DuPont Pompton Lakes Works
2000 Cannonball Road
Pompton Lakes, NJ 07442

June 28, 2013

Mr. Anthony Cinque
New Jersey Department of Environmental Protection
Division of Responsible Party Site Remediation
401 East State Street
P.O. Box 028
Trenton, New Jersey 08625-0028

RE: Onsite Soils Corrective Measures Study
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey
PI #007411

Dear Mr. Cinque:

As requested by the New Jersey Department of Environmental Protection in correspondence dated February 20, 2012 and February 21, 2013, enclosed for your review is the *Onsite Soils Corrective Measures Study* for the Pompton Lakes Works Site located in Pompton Lakes, New Jersey. One bound copy and three CDs are included herein.

If you have any questions, please contact me at (973) 492-7733.

Sincerely,

David E. Epps

David E. Epps, P.G.
Project Director, Pompton Lakes Works
DuPont Corporate Remediation Group

cc: Phil Flax, USEPA (1 bound copy + 3 CDs)
PLW File

REPORT

Onsite Soils Corrective Measures Study
Pompton Lakes Works
Pompton Lakes, Passaic County, New Jersey
PI #007411

E.I. du Pont de Nemours and Company
2000 Cannonball Road
Pompton Lakes, NJ 07442

June 28, 2013

O'BRIEN & GERE

REPORT

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O'BRIEN & GERE

SECTION M. PERSON RESPONSIBLE FOR CONDUCTING THE REMEDIATION INFORMATION AND CERTIFICATION

Full Legal Name of the Person Responsible for Conducting the Remediation: E.I. du Pont de Nemours and Company

Representative First Name: Michael Representative Last Name: Lukas

Title: Remediation Team Manager

Phone Number: (302) 999-3567 Ext: Fax:

Mailing Address: Chestnut Run Plaza Bldg 715, 4417 Lancaster Pike

City/Town: Wilmington State: DE Zip Code: 19805

Email Address: michael.j.lukas@dupont.com

This certification shall be signed by the person responsible for conducting the remediation who is submitting this notification in accordance with Administrative Requirements for the Remediation of Contaminated Sites rule at N.J.A.C. 7:26C-1.5(a).

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, including all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting false, inaccurate or incomplete information and that I am committing a crime of the fourth degree if I make a written false statement which I do not believe to be true. I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties.

Signature: Michael J. Lukas Date: 6/27/13

Name/Title: Michael J. Lukas, DuPont CRG Remediation Team Manager **No Changes Since Last Submittal** ☐

SECTION N. NON-LSRP SITE REMEDIATION PROFESSIONAL STATEMENT			
First Name: Norma		Last Name: Eichlin	
Phone Number: (973) 492-7725	Ext:	Fax: (973) 492-7749	
Mailing Address: 2000 Cannonball Road			
City/Town: Pompton Lakes	State: NJ	Zip Code: 07442	
Email Address: norma.eichlin@obg.com			
I believe that the information contained herein, and including all attached documents, is true, accurate and complete.			
Signature: Norma L. Eichlin		Date: 6/27/13	
Name/Title: Norma L. Eichlin, Vice President		**No Changes Since Last Submittal** ☐	
Company Name: O'Brien & Gere			

Completed forms should be sent to:

Bureau of Case Assignment & Initial Notice
Site Remediation Program
NJ Department of Environmental Protection
401-05H
PO Box 420
Trenton, NJ 08625-0420

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ACRONYMS

ACO	Administrative Consent Order
AOC	area of concern
BEE	baseline ecological evaluation
bgs	below ground surface
CGMP	*Comprehensive Groundwater Monitoring Program*
CMIWP	Corrective Measure Implementation Work Plan
CMS	Corrective Measure Study
CSM	conceptual Site model
COC	constituent of concern
COPEC	constituent of potential ecological concern
DuPont	E.I. du Pont de Nemours and Company
EMA	Former Eastern Manufacturing Area
ESNR	environmental sensitive natural resource
ERG	ecological risk-based remediation goal
GWET	groundwater extraction and treatment
GWIIA	Class IIA Ground Water Quality Standard
HMW PAH	high molecular weight polycyclic aromatic hydrocarbon
HSWA	Hazardous and Solid Waste Amendments of 1984
I-287	New Jersey Interstate 287
IGW	impact to groundwater
IGWSSL	Impact to Groundwater Soil Screening Level
IRM	interim remedial measure
KH	Henry's Law Constant
K_{oc}	water/organic carbon partition coefficient
LMW PAH	low molecular weight polycyclic aromatic hydrocarbon
mg/kg	milligrams per kilogram
M/T/V	mobility, toxicity, and/or volume
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NMA	Former Northern Manufacturing Area
NRDCSRS	Non-Residential Direct Contact Soil Remediation Standard

PCB	polychlorinated biphenyl
PAH	polycyclic aromatic hydrocarbon
PLW	Pompton Lakes Works
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RDCSRS	Residential Direct Contact Soil Remediation Standard
RI	remedial investigation
RIR	Remedial Investigation Report
SESOIL	Seasonal Compartment Model
SOGWIR	*Supplemental Onsite Groundwater Investigation Report*
SPLP	synthetic precipitation leaching procedure
SRS	soil remediation standard
TRSR	*Technical Requirements for Site Remediation*
UCL_{95}	95% upper confidence limit of the arithmetic mean concentration
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WMA	Former Western Manufacturing Area

1. INTRODUCTION

The E.I. du Pont de Nemours and Company (DuPont) Pompton Lakes Works (PLW) Site (Site) is located at 2000 Cannonball Road in Pompton Lakes, Passaic County, New Jersey (see Figure 1). The Site is divided into the following three former manufacturing areas:

- Eastern Manufacturing Area (EMA) located east of the Wanaque River, south of New Jersey Interstate 287 (I-287), and west of Ringwoood State Park. This area is further broken into the northern, middle, and southern portions on the eastern side of the Site;
- Northern Manufacturing Area (NMA) located north of I-287 along the Wanaque River; and
- Western Manufacturing Area (WMA) located south of I-287 along the Wanaque River.

1.1 REGULATORY BACKGROUND

In September 1988, DuPont entered into an Administrative Consent Order (ACO) with the New Jersey Department of Environmental Protection (NJDEP). In June 1992, the U.S. Environmental Protection Agency (USEPA) issued DuPont a Hazardous Waste Management Facility Permit under Section 9003 of the Hazardous and Solid Waste Amendments of 1984 (HSWA). The ACO and HSWA permit, which were revised in 1996, required DuPont to conduct a remedial investigation (RI) addressing contamination at, or emanating from, the Site. RI activities and remedial actions have been ongoing, both onsite and offsite, since 1988 to address media potentially impacted by former Site operations.

For onsite soils, the following Remedial Investigation Reports (RIRs) have been submitted to NJDEP and USEPA:

- The *South Plant Remedial Investigation Report* (encompassing activities in the southern portion of the EMA) was submitted on October 2, 2002. NJDEP and USEPA approved the report on March 26, 2003.
- The *Remedial Investigation Report Western Manufacturing Area* was submitted on June 30, 2010. Responses to NJDEP comments on the RIR were submitted on October 7, 2010. The WMA RIR and response to comments were approved by NJDEP and USEPA on November 24, 2010.
- The *Remedial Investigation Report Northern Manufacturing Area* was submitted on June 30, 2010. Responses to NJDEP comments on the RIR were submitted on December 21, 2010. The NMA RIR and response to comments were verbally approved by NJDEP and USEPA during meetings held on December 6 and 8, 2011.
- The *Remedial Investigation Report Eastern Manufacturing Area* (encompassing activities in the northern and middle portions of the EMA) was submitted on June 30, 2010. On September 12, 2011, NJDEP provided comments on the report and identified areas where additional soil sampling was required to address data gaps. Responses to NJDEP's comments on the RIR were submitted on November 2, 2011 and a supplemental RI was conducted in 2012 to address the data gaps. The *Former Eastern Manufacturing Area Supplemental Remedial Investigation Report* was submitted on October 15, 2012. NJDEP and USEPA approved the report on February 20, 2013.

NJDEP and USEPA's February 20, 2013 correspondence approved the RIRs for the Site which constituted the completion of the RI phase for onsite soils. The correspondence requested the submittal of a Corrective Measures Study (CMS) as the next phase to evaluate remedial actions for impacted soils in the EMA, NMA, and WMA.

1.2 PURPOSE OF CORRECTIVE MEASURE STUDY

NJDEP's *Technical Requirements for Site Remediation* (TRSR) no longer requires that a Remedial Action Selection Report be completed as part of a remedial action. Therefore, as directed by NJDEP and USEPA, this CMS is being completed for onsite soils in accordance with USEPA's *RCRA Corrective Action Plan* (Chapter 5 – Corrective Measure Study).

The purpose of the CMS phase of the Resource Conservation and Recovery Act (RCRA) corrective action process is to identify and evaluate potential remedial alternatives for the impacted media that have been identified at a facility. To date, RIs for onsite soils have been completed for the three former manufacturing areas (EMA, WMA, and NMA) and remedial measures have been completed for select Areas of Concern (AOCs) (see Figure 2). The impacted media evaluated as part of this CMS is onsite soils. Onsite groundwater is currently being addressed under the *Groundwater Remedial Action Plan* (approved in 1993 and implemented in 1998) with NJDEP and USEPA, and as a part of the *Comprehensive Groundwater Monitoring Program* (CGMP) which has been ongoing at the Site since 1996. Soils that could represent a potential source of volatile organic compounds (VOCs) to groundwater (e.g., Well 13 area) are currently being addressed under a separate interim remedial measure (IRM) work plan.

The objective of this CMS is to identify a potential remedial alternative to address impacts associated with former manufacturing operations for onsite soils in a comprehensive, Site-wide manner to satisfy the requirements of the ACO and HSWA and be protective of people and the environment. Beneficial reuse of the property is also considered in identifying and selecting the remedial alternative.

As allowed under USEPA's *RCRA Corrective Action Plan* and agreed to by USEPA and NJDEP, a streamlined CMS was prepared for the Site and presents a single proposed alternative for onsite soils. This proposed remedial alternative is presented in terms of its effectiveness in providing protection to people and the environment as well as its implementability.

Additional soil data are currently being collected to further refine the boundaries of where remediation will be conducted as well as to support remedy implementation. These data will be presented as part of the Corrective Measure Implementation Work Plan (CMIWP) for final approval of the remedy being proposed for onsite soils.

1.3 REPORT ORGANIZATION

The overall organization of this report is consistent with USEPA's CMS process as outlined in Chapter 5 of the *RCRA Corrective Action Plan* (May 1994). Brief summaries of the remaining sections are presented below.

- Section 2: *Site Background and Physical Setting* – This section provides a description of the Site, operational history, land use, and summary of previous investigations and remedial activities. It also provides a detailed summary of the physical setting of the Site, including a description of the conceptual Site model (CSM).
- Section 3: *Development of Remedial Action Objectives* – This section presents the applicable remediation standards and development of remedial action objectives (RAOs) for onsite soils.
- Section 4: *Screening and Development of Corrective Measure Alternative* – This section identifies the technology screening process and criteria used in the selection of an appropriate remedial action for onsite soils.
- Section 5: *Proposed Corrective Measure Alternative* – This section presents a description of the proposed remedial alternative to address onsite soils.

- Section 6: *Path Forward* – This section discusses the path forward for future work pertaining to onsite soils.

2. SITE BACKGROUND AND PHYSICAL SETTING

2.1 SITE DESCRIPTION AND LOCATION

The approximate 588-acre Site consists of northeast/southwest trending ridges and valleys containing two major drainage areas: the Wanaque River (former Lake Inez) on the west and Acid Brook on the east. I-287 crosses the northern and western portions of the Site isolating approximately 70 acres. The Site is bordered to the northeast and east by Ringwood State Park, to the south by the town of Pompton Lakes (industrial, commercial/services, and residential land use) and Pompton Lake, and to the west and northwest by Twin Lake Valley (commercial/services and residential land use) and the Borough of Wanaque.

2.2 SITE OPERATIONAL HISTORY

In the late 1800's, the H. Julius Smith Blasting Cap Plant and the American Smokeless Powder Plant operated in the western portion of the Site, and the Metallic Cap Company operated in the eastern portion. In 1902, DuPont purchased the Site and began operation of the DuPont Electric Exploder Company in the WMA. Structures within the WMA consisted of buildings for manufacturing, magazine storage for explosive products and materials, and an engineered tunnel for conducting cladding operations. These structures were primarily located along the banks and ridge slopes of Lake Inez (Wanaque River). In 1908, DuPont opened the DuPont Cap Works in the EMA. DuPont ceased production in the WMA in 1926 and consolidated operations in the EMA. Structures within the EMA consisted of buildings for manufacturing and offices, quality control laboratories, magazine storage for explosive products, and an engineered tunnel for conducting cladding operations. These structures were primarily located in the low-lying lands of the valley. From that time until April 1994 when operations permanently ceased, DuPont production activities manufactured a variety of explosive products. A majority of the structures across the Site have been removed (with the exception of four buildings in the southern portion of the EMA) and the two cladding tunnel entrances have been sealed.

2.3 SITE LAND USE

The Site totals approximately 588 acres within multiple tax lots. Six tax lots totaling approximately 299 acres are located in the Borough of Wanaque, and three tax lots totaling approximately 289 acres are located in the Borough of Pompton Lakes (see Figure 3). The reasonably anticipated future land uses for the Site were identified through the completion of a comprehensive reuse assessment by DuPont and its consultant, Vita Nuova, LLC. The reuse assessment process conducted on the property was consistent with USEPA guidance documents and considered the following:

- Current and historic land use;
- Local and regional setting and land use policies;
- Surrounding land use;
- Property location, characteristics, and infrastructure;
- Ecosystems including wetlands, flood plains, and forests;
- Real estate market; and
- Community input.

2.3.1 Current Land Use

Borough of Wanaque Parcels

The following six parcels are located within the Borough of Wanaque:

- Block 479, Lot 3 – located north of I-287 and encompassing the western portion of the NMA;
- Block 479, Lot 4 – located north of I-287 and encompassing the eastern portion of the NMA;
- Block 479, Lot 5 – located west of I-287;
- Block 479.01, Lot 1 – located south of I-287 and encompassing the northwestern portion of the WMA;
- Block 479.01, Lot 2 – located south of I-287 and Block 479.01, Lot 1 in the WMA; and
- Block 479.01, Lot 3 – located south of I-287 in the northern portion of EMA, spanning south along the northeastern portion of the WMA, and ending in the western portion of the WMA south of Block 479.01, Lot 2.

Currently, the land located in Wanaque is generally used as passive buffer land and features heavily wooded terrain of steep and varying topography. The Wanaque River passes through the western side of the parcels.

Adjacent and surrounding properties to the north of Block 479, Lots 3 and 4, and west of Block 479, Lot 4 and Block 479.01, Lot 3 are currently used as open space. A small number of residential houses are located adjacent to the southwest corner of Block 479.01, Lot 3. Land to the east and south of the Wanaque parcels consists of the remainder of the Site located within the Borough of Pompton Lakes. A majority of the Site located in Wanaque has been designated as a Preservation Area under the New Jersey Highlands Water Protection and Planning Act. Additionally, portions of the property in Wanaque have been identified as potential open space use by Passaic County.

Borough of Pompton Lakes Parcels

The following three parcels are located within the Borough of Pompton Lakes:

- Block 100, Lot 3 – encompasses the majority of the EMA and southeastern portion of the WMA;
- Block 100, Lot 6.01 – portion of the Wanaque River; and
- Block 100, Lot 7 – southwestern portion of the WMA.

The two western tax parcels (Block 100, Lots 6.01 and 7) located in Pompton Lakes consist of open space and the Wanaque River. This area of the property is currently used as passive buffer land and features heavily wooded landscape, waterway, and floodplain. The main parcel (Block 100, Lot 3) located in Pompton Lakes includes approximately 231 acres of land. Features in this main parcel include a mix of open areas and heavily wooded terrain of steep and varying topography. A freight rail is adjacent to the property along the southeastern border. Various surface water tributaries pass through the parcel. The entire Site located in Pompton Lakes has been designated as a Planning Area under the New Jersey Highlands Water Protection and Planning Act.

Ringwood State Park borders the property to the east. An active industrial facility and a small residential area border the property to the south. The only vehicular access to the property is through Cannonball Road, a corridor primarily consisting of industrial, commercial, and multi-family land uses.

2.3.2 Anticipated Future Land Use

A reuse assessment was completed for the Site by Vita Nuova, LLC to achieve the following objectives:

- Provide information that supports potentially-viable options for redevelopment of the property;
- Identify portions of the property for an enduring and sustainable productive reuse; and
- Ensure the reuse of the property is compatible with the potential remedial actions being considered for the Site.

The reuse assessment considered data relative to the property and the northern New Jersey market. It focused on information relative to the real estate market, physical characteristics of the Site, and potential opportunities/constraints associated with these elements.

Key findings of the assessment were as follows:

- Located in northern New Jersey in the central core of Passaic County, the property is in a vibrant economic region in close proximity to major highway and rail corridors.
- The property is large with approximately 588 acres of land, which is unique in the market. A review of the parcel characteristics has identified a potential development area totaling approximately 50 to 70 acres.
- The Site has historically been used for industrial purposes. Existing onsite and public infrastructure may be of value to future users. An adjacent freight rail line may be of further interest to the real estate market.
- The real estate market has been challenged over the past several years due to regional and national economic conditions. Recent activity suggests improvements within the market.
- Specialty uses within niche real estate markets continue to present opportunities for reuse.
- A majority of the property contains steep slopes, with intermittent areas of moderately level land, rendering many areas inaccessible. The Site contains documented critical habitats, environmentally sensitive ecological assets, intermittent wetlands, and two watercourses. These ecological assets, combined with the Site's location with the boundaries of the New Jersey Highlands Act, suggest a majority of the Site should be conserved as open space and preservation land.
- Based on the location, characteristics, and market conditions, future use of the property is likely to be a mix of commercial/light industrial/institutional and conservation/preservation.

Based on the reuse assessment, for the purposes of this CMS the anticipated future land use of the property is a mix of conservation, preservation, and commercial/industrial uses as depicted in the Site Reuse Conceptual Model (see Figure 4).

- Approximately 70 acres of land north and west of I-287 in Wanaque has been designated for transfer to the State of New Jersey under a previously negotiated settlement agreement.
- Land along and to the west of the Wanaque River, encompassing approximately 194.5 acres, is anticipated to be used in the future for conservation open space purposes. This area, including the Wanaque River, would likely be made available for public access and passive use.
- Approximately 254.5 acres to the east of the Wanaque River, and adjacent to the Ringwood State Park, is likely to be preserved as protected forest land.

- The remaining land area, approximately 69 acres in size, has been indentified for future industrial and commercial uses. This anticipated use is based on its location along an industrial corridor, proximity to freight rail, limited commercial and industrial land in the Borough, and market demand.

2.4 PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

2.4.1 Previous Remedial Investigations

As depicted on Figure 2, there are 202 AOCs identified at the Site. A total of 60 AOCs require no further action as approved by NJDEP and USEPA in the five RIRs submitted for the Site (as outlined in Section 1.1). Soils from the remaining 142 AOCs are being evaluated as part of this CMS.

Numerous investigations have been performed at the Site to facilitate the characterization of onsite soils. The five RIRs, approved by NJDEP and USEPA, provide information related to the delineation and characterization of potential impacts associated with former operations at AOCs located within the EMA, NMA, and WMA.

2.4.2 Previous Remedial Actions

Soils impacted by Site-related constituents at 29 of the 202 AOCs have been addressed by remedial and/or stabilization measures while groundwater remedial activities include an ongoing groundwater extraction and treatment (GWET) system.

The following IRMs have been conducted for impacted soils in the EMA:

- Acid Brook (AOC 118) was desilted onsite and offsite then restored with clean fill, geotextile, and riprap stone. Part of the restoration included installation of engineering controls to control storm water run-off.
- Soils in the northern portion of the EMA have been excavated from the old cap destruction facility (AOC 1), shooting pond (AOC 5), and shooting pond sludge pile (AOC 6). The upper burning ground (AOC 2) and old lead recycling area (AOC 3) have had interim stabilization measures installed to help control erosion.
- Soils in the middle portion of the EMA have been excavated from the black powder mill (AOC 47), mercury fulminate storage building (AOC 52), sawdust pile (AOC 56), old cap test area (AOC 57), burned wire dump (AOC 58), cap test well (AOC 59), canister disposal (AOC 104), and scrap metal dump (AOC 105). Additionally, soils from the mercury fulminate plant (AOC 74) have been excavated and the mercury fulminate fume lines (AOCs 75 and 76) were removed. The lower burning ground (AOC 60) and old lead recycling area (AOC 61) have had interim stabilization measures installed to help control erosion.
- Soils in the southern portion of the EMA have been excavated from the rivet line lagoon (AOC 102) and sewage treatment (AOC 106). Additionally, three gasoline underground storage tanks were removed (AOCs 120, 121, and 122).

The following IRMs have been conducted for impacted soils in the WMA;

- Soils have been excavated from the main office shooting ground (AOC 107), old fuze works wire dump (AOC 192), old fuze works dump (AOC 194), and area of tar deposits (AOC 198).
- The old fuze works miscellaneous waste site (AOC 193) had interim stabilization measures installed to help control erosion.
- Offsite soils south of the property boundary associated with the eastern and western banks of the Wanaque River have been remediated through excavation.

2.5 CONCEPTUAL SITE MODEL

A CSM is an essential tool that is used to clearly describe and explain site-specific information and conditions within an environmental system. Data collected as part of environmental investigations are used to understand the extent and source(s) of site-specific impacts along with the physical, chemical, and biological processes that determine the fate and transport of these constituents and understand the potential receptors (human and ecological) that may be potentially exposed. CSMs are continually re-evaluated and refined, as necessary, when new data are collected. The CSM developed for onsite soils is presented in the following sections based on the investigations completed across the Site.

2.5.1 Environmental Setting

2.5.1.1 Geology

The Site is situated within the Highlands Physiographic Province adjacent to the northwestern boundary of the Newark Basin. Bedrock beneath the Site consists of Precambrian gneiss and diabase. Previous studies show that two primary geologic units, crystalline bedrock and alluvial deposits consisting of colluviums and stratified glacial drift, underlie the Site. The crystalline bedrock is comprised of deformed and metamorphosed high-grade gneisses.

The topography of the bedrock surface varies from gently undulating to steeply sloping. A 45-foot thick diabase dike bisects the Site on the eastern ridge between the EMA and WMA. The bedrock contains joints that are observable in outcrops at the Site.

Former Eastern Manufacturing Area

The EMA is characterized by bedrock ridges with extensive to scattered outcrops in the northern and middle portions and along the western edge in the southern portion. The alluvial deposits in the EMA are up to 120 feet thick in the southern portion thinning up the valley to approximately 10 feet or less in the northern portion. The alluvial deposits are a fining downward stratified glacial sequence which can generally be divided into three depositional types. The shallow alluvial depositional type is comprised of fill, colluvium, and till deposits and ranges from approximately 5 to 20 feet thick. The intermediate alluvial deposits are generally comprised of very fine to medium-grained sand and range from 15 to 80 feet thick. The intermediate zone is not present in the northern portion of the EMA. The deep alluvial deposits are generally comprised of very fine-grained silty sand and very fine-grained sandy silt. The thickness of this zone is highly variable and can be up to 90 feet thick in bedrock surface structural lows. The deep zone pinches out in the middle portion of the EMA and is not present in the northern portion.

Former Northern/Western Manufacturing Areas

The NMA/WMA is characterized by bedrock ridges with extensive to scattered outcrops in the east and west. The topography of the bedrock surface is moderately steep to very steeply sloping. The alluvial deposits are roughly confined to the 100-year floodplain. The alluvium is composed of poorly sorted fine to coarse-grained sand and gravel, and may contain layers of very coarse gravel, and traces of silt, clay, and cobbles. The deposits range in thickness from a thin soil cover where bedrock outcrops to approximately 60 feet. No weathered zone has been detected at the bedrock surface.

2.5.1.2 Hydrogeology

The ridge between the NMA/WMA and EMA creates a groundwater divide, as does the ridge between Wanaque River and Twin Lake to the west. Generally, groundwater flow occurs within the alluvial aquifer and becomes restricted to the surface of the overburden/bedrock interface at locations of limited overburden. Groundwater flow directly between the bedrock and the alluvial aquifers is considered to be limited because of the low permeability of the bedrock and the fact that there is a groundwater divide between the two watersheds. The limited groundwater observed in the bedrock ridges flows toward the valleys, generally following the topography, so that the groundwater surface mimics the topography. A component of groundwater recharge is comprised of run-off from the bedrock hills around the Site that infiltrates into the alluvial aquifer.

Former Eastern Manufacturing Area

Groundwater depths measured in existing monitoring wells in the EMA range from approximately 3 to 26 feet below ground surface (bgs). Water levels fluctuate up to 5 feet seasonally in response to precipitation. The saturated thickness of the alluvial aquifer ranges from several feet in the northern portion of the EMA to 125 feet near the southern Site boundary. Since the alluvium is a fining downward sequence, groundwater will flow faster in the shallower zones because it is more permeable (courser) than the deep zones. Groundwater within the EMA generally flows toward the south. However, where the alluvium is thin in the areas of bedrock outcrops, topography controls the groundwater flow direction and groundwater flows down slope towards Acid Brook or its tributaries until it flows into the main valley area.

Former Northern/Western Manufacturing Areas

Groundwater depths measured in existing monitoring wells in the WMA range from approximately 6 to 19 feet bgs. Water levels fluctuate from 7 to 11 feet seasonally in response to precipitation, run-off into the Wanaque River, and water discharged from the Wanaque Reservoir into the river. The saturated thickness of the alluvial aquifer ranges from approximately 32 feet mid-valley to 47 feet near the southern boundary of the WMA. The groundwater flow direction in the alluvium is generally toward the river and south. However, where the alluvium is thin in the areas of scattered to extensive bedrock outcrops, topography controls the groundwater flow direction and groundwater flows down slope.

2.5.1.3 Surface Water

There are two surface water bodies present on the former facility, Acid Brook and Wanaque River.

Acid Brook

Acid Brook generally flows from north to south. This intermittent stream originates in the Ringwood State Park land north/northeast of the Site where several springs combine with overland flow. Acid Brook enters the Site on the northeastern boundary just north of the shooting pond and flows westerly until it meets the main valley area (vicinity of Well 20), where it flows to the south. Approximately one-half mile south of the Site, Acid Brook discharges into Pompton Lake.

Groundwater flow generally mimics surface topography, flowing down slope toward Acid Brook and its tributaries in the north and middle reaches. The interaction between groundwater and surface water changes seasonally and spatially. If the water table elevation is greater than the elevation of the bottom of the stream, groundwater is discharging to the stream, but if the water table is lower, then any water in the stream is discharging to groundwater. Seasonally, when the recharge and run-off rates are high, Acid Brook is a gaining stream. Spatially, the stream is usually a gaining stream in the north and middle reaches, and a losing stream in the southern reach.

Wanaque River

The Wanaque River flows from north to south. The river originates at the Wanaque Reservoir, where water flow is controlled approximately one mile upstream of the Site as water exits the Wanaque Reservoir through Raymond Dam. Wanaque River eventually discharges into the Pequannock River at the Riverdale-Pompton Lakes municipal boundary. The river was formerly dammed just downstream of the WMA to create Lake Inez; however, the dam was removed in 1984 and the river returned to its channel.

In the WMA, the width of the Wanaque River is variable, ranging from approximately 40 feet wide in the northern portion to 100 feet wide in the section upstream of the former dam. The river is relatively shallow with depths generally less than 2 feet. Groundwater flows toward the river and south, eventually discharging in the river. Based on the limited data available, Wanaque River appears to be a gaining water body in the northern portion of the WMA (based on information collected at Well 141-D). However, as the river travels toward the southern boundary of the Site, it becomes a losing water body (adjacent to the Well 142 cluster).

2.5.2 Summary of Soil Constituents of Concern

Extensive soil sampling programs have been completed as part of the RIs at the Site. As documented in the NJDEP- and USEPA-approved RIRs, onsite soils have been delineated to the appropriate NJDEP Soil Remediation Standards (SRS) as follows:

- Soils within the NMA were delineated to the Residential Direct Contact Soil Remediation Standards (RDCSRS);
- Soils at the property boundary in the EMA and WMA, where historical manufacturing activities occurred in the area, were delineated to the RDCSRS; and
- Remaining soils within the EMA and WMA were delineated to the Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS).

Based on the comparisons of these standards to the analytical results presented in the RIRs, the primary constituents of concern (COCs) in soil for each manufacturing area are as follows:

Table 1 – Constituents of Concern for Onsite Soils

COC	EMA	WMA	NMA
Metals			
Arsenic	●	●	●
Antimony	●	●	
Cadmium	●		
Copper	●	●	
Lead	●	●	●
Mercury	●	●	
Selenium		●	
Vanadium	●		
Polycyclic Aromatic Hydrocarbons			
Benzo(a)anthracene	●	●	
Benzo(b)fluoranthene	●	●	
Benzo(a)pyrene	●	●	●
Dibenz(a,h)anthracene	●	●	
Indeno(1,2,3-cd)pyrene	●	●	
Naphthalene	●		
Volatile Organic Compounds			
Carbon tetrachloride	●		
Chloroform	●		
Tetrachloroethene (PCE)	●		
Trichloroethene (TCE)	●		
Polychlorinated Biphenyls			
PCBs	●		

These COCs are consistent with the Site's operational history in the production of a variety of explosive products.

As part of the NJDEP- and USEPA-approved RIRs, the following baseline ecological evaluations (BEEs) were completed to evaluate constituents of potential ecological concern (COPECs) for the Site:

- *Eastern Manufacturing Area Baseline Ecological Evaluation* (Appendix D of EMA RIR);
- *Northern Manufacturing Area Baseline Ecological Evaluation* (Appendix D of NMA RIR); and
- *Western Manufacturing Area Baseline Ecological* Evaluation (Appendix F of WMA RIR).

Based on the results of these BEEs, the following COPECs were identified for each manufacturing area:

Table 2 – Constituents of Potential Ecological Concern for Onsite Soils

COPEC	EMA	WMA	NMA
Metals			
Antimony	●	●	
Arsenic	●	●	●
Barium	●		
Cadmium	●	●	
Chromium	●	●	
Cobalt	●		
Copper	●	●	●
Lead	●	●	●
Manganese	●		
Mercury	●	●	●
Nickel	●	●	
Selenium	●	●	●
Silver	●	●	
Thallium	●	●	
Vanadium	●		
Zinc	●	●	●
Cyanide	●		
Volatile Organic Compounds			
Tetrachloroethene	●		
Polycyclic Aromatic Hydrocarbons			
Total Low Molecular Weight (LMW)	●		
Total High Molecular Weight (HMW)	●	●	●
Other Semivolatile Organic Compounds			
Bis(2-ethylhexyl)phthalate	●		

COPECs identified in the EMA only include data from the middle and northern portions. COPECs were not identified for the southern portion of the EMA due to the lack of environmental sensitive natural resources (ESNRs) identified in this area and the anticipated development of this area for commercial use.

2.5.3 Fate and Transport

The migration of chemical constituents through various media is governed by the physical and chemical properties of the detected chemicals and the surface and subsurface media through which the chemicals are present. The principal properties affecting environmental fate and transport of chemical constituents are solubility, chemical partitioning coefficients, degradation rates, and Henry's Law Constant. These properties provide information that can be used to evaluate constituent mobility in the environment.

The water solubility is a measure of the saturated concentration of a constituent in water at a given temperature and pressure. Generally, the tendency for a constituent to be transported by groundwater is directly related to its solubility and inversely related to both its tendencies to adsorb to soil and to volatilize from water. Constituents with high water solubilities tend to desorb from soils, are less likely to volatilize from water, and are susceptible to biodegradation. The water solubility of a constituent varies with temperature, pH, and the presence of other dissolved constituents (including organic carbon and humic acids).

Partitioning coefficients are used to assess the relative affinities of constituents for solution or solid phase adsorption. The tendency of organic chemicals to be sorbed is also dependant on the organic content of the soil and the degree of hydrophobicity (lack of affinity for water) of the solute (constituent). The octanol-water partition coefficient can be used to estimate the tendency for a chemical to partition between environmental phases of different polarity. The water/organic carbon partition coefficient (K_{oc}) is a measure of the tendency of a constituent to partition between soil and water. The K_{oc} is defined as the ratio of the absorbed constituent per unit weight of organic carbon to the aqueous solute concentration. This coefficient can be used to estimate the degree to which a compound will adsorb to soil and thus not migrate with groundwater.

The Henry's Law Constant value (KH) for a constituent is a measure of the ratio of the compound's vapor pressure to its aqueous solubility. The KH value can be used to make general predictions about the compound's tendency to volatilize from water.

As summarized on Table 1 above, metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and VOCs are the COCs for the EMA while only metals and PAHs are COCs for the WMA and NMA. The fate and transport of these COCs provide the basis for characterizing potential exposure pathways and receptors, which in turn provide a framework for evaluating appropriate remedial alternatives for onsite soils.

Metals

The transport of metals in soil is generally governed by the ability to mobilize to groundwater and physical movement of the soil in which the constituent is present. In general, most metals in soil tend to adsorb onto the soil particles. Surface run-off or wind can potentially cause erosion resulting in the transport of soil particles containing these metals. Precipitation and surface run-off may also cause the dissolution of some metals into water, and transport these dissolved metals via surface run-off or cause downward migration through the soil column where it may potentially reach groundwater. However, there are numerous factors that can influence the transport of metals in soil, including ground cover (i.e., vegetative, asphalt), topography, soil chemistry, and physical/chemical properties of the metals.

Metals adsorbed onto soil particles in surface and subsurface soils generally have limited ability to undergo dissolution and be transported vertically through the soil column. Therefore, migration to groundwater is expected to be minimal (McLean and Bledsoe, 1992). The dissolution of metals into groundwater and the fate of dissolved metals in groundwater are controlled by the soil and water chemistry. The metals of concern generally have limited solubility in groundwater with naturally occurring geochemistry, and consequently will remain in the soil and not dissolve into the groundwater. Should dissolved metals be introduced into the groundwater, the metals will tend to sorb to soil or combine with other constituents in the groundwater and precipitate out of solution. These processes will tend to limit the magnitude and extent of dissolved metal transport in groundwater.

The metals identified as COCs in Table 1 can and do occur naturally in the environment. For areas of the Site where the concentrations of these metals in soil may have resulted from historic Site manufacturing operations, Site soil and groundwater data provide multiple lines of evidence that support the CSM in that metals of concern have limited ability to migrate to and/or be transported to groundwater.

As presented in the RIRs, impacts to soils due to metals are primarily found in surface soils. There are localized impacts to soils at depth in the EMA and WMA due to historic manufacturing operations that would generate dissolved metals concentrations (i.e., lagoons, sumps, dry wells, disposal operations) as well as historic redevelopment and repurposing of operational areas.

As documented in the *Supplemental Onsite Groundwater Investigation Report* (SOGWIR) dated November 15, 2012, groundwater investigations were conducted in the NMA, WMA, and EMA to assess the potential for metals concentrations in soil to impact groundwater:

- NMA - The presence of overburden groundwater is limited within the NMA and groundwater metals concentrations are below NJDEP's Class IIA Ground Water Quality Standards (GWIIA). These findings support the fact that these metals are sorbed onto soil particles with minimal dissolution into and migration with groundwater.
- WMA - The groundwater data presented in the SOGWIR indicated that COC metal concentrations are below the GWIIA with the exception of localized detections of selenium, copper, and arsenic. The selenium and copper detections above the GWIIA were localized since downgradient concentration of these metals did not exceed the GWIIA. These findings support the fact that metals are sorbed onto soil particles with minimal dissolution into and migration with groundwater. The occurrence of arsenic has been demonstrated to be naturally occurring.
- EMA - The groundwater data indicate that COC metal concentrations are below the GWIIA with the exception of localized detections of arsenic (3 out of 38 total samples collected), lead (2 out 38 samples), mercury (6 out of 38 samples), and selenium (1 out of 38 samples). The occurrence of arsenic has been demonstrated to be naturally occurring. Historic groundwater investigations indicate that soil concentrations of metals (lead, mercury, and selenium) have only impacted groundwater at localized locations. Dissolved metals concentrations in groundwater were lower than total metals concentrations in most samples, indicating samples may have been affected by soil particles entrained into the sample. Metals exceedances of the GWIIA were not observed down and side gradient of localized exceedances. These findings support the fact that metals are sorbed onto soil particles with minimal dissolution into and migration with groundwater.

A well-established vegetative cover exists throughout the Site. Its presence minimizes the potential erosional effects of both wind and surface run-off. Areas of the Site with impacted soils also have a generally flat topography which limits transport of metals via overland flow. However, there are areas of the Site where impacted soil may be transported to surface water (i.e., some areas along the Wanaque River banks). Potential impacts to surface water in the Wanaque River have been evaluated as part of the August 2011 *Wanaque River Remedial Investigation Report* and are being addressed as a separate IRM. The *Wanaque River Interim Remedial Measure Work Plan* was submitted to NJDEP and USEPA on May 28, 2013.

PAHs and PCBs

Both PAHs and PCBs in soils are strongly sorbed to soil particles. PCBs experience tight adsorption with adsorption generally increasing with the degree of chlorination of the PCB. They generally do not leach significantly in aqueous soil systems; the higher chlorinated congeners have a lower tendency to leach than the lower chlorinated congeners. Although the biodegradation of higher chlorinated congeners may occur very slowly on an environmental basis, no other degradation mechanisms have been shown to be important in natural water and soil systems.

Erosion of soil via surface run-off or wind can result in the transport of these constituents. Unlike metals, both of these constituent groups biodegrade and can volatilize in soil and water. Volatilization is generally not considered a significant transport or fate process for PAHs and PCBs because of their low KH (see Table 3 below). The dissolution of PAHs and PCBs into water and the fate of dissolved PAHs and PCBs in surface water and groundwater are typically limited as documented by their low solubility (see Table 3 below). Both PAHs and PCBs strongly sorb to soil, as documented by their high K_{oc} values (see Table 3 below), and sorption increases in the presence of naturally occurring organic carbon in the soil. If PAHs and PCBs are detected in groundwater, they are usually associated with dissolved solids within the water column, thereby limiting the extent of transport within groundwater.

As presented in the RIRs, impact to soils due to PAHs and PCBS are primarily found in surface soils. PCBs are localized to areas where former pole- or pad-mounted transformers were located. PAHs are localized to areas adjacent to locations where former operations were decommissioned. As documented in the SOGWIR, groundwater investigations were conducted in the EMA to assess the potential for PCB concentrations in soil to impact groundwater. PCBs were not detected or were detected at concentrations below the GWIIA in groundwater, which is consistent with their low solubility and low mobility. Historic groundwater investigations did not identify PAHs in Site groundwater, which is consistent with the fate and transport mechanisms for PAHs.

A well-established vegetative cover exists throughout the Site. Its presence minimizes the potential erosional effects of both wind and surface run-off. Areas of the Site with impacted soils also have a generally flat topography which also limits transport of PAHs and PCBs via overland flow.

VOCs

VOCs move in soils by diffusion and advection. Some VOCs (e.g., non-polar, such as PCE) are adsorbed predominantly by soil organic matter. VOC vapors are also absorbed by soil minerals. Physical transport of VOCs at the Site could occur by the erosion and transport of soil particles. VOCs will preferentially tend to volatilize directly to the atmosphere from surface soils. While surface water transport of dissolved VOCs can occur, the magnitude and extent of transport is typically limited because the VOCs tend to volatilize into the atmosphere. The extent of transport can be controlled by the subsurface soil permeability, sorption, dispersion, dilution, volatilization, and biodegradation. These processes will act to reduce the concentrations and extent of VOC transport. Some of the physical properties to be considered as it relates to potential transport of Site-related constituents are provided in Table 3 below.

VOCs are not present in surface soils across the Site, therefore physical transport of soils are not considered a primary migration pathway for this COC group. Site-related VOCs observed to be present within low permeable subsurface soils can become stored as sorbed phase in or on soils and potentially migrate to groundwater were present. Over time, the VOCs can be released into the more transmissive zones beneath the low permeable soils by diffusion or slow advection due to degradation of the dissolved phase VOCs within the transmissive zone. Both adsorption and diffusion/advection are the main transport mechanisms occurring at the Site as seen at AOC 66 (Boron Red Lead Waste Water) and AOC 72/143/144 (Powder Sump Areas).

VOCs are also subject to biodegradation both when they are sorbed to soil and when they are dissolved in water. Biodegradation will act to reduce concentrations, degrade constituents into other VOCs, and eventually break down the VOCs. VOC degradation parameters are detected in Site groundwater, suggesting that biodegradation is occurring.

VOCs in Site soils are subject to the following fate and transport mechanisms: adsorption, diffusion/advection, and biodegradation. VOC's are not present in surface soils across the Site, therefore physical transport of soils are not considered a primary migration pathway for this COC group.

Table 3 – Physical Properties of Organic Constituents of Concern

Constituent	**Molecular Weight (g/mol)**	**Density (g/cm^3)**	**Solubility (mg/l)**	**K_{oc} (ml/g)**	**Henry's Constant ($atm\text{-}m^3/mol$)**
PAHs					
Benzo(a)anthracene	*228.3*	*1.274*	0.0094	358,000	0.00000335
Benzo(a)fluoranthene	*252.3*	---	*0.0012*	---	*0.0000122*
Benzo(a)pyrene	*252.3*	*0.9*	0.00162	969,000	0.00000113
Dibenz(a,h)anthracene	*278.35*	*1.282*	0.00249	1,790,000	1.47E-08
Indeno(1,2,3-cd)pyrene	*276.3*	---	0.000022	3,470,000	0.0000016
Naphthalene	128.19	---	31	1,190	0.000483
PCBs					
PCBs (1016 - 1268)	*258 - 453*	1.37 - 1.81	0.59 - 0.0027	>5,000	0.0046 - 0.00029
VOCs					
Carbon tetrachloride	153.8	1.59	825	439	0.0298
PCE	165.8	1.63	200	155	0.0184
TCE	131.5	1.46	1,100	166	0.0103
Chloroform	*119.4*	1.49	8,000	44	0.00358

Sources: Pankow and Cherry, 1996
Shaded – USEPA Soil Screening Guidance Tables, July 1996 (http://www.epa.gov/superfund/health/conmedia/soil/pdfs/part_5.pdf)
Shaded –http://www.epa.gov/oswer/riskassessment/pdf/1340-erasc-003.pdf
Shaded – http://www.epa.gov/ogwdw/pdfs/factsheets/soc/tech/pcbs.pdf
Italic – http://www.toronto.ca/health/pdf/cr_appendix_b_pah.pdf

$atm\text{-}m^3/mol$ = atmosphere-meter per mold
g/mol = grams per mole
g/cm^3 = grams per cubic centimeter
K_{oc} = Soil Organic Carbon-Water Partitioning Coefficient
mg/l = milligrams per liter
ml/g = milliliters per gram
--- = no value

Summary

The fate and transport of the Site COCs in soils is influenced by numerous factors. Physical and chemical properties of the constituents themselves as well as that of the environmental media can limit the migration of COCs. As indicated by Site data, metals, PAHs, and PCBs concentrations in soils generally remain with the soil; concentrations are generally not detected above the GWIIA or

GWIIA exceedances have been demonstrated to be localized or naturally occurring. VOCs are primarily present in the subsurface soils across the Site. Sorption, dispersion, dilution, volatilization, and biodegradation are processes that are acting to reduce the concentrations and extent of VOC transport. Subsurface soils that could represent a potential source of VOCs to groundwater (e.g., Well 13 area) are currently being addressed under a separate IRM work plan.

Migration of COCs at the Site due to erosion and transport of soil particles is not anticipated. The potential for erosional effects of metals, PAHs, and PCBs due to wind and surface run-off are minimized due to the well-established vegetative cover throughout the Site and the generally flat topography in areas of impacted soils. Potential impacts to surface water in the Wanaque River due to metals (mercury) in river bank soils have been evaluated and are being addressed under a separate IRM work plan.

2.5.4 Potential Receptors and Exposure Pathways

As discussed above, migration of the COCs due to physical and chemical properties of the constituents are limited. Potential impacts to the groundwater or surface water pathway are being addressed as separate IRMs. For the purpose of this CMS, the medium of concern is onsite soils.

Potential Receptors

Direct contact with COCs present in soils may result in exposure to ecological and human receptors. Based on the proposed beneficial reuse for the Site, the following potential receptors were identified for each potential land use (see Figure 4):

- State of New Jersey Land Transfer – wildlife receptors and recreational users;
- Conservation area – wildlife receptors and recreational users;
- Preservation area – wildlife receptors and recreational trespassers; and
- Industrial/Commercial – non-residential users which assumes potential exposure of adult workers during an 8-hour work day.

Exposure Pathways

Exposure to soil due to erosion and transport of soil particles is not anticipated. The well-established vegetative cover throughout the Site and the generally flat topography in areas of impacted soils minimizes the potential for erosional effects. Direct contact with onsite soils is the primary exposure to the COCs. The methods by which receptors can come into direct contact with constituents include ingestion, inhalation, and dermal contact. The areas of potential direct contact is identified as the surface vertical zone of 0 to 2 feet bgs.

3. DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

3.1 MEDIA OF CONCERN

For the purpose of this CMS, the medium of concern is onsite soils.

3.2 APPLICABLE REMEDIATION STANDARDS

Regulatory standards applicable to onsite soils were identified and based on the proposed future land use. As shown on Figure 4, the proposed Site Reuse Conceptual Model separates the Site into the following four types of potential land use:

- State of New Jersey Land Transfer,
- Industrial/Commercial,
- Conservation, and
- Preservation.

Based on the potential receptors identified for each area of potential land use, applicable remediation standards were evaluated for human health, ecological receptors, and impact to groundwater as discussed below. The most conservative (or lowest) of the applicable remediation standards for each area of the Site will be used to evaluate compliance during the remedial action. The human health SRS and ecological risk-based remediation goals (ERGs) are considered applicable to the area of potential direct contact identified as the surface vertical zone of 0 to 2 feet bgs.

3.2.1 Arsenic

In accordance with the NJDEP's *Soil Investigation Technical Guidance* dated February 21, 2012 and with the concurrence of NJDEP and USEPA, an investigation was conducted to determine the natural background concentration for arsenic in soil at the Site. A summary of the findings were presented in the *Arsenic Natural Background Investigation for Soil Technical Memorandum* dated September 4, 2012. NJDEP and USEPA approved this technical memorandum on February 21, 2013.

Based on the analytical results and statistical evaluation presented in the technical memorandum, a background-based Site-specific SRS of 75 milligrams per kilogram (mg/kg) for arsenic has been established for onsite soils. Detected arsenic concentrations above this standard will be further evaluated as part of the remedial action for Site soils. Pursuant to N.J.S.A. 58:10B-12g(4), remediation beyond natural background levels is not required. Therefore, no further action is proposed for arsenic soil concentrations detected below this Site-specific SRS.

3.2.2 Human Health

Based on the proposed future use for the Site, the applicable human health SRS for the NMA (State of New Jersey Land Transfer) will be the RDCSRS. The applicable remediation standards for the southern portion of the EMA identified for industrial/commercial reuse will be the NRDCSRS. Direct contact SRS values for residential and non-residential scenarios are promulgated in New Jersey Administrative Code (N.J.A.C.) 7:26D.

Consistent with Section 7 and Appendix 4 of N.J.A.C. 7:26D, alternative remediation standards can be developed for the protection of human health based on future use of portions of the Site for recreational purposes. NJDEP defines recreational purposes as site-specific uses that do not reflect either a residential or non-residential land use scenario. Conservation land use is proposed for the western portion of the WMA. Preservation land use is proposed for the northern and middle portions of the EMA and eastern portion of the WMA. Recreational access will be allowed in the conservation area. No public access to the preservation area will be allowed. However, for the purpose of developing a remedial standard, passive recreational land use (such as walking or hiking) was considered for both the conservation and preservation areas. The development and establishment of the alternative remediation standards is documented in Appendix A.

A summary of the proposed human health SRS for the COCs associated with each of the proposed future land uses are as follows:

Table 4 – Human Health Soil Remediation Standards

Analyte	**Human Health Soil Remediation Standards (mg/kg)**			
	Alternative SRS		**NRDCSRS**	**RDCSRS**
	Preservation *(EMA northern and middle portions and WMA eastern portion)*	**Conservation** *(WMA western portion)*	**Industrial/ Commercial** *(EMA southern portion)*	**State of New Jersey Land Transfer** *(NMA)*
Antimony	760	590	-	-
Cadmium	1,800	-	-	-
Copper	76,000	59,000	45,000	-
Lead	1,300	1,100	800	400
Mercury	570	450	65	-
Selenium	9,600	7,400	-	-
Vanadium	9,600	-	-	-
Benzo(a)anthracene	5	4	2	-
Benzo(b)fluoranthene	5	4	2	-
Benzo(a)pyrene	0.5	0.4	0.2	0.2
Dibenz(a,h)anthracene	0.5	0.4	0.2	-
Indeno(1,2,3-cd)pyrene	5	4	2	-
Naphthalene	280	-	17	-
Carbon tetrachloride	70	-	-	-
Chloroform	30	-	-	-
Tetrachloroethene	2,300	-	5	-
Trichloroethene	150	-	20	-
PCBs	2	-	1	-

- = Not a COC for human health as identified in the RIRs (see Table 1)

The SRS presented above do not represent a not-to-exceed concentration at any single sampling location, but rather an average concentration that is not to be exceeded. Several averaging methods can be used including, but not limited to, the arithmetic mean, the 95% upper confidence limit of the arithmetic mean concentration (UCL_{95}), spatially-weighted averaging (e.g., Thiessen polygons), or 75%/10X rule. Compliance averaging will be applied in accordance with NJDEP's *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*.

3.2.3 Ecological

ERGs for onsite soils were developed for the protection of wildlife receptors that may be exposed to COPECs at the Site. Consistent with NJDEP's *Ecological Evaluation Technical Guidance*, these numeric goals are intended to serve as delineation criteria for soils to evaluate the extent of potential remedial actions on the basis of ecological risk.

ERGs for the protection of ecological receptors were evaluated for COPECs identified in BEEs completed for the following areas of the Site:

- EMA (middle and northern portions),
- NMA, and
- WMA.

ERGs were not derived for the southern portion of the EMA due to the lack of ESNRs identified in this area during the BEE and the anticipated future development of this area for commercial use.

Documentation on how the ERGs were derived for the protection of wildlife is presented in Appendix A. A summary of the proposed ERGS for the COPECs associated with the Site are as follows:

Table 5 – Ecological Risk-Based Remediation Standards

Analyte	Ecological Risk-Based Remediation Goals (mg/kg)
Antimony	62
Arsenic	154
Barium	3,270
Cadmium	5.7
Chromium	455
Cobalt	521
Copper	1,100
Lead	892
Manganese	9,091
Mercury	20.4
Nickel	609
Selenium	5
Silver	181
Thallium	4.3
Vanadium	62
Zinc	1,507
LMW PAHs	382
HMW PAHs	48

As outlined in NJDEP's *Ecological Evaluation Technical Guidance*, ERGs are intended to serve as delineation criteria for soils in determining the potential extent of remedial action. However, the calculated ERGs, as listed above, represent the concentration that may potentially result in adverse effects to wildlife through integrated exposure over the entire foraging range of each representative receptor. As a result, the ERG does not represent a not-to-exceed concentration at any single sampling location, but rather an average concentration that is not to be exceeded over the entire foraging range of the most sensitive receptor.

To evaluate the need for remedial action based on wildlife exposure, soil ERGs will be compared to the UCL_{95} calculated for each COPEC for the potential remedial areas within the Site. If the UCL_{95} exceeds the ERG for a given COPEC, the iterative truncation method will be used to identify the maximum soil concentration to be addressed through remedial action to reduce the overall exposure point concentration below the ERG. As described in USEPA's *Guidance on Surface Soil Cleanup at Hazardous Waste Sites: Implementing Cleanup Levels*, iterative truncation involves removing (truncating) maximum values, replacing the next highest value with the concentration in clean fill, and calculating the hypothetical post-remediation concentration. In accordance with this USEPA guidance, the UCL_{95} will be calculated for the dataset following each iteration with the USEPA software program ProUCL Ver. 4.1 until the UCL_{95} exposure point concentration is at or below the ERG.

3.2.4 Impact to Groundwater

Groundwater Investigations

Groundwater has been investigated and sampled extensively at the Site since 1981 under a variety of programs to identify if concentrations of Site-related COCs in soil have resulted in exceedances of the GWIIA. An evaluation of the dataset collected between 1981 and 1995 was conducted for multiple analytes from 126 monitoring wells onsite and offsite. The evaluation provided information and insight for the development of a more complete and efficient comprehensive program to monitor groundwater conditions at the Site. The results of the evaluation were presented in the November 1995 CGMP.

A supplemental onsite groundwater investigation was conducted in 2011 and 2012 to address NJDEP comments on the EMA, NMA, and WMA RIRs regarding the potential for Site-related constituents in soil above NJDEP's default Impact to Groundwater Soil Screening Levels (IGWSSL) to impact groundwater. Based on discussions with NJDEP's technical team, an investigation plans was developed that included the collection of synthetic precipitation leaching procedure (SPLP) samples within the NMA and WMA and the collection of groundwater samples from select existing monitoring wells and temporary wells within the EMA, NMA, and WMA. The overall goal of the investigation was to collect groundwater data at specific locations where soil concentrations were elevated to assess if Site-related constituents were present in groundwater. The results of the investigation were presented in the SOGWIR.

Results

The evaluation documented in the CGMP identified the following 10 VOCs as the primary COCs in groundwater at the Site: tetrachloroethene, trichloroethene, 1,1,1-trichloroethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, carbon tetrachloride, and vinyl chloride. Historic groundwater investigations did not identify PAHs in Site groundwater, which is consistent with the fate and transport mechanisms for this constituent group. Additionally, metals (arsenic, antimony, copper, lead, and mercury) were not identified as COCs in Site groundwater due to limited and low frequency of detection.

Although results from SPLP sampling within the NMA and WMA indicate the potential for metals in soil to migrate into groundwater, the results from the temporary well installation and sampling largely indicated that soil metals concentrations have not impacted groundwater. Metals were not detected above the GWIIA in the NMA. Metals (arsenic, selenium, and copper) were detected above the GWIIA at three existing monitoring wells in the WMA. These detections in the WMA have been associated with background (arsenic) or localized metals exceedances.

The sampling of Site-related constituents within the EMA identified localized exceedances of trichloroethene and metals (arsenic, lead, mercury, and selenium) at ten temporary well locations across the EMA. Analytical results for other constituents investigated, specifically PCBs, were not detected above the GWIIA.

Impact to Groundwater Modeling

To confirm the results of the metals evaluation in the CGMP and the metal/PCB sampling results from the 2012 supplemental groundwater investigation, an initial impact to groundwater (IGW) evaluation was conducted. This evaluation was completed utilizing NJDEP's *Using the SESOIL Transport Model to Assess The Impact to Ground Water Pathway* guidance document, revised December 2008, and the Seasonal Compartment Model (SESOIL).

The first step in the evaluation consisted of reviewing RI and SOGWIR data collected to establish the primary COCs (lead, mercury, and PCBs) which have elevated concentrations in soil above the IGWSSL; therefore, the greatest potential to impact groundwater. These COCs were selected and based on their soil concentration ranges, frequency of occurrence at the Site, and concentration/frequency of detection in groundwater. The evaluation was focused within the EMA since the soil concentrations present are higher and the supplemental groundwater investigation completed in the WMA demonstrated that locations with elevated concentrations did not migrate to groundwater. As discussed above, no exceedances of the GWIIA were observed in the NMA. Modeling was completed in a phased approach to validate the results of historic investigations and the CSM. The results of this effort are provided in Appendix B.

The SESOIL modeling and evaluation findings for lead, mercury, and PCBs are consistent with Site groundwater results for these constituents.

Significance of Findings.

Site-related VOCs have been detected in onsite groundwater above the GWIIA but have not been attributed to a specific source area. Dissolved phase concentrations are likely the result of the historic Site handling of tetrachloroethene used to clean equipment and machinery as part of normal Site operations.

Although results from soil sampling indicate the potential for Site-related COC concentrations in soil to migrate into groundwater, historic groundwater investigations indicate that soil concentrations of metals (copper, lead, mercury, and selenium) have only impacted groundwater in localized areas. Concentrations of arsenic observed in groundwater are attributed to natural background arsenic levels detected in soil as well as the fact that historic operating records for the Site indicate arsenic was never used, stored, or disposed at the facility.

Concentrations of non-VOC related constituents above the IGWSSL do not necessarily indicate groundwater is or will be impacted. As discussed in Section 2.5.3, the non-VOC related Site constituents, specifically metals, PAHs, and PCBs, have strong tendencies to sorb onto soil and are not mobile due to limited or low solubility. Historic groundwater investigations did not identify PAHs in Site groundwater and PCBs were not detected above the GWIIA in groundwater samples collected during the supplemental groundwater investigation.

Metals concentrations detected above the GWIIA were localized and limited. Concentrations of dissolved metals from the supplemental groundwater investigation were lower than the total metals concentration, or below the GWIIA in most of the samples. This supports that the metals are associated with particulates within the groundwater and less likely to be transported with groundwater flow.

The results of the supplemental groundwater investigation were consistent with the evaluation documented in the CGMP. Furthermore, the SESOIL modeling effort validated the conclusions from the CGMP and SOGWIR. Impacts to groundwater from metals, and PCBs are not anticipated outside of the few localized metals impacts described in the SOGWIR. Monitoring of VOC concentrations in groundwater will continue in accordance with the CGMP and concentrations are being addressed with institutional controls (i.e., Classification Exception Areas), and the existing GWET system.

3.3 REMEDIAL ACTION OBJECTIVE

RAOs are media-specific goals that are aimed at protecting human health and the environment. RAOs were developed based on the end-use of the Site. Given the above considerations, the RAO developed for the Site is as follows:

- Reduce potential human and ecological exposure to COCs in onsite soils with concentrations above relevant risk-based remediation standards/goals and Site-specific background based remediation standards.

4. SCREENING AND DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVE

The primary objective of this CMS is to identify a potential remedial alternative for onsite soils in a comprehensive, Site-wide manner. This report is a streamlined CMS which presents a single proposed alternative for onsite soils. In accordance with the RCRA *Corrective Action Plan*, a technology screening process was used to evaluate the effectiveness and impelementability of the proposed remedial alternative.

4.1 TECHNOLOGY SCREENING PROCESS AND CRITERIA

The purpose of the technology screening process is to evaluate the general suitability of the remedial technology to meet the RAO. Effectiveness and implementability criteria are the main factors evaluated for the proposed alternative.

The effectiveness criterion considers the degree to which the proposed action can attain the stated RAOs and the degree to which the action provides sufficient long-term control to be protective of human and environmental receptors. These factors can generally be assessed by evaluating the following:

- Performance and effectiveness in meeting the RAO;
- Ability to attain the applicable remediation standards;
- Reduction in mobility, toxicity, and/or volume (M/T/V) of constituents;
- Mitigation of the migration of constituents;
- Demonstrated performance history at other sites;
- Expected long-term durability/reliability; and
- Maintenance requirements.

The implementability criterion considers technical and administrative factors such as:

- Engineering and scientific feasibility of the technology;
- Availability of services and resources required for implementation;
- Uncertainties associated with the construction, operation, and performance;
- Whether the technology can be implemented within a reasonable timeframe;
- Consistency with other applicable laws and regulations; and
- Impacts on local community.

As part of the technology screening process, the potential for the implementation of the remedial alternative to cause a natural resource injury is also evaluated.

4.2 SUMMARY

The criteria outlined above were used to identify the appropriate remedial action for onsite soils. The proposed remedial alternative and a summary of how the proposed alternative meets the evaluation criteria are presented in Section 5.

5. PROPOSED CORRECTIVE MEASURE ALTERNATIVE

The comprehensive reuse assessment (discussed in Section 2.3) identified that the appropriate beneficial reuse of the Site is separated into the following four types of potential land use which include:

- State of New Jersey Land Transfer,
- Industrial/Commercial,
- Conservation, and
- Preservation.

Based on the beneficial reuse of the Site, the proposed alternative for onsite soils includes excavation of select soils above remediation standards, offsite disposal of select excavated material, onsite consolidation of select excavated material (i.e., subsurface in the tunnels, reuse in industrial/commercial areas), capping of in-place and consolidated soils, and implementation of institutional controls.

Evaluation of Proposed Alternative

The effectiveness and implementability of the proposed alternative was evaluated in accordance with the criteria discussed in Section 4. The following demonstrates how the proposed alternative meets the evaluation criteria:

- The proposed remedial alternative will meet the RAO by reducing and controlling the potential for human and ecological exposure to impacted soils.
- The most conservative (or lowest) of the applicable remediation standards identified in Section 3.2 for each area of the Site will be used to evaluate compliance during the remedial action.
- Excavation, consolidation, and capping of impacted soils will reduce the overall area of potential exposure to impacted material. The proposed remedy will eliminate the potential direct contact with impacted soils, thus eliminating the potential exposure pathway for soils as identified in Section 2.5.4. Additionally, offsite disposal of select excavated material will reduce the overall volume of soils remaining onsite.
- Institutional measures to control, limit, and monitor activities onsite will be implemented as part of the remedial action to control the potential for exposure to impacted media, and control future redevelopment or excavation at the Site.
- The proposed remedial alternative uses conventional technologies that have a demonstrated performance history at other sites.
- Excavation, consolidation, and capping are reliable controls that, with proper maintenance of the cap, constitute a permanent remedy.
- The long-tem monitoring and maintenance of the cap will be adequate and reliable for verifying that the remedy is providing protection over time.
- The proposed alternative allows for beneficial reuse of the Site immediately after implementation (construction) of the remedy.
- The proposed alternative is consistent with local, state, and federal laws and regulations.

This evaluation identified that the proposed alternative of excavation, consolidation, and capping consists of proven technologies that will be effective in controlling and reducing potential exposure to human and ecological receptors identified for the future land uses. The excavation and consolidation/capping activities will reduce and control the potential for human and ecological exposure to impacted soils, which is the RAO for the Site. This alternative will be readily implementable using conventional technologies and will return the Site to beneficial reuse as soon as practicable.

Implementation of Alternative

No further action is proposed for AOCs where excavation and capping were previously conducted as IRMs, as described in Section 2.4.2. To meet the RAO for the Site, the proposed remedial alternative will be implemented for each proposed land use area as follows:

- The State of New Jersey Land Transfer will include excavation of soils to the applicable standards for human (RDCSRS) and ecological receptors. Management of excavated soils will include a combination of offsite disposal and select consolidation within the industrial/commercial area.
- The conservation area will include excavation to the applicable standards and subsurface consolidation (in the former eastern and western cladding tunnels only). Management of excavated soils will include a combination of offsite disposal, consolidation within the former cladding tunnels, and select consolidation within the industrial/commercial area. Consolidation of material within the former cladding tunnel will eliminate the potential safety and trespasser hazards associated with this open area located onsite.
- The preservation area will include excavation to the applicable standards and subsurface consolidation (in the former eastern cladding tunnel only). Management of excavated soils will include a combination of offsite disposal, consolidation within the former cladding tunnels, and select consolidation within the industrial/commercial area. Consolidation of material within the former cladding tunnel will eliminate the potential safety and trespasser hazards associated with this open area located onsite.
- In the industrial/commercial area, select soils excavated from the Site will be consolidated within this area to assist in the future redevelopment of the Site with the goal of maximizing the amount of property available for beneficial reuse. Consolidation activities will be completed in accordance with applicable NJDEP guidance

The removal activities will be dictated by the appropriate remediation standards discussed above and resulting surface soils will meet both human health and ecological standards/goals in each area with potential backfilling, as necessary. Consolidation and capping activities will be conducted in accordance with NJDEP's *Alternative and Clean Fill Guidance for SRP Sites.* In addition, subsurface soils (below 2 feet) in specific areas where elevated contractions of Site-related constituents are present, but do not represent a potential exposure pathway, may be removed to assist in the future redevelopment of the Site. These areas will be defined in the CMIWP.

Institutional measures to control, limit, and monitor activities onsite will be implemented as part of the remedial action. The objectives of the institutional measures are to control the potential for exposure to impacted media, and control future redevelopment or excavation at the Site. A deed restriction on the property and continued use of existing Classification Exception Areas in accordance with N.J.A.C. 7:26E will accomplish these objectives.

6. PATH FORWARD

Preparation of a CMIWP for the proposed remedial action is contingent on NJDEP and USEPA approval of this CMS. Prior to submittal of a CMIWP, additional design activities will be completed to identify the limits of excavation; select an appropriate approach for excavation in each area; evaluate transportation methods; prepare a proposed consolidation plan; and design a cap. Upon approval of this report, the supplemental design activities will be completed.

The CMIWP will be submitted to NJDEP and USEPA for review within 270 days of approval of this CMS.

7. REFERENCES

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URS. June 2010. *Western Manufacturing Area Baseline Ecological Evaluation*.

Figures

FIGURE 1

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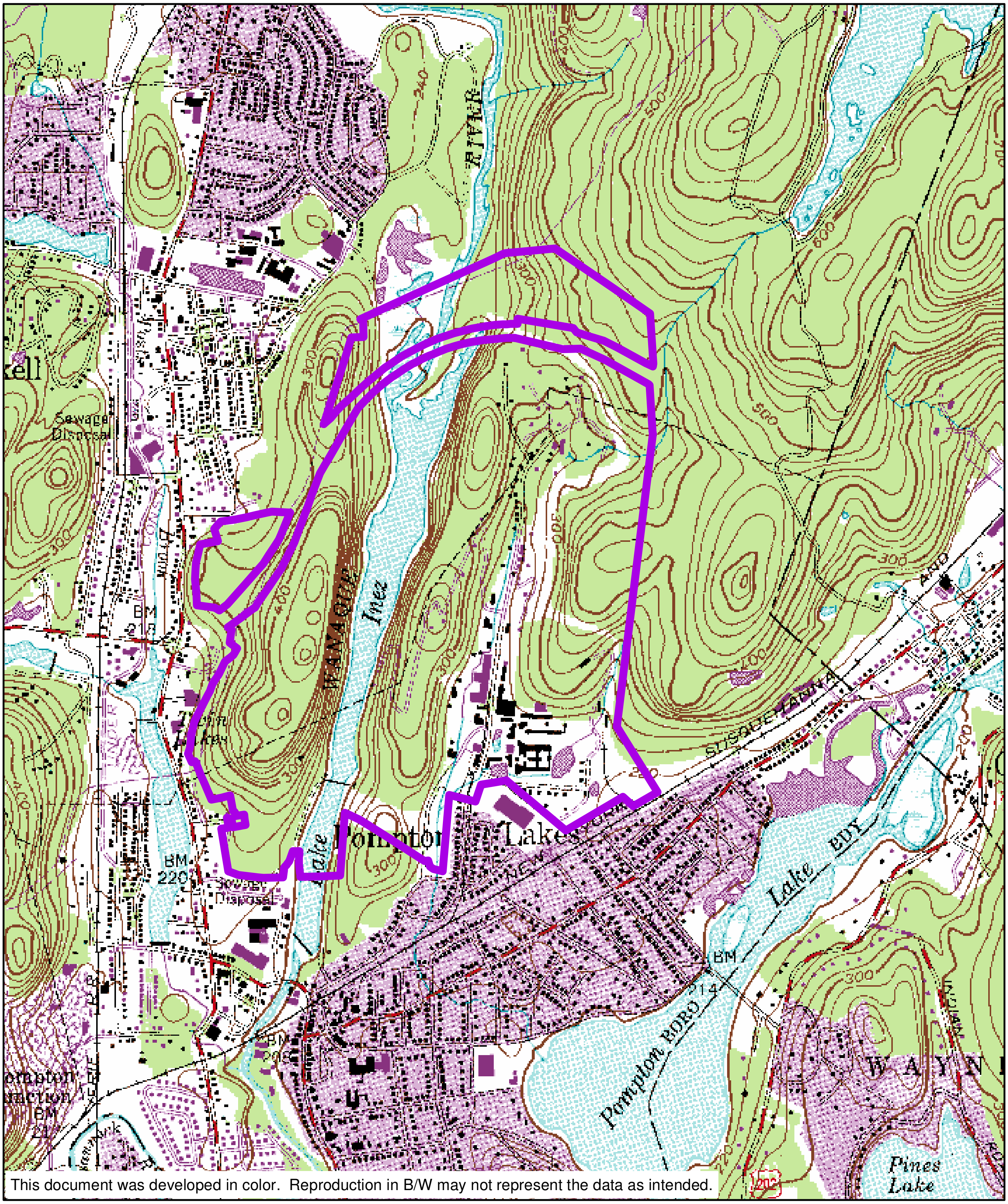


DUPONT
POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

Site Location Map

Legend

DuPont PLW Property Boundary

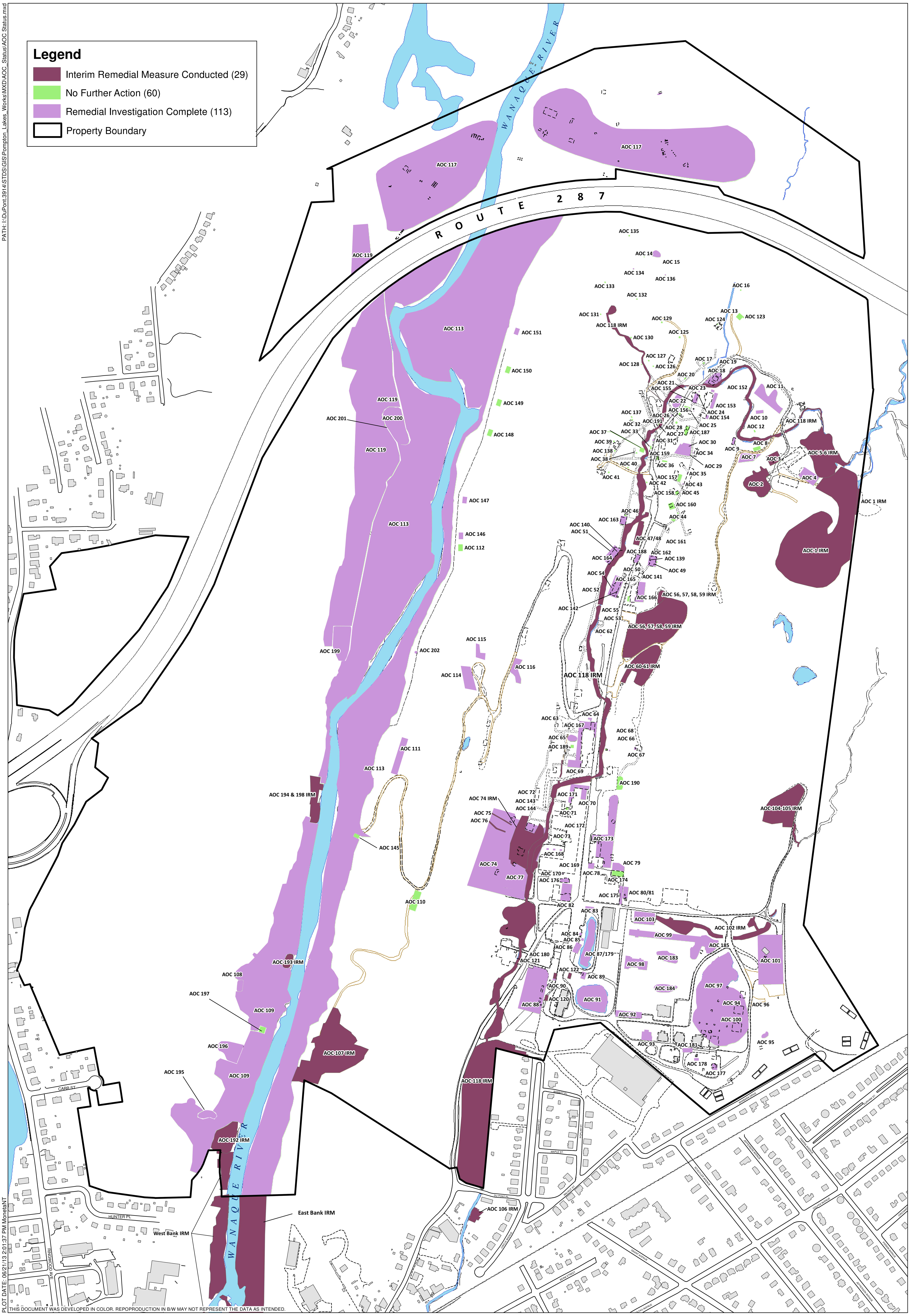
Base is portion of the USGS Wanaque and Pompton Plains QUAD.

0 0.25 0.5 1

Miles

N

O'BRIEN & GERE



AREA OF CONCERN STATUS

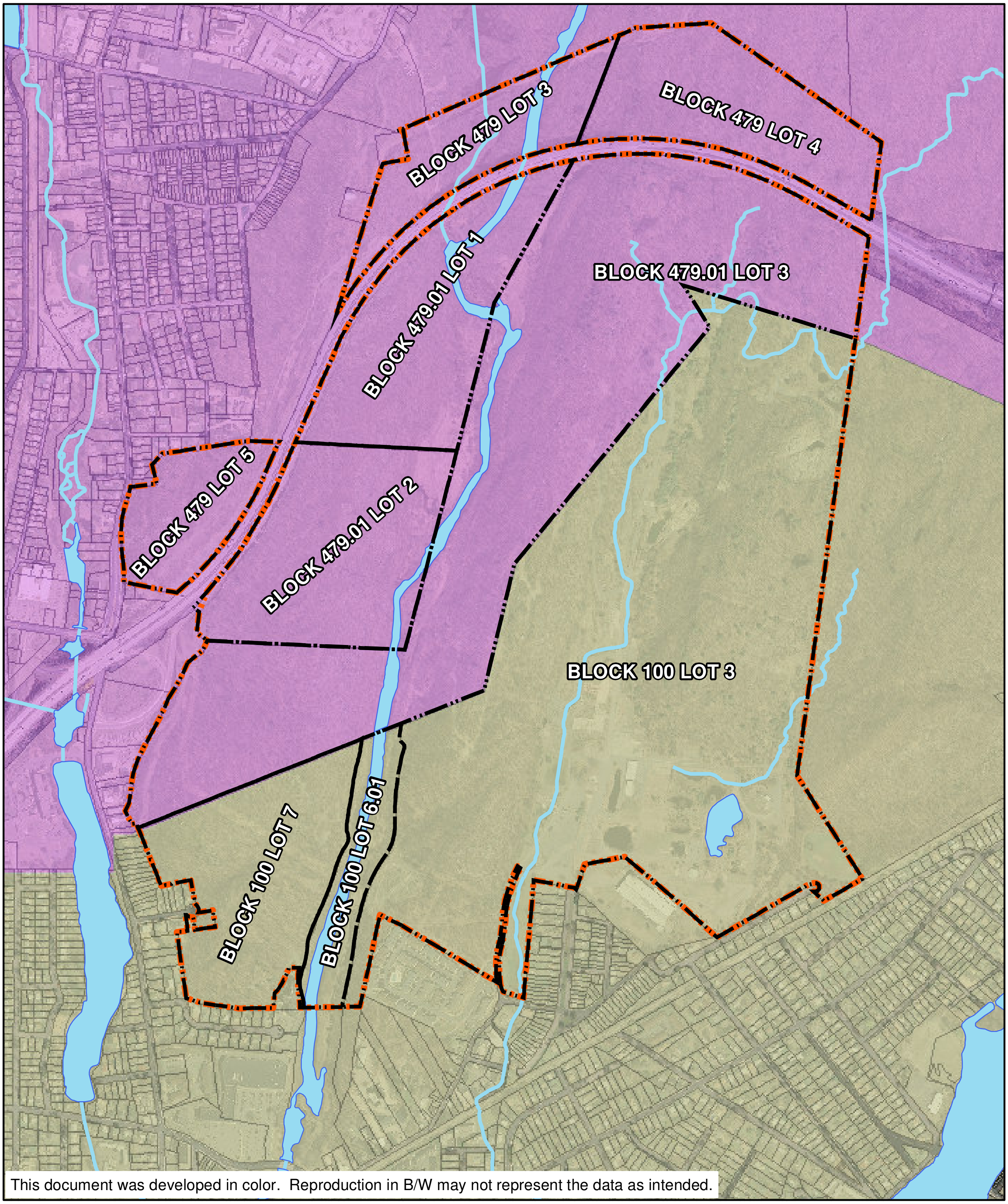
FIGURE 2

DUPONT
POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

0 100 200 400 600 800
Feet

O'BRIEN & GERE

FIGURE 3



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Note: Based on information provided by Vita Nuova.

LEGEND

- Site Boundary
- Site Tax Parcels
- Pompton Lakes Borough
- Wanaque Borough

DUPONT
POMPTON LAKE WORKS
POMPTON LAKES, NEW JERSEY

TAX PARCELS

0 500 1,000 2,000
Feet
1 inch = 1,000 feet

N

O'BRIEN & GERE

JUNE 2013
48022.013

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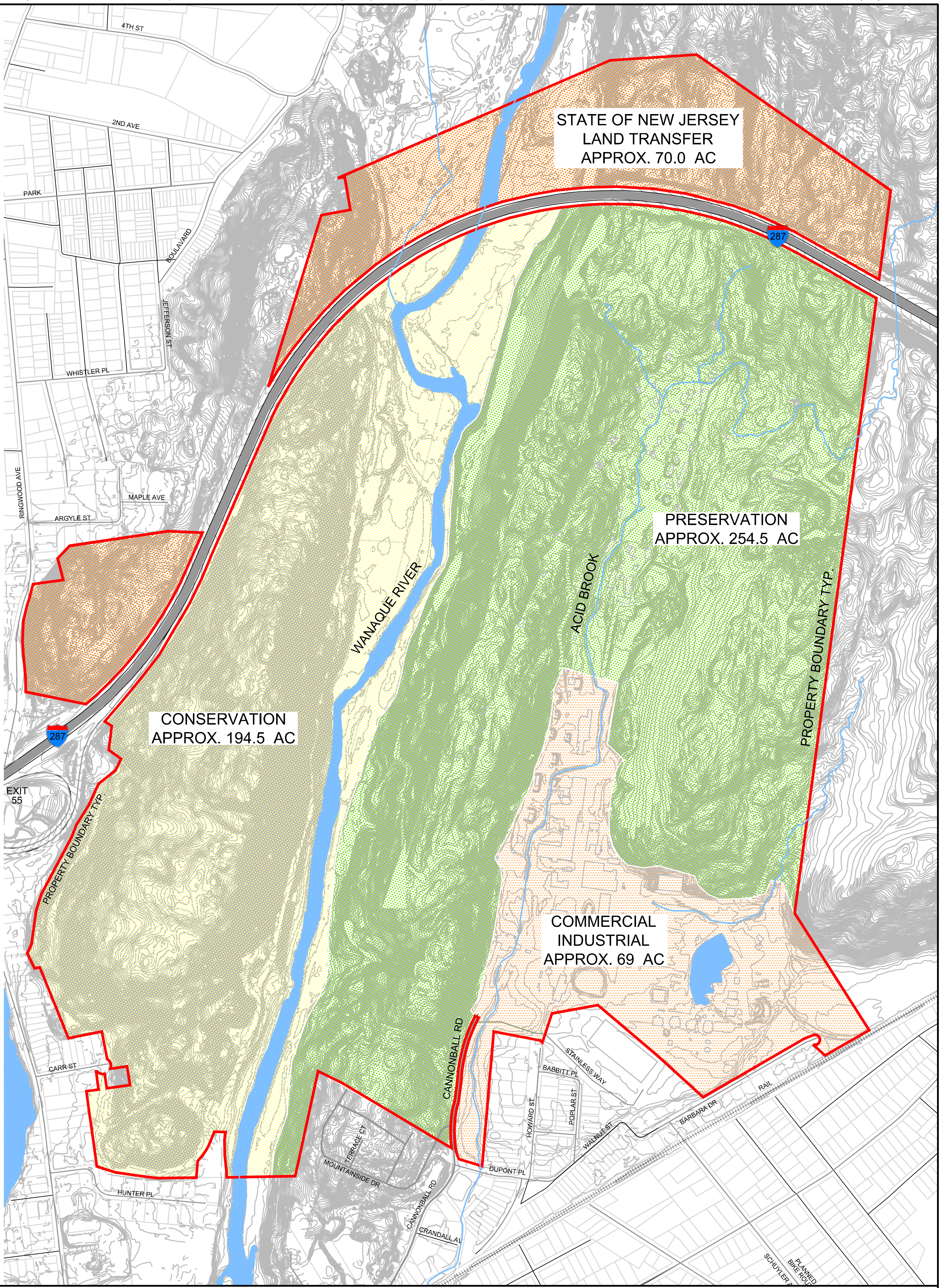

NOTE: BASED ON INFORMATION PROVIDED BY VITA NUOVA.

LEGEND: PROPOSED LAND USES

- CONSERVATION
- PRESERVATION
- STATE OF NEW JERSEY LAND TRANSFER
- COMMERCIAL/INDUSTRIAL

FIGURE 4

DUPONT
POMPTON LAKES WORKS
POMPTON LAKES, NEW JERSEY

SITE REUSE CONCEPTUAL MODEL

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JUNE 27, 2013

1"=600' 600 0 600

O'BRIEN & GERE

Appendix A

Alternative Soil Remediation Standards Memorandum

Memorandum

Date: May 30, 2013

To: Dave Epps – DuPont CRG

From: Dana McCue, Gary Long

DuPont Project No.: 507505
URS Project No.: 18986412

Subject: **Alternative Soil Remediation Standard**
DuPont Pompton Lakes Works

This memorandum describes the development of alternative soil remediation standards (SRS) for the former E.I. du Pont de Nemours and Company (DuPont) Pompton Lakes Works (PLW) site located in Pompton Lakes, New Jersey (the site). The alternative SRS values will be used to support the Corrective Measures Study (CMS) being prepared for the former manufacturing areas. In particular, the alternative SRS values will form the basis to determine the extent (i.e., define the horizontal and vertical excavation limits) of remedial action. The proposed Site Reuse Conceptual Model separates the Site into the following four types of potential land use:

- State of New Jersey Land Transfer,
- Industrial/Commercial,
- Conservation
- Preservation

Further discussion of future land use and associated institutional controls to be established is provided in the CMS.

The applicable remediation standards for the Northern Manufacturing Area (NMA) (State of New Jersey Land Transfer) will be the Residential Direct Contact Soil Remediation Standards (RDCSRS). The applicable remediation standards for southern portion of the Eastern Manufacturing Area (EMA South Plant) identified for industrial/commercial reuse will be the Non-Residential Direct Contact Soil Remediation Standards (NRDCSRS). Direct contact SRS values for protection of residential and non-residential receptors are promulgated in the New Jersey Administrative Code (NJAC) 7:26D – Remediation Standards (date last amended May 7, 2012).

Consistent with Section 7 and Appendix 4 of N.J.A.C. 7:26D, alternative remediation standards can be developed for the protection of human health based on future use of portions of the site for recreational purposes. New Jersey Department of Environmental Protection (NJDEP) defines recreational purposes as site-specific uses that do not reflect either a residential or nonresidential land use scenario. Conservation land use is proposed for the western portion of the Western Manufacturing Area (WMA) and preservation land use is proposed for a portion of the EMA (EMA North and Mid-Plant) and the eastern portion of the WMA. Recreational access will be allowed in the conservation area. No public access to the preservation area will be allowed. However, passive recreational land use (such as walking or hiking) was considered for both the conservation and preservation areas for the purpose of evaluating alternative standards. Alternative SRS values were, therefore, developed in this memorandum.

Alternative SRS values for the protection of human health direct contact exposure pathways were calculated consistent with procedures found in NJAC 7:26D, and the NJDEP guidance documents *Development of Alternative Remediation Standards for the Ingestion-Dermal Pathways* (NJDEP, 2008a) and *Development of Alternative Remediation Standards for the Inhalation Pathway* (NJDEP, 2008b). Alternative SRS values protective of multiple-route exposure were calculated using USEPA risk assessment methodology (USEPA, 1989). The USEPA risk assessment equations calculate risk levels based on the constituent concentration, magnitude of exposure, and the toxicity of the constituent. To calculate the alternative SRS values, the equations are rearranged to solve for an allowable constituent concentration based on a target risk level (hazard quotient of 1 or cancer risk of 10^{-6}), magnitude of exposure, and toxicity.

Ecological risk-based remediation goals (ERGs) were developed for soil for the protection of wildlife receptors consistent with NJDEP Ecological Evaluation Technical Guidance (NJDEP, 2012). ERGs were estimated as the concentration in soil equivalent to a lowest observable adverse effects level (LOAEL) dose to wildlife receptors.

1.0 Alternative SRS Values for Protection of Human Health

Alternative SRS values are intended to serve as delineation criteria for shallow soil to evaluate the extent of potential remedial action (excavation) on the basis of human health exposure.

The following sections describe the toxicity values and exposure assumptions used in the alternative SRS derivation for each of the constituents listed in the table on the following page. These constituents of potential concern (COPCs) for human health direct contact exposure pathways were identified during Remedial Investigations (RI) conducted for each area (Parsons, 2010a; Parsons, 2010b; Parsons, 2010c). A summary of the alternative SRS values calculated for the preservation and conservation areas are provided in Tables A-1 and B-1, respectively.

COPCs for Human Health	Preservation (EMA North and Mid-Plant and portion WMA)	Conservation (portion of WMA)
Metals		
Antimony	●	●
Cadmium	●	
Copper	●	●
Lead	●	●
Mercury	●	●
Selenium	●	●
Vanadium	●	
Polycyclic Aromatic Hydrocarbons (PAHs)		
Benzo(a)anthracene	●	●
Benzo(b)fluoranthene	●	●
Benzo(a)pyrene	●	●
Dibenz(a,h)anthracene	●	●
Indeno(1,2,3-cd)pyrene	●	●
Naphthalene	●	
Volatile Organic Compounds (VOCs)		
Carbon tetrachloride	●	
Chloroform	●	
Tetrachloroethylene	●	
Trichloroethene	●	
Polychlorinated Biphenyls (PCBs)		
PCBs	●	

1.1 Toxicity Values

Tables provided in Appendix A (for the preservation area) and Appendix B (for the conservation area) lists the numerical toxicity values that were used in the alternative SRS derivation. The values are reference doses (RfDs) or reference concentrations (RfCs) for systemic (noncancer) effects and slope factors (SFs) or unit risk factors (URFs) for cancer effects. Consistent with NJDEP alternative SRS guidance (NJDEP, 2008a and 2008b), toxicity values specific to the oral and inhalation pathways were obtained from EPA's Integrated Risk Information System (IRIS) online database (USEPA, 2013). Where a toxicity value was not available in IRIS the following hierarchy of sources was reviewed to identify the most up-to-date toxicity information:

- Provisional toxicity values obtained from the USEPA Environmental Criteria and Assessment Office (ECAO) as reported in the USEPA's Regional Screening Level Table (USEPA, 2012).
- Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs) (ATSDR, 2013).
- California EPA toxicity values as cited in the USEPA's Regional Screening Level Table (USEPA, 2012).
- Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997a)

Oral toxicity values used to evaluate dermal absorption were considered for adjustment in the alternative SRS derivation using the recommended criteria as found in the 2004 USEPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. Following the guidance document, toxicity values are adjusted for gastrointestinal absorption only where chemical-specific gastrointestinal absorption values were less than 50%. The following site-specific constituents met this criterion: antimony, cadmium, and mercury.

Recommendations presented in the USEPA *Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens* (USEPA 2005a) were utilized in the alternative SRS derivation. This guidance document recommends 10-fold and 3-fold adjustments in SFs to be combined with age-specific exposure estimates when estimating cancer risks from early life exposure (young children and adolescents) to carcinogens that act through a mutagenic mode of action (such as benzo[a]pyrene). Age-dependent adjustment factors (ADAFs) for youth recreational users are detailed in the appendix tables.

Consistent with recommendations in USEPA's IRIS toxicity assessment for trichloroethene (TCE), the kidney risk for TCE was assessed using the mutagenic equations and the liver and non-Hodgkin lymphoma (NHL) risk was addressed using the standard cancer equations. Toxicity factors appropriate for the aforementioned target organ are detailed in Appendix A (for the preservation area). TCE is not a site-specific constituent for the conservation area.

1.2 Exposure Assumptions

Tables A2 – A6 and Tables B2 - B6 details the calculation of the alternative SRS values for the direct contact and inhalation pathways estimated for youth receptors (7 to 16 years of age) and adult receptors using the preservation or conservation area for recreational uses. The alternative SRS values were calculated using the assumptions listed in the tables. The assumptions are conservative (likely to overestimate actual exposure) but can be used for developing remediation standards. As shown in the tables, exposure assumptions were based on a combination of NJDEP recommended values, USEPA recommended values and professional judgment considering site-specific information. Rationale for selection of these exposure assumptions are detailed below.

- **Exposure Time, Frequency and Duration** - Based on professional judgment, conservative estimates of exposure time, frequency and duration were assumed for recreational users of the conservation area. It was assumed that potential receptors would visit the conservation area more frequently in the summer months (5 days per week) and less frequently in the spring and fall months (2 days per week). It was assumed that the ground is frozen or covered three months out of the year with snow. This value (108 days per year) is considered consistent with activity patterns discussed in the USEPA's *Exposure Factors Handbook* (USEPA, 2011) and the range of values recommended by other states and regions for recreational land use (such as Maine – 90 days per year and Virginia – 195 days per year).

  No public access will be allowed in the preservation area. However, recreational trespassing activities were considered. As a result, it was assumed potential receptors would visit the preservation area 3 days per week in the summer months and 2 days per week in the spring and fall months (or 84 days per year).

  For both areas, each visit was assumed to last two hours. This value is consistent with USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).

- **Body Surface Area** - Using age-specific body part surface area measurements, a value of 4,500 cm^2 was calculated for adolescents (age 7 to 16 years) (USEPA, 2008). USEPA recommended values (5,700 cm^2) were used for adult receptors (USEPA, 2011). Receptors were assumed to wear short-sleeved shirts and shorts with shoes; therefore, the exposed skin surface is limited to head, hands, forearms, and lower legs. These assumptions are considered reasonably conservative since exposure is assumed to also occur in cooler weather months when additional clothing (and less exposed surface area) is more likely.

- **Adherence Factors** – Recommended soil adherence factors for youth soccer players (0.04 mg/cm^2 – event) was used for youth recreational users and is considered representative of sitting, walking or other low to medium intensity activities expected to occur in the preservation or conservation area. Recommended soil adherence factors for adult residents (0.07 mg/cm^2-event) were used for adult recreational users (USEPA, 2004a).

1.3 Lead Evaluation

Lead does not have USEPA-established toxicity values (such as an RfD); and, therefore development of alternative SRS values cannot be performed in the same manner as for other constituents. As a result, USEPA's *Adult Lead Model* (ALM) (USEPA, 2009a) and USEPA guidance regarding intermittent or variable exposures were used to calculate the alternative SRS values for adult recreational and youth recreational users, respectively.

1.3.1 Adult Recreational Users

The ALM is designed to estimate an average (arithmetic mean) soil lead concentration that is not expected to result in a greater than 5% probability that the fetus of an adult woman of child-bearing age has a blood lead level exceeding the level of concern of 10 micrograms per deciliter (µg/dL) of blood. Therefore, the soil lead concentration derived via this approach is considered protective of all adult recreational users, including pregnant women.

Tables A-7 and B-7 details the ALM equations, model input parameters, and results of the ALM. All input parameter values were consistent with those discussed in Section 2.2. In general, USEPA recommends the use of central tendency exposure factors for input in the ALM since the model output is an estimate of the 95th percentile (i.e., an RME) of blood lead levels. The ALM generated a preliminary remediation goal (PRG) based on baseline (PbBo) and geometric standard deviations (GSDi) for blood lead levels recommended by USEPA in the most recent iteration of the model. PRGs calculated using the ALM represent the average concentration (such as an arithmetic mean) in soil (USEPA, 2009a).

1.3.2 Youth Recreational Users

The derivation of an alternative SRS values for youth recreational users was calculated consistent with USEPA guidance regarding intermittent or variable exposures (*Assessing Intermittent or Variable Exposures at Lead Sites*, USEPA, 2003). This screening level was based on achieving a weighted average soil lead concentration of 400 mg/kg, assuming that a youth receptor (age 7 to 16 years) is exposed part of the year to soil at home (hypothetical) and part of the year to soil at the preservation or conservation area.

Tables A-8 and B-8 detail the equation, input parameters, and the calculated value. All input parameter values were consistent with those discussed in Section 2.2.

1.3.3 Model Uncertainty

The updated PbBo and GSD values used in the ALM recommended by USEPA are considered appropriate for lead risk assessments for non-residential exposures both in assessing risk and in developing PRGs (USEPA, 2009b). However, USEPA indicates that there is uncertainty in developing PRGs based on a target blood lead concentration of 10 µg/dL. Recent scientific evidence in the *Ambient Air Quality Criteria Document for Lead* (USEPA, 2006) demonstrated adverse health effects in children at blood lead concentrations below 10 µg/dL down to 5 µg/dL and possibly lower[1]. Based on the expected land use conditions, the level of uncertainty in the alternative SRS values derived for lead is considered low.

[1] In January 2012, CDC recommending lowering the reference blood lead level to 5 ug/dL for children age 1-5 years. The lowered reference level is used by public health professionals to identify children for case management of lead exposure.

1.4 Application of Alternative SRS Values for Protection of Human Health

In determining compliance with remediation standards during remedial action, SRS values for protection of human health are based on the lower of the direct contact SRS values and impact to groundwater (IGW) SRS values. This memorandum has developed alternative SRS values protective of direct contact pathways. The applicability of SRS values protective of the IGW pathway are discussed in the CMS.

Tables A-1 and B-1 provide a summary of the alternative SRS values calculated for the preservation and conservation areas, respectively. The lower of the youth and adult values for the carcinogenic and non-carcinogenic endpoints for each pathway are shown in the tables. Likewise, the lower of the lead values calculated for youth and adult receptors is also shown.The alternative SRS values presented in Tables A-1 and B-1 should not be considered a "not-to-exceed" concentration during remedial action. Consistent with NJDEP's *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (dated September 2012), compliance with the SRS values can be achieved using either single-point compliance or compliance averaging. Several averaging methods can be used including, but not limited to, the arithmetic mean, the 95 percent upper confidence limit of the mean (UCL_{95}), spatially-weighted averaging (e.g., Thiessen polygons) or 75%/10X rule.The alternative SRS values are considered applicable to the surface vertical zone (0 to 2 feet bgs). The use of the alternative SRS values to determine remedial action in deeper subsurface soils is discussed in the CMS.

2.0 Development of Ecological Risk-Based Remediation Goals

Ecological risk-based remediation goals (ERGs) for soil were developed for the protection of wildlife receptors that may be exposed to constituents of potential ecological concern (COPECs) in soil at the site. Consistent with NJDEP *Ecological Evaluation Technical Guidance*, these numeric goals are intended to serve as delineation criteria for soils to evaluate the extent of potential remedial action on the basis of ecological risk (NJDEP, 2012).

ERGs for the protection of ecological receptors were evaluated for COPECs identified in Baseline Ecological Evaluations (BEEs) completed for the following areas of the site:

- EMA – Mid and North Plant areas (URS, 2010a presented as Appendix D in Parsons, 2010a)
- NMA (URS, 2010b presented as Appendix D in Parsons, 2010b)
- WMA (URS, 2010c presented as Appendix F in Parsons, 2010c)

ERGs were not derived for the South Plant area of the EMA due to the lack of environmental sensitive natural resources (ESNRs) identified in this plant region in the BEE and the anticipated development of this area for commercial use (URS, 2010a).

COPECs identified in site areas containing habitat and potentially complete ecological exposure pathways, as identified in the BEEs include:

Constituent of Potential Ecological Concern (COPEC)	EMA[1]	WMA	NMA
Metals			
Antimony	●	●	
Arsenic	●	●	●
Barium	●		
Cadmium	●	●	
Chromium	●	●	
Cobalt	●		
Copper	●	●	●
Lead	●	●	●
Manganese	●		
Mercury	●	●	●
Nickel	●	●	
Selenium	●	●	●
Silver	●	●	
Thallium	●	●	
Vanadium	●		
Zinc	●	●	●
Cyanide	❍		
Volatile Organic Compounds (VOCs)			
Tetrachloroethylene	❍		
Polycyclic Aromatic Hydrocarbons (PAHs)			
Total Low Molecular Weight (LMW) PAHs	●		
Total High Molecular Weight (HMW) PAHs	●	●	●
Other Semi-volatile Organic Compounds (SVOCs)			
Bis(2-ethylhexyl)phthalate	❍		

Notes:

●, ERGs derived for identified COPEC

❍, ERGs not derived for identified COPEC

1, COPECs identified in the EMA include only data from the Mid and North Plant areas

ERGs were derived for 16 metals, low molecular weight polycyclic aromatic hydrocarbons (LMW PAHs), and high molecular weight PAHs (HMW PAHs) identified as COPECs in the BEEs. ERGs were not derived for cyanide, tetrachloroethylene (PCE), and bis(2-ethylhexyl)phthalate (BEHP) due to low frequency of exceedance of screening criteria and limited exceedances of screening criteria in samples collected from forested and wetland habitats identified in the EMA (URS, 2010a). Forested and wetland areas in the EMA provide greater habitat to support ecological receptors relative to the developed portions of the former manufacturing area (URS, 2010a). As reported in the BEE conducted for the EMA, cyanide concentrations in surface soils exceeded ecological screening criteria in only two of 18 samples evaluated in the Mid and North Plants; the two soil samples containing cyanide concentrations exceeding ecological screening criteria were collected within the former manufacturing area of the Mid Plant region and not in forest and wetland habitats identified in the BEE (URS, 2010a). PCE concentrations exceeded soil screening criteria in only two of 15 samples collected within the Mid and North Plant areas of the EMA. Only one exceedance of PCE was located in areas identified as ecological habitat in the BEE (URS, 2010a). BEHP concentrations exceeded ecological screening criteria in only one of 71 samples in the EMA; the sample with the BEHP concentration exceeding the soil screening criterion was located within the former manufacturing area where ecological habitat is limited. Based on the limited frequency of exceedances of the conservative ecological soil screening criteria presented in the BEE, the derivation of ERGs was not warranted for these constituents.

As summarized in Table C-1, ERGs were derived based on dietary intake models developed for the protection of wildlife species representative of the primary trophic groups that may be exposed to soils in the EMA (Mid and North Plants), WMA, and NMA (NJDEP, 2012; USEPA, 1997b). Information supporting the calculations of ERGs is presented in Tables C-2 through C-5. The following sections present the methods used to derive ERGs based on wildlife exposure.

2.1 Derivation of ERGs for the Protection of Wildlife

ERGs for the protection of wildlife were derived consistent with the approach presented in USEPA guidance for developing Ecological Soil Screening Levels (Eco-SSLs; USEPA 2005b) and NJDEP *Ecological Evaluation Technical Guidance* (NJDEP, 2012). ERGs were established by calculating the estimated daily dose to a receptor that is equivalent to a LOAEL using the exposure model represented in the equation presented in Table C-5.

Consistent with the development of Eco-SSLs, ERGs for the site were calculated for wildlife receptors that are representative of the primary trophic groups that may be exposed to terrestrial soils at the site. With the exception of one avian and one mammalian receptor, the receptors selected for the calculation of ERGs were identical to the receptors used in the derivation of Eco-SSLs. American robin was selected as a more appropriate receptor to represent avian invertivore exposure than American woodcock used in Eco-SSL development; red fox was selected as a more appropriate mammalian carnivore for the site than long-tailed weasel used in the derivation of Eco-SSLs. American robin and red fox were considered to be more appropriate receptors because they are more common and representative of the primary trophic groups at the site.

2.1.1 Receptor Exposure Parameters

Exposure parameters, including body weights, food ingestion rates, soil ingestion rates and assumed dietary composition for receptors included in the development of Eco-SSLs were identical to those presented in the Eco-SSLs guidance (USEPA, 2005b; Table C-1). Exposure parameters for American robin and red fox were derived from literature sources of wildlife exposure parameters as indicated in Table C-1 (Sample et al., 1994; Nagy, 2001; Beyer et al., 1994).

2.1.2 Estimation of Bioaccumulation

The bioaccumulation of COPECs from soil to wildlife dietary items was estimated using literature-derived bioaccumulation factors (BAFs) and regression models. Estimates of soil-to-biota uptake of COPECs were obtained primarily from literature sources used in the derivation of Eco-SSLs (Bechtel-Jacobs, 1998; Sample et al., 1999; Sample et al., 1998a, Sample et al. 1998b; Baes et al., 1984; USEPA, 2007).

Bioaccumulation estimates for mercury and thallium, constituents not included in the development of Eco-SSLs, were obtained from literature-based bioaccumulation studies. Total mercury bioaccumulation from soil to biota was estimated based on the recommended single variable regression models developed in terrestrial bioaccumulation studies (Bechtel-Jacobs 1998; Sample et al. 1999; Sample et al. 1998b). Thallium uptake into terrestrial biota was estimated based on the bioaccumulation factor presented in Baes et al. (1984) for plant uptake, USCHPPM (2004) for soil invertebrate uptake, and Sample et al. (1998b) for small mammal uptake. BAFs and regression model equations and input variables use to estimate uptake for each COPEC are presented in Table C-3.

2.1.3 Toxicity Reference Values (TRVs)

Toxicity reference values (TRVs) used in the derivation of ERGs were calculated based on LOAELs obtained from toxicological data compiled for the derivation of Eco-SSLs and other literature sources. Growth and reproductive endpoints were selected as the basis for TRVs, consistent with the derivation of Eco-SSLs (USEPA, 2007). LOAEL endpoints were used as the basis for TRVs in the calculation of ERGs to represent potential threshold concentrations above which adverse ecological effects may occur. As a result, ERGs derived based on LOAEL endpoints represent concentrations that are more appropriate as the basis for remedial decision-making than conservative ecological screening criteria (e.g., Eco-SSLs) that are intended for initial phases of the ecological risk assessment process.

With the exception of the TRVs selected for mercury, thallium, and avian exposure to PAHs, LOAELs used in the calculation of ERGs were obtained from toxicological data compiled for the derivation of Eco-SSLs (Table C-4). Studies included in the derivation of Eco-SSLs were compiled from comprehensive literature searches and screened by a rigorous data evaluation process to identify publications meeting minimum acceptance criteria (USEPA 2005b). The geometric mean of LOAELs for growth and reproduction endpoints reported from the studies meeting Eco-SSL acceptance criteria were used as TRVs for the calculation of ERGs for the site (Table C-4).

Literature studies and toxicological reviews were used to derive TRVs for mercury, thallium, and avian exposure to PAHs (Table C-4). For avian exposure to mercury, the LOAEL for inorganic mercury reported by Sample et al. (1996) was used in the calculation. No LOAEL was reported by Sample et al. (1996) for mammals exposed to inorganic mercury; therefore, the ERG for mammals exposed to inorganic mercury was conservatively based on the no observable adverse effects level (NOAEL) reported by Sample et al. (1996). A mammalian TRV for exposure to thallium was obtained from a review of toxicological studies presented in USCHPPM (2007). TRVs for avian exposure to LMW and HMW PAHs were derived from studies by Patton and Dieter (1980) and Trust et al. (1994), respectively. Insufficient data were available in the literature to support the development of avian TRVs for antimony, barium, and thallium.

2.1.4 Calculation of Soil ERGs for the Protection of Wildlife

Using Equation 1 and the input variables described in the preceding sections, the ERGs were solved iteratively for each receptor by adjusting the soil concentration (C_s) until the EDD was equivalent to the LOAEL-based TRV. The soil concentration that resulted in an EDD equivalent to the LOAEL was established as the ERG for that receptor. Calculations of ERGs for each representative receptor are presented in Table C-5. The lowest ERG calculated for avian and mammalian receptors, as shown in bold type in Table C-5, was selected as the ERG protective of wildlife exposure for each respective COPEC.

2.2 Application of Soil ERGs for Protection of Wildlife Receptors

In determining compliance and protectiveness of wildlife receptors, the type of soil (hydric vs non-hydric) needs to be considered. The soil ERG derived for mercury, which was based on uptake and exposure to inorganic forms of mercury, may not be applicable in hydric soils where the production of methylmercury, a more toxic and bioaccumulative form, is likely greater relative to upland soils (Selvendiran et al., 2008; Skyllberg et al., 2003; St. Louis et al., 1996; Rudd, 1995). Soil ERGs derived using the approach described in the preceding sections are intended for application to upland (i.e., non-hydric) soils within the EMA, NMA, WMA where habitat exists and ecological pathways are complete. The soil ERG derived for mercury, which was based on uptake and exposure to inorganic forms of mercury, may not be applicable in hydric soils where the production of methylmercury, a more toxic and bioaccumulative form, is likely greater relative to upland soils (Selvendiran et al., 2008; Skyllberg et al., 2003; St. Louis et al., 1996; Rudd, 1995).

As specified in NJDEP *Ecological Evaluation Technical Guidance*, ERGs are intended to serve as delineation criteria for soils in determining the potential extent of remedial action (NJDEP, 2012). However, the calculated ERG value, as described in the preceding sections, represents the concentration that may potentially result in adverse effects to wildlife through integrated exposure over the entire foraging range of each representative receptor. As a result, the ERG does not represent a not-to-exceed concentration at any single sampling location, but rather an average concentration that is not to be exceeded over the entire foraging range of the most sensitive receptor.

To evaluate the need for remedial action based on wildlife exposure, soil ERGs summarized in Table C-1 will be compared to the 95 percent upper confidence limit of the arithmetic mean concentration (UCL_{95}) calculated for each COPEC for the potential remedial areas within the Site. If the UCL_{95} exceeds the ERG for a given COPEC, the iterative truncation method will be used to identify the maximum soil concentration to be addressed through remedial action to reduce the overall exposure point concentration below the ERG. As described in USEPA (2004b), iterative truncation involves removing (truncating) maximum values, replacing the next highest value with the concentration in clean fill, and calculating the hypothetical post-remediation concentration. In accordance with USEPA guidance (2004b), the UCL_{95} will be calculated for the data set following each iteration with the USEPA software program ProUCL Ver. 4.1 until the UCL_{95} exposure point concentration is at or below the ERG.

3.0 Alternative SRS Summary

A summary table of the alternative SRS values for protection of human health and ERGs for protection of wildlife receptors is provided below for site-specific constituents identified for each area. The most conservative (or lowest) of the alternative SRS values and ERGs should be used to evaluate compliance during remedial action. For completeness, the table also includes generic RDCSRS and NRDCSRS values.

Analyte	Human Health Soil Remediation Standards (mg/kg)				Ecological Risk-Based Remediation Standards (mg/kg)
	Alternative SRS		NRDCSRS	RDCSRS	
	Preservation (EMA North and Mid-Plant and portion WMA)	Conservation (portion of WMA)	Industrial/ Commercial (EMA South Plant)	NJ Land Transfer (NMA)	
Antimony	760	590	-	-	62
Arsenic	-	-	-	-	154*
Barium	-	-	-	-	3270
Cadmium	1800	-	-	-	5.7
Chromium	-	-	-	-	455
Cobalt	-	-	-	-	521
Copper	76000	59000	45000	-	1100
Lead	1300	1100	800	400	892
Manganese	-	-	-	-	9091
Mercury	570	450	65	-	20.4
Nickel	-	-	-	-	609
Selenium	9600	7400	-	-	5
Silver	-	-	-	-	181
Thallium	-	-	-	-	4.3
Vanadium	9600	-	-	-	62
Zinc	-	-	-	-	1507
LMW PAHs					382
HMW PAHs					48
Benzo(a)anthracene	5	4	2	-	
Benzo(b)fluoranthene	5	4	2	-	
Benzo(a)pyrene	0.5	0.4	0.2	0.2	
Dibenz(a,h)anthracene	0.5	0.4	0.2	-	
Indeno(1,2,3-cd)pyrene	5	4	2	-	
Naphthalene	280	-	17	-	
Carbon tetrachloride	70	-	-	-	**
Chloroform	30	-	-	-	**
Tetrachloroethylene	2300	-	5	-	**
Trichloroethene	150	-	20	-	**
PCBs	2	-	1	-	**

LMW PAHs, low molecular weight polycyclic aromatic hydrocarbons
HMW PAHs, high molecular weight polycyclic aromatic hydrocarbons
'- Not a constituent of concern for human health identified in the RIs (see earlier discussion)
* The site-specific background value is 75 mg/kg as present in the Arsenic Natural Background Investigation for SoilTechnical Memorandum dated September 4, 2012.
** Not a COPEC identified in the BEEs or an ERG not derived (see earlier discussion)

4.0 References

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Table A-1
Summary of Alternative Soil Remediation Standard (SRS) - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

Analyte	CAS No.	Site-Specific Recreational Ingestion-Dermal Health Based Criterion (mg/kg)	Site-Specific Recreational Inhalation Health Based Criterion (mg/kg)	Site-Specific Recreational Direct Contact Soil Remediation Standards (mg/kg)
Antimony	7440-36-0	760	-	760
Cadmium	7440-43-9	1800	120000	1800
Copper	7440-50-8	76000	-	76000
Lead	7439-92-1	1300	-	1300
Mercury	7439-97-6	570	1400	570
Selenium	7782-49-2	9600	1000000	9600
Vanadium	NA	9600	-	9600
Benzo(a)anthracene	56-55-3	5	1000000	5
Benzo(b)fluoranthene	205-99-2	5	1000000	5
Benzo(a)pyrene	50-32-8	0.5	190000	0.5
Dibenz(a,h)anthracene	53-70-3	0.5	180000	0.5
Indeno(1,2,3-cd)pyrene	193-39-5	5.0	1000000	5
Naphthalene	91-20-3	31000	280	280
Carbon tetrachloride	56-23-5	100	70	70
Chloroform	67-66-3	230	30	30
Tetrachloroethylene	127-18-4	3400	2300	2300
Trichloroethene	79-01-6	150	150	150
PCBs	1336-36-3	2	1000000	2

Notes:
Calculated values greater than 1,000,000 were replaced with 1,000,000
Lower of values calculated for youth and adult receptors shown for each pathway (ingestion-dermal and inhalation)
- Toxicity data is unavailable to calculate a value for the pathway
The overall direct contact SRS in the shaded column is the lower of the inhalation and ingestion-dermal values

Table A-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times BW \times AT \times 365\ d/yr}{(EF \times ED \times CF \times ADAF) \times ((IR \times SFo) + (SA \times EV \times AF \times ABSd \times SF_{ABS}))}$$

Parameter	Definition	Older Child/Youth Value	Adult Value	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
TR	Target risk (unitless)	1.00E-06	1.00E-06	Default
AT	Averaging time (yr)	70	70	Default
BW	Body weight, kg	44	70	USEPA, 2008 (Average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
SFo	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Chemical-Specific	Chemical-Specific	
SF_{ABS}	Dermally adjusted cancer slope factor $(mg/kg\text{-}day)^{-1}$	SFo/ABS_{GI}	SFo/ABS_{GI}	
ADAF	Age-dependent Adjustment Factor for mutagens	3	1	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	
SA	Skin Surface Area, cm^2	4500	5700	USEPA, 2008 (Average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))
AF	Skin-soil adherence factor (mg/cm^2-event)	0.04	0.07	Older Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
ED	Exposure duration, years	10	30	Child/Youth age 7-16 years
EF	Exposure frequency (days/yr)	84	84	3 days/week in summer; 2 days/week in spring and fall
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	Default
CF	Conversion factor, kg/mg	1.00E-06	1.00E-06	Default
IR	Soil ingestion rate, mg/day	100	100	Default

Analyte	SFo	Source	SF_{ABS}	ABSd	RS - Youth	RS - Adult	
Antimony	-	-	-	-	-	-	
Cadmium	-	-	-	1.00E-03	-	-	
Copper	-	-	-	-	-	-	
Mercury	-	-	-	-	-	-	
Selenium	-	-	-	-	-	-	
Vanadium	-	-	-	-	-	-	
Benzo(a)anthracene	7.30E-01	ECAO	7.30E-01	1.30E-01	5	6	m
Benzo(b)fluoranthene	7.30E-01	ECAO	7.30E-01	1.30E-01	5	6	m
Benzo(a)pyrene	7.30E+00	IRIS	7.30E+00	1.30E-01	0.5	0.6	m
Dibenz(a,h)anthracene	7.30E+00	ECAO	7.30E+00	1.30E-01	0.5	0.6	m
Indeno(1,2,3-cd)pyrene	7.30E-01	ECAO	7.30E-01	1.30E-01	5	6	m
Naphthalene	-	-	-	1.30E-01	-	-	
Carbon tetrachloride	7.00E-02	IRIS	7.00E-02	-	190	100	
Chloroform	3.10E-02	Cal EPA	3.10E-02	-	430	230	
Tetrachloroethylene	2.10E-03	IRIS	2.10E-03	-	6400	3400	
Trichloroethene	4.60E-02	IRIS	4.60E-02	-	-	150	
Trichloroethene (NHL+Liver)	3.70E-02	IRIS	3.70E-02	-	360	-	
Trichloroethene (ADAF)	9.30E-03	IRIS	9.30E-03	-	480	-	m
PCBs	2.00E+00	IRIS	2.00E+00	1.40E-01	5	2	

$TCE = 1/((1/TCE_{NHL+Liver}) + (1/TCE_{ADAF}))$
210

Table A-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

Notes:
IRIS - USEPA's Integrated Risk Information System
ECAO - Environmental Criteria and Assessment Office as cited in EPA's Regional Screening Level Table (November 2012 edition)
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2012 edition)
m-mutagen

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Table A-3
Combined Ingestion and Dermal Absorption Exposure to Non-Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times BW \times AT \times 365\ d/yr}{(EF \times ED \times 10^{-6}\ kg/mg) \times [(1/RfDo \times IR) + (1/RfD_{ABS} \times AF \times ABS_d \times EV \times SA)]}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
THQ	Target hazard quotient unitless	1	1	Default
BW	Body weight (kg)	44	70	USEPA, 2008 (Average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
AT	Averaging time (yr)	10	30	Default
RfDo	Oral reference dose (mg/kg-day)	Chemical-Specific	Chemical-Specific	
IR	Soil ingestion rate (mg/day)	100	100	Default
RfD_{ABS}	Dermally adjusted reference dose (mg/kg-day)	RfDo x ABS_{GI}	RfDo x ABS_{GI}	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	Consistent with RAGs Part E, used 100% absorption (no adjustment)
AF	Skin-soil adherence factor (mg/cm^2-event)	0.04	0.07	Older Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
EF	Exposure frequency (days/yr)	84	84	3 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (years)	10	30	Child/Youth age 7-16 years
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	Default
SA	Skin Surface Area, cm^2	4500	5700	USEPA, 2008 (Average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))

Analyte	RfDo	Source	RfD_{ABS}	ABSd	RS - Youth	RS - Adult	
Antimony	4.00E-04	IRIS	6.00E-05	-	760	1200	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Cadmium	1.00E-03	IRIS	2.50E-05	1.00E-03	1800	2600	
Copper	4.00E-02	Heast	4.00E-02	-	76000	120000	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Mercury	3.00E-04	IRIS	2.10E-05	-	570	910	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Selenium	5.00E-03	IRIS	5.00E-03	-	9560	15200	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Vanadium	5.00E-03	RSL	5.00E-03	-	9600	15200	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Benzo(a)anthracene	-	-	-	1.30E-01	-	-	
Benzo(b)fluoranthene	-	-	-	1.30E-01	-	-	
Benzo(a)pyrene	-	-	-	1.30E-01	-	-	
Dibenz(a,h)anthracene	-	-	-	1.30E-01	-	-	
Indeno(1,2,3-cd)pyrene	-	-	-	1.30E-01	-	-	
Naphthalene	2.00E-02	IRIS	2.00E-02	1.30E-01	31000	40000	
Carbon tetrachloride	4.00E-03	IRIS	4.00E-03	-	7600	12000	
Chloroform	1.00E-02	IRIS	1.00E-02	-	19000	30000	
Tetrachloroethylene	6.00E-03	IRIS	6.00E-03	-	11000	18000	
Trichloroethene	5.00E-04	IRIS	5.00E-04	-	960	1500	
PCBs	-	-	-	1.40E-01	-	-	

Notes:
IRIS - USEPA's Integrated Risk Information System
Heast -HEAST values as cited in EPA's Regional Screening Level Table (November 2012 edition)

References:
USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment).
Final. EPA/540/R/99/005. July 2004 (with 2007 errata).

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

Table A-4
Inhalation Soil Remediation Standards for Carcinogenic Particulate
Contamination for Site-Specific Recreational Land Use - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times AT \times 365\ d/yr}{URF \times ADAF \times 1{,}000\ ug/mg \times EF \times ED \times ET \times (1\ day/24\ hour) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
TR	Target risk (unitless)	1.0E-06	1.0E-06	
AT	Averaging time (yr)	70	70	
URF	Unit Risk Factor $(ug/m^3)^{-1}$	Chemical-Specific	Chemical-Specific	
ADAF	Age-dependent Adjustment Factor for mutagens	3	1	
ET	Exposure time (hours/day)	2	2	Each visit was assumed to last two hours. This value is consistent with USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	84	84	3 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	NJ default

Analyte	URF	Source	VF	Inh_pSRS Youth	Inh_pSRS Adult	
Antimony	-	-	-	-	-	
Cadmium	1.80E-03	IRIS	-	350000	120000	
Copper	-	-	-	-	-	
Mercury	-	-	87388	-	-	
Selenium	-	-	-	-	-	
Vanadium	-	-	-	-	-	
Benzo(a)anthracene	1.10E-04	Cal EPA	-	**1920000**	**1920000**	m
Benzo(b)fluoranthene	1.10E-04	Cal EPA	-	**1920000**	**1920000**	m
Benzo(a)pyrene	1.10E-03	Cal EPA	-	190000	190000	m
Dibenz(a,h)anthracene	1.20E-03	Cal EPA	-	180000	180000	m
Indeno(1,2,3-cd)pyrene	1.10E-04	Cal EPA	-	**1920000**	**1920000**	m
Naphthalene	3.40E-05	Cal EPA	77580	830	280	
Carbon tetrachloride	6.00E-06	IRIS	3469	210	70	
Chloroform	2.30E-05	IRIS	6470	100	30	
Tetrachloroethylene	2.60E-07	IRIS	4925	6910	2300	
Trichloroethene	4.10E-06	IRIS	4905	-	150	
Trichloroethene (NHL+Liver)	3.10E-06	IRIS	4905	580	-	
Trichloroethene (ADAF)	1.00E-06	IRIS	4905	600	-	m
PCBs	1.00E-04	IRIS	-	**6349490**	**2116500**	

$TCE = 1/((1/TCE_{NHL+Liver}) + (1/TCE_{ADAF}))$
290

Notes:
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2012 edition)
IRIS - USEPA's Integrated Risk Information System
Cells highlighted have values greater than 1,000,000
m - mutagen

References:
USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table A-5
Inhalation Soil Remediation Standards for Non-Carcinogenic Particulate
Contamination for Site-Specific Recreational Land Use - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times AT \times 365\ d/yr}{EF \times ED \times ET \times (1\ day/24\ hours) \times (1/RfC) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
THQ	Target hazard quotient (unitless)	1	1	
AT	Averaging time (yr)	10	30	
RfC	Inhalation reference concentration (mg/m^3)	Chemical-Specific	Chemical-Specific	
ET	Exposure time (hours/day)	2	2	Each visit was assumed to last two hours. This value is consistent with USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	84	84	3 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	NJ default

Analyte	RfC	Source	VF	Inh_pSRS Youth	Inh_pSRS Adult
Antimony	-	-	-	-	-
Cadmium	2.00E-05	Cal EPA	-	**1814100**	**1814100**
Copper	-	-	-	-	-
Mercury	3.00E-04	IRIS	87388	1400	1400
Selenium	2.00E-02	Cal EPA	-	**1814140300**	**1814140300**
Vanadium	-	-	-	-	-
Benzo(a)anthracene	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-
Benzo(a)pyrene	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-
Naphthalene	3.00E-03	IRIS	77580	12100	12100
Carbon tetrachloride	1.00E-01	IRIS	3469	18100	18100
Chloroform	9.80E-02	ATSDR	6470	33100	33100
Tetrachloroethylene	4.00E-02	IRIS	4925	10300	10300
Trichloroethene	2.00E-03	IRIS	4905	510	510
PCBs	-	-	-	-	-

Notes:
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2012 edition)
IRIS - USEPA's Integrated Risk Information System
ATSDR - ATSDR values as cited in EPA's Regional Screening Level Table (November 2012 edition)
Cells highlighted have values greater than 1,000,000

References:
USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table A-6
Soil-to-Air Volatilization Factor Calculation - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$VF\ (m^3/kg) = \frac{Q/C \times (3.14 \times Da \times T)^{1/2} \times 10^{-4}\ (m^2/cm^2)}{(2 \times rb \times Da)}$$ EPA 1996, eqn. 8

where:

$$Da = \frac{(qa^{10/3} \times Di \times H' + qw^{10/3} \times Dw)/n^2}{rb \times Kd + qw + qa \times H'}$$

Parameter			Value	Reference
VF	=	volatilization factor (m^3/kg)	Calculated	
Da	=	apparent diffusity (cm^2/sec)	Calculated	
Q/C	=	inverse of mean concentration at the center of a source (g/m^2-sec per kg/m^3)	90.4	NJ default for 0.5-acre site
T	=	release interval (seconds)	9.5E+08	NJ default
rb	=	dry soil bulk density (g/cm^3)	1.5	NJ default
qa	=	air-filled soil porosity (Lair/Lsoil) where qa = n - qw	0.180	NJ default
n	=	total soil porosity (Lpore/Lsoil) where n = 1-(rb/rs)	0.410	NJ default
qw	=	water-filled soil porosity (Lwater/Lsoil)	0.23	NJ default
rs	=	soil particle density (g/cm^3)	2.65	NJ default
Di	=	diffusivity in air (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2012
H	=	Henry's law constant (atm-m3/mol)	chem-spec	EPA Regional Screening Level Table, November 2012
H'	=	dimensionless Henry's law constant where H' = H x 41	chem-spec	
Dw	=	diffusivity in water (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2012
Kd	=	soil-water partition coefficient (cm^3/g)	chem-spec	NJ background and basis document
Koc	=	soil organic carbon/water partition coefficient (cm^3/g)	chem-spec	EPA Regional Screening Level Table, November 2012
foc	=	fraction organic carbon in soil (g/g)	0.002	NJ default

Constituent	Di	H	H'	Dw	Kd	Koc	Da	VF
Mercury	3.1E-02	1.1E-02	4.7E-01	6.3E-06	5.3E+01	-	3.5E-06	87388
Naphthalene	6.1E-02	4.4E-04	1.8E-02	8.4E-06	3.1E+00	1.5E+03	4.5E-06	77580
Carbon tetrachloride	5.7E-02	2.8E-02	1.1E+00	9.8E-06	8.8E-02	4.4E+01	2.2E-03	3469
Chloroform	7.7E-02	3.7E-03	1.5E-01	1.1E-05	6.4E-02	3.2E+01	6.4E-04	6470
Tetrachloroethylene	5.0E-02	1.8E-02	7.3E-01	9.5E-06	1.9E-01	9.5E+01	1.1E-03	4925
Trichloroethene	6.9E-02	9.9E-03	4.0E-01	1.0E-05	1.2E-01	6.1E+01	1.1E-03	4905

Chemical-specific values obtained from chemical parameters table in EPA's Regional Screening Level Table (November 2012 edition)
Naphthalene values from EPA's Vapor Intrusion Screening Level (VISL) table (May 2012 edition)
Mercury Kd value obtained from NJDEP Background and Basis Document (June 2008)

References:
EPA 1996, Soil Screening Guidance: User's Guide. EPA/540/R-96/018.

EPA 2012a. Regional Screening Level Table. November 2012 edition.

EPA, 2012b. Vapor Intrusion Screening Level Calculator. May 2012 edition. Available on-line at http://www.epa.gov/oswer/vaporintrusion/

NJDEP 2008 . Inhalation Exposure Pathway Soil Remediation Standards, Background and Basis Document. June.

Table A-7
Soil Remediation Standard Calculation for Lead in Soil
Site-Specific Recreational Land Use Scenario (Adult Receptor) - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

Calculations of Preliminary Remediation Goals (PRGs)
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	Reference
$PbB_{fetal, 0.95}$	95th percentile PbB in fetus	ug/dL	10	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.8	Default
PbB_0	Baseline PbB	ug/dL	1.0	Default
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	NJ default for adult residents
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	Default
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	84	3 days/week in summer; 2 days/week in spring and fall
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	270	9 month exposure duration
PRG		**ppm**	**2,160**	

Where:

$$PRG = \frac{(PbB_{adult,central,goal} - PbB_0) \times AT_{S,D}}{(BKSF \times IR_s \times AF_{S,D} \times EF_{S,D})}$$ (Equation 4 - EPA, 2003)

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}}$$ (Equation 2 - EPA, 2003)

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*
EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

Table A-8
Soil Remediation Standard Calculation for Lead in Soil
Site-Specific Recreational Land Use Scenario (Youth Receptor) - Preservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

Objective: Calculate a weighted average that reflects the fraction of each year during which a child is exposed to soil and dust with different lead concentrations.

Where:

$C_{total} = (C_{site} * EF_{site} + C_{res} * EF_{res})/365$ (Equation 1)

Rearranging to solve for C_{site}:

$C_{site} = ((C_{total} * 365) - (C_{res} * EF_{res}))/EF_{site}$ (Equation 2)

Variable	Description	Value	Source
C_{total}	Residential soil lead screening level (child exposure), mg/kg	400	USEPA value, Will not exceed a 5% risk of exceeding blood lead level of 10 ug/dl
C_{site}	Recreational site soil screening level (child exposure), mg/kg	Calculated	
C_{res}	Lead level in presumed backyard, mg/kg	200	Default Soil/Dust Concentration, IEUBK Model
EF_{site}	Exposure frequency at the site, day/yr	84	3 days/week in summer; 2 days/week in spring and fall
EF_{res}	Exposure frequency at presumed backyard, day/yr	186	270 d/yr - EF_{site}

Using Equation 2: **C_{site}= 1295**

USEPA, 2003. *Assessing Intermittent or Variable Exposures at Lead Sites* [0SWER #9285.7-76].(November 2003)

Table B-1
Summary of Alternative Soil Remediation Standard (SRS) - Conservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

Analyte	CAS No.	Site-Specific Recreational Ingestion-Dermal Health Based Criterion (mg/kg)	Site-Specific Recreational Inhalation Health Based Criterion (mg/kg)	Site-Specific Recreational Direct Contact Soil Remediation Standards (mg/kg)
Antimony	7440-36-0	590	-	590
Copper	7440-50-8	59000	-	59000
Lead	7439-92-1	1100	-	1100
Mercury	7439-97-6	450	1100	450
Selenium	7782-49-2	7400	1000000	7400
Benzo(a)anthracene	56-55-3	4	1000000	4
Benzo(b)fluoranthene	205-99-2	4	1000000	4
Benzo(a)pyrene	50-32-8	0.4	150000	0.4
Dibenz(a,h)anthracene	53-70-3	0.4	140000	0.4
Indeno(1,2,3-cd)pyrene	193-39-5	4	1000000	4

Notes:
Calculated values greater than 1,000,000 were replaced with 1,000,000
Lower of values calculated for youth and adult receptors shown for each pathway (ingestion-dermal and inhalation)
- Toxicity data is unavailable to calculate a value for the pathway
The overall direct contact SRS in the shaded column is the lower of the inhalation and ingestion-dermal values

Table B-2
Combined Ingestion and Dermal Absorption Exposure to
Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - C onservation Area
Pompton Lakes Works

Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{TR \times BW \times AT \times 365\ d/yr}{(EF \times ED \times CF \times ADAF) \times ((IR \times SFo) + (SA \times EV \times AF \times ABSd \times SF_{ABS}))}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
TR	Target risk (unitless)	1.00E-06	1.00E-06	Default
AT	Averaging time (yr)	70	70	Default
BW	Body weight, kg	44	70	USEPA, 2008 (Average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
SFo	Oral Slope Factor (mg/kg-day)-1	Chemical-Specific	Chemical-Specific	
SF_{ABS}	Dermally adjusted cancer slope factor (mg/kg-day)-1	SFo/ABS_{GI}	SFo/ABS_{GI}	
ADAF	Age-dependent Adjustment Factor for mutagens	3	1	ADAF applicable for mutagens (m) only
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	
SA	Skin Surface Area, cm^2	4500	5700	USEPA, 2008 (Average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))
AF	Skin-soil adherence factor (mg/cm^2-event)	0.04	0.07	Older Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
ED	Exposure duration, years	10	30	Child/Youth age 7-16 years
EF	Exposure frequency (days/yr)	108	108	5 days/week in summer; 2 days/week in spring and fall
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	Default
CF	Conversion factor, kg/mg	1.00E-06	1.00E-06	Default
IR	Soil ingestion rate, mg/day	100	100	Default

Analyte	SFo	Source	SF_{ABS}	ABSd	RS - Youth	RS - Adult	
Antimony	-	-	-	0.00E+00	-	-	
Copper	-	-	-	0.00E+00	-	-	
Mercury	-	-	-	0.00E+00	-	-	
Selenium	-	-	-	0.00E+00	-	-	
Benzo(a)anthracene	7.30E-01	ECAO	7.30E-01	1.30E-01	4	5	m
Benzo(b)fluoranthene	7.30E-01	ECAO	7.30E-01	1.30E-01	4	5	m
Benzo(a)pyrene	7.30E+00	IRIS	7.30E+00	1.30E-01	0.4	0.5	m
Dibenz(a,h)anthracene	7.30E+00	ECAO	7.30E+00	1.30E-01	0.4	0.5	m
Indeno(1,2,3-cd)pyrene	7.30E-01	ECAO	7.30E-01	1.30E-01	4	5	m

Notes:

IRIS - USEPA's Integrated Risk Information System

ECAO - Environmental Criteria and Assessment Office as cited in EPA's Regional Screening Level Table (November 2012 edition)

m - mutagen

References:

USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R/99/005. July 2004 (with 2007 errata).

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

Table B-3
Combined Ingestion and Dermal Absorption Exposure to
Non-Carcinogenic Contaminants in Soil
Site-Specific Recreational Land Use Scenario - Conservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times BW \times AT \times 365\ d/yr}{(EF \times ED \times 10^{-6}\ kg/mg) \times [(1/RfDo \times IR) + (1/RfD_{ABS} \times AF \times ABS_d \times EV \times SA)]}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
THQ	Target hazard quotient unitless	1	1	Default
BW	Body weight (kg)	44	70	USEPA, 2008 (Average of age-specific body weight for ages 6-11 years and 11-16 years in Table 8-1). Default value for adult.
AT	Averaging time (yr)	10	30	Default
RfDo	Oral reference dose (mg/kg-day)	Chemical-Specific	Chemical-Specific	
IR	Soil ingestion rate (mg/day)	100	100	Default
RfD_{ABS}	Dermally adjusted reference dose (mg/kg-day)	RfDo x ABS_{GI}	RfDo x ABS_{GI}	
ABS_{GI}	Gastrointestinal absorption factor (unitless)	Chemical-Specific	Chemical-Specific	Consistent with RAGs Part E, used 100% absorption (no adjustment)
AF	Skin-soil adherence factor (mg/cm^2-event)	0.04	0.07	Older Child/Youth AF value: Recommended AF for youth soccer players, considered representative of sitting, walking or other low to medium intensity activities
EF	Exposure frequency (days/yr)	108	108	5 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (years)	10	30	Child/Youth age 7-16 years
ABSd	Dermal absorption fraction (unitless)	Chemical-Specific	Chemical-Specific	USEPA, 2004
EV	Event frequency (events/day)	1	1	Default
SA	Skin Surface Area, cm^2	4500	5700	USEPA, 2008 (Average of age-specific body parts for ages 6-11 years and 11-16 years in Table 7-2 (mean))

Analyte	RfDo	Source	RfD_{ABS}	ABSd	RS - Youth	RS - Adult	
Antimony	4.00E-04	IRIS	6.00E-05	0.00E+00	590	900	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Copper	4.00E-02	Heast	4.00E-02	0.00E+00	59000	95000	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Mercury	3.00E-04	IRIS	2.10E-05	0.00E+00	450	710	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Selenium	5.00E-03	IRIS	5.00E-03	0.00E+00	7400	12000	per RAGs Part E, dermal pathway not assessed without a chemical-specific ABSd
Benzo(a)anthracene	-	-	-	1.30E-01	-	-	
Benzo(b)fluoranthene	-	-	-	1.30E-01	-	-	
Benzo(a)pyrene	-	-	-	1.30E-01	-	-	
Dibenz(a,h)anthracene	-	-	-	1.30E-01	-	-	
Indeno(1,2,3-cd)pyrene	-	-	-	1.30E-01	-	-	

Notes:
IRIS - USEPA's Integrated Risk Information System
Heast -HEAST values as cited in EPA's Regional Screening Level Table (November 2012 edition)

References:

USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R/99/005. July 2004 (with 2007 errata).

USEPA, 2008. Child-Specific Exposure Factors Handbook. EPA/600/R-06/096F. September 2008

Table B-4

Inhalation Soil Remediation Standards for Carcinogenic

Contamination for Site-Specific Recreational Land Use - Conservation Area

Pompton Lakes Works

Pompton Lakes, New Jersey

$$\text{RS (mg/kg)} = \frac{\text{TR x AT x 365 d/yr}}{\text{URF x ADAF x 1,000 ug/mg x EF x ED x ET x (1 day/24 hour)x (1/PEF +1/VF)}}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
TR	Target risk (unitless)	1.0E-06	1.0E-06	
AT	Averaging time (yr)	70	70	
URF	Unit Risk Factor $(ug/m^3)^{-1}$	Chemical-Specific	Chemical-Specific	
ADAF	Age-dependent Adjustment Factor for mutagens	3	1	ADAF applicable for mutagens (m) only
ET	Exposure time (hours/day)	2	2	Each visit was assumed to last two hours. This value is consistent with USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	108	108	5 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	Calculated value
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	NJ default

Analyte	URF	Source	VF	Inh_pSRS Youth	Inh_pSRS Adult	
Antimony	-	-	-	-	-	
Copper	-	-	-	-	-	
Mercury	-	-	87388	-	-	
Selenium	-	-	-	-	-	
Benzo(a)anthracene	1.10E-04	Cal EPA	-	**1500000**	**1500000**	m
Benzo(b)fluoranthene	1.10E-04	Cal EPA	-	**1500000**	**1500000**	m
Benzo(a)pyrene	1.10E-03	Cal EPA	-	150000	150000	m
Dibenz(a,h)anthracene	1.20E-03	Cal EPA	-	140000	140000	m
Indeno(1,2,3-cd)pyrene	1.10E-04	Cal EPA	-	**1500000**	**1500000**	m

Notes:

Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2012 edition)

Cells highlighted have values greater than 1,000,000

m - mutagen

References:

USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table B-5
Inhalation Soil Remediation Standards for Non-Carcinogenic
Contamination for Site-Specific Recreational Land Use - Conservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$RS\ (mg/kg) = \frac{THQ \times AT \times 365\ d/yr}{EF \times ED \times ET \times (1\ day/24\ hours) \times (1/RfC) \times (1/PEF + 1/VF)}$$

Parameter	Definition	Value: Older Child/Youth	Value: Adult	Source
RS	Remediation Standard (mg/kg)	Calculated	Calculated	
THQ	Target hazard quotient (unitless)	1	1	
AT	Averaging time (yr)	10	30	
RfC	Inhalation reference concentration (mg/m^3)	Chemical-Specific	Chemical-Specific	
ET	Exposure time (hours/day)	2	2	Each visit was assumed to last two hours. This value is consistent with USEPA recommended values for time spent outdoors by adolescents (USEPA, 2011).
EF	Exposure frequency (days/yr)	108	108	5 days/week in summer; 2 days/week in spring and fall
ED	Exposure duration (yr)	10	30	
VF	Volatilization Factor (m^3/kg)	Chemical-Specific	Chemical-Specific	
PEF	Particulate Emission Factor (m^3/kg)	1.7E+09	1.7E+09	NJ default

Analyte	RfC	Source	VF	Inh_pSRS Youth	Inh_pSRS Adult
Antimony	-	-	-	-	-
Copper	-	-	-	-	-
Mercury	3.00E-04	IRIS	87388	1100	1100
Selenium	2.00E-02	Cal EPA	-	**1411000000**	**1411000000**
Benzo(a)anthracene	-	-	-	-	-
Benzo(b)fluoranthene	-	-	-	-	-
Benzo(a)pyrene	-	-	-	-	-
Dibenz(a,h)anthracene	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	-	-	-	-	-

Notes:
IRIS - USEPA's Integrated Risk Information System
Cal EPA -California EPA values as cited in EPA's Regional Screening Level Table (November 2012 edition)
Cells highlighted have values greater than 1,000,000

References:
USEPA, 2011. Exposure Factors Handbook, 2011 Edition. EPA/600/R-09/052F.

Table B-6
Soil-to-Air Volatilization Factor Calculation - Conservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

$$VF\ (m^3/kg) = \frac{Q/C \times (3.14 \times Da \times T)^{1/2} \times 10^{-4}\ (m^2/cm^2)}{(2 \times rb \times Da)}$$ EPA 1996, eqn. 8

where:

$$Da = \frac{(qa^{10/3} \times Di \times H' + qw^{10/3} \times Dw)/n^2}{rb \times Kd + qw + qa \times H'}$$

Parameter			Value	Reference
VF	=	volatilization factor (m^3/kg)	Calculated	
Da	=	apparent diffusity (cm^2/sec)	Calculated	
Q/C	=	inverse of mean concentration at the center of a source (g/m^2-sec per kg/m^3)	90.4	NJ default for 0.5-acre site
T	=	release interval (seconds)	9.5E+08	NJ default
rb	=	dry soil bulk density (g/cm^3)	1.5	NJ default
qa	=	air-filled soil porosity (Lair/Lsoil) where qa = n - qw	0.180	NJ default
n	=	total soil porosity (Lpore/Lsoil) where n = 1-(rb/rs)	0.410	NJ default
qw	=	water-filled soil porosity (Lwater/Lsoil)	0.23	NJ default
rs	=	soil particle density (g/cm^3)	2.65	NJ default
Di	=	diffusivity in air (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2012
H	=	Henry's law constant (atm-m3/mol)	chem-spec	EPA Regional Screening Level Table, November 2012
H'	=	dimensionless Henry's law constant where H' = H x 41	chem-spec	
Dw	=	diffusivity in water (cm^2/sec)	chem-spec	EPA Regional Screening Level Table, November 2012
Kd	=	soil-water partition coefficient (cm^3/g)	chem-spec	NJ background and basis document
Koc	=	soil organic carbon/water partition coefficient (cm^3/g)	chem-spec	EPA Regional Screening Level Table, November 2012
foc	=	fraction organic carbon in soil (g/g)	0.002	NJ default

Constituent	Di	H	H'	Dw	Kd	Koc	Da	VF
Mercury	3.1E-02	1.1E-02	4.7E-01	6.3E-06	5.3E+01	-	3.5E-06	87388

Chemical-specific values obtained from chemical parameters table in EPA's Regional Screening Level Table (November 2012 edition)
Mercury Kd value obtained from NJDEP Background and Basis Document (June 2008)

References:

EPA 1996, Soil Screening Guidance: User's Guide. EPA/540/R-96/018.

EPA 2012a. Regional Screening Level Table. November 2012 edition.

NJDEP 2008 . Inhalation Exposure Pathway Soil Remediation Standards, Background and Basis Document. June.

Table B-7
Soil Remediation Standard Calculation for Lead in Soil
Site-Specific Recreational Land Use Scenario (Adult Receptor) - Conservation Area
Pompton Lakes Works
Pompton Lakes, New Jersey

Calculations of Preliminary Remediation Goals (PRGs)
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	Reference
$PbB_{fetal, 0.95}$	95^{th} percentile PbB in fetus	ug/dL	10	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.8	Default
PbB_0	Baseline PbB	ug/dL	1.0	Default
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	NJ default for adult residents
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	Default
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	108	5 days/week in summer; 2 days/week in spring and fall
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	270	9 month exposure duration
PRG		**ppm**	**1,680**	

Where:

$$PRG = \frac{(PbB_{adult,central,goal} - PbB_0) \times AT_{S,D}}{(BKSF \times IR_s \times AF_{S,D} \times EF_{S,D})}$$ (Equation 4 - EPA, 2003)

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}}$$ (Equation 2 - EPA, 2003)

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*
EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

Table B-8

Soil Remediation Standard Calculation for Lead in Soil

Site-Specific Recreational Land Use Scenario (Youth Receptor) - Conservation Area

Pompton Lakes Works

Pompton Lakes, New Jersey

Objective: Calculate a weighted average that reflects the fraction of each year during which a child is exposed to soil and dust with different lead concentrations.

Where:

$C_{total} = (C_{site} * EF_{site} + C_{res} * EF_{res})/365$ (Equation 1)

Rearranging to solve for C_{site}:

$C_{site} = ((C_{total} * 365)-(C_{res} * EF_{res}))/EF_{site}$ (Equation 2)

Variable	Description	Value	Source
C_{total}	Residential soil lead screening level (child exposure), mg/kg	400	USEPA value, Will not exceed a 5% risk of exceeding blood lead level of 10 ug/dl
C_{site}	Recreational site soil screening level (child exposure), mg/kg	Calculated	
C_{res}	Lead level in presumed backyard, mg/kg	200	Default Soil/Dust Concentration, IEUBK Model
EF_{site}	Exposure frequency at the site, day/yr	108	5 days/week in summer; 2 days/week in spring and fall
EF_{res}	Exposure frequency at presumed backyard, day/yr	162	270 d/yr - EF_{site}

Using Equation 2: **C_{site}= 1052**

USEPA, 2003. *Assessing Intermittent or Variable Exposures at Lead Sites* [0SWER #9285.7-76].(November 2003)

Table C-1
Summary of Ecological Risk-Based Remediation Goals (ERGs) for Soil
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Ecological Risk-Based Remediation Goals (ERGs) for Soil	
	LOAEL-Based Soil ERGs (mg/kg)	Most Sensitive Receptor(s)
Antimony	62	Short-tailed shrew
Arsenic	153.5	Mourning dove
Barium	3,270	Short-tailed shrew
Cadmium	5.7	Short-tailed shrew
Chromium	455	Mourning dove
Cobalt	521	American robin
Copper	1,100	Mourning dove
Lead	892	American robin
Manganese	9,091	Mourning dove
Inorganic Mercury	20.4	Mourning dove
Nickel	609	Mourning dove
Selenium	5	Short-tailed shrew
Silver	181	American robin
Thallium	4.3	Short-tailed shrew
Vanadium	62	Mourning dove
Zinc	1,507	American robin
Total LMW PAHs	382	Short-tailed shrew
Total HMW PAHs	47.5	American robin

Notes:
LOAEL, Toxicity reference value (TRV) based on lowest observable effects level (LOAEL) endpoints for growth and reproduction

Table C-2
Wildlife Receptor Exposure Parameters
Pompton Lakes Works

Pompton Lakes, New Jersey

Receptor Group	Body Weight[1]	Food Ingestion Rate (FIR)[2]	Soil Ingestion	Assumed Diet
(Surrogate Species)	(kg)	(kg dw/kg bw day)	(P_s)[3,4]	
Mammalian Herbivore (Meadow vole)	0.039	0.0875	0.032	100% foliage
Mammalian Ground Invertivore (Short-tailed shrew)	0.018	0.209	0.03	100% earthworms
Mammalian Carnivore (Red fox)	4.5	0.032	0.028	100% small mammals
Avian Granivore (Mourning dove)	0.115	0.19	0.139	100% seeds
Avian Ground Invertivore (American robin)	0.077	0.156	0.104	100% earthworms
Avian Carnivore (Red-tailed hawk)	1.076	0.0353	0.057	100% small mammals

Notes:
1. Body weight for American robin and red fox were obtained from Sample et al. (1994); Body weight for all other receptors based on USEPA (2003).
2. FIR for American robin and red fox calculated based on allometric equations provided by Nagy (2001); FIR for other receptors based on USEPA (2005).
3. P_s, soil ingestion as proportion of diet
4. Soil ingestion rate for American robin and red fox calculated based on Beyer et al. (1994); Soil ingestion rate for other receptors based on USEPA (2005).

Table C-3
Terrestrial Soil-to-Biota Uptake Equations
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Soil-to-Plants		Soil-to-Earthworms		Soil-to-Small Mammals	
	Model	Source	Model	Source	Model	Source
Antimony	$\ln(C_p) = 0.938 * \ln(C_s) - 3.233$	6	$C_e = C_s$	6	$C_m = 0.001 * 50 * C_d$	6
Arsenic	$\ln(C_p) = -1.992 + 0.564 * \ln(C_s)$	1	$\ln(C_e) = -1.421 + 0.706 * \ln(C_s)$	2	$\ln(C_m) = 0.8188 * \ln(C_s) - 4.8471$	3
Barium	$C_p = 0.156 * C_s$	1	$C_e = 0.091 * C_s$	4	$\ln(C_m) = -1.4120 + 0.700 * \ln(C_s)$	3
Cadmium	$\ln(C_p) = -0.476 + 0.546 * \ln(C_s)$	1	$\ln(C_e) = 2.114 + 0.795 * \ln(C_s)$	2	$\ln(C_m) = -1.2571 + 0.4723 * \ln(C_s)$	3
Chromium	$C_p = 0.041 * C_s$	1	$\ln(C_e) = 2.481 + (-0.067 * \ln(C_s))$	2	$\ln(C_m) = -1.4599 + 0.7338 * \ln(C_s)$	3
Cobalt	$C_p = 0.0075 * C_s$	1	$C_e = 0.122 * C_s$	4	$\ln(C_m) = 1.307 * \ln(C_s) - 4.4669$	3
Copper	$\ln(C_p) = 0.669 + 0.394 * \ln(C_s)$	1	$\ln(C_e) = 1.67 + 0.26 * \ln(C_s)$	2	$\ln(C_m) = 2.042 + 0.1444 * \ln(C_s)$	3
Lead	$\ln(C_p) = -1.328 + 0.561 * \ln(C_s)$	1	$\ln(C_e) = -0.218 + 0.807 * \ln(C_s)$	2	$\ln(C_m) = 0.0761 + 0.4422 * \ln(C_s)$	3
Manganese	$C_p = 0.079 * C_s$	1	$\ln(C_e) = 0.682 * \ln(C_s) - 0.809$	2	$C_m = 0.0205 * C_s$	3
Total Mercury	$\ln(C_p) = -0.996 + 0.544 * \ln(C_s)$	1	$C_e = C_s * 0.0543$	4	$\ln(C_m) = -4.867 + (-2.276 * \ln(C_s))$	3
Nickel	$\ln(C_p) = 0.748 * \ln(C_s) - 2.223$	1	NA	--	$\ln(C_m) = 0.4658 * \ln(C_s) - 0.2462$	3
Selenium	$\ln(C_p)= -0.678 + 1.104 * \ln(C_s)$	1	$\ln(C_e) = -0.075 + 0.733 * \ln(C_s)$	2	$\ln(C_m) = -0.4158 + 0.3764 * \ln(C_s)$	3
Silver	$C_p = 0.014 * C_s$	1	$C_e = 2.045 * C_s$	2	$C_m = 0.004 * C_s$	3
Thallium	$C_p = C_s * 0.004$	5	$C_e = C_s * 0.054$	7	$C_m = 0.1124 * C_s$	3
Vanadium	$C_p = 0.00485 * C_s$	1	$C_e = 0.042 * C_s$	4	$C_m = 0.0123 * C_s$	3
Zinc	$\ln(C_p) = 1.575 + 0.555 * \ln(C_s)$	1	$\ln(C_e) = 4.449 + 0.328 * \ln(C_s)$	2	$\ln(C_m) = 4.4713 + 0.0738 * \ln(C_s)$	3
Total LMW PAHs	$\ln(C_p) = 0.4544 * \ln(C_s) - 1.3205$	6	$C_e = 3.04 * C_s$	6	$C_m = 0$	6
Total HMW PAHs	$\ln(C_p) = 0.9469 * \ln(C_s) - 1.7026$	6	$C_e = 2.6 * C_s$	6	$C_m = 0$	6

Notes:

Abbreviations:

C_s, Concentration in soil (mg/kg dw)

C_p, Concentration in plant tissue (mg/kg dw)

C_e, Concentration in earthworms (mg/kg dw)

C_m, Concentration in small mammals (mg/kg dw)

Sources

1, Bechtel-Jacobs (1998)

2, Sample et al. (1999)

3, Sample et al. (1998a) (mammals)

4, Sample et al. (1998b) (earthworms)

5. Baes et al. (1984)

6. USEPA. 2007.

7. USCHPPM, 2004

Table C-4
Summary of Toxicity Reference Values (TRVs)
Pompton Lakes Works
Pompton Lakes, New Jersey

Constituent	Avian Receptors		Mammalian Receptors	
	Chronic LOAEL (mg/kg BW d^{-1})	**Source**	**Chronic LOAEL (mg/kg BW d^{-1})**	**Source**
Antimony	-	No TRV	13.3	Eco-SSL Geometric Mean[1]
Arsenic	4.5	Eco-SSL Geometric Mean	4.55	Eco-SSL Geometric Mean
Barium	-	No TRV	82.7	Eco-SSL Geometric Mean
Cadmium	6.35	Eco-SSL Geometric Mean	6.9	Eco-SSL Geometric Mean
Chromium	15.6	Eco-SSL Geometric Mean	58.2	Eco-SSL Geometric Mean
Cobalt	18.3	Eco-SSL Geometric Mean	18.9	Eco-SSL Geometric Mean
Copper	34.9	Eco-SSL Geometric Mean	69.0	Eco-SSL Geometric Mean
Lead	44.6	Eco-SSL Geometric Mean	187.6	Eco-SSL Geometric Mean
Manganese	376.6	Eco-SSL Geometric Mean	145.7	Eco-SSL Geometric Mean
Inorganic Mercury	0.9	Sample et al. (1996)	1.0	Sample et al. (1996)[2]
Nickel	18.6	Eco-SSL Geometric Mean	14.8	Eco-SSL Geometric Mean
Selenium	0.82	Eco-SSL Geometric Mean	0.66	Eco-SSL Geometric Mean
Silver	60.47	Eco-SSL Geometric Mean	118.62	Eco-SSL Geometric Mean
Thallium	-	No TRV	0.075	USCHPPM (2007)
Vanadium	1.7	Eco-SSL Geometric Mean	9.44	Eco-SSL Geometric Mean
Zinc	171.4	Eco-SSL Geometric Mean	297.6	Eco-SSL Geometric Mean
Total LMW PAHs	161.0	Patton & Dieter (1980)	355.9	Eco-SSL Geometric Mean
Total HMW PAHs	20	Trust et al. (1994)	38.4	Eco-SSL Geometric Mean

Notes:
1, Dose represents the geometric mean of no observable adverse effect level (NOAEL) endpoints from the Eco-SSL studies with growth and reproduction endpoints
2, Dose represents a no observable adverse effect level (NOAEL) endpoint; No LOAEL was reported for mammals by Sample et al. (1996)

Table C-5
Calculation of Soil ERGs for the Protection of Wildlife
Pompton Lakes Works
Pompton Lakes, New Jersey

Antimony				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	2706	65.4	13.3	13.3
Mammalian Ground Invertivore (Short-tailed shrew)	**61.8**	61.8	13.3	13.3
Mammalian Carnivore (Red fox)	5327	266.4	13.3	13.3
Avian Granivore (Mourning dove)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Ground Invertivore (American robin)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV

Arsenic				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	1375	8.0	4.55	4.55
Mammalian Ground Invertivore (Short-tailed shrew)	287.5	13.1	4.55	4.55
Mammalian Carnivore (Red fox)	4785	8.1	4.55	4.55
Avian Granivore (Mourning dove)	**154**	2.3	4.50	4.50
Avian Ground Invertivore (American robin)	185	9.6	4.50	4.50
Avian Carnivore (Red-tailed hawk)	2160	4.2	4.50	4.50

Barium				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	5027	784.2	82.7	82.7
Mammalian Ground Invertivore (Short-tailed shrew)	**3270**	297.6	82.7	82.7
Mammalian Carnivore (Red fox)	70705	604.5	82.7	82.7
Avian Granivore (Mourning dove)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Ground Invertivore (American robin)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV

Cadmium				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	1435	32.9	6.9	6.9
Mammalian Ground Invertivore (Short-tailed shrew)	**5.7**	32.9	6.9	6.9
Mammalian Carnivore (Red fox)	7029	18.7	6.9	6.9
Avian Granivore (Mourning dove)	167	10.2	6.35	6.35
Avian Ground Invertivore (American robin)	7.3	40.0	6.35	6.35
Avian Carnivore (Red-tailed hawk)	2937	12.4	6.35	6.35

Chromium				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	9104	373	58.2	58.2
Mammalian Ground Invertivore (Short-tailed shrew)	9058	6.5	58.2	58.2
Mammalian Carnivore (Red fox)	43784	591.2	58.2	58.2
Avian Granivore (Mourning dove)	**455**	18.7	15.6	15.6
Avian Ground Invertivore (American robin)	887	7.6	15.6	15.6
Avian Carnivore (Red-tailed hawk)	5473	128.6	15.6	15.6

Cobalt				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	5469	41.0	18.9	18.9
Mammalian Ground Invertivore (Short-tailed shrew)	595	72.6	18.9	18.9
Mammalian Carnivore (Red fox)	3502	492.6	18.9	18.9
Avian Granivore (Mourning dove)	659	4.9	18.3	18.3
Avian Ground Invertivore (American robin)	**521**	63.5	18.3	18.3
Avian Carnivore (Red-tailed hawk)	2766	361.9	18.3	18.3

Copper				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	21535	99.5	69	69
Mammalian Ground Invertivore (Short-tailed shrew)	9110	56.9	69	69
Mammalian Carnivore (Red fox)	75650	39.0	69	69
Avian Granivore (Mourning dove)	**1100**	30.8	34.9	34.9
Avian Ground Invertivore (American robin)	1795	37.3	34.9	34.9
Avian Carnivore (Red-tailed hawk)	16795	31.4	34.9	34.9

Lead				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	62925	130.4	187.6	187.6
Mammalian Ground Invertivore (Short-tailed shrew)	4812	753.3	187.6	187.6
Mammalian Carnivore (Red fox)	200800	238.7	187.6	187.6
Avian Granivore (Mourning dove)	1570.5	16.5	44.6	44.6
Avian Ground Invertivore (American robin)	**892**	193.3	44.6	44.6
Avian Carnivore (Red-tailed hawk)	20635	87.3	44.6	44.6

Manganese				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	15001	1185.1	145.7	145.7
Mammalian Ground Invertivore (Short-tailed shrew)	13498	292.1	145.7	145.7
Mammalian Carnivore (Red fox)	93863	1924.2	145.7	145.7
Avian Granivore (Mourning dove)	**9091**	718.2	376.6	376.6
Avian Ground Invertivore (American robin)	19610	376.8	376.6	376.6
Avian Carnivore (Red-tailed hawk)	137645	2821.7	376.6	376.6

Inorganic Mercury				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	170	6.0	1.0	1.0
Mammalian Ground Invertivore (Short-tailed shrew)	129	0.9	1.0	1.0
Mammalian Carnivore (Red fox)	375	20.4	1.0	1.0
Avian Granivore (Mourning dove)	**20.4**	1.9	0.9	0.9
Avian Ground Invertivore (American robin)	45	0.8	0.9	0.9
Avian Carnivore (Red-tailed hawk)	217	11.8	0.9	0.9

Table C-5
Calculation of Soil ERGs for the Protection of Wildlife
Pompton Lakes Works
Pompton Lakes, New Jersey

Nickel				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	3698	50.5	14.8	14.8
Mammalian Ground Invertivore (Short-tailed shrew)	NA	Not modeled - no uptake factor	Not modeled - no uptake factor	14.8
Mammalian Carnivore (Red fox)	14097	66.9	14.8	14.8
Avian Granivore (Mourning dove)	**609**	13.1	18.6	18.6
Avian Ground Invertivore (American robin)	NA	Not modeled - no uptake factor	Not modeled - no uptake factor	18.6
Avian Carnivore (Red-tailed hawk)	8311	52.3	18.6	18.6

Selenium				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	11.0	7.2	0.66	0.66
Mammalian Ground Invertivore (Short-tailed shrew)	**5.0**	3.0	0.66	0.66
Mammalian Carnivore (Red fox)	493	6.8	0.66	0.66
Avian Granivore (Mourning dove)	5.8	3.5	0.82	0.82
Avian Ground Invertivore (American robin)	8.3	4.4	0.82	0.82
Avian Carnivore (Red-tailed hawk)	307.0	5.7	0.82	0.82

Silver				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	29471	412.6	118.6	118.6
Mammalian Ground Invertivore (Short-tailed shrew)	274	559.3	118.6	118.6
Mammalian Carnivore (Red fox)	115841	463.4	118.6	118.6
Avian Granivore (Mourning dove)	2080	29.1	60.5	60.5
Avian Ground Invertivore (American robin)	**181**	369.3	60.5	60.5
Avian Carnivore (Red-tailed hawk)	28082	112.3	60.5	60.5

Thallium				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	23.7	0.1	0.075	0.075
Mammalian Ground Invertivore (Short-tailed shrew)	**4.3**	0.2	0.075	0.075
Mammalian Carnivore (Red fox)	16.7	1.9	0.075	0.075
Avian Granivore (Mourning dove)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Ground Invertivore (American robin)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - no TRV	Not modeled - no TRV	No TRV

Vanadium				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	2927	14.2	9.4	9.4
Mammalian Ground Invertivore (Short-tailed shrew)	627	26.3	9.4	9.4
Mammalian Carnivore (Red fox)	7317	90.0	9.4	9.4
Avian Granivore (Mourning dove)	**62**	0.3	1.7	1.7
Avian Ground Invertivore (American robin)	74.7	3.1	1.7	1.7
Avian Carnivore (Red-tailed hawk)	694.9	8.5	1.7	1.7

Zinc				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	47086	1894	297.6	297.6
Mammalian Ground Invertivore (Short-tailed shrew)	4035	1303	297.6	297.6
Mammalian Carnivore (Red fox)	324174	223	297.6	297.6
Avian Granivore (Mourning dove)	3347	436.7	171.4	171.4
Avian Ground Invertivore (American robin)	**1507**	943.2	171.4	171.4
Avian Carnivore (Red-tailed hawk)	81650	201.5	171.4	171.4

Total LMW PAHs				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	125383	55.4	355.9	355.9
Mammalian Ground Invertivore (Short-tailed shrew)	**555**	1686	355.9	355.9
Mammalian Carnivore (Red fox)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	355.9
Avian Granivore (Mourning dove)	2370	518.0	161.0	161.0
Avian Ground Invertivore (American robin)	**382**	993.2	161.0	161.0
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	161.0

Total HMW PAHs				
Receptor	**Soil Benchmark Concentration (C_s) (mg/kg)**	**Concentration in dietary item (B_i) (mg/kg)**	**EDD (mg/kg BW d^{-1})**	**LOAEL (mg/kg BW d^{-1})**
Mammalian Herbivore (Meadow vole)	1728	384.0	38.4	38.4
Mammalian Ground Invertivore (Short-tailed shrew)	69.8	181.5	38.4	38.4
Mammalian Carnivore (Red fox)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	38.4
Avian Granivore (Mourning dove)	274	67.2	20.0	20
Avian Ground Invertivore (American robin)	**47.5**	123.5	20.0	20
Avian Carnivore (Red-tailed hawk)	NA	Not modeled - No uptake by prey	Not modeled - No uptake by prey	20

Notes:
1, Soil benchmark concentration solved iteratively by adjusting Cs until EDD = LOAEL:

$$EDD = FIR \times (C_s \times P_s + B_i) = LOAEL$$

where:
EDD = Estimated daily dose to the receptor (mg/kg BW d-1)
FIR = Food ingestion rate (kg food [dry weight]/kg bw [wet weight]/d)
P_s = Soil ingestion as proportion of diet
C_s= Soil concentration (mg/kg)
B_i= Estimated concentration in dietary item (mg/kg bw/d)
LOAEL= Lowest observable adverse effects level (mg/kg BW d-1)
2, Receptor parameters provided in Table C-2; Soil-to-biota accumulation models used to estimate prey concentrations provided in Table C-3
3, Doses are calculated on a dry weight basis
4, Bold values indicate ecological soil delineation criterion based on most sensitive wildlife receptor.
NA, Not applicable

Appendix B

Impact to Groundwater Evaluation

This technical memorandum describes the impact to groundwater evaluation conducted for the former E.I. du Pont de Nemours Company (DuPont) Pompton Lakes Works (PLW) Site (Site) located in Pompton Lakes, New Jersey. This evaluation is being conducted to assess the potential for metals (lead and mercury) and polychlorinated biphenyl (PCB) concentrations in soil to affect groundwater. Additionally, the findings of this evaluation will be utilized to validate the following:

- The metals in groundwater evaluation presented in the Site *Comprehensive Groundwater Monitoring Program* (CGMP), dated November 1995; and
- The findings and conclusions presented in the *Supplemental Onsite Groundwater Investigation Report* (SOGWIR), dated November 2012.

BACKGROUND

Groundwater has been investigated and sampled extensively at the Site since 1981 under a variety of programs to identify if concentrations of Site related COCs in soil have resulted in exceedances of New Jersey Department of Environmental Protection's (NJDEP) Class IIA Ground Water Quality Standards (GWIIA). An evaluation of the dataset collected between 1981 and 1995 was conducted for multiple analytes from 126 monitoring wells onsite and offsite. The evaluation provided information and insight for the development of a more complete and efficient comprehensive program to monitor groundwater conditions at the PLW Site. The results of the evaluation were presented in the CGMP.

A supplemental onsite groundwater investigation was conducted in 2011 and 2012 to address NJDEP comments on the EMA, NMA, and WMA RIRs regarding the potential for Site-related constituents in soil above NJDEP's default Impact to Groundwater Soil Screening Levels (IGWSSL) to affect groundwater. Investigation elements included the collection of synthetic precipitation leaching procedure (SPLP) samples within the NMA and WMA and collection of groundwater samples from select existing monitoring wells and temporary wells within the EMA, NMA, and WMA. The overall goal of the investigation was to collect data at specific locations where soil concentrations were elevated to assess if Site-related constituents were present. The results of the investigation were presented in the SOGWIR.

The results of the metals evaluation conducted in the CGMP did not identify metals (arsenic, antimony, copper, lead, and mercury) as a contaminant of concern (COC) in Site groundwater due to limited and low frequency of detection. The 2011 and 2012 investigations identified SPLP samples within the NMA and WMA with leachate concentrations for metals above the default NJDEP criteria; however, groundwater samples collected at these locations were below the GWIIA. Additionally, localized metals exceedances of the GWIIA were observed within the EMA and WMA and one trichloroethene (TCE) exceedance of the GWIIA in the EMA. Metals were not detected above the GWIIA in the NMA, and all other sampling parameters in the EMA (explosives, perchlorate, and PCBs) were below the GWIIA. The supplemental groundwater investigation confirmed the results of the 1995 evaluation and concluded the following:

- Dissolved metals concentrations in groundwater were lower than total metals concentrations in most samples, indicating samples may have been affected by soil particles entrained into the sample.
- Results from soil sampling indicate the potential for Site-related COC concentrations in soil to migrate into groundwater; however, historic groundwater investigations indicate that soil concentrations of metals (copper, lead, mercury, and selenium) have only impacted groundwater at localized locations.
- Metals exceedances of the GWIIA were not observed down and side gradient of localized exceedances.
- Concentrations of arsenic observed in groundwater are attributed to natural background arsenic levels detected in soil and historic operating records for the Site indicate arsenic was never used, stored, or disposed at the facility.

Concentrations of non-VOC related constituents above the IGWSSL do not necessarily indicate groundwater is or will be impacted. As discussed in fate and transport section (Section 2.5.3) of the Corrective Measures Study (CMS), the non-VOC related Site constituents, specifically metals and PCBs have strong tendencies to sorb onto soil, and are not mobile due to limited or low solubility values. The fate and transport of metals and PCBs is consistent with results of the 2011 and 2012 supplemental investigation and the evaluation documented within the CGMP; therefore, the mechanism for metals and PCBs to affect groundwater at Site does not exist. Localized areas where metals concentrations are detected above the GWIIA are likely related to dissolved phased concentrations of metals that migrated into groundwater. Locations where lead, mercury, copper, and selenium were observed above the GWIIA are adjacent to Areas of Concern (AOCs) where dissolved phase concentrations of metals were generated by Site processes and concentrations likely migrated into groundwater due the handling of process related materials or are associated with soil particles entrained in the samples.

SESOIL MODELING

To validate the results of metals evaluation in the CGMP and sampling results (metals and PCBs) from supplemental groundwater investigation, an impact to groundwater (IGW) evaluation was conducted. The evaluation was completed utilizing the NJDEP guidance document *Using the SESOIL Transport Model to Assess The Impact to Ground Water Pathway*, revised December 2008, and the Seasonal Compartment Model (SESOIL).

SESOIL is a one-dimensional vertical transport model for the unsaturated zone developed for the U.S. Environmental Protection Agency (USEPA). SESOIL simulates contaminant fate and transport based on diffusion, adsorption, volatilization, biodegradation, and hydrolysis to determine whether current levels of soil contamination may impact the groundwater in the future. NJDEP provides guidance for utilizing the model to conduct an impact to groundwater assessment. A review of the SOGWIR boring logs and historic organic carbon sample results was conducted prior to running the model and NJDEP default values were used for the optional Site-specific model data.

The first step in the evaluation consisted of reviewing RI and SOGWIR data collected to establish the primary COCs which have elevated concentrations in soil above the IGWSSL; therefore the greatest potential to impact groundwater. Lead, mercury, and PCBs were selected and based on their soil concentration ranges, frequency of occurrence at the Site, and concentration/frequency of detection in groundwater. The evaluation was focused within the EMA since the soil concentrations present are higher and the supplemental groundwater investigation completed in WMA demonstrated that locations with elevated concentrations did not migrate to groundwater. As discussed above no exceedances of the GWIIA were observed in the NMA. Modeling was completed in a phased approach to validate the results of historic investigations and the CSM. The model outputs are provided in Attachment A.

Lead, mercury, and PCBs were evaluated in a phased approach in order to confirm the observations from historic groundwater investigations. During the first phase of modeling, SESOIL was run using EMA soil data from a single boring location in accordance with NJDEP's guidance to assess the sensitivity of the model and potential need for collecting Site-specific model input such as soil organic carbon, soil texture, or soil partition coefficient. NJDEP's default SESOIL values are the following:

	NJDEP Default SESOIL Values				
Contaminant of Concern	**Solubility (mg/L)**	**Partition Coefficient (L/kg)**	**K_{oc} (L/kg)**	**Soil Texture**	**Organic Carbon Content (%)**
Lead	100,000	900	0	Sand	0.2
Mercury	100,000	0.2	0	Sand	0.2
PCBs	0.7	0	309,000	Sand	0.2

Based on the initial modeling results, supplemental modeling was conducting with COC soil data from Areas of Concern (AOCs) which would produce a conservative scenario for the potential to impact groundwater, due to higher soil concentrations and concentration distribution.

SESOIL MODEL RUN 1

The first phase of modeling (model run 1 a through h) was conducted for lead, mercury, and PCBs. SESOIL was run utilizing RI data at one soil boring location within an AOC to assess the sensitivity of other potential variable model parameters (depth to water, soil type, and solubility [metals only]). Solubility was included as a variable parameter due to the difference between the high water solubility suggested for metals (100,000 milligrams/liter [mg/l]) in the NJDEP guidance and solubility presented in model database for lead (9,580 mg/l) and mercury (0.06 mg/l). Furthermore, initial modeling was used to assess the COC concentration ranges that may contribute to groundwater impacts. A summary table of the modeling results is presented below followed by a description of the results by COC.

SESOIL Model Run Summary Table								
Model Run Number	Contaminant of Concern	Concentration Range (mg/kg)	Concentration Depth Range (ft bgs)	Depth to Water (ft bgs)	Solubility (mg/L)	K_d or K_{oc}(1) (L/kg)	Soil Texture	SESOIL Model Result
1a	Lead	86.1 to 1,770	0.0 to 6.5	6.5	9,580	900	Sand	No Leachate Generated
1b	Lead	86.1 to 1,770	0.0 to 6.5	6.5	100,000	900	Sand	No Leachate Generated
1c	Lead	3,970 to 95,700	0.0 to 6.5	6.5	9,580	900	Sand	No Leachate Generated
1d	Lead	3,970 to 95,700	0.0 to 6.5	6.5	100,000	900	Sand	No Leachate Generated
1e	Total PCBs	0.42 to 2.6	0.0 to 3.0	5.22	0.7	309,000	Sand	No Leachate Generated
1f	Total PCBs	0.42 to 100	0.0 to 2.5	5.22	0.7	309,000	Sand	No Leachate Generated
1g	Mercury	2.51 to 2,510	0.0 to 7.5	7.5	0.06	0.2	Sand	0.059 mg/l leachate generated
1h	Mercury	2.51 to 2,510	0.0 to 7.5	7.5	100,000	0.2	Sand	4,051 mg/l leachate generated

Notes:

1. K_d values are for metals and K_{oc} values used for PCBs.

Lead

Model runs 1a and 1b for lead indicated leachate would not be generated from the concentrations entered into the model with the NJDEP default solubility or the SESOIL model default solubility. Additional model runs (1c and 1d) were completed with higher soil concentrations and the SESOIL model indicated leachate would not be generated.

PCBs

Model run 1e for PCBs indicated leachate would not be generated from the concentrations entered into the model. An additional model run (1f) was completed with higher soil concentrations and the SESOIL model indicated leachate would not be generated.

Mercury

Model run 1g and 1h for mercury indicated leachate would be generated. Utilizing the water solubility suggested by NJDEP (100,000 mg/l) the model predicted the leachate concentration (approximately 4,051 mg/l) to be several orders of magnitude greater than the leachate concentration (0.059 mg/l) generated utilizing the default SESOIL database solubility for mercury (0.06 mg/l). Even though the model predicted leachate would be generated, it does not necessarily mean the groundwater will be impacted. A temporary well was sampled for mercury during the supplemental groundwater investigation downgradient of the soil data utilized for model run 1g and 1h. Total mercury was detected at 0.06 micrograms per liter (ug/l) which is approximately two orders of magnitude below the GWIIA of 2 ug/l. The SESOIL model runs for mercury exhibited orders of magnitude variability in leachate generated. The model predicts leachate, even with a lower solubility, which is not consistent with Site-specific observations of mercury in groundwater.

Historic groundwater data for the onsite monitoring wells indicate that mercury has been detected in five existing monitoring wells within the middle to southern portions of the EMA, with 35 detections above the GWIIA out of 948 samples collected. Recent groundwater sampling results documented in the SOGWIR identified six total mercury detections above the GWIIA out of the 25 temporary and existing wells samples in the EMA. Dissolved mercury results from the six exceedances indicated concentrations were likely related to soil particles entrained into the sample. Furthermore, mercury was not detected above the GWIIA in all locations (eight temporary and nine permanent wells) sampled in the WMA during the 2012 supplemental investigation. Localized areas where mercury concentrations are detected above the GWIIA are likely related to dissolved phased concentrations of mercury that migrated into groundwater. Locations where mercury was observed above the GWIIA are adjacent to Areas of Concern (AOCs) where dissolved phase concentrations of metals were generated by Site processes and concentrations likely migrated into groundwater due the handling of process related materials or are associated with soil particles entrained in the samples.

The results of the initial modeling for mercury and historic groundwater sampling for mercury and information discussed in the CSM, prompted further assessment of mercury's solubility, environmental conditions that may affect it's mobility, and the soil partitioning coefficient for mercury (Kd). The results of the mercury assessment are described below.

MERCURY ASSESSMENT (SOLUBILITY, SITE GW PARAMETERS, KD)

An assessment of mercury's solubility, environmental conditions that may affect its mobility, and Kd was conducted through a literature search. The goal of the assessment was to establish solubility and Kd values to use with the SESOIL model and identify if Site conditions have the potential to cause mercury to be less adsorbed onto the soil particles and more soluble in groundwater.

Mercury solubility is typically described in generic terms because the environmental factors influencing solubility of a chemical compound can vary greatly based on the mercury complexes found in the environment. Historic Site use of mercury included the production of mercury fulminate, $(HgCNO)_2$, for use in blasting caps. Mercury fulminate was produced by treating mercury with a solution of nitric acid and alcohol. Mercury fulminate production ceased in 1955 due it's relatively poor stability (purity deteriorates and is no longer useful as an explosive primer). Site use of mercury fulminate ended in 1960. Mercury fulminate is desensitized by water, reacts with metals in a moist atmosphere, and is very sensitive to sunlight (Akhavan 2004, Boileau J et al 2009). Due to these chemical/physical properties and its poor stability mercury fulminate is not likely present in the fulminate form.

The literature search identified several compounds, including elemental mercury, with a wide range of solubility values. Most reference sources generally describe elemental mercury (Hg^0) as having a low solubility or "slight solubility" in water (Clever *et al*., 1985, ICPS 2000a, WHO, 2003). Mercury fulminate is also described as only "slightly soluble". The solubility of several other common mercury salts and inorganic mercury compounds are referenced in various peer reviewed articles, but none are described as having soluble properties which exceed those of mercuric chloride ($HgCl_2$) (yielding solute Hg(II))and mercurous chloride (Hg_2Cl_2) (yielding solute Hg(I)) (H. Biester *et al*., 2002b, Clever *et al*., 1985, ICPS 2000a-d, WHO, 2003). Mercuric chloride ($HgCl_2$) and mercurous chloride (Hg_2Cl_2) are considered "very soluble in water". Based on a review of the Site's operational history, mercuric chloride and mercurous chloride were not used on Site and are only discussed as examples of more soluble forms of mercury.

As discussed above, NJDEP's SESOIL guidance suggests a high water solubility for mercury (100,000 mg/l) as the default solubility value when no specific value for a cation/metal can be established. The SESOIL database established a default solubility orders of magnitude lower than NJDEP guidance, 0.06 mg/l.

The solubility values for mercury and mercury compounds presented below are documented by the World Health Organization (WHO) in Concise International Chemical Assessment Documents 50 (CICADs), *Elemental Mercury and Inorganic Mercury Compounds: Human Health Aspects.*

- Elemental mercury Hg 0.0056 mg/l
- Mercurous chloride (Hg_2Cl_2) 2 mg/l
- Mercuric chloride ($HgCl_2$) 28,600 mg/L

The *Encyclopedia of Explosives and Related Items, PATR 2700 Volume 6* identifies the solubility of mercury fulminate to be the following:

- 710 mg/l at 12 ^{o}C
- 1,740 mg/l at 49 ^{o}C
- 7,700 mg/l at 100 ^{o}C

As indicated by the values listed above, the range for mercury compounds is significant (6 orders of magnitude). Due to mercury fulminates chemical/physical properties and its poor stability, mercury fulminate is not likely present in the fulminate form.

The reduction/oxidation state and pH of the water is also an important factor in determining mercury solubility. Research suggests that the groundwater pH and redox (eH) states need to be less than a pH of 6 with oxidizing states (eH) greater than 500 millivolts (mv) in order to change the dissolved state of mercury from its most stable form with the lowest solubility (Hg^0) to one of the more oxidized states with a higher solubility Hg(I) or Hg(II) (Brookins, 1998). Even when these conditions are met, oxidized states of mercury are not likely thermodynamically stable unless the oxidizing conditions are above eH > 700 mv and pH < 5 (Camps Arbestain *et al.,* 2009). These conditions are outside what is typically encountered in groundwater and surface water conditions. When redox and pH conditions return to more typical conditions, Hg(II) will likely reduce to elemental mercury, precipitate as an inorganic mercury compound, and/or adsorb onto soil particles to form some organically bound complex (H. Biester *et al*., 2002b).

Redox and pH field measurements collected during sampling events for on-Site monitoring wells indicate a redox range of -439.2 to 419 mv and pH range of 4.88 to 10.53. Although pH has been observed below 6, redox field measurements are still below 500 mv, so the optimal conditions for changing and keeping mercury in a more soluble form are not found on Site. Additionally, mercury sampling results from the monitoring wells with pH measurements less than 6 were all below the GWIIA, with only 8 mercury detections (ranging in concentration from 0.06 to 0.3 ug/l) in 123 samples collected from the wells. Ten temporary wells installed during the investigation documented in the SOGWIR produced pH readings less than 6. The sampling of those temporary wells only identified one mercury exceedance of the GWIIA. The other nine mercury results were at least an order of magnitude below the GWIIA, or below detection limits.

All the reviewed documents identified that Kd plays an equally important role with respect to the transportation of mercury in the environment. Therefore, Kd values should be considered with respect to the SESOIL modeling effort. NJDEP's chemical properties table defines Kd for mercury as 0.2 liters per kilogram (L/kg). The soil partitioning coefficient ranges presented in literature reviewed during the assessment are below:

- Battelle (1989) 322 - 5,280 L/kg
- EPA Guidance SSG for Mercury II 0.04 – 200 L/kg

The default soil partitioning coefficient listed in the SESOIL model is on the conservative end of the values identified (least likely to partition to soil), and research indicates that the value is based solely on theoretical modeling of Hg (II). The USEPA Soil Screening Guidance (SSG) listed above may be the source for this value. The modeling, conducted by USEPA, used only the dissolved state of mercury Hg (II) (U.S. EPA, 2005. *Partition Coefficients for Metals In Surface Water, Soil, and Waste)*, which, as indicated in the redox and pH discussion above, is not likely to exist under natural environmental conditions (D.G. Brookins, 1988). Comprehensive research and field data compiled and published in the *Chemical data bases for Multimedia Environmental Pollutant Assessment System (MEPAS): Version 1*, Battelle, (1989) presents a more reasonable range (322 - 5,280 L/kg) of soil partition coefficients that likely more representative of typical environmental conditions for the modeling effort.

In order to assign specific solubility and Kd values for the mercury SESOIL modeling, Site specific mercury compounds would need to be identified. However, identifying Site specific mercury compounds is difficult due to limited availability of commercial labs certified to perform analysis for defining mercury compounds, and the lack of methods for predicting how mercury will complex in the natural environment due to the complexity of the mercury cycle. In the absence of this information, historic Site practices and information about the mercury compounds present on the Site can be utilized. The two most likely compounds are elemental mercury and mercury fulminate. Mercury fulminate use ceased in 1960, and due to its chemical/physical properties and poor stability, mercury fulminate is not likely present in the fulminate form. The recommended solubility for the modeling should be the default mercury solubility number provided in the SESOIL model for elemental mercury, 0.06 mg/l. This number represents the most factually supported scenario for mobilizing mercury from soil.

The model should also incorporate soil partitioning coefficients for elemental mercury. This range is detailed above (322-5280 L/kg). The EPA SSG guidance lists the default soil partitioning value as 52 L/kg for Hg (II). The NJDEP *Chemical Properties for Calculation of Impact to Ground Water Soil Remediation Standards* lists the default soil partitioning value as 0.2 L/kg which is in the range identified for Hg (II). As described above, these values are calculated from modeling based on dissolved mercury in its most oxidized state (2+). Unsaturated conditions are not likely to create acidic and highly oxidizing conditions in order to dissolve elemental mercury to Hg (II). Therefore, the range of values for Hg (II) do not represent the soil partitioning for elemental mercury or a mercury compound like mercury fulminate, and the soil partitioning coefficient of 322 L/kg should be used to represent a conservative scenario for the mercury modeling effort.

Based on the results of the assessment, SESOIL modeling was conducted with mercury concentrations above the New Jersey Residential Direct Contact Soil Remediation Standard (NJ RDCSRS) from a single boring with 0.06 mg/l for solubility (SESOIL database default) and 322 L/kg for Kd (Battelle 1989). The model predicted no leachate generation; therefore no impact to groundwater. Additionally, the results of model run 1g were re-evaluated using a Kd value of 322 L/kg. The model predicted leachate generation of 0.0187 mg/l which is below NJDEP's leachate criteria for mercury (0.026 mg/l); therefore no impact to groundwater. Modeling results (model run 2a and 2b) are provided in Attachment A. Utilizing the parameters derived from the mercury assessment, the SESOIL model supported the data evaluation presented in the CGMP and the conclusions from the SOGWIR.

SESOIL Model Run Summary Table

Model Run Number	Contaminant of Concern	Concentration Range (mg/kg)	Concentration Depth Range (ft bgs)	Depth to Water (ft bgs)	Solubility (mg/L)	K_d or K_{oc} (1) (L/kg)	Soil Texture	SESOIL Model Result
2a	Mercury	0.128 to 69.4	0.0 to 5.0	5.07	0.06	322	Sand	No Leachate Generated
2b	Mercury	2.51 to 2,510	0.0 to 7.5	7.5	0.06	322	Sand	0.0187 mg/l leachate generated[2]

Notes:

1. K_d values are for metals and K_{oc} values used for PCBs.
2. NJDEP leachate criteria for mercury is 0.026 mg/l.

SESOIL MODEL RUN 2

The final SESOIL model runs for lead and PCBs (model run numbers 2c, 2d, and 2e) incorporated lithologic and analytical data collected during historic investigations that would likely produce a conservative scenario for the potential to impact groundwater. The data from the following AOCs were selected to estimate a conservative model:

- Lead; AOC 18 and 19 – Former Lead Azide Ponds was selected for lead because the RI identified lead as the primary COC within the AOC, lead concentrations are distributed throughout the AOC (approximately 9,200 square feet [SF]), and the highest lead concentrations in the EMA at depths greater than two feet (closer to the groundwater table) were observed within this AOC.
- PCB; AOC 47 and 48 – Former Black Powder Mill and Delay Tube Manufacturing was selected for PCBs because the RI and supplemental RI identified PCBS as one of the primary COCs with the AOC, PCBs concentrations are distributed throughout the AOC (approximately 3,900 SF), and the highest PCB concentrations within the EMA were observed within this AOC.

The final SESOIL model output for lead and PCBs (included in Attachment A) predicted no leachate generation. A summary of the results are presented below. Lithologic and analytical data used for SESOIL modeling of AOCs 18, 19, 47, and 48 is provided in Attachment A. Tables 1 and 2 are presented in NJDEP's format for consolidating data for use in the SESOIL model.

SESOIL Model Run Summary Table

Model Run Number	Contaminant of Concern	Concentration Range (mg/kg)	Concentration Depth Range (ft bgs)	Depth to Water (ft bgs)	Solubility (mg/L)	K_d or K_{oc} (1) (L/kg)	Soil Texture	SESOIL Model Result
2c	Lead	6,040 to 137,000	0.0 to 4.5	4.6	9,580	900	Sand	No Leachate Generated
2d	Lead	6,040 to 137,000	0.0 to 4.5	4.6	100,000	900	Sand	No Leachate Generated
2e	Total PCBs	0.42 to 100	0.0 to 2.5	5.22	0.7	309,000	Sand	No Leachate Generated

CONCLUSIONS

Although results from soil sampling indicate the potential for Site-related COC concentrations in soil to migrate into groundwater, historic groundwater investigations indicate that soil concentrations of metals (copper, lead, mercury, and selenium) have only impacted groundwater at localized locations. Concentrations of arsenic observed in groundwater are attributed to natural background arsenic levels detected in soil and historic operating records for the Site indicate arsenic was never used, stored, or disposed at the facility.

Concentrations of non-VOC related constituents above the IGWSSL do not necessarily indicate groundwater is or will be impacted. As discussed in Section 2.5.3 of the CMS, the non-VOC related Site constituents, specifically metals and PCBs have strong tendencies to sorb onto soil, and are not mobile due to limited or low solubility values. PCBs were not detected above the GWIIA in groundwater samples collected during the supplemental investigation.

Localized areas where metals concentrations are detected above the GWIIA are not likely related to the dissolution of constituents into groundwater. Concentrations in groundwater can be attributed to dissolved phase concentrations of metals generated by Site processes at AOCs directly adjacent to the metals exceedance. Dissolved phased concentrations migrated into groundwater due the handling of process related materials or are associated with soil particles entrained in the samples.

The results of the 2011 and 2012 supplemental investigation were consistent with the evaluation documented within the CGMP. The SESOIL modeling effort validated the conclusions from the CGMP and SOGWIR. Impacts to groundwater from metals and PCBs are not anticipated outside of the few localized metals impacts described in the SOGWIR.

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ACRONYMS

AOC	Area of Concern
CEA	Classification Exception Area
CGMP	*Comprehensive Groundwater Monitoring Program*
CICAD	Concise International Chemical Assessment Document
CMS	Corrective Measure Study
COC	constituent of concern
DuPont	E.I. du Pont de Nemours and Company
eH	redox
EMA	Eastern Manufacturing Area
GWET	groundwater extraction and treatment
GWIIA	Class IIA Groundwater Quality Standard
Hg^0	elemental mercury
Hg (II)	mercury II
IGW	impact to groundwater
IGWSRS	impact to ground water soil remediation standards
L/kg	liters per kilogram
Kd	partitioning coefficient
MEPAS	*Multimedia Environmental Pollutant Assessment System*
mg/l	milligrams per liter
mv	millivolts
NJDEP	New Jersey Department of Environmental Protection
NJ NRDCSRS	New Jersey Non-Residential Direct Contact Soil Remediation Standard
NJ RDCSRS	New Jersey Residential Direct Contact Soil Remediation Standard
NMA	Northern Manufacturing Area
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PLW	Pompton Lakes Works
RI	remedial investigation
SESOIL	Seasonal Compartment Model
SF	square feet
SOGWIR	*Supplemental Onsite Groundwater Investigation Report*

SSG	Soil Screening Guidance
TCE	trichloroethene
ug/l	micrograms per liter
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WMA	Western Manufacturing Area
WHO	World Health Organization

Attachment A
SESOIL Model Table 1 - Lead Data for AOCs 18 and 19
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

Depth Interval (sublayer interval) (ft)	SESOIL model concentration	330-268	330-270	330-271	330-272	333-351	333-60	333-61	333-62	330-268	330-385	330-386
0-1	53,325.30	282.089	5.148	2.356	5.024	1,020	--	72.157	120.352	282.089	5,359.174	53,325.3
1-2	137,000.00	--	--	--	--	--	--	--	--	--	--	--
2-3	6,040.00	--	--	--	--	6,040	--	--	--	--	--	--
3-4	95,700.00	--	--	--	--	--	4,010.039	1,189.793	17.817	--	--	--
4-5	53,527.52	--	--	--	--	--	--	1,858.057	--	--	--	--

Depth Interval (sublayer interval) (ft)	SESOIL model concentration	330-460	330-461	330-462	333-352	333-354	333-62	333-63	333-64	333-65	333-389	333-429
0-1	53,325.30	1,079.354	293.282	1,652.558	910	77.6	--	22,341.369	431.552	355.014	--	104
1-2	137,000.00	--	--	--	1,820	--	--	--	--	--	137,000	--
2-3	6,040.00	--	--	--	--	38.8	--	--	--	--	--	--
3-4	95,700.00	--	--	--	--	--	--	280.017	39.332	--	3,530	--
4-5	53,527.52	--	--	--	--	--	314.537	--	8,098.275	--	--	--

Depth Interval (sublayer interval) (ft)	SESOIL model concentration	333-439	333-354	333-355	333-428	333-429	333-59	333-60	333-65	333-66	333-58
0-1	53,325.30	361	--	10,300	--	104	--	1,146.248	--	1,165.58	2,662.48
1-2	137,000.00	--	--	--	--	--	--	--	--	--	6,380
2-3	6,040.00	--	--	--	--	--	--	--	--	--	--
3-4	95,700.00	--	--	95,700	8.01	--	--	--	618.872	3,527.44	--
4-5	53,527.52	--	9,370	--	--	--	53,527.516	--	3,223.025	--	--

Notes:
-- = samples not analyzed at depth interval.
Depth to water within AOC is approximately 4.6 feet below the ground surface.

Attachment A
SESOIL Model Table 2 - PCB Data for AOCs 47 and 48
DuPont Pompton Lakes Works
Pompton Lakes, New Jersey

Depth Interval (sublayer interval) (ft)	SESOIL model concentration	332-121A	332-121B	332-121C	332-121D	332-121E	332-121F	332-121G	332-121H	332-121I	332-121J	332-121K	332-121M
0-1	100	4.7	1.1	1.5	100	20	15	18.5	7	3.3	2.87	0.66	3.8
1-2	3.7	0.32	--	--	1.38	0.55	--	0.071	--	--	--	--	--
2-3	0.42	--	--	--	0.42	--	--	--	--	--	--	--	--

Depth Interval (sublayer interval) (ft)	SESOIL model concentration	332-121P	332-121Q	332-121R	332-122D	332-122G	332-122J	332-123A	332-123D	332-123G	332-123J	332-308A	332-308B
0-1	100	5.3	1.2	0.65	0.125	0.015	0.07	0.052	0.037	0.079	0.044	10.3	0.16
1-2	3.7	--	--	--	--	--	--	--	--	--	--	0.84	--
2-3	0.42	--	--	--	--	--	--	--	--	--	--	--	--

Depth Interval (sublayer interval) (ft)	SESOIL model concentration	332-350D	332-350A	332-350F	332-121	332-122	332-123	332-294	332-308	332-350	332-351
0-1	100	0.181	0.172	0.34	7.1	1.25	3.7	6.4	--	2.6	0
1-2	3.7	--	--	--	3.7	--	1.35	0.61	1.55	1.3	--
2-3	0.42	--	--	--	--	--	0.021	--	--	0.42	--

Notes:
-- = samples not analyzed at depth interval.
Depth to water within AOC is approximately 5.2 feet below the ground surface.
Sampling data not collected below 2 to 3 foot interval.

O'BRIEN & GERE

BORING LOG

WELL NO. TW-32

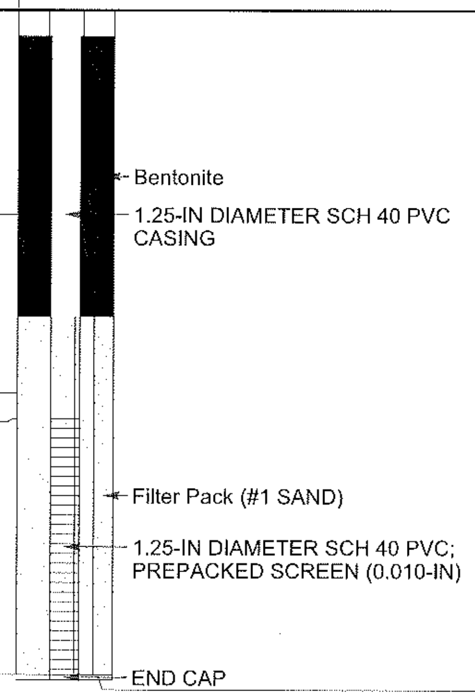
PROJECT:	NMA/WMA/EMA Temporary Well Installation	SHEET 1 OF 1	
CLIENT:	DuPont PLW		
INSPECTOR:	Satish Ramrup, Nicole Moneta	JOB NO.	49137

DRILLING CONTRACTOR:	Parratt Wolff, Inc.					GROUND ELEV.	
DRILLER:	Ian Grassie						
PURPOSE:	Install Temporary Wells		SAMPLE	CORE	CASING	DATUM	NAVD 1988
DRILLING METHOD:	Direct Push	TYPE	GM	---	PVC	DATE STARTED	7/17/2012
DRILL RIG TYPE:	Geoprobe 6620DT	DIA.	3"	---	1 1/4"	DATE FINISHED	7/17/2012

DEPTH (ft)	USCS SYMBOL	GRAPHIC LOG	LAYER DEPTH	MATERIAL DESCRIPTION
0–4	FILL		4.0	FILL (dry, firm, brown, mixed fill material gravel and ash)
4–7.5	SPG		7.5	SAND & SILT (moist, firm, brown, f SAND and silt, few gravel)
7.5–8	SP		8.0	SAND (saturated, firm, brown, m SAND, some silt)
8–13			13.0	Additional macrocores not collected, due to saturation observed in previous macocore, pushed outer rods to desired depth to install temporary well.
				End of Borehole at 13.0'.

Depth scale (ft): 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24

WELL DIAGRAM



Notes:

O'BRIEN & GERE	BORING LOG	WELL NO. **TW-42**

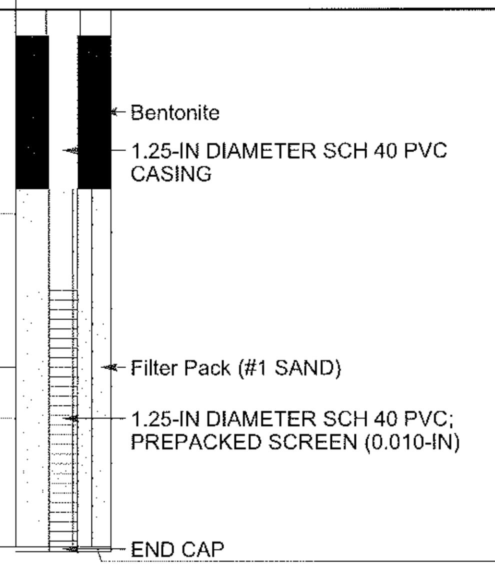
PROJECT:	NMA/WMA/EMA Temporary Well Installation	SHEET 1 OF 1	
CLIENT:	DuPont PLW		
INSPECTOR:	Satish Ramrup, Nicole Moneta	JOB NO.	49137
		GROUND ELEV.	
		DATUM	NAVD 1988
		DATE STARTED	7/16/2012
		DATE FINISHED	7/16/2012

DRILLING CONTRACTOR:	Parratt Wolff, Inc.
DRILLER:	Ian Grassie
PURPOSE:	Install Temporary Wells
DRILLING METHOD:	Direct Push
DRILL RIG TYPE:	Geoprobe 6620DT

	SAMPLE	CORE	CASING
TYPE	GM	---	PVC
DIA.	3"	---	1 1/4"

DEPTH (ft)	USCS SYMBOL	GRAPHIC LOG	LAYER DEPTH	MATERIAL DESCRIPTION
	SP			SAND & SILT (dry, firm, light brown, SILT, few f)
2				SAND & SILT (dry, firm, light brown, vf SAND, trace silt)
			4.0	SAND & SILT (dry, firm, light brown, vf SAND, trace silt)
4	ML			SILT (dry, firm, orange-brown, SILT)
6			7.0	SILT (dry, firm, gray, SILT)
	SP		8.0	SAND & SILT (moist, firm, orange, gravelly SAND, some silt)
8	SW			SAND (saturated, firm, gray, m-c SAND)
10			10.5	SAND & SILT (saturated, firm, brown-orange SILT, some gravelly sand)
12				INFERRED BEDROCK Refusal at 10.5'. End of Borehole at 10.5'.
14				
16				
18				
20				
22				
24				

WELL DIAGRAM



Notes:

MODEL RUN 1A

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness (cm)	Thickness (feet)	Intrinsic Permeability (cm ^{2})	Organic Carbon Content (percent)	Adsorption Coefficient ($\frac{\mu g/g}{\mu g/mL}$)	Cation Exchange Capacity ($\frac{mEq}{100\ g\ soil}$)	Freundlich Exponent (unitless)	Solid Phase Degradation Rate (1/day)	Liquid Phase Degradation Rate (1/day)	Soil pH (pH)
1	6	183.0	6.00	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	15.2	0.50	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm ^{3})	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

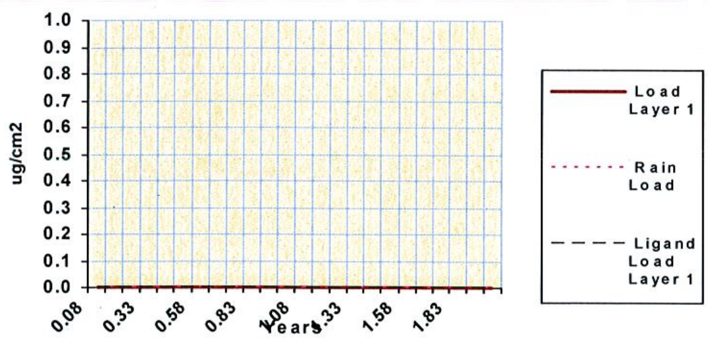
Area	cm ^{2}	5.69E+4
	ft ^{2}	61.25
Latitude	degrees	41.0
Spill Index		1

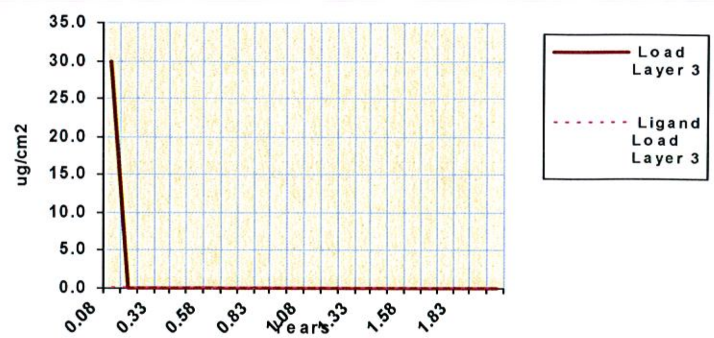
Chemical Parameters

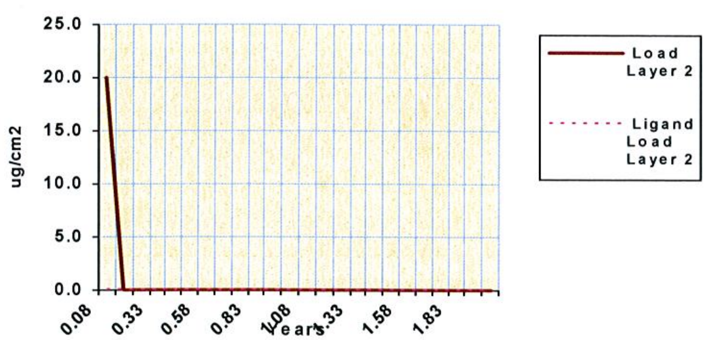
Water Solubility (µg/mL)	9.58E+3	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M ^{3}-atm/mol)	0.00	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm ^{2}/sec)	0.00	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm ^{2}/sec)	0.00	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	207.00		

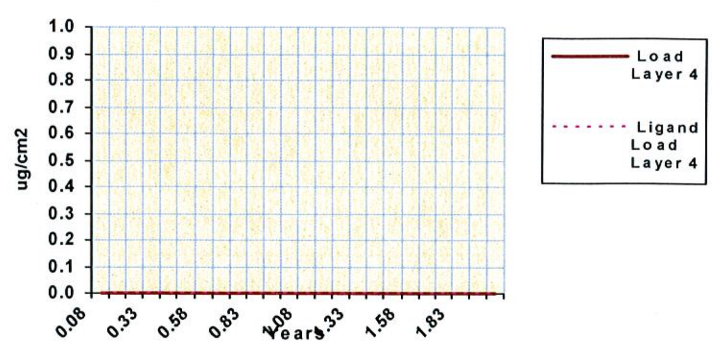
Output File: Dupont Lead Run 3 DTW 6.5' default solubility sand soil
C:\SEVIEW63\PBR3DSAN.OUT
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADANDC.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Lead Column DTW 6.5' sand
C:\SEVIEW63\PBCOLV0.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	1.21E+02			1.70E+03						
Layer 2 (ug/g)	8.61E+01									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1A

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Lead Run 3 DTW 6.5' default solubility sand soil

SESOIL Output File: C:\SEVIEW63\PBR3DSAN.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	4.801E+09	99.01
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	2.414E+05	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	4.801E+09	99.02
Total Input	4.849E+09	
Input - Output	4.774E+07	

Maximum leachate concentration: 0.000E+00 **mg/l**

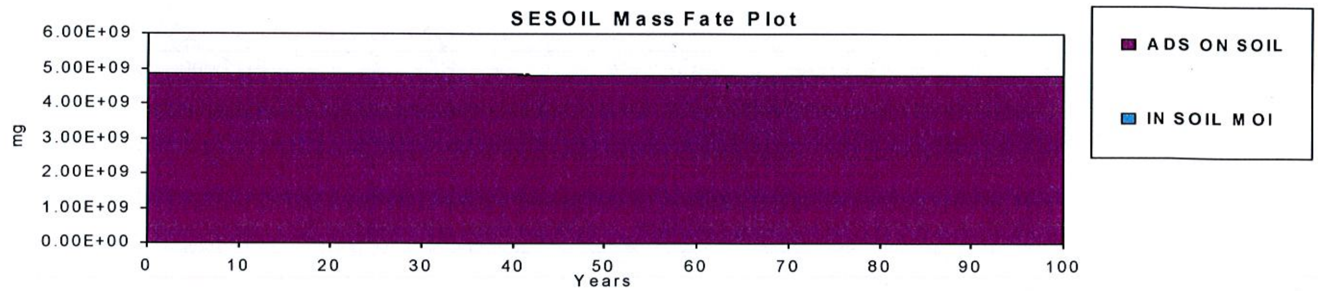
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

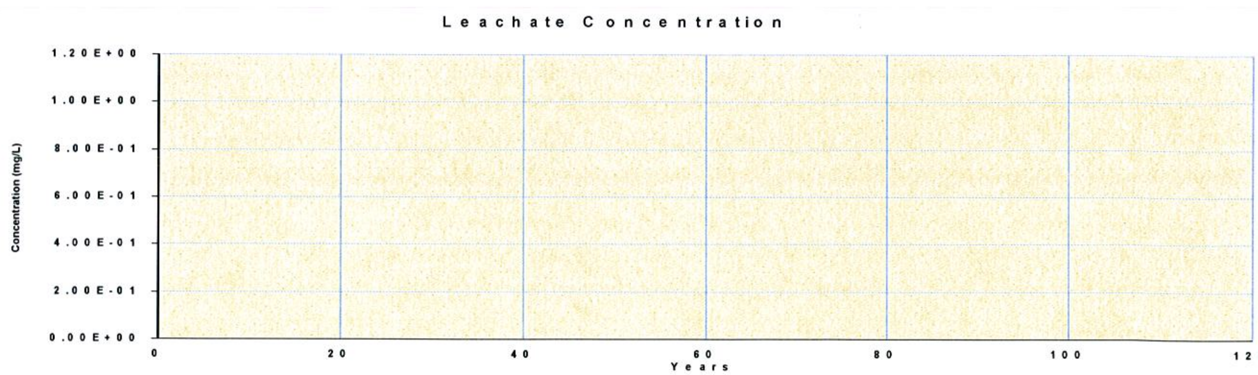
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADANDC.CHM

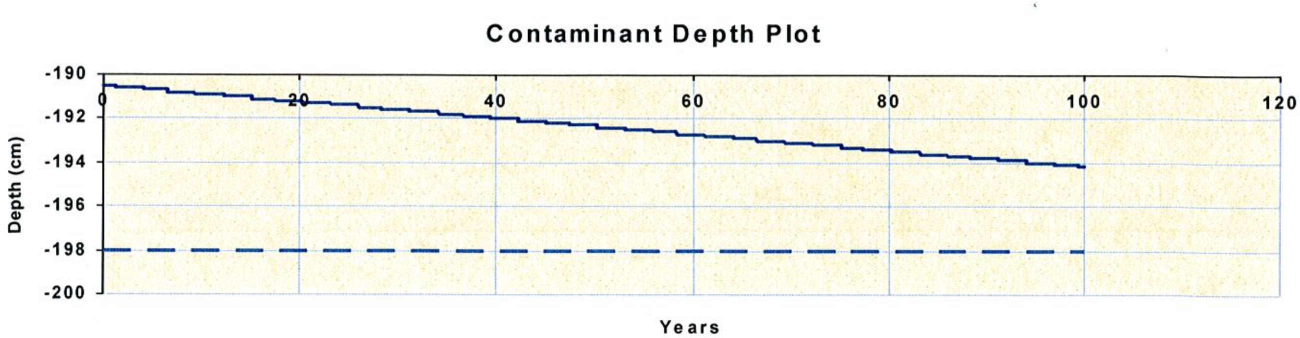
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Lead Column DTW 6.5' sand
C:\SEVIEW63\PBCOLV0.APL

Starting Depth: 190.50 **cm**
Ending Depth: 194.20 **cm**
Total Depth: 198.20 **cm**







MODEL RUN 1B

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm 2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	6	183.0	6.00	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	15.2	0.50	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

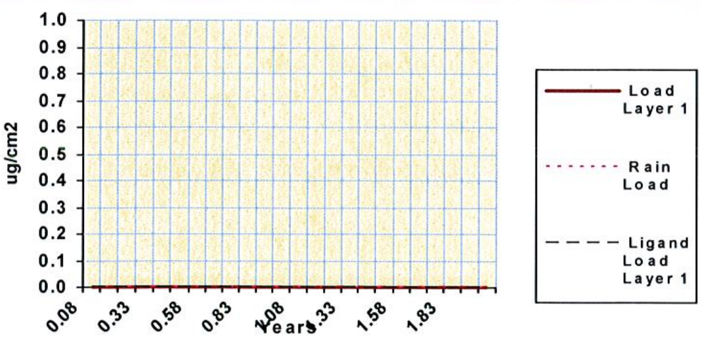
Area	cm 2	5.69E+4
	ft 2	61.25
Latitude	degrees	41.0
Spill Index		1

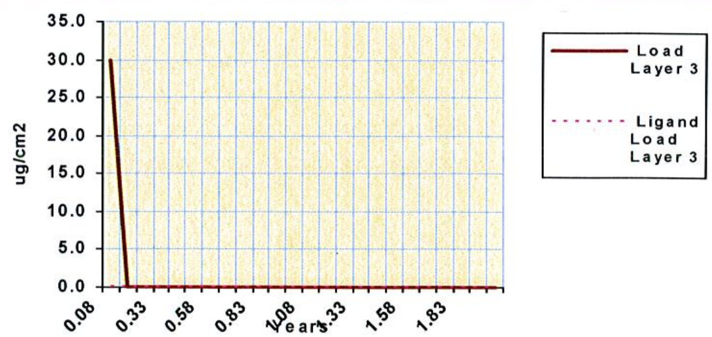
Chemical Parameters

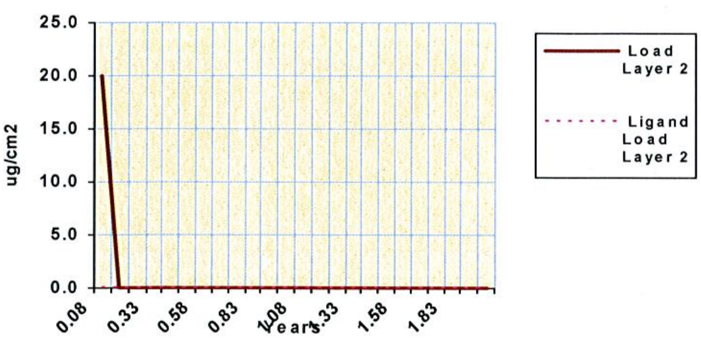
Water Solubility (µg/mL)	1.00E+5	Moles Ligand / Moles Chemical	0.00
Henry's Law (M3-atm/mol)	0.00	Ligand Molecular Weight (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	Base Hydrolysis Rate (L/mol/day)	0.00
Valance (g/mole)	0.00	Ligand Dissociation Constant	0.00
Air Diffusion Coefficient (cm2/sec)	0.00	Neutral Hydrolysis Rate (L/mol/day)	0.00
Water Diffusion Coefficient (cm2/sec)	0.00	Acid Hydrolysis Rate (L/mol/day)	0.00
Molecular Weight (g/mol)	207.00		

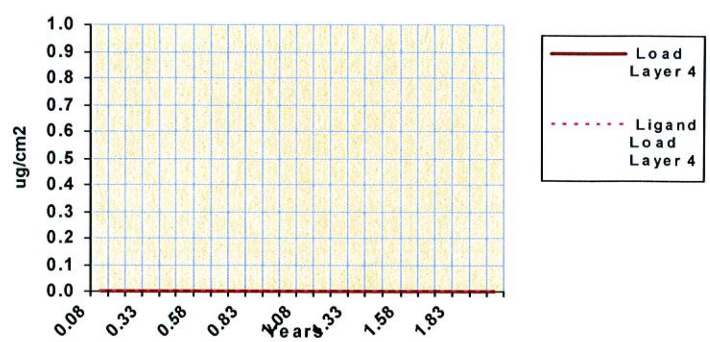
Output File: Dupont Lead Run 3 DTW 6.5' high solubility sand soil
C:\SEVIEW63\PBR3HSAN.OUT
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADHSOL.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Lead Column DTW 6.5' sand
C:\SEVIEW63\PBCOLV0.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	1.21E+02			1.70E+03						
Layer 2 (ug/g)	8.61E+01									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1B

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Lead Run 3 DTW 6.5' high solubility sand soil

SESOIL Output File: C:\SEVIEW63\PBR3HSAN.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	4.801E+09	99.01
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	2.414E+05	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	4.801E+09	99.02
Total Input	4.849E+09	
Input - Output	4.774E+07	

Maximum leachate concentration: 0.000E+00 **mg/l**

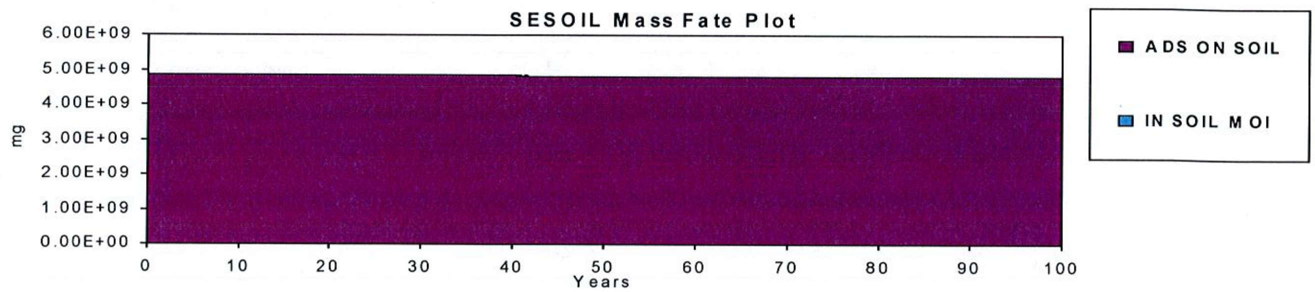
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

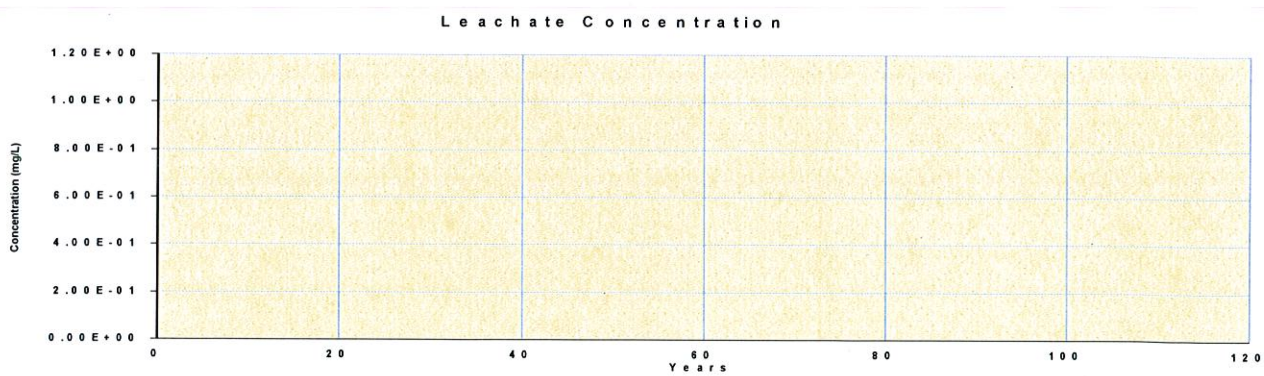
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADHSOL.CHM

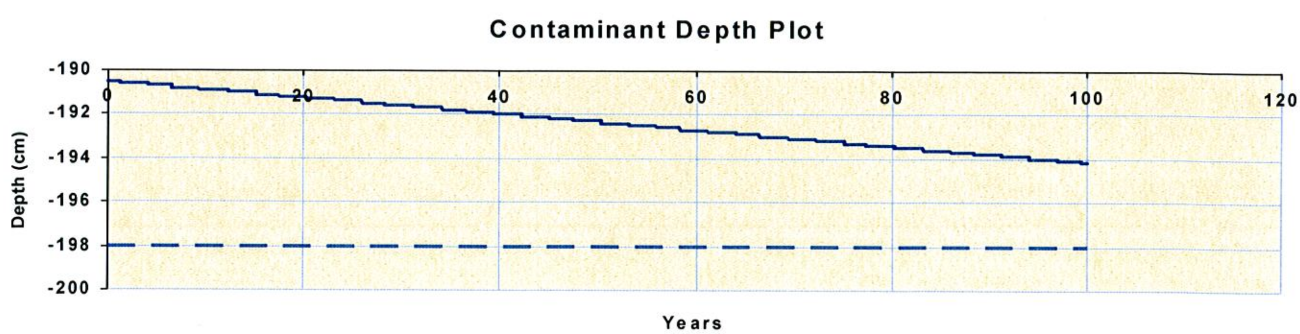
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Lead Column DTW 6.5' sand
C:\SEVIEW63\PBCOLV0.APL

Starting Depth: 190.50 **cm**
Ending Depth: 194.20 **cm**
Total Depth: 198.20 **cm**







MODEL RUN 1C
SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	6	183.0	6.00	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	15.2	0.50	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

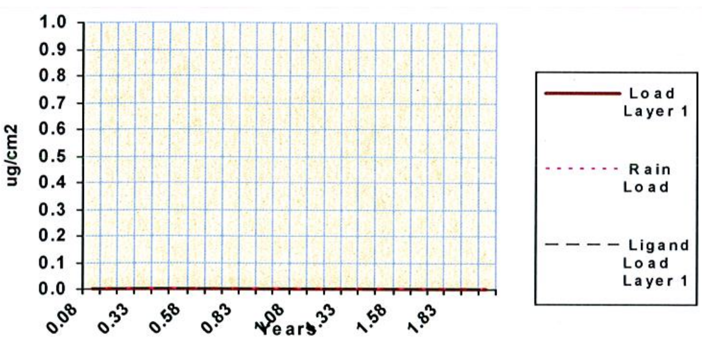
Area	cm^2	8.54E+6
	ft^2	9192.38
Latitude	degrees	41.0
Spill Index		1

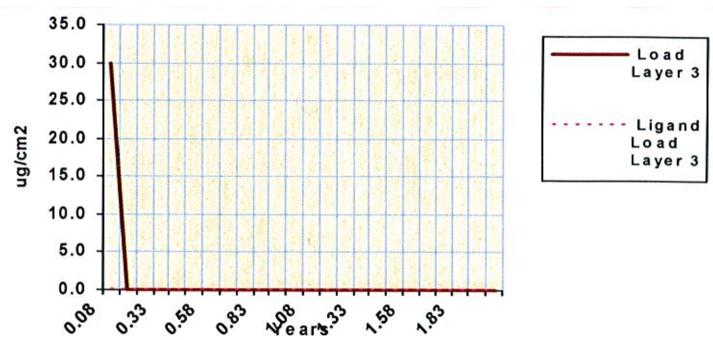
Chemical Parameters

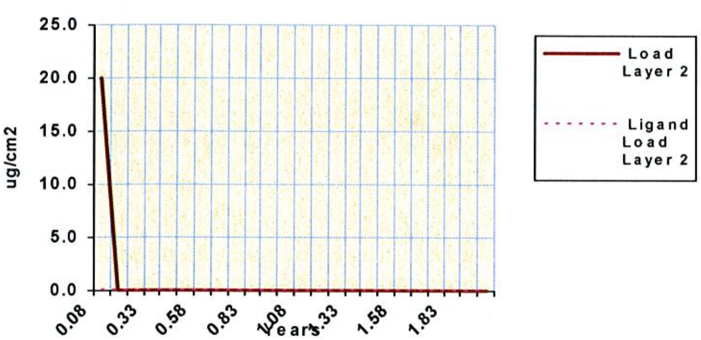
Water Solubility (µg/mL)	9.58E+3	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3atm/mol)	0.00	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	207.00		

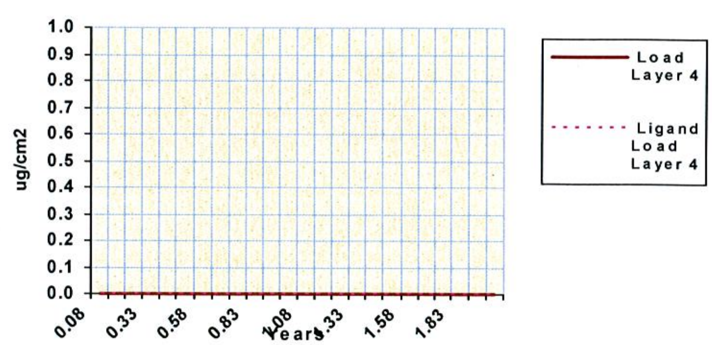
Output File: Dupont Lead DTW 6.5' sand soil loc id 333-355 default sol
C:\SEVIEW63\PB333355.OUT
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADANDC.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Lead Column Loc ID 333-355 sand DTW 6.5'
C:\SEVIEW63\PB333355.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	1.00E+04			9.50E+04						
Layer 2 (ug/g)	3.90E+03									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1C

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Lead DTW 6.5' sand soil loc id 333-355 default sol

SESOIL Output File: C:\SEVIEW63\PB333355.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	4.151E+13	99.40
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	2.087E+09	0.01
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	4.151E+13	99.41
Total Input	4.176E+13	
Input - Output	2.468E+11	

Maximum leachate concentration: 0.000E+00 **mg/l**

Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADANDC.CHM

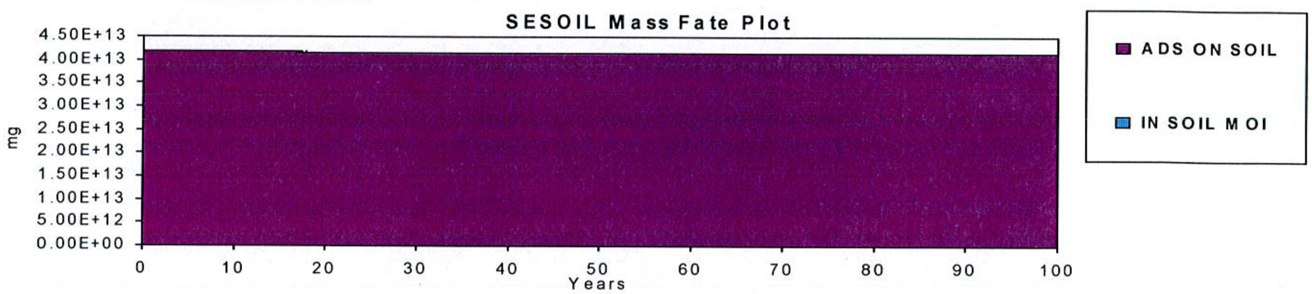
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

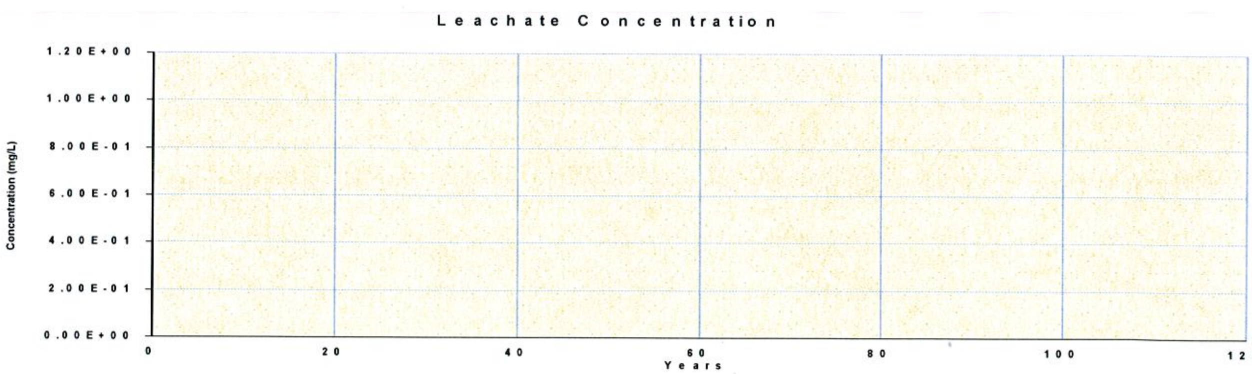
Application File: Dupont Lead Column Loc ID 333-355 sand DTW 6.5'
C:\SEVIEW63\PB333355.APL

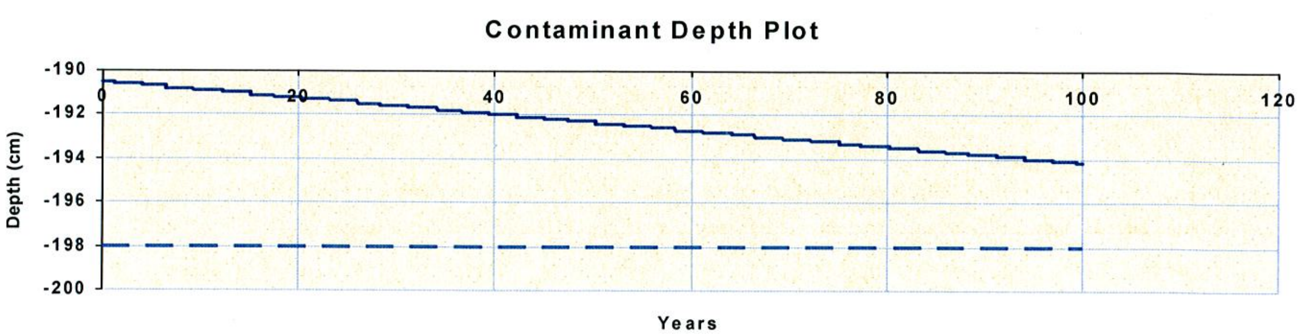
Starting Depth: 190.50 **cm**

Ending Depth: 194.20 **cm**

Total Depth: 198.20 **cm**







MODEL RUN 1D

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	6	183.0	6.00	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	15.2	0.50	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

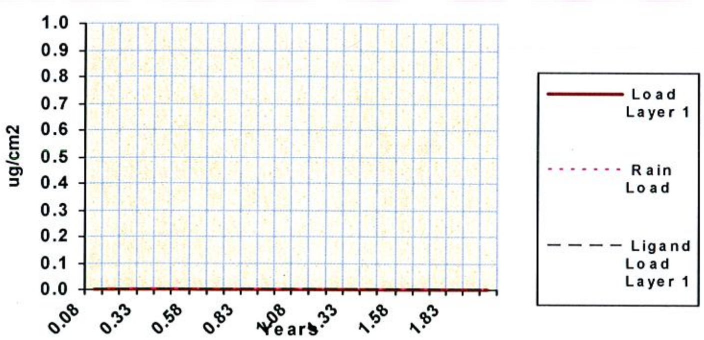
Area	cm^2	8.54E+6
	ft^2	9192.38
Latitude	degrees	41.0
Spill Index		1

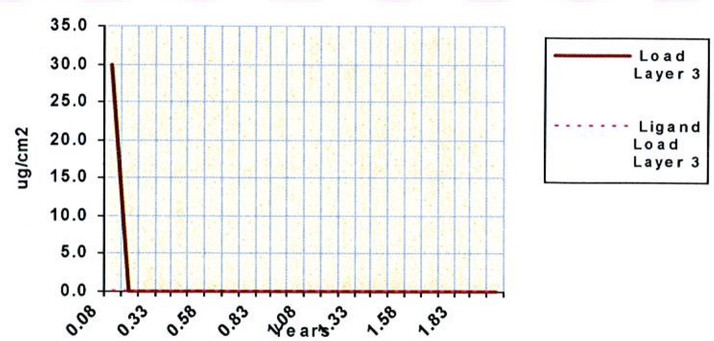
Chemical Parameters

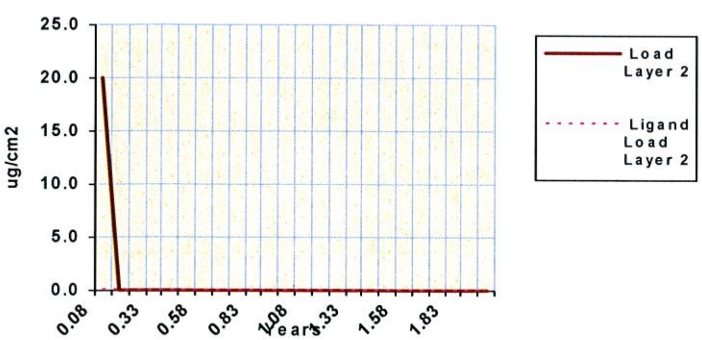
Water Solubility (µg/mL)	1.00E+5	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3atm/mol)	0.00	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	207.00		

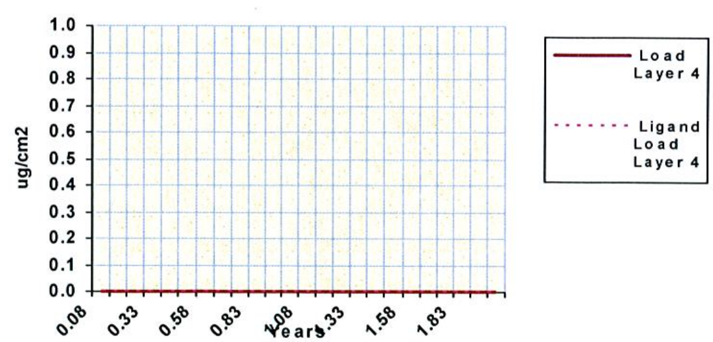
Output File: Dupont Lead DTW 6.5' sand soil loc id 333-355 high solu
C:\SEVIEW63\PB33335H.OUT
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADHSOL.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Lead Column Loc ID 333-355 sand DTW 6.5'
C:\SEVIEW63\PB333355.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	1.00E+04			9.50E+04						
Layer 2 (ug/g)	3.90E+03									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1D

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Lead DTW 6.5' sand soil loc id 333-355 high solu

SESOIL Output File: C:\SEVIEW63\PB33335H.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	4.151E+13	99.40
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	2.087E+09	0.01
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	4.151E+13	99.41
Total Input	4.176E+13	
Input - Output	2.468E+11	

Maximum leachate concentration: 0.000E+00 **mg/l**

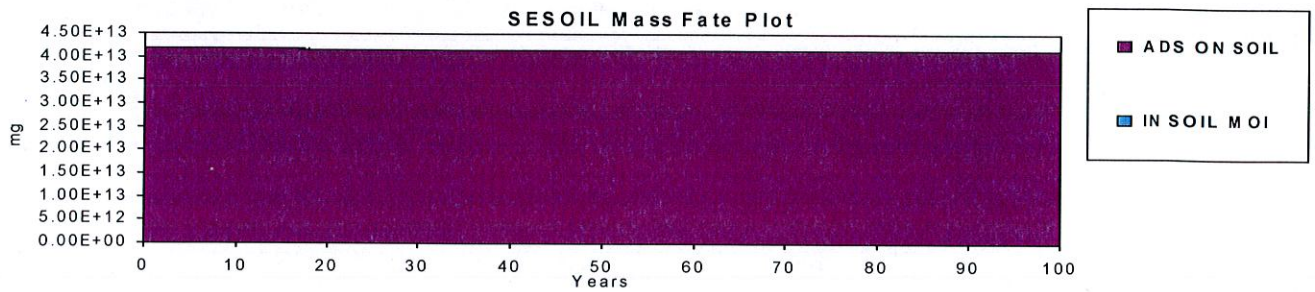
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

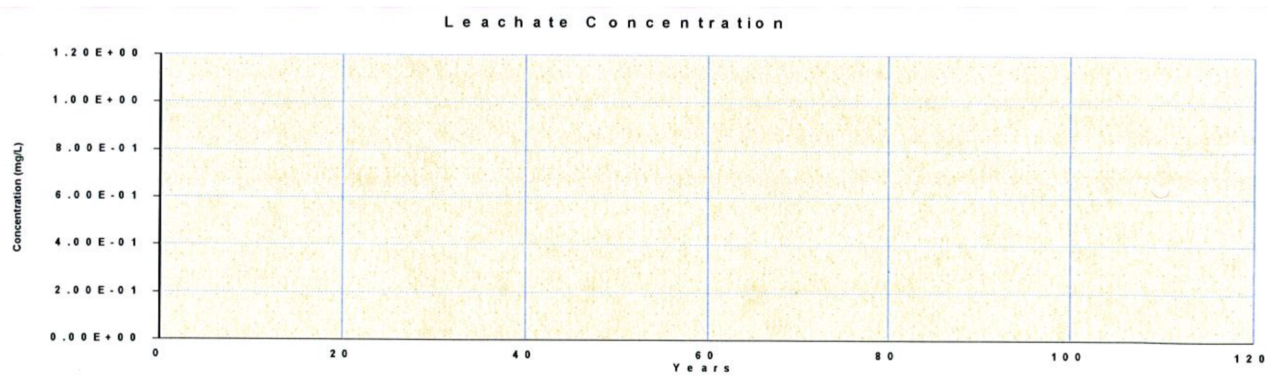
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADHSOL.CHM

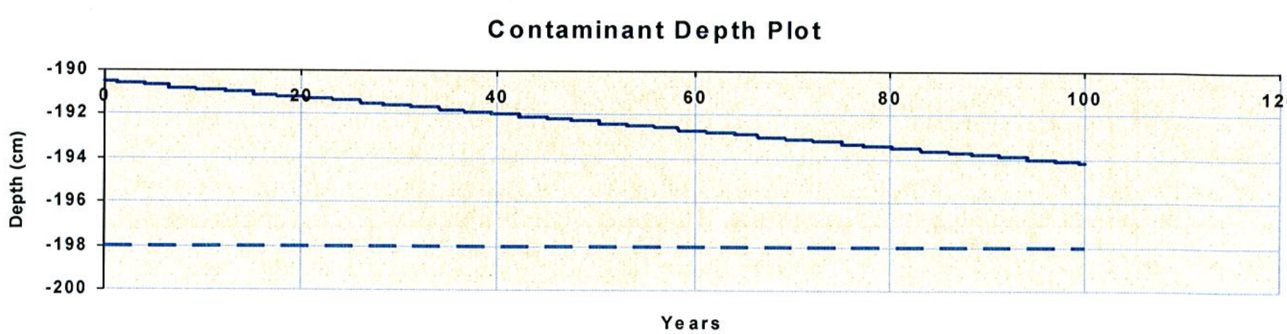
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Lead Column Loc ID 333-355 sand DTW 6.5'
C:\SEVIEW63\PB333355.APL

Starting Depth: 190.50 **cm**
Ending Depth: 194.20 **cm**
Total Depth: 198.20 **cm**







MODEL RUN 1E

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	5	152.0	4.99	1.00E-8	0.20	0.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	6.7	0.22	1.00E-8	0.20	0.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

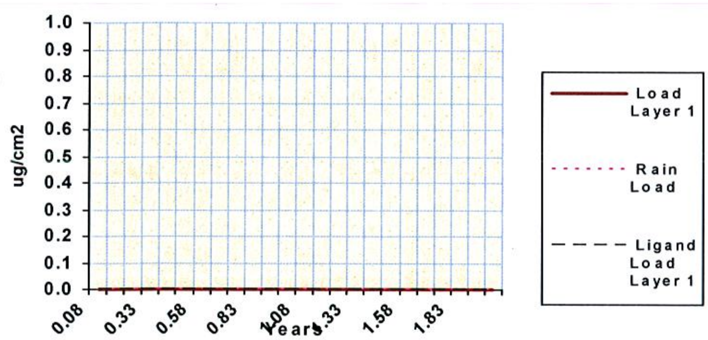
Area	cm^2	3.62E+6
	ft^2	3896.54
Latitude	degrees	41.0
Spill Index		1

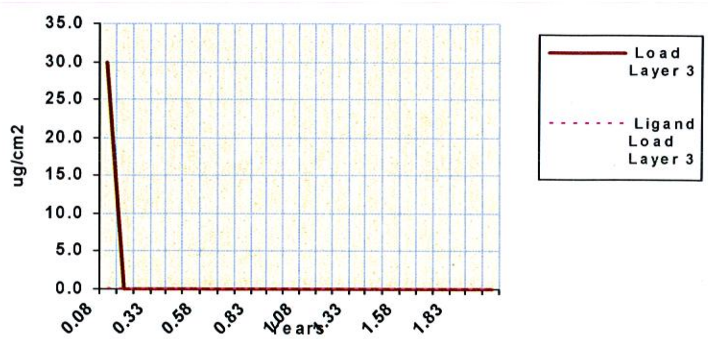
Chemical Parameters

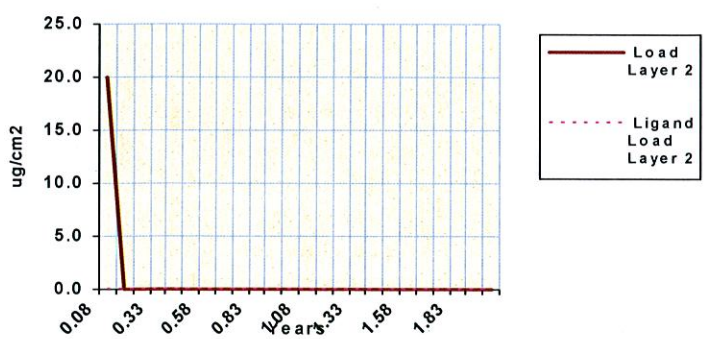
Water Solubility (µg/mL)	.700	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3-atm/mol)	2.60E-3	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	309000	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	1.75E-2	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	8.00E-6	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	326.00		

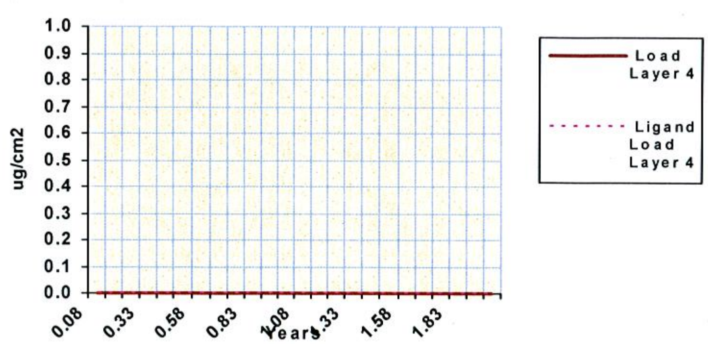
Output File: Dupont Polychlorinated Bipheyls Run 2 sand soil
C:\SEVIEW63\PCBR2SAN.OUT
Chemical File: Polychlorinated biphenyls (summed), NJDEP
C:\SV22213\POLYCHLO.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Polychlorinated Biphenyls Column
C:\SEVIEW63\PCBCOSAN.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	2.60E+00	1.30E+00	4.20E-01							
Layer 2 (ug/g)										
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1E

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Polychlorinated Bipheyls Run 2 sand soil

SESOIL Output File: C:\SEVIEW63\PCBR2SAN.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	1.898E+04	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	7.103E+08	99.34
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	5.203E+04	0.01
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	7.103E+08	99.35
Total Input	7.150E+08	
Input - Output	4.628E+06	

Maximum leachate concentration: 0.000E+00 **mg/l**

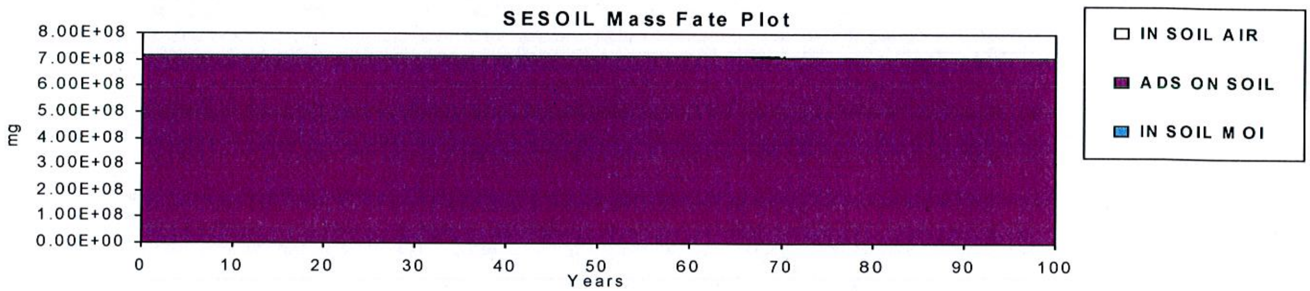
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

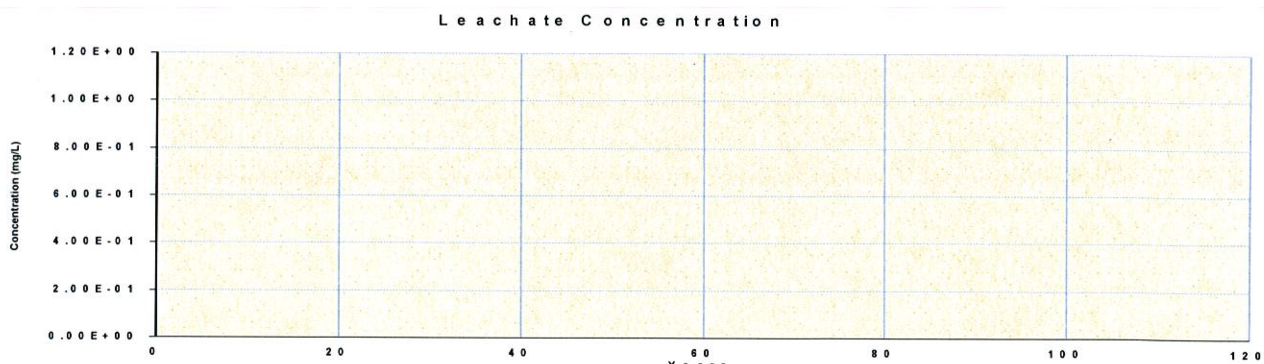
Chemical File: Polychlorinated biphenyls (summed), NJDEP
C:\SV22213\POLYCHLO.CHM

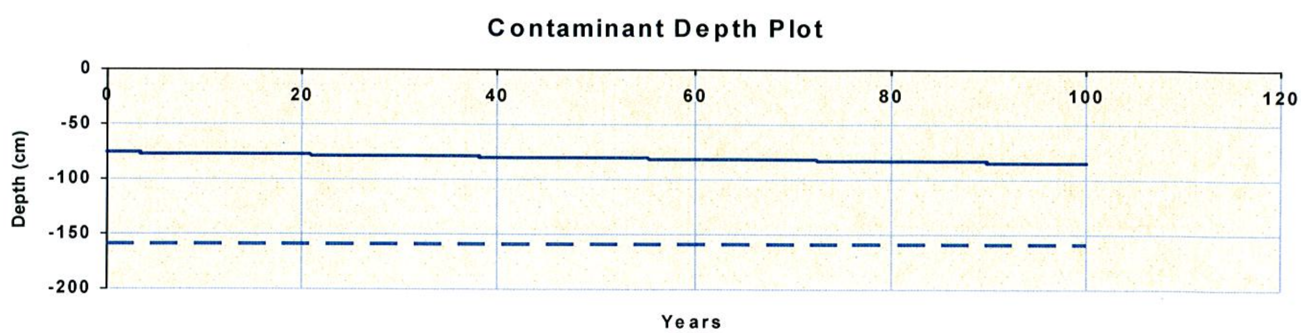
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Polychlorinated Biphenyls Column
C:\SEVIEW63\PCBCOSAN.APL

Starting Depth: 76.21 **cm**
Ending Depth: 84.99 **cm**
Total Depth: 158.71 **cm**







MODEL RUN 1F

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	5	152.0	4.99	1.00E-8	0.20	0.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	6.7	0.22	1.00E-8	0.20	0.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

Area	cm^2	3.62E+6
	ft^2	3896.54
Latitude	degrees	41.0
Spill Index		1

Chemical Parameters

Water Solubility (µg/mL)	.700	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3atm/mol)	2.60E-3	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	309000	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	1.75E-2	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	8.00E-6	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	326.00		

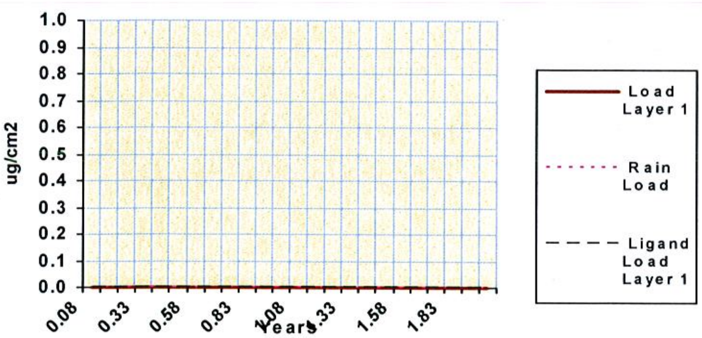
Output File: Dupont PCB Run DTW 5.22' sand soil loc id 333-121D
C:\SEVIEW63\PCB33212.OUT

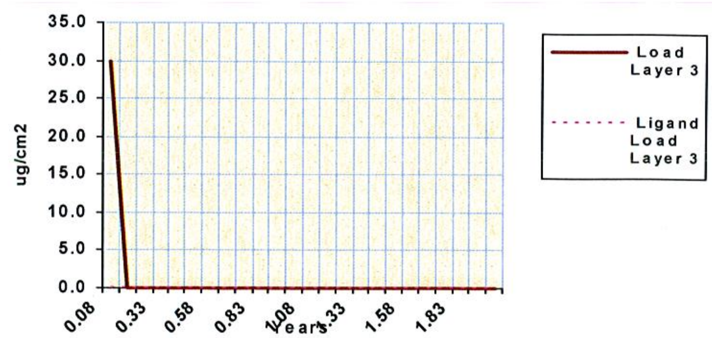
Chemical File: Polychlorinated biphenyls (summed), NJDEP
C:\SV22213\POLYCHLO.CHM

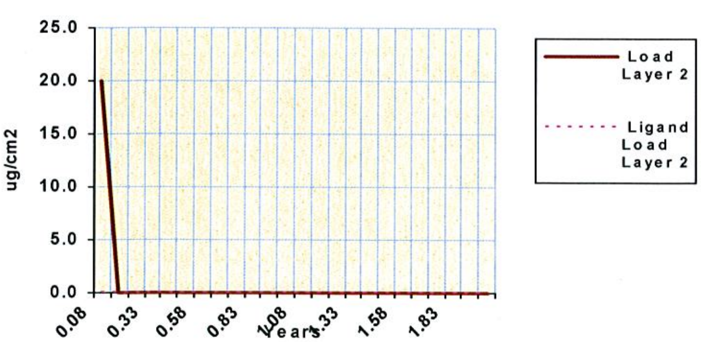
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

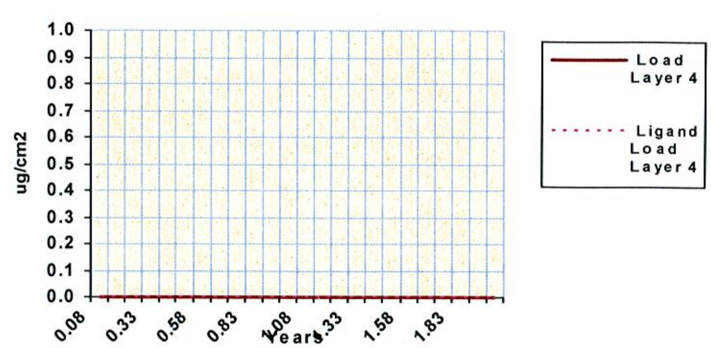
Application File: Dupont Polychlorinated Biphenyls Column 332-121D
C:\SEVIEW63\PCB33212.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	1.00E+02	1.38E+00	4.20E-01							
Layer 2 (ug/g)										
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1F

SESOIL Pollutant Cycle Report

Scenario Description: Dupont PCB Run DTW 5.22' sand soil loc id 333-121D

SESOIL Output File: C:\SEVIEW63\PCB33212.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	4.447E+05	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	1.664E+10	98.77
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	1.219E+06	0.01
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	1.664E+10	98.78
Total Input	1.685E+10	
Input - Output	2.050E+08	

Maximum leachate concentration: 0.000E+00 **mg/l**

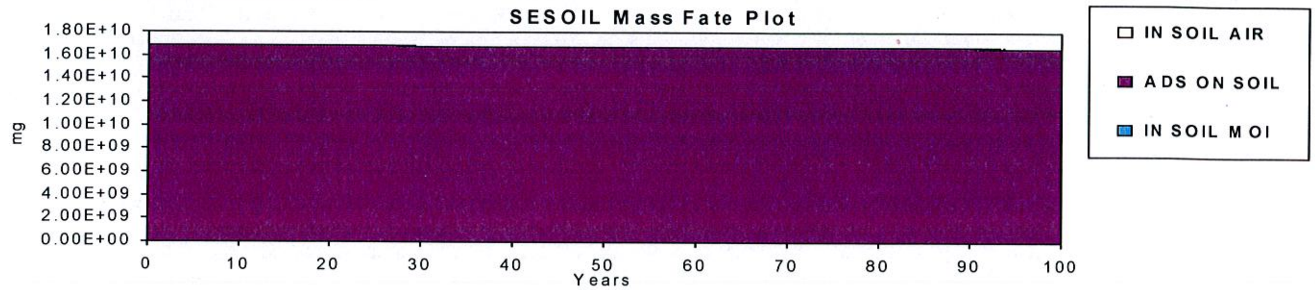
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

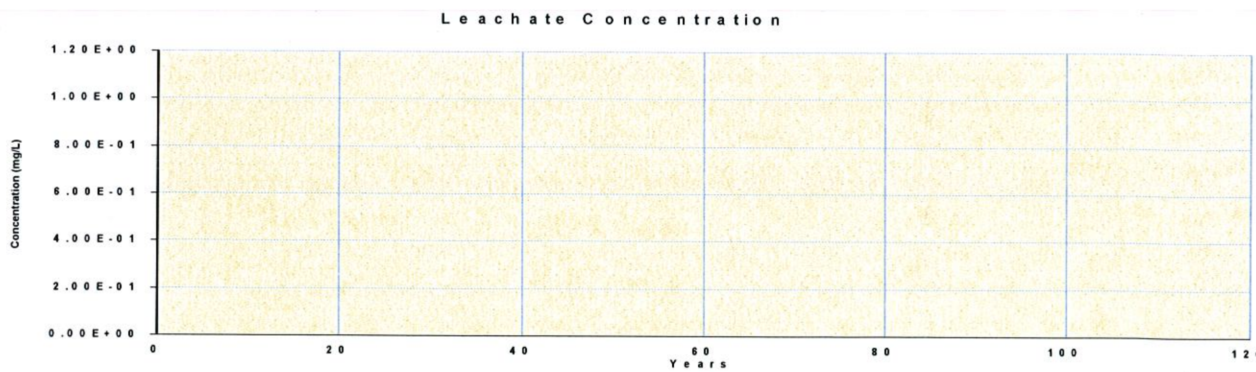
Chemical File: Polychlorinated biphenyls (summed), NJDEP
C:\SV22213\POLYCHLO.CHM

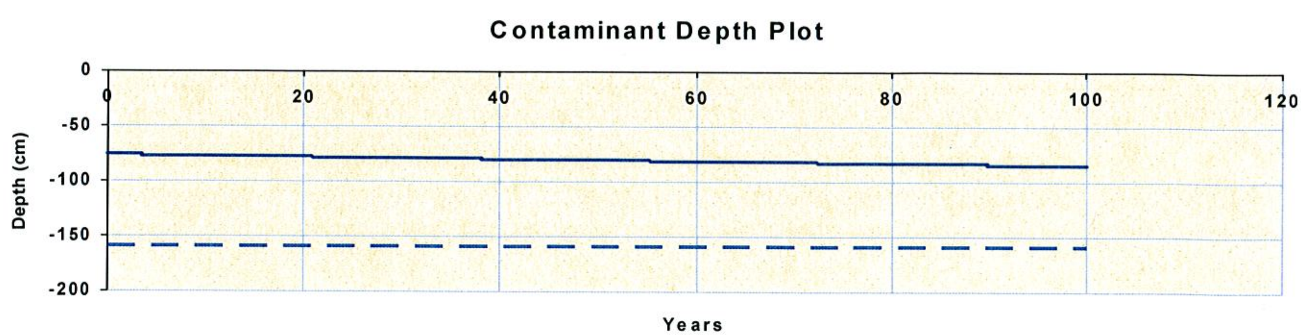
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Polychlorinated Biphenyls Column 332-121D
C:\SEVIEW63\PCB33212.APL

Starting Depth: 76.21 **cm**
Ending Depth: 84.99 **cm**
Total Depth: 158.71 **cm**







MODEL RUN 1G

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	7	213.0	6.99	1.00E-8	0.20	0.20	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	15.2	0.50	1.00E-8	0.20	0.20	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

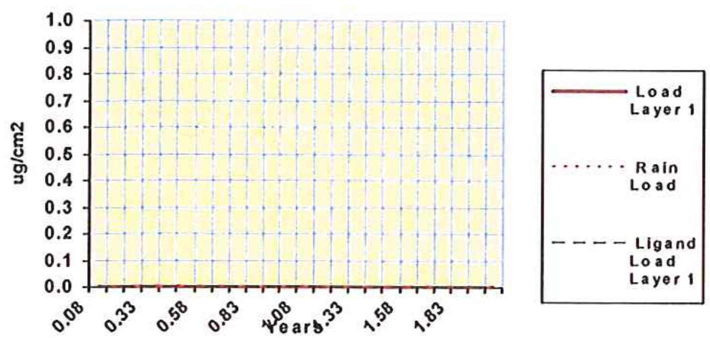
Area	cm^2	4.93E+4
	ft^2	53.07
Latitude	degrees	41.0
Spill Index		1

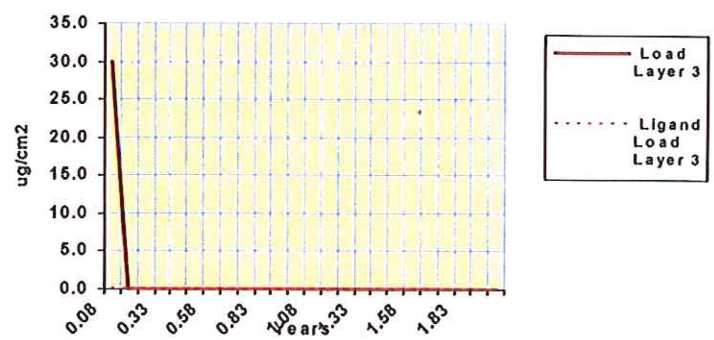
Chemical Parameters

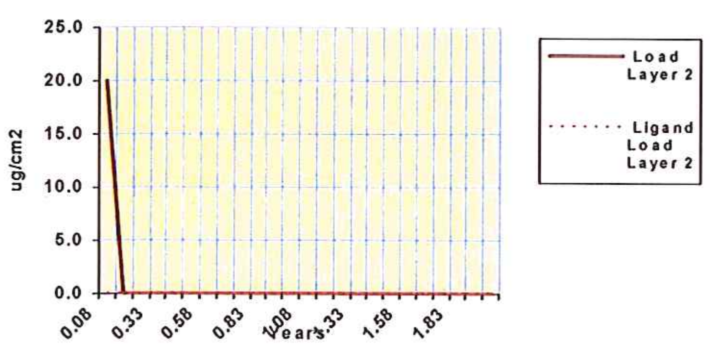
Water Solubility (µg/mL)	6.00E-2	Moles Ligand / Moles Chemical	0.00
Henry's Law (M^3atm/mol)	0.00	Ligand Molecular Weight (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	Base Hydrolysis Rate (L/mol/day)	0.00
Valance (g/mole)	0.00	Ligand Dissociation Constant	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00	Neutral Hydrolysis Rate (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00	Acid Hydrolysis Rate (L/mol/day)	0.00
Molecular Weight (g/mol)	201.00		

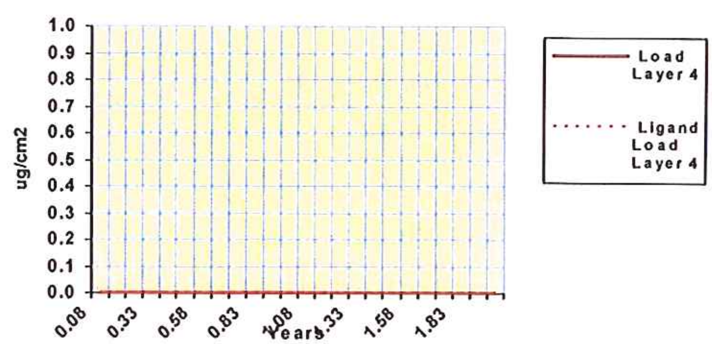
Output File: Dupont Mercury Run 3 DTW 7.5' default solubility sand soil
C:\SEVIEW63\HGR3DSAN.OUT
Chemical File: Mercury (NJDEP Kd)
C:\SV22213\MERCURYG.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Mercury Column DTW 7.5'
C:\SEVIEW63\HGCO75SD.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	5.12E+02	2.50E+03		6.00E+01			1.08E+02			
Layer 2 (ug/g)	2.51E+00									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1G

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Mercury Run 3 DTW 7.5' default solubility sand soil

SESOIL Output File: C:\SEVIEW63\HGR3DSAN.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	2.028E+05	0.00
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	7.152E+09	99.75
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	4.590E+04	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	1.406E+07	0.20
Total Output	7.167E+09	99.95
Total Input	7.171E+09	
Input - Output	3.705E+06	

Maximum leachate concentration: 5.999E-02 **mg/l**

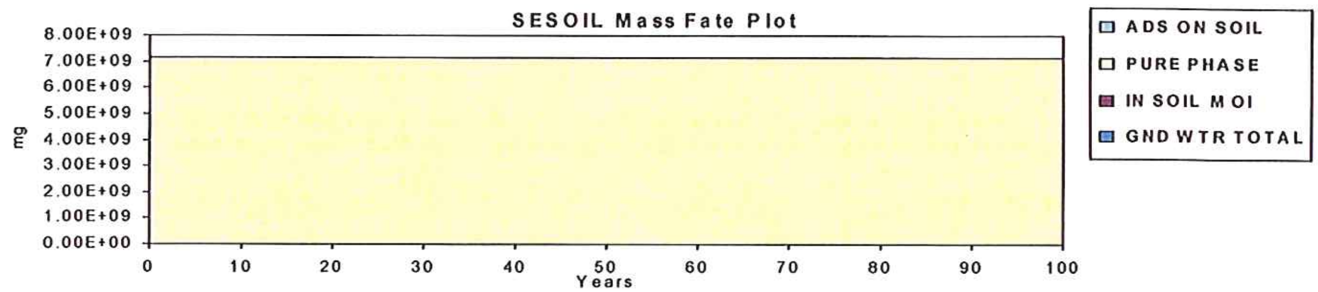
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

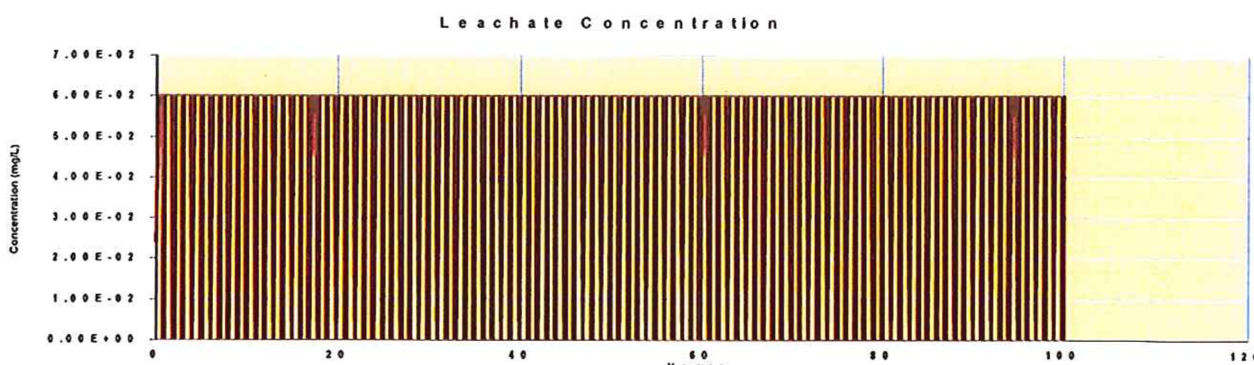
Chemical File: Mercury (NJDEP Kd)
C:\SV22213\MERCURYG.CHM

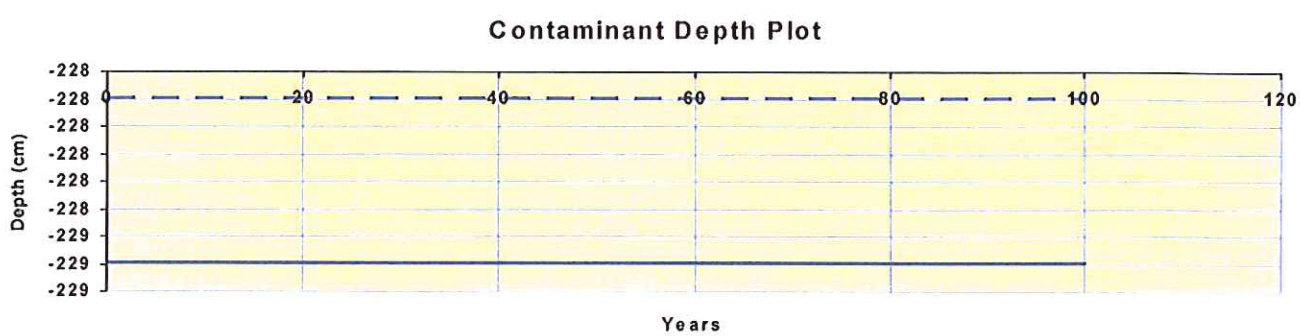
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Mercury Column DTW 7.5'
C:\SEVIEW63\HGCO75SD.APL

Starting Depth: 228.60 **cm**
Ending Depth: 228.60 **cm**
Total Depth: 228.20 **cm**







MODEL RUN 1H

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm 2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	7	213.0	6.99	1.00E-8	0.20	0.20	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	15.2	0.50	1.00E-8	0.20	0.20	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

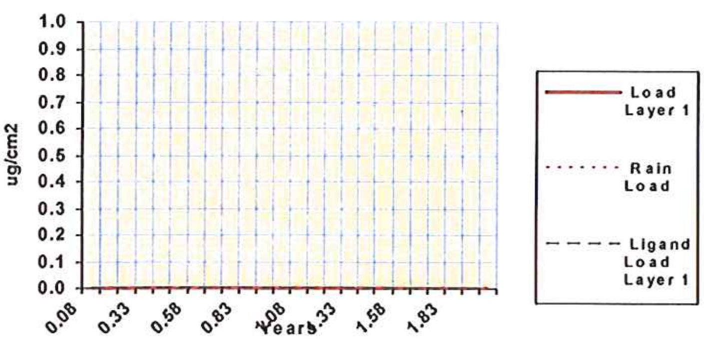
Area	cm 2	4.93E+4
	ft 2	53.07
Latitude	degrees	41.0
Spill Index		1

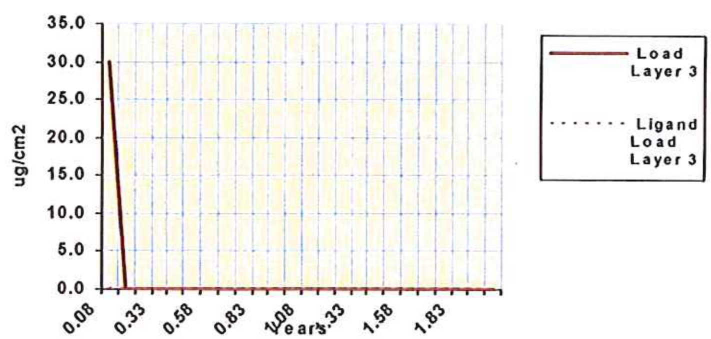
Chemical Parameters

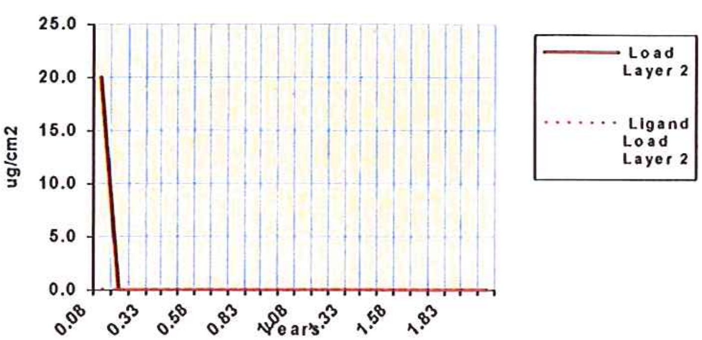
Water Solubility (µg/mL)	1.00E+5	Moles Ligand / Moles Chemical	0.00
Henry's Law (M3-atm/mol)	0.00	Ligand Molecular Weight (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	Base Hydrolysis Rate (L/mol/day)	0.00
Valance (g/mole)	0.00	Ligand Dissociation Constant	0.00
Air Diffusion Coefficient (cm2/sec)	0.00	Neutral Hydrolysis Rate (L/mol/day)	0.00
Water Diffusion Coefficient (cm2/sec)	0.00	Acid Hydrolysis Rate (L/mol/day)	0.00
Molecular Weight (g/mol)	201.00		

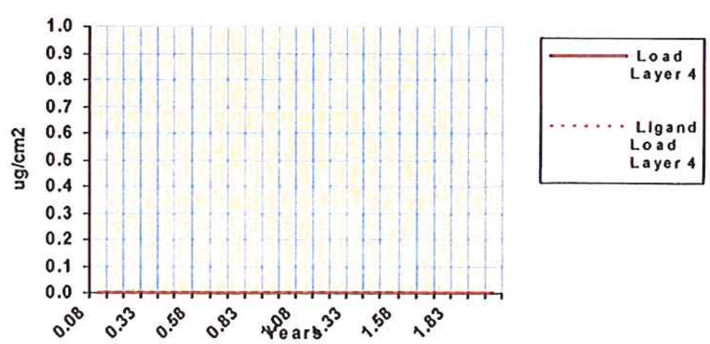
Output File: Dupont Mercury Run 3 DTW 7.5' high solubility sand soil
C:\SEVIEW63\HGR3HSAN.OUT
Chemical File: Mercury (NJDEP Kd)
C:\SV22213\MERCURYG.CHM
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Mercury Column DTW 7.5'
C:\SEVIEW63\HGCO75SD.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	5.12E+02	2.50E+03		6.00E+01			1.08E+02			
Layer 2 (ug/g)	2.51E+00									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 1H

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Mercury Run 3 DTW 7.5' high solubility sand soil

SESOIL Output File: C:\SEVIEW63\HGR3HSAN.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	9.690E-02	0.00
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	2.193E-02	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	7.170E+09	99.99
Total Output	7.170E+09	99.99
Total Input	7.171E+09	
Input - Output	8.783E+05	

Maximum leachate concentration: 4.051E+03 **mg/l**

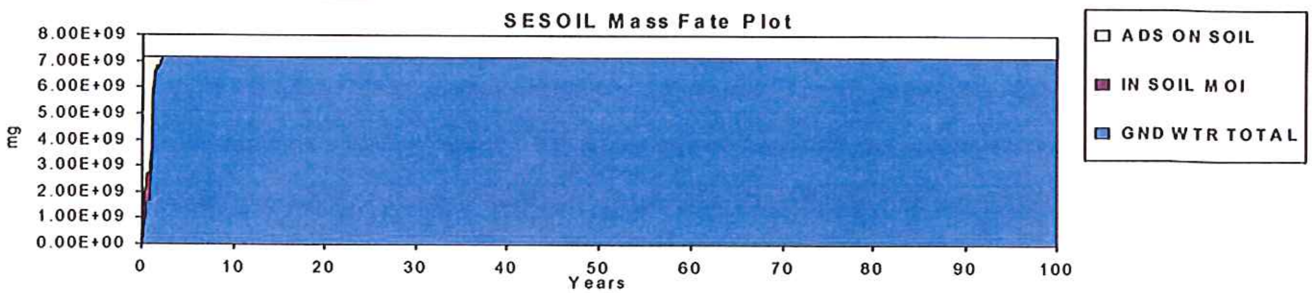
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

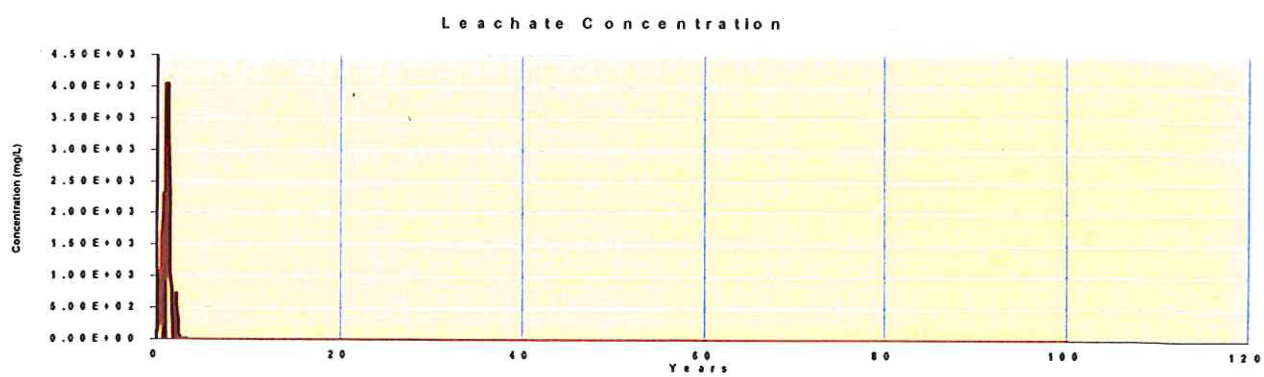
Chemical File: Mercury (NJDEP Kd)
C:\SV22213\MERCURYG.CHM

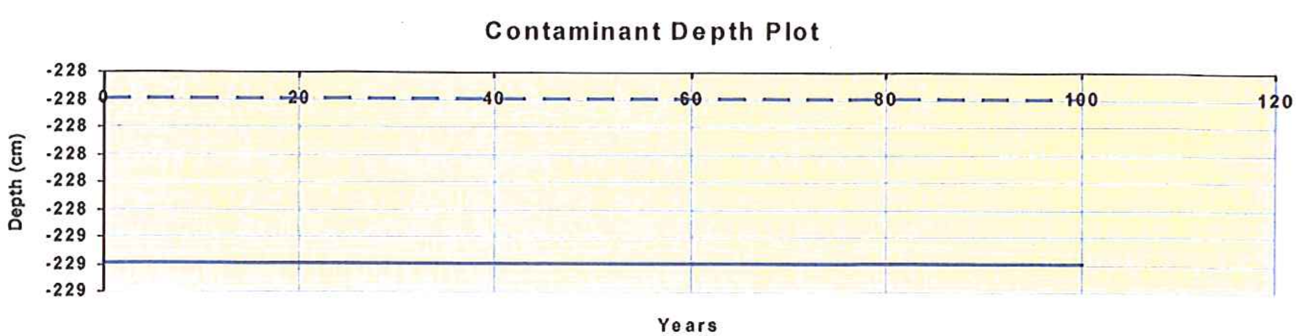
Soil File: Sand, Intr Perm = 1.0E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Mercury Column DTW 7.5'
C:\SEVIEW63\HGCO75SD.APL

Starting Depth: 228.60 **cm**
Ending Depth: 228.60 **cm**
Total Depth: 228.20 **cm**







MODEL RUN 2A

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	5	152.0	4.99	1.00E-8	0.20	322.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	2.1	0.07	1.00E-8	0.20	322.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

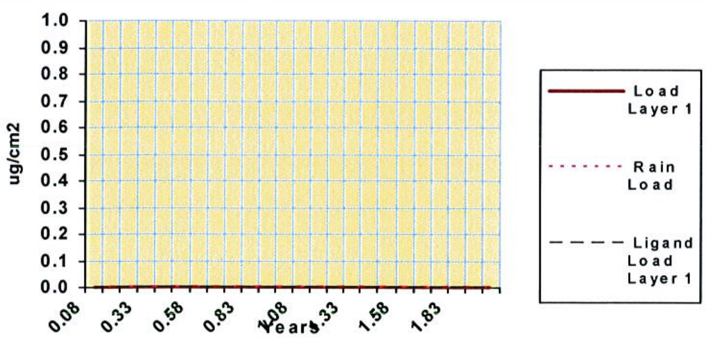
Area	cm^2	3.34E+6
	ft^2	3595.15
Latitude	degrees	41.0
Spill Index		1

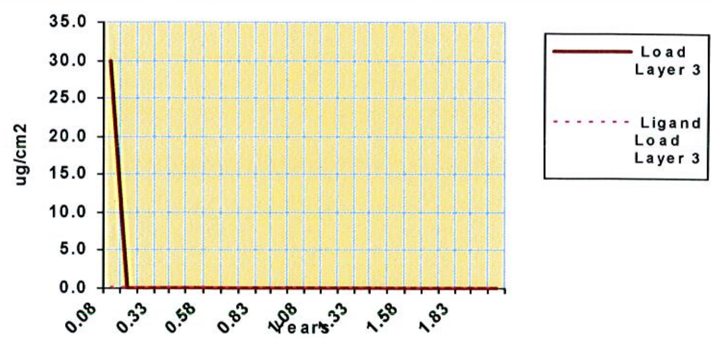
Chemical Parameters

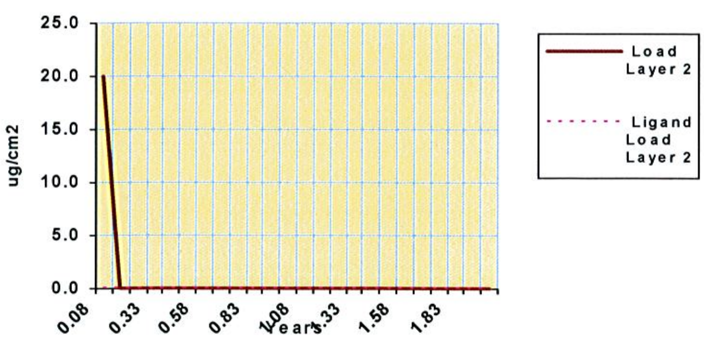
Water Solubility (µg/mL)	6.00E-2	Moles Ligand / Moles Chemical	0.00
Henry's Law (M^3atm/mol)	0.00	Ligand Molecular Weight (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	Base Hydrolysis Rate (L/mol/day)	0.00
Valance (g/mole)	0.00	Ligand Dissociation Constant	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00	Neutral Hydrolysis Rate (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00	Acid Hydrolysis Rate (L/mol/day)	0.00
Molecular Weight (g/mol)	201.00		

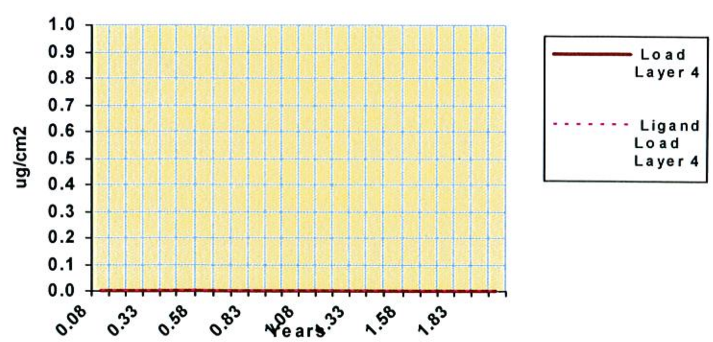
Output File: Dupont Low Mercury Run 322 L/kg Kd
C:\SEVIEW63\HG41813F.OUT
Chemical File: Mercury (elemental) (Kd)
C:\SEVIEW63\MERCURYF.CHM
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Mercury Column DTW 5.07'
C:\SEVIEW63\HG041213.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	6.94E+01	5.00E+01	1.28E-01							
Layer 2 (ug/g)										
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 2A

SESOIL Pollutant Cycle Report

Scenario Description: Dupont Low Mercury Run 322 L/kg Kd

SESOIL Output File: C:\SEVIEW63\HG41813F.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	7.805E+09	42.77
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	1.043E+10	57.19
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	1.097E+06	0.01
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	1.824E+10	99.97
Total Input	1.825E+10	
Input - Output	6.142E+06	

Maximum leachate concentration: 0.000E+00 **mg/l**

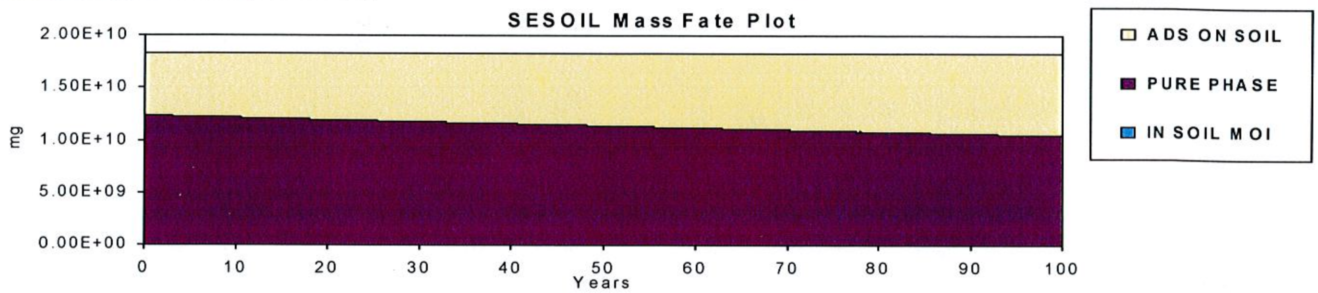
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

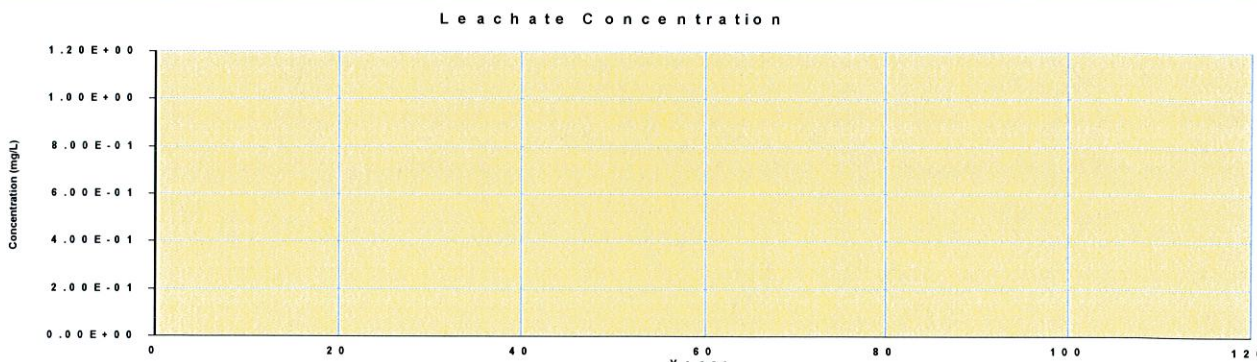
Chemical File: Mercury (elemental) (Kd)
C:\SEVIEW63\MERCURYF.CHM

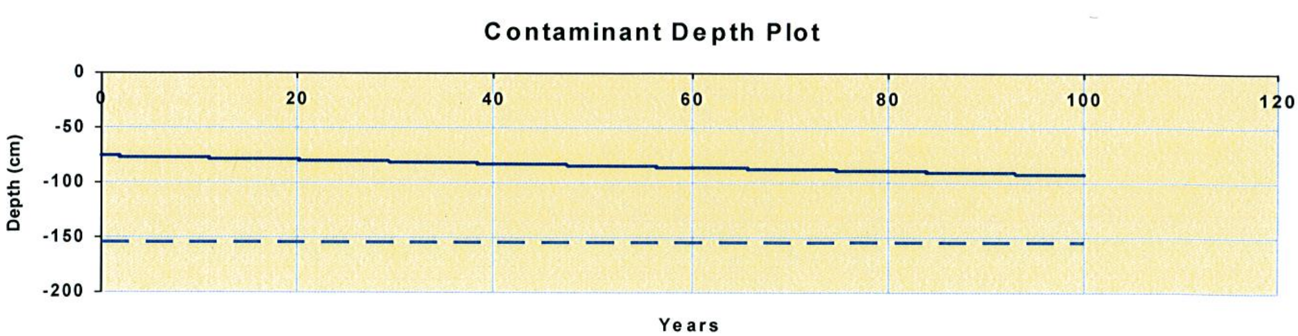
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Mercury Column DTW 5.07'
C:\SEVIEW63\HG041213.APL

Starting Depth: 76.21 **cm**
Ending Depth: 92.82 **cm**
Total Depth: 154.13 **cm**







MODEL RUN 2B

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	5	152.0	4.99	1.00E-8	0.20	322.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	2.1	0.07	1.00E-8	0.20	322.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

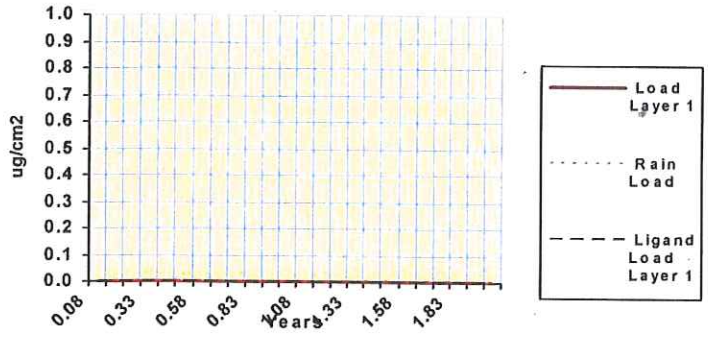
Area	cm^2	3.34E+6
	ft^2	3595.15
Latitude	degrees	41.0
Spill Index		1

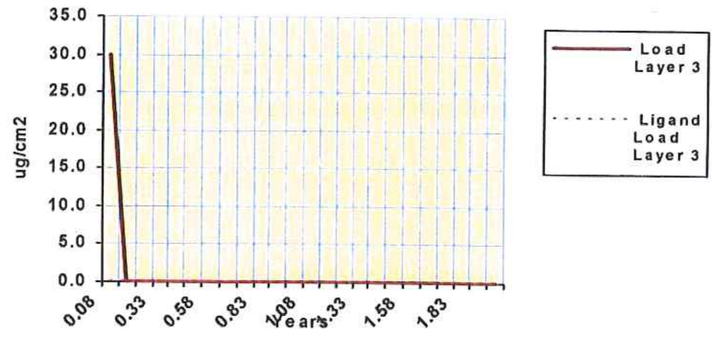
Chemical Parameters

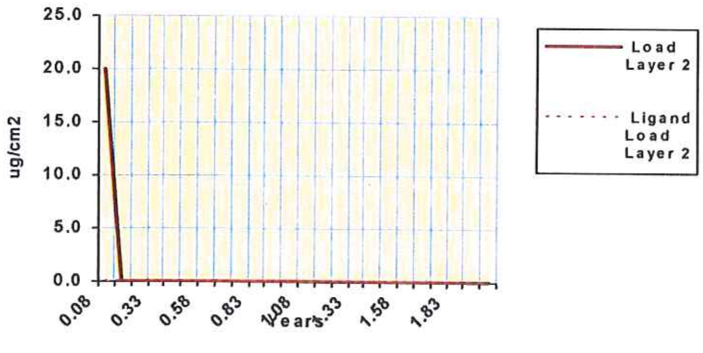
Water Solubility (µg/mL)	6.00E-2	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3-atm/mol)	0.00	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	201.00		

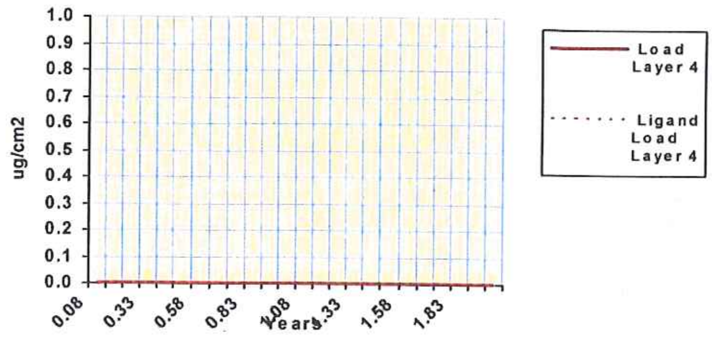
Output File: Dupont 322 kd 0.06
C:\SEVIEW63\HG322KDE.OUT
Chemical File: Mercury (NJDEP Kd)
C:\SV22213\MERCURYG.CHM
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont Mercury Column DTW 5.07'
C:\SEVIEW63\HGCO75SD.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	5.12E+02	2.50E+03		6.00E+01						
Layer 2 (ug/g)	2.51E+00									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 2B

SESOIL Pollutant Cycle Report

Scenario Description: Dupont 322 kd 0.06

SESOIL Output File: C:\SEVIEW63\HG322KDE.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	1.145E+10	2.44
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	4.572E+11	97.48
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	1.610E+06	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	1.521E+08	0.03
Total Output	4.689E+11	99.96
Total Input	4.691E+11	
Input - Output	1.986E+08	

Maximum leachate concentration: 1.817E-02 **mg/l**

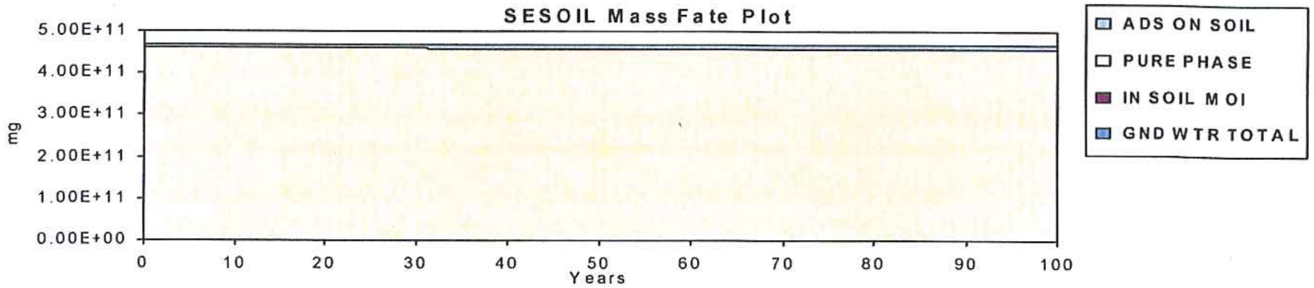
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

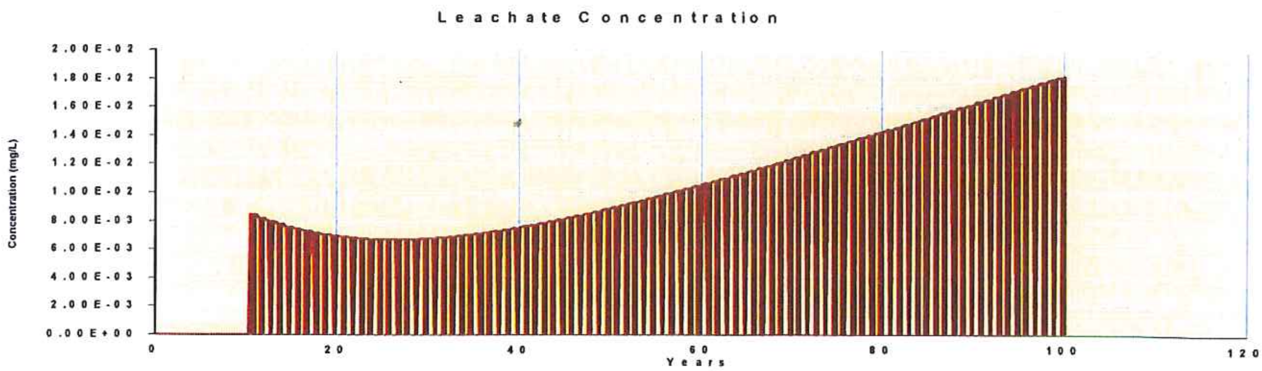
Chemical File: Mercury (NJDEP Kd)
C:\SV22213\MERCURYG.CHM

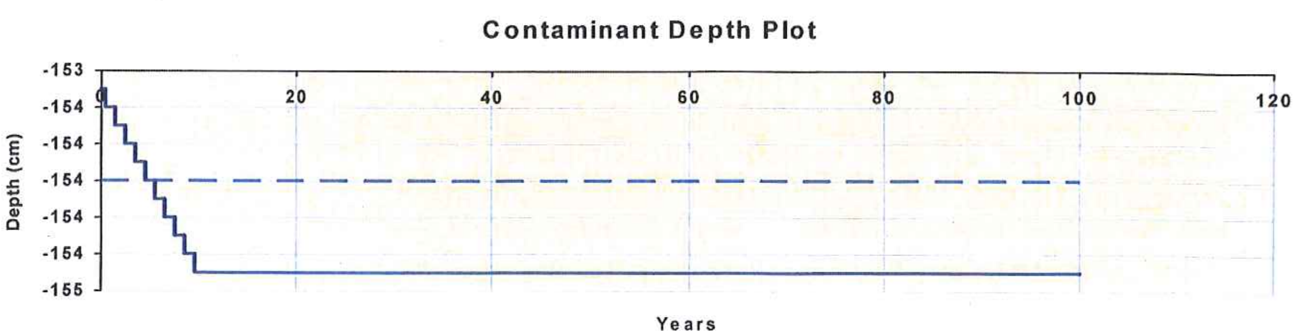
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont Mercury Column DTW 5.07'
C:\SEVIEW63\HGCO75SD.APL

Starting Depth: 153.50 **cm**
Ending Depth: 154.50 **cm**
Total Depth: 154.13 **cm**







MODEL RUN 2C

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	4	122.0	4.00	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	19.2	0.63	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

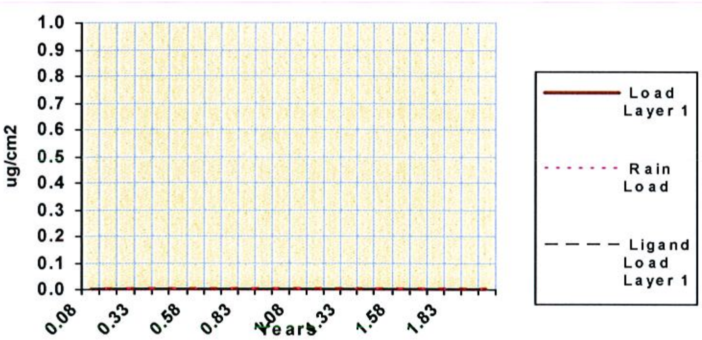
Area	cm^2	8.54E+6
	ft^2	9192.38
Latitude	degrees	41.0
Spill Index		1

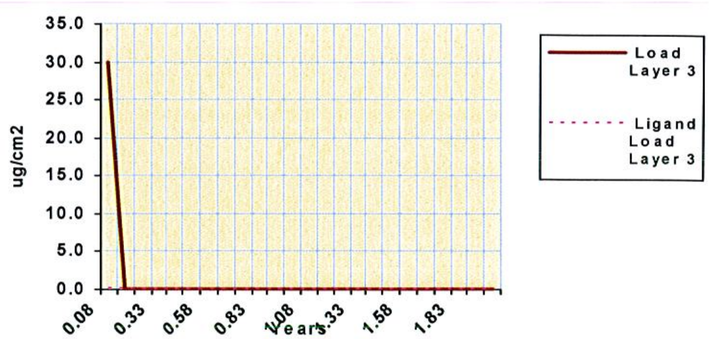
Chemical Parameters

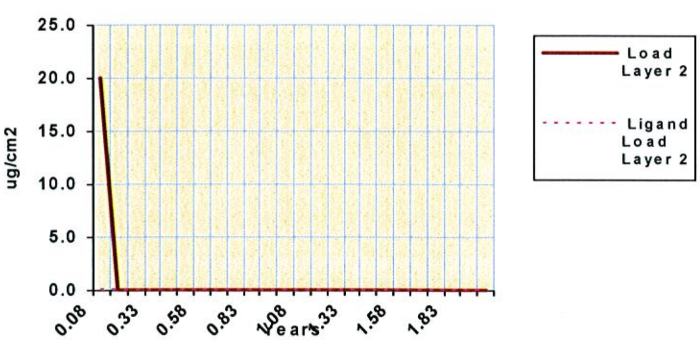
Water Solubility (µg/mL)	9.58E+3	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3atm/mol)	0.00	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	207.00		

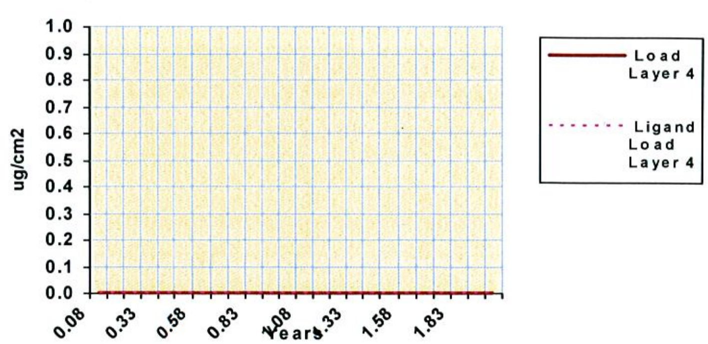
Output File: Dupont 9581 mg/L solubility DTW 4.63'
C:\SEVIEW63\PB041213.OUT
Chemical File: Lead And Compounds (Kd)
C:\SEVIEW63\LEADANDC.CHM
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: AOC 18-19 Pb DTW 4.63
C:\SEVIEW63\PB4-63RU.APL

Sublayer Loads	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Layer 1 (ug/g)	5.30E+04	1.30E+05	6.00E+03	9.50E+04						
Layer 2 (ug/g)	5.30E+04									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 2C

SESOIL Pollutant Cycle Report

Scenario Description: Dupont 9581 mg/L solubility DTW 4.63'

SESOIL Output File: C:\SEVIEW63\PB041213.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	1.228E+14	99.16
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	6.178E+09	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	1.228E+14	99.17
Total Input	1.239E+14	
Input - Output	1.033E+12	

Maximum leachate concentration: 0.000E+00 **mg/l**

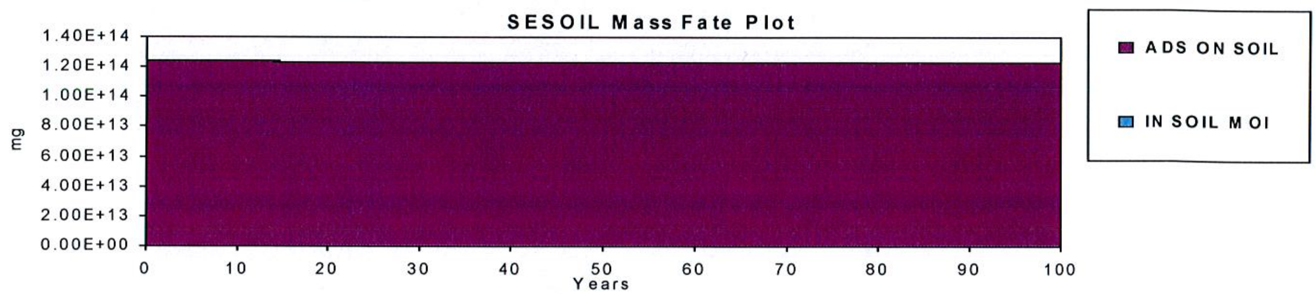
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

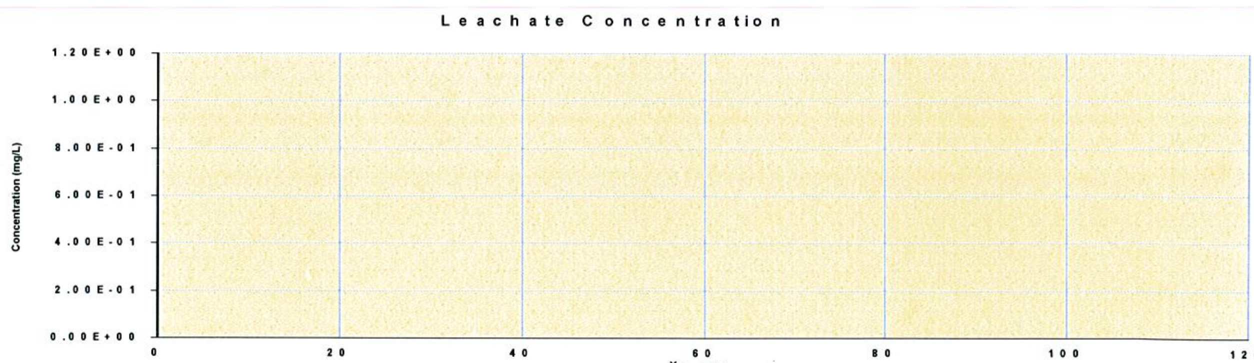
Chemical File: Lead And Compounds (Kd)
C:\SEVIEW63\LEADANDC.CHM

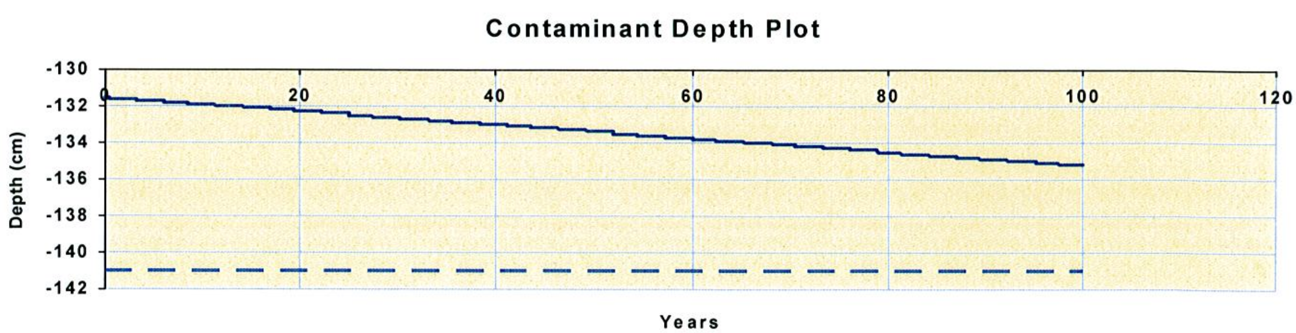
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: AOC 18-19 Pb DTW 4.63
C:\SEVIEW63\PB4-63RU.APL

Starting Depth: 131.50 **cm**
Ending Depth: 135.20 **cm**
Total Depth: 141.20 **cm**







MODEL RUN 2D

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	4	122.0	4.00	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	19.2	0.63	1.00E-8	0.20	900.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density	(g/cm^3)	1.50
Effective Porosity	(fraction)	0.30
Soil Pore Disconnectedness		3.70

Application Parameters

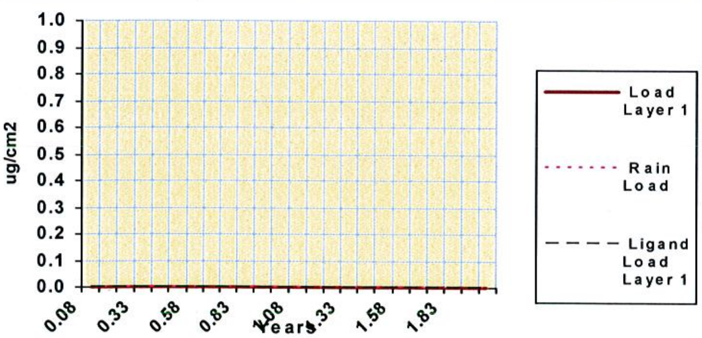
Area	cm^2	8.54E+6
	ft^2	9192.38
Latitude	degrees	41.0
Spill Index		1

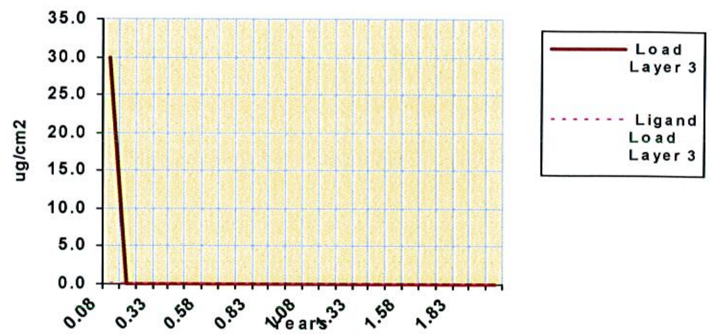
Chemical Parameters

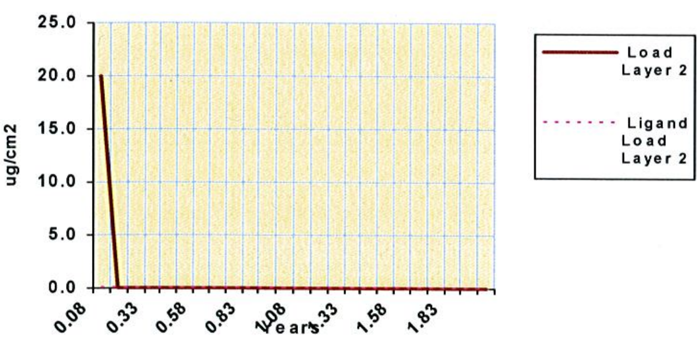
Water Solubility (µg/mL)	1.00E+5		Moles Ligand / Moles Chemical	0.00
Henry's Law (M^3atm/mol)	0.00		Ligand Molecular Weight (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	0.00		Base Hydrolysis Rate (L/mol/day)	0.00
Valance (g/mole)	0.00		Ligand Dissociation Constant	0.00
Air Diffusion Coefficient (cm^2/sec)	0.00		Neutral Hydrolysis Rate (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	0.00		Acid Hydrolysis Rate (L/mol/day)	0.00
Molecular Weight (g/mol)	207.00			

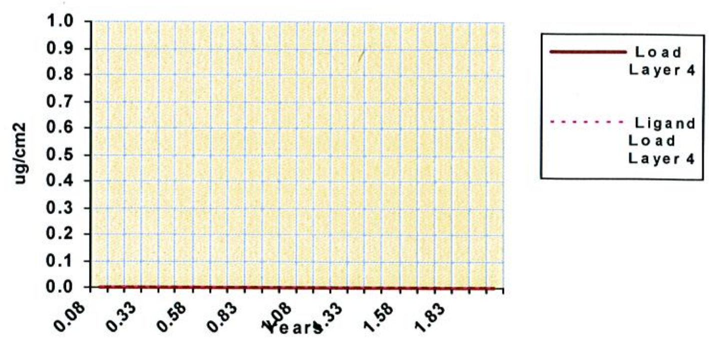
Output File:
C:\SEVIEW63\PB411132.OUT
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADHSOL.CHM
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: AOC 18-19 Pb DTW 4.63
C:\SEVIEW63\PB4-63RU.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	5.30E+04	1.30E+05	6.00E+03	9.50E+04						
Layer 2 (ug/g)	5.30E+04									
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 2D

SESOIL Pollutant Cycle Report

Scenario Description:

SESOIL Output File: C:\SEVIEW63\PB411132.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	0.000E+00	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	1.228E+14	99.16
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	6.178E+09	0.00
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	1.228E+14	99.17
Total Input	1.239E+14	
Input - Output	1.033E+12	

Maximum leachate concentration: 0.000E+00 **mg/l**

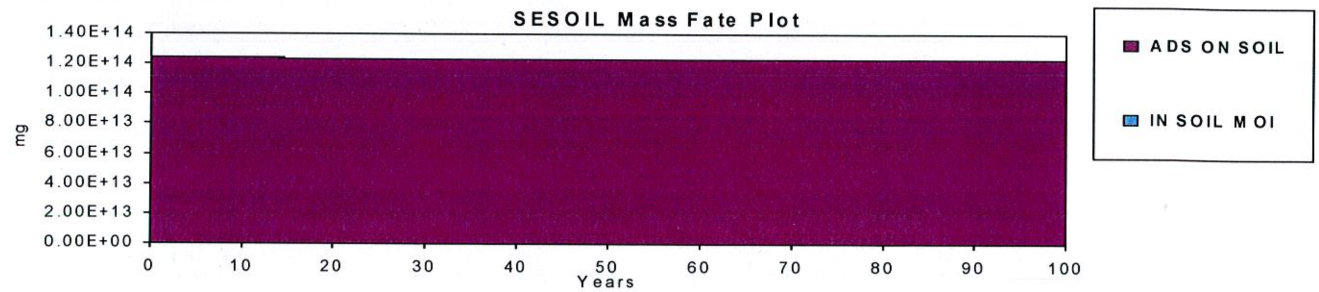
Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

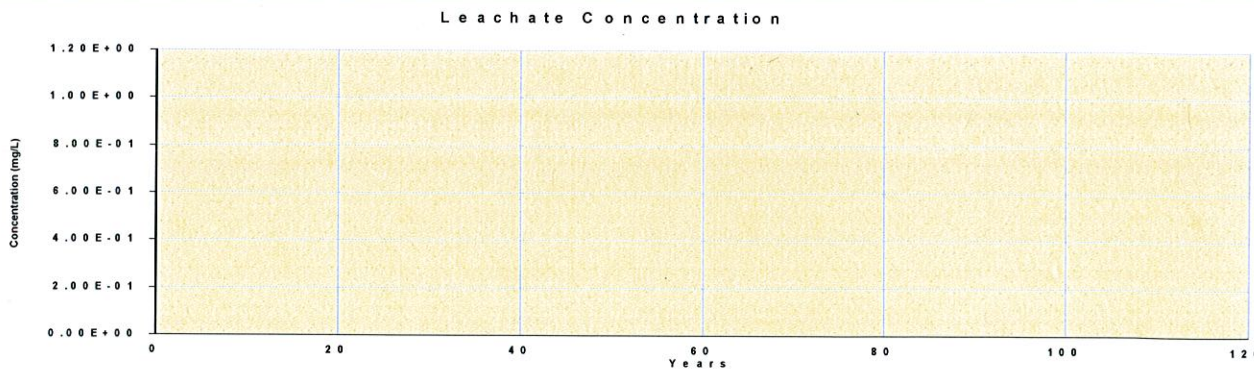
Chemical File: Lead And Compounds (Kd)
C:\SV22213\LEADHSOL.CHM

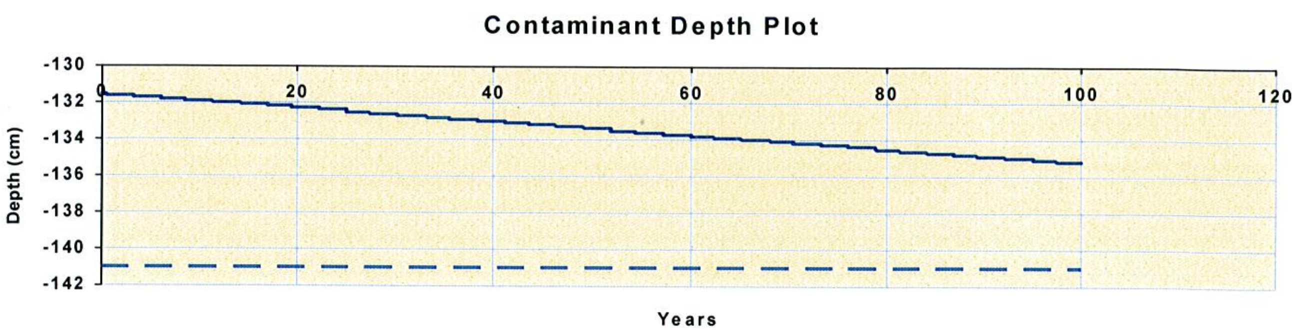
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: AOC 18-19 Pb DTW 4.63
C:\SEVIEW63\PB4-63RU.APL

Starting Depth: 131.50 **cm**
Ending Depth: 135.20 **cm**
Total Depth: 141.20 **cm**







MODEL RUN 2E

SESOIL Profile and Load Report

Layer No.	Number of Sub-Layers	Thickness		Intrinsic Permeability	Organic Carbon Content	Adsorption Coefficient	Cation Exchange Capacity	Freundlich Exponent	Solid Phase Degradation Rate	Liquid Phase Degradation Rate	Soil pH
		cm	feet	cm^2	percent	µg/g / µg/mL	mEq / 100 g soil	unitless	1/day	1/day	pH
1	5	152.0	4.99	1.00E-8	0.20	0.00	0.00	1.00	0.00E+00	0.00E+00	7.00
2	1	6.7	0.22	1.00E-8	0.20	0.00	0.00	1.00	0.00E+00	0.00E+00	7.00
3		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00
4		0.0	0.00	1.00E-8	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00

Soil Parameters

Bulk Density (g/cm^3)	1.50
Effective Porosity (fraction)	0.30
Soil Pore Disconnectedness	3.70

Application Parameters

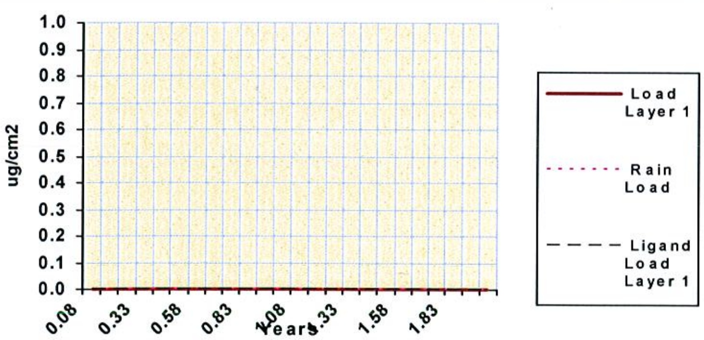
Area	cm^2	3.62E+6
	ft^2	3896.54
Latitude	degrees	41.0
Spill Index		1

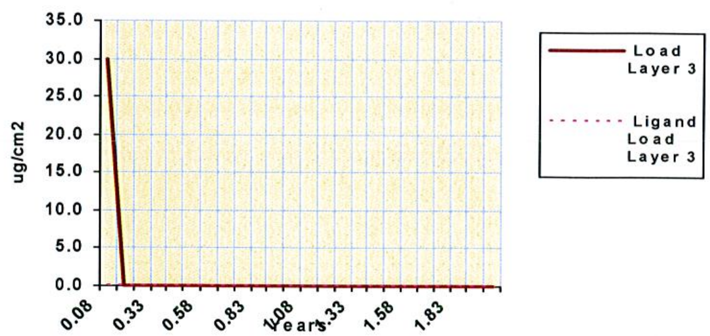
Chemical Parameters

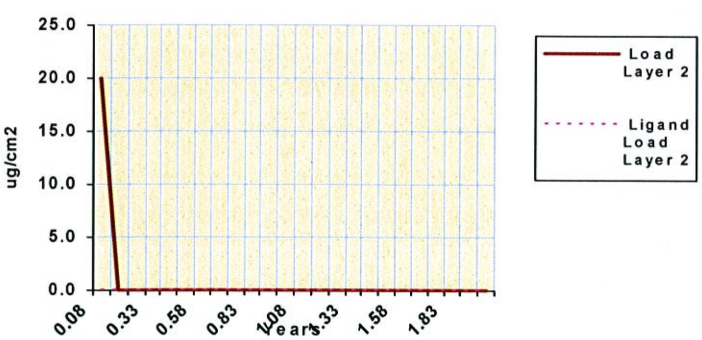
Water Solubility (µg/mL)	.700	**Moles Ligand / Moles Chemical**	0.00
Henry's Law (M^3atm/mol)	2.60E-3	**Ligand Molecular Weight** (g/mol)	0.00
K_{oc} (µg/g)/(µg/mL)	309000	**Base Hydrolysis Rate** (L/mol/day)	0.00
Valance (g/mole)	0.00	**Ligand Dissociation Constant**	0.00
Air Diffusion Coefficient (cm^2/sec)	1.75E-2	**Neutral Hydrolysis Rate** (L/mol/day)	0.00
Water Diffusion Coefficient (cm^2/sec)	8.00E-6	**Acid Hydrolysis Rate** (L/mol/day)	0.00
Molecular Weight (g/mol)	326.00		

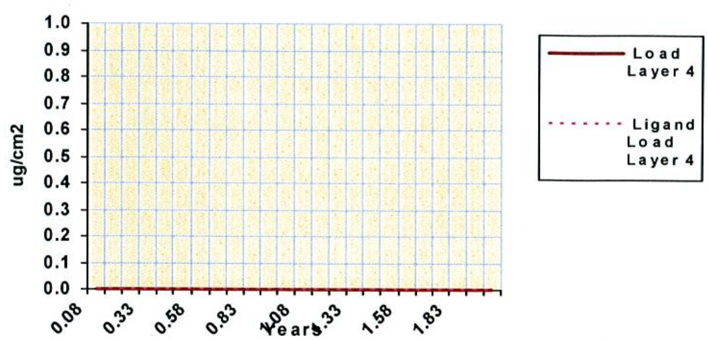
Output File: Dupont AOC 47-48 PCB Run 1
C:\SEVIEW63\PCB41113.OUT
Chemical File: Polychlorinated biphenyls (summed), NJDEP
C:\SV22213\POLYCHLO.CHM
Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI
Application File: Dupont PCB Column AOC 47-48
C:\SEVIEW63\PCBA4748.APL

Sublayer Loads	1	2	3	4	5	6	7	8	9	10
Layer 1 (ug/g)	1.00E+02	3.70E+00	4.20E-01							
Layer 2 (ug/g)										
Layer 3 (ug/g)										
Layer 4 (ug/g)										









MODEL RUN 2E

SESOIL Pollutant Cycle Report

Scenario Description: Dupont AOC 47-48 PCB Run 1

SESOIL Output File: C:\SEVIEW63\PCB41113.OUT

SESOIL Process	Pollutant Mass (µg)	Percent of Total
Volatilized	0.000E+00	0.00
In Soil Air	4.549E+05	0.00
Sur. Runoff	0.000E+00	0.00
In Washld	0.000E+00	0.00
Ads On Soil	1.702E+10	98.81
Hydrol Soil	0.000E+00	0.00
Degrad Soil	0.000E+00	0.00
Pure Phase	0.000E+00	0.00
Complexed	0.000E+00	0.00
Immobile CEC	0.000E+00	0.00
Hydrol CEC	0.000E+00	0.00
In Soil Moi	1.247E+06	0.01
Hydrol Mois	0.000E+00	0.00
Degrad Mois	0.000E+00	0.00
Other Trans	0.000E+00	0.00
Other Sinks	0.000E+00	0.00
Gwr. Runoff	0.000E+00	0.00
Total Output	1.702E+10	98.82
Total Input	1.723E+10	
Input - Output	2.032E+08	

Maximum leachate concentration: 0.000E+00 **mg/l**

Climate File: WANAQUE RAYMOND DAM
C:\SV22213\WANAQUER.CLM

Chemical File: Polychlorinated biphenyls (summed), NJDEP
C:\SV22213\POLYCHLO.CHM

Soil File: Sand, Int Perm = 1.00E-8 cm^2
C:\SEVIEW63\SAND.SOI

Application File: Dupont PCB Column AOC 47-48
C:\SEVIEW63\PCBA4748.APL

Starting Depth: 76.21 **cm**

Ending Depth: 84.99 **cm**

Total Depth: 158.71 **cm**