Health Consultation

Public Health Implications of Ambient Naphthalene Exposure

QUANTA RESOURCES

EDGEWATER, NEW JERSEY

EPA FACILITY ID: NJD000606442

Prepared by the
New Jersey Department of Health

March 20, 2019

Prepared under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner 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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QUANTA RESOURCES SUPERFUND SITE

BERGEN COUNTY, NEW JERSEY

EPA FACILITY ID: NJD000606442

Prepared by the
New Jersey Department of Health
Environmental and Occupational Health Surveillance Program
under a Cooperative Agreement with the
U.S. Department of Health and Human Services
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Summary

Introduction On January 11, 2001, the U.S. Environmental Protection Agency (USEPA) proposed to add the Quanta Resources Corporation site, Edgewater, Bergen County, New Jersey, to the National Priorities List (NPL). USEPA added the site to the NPL on September 5, 2002. Manufacturing activities at the Quanta and adjacent properties and uncontrolled release of hazardous wastes have resulted in the contamination of soil and groundwater. At this site, various companies produced coal tar, paving and roofing materials for more than 100 years, leaving behind gross contamination of the property. The major contaminants associated with the site are polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals. ATSDR and NJDOH released a Public Health Assessment (PHA) based on limited data available in 2002, but a complete evaluation could not be conducted since on- and off- site data were unavailable at that time. Another PHA was released for public comment in 2015 and finalized in 2018. Remediation work at the Quanta site first commenced in April 2017 and numerous odor complaints associated with site remediation activities have been reported by the community adjacent to the site. Community members asked NJDOH if exposures to the odors in the ambient air around the site are a threat to human health.

This health consultation summarizes NJDOH's evaluation of air sampling data (from the period July 2017 to May 2018) and potential naphthalene exposures resulting from remediation activities at the Quanta site. Recommendations based on short- and long-term (acute and chronic) exposures to naphthalene are included. The top priority of ATSDR and NJDOH at this site is protect public health and ensure that the community around the site has the best information possible to safeguard its health.

Conclusions The NJDOH has reached three conclusions in this report:

Conclusion 1 *Before the USEPA made changes to the remediation schedule/work practices at the site in mid-March 2018, exposure to ambient air concentrations of naphthalene released from the site were high enough to potentially cause harmful short-term (acute) health effects in community members.*

Basis for Conclusion	Site perimeter SUMMA canister concentrations averaged over the working day (from July 18, 2017 to March 18, 2018) indicate that peak exposures (as high as 1000 $\mu g/m^3$) on some days were considerably higher than the ATSDR health-based screening value for acute health impacts (60 $\mu g/m^3$). This suggests that the hourly maximum concentrations could have exceeded a range of inhalation exposure ($\geq$500 $\mu g/m^3$) that has been identified with damage to the nasal epithelium, which is the lining of the nasal cavities. Therefore, on those days when there were detections above 500 $\mu g/m^3$, there was a potential health risk to area residents from exposure to maximum peak concentrations of naphthalene at the site perimeter fence. Additionally, qualitative review of data from perimeter real time total volatile organic compounds (TVOC) monitors indicate that there were some 15-minute readings (adjusted for naphthalene proportion) that were consistently above ATSDR's acute screening level of 60 $\mu g/m^3$ and were present at concentrations at which respiratory effects have been noted in animal studies. Residents in the surrounding areas have complained about the odors emanating from the Quanta site. Peak naphthalene concentrations could have potentially caused respiratory irritation, exacerbation of pre-existing respiratory conditions, and/or irritation of the nasal passage and airways of exposed individuals. Some individuals may have experienced adverse reactions to odor, and at times naphthalene was present at concentrations easily detected by the human nose. Residents exposed to strong naphthalene odors in this community may have experienced a reduced quality of life, and non-life-threatening symptoms such as fatigue, headache, and nausea.

Conclusion 2	*After the USEPA made changes to the remediation schedule/work practices at the site, short-term concentrations of naphthalene were greatly reduced and are much less likely to cause harmful health effects.*

Basis for Conclusion	Since work practices changed on March 16, 2018 to address the odor complaints, 88 percent of the measured daily averages were below the ATSDR health-based screening value for acute health impacts. There were no reported values that exceeded levels associated with health effects ($\geq$500 $\mu g/m^3$). It is to be noted that real time naphthalene specific monitoring results are needed to verify this conclusion. If these amended work practices and other associated measures remain in place, short-term health effects associated with acute exposures to naphthalene are not expected.

Conclusion 3	*Long-term health effects are not expected from the measured naphthalene. concentrations.*

Basis for Conclusion	Adverse health effects from long-term naphthalene exposure are not expected as the exposure point concentration calculated for naphthalene from the site perimeter SUMMA monitors is well below the human equivalent Lowest Observed Adverse Effect Level (LOAEL) of 1,048 µg/m^3, based on long-term exposure to laboratory animals. The Lifetime Excess Cancer Risk (excess cancer cases in an exposed population in addition to the background risk of cancer) was calculated to be approximately three excess cancer cases in a population of 100,000 over a lifetime of exposure. To put these risks in perspective, based on U.S. cancer rates, the lifetime risk of cancer in the general population is approximately 1 in 2.6, or approximately 38.4 percent of men and women will be diagnosed with cancer of any site at some point during their lifetime.
Next Steps	• NJDOH recommends that USEPA explore alternate perimeter real time monitors that measure naphthalene specifically (as opposed to a TVOC measurement) so that short-term health effects can be evaluated using an acute screening level for naphthalene. • NJDOH recommends continuing implementation of measures and exploration of other options to reduce naphthalene emissions when the remediation work resumes in early 2019. • NJDOH recommends continuing efforts to prevent odor releases from the site because exposure to odors reduces the quality of life of exposed communities. Provided is a link to the ATSDR odor website for information: https://www.atsdr.cdc.gov/odors/ • NJDOH recommends that monitoring of ambient air continue to demonstrate the effectiveness of changes in remediation schedule/work practices in reducing the levels of potential exposure.
For More Information	Copies of this report will be provided to community members near the site via the township libraries and will be posted on the NJDOH website. Questions about this health consultation should be directed to the NJDOH at (609) 826-4984.

Statement of Issues

On January 11, 2001, the U.S. Environmental Protection Agency (USEPA) proposed to add the Quanta Resources Corporation site, Edgewater, Bergen County, New Jersey, to the National Priorities List (NPL). USEPA added the site to the NPL on September 5, 2002. Manufacturing activities at the Quanta and adjacent properties and uncontrolled release of hazardous wastes have resulted in the contamination of soil and groundwater. At this site, various companies produced coal tar, paving and roofing materials for more than 100 years, leaving behind gross contamination of the property. The major contaminants associated with the site are polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals. ATSDR and NJDOH released a Public Health Assessment based on limited data available in 2002, but a complete evaluation could not be conducted since on- and off- site data were unavailable at that time. Another PHA was released for public comment in 2015 and finalized in 2018. Remediation work at the Quanta site first commenced in May 2017 and odor complaints associated with site remediation activities were first reported in fall of 2017. Community members asked NJDOH if exposures to the odors in the ambient air around the site are a threat to human health.

This health consultation evaluates the potential public health implications of community exposures to naphthalene in the ambient air resulting from remediation activities at the Quanta site. The report summarizes the NJDOH's evaluation of potential naphthalene exposures between July 18, 2017 and March 16, 2018. It provides an additional evaluation of measured naphthalene air levels after the USEPA adjusted remediation schedule/work practices on March 16 through May 18, 2018, when intrusive remediation work was stopped. This report includes recommendations based on short- (acute) and long-term (chronic) exposures to naphthalene following the evaluation of air sampling data collected at site perimeter and residential areas.

Background

Site Description and Operational History

The Quanta Resources Corporation site is in the Borough of Edgewater, Bergen County, New Jersey (see Figure 1 below and Figure A1 in the Appendix). The site is in a former heavily industrialized area of Bergen County, on the west bank of the Hudson River. This area has been undergoing a major revitalization with development of apartment and condominium complexes, shopping malls, and a movie theater. The site is bordered by the "new" River Road to the west. The Multiplex Cinemas and Independence Harbor, a residential waterfront development of approximately 500 units, is located to the north. A 331-unit multi-story residential and commercial development, City Place, is located directly north of the site. Northeast of the site is a 162-unit complex of condominiums and apartments, known as The Promenade, constructed on a pier extending over the Hudson River (see Figures 2 and 3). The 115 River Road building is on the southern end of the site and is currently undergoing demolition, which is expected to be completed in late December 2018 [USEPA 2018a]. The 115 River Road pier building, which

houses a restaurant and other businesses, is connected to the property on the southern end and is not part of the demolition.

The Quanta property was the home of a roofing tar plant for more than 100 years. Roofing tar was produced from coal tar. Coal/roofing tar, also called to creosote, has a distinct odor similar to asphalt or mothballs. The site is currently fenced to restrict access.

Figure 1: Site Map of Quanta and surrounding properties

Image courtesy of: http://www.quantaremediation.com/_resources/images/map.jpg

Regulatory and Remedial History

Under the direction of the USEPA and New Jersey Department of Environmental Protection (NJDEP), Honeywell is implementing the agreed upon remedy in two operable units. Operable Unit 1 (OU1) addresses the land and groundwater and Operable Unit 2 (OU2) addresses the sediments and the river. In May 2017, cleanup of the site began on the west side of River Road on the Block 93 parcel and took approximately 15 weeks to complete. The cleanup activities moved to the main Quanta between River Road and the Hudson River on July 24, 2017. Cleanup of the land portion (OU1) of the main site is estimated to take 18 months. As of May 2018, approximately 46% of the cleanup work on OU1 is complete. On May 18, 2018, soil solidification work at the Quanta site was suspended to accommodate the demolition of the land portion of the 115 River Road building, which commenced in September 2018, and is expected to last three months [USEPA 2018a].

The major component of the cleanup plan for OU1 includes *in-situ* solidification and stabilization (ISS), a process that involves mixing cement into soil to permanently immobilize heavy metals, coal tar, and waste oils so contaminants cannot migrate. Approximately 150,000 cubic yards of soil is being treated using soil solidification. Cement and slag are mixed with the soil using an auger or excavator bucket. The mixed material hardens into a solidified mass, locking up arsenic, coal tar, and waste oil, and prevents groundwater from moving through the

contaminated soil [USEPA 2018a, 2018b]. USEPA and NJDEP have been working with the contractor to address odor issues at the site. The odors are associated with coal tar. Coal tar on the site is a viscous liquid located a foot or more beneath the ground surface. It has a low odor threshold[1], which means the human nose can detect this odor even at very low concentrations. Extensive efforts are being made to minimize odors from the coal/roofing tar that remain in the Quanta site soil; however, odors have been generated as soil containing coal/roofing tar is uncovered.

On May 18, 2018, soil solidification work at the Quanta site was suspended to accommodate the demolition of the land portion of the 115 River Road building. The soil solidification work will resume in January 2019. During the pause in solidification work, the USEPA continues to monitor air quality and site conditions and share information with residents and local officials. During the suspension of soil solidification, USEPA continues oversight of activities at the site [USEPA 2018a].

Prior NJDOH/ATSDR Involvement

- On January 11, 2001, the USEPA proposed to add the Quanta Resources Corporation site, Edgewater, Bergen County, New Jersey, to the National Priorities List. ATSDR and NJDOH released a Public Health Assessment (PHA) based on limited data available in 2002, but a complete evaluation could not be conducted since on- and off- site data were unavailable.

- In September 2011, the USEPA released a Record of Decision describing the selected alternative for the soil and groundwater contamination remediation. With the availability of on- and off-site soil and groundwater contamination delineation data, the NJDOH prepared a draft PHA through a cooperative agreement with the ATSDR. The NJDOH held a public comment period from March 4, 2015, through April 5, 2015, to provide an opportunity for interested parties to comment on the draft PHA prepared for the Quanta Resources Corporation Site.

- In the final PHA released in 2018, the NJDOH and ATSDR concluded that currently there are no ongoing site-related exposures from ingestion of soil contaminants (collected at a depth of 0 to 2 feet) at the Quanta Resources Corporation and adjacent properties that can harm people's health. The NJDOH and ATSDR also concluded that past exposures to site-related contaminants detected in the soil (a depth of 0 to 2 feet) may have harmed people's health. The NJDOH and ATSDR could not conclude if exposure to the sediment and surface water of the Hudson River harmed people's health as data associated was unavailable.

[1] USEPA odor threshold is 440 µg/m^3 (https://www.epa.gov/sites/production/files/2016-09/documents/naphthalene.pdf); ATSDR odor threshold is 440 µm^3 (https://www.atsdr.cdc.gov/toxprofiles/tp67-c4.pdf); OSHA odor threshold is 1,572 µg/m^3 (https://www.osha.gov/dts/sltc/methods/organic/org035/org035.html)

Land Use and Demographics

The area surrounding the Quanta site is mixed residential and commercial. According to the 2010 U.S. Census, the ATSDR estimates that there are approximately 46,000 people living within one mile of the site. Figure A1 (**Appendix**) shows the demographic map and statistics for the area surrounding the site. Majority of the population are Caucasian (66 percent). Within a 1-mile buffer of this site, there are 6,000 adults 65 years and older and approximately 4,000 children aged 6 or younger.

Community Concerns

NJDOH and ATSDR gathered information on community health concerns by attending two public availability sessions. These meetings were hosted by the USEPA on March 28 and May 22, 2018. Approximately 100 residents attended both meetings. Community concerns have also been expressed through news articles and on social media.

The community is concerned about how exposures to naphthalene odors from the site potentially impact their health. These health concerns include cancer, breathing problems, bloody noses, runny noses, headaches, and sore throats. Concerns were also expressed about worker health and impacts on pregnant women and children.

Environmental Contamination

The process by which ATSDR evaluates the potential for adverse health effects resulting from exposure to contaminants is described briefly below. This process focuses on evaluation of the air pathway for transport of contaminants to the community around the Quanta site.

ATSDR first screens air analytical results against chemical-specific comparison values (CVs). CVs are concentrations of chemicals in air below which no harmful health effects are expected to occur, even with continual exposure (ATSDR 2005). Concentrations higher than the corresponding CV do not necessarily result in harm but must be evaluated further. CVs may include values derived by ATSDR and values developed by other state, federal, or international organizations.

If concentrations exceed the environmental CV, these substances are referred to as Contaminants of Concern (COC). The next step in the evaluation process involves an in-depth health-effects evaluation of the contaminants detected in the air above their respective CVs. The primary focus of this effort is to evaluate the potential for the contaminant(s) to produce cancer and non-cancer health effects resulting from human exposure.

Environmental Guideline Comparison

There are a number of environmental CVs available for screening environmental contaminants to identify COCs [ATSDR 2005]. Contaminants of concern were determined by

employing a screening process that compares sampling results to chemical-specific, health-based screening levels developed by ATSDR [ATSDR's minimal risk levels (MRLs) and ATSDR's cancer risk evaluation guides (CREGs)] or other agencies [USEPA Reference Concentration (RfC) or Screening Level (SL)] for cancer and non-cancer effects. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed over their lifetime. These CVs offer a high degree of protection and assurance that people are unlikely to be harmed by contaminants in the environment.

Below is a brief description and summary of air sampling conducted by USEPA at the Quanta site and properties adjacent to the site.

Air sampling and monitoring

The air monitoring network included both site perimeter monitoring and off-site air monitoring at residential properties as shown below in Figure 2.

The two types of sampling conducted during remediation were:

1. Real-time site perimeter monitoring of total volatile organic compounds (TVOC) and dust in air (over an 8-10 hour workday duration). Figure 2 shows the eight real-time site perimeter monitoring locations labelled as FD01 to FD08. TVOC and dust readings were collected at fifteen-minute intervals.

2. Periodic (every other day or daily as the project progressed) 8-10 hour work day sampling and 24-hour samples were collected in SUMMA canisters at twelve sites (three were the collocated with TVOC real-time monitors) for laboratory analysis of seventeen volatile/semi-volatile organic compounds at the perimeter locations (FD01, FD02 and FD06) and at nine off-site residential locations. The off-site sampling at residential locations for SUMMA canister analyses were located at: North of Quanta-Independence Harbor (locations OSHR, OSHW, OSHE); City Place (locations OSCW, OSCN, OSCE); and South of Quanta-iPark (locations OSIW, OSIP, OSIE).

   The seventeen volatile/semi-volatile organic compounds collected in SUMMA canisters from the perimeter locations are as follows: Arsenic, benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, naphthalene, benzene, ethylbenzene, isopropylbenzene, n-propylbenzene, toluene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and xylenes (total).

Figure 2: Air sampling network at Quanta (March 16, 2018 – May 9, 2018)

Real-time air monitoring, meteorological monitoring, and air sampling have been ongoing at the site since intrusive activities began in May 2017. Honeywell, in response to direction from USEPA, has adjusted the air monitoring based on observed detections of naphthalene. These adjustments have included:

- Perimeter air sampling frequency increased from twice per week to daily, starting September 14, 2017.
- Offsite air samples were collected from three locations during a 2-week period, from October 23 to November 3, 2017, with the offsite sampling locations based on the results from a volatile organic compound (VOC) air survey performed using a real-time monitoring instrument. Because naphthalene concentrations in the offsite air samples were below the applicable screening levels or not detected, offsite air sampling in these locations was suspended.
- Starting on March 16, 2018, the perimeter air monitoring plan was increased to include both 10-hour and 24-hour samples at all locations for VOCs. Perimeter locations were increased to include three locations (FD-01, FD-02, and FD-06), and offsite samples were added to City Place, iPark, and Independence Harbor, all to be sampled for VOCs (Figures 1 and 2).
- Starting the weekend of April 28, 2018, weekend sampling was performed at City Place and iPark.
- On May 10, 2018, two of the Independence Harbor sample locations were adjusted and relocated to The Metropolitan (location OSME) and The Promenade (location OSPM) residential buildings (Figure 3).

Figure 3: Air sampling network at Quanta (May 10, 2018 – July 2018)

Summarized below are steps taken to change work practices to reduce odors prior to May 18, 2018:

- Reduced the area of disturbed soil and improved debris management.
- Increased use of a white non-toxic foam (Rusmar) to suppress odor and dust from areas of disturbed soil and stockpiles.
- Increased application of a durable, weather-proof hard-shell covering (Posi-shell) to the areas of exposed soil as necessary throughout the day and at the end of each workday.
- Increased the amount of Portland cement in the Posi-shell.
- Expanded monitoring network to improve data on potential volatile organic compound migration to residential and retail shopping areas.
- Limited soil exposed to the air.
- Covered disturbed areas with plastic poly sheeting.
- Increased number of perimeter misters.
- Instituted other operational adjustments to work schedule.

On May 18, 2018, soil solidification work at the Quanta site was suspended so that the land portion of the 115 River Road building could be demolished. The demolition work commenced in September 2018 and is expected to take approximately three months. Soil solidification work is scheduled to resume in January 2019. Details can be found at: http://www.quantaremediation.com/

The following section describes results from air sampling from site perimeter monitors for SUMMA canisters over the July 2017 – May 18, 2018, sampling period. It includes all samples from both site perimeter and off-site SUMMA canisters over this period. Air samples have been collected from the perimeter since remediation started in May 2017 and have been analyzed for the seventeen site-related volatile organic compounds (VOCs) present in the soil.

Table 1: Results from SUMMA canisters from perimeter and off-site locations (July 2017 – May 2018)

Contaminants	No. of Samples	No. of Non-Detects	Maximum Concentration ($\mu g/m^3$)	Comparison Value (CV) ($\mu g/m^3$)	No. above CV
Arsenic	136	135	0.022	0.00023 (ATSDR CREG[a])	1
Benz[a]anthracene	136	135	0.176	0.017 (USEPA RSL[b])	1
Benzo[a]pyrene	136	135	0.175	0.0017 (USEPA RSL)	1
Benzo[b]fluoranthene	136	135	0.201	0.017 (USEPA RSL)	1
Benzo[k]fluoranthene	136	135	0.13	0.17 (USEPA RSL)	0
Chrysene	136	135	0.232	1.7 (USEPA RSL)	0
Dibenz[a,h]anthracene	136	136	-	0.0017 (USEPA RSL)	0
Indeno[1,2,3-cd]pyrene	136	136	-	0.017 (USEPA RSL)	0
Naphthalene	1,508	658	1,000	3.7 (ATSDR EMEG[c])	623
Benzene	1,508	686	51	0.13 (ATSDR CREG)	822
Ethylbenzene	1,508	1,193	29	260 (USEPA RSL)	0
Isopropylbenzene	1,508	1,474	8	420 (USEPA RSL)	0
n-Propylbenzene	1,508	1,506	1	1,000 (USEPA RSL)	0
Toluene	1,508	328	64	3,800 (ATSDR EMEG)	0
1,2,4-Trimethylbenzene	1,508	1,163	26	63 (USEPA RSL)	0
1,3,5-Trimethylbenzene	1,508	1,376	12	63 (USEPA RSL)	0
Xylenes (total)	1,508	890	87	220 (ATSDR EMEG)	0

[a]Cancer Risk Evaluation Guides (CREG) are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (78 years).
[b]USEPA Regional Screening Levels (RSL) are developed using risk assessment guidance from the EPA Superfund program and can be used for Superfund sites. They are risk-based concentrations derived from standardized equations combining exposure information assumptions with EPA toxicity data.
[c]Environmental Media Evaluation Guide (EMEG) and is an estimated contaminant concentration that is not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation. EMEGs are based on ATSDR MRLs and conservative assumptions about exposure, such as intake rate, exposure frequency and duration, and body weight.

Table 1 shows that benzene and naphthalene were detected above their comparison values on multiple occasions. Benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene and arsenic were detected in only one instance and these detections were slightly above their respective comparison values. They are not considered for further analysis as they were not detected in rest of the sampling.

Benzene was detected in over half of the samples and the concentration ranged from non-detects to 51 µg/m^3. A 95th percentile upper confidence limit (95% UCL) of the arithmetic mean[2] was calculated to be 1.8 µg/m^3. People living in cities or industrial areas are generally exposed to higher levels of benzene in air than those living in rural areas. Benzene is found in emissions from burning coal and oil, motor vehicle exhaust, and evaporation from gasoline service stations and in industrial solvents. These sources contribute to elevated levels of benzene in the ambient air. In New Jersey, the NJDEP measures outdoor concentrations of air toxics (including benzene) at four monitoring sites located in Camden, Elizabeth, New Brunswick, and Chester. The annual average benzene concentration measured Elizabeth (approximately 25 miles south of Edgewater) is approximately 0.8 µg/m^3, which is close to the 95% UCL benzene concentration (1.8 µg/m^3) measured in the SUMMA canisters around the site (NJDEP 2018). Additionally, benzene was detected in off-site background monitors located both north and south of the Quanta site. The benzene levels detected are near background levels and the 95% UCL was below ATSDR's chronic (9.6 µg/m^3) and acute (29 µg/m^3) noncancer screening values. The 95% UCL is marginally above the cancer screening value (0.13 µg/m^3) and the risk from exposure to benzene at the detected levels would not significantly add to the risk from naphthalene. For this reason, elevated concentrations of benzene from this site are not considered for further analysis as the measured levels are consistent with modeled urban benzene concentrations and not likely emissions from the site.

All other chemicals detected in air samples have been below comparison values except naphthalene. Therefore, naphthalene is retained for further analysis and is the contaminant of concern (COC) for this site.

To evaluate chronic naphthalene exposures, the site perimeter SUMMA canister results from July 18, 2017 to March 16, 2018, as summarized in Table 2 below, present the combined results for SUMMA canisters from site perimeter sampling around the Quanta site. The 95% UCL was determined to be 62 µg/m^3.

[2] When assessing an exposure risk to a COC, the USEPA recommends use of the 95th percentile upper confidence limit (95% UCL) of the arithmetic mean to determine the exposure point concentrations (EPC) for site-related contaminants (USEPA 2013). An EPC is considered to be the concentration of a contaminant at the point of human exposure. The 95% UCL is considered a 'conservative estimate' of the average contaminant concentrations in an environmental medium to represent the EPC. To determine EPCs, site data were analyzed using ProUCL® 5.1 developed by the USEPA [USEPA 2015].

Table 2: Summary of naphthalene site-perimeter SUMMA sampling from July 18, 2017 – May 18, 2018

Perimeter SUMMA sampling from July 2017 – May 2018	
Number of Samples	474
Number of Non-Detects	38
Number of Detects below ATSDR MRL (3.6 µg/m^3)	127
Number of Detects above ATSDR MRL (3.6 µg/m^3)	309
95% UCL	62 µg/m^3

Summary of off-site SUMMA sampling conducted at City Place, Independence Harbor, iPark, Promenade and Metropolitan is included in the Appendix for informational purposes (see Table A1).

Discussion

The method for assessing whether a health hazard exists in a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, a receptor population does not come into contact with contaminated media. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

For chemicals in air that exceed CVs, ATSDR compares the air concentrations with known health effect levels identified in ATSDR's toxicological profiles, USEPA's Integrated Risk Information System, or other scientific literature. For cancer-causing substances, an estimate of the increased risk of developing cancer from the exposure is calculated by multiplying the air concentration by an appropriate inhalation unit risk.

At the Quanta site, the community is concerned about how the naphthalene levels from the site may impact their health during the period from when remediation commenced to when it was paused (May 2017 to May 2018). The following exposure pathway is considered to pose the greatest concern and has the potential to affect the greatest number of people:

Inhalation Pathway: The inhalation pathway is complete because naphthalene is a contaminant associated with on-site contamination and subsequent elevated ambient air concentrations in the community have been well documented and verified by monitoring and reports of odors from community members.

A completed exposure pathway does not necessarily mean that harmful health effects will occur. A chemical's ability to harm health depends on many factors, including how much of the chemical is present, how long and how often a person is exposed to the chemical, and how toxic the chemical is. Further evaluation of the specific exposure occurring is needed to determine whether the exposure could cause harmful effects.

Naphthalene is a white crystalline powder that is produced from coal tar and has the characteristic odor of mothballs. It is naturally present in fossil fuels such as petroleum and coal and is produced when wood or tobacco is burned. Naphthalene is used as a moth repellent, disinfectant, and deodorizer. It is also used in making concrete, plasterboards, rubber, paints, and as a tanning agent in the leather industry. The major commercial use of naphthalene is in the manufacture of polyvinyl chloride (PVC) plastics. Its major consumer use is in moth repellents and toilet deodorant blocks [ATSDR 2005].

The following sections describe air monitoring results in the community surrounding the Quanta site and potential for naphthalene health effects.

Public Health Implications of Completed Exposure Pathway

Health Guideline Comparison – Non-Cancer Health Effects

To assess non-cancer health effects, ATSDR uses Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites [ATSDR 2005]. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. MRLs are developed for a route of exposure (i.e., ingestion or inhalation) and duration (i.e., acute (less than 14 days); intermediate (15-364 days); or chronic (365 days or more)). When MRLs for specific contaminants are unavailable, other health-based values such as the EPA's Reference Concentration (RfC) are used. The RfC is an estimate of a daily inhalation exposure to the

human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure.

MRLs and RfCs are based largely on toxicological studies in animals and on reports of human occupational (workplace) exposures. MRLs and RfCs are usually extrapolated doses from observed effect levels in animal toxicological studies or occupational studies and are adjusted by a series of uncertainty (or safety) factors or using statistical models. In toxicological literature, observed effect levels include:

- no-observed-adverse-effect level (NOAEL); and
- lowest-observed-adverse-effect level (LOAEL).

A NOAEL is the highest tested dose of a substance that does not result in harmful (adverse) health effects in people or animals. LOAEL is the lowest tested dose of a substance that does not result in harmful (adverse) health effects in people or animals. In order to provide additional perspective on these health effects, the calculated exposure doses are compared to observed effect levels (e.g., NOAEL, LOAEL). As the exposure dose increases beyond the MRL or RfC to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.

Figure A2 (Appendix) includes a naphthalene toxicological tree developed by NJDOH to summarize the current toxicological information and federal guidelines.

Non-Cancer Exposure Evaluation for Naphthalene: Acute Exposure

ATSDR does not have an acute inhalation MRL for naphthalene. Based on chronic inhalation studies, it is anticipated that the nasal epithelium is the most sensitive tissue in the respiratory tract. However, several animal studies have documented the toxic effect of naphthalene on the respiratory tract following short-term exposure. Dodd et al. (2010) conducted a study on rats with whole body exposure to naphthalene and suggested a range of inhalation exposure between 500-1,600 $\mu g/m^3$ could be a threshold for injury to the nasal epithelium. It should be noted that in this study it was observed that there is a compensatory adaptive mechanism where this injury to the Clara cells can be repaired almost functioning as a repair process. West et al. (2001) exposed mice to naphthalene vapors for 4 hours and reported that the Lowest Observed Adverse Effect Level (LOAEL) was 50,000 $\mu g/m^3$ and the No Observed Adverse Effect Level (NOAEL) was 10,000 $\mu g/m^3$ for necrotic effect on Clara cells, which are cells deeper in the respiratory tract. In a previous ATSDR report, this study was used as the basis for an acute health-based screening level of 60 $\mu g/m^3$ for acute health impacts [ATSDR 2014]. This represents a concentration below which no harmful health effects are expected; higher concentrations do not necessarily result in harm but must be evaluated further.

Naphthalene air sampling results from the site perimeter air monitors using SUMMA canisters was used to estimate acute exposure to naphthalene (see Figures 2 and 3). Ideally, real time hourly data are best to assess short-term (acute) exposure. However, at this site the real-time perimeter monitors only measured TVOCs in air and not naphthalene specifically. NJDOH

utilized naphthalene detections from site perimeter SUMMA canisters for estimating exposure and associated health effects.

The data evaluation is presented below for two separate periods: July 18, 2017 to March 15, 2018 and from March 16, 2018 to May 18, 2018. The latter period represents SUMMA canister data following changes made to the remediation effort and work schedule, and these changes were reflected in the observed measurements.

Site perimeter SUMMA canister data from July 18, 2017 to March 15, 2018

Table 3 summarizes naphthalene detections over the workday (ranging from 8-10 hours) at the concentration ranges specified below from July 18, 2017 to March 15, 2018. This time represents air sampling results when remediation first began at the Quanta site to when work practices changed at the site. The table displays the data in grouped intervals; the basis for this was to organize the data to best represent the naphthalene toxicological data for evaluating public health implications.

Table 3 shows that about 80% of the daily workday averages of naphthalene are below the acute screening MRL of 60 µg/m^3. The other 20% of the time, the daily naphthalene levels averaged over the workday were above the ATSDR screening value. Three of 331 samples had levels above 500 µg/m^3, a level that has been identified as within a range that could cause damage to the nasal epithelium. These levels, collected at the site perimeter fence line (averaged over the workday), were 1,000 µg/m^3, 840 µg/m^3 and 510 µg/m^3;

Table 3: Frequency of naphthalene levels from site perimeter *SUMMA* monitors averaged over a workday (July 18, 2017-March 15, 2018)

Concentration Range (µg/m^3)	Number of Naphthalene observations (% of total observations)	Screening levels
ND – <3.6	63 (19)	3.6 µg/m^3 - ATSDR chronic MRL (ATSDR 2005)
3.6 – <60	198 (60)	60 µg/m^3 - ATSDR health-based screening value for acute health impacts (ATSDR 2014)
60 – <440	67 (20)	440 µg/m^3 - ATSDR/USEPA's naphthalene odor threshold (ATSDR 2005; USEPA 2016)
440 – <500	0 (0)	500 µg/m^3 - Threshold for injury to nasal epithelium (Dodd et al. 2010)
500 – <1,800	3 (1)	1,800 µg/m^3 - ATSDR human equivalent NOAEL (West et al. 2001)
>1,800	0 (0)	
Total Number of measurements	**331**	

As mentioned earlier, since the quantitative real-time naphthalene measurements were unavailable, NJDOH conducted a qualitative evaluation of real-time TVOC data to assess the acute exposures to naphthalene that shows how much of the TVOCs is naphthalene to provide a range of what short-term naphthalene levels could have been. This analysis is explained in detail in the Appendix. The values in Tables 3 and Table A3 (Appendix) exceed an inhalation exposure that could potentially cause damage to the nasal epithelium (≥500 µg/m^3). Therefore, there was a potential health risk to area residents from exposure to naphthalene.

Residents in Edgewater have complained about the odors emanating from the Quanta site. The odor threshold for naphthalene has been reported as 440 µg/m^3 and as shown in Tables 3 and A3, both daily averages and real-time measurements (estimated) have been elevated above this concentration on multiple occasions. Approximately, seven percent of estimated real time measurements were above 440 µg/m^3 [ATSDR 2005; USEPA 2016]. These peak concentrations could cause respiratory irritation and the exacerbation of pre-existing respiratory conditions and may irritate the nasal passage and airways of exposed individuals.

Following change in work practices due to odor complaints:

On March 16, 2018, Honeywell, under USEPA oversight, implemented changes in remediation work practices/schedule to address the concerns expressed by people living and working near the site. Table 4 summarizes the SUMMA site perimeter monitoring results for the sampling period after March 16, 2018. The results show that the naphthalene levels did not exceed threshold for injury to the nasal epithelium (≥500 µg/m^3). These results show that changes in remediation work practices/schedule have been successful in keeping the daily workday averages of naphthalene below 500 µg/m^3. Hourly real-time monitoring is needed when future remediation work begins to verify naphthalene levels remain below levels of concern.

Table 4: Frequency of naphthalene levels from site perimeter SUMMA monitors averaged over a workday (March 16, 2018 -May 18, 2018)

Concentration Range (µg/m^3)	Number of Naphthalene observations (% of total observations)	Screening levels
ND – <3.6	40 (28)	3.6 µg/m^3 - ATSDR chronic MRL (ATSDR 2005)
3.6 – <60	87 (60)	60 µg/m^3 - ATSDR health-based screening value for acute health impacts (ATSDR 2014)
60 – <440	17 (12)	440 µg/m^3 - ATSDR/USEPA's naphthalene odor threshold (ATSDR 2005; USEPA 2016)
440 – <500	0 (0)	500 µg/m^3 - Threshold for injury to nasal epithelium (Dodd et al. 2010)
500 – <1,800	0 (0)	1,800 µg/m^3 - ATSDR human equivalent NOAEL (West et al. 2001)
>1,800	0 (0)	
Total Number of Measurements	**144**	

Non-Cancer Exposure Evaluation for Naphthalene: Chronic Exposure

ATSDR's chronic MRL for naphthalene is 3.6 µg/m^3 [ATSDR 2005]. The lowest exposure level in both mice and rat studies, 52,400 µg/m^3, was a LOAEL in both sexes of both species for lesions in nasal olfactory epithelium and respiratory epithelium. Applying the USEPA approach for inhalation dosimetry, a human equivalent LOAEL of 1,048 µg/m^3, based on the rat data, was selected as the point of departure for the chronic inhalation MRL. The uncertainty factor was 300 (10 for use of a LOAEL; 3 for extrapolation from animals to humans with dosimetric adjustment used in MRL derivation; 10 for human variability) [ATSDR 2005].

USEPA's RfC for naphthalene is 3 µg/m^3 [USEPA 1998]. USEPA developed the RfC for naphthalene based on respiratory effects (nasal inflammation, olfactory epithelial metaplasia, respiratory epithelial hyperplasia) in rats and mice with a LOAEL of 52,000 µg/m^3, which was the lowest dose the animals were exposed to. Applying the USEPA approach for inhalation dosimetry, a human equivalent LOAEL of 9,300 µg/m^3 was selected as the point of departure. The uncertainty factor was 3,000 (10 for extrapolation from mice to humans, 10 to protect sensitive humans, 10 for extrapolation from a LOAEL to a NOAEL, and 3 for database deficiencies) [USEPA 1998].

Site perimeter results: The 95% UCL of 62 µg/m^3 was used as the EPC, which is above the ATSDR chronic inhalation MRL of 3.6 µg/m^3 (see Table 2). It is well below the LOAEL (i.e., 52,400 µg/m^3 associated with lesions in nasal olfactory epithelium and respiratory epithelium) in both mice and rat animal studies. It is also significantly below the human equivalent LOAEL of 1,048 µg/m^3, based on the rat data, and therefore, adverse health effects are unlikely from chronic exposures to naphthalene.

Health Guideline Comparison – Cancer Exposure Evaluation for Naphthalene

The site-specific lifetime excess cancer risk (LECR) indicates the cancer potential of contaminants. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background risk of cancer. Typically, health guideline comparison values developed for carcinogens are based on one excess cancer case per 1,000,000 individuals. The NJDOH considers estimated cancer risks of less than one additional cancer case among one million persons exposed as no increased risk.

There is no direct evidence in humans that naphthalene causes cancer. However, cancer from naphthalene exposure has been seen in animal studies. Some female mice that breathed naphthalene vapors daily for a lifetime developed lung tumors. Some male and female rats exposed to naphthalene in a similar manner also developed nose tumors. Based on the results from animal studies, the International Agency for Research on Cancer conclude that naphthalene is possibly carcinogenic to humans [ATSDR 2005]. Under the USEPA 1986 cancer guidelines, naphthalene was assigned to Group C as a possible human carcinogen.

Exposure point concentrations for cancer health effects to indoor air contaminants were calculated using the following formula [USEPA 2009]:

$$EPC_{cancer} = \frac{C \times ED}{AT}$$

where

EPC_{cancer} = exposure point concentration of contaminant in air (µg/m^3),
C = 95% UCL (62 µg/m^3) calculated from SUMMA site perimeter samples,
ED = exposure duration (1 year), and
AT = averaging time (78 years).

The LECR for residents was calculated using the following formula [USEPA 2009]:

$$LECR = EPC_{cancer} \times IUR$$

where

EPC_{cancer} = exposure point concentration of contaminant in air (0.79 µg/m^3), and
IUR = inhalation unit risk of naphthalene in air (3.4E-05 µg/m^3)$^{-1}$.

USEPA defines the IUR as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 µg/m^3 in air [USEPA 2008]. This IUR was developed by California Office of Environmental Health Hazard Assessment [OEHHA 2004]. LECR estimates are excess cancer cases in an exposed population in addition to the background rate of cancer. The site-specific LECR indicates the cancer-causing potential of contaminants found at the site.

The LECR was calculated to be approximately three additional cancer cases among 100,000 people exposed (1E-05). This is considered a low cancer risk. To put these risks in perspective, based on U.S. cancer rates, the lifetime risk of cancer in the general population is approximately 1 in 2.6, or approximately 38.4 percent of men and women will be diagnosed with cancer of any site at some point during their lifetime (NIH 2018). The NJDOH considers estimated cancer risks of less than one additional cancer case among one million persons exposed (expressed exponentially as 10^{-6} or expressed as 1E-06) as no increased risk.

Conclusions

NJDOH reached three conclusions in this health consultation.

Conclusion 1. Before the USEPA made changes to the remediation schedule/ work management practices at the site in mid-March 2018, ambient air concentrations of naphthalene released from the site were high enough to potentially cause harmful short-term health effects in community members. Site perimeter SUMMA canister concentrations averaged over the working day (from July 18, 2017 to March 18, 2018) indicate that peak exposures at the perimeter fence of the site (as high as 1,000 µg/m^3) on some days were considerably higher than the ATSDR health-based screening value for acute health impacts (60 µg/m^3). This suggests that the hourly maximum concentrations could have exceeded a range of inhalation exposure that has been identified with damage to the nasal epithelium (≥500 µg/m^3). Therefore, on those days when there were detections above 500 µg/m^3, there was a potential health risk to area residents from exposure to maximum peak concentrations of naphthalene at the site perimeter fence. Additionally, qualitative review of data from perimeter real time total

volatile organic compounds (TVOC) monitors indicate that there were some 15-minute readings (adjusted for naphthalene proportion) that were consistently above ATSDR's acute screening level of 60 µg/m^3 and were present at concentrations at which respiratory effects have been noted in animal studies.

Residents in the surrounding areas have complained about the odors emanating from the Quanta site. Peak naphthalene concentrations could potentially cause respiratory irritation, exacerbation of pre-existing respiratory conditions, and/or irritation of the nasal passage and airways of exposed individuals. Some individuals may experience adverse reactions to odor, and at times naphthalene was present at concentrations easily detected by the human nose. Residents exposed to strong naphthalene odors may experience a reduced quality of life, and non-life-threatening symptoms such as fatigue, headache, and nausea.

Conclusion 2. After the USEPA made changes to the remediation schedule/work management practices at the site, short-term concentrations of naphthalene were greatly reduced and are much less likely to cause harmful health effects. Since work practices changed to address the odor complaints, 88 percent of the measured daily averages were below the ATSDR health-based screening value for acute health impacts. Furthermore, there are no reported values that exceeded levels associated with health effects (≥500 µg/m^3). This is indicative of the beneficial effects of the remedial actions that were implemented at the site starting March 16, 2018. It is to be noted that real time naphthalene specific monitoring results are needed to verify this conclusion. If these amended work practices and other associated measures remain in place, short-term health effects associated with acute exposures to naphthalene are not expected.

Conclusion 3. Long-term health effects are unlikely from the measured naphthalene detections. Adverse health effects from long-term naphthalene exposure are not expected as the exposure point concentration calculated for naphthalene from the site perimeter SUMMA monitors is well below the human equivalent Lowest Observed Adverse Effect Level (LOAEL) of 1,048 µg/m3, based on long-term exposure laboratory animal data. The Lifetime Excess Cancer Risk (excess cancer cases in an exposed population in addition to the background risk of cancer) was calculated to be approximately three excess cancer cases in a population of 100,000 over a lifetime of exposure. This is considered a low cancer risk. To put these risks in perspective, based on U.S. cancer rates, the lifetime risk of cancer in the general population is approximately 1 in 2.6, or approximately 38.4 percent of men and women will be diagnosed with cancer of any site at some point during their lifetime.

Recommendations

1. NJDOH recommends that USEPA explore alternate perimeter real time monitors that measure naphthalene specifically (as opposed to a TVOC measurement) so that short-term health effects can be evaluated using an acute screening level for naphthalene.

2. NJDOH recommends continuing implementation of measures and exploration of other options to reduce naphthalene emissions when the remediation work resumes in early 2019.

3. NJDOH recommends continuing efforts to prevent odor releases from the site because exposure to odors reduces the quality of life of exposed communities. Provided is a link to the ATSDR odor website for information: https://www.atsdr.cdc.gov/odors/

4. NJDOH recommends that monitoring of ambient air continue to demonstrate the effectiveness of changes in remediation schedule/work practices in reducing the levels of potential exposure.

Public Health Action Plan

The purpose of a Public Health Action Plan is to ensure that this health consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the NJDOH to follow-up on this plan to ensure that it is implemented. The public health actions to be implemented by the NJDOH are as follows:

Public Health Actions Taken

1. The NJDOH reviewed information provided by the EPA to evaluate the potential health implications resulting from naphthalene air concentrations surrounding the Quanta site in response to community concerns about naphthalene odors.

2. The NJDOH attended two public information sessions at the request of the USEPA on March 28 and May 22, 2018.

Public Health Actions Planned

1. Copies of this health consultation will be provided to the EPA and to the local health department. This document will also be provided to the NJDEP and made available via the city libraries and the NJDOH website. Additionally, community members who contact the NJDOH will be aided in understanding the findings of this report.

2. NJDOH will hold a public availability session to present the findings of this Health Consultation.

3. The NJDOH will continue to review and evaluate data as it is made available.

4. Community members or workers with health concerns regarding potential past exposures to site contaminants can ask the NJDOH for help with outreach to their physicians and trained experts specializing in occupational and environmental exposures to hazardous substances.

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Report Preparation

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APPENDIX

Summary of off-site SUMMA sampling

For informational purposes, Table A1 below summarizes the naphthalene results for SUMMA canisters from off-site residential locations. The majority of the off-site sampling yielded non-detects at all the locations. The 95% UCL was not calculated as the off-site data will not be used for further analysis. Perimeter sampling will be used instead because it typically represents the worst-case community exposures.

Table A1: Summary of off-site SUMMA sampling (24-hr samples) from March 16* – May 18, 2018 for naphthalene

Off Site Locations	City Place	Independence Harbor	iPark	Promenade	Metropolitan
Number of Samples	159	138	148	8	8
Number of Non-Detects	69	125	110	7	5
Number of Detects up to ATSDR MRL (3.6 $\mu g/m^3$)	34	9	33	1	1
Number of Detects above ATSDR MRL (3.6 $\mu g/m^3$)	55	4	5	0	2

*Included are off-site sampling (from 10/27/17 – 11/02/17) for iPark and Independence Harbor locations in addition to Spring 2018 sampling

Qualitative Evaluation of TVOC Data

Since the quantitative real-time naphthalene measurements were unavailable, NJDOH conducted a qualitative evaluation of real-time TVOC data to assess the acute exposures to naphthalene. As reported in the Environmental Contamination section, sixteen of the seventeen VOC chemicals analyzed in the air samples have been recorded at levels below their respective comparison values. Since naphthalene has been the only VOC consistently detected at levels much higher than the other VOCs (ranging from mostly non-detect to low levels), it can be assumed that the TVOC readings largely represent naphthalene. To approximately quantify this proportion, NJDOH conducted an analysis. SUMMA canister data for two site perimeter locations (FD02 and FD06) were evaluated to calculate the proportion of naphthalene based on the sum of the sixteen other VOCs. Table A2 shows that on an average, naphthalene compromised 60 percent of the total VOCs in the SUMMA canister date that were evaluated.

Table A2: Estimation of percent naphthalene in SUMMA canisters

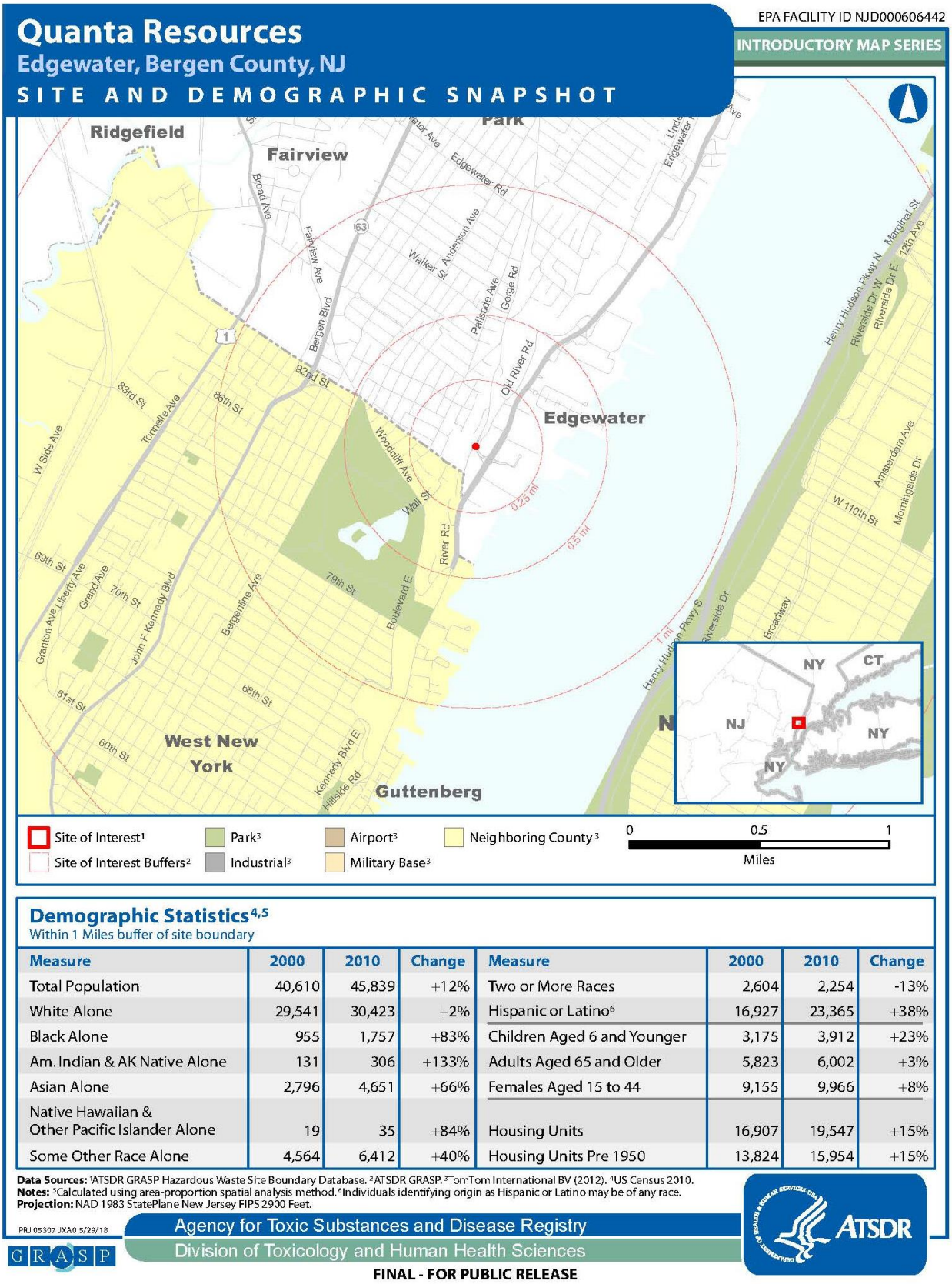
Monitor	Average Naphthalene (%)	Standard Deviation (%)	Sampling Date range
FD02	61	20	August 11, 2017 – May 18, 2018
FD06	59	19	July 18 – December 29, 2017

The TVOC data were adjusted by the percentage estimated above (60%) to give a range of what peak naphthalene levels that could have been present at 15-minute intervals. Table A3 below presents an estimate of real-time naphthalene data from site perimeter real time monitors that measured TVOC every 15 minutes.

Table A3: Frequency of naphthalene (from adjusted TVOC levels) from *Real Time* site perimeter monitors (July 18, 2017-March 15, 2018)

Concentration Range (µg/m^3)	Number of naphthalene observations from all monitors (% of total observations)	Comments
ND – <3.6	59,353 (74)	3.6 µg/m^3 - ATSDR Chronic MRL (ATSDR 2005)
3.6 – <60	2,924 (4)	60 µg/m^3 - ATSDR Health based screening value for acute health impacts (ATSDR 2014)
60 – <440	12,020 (15)	440 µg/m^3 - ATSDR/USEPA's Naphthalene Odor Threshold (ATSDR 2005; USEPA 2016)
440 – <500	1,093 (1)	500 µg/m^3 - Threshold for injury to nasal epithelium (Dodd et al. 2010)
500 – <1,800	4,635 (6)	1,800 µg/m^3 - ATSDR Human Equivalent NOAEL (West et al. 2001)
1,800 – <10,480	315 (less than 1%)	10,480 µg/m^3 - Study animal (mouse) NOAEL (West et al. 2001)
>10,480	4 (less than 1%)	
Total Number of Measurements	**80,344**	

Figure A1: ATSDR Demographics Map



Demographic Statistics[4,5]

Within 1 Miles buffer of site boundary

Measure	2000	2010	Change	Measure	2000	2010	Change
Total Population	40,610	45,839	+12%	Two or More Races	2,604	2,254	-13%
White Alone	29,541	30,423	+2%	Hispanic or Latino[6]	16,927	23,365	+38%
Black Alone	955	1,757	+83%	Children Aged 6 and Younger	3,175	3,912	+23%
Am. Indian & AK Native Alone	131	306	+133%	Adults Aged 65 and Older	5,823	6,002	+3%
Asian Alone	2,796	4,651	+66%	Females Aged 15 to 44	9,155	9,966	+8%
Native Hawaiian & Other Pacific Islander Alone	19	35	+84%	Housing Units	16,907	19,547	+15%
Some Other Race Alone	4,564	6,412	+40%	Housing Units Pre 1950	13,824	15,954	+15%

Data Sources: ¹ATSDR GRASP Hazardous Waste Site Boundary Database. ²ATSDR GRASP. ³TomTom International BV (2012). ⁴US Census 2010.
Notes: ⁵Calculated using area-proportion spatial analysis method. ⁶Individuals identifying origin as Hispanic or Latino may be of any race.
Projection: NAD 1983 StatePlane New Jersey FIPS 2900 Feet.

PRJ 05307 JXA0 5/29/18

Agency for Toxic Substances and Disease Registry
Division of Toxicology and Human Health Sciences

GRASP

ATSDR

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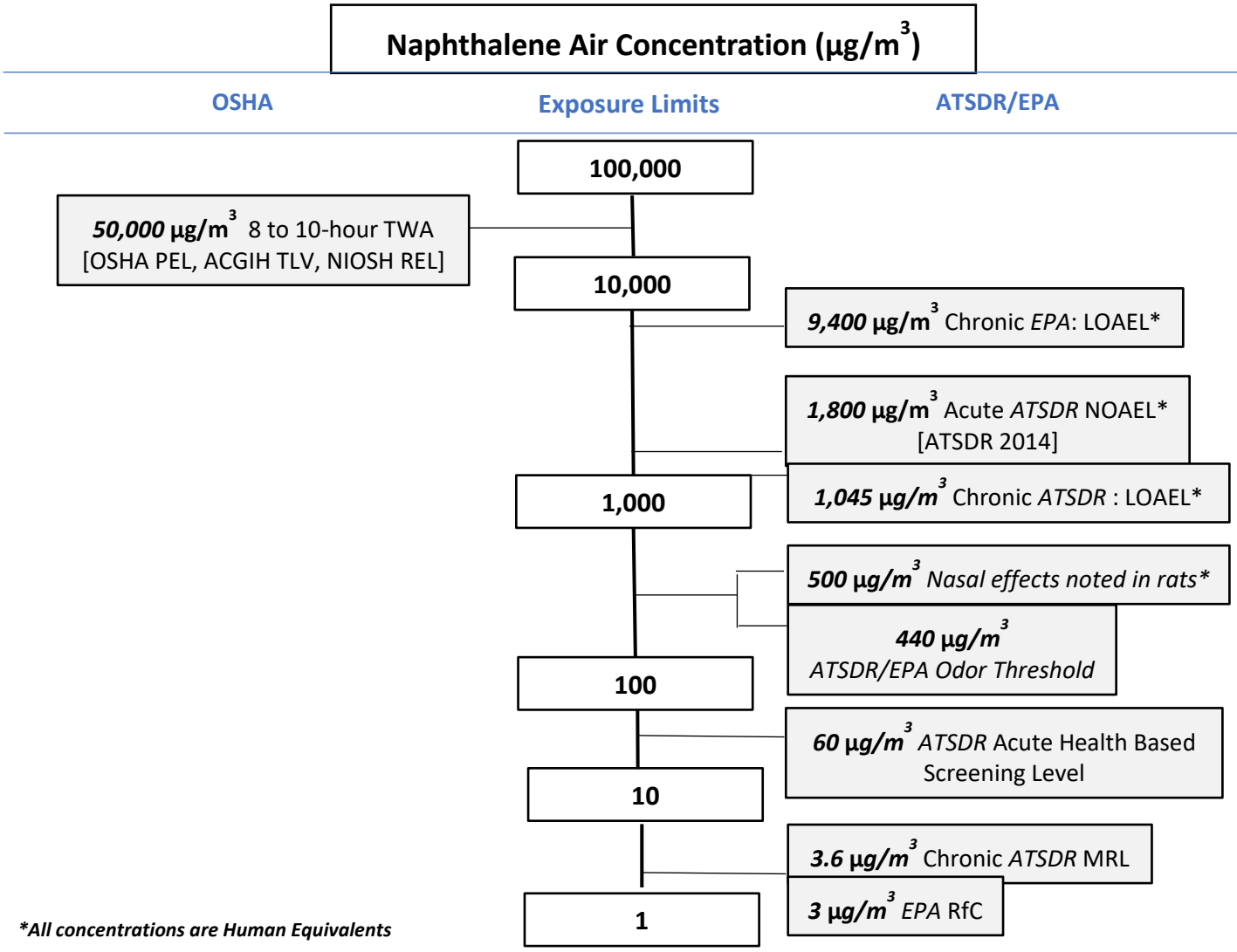
Figure A2: NJDOH Naphthalene ToxTree



Acute: 1-14 days exposure duration. **Chronic**: 365 days and longer exposure duration.

ATSDR MRL: Agency for Toxic Substances and Disease Registry's Minimal Risk Level is an estimate of daily human exposure to a hazardous substance unlikely to pose a measurable risk of harmful noncancerous effects.

OSHA PEL: The Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limit (TWA) expressed as a time-weighted average (TWA)--the concentration of a substance to which most workers can be exposed without adverse effect, averaged over a normal 8-h workday or a 40-h workweek.

ACGIH TLV: The American Conference of Governmental and Industrial Hygienists' Threshold Limit Value expressed as a TWA--the concentration of a substance to which most workers can be exposed without adverse effects, conventionally an 8-h workday and a 40-h workweek.

NIOSH REL: The National Institute for Occupational Safety and Health' recommended exposure limit expressed as a TWA—the concentration for up to a 10-hour workday during a 40-hour workweek.

EPA RfC: Environmental Protection Agency's Reference Concentration is an estimate of a daily inhalation exposure of the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime.

NOAEL: No observed adverse effect level in animals. **LOAEL**: Lowest observed adverse effect level in animals.

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