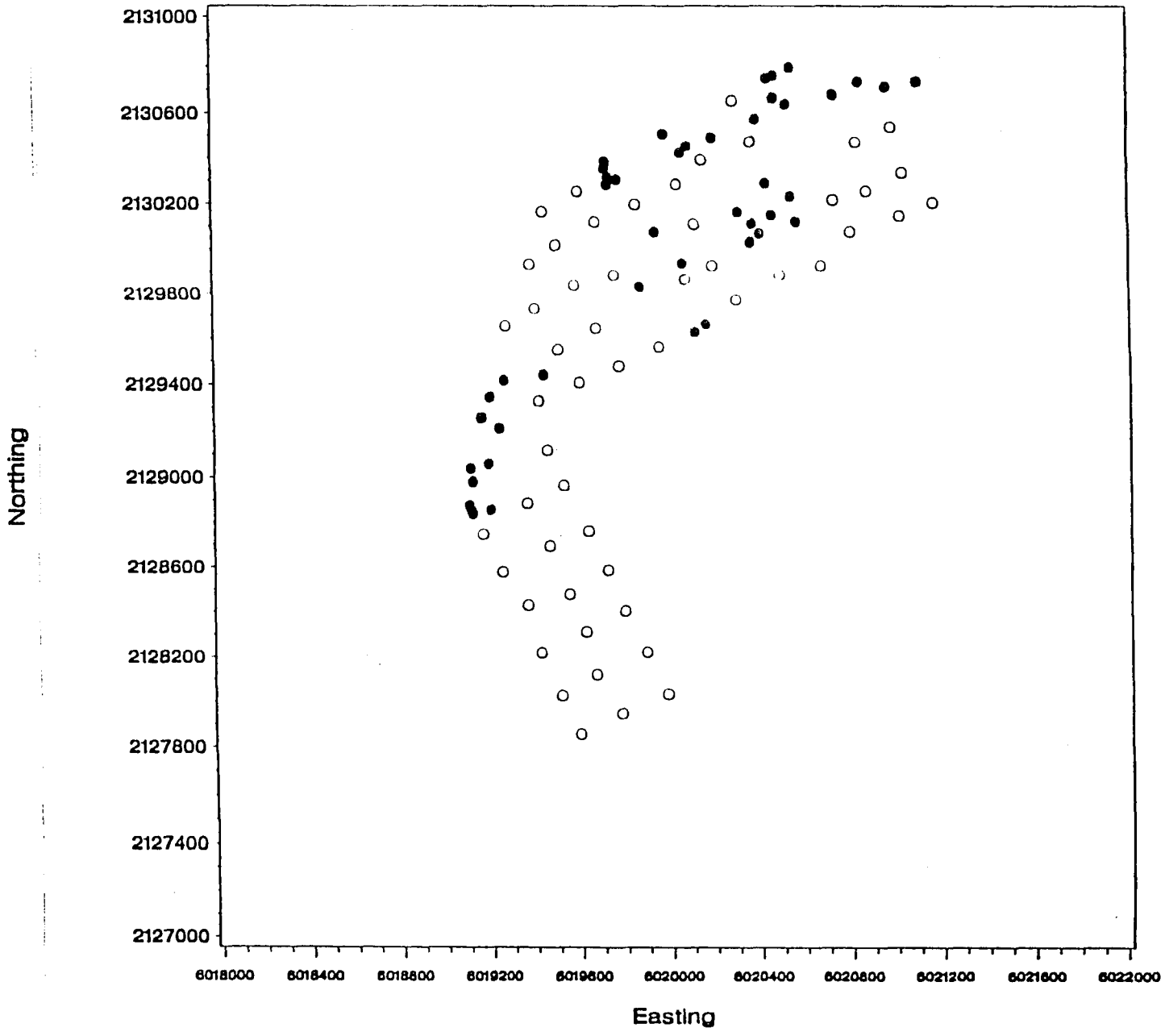
LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/l)	Motor Oil (ug/l)	Gasoline (ug/l)	Total TPH (ug/l)
12HP137	2129139.80	6019104.90	0.00	0	11/04/97	120	100	50	270
			0.00	0	11/04/97	120	100	50	270
12HP138	2129218.40	6019257.90	0.00	0	11/04/97	120	100	50	270
12HP139	2129328.70	6019420.60	0.00	0	11/04/97	120	100	50	270
12HP140	2129406.90	6019602.30	0.00	0	11/04/97	120	100	50	270
12HP141	2129477.70	6019778.80	0.00	0	11/05/97	120	100	50	270
12HP142	2129560.40	6019960.10	0.00	0	11/10/97	120	240	50	410
12HP143	2129770.60	6020304.30	0.00	0	11/10/97	120	240	50	410
12HP144	2129882.60	6020499.70	0.00	0	11/11/97	120	240	50	410
12HP145	2129923.30	6020681.60	0.00	0	11/11/97	120	240	50	410
12HP146	2130071.50	6020811.80	0.00	0	11/11/97	120	240	50	410
12HP147	2130140.00	6021031.20	0.00	0	11/12/97	120	240	50	410
12HP148	2130198.10	6021177.90	0.00	0	11/13/97	120	240	50	410
12HP149	2129473.20	6019348.50	0.00	0	11/05/97	120	100	50	270
12HP150	2129548.20	6019509.80	0.00	0	11/05/97	120	100	34	254
12HP151	2129643.40	6019679.30	0.00	0	11/06/97	120	100	50	270
12HP152	2129739.40	6019868.30	0.00	0	11/06/97	120	100	50	270
			0.00	0	11/06/97	120	320	50	490
12HP153	2129863.30	6020080.00	0.00	0	11/12/97	760	1800	50	2610
			0.00	0	11/12/97	730	1800	50	2580
12HP154	2129924.00	6020201.00	0.00	0	11/11/97	120	240	230	590
12HP156	2130211.10	6020740.50	0.00	0	11/13/97	120	240	50	410
12HP157	2130249.40	6020886.50	0.00	0	11/12/97	120	240	50	410
12HP158	2130329.80	6021044.10	0.00	0	11/12/97	120	240	50	410
12HP159	2129653.20	6019274.60	0.00	0	11/05/97	120	100	58	278
12HP160	2129731.00	6019406.70	0.00	0	11/05/97	120	100	50	270
12HP161	2129835.90	6019586.30	0.00	0	11/06/97	120	310	50	480
12HP162	2129882.70	6019764.10	0.00	0	11/10/97	120	240	50	410
12HP166	2130467.50	6020842.20	0.00	0	11/13/97	120	240	50	410
12HP168	2129931.90	6019388.40	0.00	0	11/07/97	120	240	50	410
12HP169	2130014.90	6019504.70	0.00	0	11/07/97	120	460	50	630
12HP170	2130116.20	6019682.60	0.00	0	11/07/97	120	240	50	410
12HP171	2130192.30	6019863.10	0.00	0	11/11/97	120	240	50	410
			0.00	0	11/11/97	120	240	50	410
12HP174	2130470.70	6020376.70	0.00	0	11/13/97	120	240	50	410
12HP175	2130658.40	6020749.30	0.00	0	11/14/97	120	240	50	410

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	CORE	SAMPDATE	Diesel Oil (ug/l)	Motor Oil (ug/l)	Gasoline (ug/l)	Total TPH (ug/l)
12HP176	2130162.50	6019449.20	0.00	0	11/12/97	120	550	50	720



Attachment 3

PLTCODE ○○○ <= 26000 ●●● <= 260000 ●●● > 260000



Sampling ○○○ 1997 ●●● Before 1997

Attachment 4

18

SHALLOW=Depth <= 1.5 SAMPLING=1997

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
NORTHING	Y COORD (Northing)	54	2129462.00	834.0146710	2127856.10	2130651.50
EASTING	X COORD (Easting)	54	6019921.10	542.3628405	6019166.80	6021177.90
TOPDEPTH		54	0.5462963	0.1755992	0	1.0000000
BOTDEPTH		54	1.5462963	0.1755992	1.0000000	2.0000000
DEPTH		54	1.0462963	0.1755992	0.5000000	1.5000000
CORE		54	1.0000000	0	1.0000000	1.0000000
SAMPDATE		54	13824.26	5.3805561	13816.00	13832.00
DIESEL		54	71235.19	447783.47	4100.00	3300000.00
MOTOROIL		54	287251.85	637681.63	7900.00	3700000.00
GASOLINE		54	53.4259259	15.9345381	31.0000000	160.0000000
TOTALTPH		54	358540.46	1019145.65	14453.00	7000160.00

SHALLOW=Depth <= 1.5 SAMPLING=Before 1997

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
NORTHING	Y COORD (Northing)	15	2130169.21	605.3222399	2128839.42	2130734.95
EASTING	X COORD (Easting)	15	6020240.52	605.4244678	6019104.93	6021111.23
TOPDEPTH		15	0.8500000	0.3872983	0	1.2500000
BOTDEPTH		15	1.2833333	0.4711940	0	1.7500000
DEPTH		15	1.0666667	0.4248599	0	1.5000000
CORE		15	0.4333333	0.1484042	0	0.5000000
SAMPDATE		15	13114.53	156.2405959	13024.00	13415.00
DIESEL		15	65466.67	81912.73	10000.00	260000.00
MOTOROIL		15	698400.00	1010751.40	10000.00	3600000.00
GASOLINE		15	522.0000000	41.7817458	390.0000000	570.0000000
TOTALTPH		15	764388.67	1056859.31	20520.00	3646560.00

SHALLOW=Depth > 1.5 SAMPLING=1997

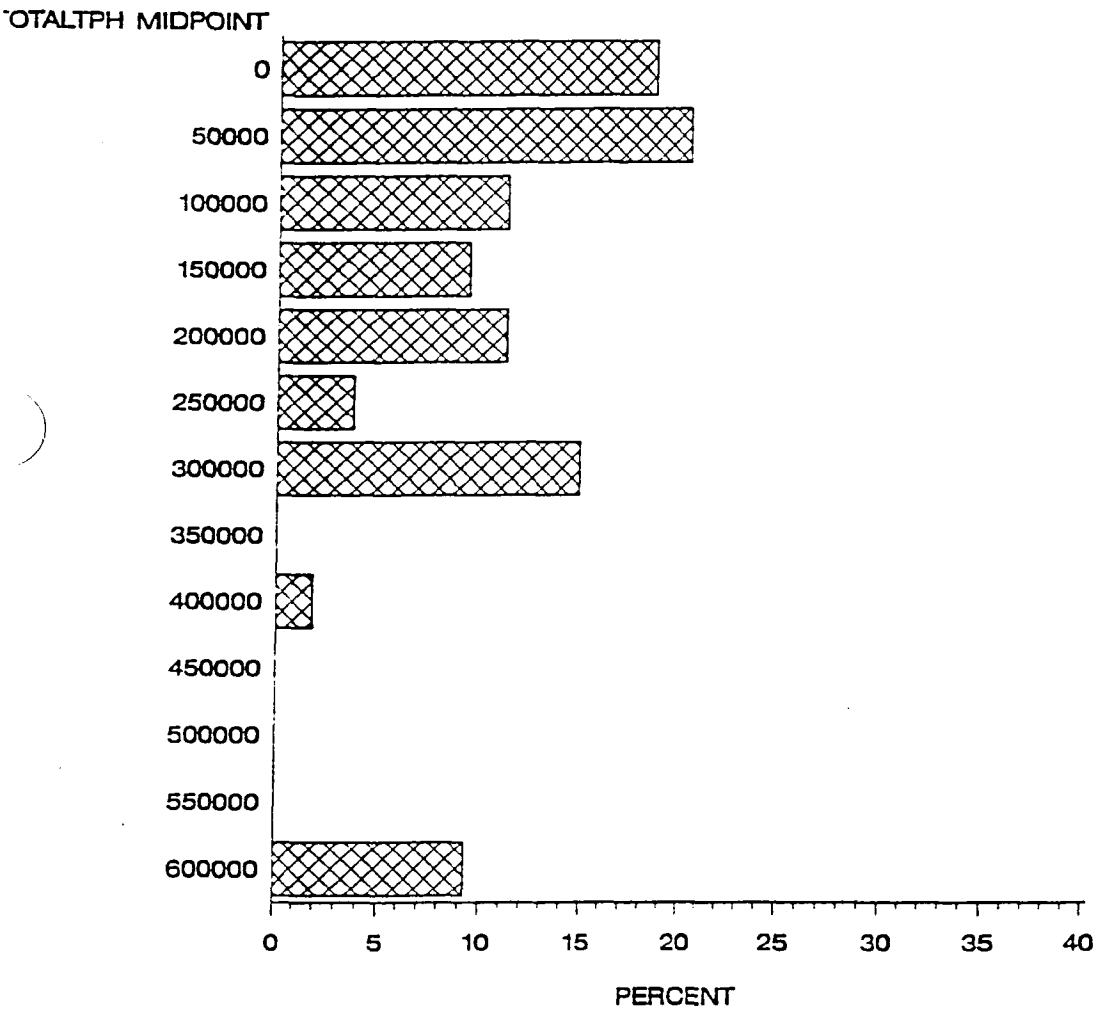
Variable	Label	N	Mean	Std Dev	Minimum	Maximum
NORTHING	Y COORD (Northing)	52	2129426.37	829.4021855	2127856.10	2130651.50
EASTING	X COORD (Easting)	52	6019911.93	550.7980968	6019166.80	6021177.90
TOPDEPTH		52	2.8269231	0.6408069	1.5000000	4.5000000
BOTDEPTH		52	3.8173077	0.6419093	2.5000000	5.5000000
DEPTH		52	3.3221154	0.6404206	2.0000000	5.0000000
CORE		52	0.9903846	0.0693375	0.5000000	1.0000000
SAMPDATE		52	13824.00	5.3136893	13816.00	13832.00
DIESEL		52	27200.00	101217.37	6000.00	720000.00
MOTOROIL		52	146276.92	275448.69	7400.00	1600000.00
GASOLINE		52	51.5192308	9.5393723	27.0000000	75.0000000
TOTALTPH		52	173528.44	366174.08	13451.00	2320056.00

SHALLOW=Depth > 1.5 SAMPLING=Before 1997

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
NORTHING	Y COORD (Northing)	37	2129922.61	644.3597559	2128839.42	2130796.24
EASTING	X COORD (Easting)	37	6019925.72	581.6307576	6019104.93	6020975.17
TOPDEPTH		37	3.3108108	1.0710934	1.5000000	6.7500000
BOTDEPTH		37	3.7972973	1.0571152	2.0000000	7.2500000
DEPTH		37	3.5540541	1.0629250	1.7500000	7.0000000
CORE		37	0.4864865	0.1011384	0.2500000	0.7500000
SAMPDATE		37	13104.62	139.4746794	13018.00	13415.00
DIESEL		37	138513.51	223098.46	10000.00	880000.00
MOTOROIL		37	756405.41	1393544.17	10000.00	6100000.00
GASOLINE		37	10234.32	38810.91	290.0000000	220000.00
TOTALTPH		37	905153.24	1582787.54	20520.00	6982800.00

Attachment 5

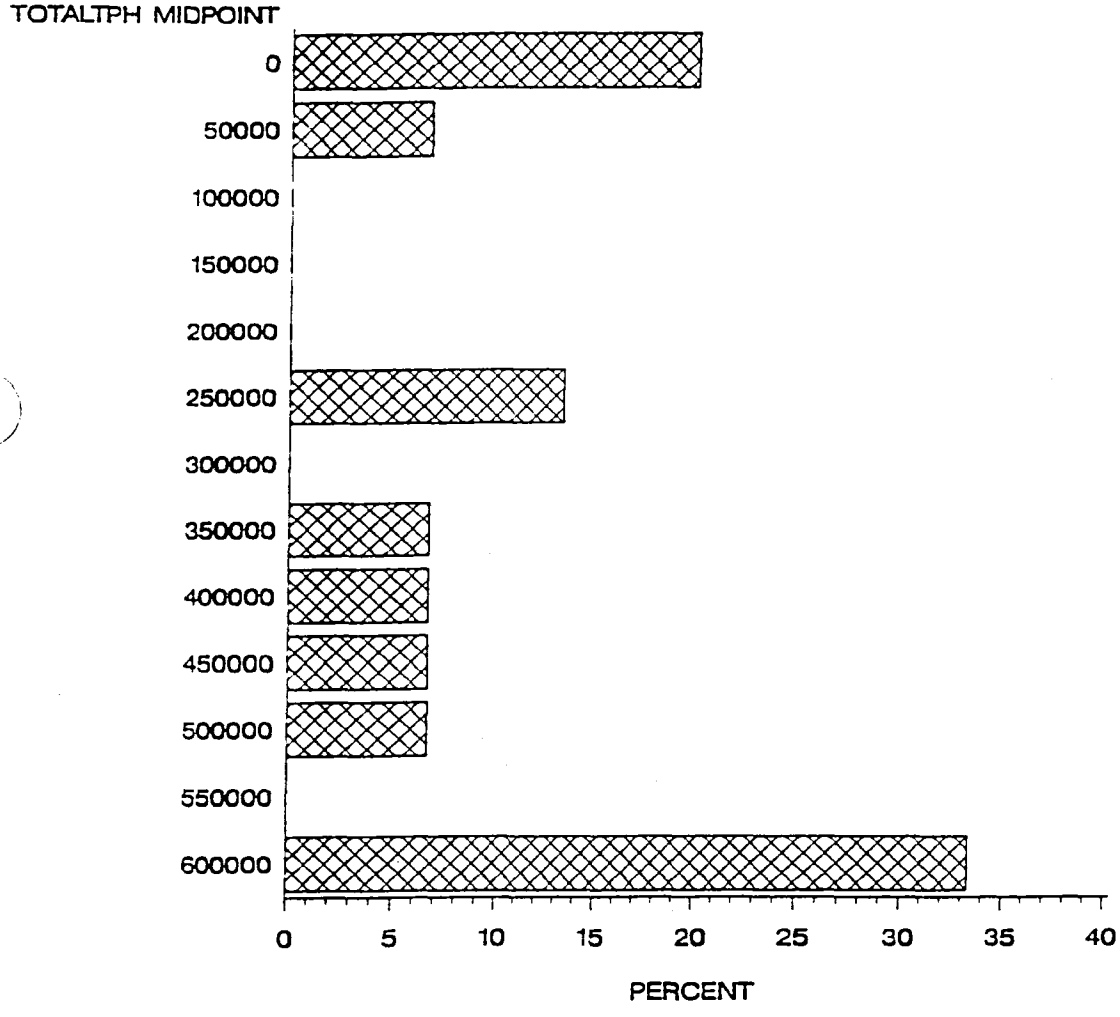
Treasure Island Results
Soil
SHALLOW=Depth <= 1.5 SAMPLING=1997



FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
10	10	18.52	18.52
11	21	20.37	38.89
6	27	11.11	50.00
5	32	9.26	59.26
6	38	11.11	70.37
2	40	3.70	74.07
8	48	14.81	88.89
0	48	0.00	88.89
1	49	1.85	90.74
0	49	0.00	90.74
0	49	0.00	90.74
0	49	0.00	90.74
5	54	9.26	100.00

Attachment 6

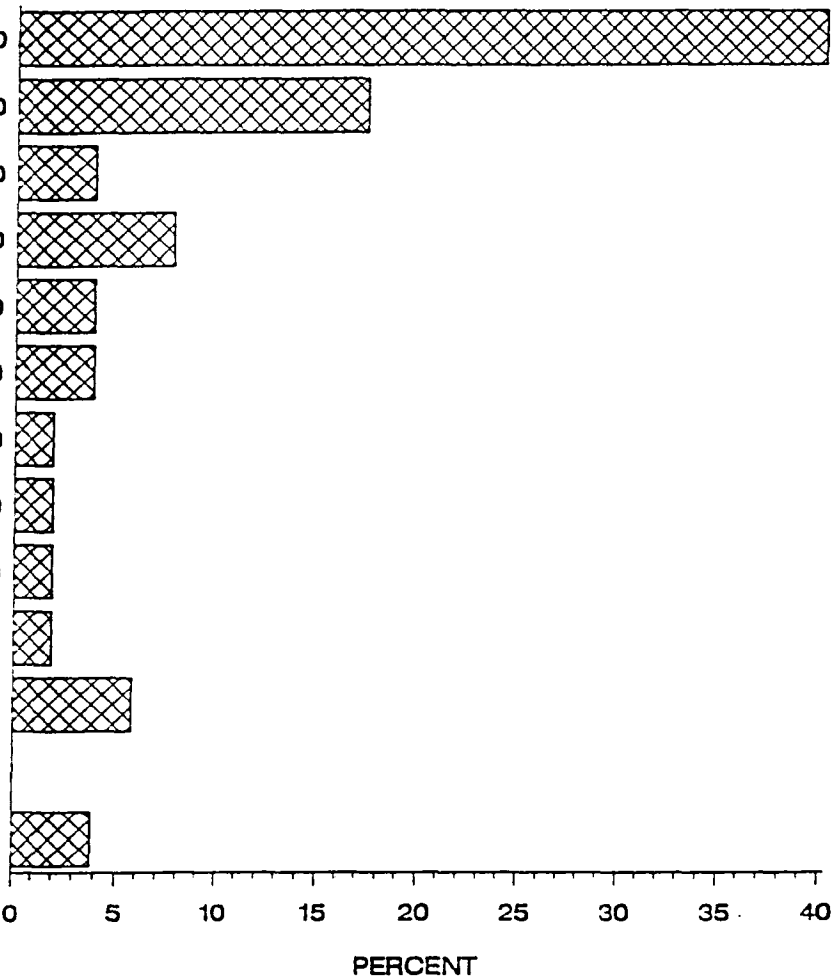
Treasure Island Results
Soil
SHALLOW=Depth <= 1.5 SAMPLING=Before 1997



FREQ.	CUM. FREQ.	PCT.	CUM PC
3	3	20.00	20.0
1	4	6.67	26.6
0	4	0.00	26.6
0	4	0.00	26.6
0	4	0.00	26.6
2	6	13.33	40.0
0	6	0.00	40.0
1	7	6.67	46.6
1	8	6.67	53.3
1	9	6.67	60.0
1	10	6.67	66.6
0	10	0.00	66.6
5	15	33.33	100.0

Attachment 7

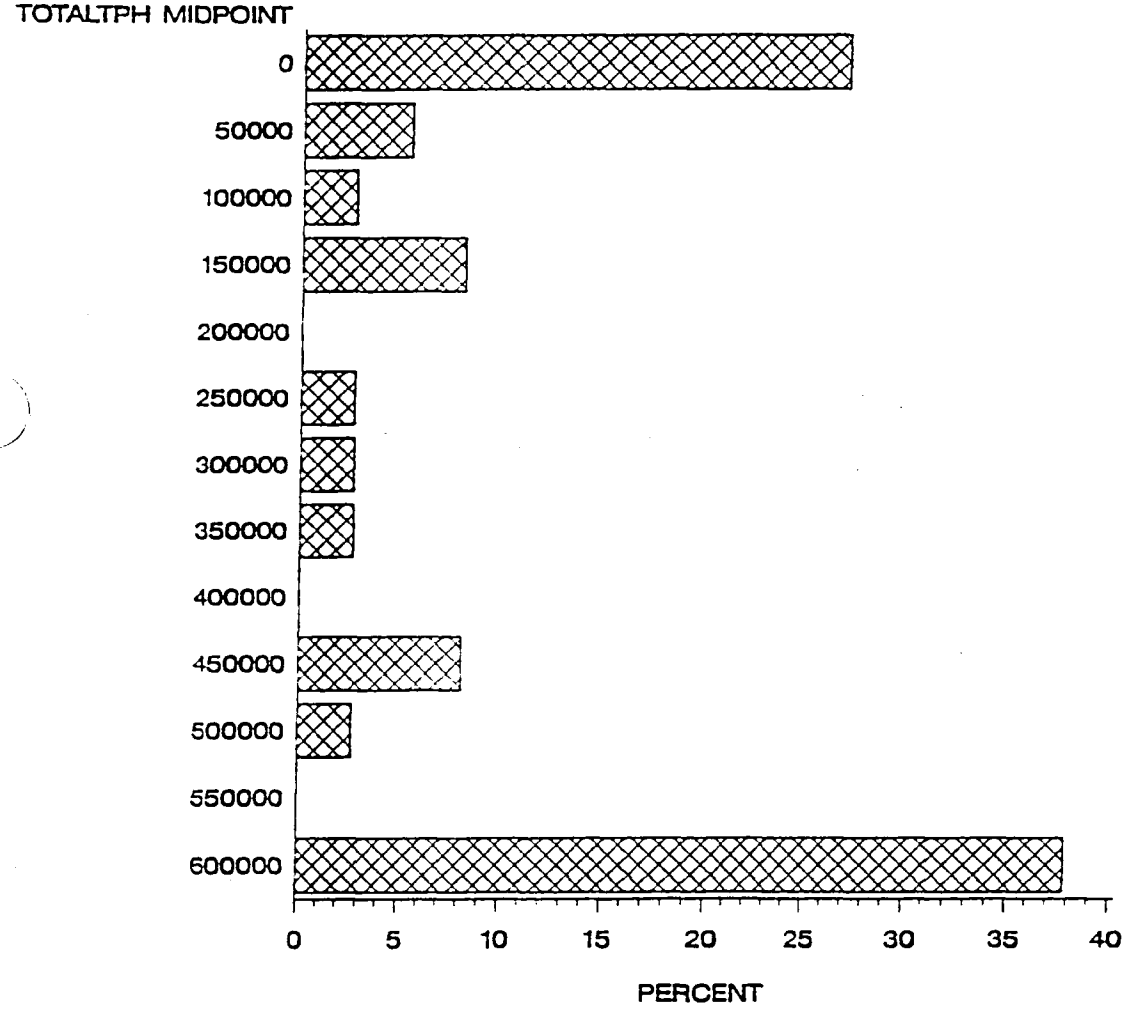
Treasure Island Results
Soil
SHALLOW=Depth > 1.5 SAMPLING=1997



OTALTPH MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	24	24	46.15	46.15
50000	9	33	17.31	63.46
100000	2	35	3.85	67.31
150000	4	39	7.69	75.00
200000	2	41	3.85	78.85
250000	2	43	3.85	82.69
300000	1	44	1.92	84.62
350000	1	45	1.92	86.54
400000	1	46	1.92	88.46
450000	1	47	1.92	90.38
500000	3	50	5.77	96.15
550000	0	50	0.00	96.15
600000	2	52	3.85	100.00

Attachment 8

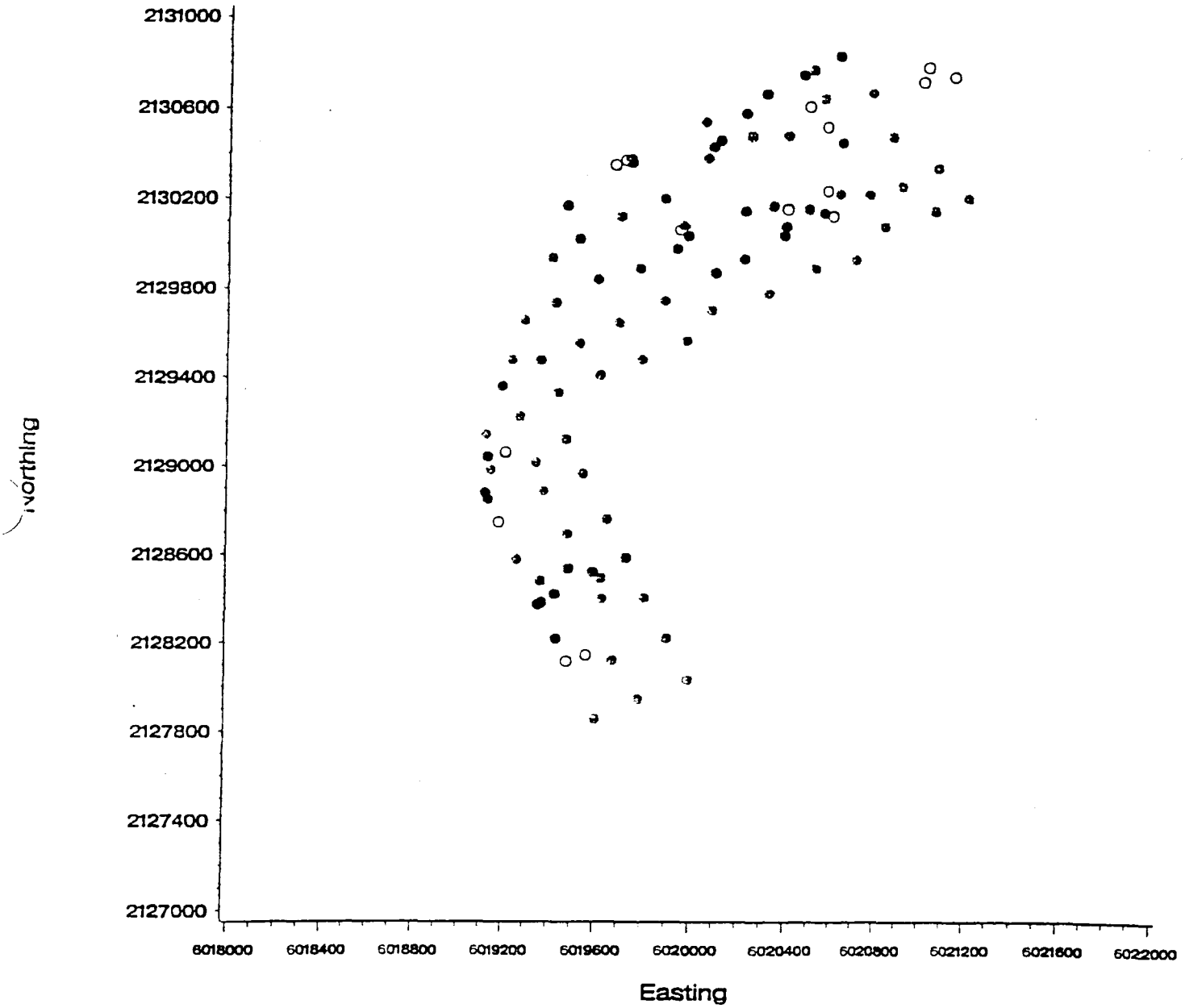
Treasure Island Results
Soil
SHALLOW=Depth > 1.5 SAMPLING=Before 1997



FREQ.	CUM. FREQ.	PCT.	CUM PCT
10	10	27.03	27.0
2	12	5.41	32.4
1	13	2.70	35.1
3	16	8.11	43.2
0	16	0.00	43.2
1	17	2.70	45.9
1	18	2.70	48.6
1	19	2.70	51.3
0	19	0.00	51.3
3	22	8.11	59.4
1	23	2.70	62.1
0	23	0.00	62.1
14	37	37.84	100.0

Attachment 9

Treasure Island Water Results

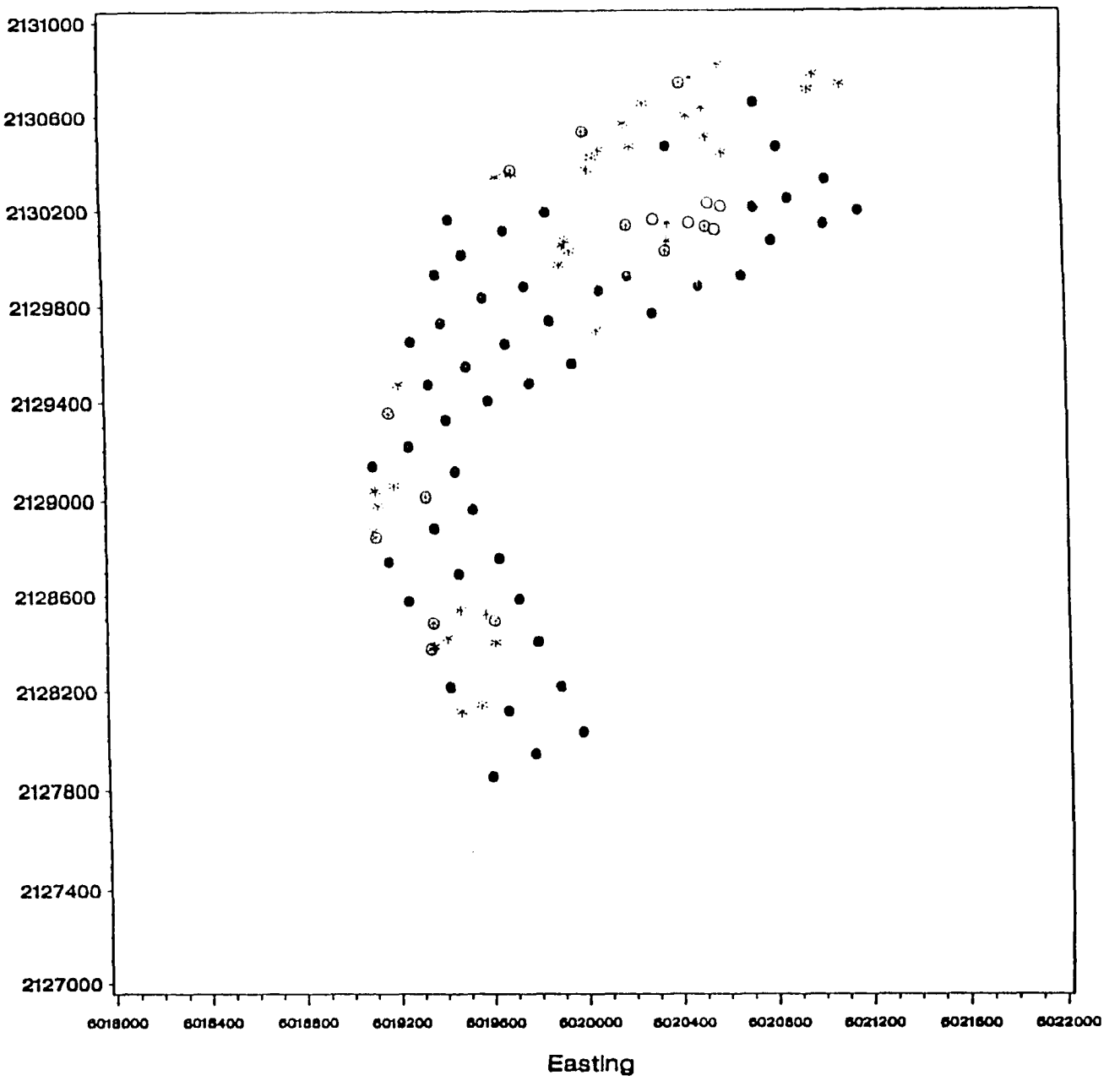


Attachment 10

20

PLTCODE ○○○ <= 250 ●●● <= 500 ●●● > 500

Treasure Islan ater Data



Sampling ●●● 1997 ○○○ 1996 ✳✳✳ Before 1996

Attachment 11

21

SAMPLING=1997

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
SAMPDATE		48	13824.44	4.8020663	13816.00	13832.00
TOPDEPTH		48	0	0	0	0
BOTDEPTH		48	0	0	0	0
DEPTH		48	0	0	0	0
CORE		48	0	0	0	0
NORTHING	Y COORD (Northing)	48	2129444.52	759.4959788	2127856.10	2130658.40
EASTING	X COORD (Easting)	48	6019888.01	572.3376122	6019104.90	6021177.90
TYPE		48	0	0	0	0
FREQ		48	1.1041667	0.3087093	1.0000000	2.0000000
DIESEL		48	172.1875000	284.1297019	120.0000000	2000.00
MOTOROIL		48	217.0833333	254.5748089	100.0000000	1800.00
GASOLINE		48	54.1250000	27.2807508	26.0000000	230.0000000
TOTTPH		48	443.3958333	452.5870665	246.0000000	2595.00

SAMPLING=1996

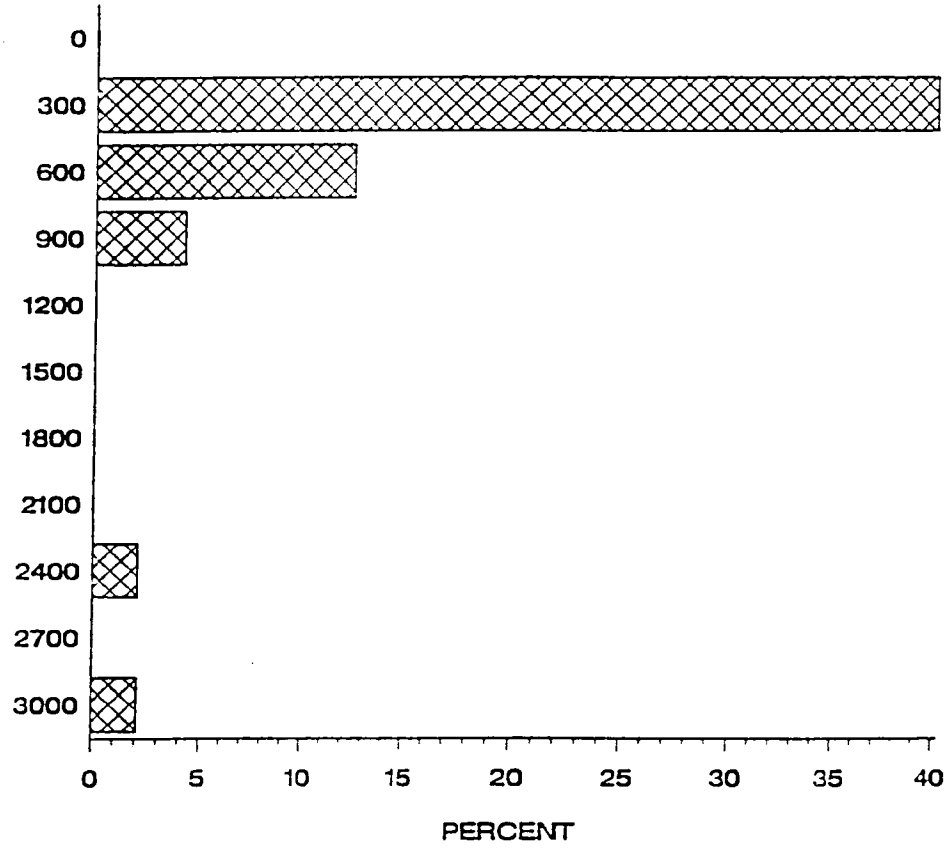
Variable	Label	N	Mean	Std Dev	Minimum	Maximum
SAMPDATE		41	13317.76	83.8524837	13206.00	13415.00
TOPDEPTH		41	0.5365854	1.4848832	0	6.0000000
BOTDEPTH		41	0.7804878	2.1390675	0	8.0000000
DEPTH		41	0.6585366	1.8112117	0	7.0000000
CORE		41	0.2439024	0.6625892	0	2.0000000
NORTHING	Y COORD (Northing)	41	2129618.42	822.1280050	2128371.82	2130738.95
EASTING	X COORD (Easting)	41	6019858.93	534.3830626	6019116.00	6020606.18
TYPE		41	0	0	0	0
FREQ		41	1.0975610	0.3004062	1.0000000	2.0000000
DIESEL		41	792.6829268	2989.53	55.0000000	19000.00
MOTOROIL		41	790.0609756	2814.64	53.0000000	18000.00
GASOLINE		41	67.9390244	51.9800677	33.0000000	280.0000000
TOTTPH		41	1650.68	5818.35	166.0000000	37160.00

SAMPLING=Before 1996

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
SAMPDATE		61	13018.92	108.6700350	12733.00	13118.00
TOPDEPTH		61	2.2377049	2.2076695	0	6.5000000
BOTDEPTH		61	3.3196721	3.1718591	0	8.5000000
DEPTH		61	2.7786885	2.6860358	0	7.5000000
CORE		61	1.0819672	1.0049060	0	2.0000000
NORTHING	Y COORD (Northing)	61	2129902.44	851.0215468	2128116.31	2130821.78
EASTING	X COORD (Easting)	61	6020007.90	534.2680898	6019104.93	6021111.23
TYPE		61	0	0	0	0
FREQ		61	1.0327869	0.1795562	1.0000000	2.0000000
DIESEL		61	2372.56	14211.35	50.0000000	110000.00
MOTOROIL		61	1203.57	4784.66	57.0000000	36000.00
GASOLINE		61	1878.16	14074.54	25.0000000	110000.00
TOTTPH		61	5454.29	30062.92	162.0000000	230000.00

Attachment 12

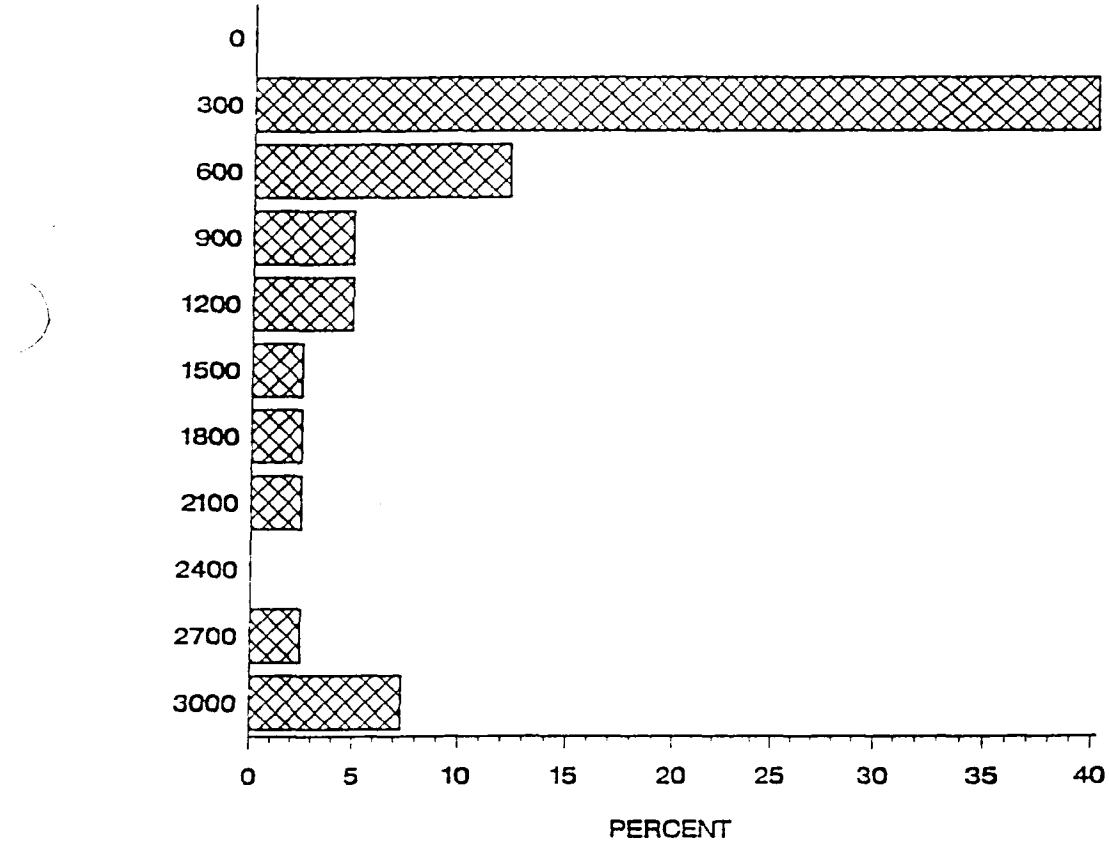
Treasure Island Results
Water
SAMPLING = 1997



TOTTPH MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM PC
0	0	0	0.00	0.0
300	38	38	79.17	79.1
600	6	44	12.50	91.6
900	2	46	4.17	95.8
1200	0	46	0.00	95.8
1500	0	46	0.00	95.8
1800	0	46	0.00	95.8
2100	0	46	0.00	95.8
2400	1	47	2.08	97.9
2700	0	47	0.00	97.9
3000	1	48	2.08	100.0

Attachment 13

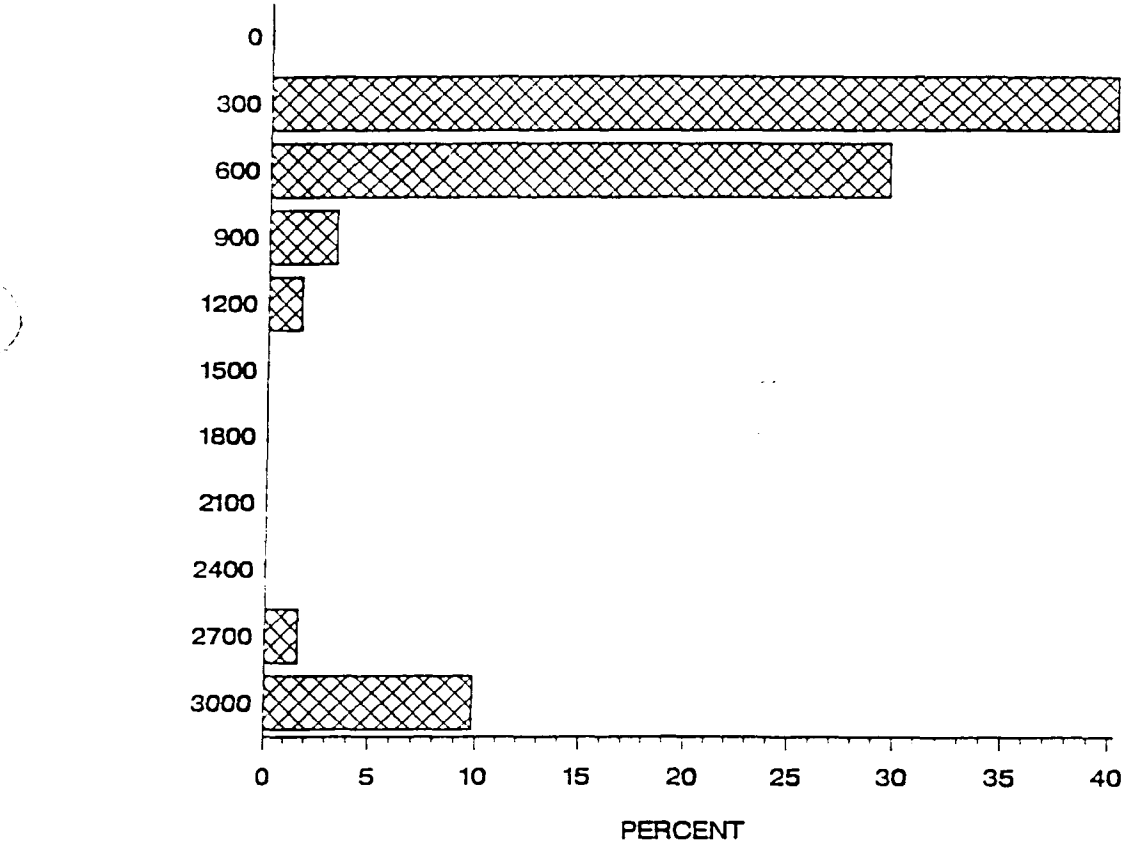
Treasure Island Results
Water
SAMPLING=1996



TOTTPH MIDPOINT	FREQ.	CUM. FREQ.	PCT.	CUM. PCT.
0	0	0	0.00	0.00
300	25	25	60.98	60.98
600	5	30	12.20	73.17
900	2	32	4.88	78.05
1200	2	34	4.88	82.93
1500	1	35	2.44	85.37
1800	1	36	2.44	87.80
2100	1	37	2.44	90.24
2400	0	37	0.00	90.24
2700	1	38	2.44	92.68
3000	3	41	7.32	100.00

Attachment 14

Treasure Island Results
Water
SAMPLING = Before 1996



FREQ.	CUM. FREQ.	PCT.	CUI PC
0	0	0.00	0.(
33	33	54.10	54.:
18	51	29.51	83.(
2	53	3.28	86.8
1	54	1.64	88.5
0	54	0.00	88.5
0	54	0.00	88.5
0	54	0.00	88.5
0	54	0.00	88.5
1	55	1.64	90.1
6	61	9.84	100.0

Attachment 15

Treasure Island Site 12, TPH Data
Estimated Mean Concentrations
(8/6/98)

This memorandum documents statistical estimates which were requested by Paul West and Camille Garibaldi during our conference call on July 7. These estimates are as follows:

a. Mean total TPH concentration in groundwater across the entire Site 12.

b. Mean total TPH concentration in groundwater across the shoreline of Site 12 (i.e., within 200 feet of the shore.)

c. Mean total TPH concentration in groundwater within each of three subareas (either Areas 1, 2, and 3 or Areas A, B, and C).

d. Mean total TPH concentration in soil for same areas defined in a, b, c above.

e. Estimated kilograms of total TPH in groundwater and soil calculated for the areas defined in a, b, c, d above. (Estimates are still required of aquifer thickness and surface soil thickness, as well as aquifer porosity and soil bulk density.)

f. In addition, Battelle was asked to consider whether the groundwater total TPH levels are correlated with soil total TPH concentrations measured at the same sampling locations.

This memo discusses the results for items a, b, and d; the other items require information from EPA West before they can be completed.

1. Initial data summaries (Battelle memo dated 6/16/98) indicated generally decreasing TPH levels in both groundwater and soil measured from 1995 to 1997. Therefore, to provide the most accurate assessment of current conditions at Site 12, the estimates requested in a-e above were all calculated using only 1997 TPH concentrations. Deleting the 1995 and 1996 data from the statistical calculations could lead to less precise estimates due to the smaller data set retained. However, including the higher 1995 and 1996 TPH concentrations would have introduced a significant upward bias to the estimates of current TPH levels.

2. The 1997 groundwater and soil TPH sampling locations are shown in Attachment 1. This figure also shows the horizontal boundaries of Site 12, and the 200 ft. wide shoreline of Site 12.

3. Corresponding TPH concentrations measured at each location are listed in Attachments 2 and 3, for groundwater and soil, respectively. In cases where the diesel oil, motor oil, or gasoline TPH in a sample was found to be below the analytical detection limit, a value of one-half the detection limit was added into the calculation of total TPH concentration. In these cases, the

enc/ (2)

total TPH values listed in Attachments 2 and 3 are lower than corresponding values shown in our memo of 6/16/98.

4. A "big-block" approach was used to calculate the required mean TPH concentrations. Since our BATGAM geostatistical software (based on GSLIB software; Deutsch and Journel, 1992) can not calculate estimates for irregularly-shaped areas like Site 12, we were required to approximate Site 12 and the other areas by two or more large rectangular blocks. Attachment 4 shows the sampling locations, Site 12 boundaries, and two large rectangular blocks used to approximate Site 12. Attachment 5 shows the sampling locations, shoreline boundaries, and three rectangular blocks used to approximate the shoreline of Site 12. Since the estimates in each area are based on overall averages of the data, the approximation of using big blocks to represent the areas should introduce no significant bias to the estimated mean concentrations or statistical upper confidence bounds.

5. In the big-block approach, each sampling location is associated with at most one rectangular block (in some cases a sampling location is too far away to be associated with any block). The plotting symbols in Attachments 4 and 5 indicate the blocks with which each sampling location was associated. Then, the mean TPH concentration for each block is estimated using only those data associated with the given block. Finally, the mean TPH concentration for the entire area is calculated as the weighted sum of the block estimates, where the weighting factors are proportional to the surface area of each block. The estimation variance for each area is calculated as the weighted sum of the block estimation variances, where the weighting factors are proportional to the squared surface area of each block. This variance calculation assumes that the block estimation errors are independent, which is an assumption that is reasonable since for each area (i.e., all of Site 12 or the shoreline) each measured TPH datum is used in the estimation of just one block.

<u>Groundwater Across Entire Site 12</u>

6. As the first step in the estimation. experimental semivariograms, quantifying spatial correlation, were calculated with all 53 groundwater TPH concentrations measured at Site 12. The results are shown in Attachment 6 (north, northeast, east, southeast, and omni-directional separation directions), along with the spherical semivariogram model which was fitted to the omni-directional experimental semivariogram points. The fitted model parameters are as follows: model type = spherical, nugget variance = 30,000 $(\mu g/L)^2$, total variance = 350,000 $(\mu g/L)^2$, correlation range = 500 feet).

7. Because of the approximately uniform spatial coverage of sampling locations, the estimated mean concentrations for each block were calculated as the straight arithmetic average of the data associated with the block (see Attachment 4). For the five sampling locations where duplicate groundwater TPH concentrations were measured (see Attachment 2), the two duplicate data were first averaged together before being included in the block arithmetic averaging.

8. The estimation variance (i.e., uncertainty) associated with the mean concentration was calculated using the semivariogram model (see Attachment 6) and the method of compositing

extension variances (Journel and Huijbregts, Mining Geostatistics, 1981, Academic Press, p. 410). In this method, which is appropriate for uniform spatial sampling patterns like that at Site 12, each datum is viewed as estimating its local area of influence (e.g., about 48,000 ft^2, or an area about 220 ft. square for each datum of Block 1). To calculate the overall estimation variance for each block, the variance of this local estimation (called an extension variance) is then divided by the total number of available data (e.g., n=17 for Block 1), assuming independence of the local estimations. The overall estimation variance for Site 12 is then calculated as the weighted average of the block estimation variances, where the weighting factors are proportional to the squared surface area of each block.

9. A statistical upper confidence limit (UCL) for the Site 12 estimated mean TPH concentration in groundwater was calculated as the estimated mean concentration plus 1.645 times the estimation standard error (i.e., square-root of estimation variance). This calculation assumes that the estimation error is normally distributed, which is an assumption that has been shown to be appropriate in practice for estimation of large areas like this estimation for Site 12.

10. Results of the statistical calculations for Site 12 are presented in Table 1. The estimated mean TPH concentration in groundwater is 294.8 µg/L, and a 95% UCL for this estimate is 386.1 µg/L. Since this UCL is below the stated action level of 1400 µg/L for TPH in groundwater, it is appropriate to conclude that the true mean TPH concentration is statistically significantly below the action level.

Table 1. Estimate of Mean Groundwater TPH Across Entire Site 12

Area	Surface Area (ft^2)	n	Mean TPH (µg/L)	Estimation Variance $(\mu g/L)^2$	95% UCL (µg/L)
Block 1	820,800	17	272.4	8,071	–
Block 2	1,928,500	31	304.3	4,787	–
Entire Site 12	2,749,300	48	294.8	3,075	386.1

Groundwater Across the Shoreline of Site 12

11. A similar approach was used to calculate the groundwater estimated mean TPH concentration and UCL for the shoreline of Site 12, defined to be within 200 feet of the coast (see Attachment 1). The shoreline was approximated by three big blocks, as shown in Attachment 5. Results of these calculations are presented in Table 2. To distinguish results for all of Site 12 from those for the shoreline, the three blocks used to represent the shoreline in our calculations are referred to in the tables as "Shore 1", "Shore 2", and "Shore 3".

12. The estimated mean TPH concentration in groundwater across the shoreline of Site 12 is 291.2 µg/L, and a 95% UCL for this estimate is 439.1 µg/L. (Note that because of the smaller

number of data used to estimate the shoreline and the smaller size of the shoreline, the shoreline UCL is higher (i.e., the uncertainty is greater) than the entire Site 12 UCL, even though the estimated mean concentrations are approximately the same.) Since the UCL is below the action level of 1400 µg/L, it is appropriate to conclude that the true mean TPH concentration is statistically significantly below the action level.

Table 2. Estimate of Mean Groundwater TPH Across Site 12 Shoreline

Area	Surface Area (ft^2)	n	Mean TPH (µg/L)	Estimation Variance $(\mu g/L)^2$	95% UCL (µg/L)
Shore 1	264,000	8	427.0	14,950	–
Shore 2	244,000	11	251.5	9,418	–
Shore 3	304,000	4	205.0	40,300	–
Entire Shoreline	812,000	23	291.2	8,079	439.1

Surface Soil Across Entire Site 12

13. Similar calculations were also made for the mean TPH concentration in surface soil at Site 12. Generally, soil sampling was performed for depths up to about 3-5 feet below ground surface (see Attachment 3); and at each sampling location, measurements were made at two depths. Since the data seem to indicate a vertical differentiation in TPH levels (see memo of 6/16/98), estimated mean TPH concentrations were calculated for two depths, the higher sampling elevation (referred to as "TOP 1.5 ft") and the lower sampling elevation (referred to as "BOTTOM 1.5 ft").

14. The experimental semivariograms and fitted model for soil TPH are shown in Attachment 7. Most results in this figure are for horizontal separations between data (assuming a flat surface topography at Site 12 so that similar sampling depths fall on the same horizontal plane). However, the first point plotted, for a separation distance of about 2 feet, represents the variability between the two vertical TPH measurements collected at the same sampling location. In the fitted model, this variability is also assumed to adequately represent differences in TPH concentration that can be expected at similar short horizontal separations. The fitted model parameters for soil TPH are as follows: model type = linear, nugget variance = 615,000 $(mg/kg)^2$, slope = 368 $(mg/kg)^2/ft$.

15. Results of the statistical calculations for soil across the entire Site 12 are presented in Table 3. The estimated mean TPH concentration in soil for the top 1.5 ft. elevation is 355.6 mg/kg, with a 95% UCL for this estimate of 541.4 mg/kg. For the bottom sampling elevation, the estimated mean concentration is 179.1 mg/kg, with a 95% UCL of 365.0 mg/kg. Since both of these UCLs are above the stated action level for soil of 100 mg/kg, it can not be concluded that the true mean TPH concentration in soil is below the action level.

Table 3. Estimate of Mean Soil TPH Across Entire Site 12

Area	Surface Area (ft^2)	n	Mean TPH (mg/kg)	Estimation Variance $(mg/kg)^2$	95% UCL (mg/kg)
TOP 1.5 ft					
Block 1	820,800	19	367.3	34,590	--
Block 2	1,928,500	34	350.6	19,493	--
Entire Site 12	2,749,300	53	355.6	12,674	541.4
BOTTOM 1.5 ft					
Block 1	820,800	19	89.6	34,590	--
Block 2	1,928,500	34	217.1	19,493	--
Entire Site 12	2,749,300	53	179.1	12,674	365.0

Surface Soil Across the Shoreline of Site 12

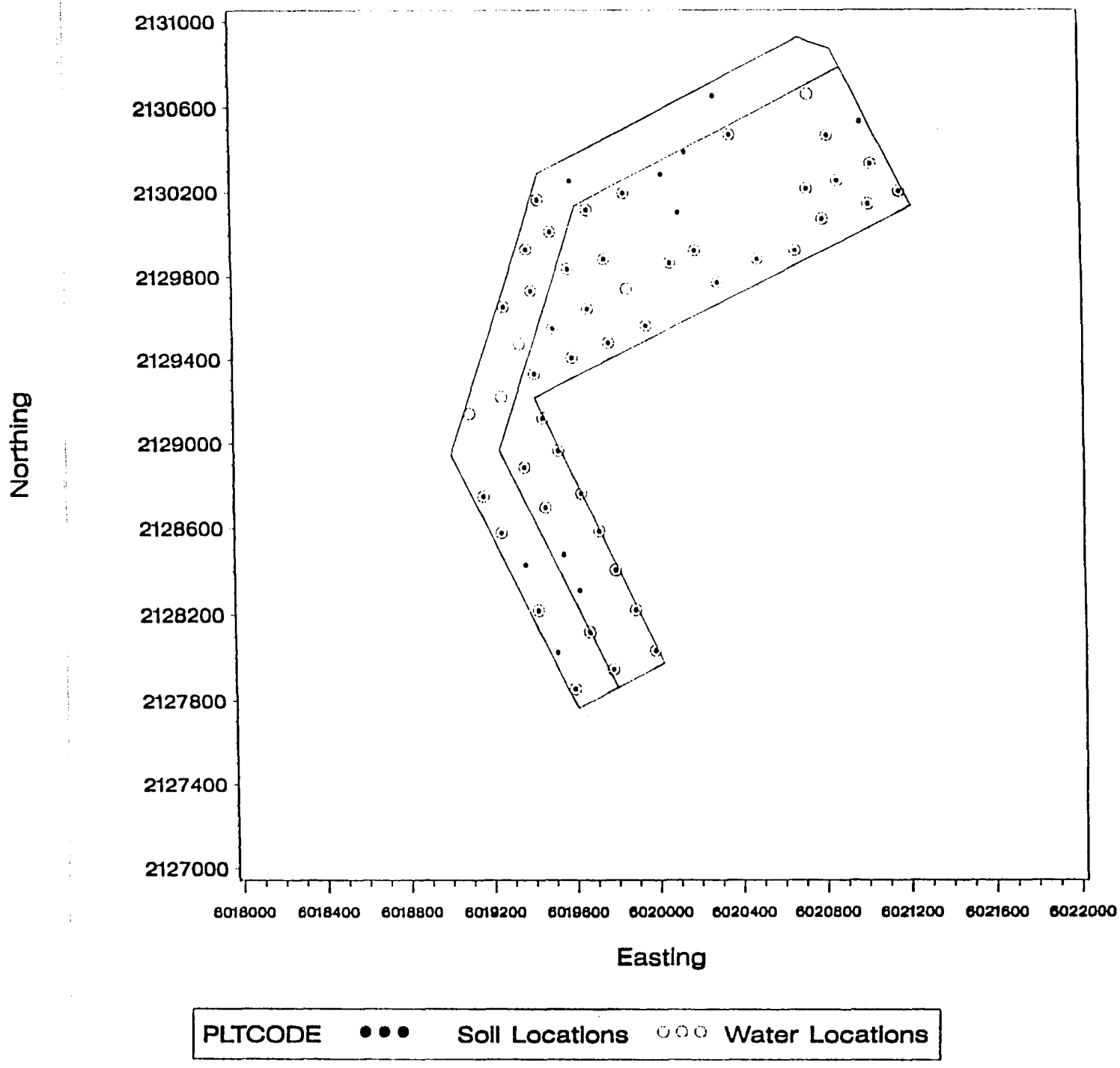
16. Statistical calculations were also made for the surface soil of the shoreline of Site 12, and the results are presented in Table 4. The estimated mean TPH concentration for the shoreline at the top 1.5 ft. elevation is 276.3 mg/kg, with a 95% UCL of 542.8 mg/kg. For the bottom sampling elevation, the estimated mean concentration is 194.7 mg/kg, with a 95% UCL of 461.2 mg/kg. Since both of these UCLs are above the stated action level for soil of 100 mg/kg, it can not be concluded that the true mean TPH concentration in soil is below the action level.

Table 4. Estimate of Mean Soil TPH Across Site 12 Shoreline

Area	Surface Area (ft^2)	n	Mean TPH (mg/kg)	Estimation Variance $(mg/kg)^2$	95% UCL (mg/kg)
TOP 1.5 ft					
Shore 1	264,000	12	518.9	54,160	--
Shore 2	244,000	8	121.4	80,448	--
Shore 3	304,000	7	190.0	95,421	--
Entire Shoreline	812,000	27	276.3	26,364	542.8
BOTTOM 1.5 ft					
Shore 1	264,000	12	99.5	54,160	--
Shore 2	244,000	8	320.8	80,448	--
Shore 3	304,000	7	176.3	95,421	--
Entire Shoreline	812,000	27	194.7	26,364	461.2

s:\buxt\misc\treasure island2.wpd

Treasure Island Sites



Attachment 2

Treasure Island Site 12 Total TPH in Water

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	Total TPH (ug/l)
12HP118	2127856.10	6019596.40	0	135
12HP119	2127946.70	6019781.10	0	135
12HP120	2128033.40	6019984.60	0	135
12HP122	2128119.90	6019670.00	0	135
12HP123	2128220.00	6019893.80	0	135
			0	135
12HP124	2128217.70	6019424.70	0	2470
12HP126	2128403.10	6019799.50	0	135
12HP129	2128584.90	6019722.60	0	135
12HP130	2128576.50	6019251.30	0	135
12HP131	2128693.10	6019466.20	0	135
12HP132	2128758.90	6019638.50	0	135
12HP133	2128745.10	6019166.80	0	136
12HP134	2128884.10	6019365.20	0	135
12HP135	2128963.00	6019529.40	0	135
12HP136	2129117.60	6019457.20	0	135
12HP137	2129139.80	6019104.90	0	135
			0	135
12HP138	2129218.40	6019257.90	0	135
12HP139	2129328.70	6019420.60	0	135
12HP140	2129406.90	6019602.30	0	135
12HP141	2129477.70	6019778.80	0	135
12HP142	2129560.40	6019960.10	0	205
12HP143	2129770.60	6020304.30	0	205
12HP144	2129882.60	6020499.70	0	205
12HP145	2129923.30	6020681.60	0	205
12HP146	2130071.50	6020811.80	0	205
12HP147	2130140.00	6021031.20	0	205
12HP148	2130198.10	6021177.90	0	205

Attachment 2
Treasure Island Site 12 Total TPH in Water

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	Total TPH (ug/l)
12HP149	2129473.20	6019348.50	0	135
12HP150	2129548.20	6019509.80	0	144
12HP151	2129643.40	6019679.30	0	135
12HP152	2129739.40	6019868.30	0	135
			0	405
12HP153	2129863.30	6020080.00	0	2585
			0	2555
12HP154	2129924.00	6020201.00	0	410
12HP156	2130211.10	6020740.50	0	205
12HP157	2130249.40	6020886.50	0	205
12HP158	2130329.80	6021044.10	0	205
12HP159	2129653.20	6019274.60	0	168
12HP160	2129731.00	6019406.70	0	135
12HP161	2129835.90	6019586.30	0	395
12HP162	2129882.70	6019764.10	0	205
12HP166	2130467.50	6020842.20	0	205
12HP168	2129931.90	6019388.40	0	205
12HP169	2130014.90	6019504.70	0	545
12HP170	2130116.20	6019682.60	0	205
12HP171	2130192.30	6019863.10	0	205
			0	205
12HP174	2130470.70	6020376.70	0	205
12HP175	2130658.40	6020749.30	0	205
12HP176	2130162.50	6019449.20	0	635

Attachment 3
Treasure Island Site 12 Total TPH in Soil

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	Total TPH (ug/kg)
12HP118	2127856.10	6019596.40	1.00	21015.0
			3.00	10679.5
12HP119	2127946.70	6019781.10	1.00	1229025.5
			3.00	406060.0
12HP120	2128033.40	6019984.60	1.00	9726.0
			4.00	9835.0
12HP121	2128025.80	6019513.40	1.00	41276.5
			2.50	30529.0
12HP122	2128119.90	6019670.00	1.00	99276.5
			4.00	10502.0
12HP123	2128220.00	6019893.80	1.50	213376.5
			3.00	123478.0
12HP124	2128217.70	6019424.70	1.00	9726.5
			3.00	86075.0
12HP125	2128311.10	6019623.80	1.00	2969057.0
			4.00	21276.0
12HP126	2128403.10	6019799.50	1.00	55200.0
			3.50	45377.0
12HP127	2128428.50	6019367.00	1.00	226526.0
			3.50	79377.0
12HP128	2128476.60	6019551.50	1.00	718566.0
			4.00	9827.0
12HP129	2128584.90	6019722.60	1.00	213076.0
			3.50	44126.0
12HP130	2128576.50	6019251.30	1.00	163444.0
			3.00	20629.5
12HP131	2128693.10	6019466.20	1.50	9726.0
			3.00	9826.5
12HP132	2128758.90	6019638.50	1.00	66125.5
			3.00	266925.5
12HP133	2128745.10	6019166.80	1.00	422026.0
			2.50	498030.0
12HP134	2128884.10	6019365.20	1.00	317326.5
			3.00	11331.0
12HP135	2128963.00	6019529.40	1.00	71276.0
			3.00	9126.0
12HP136	2129117.60	6019457.20	1.00	123226.0
			3.00	9726.5

Attachment 3

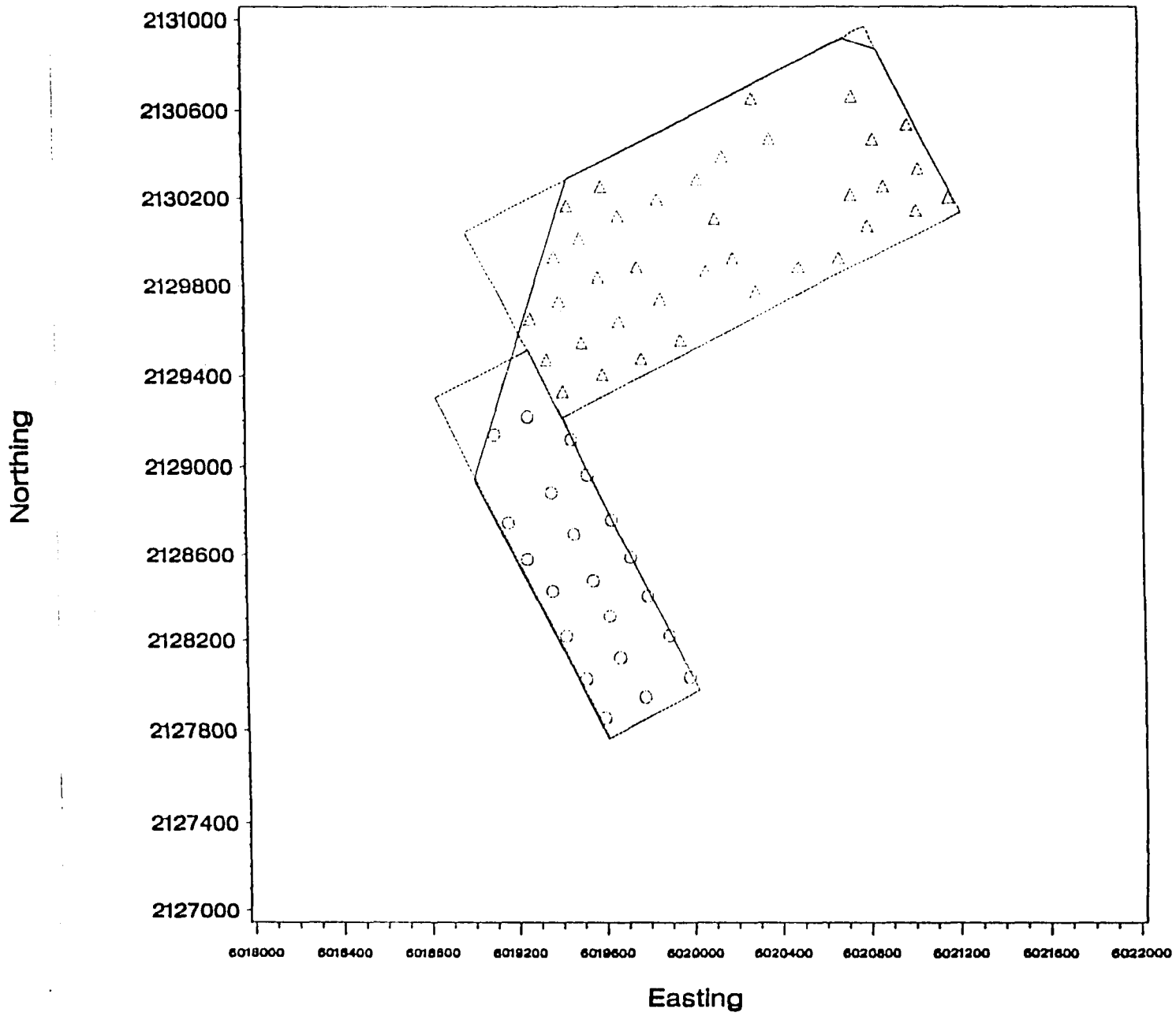
Treasure Island Site 12 Total TPH in Soil

LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	Total TPH (ug/kg)
12HP139	2129328.70	6019420.60	1.50	84225.5
			3.50	30276.0
12HP140	2129406.90	6019602.30	1.00	95226.0
			3.50	9126.0
12HP141	2129477.70	6019778.80	1.00	7000160.0
			3.50	9827.0
12HP142	2129560.40	6019960.10	1.00	86126.0
			3.00	9075.5
12HP143	2129770.60	6020304.30	1.50	310027.0
			3.50	9726.0
12HP144	2129882.60	6020499.70	1.00	22427.5
			3.50	9826.5
12HP145	2129923.30	6020681.60	1.00	12925.5
			3.50	9877.0
12HP146	2130071.50	6020811.80	1.00	18181.0
			3.50	9678.0
12HP147	2130140.00	6021031.20	1.00	27125.5
			3.50	9675.5
12HP148	2130198.10	6021177.90	1.00	42485.0
			4.50	216026.5
12HP150	2129548.20	6019509.80	1.50	10528.0
			3.50	9776.5
12HP151	2129643.40	6019679.30	1.00	178026.0
			3.00	22327.0
12HP153	2129863.30	6020080.00	1.00	263027.0
			3.50	2320028.0
12HP154	2129924.00	6020201.00	1.00	288226.0
			3.00	479026.5
12HP156	2130211.10	6020740.50	1.00	14125.5
			5.00	10425.5
12HP157	2130249.40	6020886.50	1.00	33427.5
			3.50	9725.5
12HP158	2130329.80	6021044.10	1.00	154125.5
			4.50	23177.0
12HP159	2129653.20	6019274.60	1.00	23697.0
			2.50	170036.5
12HP160	2129731.00	6019406.70	1.00	181037.0
			3.50	1150027.0

Attachment 3
Treasure Island Site 12 Total TPH in Soil

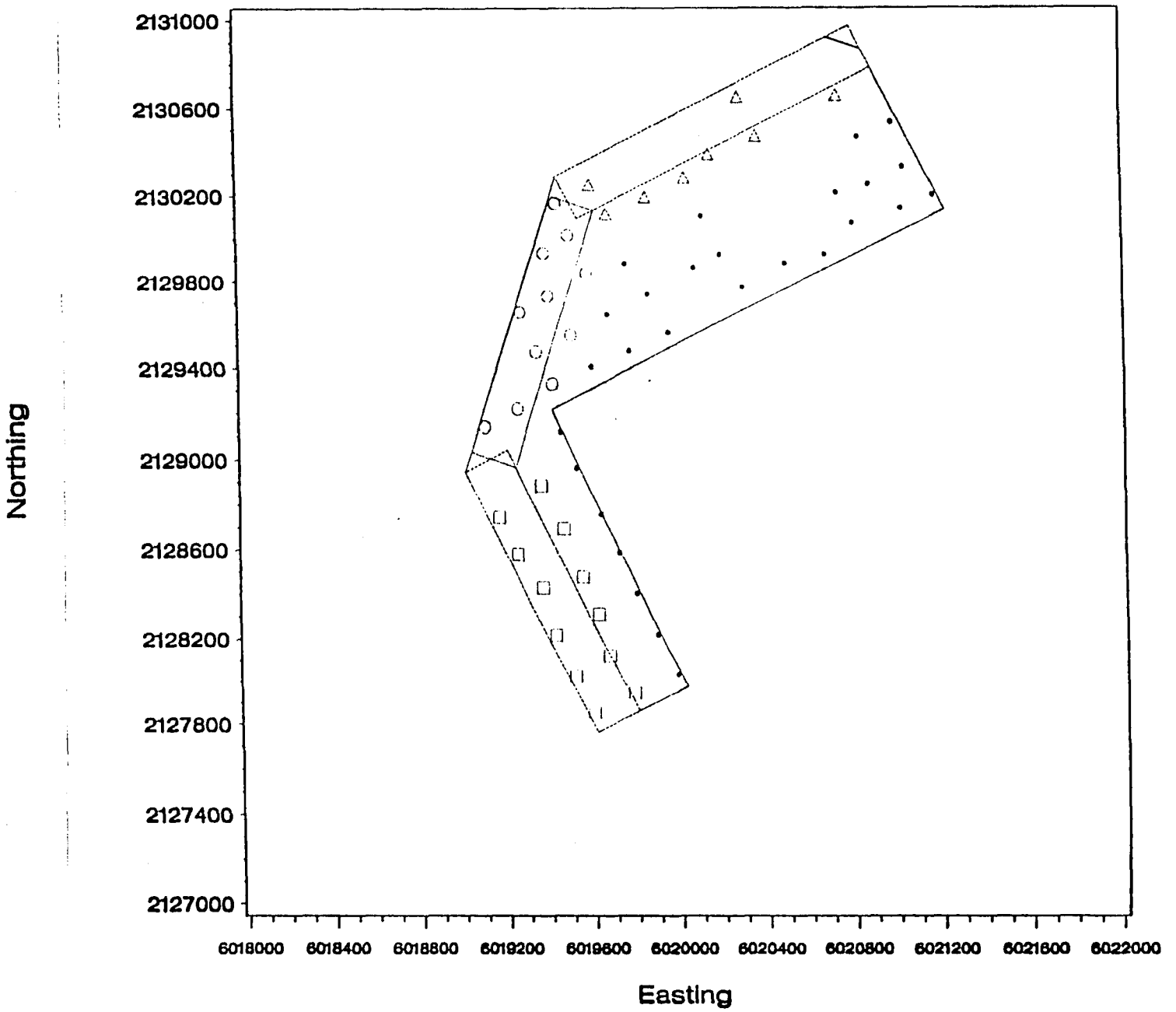
LOCATE	Y COORD (Northing)	X COORD (Easting)	DEPTH	Total TPH (ug/kg)
12HP161	2129835.90	6019586.30	1.00	123235.0
			3.50	147039.0
12HP162	2129882.70	6019764.10	1.00	93377.0
			3.50	49326.5
12HP163	2130104.40	6020122.70	1.00	170027.0
			3.00	311026.0
12HP166	2130467.50	6020842.20	1.00	10726.0
			5.00	9175.5
12HP167	2130533.50	6020995.90	1.00	798025.5
			3.25	55176.0
12HP168	2129931.90	6019388.40	1.00	213345.0
			4.00	521027.0
12HP169	2130014.90	6019504.70	1.00	324026.5
			3.50	192027.5
12HP170	2130116.20	6019682.60	1.00	276726.0
			3.00	123226.0
12HP171	2130192.30	6019863.10	1.00	58276.0
			2.00	20478.5
12HP172	2130281.40	6020045.80	1.00	48226.5
			2.50	9877.5
12HP173	2130388.40	6020159.50	0.50	224026.5
			1.50	324028.0
12HP174	2130470.70	6020376.70	1.00	113579.0
			2.00	44329.0
12HP176	2130162.50	6019449.20	1.00	11176.5
			3.00	346028.0
12HP177	2130250.40	6019606.60	1.00	295027.0
			3.50	465026.5
12HP178	2130651.50	6020298.40	1.00	314050.0
			2.00	247128.0

Treasure [illegible]d Sites



PLTCODE ○○○ Block 1 Samples △△△ Block 2 Samples

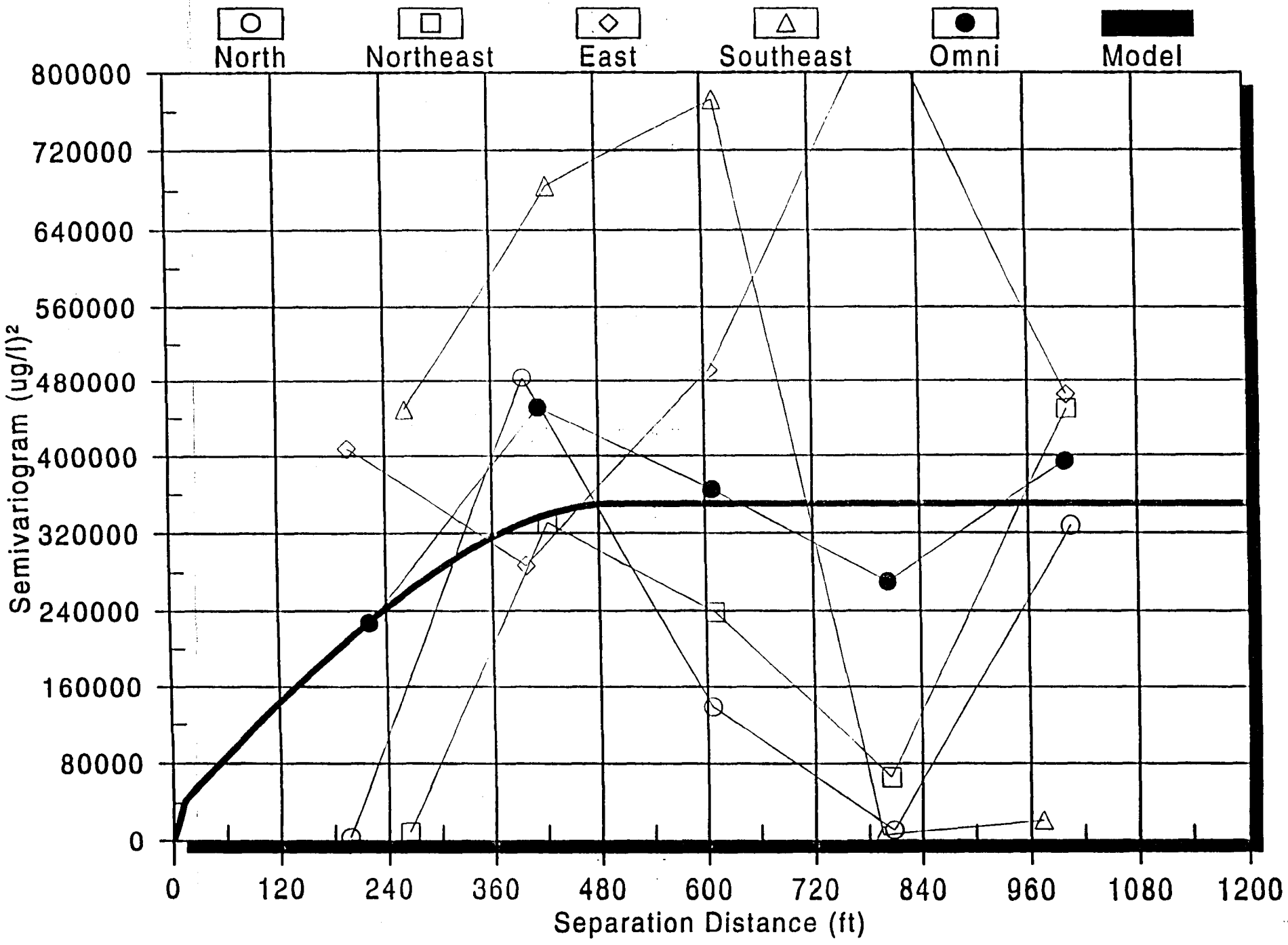
Attachment 5
Treasure Island Sites

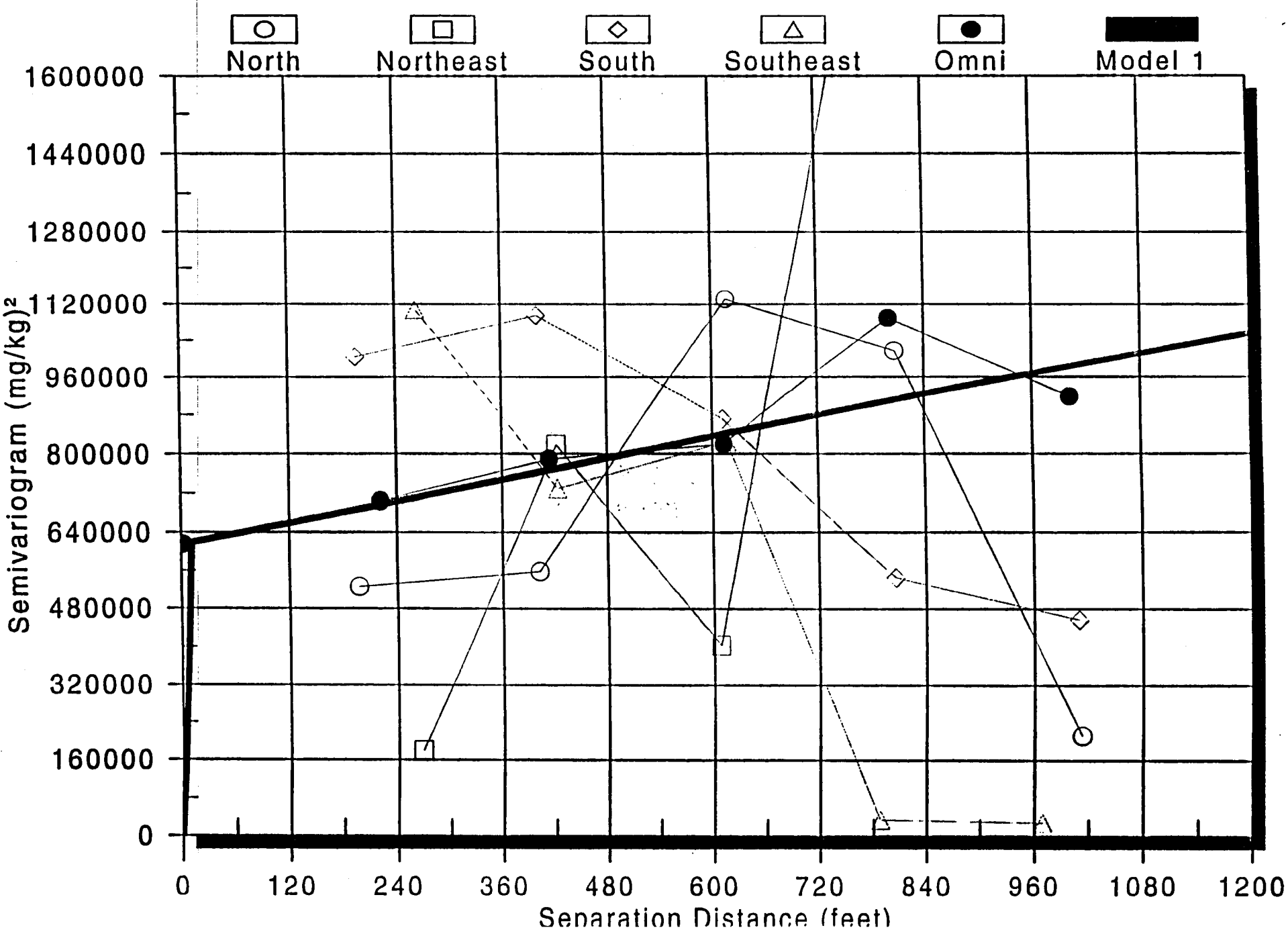


PLTCODE □□□ Block 1 Samples ○○○ Block 2 Samples △△△ Block 3 Samples

Treasure Isla 1997 Water

200 ft lag – Attachment 6



Semivariograms for TPH in Soil

Attachment 7