

Memorandum




Date: November 7, 2004

To: Jose Gonzales, P.E. Chief
Pollution Control Division

To: Section Chiefs
Pollution Control Division

To: PRS Staff

From: Wilbur Mayorga, P.E., Chief
Pollution Remediation Section 

Subject: Natural Background Soil Concentrations for the Barrier Islands of Miami-Dade County

The table below provides the naturally occurring background concentrations of thirteen inorganic chemicals in soils from the barrier islands of Miami-Dade County. The information was developed through statistical analysis of laboratory results from surficial soil samples obtained at 27 locations along Miami Beach and the Spoil Islands (see attached Map). Where feasible, samples were obtained from the 0-1 foot interval and the 1-2 feet interval at each location. The listed concentrations represent the Minimum Variance Unbiased Estimate (MVUE) of the mean for each chemical. If no statistically significant difference ($p > 0.05$) was determined between the two intervals, the datasets were combined and a single MVUE is reported. However, for populations indicating a significant difference with depth, the MVUE for each interval is presented.

Natural Background Soil Concentrations for the Barrier Islands of Miami-Dade County

Chemical Name	Natural Background Concentration (mg/kg)	
	0-2 ft interval	
Arsenic	5.2	
Aluminum	798.7	
Cadmium	0.3	
Iron	2050.7	
Selenium**	<0.5	
Zinc	13.1	
Silver*	0.4	
	0-1 ft interval	1-2 ft interval
Barium	8.1	5.9
Chromium	7.9	5.7
Copper	5.4*	2.3*
Lead	15.0	5.2*
Mercury	0.054	0.026*
Nickel	1.08*	0.66*

*Represents censored data. Datasets censored to fit lognormal distribution

** Data for selenium not analyzed statistically since all results were below the detection limit

Table 1: Statistical Descriptors

<i>Descriptive Statistics</i>	As	Al	Cd	Fe	Zn	Ag	Ba (0-1ft)	Ba (1-2ft)	Cr (0-1ft)	Cr (1-2ft)	Cu (0-1ft)	Cu (1-2ft)	Pb (0-1ft)	Pb (1-2ft)	Hg (0-1ft)	Hg (1-2ft)	Ni (0-1ft)	Ni (1-2ft)	
n	51*	52*	51*	52*	50*	52*	27	26	25*	26	26*	26	26*	25*	25*	25*	26*	26	
Minimum	ND	206.7	ND	402.4	1.4	ND	2.8	2.2	3.7	2.6	ND	ND	ND	0.3	0.008	ND	ND	ND	
Maximum	15.1	2494.5	0.6	6301.0	47.5	1.2	17.8	15.5	18.3	9.4	17.5	19.8	53.0	16.5	0.2	0.1	2.6	1.9	
Arithmetic Mean	4.5	677.5	0.3	2057.6	12.9	0.3	8.1	5.9	7.9	5.7	4.3	2.7	13.8	3.9	0.1	0.020	0.9	0.7	
Arithmetic Std	3.3	494.0	0.1	1261.8	12.6	0.4	4.1	2.6	4.2	1.8	5.9	3.9	13.0	4.3	0.045	0.020	0.6	0.4	
Mean (ln transformed data)	1.1	6.3	-1.6	7.5	2.1	0.3	2.0	1.7	2.0	1.7	4.3	0.2	2.1	0.7	0.004	0.003	-0.3	-0.6	
STD (ln transformed data)	1.0	0.6	0.7	0.6	1.0	0.4	0.5	0.4	0.5	0.3	5.9	1.2	1.1	1.4	0.001	0.002	0.7	0.7	
Geomean	3.3	551.1	0.2	1759.8	8.3	0.3	7.3	5.5	7.1	5.4	3.5	1.8	8.5	2.3	0.039	0.015	0.8	0.7	
95% Upper Tolerance Limit	11.3	1695.5	0.5	4657.8	38.9	1.1	17.4	11.8	17.5	9.8	17.7	11.6	43.4	13.7	0.2	0.06	2.3	1.6	
<i>Goodness-of-Fit Results</i>																			
Distribution recommended																			
Normal	TRUE	FALSE	TRUE	FALSE	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Log Normal	FALSE	TRUE	FALSE	TRUE	TRUE	TRUE ^{ac}	TRUE	TRUE	TRUE	TRUE	TRUE ^{ac}	TRUE ^{ac}	TRUE	TRUE ^c	TRUE	TRUE ^c	TRUE ^c	TRUE ^{ac}	TRUE ^{ac}
<i>UCL Statistic</i>																			
n	51	52	51	52	50	52	27	26	25	26	26	26	26	19	25	22	20	26	
MVUE Mean	5.2	667.0	0.26	2050.7	13.1	0.4	8.1	5.9	7.8	5.7	5.4	2.4	15	5.2	0.054	0.025	1.1	0.7	
MVUE STD	6.8	456.0	0.18	1226.8	15.7	0.31	3.9	2.3	3.7	1.9	37.3	3.4	20.3	4.9	0.048	0.016	0.5	0.5	
95% UCL (FL UCL)	5.3	798.7	0.28	2394.3	18.3	0.42	9.7	6.8	9.5	6.5	6.3	5.4	24.8	8.7	0.079	0.034	1.3	0.9	
95% UCL (Pro UCL)	5.3	797.4	0.29	2390.9	18.2	0.49	9.4	6.6	9.3	6.4	8.9	3.5	27.9	8.7	0.079	0.034	1.3	0.8	

* Outliers removed before results were analyzed

^c = Dataset censored (non-detects removed to fit distribution)

^{ac} Results reflects censored parameter estimations based on distributional assumption (estimations performed by statistical software)

Table 2: Concentrations of Eleven Inorganics in Soils from the Barrier Islands of Miami-Dade County

Sampling Location	Sampling Location ID	As (0-1)	As (1-2)	Al (0-1)	Al (1-2)	Ag (0-1)	Ag (1-2)	Ba (0-1)	Ba (1-2)	Cd (0-1)	Cd (1-2)	Cr (0-1)	Cr (1-2)
Section 1 Grid 219	1	0.50	0.58	930.67	1039.64	0.15	0.15	5.00	3.80	0.12	0.10	4.07	2.58
Section 1 Grid 233	2	0.50	0.50	928.74	981.94	0.62	0.43	4.10	3.30	0.16	0.18	4.31	4.24
Section 2 Grid 194	3	0.50	1.29	817.64	1001.04	0.30	0.15	5.60	9.20	0.21	0.23	5.33	7.56
Section 2 Grid 197	4	1.36	1.13	2049.01	1086.74	0.15	0.40	9.70	6.30	0.28	0.15	15.46	8.96
Section 3 Grid 168	5	5.80	5.80	2494.49	294.42	0.61	0.89	6.40	5.60	0.15	0.10	5.28	4.19
Section 3 Grid 171	6	3.59	4.37	348.68	315.33	0.22	0.15	7.40	4.70	0.18	0.10	5.94	4.75
Section 4 Grid 122	41	15.09	9.05	297.90	206.80	0.15	0.26	7.30	4.80	0.61	0.37	5.14	3.29
Section 4 Grid 128	7	5.93	1.31	689.49	274.58	0.16	0.15	11.50	6.00	0.36	0.10	8.13	3.40
Section 4 Grid 130	8	12.87	7.70	612.03	252.74	0.28	0.39	8.20	4.10	0.41	0.25	7.45	3.94
Section 4 Grid 134	42	2.91	5.77	3017.00	1101.00	0.15	0.15	14.30	8.00	0.46	0.43	9.29	7.06
Section 4 Grid 147	9	6.74	5.27	1914.87	842.06	0.15	0.15	16.60	15.50	0.60	0.21	18.27	6.45
Section 4 Grid 148	10	2.73	3.64	1647.26	377.28	0.42	0.76	6.50	5.70	0.16	0.17	11.27	8.46
Section 5 Grid 101	14	3.85	5.09	440.85	277.95	1.18	1.07	6.70	5.10	0.25	0.21	7.63	4.68
Section 5 Grid 110	15	4.94	4.58	457.39	236.43	0.61	0.62	8.60	5.30	0.31	0.19	12.52	6.32
Section 5 Grid 74	44	10.72	4.72	805.50	276.80	0.48	0.35	17.80	7.00	1.26	0.33	35.79	5.96
Section 5 Grid 77	43	7.74	6.43	622.50	787.80	0.15	0.15	6.60	5.50	0.35	0.32	4.34	5.54
Section 6 Grid 25	22	1.48	1.25	677.38	365.67	0.69	0.87	9.00	5.10	0.25	0.12	6.64	5.06
Section 6 Grid 42	40	3.26	1.85	538.20	438.30	0.28	0.15	8.60	5.20	0.45	0.19	17.28	4.78
Section 6 Grid 43	24	4.37	7.18	222.75	567.93	0.96	0.91	5.60	7.10	0.10	0.33	3.69	6.85
Section 6 Grid 45	25	7.98	9.53	774.08	463.28	0.15	0.26	8.20	5.30	0.30	0.27	9.66	8.05
Section 6 Grid 50	26	5.26	5.14	558.88	271.68	0.38	0.84	6.60	5.00	0.29	0.13	5.72	5.25
Section 6 Grid 56	27	7.24	6.40	476.59	964.37	0.37	0.15	6.20	9.60	0.27	0.30	8.75	9.42
Section 7 Grid 14	29	4.07	1.47	356.94	430.60	30.40	0.83	4.07	4.10	0.16	0.10	6.26	5.24
Section 7 Venetian	30	38.41	22.69	1444.48	561.37	0.21	0.80	17.20	6.60	1.18	0.57	37.51	7.27
Section 8 Crandon Park	32	3.73	4.23	346.10	206.70	0.15	0.20	2.80	3.90	0.24	0.24	5.86	4.94
Section 8 East KB	33	1.27	1.31	372.30	371.80	0.30	0.35	4.40	2.17	0.20	0.20	4.52	4.57
Section 8 Virginia Key	31	2.20	ns	410.60	ns	0.31	ns	3.70	ns	0.19	ns	5.00	ns

Table 2 cont: Concentrations of Eleven Inorganics in Soils from the Barrier Islands of Miami-Dade County

Sampling Location	Sampling Location ID	Cu (0-1)	Cu (1-2)	Fe (0-1)	Fe (1-2)	Hg (0-1)	Hg (1-2)	Ni (0-1)	Ni (1-2)	Pb (0-1)	Pb (1-2)	Se (0-1)	Se (1-2)	Zn (0-1)	Zn (1-2)
Section 1 Grid 219	1	4.93	2.73	1386.35	1399.15	36.80	21.30	0.94	0.88	4.74	2.29	0.50	0.50	3.92	3.54
Section 1 Grid 233	2	2.93	1.23	1130.09	1056.14	29.30	21.00	0.96	1.21	6.09	3.34	0.50	0.50	28.61	10.18
Section 2 Grid 194	3	6.31	7.31	1285.79	3021.72	28.80	40.90	0.71	1.13	9.69	16.55	0.50	0.50	23.41	89.99
Section 2 Grid 197	4	7.42	2.08	4717.32	1531.33	70.60	43.70	2.66	1.02	7.95	3.26	0.50	0.50	25.76	6.84
Section 3 Grid 168	5	1.63	1.00	402.42	1981.18	11.10	11.10	0.50	0.58	4.36	0.50	0.50	0.50	5.62	1.71
Section 3 Grid 171	6	6.91	1.00	1794.72	1903.38	35.60	12.10	0.61	0.50	32.01	5.33	0.50	0.50	12.27	3.42
Section 4 Grid 122	41	1.00	1.00	3463.00	1611.00	49.70	27.00	0.51	0.58	25.58	5.65	0.50	0.50	10.52	4.13
Section 4 Grid 128	7	6.80	1.00	2276.98	1021.70	76.00	12.20	0.80	0.50	23.22	2.14	0.50	0.50	16.33	3.73
Section 4 Grid 130	8	9.64	1.57	2064.63	1120.63	122.80	25.70	1.01	0.50	38.67	10.26	0.50	0.50	11.56	4.26
Section 4 Grid 134	42	6.54	1.00	6059.00	10047.00	41.10	14.10	2.62	1.87	11.86	0.53	0.50	0.50	52.88	35.42
Section 4 Grid 147	9	15.27	3.82	3885.45	4327.19	64.60	18.70	2.00	0.72	26.86	5.75	0.50	0.50	32.89	16.31
Section 4 Grid 148	10	6.52	3.98	710.44	1833.63	48.30	51.00	0.69	0.50	8.13	5.32	0.50	0.50	12.52	10.33
Section 5 Grid 101	14	13.31	2.69	1083.16	959.23	65.70	18.50	0.63	0.50	6.26	1.08	0.50	0.50	10.80	14.71
Section 5 Grid 110	15	3.68	1.00	1888.18	1290.50	43.30	11.50	0.90	0.50	11.90	1.37	0.50	0.50	13.77	5.34
Section 5 Grid 74	44	17.53	1.00	3052.00	1165.00	206.60	22.30	2.07	0.50	53.04	3.68	0.50	0.50	43.71	8.14
Section 5 Grid 77	43	2.20	1.00	3701.00	6301.00	24.30	10.00	0.76	1.62	10.02	0.50	0.50	0.50	5.87	1.32
Section 6 Grid 25	22	3.65	1.00	1639.04	1277.27	57.90	22.10	1.16	0.50	22.79	2.73	0.50	0.50	24.18	7.30
Section 6 Grid 42	40	2.73	1.00	1941.00	2817.00	37.80	1.00	0.97	0.63	3.42	0.50	0.50	0.50	11.53	1.63
Section 6 Grid 43	24	1.00	2.05	1043.86	2392.41	8.10	20.80	0.50	0.58	1.13	6.14	0.50	0.50	3.29	9.25
Section 6 Grid 45	25	3.09	1.00	2582.80	2045.36	1162.90	370.70	1.06	0.50	16.21	3.06	0.50	0.50	9.96	2.47
Section 6 Grid 50	26	8.44	1.00	2228.88	1419.41	143.00	81.00	0.83	0.50	12.62	3.94	0.50	0.50	11.16	3.88
Section 6 Grid 56	27	1.00	7.02	2071.90	2469.99	11.10	56.40	0.50	0.86	1.25	14.21	0.50	0.50	3.28	23.85
Section 7 Grid 14	29	1.00	19.81	1805.35	1302.19	30.40	1.00	0.50	0.71	13.15	0.50	0.50	0.50	2.13	47.49
Section 7 Venetian	30	19.81	2.67	3216.03	2011.80	61.60	23.50	1.86	0.50	188.16	22.99	0.50	0.50	47.49	38.19
Section 8 Crandon Park	32	1.00	1.00	1653.00	1217.00	15.20	1.00	0.50	0.50	0.95	0.50	0.50	0.50	1.42	3.28
Section 8 East KB	33	1.00	1.00	673.90	876.35	17.60	10.70	0.50	0.72	1.91	0.50	0.50	0.50	2.93	2.17
Section 8 Virginia Key	31	1.00	ns	887.25	ns	1.00	ns	0.78	ns	3.99	ns	0.50	ns	3.01	ns



**SAMPLING LOCATIONS FOR THE
MIAMI DADE COUNTY
BARRIER ISLANDS BACKGROUND
STUDY**