Preliminary Assessment Report for Class Certification of Residential Properties with Metals Contamination from the U.S. Metals Refining Company Facility in Carteret, New Jersey

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Subject: Preliminary Assessment Report for Class Certification of Residential Properties with Metals Contamination from the U.S. Metals Refining Company Facility in Carteret, New Jersey

Dear Mr. German:

Soil Water Air Protection Enterprise ("SWAPE") is pleased to provide German Rubenstein LLP with this *Preliminary Assessment Report for Class Certification of Residential Properties with Metals Contamination from the U.S. Metals Refining Company* ("USMR") Facility in Carteret, New Jersey (the "Facility" or "Site"). This Preliminary Report presents information on previous environmental assessments and remedial actions conducted by Freeport Minerals, Inc., Freeport McMoran, Inc., and USMR at residential properties in the surrounding community. This Report also presents the results of my evaluations, which demonstrate that contamination extends beyond the areas that USMR has delineated and indicate that all properties in the Proposed Class Area, displayed in Exhibit 1, have been impacted by the Facility. My compensation for consulting work is $225/hour. For depositions in Los Angeles my compensation rate is $4,000/day. For depositions and trial testimony outside of Los Angeles, my compensation rate is $5,000/day. Due to the ongoing nature of this matter, we reserve the right to modify our work and any information presented in this Preliminary Report as new information becomes available.

Sincerely,

Paul E. Rosenfeld, Ph.D.

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1 INTRODUCTION

1.1 Background and Purpose of Report

Soil Water Air Protection Enterprise ("SWAPE") was retained by German Rubenstein LLP to prepare this report in the matter of *Duarte, et al. v. United States Metals Refining Company, et al*. This Preliminary Assessment Report presents an overview of environmental assessments and remedial investigations conducted by U.S. Metals Refining Company ("USMR"), Freeport Minerals, Inc., and Freeport McMoran, Inc. at residential properties located near the former USMR Facility in Carteret, New Jersey (the "Facility" or "Site"). This Report also presents my evaluations and findings regarding the extent of contamination in the residential community. Plaintiffs and the residential community impacted by historical emissions from the former Facility are located within approximately two miles of the former Facility (the "Proposed Class Area", see **Exhibit 1**).

USMR constructed and operated a metals processing plant in Carteret, New Jersey for more than 80 years (1901-1986).[1] The historical operation of the Facility produced emissions to the atmosphere, as well as discharges of wastewater, stormwater, and deposits of waste materials at and around the Facility.[2]

Process and fugitive emissions from the Site resulted in the historical deposition of contaminants in shallow soils at residential properties in the surrounding community. The most common transport mechanism for off-site metals deposition associated with copper smelting operations is air deposition.[3] The contaminants of concern ("COCs") discussed in this Preliminary Report are lead and arsenic, with copper being an indicator of emissions from the Facility.

In 1988, the New Jersey Department of Environmental Protection ("NJDEP") issued an Administrative Consent Order to USMR, which directed them to "fully delineate the horizontal and vertical extent of pollution at and/or emanating from the site.[4] No action was taken on the part of USMR to determine the extent of contamination beyond the facility until they conducted soil sampling assessments at residential properties closest to the Facility starting in 2015. The first properties investigated by USMR were those located inside a pre-determined boundary within approximately 2,500 feet of the Site. This boundary, or Area of Concern ("AOC"), was used to initiate the delineation of the aerial extent of properties with potentially unsafe levels of COCs. USMR stated early on as a part of its process of off-site investigation that the boundary "… will be extended laterally until an off-site AOC can be established".[5]

[1] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012.
[2] Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008.
[3] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 2-1.
[4] Deposition of Joseph A. Brunner. Taken June 6, 2018. Exhibit 54. Bates No. USMR00017674.
[5] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 1-2.

USMR used this to establish a boundary known as the "Off-site AOC" to limit the extent of its remedial investigations.

In 2017, USMR conducted soil sampling at a limited number of residential properties located beyond the "Off-site AOC". Sampling was performed at properties located along three lines or transects moving outward and away from the former Facility. These properties were intended to be distributed spatially from the off-site AOC boundary out to around 1,600 meters from the former smelter at the Facility and were selected based on development history to represent worst-case scenario impacts.[6,7] The results of soil sampling at properties along these transects indicated that Facility-related metals contamination extends far beyond the original "Off-site AOC". Recent soil sampling conducted by Plaintiffs in 2019 demonstrates that metals contamination at unsafe levels extends even farther toward the boundary of the Proposed Class Area.

Within the original Off-site AOC defined in 2016, USMR has conducted individual site assessments and remediation (e.g., soil excavation) at approximately 300 residential properties in the "Off-site AOC" only. This work is still underway. USMR has subsequently taken the position that no additional site investigation and remediation is needed outside of the Off-site AOC boundary.

This Report provides an overview of previous site assessments by USMR and my evaluations, demonstrating that elevated levels of COCs have not been fully delineated in the Proposed Class Area. A property-by-property analysis is not necessary to demonstrate which properties are impacted by the USMR Facility. From my analysis, it is evident that the former USMR facility is the primary source of anthropogenic soil contamination in the Class Area, and air deposition is the primary migration pathway of COCs from the smelter to soil. Due to the nature of air deposition, the extent of soil contamination surrounding the facility is a contiguous area, and all land within the Proposed Class Area is similarly impacted by smelter contamination. Lead, arsenic, and copper do not degrade naturally, meaning these COCs will persist in soil indefinitely. Accordingly, this area requires remediation and, akin to the remedial actions already conducted by USMR at residential properties within the "Off-site AOC", excavation of soils in excess of safety standards.

1.2 Qualifications

I received a B.A. in Environmental Studies from the University of California, Santa Barbara in 1991, an M.S. in Environmental Science from the University of California, Berkeley in 1995, and a Ph.D. in Soil Chemistry from the University of Washington in 1999. In addition to my education, I have extensive experience in evaluating the fate and transport of environmental contaminants, risk and exposure

[6] Remedial Action Work Plan Addendum - Boundary Evaluation Soil Sampling Program. Arcadis U.S., Inc. November 2016. Page 4.
[7] Deposition of Dr. Jeffrey Kurtz. Page 58. December 13, 2018.

assessment of contaminants released from pollution sources, and monitoring and modeling of pollution sources that may cause impacts on human health and ecological systems. I am presently practicing as a principal environmental scientist and risk assessor at SWAPE, which I founded in 2003. My Curriculum Vitae is appended as **Exhibit 9** at the end of this report.

I obtained much of my experience in evaluating contaminated sites while working for the United States Navy, where I served as a Remedial Project Manager for the Navy Base Realignment and Closure ("BRAC") Team, South West Division on Treasure Island, California. While working for BRAC, I managed many sites with environmental contamination concerns and oversaw remediation activities. This experience encompassed a considerable amount of work on site investigations and remedial actions.

I have previously taught courses on the subject of environmental health at the University of California, Los Angeles ("UCLA") and presented at professional environmental conferences on various subjects involving environmental contamination and remediation. I have published scientific studies of contaminant fate and transport and treatment technologies. I have also co-authored several books concerning environmental contamination and best practices in the chemical industry. These publications include The Risks of Hazardous Waste (2011), Handbook of Pollution Prevention and Cleaner Production: Best Practices in the Agrochemical Industry (2011), Handbook of Pollution Prevention and Cleaner Production: Best Practices in the Wood and Paper Industries (2010), and Handbook of Pollution Prevention and Cleaner Production, Best Practices in The Petroleum Industry (2009).

I use my education, experience, knowledge, and expertise to conduct investigations and prepare risk assessments. I have performed numerous investigations and assessments for governmental and private entities concerning risks to human health and the environment due to contamination from particulate matter, pesticides, polychlorinated biphenyls, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, dioxins/furans, volatile organic compounds, perchlorate, heavy metals, perfluorochemicals, asbestos, mold, bacteria, and other contaminants. I have conducted numerous risk assessments over a period of more than twenty years specifically relating to air contaminants and have testified at deposition and/or at trial as an expert witness on numerous cases involving environmental contamination, exposure, and human health risk. My testimony experience is provided in my Curriculum Vitae, which is provided separately in the *Supporting Documents*[8] that accompany this Preliminary Report.

[8] Supporting Documents are provided in digital format (e.g., Adobe Portable Document Formation, PDF) in a folder provided with a copy of this report, exhibits and references.

1.3 Documents Reviewed and Limitations

Documents and information reviewed in preparation of this Preliminary Report were obtained from the following sources:

- Documents provided German Rubenstein LLP and co-counsel;
- USMR Soil Project Database (https://gis.craworld.com/freeportmcmoran/TIA.htm);
- Records of the New Jersey Department of Environmental Protection ("NJDEP");
- Records of the United States Environmental Protection Agency ("U.S. EPA");
- Public domain sources of documents on environmental regulatory policies and guidance;
- Public domain sources of technical and scientific literature.

Until such time that site-specific information becomes available, the information presented herein should be considered preliminary and subject to change. As more information becomes available in the future, this Preliminary Report may be modified and amended. Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable environmental consultants practicing in this or similar localities at the time of service.

2 FACILITY AND PROPOSED CLASS AREA

2.1 Former USMR Facility

This section provides a brief summary of the historical processes at the Facility taken from a 2008 *Local and Regional Environmental Impacts* report concerning operations and emissions at the former USMR Facility.[9] The primary operations at the former Facility included smelting and refining of copper-bearing materials, producing standard and unconventional copper, and smelting and refining of scrap materials to recover precious metals. These historical operations resulted in emissions and releases of metals at the Site and in the surrounding area.

The USMR Facility was originally constructed as a primary copper smelter in around 1901. In later years, the Facility was also used to process secondary scrap aluminum (1943 to 1954), produce an inorganic copper fungicide (1940 to 1960), and process solder from old radiators (to late 1950s). From 1927 through the late-1940s, zinc was captured in flue gases for producing zinc oxide. Zinc leach residue was also smelted to produce "white metal" alloys of tin and lead. White metal alloys were also refined to produce alloys for solder. In 1934, a "selenium plant" was expanded to refine tellurium. A germanium recovery unit was in operation from 1957 to the mid-1960s. The facility was also used to process metal-

[9] Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008. Page 1-3.

bearing scrap and recover precious metals (iridium, tellurium, rhodium, ruthenium, gold and silver). The raw materials used for the secondary copper smelter reportedly included shredded telephones and switchboard equipment, iron, brass, discarded electrical equipment, and other copper-bearing materials.

Lead was present in the copper ores and remained present in slag after recovery of copper. Slag was disposed in various areas of the Site, such as in an area south of the former copper smelter where slag pile elevations reportedly reached over 30 feet above grade. Slag from an electric arc furnace used from 1972 to 1986 was also discarded in numerous slag piles at the Site. The Facility reportedly operated a lead smelting unit in the southern portion of the Site. This lead smelter is believed to have operated from before 1931 until at least 1951.

A variety of scrap materials containing metals was processed at the Site to recover copper and precious metals. These metals sources included batteries, automotive parts, electric motors, and insulated wire. Scrap wire processed at the Facility reportedly contained more than 600 types of insulating materials, including polyvinyl chloride, neoprene, rubber, and asphaltic substances. The processing of these materials reportedly included open burning of large quantities of insulated copper wire to remove the insulation.

During the 80-year period that the Facility operated, emissions occurred from various process units, including: copper smelting, refining and casting; precious metals refining; white metal recovery; and lead recovery. Wastes and byproducts from historical operations also included piles of slag and dust from various emission sources. Other areas of the Site were used to store concentrates (copper ores) and scrap copper materials. Metals contained in the slag included lead, arsenic, chromium, copper, and zinc. Atmospheric emissions contained lead, cadmium, copper, zinc, and iron.

2.2 Proposed Class Area

The Proposed Class Area is in Carteret, a borough in Middlesex County, New Jersey, and a portion of Port Reading, New Jersey, and is situated immediately northwest of the former USMR Facility (see **Exhibit 1**). The Proposed Class Area is defined in the *Amended Class Action Complaint,*[10] and is generally delineated as an area bounded by Carteret Street, Rosewood Lane, Jackson Avenue, Varga Drive and Monroe Avenue to the West; Roosevelt Avenue, Grant Avenue, Hayward Avenue, and Beverly Street to the North; Peter J. Sica Industrial Highway and Middlesex Avenue to the East; and Chrome Avenue, Pershing Avenue, Bergen Street, Edwin Street, and Port Reading Avenue to the South. Based on real

[10] Duarte, et al. v. United States Metals Refining Company, et al. – Amended Class Action Complaint and Jury Demand. In the District Court of New Jersey. Civil Action No.: 2:17-cv-01624 (ES)(SCM). December 27, 2017.

property tax parcels identified in a geographic information system ("GIS") database, there are over 5,700 residential properties in the Proposed Class Area.[11]

The Proposed Class Area represents a substantial portion of the Borough of Carteret. According to Middlesex County data from 2015, Carteret Borough contained approximately 7,790 total households.[12] Fifty-eight percent (58%) of the population in 2015 was identified as white, followed by Hispanic/Latino (29%), Asian (24%), and black/African American (15%). The median household income was $67,068 in 2015 and the median home value was $245,500. For reference, the national median household income in 2015 was estimated at $56,516.[13]

3 REMEDIAL INVESTIGATIONS BY USMR

3.1 Environmental Investigations at USMR Facility

Numerous environmental investigations have occurred at the former USMR Facility since the late 1980s. A review of the nature and extent of these many investigations is beyond the scope of this Report. However, this section provides an overview of information obtained from a 2008 *Local and Regional Environmental Impacts* report describing the extent of lead and copper contamination found in areas of the former USMR Facility and off-site areas.[14]

CH2MHill (2008) reported that the primary sources of metals contamination at the Site and in the surrounding region were historical processes and waste disposal operations at the USMR Facility, including land disposal of metal slag, historical fill, deposition of metals from air emissions, and discharges of wastewater and stormwater. A section of this 2008 report summarized soil analytical results collected from parcels in the southern portion of the Site and indicating percent levels of lead and copper in slag fill areas at the Facility. For example, samples collected from three slag disposal areas at the Site reportedly demonstrated fill materials with up to 4% lead composition (by weight).[15] CH2MHill (2008) also reported a lead concentration of 94,200 mg/kg (9% by weight) in a soil sample

[11] Parcel Data, geospatial database maintained by Middlesex County. Obtained from Middlesex County Open Data Portal, online at: https://mcgisweb.co.middlesex.nj.us/open-data-portal/. Accessed March 2019.
[12] Statistics & Demographics, Carteret Borough, Demographic Summary (2015 Data). Available online at: http://www.middlesexcountynj.gov/About/StatisticsDemographics/Pages/default.aspx. Middlesex County, New Jersey. Accessed April 2019.
[13] Income and Poverty in the United States: 2015. United States Census. Report No. P60-256. Available online at: https://www.census.gov/library/publications/2016/demo/p60-256.html. U.S. Census. Accessed April 2019.
[14] Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008.
[15] Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008. Page 2-4 (Table 2-2).

collected from the top six inches of soil at a parcel of the former Facility occupied by Staflex.[16] This property is located on the northwest side of Middlesex Avenue near the southerly boundary of the "Off-site AOC" (discussed below).

This CH2MHill (2008) report appended several isoconcentration maps illustrating metals concentrations in surface soil and fill materials in the southern portion of the Facility from sampling conducted in around 1990. These maps showed areas of the southern portion of the Site with levels of lead and copper exceeding 25,000 mg/kg and 60,000 mg/kg, respectively.[17] These maps indicated metals contamination delineated up to the boundary of the Site and suggested contamination existed beyond the Site boundary.

CH2MHill (2008) also reported elevated lead concentrations in soil adjacent to the former lead manufacturing facility at the Site on a parcel owned/occupied at the time by Reichhold.[18] Reportedly, Reichhold discovered multiple battery casings at its property during a soil removal action. These materials were found in an area reportedly associated with a battery breaker building on the former USMR property. Battery casings are often associated with lead manufacturing facilities because battery cores are used as a source of lead.

3.2 Evolution of Off-Site Area of Concern

In 1988, the NJDEP issued an Administrative Consent Order, directing USMR to "fully determine the horizontal and vertical extent of pollution at and/or emanating from the site."[19] The COCs of interest were lead, arsenic and copper, which were potentially present in residential soils beyond the Facility boundary. In 2012, USMR retained Arcadis U.S., Inc. ("Arcadis") to develop and implement a Remedial Investigation ("RI") to respond to this request.

In August 2012, Shaw Environmental, Inc. ("Shaw") submitted a *Soil Sampling and Analysis Plan* ("SAP") to determine whether the former Facility may have impacted off-site areas, primarily resulting from air deposition.[20] Shaw proposed delineation of soils with concentrations of metals above SRSs to define the Off-site Area of Concern (the "Off-site AOC") and sampling of individual properties within this area. Shaw stated that exceedances of SRSs at individual residential properties would be determined after

[16] Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008. Page 2-8.
[17] Appendix H. Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008.
[18] Local and Regional Environmental Impacts from the U.S. Metals Refining Company Facility Operations in Carteret, New Jersey. CH2MHill (Philadelphia, PA). August 2008. Page 2-9.
[19] Deposition of Joseph A. Brunner. Taken June 6, 2018. Exhibit 54. Bates No. USMR00017674.
[20] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012.

approval of the Off-site AOC by the NJDEP Licensed Site Remediation Professional ("LSRP").[21] At this time, the LSRP assigned to oversee off-site investigations was Mr. Michael McNally, P.E. with the ELM Group. [22,23]

Shaw delineated a boundary in its SAP defined as an Initial Soil Delineation Area ("ISDA"). The ISDA was stated to be the planned boundary for initial off-site soil investigation. The Off-Site AOC would be determined from evaluation of a "statistically-significant number of soil samples" throughout the ISDA (see **Exhibit 2**). Shaw further stated "if the evaluation of soil concentrations for these key metals indicates that the off-site AOC extends beyond the ISDA, the soil delineation process described within this SAP will be extended laterally until an off-site AOC can be established".[24]

In 2013 and 2014, Arcadis conducted their Remedial Investigation, which included extensive soil sampling at residential properties "… to determine the existence and extent of any impacts".[25] This RI consisted of developing a Conceptual Site Model ("CSM"), which tentatively established an Off-site AOC and involved the collection and analysis of soil samples from approximately 60 residential properties within the AOC. Based on the results of the RI sampling and other evaluations, the boundary line for the Off-site AOC was reported in an *Interim Data Report* to the LSRP in July 2014.[26] The boundary of the Off-site AOC evolved based on results of sampling as well as other factors such as input from the Borough of Carteret.[27] Two similar iterations of the Off-site AOC boundary drafted by Arcadis in around late 2014 to early 2015 are presented in **Exhibit 3**.

The *Interim Data Report* was later incorporated into an *Off-Site Area of Concern Remedial Investigation Report* ("Off-site RI Report") submitted to NJDEP. Arcadis performed analyses that "…indicated a decline in soil concentrations the farther the samples were collected from the On-site area".[28] The Off-site RI Report, which detailed the methodology to establish the Off-site AOC, was submitted to NJDEP in May 2016.

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[21] The LSRP is a person licensed by the NJDEP to provide oversight of remediation at contaminated sites in accordance with the Department's applicable standards and regulations. See Overview of the Licensed Site Remediation Professional (LSRP) Program. New Jersey Department of Environmental Protection. June 2014.
[22] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 1-1.
[23] Videotaped Deposition of Michael McNally. Reported by Angela M. Shaw-Crocket, Golkow Litigation Services. August 17, 2018.
[24] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 1-2.
[25] Remedial Action Work Plan Addendum - Boundary Evaluation Soil Sampling Program. Arcadis U.S., Inc. November 2016. Page 1.
[26] Remedial Action Work Plan Addendum - Boundary Evaluation Soil Sampling Program. Arcadis U.S., Inc. November 2016. Page 1.
[27] Exhibit 70, Oral and Videotaped Deposition of Joseph A. Brunner. Volume 2. June 7, 2018. Page 343.
[28] Good Faith Estimate - Maximum Potential USMR Off-Site Area of Concern Expansion Area. Arcadis Design & Consultancy. September 15, 2017.

In September 2016, Arcadis completed a *Remedial Action Work Plan* (RAWP) [29] that presented a program for soil investigations in the Off-Site AOC. The LSRP approved the RAWP in September 2016.[30] In November 2016, Arcadis prepared a *Remedial Action Work Plan Addendum* ("RAWP Addendum"). This RAWP Addendum stated:

> *"Because addressing impacted soil within the Off-Site AOC requires USMR to investigate approximately 300 individual properties within the Off-Site AOC and remediate exceedances of residential soil cleanup standards for the constituents of concern, this remedial action work necessarily includes additional soil sampling of every such property in the area in order for USMR to design, for each individual property, the precise scope of remedial action necessary to address impacted soil".* [31]

The RAWP Addendum contemplated the need to confirm the boundary of the Off-site AOC and acknowledged that concentrations of COCs exceeding SRSs were present in soils from properties at or near the boundary of the Off-site AOC. [32,33] Accordingly, the RAWP Addendum proposed additional sampling outside the boundary of the Off-site AOC to confirm its location. This additional soil sampling was indicated to include "… a series of transects well beyond the current boundary of the Off-Site AOC (up to 500 meters)". USMR reportedly contracted with Geosyntec Consultants ("Geosyntec") to evaluate potential expansion of the boundaries of the Off-site AOC. Using an air dispersion model, Geosyntec estimated that the maximum expansion of the Off-site AOC would be approximately 500 meters past the outer edge of the existing boundary.[34] The expanded "Potential AOC Expansion Area" developed as a result of this work by Geosyntec is presented in **Exhibit 4**.

In September 2017, Arcadis prepared a *Good Faith Estimate* of costs associated with further property investigation and remediation within the Potential AOC Expansion Area.[35] Arcadis estimated that there were 1,090 properties in their Potential AOC Expansion Area, which was divided into four (4) zones, where Zone 1 is closest, and Zone 4 is the farthest from the USMR Facility (see **Exhibit 4**). This cost estimate presented a scope of work for the investigation activities, as well as estimates of numbers of properties in each Zone that would require remediation. At this time, Arcadis estimated that 90% of

[29] Remedial Action Work Plan - Off-Site Area of Concern. Arcadis U.S., Inc. September 2016.
[30] Remedial Action Work Plan Addendum - Boundary Evaluation Soil Sampling Program. Arcadis U.S., Inc. November 2016. Page 2.
[31] Remedial Action Work Plan Addendum - Boundary Evaluation Soil Sampling Program. Arcadis U.S., Inc. November 2016. Page 2.
[32] Remedial Action Work Plan Addendum - Boundary Evaluation Soil Sampling Program. Arcadis U.S., Inc. November 2016. Page 2.
[33] Good Faith Estimate - Maximum Potential USMR Off-Site Area of Concern Expansion Area. Arcadis Design & Consultancy. September 15, 2017.
[34] Geosyntec's modeling was conducted using the 2012 McVehil air dispersion model.
[35] Good Faith Estimate - Maximum Potential USMR Off-Site Area of Concern Expansion Area. Arcadis Design & Consultancy. September 15, 2017.

properties in Zone 1 (285/317) would require remediation, and only 10% of properties in Zone 4 (22/218) would need remediation. Based on these estimates, the costs for investigation and remediation were estimated to be $24M and $31M, respectively. However, these estimates were based on flawed methodologies and assumptions about decreasing contamination levels with distance, which were made during the delineation of the ISDA. As discussed previously, the ISDA was developed based on sampling within the AOC only; however, data collected later outside the AOC indicates there is a need for widespread remediation of this area.

Information and documents describing USMR's position on the need for additional property investigations in the Potential AOC Expansion Area have not been located. USMR is focusing its efforts on completing actions in the Off-site AOC at this time. This work, which is summarized below, may be a model to consider as the minimum of actions necessary to address residential properties within the proposed Class Area.

3.3 Remedial Actions in Off-Site AOC

Remedial actions conducted by USMR at residential properties in the Off-site AOC can be summarized based on information provided in a June 2017 *Remedial Action Report* for a residential property located at 25 Salem Avenue (as the "*25 Salem RAR Report*").[36] This residential property is centrally-located in the Off-site AOC. The *25 Salem RAR Report* explains USMR's general approach for decision-making, sampling, evaluating results, and conducting remedial actions at residential properties contained within the Off-site AOC boundary. The following can also be considered as a minimum standard for additional future actions to be conducted outside of the Off-site AOC boundary.

In September 2017, Michael McNally sent a proposal to USMR for remedial actions in the Off-Site AOC.[37] This proposal indicates that the LSRP would provide input and review for approximately 301 properties in the Off-site AOC. The proposal indicated Remedial Action Reports ("RARs") would be prepared and submitted for each property. One such RAR report is discussed below for a residential property located in the central portion of the Off-site AOC.

3.3.1 Property Investigation Design

As stated at the start of the *25 Salem RAR Report*¸ the Off-site AOC is defined as a boundary where USMR is conducting remedial action investigations. This Off-site AOC was based on the already-completed RI, which was an action "designed to collect sufficient data to perform the delineation using

[36] Remedial Action Report – Off-site Area of Concern. Arcadis Design & Consultancy. June 2017.
[37] USMR Carteret LSRP Services – Remedial Actions – Proposal and Service Agreement Request. The Elm Group. September 13, 2017. Exhibit 190 to the Videotaped Deposition of Michael McNally.

an extrapolation of concentration trends".[38] The *25 Salem RAR Report* presented a depiction of the Off-Site AOC boundary (see **Exhibit 5**).

According to the *25 Salem RAR Report*, the remedial action (RA) investigation in the Off-site AOC was implemented in accordance with the Remedial Action Work Plan (RAWP).[39] The RA consisted of a series of steps to collect data, as summarized below. Each property was divided into "functional areas" not exceeding 10,800 square feet. At residential properties, these functional areas were typically separated such that front and back yards were separated. Each functional area was assigned ten (10) soil boring locations. Soil samples were collected from 6-inch depth intervals up to four (4) feet below ground surface ("ft bgs"). Initially, soil samples from 0-6 inch and 6-12 inch depth intervals were analyzed for lead, arsenic, and copper. If any sample from the deepest analyzed interval contained a COC concentration exceeding its respective SRS, then all the samples from the next depth interval were analyzed. This process was continued until none of samples from a depth interval were above the SRS.

3.3.2 Depth Interval and Remediation Compliance Averaging

According to the *25 Salem RAR Report*, "the horizontal and vertical extents of soil contamination exceeding the SRS were defined in all directions". The limits of remedial excavation were established using a 95% upper confidence limit ("UCL") approach. The UCL was determined using ProUCL statistical software in accordance with NJDEP guidance. Compliance averaging was used to calculate the 95% UCLM for each functional area and depth interval. An iterative process was used to evaluate each functional area to determine if the area required remedial action. "If required, each dataset was evaluated for outliers".[40] An outlier is a value (concentration) that is outside (lower or higher) than the main dominant population in a data set. "If the analysis indicated that outliers were present, the outlier results were not included in calculation of the remediation UCLMs".

For each depth interval in a functional area, a 95% UCLM was calculated separately for lead, arsenic, and copper. Each data set was also evaluated for outliers (using ProUCL software), and any identified outliers were removed. If the concentration of lead, arsenic, or copper in any sample from a depth interval exceeded the SRS, then all samples from the next depth interval were analyzed. If all the calculated depth-interval UCLMs were below the SRS, remediation was not required. However, if the 0-6 inch depth interval 95% UCLM exceeded the SRS, all locations in the 0-6 inch interval that exceeded the SRS were excavated regardless of the pre-remediation 95% UCLM calculated for the entire 0-2 foot interval.

Pre- and post-remediation compliance averaging UCLMs were calculated for each functional area. Each soil boring was evaluated separately to determine the deepest sample interval. If the pre-remediation

[38] Remedial Action Report – Off-site Area of Concern. Arcadis Design & Consultancy. June 2017. Page 5.
[39] Remedial Action Work Plan - Off-Site Area of Concern. Arcadis U.S., Inc. September 2016.
[40] Remedial Action Report – Off-site Area of Concern. Arcadis Design & Consultancy. June 2017. Page 6.

95% UCLM was below the applicable SRS, a remedial action (RA) was not required for that metal. However, if the 95% UCLM was above the applicable SRS, an RA was required for that metal (e.g., lead). The horizontal and vertical extents of remediation were then defined and excavation(s) performed. Certified clean backfill was used for restoring excavation areas. Post-remediation 95% UCLMs were calculated by replacing the pre-remediation values in areas to be excavated with the certified clean fill concentrations. Excavation of contaminated sample areas and replacement with clean fill was continued until the post-remediation 95% UCLM was below the SRS for each analyte.

The residential property discussed in the *25 Salem RAR Report* was remediated using the methodology explained above. At this property, the entire front yard (4,100 square feet) was excavated to a depth of 6 inches. Clean fill was used to restore this area back to grade. The pre-remediation 95% UCLMs for arsenic and lead were 23.2 mg/kg and 563.6 mg/kg, respectively. By excavating the top 6-inches of soil in the functional area and replacing pre-remediation ULCMs with values for clean fill materials, the post-remediation UCLMs for arsenic and lead were 16.7 mg/kg and 330.6 mg/kg, respectively. Thus, the post-remediation UCLMs were below the SRSs for arsenic (19 mg/kg) and lead (400 mg/kg), which allowed USMR to deem the cleanup complete at this property. However, this procedure allowed for lead and arsenic to remain in place despite exceeding the NJ SRS, and, furthermore, lead was not remediated below 200 mg/kg cleanup level, as necessary, as will be discussed later in this report.

According to records in the *USMR Soil Project Database*,[41] USMR's actions necessary to investigate and remediate the property at 25 Salem Avenue extended from around September 2015 (access obtained) until December 2016 (post-cleanup inspection complete). A final letter to the property owners was not provided until May 2018.[42] The method used by USMR for remediation of this site resulted in removal and replacement of the top 6-inches of soil only and elevated concentrations of arsenic (19.8 to 27.9 mg/kg) and lead (512 to 870 mg/kg) at the 6-12 inch depth interval were left in place.[43] This cleanup action appears satisfactory in terms of the surficial soils being largely replaced. However, as discussed in a following section, the SRS for lead that serves as a basis for decision-making is deserving of evaluation.

4 EVALUATIONS IN PROPOSED CLASS AREA

As discussed in the previous section of this Preliminary Report, USMR has conducted several phases of environmental site assessments at residential properties nearest to the Site. These investigations have included predetermined areas or zones, including the "Off-Site AOC" and "Potential AOC Expansion

[41] USMR Soil Project Database. Available online at: https://gis.craworld.com/freeportmcmoran/TIA.htm.
[42] Completion of Soil Cleanup 25 SALEM AVENUE / Parcel ID: 1201_7603_11/ PPIN: 1046 - Carteret, NJ 07008. USMR Soil Project. May 29, 2018.
[43] Remedial Action Report – Off-site Area of Concern. Arcadis Design & Consultancy. June 2017. Page 6.

Area". USMR has performed property-specific assessments and some remedial actions (RAs) at residential properties within the Off-site AOC only.

This section presents my evaluations demonstrating that all properties within the "Potential AOC Expansion Area" and extending laterally to the bounds of the Proposed Class Area must be remediated. This process would be consistent with the design of previous off-site investigations by USMR and the rationale indicated in numerous work plans and reports submitted to NJDEP.[44] As discussed further herein, it is my opinion that the entire proposed Class Area requires remediation.

4.1 Impacts in the Off-Site AOC

4.1.1 Soil Remediation Standard Used by USMR

As discussed in the previous sections, USMR has conducted several phases of remedial investigations relating to the "Off-Site AOC" boundary. These include phases of remedial investigation (RI), property-specific site investigations, and remedial action (RA). USMR utilized a data collection and evaluation approach that is documented. Various procedures were used to evaluate the sampling data, including data processing and expelling of outliers (low or high results) from data sets used for calculating UCLMs.

The applicable NJDEP remediation standards and screening levels that have been used by USMR to direct remedial actions at residential properties are the Residential Direct Contact ("RDC") SRSs. The SRSs for lead and arsenic are 400 milligrams per kilogram ("mg/kg") and 19 mg/kg, respectively. Copper, which is not believed to be present in residential soils at levels of concern, has an SRS of 3,100 mg/kg. Copper is considered a reliable indicator of metals concentrations associated with the former USMR operations.[45] These SRSs were utilized by USMR as part of its decision-making for remedial investigations and remedial actions at residential properties.[46]

4.1.2 Evolution of Remediation Standards for Lead

Lead is one of the most prevalent and monitored sources of childhood poisoning. According to the State of New Jersey Department of Health,

> *"The effects of lead-poisoning on children can be devastating. Just 10 micrograms of lead per day (the equivalent of 3 grains of sugar) can place a child in danger. Irreversible learning disabilities as well as lowered intelligence are the usual result. Lead poisoning occurs when lead has been introduced into the bloodstream by ingestion and inhalation of lead dust or fumes. Our bodies cannot distinguish lead*

[44] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 1-2.
[45] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 2-1.
[46] Remedial Action Report – Off-Site Area of Concern. Arcadis Design & Consultancy. June 2017.

> *from other minerals, like iron and calcium, which out bodies actually need, and sends it directly to the vital organs. Lead is then deposited in these organs as well as our brain and bone marrow."*[47]

The Department of Health goes on to explain that "women of childbearing age and children under the age of six are considered to be at the highest risk…The main reason for this is the way a child's body assimilates lead (thinking it is a vital nutrient). In addition, children (both born and unborn) have bodies which are still developing, and a low body weight. In addition, small children have a high rate of hand-toy-to-mouth contact."[47]

Federal, state, and local programs to identify and prevent childhood exposure to lead have been in place for decades. In the past, a blood lead level ("BLL") of 10 micrograms per deciliter ("ug/dL") was considered a "level of concern", above which actions would be taken to reduce exposure.[48] In 2012, the Centers for Disease Control and Prevention ("CDC") changed its BLL recommendation to a "reference level" of 5 ug/dL, which is based on the 97.5th percentile of blood lead distribution in children based on national surveys. This change was based on scientific studies demonstrating even low BLLs can cause adverse health outcomes, such as those discussed previously.

The U.S. EPA maintains a generic Regional Screening Level ("RSL") of 400 mg/kg for lead in residential soil.[49] U.S. EPA's RSL for lead is equivalent to NJDEP's SRS and it is this criterion of 400 mg/kg that is being used as the soil cleanup standard by USMR for its remedial actions in the Carteret area. However, there are indications that CDC's change to a blood lead "reference level" of 5 ug/L will result in lower cleanup levels for lead in areas that may involve exposure to children and women of childbearing age. This section demonstrates that the 400 mg/kg cleanup standard is too high to be protective of sensitive groups in the Proposed Class Area.

The NJDEP SRS of 400 mg/kg is based on the U.S. EPA's Integrated Exposure Uptake Biokinetic ("IEUBK") model, which, utilizing the default parameters, is designed to protect 95% of the target population (children) at a blood lead level of 10 ug/dL.[50] This model calculates the soil remediation goal based on user inputs and is highly sensitive to the BLL level. For example, at a BLL cutoff of 10 ug/dL, the IEUBK model defaults to a soil and/or dust remediation goal of around 400 mg/kg. However, at a BLL cutoff of 5 ug/dL, the remediation goal for lead drops to around 154 mg/kg using IEUBK default assumptions.

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[47] Lead Frequently Asked Questions. State of New Jersey Department of Health. Online at: https://www.state.nj.us/health/ceohs/lead/lead-faq/#3. Accessed April 2019.
[48] What Do Parents Need to Know to Protect Their Children? Centers for Disease Control and Prevention. Online at: https://www.cdc.gov/nceh/lead/ACCLPP/blood_lead_levels.htm. Accessed February 2019.
[49] Regional Screening Levels (RSLs) - Generic Tables. United States Environmental Protection Agency. Online at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. Accessed February 2019.
[50] Site Remediation Program – Soil Cleanup Criteria (mg/kg). New Jersey Department of Environmental Protection. Online at: https://www.nj.gov/dep/srp/guidance/scc/. Accessed February 2019.

U.S. EPA's RSL and NJDEP's SRS are default values and are generic. That is, these are minimum cleanup criteria that can be applied as a default. The IEUBK model is the basis for these cleanup values, and as indicated above is sensitive to the BLL cutoff being considered. If a lead risk assessment was performed in the Carteret area, it is certain that a lower cleanup standard would be recommended. In his August 2018 deposition, Michael McNally, the Site LSRP, acknowledges that a lower cleanup standard may be appropriate in Carteret based on information from Fred Mumford at the NJDEP. In an email to Joseph Brunner, Mr. McNally stated "that a recent Superfund site in New Jersey decided to clean up to a lower standard of around 250 mg/kg for lead based an updated EPA screening/risk value related to juvenile blood concentrations," and that Mr. Mumford brought this to his attention "in case we wanted to consider using the more stringent value".[51]

The latest CDC recommendation for BLL was considered for a former Sherwin-Williams site referred to as the Route 561 Dump Site in Gibbsboro, New Jersey. As part of the remedial investigation activities, a Human Health Risk Assessment ("HHRA") was conducted by Gradient in July 2015.[52] This HHRA included a discussion on uncertainties in setting a target lead risk. Gradient acknowledged in the HHRA that CDC had recently replaced the "level of concern" concept with a "reference level" of 5 ug/dL. However, U.S. EPA had not yet adopted a reference level of 5 ug/dL for use in lead risk assessment. At this time, U.S. EPA's RSL for lead was 400 mg/kg, which was based on EPA's risk reduction goal to limit the probability of a child's BLL exceeding 10 ug/dL. Gradient's HHRA at this site in 2015 marks a point in time where changes were not yet adopted but at least being evaluated.

In September 2017, U.S. EPA published a *Record of Decision* for the Matteo & Sons Superfund Site in West Deptford, New Jersey.[53] This ROD addressed contaminated soil at residential properties with unsafe concentrations of lead. The selected remedies included temporary relocation of residents, remedial excavation and restoration, and institutional controls to prevent future exposure. This U.S. EPA cleanup specifically called for a risk reduction goal where the average lead concentration within the top two feet across each residential property must be at or below 200 mg/kg once the selected remedial action targeting detections above 400 mg/kg is complete".[54] A residential soil cleanup level of 200 mg/kg was selected "to reflect IEUBK modeling results based on a target blood lead level of 5 ug/dL".[55]

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[51] Deposition of Michael McNally. Exhibit 219. Email dated November 13, 2017. Deposition dated August 17, 2018.
[52] Human Health Risk Assessment for the Route 561 Dump Site, Gibbsboro, New Jersey. Gradient. July 2015. Page 53.
[53] Record of Decision - Operable Unit Two, Matteo and Sons, Inc. Superfund Site, West Deptford, Gloucester County, New Jersey. United States Environmental Protection Agency. September 2017.
[54] Matteo and Sons, Inc. Superfund Site - Record of Decision Operable Unit 1. New Jersey Department of Environmental Protection. September 13, 2017. Page 11.
[55] Final Remedial Investigation Report – Matteo & Sons, Inc. Site. U.S. Environmental Protection Agency. May 2017. Page 4-2

NJDEP reviewed and concurred with this *Record of Decision* and acknowledged "this site cleanup represents the first use of the region's new lead strategy to achieve a target blood lead level of 5 ug/dL for residents potentially impacted by the site".[56] NJDEP also supported U.S. EPA's strategy to use "rounding to a 200 mg/kg lead level for use in the surface representing the top two feet and using the state lead soil standard of 400 mg/kg at deeper depths". The Matteo & Sons *Record of Decision* in 2017 marks a point in time where the U.S. EPA's Region 2 has now adopted a lead strategy to achieve a target BLL of 5 ug/dL.

It is evident from the examples presented above that regulatory agencies are moving toward more protective cleanup standards for remediation of lead in residential soil. These changes are of greatest importance in areas where children are potentially exposed, such as residential soils. In fact, the California Office of Environmental Health Hazard Assessment ("OEHHA") adopted a residential lead California Human Health Screening Standard Level ("CHHSL") of 80 mg/kg in 2009, based on a BLL of 1 ug/dL.[57] While the NJDEP and U.S. EPA still maintain cleanup standards of 400 mg/kg, lower standards have been adopted by EPA in New Jersey and acknowledged by NJDEP. Because both agencies rely on risk assessment to set default values, it is also considerable that the IEUBK model will recommend a lead cleanup criterium of around 154 mg/kg using the CDC's "reference level" BLL of 5 ug/dL. Furthermore, the LSRP for the Site, Michael McNally, indicated in his 2018 deposition that a lower standard of 250 mg/kg is appropriate.[58]

4.1.3 Arsenic Remediation Standard

Arsenic exposure is also associated with significant health consequences. The NJDEP website includes the following information:

> *"Arsenic is one of a relatively small number of chemicals that has been classified by USEPA as a known human carcinogen, based on human epidemiological data…. Ingestion of inorganic arsenic is associated with increased risk of several types of cancer in humans including skin, lung, liver, kidney and urinary bladder. Other potential effects of ingestion of elevated arsenic include gastrointestinal ailments,*

[56] Letter from Mark J. Pedersen, Assistant Commissioner, Site Remediation & Waste Management Program, re: Matteo and Sons, Inc. Superfund Site - Record of Decision Operable Unit 1. New Jersey Department of Environmental Protection. September 13, 2017.
[57] Revised California Human Health Screening Levels for Lead. California EPA Office of Environmental Health Hazard Assessment. September 2009.
[58] Deposition of Joseph A. Brunner. June 6, 2018. Page 289.

such as diarrhea and cramping, thickening and/or discoloration of the skin, increased risk of diabetes and cardiovascular impacts."[59]

Based on these health impacts, NJDEP has adopted a Residential Direct Contact SRS of 19 mg/kg.[60] As discussed previously, this is the standard which USMR has followed in remedial actions and should be used in future cleanup in the Class Area.

4.2 Impacts Beyond the Off-Site AOC

4.2.1 Flaws in Development of AOC Boundaries

As previously discussed, USMR began their off-site "Area of Concern" investigations by establishing an "Initial Soil Delineation Area" or ISDA boundary based on roughly sixty sample locations within the AOC. USMR stated early on as a part of its process of site investigation that the boundary "… will be extended laterally until an off-site AOC can be established".[61] Remedial investigation (RI) was conducted in the ISDA area and was used by USMR to delineate the "Off-site AOC" boundary. This Off-site AOC has been the focus of most of the actions taken by USMR to address property-specific investigations and remediation actions. USMR conducted air modeling to evaluate the potential for impacts beyond the "Off-site AOC". As a result of this modeling, an estimated "Potential AOC Expansion Area" was established by Arcadis. The "Potential AOC Expansion Area," is based on qualitative modeling performed by Dr. George McVehil of Geomatrix and the limited set of initial sample locations tested as part of the ISDA, which ignores the thousands of additional soil sample locations and data available to them for analysis. During the remediation investigation, USMR developed a Conceptual Site Model based on this air modeling, which, as Joe Brunner explained during his deposition, shows a "general exponential decrease of concentrations as you moved away from the facility".[62] There are several lines of evidence suggesting that neither the "Off-Site AOC" nor the "Potential AOC Expansion Area" boundary are adequate to encompass the full extent of soil contamination. Arcadis divided the "Potential AOC Expansion Area" into four Zones (see **Exhibit 4**).[63] Additional soil sampling was conducted by USMR at 38 properties located along transects in the "Potential AOC Expansion Area". As discussed in the next section of this Report, the results of this soil sampling indicate elevated concentrations of COCs extend throughout the areas sampled in the "Potential AOC Expansion Area".

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[59] A Homeowner's Guide to Arsenic in Drinking Water. New Jersey Department of Environmental Protection. Online at: https://www.state.nj.us/dep/dsr/arsenic/guide.htm. Accessed April 2019.
[60] Remediation Standards (N.J.A.C. 7:26D). Last amended September 18, 2017. Online at: https://www.nj.gov/dep/rules/rules/njac7_26d.pdf. Accessed April 2019.
[61] Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. Page 1-2.
[62] Deposition of Joseph A. Brunner. June 6, 2018. Page 183.
[63] Good Faith Estimate - Maximum Potential USMR Off-Site Area of Concern Expansion Area. Arcadis Design & Consultancy. September 15, 2017.

In addition to this soil data, **Exhibit 6** presents historic photographs taken during the period that USMR operated at the Site, which visually demonstrate the extent of air pollution emanating from the facility. These images lend further support to the conclusion that the soil contamination seen throughout the Class Area originated from the USMR facility. In addition, between 1983 and 1986, USMR received numerous air quality permit violations resulting from smelter activity.[64]

Michael McNally, the Site LSRP, made several admissions during his August 2018 deposition that indicate that the full extent of contamination has not been determined. When asked if USMR is required to delineate the full extent of off-site contamination, Mr. McNally said, "to the cleanup standards, yes."[65] He then went on to explain that the boundary of the Off-Site AOC is subject to change based on new data, stating, "if we have data that continues to support that it goes further than that line, we'll continue to remediate…I would require them to continue to remediate".[66] When presented with transect data collected outside of the Off-Site AOC, Mr. McNally stated "it does appear like the AOC's boundaries extend. This is the first time I've seen the data, so without looking at it further, I assume so. It looks like it would."[67] The boundary of the Off-Site AOC was arbitrarily established in 2012 and approved by Mr. McNally based on incomplete data, which did not cover the full extent of the Class Area. As will be discussed in the following section of this Report, data collected outside of the Off-Site AOC confirms that this boundary must be extended in order to encompass the entire impacted area.

4.2.2 Evaluation of USMR Transect Sampling Data

As discussed previously, in 2017, Arcadis prepared a *Good Faith Estimate* of the costs associated with the remediation of potential contamination in the area surrounding the Off-Site AOC. The purpose of this report was to estimate the costs associated with a remedial investigation in the Potential AOC Expansion Area. In pursuit of this goal, Arcadis collected a limited number of samples in this area in order to characterize the vertical and horizontal extent of contamination beyond the Off-Site AOC. Of the 1,090 properties they estimated were within the Potential AOC Expansion Area, Arcadis collected soil samples from a total of 38 properties, which were then analyzed for lead, arsenic, and copper. Arcadis then estimated the number of properties in each zone that would require remediation based on NJDEP SRSs for lead and arsenic. Overall, Arcadis estimated that there would be a significant decrease in lead and arsenic concentrations moving outwards from Zone 1 to Zone 4. The report concludes that approximately 90% of properties in Zone 1, 60% of properties in Zone 2, 30% of properties in Zone 3, and 10% of properties in Zone 4 would require remediation.

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[64] Deposition of John Alvin Fenn. Exhibit 47 (Bates No. USMR00005602). Exhibit 48 (Bates No. USMR 00006943). Exhibit 49 (Bates No. USMR 00830289). June 4, 2018.
[65] Deposition of Michael McNally. August 17, 2018. Page 230.
[66] Deposition of Michael McNally. August 17, 2018. Page 33.
[67] Deposition of Michael McNally. August 17, 2018. Page 390.

In order to interpret the Arcadis analysis, SWAPE re-analyzed the soil sampling data collected by Arcadis. The methods used for this analysis were based on those used in the *Good Faith Estimate*, as well as guidance from NJDEP and USEPA. Accordingly, the analysis was conducted in the following manner. Because the database maintained by Arcadis included sampling results from the Off-Site AOC as well as the Potential AOC Expansion Area, it first had to be determined which parcels fell within each zone. Each parcel included in the Arcadis database was associated with a unique Parcel Identification Number ("PPIN"). The database also included GIS maps displaying the spatial location of each PPIN in the Potential AOC Expansion Area and the AOC. Using these maps and the Zone map included in the report (see **Exhibit 4**), SWAPE was able to determine which parcels fell within each zone. In total, four properties were evaluated in Zone 1, 10 properties in Zone 2, 10 properties in Zone 3, and 14 properties in Zone 4. Once this was determined, the data related to the parcels in Zones 1-4 were isolated from that of the parcels in the Off-Site AOC.

In order to estimate the percentage of properties that would require remediation in each zone, Arcadis calculated the 95% Upper Confidence Level ("UCL") for each COC in each parcel. Any parcels with a UCL exceeding the SRS for either COC would require remediation. In accordance with NJDEP guidance, SWAPE utilized ProUCL software to calculate UCLs for each parcel in the Potential AOC Expansion Area. Before calculating UCLs, ProUCL's outlier analysis function was used to remove potential outliers from each set of parcel data. Following the methods utilized by Arcadis, ProUCL's outlier analysis was run twice for each parcel, once for the 0-6 inch samples and once for the 6-12 inch samples. In total, 32 outliers were removed from the lead dataset and 15 outliers were removed from the arsenic dataset.

The data for all sample depths were then combined and a 95% UCL was calculated once for the top foot of soil in each parcel. ProUCL calculates several UCLs for different types of distributions and recommends the most appropriate UCL based on the data. In some cases, the software recommends several different UCLs; in such instances, the lowest output was chosen in order to provide a conservative analysis. After calculating UCLs, each one was compared to the appropriate SRS. As discussed in the previous section, NJDEP maintains a Residential Direct Contact SRS for lead of 400 mg/kg; however, current research and a previous remediation project overseen by NJDEP suggest a proposed cleanup standard of 200 mg/kg is more appropriate and is, therefore, being proposed in this report.

Our results demonstrate that Arcadis's analysis underestimates the number of properties in the Potential AOC Expansion Area that require remediation. Overall, 55% (21/38) of parcels exceeded the lead SRS of 400 mg/kg, 89% (34/38) exceed the proposed lead cleanup standard of 200 mg/kg, and 92% (35/38) of parcels exceeded the arsenic SRS of 19 mg/kg. The results of this analysis are displayed spatially in **Exhibit 7.** By zone, the percentages of properties exceeding cleanup standards based on this compliance averaging approach are summarized in **Table 1A** below. Additionally, because compliance

averaging involves the removal of outliers, using this method to characterize the extent of contamination may disregard legitimate areas of contamination. When a dataset is not distributed normally, as is the case in this instance, it is difficult to differentiate between high samples and outlier samples. Therefore, ProUCL often mischaracterizes these elevated samples as outliers, which artificially reduces the UCL for that property. In order to avoid such statistical errors and ensure that the entire impacted area is properly delineated, **Table 1B** displays the percentage of properties which contain at least one sample above any of the cleanup standards. This is the method proposed to address contamination in the Class Area, as it more accurately portrays the existence of contamination on residential properties and is therefore more health protective because it ensures that all areas of contamination are accounted for when determining which areas require remediation.

Table 1A. Parcels exceeding cleanup standards for lead and arsenic in the Potential AOC Expansion Area, based on compliance averaging.

		Number of Parcels			***Percentage of Parcels***		
		Lead		**Arsenic**	**Lead**		**Arsenic**
Zone	**Total Parcels**	**>400 PPM**	**>200 PPM**	**>19 PPM**	**>400 PPM**	**>200 PPM**	**>19 PPM**
1	4	2	4	3	50%	100%	75%
2	10	7	10	10	70%	100%	100%
3	10	6	8	9	60%	80%	90%
4	14	6	12	13	43%	86%	93%

Table 1B. Parcels exceeding cleanup standards for lead and arsenic in the Potential AOC Expansion Area, based on individual samples.

		Number of Parcels			***Percentage of Parcels***		
		Lead		**Arsenic**	**Lead**		**Arsenic**
Zone	**Total Parcels**	**>400 PPM**	**>200 PPM**	**>19 PPM**	**>400 PPM**	**>200 PPM**	**>19 PPM**
1	4	4	4	4	100%	100%	100%
2	10	10	10	10	100%	100%	100%
3	10	8	10	10	80%	100%	100%
4	14	12	14	14	86%	100%	100%

As previously discussed, Arcadis estimated that 90% of properties in Zone 1, 60% of properties in Zone 2, 30% of properties in Zone 3, and 10% of properties in Zone 4 would require remediation. The results of SWAPE's compliance averaging analysis show that these are underestimates and that the zones created

by Arcadis are not based on actual data but are based on flawed assumptions regarding the decreasing impacts with distance developed originally in the ISDA. These facts become even more clear when each property sampled is considered on an individual basis. Based on these results, the Potential AOC Expansion Area does not cover the full extent of soil contamination in the area surrounding the Off-Site AOC.

4.2.3 Evaluation of Additional Sampling by Plaintiffs

In order to further delineate the extent of the Class Area Impacted by U.S. Metals, three additional datasets were collected by Plaintiffs' counsel, in January, February, and April 2019. The results of these sampling events were analyzed by SWAPE following the methods described below.

In 2019, a total of 43 properties were sampled, and up to 6 samples were collected from the top foot of soil at each property (2 depths per location). These samples were then analyzed for lead, arsenic, and copper.

SWAPE analyzed these samples in order to compare them to NJDEP SRSs. Because NJDEP regulations suggest that a minimum of 10 samples be collected per property in order to use ProUCL, we were unable to remove outliers or calculate UCLs for these properties. Accordingly, arithmetic means were calculated for all the samples in each property. However, the dataset included a few non-detect values. In such instances, these values were recorded as the detection limit divided by two. These means were then compared to the SRSs for lead and arsenic.

4.2.4 Delineation of the Proposed Class Area

These additional sampling events, in combination with previous USMR investigations, provide enough information to characterize the extent of soil contamination in the entire Class Area Impacted by U.S. Metals. A property-by-property analysis is not necessary to determine which areas are affected by the USMR Facility, as these data demonstrate that smelter impacts can be seen throughout the entire proposed Class Area, which, consequently, requires further investigation and remediation. Areas in close proximity to the USMR facility are more impacted than those on the edge of the Class Area, though all areas within the Class Area show evidence of contamination from USMR activities.

Based on our analysis of the USMR transects and additional data collected throughout the community, SWAPE has determined that the entire proposed Class Area is significantly and sufficiently impacted by historical USMR operations such that the soils in this area require immediate remedial action. The results of the sampling conducted by the Plaintiff's counsel and USMR are presented in **Exhibit 8**.

4.2.5 Evaluation of Copper Soil Sampling in the Class Area

In addition to lead and arsenic, copper was also analyzed for all soil samples collected in the Class Area, which have already been discussed in the previous sections of this report. Following the same protocol used to analyze lead and arsenic, SWAPE evaluated the extent of copper contamination in the Class Area (i.e. 95% UCLs were calculated for properties in the Potential AOC Expansion Area and arithmetic means were calculated for the 2019 sampling conducted by Plaintiff counsel). The results of this analysis are displayed in **Exhibit 8**. Determining a reasonable background level of copper in soil is not within the scope of this report; however, it is clear that copper has impacted the entire Class Area based on the sampling data presented in **Exhibit 8.**

5 FINDINGS AND OPINIONS

Based on my review of information and documents concerning USMR's remedial investigations, and the results of my evaluations concerning environmental impacts in the Proposed Class Area, the following findings and opinions are proffered, all to a reasonable degree of scientific certainty:

- USMR operated a metals refining and processing facility in Carteret for more than 80 years. The historical operations at the former Facility resulted in emissions and discharges of contaminants such as lead and arsenic. These COCs deposited in soil within the surrounding residential community as a result of emissions from the Site.
- USMR has conducted environmental investigations at its former Facility since the 1980s. USMR has found very high levels of COCs in soils at the former Facility and nearby industrial parcels.
- The soil contamination described above is a result of a single, primary migration pathway, namely, air deposition from smelter activity at the former USMR facility.
- While additional sources of these COCs may exist in Carteret, it is evident that USMR is the primary source of anthropogenic soil contamination in the proposed Class Area.
- Lead, arsenic, and copper do not degrade naturally; therefore, soil contamination in the impacted area will persist until remediation actions are taken.
- USMR was ordered by NJDEP to investigate off-site contamination in 1988 but failed to adequately do so.
- USMR has conducted a series of investigations at off-site locations in residential community starting in around 2015. An evolution of off-site investigation areas has occurred over time based on soil sampling, air modeling, and/or other considerations. The area where USMR committed to conducting residential property assessments is referred to as the "Off-Site AOC".

- USMR conducted an expanded investigation at some residential properties beyond the Off-site AOC and farther away from the former Facility. This "Potential AOC Expansion Area" consisted of properties located within 500 meters of the Off-site AOC boundary. This additional area was based on air modeling evaluations performed by USMR contractors. The objective was to determine the potential maximum limit of residential properties that were impacted by Facility emissions that would require investigation and potential remediation.
- USMR still has not fully delineated the extent of lead, arsenic, and copper contamination at residential properties. USMR data for soil sampling at 38 residential properties located along three lines or transects extending away from the former Facility demonstrate that elevated concentrations of COCs are present beyond off "Off-site AOC" boundary. Only limited soil sampling has occurred in the "Potential AOC Expansion Area"; however, this data indicates that metals contamination extends far beyond the Off-site AOC.
- The results of USMR's limited site assessment along transects in the Potential AOC Expansion Area show that USMR significantly underestimated the number of properties requiring remediation.
- The State-appointed, Licensed Site Remediation Professional (LSRP) for off-site investigations, Michael McNally, has testified that additional delineation beyond the Off-site AOC would be warranted if soil sampling within the Potential AOC Expansion Area indicated residential properties with COCs in soil at levels above Soil Remediation Standards (SRSs), as is the case here.
- At the time of his deposition testimony in August 2018, Mr. McNally had not been provided with access to USMR's soil remediation project database or the results of soil sampling conducted by USMR at residential properties in the Potential AOC Expansion Area.
- Soil sampling at 43 residential properties by Plaintiffs in 2019 demonstrates that the levels of COCs present beyond the "Potential AOC Expansion Area" boundary indicate the presence of a significant impact by USMR.
- Exposure to elevated levels of lead and arsenic in soil may cause significant health effects, such as learning disabilities and cancer.
- The methodology used by USMR to evaluate soil sampling data uses the NJDEP's lead SRS of 400 mg/kg. This criterium is based on IEUBK default parameters and an assumed BLL of 10 ug/dL. Since 2012, CDC has recommended a "reference level" of 5 ug/dL and there are indications that lower lead remediation standards will be adopted in the future. U.S. EPA Region 2 has adopted a risk reduction goal of 5 ug/dL and proposed a 200 mg/kg lead cleanup standard for the upper

two feet of soil at residences being remediated at the Matteo & Sons Superfund Site in 2017. NJDEP concurred with these cleanup goals.

- Independent of the applicable cleanup standard, it is evident that the extent of impacted land continues far beyond the "Off-site AOC" boundary. Many properties within the "Potential AOC Expansion Area" and the Proposed Class Area at large have not been investigated. In keeping with previous objectives of USMR in past work plans, the investigation boundary should "… be extended laterally until an off-site AOC can be established" and the full nature and extent of contamination has been delineated.
- The migration pathway and geographic extent of lead, arsenic, and copper contamination in Carteret is not complex; rather, it is a contiguous area extending outward from the USMR facility due to emissions from the facility blanketing the Class Area.
- The Proposed Class Area (see **Exhibit 1**) represents the area that was significantly impacted by smelter emissions. All land within the Proposed Class Area is similarly impacted by smelter emissions from the USMR facility. The Class Area boundaries are supported by multiple lines of evidence, including soil sampling collected by USMR, transect data collected by USMR and Arcadis, soil sampling conducted by Plaintiffs' counsel, historical emissions data, historical operations information, historic aerial photographs, historical air modeling, the air modeling prepared by Sullivan Environmental Consulting, soil trend analyses as discussed by Sullivan Environmental Consulting and Dr. George Flowers, the conceptual site model discussed during the deposition of Joe Brunner, and the history of air quality violations at USMR presented during the deposition of John Alvin Fenn.
- The contaminants detected in the Proposed Class Area raise significant health and environmental concerns. The residents in the Proposed Class Area could reasonably be concerned about the presence of pollution in their surrounding environment.
- The remedial actions discussed in Section 3.3 and 4.0 (above) constitute the minimum standard for future remedial actions to be conducted at all properties in the proposed Class Area.

Exhibit 1

Exhibit 1 – Location of USMR Facility and Surrounding Class Area

s: Basemap obtained from ArcGIS.

Exhibit 2

Exhibit 2 – Initial Soil Delineation Area (ISDA) Presented by Shaw in 2012

References:
Figure 1-2. Soil Sampling and Analysis Plan, Carteret, New Jersey. Shaw Environmental, Inc. August 2012. (USMR00835998)

Exhibit 3

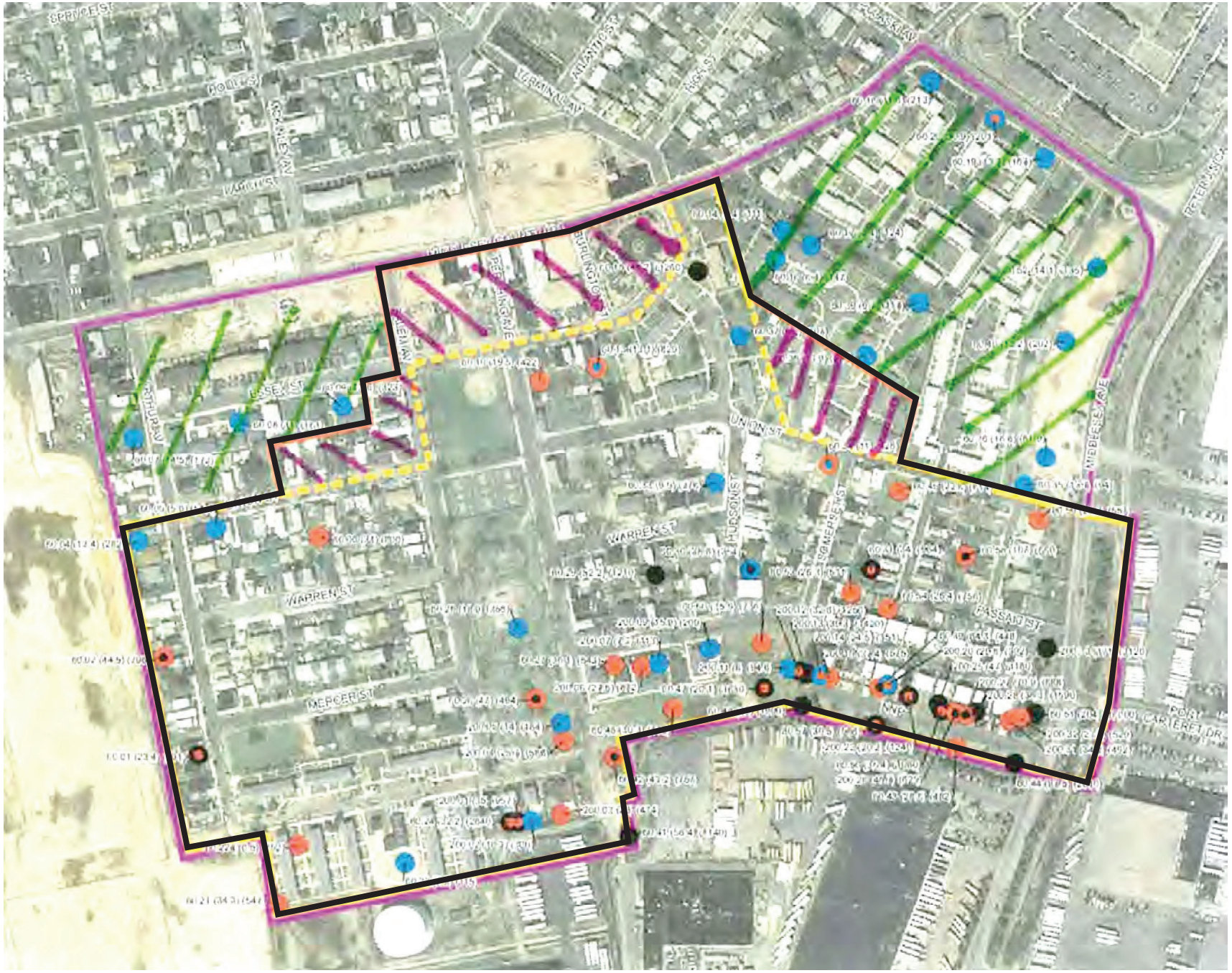


Exhibit 3 – Expanded Off-site AOC by Arcadis in 2013-2014

References:
Expanded AOC Boundary. No date. Exhibit 70, Oral and Videotaped Deposition of Joseph A. Brunner. Volume 2. June 7, 2018. (USMR00173777)

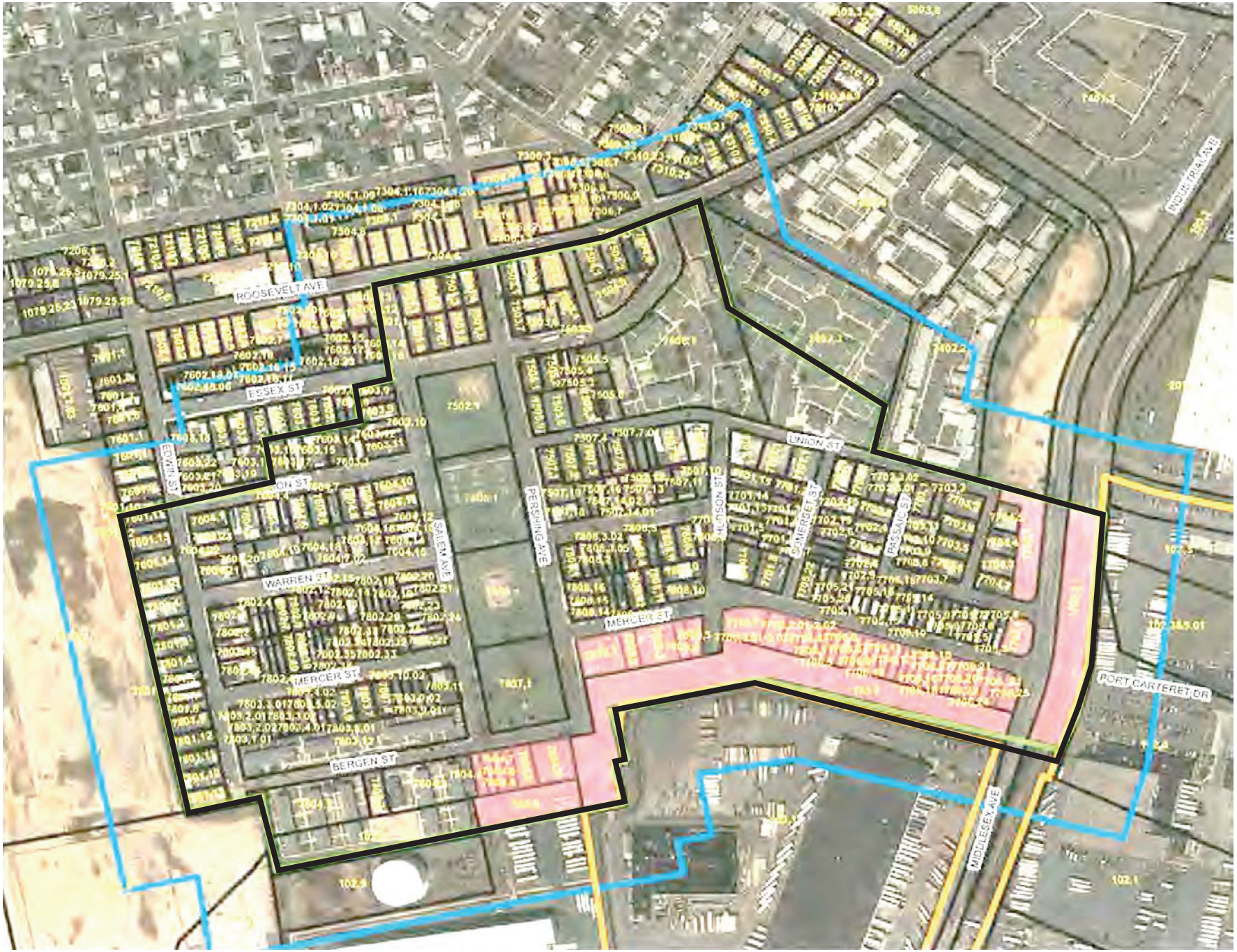


Exhibit 3 – Expanded Off-site AOC by Arcadis in 2013-2014

References:
Expanded AOC Boundary. No date. Exhibit 71, Oral and Videotaped Deposition of Joseph A. Brunner. Volume 2. June 7, 2018. (USMR00835372)

Exhibit 4

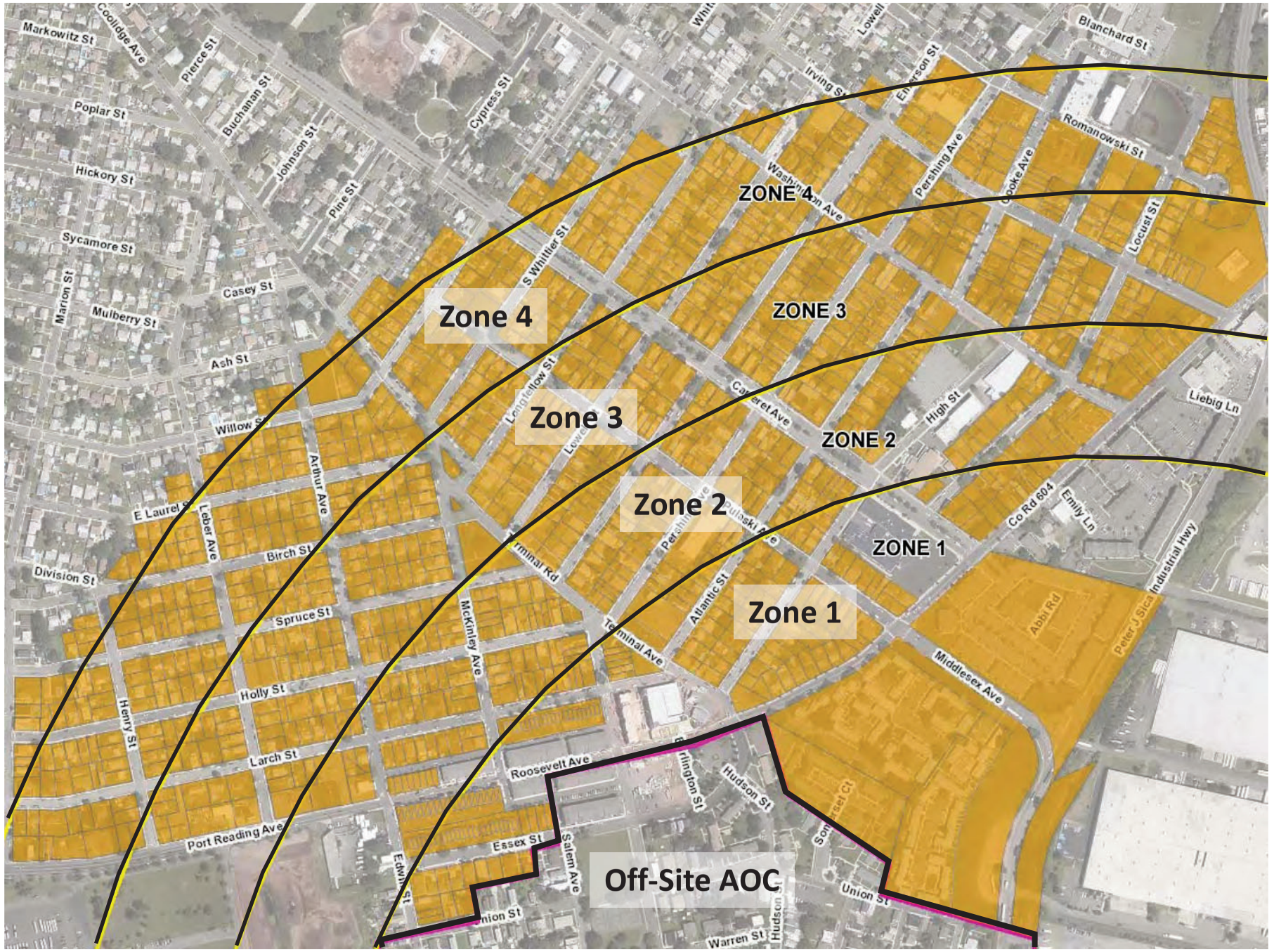


Exhibit 4 – Potential AOC Expansion Area Presented by Arcadis in 2017

References:

Figure 1. Good Faith Estimate - Maximum Potential USMR Off-Site Area of Concern Expansion Area. Arcadis Design & Consultancy. September 15, 2017. (USMR00855144).

Exhibit 5

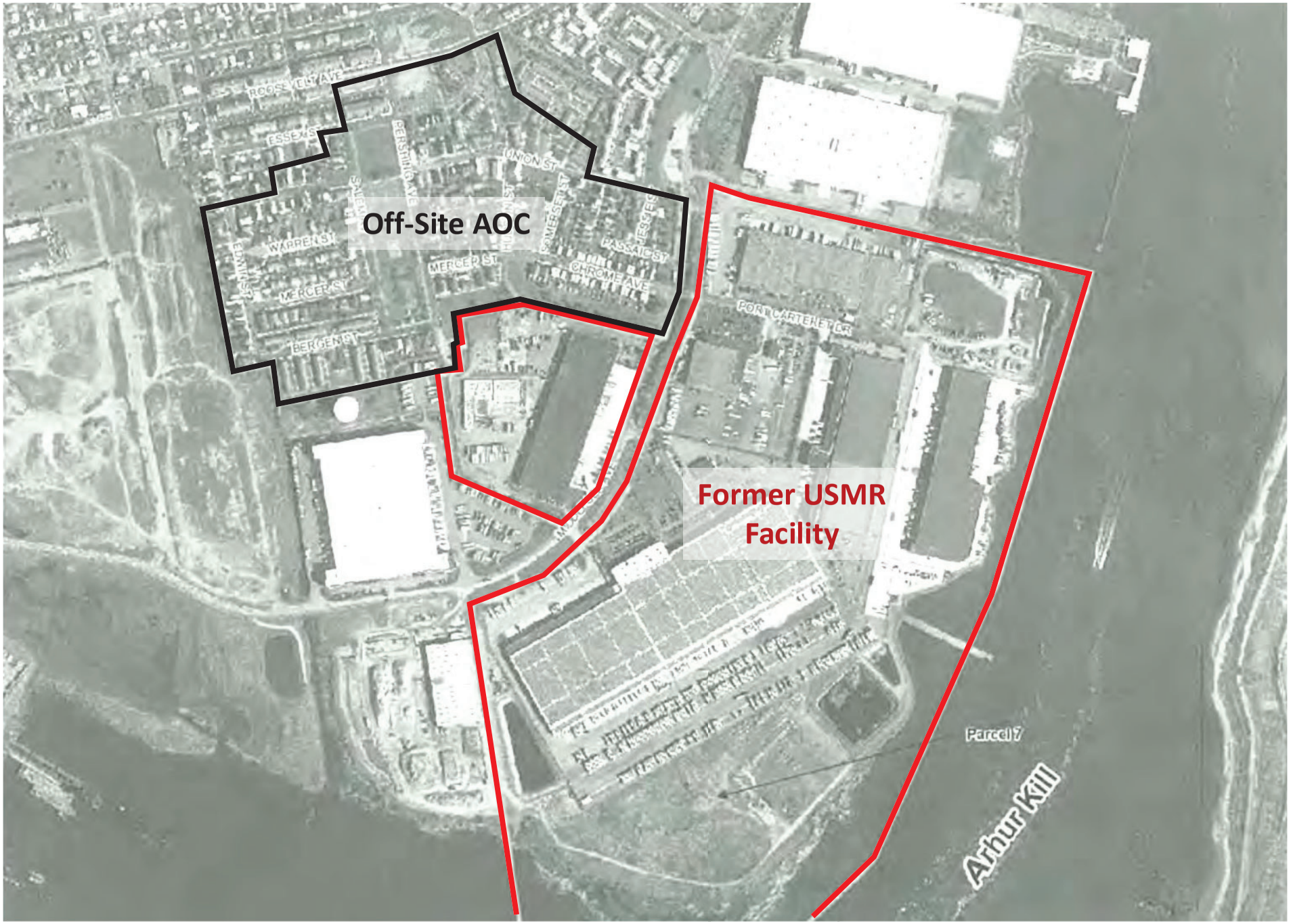


Exhibit 5 – Off-site AOC Boundary Presented by Arcadis in 2017

References:

Figure 1. Remedial Action Report – Off-site Area of Concern. Arcadis Design & Consultancy. June 2017. (USMR00085795).

Exhibit 6

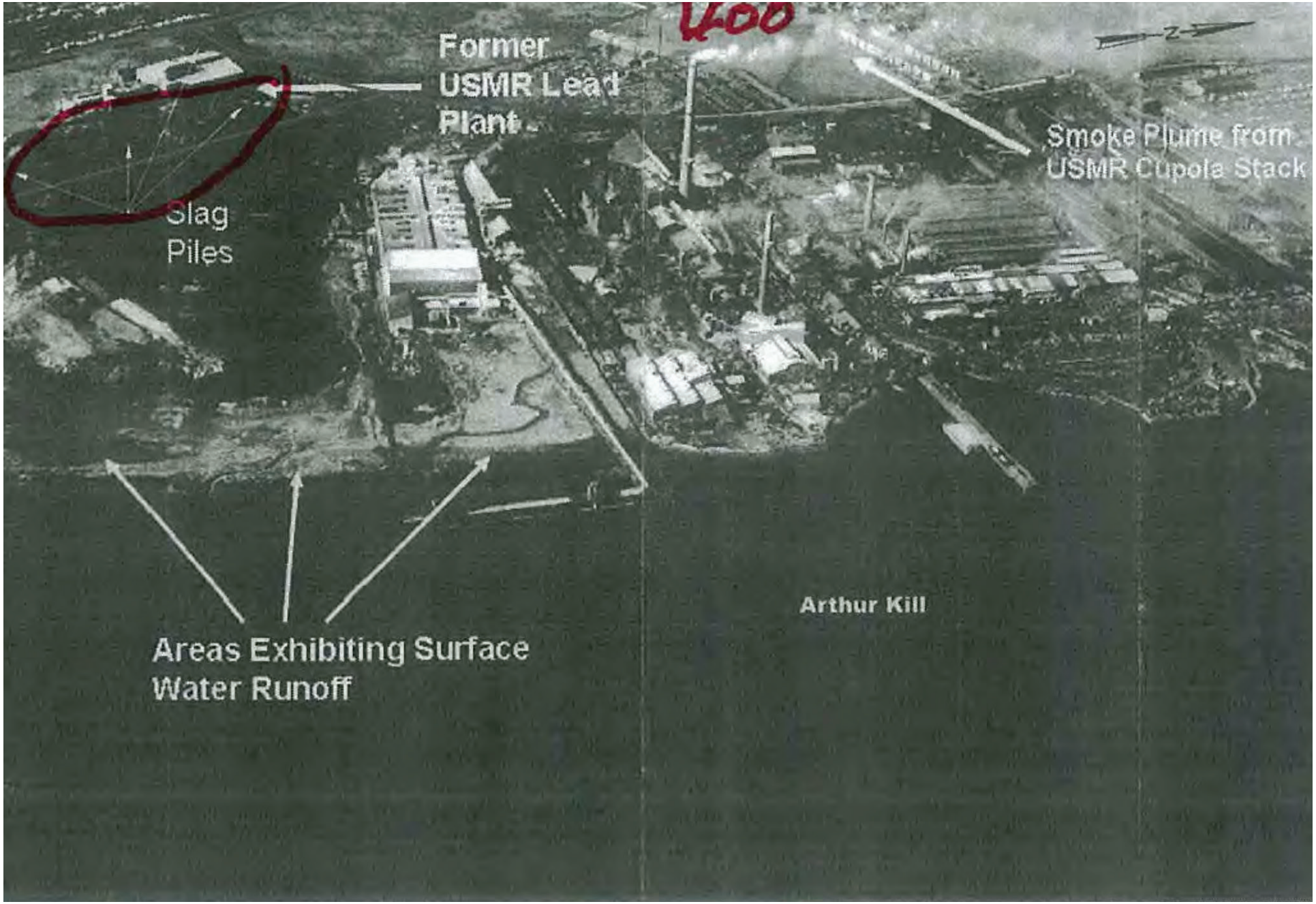


Exhibit 6A – USMR Facility Aerial Photograph (1948)

References:
Figure 3-1. Former USMR Facility, Uncontrolled Stormwater Runoff (USMR00027557). Exhibit 8 to the Deposition of Testimony of John Alvin Fenn. June 4, 2018.

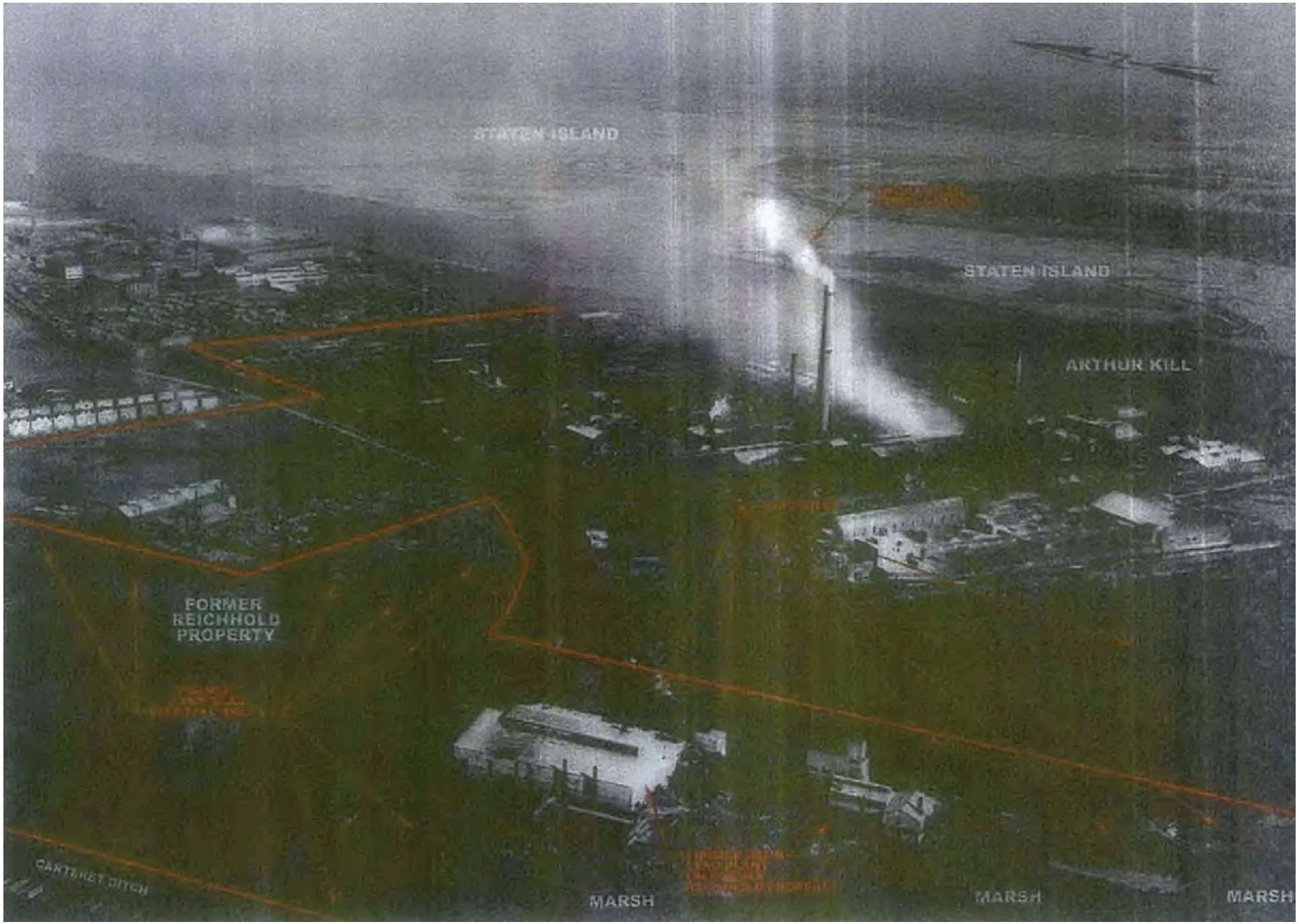


Exhibit 6B – USMR Facility Aerial Photograph

References:
Figure 1-3. USMR Facility, 1948 Aerial Photograph, Southwest Perspective (USMR00017551). Exhibit 9 to the Deposition of Testimony of John Alvin Fenn. June 4, 2018.

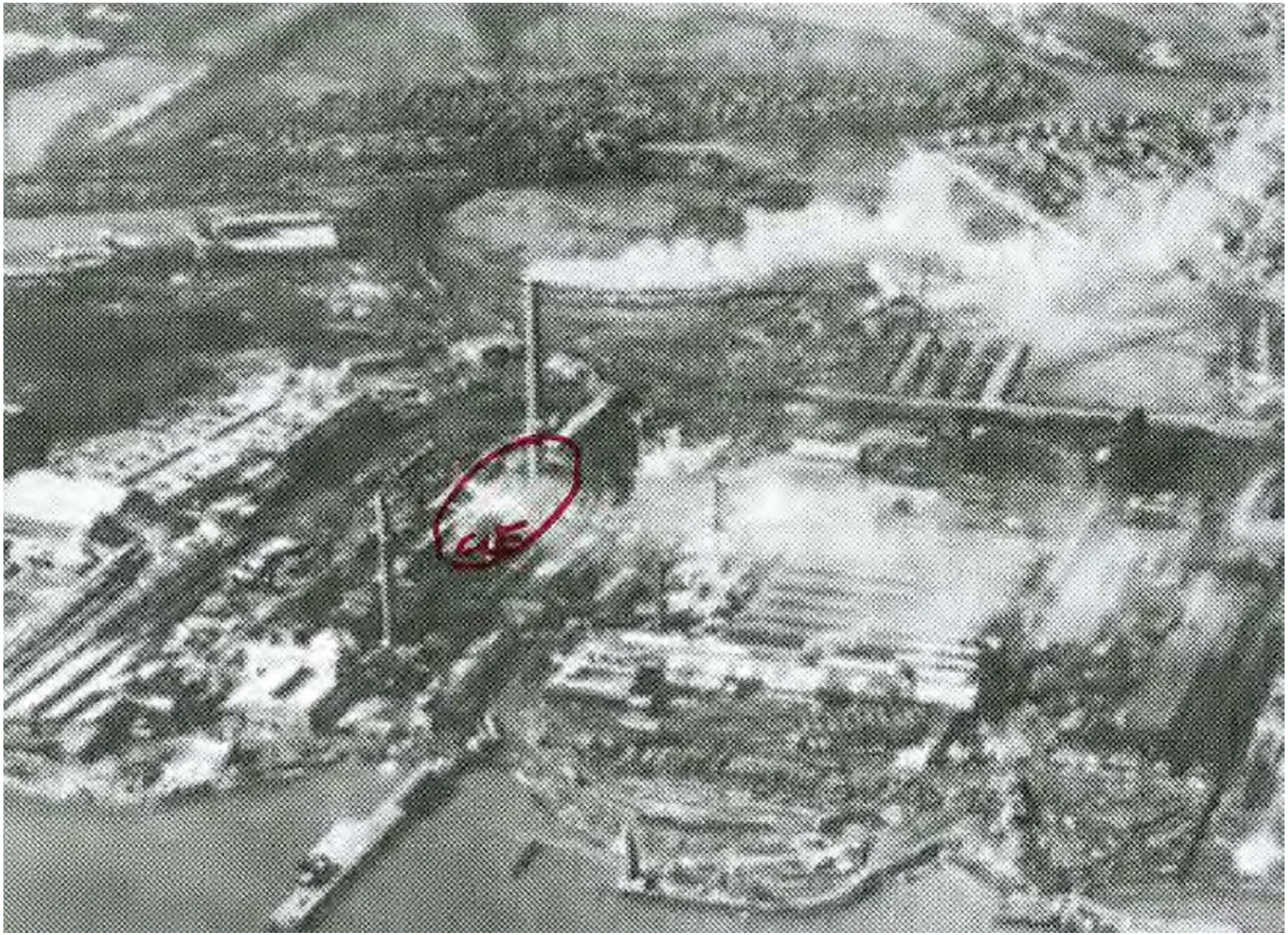


Exhibit 6C – USMR Facility Aerial Photograph

References:
Exhibit 9 to the Deposition of Testimony of John Alvin Fenn. June 4, 2018.

Exhibit 6D – USMR Facility Aerial Photograph

References:

Carteret reaches $7.4M settlement with former smelter operator. Photo provided by Carteret Mayor Daniel J. Reiman's office. Nj.com. November 9, 2017.

Exhibit 6E – USMR Facility Aerial Photograph (1929)

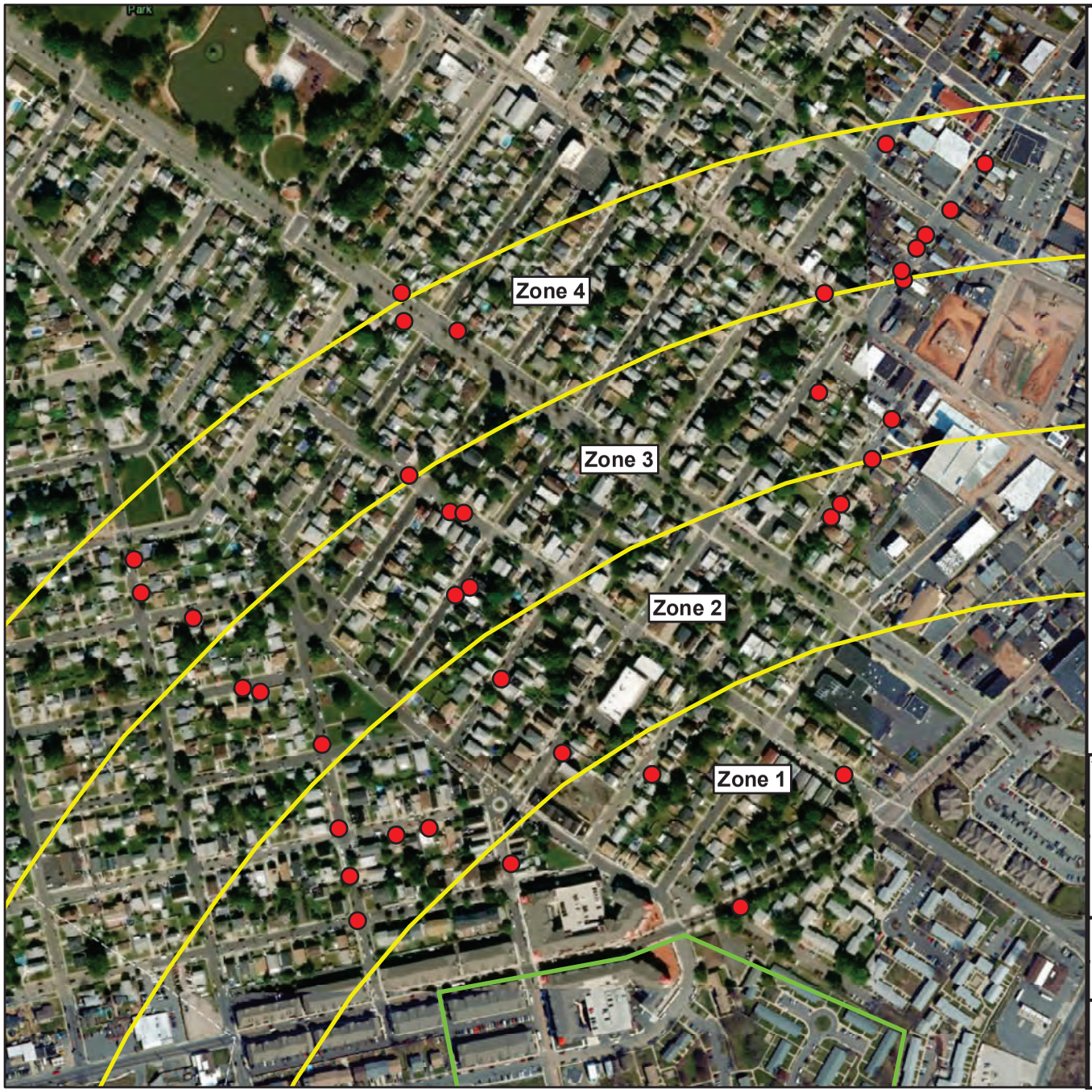
References:

Two Smelter Brownfield Redevelopment Projects - Freeport-McMoRan Copper & Gold. Oklahoma Brownfields Conference 2012. May 22-23, 2012

Exhibit 6F – USMR Facility Aerial Photograph (1954)

References:
Exhibit to the deposition of A.J. Gravel. Bates No. FTI_CNJ00010508. April 10, 2019.

Exhibit 7



Legend:

Maximum Result

- Parcels >200 PPM Lead and/or >19 PPM Arsenic
- Parcels <200 PPM Lead and <19 PPM Arsenic
- Off-Site AOC Boundary
- Zone Boundaries

Notes:

1. All locations are approximate.
2. The maximum value for each property is displayed.

0 115 230 460 690 920
Feet

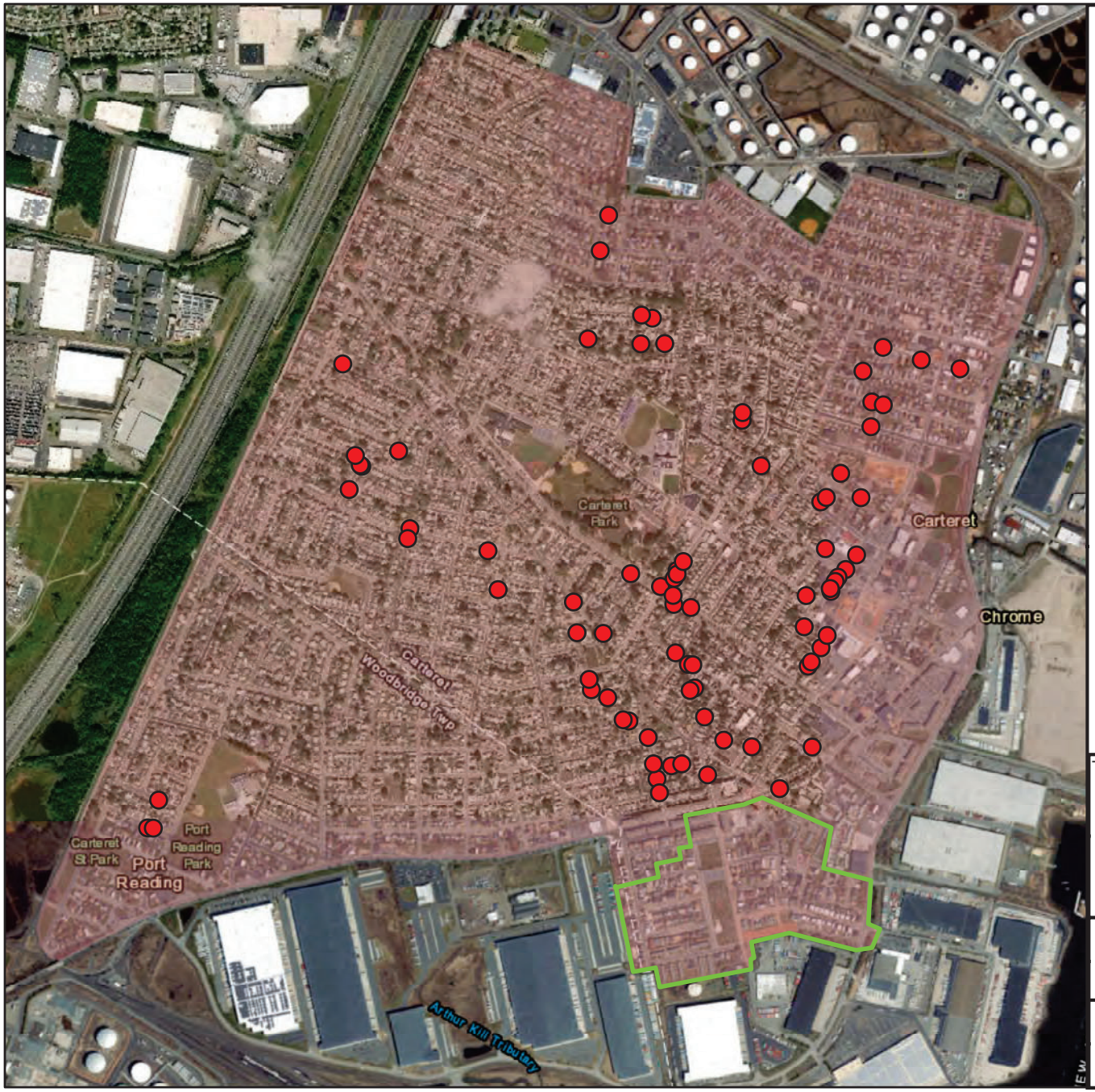
N

Title:

Lead and Arsenic Soil Samples in the Potential AOC Expansion Area (Results in PPM)

Project Number:	Drawn By:	Figure:
1387	SRB	7
Approved By:	Date:	
PER	5/6/2019	SWAPE

Exhibit 8



Legend:

Maximum Result

- Parcels <75 PPM
- Parcels >75 PPM
- Off-Site AOC Boundary
- Class Area

Notes:

1. All locations are approximate.
2. The maximum value for each property is displayed.

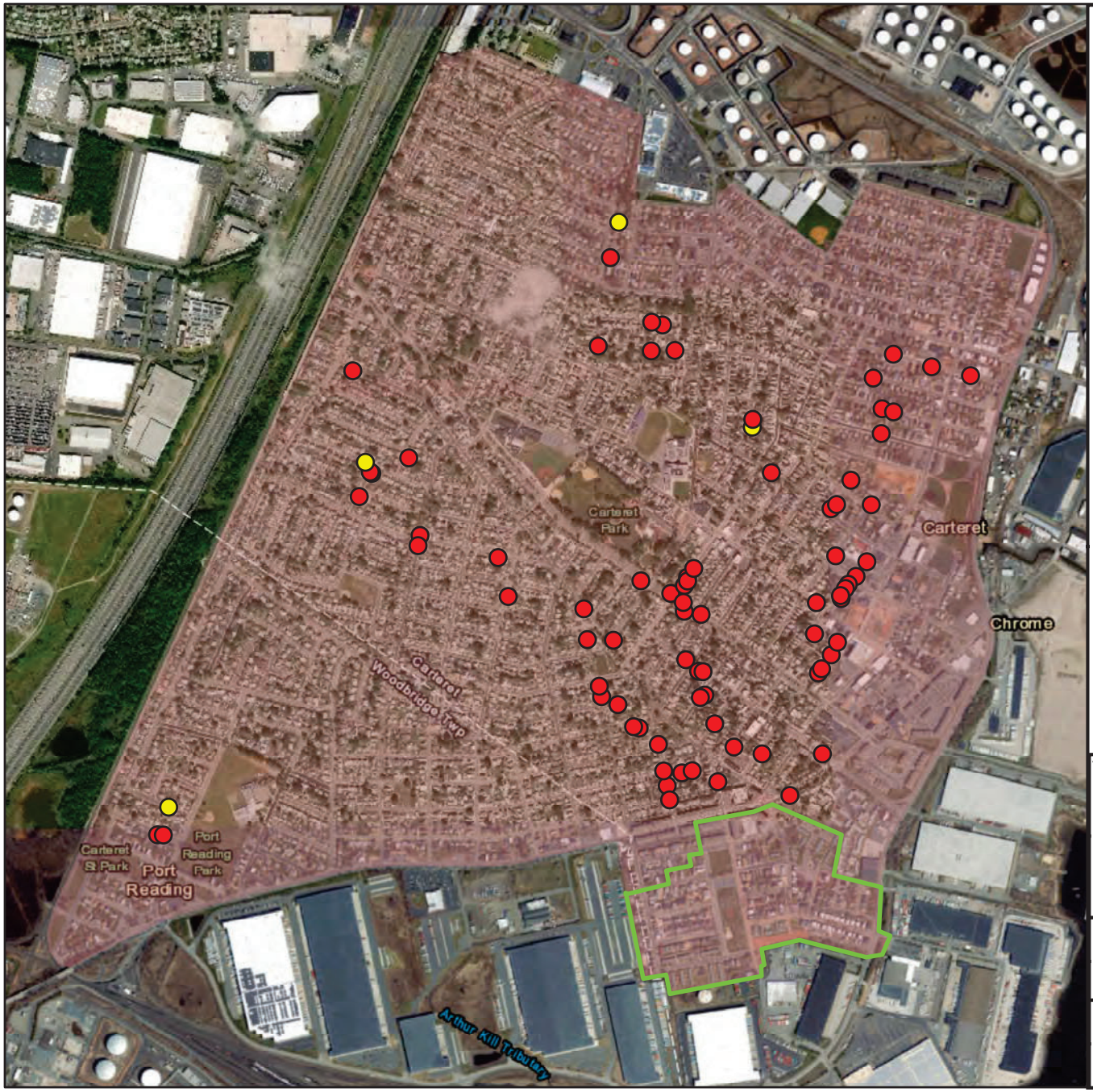
0 370 740 1,480 2,220 2,960
Feet

N

Title:

Copper Soil Samples in the Proposed Class Area (Results in PPM)

Project Number:	Drawn By:	Figure:
1387	SRB	8A
Approved By:	Date:	
PER	5/6/2019	SWAPE



Legend:

Maximum Result

- Parcels >200 PPM Lead and/or >19 PPM Arsenic
- Parcels <200 PPM Lead and <19 PPM Arsenic
- Off-Site AOC Boundary
- Class Area

Notes:

1. All locations are approximate.
2. The maximum value for each property is displayed.

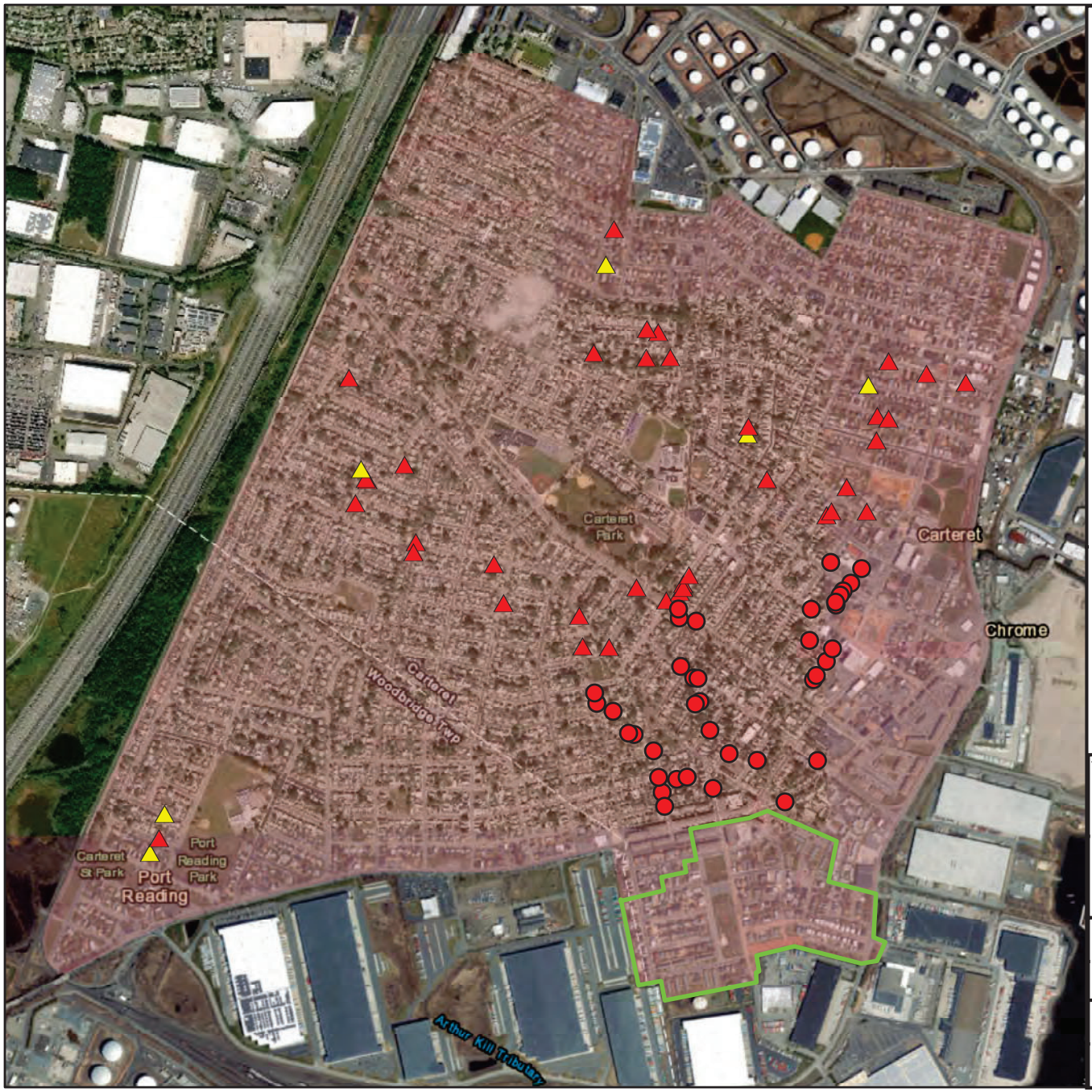
0 370 740 1,480 2,220 2,960
Feet

N

Title:

Lead and Arsenic Soil Samples in the Proposed Class Area (Results in PPM)

Project Number:	Drawn By:	Figure:
1387	SRB	8B
Approved By:	Date:	
PER	5/6/2019	SWAPE



Legend:

95% UCL

- Parcels <75 PPM
- Parcels >75 PPM

Arithmetic Mean

- Parcels <75 PPM
- Parcels >75 PPM
- Off-Site AOC Boundary
- Class Area

Notes:

1. All locations are approximate.
2. 95% UCL parcels were sampled by Arcadis in 2015-2018. Arithmetic Mean parcels were sampled by Plaintiff counsel in 2019.

0 370 740 1,480 2,220 2,960

Feet

N

Title:

Copper Soil Samples in the Proposed Class Area (Results in PPM)

Project Number:	Drawn By:	Figure:
1387	SRB	8C
Approved By:	Date:	
PER	5/6/2019	SWAPE

Legend:

95% UCL

- Parcels >200 PPM Lead and/or >19 PPM Arsenic
- Parcels <200 PPM Lead and <19 PPM Arsenic

Arithmetic Mean

- Parcels >200 PPM Lead and/or >19 PPM Arsenic
- Parcels <200 PPM Lead and <19 PPM Arsenic
- Off-Site AOC Boundary
- Class Area

Notes:

1. All locations are approximate.
2. 95% UCL parcels were sampled by Arcadis in 2015-2018. Arithmetic Mean parcels were sampled by Plaintiff counsel in 2019.

0 370 740 1,480 2,220 2,960
Feet

N

Title:

Lead and Arsenic Soil Samples in the Proposed Class Area (Results in PPM)

Project Number:	Drawn By:	Figure:
1387	SRB	8D
Approved By:	Date:	
PER	5/6/2019	SWAPE

Exhibit 9

SWAPE Technical Consultation, Data Analysis and Litigation Support for the Environment

SOIL WATER AIR PROTECTION ENTERPRISE
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Paul Rosenfeld, Ph.D.

Chemical Fate and Transport & Air Dispersion Modeling

Principal Environmental Chemist

Risk Assessment & Remediation Specialist

Education

Ph.D. Soil Chemistry, University of Washington, 1999. Dissertation on volatile organic compound filtration.

M.S. Environmental Science, U.C. Berkeley, 1995. Thesis on organic waste economics.

B.A. Environmental Studies, U.C. Santa Barbara, 1991. Thesis on wastewater treatment.

Professional Experience

Dr. Rosenfeld has over 25 years' experience conducting environmental investigations and risk assessments for evaluating impacts to human health, property, and ecological receptors. His expertise focuses on the fate and transport of environmental contaminants, human health risk, exposure assessment, and ecological restoration. Dr. Rosenfeld has evaluated and modeled emissions from unconventional oil drilling operations, oil spills, landfills, boilers and incinerators, process stacks, storage tanks, confined animal feeding operations, and many other industrial and agricultural sources. His project experience ranges from monitoring and modeling of pollution sources to evaluating impacts of pollution on workers at industrial facilities and residents in surrounding communities.

Dr. Rosenfeld has investigated and designed remediation programs and risk assessments for contaminated sites containing lead, heavy metals, mold, bacteria, particulate matter, petroleum hydrocarbons, chlorinated solvents, pesticides, radioactive waste, dioxins and furans, semi- and volatile organic compounds, PCBs, PAHs, perchlorate, asbestos, per- and poly-fluoroalkyl substances (PFOA/PFOS), unusual polymers, fuel oxygenates (MTBE), among other pollutants. Dr. Rosenfeld also has experience evaluating greenhouse gas emissions from various projects and is an expert on the assessment of odors from industrial and agricultural sites, as well as the evaluation of odor nuisance impacts and technologies for abatement of odorous emissions. As a principal scientist at SWAPE, Dr. Rosenfeld directs air dispersion modeling and exposure assessments. He has served as an expert witness and testified about pollution sources causing nuisance and/or personal injury at dozens of sites and has testified as an expert witness on more than ten cases involving exposure to air contaminants from industrial sources.

Professional History:

Soil Water Air Protection Enterprise (SWAPE); 2003 to present; Principal and Founding Partner
UCLA School of Public Health; 2007 to 2011; Lecturer (Assistant Researcher)
UCLA School of Public Health; 2003 to 2006; Adjunct Professor
UCLA Environmental Science and Engineering Program; 2002-2004; Doctoral Intern Coordinator
UCLA Institute of the Environment, 2001-2002; Research Associate
Komex H_2O Science, 2001 to 2003; Senior Remediation Scientist
National Groundwater Association, 2002-2004; Lecturer
San Diego State University, 1999-2001; Adjunct Professor
Anteon Corp., San Diego, 2000-2001; Remediation Project Manager
Ogden (now Amec), San Diego, 2000-2000; Remediation Project Manager
Bechtel, San Diego, California, 1999 – 2000; Risk Assessor
King County, Seattle, 1996 – 1999; Scientist
James River Corp., Washington, 1995-96; Scientist
Big Creek Lumber, Davenport, California, 1995; Scientist
Plumas Corp., California and USFS, Tahoe 1993-1995; Scientist
Peace Corps and World Wildlife Fund, St. Kitts, West Indies, 1991-1993; Scientist

Publications:

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Rosenfeld, P.E., Sutherland, A; Hesse, R.; Zapata, A. (October 3-6, 2013). Air dispersion modeling of volatile organic emissions from multiple natural gas wells in Decatur, TX. *44th Western Regional Meeting, American Chemical Society.* Lecture conducted from Santa Clara, CA.

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Paul Rosenfeld Ph.D. (September 19, 2005). Brominated Flame Retardants in Groundwater: Pathways to Human Ingestion, *Toxicology and Remediation PEMA Emerging Contaminant Conference*. Lecture conducted from Hilton Hotel, Irvine California.

Paul Rosenfeld Ph.D. (September 19, 2005). Fate, Transport, Toxicity, And Persistence of 1,2,3-TCP. *PEMA Emerging Contaminant Conference.* Lecture conducted from Hilton Hotel in Irvine, California.

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Paul Rosenfeld Ph.D. (July 21-22, 2005). Brominated Flame Retardants in Groundwater: Pathways to Human Ingestion, Toxicology and Remediation. *2005 National Groundwater Association Ground Water and Environmental Law Conference.* Lecture conducted from Wyndham Baltimore Inner Harbor, Baltimore Maryland.

Paul Rosenfeld, Ph.D. and James Clark Ph.D. and Rob Hesse R.G. (May 5-6, 2004). Tert-butyl Alcohol Liability and Toxicology, A National Problem and Unquantified Liability. *National Groundwater Association. Environmental Law Conference*. Lecture conducted from Congress Plaza Hotel, Chicago Illinois.

Paul Rosenfeld, Ph.D. (March 2004). Perchlorate Toxicology. *Meeting of the American Groundwater Trust*. Lecture conducted from Phoenix Arizona.

Hagemann, M.F., **Paul Rosenfeld, Ph.D.** and Rob Hesse (2004). Perchlorate Contamination of the Colorado River. *Meeting of tribal representatives*. Lecture conducted from Parker, AZ.

Paul Rosenfeld, Ph.D. (April 7, 2004). A National Damage Assessment Model For PCE and Dry Cleaners. *Drycleaner Symposium. California Ground Water Association*. Lecture conducted from Radison Hotel, Sacramento, California.

Rosenfeld, P. E., Grey, M., (June 2003) Two stage biofilter for biosolids composting odor control. *Seventh International In Situ And On Site Bioremediation Symposium Battelle Conference* Orlando, FL.

Paul Rosenfeld, Ph.D. and James Clark Ph.D. (February 20-21, 2003) Understanding Historical Use, Chemical Properties, Toxicity and Regulatory Guidance of 1,4 Dioxane. *National Groundwater Association. Southwest Focus Conference. Water Supply and Emerging Contaminants*.. Lecture conducted from Hyatt Regency Phoenix Arizona.

Paul Rosenfeld, Ph.D. (February 6-7, 2003). Underground Storage Tank Litigation and Remediation. *California CUPA Forum*. Lecture conducted from Marriott Hotel, Anaheim California.

Paul Rosenfeld, Ph.D. (October 23, 2002) Underground Storage Tank Litigation and Remediation. *EPA Underground Storage Tank Roundtable*. Lecture conducted from Sacramento California.

Rosenfeld, P.E. and Suffet, M. (October 7- 10, 2002). Understanding Odor from Compost, *Wastewater and Industrial Processes. Sixth Annual Symposium On Off Flavors in the Aquatic Environment. International Water Association*. Lecture conducted from Barcelona Spain.

Rosenfeld, P.E. and Suffet, M. (October 7- 10, 2002). Using High Carbon Wood Ash to Control Compost Odor. *Sixth Annual Symposium On Off Flavors in the Aquatic Environment. International Water Association*. Lecture conducted from Barcelona Spain.

Rosenfeld, P.E. and Grey, M. A. (September 22-24, 2002). Biocycle Composting For Coastal Sage Restoration. *Northwest Biosolids Management Association*. Lecture conducted from Vancouver Washington..

Rosenfeld, P.E. and Grey, M. A. (November 11-14, 2002). Using High-Carbon Wood Ash to Control Odor at a Green Materials Composting Facility. *Soil Science Society Annual Conferenc*e. Lecture conducted from Indianapolis, Maryland.

Rosenfeld. P.E. (September 16, 2000). Two stage biofilter for biosolids composting odor control. *Water Environment Federation.* Lecture conducted from Anaheim California.

Rosenfeld. P.E. (October 16, 2000). Wood ash and biofilter control of compost odor. *Biofest.* Lecture conducted from Ocean Shores, California.

Rosenfeld, P.E. (2000). Bioremediation Using Organic Soil Amendments. *California Resource Recovery Association*. Lecture conducted from Sacramento California.

Rosenfeld, P.E., C.L. Henry, R. Harrison. (1998). Oat and Grass Seed Germination and Nitrogen and Sulfur Emissions Following Biosolids Incorporation With High-Carbon Wood-Ash. *Water Environment Federation 12th Annual Residuals and Biosolids Management Conference Proceedings*. Lecture conducted from Bellevue Washington.

Rosenfeld, P.E., and C.L. Henry. (1999). An evaluation of ash incorporation with biosolids for odor reduction. *Soil Science Society of America*. Lecture conducted from Salt Lake City Utah.

Rosenfeld, P.E., C.L. Henry, R. Harrison. (1998). Comparison of Microbial Activity and Odor Emissions from Three Different Biosolids Applied to Forest Soil. *Brown and Caldwell.* Lecture conducted from Seattle Washington.

Rosenfeld, P.E., C.L. Henry. (1998). Characterization, Quantification, and Control of Odor Emissions from Biosolids Application To Forest Soil. *Biofest.* Lecture conducted from Lake Chelan, Washington.

Rosenfeld, P.E, C.L. Henry, R. Harrison. (1998). Oat and Grass Seed Germination and Nitrogen and Sulfur Emissions Following Biosolids Incorporation With High-Carbon Wood-Ash. Water Environment Federation 12th Annual Residuals and Biosolids Management Conference Proceedings. Lecture conducted from Bellevue Washington.

Rosenfeld, P.E., C.L. Henry, R. B. Harrison, and R. Dills. (1997). Comparison of Odor Emissions From Three Different Biosolids Applied to Forest Soil. *Soil Science Society of America*. Lecture conducted from Anaheim California.

Teaching Experience:

UCLA Department of Environmental Health (Summer 2003 through 20010) Taught Environmental Health Science 100 to students, including undergrad, medical doctors, public health professionals and nurses. Course focused on the health effects of environmental contaminants.

National Ground Water Association, Successful Remediation Technologies. Custom Course in Sante Fe, New Mexico. May 21, 2002. Focused on fate and transport of fuel contaminants associated with underground storage tanks.

National Ground Water Association; Successful Remediation Technologies Course in Chicago Illinois. April 1, 2002. Focused on fate and transport of contaminants associated with Superfund and RCRA sites.

California Integrated Waste Management Board, April and May, 2001. Alternative Landfill Caps Seminar in San Diego, Ventura, and San Francisco. Focused on both prescriptive and innovative landfill cover design.

UCLA Department of Environmental Engineering, February 5, 2002. Seminar on Successful Remediation Technologies focusing on Groundwater Remediation.

University Of Washington, Soil Science Program, Teaching Assistant for several courses including: Soil Chemistry, Organic Soil Amendments, and Soil Stability.

U.C. Berkeley, Environmental Science Program Teaching Assistant for Environmental Science 10.

Academic Grants Awarded:

California Integrated Waste Management Board. $41,000 grant awarded to UCLA Institute of the Environment. Goal: To investigate effect of high carbon wood ash on volatile organic emissions from compost. 2001.

Synagro Technologies, Corona California: $10,000 grant awarded to San Diego State University.
Goal: investigate effect of biosolids for restoration and remediation of degraded coastal sage soils. 2000.

King County, Department of Research and Technology, Washington State. $100,000 grant awarded to University of Washington: Goal: To investigate odor emissions from biosolids application and the effect of polymers and ash on VOC emissions. 1998.

Northwest Biosolids Management Association, Washington State. $20,000 grant awarded to investigate effect of polymers and ash on VOC emissions from biosolids. 1997.

James River Corporation, Oregon: $10,000 grant was awarded to investigate the success of genetically engineered Poplar trees with resistance to round-up. 1996.

United State Forest Service, Tahoe National Forest: $15,000 grant was awarded to investigating fire ecology of the Tahoe National Forest. 1995.

Kellogg Foundation, Washington D.C. $500 grant was awarded to construct a large anaerobic digester on St. Kitts in West Indies. 1993.

Deposition and/or Trial Testimony:

In The Superior Court of the State of California In And For The County Of Los Angeles – Santa Monica
Carole-Taddeo-Bates et al., vs. Ifran Khan et al., Defendants
Case No.: No. BC615636
Rosenfeld Deposition, 1-26-2019

In The Superior Court of the State of California In And For The County Of Los Angeles – Santa Monica
The San Gabriel Valley Council of Governments et al. vs El Adobe Apts. Inc. et al., Defendants
Case No.: No. BC646857
Rosenfeld Deposition, 10-6-2018; Trial 3-7-19

In United States District Court For The District of Colorado
Bells et al. Plaintiff vs. The 3M Company et al., Defendants
Case: No 1:16-cv-02531-RBJ
Rosenfeld Deposition, 3-15-2018 and 4-3-2018

In The District Court Of Regan County, Texas, 112th Judicial District
Phillip Bales et al., Plaintiff vs. Dow Agrosciences, LLC, et al., Defendants
Cause No 1923
Rosenfeld Deposition, 11-17-2017

In The Superior Court of the State of California In And For The County Of Contra Costa
Simons et al., Plaintiffs vs. Chevron Corporation, et al., Defendants
Cause No C12-01481
Rosenfeld Deposition, 11-20-2017

In The Circuit Court Of The Twentieth Judicial Circuit, St Clair County, Illinois
Martha Custer et al., Plaintiff vs. Cerro Flow Products, Inc., Defendants
Case No.: No. 0i9-L-2295
Rosenfeld Deposition, 8-23-2017

In The Superior Court of the State of California, For The County of Los Angeles
Warrn Gilbert and Penny Gilber, Plaintiff vs. BMW of North America LLC
Case No.: LC102019 (c/w BC582154)
Rosenfeld Deposition, 8-16-2017, Trail 8-28-2018

In the Northern District Court of Mississippi, Greenville Division
Brenda J. Cooper, et al., *Plaintiffs,* vs. Meritor Inc., et al., *Defendants*
Case Number: 4:16-cv-52-DMB-JVM
Rosenfeld Deposition: July 2017

In The Superior Court of the State of Washington, County of Snohomish
Michael Davis and Julie Davis et al., Plaintiff vs. Cedar Grove Composting Inc., Defendants
Case No.: No. 13-2-03987-5
Rosenfeld Deposition, February 2017
Trial, March 2017

In The Superior Court of the State of California, County of Alameda
Charles Spain., Plaintiff vs. Thermo Fisher Scientific, et al., Defendants

Case No.: RG14711115
Rosenfeld Deposition, September 2015

In The Iowa District Court In And For Poweshiek County
Russell D. Winburn, et al., Plaintiffs vs. Doug Hoksbergen, et al., Defendants
Case No.: LALA002187
Rosenfeld Deposition, August 2015

In The Iowa District Court For Wapello County
Jerry Dovico, et al., Plaintiffs vs. Valley View Sine LLC, et al., Defendants
Law No,: LALA105144 - Division A
Rosenfeld Deposition, August 2015

In The Iowa District Court For Wapello County
Doug Pauls, et al.,, et al., Plaintiffs vs. Richard Warren, et al., Defendants
Law No,: LALA105144 - Division A
Rosenfeld Deposition, August 2015

In The Circuit Court of Ohio County, West Virginia
Robert Andrews, et al. v. Antero, et al.
Civil Action N0. 14-C-30000
Rosenfeld Deposition, June 2015

In The Third Judicial District County of Dona Ana, New Mexico
Betty Gonzalez, et al. Plaintiffs vs. Del Oro Dairy, Del Oro Real Estate LLC, Jerry Settles and Deward DeRuyter, Defendants
Rosenfeld Deposition: July 2015

In The Iowa District Court For Muscatine County
Laurie Freeman et. al. Plaintiffs vs. Grain Processing Corporation, Defendant
Case No 4980
Rosenfeld Deposition: May 2015

In the Circuit Court of the 17th Judicial Circuit, in and For Broward County, Florida
Walter Hinton, et. al. Plaintiff, vs. City of Fort Lauderdale, Florida, a Municipality, Defendant.
Case Number CACE07030358 (26)
Rosenfeld Deposition: December 2014

In the United States District Court Western District of Oklahoma
Tommy McCarty, et al., Plaintiffs, v. Oklahoma City Landfill, LLC d/b/a Southeast Oklahoma City Landfill, et al. Defendants.
Case No. 5:12-cv-01152-C
Rosenfeld Deposition: July 2014

In the County Court of Dallas County Texas
Lisa Parr et al, *Plaintiff*, vs. Aruba et al, *Defendant.*
Case Number cc-11-01650-E
Rosenfeld Deposition: March and September 2013
Rosenfeld Trial: April 2014

In the Court of Common Pleas of Tuscarawas County Ohio
John Michael Abicht, et al., *Plaintiffs,* vs. Republic Services, Inc., et al., *Defendants*
Case Number: 2008 CT 10 0741 (Cons. w/ 2009 CV 10 0987)
Rosenfeld Deposition: October 2012

In the United States District Court of Southern District of Texas Galveston Division
Kyle Cannon, Eugene Donovan, Genaro Ramirez, Carol Sassler, and Harvey Walton, each Individually and on behalf of those similarly situated, *Plaintiffs,* vs. BP Products North America, Inc., *Defendant.*
Case 3:10-cv-00622
Rosenfeld Deposition: February 2012
Rosenfeld Trial: April 2013

In the Circuit Court of Baltimore County Maryland
Philip E. Cvach, II et al., *Plaintiffs* vs. Two Farms, Inc. d/b/a Royal Farms, Defendants
Case Number: 03-C-12-012487 OT
Rosenfeld Deposition: September 2013