March 24, 2017

Samir Elmir
Environmental Health Director
Miami-Dade County Health Department
1725 NW 167 Street
Floor: 01 Room: 220
Miami, FL 33056

Dear Mr. Elmir:

As requested, we reviewed the Continental Park soil arsenic test results from the Miami-Dade County Department of Regulatory and Economic Resources. We found little risk of non-cancer illness and a very low increased risk of cancer.

If I can be of further assistance, or if you have any questions concerning this evaluation, please do not hesitate to contact me at (850) 245-4444, extension 2316.

Sincerely,

Connie B. Garrett

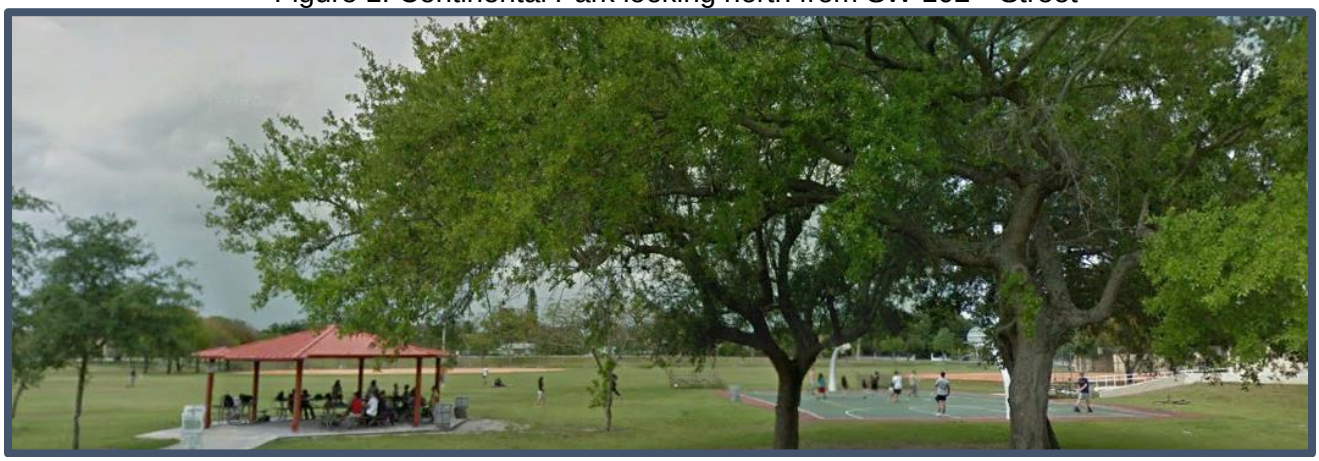
Connie Garrett, M.S., P.G.,
Environmental Specialist III

PURPOSE

The Department of Health (DOH), in Miami-Dade County monitors public health and often answers questions regarding environmental health and safety. Outdoor parks are important shared areas frequented by the public. As with any high use outdoor area, the public can potentially be exposed to environmental contaminants.

Continental Park, at 1000 SW 82nd Ave. Kendall, FL 33156, is in a residential area one-third mile west of U.S. Highway 1. The park includes baseball fields, a basketball court, two picnicking pavilions, 8 tennis courts and an electric substation.

Figure 1. Continental Park looking north from SW 102nd Street



[Google Earth April 2011]

In 2012 the Miami-Dade County Department of Regulatory and Economic Resources (DRER) took one soil sample from Continental Park and analyzed for total arsenic. In late 2014 and early 2015 they tested 49 more soil samples, On February 17, 2017 DOH Miami-Dade sent us the results and requested our review.

DRER found elevated arsenic levels in the soil. The source of arsenic may be historical use of monosodium methanearsonate (MSMA); an organic arsenical herbicide applied to turf grass. Surface soil samples had higher levels than subsurface soil. This is consistent with MSMA herbicide application (Table 1). Currently, MSMA is only approved for use on cotton in certain Florida counties [EPA 2016].

METHODS

Evaluation of Continental Park Data (Table 1)

We estimate the probability of harm for people who may be exposed to arsenic in soil. To do this, we calculate doses based on a plausible exposure scenario which takes into account arsenic concentration, exposure duration, exposure frequency, body weight, and averaging time. We compare these doses to health benchmarks.

We evaluated surface soil samples 0 to 6 inches deep because park visitors are usually only exposed to surface soil. DRER collected samples near the walking path around the park as well as from the clay, dugouts, and outfields of the four baseball fields (Figure 3).

Figure 2. Continental Park Community Center looking west from SW 82nd Ave.

[Google Earth June 2016]

We calculated doses using risk assessment guidance from U.S. Environmental Protection Agency (EPA) and the Agency for Toxic Substances and Disease Registry (ATSDR). We assume people's hand to mouth activities after touching soil leads to incidental ingestion. We used the following inputs and calculations [ATSDR 2005; US EPA 1989].

Values for non-cancer and cancer calculations for soil ingestion exposure

Arsenic concentration	38 mg/kg (highest measured level 116 mg/kg with 33% absorption factor) [Roberts et al./ 2002]
Exposure frequency	250 day/year
Conversion factor	0.000001 kg/mg

Exposure durations, averaging times, body weights, and ingestion rates vary with age (Table 2)

Dose equation

$D = (C)(IR)(EF)(ED)(CF)/(BW)(AT)$

Cancer slope factor

Arsenic cancer slope factor (CSF) 1.5 per mg/kg/

Cancer risk equation

Cancer Risk (unitless) = $(CSF)(CancerD_{by\ age})$

Table 3 shows the non-cancer doses and cancer risks we calculated, by age.

CONCLUSIONS

Non-cancer risks

The estimated arsenic exposure doses for Continental Park users were below ATSDR's chronic minimal risk level and thus not likely to cause non-cancer illness.

Cancer risks

The increased cancer risk for Continental Park users from arsenic in the soil is very low: between 3 and 10 in a million for those younger than 21 and 4 in a million for those older than 21.

UNCERTAINTY

We may have underestimated the risk because soil exposures typically occur in the top two inches of soil and the data we evaluated was for the top six inches.

We may have overestimated the risk because we assumed all of the arsenic was in the more toxic inorganic form. It's likely that the arsenic was in the less-toxic MSMA organic form.

REFERENCES

[ATSDR 2005 Update]. Public Health Assessment Guidance Manual. Appendix G: Calculating Exposure Doses.

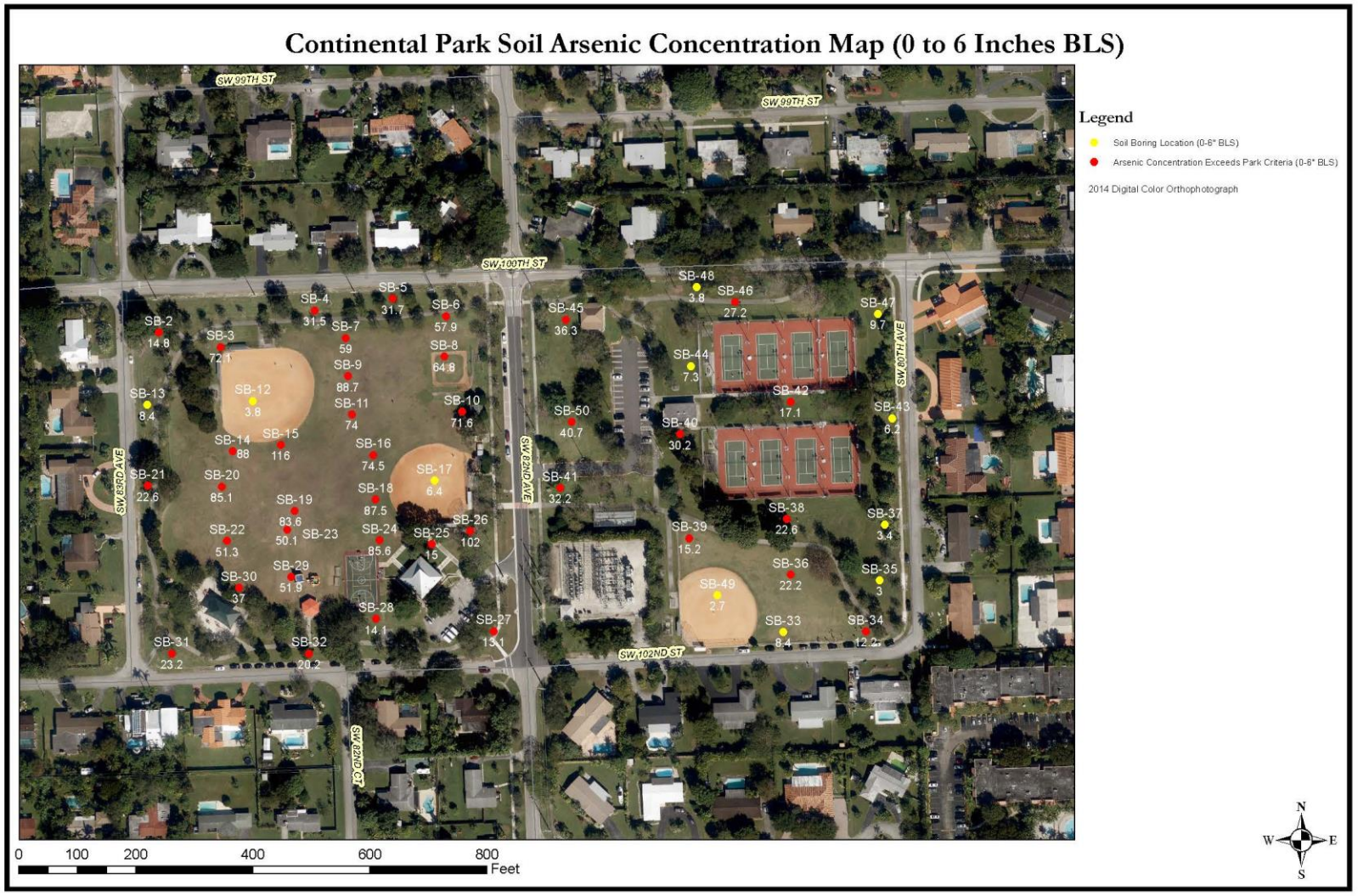
[DRER 2015] Miami-Dade County Department of Regulatory and Economic Resources, arsenic in soil test results from 2012, 2014 and 2015, in table and map form.

[EPA 2016] Monosodium Methanearsonate (MSMA) product registration information https://www.epa.gov/ingredients-used-pesticide-products/monosodium-methanearsonate-msma-organic-arsenical

[Roberts et al. 2002] Stephen M. Roberts, William R. Weimar, J. R. T. Vinson, John W. Munson, Raymond J. Bergeron; Measurement of Arsenic Bioavailability in Soil Using a Primate Model. *Toxicol Sci* 2002; 67 (2): 303-310. doi: 10.1093/toxsci/67.2.303

[US EPA 1989] Risk Assessment Guidance for Superfund Volume 1. Human Health Evaluation Manual (Part A). Interim Final.

Figure 3. Continental Park Soil Arsenic Concentration Map (0 to 6 Inches Below Land Surface)



[DRER 2015]

Table 1, Arsenic Test Results for Continental Park Soil

Continental Park DERM Soil Sample Results - Arsenic

Parameter	Sample Id	SB-1	SB-1	SB-1	SB-1	SB-2	SB-2	SB-2	SB-3	SB-3	SB-3	SB-4	SB-4	SB-4	SB-5	SB-5	SB-5	SB-6	SB-6	SB-6	SB-7	SB-7	SB-7
	Sample	0-6"	6-24"	0-6"	6-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"
	Sample Type	Composite	Composite	Composite	Composite	Discrete	Discrete	N/A	Discrete	Discrete	N/A	Discrete	N/A	N/A	Discrete	Discrete	N/A	Discrete	Discrete	N/A	Discrete	N/A	N/A
	Sample Date	4/19/2012	4/19/2012	12/5/2014	12/5/2014	1/20/2015	1/20/2015	N/A	1/27/2015	1/27/2015	N/A	1/13/2015	N/A	N/A	1/13/2015	1/13/2015	N/A	1/13/2015	1/13/2015	N/A	1/13/2015	N/A	N/A
Arsenic		29.7	10.3	71.2	34.2	14.8	6.1	N/A	72.1	22.4	N/A	31.5	N/A	N/A	31.7 JM1	6.5 d3	N/A	57.9 d3	16.3	N/A	59	N/A	N/A

Parameter	Sample Id	SB-8	SB-8	SB-8	SB-9	SB-9	SB-9	SB-10	SB-10	SB-10	SB-11	SB-11	SB-11	SB-12	SB-12	SB-12	SB-13	SB-13	SB-13	SB-14	SB-14	SB-14
	Sample	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"
	Sample Type	Discrete	Discrete	N/A	Discrete	Discrete	N/A	Discrete	Discrete	Discrete	Discrete	N/A	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete
	Sample Date	1/13/2015	1/13/2015	N/A	1/13/2015	1/13/2015	N/A	1/13/2015	1/13/2015	1/13/2015	1/13/2015	N/A	N/A	1/27/2015	1/27/2015	1/27/2015	1/20/2015	1/20/2015	1/20/2015	1/27/2015	1/27/2015	1/27/2015
Arsenic		64.8	24.4	N/A	88.7	15 d3	N/A	71.6	37.4	20.6 d3	74 D3	N/A	N/A	3.8	4.3	20.7	8.4	15.3	15.6	88	21	8

Parameter	Sample Id	SB-15	SB-15	SB-15	SB-16	SB-16	SB-16	SB-17	SB-17	SB--17	SB-18	SB-18	SB-18	SB-19	SB-19	SB-19	SB-20	SB-20	SB-20	SB-21	SB-21
	Sample	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"
	Sample Type	Discrete	Discrete	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	N/A	Discrete	Discrete
	Sample Date	1/27/2015	1/27/2015	N/A	##2/2015	1/12/2015	N/A	1/12/2015	1/12/2015	1/12/2015	1/12/2015	1/12/2015	N/A	1/23/2015	1/23/2015	1/23/2015	1/27/2015	1/27/2015	N/A	1/20/2015	1/20/2015
Arsenic		**116**	25.1	N/A	74.5	53.7	N/A	6.4	5.1	4	87.5	39 d3	N/A	83.6	44.6	17.5	85.1	65.7	N/A	22.6	8

Parameter	Sample Id	SB-21	SB-22	SB-22	SB-22	SB-23	SB-23	SB-23	SB-24	SB-24	SB-24	SB-25	SB-25	SB-25	SB-26	SB-26	SB-26	SB-27	SB-27	SB-27	SB-28
	Sample	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"
	Sample Type	N/A	Discrete	Discrete	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	N/A	Discrete	N/A	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	N/A	Discrete
	Sample Date	N/A	1/23/2015	1/23/2015	N/A	1/23/2015	1/23/2015	1/23/2015	1/12/2015	1/12/2015	N/A	1/12/2015	N/A	N/A	1/12/2015	1/12/2015	1/12/2015	1/12/2015	1/12/2015	N/A	1/12/2015
Arsenic		N/A	51.3	46.7	N/A	50.1	51.2 c11	44.4	85.6	56.2 JM1	N/A	15	N/A	N/A	102	71	33.2	13.1	6	N/A	14.1

Parameter	Sample Id	SB-28	SB-28	SB-29	SB-29	SB-29	SB-30	SB-30	SB-30	SB-31	SB-31	SB-31	SB-32	SB-32	SB-32	SB-33	SB-33	SB-33	SB-34	SB-34	SB-34
	Sample	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"
	Sample Type	Discrete	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	N/A	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete
	Sample Date	##2/2015	N/A	1/23/2015	1/23/2015	1/23/2015	1/23/2015	1/23/2015	1/23/2015	1/20/2015	1/20/2015	1/20/2015	1/23/2015	1/23/2015	N/A	1/30/2015	1/30/2015	1/30/2015	2/2/2015	2/2/2015	2/2/2015
Arsenic		15.8	N/A	51.9	17.8	30.9	37	21.6	18.3	23.2	9.7	3.9	20.2	9.8	N/A	8.4	3.5	3.7	12.2	22	17.4

Parameter	Sample Id	SB-35	SB-35	SB-35	SB-36	SB-36	SB-36	SB-37	SB-37	SB-37	SB-38	SB-38	SB-38	SB-39	SB-39	SB-39	SB-40	SB-40	SB-40	SB-41	SB-41
	Sample	0-6"	6-12'	12-24"	0-6"	6-12'	12-24"	0-6"	6-12'	12-24"	0-6"	6-12'	12-24"	0-6"	6-12'	12-24"	0-6"	6-12'	12-24"	0-6"	6-12'
	Sample Type	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete	NA	Discrete	Discrete	Discrete	Discrete	Discrete	NA	Discrete	Discrete	Discrete	Discrete	Discrete
	Sample Date	2/2/2015	2/2/2015	2/2/2015	1/30/2015	1/30/2015	1/30/2015	2/2/2015	2/2/2015	NA	1/30/2015	1/30/2015	1/30/2015	1/30/2015	1/30/2015	NA	2/19/2015	2/19/2015	2/19/2015	2/19/2015	2/19/2015
Arsenic		3	1.3	11	22.2	19.4	20.8	3.4	4.7	NA	22.6	20.2	13.3	15.2	13.9	NA	30.2	15.6	17.2	32.2	20

Parameter	Sample Id	SB-41	SB-42	SB-42	SB-42	SB-43	SB-43	SB-43	SB-44	SB-44	SB-44	SB-45	SB-45	SB-45	SB-46	SB-46	SB-46	SB-47	SB-47	SB-47	SB-48
	Sample	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"
	Sample Type	Discrete	Discrete	Discrete	NA	Discrete	Discrete	NA	Discrete	Discrete	Discrete	Discrete	Discrete	NA	Discrete	Discrete	NA	Discrete	Discrete	Discrete	Discrete
	Sample Date	2/19/2015	2/19/2015	#####	NA	2/19/2015	2/19/2015	NA	2/3/2015	2/3/2015	2/3/2015	2/3/2015	2/3/2015	NA	2/3/2015	2/3/2015	NA	2/19/2015	2/19/2015	2/19/2015	2/3/2015
Arsenic		9	17.1	16.4	NA	6.2	5.8	NA	7.3	4.8	2.9	36.3	39.5	NA	27.2	32.6	NA	9.7	13	6.9	3.8

Parameter	Sample Id	SB-48	SB-48	SB-49	SB-49	SB-49	SB-50	SB-50	SB-50
	Sample	6-12"	12-24"	0-6"	6-12"	12-24"	0-6"	6-12"	12-24"
	Sample Type	Discrete	NA	Discrete	Discrete	Discrete	Discrete	Discrete	Discrete
	Sample Date	2/3/2015	NA	2/2/2015	2/2/2015	2/2/2015	2/19/2015	2/19/2015	2/19/2015
Arsenic		4.4	NA	2.7	3.8	4	40.7	20.6	7.7

Results in mg/kg / u- undetected at the Lab MDL / i-conc. between lab MDL and PQL / DS- Sample diluted due to presence of non-target analyte / JM1-Estimated / NA - Note Analyzed

Highest Conc. - 116 mg/kg

[DRER 2015]

Table 2. Estimated doses and increased cancer risks for visitors to Continental Park exposed to arsenic-contaminated soil

Age Group (years)	Body Weight (kg)	Highest Concentration Absorbed (mg/kg)	Estimated Non-cancer Dose (mg/kg/day) CTE	ATSDR MRL Oral Chronic (mg/kg/day)	Estimated Cancer Dose (mg/kg/day) CTE	Oral Cancer Slope Factor $(mg/kg/d)^{-1}$	Estimated Increased Cancer Risk CTE
6 weeks to <1	9.2	38*	2×10^{-4}	3×10^{-4}	2×10^{-6}	1.5	3×10^{-6}
1 to <2	11.4		2×10^{-4}		3×10^{-6}		4×10^{-6}
2 to <6	17.4		1×10^{-4}		8×10^{-6}		1×10^{-5}
6 to <11	31.8		8×10^{-5}		5×10^{-6}		8×10^{-6}
11 to <16	56.8		5×10^{-5}		3×10^{-6}		4×10^{-6}
16 to <21	71.6		4×10^{-5}		2×10^{-6}		4×10^{-6}
≥21	80		2×10^{-6}		3×10^{-6}		4×10^{-6}

***** Because absorption of arsenic from soil in only about one third of arsenic from a liquid, we estimated the maximum soil concentration of 116 mg/kg would result in an equivalent absorbed concentration of 38 mg/kg.
CTE – Central Tendency Exposure, see soil intake assumptions below
mg/kg – milligrams per kilograms
ATSDR MRL – Minimal Risk Level. An estimate of the daily human exposure to a hazardous substance that is not likely to have an appreciable risk of adverse non-cancer health effects over a specified duration of exposure.

Age Groups	**CTE Soil Intake in milligrams per day**
6 weeks to less than 1 year	60
1 year to less than 2 years	100
2 year to less than 6 years	100
6 year to less than 11 years	100
11 year to less than 16 years	100
16 year to less than 21 years	100
Older than 21	50