Health Consultation

KENILWORTH PARK LANDFILL – SOUTH SIDE
NE WASHINGTON, DC

EPA FACILITY ID: DCSFN0305462

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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Prepared by:

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Table of Contents

Introduction

Statement of Issues and Purpose

In October 2002, the District of Columbia Department of Health (DC DOH) asked that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct a public health consultation of the Kenilworth Park Landfill (KPL) site (1). The landfill site is owned by the U. S. Government and administered by the National Park Service (NPS). DC DOH concerns include the fact that NPS intends to reopen the site for recreational use (1) and that chemical concentrations in several environmental media are above U.S. Environmental Protection Agency (EPA) risk-based concentrations for a residential area (2, 3). A January 21, 2003, letter from the Centers for Disease Control and Prevention (CDC) to the DC DOH indicates that ATSDR will consider the request to evaluate Kenilworth Park Landfill (4).

Site Visit

As part of our evaluation of the Kenilworth Park Site, ATSDR met with the DC DOH (5) and the NPS (6) on June 17 and 18, 2003, respectively, to discuss the site. In our meeting NPS requested that because of their pending proposed plans for a junior golf course, we consider the south side of Kenilworth Landfill Park first. Accordingly, this health consultation, which evaluates the landfill, documents our findings and recommendations for the south side of Kenilworth Landfill Park. This health consultation also evaluates current and possible future conditions but not past conditions that were present during waste disposal and open burning. Our evaluation is based on the KPL site being used for recreation—not for residential purposes.

Site Description and History

We compiled the information provided in this health consultation from the Remedial Investigation (RI) report of the Kenilworth Park Landfill. In January 2002, Ecology and Environment, Inc. prepared the RI for the National Park Service.

Kenilworth Park consists of a southern (hereafter referred to as Kenilworth Park South) and a northern area (hereafter referred to as Kenilworth Park North), separated by Watts Branch, a tributary of the Anacostia River (Figure 1). South of the landfill site is a power plant, a waste transfer station, and the River Terrace community. Southeast of the landfill is the Neval H. Thomas Elementary School, east of the landfill is a residential neighborhood, and west is the Anacostia River. Residential property is primarily to the south and east. Kenilworth Aquatic Gardens is north of the landfill. Approximately 22,488 people reside within 1 mile of Kenilworth Landfill South (Figure 1).

Kenilworth Park North is currently being used for soccer and baseball. The District of Columbia Department of Parks and Recreation manages the tennis courts in the northeast section of Kenilworth North, and this section is in the process of transfer to the District. A youth golf facility is under consideration for Kenilworth Park South (7).

During our June 18 site visit, no hazardous debris was noted on the surface of the landfill, and a temporary storm water management system and sediment controls were in place (the most recent changes were to the sedimentation pond near the confluence of the Anacostia River and Watts Branch). A brief historical summary follows.

1937–1940s

In 1937, the United States Army Corps of Engineers dredged the Anacostia River to make the channel both wider and deeper. During this activity the adjoining wetlands were nearly all filled in; the NPS administers the newly created land.

1942–1968

The District used Section G of the land for disposal and burning of municipal waste. The landfill extended directly into the river without any barrier, and landfill wastes mixed with soil entered the water. By the time the Resource Conservation and Recovery Act (RCRA) became law the District Landfill was closed, so the landfill never had a permit.

1968–1970

Sanitary landfill operations were used at Kenilworth to dispose of the District's waste. When the filling was almost complete, the landfill was closed and largely capped (no impermeable cap was used; it is believed that sediment was dredged from the Anacostia River). At completion, the Kenilworth landfill contained around 4 million tons of raw refuse, incinerator ash, and other burned residue, had an average depth of 25 feet, and covered an area of about 145 acres (8). The NPS began to convert the land for use as a park with baseball and softball fields.

1977–1978

A major trunk of sewer (108 inches in diameter) was laid through the southern edge of the park. This sewer empties below sea level.

1980

By May, the park was complete. The site was a grassy area served by a road, with public toilets, a parking lot, and a set of exercise stations around the periphery. The center of the site had a maximum elevation of 28 feet above mean sea level.

1997–1998

New fill was deposited to cover part of the old landfill south of Watts Branch, raising the park surface by as much as 27 feet. The recent fill is in two sections: east (from the Driggs Corporation) and west (from the Barrett Tucker Corporation) of Deane Avenue. The fill was mostly excavation materials and construction debris.

1998

In October, the Environmental Health Division of the District's Department of Health issued a Notice of Violation to NPS regarding the placement of fill with objectionable materials (construction debris) on the site without a permit. The NPS began an investigation of Kenilworth Park South.

1999

NPS modified drainage and graded the west side of the fill—as temporary erosion and runoff control measures—and removed some surface rubble to reduce physical hazards. Later in the year, Driggs Corporation began crushing and sorting concrete, extracting reinforcing wire and rebar and other metal waste, excavating accessible asphalt, and stockpiling material for removal. The NPS contracted for the removal of the stockpiled construction debris.

2002

The area not covered by recent (1997–1998) fill is heavily overgrown. A hedgerow screens the Neval H. Thomas Elementary School from the site. The site is not fully fenced, and pedestrian access is unrestricted. The RI reports approximately 2,000 people live within ½-mile radius of the site.

The NPS prepared a Feasibility Study Report.

2003

ATSDR met with DC DOH and NPS to discuss the site.

Environmental Data and Pathways for the Kenilworth Park South Landfill

In this section, ATSDR evaluates whether community members are currently or will in the future be exposed to harmful levels of chemicals. ATSDR screens the concentrations of contaminants in environmental media (e.g., groundwater or soil) against health-based comparison values (CVs) (refer to text box). Because CVs are not thresholds of toxicity, environmental levels that exceed CVs would not necessarily produce adverse health effects. If a chemical is found in the environment at levels exceeding its corresponding CV, ATSDR further evaluates site-specific exposures and the likelihood of adverse health effects.

About ATSDR's Comparison Values (CVs)

CVs are not thresholds for adverse health effects. ATSDR CVs represent contaminant concentrations many times lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. If contaminant concentrations are above CVs, ATSDR further analyzes exposure variables (for example, duration and frequency of exposure), the toxicology of the contaminant, other epidemiology studies, and the weight of evidence for health effects. Some of the CVs used by ATSDR scientists include:

EMEGs — environmental media evaluation guides

RMEGs — reference dose media evaluation guides,

CREGs — cancer risk evaluation guides, and

MCLs — EPA's maximum contaminant levels

MCLs, EMEGs, RMEGs, and CREGs are nonenforceable, health-based CVs developed by ATSDR for screening environmental contamination for further evaluation. MCLs are enforceable drinking water regulations developed to protect public health.

You can find out more about the ATSDR evaluation process by reading ATSDR's Public Health Assessment Guidance Manual at: http://www.atsdr.cdc.gov/HAC/HAGM/, or contacting ATSDR at 1-888-42ATSDR.

What is meant by exposure?

ATSDR's PHCs are driven by evaluation of the potential for human exposure or contact with environmental contaminants. Chemical contaminants released into the environment have the potential to cause adverse health effects. That said, however, *a release does not always result in human exposure*. People can only be exposed to a contaminant if they come in contact with it—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant.

How does ATSDR determine which exposure situations to evaluate?

ATSDR scientists evaluate site conditions to determine if people are, or could be exposed (i.e., exposed in a current or future scenario) to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, sediment, water, air, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

How does ATSDR decide which contaminants may be present at levels of concern?

If exposure was, is, or could be possible, ATSDR scientists consider whether contamination is present at levels that might affect public health.

ATSDR scientists select contaminants for further evaluation by comparing them against health-based CVs. These are developed by ATSDR from available scientific literature related to exposure and health effects. CVs are derived for each of the different media and reflect an estimated contaminant concentration that is *not likely* to cause adverse health effects for a given chemical, assuming a standard daily contact rate (e.g., an amount of water or soil consumed or an amount of air breathed) and body weight.

Environmental Data

The RI report provided data for surface soil, subsurface soil, groundwater, surface water, and sediment. In most cases, data were collected during a 1998 sampling event, for the 2000 Preliminary Assessment/Site Investigation (PA/SI) (9), and for the 2002 RI. The Landfill Gas Testing Programs at Kenilworth and Oxon Cove Landfills (8) provided data for methane levels in the old landfill in 1979/1980. Moreover, the RI showed that explosive gas levels were detected in wells and drilled boreholes extending to the former District landfill just West of Deane Avenue and in the Northeast section. (3)

Surface Soil

During the 1998 sampling event, 24 surface soil samples at depths less than 3” were analyzed for BNAs (base/neutral acid extractible organics) and metals. In a few locations the new fill area exceeded EPA’s residential soil risk-based concentrations (RBCs) for polycyclic aromatic hydrocarbons (PAHs). Compounds exceeding RBCs are provided in Table 1.

For the 2000 PA/SI, a total of 35 surface soil samples at depths less than 3” were analyzed for PAHs and metals; five samples were also analyzed for polychlorinated biphenyls (PCBs). Compounds exceeding RBCs are provided in Table 1.

For the 2002 RI, surface soil samples were collected from 4 on-site locations and analyzed for PAHs, PCBs, and metals. Nine background samples were also collected from nearby NPS properties and analyzed for PCBs. Sampling depth was not provided. Compounds exceeding ATSDR Substance Comparison values are provided in Table 1.

Table 1: Surface Soil Exceeding Comparison Values

Compound	*Range On-site 1998 Report µg/kg*	*Range On-site 2000 PA/SI µg/kg*	*Range On-site 2002 RI µg/kg*	*Range Background from RI*	*ATSDR Substance Comparison Values µg/kg*
Benzo(a)pyrene	ND – 7700	11.0 – 2950	ND – 509	NA	100[1]
Dibenz(a,h)anthracene	ND – 110	ND – 1470	86.8 – 942	NA	90*
Aroclor 1254	NA	ND – 79.5	ND – 3160	278	1000[2]
Aroclor 1260	NA	30.6 – 83.4	119 – 2510	124 – 194	1000[2]

ND = Not detected
NA = Not analyzed
RBC = Risk based concentration
* = EPA Soil Screening Level
[1] = Chronic Oral CREG Value
[2] = Chronic Oral EMEG Value

In addition, three surface soil samples were collected in the schoolyard at Neval H. Thomas Elementary School. Total PAHs averaged 1770 µg/kg, and benzo(a)pyrene averaged 183.5 µg/kg.

Subsurface Soil

During the 1998 sampling event, eight subsurface soil samples were collected at depths ranging from 8 to 15 feet below ground surface (bgs) and analyzed for BNAs, total petroleum hydrocarbons (TPHs), and metals. Analysis of these former District landfill materials revealed elevated levels of arsenic, lead, cadmium, and PAHs. Information is provided in Table 2.

For the 2000 PA/SI, a total of 49 subsurface soil samples were collected from 22 boreholes. Analysis of the samples indicated PAHs, PCBs, and metals exceeded ATSDR health screening levels (see Table 2).

For the 2002 RI, 14 subsurface soil samples were collected at depths ranging from 1 foot to 12 feet bgs. All samples were analyzed for PAHs, PCBs, and metals. Compounds exceeding ATSDR Substance Comparison values are provided in Table 2.

Table 2: Subsurface Soils Exceeding Comparison Values

Compound	***Range On-site*** ***1998 Report µg/kg***	***Range On-site 2000 PA/SI µg/kg***	***Range On-site*** ***2002 RI µg/kg***	***ATSDR Substance Comparison Values (µg/kg)***
Benzo(a)pyrene	ND – 920	ND – 18000	8.82 – 6250	100 [1]
Benzo(a) anthracene		98.7 – 5860		900 *
Benzo(b)fluoranthene	ND – 980	ND – 16000	9.25 – 6370	90 *
Dibenz(a,h)anthracene	ND	ND – 3400	ND – 791	90 *
Indeno(1,2,3-cd)pyrene	ND – 190	ND – 17000	4.90 – 4110	900 *
Lead	21 – 4300 mg/kg	2.8 – 2500 mg/kg	13.0– 10500 mg/kg	400 mg/kg*

ND = Not detected
* = EPA Soil Screening Level
[1] = Chronic Oral CREG Value

Groundwater

During the 1998 sampling event, eight groundwater samples were analyzed for BNAs, volatile organic compounds (VOCs), TPHs, and metals. The RI reported that the groundwater had high levels of heavy metals, but due to water turbulence the levels were more likely the result of suspended solids rather than dissolved metal ions. VOCs, BNAs other than PAHs, and TPHs were found at low or non-detect levels.

For the 2000 PA/SI, 11 groundwater samples were analyzed for organics, pesticides, PCBs, TPHs, and metals. In May 1999, metals exceeded drinking water standards; but again, the samples had high turbidity and were probably the result of suspended solids.

As reported in the RI, "all of the wells are screened at least partially against the former District wastes, which were repeatedly burned. The resultant ash material is fine grained and has a high metal content… The low flow rates in these wells made it difficult to develop some of these wells enough to yield clear, nonturbid water." Therefore, during sampling in March 2000, each well was sampled twice: once for unfiltered samples and once for filtered samples. None of the wells showed significant levels of metals. Only one unfiltered sample marginally exceeded the MCL for cadmium. Levels of organics were low, and only bis(2-ethylhexyl)phthalate exceeded its MCL in two wells.

For the 2002 RI, 11 samples were collected from previously sampled monitoring wells and analyzed for metals only. Also, two samples and one duplicate sample were collected from two newly constructed monitoring wells and analyzed for organic and inorganic compounds. Compounds exceeding ATSDR Substance Comparison values are provided in Table 3. (Of note, it appears Table 4-7 in the RI was not labeled with the correct units).

Table 3: Metals Exceeding Comparison Values in Groundwater

Compound	*Range On-site 1998 Report µg/L*	*Range On-site 2000 PA/SI µg/L*	*Range On-site 2002 RI µg/L*	*ATSDR Substance Comparison Values µg/L*	*DC Standard µg/L*
Antimony	NP	ND – 53	ND – 14.0	10[1]	N/A
Barium	930 – 27000	ND – 4000	191 – 6880	700[1]	1000
Iron	NP	7300 – 220000	1390 – 92800	300[2]	N/A
Lead	380 – 17000	ND – 2800	ND – 53.4	15[3]	50
Manganese	NP	89 – 4500	38.7 – 3180	500[1]	N/A

DC = District of Columbia
N/A = Not applicable
ND = Not detected
NP = Not provided
[1] = Chronic RMEG Value
2 = EPA's National Secondary Drinking Water Regulation
3 = EPA Action Level

Surface Water

During the 1998 PA/SI sampling, four surface water samples were analyzed for organics and metals (two of the samples were considered background). One of the samples collected in the Anacostia River showed a lead concentration of 12µg/L, although that concentration is, possibly, a reflection of suspended solids. Overall analytical results did not indicate the Kenilworth Park site has affected surface water quality.

No new surface water samples were collected during 2001 RI activities.

Sediment

Also, during the first round of 1998 PA/SI sampling, 14 samples were analyzed for BNAs and TPHs. Sediments collected during the second round of sampling were analyzed for PAHs, PCBs, and metals (Table 4).

During the 2000 sampling event, five sediment samples were analyzed for BNAs, TPHs, pesticides, PCBs, and metals. Sediments around the site contained elevated PAHs and metal levels. Compounds exceeding ATSDR Substance Comparison values are shown in Table 4.

Methane

Between October 22, 1979 and January 17, 1980, probes and test wells were installed at Kenilworth Landfill to evaluate methane gas for heating greenhouses (8). Fifteen test probes and 16 wells were installed in the old landfill at Kenilworth Park. Gas samples were collected at the probe and analyzed by gas chromatography. Levels were found from zero to 98.42 percent by volume. Although no specific gas monitoring was performed during PA/SI or RI/FS activities, for safety purposes explosive gas was monitored during drilling activities. When penetrating the former landfill materials, levels of explosive gases were encountered above 20% of the Lower

Explosive Limit. Still, no explosive gas was detected in breathing zones, or above landfill materials, at levels that would indicate an explosive hazard.

Table 4: Sediment

Compound	***Range 1998 Report µg/kg***	***Range 2000 PA/SI µg/kg***	***ATSDR Substance Comparison Values µg/kg***
Benzo(a)pyrene	310 – 680	ND – 1290	100 [1]
Dibenz(a,h)anthracene	ND – 100	ND – 240	90 *

ND = Not detected

* = EPA

[1] = Chronic Oral CREG Value

Pathways

Exposure pathways are the different ways that contaminants move in the environment and the different ways that people can come into contact with these contaminants—by touching, eating or drinking. When information shows that people have come into contact with a contaminant in soil, air, or water, a completed exposure pathway exists. Completed exposure pathways can occur in the past or in the present.

Surface soil:

> As reported previously, the site is not fully fenced and pedestrian access is unrestricted. The NPS plans to reopen the landfill site as a park. Adults and children playing at the park will have completed an exposure pathway to surface soil. Dermal and incidental ingestion are the routes of exposure. Surface soil concentrations of PAHs, PCBs, and arsenic exceeded ATSDR Substance Comparison Values. (See Table 1.)

Subsurface soil:

> Workers involved with building structures on the property may be exposed to subsurface soil during digging/excavating activities. Dermal and incidental ingestion are the routes of exposure. Subsurface soil concentrations of PAHs, PCBs, and metals exceeded ATSDR Substance Comparison Values. (See Table 2.)

Groundwater:

> According to the PA/SI, at the present time no water supply wells—municipal, commercial, or domestic—can be affected by the landfill site. Accordingly, groundwater can be eliminated as a potential human exposure pathway.

Surface water:

> The Anacostia River is not a source of water for home or commercial use. Also, the RI states that sewer overflow problems prevent swimming in the river; floating trash was listed as a major problem. Limited sampling conducted in 1998 showed that KPL does not affect the water quality of Anacostia River (see Environmental Data and Pathways for the Kenilworth Park South Landfill: *Surface water*). ATSDR determined that the Anacostia River can be eliminated as a potential human exposure pathway. Our conclusion is based on the KPL site

being used as a junior golf course—not as a recreational facility where swimming or fishing occur. Fish advisories from DC DOH are in effect for Anacostia River (http://doh.dc.gov/doh/cwp/view,a,1374,q,584650,dohNav_GID,1837.asp), and signs are posted at KPL cautioning people from fishing or swimming. ATSDR believes this course of action is prudent and will ensure that public health is protected.

Sediment:

See *Surface water*. Swimming and other water activities are not known to occur in the section of the Anacostia River near the site. Therefore, river sediment can be eliminated as a potential human exposure pathway. It is unclear from available documentation, however, whether wading or other such activities could occur in Watts Branch, thereby exposing residents to this sediment. Dermal and incidental ingestion are the routes of exposure. Sediment concentrations of PAHs exceeded ATSDR Substance Comparison Values. (See Table 4.)

Biota:

No data are available. In 1998, through a survey on recreational fishing in the District of Columbia, the Fish & Wildlife Office of DC DOH documented that people consume fish caught in the Anacostia River. In April 2002, people were observed fishing from the banks of the Anacostia River, about 1½ miles downstream from the landfill site. Because of the levels of PCBs, a fish consumption advisory is in effect for fish caught in freshwater rivers and lakes in DC, including the Anacostia River. Specifically, the fish advisory warns the general population against consumption of American eel, catfish, and carp. The fish advisory for DC also warns that all other fish consumed by the general population should be restricted by the size of the fish, by the frequency of fish meals, or by both (information on fish obtained at www.epa.gov/waterscience/fish/).

Off-site data:

No records show that off-site soil samples were collected from residential areas to the east of the landfill property. The RI reports problems in the past with erosion and run-off. It also reports that the recent fill is poorly vegetated, and that the steep slopes around the edges of the fill favor erosion. Although the current drainage directs runoff and storm water to ditches and silt ponds, whether in the past off-site areas could have been affected by the site is unclear.

Physical Hazards:

In several places the RI report mentions physical hazards, but these hazards are not clearly spelled out. The potential exists for harm to human health from physical hazards. Some of these physical hazards include construction debris that may be exposed during soil excavation.

Methane:

During digging/excavating activities, workers on the property may be exposed to explosive levels of methane. If a new cap prevents upward migration of gases, residents in the area may be potentially exposed to methane and other gases due to lateral migration. Methane presents two threats to people: explosion and asphyxiation.

Child Health Considerations

ATSDR recognizes that in communities with contamination in water, soil, air, or food, infants and children may be more sensitive to exposures than are adults. This sensitivity is the result of a number of factors. Children are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. Most children are shorter than adults, which means children breathe dust, soil, and heavy vapors close to the ground. Children are also smaller, potentially resulting in higher doses of chemical exposure per unit body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and for management decisions, housing decisions, and access to medical care. Therefore, as part of the ATSDR Child Health Initiative, ATSDR is committed to evaluating childrens' special interests at sites such as the Kenilworth Landfill.

Like other people who play, live, and work at or near Kenilworth Landfill, children may contact contaminated soils or sediments as well as other media (e.g., air and water). As discussed in the Environmental Data and Pathways section of this PHC, current and future exposures for children could include contact with contaminated soils or sediments in recreational areas or other areas where children may play, resulting in ingestion of contaminated foods or non-food items (e.g., dirt), or resulting in breathing contaminated air.

To evaluate whether children may experience adverse health affects through current or future exposures to site contaminants, ATSDR estimated the potential doses for children. To estimate these doses, ATSDR used health-protective assumptions that likely overestimate the levels of actual exposure. The assumptions used and the estimated doses are found in Appendices C and D.

NPS plans to eliminate contact with soil at Kenilworth Park Landfill South by regrading and capping the landfill. This should eliminate any pathways of concern and prevent children from coming in contact with contaminated soils. ATSDR believes that NPS actions are prudent and will ensure that the public health and childrens' welfare are both protected.

Discussion of Potential Public Health Issues

ATSDR has reviewed the data from the 1998 report, the 2000 PA/SI, and the 2002 RI. We found that PCBs, PAHs, and metals at levels above ATSDR Substance Comparison values for soil, subsurface soil and sediments present a potential exposure. Nevertheless, while building the junior golf course NPS plans to eliminate contact with soil by regrading and capping the area. Because this should prevent contact with soil contamination in the future, such a course of action is prudent and protective of public health.

Because data are not available, ATSDR does not address past exposure pathways or past health related issues. Still, the 25+ yrs of burning/ash disposal has in all likelihood led to exposures of those who resided near the landfill and of employees working at Kenilworth Park Landfill.

One of our concerns from the June 13, 2003, site visit was the proximity of Neval H. Thomas Elementary School and the school's use of 200+ feet of NPS property as a recreational area. Moreover, the frequent accessibility that students currently have to the landfill may become a problem during construction of the golf course. That will be an issue that NPS will have to address to prevent the students from contacting soil contaminants.

NPS stated that Eastland Paradise Garden Apartments—the closest community to Kenilworth Park Landfill—has not raised any public health questions to ATSDR or to other government health agencies. Therefore, any community health concerns from potential environmental exposures to this community are presently unknown (6).

Another concern is that the new fill could contribute to an increase in methane levels; in other words, disturbance of old fill could release methane (10).

Compounds of Concern

Polychlorinated Biphenyls

The daily estimated exposure for all exposed persons (i.e., workers, adults, and children) does not exceed the chronic minimum risk level (MRL) of .00002 mg/kg/day (11). Hence, exposure of these groups to PCB-contaminated soil at the landfill area is not of public health concern and is not likely to result in adverse non-cancerous health effects. ATSDR looked further at site-specific exposures for Kenilworth Park by adjusting the exposure dose parameters (Appendix D). We found that even if exposure occurs, exposure to soil contaminants would not be at levels of public health concern for cancerous or non-cancerous health effects.

Polycyclic Aromatic Hydrocarbons

As previously stated, although no potential exposure to soil contaminants threatens adults and children using the golf course, ATSDR compared screening levels and site-specific contaminant levels for subsurface soils. Although workers may be exposed to subsurface soil during digging/excavating activities, a site-specific exposure model (Appendix D) shows that the levels of exposure are not of public health concern.

Safe limits for exposure to PAHs by ingestion have not been established. Still, people exposed to PAHs in non-occupational settings have not experienced noncancerous health effects (12). Some of the health effects that have been seen in workers exposed to substances that contain PAHs are chronic dermatitis and hyperkeratosis. But those exposures were at much greater concentrations than those expected from landfill area. Hence, exposure to the concentrations of PAHs in soil at the landfill area is not expected to result in adverse noncancerous health effects in adults or children.

Methane

Methane is a colorless and odorless, naturally occurring gas. Landfills are the largest source of methane emissions generated in the United States. Methane is produced in landfills by the process of anaerobic digestion of organic solid waste. Uncontrolled landfill gas can migrate through soil as far as 1500 feet from the landfill boundary (13). Migration and accumulation of methane in the landfill can cause both an explosion and asphyxiation hazard to construction and utility workers and to occupants of neighboring buildings. Methane gas was tested in July of 1980 and in its Feasibility Study NPS plans to place a 1-foot thick soil cap over much of the landfill area. Soil gas tends to migrate from areas of high pressure/concentration to areas of low pressure/concentration through paths of lesser resistance (14). Upward migration of gas could be hindered by an impermeable or possibly semi-permeable cap; therefore, the composition of the cap must be taken into account to prevent any lateral migration that could affect the school and the surrounding community.

ATSDR is concerned about potential public health hazards resulting from explosion and exposure issues associated with methane and other landfill gases at Kenilworth Park Landfill because

1. New fill may contribute to formation of methane—some of the typical construction and demolition debris constituents/components are organic;
2. Gas migration pathways may be altered by construction activities and the new fill, all of which could potentially result in explosive concentrations of methane in nearby structures; and
3. Construction and remediation workers could be injured by unknowingly digging into soil containing high levels of methane.

Conclusions

ATSDR determined that Kenilworth Park Landfill South does not pose a public health hazard when, as proposed by NPS, it is used as a youth golf facility. Our evaluation is based on the Kenilworth Park landfill South site being safe for recreational, not residential, use. Moreover, we assume that land use restrictions will prevent groundwater from becoming a source of residential or commercial water.

Because, however, little information on methane sampling is available, the potential exists for lateral migration. Thus for methane gases Kenilworth Park Landfill South is an indeterminate public health hazard. Capping the landfill will eliminate exposure to persons using the golf course. Migration and accumulation of methane in the landfill during renovation and capping of landfill can, however, cause both an explosive and asphyxiation hazard to construction and utility workers, and potentially to occupants of neighboring buildings.

NPS plans to eliminate contact with soil and waste by capping the landfill. ATSDR believes this course of action is prudent and will ensure that public health is protected.

Chemical contamination from Kenilworth Park Landfill South does not pose a present or future public health hazard to adjacent communities such as Eastland Paradise Gardens.

The boundaries of the landfill—Kenilworth landfill North and landfill South—are not clearly delineated. ATSDR determined that this presents an indeterminate public health hazard because of the proximity of the elementary school to the NPS property and the limited sampling conducted in the 200+ yards of NPS property that the elementary school is using. For example, only three samples were taken from this area for the PA/SI.

Recommendations

ATSDR recommends that

- to prevent potential exposure of students to surface soils that may contain harmful contaminants, NPS restrict access of Neval H. Thomas Elementary students to NPS property.
- to ensure no contamination from the landfill affects the surrounding communities, more testing be done along the property boundaries during and after landfill renovations.

- additional testing on the 200+ yards of NPS property that the elementary school is using to determine if there are high levels of PCBs, PAHs, and metals.
- NPS provide preventive methods for accidental exposure during capping of soil, (e.g., dust suppression methods).
- during and after landfill renovation and placement of a new cap, monitor for methane gas on the landfill, along the perimeters of the landfill near Thomas Elementary, and in the residential area to the East (Eastland Paradise Garden).

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Figure 1: Demographic Intro Map

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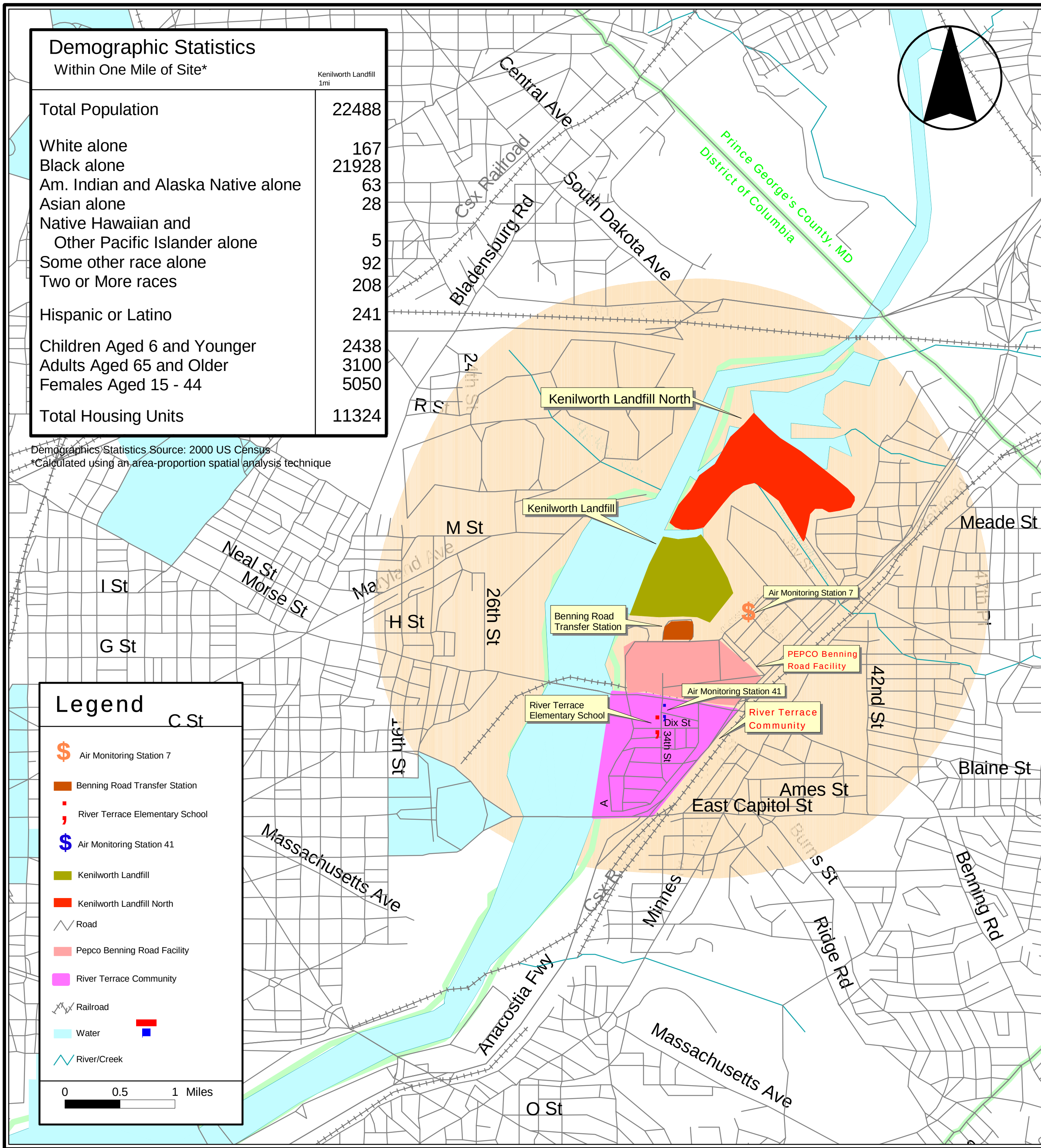

Kenilworth Landfill

Washington, DC

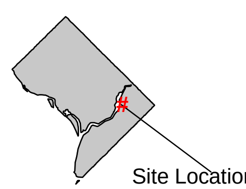

FIGURE 1: VICINITY MAP

District of Columbia

Base Map Source: 1995 TIGER/Line Files

JVA091003

Appendix A. Screening Analysis

Adult Screening Levels						
SURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	0.509	0.0001	1	1	70	**7.27143E-07**
Dibenzo(a,h)anthracene	0.942	0.0001	1	1	70	**1.34571E-06**
Σ PAHs	1.451	0.0001	1	1	70	**2.07286E-06**
Aroclor 1254	3.16	0.0001	1	1	70	**4.51429E-06**
Aroclor 1260	2.51	0.0001	1	1	70	**3.58571E-06**
Σ PCBs	5.67	0.0001	1	1	70	**0.0000081**
	Cancer Risk					
Compound	**TEF**	**TEQ**	**CSF**	**CR**		
Benzo(a)pyrene	1	7.27143E-07	7.3	**5.31E-06**		
Dibenzo(a,h)anthracene	1	1.34571E-06	7.3	**9.82E-06**		
Σ PAHs	1	2.07286E-06	7.3	**1.51E-05**		
Aroclor 1254		4.51429E-06	2	**9.03E-06**		
Aroclor 1260		3.58571E-06	2	**7.17E-06**		
Σ PCBs		0.0000081	2	**1.62E-05**		
SUBSURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	6.25	0.0001	1	1	70	**8.92857E-06**
Benzo(b)fluoranthene	6.37	0.0001	1	1	70	**0.0000091**
Dibenzo(a,h)anthracene	0.791	0.0001	1	1	70	**0.00000113**

Indeno(1,2,3-cd)pyrene	4.11	0.0001	1	1	70	**5.87143E-06**
Σ PAHs	17.521	0.0001	1	1	70	**0.00002503**
	Cancer Risk					
Compound	**TEF**	**TEQ**	**CSF**	**CR**		
Benzo(a)pyrene	1	8.92857E-06	7.3	**6.52E-05**		
Benzo(b)fluoranthene	0.1	0.00000091	7.3	**6.64E-06**		
Dibenzo(a,h)anthracene	1	0.00000113	7.3	**8.25E-06**		
Indeno(1,2,3-cd)pyrene	0.1	5.87143E-07	7.3	**4.29E-06**		
Σ PAHs		1.15557E-05	7.3	**8.44E-05**		
SEDIMENT						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	1.29	0.0001	1	1	70	**1.84286E-06**
Dibenzo(a,h)anthracene	0.24	0.0001	1	1	70	**3.42857E-07**
Σ PAHs	1.53	0.0001	1	1	70	**2.18571E-06**
	Cancer Risk					
Compound	**TEF**	**TEQ**	**CSF**	**CR**		
Benzo(a)pyrene	1	1.84286E-06	7.3	**1.35E-05**		
Dibenzo(a,h)anthracene	1	3.42857E-07	7.3	**2.5E-06**		
Σ PAHs		2.18571E-06	7.3	**1.6E-05**		

Child Screening Levels						
SURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	0.509	0.0002	1	1	30	**3.39333E-06**
Dibenzo(a,h)anthracene	0.942	0.0002	1	1	30	**0.00000628**
Σ PAHs	1.451	0.0002	1	1	30	**9.67333E-06**
Aroclor 1254	3.16	0.0002	1	1	30	**2.10667E-05**
Aroclor 1260	2.51	0.0002	1	1	30	**1.67333E-05**
Σ PCBs	5.67	0.0002	1	1	30	**0.0000378**
	Cancer Risk					
Compound	**TEF**	**TEQ**	**CSF**	**CR**		
Benzo(a)pyrene	1	3.39333E-06	7.3	**2.48E-05**		
Dibenzo(a,h)anthracene	1	0.00000628	7.3	**4.58E-05**		
Σ PAHs	1	9.67333E-06	7.3	**7.06E-05**		
Aroclor 1254		2.10667E-05	2	**4.21E-05**		
Aroclor 1260		1.67333E-05	2	**3.35E-05**		
Σ PCBs		0.0000378	2	**7.56E-05**		
SUBSURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	6.25	0.0002	1	1	30	**4.16667E-05**
Benzo(b)fluoranthene	6.37	0.0002	1	1	30	**4.24667E-05**
Dibenzo(a,h)anthracene	0.791	0.0002	1	1	30	**5.27333E-06**

Indeno(1,2,3-cd)pyrene	4.11	0.0002	1	1	30	**0.0000274**
Σ PAHs	17.521	0.0002	1	1	30	**0.000116807**
	Cancer Risk					
Compound	**TEF**	**TEQ**	**CSF**	**CR**		
Benzo(a)pyrene	1	4.16667E-05	7.3	**0.000304**		
Benzo(b)fluoranthene	0.1	4.24667E-06	7.3	**3.1E-05**		
Dibenzo(a,h)anthracene	1	5.27333E-06	7.3	**3.85E-05**		
Indeno(1,2,3-cd)pyrene	0.1	0.00000274	7.3	**2E-05**		
Σ PAHs		5.39267E-05	7.3	**0.000394**		
<u>SEDIMENT</u>						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	1.29	0.0002	1	1	30	0.0000086
Dibenzo(a,h)anthracene	0.24	0.0002	1	1	30	0.0000016
Σ PAHs	1.53	0.0002	1	1	30	0.0000102
	Cancer Risk					
Compound	**TEF**	**TEQ**	**CSF**	**CR**		
Benzo(a)pyrene	1	0.0000086	7.3	**6.28E-05**		
Dibenzo(a,h)anthracene	1	0.0000016	7.3	**1.17E-05**		
Σ PAHs		0.0000102	7.3	**7.45E-05**		

Appendix B. Site-Specific Analysis

Worker Site-Specific Data						
SURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	0.509	0.0001	0.038	1	70	**2.76314E-08**
Dibenzo(a,h)anthracene	0.942	0.0001	0.038	1	70	**5.11371E-08**
Σ PAHs	1.451	0.0001	0.038	1	70	**7.87686E-08**
Aroclor 1254	3.16	0.0001	0.038	1	70	**1.71543E-07**
Aroclor 1260	2.51	0.0001	0.038	1	70	**1.36257E-07**
Σ PCBs	5.67	0.0001	0.038	1	70	**3.078E-07**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	2.76314E-08	7.3	**2.02E-07**	0.04	6.90786E-07
Dibenzo(a,h)anthracene	1	5.11371E-08	7.3	**3.73E-07**	0.04	1.27843E-06
Σ PAHs	**1**	7.87686E-08	7.3	**5.75E-07**	0.04	1.96921E-06
Aroclor 1254		1.71543E-07	2	**3.43E-07**	0.00002	0.008577143
Aroclor 1260		1.36257E-07	2	**2.73E-07**	0.00002	0.006812857
Σ PCBs		3.078E-07	2	**6.16E-07**	0.00002	0.01539
SUBSURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	6.25	0.0001	0.038	1	70	**3.39286E-07**
Benzo(b)fluoranthene	6.37	0.0001	0.038	1	70	**3.458E-07**
Dibenzo(a,h)anthracene	0.791	0.0001	0.038	1	70	**4.294E-08**

Indeno(1,2,3-cd)pyrene	4.11	0.0001	0.038	1	70	**2.23114E-07**
Σ PAHs	17.521	0.0001	0.038	1	70	**9.5114E-07**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	3.39286E-07	7.3	**2.48E-06**	0.04	8.48214E-06
Benzo(b)fluoranthene	0.1	3.458E-08	7.3	**2.52E-07**	0.04	0.000008645
Dibenzo(a,h)anthracene	1	4.294E-08	7.3	**3.13E-07**	0.04	1.0735E-06
Indeno(1,2,3-cd)pyrene	0.1	2.23114E-08	7.3	**1.63E-07**	0.04	5.57786E-06
Σ PAHs		4.39117E-07	7.3	**3.21E-06**	0.04	2.37785E-05
SEDIMENT						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	1.29	0.0001	0.038	1	70	**7.00286E-08**
Dibenzo(a,h)anthracene	0.24	0.0001	0.038	1	70	**1.30286E-08**
Σ PAHs	1.53	0.0001	0.038	1	70	**8.30571E-08**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	7.00286E-08	7.3	**5.11E-07**	0.04	**1.75071E-06**
Dibenzo(a,h)anthracene	1	1.30286E-08	7.3	**9.51E-08**	0.04	**3.25714E-07**
Σ PAHs		**8.30571E-08**	**7.3**	6.06E-07	**0.04**	**2.07643E-06**

Adult Site-Specific Data						
SURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	0.509	0.0001	0.344	1	70	**2.50137E-07**
Dibenzo(a,h)anthracene	0.942	0.0001	0.344	1	70	**4.62926E-07**
Σ PAHs	1.451	0.0001	0.344	1	70	**7.13063E-07**
Aroclor 1254	3.16	0.0001	0.344	1	70	**1.55291E-06**
Aroclor 1260	2.51	0.0001	0.344	1	70	**1.23349E-06**
Σ PCBs	5.67	0.0001	0.344	1	70	**2.7864E-06**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	2.50137E-07	7.3	**1.826E-06**	0.04	6.25343E-06
Dibenzo(a,h)anthracene	1	4.62926E-07	7.3	**3.37936E-06**	0.04	1.15731E-05
Σ PAHs	1	7.13063E-07	7.3	**5.20536E-06**	0.04	1.78266E-05
Aroclor 1254		1.55291E-06	2	**3.10583E-06**	0.00002	0.077645714
Aroclor 1260		1.23349E-06	2	**2.46697E-06**	0.00002	0.061674286
Σ PCBs		2.7864E-06	2	**5.5728E-06**	0.00002	0.13932
SUBSURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	6.25	0.0001	0.344	1	70	**3.07143E-06**
Benzo(b)fluoranthene	6.37	0.0001	0.344	1	70	**3.1304E-06**
Dibenzo(a,h)anthracene	0.791	0.0001	0.344	1	70	**3.8872E-07**

Indeno(1,2,3-cd)pyrene	4.11	0.0001	0.344	1	70	**2.01977E-06**
Σ PAHs	17.521	0.0001	0.344	1	70	**8.61032E-06**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	3.07143E-06	7.3	**2.24214E-05**	0.04	7.67857E-05
Benzo(b)fluoranthene	0.1	3.1304E-07	7.3	**2.28519E-06**	0.04	0.00007826
Dibenzo(a,h)anthracene	1	3.8872E-07	7.3	**2.83766E-06**	0.04	0.000009718
Indeno(1,2,3-cd)pyrene	0.1	2.01977E-07	7.3	**1.47443E-06**	0.04	5.04943E-05
Σ PAHs		3.97517E-06	7.3	**2.90187E-05**	0.04	0.000215258
SEDIMENT						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	1.29	0.0001	0.344	1	70	**6.33943E-07**
Dibenzo(a,h)anthracene	0.24	0.0001	0.344	1	70	**1.17943E-07**
Σ PAHs	1.53	0.0001	0.344	1	70	**7.51886E-07**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	6.33943E-07	7.3	**4.62778E-06**	0.04	1.58486E-05
Dibenzo(a,h)anthracene	1	1.17943E-07	7.3	**8.60983E-07**	0.04	2.94857E-06
Σ PAHs		7.51886E-07	7.3	**5.48877E-06**	0.04	1.87971E-05

Child Site-Specific Data						
SURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	0.509	0.0002	0.089	1	30	**3.02007E-07**
Dibenzo(a,h)anthracene	0.942	0.0002	0.089	1	30	**5.5892E-07**
Σ PAHs	1.451	0.0002	0.089	1	30	**8.60927E-07**
Aroclor 1254	3.16	0.0002	0.089	1	30	**1.87493E-06**
Aroclor 1260	2.51	0.0002	0.089	1	30	**1.48927E-06**
Σ PCBs	5.67	0.0002	0.089	1	30	**3.3642E-06**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	3.02007E-07	7.3	**2.2E-06**	0.04	7.55017E-06
Dibenzo(a,h)anthracene	1	5.5892E-07	7.3	**4.08E-06**	0.04	0.000013973
Σ PAHs	1	8.60927E-07	7.3	**6.28E-06**	0.04	2.15232E-05
Aroclor 1254		1.87493E-06	2	**3.75E-06**	0.00002	0.093746667
Aroclor 1260		1.48927E-06	2	**2.98E-06**	0.00002	0.074463333
Σ PCBs		3.3642E-06	2	**6.73E-06**	0.00002	0.16821
SUBSURFACE SOIL						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	6.25	0.0002	0.089	1	30	**3.70833E-06**
Benzo(b)fluoranthene	6.37	0.0002	0.089	1	30	**3.77953E-06**
Dibenzo(a,h)anthracene	0.791	0.0002	0.089	1	30	**4.69327E-07**

Indeno(1,2,3-cd)pyrene	4.11	0.0002	0.089	1	30	**2.4386E-06**
Σ PAHs	17.521	0.0002	0.089	1	30	**1.03958E-05**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	3.70833E-06	7.3	**2.71E-05**	0.04	9.27083E-05
Benzo(b)fluoranthene	0.1	3.77953E-07	7.3	**2.76E-06**	0.04	9.44883E-05
Dibenzo(a,h)anthracene	1	4.69327E-07	7.3	**3.43E-06**	0.04	1.17332E-05
Indeno(1,2,3-cd)pyrene	0.1	2.4386E-07	7.3	**1.78E-06**	0.04	0.000060965
Σ PAHs		4.79947E-06	7.3	**3.5E-05**	0.04	0.000259895
SEDIMENT						
Compound	**C**	**IR (kg,day)**	**EF**	**AF**	**BW**	**ED mg/kg/day**
Benzo(a)pyrene	1.29	0.0002	0.089	1	30	**7.654E-07**
Dibenzo(a,h)anthracene	0.24	0.0002	0.089	1	30	**1.424E-07**
Σ PAHs	1.53	0.0002	0.089	1	30	**9.078E-07**
	Cancer Risk				**RME =**	**ED*MRL**
Compound	**TEF**	**TEQ**	**CSF**	**CR**	**MRL**	**REM**
Benzo(a)pyrene	1	7.654E-07	7.3	**5.59E-06**	0.04	0.000019135
Dibenzo(a,h)anthracene	1	1.424E-07	7.3	**1.04E-06**	0.04	0.00000356
Σ PAHs		9.078E-07	7.3	**6.63E-06**	0.04	0.000022695

Appendix C. Comparison of Exposure Doses to Health Guidelines

SURFACE SOILS					
	ED (mg/kg/day)		MRL	NOAEL	LOAEL
	Adult	Child	mg/kg/day	mg/kg/day	mg/kg/day
Aroclor 1254	4.5x10-6	6.32x10-5	.00002		.005
Aroclor 1260	3.58x10-6	5.02x10-5	.00002		.005
Σ PCBs	1.62x10-5	1.134x10-4	.00002		.005
Benzo(a)pyrene	7.3x10-7	1.02x10-5	.04	90	125
Dibenz(a,h)anthracene	1.34x10-6	1.88x10-5	.04	100	125
Σ PAHs	2.07x10-6	2.9x10-5	.04	90	125

SUBSURFACE SOILS					
	ED (mg/kg/day)		MRL	NOAEL	LOAEL
	Adult	Child	mg/kg/day	mg/kg/day	mg/kg/day
Benzo(a)pyrene	2.57x10-5	3.6x10-4	.04	90	125
Benzo(a) anthracene	8.92x10-6	1.17x10-4	.04	100	125
Benzo(b)fluoranthene	9.1x10-6	1.27x10-5	.04	90	125
Dibenzo(a,h)anthracene	1.13x10-6	1.58x10-5	.04	100	125
Indeno(1,2,3-cd)pyrene	5.87x10-6	8.22x10-5	.04	90	125
Σ PAHs	2.5x10-5	3.5x10-4	.04	90	125
Lead	.015	.21		.001 A	.1

SEDIMENT					
	ED (mg/kg/day)		**MRL**	**NOAEL**	**LOAEL**
	Adult	Child		mg/kg/day	mg/kg/day
Benzo(a)pyrene	1.84x10-6	2.58x10-5	.04	90	125
Benzo(a) anthracene	3.42x10-7	4.8x10-6	.04	88	125
Σ PAHs	2.18x10-6	3.06x10-5	.04	90	

Appendix D. Exposure Dose Methods

Site-Specific

On our first initial screen we assumed that the parameters of the exposure dose formula represented the worst case scenario, given

$$ED = C \times IR \times EF \times \frac{AF}{BW}$$

Where

ED = Exposure Dose; at its maximum,

C = Contaminant Concentration; 95% Upper CI,

EF = Exposure Factor, the frequency and duration of exposure;

AF = Absorption Factor: the percentage of the chemical ingested that actually makes it into the bloodstream; and

BW= Body Weight in kilograms (kg), using ATSDR defaults of 70kg for adult and 10kg for children.

We compared the exposure doses obtained from health guidelines (MRL, LOAEL, NOAEL) (Appendix C); we screened out contaminants, non-carcinogenic effects, or age groups. Once we found contaminants that may be of concern, we repeated the same procedures using site-specific exposure doses (Appendix B). In this case we changed the EF parameters as follows:

Adult: 0.603*0.571 = .344

220 days of exposure – frequency of exposure for 11 months times 5 days a week assuming that winter weather may impede persons for playing and/or working at the golf course. 220/365= 0.603

40 year exposure – maximum amount of exposure that an adult may spend at the golf course throughout his/her lifetime. 40/70 = 0.571

Worker: 0.54* 0.71

200 days of exposure - frequency of exposure for 10 months times 5 days a week assuming that winter weather may impede work at the golf course. 200/365= 0.54

5 year exposure – time that it would take to build the golf course; this is still a conservative number. 5/70 = .038

Child: 0.394*0.089

144 days of exposure - frequency of exposure for 12 months times 3 days a week assuming that winter weather may impede play at the golf course. 144/365= 0.089

16 year exposure – based on assumption that a child/teenager will play at the course for an average of 16 yrs until the child comes close to the age 21 and move on to a senior course. 16/70 = 0.228

Furthermore, when analyzing exposure dose of the PAHs and PCBs, we used the sum of them from each category – surface soil, sub-surface soil, and sediment – to further increase their effect. Although it is not representative of real life, most of these chemicals are found together in soil but do not act together to cause an additive effect—we used this method to demonstrate that there is no apparent exposure at the site.